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4th IFIP TC 12 Conference, CCTA 2010
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Selected Papers, Part III

3 Part III

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- Open conferences;
- Working conferences.

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Daoliang Li Yande Liu Yingyi Chen (Eds.)

Computer and Computing Technologies in Agriculture IV

4th IFIP TC 12 Conference, CCTA 2010
Nanchang, China, October 22-25, 2010
Selected Papers, Part III

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Preface

I want to express my sincere thanks to all authors who submitted research papers to the 4th IFIP International Conference on Computer and Computing Technologies in Agriculture and the 4th Symposium on Development of Rural Information (CCTA 2010) that were held in Nanchang, China, 22–25 October 2010.

This conference was hosted by CICTA (EU-China Centre for Information & Communication Technologies, China Agricultural University); China Agricultural University; China Society of Agricultural Engineering, China; International Federation for Information Processing (TC12); Beijing Society for Information Technology in Agriculture, China. It was organized by East China Jiaotong University.

CICTA focuses on research and development of advanced and practical technologies applied in agriculture and aims at promoting international communication and cooperation.

Sustainable agriculture is currently the focus of the whole world, and the application of information technology in agriculture has become more and more important. 'Informatized agriculture' has been the goal of many countries recently in order to scientifically manage agriculture to achieve low costs and high income.

The topics of CCTA 2010 covered a wide range of interesting theories and applications of information technology in agriculture, including simulation models and decision-support systems for agricultural production, agricultural product quality testing, traceability and e-commerce technology, the application of information and communication technology in agriculture, and universal information service technology and service systems development in rural areas. We selected 352 best papers among those submitted to CCTA 2010 for these proceedings. It is always exciting to have experts, professionals and scholars getting together with creative contributions and sharing inspiring ideas which will hopefully lead to great developments in these technologies.

Finally, I would like also to express my sincere thanks to all the authors, speakers, session chairs and attendees for their active participation and support of this conference.

October 2010 Daoliang Li

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Study on XML-Based Heterogeneous Agriculture Database Sharing Platform

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Abstract. At present, there are large quantities of heterogeneous agriculture database in the network. Agriculture information resources sharing are the tendency of modern agriculture development. Being aimed at the problem of "information island", "duplication of similar projects" and urgent need for agriculture information resources sharing existing in agriculture database construction, the feature of XML's suitable for information sharing is analyzed, some key techniques of information sharing are studied, and the implementation plan of agriculture information resources sharing system is provided based on XML in this paper. The system realizes the information sharing and integration of heterogeneous agriculture databases making full use of the advantages of the XML's independence with platform, easy extension and may format. The system has good extendibility.

Keywords: XML; Heterogeneous database; Agriculture information; Data sharing.

1 Introduction

In recent years, with the promoting of new rural construction, many agricultural research institutes and agriculture sectors have developed website of agriculture comprehensive information strongly supported by the government, at the same time a large number of agriculture information databases have been created. This agriculture information has played a positive role in Chinese socialist new rural construction to a certain degree. But most of agriculture information scattered in agricultural research institutes or agriculture sector, and these databases are Heterogeneous because of different construction time and technology, such as different of architecture, different of operating system, different of data semanteme etc. Therefore it is difficult to realize interconnection and share information, so that makes the redundancy construction and waste of resources. [1]

With the development of the rural area informationization, many information system need to access the data of these heterogeneous agriculture databases. Therefore it is necessary to establish a new system framework to solve the problem of information sharing and integration existing in heterogeneous databases. XML has the characteristic of the platform independent, easy expansion, better interactivity, strong semantic, may format and so on. So it enables the XML became a major standards of

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the Web data express and exchange. According to practical applications, the necessity of the construction of heterogeneous agriculture database sharing platform is analyzed, the implementation plan of heterogeneous databases sharing system is provided based on XML with B/S mode and integration and query of heterogeneous data is implemented with uniform XML view. The system has good extendibility because of making full use of advantage of XML's data model.

2 XML's Features for Data Sharing

XML is a meta-markup language, user can define its own symbol and describe semi-structured data even Unstructured Data. It provides a bridge of data exchange between databases, it makes it easy to barrier-free communicate with heterogeneous systems. XML's advantage in data sharing aspect are as follows:

(1) Platform independent

XML is independent of platform and applications. So it is easy to solve the problem of data sharing and exchange between different application system or data source using XML effectively. Data expressed in XML format can be distinguished by other data source without any transition.

(2) Realizing multi display of data

XML is a markup language which can store and transmit data, which keep separation between store and display of data, and can display in Web browser with the help of other languages. A XML document can have the different display results with the different style sheet.

(3) Convenient for data release of Web

XML based on text format can be transmitted through the existing protocol of network communication like HTML, don't need to change anything.

(4) Reducing the network burden

Production documents writing in XML is convenient to be saved, transmitted, modified, searched and archived. Perhaps User wants only to browse or download one part of a product file through a network, doesn't want to download the whole files. If we use traditional text editor to write production document, Users have to download the entire document editing in traditional text editor, which easily cause network blocking. Any part of the production document based on XML can be easily extracted by the style, without involving the entire document. Taking advantage of the characteristics of XML, the complicated agriculture information can be determined and described standardized, and also can be transmitted and accessed effectively in the network. [2][3][4]

3 Design of XML-Based Heterogeneous Agriculture Database Sharing Platform

Firstly, in order to realize information sharing among the heterogeneous and distributed databases, a communication platform providing a uniform interface to access the databases need to be established. When user access heterogeneous databases, they only need to specify the desired data, don't care for Data Schema, data extraction, data synthesis and data collection method. User can access heterogeneous databases transparently through accessing sharing platform.

3.1 System Architecture

Most of the agriculture information database is distributed in the agricultural research institutes and agriculture sectors. Databases of all departments are independent entities which have the characteristic of independence. In the sharing, users only have the privilege of query, can't modify the sharing database. In order to realize the function of query, the best way is servicing for the user through the B/S mode. Therefore, the three-level system structure is adopted based on B/S mode[5]. The architecture chart is shown in Figure 1:

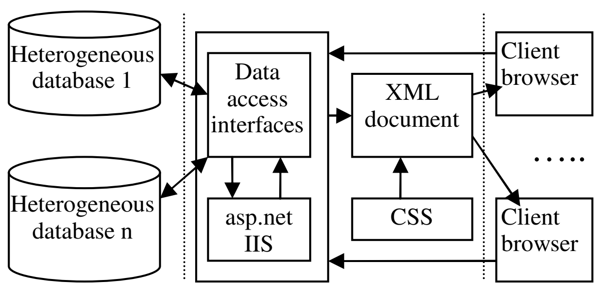

Fig. 1. Three-level architecture chart based on B/S mode

(1) User layer

On the client, users can access the agricultural information databases through submitting corresponding query on the Web, as long as users have the browser.

(2) Middle layer

A Web services middle layer established between multiple heterogeneous data sources and users acting as the communication platform for sharing information, which connect with heterogeneous data sources by using ADO data access technology and so on. The layer is the core part of the three-layer structure, which is responsible for receiving the remote or local of the query request and then converts the query into XML documents which will be uploaded to the application server. The application server deal with the logic request , deliver the corresponding SQL statement to the database server and obtain data from heterogeneous database; The query results are converted into XML documents, and translated into HTML or a variety of Script language, and then sent to the query browser. Similarly, the browser will also send request of changing, deleting and adding records to Web server, Web server complete these tasks through accessing the database.

(3) Data layer

Data layer consists of heterogeneous databases and files.

3.2 Model of Converting Heterogeneous Database Data into XML Data

In order to provide with user heterogeneous data of variety of different structures in a standardized format, the first thing we should do is to convert these data into standard XML data model format. Conversion process is shown in Figure 2:

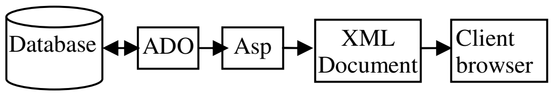

Fig. 2. Process of Conversion data into the XML document

The reference model of converting the query results for heterogeneous database into XML data through Web. The application program of ASP.NET extract data from the database through ADO, convert ADO dataset into XML document and then pass them to the Web server. The data is processed and displayed through Web browser as soon as data is stored in the server with XML standard format. The XML is shown exactly in DTD-defined format on client browser, so user can access heterogeneous database through Web.

3.3 Generating XML Pages Using ASP.NET

The relational data source convert into XML data source usually using ASP.NET, rather than creating the static XML document. The XML document generated dynamically from database can update automatically along with the update of database. ASP files can be used to create HTML pages and XML data source. The biggest difference between the them is the basic structure of a page one is the HTML page, the other is the XML data source. The output of ASP file is XML data source just like HTML page. [6]

The way of creating XML data source has two advantages:

Firstly, XML data sources can be generated using the script, which is convenient for converting a large number of relational data or general document data. Secondly, XML data sources of query can updated automatically with the update of database, because the XML data source is generated dynamically according to data in the database. So the query results of user can keep unanimous with the data of current database only through the data maintenance and management of every heterogeneous databases management system.

The key of the type of dynamic page generating in ASP.NET is to set the content type property of the response object. The dynamic HTML page is generated when content type property is text/html; the dynamic XML page is generated when content type property is text/xml. All text of XML page must be generated dynamically when XML page is generated dynamically using ASP.NET. Each statement of the page can be generated with response object of ASP.NET. For example, the following script can generate the XML text of large family of the major information:

```
<%@language=VBSCRIPT%>
<%
Response.write <?xml version='1.0' encoding='GB2312'
Response. Write <MajorFamily>
Response.write <no=2010011001>
Response.wrlte <name>WangNiu</name>
Response.write <sex>Male</sex>"
Response.write <speciality> Milk Cow Feeding
                  </speciality >
response.write </ MajorFamily >
%>
```

When users query databases, the system generates dynamically SQL statement according to the sharing data structure of system database which is defined by the administrator of heterogeneous data sources. In general, the definition of table structure has represented the meaning of the data saved, when the structure of the sector system database is defined. So each table field names can be used as the tag of the data. Therefore, the generation of the tag can be simply expressed as:

The tag name= Rs（TabName）& Rs（ColName）

Rs is the result set which is returned by the local connection object when it queries the database.

In this format, two kinds of data need to be generated dynamically: one is the generation of the tag and the other is the generation of specific data.

The key of the generation of tag is to obtain the data and field name of the shared data structure which is defined in the various databases. Using ADO local connection object, the table and field names can be obtained from the sharing information tables, like the database query statement is generated dynamically. A tag name is composed of table name and field name. It can avoid duplicate tag name because there are the same field name in the different tables.

The specific data is obtained from the heterogeneous database. Therefore, the ADO remote connection object is needed; the query results are saved in the record set. The table of tags and the information of field are easily combined to the query results because the query statement of the heterogeneous database is generated according to the information of local database sharing information table. The data generation can be expressed as:

Data=R_Rs（TabName.ColName）

R_Rs is the record set which save data result returned by ADO remote connection object.

3.4 Display of XML Document on the Client

The correct display of XML document on the client browser not only need the XML document itself to be get the correct interpretation, but also need define XML's display style on the client. The structure content of XML document and display control is separated. There are two display methods of controlling XML documents: CSS (Cascading Style Sheets) and XSL (Extensible Stylesheet Language).

CSS provide a technology to make a Web page more fascinating on the browser, unlike the HTML that need to add the standard mark of control display frequently.

XML allows user to use any custom tag in documents, but the browser does not know how to display specific elements according to document tags in advance. So when the XML document is sent to the client, the information of how to display the document elements needs to be sent also. One of the ways to solve this problem is organizing the information of controlling document element's display into the mode of style sheet. By the style sheet, the browser knows how to format the element and display data exactly.

In the sharing systems of heterogeneous database, when the data in the heterogeneous database is converted into XML document, the output format needs to be controlled by the corresponding CSS on the client. The generation of tag is uncertain in the process of generating dynamic XML document, the definition of the display format of each tag becoming a difficult problem in CSS. The tag of root element is fixed by system in the process of generating XML document. CSS has the characteristics that the child elements inherit the parent element's attributes automatically. It is not necessary to consider the specific definition of each tag as long as the display format of the root element is defined and the CSS link declarations is included at the beginning of the XML document.

XML data is correctly shown on the client browser under the constraints of CSS. The different performance ways of the root element can be defined according to different needs. They are mainly font, color, effect and so on.

4 Conclusion

The sharing of agricultural information resources is the development tendency of modern agriculture. The construction schema of heterogeneous agriculture database sharing platform is provided using the existing network resources, and it is easy to be popularized. Some related technologies about the implementation of schema are introduced. Basing on the national and international research results, and according to the actual situations of Dingzhuang town, Dongying city and Xiangyin village, Taian town, a large number of agriculture information databases are created, such as practical agrotechniques database, agriculture policy information database, agricultural scientific talents database, produce market supply and demand database. On this basis, the XML-based agriculture database sharing platform is constructed. The platform adopts B/S three-tier architecture mode, and users on the client can access easily heterogeneous database only through Web browser.

Months of test operation at Dingzhuang town and Xiangyin village shows the system is stable and reliable, and it can meet the requirement of agriculture information resources sharing. The system effectively resolve the problem of "information island" and "duplication of similar projects" existing in the construction of agricultural informationization. It has a great significance for carrying out the national policy of "information Huimin", realizing perfect docking between the small peasant and big society and speeding up the process of the construction of socialist new countryside.

Acknowledgements

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Studying on Construction Programs of the Platform of Primary Products Marketing

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Abstract. As a kind of advanced productive forces, the advantage and potential of E-commerce could not be ignored for upgrading the industrialization degree of agriculture, adjusting the agricultura structure, reducing the transaction cost of agricultural products and enlarging the market sale range and channels of agricultural products. This paper analyzes the present status and problems of application of Chinese agricultural E-commerce, points out that constructing primary products marketing platform is the first step to develop agricultural E-commerce. Combining with the situation and characteristics of Chinese agriculture, it gives out constructing programs and the frameworks of Chinese primary products marketing platform. Anlysize these programs and proposed Implementation Strategy from the Adaptive Point of View.

Keywords: Agriculture; Electronic Commerce Platform; Primary products Marketing; Implementation Strategy.

With the rapid development of modern information technology, the information technology is applied more and more widely in the agriculture field and becomes an important measure on promoting development of agricultural science and technology and agricultural and rural economy. At present, series of websites related with agriculture and agricultural informatization platforms have been initially formed and play an important role in transforming traditional agriculture and developing modern agriculture.

1 General Introduction to Rural Informatization and Agricultural Electronic Commerce Development in China

The gap between urban and rural informatization is great in China, so is the gap between urban and rural utilization ratio. According to a survey by CNNIC in July 2006, the netizens who engage in the occupation related with agriculture account for only 1.29 % of the total. Most netizens are agriculture managers and technicians and

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are concentrated in the developed regions like Beijing, Shanghai, Guangdong, Zhejiang and Jiangsu, and farmers surfing on Internet are few, which indicates that farmers and farm owners haven't attached importance to the agricultural electronic commerce, so its regional distribution is imbalanced and its popularization and application is at low level. The Survey Report on Rural Internet Development in China 2009 by CNNIC shows that by the end of 2009, the number of urban netizens has reached 277.19 million, much higher than that of netizens in rural areas with greater population. Fortunately, compared with the situation in the previous two years, the growth rate of number of rural netizens is great. According to statistics, the scale of rural netizens in China increased very quickly and by the end of December 2009, their number has reached 106.81 million, with an annual growth rate of 26.3%.

China is a large agricultural country, with the popularization of Internet in Agriculture and rural area, the development of agricultural electronic commerce shows vigorous trend: the application of electronic commerce in agriculture becomes wide, the agricultural information networks are established in many provinces, with some large online markets emerging. The varieties operated online change from food and fertilizer previously playing a key role to subsidiary food, poultry, pesticide, special and local product, flowers, gardens, aquatic products, tea and fresh fruits which are all operated online, establishing platforms for rural economic information to spread to villages and households. According to statistics by CNNIC, by the end of 2009, there have been over 10000 websites related with agriculture, which release a lot of agricultural supply and demand information for vegetables, melons and fruits, tree seedlings, livestock and poultry and raising and relevant economic information and investment invitation information, playing an important role for promoting agricultural products, improving agricultural efficiency and increasing farmers' income. The websites with great influence are China Agricultural Technology Information Net(www.caas.net), China Agricultural Information Net (www.agri.sov.cn), China National Seed Group Co., Ltd. (www.chinaseeds.com.cn). The rural supply and demand information service system, national broadcast system for rural supply and demand information currently has 35000 registered members and release 8000 pieces of information with over 250 thousand pieces of content retrieval. All this indicates that the agricultural electronic commerce in China enters stage of rapid development.

2 Problems of Electronic Commerce Platform for Agricultural Products in China

The factors such as low computer penetration and inadequate information, lead to the situation of long marketing link, high transaction cost and serious separation of supply and demand chains for agricultural products in China. So the issues of agriculture, farmer and rural area like difficulty for farmers' income increase, heavy agricultural burden and various problems in rural area still hinder the development of rural areas in China. In addition, the individual farmer's and small-scale agricultural organization's poor ability for collecting, seizing and analyzing market information seriously restricts the development of agricultural electronic commerce. In summary, the main factors restricting the development of electronic commerce platform for agricultural products are as follows:

2.1 Few Information Sources and Updating Not in Time

As for agricultural electronic commerce platform, it is very important to provide supply and demand information, price information and agricultural materials. Therefore, in-time updating of information and broad information sources plays an important role in the platform, or the online effective resources will be deficient.

2.2 Imperfect Transaction Functions and Safety Hazard

Most platforms don't have online order transaction system and can't realize real function of electronic commerce. Moreover, the platform is lack of safety mechanism. It only provides information service functions and is lack of identification and supervision and management for membership. Also it is not definite for member system and classification for member levels, bringing safety hazard for transaction.

2.3 Unable to Contact with Chains of Agricultural Production Closely

Most agricultural product platforms pay too much attention to the finish products, the postproduction chain, but can't contact with the pre-production or mid-production chains. Therefore, the following situation occurs: the blind pre-production plan causes the imbalance of supply and sales which will lead to the price fluctuation and further affect social stability and farmer's enthusiasm; the lack of supplying the information for pesticide, seeds and fertilizer together with the limited ability of farmers to process information decrease the effective utilization of information.

2.4 Characteristics of Agricultural Products

Many agricultural products have the characteristics of seasonality and difficulty for storage, so it is difficult to keep them fresh, transport them and conduct post processing for them, which increases the difficulty for their logistics chains, compared to the industrial products, further increases the difficulty to carry out agricultural electronic commerce and restricts the development of electronic commerce platform for agricultural products.

2.5 Poor Electronic Commerce Consciousness

The core of information technology is information rather than technology, while the core of electronic commerce is commerce rather than electronization. The internet is only one new channel for enterprises to expand business. Some enterprises, during the implementation of electronic commerce, excessively pursuit the advanced hardware equipment and immature high technology and ignore the optimization and integration of internal and external information resources of the enterprises. So it is difficult for them to realize high-quality, high-efficiency and high-benefit commercial activities.

2.6 Unsound Electronic Commerce Environment

At present, the imperfection of the standards and regulations of bank, information industry, tax, customs, finance and laws, related with electronic commerce in China, and poor standardization and organization of agricultural product markets affect farmers' trust on electronic commerce. In addition, the low level of standardization for agricultural products in China and difficulty to unify the standards for many agricultural products, to some extent, limit the development of electronic commerce for agricultural products.

In general, the agriculture in China develops backward currently. However, the annual national policy and support for agriculture is constantly strengthened. Thus the infrastructure construction for agricultural informatization, the farmers' cultural quality and application level of information technology, management concept of agricultural enterprises and the operation environment for electronic commerce will be improved rapidly and the network operation cost will be reduced quickly. Therefore, it is urgent to quickly establish application platforms for agricultural electronic commerce, guide the agricultural enterprises to transform operation concept and management mode to implement electronic commerce as soon as possible.

3 Development Strategy of the Electronic Commerce Platform for Chinese Agricultural Product

The following development strategies are applied focused on the current problems existing in the electronic commerce platform for Chinese agricultural products:

3.1 Perfecting the Information Network System and Strengthening the Channel of Acquiring the Information

Once the wide and complete social information network system is established, the effective information in a wide range can be acquired on time, thus forming the dynamic and intensive social information network. In such a way of acquiring the effective information, the correct and latest information can be provided to the platform member, not only improving the credit from the members but also founding the base of the network service. And also, the complete information channel is the guarantee to provide the correct information for tendering the better services to the peasant households and enterprise. Therefore the platform for agricultural products can develop the cooperation relationship with the various important agricultural information networks and agricultural media to acquire more complete and valuable information.

3.2 Perfecting the Function of Online Transaction on the Third-Party Platform

The third-party electronic commerce platform is suitable for the medium- and small-size agricultural operation units. Based on the public platform provided by the third-party platform, these units can carry out the electronic commerce activities, not only implementing the electronic commerce, but also participating in the third-party commerce platform with only a relatively small cost, so they can enjoy the professional information service and value-added service and have more chances of developing the market. Meanwhile, the third-party electronic supplier shall, with using the operating mechanism of the commercial Web site and under the framework of the electronic trade, establish the open inter-trade electronic commerce system used really aimed to provide the whole commerce course.

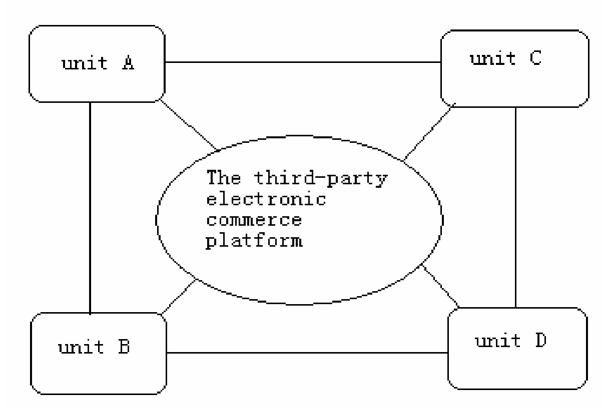

Fig. 1. The third-party electronic commerce platform framework

The third-party commerce, over several years' exploration and operation, has become mature and its mode is a very effective method of accelerating the development of the electronic commerce of the Chinese agriculture. Under the support form the society and the government, the third-party agricultural electronic commerce platform shall cover the perimeter zone and surrounding provinces with the region as the center, to provide the better and more effective service support to more agricultural production operation units.

The third-party electronic commerce platform not only requires the functions of releasing the basic demand information and the product price information, but also requires a further improvement in the aspects of safety, payment and customer relationship. So far, many electronic commerce platform involved in the agriculture is just for the visitors browsing the statistic information, and that is far from the requirement, and it should be equipped with the functions as follows: releasing the product information, checking the production information quickly, online customer consulting, querying the order, commercial negotiation on line, online transaction and payment, logistics distribution and delivery, customer's feed back, customer service, investment opportunities, product information, solutions to the common problems and questions, global sales network distribution, global purchasing, news center, product center and human resource center and so on. Only the electronic commerce platform with the complete functions can win more commercial opportunities.

3.3 Proving the Safe Transaction Environment

The traditional agricultural product transaction habit, which mainly is the opposite transaction with settling the goods and payment face to face and being afraid of the virtual network has made it difficult to maintain the client group and constrained the expansion of the client range. So the electronic commerce platform providing a safe traction environment is the fundamental guarantee for the success of an electronic commerce platform. For such a concern, it is necessary to establish a uniform, authoritative and nationwide certification center of the agricultural products as quickly as possible, integrating the sources, strengthening the certification to the enterprises and individuals and enhancing the network safety.

3.4 Closely Combined with All Chains of Production

The platform pays too much attention to the sales of finish agricultural products, and ignores the preproduction and mid-production service of agricultural products. Based on the price information and transaction information of agricultural products provided, conduct selection, analysis and treatment of information provided to predict the preproduction price and sales volume and guide the production scale and investment cost for members; provide subsidiary agricultural products for industry information production technology in the mid-production process to minimize the production cost. This mode solves the sales problems(agricultural product marketing or purchase problems of processing enterprises)for producers. Through the above process connect the production and sales to actively promote the online transaction.

3.5 Properly Promoting Platforms Online

Properly publicize and promote the websites for electronic commerce platform for agricultural products, to expand visiting volume and win the social concern and recognition. Attention shall be paid to the following items: the platform design shall have agricultural characteristics, excellent safety and interchangeability; release website information on various public media; release advertisement bar in the relevant websites of Internet and set relevant links; send e-mail to potential customers and seek potential trade opportunities; set own position in the search engine to make yourself be found by the potential customers.

The electronic commerce in China has just started. The agricultural electronic commerce faces huge opportunity and serious challenge. There are many problems and difficulties ahead. The construction of electronic commerce platform for agricultural products can only be a successful one when based on the actual situation and further open the market for agricultural products. And the platform can only succeed in the trend of economic globalization through breaking the territories and countries and participating in the international competition.

Acknowledgments

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Supply Chain Integration Based on Core Manufacturing Enterprise

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Abstract. System integration solutions and model of supply chain are proposed based on core manufacturing companies, combining the actual operation of the supply chain process of a motor enterprise. The operation of the supply chain is discussed from the supplier integration, internal integration, and customer integration. The process integration is studied from the logistics integration, information flow integration and capital flow integration. Strategic decision management corresponding to cultural integration, separately discuss from the development strategic integration, concept integration and management integration.

Keywords: Supply chain (SC); Integration; Logistics; Core manufacturing enterprise.

1 Introduction

China is becoming a center of world manufacture, which is a good opportunity for the Chinese manufacturers [1]. The paper responses to the urgent needs of manufacturing enterprises, combining with personal experiences of K Company (a medium car manufacturer) integration, which is for manufacturing company's supply chain management [2-3]. The core manufacturer in the supply chain plays leading role in the integration process, relying on the superiority of their own capital, technology and brand to influence and integrate the upstream and downstream businesses from strategic level to plan and control layer [4-5].

2 Prerequisite of the Core Manufacturing Supply Chain Integration

For supply chain integration, the core manufacturing enterprise should have certain conditions to play leading role in the supply chain integration. Core business must have at least the following three conditions [6].

1). Perfect internal management information system. Business should have enterprise resource planning system Etc. to grasp all kinds of raw materials, semi

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finished goods inventory and shipments in order to promptly respond to market; should have good customer relationship management system to respond customer needs and personalized service. Therefore, the core business should have a more complete internal management information system to integrate internal resources and companies.

2). Smooth and efficient business processes. The business can achieve effective interface between the upstream and downstream enterprises with smooth and efficient business process. So business in the supply chain business process integration should be preceded by rationalization, optimization and reconstruction, the establishment of efficient standardization of business norms.

3). A sound management system and operating specifications. Different enterprise has different business processes and operations, which make a lot of inconvenience in communication. The core business should establish a unified management and operating standards, and information systems integration standards.

3 Contents and Methods of Supply Chain Integration

Based on core manufacturing companies, supply chain integration will be divided by the executive level into the strategic level integration, planning and control layer integration, basic layer integration. Strategic level integration includes development strategic integration, concept integration, management integration; planning and control layer includes logistics integration, process integration, information integration and capital flow integration; basic layer integration includes supplier integration, internal integration and customer integration. Integration model is shown in Figure 1.

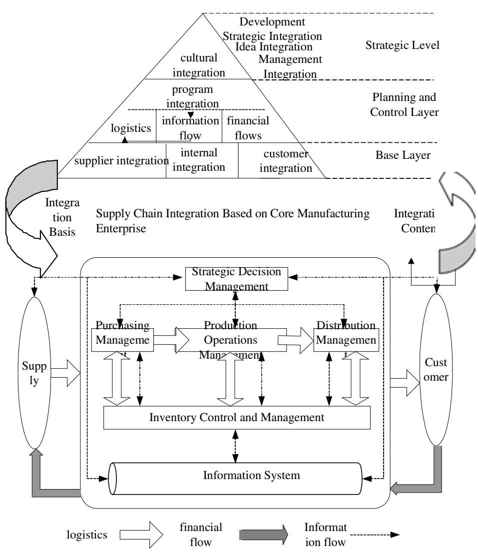

Fig. 1. The integration model of supply chain

3.1 Basic Layer Integration

1. Internal Integration: Good internal integration is successful experience for other businesses in supply chain. Internal integration is divided into two levels: the internal process and information integration, organizational integration [7].

1) The internal process and information integration: Business should identify and optimize core business processes, establish standard operation procedures to improve the speed and quality of processes. Internal information of core business should be integrated by process to respond to market changes and customer demands.

2) Organizational integration: Organizational integration should enable organizational design, structure and operation to meet the system objectives, and establish process-oriented management mode. Distributed logistics should be unified and integrated with procurement to set up an integrated logistics system, whose all logistics-related functions are unified.

2. Supplier integration Core business should have a good supplier management system, optimize supply chain structure from the number of suppliers, quality and other aspects in the global integration.

In the implementation of supplier integration process, business can start from the following areas.

1) Establish strategic partnership with key suppliers. Establishment of strategic partnership can strengthen procurement, and timely meet the needs of the supply chain to reduce supply chain inventories through JIT purchasing. At the same time, the core business should integrate design and research capabilities of supplier to build collaborative design relationship with strategic cooperation partners.

2) Establish information sharing mechanisms with key strategic partners. Sharing information of production planning, production information, inventory information, demand forecast information with key suppliers can reduce information distortion.

3) The supplier selection and management scope expand to supplier's supplier. Integration from the source of supply chain can ensure reliable raw materials, which can boost the competitiveness of suppliers and enhance the whole supply chain competitiveness.

4) Integration outsourcing service provider. Outsourcing service helps companies to use resources and capacity that they don't have. So the selection and integration of outsourcing service providers should be more emphasis on its core competence and the integration degree of supply chain, so that outsourcing service providers can better enhance the supply chain's competitive advantage and flexibility.

3. Customer integration: Customer integration includes enterprises in the entire distribution chain node (wholesalers, distributors, retailers and ultimately customers) integration. Selection of various vendors according to established evaluation index is to expand the sales network, optimize the distribution chain structure to reach distribution chain's labor clear (including the sale of product categories, covering the area, etc.). Three main aspects are for clients to integrate [8].

1) To provide management and technical support for the distributor, to establish a unified application system to real-time master distributor sales information; to form a strategic alliance with dealers to design distribution channels.

2) To establish partnerships with major customers to provide personalized products and services; to establish an effective customer feedback mechanism to keep abreast of

changing customer needs and requirements; to share market information, sales information, demand forecast information, inventory information, production planning information with major customers.

3) To reduce the level of distribution channels, combining retail channels of distribution and online. Online sales are an important sales channel development trends, which can save investment costs.

3.2 Planning and Control Layer Integration - Process Integration

Supply Chain business process is an independent design, which is lack of effective convergence and required to integrate accordingly, such as the sale of a business process is another company's procurement process [9]. Based on all aspects of supply chain business process optimization among the basic implementation strategy, the core processes should be optimized to improve the efficiency of the whole supply chain and value creation capabilities.

Process integration should be based on the process management idea, whose three levels are process specification, and process optimization and process Reengineering. The supply chain core processes has different expression form by different classification, where are expressed by logistics, information flow and cash flow.

In the operation of the supply chain, the process of manufacturing resource materials or products, finished in different position or performance over time is known as logistics; the information of the production and marketing performance for the material in three main areas of change and shift is known as information flows; the costs associated with material value-added data is known as cash flow.

1. Logistics Integration: Internal production and logistics integration can improve their ability to optimize the allocation of resources; supply chain logistics integration can enhance the use of external resources to gain competitive advantages. Logistics integration also can improve time response, gain competitive advantage. Logistics integration ultimate aim is to meet customer demand, gain the fastest way the lowest cost to deliver products and services to customers.

Internal logistics integration refers to the integration of enterprise procurement, distribution, manufacturing, logistics, to achieve the integrated operation of the system, and upstream suppliers and downstream customers connected. Supply chain logistics integration concerns integration of logistics operations group, the wider and deeper level to improve the operation of the logistics system performance. Integration of logistics includes two levels of integration, logistics information and logistics facilities [10].

1) Logistics Information Integration. Related logistics information system is a bridge in the transfer logistics information, whose related information systems include inventory management information systems, distribution systems, data exchange and transmission systems, electronic financial transactions systems, retail point-of-systems and so on. Effective integration of information systems can increase the interface function; improve information sharing and the logistics efficiency of the system.

2) Logistics facilities integration. Core enterprise should overall plan infrastructure of supply chain, to make full use of co-members’ infrastructure, such as distribution centers and warehouses. The establishment of efficient supply chain distribution system can reduce duplication of investment and increase resource utilization. Channel design and network analysis, optimization of supply chain manufacturing plants,

distribution centers, distribution centers, warehouses and other infrastructure facilities, location and number are to make the entire supply chain logistics system more rational.

2. Information Integration. Information integration is an important level of supply chain integration, which decides the success of supply chain integration. Core business should integrate internal information to make the full internal information sharing between the different functions of application, so that the different departments can in a timely manner, quickly and accurately respond to changes in the market coordination to meet customer needs.

Supply chain systems integration with internet on the basis of internal information can increase the visibility levels of whole supply chain information, forecast and plan production with suppliers, customers to achieve reasonable allocation of the supply chain resources, timely and effective from order to delivery. Information integration approach can be integrated by IT technology integration and the relationship between two channels.

3. Financial flows integration. Integration of financial flows mainly includes integration of each node's credit, payment, accounts, receivable accounts payable and other aspects. An effective corporate credit tracking system and a unified method of payment should be established to enhance the utilization rate of capital turnover. Supply chain logistics, financial flow, information flow are accompanied, which constitute the entire value stream as shown in Figure 2.

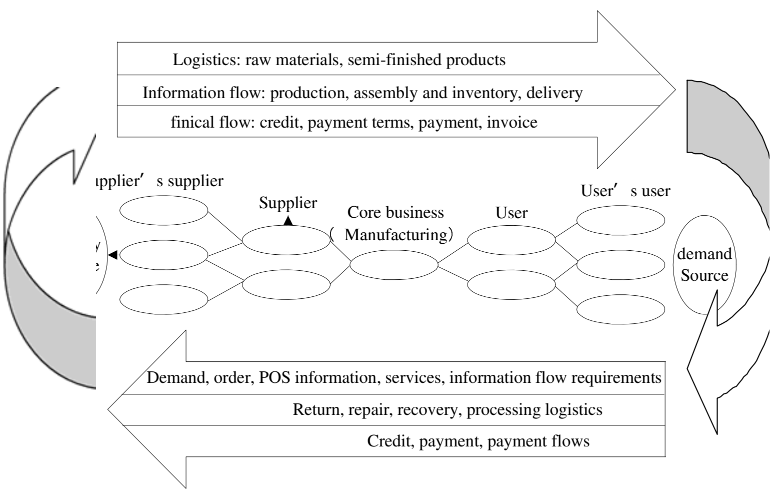

Fig. 2. The logistics, information flow and finical flow of supply chain

3.3 Strategic Level Integration Cultural Integration

Cultural integration is the highest level of supply chain integration, which can be divided into internal cultural integration and partner cultural integration. Within the enterprise, cultural integration should further highlight the characteristics of enterprises, namely the outstanding business value, business spirit, corporate style, business sense of service. The cultural integration of the supply chain is to create a unified culture, or each node integration between corporate culture and enhance supply chain cohesion and competitiveness. For the whole supply chain, cultural integration is mainly from the development strategy, ideas and management models.

4 Conclusions

This research based on the core manufacturer's supply chain management, with value-added process procurement, manufacturing and sales as line, provide reference model of supply chain integration and its implementation measures to integrate resource.

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Target Recognition for the Automatically Targeting Variable Rate Sprayer

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Abstract. In order to quickly and accurately realize target recognition when the crop demanding, adopt green strength of RGB`s method to identify the crop from the background of elaphic, the recognition accuracy was more than 98%. Use density DBSCAN fuzzy clustering algorithm, by means of setting two parameters ε and MinN, in the density DBSCAN fuzzy clustering algorithm, to determine a cluster gather on the each target, by means of judging the existence of the clustering gather or not to determine the target. With the help of image division technology, calculate the area ratio of the target and calculate the need of quantity of spraying. By means of calculating the centre point of each clustering gather(target), realize to control sprayer motion trail, realize accurately targeting and variable rate spraying pesticide（Fertilizer） when the crop sowing in line at seeding.

Keywords: fuzzy clustering algorithm, image division technology, target recognition.

1 Introduction

For a long time, as the low level of pesticide use (the effective utilization rate is only about 30%), not only wasted the massive agricultural chemicals, but also has caused the serious pollution to the ecological environment. In order to solve the environment pressure which the agricultural chemicals spray massively cause, study automatic spraying device on the target through the imagery processing technology development. Precision spraying has become an important tendency in modern agriculture development [1-2-3]. Automatic spraying system can achieve the target precision pesticide spraying and the purpose of saving. Target recognition is the key technology.

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In the 1990s, developed countries had carried out a study of the precise spraying and the target recognition. University of California, Davis institute, D. C. Slaughter, R. D. Lamm and D. K. Giles developed cotton weeding machine robot based on the cultivation platform in 2002[4], University of Kansas, NINGWANG designed a real-time embedded wheat weed identification and spraying on the target system in 2002[5], Gerhards designed the precise spraying system based on map information[6], R. Tangwongkit, V. M. Salokhe development variable spraying embedded system between the sugarcane lines and based on machine vision[7]. China Agricultural University study of automatic target pesticide system[8], Orchard Automatic Target electrostatic sprayer[9], automatic spraying system that automatically spraying disease plant [10], Nanjing Forestry University of trees study of a system based on machine vision image acquisition and real-time identification system[11].

To achieve accuracy of the target pesticide, first of all, to solve the target object to identify and determine the amount of pesticide spraying, Use density DBSCAN fuzzy clustering algorithm, by means of setting two parameters ε and MinN, in the density DBSCAN fuzzy clustering algorithm, to determine a cluster gather on the each target, by means of judging the existence of the clustering gather or not to determine the target. Calculated green plant the number of pixels in the image and its corresponding area ratio though Image Segmentation. The system can accurately identify targets, at the same time meet the requirements of real-time processing.

2 Identification of Crop and Soil Background

In the experimental field of Qingdao Agricultural University with SONYDSC-S730 digital camera, in different light (sunny / cloudy), different land conditions, Screen corn`s color image captures. Digital cameras capture the image is JPEG format, to easily deal with, programming using Microsoft Visual C++6.0, the 24-bitJPEG format images were converted to 24 - bitBMP format images, taking BMP image as original image to deal with. Each image in each pixel has R, G, B three components constitute, which was affected by the light under natural condition, each image’s pixel R, G and B will change.

The 2G-R-B's value as the color segmentation factor is that in this division factor in the increased weight of green crops, highlighting the characteristics of green crops, and thus can make better segmentation and background of green crops. Green plants of the G-B and G-R to the value slightly higher than the value of non-green plants, which is the first comparison of the RGB, then calculate the division factor, Formula as follows:

$$
\begin{aligned}
&f(i, j)=255 && \text{when } R>G \text{ or } B>G \\
&f(i, j)=2G-R-B && \text{else}
\end{aligned}
$$

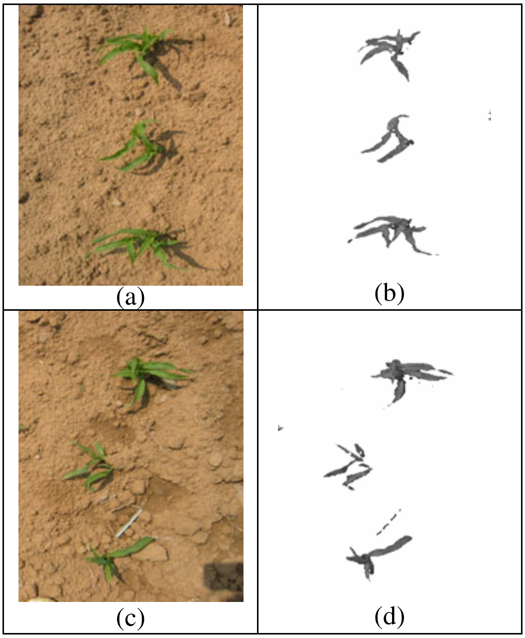

Fig. 1. Green strength of RGB`s method to identify the crop from the background of elaphic (a)(c)original image from field (b)(d)the image with Green RGB feature algorithm

3 Determining the Clustering on Each Plant Crops

In this study, fuzzy clustering algorithm based on DBSCAN thought, the algorithm core ideas: that a class for each object in its neighborhood of a given radius of the object that contains not less than a given number. The basic idea is that, $\forall x_i, x_j \in X$, if $x_j \in N_\varepsilon(x_i)$ and $|N_\varepsilon(x_i)| \geq \text{MinN}$, x_j direct density up to x_i, where $N_\varepsilon(x_i) = \{x_t \mid x_t \in X, D(x_i, x_t) \leq \varepsilon\}$ is a close neighbor to become the core of the object. The algorithm is in the desktop (CPU: P41. 6 G, RAM: 256 M, hard disk capacity: 40 GB) use object-oriented language of Microsoft Visual C++6.0 to program.

DBSCAN clustering algorithm, the algorithm steps:

Step 1. Input ε >0， MinN>0;
Step 2. Calculate X, the number of neighbors for each point ε , find all of the core object X;
Step 3. Automatically select any one of the core that does not belong to any cluster object ε neighbors to create a new cluster;
Step 4. Circulating collection of the clustering of the core object until ε neighbor to join the cluster by adding a new core object;
Step 5. If there is no clustering of the core of any object, end algorithm Otherwise jump back step3;
Step 6. All images are scanned, the processing end.

Experimental results:

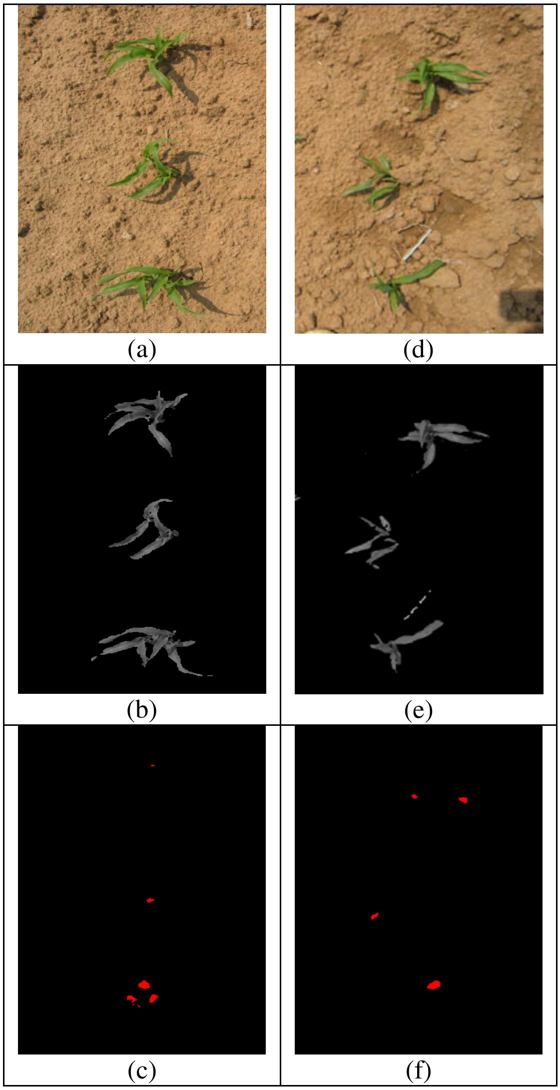

Fig. 2. Use density DBSCAN fuzzy clustering algorithm to determine a cluster gather on the each target. (a)(d) field collection of original image (b)(e) I grayscale (c)(f)image that used the fuzzy clustering algorithm.

First image (a) and (d) for conversion, RGB model is transformed into a HIS model, generated I component of the gray image (b) and (e). I grayscale was application by DBSCAN clustering algorithm, which can find pixels that density was more concentrated, with this method, we can , in the image, find the green plants of each strain to one or several cluster set (also the same pixel density is set). The results shown in Figure (c) and (f) . Using API function timeGetTime() of MicrosoftVisualC++6.0 get the algorithm time consuming, time accurate to ms, DBSCAN clustering algorithm runs in before the call timeGetTime() to get a time value dwStart, and then in the end of DBSCAN clustering algorithm called timeGetTime() be another time value dwEnd, then time consuming of the algorithm is dwEnd-dwStart. The fuzzy clustering algorithm consumes time 31ms-33ms in this method.

4 Determining the Centre Point of Each Clustering Gather(Target) and the Sprayer Motion Trail

Regional marker is attached to the connection with the same pixel tags, links to content on different regions with different tags attached.

The algorithm as follow:

- Step 1. Scanned images, encountered not the goal marking pixels, to add a new tag (lable).
- Step 2. The target pixel to pixel connected to add the same tag.
- Step 3. The pixel connected to Marking pixels add the same tag.
- Step 4. Connected pixels until all is added tags. Thus, a connection component was added the same tag.
- Step 5. Back Step1, re-add the tag and find new unmarking pixels, Repeat the steps above.

Figure 3 is processed by the regional labeling algorithm, the results as follow:

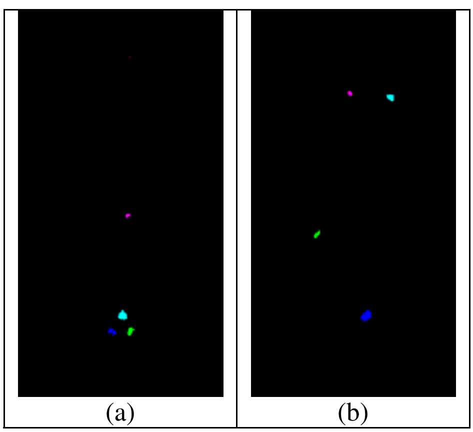

Fig. 3. Regional markers algorithm (a)(b) Not improved region labeling algorithm to generate image (c)(d) Improved region labeling algorithm to generate image

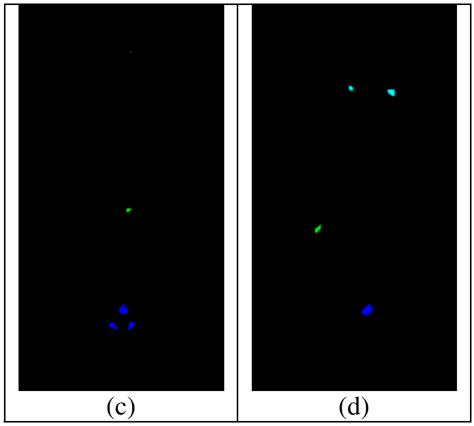

Fig. 3. (*Continued*)

By improving region labeling algorithm can make the green with a collection of different clustering using the same tag, and then struck the center of green plants per plant, in turn connect the center produce a track (composed of white pixels Line), this track is the lower level machine nozzle trajectory, The results shown in Figure 4-a and 4-b as follows:

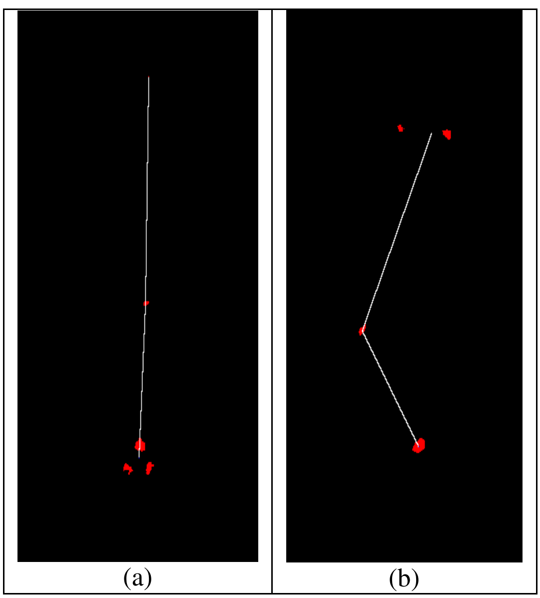

Fig. 4. Sprayer motion trail (a)(b) the image of sprayer motion trail

5 Computing Crop Area Ratio of Pixels

The pixel size was defined the total number of pixels, Therefore, crop area ratio of pixels was pixel area of crops and the ratio of total pixel area, then $\rho_{\text{ratio of pixel area of crops}} = \frac{S_{\text{crop}}}{S_{\text{the total pixel area}}}$, on fig 1-a, the pixel is 300×480, that the number of pixels is 300×480 = 144 000, $S_{\text{the tatal pixel area}}$ =144000, S_{crop} need to be calculated through the procedure, first fig 1-a map was carried through identifing crops from soil, and statisticing the number of green pixels. In figure 1-a S_{crop} =6085, $S_{\text{ratio of pixel area of crop}}$ =0.04225. When calculating pixel area of each crop, each crop was divided into the original image to 1/3, and then to calculate S_{crop} , as shown below:

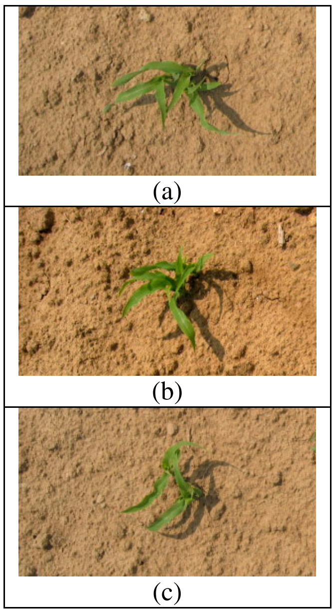

Fig. 5. Image Segmentation (a)(b)(c) Figure trisection

Pixel number and area ratio as shown in Table 1:

Table 1. The number of pixels per plant and the area ratio of crop

	the number of pixels	area ratio
$S_{1\text{crop}}$	2417	2417/144000
S_{2crop}	2066	2066/144000
$S_3 crop$	1062	1062/144000
$S_{\text{the total pixel area}}$	144000	144000/144000

Drawn from Table 1 that each plant crops the number of pixels in the image and its corresponding area ratio.

6 Conclusion

1) Adopt green strength of RGB`s method to identify the crop from the background of elaphic, the recognition accuracy was more than 98%. Handle a 300×480 pixel image, time-consuming 15ms.

2) Use density DBSCAN fuzzy clustering algorithm, by means of setting two parameters ε and MinN, in the density DBSCAN fuzzy clustering algorithm, to determine a cluster gather on the each target, by means of judging the existence of the clustering gather or not to determine the target. With the help of image division technology, calculate the area ratio of the target and calculate the need of quantity of spraying. By means of calculating the centre point of each clustering gather(target), realize to control sprayer motion trail, realize accurately targeting and variable rate spraying pesticide（Fertilizer） when the crop sowing in line at seeding. Handle a 300×480 pixel image, time-consuming 31ms-33ms.

3) Through image segmentation, the image is divided into, each division contains only one green, and then calculate the number of green pixels and the total number of pixels the image ratio, calculated area ratio. According to the value of area ratio, calculated the value of the corresponding application rate, controlled lower machine to achieve the precise purpose of spraying.

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Target Recognition of Software Research about Machine System of Accurately Spraying

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Abstract. The software is used modularity and qeneric idea, realize target recognition and accurately spraying, it consist of five modules: module of image process, module of identifing the crop from the background of elaphic, module of target recognition and classification of treatment, module of intelligent decision-making and helpness. Image process is made of distortion adjustment,gray strengthen, neighbourhoods average, histogram equalization and median filter; the module of identifing the crop from the background of elaphic is made of division of green strength threshold, division of H hue threshold and segmentation afterwards process and so on; the module of target recognition consist of recognition of fruiter, rice, wheate and target process and area calculating, the module of recognition of fruiter include centre recognition function; the module of intelligent decision-making include information target transmited. The system has fault-tolerant function and automatically judges the input of image or not, automatically detects input of camera and terminal setting, connection situation of singlechip, creating executable file, breaking away from VC++ then direct running. Limiting surface of software system is friendly, simple clear and satisfy the real-time processing the request.

Keywords: precision employing pesticide, image process, the soft of recognition.

1 Introduction

Precision spraying technology are areas of precision agriculture, mainly refer to the help of computer vision technology, identify the weed coverage rate and determine the location of weeds. Accordingly the implementation of appropriate, positioning the spraying of herbicides, the absence of regional weed not spraying herbicides. This not only can effectively reduce weeds, improve yield and quality of agricultural products,

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but also significantly savings in the use of herbicides liang, lower input, protect the ecological environment, have important economic significance and ecological significance.

Many scholars have conducted extensive studies. Won Suk Lee from USA, Claim that they have developed a real-time and between the lines system used to control weeding intelligent robot[1-2]. M.E.R.Paice, P.C.H.Millerdesigned a injection metering system, by changing the mixing ratio of the method to adjust the liquid volume spraying[3-4]. May.Kenzel invented a spray bar height can be adjusted and automatically sprayed herbicides on the target machine system[5]. Nanjing Forestry University, Mao-Cheng Zhao design a system based on Tree features real-time accurate image of the pesticide on the target and can be variable spraying[6]. QIU Bai-jing from Jiangsu University developed a variable spray device, it can be installed in the hardware and software equipment and DGPS for guidance, according to their location automatically adjust the size of spray volume. The equipment includes sprayers, adjust the controller, the computer console, AgGPS132, farm tractors and other equipment[7].

Precision of the target application techniques one of the difficulties is the fast and accurate identification on the target, target image acquisition and processing are key part of machine vision, This article is used modularity and qeneric idea, realize target recognition and accurately spraying, it consist of five modules: module of image process, module of identifing the crop from the background of elaphic, module of target recognition and classification of treatment, module of intelligent decision-making and helpness.

2 Image Acquisition and Preprocessing

2.1 Image Acquisition

Realize dynamic acquisition with a CCD camera image in the actual system, image was real-time input computer through image acquisition card.

2.2 Image Preprocessing

As the spraying system image acquisition is in the outdoor, and the camera installed in the movement of locomotive, the collection of images often have many problems, such as the image edge is too vague and have some images made unexpected white spots or black spots, image distortion, affected by various natural conditions, such as wind, light, uneven exposure factors, the input image in the visual effects and identify possible have so many problems, these factors resulted in images "quality" problem. Therefore, the first pre-process the image. In the pre-processing stage, using distortion correction, gray transformation enhancement, histogram equalization algorithm, to improve the image quality.

3 Image Segmentation and Target Identification

3.1 Image Segmentation

Making weed identification should be based on different backgrounds to choose a different recognition method. The weeds on the soil background recognition can be applied to spectrum and color of law, according to weed and background material in the color and spectral characteristics of the differences in segmentation. Green weed in the context of recognition are more complex, the background of the intensive plants, such as lawn, generally use shape feature method or texture feature method. Background of the drilling plant, to achieve the rapid division of weeds and crops with position characteristic; background-demand plants, the shape feature method is more used.

3.2 Target Identification

This study, on crop and background segmentation, used ultra-green method and tone method, in which the threshold was automatically determined, greater than the threshold value for the pixels to given the background color, less than the threshold value was given the same color of the pixel.

Such as drilling wheat crop planted artificially, so its position distribution is the rule - by line of distribution; and the growth of weeds is natural, non-regularly distributed between crop rows. In this study, the division of wheat and weeds used location characteristics method. Corn crop demand, 3 ~ 5 leaves, has certain spacing and line spacing between adjacent plants, plant leaves overlap to a lesser. Therefore, for corn, the first extract their shape characteristics, and to train artificial neural network for recognition.

3.3 Segmentation to Remove Noise

The image segmented more or less has noise. The noise of the area generally consists of several pixels, the form of a point-like. By median filtering method to filter the image processing.

3.4 Determine Target Area

The binary image was divided into 24 squares and was statisticed (where the size of each small square region is just a liquid spray nozzle effective area), statistics for each small box the white pixels and the ratio of black pixels, the ratio is as the volume of the signal box region spray.

Binary image defined area A pesticide is sprayed area that contains the number of pixels. Hypothesis, the size of each square b(x,y) equal $M \times N$, $b(x, y) = 1$, the background is zero, the target area A:

$$A = \sum_{x=0}^{M=1} \sum_{y=0}^{N=1} b(x, y)$$

4 Software System Design

The system was used Microsoft Visual C++6.0 MFC to generate the basic framework, and then programmed with the Win32 API programming language, Microsoft has introduced the development of Win32 environment that is a visual integration of object-oriented programming environment. It is not only a procedural framework for automatic generation of flexible class management, coding and integration interaction interface design, can develop a variety of procedures (application, DLL, ActiveX controls, etc.), but also by a simple set can process framework to generate support for database interface, OLE2, Winsock network, 3D control interface.

4.1 System Overview

In the software process taking a good design is important. Rational design of software is not only development cycle short, low cost, but also readable, easy to maintain. On the contrary, free software written in is not only difficult to grasp, but also poor to read, hard to maintain, there may even be unable to complete the code and lead to the situation half-way scrap. The modular software design with high cohesion, low coupling principle of the software is divided into relatively independent of the number of parts in order to separate design and code of preparation, make the structure of the whole system easily understand. Have been introduced earlier in this article all aspects of the VC+ + programming, the use of modular programming, can take advantage of all the previous subroutine, after simple treatment can be integrated into the total program.

The software is divided into modularity through function, it consist of five modules: it consist of five modules: module of image process, module of identifing the crop from the background of elaphic, module of target recognition and classification of treatment, module of intelligent decision-making and helpness. Image process is made of distortion adjustment, gray strengthen, neighbourhoods average, histogram equalization and median filter; the module of identifing the crop from the background of elaphic is made of division of green strength threshold, division of H hue threshold and segmentation afterwards process and so on; the module of target recognition consist of recognition of fruiter, rice ,wheate and target process and area calculating, the module of recognition of fruiter include centre recognition function; the module of intelligent decision-making include information target transmited.

Program was used class-based ideology. In the program the images are a variety of operations and operations in the form of packaging up to class so that they can work for future expansion.

4.2 System Framework

The process is as follows:

(1) Frist, CCD images were collected, then were pretreatment, and binary image was processed with Green features. Crops and the background binary image was obtained.

(2) The image was processed with morphological operations, eliminatie a lot of noise.
(3) Judgments are fruit trees, wheat or corn images into the appropriate processing module.
   (a) There is tree, tree crown recognition.
   (b) There is wheat, extracting centerline.
   (c) There is crop, region marking, according to the distance between the region for regional consolidation, the feature of region of the combined was extracted, on the identification of maize, the input feature vectors extracted BP neural network classifier to judge whether the target.
(4) Calculate Target area and position.
(5) Send information.

Total system flow chart as follow:

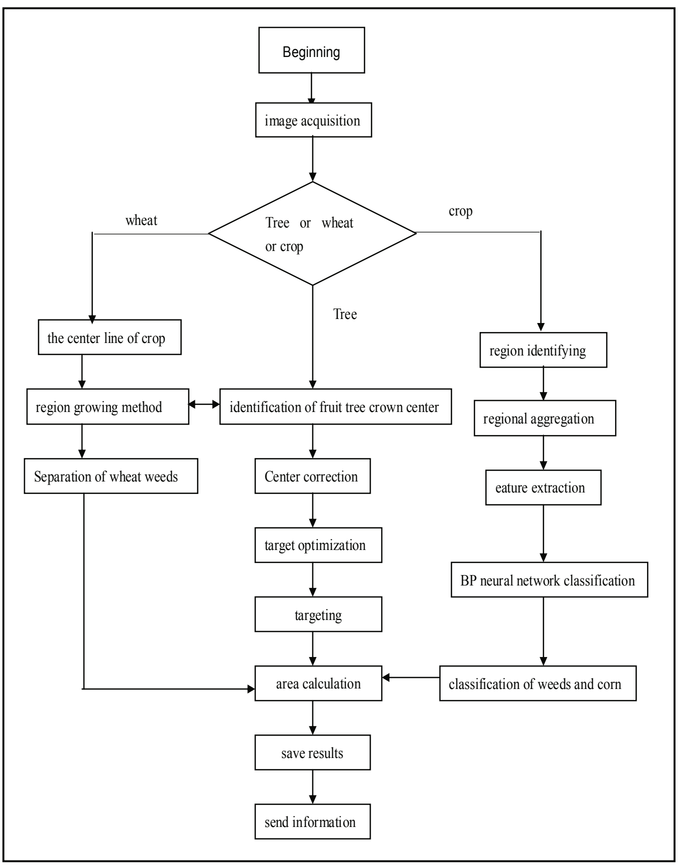

Fig. 1. Total system flow chart

System software build platform as follow:

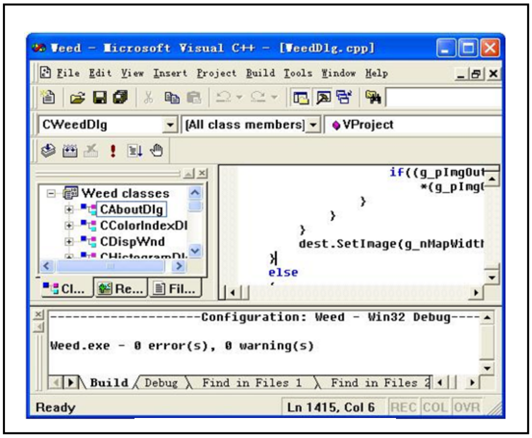

Fig. 2. System build platform

5 Summary

This article introduce the identification of software systems. The software system was designed with modular and class ideas. It consisted of five modules: module of image process, module of identifing the crop from the background of elaphic, module of target recognition and classification of treatment, module of intelligent decision-making and helpness. The system has fault-tolerant function and automatically judges the input of image or not, automatically detects input of camera and terminal setting, connection situation of singlechip, creating executable file, breaking away from VC++ then direct running. Limiting surface of software system was friendly, simple clear and satisfy the real-time processing the request.

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The Application of CPLD and ARM in Food Safety Testing Data Fusion

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Abstract. Analyzes the main features of CPLD, and describes the process that use ARM for data fusion after obtaining a large number of food safety testing signals, and gives principle of CPLD. This system has realized the data fusion processing, and has the performances that easy to operation, high sensitivity, strong data analysis capability, stable output and so on. Improving the performance of system data processing greatly and reducing the development costs effectively, provides an effective method of data processing for food safety testing.

Keywords: ARM, CPLD, Data fusion, Food safety testing.

1 Introduction

As food safety affecting people's health and safety directly, more and more attention has been paid to it. While food security becoming the focus of which the public concern about, administration departments have also taken various measures to enhance the work of food safety testing. With the development of safety detection, all kinds of test items and test equipments were available. After each test, there will be a large number of data. In this case, on one side, could improve the level of food security testing, and on the other hand, new requirements for data acquisition and processing technology would be proposed.

CPLD is short for Complex Programmable Logic Device. Comparing with previous data collector, it has a higher acquisition speed and more stable. In the previous case, after data collecting, single chip microcomputer was used as the main tool for data Analysis. But with the growing data flow and the requirements for real-time from modern testing technology, the single chip microcomputer can not meet these requirements[1]. ARM embedded technology could be used to solve these problems wonderfully. It will meet the requirements of improving data collection speed and data processing speed effectively by combining CPLD technology with the ARM.

2 The Design of System Structure

This system use EPM7128S and ARM7. System flow chart is shown in Figure 1. There will be a variety of detection volume during food safety testing process and circuit

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designed are multi-sensor circuit. Basing on actual requirements we can increase or decrease sensors signals output channels. Signals from various channels enter into CPLD first. CPLD controls signals from the strobe. The sensors output signals are so weak that system will take on signal amplification and frequency processing after signals gating through the CPLD. After processing the signals, they will be sent into A/D. In this way , it will be easy for ARM to take on data fusion. In the ARM processor, the signals collected will be processed by many methods , including wavelet analysis, least-squares method, DS evidence theory ,fuzzy neural network and so on.Then calling for database to analyze and compare the signals. Finally, the test results are sent to the monitors, printers, or saved by network. Test results are saved for the purpose of data analysis and archiving.

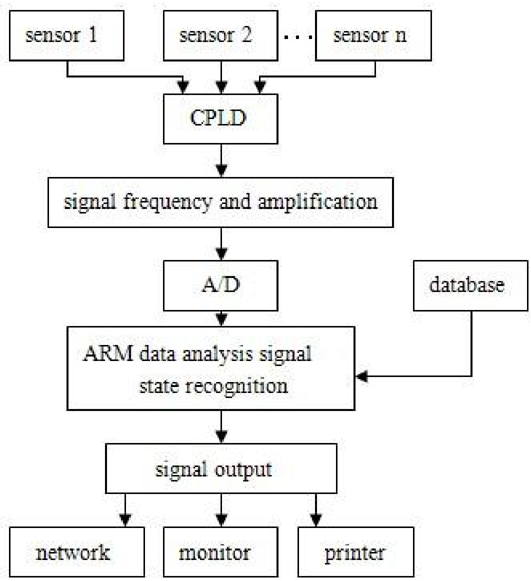

Fig. 1. System Flow Chart

3 Principle of CPLD

CPLD work logic flow chart is shown in Figure 2. The main functions of CPLD are controlling of data collection, determining sensors work state, controlling A/D change. Food safety testing has so many detection items that a lot of types and a large number of sensors are involved. It is very important to judge the state of the sensors [2]. Through a preliminary analysis of sensors output signals, we can discover non-normal state sensors. When the sensors are not working properly that the system will send warning signals immediately. This will remind the inspectors not to analyze the wrong output. In this way, it will save the time of data acquisition and analysis. What’s more, it can also increase system efficiency and reliability. As the multiple sources put into the circuit nearly at the same time that it needs CPLD to control A / D conversion work. Through the CPLD module internal clock frequency, pulse signals are generated [2]. Once count time, A / D conversion start to work for one time. Another pulse signal will be issued after A / D conversion completed. And then the data will be sent to the ARM for the next step processing. CPLD's work signal is empty at that time, indicating that the data has been removed by ARM processor [3] and CPLD can select a new signal channel and receive the new sensors output signals.

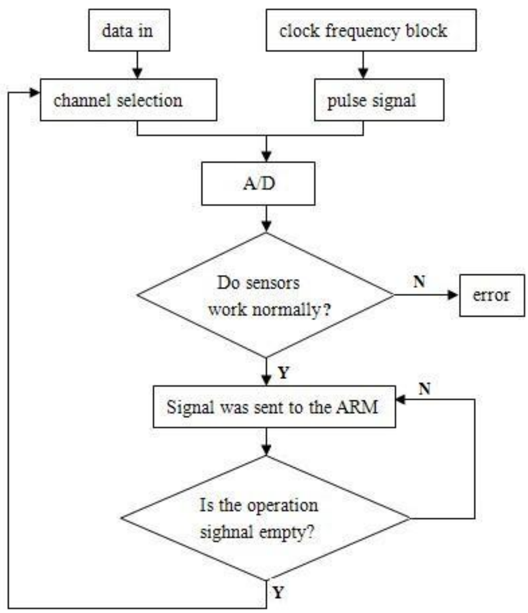

Fig. 2. CPLD Work Logic Flow Chart

4 ARM Data Processing

During the previous data fusion process, use single chip microcomputer for data processing when the amount of data is small. Data will be sent to the PC when there is a large amount of data. So there are some problems. For example: some data may lose during the process of transmission; A longer transmission time will be needed when there is enormous amount of data, and it is easy to be affected by the external environment. In the process of food testing, as the sensors signals have an important influence on test results, and many cases require to achieve the rapid detection, so the whole system have a higher demand with real-time data transmission and stability. With the development of embedded technology, the system's data processing capabilities continue to increase, and can completed the work of data fusion in the field gradually [4].

In this system, ARM processor needs to monitor the working status of each sensor and use several fusion algorithms on the sensors output signals at the same time. There has been a simple comparative analysis to evaluate sensors working conditions when the data into the CPLD. But only a simple estimate is not enough. It still needs the ARM processor for further identification. System identification method is adaptive fusion algorithm in wavelet analysis. In the testing process, by calling the database, compare with the state of each sensor in sensor systems. Estimate the reliability of data[5] and accept the sensor data according to the reliability. Sensors data fusion use the least square method, DS evidence theory and fuzzy neural network technology. Least squares method is simple and easy to operate. In this way the system can reduce the computational burden. DS evidence theory has the advantage of a strong theoretical foundation. It can deal with the uncertainty caused by random and ambiguity[6]. This has great significance. Because during the process of sampling, the sensor may be affected by sampling time, sampling frequency, a sudden change in environmental conditions and so on. System can not avoid to occur some errors and uncertainties. DS evidence theory can analyze and solve such problems effectively. Fuzzy neural network has the function of learning algorithm and high convergence speed. It can get the required input-output relationship quickly[7]. So, in this way, by calling the database, system can analyze data by itself. This can reduce the pressure on the system operation and save the test time.

5 Conclusion

Food safety testing technology plays a significant role in the process of protecting food safety. Detection system with the CPLD can be used to improve data acquisition speed and ensure the security of data acquisition and stability at the same time. That will display the multi-sensor group's function fully. Using of ARM technology and a variety of data fusion methods will help to achieve real-time data analysis and improve the the speed of system detection. It will also help to facilitate the system in the actual detection and promotion. The using of multi-sensor group will meet the requirement that the same or different materials can be tested at the same time. This can reduce test cost and improve the detection speed. This method can simplify the process of food safety testing operation and easy to handle. So it will reduce the work volume and improve the level of food safety testing to some extent.

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The Application of Three-Dimensional Visualization Technology in Village Information Service Platform

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Abstract. Recently Three-Dimensional (3D) Visualization Technology has been widely used in several industries. This is about the application of 3D visualization technology into the construction of village information service platform. Because village has small scope of management, the existing large-scale 3D visualization technology can't be used in the construction of village information service platform. By the use of high-resolution remote sensing image and high precision DEM solve the problem of fine terrain. In the view of the situation that most town building are domestic architecture and they have the same appearance, research the technology of rapid model. Using the data obtain from high-resolution remote sensing image we can more quickly establish model. Use ShanDong Province DingZhuang village as a demonstration site, establish the 3D scene of DingZhuang village, that can be a good foundation of the establishing of village information service platform for DingZhuang.

Keywords: 3D visualization technology, sensing image, DEM.

1 Introduction

3D visualization includes two respects content: virtual reality and real[1] [2] [3], need comprehensive application of remote sensing and GIS, multimedia, network technology and virtual simulation [4] [5]. 3D visualization is an important part of rural informationization construction, and an important way to improve rural informationization management level. The existing large-scale 3D visualization technology can't be used in the construction of village information service platform: village management has small scope but need high precision, always need to every household. Thus research the rapid modeling technique based on rural is an important part of rural 3D visualization, and today's high-resolution remote sensing images and digital terrain model provides important support for modeling. Use ShanDong Province DingZhuang village as a demonstration site, discuss rapid modeling technique, found 3D scene, that can be a good foundation of the establishing of village information service platform for DingZhuang.

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2 Rebuild the Scene Based on High-Resolution Remote Sensing Images and DEM

The image-forming principle of remote sensing images is using camera vertical shooting the surveyed area from a high point [6], and using frame shoot method, finally all the frames will joined into one remote sensing image of the surveyed area. DEM is one of the data set of plane coordinates(x,y) and elevation(z) within a scope of regular grid, mainly used to describe the physiographic space distribution of the surveyed area. Combining remote sensing images and DEM can integrallty describe the 3D terrain characteristics.

For buildings, remote sensing images have the ground projection that like shows in Figure 1. After shooted by the camera, the polygon AA''B''C''CD formed by add thick line is the building's projection on the ground. Therefore, we can divide the projection on the ground into two categories: vertical shooting and deflection shooting. For the vertical shooting, we can only get the building's width and length from remote sensing images, in order to elaborate modeling the buildings, we still need on-site measure the height of the building, create the result that this type of building's modeling must take even more time. For deflection shooting, we can fully use remote sensing image get width, length and height of the building, use the data get from the image we can rapid modeling.

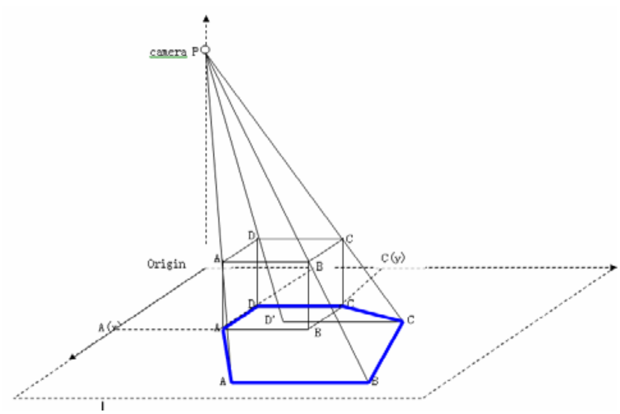

Fig. 1. Building's projection on the ground

2.1 Restore the Camera's Position

In order to restore the camera's position, we need on-site measure a deflection shooting building's data. Suppose that length (AB) of the building(ABCD-A'B'C'D') is L, the width(AD) of it is W and the height(AA') is H, the coordinate of the camera is (0,0,Hp), thus we can restore the camera's position use the under formula:

$$\frac{A''A}{A''A + AO} = \frac{\mathrm{H}}{H_p} \quad (1)$$

$$\frac{B''B}{B''B+BO}=\frac{H}{H_p}. \tag{2}$$

$$\frac{C''C}{C''C+CO}=\frac{H}{H_p}. \tag{3}$$

Formula (1) is proved as follow:

$\because$ triangle A'A''A ≌ PA''O

$$\therefore \frac{A''A}{A''A+AO}=\frac{H}{H_p}$$

Formula (2), (3) is similar as (1), here no longer prove .

Further simplify and processing the formula:

$$\frac{A''A}{A''A+AO}=\frac{B''B}{B''B+BO}=\frac{C''C}{C''C+CO}$$

$$=\frac{A''A}{A''A+\sqrt{A^2(x)+A^2(y)}} \qquad =\frac{B''B}{B''B+\sqrt{B^2(x)+B^2(y)}}$$

$$=\frac{C''C}{C''C+\sqrt{C^2(x)+C^2(y)}}$$

$$=\frac{A''A}{A''A+\sqrt{(B(x)-L)^2+B^2(y)}} \qquad =\frac{B''B}{B''B+\sqrt{B^2(x)+B^2(y)}}$$

$$=\frac{C''C}{C''C+\sqrt{B^2(x)+(B(y)+W)^2}}$$

A(x) is the x axis distance from the building point A to the camera, A(y) is the y axis distance from the building point B to the camera, then B(x)=A(x)+L, B(y)=A(y), B(x)=C(x), B(y)=C(y)-W. A''A and BB'' can be directly measured from remote sensing images. Thus we can get the distance from camera P to every point of the building, according to the coordinate of the building's point we can get the camera P's position.

2.2 According to the Position of Camera P Get the Data of the Building

This is the inverse process of restore the camera's position, we have get the position of camera P and measured data from remote sensing images, according to the formula (1),(2),(3), we can get every building's data. Because all the building's data can obtain from the image, we needn't on-site measure the buildings, so the modeling speed will be very quick.

2.3 Overlay DEM

For real surveyed area, its physiographic characteristics is impossible unchangeable, after overlay DEM will make the surveyed area data more realistic.

3 The Establish of Rural 3D Visualization

Paper use ShanDong Province DingZhuang village as a demonstration site, discuss the method of rapid modeling. Rural 3D visualization system has its characteristics:

Village has small scope, usually dozens of square kilometers to one or two hundreds square kilometers, so rural 3D visualization has small amount of data.

Rural 3D visualization system not only used to browse, often need have the function of inquire. This prompt a higher require to the 3D visualization system, always need model in a even small unit, rural 3D visualization system need inquire precisely to every household or to every piece of paddy field.

Rural scene is different from city scene, most of the area is farmland, and most folk houses have the similar appearance. This is an important condition of rapid modeling.

According to the characteristics mentioned above, we can establish rural 3D visualization system follow under step:

1. Obtain high-resolution remote sensing image and high precision DEM of the village.
2. Overlay the remote sensing image and DEM.
3. On-site measure a building, restore the position of the camera.
4. Because village building has similar appearance, we can select typical building, according to the camera’s position get its data, establish model, put them to the accurate position.

4 Conclusion

In order to achieve precise requirement, the existing process of modeling always need on-site measure, and establish model for every building. This leads to the result that there are lots of model and large amounts of data. At the same time because need on-site measure, the modeling speed will be very slow. This paper discuss how to use high-resolution remote sensing image and high precision DEM establish rural 3D visualization. First we restore the position of camera, then use the position of the camera obtain the data of deflection shooting building. In this way we save lots of time, greatly improves the speed of modeling.

Acknowledgements

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Research and Application of Data Security for Mobile Devices

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Abstract. Mobile devices have been increasingly become important tools for the information system application in agriculture, but the safe problem that follow also results in risks of economy lose. Considering above problems and combining the application of an agriculture chain logistics management system, a series of jobs have been done. This paper presents a data security solution which encrypts the configuration files to protect sensitive information and uses SSL protocol to protect the network transmission security. At present, this solution has been modular integrated with the agriculture chain logistics management system. This paper also provides reference for data security problems of other mobile devices.

Keywords: Mobile devices, data transmission, security, XML encryption, SSL protocol.

1 Introduction

Due to the flexible and customizable feature, wireless mobile devices agree with the special requirements of the agriculture application, such as wide region and poor infrastructure condition. Therefore, related application based on wireless mobile devices will become the development direction of agricultural information system. However, the smallness and portable characteristics also cause the security problems of the sensitive data seem more outstanding. Moreover, the wireless mobile devices currently send data by GPRS while GPRS at this stage need to transmit information via public network. So, the data security in the process of passing data through network faces crucial threat. Data security during transmission of mobile devices application has become an urgent problem to be solved. Aiming at these problems and according to the practical requirement, this paper proposed a set of data security solution. This solution has been applied to an agriculture chain logistics management system. The effectiveness has been demonstrated.

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2 Introduction of the Agriculture Chain Logistics Management System

The system is composed of client-side and server-side, which communicate data via GPRS. The client-side system running on mobile devices integrates agricultural material reservation, acceptance of the goods, returned goods, sales record and price acquisition. These five modules implement basic business requirement of agricultural material chain stores. The server-side system also integrates these five modules to ensure that the business functions can be completed in the case of client-side system failure. In addition, the server-side system provides inquiry and statistics to each module. Basic data management module of the server-side system makes a uniform management on basic information of agricultural material. These basic information can be transmitted to client-side to support the client-side system operation. And server's IP address, data transmission URL, system username and password are stored in the system configuration module of client-side system.

In the system, there are two significant data security risks as below:

a. Loss of mobile devices may compromise business data and sensitive information which is stored in the devices. People who intercepted above information would spread trade secrets or attack servers.
b. Data interception during transmission will pose a threat to confidentiality, interity and availability of data. If the hackesrs tampered, disguised, replayed the data or made the server deny the data from client-sides, the agricultural material sellers would sustain a great loss.

3 Data Security Solution Design

Aiming at the significant safety hazards in the application process of the system and following the simple, practical, low-power principle, this paper designs a security solution as below:

a. Block encrypting configuration files of client-side system. Because part of the profile information needs to be exposed to prepare for flexibly changing, only the server address, database address and other important information require for encrypted storage.
b. SSL protocol to protect data security during the process of network connection. SSL handshake protocol will automatically perform exchanging keys and symmetrical encrypt to prevent the safety hazards after the transmission attacking.

Above both security modules have been established in the agriculture chain logistics management system. To meet the needs of flexible application on other systems, lots of jobs have also been done to reduce the coupling degree. This solution, though, has certain pertinence; it covers most of the basic security requirement of mobile devices. Superadded the modular development, this solution has a general significance for other applications.

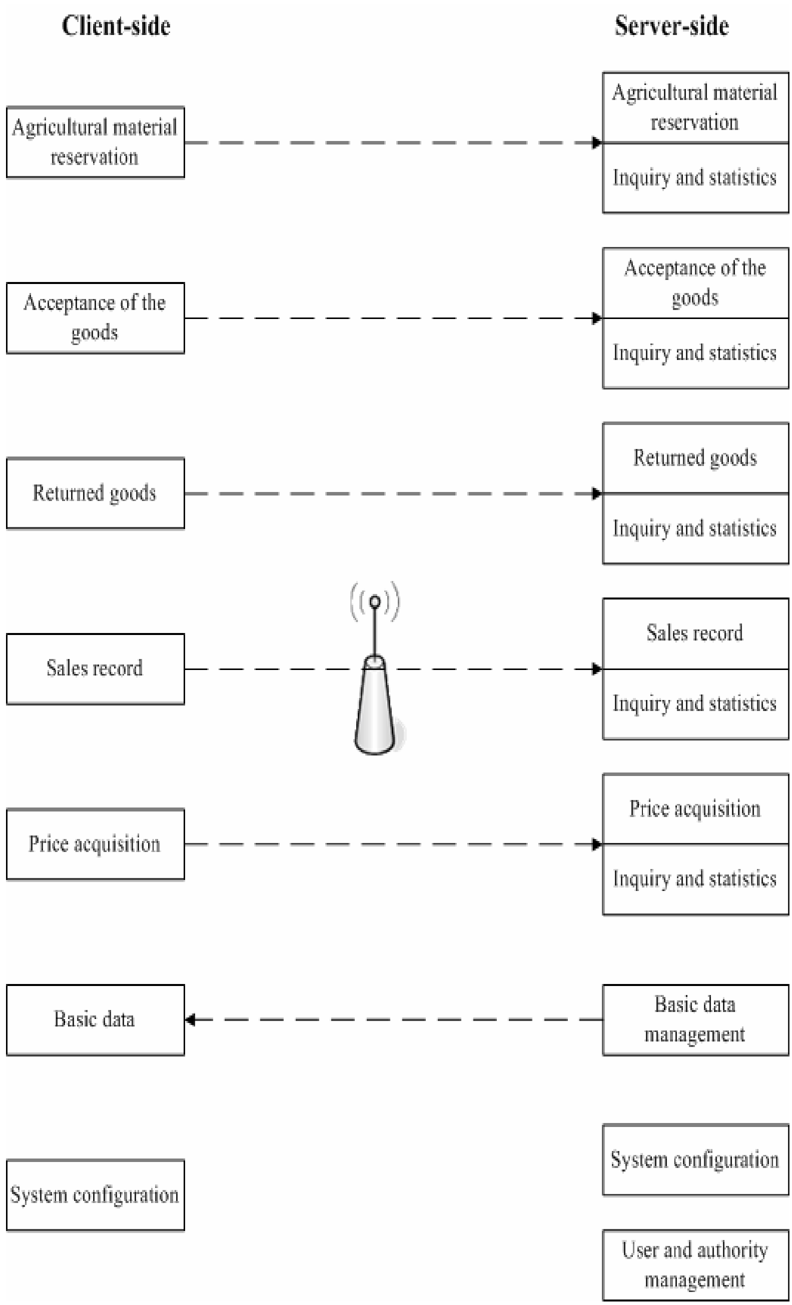

Fig. 1. Agriculture Chain Logistics Management System Structure

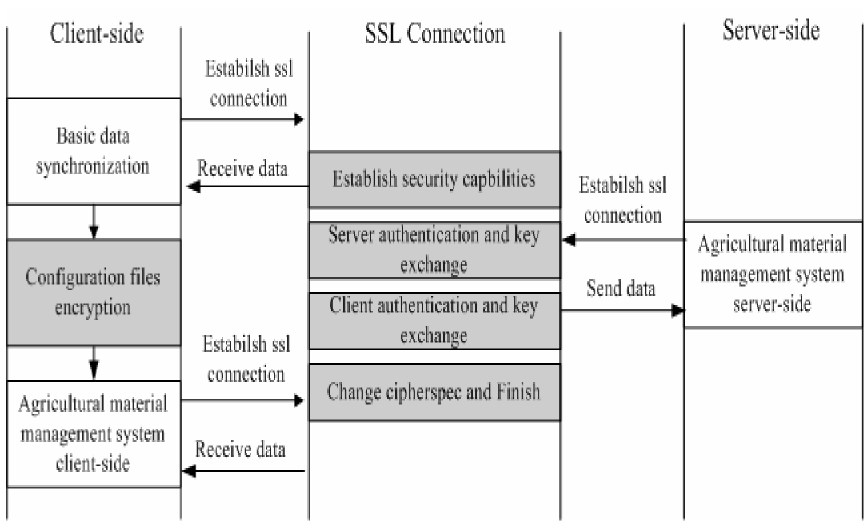

Fig. 2. Data security solution

4 Configuration Files Encryption

The system configuration files are XML format, so we mainly study XML encryption. The biggest difference between XML encryption and conventional encryption is the introduction of the concept of encryption granularity; you can encrypt the whole document, the document element or document element content. After encryption the whole element is replaced with an element named <EncryptedData>. The element contains information with encryption or decryption information, encrypted data and encrypted data references, etc.. The <EncryptedData> element is the core element in the syntax. Not only does its cipherdata child contain the encrypted data, but it's also the element that replaces the encrypted element, or serves as the new document root. When encrypting an XML element or element content the <EncryptedData> element replaces the element or content (respectively) in the encrypted version of the XML document [1].

Encrypt the xml using a combination of asymmetric and symmetric encryption requires a symmetric session key to encrypt the data and an asymmetric key to protect the session key. Both the encrypted session key and the encrypted data are stored together in the xml document. The public asymmetric key is used to encrypt the session key while the private asymmetric key is used to decrypt the key [2].

5 SSL

Short for Secure Sockets Layer, a protocol developed by Netscape for transmitting private documents via the Internet. SSL uses a cryptographic system that uses two keys to encrypt data a public key known to everyone and a private or secret key known only to the recipient of the message. Both Netscape Navigator and Internet Explorer support SSL, and many Web sites use the protocol to obtain confidential user information, such as credit card numbers. By convention, URLs that require an SSL connection start with https: instead of http:.

The primary goal of the SSL Protocol is to provide privacy and reliability between two communicating applications. The protocol is composed of two layers. At the lowest level, layered on top of some reliable transport protocol (e.g. [TCP]), is the SSL Record Protocol. The SSL Record Protocol is used for encapsulation of various higher level protocols. One such encapsulated protocol, the SSL Handshake Protocol, allows the server and client to authenticate each other and to negotiate an encryption algorithm and cryptographic keys before the application protocol transmits or receives its first byte of data. One advantage of SSL is that it is application protocol independent. A higher level protocol can layer on top of the SSL Protocol transparently.

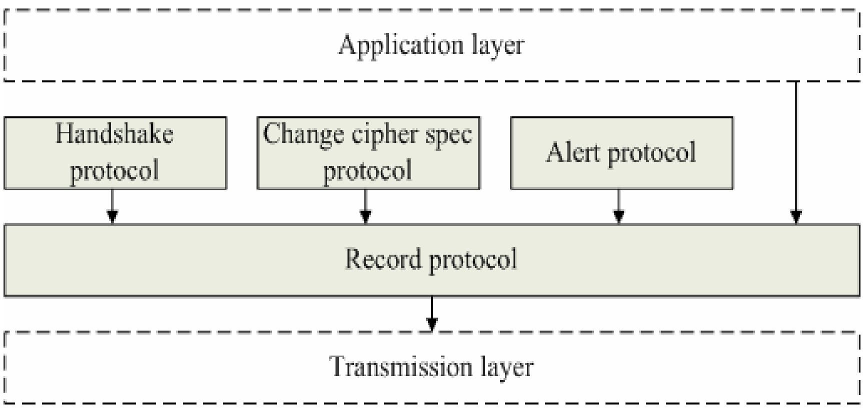

Fig. 3. SSL Protocol

The SSL Handshake Protocol is one of the defined higher level clients of the SSL Record Protocol. This protocol is used to negotiate the secure attributes of a session. Handshake messages are supplied to the SSL Record Layer, where they are encapsulated within one or more SSLPlaintext structures, which are processed and transmitted as specified by the current active session state [12-14].

a. The client sends the server the client's SSL version number, cipher settings, randomly generated data, and other information the server needs to communicate with the client using SSL.
b. The server sends the client the server's SSL version number, cipher settings, randomly generated data, and other information the client needs to communicate with the server over SSL. The server also sends its own certificate and, if the client is requesting a server resource that requires client authentication, requests the client's certificate.

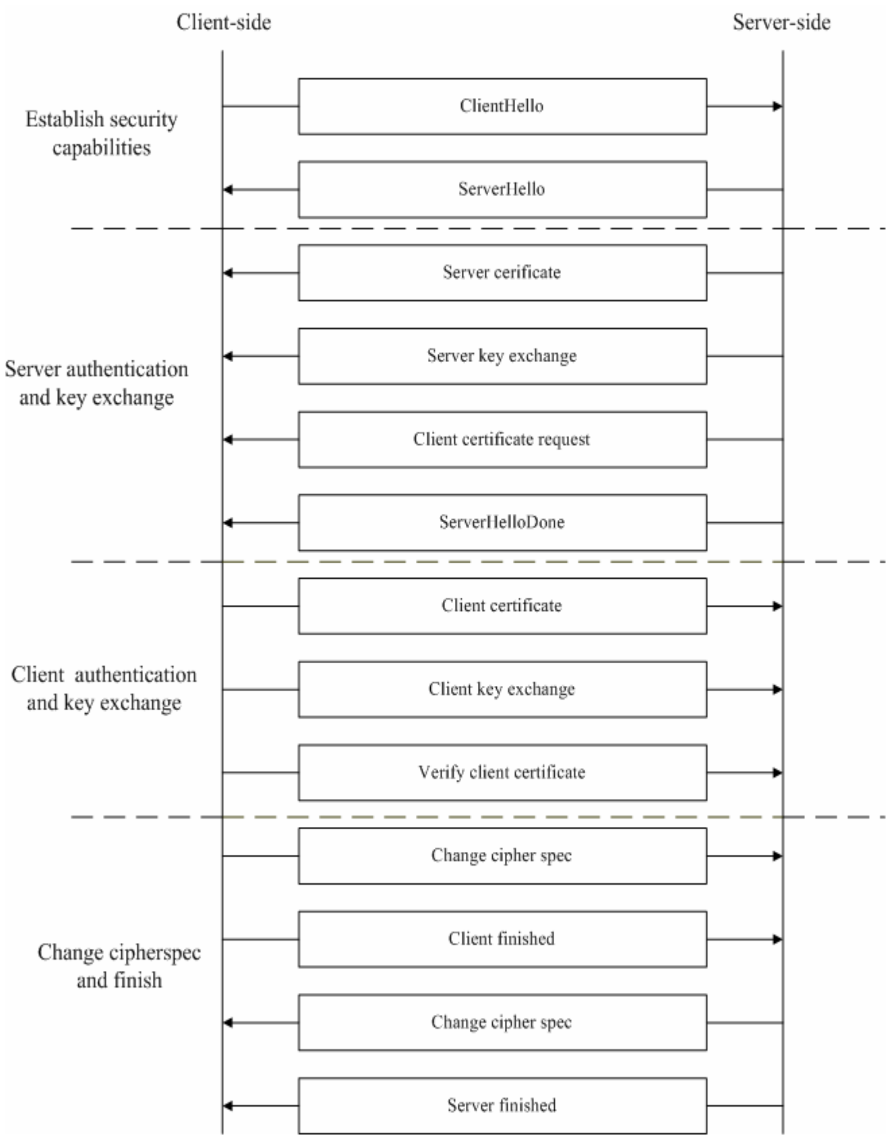

Fig. 4. Handshake protocol

c. The client uses some of the information sent by the server to authenticate the server (see Server Authentication for details). If the server cannot be authenticated, the user is warned of the problem and informed that an encrypted and authenticated connection cannot be established.
d. Using all data generated in the handshake so far, the client (with the cooperation of the server, depending on the cipher being used) creates the premaster secret for

the session, encrypts it with the server's public key, and sends the encrypted premaster secret to the server.

e. If the server has requested client authentication (an optional step in the handshake), the client also signs another piece of data that is unique to this handshake and known by both the client and server. In this case the client sends both the signed data and the client's own certificate to the server along with the encrypted premaster secret.
f. If the server has requested client authentication, the server attempts to authenticate the client (see Client Authentication for details). If the client cannot be authenticated, the session is terminated. If the client can be successfully authenticated, the server uses its private key to decrypt the premaster secret, then performs a series of steps (which the client also performs, starting from the same premaster secret) to generate the master secret.
g. Both the client and the server use the master secret to generate the session keys, which are symmetric keys used to encrypt and decrypt information exchanged during the SSL session and to verify its integrity--that is, to detect any changes in the data between the time it was sent and the time it is received over the SSL connection.
h. The client sends a message to the server informing it that future messages from the client will be encrypted with the session key. It then sends a separate (encrypted) message indicating that the client portion of the handshake is finished.
i. The server sends a message to the client informing it that future messages from the server will be encrypted with the session key. It then sends a separate (encrypted) message indicating that the server portion of the handshake is finished.
j. The SSL handshake is now complete, and the SSL session has begun. The client and the server use the session keys to encrypt and decrypt the data they send to each other and to validate its integrity [12-14].

6 Implementation of Secure Data Transfer Solution

6.1 Encrypting Configure File

We encrypted the key of symmetric encryption algorithm using asymmetric algorithm on configure file, to ensure the security of key exchange, then we make encryption and decryption on file data using symmetric encryption algorithm, which is the recommended method of XML encryption specification. In the process of configure file encrypting, firstly public key and private key pair was generated and saved into security key container, secondly one single session key was generated by AES algorithm, by which XML document element was Encrypted, thirdly AES session key was Encrypted using RSA public key, finally the encrypted AES session key and encrypted XML data was saved to new element of <EncryptedData> in XML document. When calling configure file, decrypt opposite direction [10]. Below is one example of configure file.

```
<?xml version="1.0" encoding="utf-8" ?>

<BaseData>

  <SERECTDATA>
<SENDURL>http://192.168.2.215:8080/SMS/ws/WSPort?wsdl</
SENDURL>
<BASEURL>http://192.168.2.215:8080/SMS/ws/BaseWSPort?ws
dl</BASEURL>

    <CONNECT>Data Source =
{0}\DB\SMSDB.sdf;Password=******</CONNECT>

  </SECRETDATA>

  <ORDERTIME>14</ORDERTIME>

</BaseData>
```


Among of them, <SENDURL> is the URL where sends agricultural material reservation order; <BASEURL> is the URL where Synchronize basic information of agricultural material; <CONNECT> is the connecting information to database system. Because the leaking of this information will bring threat to the server, it is necessary to encrypt these elements. Whereas <ORDERTIME> is time limiting information of sending agricultural material reservation order, which can be exposure and edited, so we don't encrypt this element, then the encrypted configure file is as below:


```
<?xml version="1.0" encoding="utf-8"?>

<BaseData>

  <EncryptedData Id="EncryptedElement1"
Type="http://www.w3.org/2001/04/xmlenc#Element"
xmlns="http://www.w3.org/2001/04/xmlenc#"><EncryptionMe
thod
Algorithm="http://www.w3.org/2001/04/xmlenc#aes256-cbc"
/><CipherData><CipherValue>OQ+TkM4IIcQqDbUzoiBo8R1ZG6mB
YdZgJKqHR6xNy0FE0OeVx2pc11NbEcKyW45vHFtU7Ihe6X0f8+z9kX0
K5rqGarPn9ARm/rDUUlrhXPF54981/7uoIw3gR7q1u24uKwpWwdERtn
gjo73GfwXgpGTrF/hjtv91X1RQO1BShMNuJTEducitlNUEy82JBHWgo
+2yvLzhFHWXScJP+w89oVFIhy3XTS880tehjBYI8Sz4xbo9/AO5ptDc
w4DZEVOVKZ9uqfh4497UgDy4hh6WAg7OhgsXTecFkzpNFG3LkmY3/hS
```

```
5mxDCLE7HAdk8k/uhnu5EDI5osc1r+xSCkkip3uqOFC85GRyiRNDu13
OMwj0=</CipherValue></CipherData></EncryptedData>

  <ORDERTIME>14</ORDERTIME>

</BaseData>
```

6.2 Implementation of SSL

There are several kinds of SSL implementation tool box in the market, such as OpenSSL, Mod_ssl etc. Although these tool boxes are powerful, they are too large for embedded device. MatrixSSL and axTLS are specially developed for SSL implementation in embedded device. MatrixSSL's library is smaller than 50K, but tedious when handling I/O. AxTLS has least function, just providing several encryption algorithm, but considering the specificity of embedded device, it is a good choice. In the Agriculture Chain Logistics Management System, We implemented SSL protocol using axTLS. The client software of the system was developed in C# language, whereas the server software was developed in Java language. The client was hosted in PDA moving equipment. Server software was hosted in the Server machine, handling accesses from external network. One example of SSL connecting process is below:

- Firstly initialize client function as below:

```
axTLS::SSLClient::SSLClient  (  uint  options,
  int  num_sessions
 )  [inline]
```

- Apply for establishing a new SSL connection from server

```
SSL axTLS::SSLClient::Connect  (  Socket  s,
  byte[]  session_id
 )  [inline]
```

The sever side will return handshake status to judge if success of Handshake

- Data Transfer

After the success of handshake we can make secure data transfer. In axTLS, we use the function of read() and write() to accomplish read and white operations of socket

```
int axTLSj::SSLCTX::read  (  SSL  ssl,
  SSLReadHolder  rh
 )  [inline]
```

```
int axTLSj::SSLCTX::write  (  SSL  ssl,
  byte[]  out_data
 )  [inline]
```

➢ Close Communication

When the communication finishes between client and server, Dispose() function should be called to release SSL resources.

```
void axTLSj::SSLCTX::dispose  ()  [inline]
```

7 Conclusions

In this article, we introduced a secure data transfer solution of moving equipment using XML encryption and SSL protocol, and implemented it in Agriculture Chain Logistics Management System. In the practice, the solution satisfied the security requirement of data transfer in system, in which the server side is in Myeclipse framework and client side is in .NET3.5 framework. We believe as the moving equipment in agriculture becomes more and more Diversity the data transfer security problem will drawn wide attention.

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The Design and Development of the Land Management System in Dingzhuang Town Based on Spatial Data

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Abstract. Taking as an example the land resources management in Dingzhuang town, Guangrao county, Shandong province, this thesis makes sufficient investigation and demand analysis in accordance with the features of land resources management in villages and towns. It studied in details the main content of land resources management in villages and towns. On this basis, the thesis first makes a general design of the land resources management system in Dingzhuang town, and an in-depth investigation of the functions of every modules in the information system of land resources management in villages and towns, together with the necessary principles for the design of system interface. In the following steps, it establishes through research the spatial database and attribute database, along with the platform of the geographic information system of Dingzhuang town on the basis of the spatial data and attribute data of this town. On this platform, it uses the relevant data of Dingzhuang town land resources and groupware second development technology to research and develop the information system of land resources management in villages and towns. The basic functions of this system include land use planning, basic farmland management, the management of land for construction use, land survey, land registration and so on. Besides, it realizes the basic land management of each patch in the village and town level, as well as property search map and map search function.

Keywords: spatial data, land management, system design, basic farmland.

1 Introduction

In the 2007 government report, Premier Wen pointed out, "With regard to land, we shall not make uncorrectable historical mistakes which will in turn bring our descendants catastrophes. Therefore, we must hold to the red string— at least 1.8 billion mu of cultivated land." According to his remarks, the protection of cultivated land, especially basic farmland is highly relative to national grain safety, economic development, social stability and vital interests of the farmers. It is the primary task of the land resources management. In addition, according to *The Decision of CPCCC on Several Major Problems Concerning Propelling the Reform and Development in Rural Areas* passed by

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the Third Plenary Session of the seventeenth Central Committee in 2008, farmers have the right to circulate the contracting right in different ways. Thus how to standardize land circulation through effective mechanisms has become a new project for land management in rural areas. With the fast economic development and steady increase of the popularity, the contradictions between man and land will deteriorate. Thus, we must strengthen the land management of rural areas. As the traditional inquiry of informaton by hand and the inefficient management style of independent dealing by different departments cannot satisfy the requirement of the dynamic land resources management in rural areas, the informationalization of this management with modern measures and scientific, efficient administration is highly in need.

Land management information system is the technique and method for land planning, management quantificaton and rationalization together with quick inquiry, analysis and innovation of land information. It provides supplementary support for decision making. The land resources management system based on spatial data improves the traditional land management system through computer technologies, communications net, remote sensing, geographic information system, satellite positioning system and so on. It realizes functions like the spatial visual management of land resources and the real-time innovation of spatial dynamic data.

According to long-term investigation, some cities and counties have had land resources management system, nevertheless, such systems in villages and towns are far from satisfaction. Nowadays, the building of new-typed countryside is being systematically carried out. The establishment of an efficient comprehensive information service system in rural area land management plays an important role in promoting town and country unification management and the rational, efficient and organized use of land in villages and towns. Therefore, this thesis takes as an example the land resources management in Dingzhuang town, Guangrao county, Shandong province, and focuses on the research and development of spatial data-based information system of land resources management in villages and towns.

2 Requirements Analysis and Module Design

Dingzhuang town, Guangrao county is located within the Half-hour economic circle of Dongying municipality and Shengli oilfield. It covers an area of 363 square kilometers, having jurisdiction of 45 administrative villages with a population of 42 thousand people. In this town, there is 160 thousand mu farmland, 11.8 kilometers coastline, 53 thousand low-lying beach land and over 40 thousand mu fresh water and seawater cultivation. In 2008, the total output value of the town reached 965 million RMB, and the fiscal revenue reached 8.063 million RMB. The farmers' per capita net income was 5390 RMB.

In terms of the building of new-typed countryside, Dingzhuang town seized the chance of being the pilot site of this activity in Dongying municipality and carried out the construction in a steady way. According to the reality of this town, it is not industrial and mining area, nor a resident county with little collective income in villages and relatively weak financial resources. On this basis, Dingzhuang town formed a clear train of thought for construction in accordance with the twenty-word guiding principle of new village construction, that is "Do not pursue large scale or learn from the West blindly; do not pursue an impractical and overly ambitious goal; base the constructions on the reality; exert the advantages and avoid the weaknesses; advance in an overall way".

The land management system in villages and towns mainly caters to land administrations in villages and towns, whose design philosophy is easy operation and convenient use and management. Moreover, for timely renewal of the management and the system, the users of the system are divided into common users and system administrator. Common users can search and download relative information, and search the attribute information of the maps and so on. The system administrator can maintain the system by entering administrator name and code. Based on field investigation and analysis, the land management information system in villages and towns includes six parts: land use and management, farmland protection and management, land registry management, land planning management, law enforcement and supervision of land, together with system maintenance. The structure of this system is illustrated in Figure 1.

Land-use module contains two sub modules: the management of land for foundation of houses; the management of construction land for township enterprises, common facilities and public welfare undertaking. Its functions include application procedures for relative laws and regulations; map search management for land of foundation houses; attribute search; measurement of area, length and so on.

Farmland protection management contains five sub modules: basic laws and regulations; fundamental introduction; basic farmland; land development and organization; farmland conversion and expropriation. It introduces relative laws and regulations; basic situation of farmland; feasibility report for land development and organization; relative laws for the procedures of land conversion and expropriation applications. In addition, this module provides a form of the area of basic farmland reserves and basic farmland figures for relative inquiry.

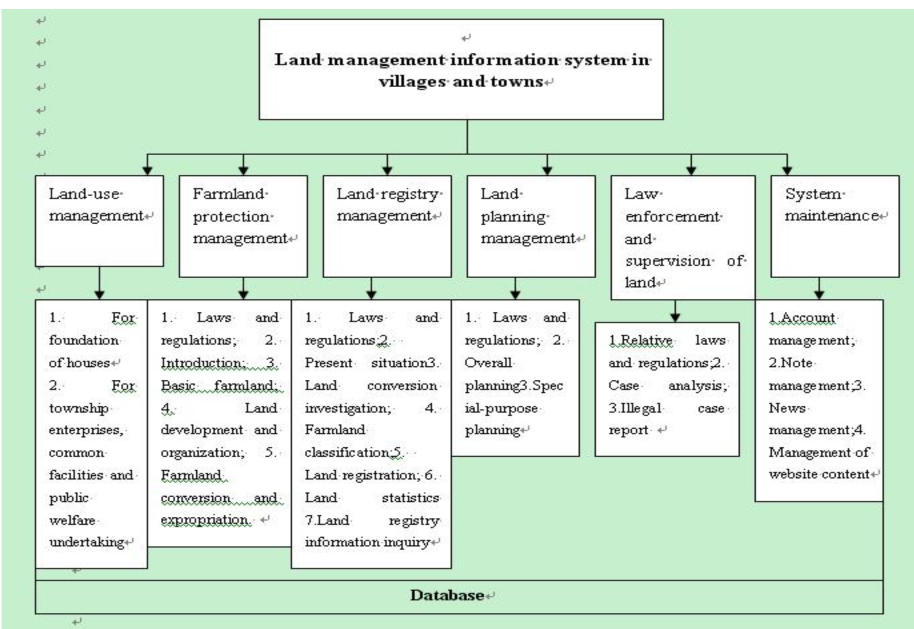

Fig. 1. Structure of land management information system in villages and towns

Land registry management module contains seven sub modules: relative laws and regulations; the present situation of land use; land conversion investigation; farmland classification; land registration; land statistics and land registry information inquiry. This module provides the figures of present situation of land use, figures for soil classification, land registry figures and so on. It realizes functions like attribute inquiry and statistics as well as the measurement of area and length.

Land planning management contains three sub modules: relative laws and regulations; overall planning and special-purpose planning. It introduces relative laws and the overall planning aims of standard villages and towns, providing information for land planning administrations.

The module of law enforcement and supervision of land contains several sub modules: relative laws and regulations; case analysis; illegal case report and so on. It introduces details of the illegal cases and punishments, providing cases for the legal land use of land users.

System maintenance module contains four modules: account management; note management; news management and the management of website content, helping the administrator give timely renewal and maintenance.

3 Main Functions of the System

The information system of land resources management in villages and towns caters to the land administrations' need for the automation inside an office of land management, and helps to improve professionals' efficiency so as to manage large amounts of land use data effectively. This system provides scientific basis for the planning of land use in villages and towns, basic farmland protection and the decision-making people. The main functions include three aspects:

(1). An online unified management platform for land use information in villages and towns, which can deal with and reveal information visually, and can enable the end of users to get information through different ways. This can ensure the convenience, quickness and acuracy of information inquiry.

(2). An information renewal platform for land in villages and towns, which realizes a quick and convenient importing of land information. This can enable the administrators to import the latest land management information, which realizes the real time and synchronious innovation of land information.

(3). A complete use of all kinds of communication nets, which achieves the openness of land information in villages and towns; a reasonable direction in which the information flows; quick issue of land arrangement planning; timely report and solution of illegal land cases.

4 Design, Research and Development of Main Interfaces

There are two major principles for the design of users' interface: beautiful and accordance. In real design, the menus of the interface and special projects should be practical and classical, while all the menus, forms, controls and shortcut keys should be unified. Whether the interface is friendly or not determines the practicality of it and ease for use. The users of the land investigation information system are not all GIS professionals, thus the design of the users' interface should satisfy the need of all kinds of users, giving the system great applicability. This system is Windows Form application program designed by C# which enables the computer users to use all kinds of Windows software without specific training through graphic interfaces. Besides, it is the standard that the program designers have to follow while designing Windows program interface, which reduces the burden of program designers and help concentrate their attention on solving and realizing the problems. C#.Net, a kind of visual programming language, further simplifies the design work of the program interface. Only with few codes can we have the standard application program interface. However, if a person does not understand the design principles of Windows program interface, he could not design an interface that can both match general requirements and satisfy industry demands. The major principles for interface design are as follows:

(1). Convenient for operation. The system should reduce the frequency of operation and the memory burden of users. It should provide clues for relative operations and good help system, as well as setting hot keys for frequently conducted operations so as to realize the conciseness and efficiency of the interface functions.

(2). Reversibility of the operation. This is very useful for people without professional knowledge. The reversible actions can be single operation or a relatively independent operation formation.

(3). Unanimity of the interface style. For example the menus, windows, tools and buttons should be in accordance with each other. Same terms should be used in menus and help system. The dialog boxes should have the same style.

(4). Provide information feedback and simple error solution. There should be feedbacks for important operations of the operators, especially for the seldom used and most important operations. When there is an error, the system should detect the error and provide simple and clear solutions.

4.1 Design, Research and Development of the General Interface of the System

According to the above principles, this system borrows from the thought of "Modularity" and designs the system interface into a host interface and several sub-interfaces. A sub-interface is one function module, which can be started through host interface or started independently. All the sub-interfaces keep the same style. The host interface of the system is showed in Figure 2.

4.2 Design, Research and Development of System Basic Modules

System basic module mainly includes two functions: users' inquiry and administrators' updating the information and maintaining the system. The modules for users' inquiry include five modules: land use management; farmland protection management; land registry management; land planning management; law enforcement and supervision of land. Each module contains several small modules. The users can inquire certain information and download relative data and materials, as showed in Figure 3. Besides, the maps of standard villages and towns can be browsed and inquired in independent interfaces, as showed in Figure 4.

This spatial information inquiry function contains four modules: layer demonstration; Hawkeye; attribute inquiry; inquiry outcome demonstration. In addition, there are other human-friendly functions like enlargement, shrinking, measurement, whole layer demonstration and so on. The first feature is that the users can inquire all kinds of land data information by clicking graphs, such as land plot basic information, land conversion information, basic geographic information and so on. The second feature is that users can inquire spatial graphic information by inputting conditions and also make inquiries by selecting land categories, the administration it belongs to and administrative region.

Fig. 2. Host interface of the system

Fig. 3. Farmland protection interface

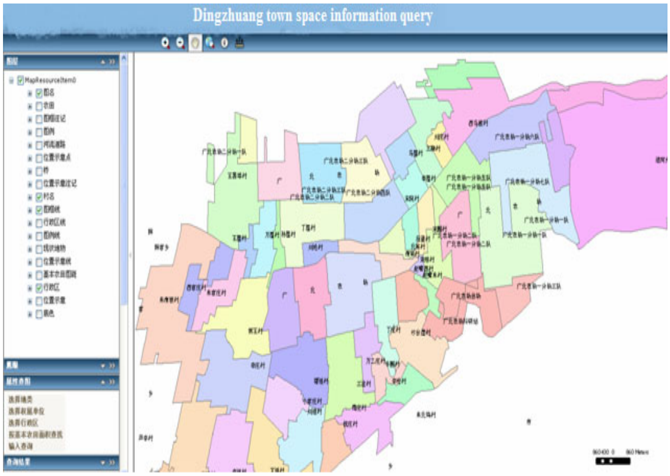

Fig. 4. The page of map browsing and inquiry

4.3 Design, Research and Development of System Data Renewal and Maintenance Module

The most important thing for establishing a system is not how to use it, but the renewal and maintenance of it. The data should be new, or it will be of no value but decorations. The main task of this system is to realize the renewal and maintenance of special subjects.

The renewal of data includes inputting the latest data into the system, correcting the existing data, supplement of needed data, deleting outdated data and so on. The maintenance mainly includes checks and corrections of integrity and cognation of data.

The renewal of data is large in amount and pressing in time. It requires regular renewal of some data. For example, annual land use and the change of right of ownership or other special projects. As to the change of some attribute data, for example, the change of the name of administrative villages, we only need to correct relative spatial information. These corrections can be made directly in layer operations instead of in the whole layer. In this way, the data redundancy created by the system is the lowest and difficulties in data management can be avoided, while the historical data are well preserved.

In this system, the administrator can log in administrator management module easily by inputting user name and code. This module contains account management, proclamation management, news management and website content management. Operations in different interfaces like corrections, addition and deletion can be conducted by merely clicking relative items. The interface is showed in Figure 5.

As the length of the thesis is limited, the design, research and development of other sub modules will not be illustrated.

Fig. 5. System maintenance module interface

5 Conclusion

Based on complete use of mature spatial information technologies and serious research on land use and management, this thesis researched and developed seven modules including land conversion inquiry module and basic farmland management module. On this basis, it researched and developed the Dingzhuang town information system of land resources management based on spatial data. It provides land use and management with the real-time information and realizes functions like property search map, map search function, visual inquiry of land information and dynamic innovation of spatial graphic data. It raises the efficiency and level of primary level land management.

The system mainly has five features:

(1). Complete range of functions, flexible operations, easy manipulation and high practicality.

(2). Thorough use of mature visual technologies, multimedia technologies, database technologies and object-oriented technology. Good universality and maintainability.

(3). Information inquiry system based on geographic information system, which realizes graphic expression of spatial data information and the graphic expression and inquiry of relative land information.

(4). Remote renewal of present land use data and integration of electronic information provide public users with functions like online browsing, inquiry and issue of land development information.

(5). High integration and application of GIS and internet technologies greatly raises working efficiency and increases data reliability which better satisfies the needs of different departments.

Three major innovation points:

(1). Independent research and development of database management system of Dingzhuang town, which realizes unified management of multi-source data and establishes service-oriented integrated module for heterogeneous data.

(2). Independent research and development of land management system of Dingzhuang town, which realizes basic farmland management of each patch, three generations of land conversion and dynamic management of land contract management right.

(3). Integrated and internet management of attribute data and spatial data in villages and towns, which realizes property search map and map search function and so on.

The research and development of the land management system in Dingzhuang town based on spatial data serve as a model in survey protection and service in building new-typed countryside around the country and propel the application of spatial information technologies in land management of villages and towns.

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The Design of Portable Equipment for Greenhouse's Environment Information Acquirement Based on Voice Service

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Abstract. For settling the problem of acquiring environment parameters quickly and responding in time in greenhouse which has low ability of auto-controlling environment. This paper designed a voice service system which was used in greenhouse for environment information collecting. This equipment can acquire and analyze the parameters of temperature, humidity, illumination, dew point temperature, soil temperature, soil humidity. And it offered alarm and environment controlling suggestion by voice. This equipment achieved data acquiring, storage, displaying and voice service by MCU msp430 and voice chip PM50S100. Expert knowledge which had simple decision logic was embedded in this system. This equipment offered simple voice service based on the collecting data in greenhouse. And it had advantages of convenience operation, low power consumption through the test in greenhouse.

Keywords: greenhouse, environment parameters, voice service, portable equipment.

1 Introduction

The main symbol of agriculture modernization's level is the facilities agriculture's development which uses protected agriculture as the main representative. Facilities agriculture in China has made rapid development in recent years. And it plays an important role to improve farmer's incomes and quality of life. But at present, simple structure greenhouses such as solar greenhouse & plastic greenhouse which are widely used in China. Most of these greenhouses have backward technology, low levels of machinery and automation. The current advanced information technology is not used in these greenhouse deeply. Facilities production remains in experience management, unscientific & non-standard management. All these situations are seriously affected the yield and efficiency. Most of information collection instruments in greenhouse environment are expensive, un-flexible and single parameter collection. But equipments with more parameters acquisition function has large size, high power

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consumption and bring the inconvenience in installation and maintenance. All these equipments also need personal view and recording by operators. When many equipments are used in large-scale greenhouses, it is needed for additional staff and long time observation which may cause nervous fatigue and error record[1]. The voice communication technology combines with the environment information collection equipment is a new direction of greenhouse environment collection & controlling in intelligence and information. The technology which mentioned upon is used in many fields. Agricultural consulting and calling business has matured in Europe and United States[2]. One of U.S. research institution designed a soil moisture meter with wireless voice service which could dial to user's cell phone to send alarm information when the data exceeded the setting[3]. Agricultural calling center base on mid-ware which designed by Beijing Institute of machinery had made expert system in networks, remote consultation and calling center to come true. And built a model which could bring out 24 hour pest diagnosis, advisory services. Beijing Academy of Agriculture and Forestry had similar system[4][5]. Bo Jing, Xiaojun Qiao proposed and developed the voice warning system for the environmental information in greenhouse[1]. Caili designed a voice-alarm system for greenhouse base on DDE and FCS technique[6]. The applications above focused on passive network calling and initiative alarm. But there are lack of deep study in the expert knowledge and smart voice technology which integrated with portable greenhouse environment information acquisition device. It is urgent need to design low price and practical product which rely on the voice service technology.

This paper has designed a portable equipment for greenhouse's environment information acquirement base on voice service. This equipment is cost-effective, easy to use, multi-parameters measurement and can use voice to guide the different cultural level farmers to manage greenhouse production according to different crop growth stages' demands. Promote the use of this product can effectively increase the level of greenhouse production and management, and give full play to the potential of greenhouse production.

2 Design Ideas Overview

As figure 1 showed greenhouse site needs to measure the common environment parameters accurately by external ways. Temperature & humidity, soil temperature, light etc. are the key parameters in greenhouse management. Solar radiation shield is used for measuring temperature & humidity avoiding solar radiation and bad weather. The portable equipment obtains and stores data from sensors according to the setting time interval. And data were showed in the liquid crystal displayer at the same time. Simple logic expert knowledge table was integrated in the device. So it could guide farmer by voice. Many communication methods were used in this system. RS485 /Internet/Wireless achieved the greenhouses monitoring by network. When used USB to communication with the PC, this equipment as a portable device to measure the data from greenhouse by moving. This paper focus on the design of sensor, data gathering equipment and PC software.

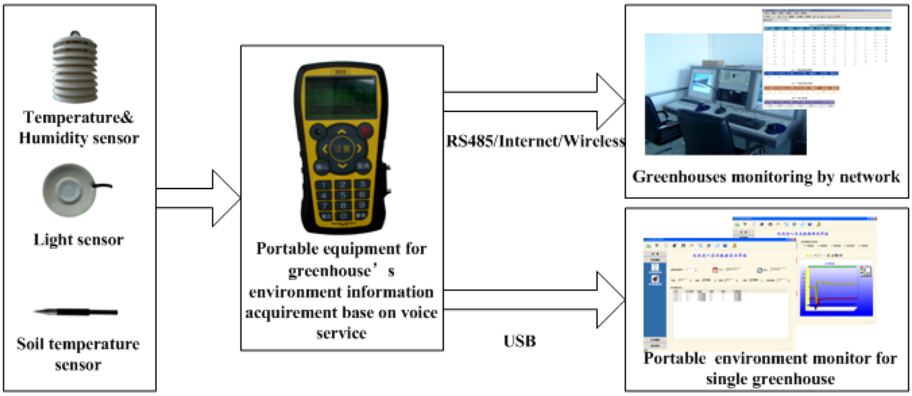

Fig. 1. Structure of portable equipment for greenhouse's environment information acquirement base on voice service

3 The Design of Underlying Hardware and Software

3.1 The Structure of Hardware

The hardware design used ultra-low power MCU MSP430F149 which had 60KB flash, 2KB RAM, two 16bit timers, eight channels 12bit A/D converter, USART/SPI port and so on[7]. 128*64 dots matrix LCD was used for displaying the sensor data and setting menu. Real time clock chip DS1302 provided clock and date for system. Flash data storage memory chip AT45DB081 provided 1Mbytes space for store the data of environment[8]. 4*5 touch panel was used for system setting. Embedded real audible voice module (PM50S100) was used for voice service. Charge chip LTC4055

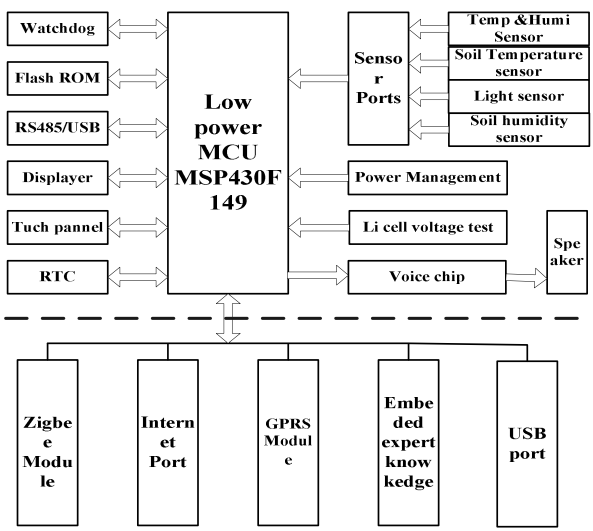

Fig. 2. Structure of hardware

charged for the inside 2A lion battery . NCP500 provided 3.3V voltage for the system. Ti's chip TPS2044 was used for managing the power of sensors. Zigbee module, GPRS module, Internet module, usb and RS485 could used in this equipment. User can choose the suitable communication ways for application. Some kinds of crop production's expert knowledge were embedded in the ROM chip FM24CL64. Temperature and humidity sensor SHT11 was used in this system. This sensor integrated sensor element plus signal processing on a tiny foot print and provide a fully calibrated digital output. The applied CMOSens® technology guarantees excellent reliability and long term stability. Both sensors are seamlessly coupled to a 14bit analog to digital converter and a serial interface circuit. DS18B20 encapsulated in stainless steel was used for measuring the soil temperature. Programmable light to frequency converter chip TSL230B was used for measuring the light.

3.2 Voice Processing Circuit

This design used smart voice chip PM50S100 which was produced by ATVOC company. Compared with the ISD's voice chip, PM50 had better tone quality and lower price. This chip was made up of voice MCU and Flash RAM. 100 seconds playback function was enough for this equipment. Actual circuit is showed in Figure 3. MSP430F149 sent instruction to PM50 for controlling the voice file by series port. Voice signal could through the op amp LM386 for output or PWM mode was used for driving 8 ohm 0.5W speaker directly[9].

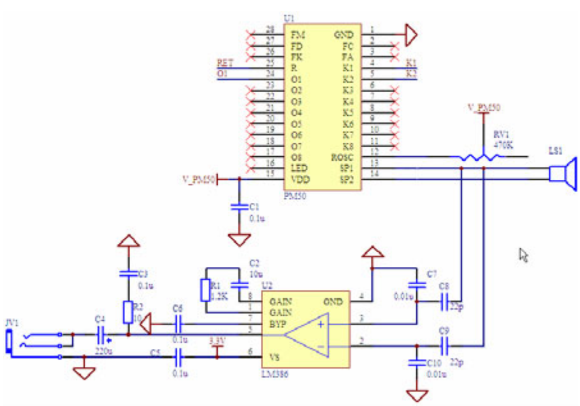

Fig. 3. Voice processing circuit

Voice files were recorded by professional recording equipment. Software Cool editor edited the voice files and divided file into sections which were programmed to voice chip by the program copier easily. Voice files were cheesed from greenhouse environment control equipments, methods, alarm mode, common voice phrases and sentence in solar greenhouse and plastic greenhouse production. Part of sound logic as follows.

- IF Tn> Tmax then voice file "baby cry sound", "It's too hot, open the windshield quickly".
- IF Tn< Tmin then voice file "baby cry sound", "It's too cold, close the windshield quickly".

Tn is the temperature now, Tmax is the setting maximum temperature, Tmin is the setting minimum temperature.

3.3 Integrated Design of Expert Knowledge

This design choosed the representative crops which often grow in greenhouse. These crops were also classified into six kinds, and coded in binary. (See the Table 1)

Table 1. Actual crops' kings and codes

Crop kinks	Code	Crops
Eggplant	0001	Tomato, Pepper
Melon and fruit	0010	Muskmelon, Cucumber
Leafy	0011	Fennel, Celery
Fruit trees	0101	Grape, Pear
Flowers	0110	China rose, Chrysanthemum

The 64Kbit FRAM FM24CL64 used for storing the expert knowledge[10]. User can choose different crops and growth stages from the expert knowledge. The data in the expert knowledge table was also changed by user's experience and actual environment. FAT store structure was used for storing the expert knowledge. Expert knowledge divided the crops into eggplant, melon and fruit, leafy, beans, fruit trees, flowers. The RAM address 0x0000-0x001F was used as the first index of partition which was showed in Table 2. The equipment get the actual crop's store address through index address in Table 2. Actual crop's store information was store in the second index of partition (partition's address is 0x0020-0x01FF). Table 3 showed part of actual crop's store information. The stages in Table 3 means that the number of stages. promote germination period, germination period, seeding period, transplant period, after transplant period, one week before planting, planting to seeding stage, growth stage, flowering fruit setting period, expanding fruit stage, harvest storage period were used in expert knowledge[10]. Table 4 showed that the actual data in promote germination period. All the tables showed that the physical address was memory's address, and the number is the content stored in this address.

The expert knowledge table which mentioned above was managed by two levels address index method. This method made the expert knowledge's embedded application conveniently because it searched data easily and saved the memory space.

Table 2. The first index of partition (0x0000-0x001F)

Physical Address	0x0000	0x0001	0x0002	0x0003
Note	eggplant	kinds	Address. H	Address. L
Number	0x01	0x02	0x00	0x20

Table 3. The second index of partition (0x0020-0x00FF)

Physical Address	0x0020	0x0021	0x0022	0x0023
Note	tomato	stages	Address. H	Address. L
Number	0x01	0x04	0x02	0x00

Table 4. Part of parameter table of expert knowledge

Physical Address	0x0280	0x0281	0x0282	0x0283	0x0284	0x0285	0x0286	0x0287	0x0288
Note	germination	Tdmax.L	Tdmax.H	Tdmin.L	Tdmin.H	Tnmax.L	Tnmax.H	Tnmin.L	Tnmin.H
Number	0x01	16	25	16	15	16	25	15	16
Physical Address	0x0289	0x028A	0x028B	0x028C	0x028D	0x028E	0x028F	0x0290	0x0291
Note	Hdmax	Hdmin	Hnmax	Hnmin	Lmin	Lmax	STdmax.L	STdax.H	STdmin.L
Number	60	80	60	80	2	30	16	36	10
Physical Address	0x0292	0x0293	0x0294	0x0295	0x0296	0x0297	0x0298	—	—
Note	STdmin.H	STnmax.L	STnmax.H	STnmin.L	STnmin.H	SHmin	SHmax	---	---
Number	16	16	26	10	16	obligate	obligate	----	----

**T: temperature, H: humidity, L: light, ST: soil temperature, SH: soil humidity, d: daylight, n: night*

3.4 Low Power Embedded Software Design

As a portable equipment whose sensors' data gathered, LCD displayer, background light, voice output had large power consumption. All these devices were not suited working for a long time. Work mode should been managed by software and hardware. The sensors' power must be closed when they did not used. LCD displayer was in doze mode when there were no data refreshed or keypad acted. The part of voice output's working mode was divided into real time, compare, alarm, close mode. All these modes were used in equipment could lower the power consumption.

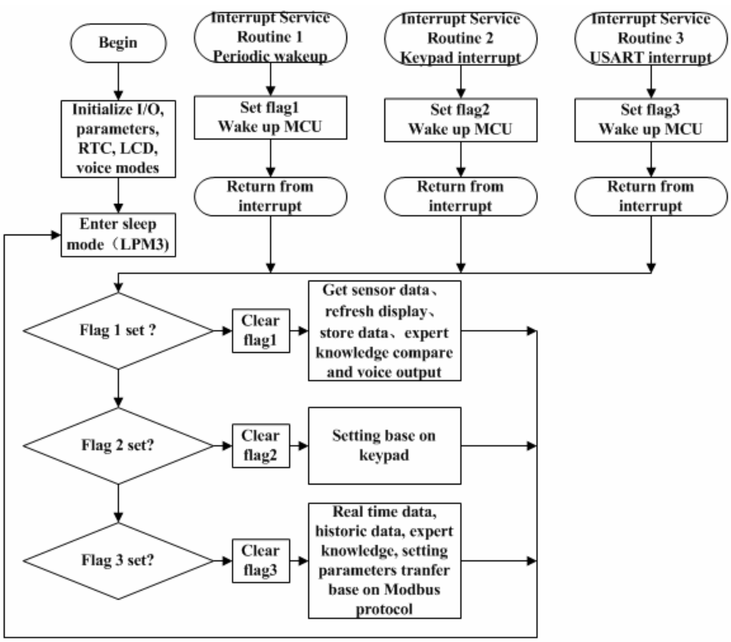

Fig. 4. The structure of low power software

The structure of low power software was showed in Figure 4. The program came into low power mode after it started and initialize the system. The flags were changed in the interrupt service routine. Subroutines were called by flags' judgment in main routine. This software coding mode base on interrupt-wake up could lower more power consumption[11].

4 PC Software Design

Base on the design of the underlying hardware and software. The information's analysis & management software was designed on PC platform. This PC software could get the environment information which gathered by the hardware. Many kinds of communication ways were used in the software. The data collected could be showed by figures and tables. Search and statistical analysis service were also provided in the PC software.

Software design based on the operation system Windows XP Professional. Programming language was Visual C++ 6.0. The software design followed the below outline.

- Good compatibility. Software was designed by module method. Other module could not affected when one of module was changed.
- Fine interface. Toolbar and pull-down menu were used in the software. User did not study the usage of the software. It is easy to operating the software by click some icons.
- Simple operation. Each operation function was distributed by user's operate habit.

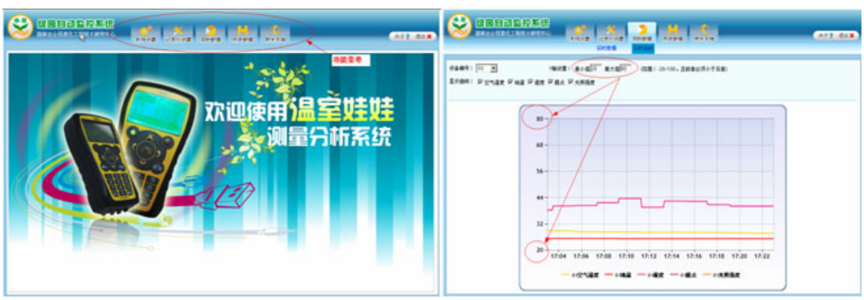

Fig. 5. Part of interface of PC software

5 The Test of Performance and Function

5.1 The Test of Sensors' Accuracy

The sensors used in this equipment were tested and calibrated by National Standards Research Center which belong to National Bureau of Quality and Technical Supervision. The sensors' performance parameters were showed in Table 5.

Took temperature and humidity testing as example. Calibration and test followed the test rules of JJG368-2000, Copper-copper nickel thermocouple was used for calibrating the temperature. Constant temperature and humidity box MFT-434A provide

Table 5. Sensors' performance parameters

Sensors	Resolution	Accuracy	Range
Temperature	0.1℃	±0.1℃	－40℃～80℃
Humidity	0.1%RH	±2%RH	0～100%RH
Soil Temp.	0.1℃	±0.2℃	－40℃～80℃
Dew point	0.1℃	±1℃	－40℃～80℃
Light	0.1 Lux	±5%	0～200000Lux

stable temperature and humidity environment. Precision equipment M4/1111H was used for testing dew point temperature. Calibrate the humidity followed the rules of JJF1076-2001. The humidity generator M4/1311DR provided stable environment. Dew point temperature calibration followed the rule of JJG499-87[12]. Calibration result was showed in Table 6. Table 6 showed the sensors were suitable for greenhouse measurement.

Table 6. The data of calibration and test

Num.	Temperature（℃）			Humidity（%RH）			Dew point（℃）		
	Standard	**Measure**	**Amend**	**Standard**	**Measure**	**Amend**	**Standard**	**Measure**	**Amend**
1	-10.5	-10.5	0.0	10.4	11.0	-0.6	-11.7	-10.8	-0.9
2	0.0	0.0	0.0	20.6	21.3	-0.7	-2.9	-3.0	-0.1
3	10.1	10.1	0.0	30.5	31.3	-0.8	2.5	2.3	+0.2
4	20.9	20.8	+0.1	40.6	40.3	+0.3	6.6	6.4	+0.2
5	30.7	30.6	+0.1	50.5	50.4	+0.1	9.8	9.9	-0.1
6	40.7	40.6	+0.1	60.5	60.0	+0.5	12.5	12.7	-0.2
7	50.6	50.5	+0.1	69.3	69.4	-0.1	14.6	14.8	-0.2
8	60.3	60.4	-0.1	78.5	78.5	0.0	16.5	16.7	-0.2
9				88.8	87.8	+1.0	18.5	18.4	+0.1

5.2 Function Test

The equipment was tested in greenhouse for a long time. The M.T.B.F. is over one year. It's stability and adaptability could meet the greenhouse's production acquirement. Test picture and real time data were showed in Figure 6.

Fig. 6. Test and real time data pictures

6 Conclusions

This design provided voice service base on the collection of greenhouse's key environment information. And expert knowledge table was embedded in the equipment. It could guide the different cultural level farmer to greenhouse production management according to different crop growth stages' demands by voice. Compare with the technology in existence. The design had a lot of characteristics and advancements. (1) Portable multi-parameter measurement. It could measurement temperature .humidity, dew point temperature, illumination, soil temperature at the same time. (2) Voice output. It could provide management knowledge and the gathered parameters by voice. (3) Good adaptability in greenhouse's environment. (4) High cost performance. It's price was one third to one second of production which had similar function. So this design had good prospect in greenhouse production.

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The Design of Smart Wireless Carbon Dioxide Measuring Instrument Used in Greenhouse

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Abstract. Different crops, seasons, greenhouse's structures and planting area need different concentration of carbon dioxide which fertilized in greenhouse. Measuring the concentration of carbon dioxide accurately in greenhouse is very important to fertilize carbon economically and reasonably Concentration of carbon dioxide measuring equipments were often used in chemical industry and environment fields, these equipments are not suitable for greenhouse's environment and had many disadvantages such as high price, high power consumption and low anti-interference ability. Based on the research of carbon dioxide measuring equipment, this design took part of Non Dispersive Infrared (NDIR) carbon dioxide sensor produced by GSS, embedded Zigbee module provided by Jennic, smart calibration program and solar panel charge system. The results showed that the accuracy was±30ppm, average power consumption was 2mW, high consistency, response fast. This design can change the present of carbon dioxide measuring instrument hard to popularize, and make carbon dioxide fertilization accurately.

Keywords: greenhouse, carbon dioxide sensor, measuring instruction, Zigbee; low power consumption.

1 Introduction

Adding carbon dioxide to fertilize can advance the crop's ratio of photosynthesis and resistance. This technology can also accelerate the growth and improve quality. So it is one of important technologies used in greenhouse production[1][2]. This technology has popularized for twenty years. Many methods have been used for achieving carbon dioxide such as nature ferment, solid carbon dioxide granule, ventilation, chemical reaction etc[3]. The amount of gas mainly calculates by manpower. CO_2 detect devices are used rarely for measuring current CO_2 concentration. This situation makes fertilize shortage and cannot achieve the desired effect. Once manual calculation or operation errors, higher CO_2 concentration can destroy the green plant photosynthetic system. The plant will appear leaf curl and even cause lack of nutrient, high temperature risk of crops[4]. Even more worse, it will do harm to the life of the operator and production human. When the CO_2 detecting devices are added for monitoring carbon dioxide concentration in real time,

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it will provided technique supplement for traditional fertilize method and device. And it makes fertilizing carbon dioxide more economical and reasonable.

Parts of agriculture gardens and research institutes can assemble CO_2 measuring equipments which are chosen from chemical industry or environment field. U.S.'s ACI, GREYSTONE have explosion-proof encapsulated and high concentration measuring devices which have transform, display, alarm and control functions. Because of the high price, these productions can not widely used in agriculture. Portable CO_2 measuring instruments such as Telaire(America)[5], Sense Air (Sweden)[6], Vaisala (Finland) etc. are not suitable for longtime measuring in greenhouse because of the activeness of operator and high power consumption. Domestic low cost CO_2 transmitters use semiconductor, solid electrolyte, electro-chemistry sensors to measure the CO_2 concentration. All these sensor probes have low precision, large drift, high repair ratio and cannot suitable for greenhouse's high temperature and humidity. The domestic research focuses on sensor measurement theory and structure[7]. The fertilize voice generator which promoted crops to absorbing CO_2 by audio[8]. But there are few studies of CO_2 measuring instruments used in facilities environment. This paper designed a smart wireless carbon dioxide measuring instrument used in greenhouse by using NDIR CO_2 sensor and embedded Zigbee module. It had advantages of cost controllable, solar panel powered, low power consumption, high precision self-calibration etc. This instrument could solve the problems, such as hard to be popularized, lack of specific products, low attention.

2 The Brief Introduction of Carbon Dioxide Measuring Technology

The mainly used methods for measuring CO_2 are titration, chromatography of gases, infra-red spectrum, electrochemistry, semiconductor ceramics, solid electrolyte etc. [9]. The titration method device is complex, low selectivity and sensitivity. Gas chromatography has advantages in sensitivity, accuracy and speed. Greenhouse needs simple measurement instrument with low price, high accuracy and rapid response CO_2. But the device based on Gas chromatography method is not suitable for greenhouse's demand for the high price and huge size. So the infra-red, electro-chemistry, semiconductor and solid electrolyte sensors are widely used. Electro-chemistry and semiconductor sensors have small size, but are not good at accuracy, stability and gas choice. The working life of the electrochemistry sensor is also very short. Table 1 shows the parameters comparison of common CO_2 sensors. The solid electrolyte sensor has low price, it is good for measuring on line for a long time. FIGARO(Japan) CDM4160 integrates the sensor of TGS4160[10], which has alarm controlling functions of four concentration points. But its' long warm-up time and high power consumption features are not suitable for accurate measuring in greenhouse. The NDIR sensor has advantages in accuracy and stability. GE/Telaire (America) 6004 which already been stopped producing has large market share before. Module 6113 is replaced. Korea's ELT H500 has low cost and small size. It is suitable for the testing production which does not sensitive with the power. Although domestic CO_2 sensor MG811's price is very low, it is not good for greenhouse application environment because its' accuracy interfered by humidity. By comprehensive comparison, U.K. GSS Company takes solid state light module and reference diode to make sensor lower price, faster, lower power, higher accuracy and long time stability. Low power module C20LP/C100LP with 10mW consumption will be brought at recent time. It is fit for combining with wireless sensor networks. This design uses this module to build greenhouse smart wireless carbon dioxide measuring instrument.

Table 1. Parameters comparison of common CO_2 sensors or module

Sensor picture					
Model	U.S.A.GE/ 6004/6113	Korea ELT H550[10]	U.K. GSS C20/C100	Japan FIGARO CDM4160	China Winson MG811
Measuring principle	NDIR	NDIR	Narrow band NDIR	Solid electrolyte	Solid electrolyte
Measuring range	0-2000ppm	0-10000ppm	0-5000ppm, 5%,100%	400-45000ppm	350-10000ppm
Voltage & power	5VDC/30mA average	9-18VDC/50mA	3.3-5V<100/10mW	5V/1.3W	6.0±0.1 V/1.2W
Signal output	Voltage\UART\SPI	UART/I2C	Voltage\UART	Analogue output	Analogue output
accucry	±40ppm	±30ppm±5%	±10ppm	±20%	No data
Response time	Less 2 minutes	30 seconds	4 seconds	Warm-up 2 hours	Warm-up half hour
Work environment	0-50℃,0-95% RH	0-50℃,0-95% RH	-25-55 ℃ , Waterproof	-10-50℃,5-95% RH	-20-50℃
Price	650 RMB	550 RMB	500-1050 RMB	400-600 RMB	150 RMB

3 The Structure of Smart Wireless CO_2 Measuring Equipment

CO_2 concentration measuring instrument in greenhouse has some functions below. (1) Transmitter function that could provide 4-20Ma, 0-5V, or frequency output, it is convenience to link with the collection and controlling devices. (2) Function of record and display. (3) Long distance transmitting function. Multi-point measurement and long distance transmission by wireless or wired to form network. (4) Controlling and alarm function, It could control the actuator and alarm devices in greenhouse by comparing data gathered with setting alarm points or critical point. All these functions were used to achieve the precise the concentration of CO_2 fertilization [12].

This design takes wireless sensor networks technology for measuring CO_2 concentration by functional module method. The sensor is installed in radiation shield. This instrument can gather, transform, display, storage the data. It also can communicate with PC or data collector by wireless of Zigbee. All the functions of this design could add or delete to control the price. And this can optimize with the performance, price and power consumption. Multi-points or single point monitor in one greenhouse, star network and point to point network are used by PC, Co-ordinator and end device. (Figure 1). Chain network was used for multi-points monitor in greenhouse. (Figure 2). This paper introduces the design of CO2 measuring instrument.

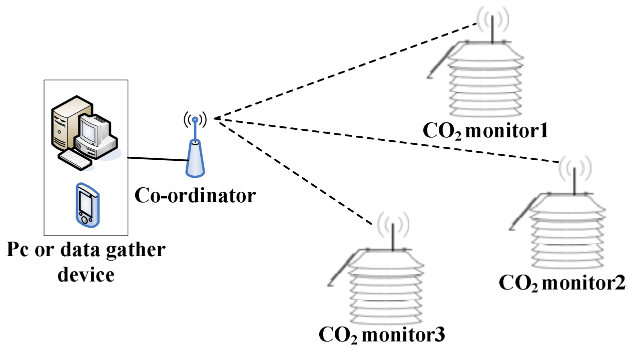

Fig. 1. Multi-points or single point measurement in single greenhouse

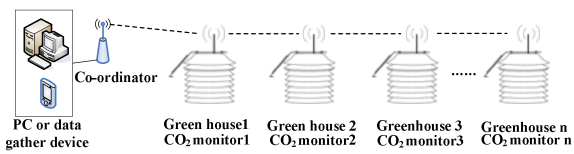

Fig. 2. Multi-points monitor in greenhouses

4 The Hardware Design of the Equipment

The design has to consider the whole functions. But it can reduce the function module to lower the cost base on the real application. 3V voltage is used in this system. All chips' power supply is managed. 2A lithium battery and solar panel were power for system's longtime working.

This instrument's hardware structure is showed in Figure 3. The Jennic company's third of generation Zigbee module JN5148 supports Zigbee Pro protocol It has low power consumption (low power module receive and transmit current is 17.5/15mA, high power module receive and transmit current is 23/110 mA), abundance resource on chip (32 bit MCU, 128Kb RAM, 128kB ROM, 12bit ADC/DAC, two UARTs etc.). The functions of this device can come true by embedding application routine.

GSS's CO2 sensor is linked with the JN5148 by UART port. It can transfer the data gathered, calibrate and setting instruction. CO_2 module's calibrate and zeroing ports were linked with the switched and MCU's I/O port which could make calibration and zeroing to come true by manual operation and automation .The chip of 74HC04 achieves the electrical level transform because CO_2 module needs 5V voltage supply.

The segment LCD display module is used to display the gathered data. FM31256 integrates real time clock, watch dog timer and FRAM in a chip[14]. It provides accuracy real time clock and 256Kbit storage space. This IC communicated with I2C port.

Transmitter module transfers digital data to 4-20mA output by IC AD694. This chip links with the module's 12bit DAC converter, and transfers 0-2V which DAC output into standard current signal.

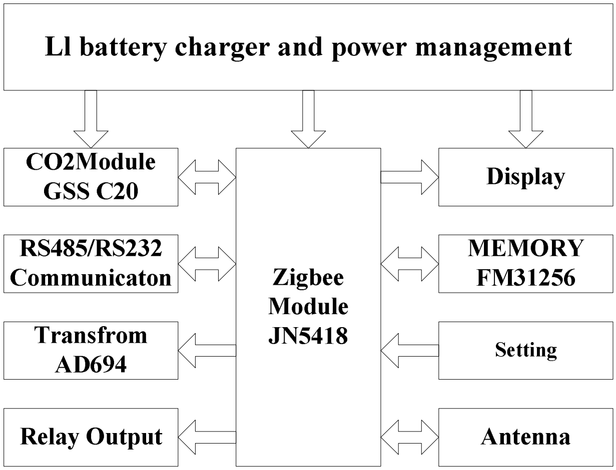

Fig. 3. Hardware design structure

This system provides dry contact by relay module. This dry contact could link with the motor and alarm devices to achieve controlling and alarm functions.

RS232/RS485 module occupies one of the URAT port. The module is used for network communication and program processing. This design provides switches for setting number, communication channel, baud rate etc.

1-2W solar panel is used for charging the 2Ah lithium battery. The charger IC CN3082 could finish this function. CN3082 can adjust charge current base on solar panel's current output ability[16]. The part of power management uses NCP500 to provide 3.3V voltage for system. Power switch IC TPS2044 controls the power supply of the lcd, communication IC. This power management method achieves minimum power consumption.

5 The Software Design of the Equipment

The software design base on Zigbee chip JN5148 uses the ZPS Configuration Editor and JenOS Configuration Editor which are integrated in IDE Eclipse for head file. Added with application program and linked to finish the development of software[17].

5.1 Overall Thinking of Software Design

The software is made up of message event which comes from ZPS protocol, Task and time trigged application program. All these message, task and software timer application are driven by the JenOS, and communicates with the ZPS protocol. Basic end device net parameters are set by ZPS Configuration. As showed in Figure 4, system has six message events. The App_msgRelaycontrol, App_msgTransmitter, App_msgPowermanage, App_msgCalibrate are used for making the controlling, transmit, low power and calibrate functions to come true. App_msgSensorevent is used to storage, display, communication etc. App_msgZpsevent was used for management App_taskSensornode.

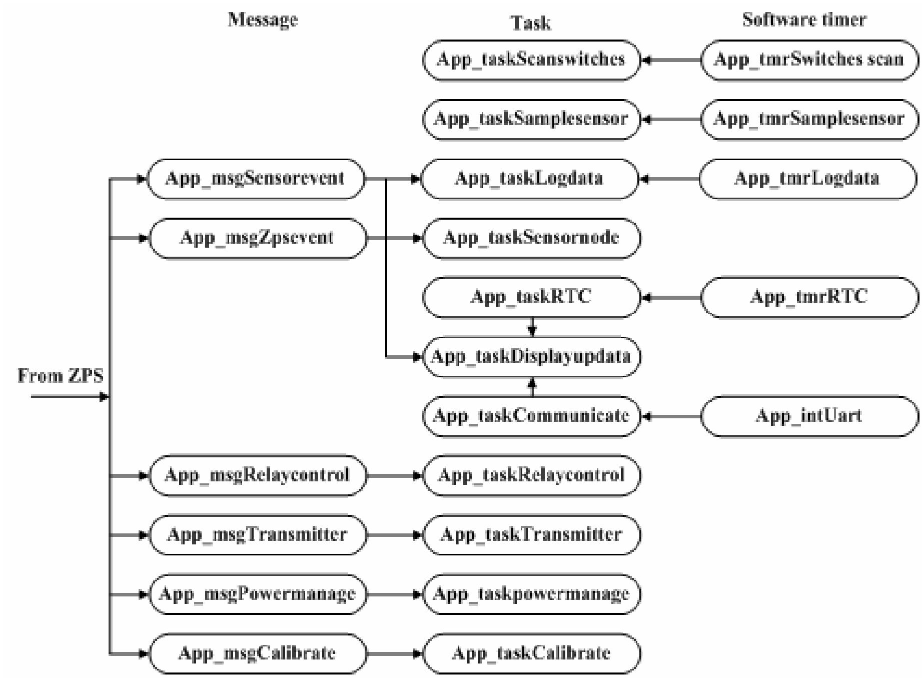

Fig. 4. Software structure

5.2 Communication with CO_2 Module

JN548 communication with CO_2 module by setting and calling UART1 API which included in Integrated Peripherals API. Related communication settings function is shown as follows:

```
void vAHI_UartEnable( E_AHI_UART_1); // Enable UART1
void vAHI_UartSetBaudRate( E_AHI_UART_1, E_AHI_
UART_RATE _9600); //Boad rate9600
void vAHI_UartSetControl (E_AHI_UART_1, ,
E_AHI_UART_PARITY_DIS ABLE , E_AHI_UART_WORD_LEN_8,
E_AHI_UART_ 1_STOP_BIT, FALSE);//data 8bit, no parity,
one end bit, no hardware flow control
```

Through setting the FIFO, interrupt of UART and recall function which used as application routine to achieve the software calibration, fast response, filter, LED's signal intension, temperature of PCB etc. functions.

Taking instruction: M6\r\n Output: Z00057z00060 for example, it means that fast output is 570ppm, and filter output is 600ppm. Other function achieved will not be listed here one by one.

5.3 The Calibration Function

Although the CO_2 module has been rigorously calibrated before delivery, measuring data will not accurate like before for long time using. So it is necessary to calibrate the sensor. Module can use the nitrogen gas or other gas which does not include CO_2 to calibrate the sensor by pulling down the pin2 of sensor. The surrounding environment is also used for calibration by pulling down the ninth pin of sensor.

For compensating the problem of easy to interference when using the air calibration method. Over sample algorithm is used in the software design[18]. This algorithm takes 12 hours as acquisition cycle in outdoor no interference air. The data measured each 15 minutes are compared with the reference data(380-400ppm) to get average calibrate factor. Then the factor is used for compensating the CO_2 concentration. Because the implementation is simple, this paper will not list the specific algorithm program.

6 Experiment and Testing

This wireless CO_2 measuring instrument has already tested and calibrated in laboratory and application site. Wireless communication, communication distance, real time and bit error rate etc. Jennic has the test reports of module and antenna. Its' features meet the demands of the greenhouse –site wireless network applications.

Different standard concentration CO_2 gas which provided by National Standard Material Research Center. The instrument's small size and wireless communication ways are suitable for calibrating in the sample gas bar. The data are showed in Table 2.

Device 1* is the instrument used in greenhouse for ten months. Device 1 was calibrated by the over sample algorithm based on Device 1. CO_2 sensor should calibrate when used over one year. As Table 2 shows the accuracy is lower than 30ppm. From the data of device 2 and 3, we can see that the sensor's accuracy could meet the demands of greenhouse production's acquirement.

Table 2. Calibrate and test table of CO_2 sensors (Unit: ppm)

Standard gas	0	200	400	600	800	1000	1200	1400	1600	1800	2000
Device 1*	0	180	390	570	870	980	1170	1360	1570	1760	1950
Device1	0	200	410	610	800	990	1210	1420	1610	1820	1970
Device 2	0	190	400	600	810	1010	1220	1410	1620	1810	2000
Device 3	0	200	390	600	780	980	1200	1390	1560	1780	1990

In Beijing Daxin district's Caiyu mum base, two instruments were used in number one greenhouse. The data of Jan.5th 2010 were show in Figure 5. From figure 5, it is to see that CO2 fertilization is needed after nine o' clock. Its consistency can meet the measure's requirement .

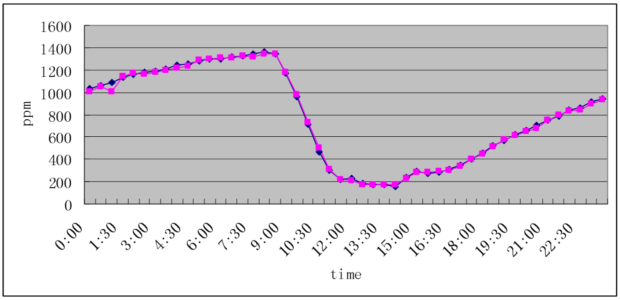

Fig. 5. Data in greenhouse

7 Conclusions

This paper aims at CO_2 fertilization which lacks of suitable facilities CO_2 detection device and depends on imports and industrial equipment to integrate the Zigbee embedded technology, low power CO_2 sensor、over sampling calibrate program (accuracy is <=±30ppm) and efficient solar power system for designing a kind of smart wireless carbon dioxide measuring instrument. This instrument has a lot of advantages, such as low power consumption (average power is 2mW), wireless communication, controlling and alarm and cost controllable (basic function is 500RMB) etc. Wireless Zigbee Pro protocol is used in wireless sensor network which provides a new model of CO_2 measurement. This design provides equipment to greenhouse CO_2 fertilization, and achieves the precise control the concentration of CO_2 fertilization.

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The Detection of Quality Deterioration of Apple Juice by Near Infrared and Fluorescence Spectroscopy

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Abstract. Processing and storage of apple juice often triggers quality deterioration regarding nutritional valuable compounds and unfavourable color changes resulting from browning. Fluorescence and near-infrared (NIR) spectroscopy were applied to detect such quality loss in apple juice. Juice samples were produced from Malus x domestica 'Pinova', stored at 20 ℃ for 4 days or heated at 80 ℃ for 10 min and stored at the same conditions. The quality of apple juice was measured by standard parameters such as soluble solids content, pH, CIE L*, a*, and b* values. Juice fluorescence spectra were recorded with fluorescence excitation at 250, 266, 355, and 408 nm and emission at 280-899 nm resulting in an excitation-emission-matrix (EEM) of 1240×4 for each sample. The NIR transmittance spectra were recorded in the wavelength range 900-1350 nm. The often used color b*-value for monitoring browning was correlated with the EEM variation and a reasonable calibration was built by means of n-way partial least squares (N-PLS) regression. The correlation coefficients were >0.9 in all treatments. NIR spectra were sensitive for predicting soluble solids content, but had poor capability to measure the color deterioration. Results indicated that the combination of NIR spectra and fluorescence EEM can be used to monitor the quality deterioration of apple juice.

Keywords: near infrared spectroscopy, fluorescence spectroscopy, EEM, N-PLS, apple juice.

1 Introduction

Apple juice is very popular due to its beneficial health effect and pleasant flavor. However, quality deterioration temporarily appears during the processing and storage. Enzymatic browning of damaged tissues of fruits during postharvest handling and processing is one of the main causes for quality loss of fresh fruit produce [1]. Enzymatic browning in fruit juice starts after the mechanical breakage of the apple

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cell integrity during the juice extraction procedure [2]. It is influenced by the substrate, which are phenolic compounds, polyphenoloxidases and influencing factors (ascorbic acid and peroxidases). The reaction is characterized by an initial enzymatic oxidation of phenols into slightly colored quinones and following polymerization. Non-enzymatic browning occurs mainly in thermal processing, which involves caramelization, ascorbic acid degradation and Maillard reaction [3].

Since quality is supremely important for apple juice, deterioration has to be controlled during processing and storage. Therefore, the fast and real-time detection of the extent of quality changes would provide a valuable tool. Conventionally, the quality of apple juice was measured by enzymatic and chromatographic methods [4], which are time-consuming and laborious. The browning degree has been formerly measured by colorimetry and the result expressed as CIE L*a*b* color system. However, all these methods have some disadvantages such as the tristimulus data is often influenced by physical changes [5].

As a fast, non-destructive and environmentally safe analyzing method, near infrared (NIR) spectroscopy was applied for measuring the quality of fresh juice with respect to sugar and water content [6,7]. Fluorescence spectroscopy was introduced to measure, e.g., bitterness in beer [8] or other parameters related to the content of auto fluorescent compounds. In the present study, NIR and fluorescence spectroscopy were applied to detect the quality deterioration of apple juice during processing and storage. The quantitative relation between variation in the NIR spectra, fluorescence spectra and the quality parameters of apple juice such as soluble solids content, pH, and color were investigated.

2 Materials and Methods

2.1 Preparation and Processing of Apple Juice

Malus x domestica 'Pinova' apples with differences in color and size for capturing a wide range of pigments and soluble solids contents were picked from an orchard in Germany and preserved at 4 ℃. The juice was extracted with a home juice extractor (Bifinett, Kompernass GmbH, Bochum, Germany). Two or three apples with similar color were consider as one sample and extracted. Totally, 30 samples were prepared. The core was eliminated, while the skin was reserved. The juice was centrifuged for 10 min with a speed of 3600 rpm and room temperature (16 ℃) (Sigma 4K 15, SIGMA Laborzentrifugen GmbH, Germany). Subsequently the juice was filtered and each sample was separated into two portions. One portion was measured immediately (marked as ‘Fresh’) and stored at 20 ℃ for 4 days (marked as ‘stored’). The other portion was heated in a water bath (Victor Rector, Krankenhaus-Laborbedarf GmbH, Germany) at 80 ℃ for 10 min. The juice was cooled rapidly with an ice-water bath, and stored at 20 ℃. On the forth day, the spectra and reference values were measured (marked as ‘heated-stored’). Resulting, three juice states were obtained.

2.2 Spectroscopic Readings

NIR spectra were measured using a UV-VIS-NIR scanning spectrophotometer (Lambda 950, PerkinElmer, USA). Because higher wavelength regions had significant noise and the lower wavelength regions were almost flat, only the wavelength range of 900-1350 nm was collected. Spectral resolution was 1 nm. Distilled water was used as zero reference.

Fluorescence emission spectra were measured using a fluorescence spectrophotometer (LS55, PerkinElmer, USA) in front-face geometry at four excitation wavelengths (250 nm, 266 nm, 355 nm, and 408 nm). The corresponding emission spectra ranged from 280-899 nm, 296-899 nm, 385-899 nm, and 438-899 nm, respectively. Spectral resolution was 0.5 nm. Therefore, an EEM with the size of 1240×4 (emission×excitation) was obtained for each sample. Appropriate cut-off filters were used to prevent the influence of direct reflectance from the excitation light. Each sample was measured twice and the average spectra were considered as the output.

2.3 Measurement of Laboratory Reference Values

Soluble solids content (SSC) was measured with a digital refractometer (PR-1, Atago Co., Ltd, Japan). The pH was measured with a pH-meter (pH340i, WTW, Germany). Color measurement was made using a colorimeter (CM-2600d, Konica Minolta Sensing, Inc. Japan) based on the CIE L*a*b color system. SCI mode was selected because it considered the influence of specular component. The colorimeter was calibrated with dark and white references. A glass cell containing the apple juice was placed against the head of the colorimeter and the three color parameters, namely L*, a*, b*, were recorded. Each sample was measured three times and the average values were calculated. The color degradation (ΔL*, Δa*, Δb*) were calculated as the difference between the processed juice and fresh juice. Also, the total color change was calculated as follows:

$$\Delta E = ((\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2)^{0.5} \tag{1}$$

2.4 Data Processing

Partial least squares (PLS) regression was used to construct the calibration model between NIR spectra and reference values. Here, the optimal number of factors were selected by leave-one-out cross validation. For each model, the reference value was arranged with an ascending order, and then every third sample was selected as calibration set, and the remaining part provided the prediction set. The correlation coefficient and standard error for the prediction set were used to measure the model quality. The n-way partial least squares (N-PLS) analysis [9] was applied to build regression models between the fluorescence excitation-emission matrices (EEM) and laboratory reference values. Mean centering was used as data preprocessing for all spectra.

2.5 Software

PLS_Toolbox 3.0 (Eigenvector Research, Inc. Manson, WA, USA) was used for PLS calculation and N-PLS were constructed with the N-way toolbox [10]. All calibrations were carried out in the environment of MATLAB (2006a, The Math Works Inc., USA).

3 Results and Discussion

3.1 Characteristics of Spectra

The three dimensional EEM of the fresh juice (Fig. 1a) mainly represents the fluorescent polyphenols (such as hydroxycinnamic acid derivates) and chlorophyll. However, chlorophyll is mostly located in the skin and although apple juice was extracted from both skin and flesh, the chlorophyll content was low. Using the spectrophotometric analysis after acetone/diethyl ether extraction [11], the chlorophyll concentration was below the detection limit. The emission spectra with excitation wavelength of 250 nm and 266 nm have show peaks with maximum at 350 nm and 630 nm. The two peaks are possibly related to polyphenols. The excitation wavelength of 355 nm yields a peak with maximum at 450 nm and a relatively smaller peak at 715 nm. The 450 nm peak is related to polyphenols, while the 715 nm peak is possibly related to chlorophyll residues [12]. The excitation wavelength of 408 nm yields one broad peak at 500 nm, which is possibly related to 5-hydroxymethylfurfural (HMF) [13]. The present study focused on the correlation between fluorescence spectra and the quality of apple juice by means of laboratory reference data SSC and colour, while the investigation of specific fluorophores in apple juice will be studied in further experiments. The NIR spectra of original fresh juice (Fig. 1b) appear with broad absorption peaks as reported earlier [14]. One spectrum that is obviously different from others was considered as outlier according to the criterion of general Mahalanobis distance [15]. Resulting, this sample was deleted and the remained 29 samples were used for NIR analysis. In the fluorescence readings, no outlier appeared (n=30).

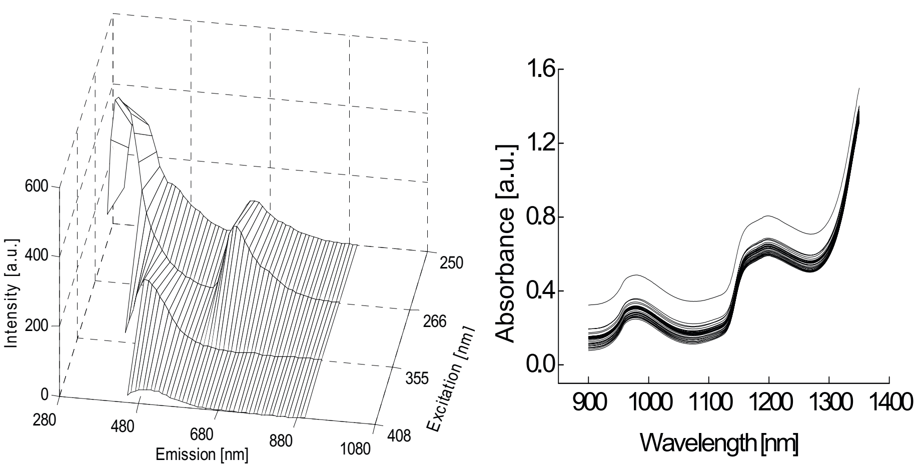

Fig. 1. (a) The mean excitation-emission matrix (EEM) for fresh juice; (b) The NIR transmission spectra of the 30 original fresh juice samples. Absorption was calculated by log (I/I0) from transmittance readings.

3.2 Characteristics of Laboratory Reference Values

The quality of juice was characterized by means of five reference parameters: SSC, pH, CIE L*, a*, and b*. Changes during heating and storage are presented in figure 2. The SSC was almost stable in all juice variants, suggesting that caramelization did not occur to a high extend due to relatively low temperature impact. In addition, heating at 80℃ for 10 minutes inactivated polyphenol oxidase [16]. Therefore, the color change observed in stored juice was mainly due to enzymatic browning. While in heated and stored juice, Maillard reaction or ascorbic acid degradation might provide the main reason for quality loss. The pH value decreased slightly during storage. The L* hardly changed during storage, but increased after heating and storage. The color

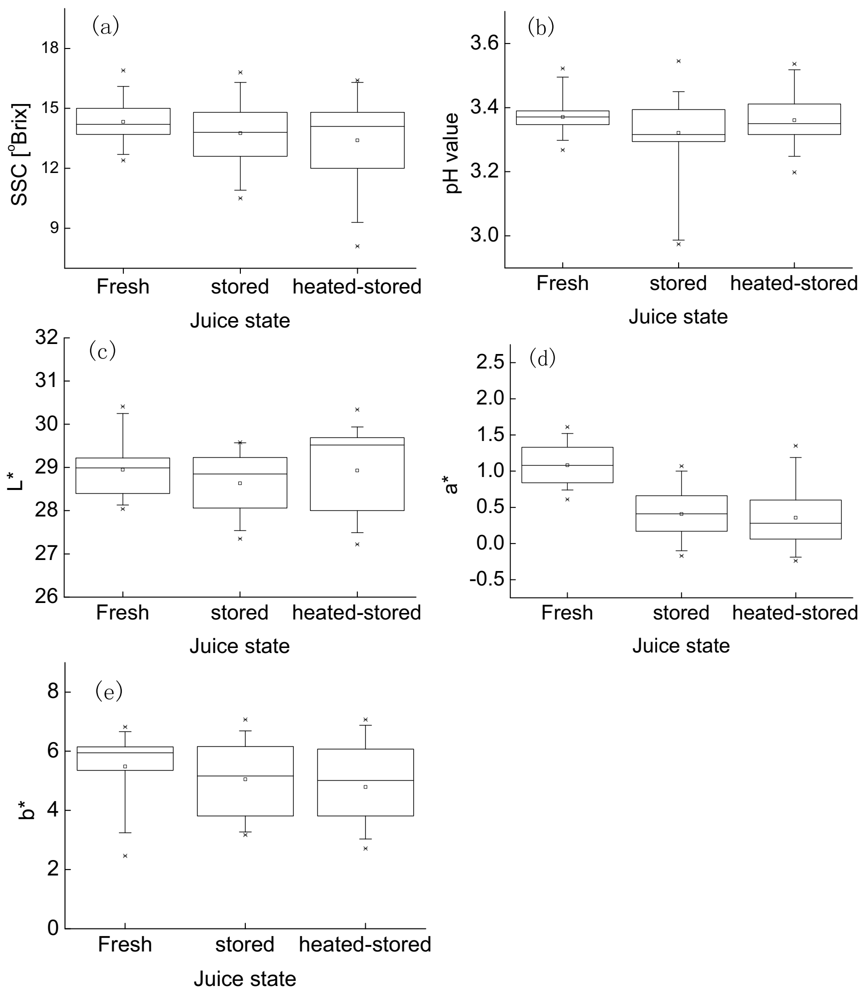

Fig. 2. Box-whisker plots of laboratory reference values

parameters a* and b* had similar changes: both values decreased after heating or storage. This indicated that SSC, pH and L* were not applicable as indicators for quality deterioration due to browning, while a* or b* can be used for this purpose.

3.3 Calibration Models

In order to see the potential ability to describe the quality of browning juice by fluorescence and NIR spectra, N-PLS was used to construct the multi-way calibration model with fluorescence EEM, and PLS was applied to construct model with NIR spectra. The quality of juice during the browning process was measured by SSC, pH, L*, a*, b*, ΔL*, Δa*, Δb*, ΔE (Table 1). The absolute NIR spectra and fluorescence EEM were used to build calibration models for SSC, pH, L*, a* and b*, while the different spectra were used to build calibration models for ΔL*, Δa*, Δb*, and ΔE. For detection of SSC, NIR showed high correlation and low measuring uncertainty, which was consistent with previous research for measuring fresh juice published by many working groups. In contrast, the correlation coefficient of models based on fluorescence EEM was low. This is consistent with the result of Seiden et al. (1996), who reported a correlation coefficient of 0.804 for 'Elstar' apple juice predicted by fluorescence spectra. Both fluorescence EEM and NIR spectra had low correlation with pH as no direct information can be expected in the spectral data. For L*, NIR had better results than fluorescence EEM. Both data sets had poor correlation for a* and Δa*.

The models based on fluorescence EEM had high correlation for both b* and Δb* prediction. Among the three parameters of colorimetric method, Krapfenbauer et al. (2006) reported that b* values changed to a greater extent in comparison to a* and L* values for cloudy apple juice. Resulting, b* is considered as being more important than other two for describing the browning extent of apple juice. Fluorescence EEM has shown a high correlation with colorimetric method and can be applied to predict

Table 1. The correlation coefficients for N-PLS model of fluorescence EEM and PLS model of NIR spectra

		SSC	pH	L*	a*	b*
Fresh juice	EEM	0.7079	0.5006	0.6963	0.4816	**0.9087**
	NIR	**0.9827**	0.5237	**0.8000**	0.7902	0.7069
Stored juice	EEM	0.6576	0.1906	0.6976	0.5998	**0.9052**
	NIR	**0.8976**	0.4024	**0.9010**	0.7693	0.6127
Heated-stored juice	EEM	0.8172	0.944	**0.8892**	0.7876	**0.9280**
	NIR	**0.9528**	0.6092	**0.9511**	0.2876	0.7921
		ΔL*	Δa*	Δb*	ΔE	
Difference between fresh and stored juice	EEM	0.6754	0.6499	**0.9610**	0.7446	
	NIR	**0.9258**	0.3465	0.7338	0.8741	
Difference between fresh and heated-stored juice	EEM	0.7833	0.3612	**0.8769**	0.4912	
	NIR	**0.8787**	0.3148	**0.9501**	0.7132	

the b*. Therefore, fluorescence EEM can be used to detect the quality change of apple juice during browning, encouraging further studies on developing a standardized method. On the other hand, NIR spectra, although high correlation was obtained for prediction of lightness parameter L* and ΔL*, showed no information for the browning color a* and b*.

4 Conclusions

During heating and storage of apple juice, the quality and color changed due to enzymatic browning and non-enzymatic browning. NIR spectra can be used to detect SSC and L* and ΔL*, while fluorescence spectra were feasible for predicting b* and Δb*. Both spectral readings had poor ability for measuring pH and a*. The results indicated that the combination of NIR spectra and fluorescence EEM provided a fast and non-invasive method for detecting quality deterioration of apple juice during storage and heating.

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The Determination of Total N, Total P, Cu and Zn in Chicken Manure Using Near Infrared Reflectance Spectroscopy

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Abstract. In this study, the 74 chicken manure samples from a chicken farm were used to take the diffuse reflection spectra from 12500 to 4000 cm^{-1} by FT-NIR spectrometer. The total N, total P, Cu and Zn of chicken manure samples were predicted by NIR spectra. For the samples of each component, an ascending order was arranged and they were divided into calibration set and prediction set according to their content. Partial least square regression (PLSR) method was applied to construct the calibration model. Results showed that the correlation coefficients of the calibration model for total N was 0.69, the root mean square error of calibration (RMSEC) was 0.66, the root mean square error of prediction (RMSEP) was 0.80. For the models of total P, Cu and Zn, the results were r=0.86, RMSEC=0.29, RMSEP=0.34; r=0.95, RMSEC=3.46, RMSEP=5.71; r=0.94, RMSEC=14.13, RMSEP=25.21, respectively. The results indicated that the NIR spectroscopy was useful to non-destructively determine the content of total N, total P, Cu and Zn of chicken manure. As a complementary detecting method to the conventional analysis, NIR spectroscopy could significantly improve the detecting efficiency.

Keywords: near infrared spectroscopy, chicken manure, total N, total P, Cu, Zn.

1 Introduction

In the last decades, intensive livestock operations produced considerable amounts of animal manure that may cause serious environmental problems [1]. China is one of the largest producers of animal manure in the world, with an annual output of more than 3 billion tonnes[2]. Composting is an appealing solution for sustainable management of animal manure especially the chicken manure[3]. Use of composting results in a stabilized, mature, deodorized and hygienic product, free of pathogens and rich in humic substances, which is environmentally friendly and marketable as an organic amendment or fertilizer[4,5].

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The parameters established by the legislation for marketable composts are electrical conductivity (EC), total organic matter (TOM), total organic carbon (TOC), total nitrogen(TN) and C/N ratio, macronutrient contents (N, P, K) and potentially pollutant element concentrations (Fe, Cu, Mn and Zn)[6]. The determination of these important parameters of composts required numerous reagents, skilled labors and expensive analytical equipments. Consequently, a more convenient and reliable method is necessary.

Near-infrared spectroscopy (NIR) (800-2500 nm), which reflects the overtones and combinations of fundamental vibrations of C–H, O–H and N–H bonds, has been widely used for quantitative and qualitative analysis for organic components in petrochemical, agricultural and pharmaceutical field[7]. Previous study have also indicated that one of the mechanism for measuring heavy metals by NIR was their inter correlation with organic compounds[8]. In recent years, NIR was also applied as an inexpensive tool for rapid analysis of important component in animal manures [9,10,11,12].

The purpose of this study was to explore the feasibility of analyzing organic and inorganic components of chicken manure using NIR simultaneously.

2 Materials and Methods

2.1 Sample Preparation and Chemical Analysis

In this study, the chicken manure samples were collected from a chicken farm from Heishan county, Liaoning Province. The samples were dried at 65 ºC in a forced-air drier to a constant weight and ground to pass a 1 mm screen for latter analysis. In total, 74 samples were prepared.

2.2 NIR Spectra Collection

NIR spectra were recorded by a Fourier transformed near-infrared spectrometer (IFS 28/N, BRUKER, Germany) with integral sphere accessory. The ground chicken manure was filled into a cylindrical quartz cup with 20 mm depth to insure that light did not permeate the sample. The cylindrical cup was rotated slowly to assure fine sample distribution. And the reflectance spectra were recorded within the band between 12500 and 4000 cm^{-1}(800-2500 nm), at 16 cm^{-1} interval. For each sample, the spectra were scanned 64 times and the average spectrum was obtained.

2.3 Measurement of Total Nitrogen, Total Phosphorus, Cu and Zn

The chemical analyses were performed by the Analysis and Test Center, Institute of Environment and Sustainable Development in Agriculture, Chinese Academy of Agricultural Science. The total nitrogen (TN) was determined by dry combustion at 975 °C using a PE-2400 C-N Elemental Analyzer (PerkinElmer Corp., USA). The total Phosphorus (TP) was determined according to the method described in NY525-2002, which is the standard of Ministry of Agriculture. The content of Cu and

Zn were measured using an acid digestion method with inductively coupled plasma–atomic emission spectroscopy (ICP–AES, PerkinElmer 3300DV) [13].

2.4 Data Analysis

The spectra were not being pre-processed since the quality of original spectra was relatively high. Principle component analysis (PCA) was used to explorer the spectra distribution in the latent space. The calibration model between reference values and spectra were constructed by partial least square regression (PLSR). The outliers for each model were eliminated according to the plot of COOK value vs. leverage value [14]. For each model, the reference value was sorted in an ascending order. Every third sample was selected as calibration set, while the remaining part the prediction set. The calibration set was used for the model construction, while the prediction set was used for the model validation. The optimal number of PLS factors was selected by leave-one-out (LOO) cross validation. The corresponding PCs were selected when the prediction residual error sum of square (PRESS) was the lowest. The predictive performance of the calibration model was evaluated by the correlation coefficient (r) for the calibration set, the standard deviation of calibration (SEC), the standard error of cross-validation (SECV), the standard deviation of prediction (SEP). A good model are supposed to have small SEC, small SEP and high r. The PCA calculation was carried out with the software Unscrambler 9.1 (Camo Corp., Norway), and the PLSR was conducted by MATLAB 7.0 (The Math Works, Inc., Natick, MA, USA).

3 Results and Discussion

3.1 The Characteristics of the Components of Chicken Manure

Table 1 shows the composition statistics in calibration sets and validation sets for total N, total P, Cu and Zn, respectively, which include the number of samples, the mean, standard deviation and range value. It could be seen that the components of prediction set full in the scope of calibration set, which assured the representative of the calibration models.

3.2 NIR Spectra and the PCA Plots of Chicken Manure

The full wavelength range of the spectra was 800-2500 nm. The original spectra were shown in Figure 1. The spectra had several absorbance peaks at the wavelength of about 1135 nm, 1340 nm, 1540 nm, 1657 nm, 1870 nm, 2010 nm, 2235 nm, 2416 nm, indicting rich information was contained in the spectra. The possible water absorption peaks was not obvious because the samples were already dried at 65 ºC to a constant weight.

Figure 2 showed the result of PCA analysis. It can be seen that the samples constituted a sample set that has some extent of representative. In addition, the first and second principle scores involved 99% variation of the original spectra.

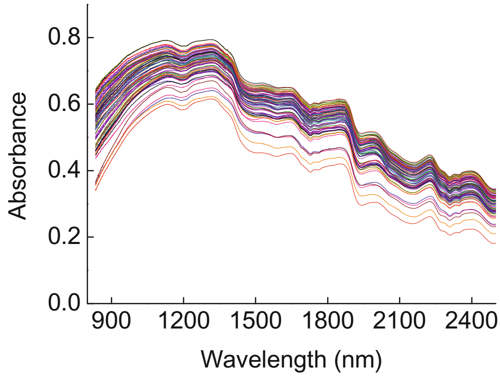

Fig. 1. The NIR spectra of chicken manure

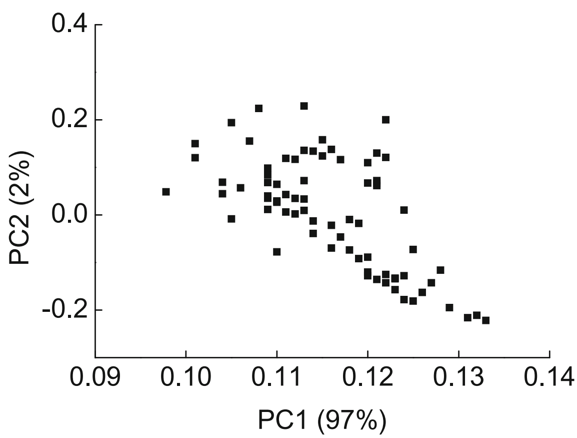

Fig. 2. The PCA score plot of chicken manure

Table 1. The statistic characteristics of calibration set and prediction set for chicken manure

		Number of samples	Min value	Max value	Mean value	Standard deviation
N(%)	Calibration	50	3.51	7.55	5.36	0.91
	Prediction	24	3.55	6.79	5.29	0.85
P(%)	Calibration	42	1.73	4.12	2.86	0.56
	Prediction	21	1.85	3.88	2.86	0.55
Cu(mg/Kg)	Calibration	47	23.41	64.22	41.93	10.85
	Prediction	23	23.80	57.24	41.44	10.53
Zn(mg/Kg)	Calibration	44	144.63	291.98	222.83	39.91
	Prediction	22	145.16	291.42	222.44	40.97

3.3 The Calibration Models for Chicken Manure

The calibration models of total N, total P, Cu and Zn were shown in Table 2. It can be seen that the total P, Cu and Zn model had high calibration accuracy, with the correlation coefficient (r) of 0.8577, 0.9479 and 0.9352, respectively. Figure 3 shows that the NIR predicted value of total P, Cu and Zn and its reference value were closely arranged with the 45^{o} line, indicating the prediction error was low. The above result suggested that total P, Cu and Zn of chicken manure could be measured by NIRS. The measurement of Cu and Zn were the indirect relation between metal elements and NIR spectra. Previous study have indicated that one of the mechanism for measuring heavy metals by NIR was their inter correlation with organic compounds[8]. For the

Table 2. The statistic results of calibration models for chicken manure

	PLS factors	r	SECV	SEC	SEP
N	4	0.6923	0.7532	0.6552	0.8047
P	6	0.8577	0.3822	0.2888	0.3418
Cu	5	0.9479	4.3503	3.4595	5.7103
Zn	8	0.9352	23.4447	14.1337	25.2114

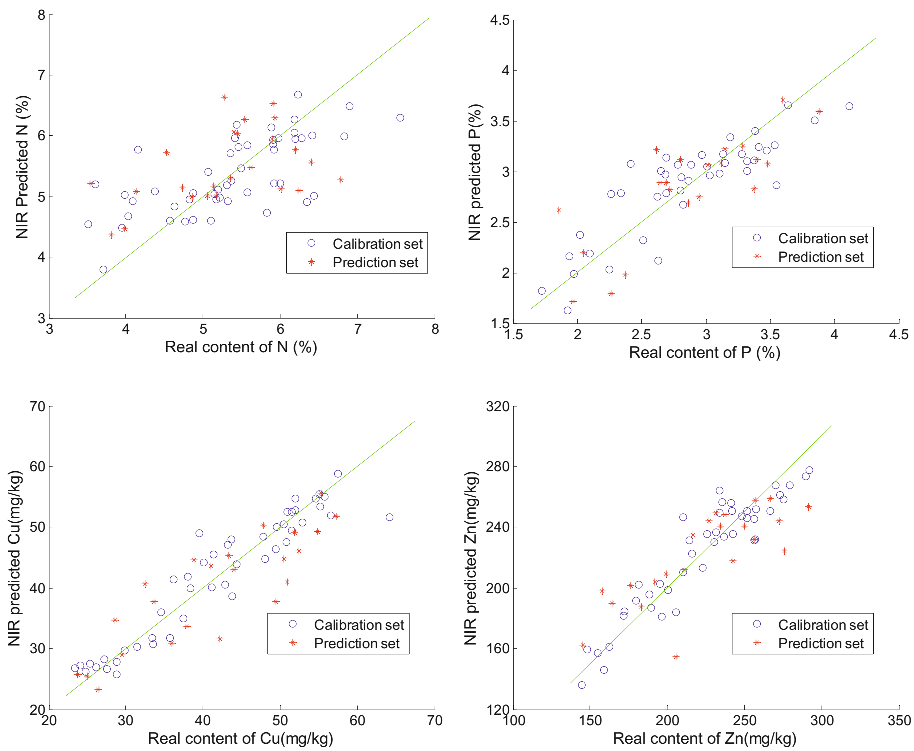

Fig. 3. The scatter plots of reference values and NIR predicted values for the components of chicken manure

Zn model of compost of pig manure on fresh and dried basis, the R^2 and r^2 values were about 0.69 and 0.6 (Huang et al., 2008). The current Zn model had higher calibration accuracy than that of previous study [15].

The calibration model of total N, however, showed relatively lower accuracy. In the calibration set, NIR spectra and total N had some certain relationship, with the correlation coefficient (r) of 0.6923, which was much lower than that of total P, Cu and Zn model. According the scatter plot, the NIR predicted total N and its reference value were also distributed aside the 45^{o} line (see Figure 3). However, they were not as close as that of Cu and Zn, indicating that the prediction error was relatively high. The calibration results suggested that although NIR spectra had some extent of relation with total N, the prediction accuracy could not satisfy the requirement of quantitative measurement. Future research may focus on how to improve the accuracy of total N model.

4 Conclusions

The current study explored the simultaneous evaluation of organic and inorganic components of chicken manure using NIRS. The results showed that the NIRS technique could be a complementary detecting method to the conventional analysis. However, further research is needed to improve the prediction precision of calibration models by enlarging the number and range of samples. The present study only constructed the linear calibration models for the four components of chicken manure. In order to improve the precision of models, future studies may apply non-linear methods such as artificial neural networks to build the non-linear relation between spectra and components.

Acknowledgements

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The Growth Phases of Information Construction in Chinese Rural Area

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Abstract. Information industry, which is regarded as the third technology wave in human history is irreversible trend in the world. The information construction in rural area is crucial factor in pushing forward rural economy, even for agriculture, rural economy, and farmer. To identify the growth phase of information construction in rural area is essential to assessment the process above. The paper analyzes the characteristics of each growth phases and market entities of information construction in rural area (the government, rural household, and market) which play role in the history of information construction in rural area, propose corresponding measures to safeguard sound development of information construction in rural area.

Keywords: information construction in rural area; investment entities; growth phase.

1 Introduction

Information industry, which is regarded as the third technology wave in human history is irreversible trend in the world. That is to say, the world has stepped into the information era. Information construction in rural area is the characteristics of modernization for social-economic development in countryside. From 2005 to 2008, the Central Document No. stressed the fourth consecutive year to promote information technology in rural areas, the Central Document No. 2009 is proposed "to encourage qualified local transformation of construction of rural multi-service centers", the use of information technology in building a more Good to promote peasant incomes. It is the key to solve agriculture, rural economy, and farmer. As a most populous developing country, the information construction in Chinese rural area must impact its social-economic development, even for the whole world.

Research on the field can promote the understanding the characteristics and trend of information construction in Chinese rural area. So far, a few researches have made progress in this field. Some researchers analyzed information construction in rural area present situation, proposed the countermeasures of further development (Wang et al., 2004, Zhang et., 2004). Others described the information infrastructure, service system, education system and so on in rural area (Zhao et., 2004). Additional researches paid

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attention to the relationship between “digital agriculture” and information construction in Chinese rural area, analyzed the probability and necessities of information construction in rural area in Shandong Province (Cao et., 2009).

These researches above focus on the regional information construction in rural area and present situation analysis. But few paper focus on the history of information construction in Chinese rural area. The paper attempted to identify the process above, analyzed its characteristics, the relationship between the information construction and social-economic development level, divide the phase of information construction in Chinese rural area at last.

2 To Define the Entities of Information Construction in Chinese Rural Area

The service target of information construction is rural area, and the service entity is rural household. Therefore, the rural household is the beneficiary and implementer, so the rural household involvement is the important indicator in the process of information construction in rural area.

The extent market intervene is considered to judge its role information construction in rural area. Along with the marketization development in rural area, market is more inseparable part in the process. Therefore, market is the primary entity and significant phase indictor of information construction in rural area.

Market economy development demonstrates: the all difficulties in economy don’t overcome by market only. Given the fuller market positive role, government interference is essential, including industrial regulation, sector policy, financial subsidy and so on. The cooperation between market and government often guarantee the sound development of information construction in rural area.

In conclusion, rural household, market, and government are inseparable three parts, they are also the important indictors in dividing the phase of rural area information.

3 Identification of Information Construction in Rural Area

In accordance with the development, characteristics, interference of rural area information construction entities, this paper divide the history of r information construction in rural area into three phases: (1) preliminary phase; (2) development phase; (3) mature phase.

3.1 Preliminary Phase

Like any other industry, information construction in Chinese rural area has also undergone the initial stage. Information construction in rural area consists of two parts: hardware and software. The hardware includes database, information pool platform, information dissemination media, and terminal equipments and so on; the software includes information processing, information management, and staff training, etc.

Because of the amount of rural area is enormous, it is inevitable to invest a huge sum capital to finish information construction in rural area, under the circumstance, any enterprise and individual doesn't assume this task solely. In the light of public good theory, the majority equipments of information construction in rural area pertain to quasi-public goods. Therefore, the government acts on investment entity in the preliminary phase in information construction in rural area. Because of absence of credible information, rural household rides the fence toward information construction in rural area process (Fig 1).

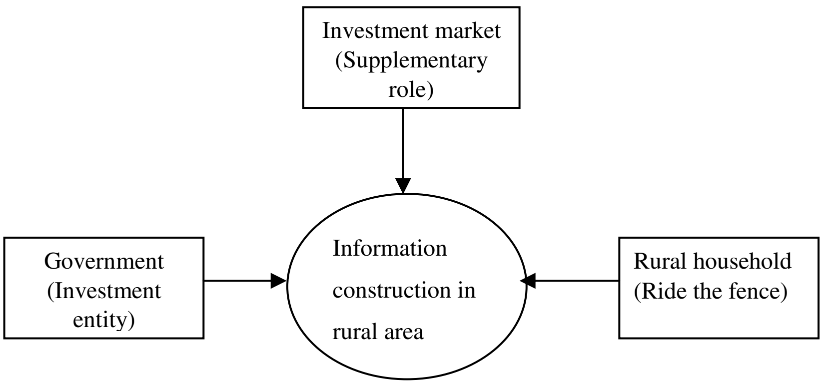

Fig. 1. Preliminary phase of information construction in Chinese rural area

3.2 Development Phase

In the preliminary phase, government invests enormous capital to build hardware infrastructure in preparation to step into development phase. In the process above, more and more rural household begin to be acquainted with the r information construction in rural area, and benefit from it at the mean time.

On the basis of preliminary phase accumulation, the direction of information construction becomes cleaner than previous phase in the development stage. The commercial opportunities in information construction in rural area attract private capital to invest it. In this phase, the government continues to improve information construction in rural area infrastructure in a planned way, intensify the safeguard measures. For example, market accessible procedure, market operation for information construction in rural area, safeguard mechanism for rural household interest, etc. So market efficiency appeals to more capital, technology, and trained personnel to involve, accelerates information construction in rural area development, realizes the integration between market and area household. They actively participate in building to information construction in rural area to obtain more agriculture efficiency. At the moment, government, market, and rural household push forward information construction in rural area together, cooperation entity shifts from the cooperation among government, market, and rural household to diversified cooperation models (Fig 2).

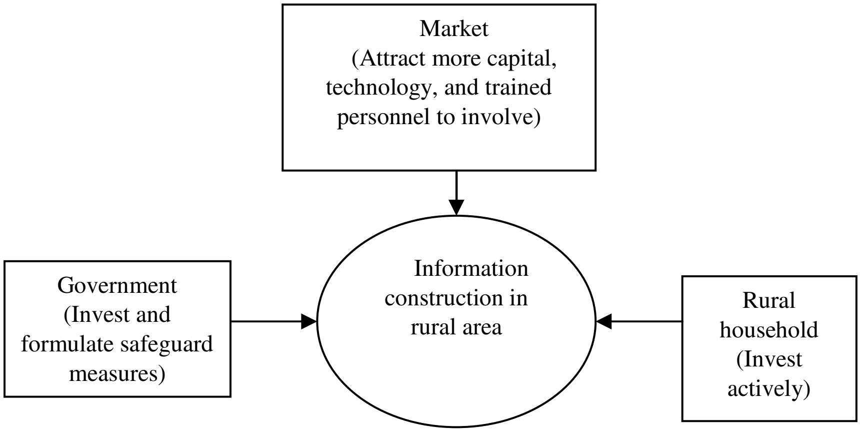

Fig. 2. Development phase of information construction in Chinese rural area

3.3 Mature Phase of Information Construction in Rural Area

During the development of information construction in rural area, all the entities cooperation become coordinated, diversified, steady, smoothly. All the interest of aspects tend towards maximum, it is the mature characteristics of information construction in rural area. In the course of this phase, rural area faces are remodeled completely, the farm's standards of living turn to better and better. At the moment, government withdraws from investment on hardware, put the emphasis on the necessary maintenance, strengthen safeguard measures for information construction in rural area, and recoup the investment in the previous two phases. Market and rural household play more important roles in information construction in rural area(Fig 3).

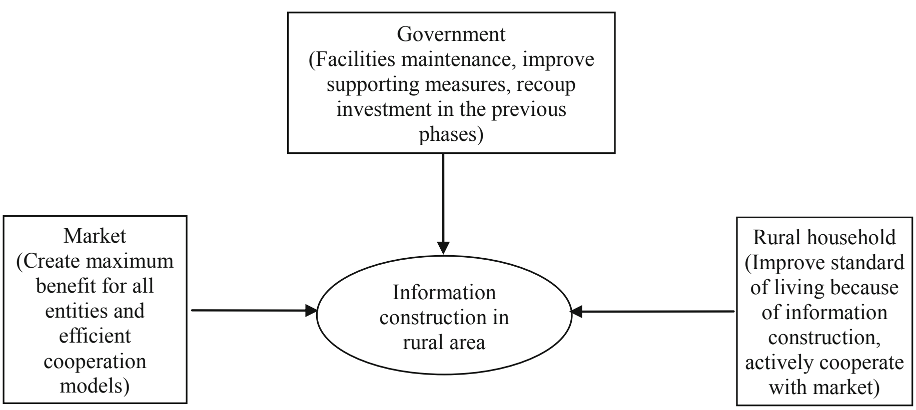

Fig. 3. Mature phase of information construction in Chinese rural area

On the three phases of information construction in rural area above analysis, rural household is principal part in the process. The farmers' production and living are improved gradually, by the economic benefit driving, information construction in rural area can accelerate to development, which is essential instrument to solve agriculture, rural area, and farmer. Only under the government leadership, can the information construction in rural area develop steadily and soundly. Government plays invigorative, catalytic, and supportive role in the process.

4 Development Countermeasures of Information Construction in Rural Area

As far as the report from the Ministry of Agriculture of China (2009.7), all levels of agricultural sector have its own information construction department, possessing 200,000 stuffs. 31 provinces (autonomous regions and municipalities), 80% (city) and 60% of the county agricultural department have set up a special web site, initially forming a national agricultural information network group. Additionally, in accordance to the report from communications industry newspaper, 70 billion will be invested into information construction in rural area in the next 3 years, and strive to build 100,000 rural information service stations by 2011, the agricultural information communication machine customers exceeds 100 million, information machines distributes all administrative villages, realize the goal of "one town one station, one village, one machine". We can infer from the above report, information construction in rural area still remains in its preliminary phase in the next few years. Market and rural household interference seldom occur. We should put the emphasis on the aspects below:

4.1 To Propaganda Information Construction in Rural Area So that Farmer Understands and Accepts Its Importance

Information construction in rural area turns towards rural area, combines farmer, services agriculture. Farmer plays utmost role in this process. In order to set up information construction in rural area, the government should establish links with farmer so that they understand the importance of information construction in rural area.

4.2 To Push Forward Marketization of Rural Area Information

Besides increase financial support, government ought to emphasize market intervene so that accelerate the step towards information construction in rural area. At present, the obstacles of market intervene originate from two aspects: (1) information asymmetry occurs between governmental policies and market players; (2) information asymmetry occurs between market players and policy makers.

4.3 To Formulate Policy in Order to Safeguard Mechanism for Information Construction in Rural Area

As the infant industry, information construction in rural area possesses expansive development space and speed. Meanwhile, indispensable policy is its safeguard. All level government should optimize information construction in rural area environment. For example: information sharing mechanisms, personnel training system, supervision and management mechanism.

4.4 To Intensify Rural Area Information Management

Unlike the traditional industrial management, information management possesses its own feature. Aiming at service agriculture, rural area, and farmer, information management should primarily disclose he relevant information of behaviors of principal part through different media instruments, and then inspire the principal part to improve their production and living behaviors. At present, we should set up agricultural database, support agricultural research, production, operation and management, technology generalization.

5 Conclusion

Information construction in rural area is at preliminary stage. All level government play role of investment. Therefore, we should vigorously explore information construction in rural area, attract private capital to intervene, combine farmer and other social sectors to participate, coordinate the benefit of investment entities, et up agricultural database, support agricultural research, production, operation and management, technology generalization and so on. In accordance with effective demand, heavy service, wide coverage, multi-mode requirements, integration of resources and build a platform to improve the rural information service system. Promote "McKinnon", "three-in-one" model of rural information and rural business information services, construction, information services and actively explore ways and means of villages and peasant households. Improve the collection and dissemination of agricultural information system for farmers and enterprises to provide timely and effective information services.

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The Judgment of Beef Marble Texture Based on the MATLAB Image Processing Technology

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Abstract. The beef texture as marble is one of the important quality indexes of beef. Since the grading of beef marbling is largely determined by the subjective experience of the graders, there are inconsistencies and errors in judgment. Therefore, how to find objective and quantitative measure of the marbling abundance degree according to the grade standard of beef marbling has been one new study in the world meat science fields. We can use image analysis tools of Matlab to preprocess the image of beef marbling. Through data analysis, the percentage of image content marbled has been obtained, the detection model can be established through the construction of neural network, so it can lay the foundation for the prediction grade of the unknown kinds of beef marbling in the future.

Keywords: marbling level; image; beef; grading.

1 Introduction

With the development of economy and the improvement of people's living standards, our food structure has changed greatly, beef consumption is growing, and the quality of beef has attracted unprecedented attention. The evaluation method and criteria for beef quality exist in many developed countries. Among them, beef marbling is one of the key indicators. According to the marbling content, According to China's agriculture industry standard – "Beef Quality Grading", marbling can be divided into four levels: very rich, rich, a little and little, 0.5 between each level [1].

The marbling of beef is often regarded as an important indicator [1,2], but currently, there are no quantitative methods and standards in China. The classification relies more on human eyes. The method is very subjective and random, and the speed of classification is slow with low accuracy. Therefore, the study of advanced computer vision technology using quantitative methods of beef grading, is of great importance for establishing the automatic classification system.

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2 Material and Methods

The test samples of selected images include four beef marbling assessed by experts in China, and a number of sites from Food Research Centre of Tianjin University of Agriculture. Test images are true color of RGB, storage format are all as BMP, the pixels of processing the image are 317x173.

Firstly, the image index of beef marbling was determined. Secondly, the image feature parameter was extracted with all kinds of methods. Finally, the relationship between image parameters and final grade rating members was established. The detailed measures are as follows: on the basis of standard images, the image feature parameters are extracted and regarded as the input variables of neural network; Then the NN is trained, the mode between the grading and characteristic parameter of the image is established. As is shown in Fig. 1.

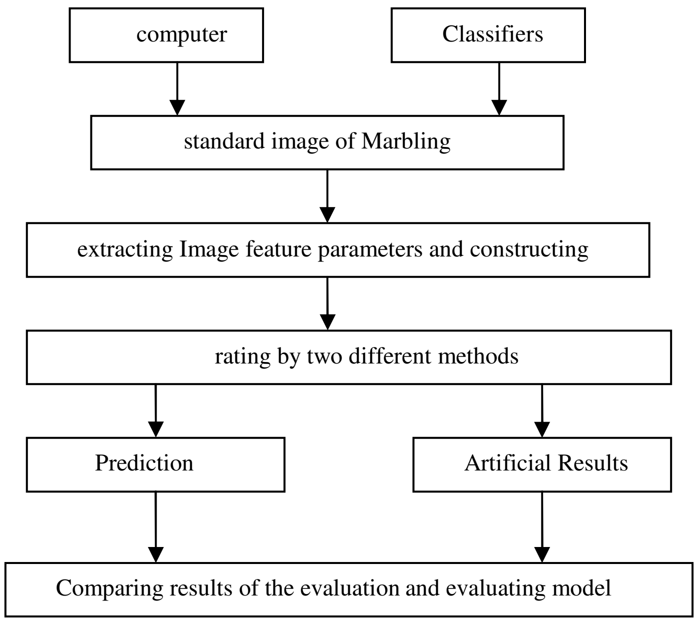

Fig. 1. Flow chart of image feature extraction

3 Image Processing

As the images will be interfered and form noises during the transmission process. This will result in visual difficulties when extracting and identifying the features from images or cause poor visual effects. Therefore, firstly, we must address the image denoising, we decided to remove noises using median filtering through experimental comparison[3,4]. Secondly, we can get the images with no background points by selecting different growing points, the last pixel was chosen as the initial growing point. Due to different images, the initial points may be different. If the background is black with dim background, it should be chosen at the first pixel where they intersect. Finally, according to the characteristics of the image level, we can use the Otsu method for image segmentation. The steps for extracting the feature parameters of standard grade beef image are shown in Fig. 2.

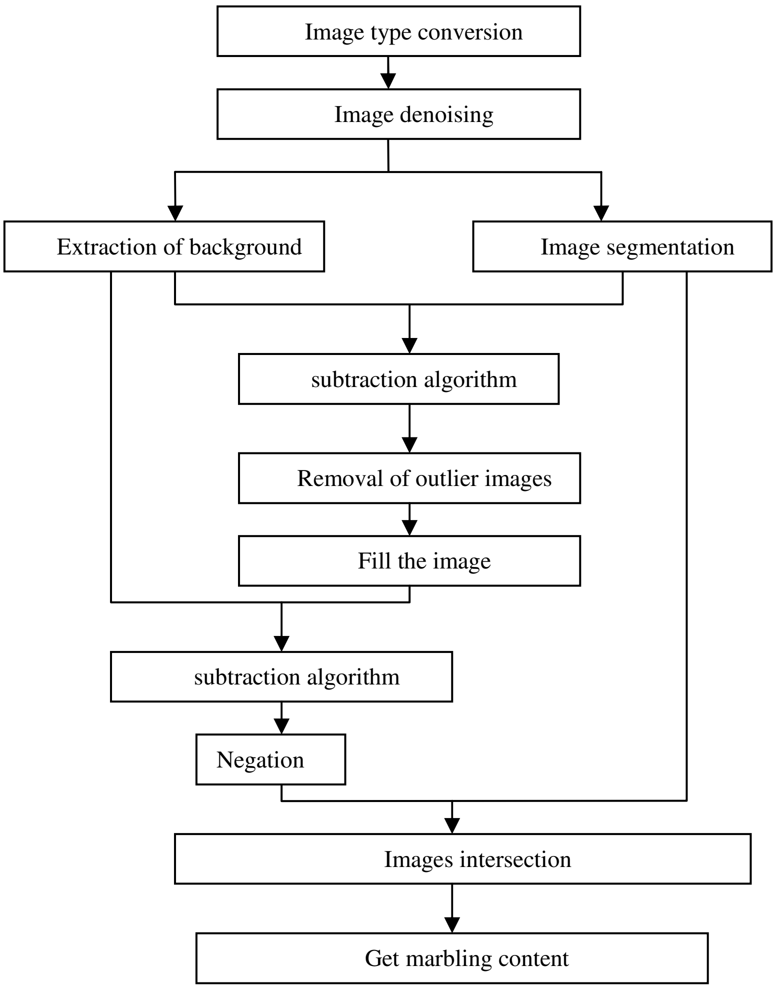

Fig. 2. Flow chart of image feature extraction

3.1 Image Type Conversion

In order to facilitate the following image processing, we can use the beef marbling image of grade A as reference to finish the following process. First, the RGB was converted into a grayscale, it achieve through rgb2grey in Matlab, as is shown in Fig. 3. and Fig. 4.

Fig. 3. RGB Chart

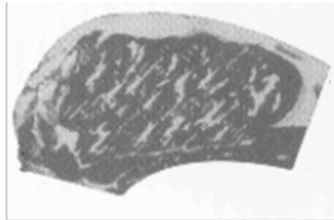

Fig. 4. The grey image

The image denoising should be done before further processing, we can use the method of median filtering to remove noises by comparing more images through average method, neighborhood average smoothing, preserving edge smoothing, median filtering and other denoising methods. To more accurately extract the background of block beef, we should note that the threshold conditions and the initial points, after repeated debugging, we will set the threshold condition is less than 0.5, and select the image lower right corner of the last row last column of a pixel as the initial growing point, then we can obtain satisfactory background segmented image.

3.2 Image Segmentation

When the image is in the process of binarization, we usually use the global threshold method. In the experiment, we will use OTSU algorithm which is based on gray-level image, to divide the image into two parts: background and foreground[4,5]. The method is simple, without affecting the image brightness and contrast characteristics, it read the threshold more accurately than from the R, G, B, L-channel histogram of each component, the error is small, and segment is more accurate, it is the best algorithm in image segmentation of threshold. As is shown in Fig. 5.

Fig. 5. Binary image

3.3 Image Subtraction Algorithm

The image subtraction method refers to the method of getting the new output image through two images, point of addition, subtraction, multiplication, division calculations[4]. Through subtracting, the unwanted areas can be removed from the image, and retain the areas which we are concerned about. Fig. 6 is the fat part of the beef, It is obtained by subtracting. Fig. 7 shows largest retained areas covered with fat after the removal of small isolated areas.

Fig. 6. Fat part

Fig. 7. Covered with fat area

3.4 Fill the Image

To remove the small muscles of fat, we use the method of filling. Fig. 8 shows us the experimental results of Fig. 7 are obtained through filling. We can get the muscular part by using the image subtraction method for the second time. Fig. 5 will be negated, and then with the muscular part to obtain the required intersection of segmentation results, it is shown in Fig. 9.

Fig. 8. The result of filling

Fig. 9. Segmentation result

Finally, Through using the method of filling and image subtraction again, we can calculate the area of Muscle tissue, marbling and Intramuscular fat with statistical functions of Matlab.

3.5 Image Analysis of Beef

Using the image analysis method, we obtain the result of different levels beef samples by programming. It is shown in Table 1.

Table 1. Image analysis results compared with manual ratings

Grade	1	2	3	4
Marbling percentage	0.0320	0.0136	0.00842	0.0042

4 Automatic Grading System of Beef

As it's difficult to establish a linear relationship between the features of beef marbling and grade, we use three-tier BP neural network in order to rapidly and accurately determine the grade of beef marbling. We use the main components, like the total area of intramuscular, marbled area and so on, which are extracted from the images of beef as the input layer of BP network. The output layer corresponds to the level of grading standards. So the mapping relationship can be established from P2 to y1.

The 35 marbling images of beef were selected randomly, in which 30samples for training, 5 as testing samples. Fig.10 shows the network structure.

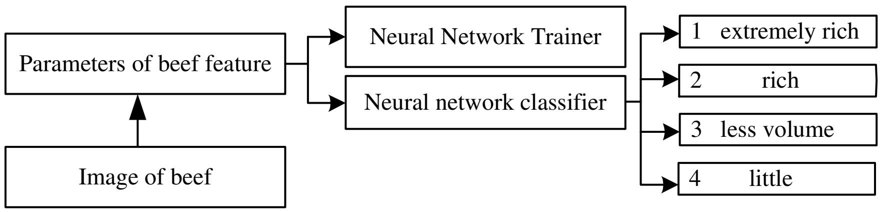

Fig. 10. Neural network system of marbling grade

Table 2 shows the forecasting grade, the true grade and the relative error of 5 samples, which are selected from prediction set. From Table 3, we can see that the relative error exist between the forecast grade and the true grade. It is mainly caused by small sample size.

Table 2. The predicted result of sample

subject	Predicted value (degree)	True value (degree)	relative error
1	3.9987	4	0.0013
2	1.1284	1	0.1284
3	3.9976	4	0.0024
4	2.9984	2	0.9984
5	2.9984	2	0.9984

5 Conclusions

This experiment proved that using image processing tools of Matlab instead of the manual methods is feasible to determine beef marbling. Through the preprocessing operation of images, the application of "Image Subtraction method" and "region growing" is an effective way to separate effective areas and extract image feature parameters of the region in a complex background. As the number of samples for network training is limited, there are still some errors of model forecasting. We can improve the accuracy of forecasting by increasing the number of samples in the future experiments. The trial lays a foundation for online tests.

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The New Method of Fruit Tree Characteristics Acquisition Using Electromagnetic Tracking Instrument

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Abstract. To achieve informatization for Orchards and fruit trees and to obtain real-time tree characteristic parameters in orchard, data acquisition system of fruit tree characteristics has established by using electromagnetic tracking instrument, Fastrack and data acquisition software. The process of acquiring tree's parameters and the method for acquiring tree characteristics using this system are discussed in detail. Finally, Outdoor measurement experiment was conducted on five 3-year-fruit trees in the experimental base. Five characteristics of fruit trees: tree height, the first main lateral branch height, angle between main branch and angle between main branch and a trunk, are acquired and compared with measurement results got from the traditional direct method. It shows that parameters of trees are basically the same: The difference of these two results is about 0.12cm ±0.06 cm. The relative error is less than 2mm and the mean difference in angle is no less than 1 degree. This means the proposed approach is feasible and has a high practical value.

Keywords: Fastrack; tree characteristics; fruit tree; measurement.

1 Introduction

China is the world's first country of fruit production. In recent decades, fruit production is improved year by year and has become one of pillar industries in some agricultural provinces. During the actual production, an advanced system of orchard management techniques, production standards and fruit production in all aspects of high-tech are important guarantees to ensure sustainable growth in fruit production due to fruit characteristics of continuous production, technically demanding and long production cycle. It is essential for the establishment of China's fruit production technology system to obtain accurate data on the characteristics of fruit trees. The accurate and quantitative description to spatial form parameters of the fruit tree may not only provide reliable evidence for the establishment of fruit production

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technology system and production standards, but also provide technical support to the development of fruit morphology.

There is usually two ways to acquire the characteristics of fruit trees: Direct measurement, such as the traditional measuring by using tape and pole; indirect measurement, such as the coordinates of the tree's characteristic points can be obtained by using modern surveying, information technology and electronic technology. Direct measurement is not only inaccurate and heavy workload but also bad to fruit trees. Indirect measurement can effectively fill up the deficiency of direct measurement, so it has been increasingly applied in practical production. Wang Wanzhang et al (2006) built a tree crown diameter measurement test system in the tractor by using ultrasonic sensors, GPS receiver and electronic compass. Which can be tested by error analysis method, and the result is good. Tumbo et al detected the volume of fruit tree by using laser sensors and ultrasonic sensors, and compared the results of orange trees of indirect measurement and manual measurement. Comparison results show that the data obtained by indirect measurement have better accuracy than manual measurement. In addition, domestic and foreign scholars have also studied the effect of various external factors during indirect measurement on the measurement accuracy.

During the actual production, the local characteristic parameters of fruit trees are very important, such as the leaf length, leaf area, shoot length, branch diameter. The present research on fruit tree characteristics acquisition mainly focused on the acquisition to the overall characteristic parameters. There is only few studies use indirect measurement to acquire the local characteristics of fruit trees. For this reason, the article studies rapid acquisition of the characteristic parameters of fruit trees branches under the orchard environment by using electromagnetic tracking instrument FASTRACK and related software. Thus it provides a reliable basis for the establishment of fruit trees production technology system and pruning techniques. And then it provides technical support for the development of fruit morphology and pruning techniques.

2 Materials and Methods

2.1 Measurement System

The system which our experiment used is composed of two parts: electromagnetic tracking instrument and the self-developed data acquisition software. The electromagnetic tracking instrument of our system is Fastrack which is developed by the Polhemus Corporation in the United States, as Figure 1 shown. Fastrack has always been considered the industry standard of electronic positioning during the last ten years. It provides the perfect solution for the position/orientation measurement and its Orientation tracker can accurately calculate the micro receiver's the orientation when it moves in space. The device eliminates the potential problems which are happened when it is carrying out dynamic 6 degrees of freedom to measure the position (Cartesian coordinates in the X, Y, Z coordinates) and orientation (azimuth, height and rotation). So it means that Fastrack is the most accurate electromagnetic tracking system. Data acquisition software system can display points' data collected in a graphical way and stored them into the database. Fastrack is connected with computer through the USB interface and is controlled by data acquisition software in computer. By this way, this system can collect Fruit characteristic point coordinate data and display them in graphical way, then store them in Access database.

Fig. 1. The Fastrack measuring equipment

2.2 Experimental Materials

In this passage, our experiment has been done in the test base of Fruit Research Institute of Chinese Academy of Agricultural Sciences, which locations in the east longitude 120 ° 44 ' and latitude 40 ° 36'. It attached to the city of Huludao. The Subjects of our experiment are five 3-year-apple trees which are chosen within Hua Xing and Hua Ping species (figure 2). Before the experiment, several tree parameters, such as height, branch length, section spacing and so on, should be measured by tape. These results which are gotten by tape can be used for comparison and analysis during the following experiment.

2.3 Experimental Methods

Fastrack that our experiment used is a measurement system based on the principle of electromagnetic wave and its precision of measurement is affected by External environment and the properties of subjects. For that reason, we must select the appropriate time and place based on the actual situation during the process of collecting data. For example, because the effective measurement range of Fastrack is limited by electromagnetic emission radius, the standard radius of Fastrack's transmitter is 1.2m. On the other hand, the height of the object in this experiment is about 2m. In order to ensure the integrity and accuracy of measurement data, the enhanced transmitting antenna of Fastrack is applied in our measurement. In the measurement process, we placed the transmitting antenna near to the target location of the tree and measured trees in the windless moment of morning or night so as to reduce the impact of external environmental factors and ensure the accuracy of experimental results.

Fig. 2. Fruit samples in the experiment

2.3.1 Equipment Placement

Before measuring using Fastrack, equipment must be placed well. The process of placement includes three sections: GPS orientation, transmitting antenna fixed and checking the environmental impact. The purpose of equipment placement is to place the Fastrack transmitter in a stable position and ensure one of its axes parallel with the GPS antenna. At the same time, through the section of checking environmental impact, the device is less affected by external so as to ensure experiments carried out smoothly.

2.3.2 Measurement of Spatial Data

Fastrack that our experiment used is controlled by software, which means that there must be two people for measuring trees: one chooses feature points of trees by detector pen and the other uses data collecting software to record data of point and other information of trees. Before collecting information, the state of measuring equipment is checked by calibration module of the data collecting software and set ruler. On the other hand, coordinate origin of measurement that is represented by “O” should be set and all coordinate data of feature point recorded by the system are “O”-based. The O point is usually located in vertical intersection between trunk axis and horizon. The flow chart of measuring trees’ feature points is as figure 3 shown.

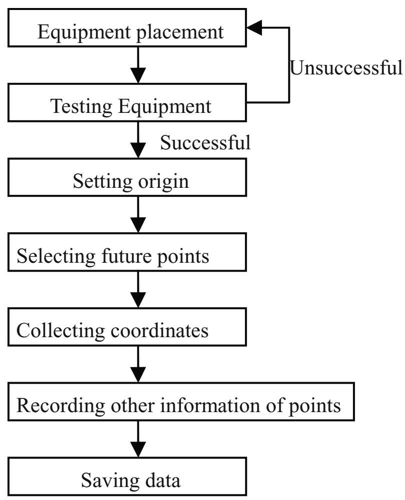

Fig. 3. Flow chart of measurement

During the measurement process, a set of rules is designed for choosing and measuring key points of trees so as to recorder the key data of fruit trees’ points. As the right side of figure 4 shown, six points which located in each knot of tree are chosen. On the other hand, between the neighboring knots, two points of tree are chosen for measuring which are as the right side of figure 4 shown. To measure as this rule, we can get $(n+1)\times 6+2\times n=8n+6$ data when measuring a branch with n knots. When measuring a tree, one operator chooses every selected point with detecting pen and coordinates of points are recorded by the data collation software. At the same time, the other information of selected points, such as point type and branch type, are also recorded for data analysis of the next step. As usual, a skilled operator can complete measurement of a fruit tree in 30 minutes, which can get data of 1000 points. All data collected are stored in ACCESS database.

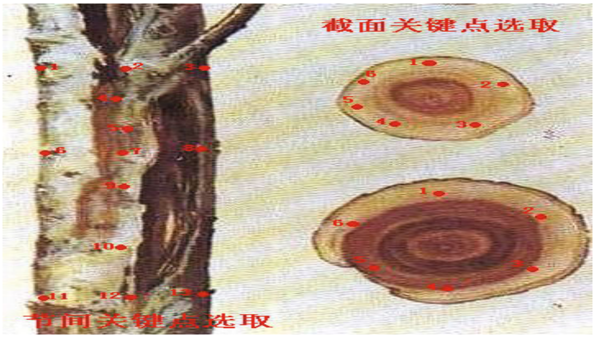

Fig. 4. The location of key point

The figure 5 is the interface of collecting software.

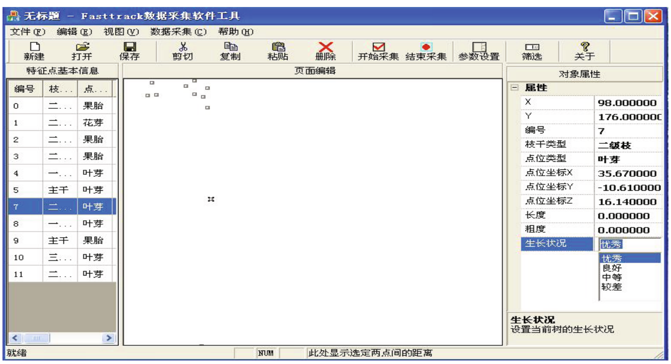

Fig. 5. The interface of collecting software

2.3.3 Calculation of Characteristic Parameters

After having gotten feature points' three-dimensional coordinates of fruit trees with Fastrack, we can compute some tree parameters, such as height, stem length, shoot length, the angle between any stems, interlayer distance, crown width, crown diameter and so on , with these coordinates of collecting data in the software.

To any pairs of points on the branch: $P_1(x_1, y_1, z_1)$ and $P_2(x_2, y_2, z_2)$, we can get distance between them with Formula (1)

$$d = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2 + (z_1 - z_2)^2} \quad (1)$$

By the formula (2), we can obtain any tree branch length:

$$\Delta d = \max(d_1, d_2, ...d_n) \quad (2)$$

where $d_1, d_2, ...d_n$ is the set of distance between any two feature points on the same branch.

The angle between any pair of stems can be computed by using the theory of the angle between two vectors, as Formula (3) shown:

$$\cos\theta = \frac{a_x b_x + a_y b_y + a_z b_z}{\sqrt{a_x^2 + a_y^2 + a_z^2} \times \sqrt{b_x^2 + b_y^2 + b_z^2}} \tag{3}$$

As the same principle, the interlayer distance of a tree can be gotten by using the distance between any two vectors, as Formula (4) shown:

$$d = \left| proj_u \overline{AB} \right| \tag{4}$$

where $proj_u$ represents the vector projection of AB onto the axis.

$P = \{(x_i, y_i, z_i)\}$ is a set of feature point coordinates of a fruit tree, where $i = 0,1,2...n$.

$$\begin{cases} \Delta x = \max(x) - \min(x) \\ \Delta y = \max(y) - \min(y) \\ \Delta z = \max(z) - \min(z) \end{cases} \tag{5}$$

According to Formula (5), tree height is given by Formula (6)

$$h = \Delta z \tag{6}$$

Based on the same principle, crown width of a fruit tree can be given by Formula (7)

$$f = \frac{\Delta x + \Delta y}{\Delta h} \tag{7}$$

where Δh represents the crown height of a fruit tree.

3 Results and Analysis

We have measured the height and the first major lateral branch height of NO.1st to 5 trees with a tap in detection height of Fastrack. The angle between main branches and the radian between the main branch and trunk can be gotten by micrometer. Theoretically, when measured, the lower the tree height, the more accurate the detection as the tree having more close to the transmitting antenna of Fastrack. Measurement results of these five fruit trees with two kinds of measurement methods which are mentioned above, are shown in table 1 and table 2.

From the data of table 1, for NO 1st to 5th trees measured with a tape and micrometer, the average height is 132.97cm, the average height of first major lateral branch is 31.00cm, the average angle between main branches is 37.2 degree and the average Radian between the main branch and trunk is 1119.4 degree. Meanwhile, from the data of table 2, for NO 1st to 5th trees measured with Fastrack, the average values mentioned above are 133.04cm, 30.89cm, 36.8 degree and 119.8 degree.

Comparing mean parameters of fruit tree gotten by these two measure methods, we can find that the relative error of the height is the smallest while the angle between main branches' relative error is largest. Values of these errors are 0.05% and 3%. It means that the result gotten by indirect measurement with Fastrack is very near to that of direct measurement with tape. The difference of these two results is about 0.12cm ±0.06 cm. The relative error is less than 2mm and the mean difference in angle is no less than 1 degree. So results from indirect measurement with Fastrack have a very high precision, which can meet the needs of the measurement parameters of fruit trees.

Specific research and comparison dada in table 1 and table 2, we can find that the result of NO 3rd tree has the largest difference among two measurement methods. Because the result gotten by direct measurement is the mean value from the results of three professional operators, the error of direct measurement can be ignored. Further investigation can be found that the site of No 3rd tree is near to a pumped well which framework contains fixture. The fixture can affect the measuring tools of Fastrack that causes higher error. Meanwhile other trees relatively far away this pumped well which can get less influence by electromagnetic interference when measured and results of them have less error. Therefore, it is important for the accuracy of Fastrack to choose the right condition and smooth away the possibility of electromagnetic interference.

Table 1. Measurement results of fruit trees using tape

Tree number	1	2	3	4	5
Height(cm)	132.98	131.55	134.34	133.20	132.76
Height of first major lateral branch (cm)	26.31	31.26	29.87	34.66	32.89
Angle between main branches(degree)	34	36	39	40	37
Radian between the main branch and trunk(degree)	118	116	123	121	119

Table 2. Measurement results of fruit trees using Fastrack

Tree number	1	2	3	4	5
Height(cm)	132.76	131.84	133.99	133.56	133.06
Height of first major lateral branch (cm)	26.01	31.54	29.53	35.01	32.34
Angle between main branches(degree)	33	36	38	41	36
Radian between the main branch and trunk(degree)	117	115	125	122	120

4 Conclusion and Discussion

In this passage, we select five 3-year-fruit trees in the experimental base of XingCheng Fruit Research Institute as research objects. Five characteristics of fruit trees: tree height, the first main lateral branch height, angle between main branch and angle between main branch and a trunk, are acquired With Fastrack. After compared these results with measurement results gotten from direct method with the tape and micrometer, it shows that parameters of trees are basically the same and relative error rate is no less than 3%. This means the proposed approach of Fastrack is feasible if the right condition is chosen and the possibility of electromagnetic interference is eliminated. Consequences using Fastrack have the same accuracy as measurement results gotten from the traditional direct method. This method using Fastrack which is characterized as convenient, fast and no damage has a high practical value.

Acknowledgements. Funding for this research was provided by “basic scientific research special fund of nonprofit research institutions at the central level” (2010j-1-06) and the “863” project of research and application of field crop diseases intelligent diagnosis system (Number: 2007AA10Z237).

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The Novel Integrating Sphere Type Near-Infrared Moisture Determination Instrument Based on LabVIEW

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Abstract. Based on the technology of near-infrared spectroscopy, a novel near-infrared moisture content determination instrument has been developed with three laser diodes of different wavelengths as light source, with one InGaAs detector as determination device, and with integrating sphere as sample holding device. Besides, LabVIEW virtual instrument program was employed for development of its operation instructions. This instrument has made full use of the integrating sphere system to remove the spectroscopic parts which are necessary in general spectrometers and has thus facilitated the improvement of system stability and signal noise ratio. Determination tests of moisture in sesame seeds and tea fresh leaves verified high precision of the instrument, showing that it can meet the primary requirement of moisture determination in practical production.

Keywords: NIR spectroscopy, moisture content, determination instrument, LabVIEW.

1 Introduction

Moisture widely exists in various natural substances. In medicine, food, tea, grain, tobacco, chemical and many other manufacturing industries, it's necessary to monitor the moisture content of raw materials and products in almost all aspects of processing. Hence, moisture measurement and control is an important aspect of the production, which directly affects product quality. Moisture content testing for wheat, corn, sesame seed, soybean, rapeseed and other agricultural products is directly related to product pricing and classification of seeds based on quality. The traditional methods of moisture content determination mainly drying method, resistance or capacitance measurement method and so on, are either testing process cumbersome, consuming too long time, or accuracy is not high enough, so cannot be used for non-contact measurement. Compared with these methods, Near-infrared (NIR) analysis technology has such advantages as non-destructive, fast, efficient, free of sample pretreatment, and suitable for process online analysis.

NIR is electromagnetic waves whose wavelength range within 780 ~ 2 526 nm, the earliest recognized waves in the non-visible light region. And after first used to

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determine water content in grains, NIR spectroscopy was subsequently used in quality assessment and analysis of other agricultural products. It is one of the earliest used and most effective ways for moisture detection in agricultural materials. In recent years, the development and production of NIR analyzer has progressed substantially in China. However, the existing NIR instruments generally use halogen lamps as light sources, which need to install splitting device, thus making the path of rays constitution and the control circuit system complex, the instrument debugging process tedious, the construction cost high, and practical application of the instruments difficult. In addition, they generally lack such functions as remote diagnosis, and remote data real-time transmission and processing. Furthermore, they have certain technical short comings as poor instrumental consistency between various parameters and high model transfer error.

To solve these problems and to promote the application of NIR special instruments, a novel NIR moisture determination instrument has been developed with integrating sphere as sample holding device, with three laser diodes (LD) of different wavelengths as light source, with an InGaAs detector, and with operation instructions developed using LabVIEW virtual instrument program. Rapid and non-destructive determination of moisture content of sesame seeds and tea fresh leaves have been completed on it.

2 Overall Scheme Design

The test system consists of two parts: hardware and software. Hardware is mainly used for standard optical signals generating and sending, reflected signal with sample information receiving, work process controlling and status monitoring. Software includes control and monitor interface, data analysis, and results displaying, developed with high-level graphical programming language LabVIEW.

Schematic and structure diagram of the integrating sphere type NIR moisture determination instrument are shown in Fig. 1 and Fig. 2. From the diagrams, a personal computer (PC) has been used to control the rotation interval of the 3 LD light sources inlayed in the integral ball along with InGaAs detector. The sample cell has been inserted into integral ball so as to eliminate measurement errors caused by the sample structural differences and realize body absorption, which makes full use of the structural characteristics of integrating sphere and good monochromaticity of LD to remove the spectroscopic parts and thus makes the device compact and stable. LD driven by match electric circuit is selected by the multiway switches to send out stable monochromatic

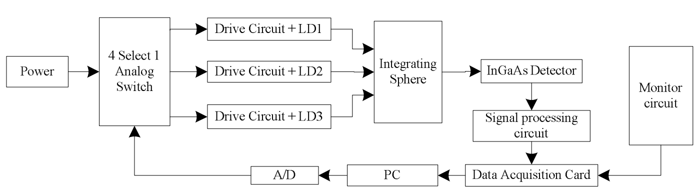

Fig. 1. Schematic of the integrating sphere type NIR moisture determination instrument

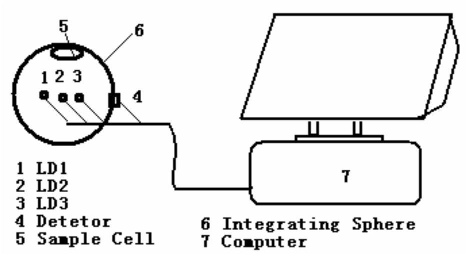

Fig. 2. Structure diagram of the integrating sphere type NIR moisture determination instrument

light. The reflection light signal with material function is then collected by the integral ball and transformed to the InGaAs detector. Through the data processing circuit, the signal enters the data acquisition card and then to the computer to run following processing to obtain the moisture content of the tested sample.

3 Hardware System Design

Hardware of the NIR moisture content determination instrument mainly consists of optical system and circuit system. As shown in Fig. 2, integrating sphere is the key component of the optical system. The integrating sphere is often used as a test sample devices in NIR test equipment, because it ① can collect most of the analysis light, greatly increasing the signal strength, improving signal to noise ratio; ② can eliminate the interference of reflection, scattering, polarization light, reducing the light incident impact of the shape and angle changes , making the instrument more stable and more reliable; ③ can reduce the impact on the measurement of uneven and spatial location as the sample changes, improving the measurement repeatability.

However, traditionally the sample room was located outside the integrating sphere, the light spot size and intensity of optical signal greatly affected the results. As the average moisture content is always the goal of moisture content determination, the sample room can be inserted into the integrating sphere, which is not only able to take full advantage of the benefits, but also increased the light intensity, thus make the influence subject to the measurement spot size disappear. The circuit system mainly includes light source driving circuit, detector detection and processing circuit, operation control and status monitoring circuit. And the light source driving circuit is essential to ensure the instrument precision from the wavelength and power stability of the emitted light.

3.1 Optical System Design

Integrating sphere is the key component of the optical system. To design it, not only the inner surface of the coating should have high reflectivity, and the integrating sphere opening area should also meet the general requirements of the integrating sphere. In this design, coating material for integrating sphere inner surface used gold to ensure its reflectivity of NIR up to 99.5%. There are 5 openings in the integrating sphere, corresponding to the 3 light sources, a detector and a sample cell port. The diameter of the integrating sphere is 200 mm. The different center wavelengths have been selected based on test data analysis of full spectrum instrument, namely 1 310 nm, 1 450 nm and 1 550 nm. Here, 1 310 nm is used as reference wavelength, 1 450 nm as water absorption peak, and 1 550 nm as amended wave.

To eliminate temperature drift due to too long operation time, and revise operating point difference of the detector to receive signals from different light sources, the driving circuit was separately designed in view of various light sources to allow the light sources work in turn. In consideration of the semiconductor laser photo source's work principle and characteristic, one kind of simple feasible automatic power control (APC) driving circuit was used to realize the constant power control so as to remove the spectroscopic parts which are necessary in general spectrometers.

3.2 Detection and Processing Circuit for Detector

InGaAs photodiode sensitive in the long wavelength has been selected as detector. Yet its output current signal is very weak. Before being input to A/D transformation chip, there should be some processing circuits. As shown in Fig. 3, after the I/V transformation, chip DS1859 achieves the detector temperature control and filtering, amplifying processing, thus obtains voltage signal in the operating region of data acquisition card.

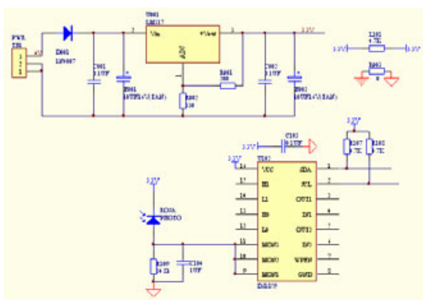

Fig. 3. Detector examination recuperation electric circuit

3.3 Monitoring Circuit

Equipment's work condition monitoring, includes environmental temperature testing, sample temperature testing, work status monitoring of light source and alarming. The current of the light sources are detected by Hall sensors, who can detect the current around the magnetic field without affecting work status of the instrument. And the temperature are detected by the digital temperature sensor DS18B20.

3.4 Data Acquisition Card

This system uses UA206D PCI bus A / D acquisition card sold by a company YouCai in Beijing. The card has two-way integrated D / A, with card-specific dynamic link library UA204.DLL, which provides simple and efficient acquisition and control functions to support various functions of UA206D. LabVIEW applications directly call Dynamic Link Library subroutines to realize a measurement process control and data acquisition.

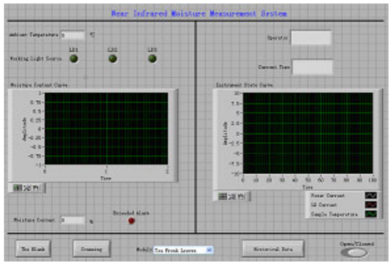

Fig. 4. Virtual instrument front panel

4 Software System Design

Software of the NIR moisture determination instrument mainly realizes instrument control, condition monitoring and data processing. Data processing includes data collection, data storage, the results display and processing. The man-machine interface is used to detect and determine the user input information to form the testing process and calls the corresponding subroutine. Background data processing fulfils analysis and judgments of the returned measurement data, forms statements and then archives. Software system controls apparatus of spectrum scanning to the measured sample while the background data processing is doing the analysis to determine whether the result reaches to the corresponding target.

As shown in Fig. 4, working process of the equipment contains: moisture content of continuous testing and monitoring, environmental temperature testing, sample temperature testing, work status monitoring of light source and alarming. The main interface will display the current operator status under the operator's rights and have different control responses on databases. During the test, the screen will display the progress of the main interface, show the data measured for some monitoring of the project as required in the interface, analyze data at the same time, and generate different forms of reporting results to the operator use. If requirements on sample are not satisfied, a warn message will appear.

5 Moisture Content Test Experiments

After assembly of hardware, design of software and debugging of the instrument, a test sample was scanned. Then, multi-dimensional linear regression (MLR) and polynomial regression algorithm was employed for establishing calibration model between relative value of system outputs and moisture content. Tea fresh leaf and sesame seed samples were used to carry out moisture content examination in the selected wavelength. The relative value of system outputs and moisture content has been established and survey examination has been carried out to the test sample.

With a group of samples of known moisture content, first scan the blank on this instrument to define instrument operating point, and then load the samples and scan them to obtain system outputs in various wavelengths. Finally, set up the calibration model between relative value of system outputs and moisture content with software NIRSA2.2. System relative output is calculated as:

$$H_i = I_i / I_R \,. \tag{1}$$

where, H_i is the system relative output in detection wavelength *i*, I_R is the reflected light intensity in reference wavelength R, I_i is the reflected light intensity in detection wavelength *i*. (R = 1 310nm, *i* = 1 450nm or 1 550nm)

5.1 Moisture Content Modeling Analysis of Tea Fresh Leaves and Sesame Seeds

The experiment altogether gathered 46 tea fresh leaf samples from the production line in a tea factory in Danyang, 30 samples as the adjustment collection, and 16 samples as the forecast collection. Scanning was carried out to examine separately to get the system relative outputs and actual moisture content of each sample, and water content measured according to GB / T 8304 -2002. 54 sesame seed samples were collected from the market in Zhenjiang, 36 samples as the adjustment collection, and 18 samples as the forecast collection. Water content was measured according to GB 5497-85, and was taken a similar testing process to the tea fresh leaves. Then the MLR model and the polynomial regression model were respectively established, and the model accuracy and error are shown in Table 1.

Table 1 shows that the integrating sphere type NIR water meter can meet the general moisture measurement requirements of the tea fresh leaves and sesame seeds. The model accuracy of tea fresh leaves is relatively poor, and the increase in precision from polynomial regression is also quite limited. This is mainly due to that the samples' loading tightness is difficult to control. As a result, the moisture content of tea fresh leaves spans a larger area, since working point adjustment device is difficult to achieve such a large measurement requirements. In sesame seeds modeling, the correlation coefficient of MLR model can reach above 0.90. That of polynomial regression model can reach 0.97, being sufficient to meet the accuracy requirement of the general test.

Table 1. Model precision of moisture measurement of tea fresh leaves and sesame seeds

Model Precision	Tea Fresh Leaves		Sesame Seeds	
	MLR	Polynomial	MLR	Polynomial
Correlation Coefficient of Model	0.733 9	0.734 1	0.925 1	0.972 1
Correlation Coefficient of Predict	0.731 8	0.733 1	0.917 5	0.977 8
RMS Error	0.032 3	0.032 3	0.023 9	0.014 8
Ave. Error	3.32%	3.31%	2.46%	1.66%
Max. Error	8.11%	8.12%	8.91%	6.64%
Pre. MSE	4.11%	4.10%	3.39%	2.52%

5.2 System Tests

Stability. Without any conditions changed, collect the reflected light intensity 13 times in 5-minute interval. The results are shown in Fig. 5, and the error analysis are shown in Table 2.

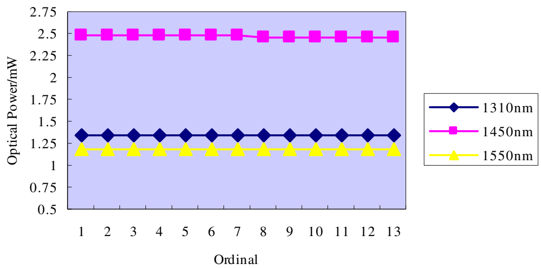

Fig. 5. Stability test results of the system

Table 2. Test result errors of stability (Unit: mW)

Error	Wavelength/nm		
	1 310	1 450	1 550
Max / Min	1.347 7/1.345 7	2.470 1/2.463 8	1.174 4/1.172 7
Extreme Difference	0.002 0	0.003 6	0.001 7
Mean	1.347 0	2.466 6	1.173 5
Standard Deviation	0.000 6	0.001 8	0.000 4

Repeatability. Take 2 sesame seed samples, each sample surveys the blank first, then surveys continuously 10 times, and record system relative outputs, substitute into sesame seed moisture content examination model to calculate water content, to test the repeatability of instrument. The results are shown in Table 3.

Error Analysis. Stability and repeatability of the instrument were obtained under the same loading condition. Considering the results of the model of tea fresh leaves and sesame seeds, the conclusion comes to that the stability of the system is high, and the system could meet the requirements of the prediction accuracy basically though the repeatability is relatively poor. Because the once reflect light from the sample is directly irradiate the detector, and the error caused by the sample compactedness in different loading is received and amplified directly. Duplication sample loading can improve forecast accuracy effectively, but it will affect the test speed and ease of use of the instrument, and also bring difficult to the transformation of online detection. Therefore, an adjustment on the internal structure of sphere accordingly is expected.

Table 3. Test results of repeatability (%)

Serial Number	Sample 1	Sample 2
1	6.46	7.68
2	6.29	7.89
3	6.64	7.69
4	6.45	7.76
5	6.76	8.12
6	6.47	7.67
7	6.45	7.69
8	6.75	7.76
9	6.56	8.11
10	6.47	7.67
Max / Min	6.76/6.29	8.12/7.67
Extreme Difference	0.47	0.45
Mean	6.53	7.80
Standard Deviation	0.15	0.18

6 Conclusions

Based on the technology of NIR spectroscopy and virtual instrument technology, a new moisture meter used for online analysis is developed. The results of system tests and moisture content detection experiment of tea fresh leaves and sesame seeds show that the instrument can meet the primary requirement of moisture determination in practical production. New application method of integrating sphere has greatly increased the signal intensity, enhanced signal to noise ratio of the instrument and reduced the influence caused by the changes of shape and angle of the reflected light, thus made the instrument more stable and reliable, as well as reduced the impact on measuring resulted from the sample unevenness and spatial changes, and improved the measurement repeatability. In addition, this system uses the rich software resources of computer to make some hardware software-based. To simplify the apparatus structure and shorten the development cycle of the instrument, it takes full advantage of the compatibility between LabVIEW software and non-NI hardware products, mostly uses domestic data acquisition cards to reduce costs. Users could create forecast model of water for different materials according to various needs, which can be easily ported to different applications. Meanwhile, the applications on remote diagnostics for the equipment failure also have been taken into account when designing the instruments.

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The Research and Realization of the Science Feed Management System in Islamic Livestock Norm Production and Quality Attestation System

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Abstract. For the request of rational and scientific farming of dairy cow, the database of dairy cow's feed composition and ratio is established, and the feed formula service management platform and transaction processing platform is realized in Science Feed Management System. The application of this system contributes to improve science of dairy cow's feed formula, enhance the utilization of the raw material, attain the target to economize cost and increase benefit. In this system, the web service management platform is developed by SQL SERVER 2005 and JSP technology, and the transaction processing platform is developed by ACCESS and VB6.0.

Keywords: feed management system, feed formula, isomerous data.

1 Introduction

For the rationalization and scientific requirements of feed formula of dairy cow and other characteristics animal, feed consumption, feed composition and economic efficiency analysis of correlation models is established, information management for animal feed and feed formula customization function modules is developed in Science Feed Management Information System.

Compared with the traditional method, the advantage of this system is not only provide the function of feed formulation management by user, but also can download the expert formulation to use and modify from server.

2 The System Development Process

The system's key issue is the establishment and collection of information of the composition and ratio of feed raw materials database.

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The Development Process of this system is shown in Figure 1:

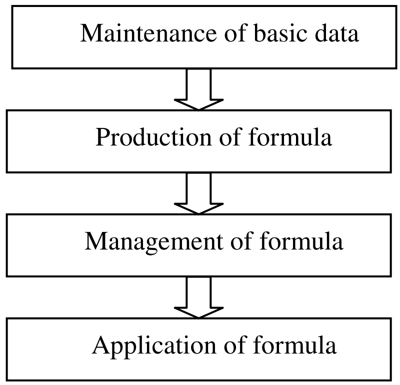

Fig. 1. Development Process

(1) Maintenance of basic data: Manage and Maintain nutrition information, materials information and raising standards information.

(2) Production of formula: produce formula information.

(3) Management of formula: insert information, update information and delete information.

(4) Application of formula: apply results, verify results and improve results.

3 The Design of System Structure

The users of "Science Feed Management Information System" are Farms, feed processing factory, etc. This system provides the management function of feed formula and informatization support for these users. The system include tow management platform: service management platform and transaction processing platform.

System structure is shown in Figure 2:

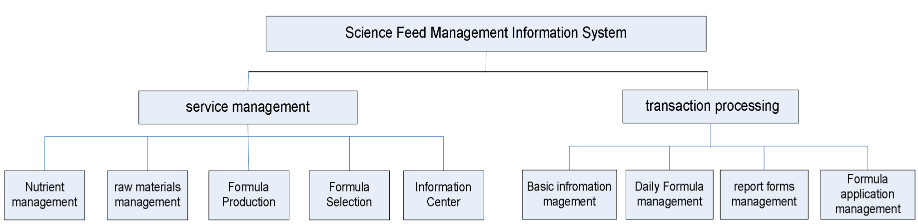

Fig. 2. System Structure

4 The Integration Design of Multisource and Isomerous Data

The integration design of Multisource and isomerous data is shown in Figure 3:

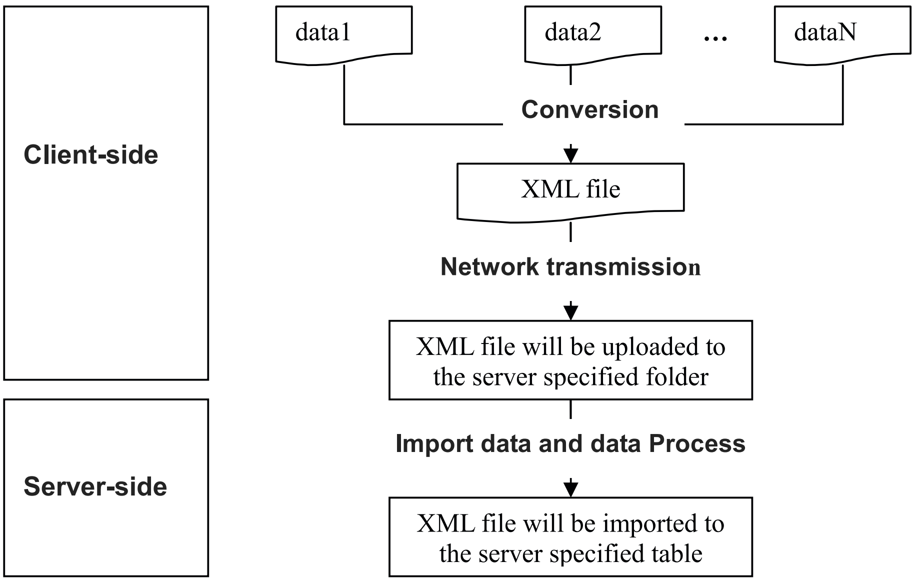

Fig. 3. Integration design of Multisource and isomerous data

5 System Data Module

The System Data Module is shown in Figure 4:

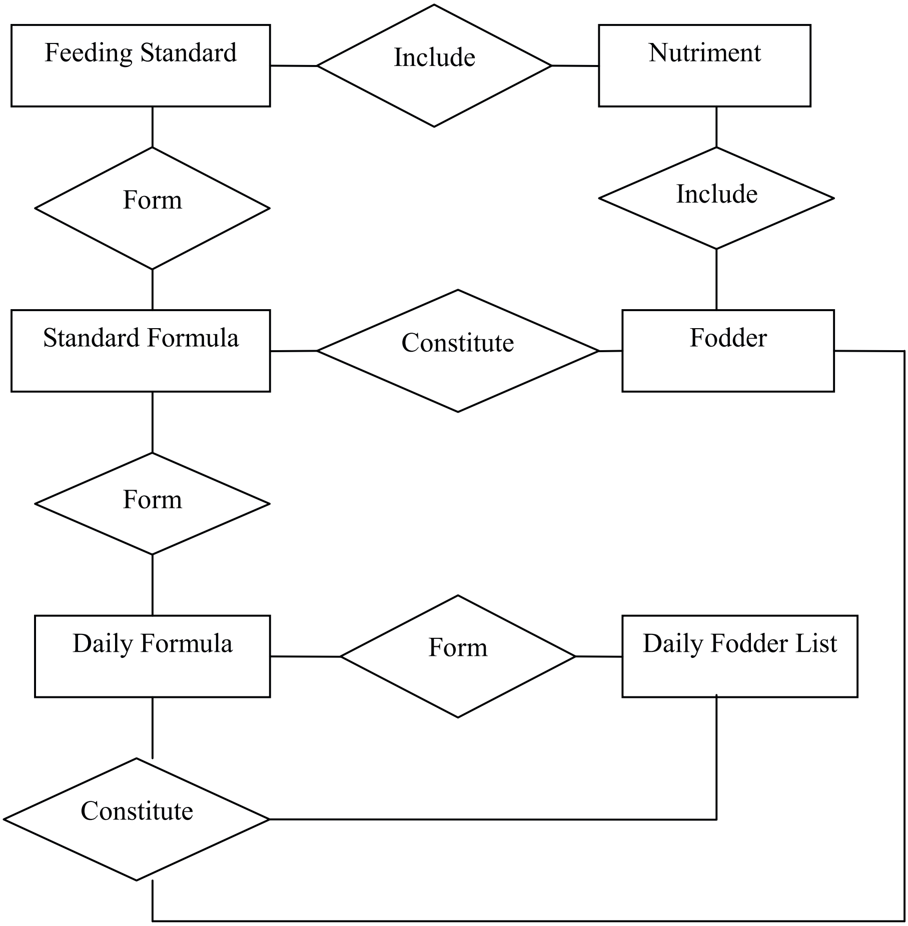

Fig. 4. System Data Module

6 System Realization

The web service management platform of Science Feed Management Information System is developed by SQL SERVER 2005 and JSP technology. Transaction processing platform is developed by ACCESS and VB6.0.

The realization of web service management platform is shown in Figure 5:

Fig. 5. Realization of web service management platform

The realization of transaction processing platform is shown in Figure 6:

Fig. 6. Realization of transaction processing platform

7 Conclusion

The application of Science Feed Management System can open widely the outlet that the farm obtains the animal feed market data and the formulation information; and have the great significance to lowering the business enterprise farming cost and raising market competition ability.

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The Simulation of the Apple Tree Form's Effects on Its Photosynthetic Efficiency

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Abstract. The form of the Apple tree is decided by the organ position of the tree, it affects not ONLY the relationship between the vegetative growth and the fruit production, but also the fruit quality. In this research, the continuous growth for 3 years was gotten with polhemus fastrak, and the apple tree model was built in the POV-ray to simulate the interception of the sunlight. A mathematic model was built between the form and the photosynthetic efficiency, the growth as the index of the form while the interception of the light as the index of the photosynthetic efficiency. Utilizing this model to analyses the effects of the form on the apple tree's photosynthetic efficiency, this result show a reference for the apple trees management.

Keywords: apple trees, light, intercept ratio, mathematic model, fine management, simulate.

1 Introduction

The study of plant architecture emerged as a new scientific discipline some 30 years ago. Plant architecture is a term applied to the organization of plant components in space which can change with time (2007, Daniel Barthelemy). Plant architecture is introduced into the research of the apple tree (2003, E. Costes). One of the researches is about the interactions between light and vegetation (2005, Rodrigo A.). The geometrical structure of the vegetation canopy, i.e. the location, shape and orientation of the apple tree elements determine the light distribution in the canopy (2005, J. Phattaralerphong). Many methods for the measurement of canopy geometry may involve direct measurement or may be inferred from radiation measurement using light sensor. Of the direct measurements, current induction in magnetic fields is the most convenient one.

In this paper, we use a polheumes fastrak to measure the parameters of the apple tree structure, such as the node, internodes, orientation angle, etc. the measured data was used to descript the apple tree in POV-Ray (Persistence of Vision Ray-Tracer). POV-Ray is a high-quality, freely available ray-tracing software package that is available for PC, Macintosh and UNIX platforms. POV-Ray is used in every industry widely, such as chemistry, art painting, architecture, agriculture, remote sensing and medicine. We simulate the light transfer in the crown, and evaluate the affection of the apple tree architecture on the interception of the sunlight.

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2 Materials and Methods

The test area is located at the Fruit Research Institute of Chinese Academy of Agricultural sciences (Figure 1).

The apple tree is HuaHong, a variety of Fuji apple, bred by the institute own self. We began this project form 2006, for about 4 years.

Fig. 1. Agricultural Fruit Research Institute

The data of the apple tree was measured with polhemus fastrak (1988, H. Sinoquet), the error is 1 mm per meter in theory, but it could be about 1 cm outside for the wind and other elements.

2.1 Topology and Geometry

The apple tree's structure is descripting as module which can be divided in detail into two components, i.e. stem and bud. A bud develops into a flower or a branch.

We define the Apple tree structure with key points which can be divided into two kinds. One is the form key point and the other is the functional key point.

The form key point (Figure 2) is such a point which decide the apple tree form, if use a single sentence to descript, that is such a point it is not in the straight branch, or branch direction is horizontal or vertical (1999, C. Godin).

These import points can be measured by polhemus fastrak.

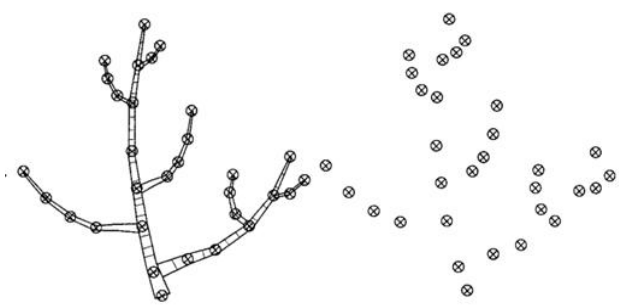

Fig. 2. The form key points

2.2 Data Structure

The point data is descript with five items, i.e. point type, point-function, pre-point, next-point and the current point orientation (x, y, z, r), as table 1.

Table 1. The description of a point

type	func	Pre	Next	orient
fruit Leaf Bud branch	Func form			(x,y,z,r)

It is very convenient to conscript the apple tree structure in such a topology (Figure 3), and can be implemented in computer language easily.

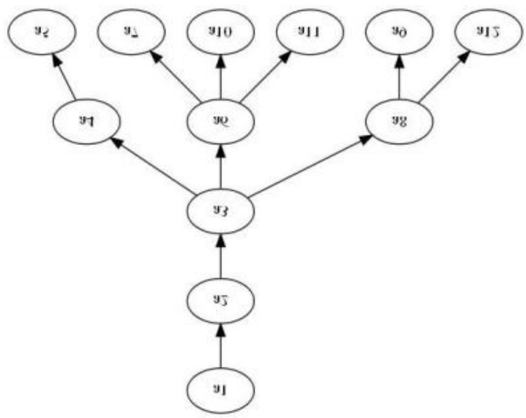

Fig. 3. Tree topology

2.3 Apple Tree Simulate

The apple tree data took with polhemus fastrak is stored in data file. The 3d apple tree is implemented by POV-ray with the data reformatted from point data to triangle data with python.

Python is a very popular script language (2010, python development team), is used in many industry. We use python to write the measured data according to the POV-ray format.

POV-ray is ray trace software, a POV-ray file mainly include an object, lights and camera.

The apple tree POV-ray file includes the sun, the camera and the tree, the tree is composed by meshes (2005, Loch B.), and the mesh is compound by triangles.

The frame of the POV-ray program is as the follow:

```
sunpos(Year, Month, Day, Hour, Minute, Lstm, LAT,
LONG).
Camera{   persp|ortho
location <>
direction <>
right x
up y
}

//object 00001
#declare color = <a, b, c, 0>;
#declare layercolor = <0, 0, 0>;
#declarephong = 0;
#declare phong_size = 0;
#declare image_map = "D"
#declare bump_map = "Cdefault.png"
#include "materials.inc"
#declare Object1Material = Material0000
#declare Object1 = mesh {
smooth_triangle{<x1,y1, z1>, <x2, y2, z2>, <x3, y3,
z3>, <x4, y4, z4>, <x5, y5, z5>, <x6, y6, z6> }
........
smooth_triangle{<xn+1,yn+1,zn+1>, <xn+2, yn+2, zn+2>,
<xn+3, yn+3, zn+3>, <xn+4, yn+4 zn+4>, <xn+5, yn+5,
zn+5>, <xn+6, yn+6, zn+6> }
}

//object 00002
//same as the object1
```

One object is an internodes, every (x, y, z) is measured with polhemus fastrak.

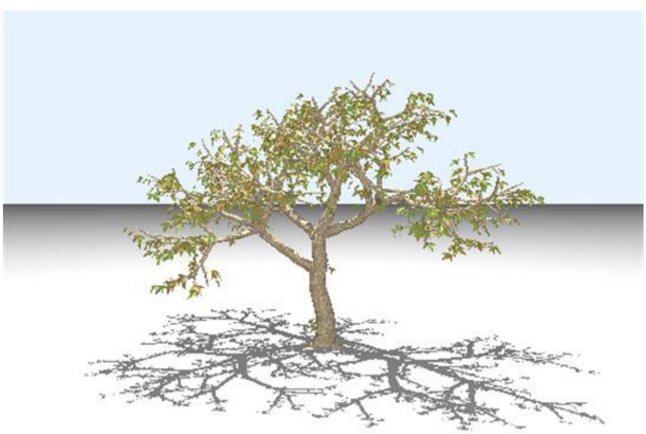

Fig. 4. Apple tree with shadow

In order to simulate the light interception of the apple tree (2005, D. A. King), we calculate the statistical parameters based on the data measured with polhemus fastrak (2005, C. Bassette). The stem length, the probability of the branch and the leaf, the average of the radius of the stem and the branches, etc…we model a virtual apple tree using the statistic parameters (2002, D. A. Pouliot), and the demonstration picture as the figure4 and figure 5.

In the POV-ray scene, we simulate a fisheye lens to take pictures of the apple tree's crown while we are altering the apple tree parameters (Gilles Tran), shown as the figure. 6. The picture after segmentation is as figure 7.

The proportion of the apple tree in the image stands for the sunlight interception, and the increment of the apple tree in the diameter for the apple tree mass increase. We develop a simulate model which present the relationship between the sunlight interception and the apple structure.

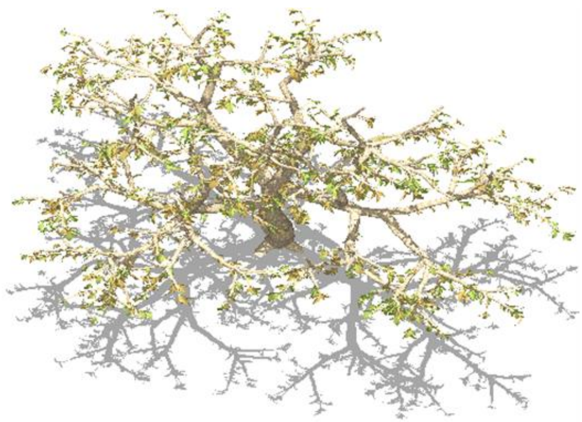

Fig. 5. Perspective of Apple tree

Fig. 6. The crown of the tree in fisheye

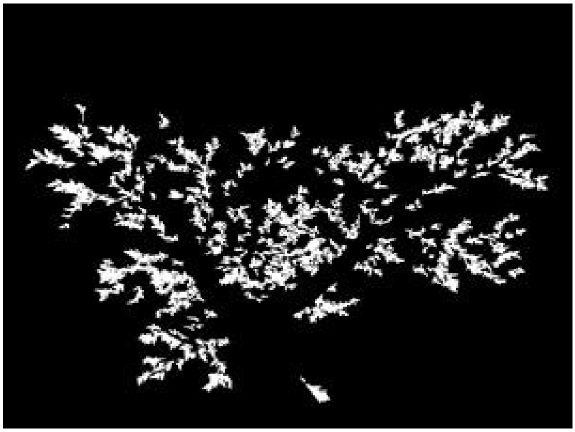

Fig. 7. The segmentation of the apple tree crown

3 Test Results

In this test, two factors, the branch angle and the branch radius, was tested, the branch angle was tested at level 15, 30, 45, 60 and 90 degree, and the branch radius was at 0.7 cm, 1,7 cm, 2.7 cm. the test result is as the table 2.

Table 2. The statics data of the segmented picture

No.	Branch angel	Branch radius	Area/box	sum	stdev
1	15	0.7	0.93	142	0.16
2	15	1.7	0.94	143.04	0.15
3	15	2.7	0.91	123	0.18
4	30	0.7	0.91	544	0.19
5	30	1.7	0.91	501.46	0.2
6	30	2.7	0.9	456.06	0.2
7	45	0.7	0.9	941.05	0.21
8	45	1.7	0.88	823	0.22
9	45	2.7	0.86	754.38	0.23
10	60	0.7	0.9	1234.62	0.21
11	60	1.7	0.88	1056.71	0.22
12	60	2.7	0.85	846.27	0.23
13	90	0.7	0.9	1504	0.21
14	90	1.7	0.89	1327.17	0.22
15	90	2.7	0.89	1106.68	0.22

The “Area/box” shows the ratio of the leaves in the whole area of the picture, and the sum means the total numbers of the pixel of the apple tree leaves.

The figure 8 shows the relationship between the interception and the branch angles, the horizontal axis shows the branch angles, and the vertical axis shows the numbers of the pixels the leaves occupied.

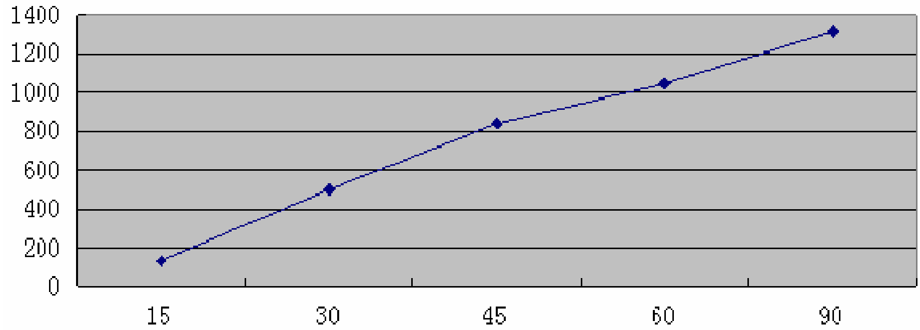

Fig. 8. The relationship between the branch angle and the light interception

The formula of the angle and the light interception is a logarithmic line, and R is near 1. The relationship shows as the equation 1.

$$Light\_interception=670.09*\ln(angle)-1713.8 \quad (1)$$

4 Discuses

The branch angle is the most important factor (1995, C. Jourdan) which affects the apple tree light interception. The result shows that the relationship between the branch angel and the light interception is a logarithmic line.

The relationship between the branch radius and the light interception cannot be described incorrectly, because when the radius of the stem increases, it will cover a big block of the branches and leaves, as shown in figure 7. From table 2, there is an inverse ratio between the two factors. Obviously, it is contrary to the general knowledge. In future, we will find a more reasonable and fitness methods to solve this problem.

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The Spatial and Temporal Prognosis of Oilseed Yield in Shandong Province

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Abstract. Based on the data about oilseed yield of 87 country units in Shandong province, the paper performed the Moran's I computerization to analyze the spatial autocorrelation characteristics of the oilseed yield on country level. Results showed that the spatial pattern of the oilseed yield presented the significant agglomeration characteristics, the Moran's I coefficient of 14 country units was noted quadrant HH, which displayed the country units with a high oilseed yield (above the average) surrounded by country units with high oilseed yield (above the average), the Moran's I coefficient of 4 country units was noted quadrant LH, which showed the country units with low value surrounded by country units with high values, the Moran's I coefficient of 22 country units was noted quadrant LL, which indicated the country units with low oilseed yield surrounded by country units with low oilseed yield, the autocorrelation of the other country units was not evident. The study also carried out to predict the total oilseed yield with ARIMA（2,1,2）model on basis of time series data, in order to explore the trend of the total oilseed yield in Shandong province, the average relative error between observation value and prediction value is 2.12% only using statistical oilseed yield data during 1978-2008, the better reliability. In a word, Moran's I coefficient and ARIMA（2,1,2）model can fairly clarify the spatial and temporal status of oilseed yield. What's more, the study is to provide a better understanding of temporal and spatial patterns of oilseed yield in Shandong province.

Keywords: Shandong Province, Oilseed yield, ARIMA model, Spatial autocorrelation.

1 Introduction

Yield and quality are always the core element for the oilseed study, the improving of oilseed yield is not only helpful for expanding oilseed crops areas in the acreage planted, but also developing good quality, high-yield and high-efficiency agriculture,

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furthermore, carrying out industrial restructuring and constructing the modern agriculture industry structure. From the literature retrieval, oilseed crop was mainly studied in the mechanism of oilseed growth [1].

The spatial autocorrelation was widely involved in the fields. López-Bazo et al. (2004) [2] applied these ESDA spatial tools to explore the variable the spatial agglomeration on a large regional scale, and the interior potential development on a smaller scale about farm area unit by Kathryn (2005) [3], It is reported that Jinfeng Wang (2007) [4] studied the spatial autocorrelation of regional parameters characteristics, such as air pollution processes, population mortality, and regional poverty levels. Yuming Wu (2005, 2007) [5] studied the spatial clustering character of the regional economic growth about 31 province units of China. Aiqing Lv (2008) [6] launched the spatial model study of factors for grain yield. However, the few study of spatial autocorrelation analysis was involved in the past years about oilseed yield on country level in Shandong province. For the time series data, an important question in the past decade has been the trend behavior of agricultural output, attention has been primarily focused on testing between the deterministic time trend model and the unit root with drift model, the ARIMA model should be useful for the long-run behavior. The time series model has certain advantage in the prediction of the total crops yield. The researcher in the past study on timing algorithm is feasible to be used to prediction production (Guifen Chen, 2009) [7]. However, the oilseed yield prediction mode based on time series data is rare reported.

In the work, we explored the comprehensive study combining spatial autocorrelation prognosis with time series data prediction. The spatial agglomeration effects of oilseed yield on country level was clarified by the autocorrelation Moran's I coefficient and the spatial patterns of oilseed yield was analyzed to understand the regional effects for adjacent country units. At the same time, based on time series data of the total oilseed yield in Shandong province, the prognosis was implemented the ARIMA study optimizing for oilseed crop industrial structure. The study focused on the temporal and spatial changes of oilseed yield, which is helpful for improving oilseed yield, so for coordinated developing primary, secondary and tertiary industries in Shandong province.

2 Material and Methodology

2.1 Review of ARIMA Model and Moran's I Coefficient

A time series is a sequence of data consisting of continuous values, this kind of model can be divided into trend component, periodical component and noisy component and the ARIMA is denoted "Auto-Regressive Integrated Moving Average", lags of the differenced series appearing in the forecasting equation are called "auto-regressive" terms, lags of the forecast errors are called "moving average" terms. Especially, the case of equation containing p lags and the model for sequence q lags, the model is called an $ARMA(p,q)$ model [8]. If $q=0$, the process is called a pure autoregressive process denoted by $AR(p)$, and if $p=0$, the process is a pure moving average process denoted by $MA(q)$.

Autoregressive integrated moving average model was shortened in $ARIMA(p,d,q)$, where: p is the number of autoregressive terms, d is the number of non-seasonal differences, and q is the number of lagged forecast errors in the prediction. The following is the structure of the model.

$$\begin{cases} \Phi(B)\nabla^d x_t = \Theta(B)\varepsilon_t \\ E(\varepsilon_t)=0\ ,\ Var(\varepsilon_t)=\sigma_\varepsilon^2, E(\varepsilon_t\varepsilon_s)=0, s\neq t \\ Ex_s\varepsilon_t = 0, \forall s<t \end{cases} \tag{1}$$

Where, $\nabla^d = (1-B)^d$; $\Phi(B)=1-\phi_1 B-\cdots-\phi_P B^p$, was regarded as the polynomial coefficients for the smooth and reversible autoregressive model. In the study, we will try to stick to "unmixed" models with either only-AR or only-MA terms, because including both kinds of terms in the same model sometimes leads to be over-fitting of the data and non-uniqueness of the coefficients. In $ARIMA(p,d,q)$ model, $\Theta(B)=1-\theta_1 B-\cdots-\theta_q B^q$ was taken as the smoothing polynomial coefficients for the reversible autoregressive model, so formula (1) was shorten as:

$$\nabla^d x_t = \frac{\Theta(B)}{\Phi(B)}\varepsilon_t \tag{2}$$

Where, $\{\varepsilon_t\}$ denotes the white noise series for the mean value based on data, formula (2) explained the difference and combination of the model embodied the essence of $ARIMA(p,d,q)$, and the differential stationary data was obtained from the suitable orders difference, then $ARIMA(p,d,q)$ was implemented and transformed into the following structure.

$$\begin{cases} x_t = \phi_0+\phi_1 x_{t-1}+\cdots+\phi_p x_{t-p}+\varepsilon_t-\theta_1\varepsilon_{t-1}-\cdots-\theta_q\varepsilon_{t-q} \\ \phi_p\neq 0\ ,\ \theta_q\neq 0 \\ E(\varepsilon_t)=0\ ,\ Var(\varepsilon_t)=\sigma_\varepsilon^2, E(\varepsilon_t\varepsilon_s)=0, s\neq t \\ Ex_s\varepsilon_t = 0, \forall s<t \end{cases} \tag{3}$$

If $\Phi(B)x_t = \Theta(B)\varepsilon_t$, $\Phi(B)=1-\phi_1 B-\cdots-\phi_p B^p$, formular (3) is regarded as the autocorrelation coefficient of p polynomial orders. If $\Theta(B)=1-\theta_1 B-\cdots-\theta_q B^q$, then the model is regarded as the autocorrelation coefficient of q polynomial orders [9,10,11,12].

Moran's I can be used in a wide variety of circumstances. As a global statistic, Moran's I quickly indicates not only the existence of spatial autocorrelation (positive or negative), but also the degree of spatial autocorrelation. The Moran's I coefficient is given by:

$$I = \frac{n}{S_0} \times \frac{\sum_{i}^{n} \sum_{j=1}^{n} w_{ij} \left(x_i - \overline{x}\right)\left(x_j - \overline{x}\right)}{\sum_{i}^{n} \left(x_i - \overline{x}\right)^2} \tag{4}$$

As discussed in the above description, I represents a decomposition of the global Moran`s I, a positive I indicates clustering of high or low values, a negative I indicates a spatial outlier.

The matrix form for

$$I = \frac{n}{S_0} \times \frac{X^{'}WX}{X^{'}X} \tag{5}$$

Where: x_i , x_j denotes the observation of the spatial unit based on the element x .

$$\overline{x} = \frac{1}{n} \sum_{i=1}^{n} x_i \tag{6}$$

Where, $\overline{x}$ stands for the mean value, $X^{'}$ stands for deviation vector about x_i and $\overline{x}$ ($n \times 1$), the elements w_{ji} indicated the way the region i is spatially connected to the region j , represented the topological relation. W denotes the spatial matrix about $n \times n$, S_0 represented the sum of all of the element about spatial weight matrix, n is regarded as the spatial units. If the spatial autocorrelation of observation value does not exist, the original random status was used to validate z value of the hypotheses which referred to the formula (7) illustration:

$$z(I) = \frac{I - E(I)}{\sqrt{\operatorname{var}(I)}} \tag{7}$$

Where: $I \in [-1,1]$, $I = 0$ stands for the independent variables, $I > 0$ stands for the positive correlation, $I < 0$ stands for the negative correlation [13,14,15,16].

Spatial autocorrelation can be defined as the coincidence of value similarity with site similarity. Therefore, there is the positive autocorrelation when high or low values of a spatial randomly variable tendency to cluster, and negative autocorrelation when sites tend to be surrounded by neighbors with very dissimilar values. Moran's I coefficient was regarded as the measurement degree of spatial autocorrelation character. On the whole, its value was divided into four quadrants. Quadrant I (on the top right corner) presents the country units with a high oilseed yield (above the average) surrounded by country units with high oilseed yield (above the average), this quadrant is usually noted HH. Quadrant II (on the top left corner) shows the country units with low value surrounded by the neighboring country units with high oilseed yield values, the quadrant is usually noted LH. Quadrant III (on the bottom left) displays the country units with low value surrounded by country units with low values, and is noted LL. Quadrant IV (on the bottom right) shows the country units with high value surrounded by country units with low values, is noted HL [17,18].

2.2 Data Acquisition

The analysis data came from Shandong Statistical Year Book-2008, Chinese county (city) social economic statistical yearbook-2008 in Shandong province. The oilseed yield on country level was obtained from the above collected data. The spatial data of 91 country units which had the developed agriculture mainly were selected to exclude 49 district units in Shandong province. Actually, the spatial autocorrelation characteristics based on 87 country units (not including Qingyun country, Yangxin country, Changdao country and Yutai country units lack of the statistical data) were selected to computerize, the scale of the vector map is 1:500000 and the projection transformation was finished.

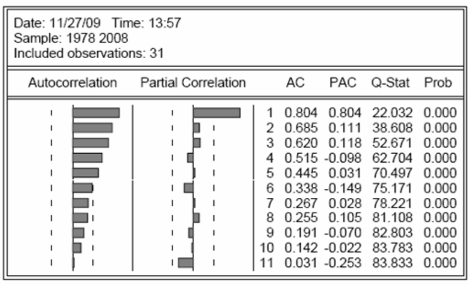
In this work, we find strong evidence in favor of global spatial autocorrelation for oilseed yield on country level in Shandong province. Furthermore, in view of the total oilseed yield, the ARIMA model was established to forecast the increase of oilseed yield on the basis of time series data from 1978 to 2008, so the main objective is the spatial and temporal prediction of the oilseed yield in Shandong province in the paper.

3 Stationary Analysis and Temporal Prediction of Oilseed Yield

3.1 The Stationary Series Stationary Process on Time Series Data

As you will see in the next section, the stability condition is that the characteristic roots of the polynomial must lie outside of the unit circle. It is also shown that if data sequence is a linear stochastic difference equation, the stability condition is the necessary condition for time series data to be stationary. More generally, the PACF of a stationary model process must ultimately decay toward zero beginning at lags p, the decay pattern depends on the coefficients of the polynomial summaries some of the properties at the ACF and PACF for various ARIMA processes.

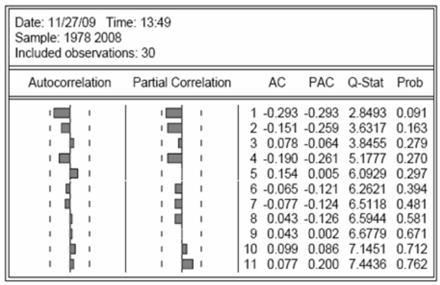
AC is the autocorrelation coefficient, and PAC is the partial autocorrelation coefficient, the last two ranks number is one Q statistics variable, the other is probability rank, probability rank number represented Q probability value, you can see that the distribution pattern of the oilseed yield, natural number of the first rank represented the lagged period. Non-stationary time series data was transformed into the stationary time series data by ARIMA model, we take the first-difference of "oilseed yield series data" to see whether the time series data becomes the stationary process, the autocorrelation and partial autocorrelation plot was thought as the stationary tool for time series data, according to autocorrelation and partial autocorrelation plot, as is illustrated in Figure 1, the autocorrelation coefficient of oilseed yield didn't rapidly decrease zero value, which verified the non-stationary time series.



Date: 11/27/09 Time: 13:57
Sample: 1978 2008
Included observations: 31

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.804	0.804	22.032	0.000
		2	0.685	0.111	38.608	0.000
		3	0.620	0.118	52.671	0.000
		4	0.515	-0.098	62.704	0.000
		5	0.445	0.031	70.497	0.000
		6	0.338	-0.149	75.171	0.000
		7	0.267	0.028	78.221	0.000
		8	0.255	0.105	81.108	0.000
		9	0.191	-0.070	82.803	0.000
		10	0.142	-0.022	83.783	0.000
		11	0.031	-0.253	83.833	0.000

Fig. 1. The autocorrelation and partial autocorrelation plot of oilseed yield from 1978 to 2008 (left)



Date: 11/27/09 Time: 13:49
Sample: 1978 2008
Included observations: 30

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	-0.293	-0.293	2.8493	0.091
		2	-0.151	-0.259	3.6317	0.163
		3	0.078	-0.064	3.8455	0.279
		4	-0.190	-0.261	5.1777	0.270
		5	0.154	0.005	6.0929	0.297
		6	-0.065	-0.121	6.2621	0.394
		7	-0.077	-0.124	6.5118	0.481
		8	0.043	-0.126	6.5944	0.581
		9	0.043	0.002	6.6779	0.671
		10	0.099	0.086	7.1451	0.712
		11	0.077	0.200	7.4436	0.762

Fig. 2. The autocorrelation and partial autocorrelation plot of oilseed yield after 1-order differential transformation (right)

So data request the stability for ARIMA model, for the stationary processes, the key points to note are the following description: (1) The ACF of ARIMA model process will begin to decay at lag q, the coefficient of the ACF will satisfy the difference equation, since the characteristic roots are inside the unit circle, the autocorrelations will decay beginning at lag q.. Moreover, the spatial pattern of the autocorrelation coefficients will mimic step by step, which is suggested by the characteristic roots. (2) The PACF of ARIMA model process will begin to decay at lag p, the coefficients of the PACF will mimic the ACF coefficients from the model, in terms of the above description, the stationary process for oilseed yield by means of the differential data in the article, after first order differential, series data trend was eliminated and the relevant information was sufficiently extracted, the variance presented the stationary characteristics, finally autocorrelation coefficient satisfied in the confidence level, which resulted into the random series data, or was noted as white noise series, referred to Figure 2. Model is recognized in terms of the autocorrelation and partial autocorrelation's function characteristics of time series sample and selected type of model, meanwhile determining the appropriate model order on basis of differential transformation. Depending on the mean value and constant variance, the time series plot presented the random oscillation characteristics with the support of the constant value, the bounder of oscillations and no evident trend and period characteristics, and no stronger change of sample, which indicated the stationary characteristics after data 1-order differential transformation about the oilseed yield, as is illustrated in Figure 3 [9,19].

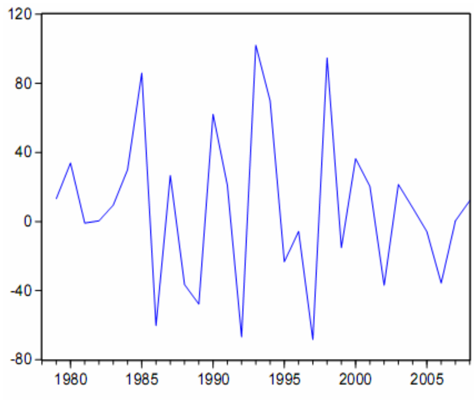


Fig. 3. Sequence plot on 1-order differential data of oilseed yield

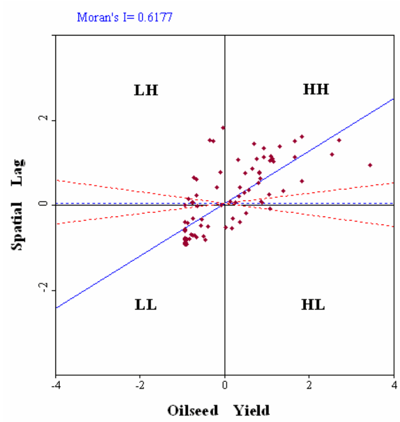


Fig. 4. Moran's I scatter plot of oilseed yield on country level

As shown in the study, there are important differences for time series, shocks to stationary time series are necessarily temporary, the mean or variance of a non-stationary series is time-dependent. To aid in the identification of a non-stationary series, we implemented the test analysis of unit root. In the paper, the unit root was carried out for the original data and the 1-order differential series data, then oilseed yield was verified as an integrated process, some typical parameters were selected during data transformation to eliminate the non-stationary characteristics, the computerization value of ADF test statistics is -1.872492, is more than 1% (The critical value should be -3.670170), 5% (The critical value should be -2.963972), 10% (The critical value should be -2.621007), which indicated the original data series was non-stationary. However, after 1-order differential transformation, the value of ADF test statistics is -7.031336, is less than 1%(The critical value should be -3.679322), 5% (The critical value should be -2.967767), 10% (The critical value should be -2.622989), which showed the time series data is in the stationary status. We also obtained the satisfactory stability after data transformation, or the characteristics roots of the polynomial must lie outside of the unit circle, the not oscillation series data was tested at the level of 0.01, unit root test was appropriate statistics, so the total oilseed yield was the integrated sequence process.

3.2 The Temporal Prognosis on ARIMA

Based on the above the content of oilseed yield after 1-order differential for the temporal prognosis model of time series data combining with the lag orders, we obtained the appropriate identification ARIMA(2,1,2) model, for oilseed yield in Shandong province. Time series data in the study is regarded as the white noise characteristics after 1-order differential transformation, the estimated results by the model, with none of root is greater than 1, and conjugation root in the unit circle, so the smoothing process is within the parameters of the model, and through a significant test in the 95% confidence level and the relevant parameters of model were stationary, the estimation and prediction was carried out for oilseed yield, the results are as following, D(oilseed yield,1)=6.822+0.480AR(2)-0.971MA(2). Goodness of fit statistics was used to measure the advantages and disadvantages of model fitting. Generally, the key index was selected to satisfy the model accuracy, such as Akaike`s Information Criterion(AIC), DW, SC. Smaller the AIC value of model is, Better the result will be, in ARIMA model , DW =2.734, AIC= 10.423, SC= 10.56, these values confirmed that the parameters of ARIMA model has goodness-of-fit [20,21].

4 Spatial Agglomeration Mode of Oilseed Yield

In our case, all Moran's I coefficients are significant in confidence level of the study. During the computerization, the spatial weight matrix is the fundamental tool used to represent the connectivity among country units, the weight matrix $w(k)$ which we use in this study is based on the k -nearest neighbors function as rules, the general form of the k-nearest neighbors weight matrix $w(k)$ is defined as follows:

$$w_{ij}(k) = 0 \;\; if \;\; i = j \tag{8}$$

$$w_{ij}(k) = 1 \;\; if \;\; d_{ij} \le d_i(k) \;\; and \;\; dw_{ij}(k) = w_{ij}(k) / \sum_j w_{ij}(k) \tag{9}$$

$$w_{ij}(k) = 0 \;\; if \;\; d_{ij} > d_i(k) \tag{10}$$

Where $d_i(k)$ is a critical cut-off distance defined for each country unit i. More precisely, $d_i(k)$ is the k^{th} order smallest distance between country units i and j such that each unit i has exactly k neighbors. Establishing the spatial weight file using a k -nearest neighbors contiguity matrix weights, which each observation has exactly the same number (k) of neighbors. Alternatively, check the weights properties and the robustness of spatial country units [22].

It is vital to understand the regional effects for the spatial pattern of oilseed yield between country units, from the results of Moran’s I coefficient analysis, spatial aggregating effect indicated the association of oilseed yield existed in adjacent to country units and the correlation relation was verified between observation vector and spatial lag vector based on Moran’s I scatter plot. In addition to the inference computation, which is started by 999-time Monte Carlo simulations, also note that the most significant p-level depends directly on the number of permutation, this will be p=0.01, as shown in Figure 4., the value listed at the top of the graph (0.6177) is the Moran’s I statistics, which is regarded as the slope of the regression line, two dashed lines will appear in the plot, how the actual Moran scatter plot slope is well outside the range corresponding to the randomly permuted data. The autocorrelation results which indicated the spatial association of the oilseed yield was positively spatial autocorrelation (Moran’s I value =0.6177, its theoretical mean value =-0.0111, the mean and standard deviation of the empirical distribution, these values are -0.0179 and 0.0745, respectively).

5 Results and Analysis

As illustrated in Figure 4, the Moran scatter plot is a useful visualization tool for assessing distribution and spatial clustering of oilseed yield. In terms of the results of oilseed yield, Moran scatter plot characters of oilseed yield of 87 country units in 2007 showed the following concrete characters. The Moran's I coefficient of 14 country units was noted Quadrant I (HH, on the top right corner), which displays the country units with a high oilseed yield (above the average) surrounded by country units with high oilseed yield (above the average), as the following country units: Haiyang country, Qixia country, Pingyi country, Juxian country, Yinan country, Wulian country, Zhucheng city, Junan country, Gaomi city, Jimo city, Laiyang, Laixi city, Pingdu city, Laizhou city etc, which indicated the high oilseed yield value is in 14 country units and neighbouring country units, and the spatial difference is small between them. The Moran's I coefficient of 22 country units was noted Quadrant III(LL, on the bottom left), which presented the country units with low oilseed yield surrounded by country units with low oilseed yield. Spatial association of the LL type is observed in the following country units, Gaotang country, Xiajin country, Huimin country, Ningjin country, Pingyuan country, Shanghe country, Jiyang country, Qihe country, Yucheng city, Linyi city, Lingxian country, Wudi country, Yangxin country, Laoling city, Guangrao country, Zouping city, Huantai country, Qingyun country, Zhanhua country, Gaoqing country, Boxing country, Linjin country, etc. Quadrant IV (HL, on the bottom right) shows the country units with high value surrounded by country units with low values, the clustering mode of HL type country units involved in the following 13 country units Changdao country, Feixian country, Wulian country, Yinan country, Yishui country, Mengyin country, Pingyi country, Longkou city, Yiyuan country, Linqu country, Xintai city, Penglai city and Wengdeng city etc.. The Moran's I coefficient of 4 country units was noted Quadrant II (LH, on the top left corner), Tancheng country, Jiaozhou city, Changyi country and Mengyin country, which showed the country units with low value surrounded by country units with high values, the evident difference existed in them.

Moran's I quickly indicates not only the existence of spatial autocorrelation (positive or negative) but also the degree of spatial autocorrelation of oilseed yield showed spatial pattern of oilseed yield was not random on country level, and the higher oilseed yield on country level adjacent to the country level, the stronger spatial convergence of oilseed yield, the detailed spatial autocorrelation results of oilseed yield are the following: the Moran's I coefficient of 14 country units was noted HH, which displays the country units with a high oilseed yield (above the average) surrounded by country units with high oilseed yield (above the average), and the spatial difference is low between the neighboring country units. The Moran's I coefficient of 22 country units was noted LL, which presented the country units with low oilseed yield surrounded by country units with low oilseed yield. 13 country units were the autocorrelation of HL type and the Moran's I coefficient of 4 country units was noted LH. In general, the more cluster trend was presented by the spatial autocorrelation characteristics analysis in 2007, the total difference of the oilseed yield presented the reasonable HH and LL tendency and the evident spatial convergence in the case study.

The temporal estimation and prediction of oilseed based on time series data was carried out for oilseed yield in Shandong province, the results are as following, D(oilseed yield,1)=6.822+0.480AR(2)-0.971MA(2). Goodness of fit statistics was used to measure the advantages and disadvantages of model fitting. Generally, the key index was selected to satisfy the model accuracy, such as Akaike`s Information Criterion(AIC), DW, SC. Smaller the AIC value of model is, Better the result will be, in the study, DW =2.734, AIC= 10.423, SC= 10.56, these values confirmed the parameters of the goodness-of-fit model. The first-order univariate characteristics of oilseed yield was embodied with the help of time series data and the stationary process was validated by differential data, after first order differential, series data trend was eliminated and the relevant information was sufficiently extracted, series data was noted as white noise series. Finally ARIMA(2,1,2) was able to predict the growth tendency of oilseed yield, the oilseed yield changes as a time function from 1978 to 2008 was calculated by model, the results indicated that the oilseed yield growth kept in touch with the last oilseed yield, closely relationship was existed in the lag value of the first order and random interference item of oilseed yield in study country units, the average relative error between observation value and prediction value is 2.12% only using statistical oilseed yield data over 1978-2008, the better reliability after computation.

6 Conclusions and Discussion

In the paper, we analyzed the spatial contiguity characteristics with the support of Moran's I autocorrelation computation of oilseed yield on country level involving in 87 country units, and also considered modeling the long-run behavior of the total oilseed yield time series data on basis of ARIMA(2,1,2) model, and preliminary analyzed the temporal and spatial characteristics of oilseed yield in Shandong province.

For spatial pattern of oilseed yield, it is clear that spatial autocorrelation of oilseed yield of country units that fall into the quadrants HH and LL, which represented clustering of high and low value respectively, 14 country units (quadrant HH), 22 country units(quadrant LL) of oilseed yield presented high spatial clustering, 4 country units (quadrant LH) and 13 country units(quadrant HL), HL and LH represent the negative association with their neighbors and can be considered as spatial outliers, there is no evident clustering characteristics of the oilseed yield for other 34 county units, so we should sum up the more suitable regional development countermeasure on the spatial autocorrelation effects of Moran's I statistics value for upgrading economic crops industry structure.

In addition, the other characteristics of the paper indicated that a great amount of historical data of oilseed yield was analyzed by means of ARIMA(2,1,2) model, and established the model and studied the trend of the changes of oilseed yield. The advantage of the ARIMA(2,1,2) model we created in this paper is simple, practical, and will have a wide range of application, which is used as the exponential smoothing and seasonal index to predict the oilseed yield. We have also estimated the equation for a subset of our data, so that we may compare prediction value based upon this model with the actual data over 1978-2008. This proved that our model is effective and feasible to predict the future yield. In a word, the spatial and temporal prediction of oilseed yield is developed comparison study and complement to each other, resulting in a good agreement with the experimental data. In addition, the study is to provide a better understanding of temporal and spatial patterns of oilseed yield in Shandong province.

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The Study and Implementation of Agricultural Information Service System Based on Addressable Broadcast

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Abstract. The broadcast population coverage has increased to 96% in china. Information services by radio have wide coverage, low cost, easy to grass-roots farmers to accept etc. characteristics. In order to play the better role of broadcast information service in rural area, the author R & D agricultural information service system based on addressable broadcast, which transformed from traditional broadcast with a set of data encoding/decoding equipments based on addressable broadcast. The agricultural information service system based on addressable broadcast can provide personalized information services for grassroots farmers, relying on a wealth of agricultural information resources, by means of controlling the addressable speakers with microprocessor. The system has five parts, which has been applied in huailai city Hebei province. The system has provided personalized information about grape and vegetable for two villages for one and a half years.

Keywords: agricultural information service system, addressable broadcast, agriculture, economic growth, panel data, regression.

1 Introduction

After several years of development, China has made the amazing progress in the development face the farmer's information service. Agricultural information service played a more positive role in solving the problem of "Farmers, Rural Areas and Agriculture Production" [1]. In the recently years, there had emerged a number of new agriculture information service patterns, which can provide timely and accurate information for farmers by the media of TV, phone and network[2]. However, we should see that the radio and TV are still playing the main role of information service infrastructure in rural. In fact, these information services mode use efficiency is very low, because the grass-roots farmers' lack of the motive due to the absence of search and use the information actively[3]. According to the latest statistics, China's radio and television coverage has increased to more than 98%. Compared with other services, broadcasting as a carrier of information services has a wide coverage and low cost,

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easy-to-grass-roots farmers to accept and so on. On the other hand, grass-roots farmers can access the information at all times whether they willing or not, because broadcast information service running in passive mode.

After the investigation and study we discovered that broadcast information service emerged quietly in many places and the prospects for development are huge[4]. To develop the broadcast information service well, we have researched and developed the rural broadcast information service system based on addressable broadcast in this paper, which can provide personalized information service.

2 Principles and Type of Addressable Broadcast

2.1 The Principle of Addressable Broadcast

Based on the existing FM radio signal transmission system and with the addressable control technology, addressable broadcast can control any one FM speaker's FM receive frequencies, switch status and volume status individually in service area. In other words, addressable broadcast achieve point to point and multi-function control.

Addressable broadcast uses the main channel of FM radio transmission audio signals, meanwhile, uses the sub-channel of FM radio transmission control information, which also known as FM-SCA addressable control system [5].

The core of addressable broadcast is FM sub-channel wireless addressable system, which is also called wireless addressable control system. By means of the wireless control technology of FM-SCA (Frequency Modulation-Subsidiary Communication's Authorizations), which transmit the addressing/controlling signal to the speakers through FM sub-channel in SCA way, wireless addressable system can control the exact speaker of the service area.

Addressable control technology of FM-SCA achieves the function of wireless control broadcast with the help of FSK (Frequency Shift Keying) in FM sub-channel. The existing FM radio only used to send signal of broadcast. As the baseband signal bandwidth of FM stereo is 53 kHz, the baseband signal bandwidth of FM mono radio is 53 kHz, so the bandwidth from 53 kHz to 100 kHz or from 15 kHz to 100 kHz in FM radio almost idle. There are several sub-channel are available for use in each frequency channel. In china, 67 kHz is used for sub-channel[6].

1. Transmitting principle of FM-SCA wireless addressable control system

The format of baseband signal source coding of FM-SCA wireless addressable control system is Manchester, and the technology of modulation is FSK. So, if some software

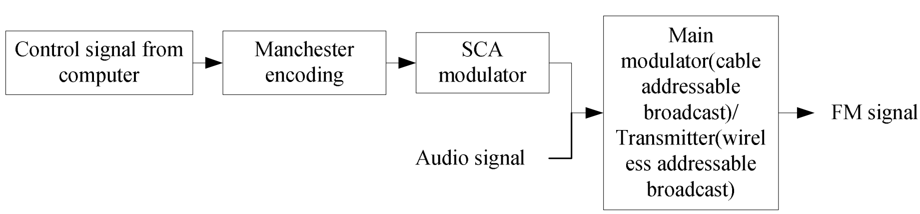

Fig. 1. Transmitting principle of FM-SCA

and hardware are added to the original FM radio, we just achieve addressable broadcast. The transmitting principle of FM-SCA wireless addressable control system is shown in Fig. 1.

At the sending end, addressing control information is encoded by way of Manchester, which must meet the energy diffusion theory in order to send reliably. SCA modulator modulates the data that has been transformed by Manchester method in the way of FSK. In other words, the required sending data are modulated to a frequency of 67 kHz sub-carrier in the way of FSK, and then 67 kHz sub-carrier signals are added to the main FM tuner.

2. Receiving principle of FM-SCA wireless addressable control system

When FM radio signals are received by antenna, after four steps, these signals are transformed into composite baseband signals, which include two kinds of signals: audio signal and addressing control signal. First, these signals are amplified by low-noise amplifier; second, these signals are mixed with a frequency of 10.7 kHz; third, these signals are filtered by BF Band filter; in the fourth step, these signals are amplified by intermediate frequency amplifier and frequency discriminator. Finally, composite baseband signals are worked out. FM radio receiver obtain audio signal by means of filtering those 53 kHz above signals with low pass filter. Meanwhile, SCA receiver gets 67 kHz addressing control information through BF Band filter after these signals are handled by frequency discriminator. These addressing control signals can control speaker's FM receive frequencies, switch status and volume status with a series of processing. The receiving principle of FM-SCA wireless addressable control system is shown in Fig. 2.

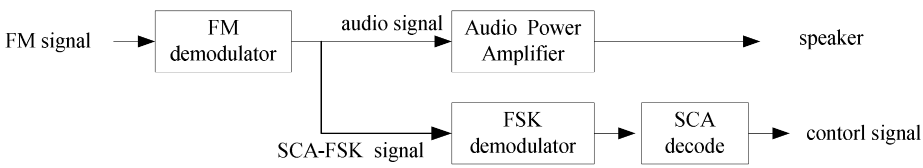

Fig. 2. Receiving principle of FM-SCA

2.2 Type of Addressable Broadcast

There are two kinds of addressable broadcast: cable addressable broadcast and wireless addressable broadcast. Cable addressable broadcast is constructed based on the CATV FM common cable transmission system, which suits for the area of CATV network coverage over and not self-built radio station. Wireless addressable broadcast suits for the county or city which has a radio station.

Cable addressable broadcast has four main parts: control software in computer, data encoder, modulation host and addressable FM speaker. The work flow of cable addressable broadcast is described below: User's instructions are received by controlling software in computer, and then these instructions are sent to data encoder through native COM port with specific format. The addressing control signals are changed to FM sub-channel by data encoder, and then sent to FM modulator together with audio signals. Those mixed signals on some RF carrier are sent to addressable FM speaker through the existing CATV network. The work flow of cable addressable broadcast is shown in Fig. 3.

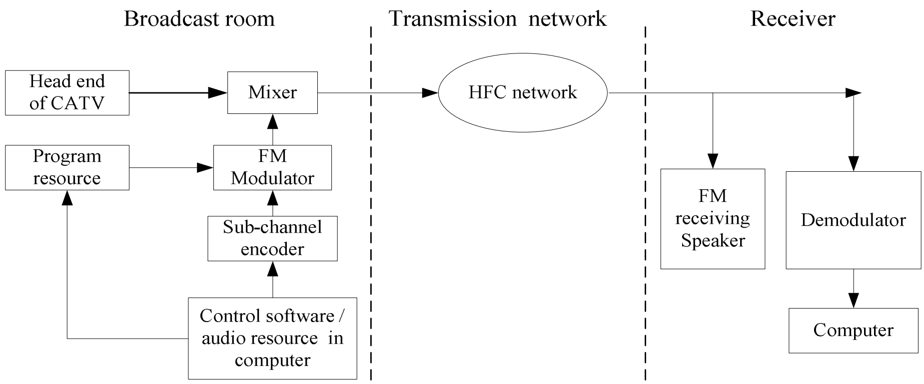

Fig. 3. Work flow of cable addressable broadcast

Based on the existing wireless radio broadcast, with the help of FM-SCA, wireless addressable broadcast can work. The work flow of wireless addressable broadcast is: User's instructions received by controlling software are sent to sub-channel encoder, and then sent by transmitter mixed with audio signals. The work flow of cable addressable broadcast is shown in Fig. 4.

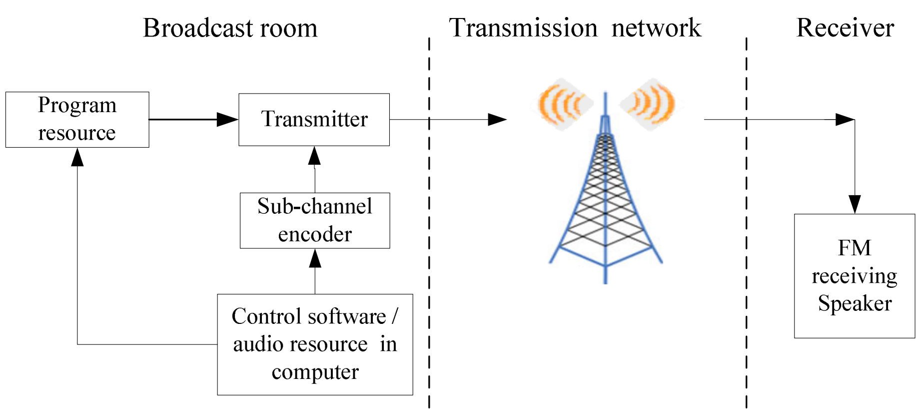

Fig. 4. Work flow of wireless addressable broadcast

3 Design of Agricultural Information Service System Based on Addressable Broadcast

3.1 Structure of Agricultural Information Service System

The work flow of agricultural information service system based on addressable broadcast is described as follow: (1) if farmers want to get some information, they tell the radio station their requirements by means of telephone or SMS;(2) radio station get the information and then edit program once receiving the requirements from farmers;(3) when the program prepared, they will broadcast by the addressable broadcast system, (4)and farmers can listen to the program with the addressing radio receiver. Fig. 5 shows the service flow of the system.

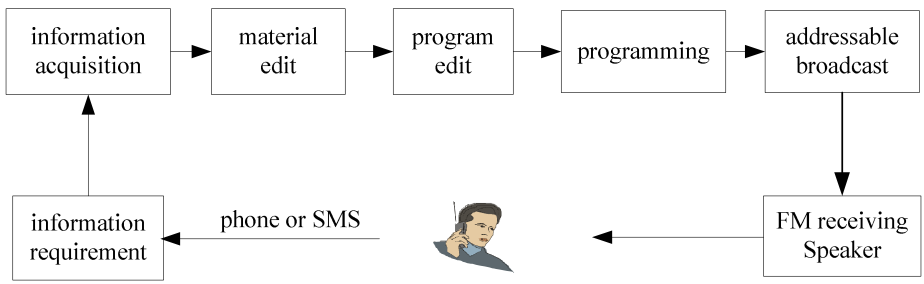

Fig. 5. Work flow of agricultural information service system

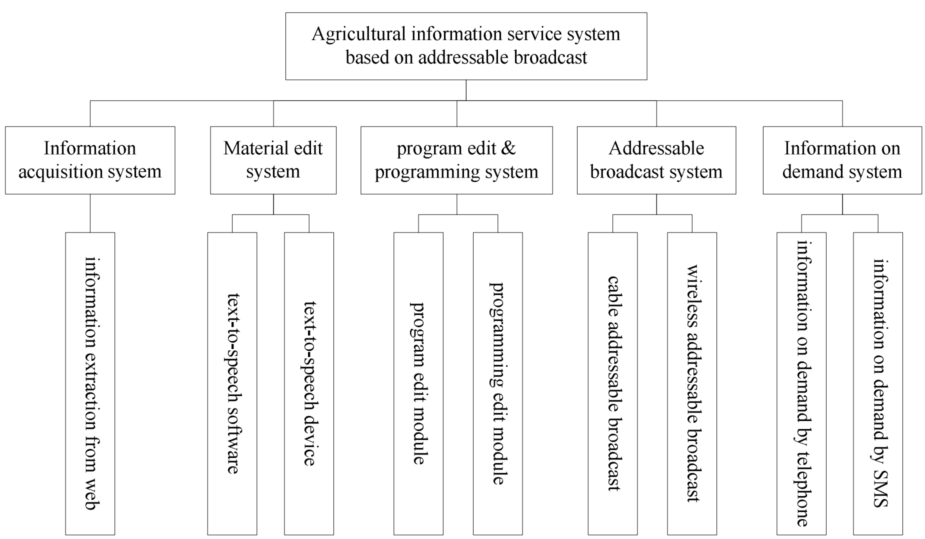

Fig. 6. Function diagram of agricultural information service system

Agricultural information service system based on addressable broadcast has five sub-systems: information acquisition system, material edit system, program edit & programming system, addressable broadcast system and information on demand system. The function diagram of agricultural information service system is shown in Fig. 6.

3.2 Function of Agricultural Information Service System

With agricultural information service system based on addressable broadcast, we can realize personalized information service. Different information needs in different regions can be satisfied by means of broadcasting different programs at the same time.

The function of five sub-systems is described as below:

(1) Information acquisition system

Information can be extracted from internet according to the requirements from farmers by the information acquisition system. The system can extract information automatically in accordance with pre-set; also can get the information specified by user.

(2) Material edit system

In material edit system, the information (text formatting) extracted from information acquisition system can be transferred into audio file through the text-to-speech software or the text-to-speech device. Those audio file generated by this system will be used in program edit module.

(3) Program edit & programming system

In this system, audio file generated by material edit module will be made into program, and then broadcast the program at a particular time with the radio equipment in radio station.

(4) Addressable broadcast system

Addressable broadcast system is the core of the whole system, which make the personalized information service possible. With the FM-SCA technology of addressable broadcast system, radio station can make different area or different speaker broadcast different program.

(5) Information on demand system

If listeners want to get some information that radio station don't provide, they can tell the radio station their personalized information requirements through information on demand system. There are two ways to express the needs for listeners: telephone or SMS.

4 Conclusion

In this paper, the principles and type of addressable broadcast is introduced, which uses the sub-channel of FM radio transmission control information. Based on the addressable broadcast, agricultural information service system is constructed in radio station, which concludes five parts. The system can provide personalized information service for farmers in rural area. The advantages of the system are concluded as follows:

(1) Agricultural information service system based on addressable broadcast is a new information service mode, which suit for rural area. As we know, the coverage of radio if very high in china, so this system has a very large scope of use.
(2) It is very easy to construct the addressable broadcast system. If there already has a radio station, we just need several equipments.
(3) With information acquisition system, radio station can get huge amounts of information; also can get the exact information meet the listener. The text formatting information can be transferred into audio files through text-to-speech module of material edit system.

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The Study of Quality and Safety Traceability System of Vegetable Produce of Hebei Province

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Abstract. To enhance the management of vegetable products quality and safety of Hebei Province, through practical research of vegetable enterprises, based on Web the authors design a quality and safety traceability system of vegetable products to enhance the monitoring of each participant in the production process. Combining the information and technology of the network and the reality of vegetable cultivation, applying the EAN•UCC system, the authors draw up the traceability coding scheme of the vegetable products, design the quality traceability label of the vegetable products and achieve the traceability management of the vegetable products quality. The system can not only provide the detailed information inquiries of vegetable products for the consumers, but also provide a good operating platform for the production management and the monitoring quality and safety of vegetable products in the enterprises.

Keywords: Vegetable products, Quality and safety, Traceability system, EAN•UCC, Traceability label.

1 Introduction

Vegetables are the major source of vitamins, minerals and dietary fiber what the human body needs. With living standards improving, people become increasingly concerned about product quality and safety of vegetables. In recent years, our high pesticide residues in vegetables to make poisoning incidents occur from time to time. How to ensure the safety of vegetables, improve product quality and safety standards of the "food basket" and let urban and rural residents eat the safety in long, which is not only the focus of attention of ordinary people, but also an important condition for improving the competitiveness of vegetable industry.

2 The Connotation of Quality and Safety of Vegetable Products

Vegetables security is a relative concept, which has narrow and broad sense. Broad concept also includes the safety of quality, nutrition and genetically modified

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vegetables. Today the potential threats of genetically modified vegetables have not been well authenticated. Narrow concepts and standards include mainly four categories: (1) Pollution-free vegetables. These vegetables are that production environment, production process and product quality meet the related standards of pollution-free of the nation or agriculture, which are qualified and certified by the quality supervision and inspection institution, which have also the pollution-free food logo of the relevant department. (2) General products. It has not been particularly explained whether these vegetables are pollution-free food, green food and organic food or not, but today many countries have formulated the industry standard. (3) Green food. Following the principles of sustainable development, in accordance with the specific production methods, these vegetables can be permitted to use the green food mark which is identified by the specialized agencies. (4) Organic food. According to the international organic standards for agricultural production and corresponding processing requirements, these vegetables are the agricultural products that they are certified by the independent organic food certification agency.

Therefore, this article defined the vegetables safety in a narrow sense. As long as the toxic substances were in limited context, which include a pesticide residue, heavy metals, nitrates, harmful micro-organisms, parasite eggs, etc, they can be called safe vegetables.

3 The Concept and Composition of Traceability System

3.1 The Concept of Traceability System

According to the European Union definition of traceability system, it can be expressed as: "The continuity security system of information flow of food market in various stages". Popular that the system can track the interrelated information systems of the entire process from production, handling, processing, distribution and sale through each product bar codes and manage files to use modern management techniques.

3.2 The Composition of Traceability System

The application object of traceability system of vegetables product quality and safety is vegetable enterprises of production, supply and integration, which is made of the center management system, the subsystem of production base management, the subsystem of distribution center management, the public inquiries subsystems. The center management system as a server, the server has the subsystem of production base management and the subsystem of distribution center management [1]. If the public want to inquiry the subsystem, they need only to call the data of the center management system. The relationship structure of each subsystem can be seen from Figure 1.

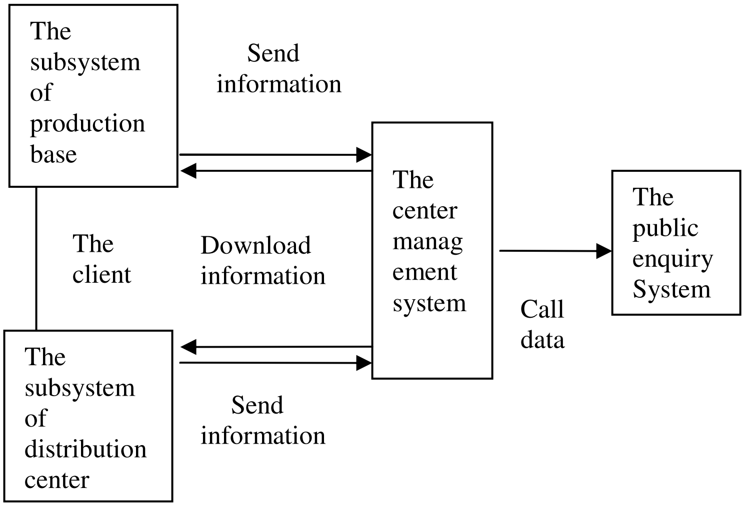

Fig. 1. The chart of Quality and Safety Traceability System of Vegetable Produce of Hebei Province

The center management system. The center management system is installed in the government administration, and the government is responsible for the management. The center management system is made of the corporate records, certification status, the base construction and the data center [2]. The center management system can finish the file management of enterprises operation and the production base, and it can also standardize and unify the production information, the information standards and the quality control information for vegetables.

The subsystem of production base management. The subsystem of production base management is installed in the vegetable production base, which includes the corporate records, the production management, the test management, the sales management and the data center. It can achieve the data management of production records management, product quality management, product sales management and production data base management. It also includes the distribution of agricultural land code and the seed, pesticide, fertilizer procurement, storage. At the same time, it can collect the quality information, automatically generate vegetable product trace label and print traceability code label.

The subsystem of distribution center management. The subsystem of distribution center management is installed in the vegetable distribution centers, which include business records, test management, sales management and data center. It mainly realizes the distribution and sales management of vegetable products in the vegetable production enterprises. It also realizes the delivery from the wholesale packaged product to the retail them and print retrospective code label.

The subsystem of public inquiries. The subsystem of public inquiries links to the Internet, which is a module subsystem of single function. It provides a platform of vegetable traceability code through the Internet. The public can check the enterprises of vegetables production, production base, harvest dates, as well as the information

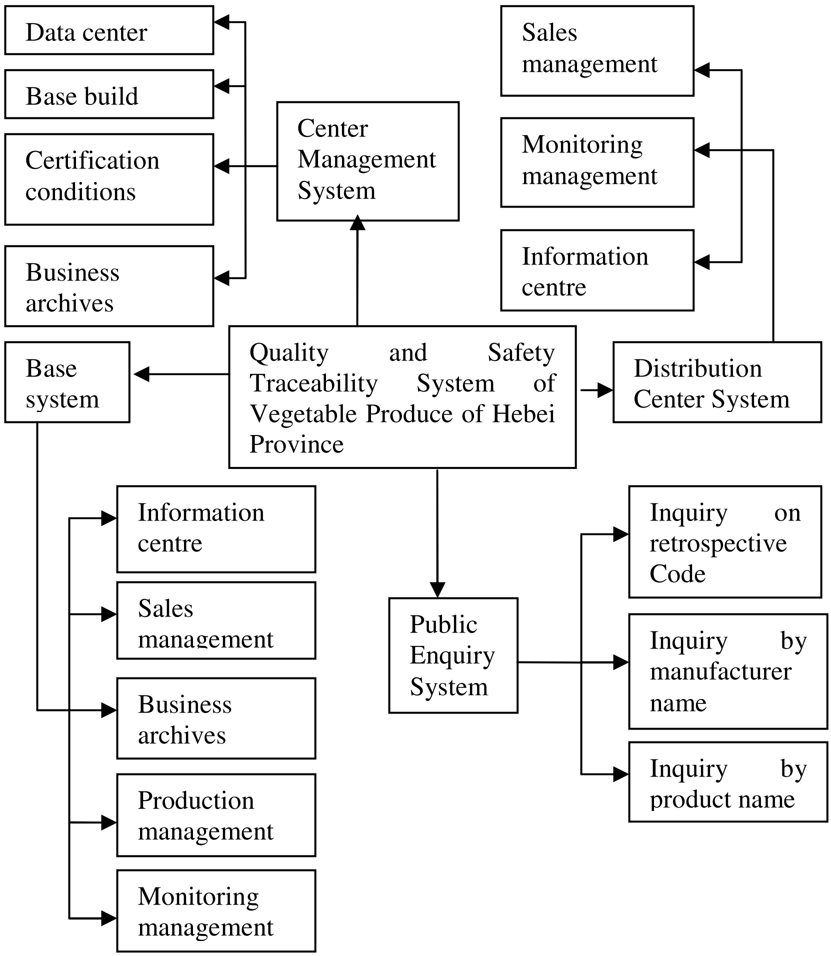

Fig. 2. The block diagram of quality and safety traceability system of vegetableproduce of Hebei Province

of the vegetable seed, fertilizer and pesticide. It can also search the vegetable information through the traceability code of vegetables names and enterprises names.

4 The Traceability Code Design of Vegetable Produce Quality and Safety of Hebei Province

According to the request of traceability code for the amount of information, drawing on existing experience, we choose EAN/UCC-128 bar code as the vegetable traceability code [3]. We also adopt GB/T16986-2003 " Application identifier of EAN•UCC system " standard to set the appropriate application identifier, the trade item identifier using AI (01) to identify the vegetable product identification code, the

Table 1. The coding table of vegetable varieties in Hebei Province (part)

Vegetables category	Vegetable varieties	Variety code
Cabbage	Chinese cabbage	01010
	Cabbage	01040
	Seaweed stalk	01050
	Stalk vegetables	01060
Brassica	Cabbage brassica	02010
	Cauliflower	02020
Melon	Cucumber	05010
	Melon	05020
	Loofah	05030
	Bitter melon	05040
Eggplant	Chili	06010
	Sweet pepper	06020
	Tomato	06030

production date identifier using AI (11) to identify the production date, with the source entity reference code identifier AI (251) to identify the farmland code.

4.1 The Identification Code of Vegetable Products

The trade item identifier AI (01) indicates the meaning of the data segment is the global trade item codes (Global Trade Item Number, for short GTIN). We have chosen the EAN • UCC-13 code structure as an example.

4.2 The Production Date Code

The production date identifier AI (11) indicates the meaning of data segment is the production date of trade item. For vegetable products, the production date is the picking date, whose coding structure adopts YYYYMMDD format [4].

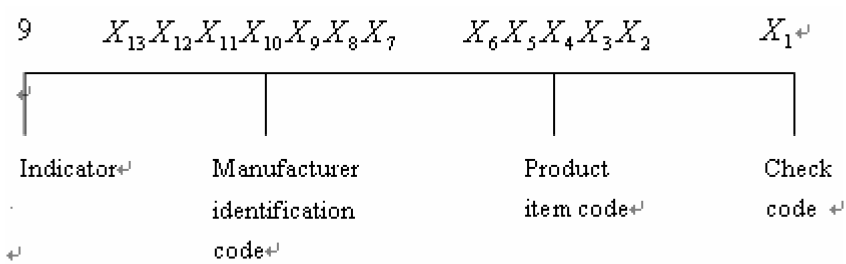

Fig. 3. The coding structure of EAN/UCC-13

4.3 The Field Code

The data segment meaning of field identifier of source entity reference code AI (251) is the source entity reference code of trade item for tracking the original source of trade item. For vegetable products, the farmland number is the field code. The field codes are distributed by the manufacturer, but they should ensure every code is unique. The vegetable products that they are same field with the growing code are identical in the same period of the planting process. Six numbers, letters or numbers and letters mixed consists of the field code [5].

We use Cabbage code of a vegetables enterprise as an example.

(01) 9 6909999 01040 3 (11) 20100415 (251) A1604

(01): Application indentifier; 9: Indicator; 6909999: Manufacturers identification code; 01040: Variety code; 3: Check code; (11): Production date application identification code; 20100415: Production date; (251): Field code application indentifier; A1604: Field number.

If a vegetable production enterprise code is "6909999", the product code of Chinese cabbage can be shown in Figure 4. It was picked in April 15, 2010, whose field code is A1604.

The traceability code is unique as the information carriers of vegetable products. While providing the product information, the origin and production date information, it meets the code standard of EAN • UCC.

4.4 The Traceability Label Design of Vegetable Products Quality

The vegetable product packaging is usually relatively simple, usually using plastic baskets, foam boxes, cartons, plastic bags or mesh bags as package after picking. The processing and distribution sectors use usually plastic bags, bandages as package, therefore, the label design should be short as much as possible, so that the bar code symbol distort little [6]. From the cost view, the label should be as small as possible,

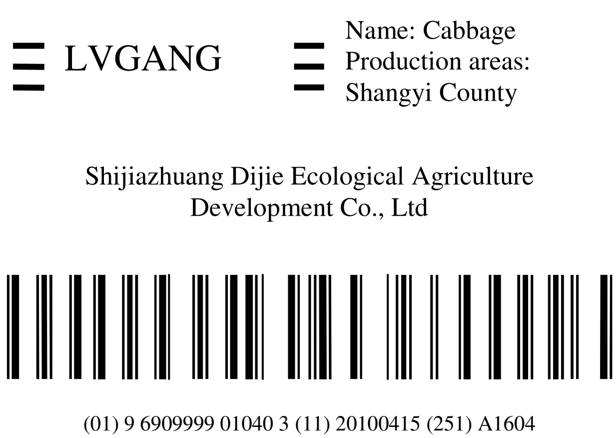

Fig. 4. The traceability label of vegetable product quality of Hebei province

but it should contain enough information. Giving adequate consideration to the circulation, the traceability label of vegetable product should also contain business name, origin and vegetable varieties. Based on enterprises, origin, date and vegetable varieties, the traceability code of vegetable product will automatically generate.

5 The Operation of Traceability System

The traceability system of quality and safety of vegetable products has been applied. The center management system has been installed in the quality inspection station of pollution-free agricultural products in Shijiazhuang. It can effectively monitor the vegetable production, circulation and quality information in the production base to establish the credit management files. Its main is the identity management, responsible management and credit management, while the function as the server can be successfully achieved for the security of management and organization, stability and orderly in the entire system and database. The management subsystem of production base is installed in the vegetable product base of the Shijiazhuang Dijie Ecological Agriculture Co., Ltd. It can make the traceability label automatically generate, and it can also make the print functions smoothly realize. The distribution centre management subsystem has been installed in the distribution centre of the Shijiazhuang Dijie Ecological Agriculture Co., Ltd. It can make the whereabouts information collection and delivery of vegetable sales reliable. The subsystem of public inquiry links to the Internet of quality and safety of vegetable product in Shijiazhuang. The consumers can quickly and easily inquire the information of quality and safety on vegetable product through the Internet.

6 Discuss

The traceability system should be established on the basis of production processes, but the mechanization level of production process is not high in the most enterprises of Hebei Province, which are mainly manual production. Therefore, when the traceability system protects the quality and safety of vegetable products, it needs more the control steps and the various factors of affecting the quality and safety of vegetable products. Based on production process to establish the traceability system, we want to learn fully each process and monitor and record the information to complete the traceability chain. The traceability system of complete supply chain should also involve the wholesalers, retailers and ultimately consumers. Today the scope of traceability system becomes larger and larger. The docking and coordination the individual information of different levels will increase the more difficulty for traceability system. Our project is developing the connectivity of the distribution, supply chain etc to form a more perfect traceability system of vegetable products.

The future development direction is digital management adopting the information technology for the vegetable production circulation, but now general agricultural and high-quality, safe agricultural products are coexist to increase the vegetable products costs. If we fully promote this system, beyond the capacity of the market, it will affect the effectiveness of the system's application to make the further application of the system become difficult. Government departments should support and guide actively, regulate the market and vigorous propaganda from point to area to push gradually the implementation of quality and safety of the traceability system.

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The Study on Building of Virtual Reality System in Large Surface Coal Mine

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Abstract. The building of virtual reality system for the opencast mine is a complicated and systemic project. The building process of virtual system includes data collection, GIS geodabase, model designing and raster textures making. GIS data is from field survey, maps, and remote sensing images. The import phase is the building of kinds of models in different environment. This paper introduced several methods for the modeling different entity, such as dumps, pits, building in Industrial sites, and reclaimed vegetation. The dump models includes real and designed entity in GIS. The building models are built by GIS data and 3DMAX.The vegetation models is builtup in other special software. Based on the ArcGlobe, the kinds of models are integrated into the virtual reality system. ArcGlobe allows efficient display and query of raster data and GIS data, and it is integrated to function with the ArcGIS geodatabase while providing support for analysis in the geoprocessing environment.

1 Introduction

Virtual Reality Geographic Information System (VRGIS) is a technology, which combine Virtual reality with geographic information system (Batty M, 2000). It not only includes spatial analysis tools, but also can simulate landscape in the real world as well as in imaginary worlds with animation and audio function. A key part in VRGIS is considered as the acquire, display and processing of 3D data. There were a number of challenges in the study of environment virtualization through 3D space and time. (K. Morris, 2000).One of challenges is how to integrate different temporal and spatial resolutions data. Additionally, In the study of VRGIS, Modeling digital landscape is very complex phenomena, focus is only on the dynamic of terrain and human perception. (MILAP P., 2006).Moore et al. (1999) developed a 3D terrain visualization system by using Java and VRML.

The technology of aerial photography survey, laser scanning, field measurement and GPS improve the accuracy and speed in VRGIS. There is no doubt that it also provides great technical support for the study of mining VRGIS. Recently, there are many research on the study of VRGIS and 3D landscape visualization in mining environment. Shen Yanchun(2001) developed VRGIS system with MultiGen CreaterPro software based on the VEGA API program in large surface mine. Wu Yougen(2004) simulated land reclamation visualization in subsidence area of mining

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based on the VRML. 3D virtualization technology still be applied in land reclamation engineering(Jiang Quan, 2010).

The VRGIS technology for application mining land reclamation, referred to as landform models, industrial building models and rehabilitate vegetation models. Meanwhile, it is critical for the system on the data integration and 3D dynamic graphics. Therefore, this paper is aimed to analyze the process of mining 3D visualization, and describe VRGIS system developed to store, access and visualize diverse environmental data by 3D model based on ArcGlobe.

2 System Development

An important criterion for assessing the suitability of visualization systems for land reclamation is the capability of simulating different kinds of movement in the landscape, such as open-pit, dump, industrial sites, reclaimed vegetation, etc. Therefore, the modeling design which is composed of terrain, building and vegetation is one of most significant part for building system.

2.1 Field Data Collection

Field survey is to collect model information by taking pictures in dump, opencast, and industrial sites. All those data can provide the size, shape texture of object for building landscape model.

2.2 Land Reclamation Investigation

Because of large area and different types of land cover in surface coal mine, remote sensing is a useful tool for field collected observations, so the reclaimed vegetation data is extracted from high resolution image. In this study, the QUICKBIRD image

a. The quickbird image of dump b. The landuse map of dump from quickbird image

Fig. 1. The QUICKBIRD image and landuse map

(0.6m) of 2006 is used to investigate the reclamation information, including the vegetation type, time, location, and so on (Figure 1). All the data are prepared to compile into database.

2.3 Model Design

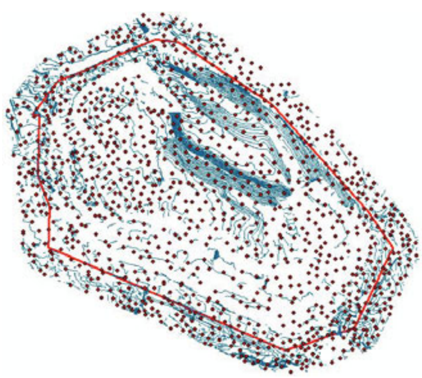
The visualization system research is mainly focus on the 3d landscape modeling, which is considered as the challenge (1) building up box model effectively with data of GIS or CAD, and topographic data; (2) generating real time animations of complex scenes represented as 3d planar polygons surface with remote sensing image or aero photograph, However , it is posed by the high prices and time-consuming, comparing other method; (3) establishing the geometric surface model with 3d mesh point using laser scanning and measurement of ground movement[4].

Recently, the commercial 3D software, such as 3D MAX, Maya, Blender, SketchUp released by Google, are widely used in landscape modeling based on map and photograph. Some software, such as tree factory, Onyx Tree, Amap are mainly used in vegetation modeling. In this study, according to complex scene and various types of landscape, many modeling way are applied to meet the practical need.

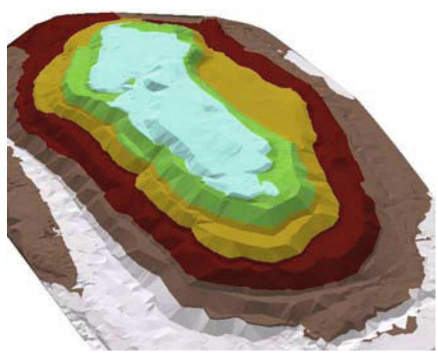
2.3.1 Modelling of Dump

Dump refers to a place for disposal of waste in surface mining process. At the beginning of the exploration, the dump is designed, including location, area, step, slope and platform. Therefore, during the modeling of dump, one part is to build from previous design data which is ideal dump model, the other part is to build from practice topography data.

The terrain data is usually captured by aerial survey or field measurement, which is the format of vector contour, and the TIN and GRID are also the models for presenting real terrain.



a. The 2D vector model of dump

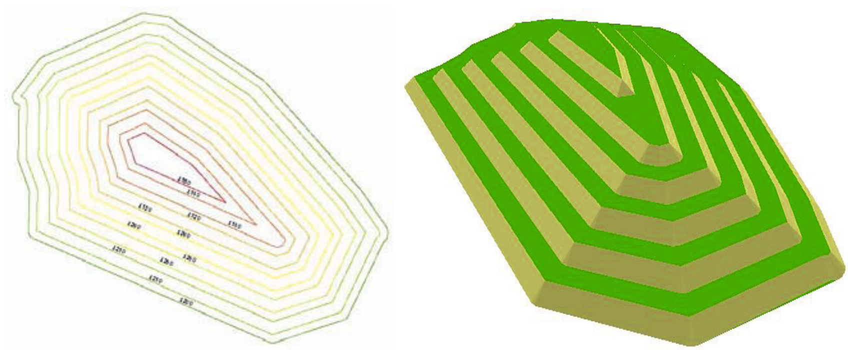


b. The 3D TIN model of dump

Fig. 2. The 2D and 3D model of dump

The original terrain data provided by mining company are used to be the AUTOCAD format, and without projection. So firstly, the data in CAD should be converted to that in GIS, and then transform it to the proper projection. In this study, the software of FME is used to complete the data conversion. The data of CAD format is converted into that of shape file format, and define the projection in the ArcGIS, After this previous data processing, terrain data in GIS is to build TIN model(Figure 2).

According to the design of dump, we could get the data of the dump boundary, width, height, and slope, and then generate contour lines of dump automatically. Finally, the Tin model is generated from the contour lines. The dump volume is easily to be calculated from this 3D model (Figure 3).

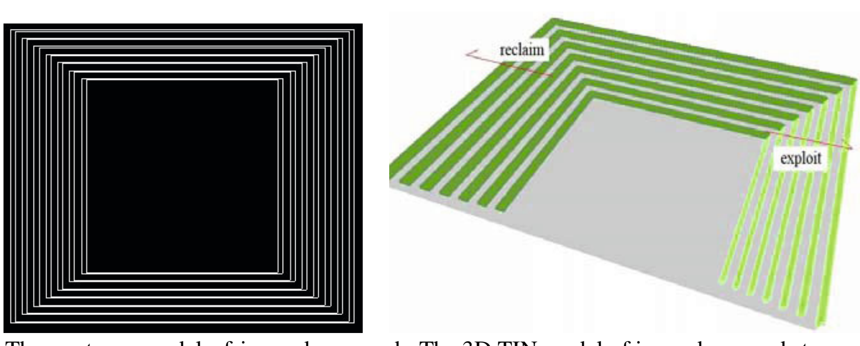


a. The designed 2D vector model of dump   b. The designed 3D TIN model of dump

Fig. 3. The designed 2D and 3D model of dump

2.3.2 Modeling of Pit

During the waste dumping process, mine waste in-pit disposal will be transited from base to the peak of the pit; meanwhile, the excavated face will be pushed forward after the forming of the mining bench.



a. The contours model of inner dump and stope   b. The 3D TIN model of inner dump and stope

Fig. 4. The models of inner dump and stope

The slope and width of waste dump is completely different from that of open-pit, The contours of stope-boundary, pit and waste dumping could be designed by ArcINFO AML program, and then to be overplayed to modify the related parameters. The tin model (Figure 4) was generated from contours.

2.3.3 Modeling of Industrial Sites

There are various buildings in industrial sites, it will cost much time when the model is built by 3DMAX or Maya software. The system of land reclamation and ecological restoration is interested in the visualization in pit, waste dump and reclaimed vegetation. Therefore, in this study, for some landmark buildings, we adopted conventional manual modeling method to build model. However, for most buildings, we used the 3d model by GIS software.

2.3.4 Modeling of Reclaimed Vegetation

In the vegetation modeling, the field survey photo is used to model the vegetation based on the Onyx Tree. Amap download from 3DMAX. Additionally, the texture from remote sensing image is also can be used to render plants and vegetation, and then to be located in each waste dump according to the reclamation.

2.4 System Integration

In virtual reality system technology, systems integration is the process of linking together different model physically or functionally based on uniform platform. System integration is also about development function. Due to the complex of the 3D engine, in this study, ArcGlobe software released by ESRI is used to integrate system, which is helpful for the virtual terrain model and accurate geographic location. Most types of raster and vector data that are spatially referenced can be loaded into a globe. ArcGlobe can display substantial amounts of data quickly and effectively. The data can be widespread or limited in extent with highly detailed or coarse resolution. It also has the function of overlay, viewshed and buffer analysis, and adding outside model through 3D label. We can get more details from Figure 5.

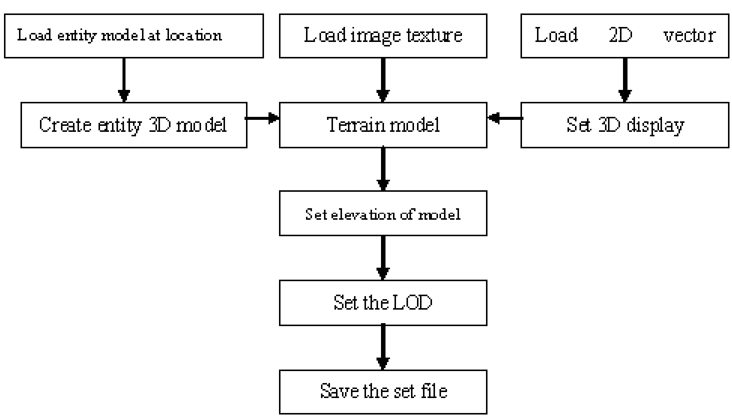


Fig. 5. The process diagram of integrating models into the VR system

3 Conclusion

This study illustrates the issues of modeling in land reclamation and ecological restoration, as well as the optimal allocation of land use resource. In conclusion: (1) For the study of large landscape modeling, The problem which should be handled is the resource and processing of high resolution data. It is necessary to data conversion from AUTOCAD format to GIS format for making terrain model; (2) There are both raw and artificial landscape in study area. For better 3D visual perception, the high resolution remote sensing image are widely applied. However, it is difficult for most software to convert image to JPEG or TIFF format, and match the local landscape and landform. Because of mass of data, map division should be used during the data process to bypass the weakness. (3) The 3D modeling is the most significant part in the virtual reality system; (4) Model making by other software should be positioned according to given coordinate. Therefore, the virtual reality system should be building based on GIS.

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The Study on Navel Orange Traceability Chain

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Abstract. Navel orange is one of the characteristic agricultural products in the middle region of china. The traceability system for navel orange can enhance consumer confidence due to the "stained navel orange" incident. Research on the navel orange traceability chain is the foundation and premise of building the traceability system. Based on the analyses of whole food chain of navel orange from origin to market, HACCP is used to evaluate the risk and latent risk of planting, harvesting, processing, packing, transportation and sale, the critical control link and the critical control point of navel orange traceability chain were fixed combined with the actual situation in china. Further, the code of the navel orange traceability is designed based on EAN.UCC system, which includes origin, processing and the end product. This study makes it possible to construct navel orange traceability system.

Keywords: navel orange, critical control point, HACCP, traceability chain, encode.

1 Introduction

Navel orange is one of characteristic agricultural products in the middle of china, which is demanding climate for growing. The origin of the navel oranges mainly distributed in south Jiangxi province, zigui, Hubei province, fengjie, Chongqing province, binzhou, Yunnan province.

Gannan is located in the sub-tropical southern margin of the South. The climate of gannan is a typical sub-tropical moist climate, the soil of gannan contains many kinds of trace elements for fruit tree and navel orange, both of them suit navel oranges grow.

Gannan is the advantageous product area of navel orange determined by ministry of Agriculture in China. Gannan is the famous base for navel orange, where is known as "town of navel orange in China". The navel orange produced in gannan has many unique features, such as large shaped, bright color, crisp flesh and taste good. Navel orange industry is an important pillar industry in Gannan region, which is one of nine advantages of agricultural products selected by ministry of agriculture in china. Many counties have taken navel orange as an important tool for local farmer income.

However, the incidents occurred in recently years, such as "dyeing navel orange" in Hong Kong in 2004, "bactrocera minax" in guangyuan city, Sichuan province, have damaged the orange industry in south of china. The "dyeing navel orange" incident made 70% order in Hong Kong cancellation, the price of navel orange fell sharply in 2004. In

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2008, affected by the "bactrocera minax" incident, all of the consumers don't want to buy navel orange in china. These events cause severe economic losses to fruit growers.

Generally, from tree planting to bear fruit need 2-3 years for navel orange tree, from blooming to outcome need 280-300 days for navel orange. There are a lot of links and elements affect the quality safety for navel orange. In order to standardize the navel oranges grow and process, "Technological regulation of navel orange cultivation in south Jiangxi, south Hunan, and north Guangxi" has been developed to standardize the whole process from tree planting to fruit picking of navel orange.

In order to guarantee the quality safety of navel orange, we should monitor the whole process from tree planting to fruit processing[1], which also called "management from orchard to table". Currently, traceability systems for agricultural products are established gradually to ensure the quality safety[2,3]. As for navel orange, confirm the critical control point based on the analysis of the whole process from tree planting to fruit processing with the HACCP (Hazard Analysis and Critical Control Point)[4], and encode the traceability chain of navel orange with EAN.UCC system, both of them are precondition of traceability system construction.

2 Main Hazard of Navel Orange

Generally, there are three kinds of hazard to person in fresh agricultural products: biological hazards, chemical hazards and physical hazards.

The biological hazards of navel orange mainly refer to the biological itself and its metabolites will pollute fruit raw materials, process and products. This pollution will damage consumer safety. As for fruit, hazard generated creatures are fungi, bacteria, viruses, natural toxins, parasites. Specifically, ulcers are the most occurred bacterial diseases for navel orange, which damage a lot to navel orange.

The chemical hazards of navel orange mainly refer to chemical substances, residues and emissions generated by human activities, which contaminated the fruit. Chemical hazards involves a broader range, including environmental pollution, pesticide residues fertilizer residues, chemical element pollution, packaging materials, such pollution damages the health of consumers. For navel orange, atmospheric pollutants are same with other fruits, including total suspended particulates, sulfur dioxide, nitrogen dioxide, and fluoride. Soil contaminants in navel orange include heavy metals, toxic substances (pesticides, various chemicals) and other pollutants. Soil pollution comes mainly from three aspects: First, the discharge of industrial waste; second pesticide, fertilizer application, etc.; third of sewage irrigation.

Physical hazards of navel orange exist in fruit with potentially harm may cause bodily injury to consumers., which are common glass, wire, nails fragments, stones fragments, metal fragments and so on.

3 Navel Orange Critical Control Point Analysis

3.1. Navel Orange Production Process Analysis

Generally, there are 11 steps from navel orange tree planting to navel orange fruit sold on market: orchard selection, sapling selection, planting, tree management, soil fertilizer and water management, flower and fruit management, insect control, harvest, washing and packing, storage and transportation [5] (shown as Fig. 1).

When an orchard was selected, we should investigate land use history, soil type, soil erosion and ground water quality. Evaluate whether the regional air, soil, irrigation water and other conditions suit for navel orange growing. During the soil fertilizer and water management period, we should determine the rate, time and method of irrigation and fertilizing. In the insect control stage, different measures should be taken to deal with different diseases, pests.

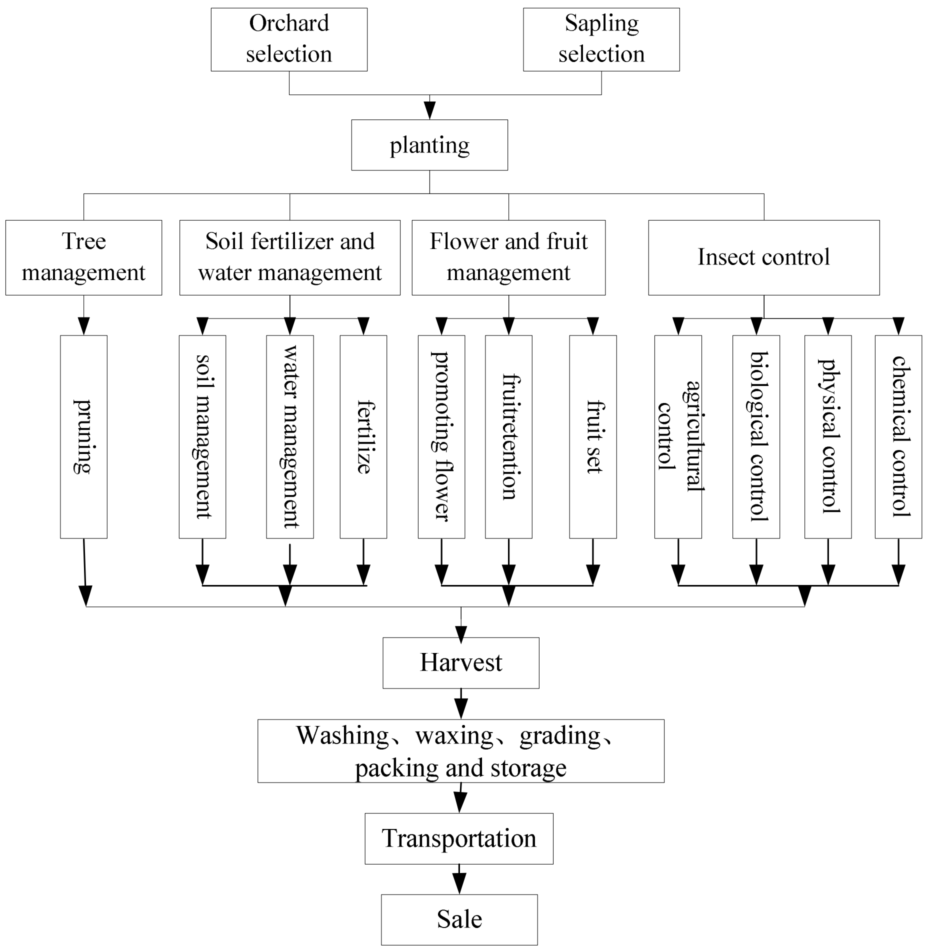

Fig. 1. 11 steps of navel orange growing

3.2. Navel Orange Safety Factor Analysis

As we known, navel orange can be sold on market after 11 steps. Among all of these process, potential hazard factors include: environmental conditions, water quality, pesticide residues, etc, which we should analyses detailed from biological hazards, chemical hazards and physical hazards three aspects, then identify the significant hazards[6].

There are many links that make navel orange infected bacteria from orchard to sale, but these hazards can generally be controlled by SSOP (Sanitation Standard Operating Procedure). So the biological hazards in navel orange significant hazard.

Chemical hazards that can impact navel orange safety mainly in the following five areas: first , pesticide residues as well as mercury, cadmium, lead, tin, chromium, arsenic, fluoride and other harmful substances residues in soil; second, fluoride and sulfide in air; third, pesticide residues and mercury, cadmium, lead, tin, chromium, arsenic, fluoride residues in irrigation water, fourth, mercury, cadmium, lead, tin, chromium, arsenic, fluorine, and antibiotics residues in fertilizer; fifth, pesticides and heavy metals exceeded in the fruit during the pest control process.

There is no physical hazard to customers in navel orange basically.

3.3 Critical Control Point of Navel Orange

Based on the whole process of navel orange and information of hazard analysis, five critical control points was determined (shown in Table 1):

(1) Surroundings, soil properties, pesticide residues and harmful substances in the orchard.
(2) Irrigation water.
(3) Fertilizer selection.
(4) Pesticides in the pest control.
(5) Disinfectant and wax during the washing, waxing, grading and packing.

Table 1. HACCP based Hazard analysis of navel orange

Production process	Hazard type	Is significant?	Judgments based on the third column	Precaution	Is CCP?
Orchard selection	biological hazard	No			No
	chemical hazard	Yes	harmful substances and heavy metals absorption from the air and water during navel orange growing	test the soil, air and water, make sure all of them line with national standards	Yes
	physical hazard	No			No
Sapling selection	biological hazard	No			No
	chemical hazard	No			No
	physical hazard	No			No
Planting	biological hazard	No			No
	chemical hazard	No			No
	physical hazard	No			No
Navel orange tree management	biological hazard	No			No
	chemical hazard	Yes	Use growth regulator	limited	No
	physical hazard	No			No
Soil management	biological hazard	No			No
	chemical hazard	Yes	Use steamed soil fumigant	limited	No
	physical hazard	No			No

Table 1. (*Continued*)

Irrigation management	biological hazard	No			No
	chemical hazard	Yes	Irrigation water contain harmful substances, heavy metals	make sure water line with national standards	Yes
	physical hazard	No			No
Fertilize management	biological hazard	Yes	fertilizer storage	separate the fertilizer and fruit	No
	chemical hazard	Yes	Fertilizer contain harmful substances, chemical and heavy metals	Handle the organic fertilizer before use	Yes
	physical hazard	No			No
Flower management	biological hazard	No			No
	chemical hazard	Yes	Use fruit growth regulator	limited	No
	physical hazard	No			No
Pest control	biological hazard	Yes	Use biological pesticide	line with national standards	No
	chemical hazard	Yes	Use chemical pesticide	line with national standards	Yes
	physical hazard	No			No
Harvest	biological hazard	No			No
	chemical hazard	Yes			No
	physical hazard	No			No
Washing、waxing、grading、packing	biological hazard	No			No
	chemical hazard	Yes	Use disinfectant and wax	make sure all of them line with national standards	Yes
	physical hazard	No			No
Storage	biological hazard	Yes	Fruit rot during the storage	Control the storage condition	No
	chemical hazard	Yes	Use chemical anti-stalling agents	limited	No
	physical hazard	No			No
Transportation	biological hazard	Yes	Generate pathogens during transportation	control transportation condition	No
	chemical hazard	No			No
	physical hazard	No			No
Sale	biological hazard	No			No
	chemical hazard	No			No
	physical hazard	No			No

4 Navel Orange Traceability Code Design

In order to track and trace the whole safety information of navel orange, the detail information of each step should be identified and recorded[7,8]. Unified encode system is the premise of navel orange traceability, is also the basis of information exchanging and processing. The encoding system should comply with the following principles: uniqueness, stability, commonality, expandability and applicability.

As for navel orange, we need four identification codes to indicate the quality safety information. There are origin code, enterprise code, processing batch code and traceability code. According origin code we can know the exactly place the navel orange produced, surroundings information of the orchard, and input information during the navel orange growing. Origin code is composed of 3 parts: administrative divisions' code of county, village code and unit sequence code. The code structure is shown in Fig. 2.

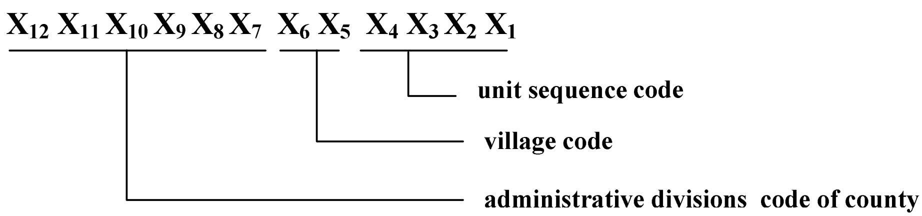

Fig. 2. The code structure of origin code for navel orange

By means of enterprise code, which refer the existing enterprise code, we can know where the navel orange washing, waxing, grading and packing.

The information about the disinfectant and wax can be obtained by means of processing batch code, which has two parts, processing date and sequence code. Processing batch code structure is shown in Fig. 3.

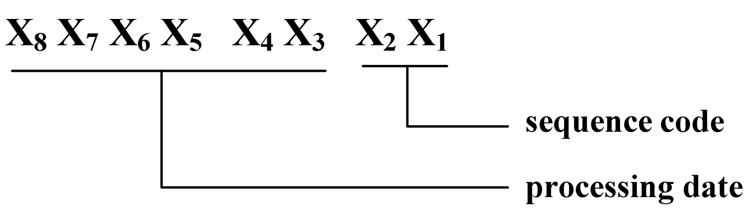

Fig. 3. The code structure of processing batch

The traceability code is the unique identification of navel orange. All of the quality and safety information of the product can be obtained through this code, combined with the navel orange traceability system. The traceability code follows the UCC/EAN-128 standard [9], which is a worldwide standard for exchanging data between different companies. The code structure is shown in Fig. 4.

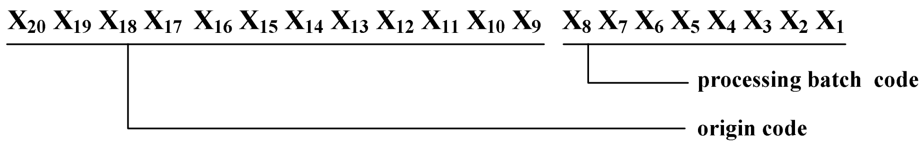

Fig. 4. The code structure of navel orange traceability

5 Conclusion

This paper discusses what the traceability system should trace; and which code should encode for implementation of the traceability system of navel orange in the traceability chain. Three main hazards of navel orange are pointed out in the paper; those may harm consumers' health. Based on analyses the whole process from orchard selection to navel orange sale, as well as safety factor of navel orange, five critical control points of navel orange are determined with HACCP method. These critical control points are the focus of the traceability system; and they should be recorded precisely during the entire process. In the end of this article, the author designs the key code of navel orange traceability chain, which includes origin code, processing batch code and traceability code. This study makes the navel orange traceability system construction possible.

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The Study on the Organization Approach of Agricultural Model Components Library Based on Topic Map

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Abstract. The definition and representation on the model base's descriptions are the basis of reuse, integration and management of heterogeneous model resources. The study proposed the organization method of the agriculture model components based on topic maps. On the basis of the meta-modeling techniques and the topic map techniques, the study comprehensively analyzed the agricultural model characteristics, extracted the model component facets and its associated descriptions, and established the agricultural model component library's description model (DM-AMCL). Then, it hierarchically mapped and annotated the model component semantic and syntactic information by using the topic map. We designed the organization framework of the agriculture model components library on topic maps (TM-AMCL). For example of wheat development model, the XTM document instance is build. The result shows that, converting the agriculture models base to TM-AMCL can provide a unified descriptions and access to data for the intelligent decision support system developers, the managers of agriculture model and the computer system.

Keywords: Topic map, model component, topic maps merging, development model, agriculture model.

1 Introductions

The agriculture model is a mathematical model or computer model to describe the characteristics, the status and the variety law of agro-ecosystems [1]. The Agricultural Decision Support System based on the agriculture models plays an important role in the field of precision agriculture, crop production management, plant pest forecasting, agriculture economic analysis and forecasting [1],[2],[3]. With the maturation and development of component-based software development approach (CBD), more and more simulation models are encapsulated as model components or web services, the

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decision support system development efficiency and quality are improved with the component reuse and assembly [4]. The APSIM research group [5] use the component assembly method to integrate the grass seed models built with the StallaTM tool into the APSIM system. van Ittersum[6] etc., established the component-based seamless integration framework (SEAMLESS-IF), the Agricultural model in different spatial and temporal scales such as land use planning, crop productivity forecasting, economic and social benefit analysis, can be integrated in this framework, and the reusable level between model components is promoted. ZHAO Chun-jiang[7] etc., applied the software component technology to agricultural intelligent system platform, raised the platform development efficiency. CAO Wei-xing [8-9] etc., developed crop growth simulation system by using the component-based method to encapsulate the model components of wheat, rice, cotton and rape and other major field crops for the objects, efficiently improved the development efficiency of the agricultural decision support system.

However, in the agriculture information research field, although many different research institutions have large amounts of different types of model component resources, but they are present in their development of independent system. These research institutions adopted different modeling approaches and component model, used different development platforms and technologies, and it's difficult to integrate, share and reuse the models. At the same time, agricultural models involve many aspects, and are high complexity, highly professional, the dependency and relationship between the sub-models are close. All of these made intelligent decision support system developers, agricultural science researchers and computer system to have a different semantics and syntax understanding for the model's input / output parameters. Therefore, to research the unified description and representation method of the agricultural model base distributed environment, can helps all kinds of users to unify the various modes of information access to heterogeneous model base. It's the basis for realizing the agriculture model integration and reuse.

Topic Maps technology [10] is a metadata model for expressing and exchanging the structured information, and has now become the ISO / IEC 13250 standard published. Topic Maps technology played an important role in the fields of heterogeneous databases sharing and integration of subject knowledge [11]. Ellouze N [12] raised a global sharing method of topic maps in different languages through continuous collaboration and fusion between topic maps. WU Xiao-fan [13] raised a method to construct the topic map-based knowledge repository warehouse, to promote information integration to knowledge integration. Although, there have many applied research of topic maps technology in fields of information resource integration and information retrieval, there have less study on the representation of agriculture model base resources, especially on the content representation and build process. This study intended to apply the topic maps technology to the information organization of agricultural model base. By analyzing the features of agriculture model and combining the business component model, the study constructed the layered description model of the agriculture model component library, confirmed the construction process and content on the topic maps of the agriculture model component library. The goal is to convert agricultural models to the topic maps, and provide a unified reuse access to agriculture models in the network environment.

2 The Representation Method of Agriculture Model Component Library Based on the Topic Maps

2.1 The Composition and Structure of Agriculture Model Base

Software component is a completely defined self-contained software unit of one or a group interface, has syntax formula, time and deployment of content, can be independently delivered and installed at a point of time of component development life cycle, and represents its effectiveness by assembling with other components [14]. The effective use of the component-based development (CBD) methods depends on the large number of component library with an effective organization. Currently, the most agriculture models are encapsulated to model components. Agricultural model library resources are commonly composed of agricultural model library, model component library and model database. Agricultural model base is a collection of agriculture model concepts and its relationship, model component library is specifically represented as the model algorithm, and is composed of the agriculture model's information of the concept terms, component properties, interface specifications and component entities. Model metadata, model parameters and model-driven run-time data is stored in the model database. Therefore, to unified organize and represent the agriculture model base, needs a totally characterization and description of the model component's semantic and syntactic information.

2.2 Topic Map Elements and the Mapping of Agricultural Model Base Resources

Topic maps (TM) are usually used to represent knowledge and to locate data structure of information resources. The TM is composed of three elements, which are topic, association and occurrence, and represents the complex relationship between knowledge concept and information resource through the meta-data XML (XML Topic Maps) [10]. The topic describes the abstract concept of things, and the topic type represents type of classified topic. The association describes the relationship between the topics. The association type depicts the interrelated nature of topic concept. Since there is no direction or order about the association, the association role is used to define the participated role in the association. The occurrence, also called event, describes the topic's link to physical resource, the occurrence type indicates the resource type linked by the topic. One topic can correspond to multiple occurrences. From the overall structure view, TM domain is divided into topic domain and resource domain. The topic domain is a collection of topics, and it contains the association. The resource domain is a collection of all physical resources. Therefore, to organize agriculture model base resource using the topic map technology, it is needed to extract the concept term, interface specification and the relationship from the model component library, and further maps to the topic and association, maps the database document and component entity etc., to the resource domain. Figure 1 mapping between agriculture model-base resources and topic map elements.

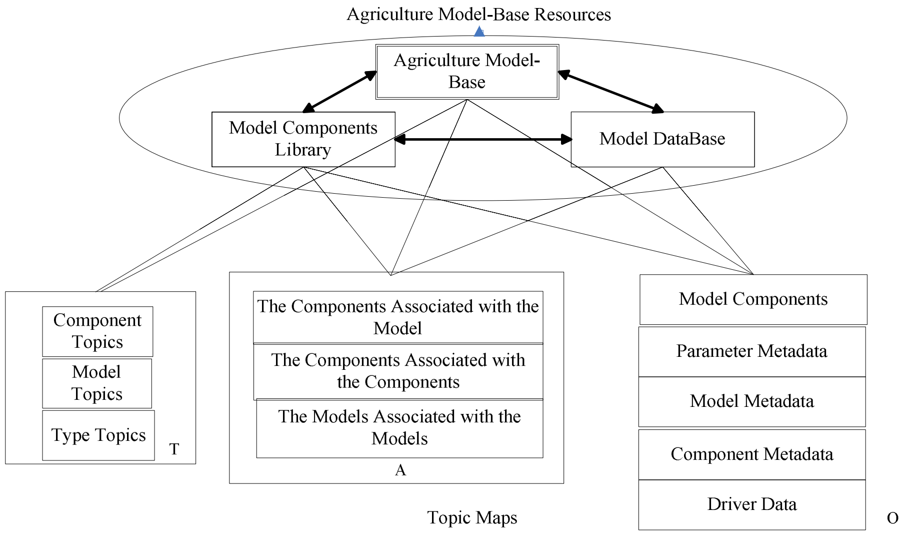

Fig. 1. The mapping of agricultural model-base resources and topic maps

3 Description Model of Agriculture Model

By using Jade Bird Component Model [15], the domain description tree and association description diagram for agriculture model component library are formed.

3.1 The Component-Based Analysis on Agriculture Model Size Level

Agricultural model is composed of the model description, model algorithms and model structure three parts [16]. The agriculture model is composed of the logic model and simulation model, the logic model uses mathematical modeling tools to reflect the objective elements of things and their relationship. The simulation model is a software realization of the logic model in the computer, the mapping relation between the logic model and simulation model is one-many. The model description describes the model static characteristic in detail. Model algorithm and model structure describe the behavioral characteristics of agricultural objects. Model structure is a set of constraint relations between concepts of model components and sub-model components, reflects the combination rules between the model and the sub-model. Model algorithm uses a series of calculations and formulas to represent the model's solving process including the model input variables, output variables, state transition variables and transition rules and calculation equations, etc., is a concretion of abstract concept model, and can be mapped to model components. Among them, input / output variables, including model parameters and the driving variable, reflect the temporal and spatial characteristics of driven model computing. For example, field scale crop growth models influenced by weather, soil, varieties and cultivation conditions, the daily temperature value are driven variable of running model. In the application process at the regional scale, crop production and management knowledge model needs to interpolate and process the daily temperature data of simulation regional meteorological stations to be used as driven variable of field scale model, this reflects the spatial characteristics of model input variables. On the whole, agriculture model is often a complex model, and it involves multiple sub-model, the input / output variables is complex and is of significant spatial and temporal characteristics. Therefore, the component size level is associated with the model size level. The sectional capacity of model can be mapped to a combination of ability of model components.

According to the characteristic analysis of component and agriculture model size level, it is known that agriculture model components are composed of atomic model components, composite model components and model framework component, the specific algorithm can be. Net components, JavaBean or web Service and other component entities. Atomic model component is a model algorithm component to complete single-function, and its internal is composed of class, conditions and equations. For example, crop growth model component has only one single-function for calculating the crop growth phenology, belongs to business components. Composite model component can guide the assembly, calls and combinations of sub-model component , realize the specific functions of application, belongs to application or service component. For example, field scale crop growth model is composed of a number of sub-model components, can complete the different levels of field scale crop systems simulation, it belongs to system-level model components. Model framework components can guide atomic model components to form composite model components.

3.2 Component-Based Description of the Agricultural Model

The semantic and grammar information of agricultural model can be expressed by the description model of the agriculture model component library (DM-AMCL). DM-AMCL is composed of Facet Description Model (FDM) and Associate Description Model (ADM).

3.2.1 Facet Description

FDM describes the model components concept space faceted terms, and is composed of model property, model parameters, the model framework and the resource files of four domains (Formula 1).

$$\text{FDM} = \{\text{ModelExplain}, \text{ModelFramework}, \text{ModelParameter}, \text{ResourceFiles}\} \tag{1}$$

Each domain contains a number of key term nodes, the key term node is divided into many groups according to the model and component, "domain + model group" and "Domain + component group" are seen as an abstract object, the characteristic facet terms of these abstract objects are property terms, which form 8 facet term trees in domain unit. Table 1 lists the FDM classification domain and property term contents. Among them, ModelExplain.ME and ModelExplain.CE are separately the descriptive property information of model and component. ModelParameter.MF describes input and output parameter's semantic information of a single atomic model. Model Parameter.CI describes syntax specification of atom model component interface. ModelFramework domain specifies a set of portfolio reference standards of composite model, and sub-model components interface adapter standard, and can guide the assembly of sub-model components. Among this, ModelFramework.δ describes composite model component hierarchy, and the combination or collaboration rules among components. ModelFramework.λ describes the interactive processes, rules and interface specification among model components composed by composite model. For example, crop growth model is a composite model, contains sub-calculation models of growth period, biomass, dry matter allocation, organ built, quality formation, soil - crop water, soil - crop nutrition etc. in its ModelFramework.δ. Wheat, rice and other crop growth model has similar simulation framework, and can simulate different levels of cereal crop systems through a combination of sub-models. Further use of component interface and component portfolio reference standard in the ModelFramework.λ, can complete the assembly of sub-model components and construct the system-level model components.

Table 1. The Facet Description Model Details of Agriculture Model Component Library

Faceted classification domain	Property glossary
ModelExplain.ME	model number, model name, plant type, model class, model type, model scale, simulation level, functional description, application fields, modeling agencies, etc.
ModelExplain.CE	model number, model name, plant type, model class, model type, model scale, simulation level, functional description, application fields, modeling agencies, etc.
ModelParameter.MF	model number, model name, plant type, model class, model type, model scale, simulation level, functional description, application fields, modeling agencies, etc.
ModelParameter.CI	component number, component name, component size, encapsulation forms, representation forms, development languages, application fields, deployment environment, instructions, etc.
ModelFramework.δ	model component sequence, combination or collaboration rules, reference input / output, etc
ModelFramework.λ	composable interface sequence, call interface rules, reference Interface Specification, etc
ResourceFiles.MR	model description file, etc
ResourceFiles.CR	component description file, component entity file, etc

3.2.2 Association Description

Although the FDM can describe the semantic and syntactic information of agricultural model faceted term space, but there is no associations between objects of the domain. By refining the association between model objects and component objects in the same domain, this study associated the model concept term space with the component concept term space and physical resource, and formed the association description model (ADM). ADM includes Atom Association Description Model (AADM) and

Complex Association Description Model (CADM). AADM is composed of model - component properties, the model parameters - component interface, model attribute - model description file, component attributes – component file, and composite model structure – component combinations statute, a total of five kinds of association types. Formula (2) reflects the mapping relationship set involved in atomic model, each mapping is of one-to-many relationship. Formula (3) reflects that the composite model has added the part of association on the basis of atomic component mapping relationship set, and the association of complex model structure - component combinations statute has a one-to-one relationship. Integrating FDM and ADM can describe semantic and grammatical information of agriculture model base totally.

$$\mathrm{ADM} = (\Pi_{\mathrm{ME} \to \mathrm{CE}}, \Pi_{\mathrm{MP} \to \mathrm{CI}}, \Pi_{\delta \to \lambda}, \Pi_{\mathrm{ME} \to \mathrm{MR}}, \Pi_{\mathrm{CE} \to \mathrm{CR}}) \tag{2}$$

$$\mathrm{AADM} = \{\Pi_{\mathrm{ME} \to \mathrm{CE}} \cap \Pi_{\mathrm{MP} \to \mathrm{CI}} \cap \Pi_{\mathrm{ME} \to \mathrm{MR}} \cap \Pi_{\mathrm{CE} \to \mathrm{CR}}\} \tag{3}$$

$$\mathrm{AADM(i)} \cap \Pi_{\delta \to \lambda} \to \mathrm{CADM} \quad \mathrm{i} \in \text{atomic model}, 1, 2, ..., n \tag{4}$$

4 Topic Map Framework Oriented Agriculture Model Components Library

The construction of topic maps includes extraction, annotation and merging of topic map elements, and saves it using XTM file storage.

4.1 Topic Map Formation

By using the information of DM-AMCL Faceted description domain and association description domain as metadata, combined with the specific model types and component models, and entity file, this study formed themes, associations and events of agriculture model component library, and established the Topic Maps of Agricultural Model Component Library (TM-AMCL) by using XTM representation. It consists of model's meta topic maps (MTM), atomic topic maps (ATM) and complex topic maps (CTM) together, and followed by a meta-data - instances of relations, and a total share of model information is realized by using topic map fusion algorithm. MTM is the basic mode for generating other thematic maps, and come directly from DM-AMCL . It is composed of meta-attributes for topic maps (AMTM) and meta-framework for topic maps (FMTM), reflects the hierarchical relationship between the generic concepts of domain model, component domain and resource domain in the model component library, and the association relationship between the domains. MTM is the abstract representation of concept and relationship of meta-model of component library, composed of local atom topic maps (LATM) and global atomic topic maps (GATM), and can reflect the different model component entity concept and association information in same type of model. Each model component corresponds to an LATM, the same type of model has more than LATM, and GATM is formed by using the topic maps merging technology, the global component level share of similar model is

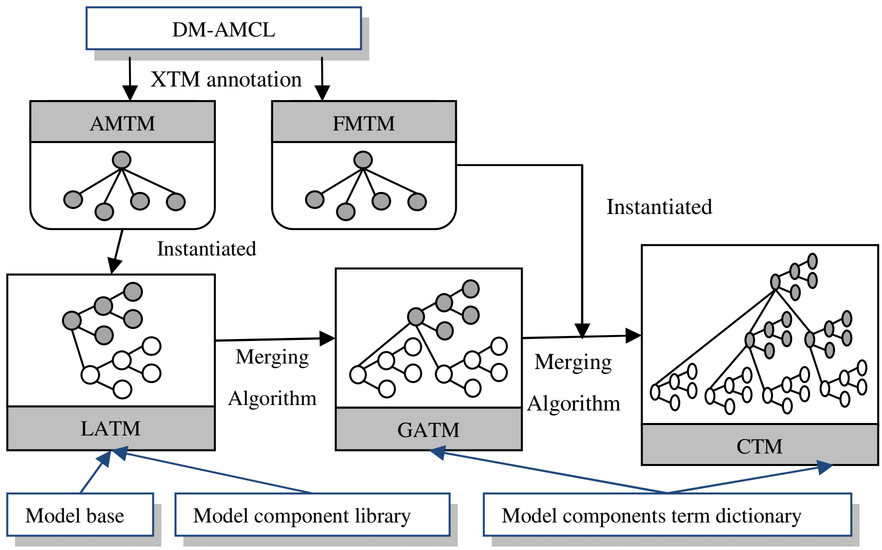

Fig. 2. The structure and the merging process of TM-AMCL

realized. CTM is the abstract representation of concept and relationship of composite model components, and can fully reflect sub-models involved in the composite model, and combination rule of sub-models etc., the global model-based system level share is realized.

Figure 2 show that TM-AMCL in turn are divided into three steps: ①MTM reflects "meta-data relationship", maps the faceted classification, terminology and association types of DM-AMCL to AMTM topic type, association type and event type separately, all represented by the topics without the relation of specific model types. The term value in the Model Framework domain is mapped to the topic type of FMTM, is related to specific model types. One type model has a set of reference standard of common model framework. ②AMTM reflects "abstract - concrete - merging relations". Based on the meta-property topic map mode, all instances of the topic are extracted from the model component database, these instances are seen as new topic and are added to the MTM structure to form new LATM. Further, under the guidance of model components term dictionary, the LATM is merged to GATM by using topic map merging algorithm, and the different crop model algorithm components of the same agriculture model type is shared. ③ CTM reflects "model composable relationship". Based on the meta-framework topic map mode, the GATM is classified and merged to form CTM, and the system-level model information is shared. In figure 2, model components term dictionary defines the related field terms and their synonyms in agriculture model component library, including number, the term name, symbol, synonyms, description and scope of use. For example, the dictionary of growth stage model includes ‘M001, development model. DEV, growth development and phenology, "Simulation of crop growth and development, computing phenological time", crop model’.

4.2 XTM Annotation of Topic Maps

The study used the XTM elements such as <topic>, <association>, <mergeMap>, <topicRef>, <scope>, <instanceOf>, <topic> and <baseName> etc., to notate the faceted and the associated term in the DM-AMC, notated the model component metadata according to level name mode[16], notated the ATM by using classified and instantiated method, and formed the agriculture model XTM file. The figure 3 list the Model Explain domain, model-component attribute association domain and the XTM fragment for AMTM document. Other facet description domain can refer to the method to notate, because it is difficult to describe in here.

```
<?xml version="1.0" encoding="gb2312"?>
<topicMap>
  <topic id=" 1_ModelExplain ">
    <baseName> <baseNameString> Model Description </baseNameString> </baseName>
  </topic>
  <topic id="2_ME. ModelID ">          <! Model Number >
    <instanceOf> <topicRef xlink:href="#1_ ModelExplain "/></instanceOf>
    <baseName> <baseNameString>2_ME/ModelID</baseNameString></baseName>
    <baseName> <baseNameString>ModelID</baseNameString></baseName>
  </topic>
<topic id="2_ME. ModelType ">          <! Model Type >
<instanceOf><topicRef xlink:href="#1_ ModelExplain "/></instanceOf>
    <baseName> <baseNameString>2_ME/ModelType</baseNameString></baseName>
    <baseName><baseNameString> ModelType </baseNameString> </baseName>
  <scope>
   Crop model, meteorological model, soil model, hydrological model, economic model, plant
   protection model </scope>
  </topic>
```

Fig. 3. The XTM fragment of AMTM

4.3 A Working Example: The Wheat Development Model Component's LATM Building

The research team saved the descriptive information of the wheat growing model components in the agricultural model component database, wrote and used C # programs to access Microsoft SQL Server database, and according to the XTM standard format, converted the field data of database table to the XTM elements and property information, such as < topicMap>, < instanceOf>, < topicRef > and < Scope>. Then, by using the leaf node faceted topics of MTM as the topic type of LATM, the appropriate topic instances are established. Each topic includes the base name and extension name. Base name is the basic name of the current topic, and extension name records the topic path information in the MTM. If the current topics are in the ModelExplain domain, then its extension name is the current model number / base name. The other topic name definition is similar. Figure 4-6 separately lists the computer-generated model class topic, model number and component number of the wheat growing model components, and XTM description fragment of component entity file information, and among this, the wheat growing model number is M001, its corresponding software component number is C001, and its corresponding binary entity file name is CDeve-Wheat_1.1.3.dll.

```
<topic id="M001/ModelClass">
  <instanceOf>
    <topicRef xmlns:xlink="#2_ME/ModelClass" />
  </instanceOf>
  <baseName> <baseNameString>Development Class</baseNameString> </baseName>
  <baseName> <baseNameString>M001/ Development Clsaal </baseNameString> </baseName>
</topic>
```

Fig. 4. The topic of wheat development model class for the M001

```
<association id="M001_C001_association">
<instanceOf><topicRefxmlns:xlink="#100_Model-Component..Explain  Associate"  /></instanceOf>
  <member> <roleSpec> <topicRef xmlns:xlink="#Model_Role"/> </roleSpec>
     <topicRef xmlns:xlink="#M001/ModelID">
  </member>
  <member> <roleSpec> <topicRef xmlns:xlink="#Com_Role"/> </roleSpec>
     <topicRef xmlns:xlink="#C001/ComID">
  </member>
</association>
```

Fig. 5. The association between the M001 and C001

```
<topic id="C001/ComID">
<occurrence>
  <instanceOf> <topicRef xmlns:xlink="#ComFile_4"/> </instanceOf>
  <resourceData>CDeve-Wheat_1.1.3.dll</resourceData>
</occurrence>
</topic>
```

Fig. 6. The occurrence of component entity for the C001

5 Conclusion

This study proposed a new approach for agriculture model description and representation with coordination of software components and topic maps. initially converted the agriculture model-base to topic map library, formed the data document by using XTM semantic notation.

(1) Combined with Jade Bird Component Model, the study formed DM-AMCL that is metadata of TM-AMCL. The faceted description is four domains. Associated description includes five kinds of association types. The unified description of agriculture model base information is initially realized.

(2) The organization framework and build process of TM-AMCL are raised. The DM-AMCL information is mapped to MTM, the LATM is created through the instances of DM-AMCL, the GATM and CTM are formed by using emerging algorithms. The study supply reference mode to different agricultural models developed by using different technologies in the network environment.

(3) The agriculture model is converted to the XTM document data, and provided the network information exchange means and the uniform access to data for developers of intelligent decision support system, managers of agriculture models, agricultural research organizations, and the computing system.

Acknowledgments

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Theory of Double Sampling Applied to Main Crops Acreage Monitoring at National Scale Based on 3S in China—CT316

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Abstract. Grain production is of great importance to any country, especially to China. It is very important for local and central governments to get accurate main crops acreage information in time. One noticeable problem is that the estimated accuracy for crops acreage in a certain year is not high, so that Remote Sensing Applications Centre (RSAC) has to use investigated data of crops acreage of two consecutive years to estimate the change rate of crops acreage.

Aiming at the issue, the theory of double sampling based on operational crops acreage investigation was brought forward by RSAC. The paper has given detailed account of the theory and a typical case. In the double sampling method, the first sampling is to estimate the proportion of small features spatially distributing in crops fields in order to purify the samples acting as basis units for calculation in the second sampling. The second sampling is called a kind of stratified sampling which is used to estimate the crops acreage. The test is by adopting the theory of double sampling with 3S to evaluate the planting acreage of cotton and late-rice, acting as representatives of main crops in China, related to operative task and project research. The experiment result described with statistic methods shows that the theory of double sampling applied to main crops acreage monitoring can efficiently improve the estimated accuracy of crops acreage.

Keywords: Theory of double sampling, Small features, Stratified sampling, estimated accuracy, estimated error, 3S.

1 Introduction

It is evidently significant that crops acreage has been highly paid attention in China due to the great number of population. For this reason, the estimated accuracy of crops acreage is an important issue discussed or researched by institutes or academies in China. The influence is not clear to the estimated accuracy of crops acreage

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by improving one or several techniques due to the restrict of RS itself in the operational monitoring system, so RSAC attempts to innovate active technology system to raise the monitoring accuracy by applying the theory of double sampling [1].

1.1 Using the Method of Stratified Sampling to Estimate Crops Acreage

The operational estimation of crops acreage is mainly carried out by RSAC in China. Based on 3S RSAC mainly adopts one method which is called stratified sampling to obtain the acreage information of main crops such as wheat, corn, cotton, soybean, rice, etc. [1] [2] [3].

The stratified sampling is a kind of sampling method for estimating investigated collectivity information such as sum of crops acreage [4]. The key step is to select background data to stratify. As soon as the background data for stratified sampling is selected, the sampling units are determined. RSAC mainly selects a sort of background data for stratified sampling which is the latest land-use data in vector format.

When the vector data of land-use is selected as background data, RSAC operate the method as the following steps. Firstly, it is to select the sampling unit such as the frame of relief map used by RSAC. Secondly, the land-use data must be assembled with the frame of relief map in GIS.

Thirdly, it is to calculate the acreage of objective crop coming from background data, which distributes in every frame of relief map. Furthermore, the result data used to stratify should be sorted in ascending or descending order according to the crop area of every unit. The last step is to stratify with statistic software and obtain layers' information.

The so-called layer is a kind of data set based on the sampling unit. There are obvious differences in sample sizes among all the layers. Meanwhile, the sampling units that belong to a certain layer generally distribute relatively concentrated. For example, the map in figure 5 shows the spatial distribution of six layers of Xinjiang province's cotton plots, in which sampling unit is the quadrangle frame of relief map with the scale 1: 25000. When the distribution map of layers has been finished, the next step is to confirm where and how many RS images should be ordered. The position of RS images can be determined using the distribution map and the quantity can be obtained from the parameters table produced by stratified sampling.

The last step is to interpreter the images covering the spatial sampling units with RS and then perform calculation according to the stratified sampling rules using the data produced by RS images interpretation and the parameters table.

1.2 Small Features and the Theory of Double Sampling

As set forth, samples used to calculate for estimating investigating collectivity should be paid more attention. Although the calculation process is ruled by the stratified sampling theory, on a large scale, the sample quality will directly affect the investigation result. The sample quality, called sample purity by RSAC, means that the samples probably contain some other features except objective features [5][6]. RSAC has realized that the issue of sample purity mainly originates from small features distributing in crops fields.

The small features mainly include varied field roads, ditches, dykes, graveyards, isolated pools, and other unused small plots. Some small features are shown below by photos in figure 1. Obviously, there is of relevance between small features with the spatial resolution of RS images [7] [8] [9]. One extreme situation is that there will be not small features if the high resolution RS images such as Quick Bird would be acted as data resource to extract crops acreage because total features would be discriminated and their acreage would be calculated. However, when to select one kind of RS data resource in operational work, the most important factor that need to be considered is spatial resolution, which determines monitoring accuracy, time and cost. RSAC has mainly selected Landsat-TM and SPOT images acted as RS data resource for many years. Therefore, the small features issue all along exists [1] [3].

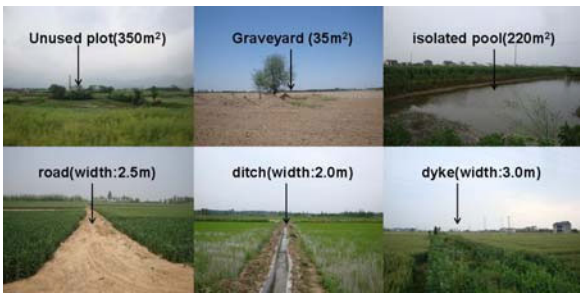

Fig. 1. Some small features in fields

Based on the issues of sample purity and small features, RSAC put forward the theory of double sampling. The first sampling is to estimate the acreage proportion of small features spatially distributing in crops fields in order to purify the samples acted as basis units for calculation in the second sampling. The second sampling is stratified sampling mentioned above which is used to estimating the collectivity of crops acreage. The process of double sampling is illustrated by the flow chart shown below in figure 2.

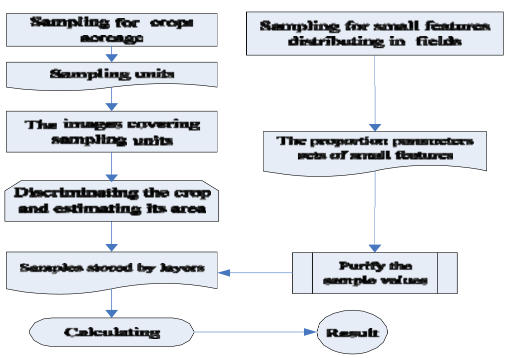

Fig. 2. Flow chart of double sampling

2 Methods

The theory of double sampling derived from productive work should be applied to the productive process. It means that the experiment of the theory should be combined with operational monitoring of crops acreage. As the second sampling mentioned above is necessary steps or process in operational work, the main problem needed to be considered is how to design the test of the first sampling aimed at small features in order to purify the samples.

2.1 The Scheme of the First Sampling for Small Features

In addition to RS technique, RSAC also adopts ground random sampling to estimate crops acreage every year [4]. Ground Random Sampling (GRS) with GPS is an independent and assistant method. The use of GRS can make up the disadvantage of RS such as images covered by clouds. What's more, ground sampling can provide independent information of agricultural condition such as crops area. The GRS' sampling unit is designed to polygons that are regularly located on farmland all over the productive regions of main crops by RSAC.

The GRS sample unit structure is mainly made up of natural borderlines such as road, ditch, dyke, ribbing, etc. The acreage of each polygon unit maybe consisted of many polygons is about 25 hectare. The sampling unit, called a sample, contains varied features of land- use, which are main crops, other crops, and small features. When all the features of the sample collected by GPS are input into GIS, the acreage of small features can be immediately extracted. The sample unit structure is shown below in figure 3. The small features can be easily found in the samples.

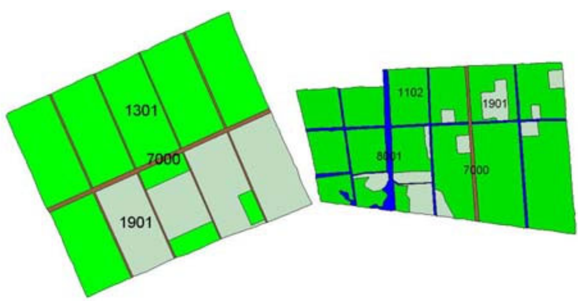

Fig. 3. The structure of sampling units

In the figure consisted of two maps, the codes shown in figure 3 indicate different types of land-use. The code of 1102 indicates paddy field for late-rice, the codes of 7000 indicate roods, the code of 8001 indicates a ditch, the code of 1301 indicates cotton field, and the codes of 1901 indicate other plots of crops.

As RSAC has a large number samples coming from GRS distributed on main crops fields in China, the proportions of small features based on these samples are easily calculated by GIS, which can be reasonably used to modify the values of samples coming from the second sampling according to some rules. Thus, the first sampling for small features can be finished by way of using the existing GRS samples collected with GPS by RSAC in the recent years.

2.2 Confirming Small Features in RS Images

Before extracting the acreage of small features, an important issue which is how to confirm small features needs to be resolved. It means that some parameters should be set up. It is clear that the issue of small features is closely related to the spatial resolution of RS images [1]. Only some features can be called small features which can not be discriminated in given RS images acted as one kind of data resource for extracting acreage of objective features such as crops plots. Figure 4 shows the situation of the small features in RS images covered by vector maps of interpretation and ground samples for cotton and late-rice.

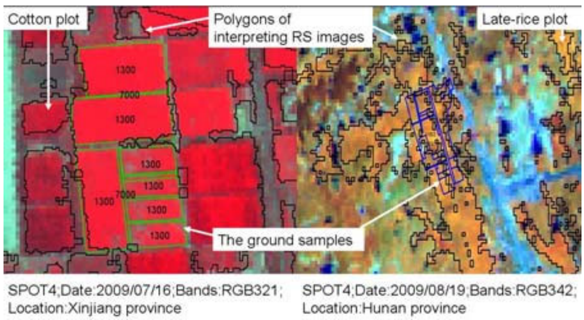

Fig. 4. The small features in RS images

RSAC mainly uses RS images of middle spatial resolution such as Land-sat TM, SPOT, CBERS, etc. in the operational work process. According to the productive demands, the threshold values of small features has been decided by researching a large number of RS images used in operational work combining with ground truth got by GPS. The parameter is shown below in table 1.

Table 1. The threshold parameters of small features

Items	The polygonal small feature acreage(square meter)	The linear small feature width(meter)
Values	Below 1600	0.5-20.0

According to the parameters of small features, it should be paid more attention to discriminate small features for calculating their acreage.

2.3 The Project of the Second Sampling for Main Crops Acreage Estimation

The second sampling is directed at crops acreage which is called stratified sampling used by RSAC for many years. In this experiment of the double sampling, the second sampling work doesn't need to do repeatedly. The method has been presented above in the introduction, processed data and result produced by RSAC can be directly applied to the experiment.

3 The Experiment for the Theory of Double Sampling

The experiment includes two samplings aiming at different objectives. Different methods and data will be used. The experiment result of main crops acreage estimation will be compared with the result directly derived from stratified sampling which can be called traditional method. Cotton selected on behalf of crops on dry land acts as the objective crop which planting acreage in 2009 will be estimated using double sampling. So does late-rice standing for crops on paddy fields.

3.1 The First Sampling for Small Features on Fields of Cotton and Late-Rice

Cotton and late-rice are planted on different farmland which distributes on different geographic and climatic regions in China. The planting habits and methods are also different between the two crops. Therefore, the small features needed to be respectively processed may be different about their acreage proportion on fields.

3.1.1 Sampling for Small Features on Cotton Fields

In 2009, RSAC had investigated cotton acreage of 7 provinces of China using 3S. So, all GRS samples of 2009 distributed on the provinces have been checked up and modified if some needs to be amended according to objective situation. On the basis of the threshold values of small features, the work of calculating the acreage proportion of small features has been completed by using computers with manual assisted methods. The first sampling for small features on cotton fields has been accomplished via transferring the GRS samples finished by RSAC in 2009. The statistic result is shown below in table 2.

Table 2. The proportion of the small features on cotton fields

Regions	Samples	Proportions
Middle & East China	629	0.0451
Middle China	188	0.0477
North China	232	0.0295
Provinces		
Xinjiang	209	0.0488
Anhui	57	0.0294
Jiangsu	67	0.0653
Hubei	64	0.0387
Shandong	54	0.0471
Henan	90	0.0339
Hebei	88	0.0140

3.1.2 Sampling for Small Feature on Late-Rice Fields

Late-rice acreage of 14 provinces of China has been estimated in 2009 using stratified sampling with 3S by RSAC. All GRS samples of 2009 distributed on provinces of 14 have also been checked up and updated to meet the experiment's needs. Adopting the same methods and threshold parameters of the small features, the acreage proportion of the small features has been calculated. Thus, the first sampling for small features on late-rice fields has been completed by means of using the GRS samples achieved by RSAC in 2009. The statistic result is shown below in table 3.

Table 3. The proportion of the small features on late-rice

Regions	samples	Proportions
Provinces of 14	831	0.0418
Middle China	397	0.0451
South China	207	0.0384
Southwest China	107	0.0429
Northeast China	120	0.0357
Provinces		
Zhejiang	73	0.0512
Anhui	60	0.0310
Jiangxi	65	0.0387
Hubei	59	0.0319
Hunan	67	0.0300
Guangdong	66	0.0461
Guangxi	81	0.0296
Hainan	60	0.0419
Liaoning	30	0.0618
Jilin	30	0.0235
Heilongjiang	60	0.0301
Jiangsu	73	0.0617
Chongqing	34	0.0269
Sichuan	73	0.0500

3.2 The Second Sampling for Cotton and Late-Rice

The second sampling named stratified sampling for cotton & late-rice also had been finished in the process of operational monitoring tasks by RSAC in 2009. Samples of the second sampling are frames of relief map containing vector data of cotton & late-rice derived from RS images, since sampling units were designed to frames of relief map spatially distributed on farmland in China. The process is presented below when cotton is selected to act as an example.

Cotton as a kind of main crops mainly distributes in middle & east of China and Xinjiang province. In 2009, provinces of 7 were investigated for the acreage of cotton. Four statistic collectivities were designed in the light of demands of data analysis and application. As a result, data sets of 4 were produced about the stratified information for statistic. The collectivities of 4 can be easily found in table 2. As an instance, figure 5 shows the state of the second sampling for cotton when Xinjiang province is selected to act as the investigation collectivity. At the same time, the stratified parameters and practical samples in 2009 are shown in table 4.

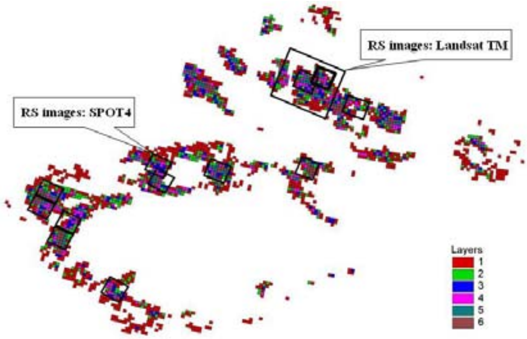

Fig. 5. The second sampling information

In this map, the distribution of layers and RS images is shown above at the same time. RS images including Landsat TM and SPOT4 spatially distribute in each layer. Total samples amounts to 404 in 2009. The detailed figure of each layer is shown below in table 4.

Table 4. The stratified and practical information

Layers	samples			Rate of sampling
	Total	Minimum	Practical	
1	1050	23	55	0.0221
2	335	7	66	
3	229	5	64	
4	211	5	77	
5	173	4	75	
6	142	3	67	

3.3 To Purify the Samples of the Second Sampling

When the acreage proportions of small features of cotton & late-rice have been achieved, the next step is to update the value of every sample of the second sampling using the parameters presented in table 2 and table 3. It is easy to understand that the effect is better using the parameters coming from smaller spatial regions than larger ones. Accordingly, all samples of every province have been updated via taking off the acreage of small features with the parameters coming from the same province. This process is called samples purification [1].

3.4 Calculating the Acreage of Cotton and Late-Rice

The method of calculating the acreage of cotton & late- rice is same as the one adopted by RSAC before. The only difference is that the sample values. Consequently, the estimated results of acreage of cotton & late-rice are also different. The formula is shown below.

$$\hat{Y} = \sum_{h=1}^{L} \sum_{j=1}^{N_h} \left(\frac{1}{n_h} \sum_{i=1}^{n_h} y_{hi} \right) \tag{1}$$

Where

y_{hi}= the crop acreage of unit i of the h layer
N_h= total number of sampling units of the h layer
$\hat{Y}$= estimate value of total area of the collectivity
L = total number of the layers
$h = 1, 2, \ldots, L$
n_h= the amount of samples of the h layer

The difference of estimated results of cotton and late- rice, which derived from the difference between the two sets figures produced by the double sampling and traditional method in 2009, is revealed below in the following figures and tables.

4 Results and Discussion

It is necessary to compare the result from the double sampling with the one from traditional method produced by RSAC. The figures of two sets should be analyzed with statistic methods. Conclusion of the experiment of the double sampling will be produced with believable reasons.

4.1 *t* Test

The essential point of the double sampling is the fact that the sample values originating from the stratified sampling are updated relative to the one produced without using the double sampling. Due to the sample values existing in the form of pairs of figures, thus, using t test based on pairs of figures it is possible to estimate whether the method of the double sampling is statistically significantly better than the one adopted by RSAC before. The formula of t test based on pairs of figures is shown below.

$$|t| = \left| \frac{\bar{d} - 0}{s / \sqrt{n}} \right| \geq t_{\alpha/2}(n-1) \tag{2}$$

Where

$\bar{d}$ = average of difference between pairs of figures
s = standard deviation of d
n = the amount of samples
$\alpha = 0.01$

The main figures derived from the process of t test of the experiment of cotton are shown below in table 5.

Table 5. The result of t test to cotton unit: ha

Region	Samples	$\bar{d}$	s	t
6 Provinces	204	120.7	171.8	10.04
Xinjiang	404	113.0	68.9	32.99
Middle China	78	152.0	188.5	6.84
North China	127	108.6	162.3	7.52

The main figures produced by using the above formula to process data of late-rice are shown below in table 6.

Table 6. The result of t test to late-rice unit: ha

Region	Samples	$\bar{d}$	s	t
14 Provinces	661	168.8	227.2	19.34
Middle China	240	237.6	212.6	17.28
South China	43	85.8	54.8	11.93
Southwest China	108	192.4	246.6	8.11
Northeast China	270	100.0	204.8	8.02

When the statistically significant level is seleced to be 0.01, the critical values of t are shown below.

$$t_{0.005}(n > 45) \approx Z_{0.005} = 2.58$$
$$t_{0.005}(42) = 2.6981$$

From table 5 & table 6, it is clear that two methods have extremely marked difference to all situations of cotton & late-rice.

4.2 Error Estimation

Based the t test, it is important conclusion that the estimated acreage results produced by double sampling are more trustworthy than the one produced by traditional method. So, the estimated error can be calculated by using the results acted as truth produced by double sampling and will be assessed from two aspects of time and spatiality in following chapters.

4.2.1 At Time Sequence

The distribution of small features keeps stable at spatial regions in several years. That means the acreage proportions of small features can be used to recent years relative to the year in which the small features is investigated. So, with the proportion parameters of small features produced by RSAC in 2009 the cotton & late-rice sample data from 2006 to 2008 produced by RSAC in operational tasks has also been updated. The updated data is used to calculate the acreage of cotton & late-rice again. Thus, the estimated errors derived from the small features about cotton and late- rice can be calculated via comparing the several years' data at time sequence.

Figure 6 shows three years' estimated errors to cotton acreage and the four years' estimated errors to late-rice acreage is shown in figure 7.

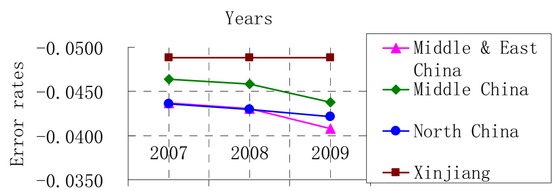

Fig. 6. The estimated errors of cotton at time sequence

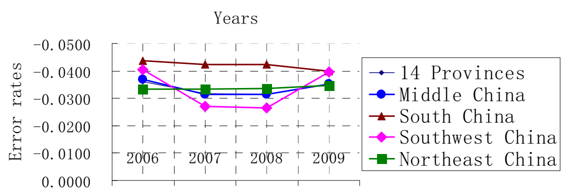

Fig. 7. The estimated errors of late-rice at time sequence

From figure 6 and figure 7, on the whole, it is revealed that the estimated errors about the total acreage of cotton & late-rice are relatively stable at time sequence. However, the error rates generally tend to descend although the one of southwest China is not normal. The reason for the descending of errors rates may be that the proportion parameters of the small features bring errors which are smaller in near year than in early years when the small features were investigated.

4.2.2 At Spatial Sequence

Meanwhile, the estimated errors for the acreage of cotton & late-rice also can be analyzed at spatial points. It is evident that the estimated errors are different along with the difference of spatial geographic regions where crops grow. The errors mainly originate from two points ,which one is the process of estimating the error of the small features and the other is the one of interpreting RS images [10] [11] [12]. So, it is also significant to make analysis for the difference at spatial regions. Figure 8 shows four regions' estimated errors of cotton acreage and the five regions' estimated errors of late-rice acreage is shown in figure 9.

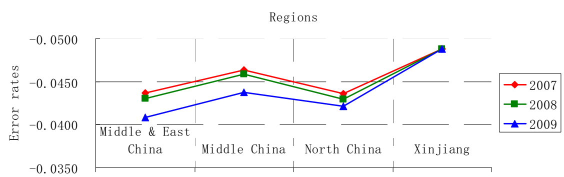

Fig. 8. The estimated errors of cotton at spatial sequence

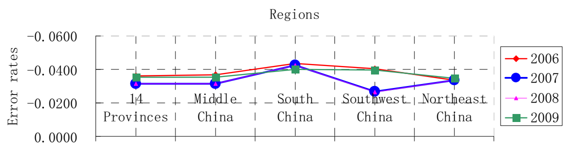

Fig. 9. The estimated errors of late-rice at spatial sequence

From figure 8 and figure 9, on the whole, it is revealed that the difference of estimated errors about the total acreage of the cotton & late-rice are not large at spatial sequence. This situation is more evident to late-rice than to cotton. However, the error rates lightly vary among these regions. The estimated error to cotton of North China is the lowest while the one to Xinjiang province is the highest. For late-rice, the estimated error to South China is relatively evidently higher than the one to other regions.

4.2.3 The Interval Estimation for the Errors

The estimated errors of acreage of cotton & late-rice can be calculated via processing the data derived from the experiment at last. That means the investigating accuracy of cotton & late-rice produced by RSAC can be estimated at numerical level. The interval estimations for the errors are shown below in table 7 and table 8.

Table 7. The estimated errors of cotton

Regions	Average	The interval
Middle & East China	-0.0425	-0.0462 ~ -0.0388
Middle China	-0.0453	-0.0488 ~ -0.0419
North China	-0.0429	-0.0448 ~ -0.0410
Xinjiang	-0.0488	-0.0488 ~ -0.0488
Average	-0.0457	-0.0474 ~ -0.0439

Table 8. The estimated errors of late-rice

Regions	Average	The interval
Provinces of 14	-0.0337	-0.0376 ~ -0.0298
Middle China	-0.0337	-0.0381 ~ -0.0294
South China	-0.0421	-0.0445 ~ -0.0397
Southwest China	-0.0334	-0.0455 ~ -0.0212
Northeast China	-0.0338	-0.0347 ~ -0.0329
Average	-0.0357	-0.0399 ~ -0.0316

5 Conclusion

The theory of double sampling is directed aiming at resolving the problem of small features distributing in fields where crops grow. The proportion parameters of small features probably hold errors produced by the designing of the first sampling including sampling units, sample amounts, sample distributions, and so on. Therefore, the error needed to be estimated would be transferred to the last result of acreage estimation.

Double sampling method is proved statistically better than the traditional means adopted by RSAC in the process of estimating the main crops acreage such as cotton & late-rice at national scale.

The traditional method brought about the estimated error at 4.57% in monitoring cotton acreage on main productive regions in China. It means that the estimated figure derived from traditional method is 4.57% larger than the one produced by using the double sampling. Meanwhile, the figure of late-rice is 3.57%. In other words, the estimated accuracy of acreage for the main crops can be raised in the operational task if the theory of double sampling is applied, and the estimated accuracy of cotton can be raised 4.57% or so while the one of late-rice can be raised about 3.57%.

However, studies on small features derived from operational work have made great progress although new problem appears and needs to be considered.

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Three-Dimensional Visualization of Soil Electrical Conductivity Variation by VRML

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Abstract. High quality three-dimensional (3-D) earth data is very important for environmental assessment studies, precision agriculture and water quality simulation modeling. In the present study, the soil apparent electrical conductivity (ECa) inversed by the EM38 linear model from aboveground EM38 measurements were selected as the data source of 3-D spatial variability. Firstly, the sphere model which built by VRML approach was used to present the 3-D distributed ECa sites. Then, the plume model was built with the help of EVS, which presents soil volume of ECa greater than a certain value. The VRML models presented a superior visualization of spatial distribution of ECa in 3-D space that 2-D interpolation can't achieve. It was shown that the field in the east corner and low salinity level in the west and northern corner of the field has a high salinity level. The salinity increased with the increase of the soil depth at the vertical direction. At last, the vrml models were placed on a WWW server, which can be opened and accessed by anyone. Using WWW to transfer information to the public is considered as a very important and practical method.

Keywords: Electrical Conductivity, Three-dimensional Variation, Three-dimensional Visualization, VRML.

1 Introduction

Soil salinization limits the growing of crops, constrains agricultural productivity (Amezketa, 2006). In the coastal land with which we are concerned, Yu et al. (1996) found that the salt profile of the upper 100cm is a good diagnostic of the suitability of the soil for arable crops. So, anyone assessing soil for farming needs to consider simultaneously the lateral and vertical variation in salt concentration. He or she needs to be able to describe and map three-dimensional distributions.

The three-dimensionality of soil is widely acknowledged. Thousands of papers and reports record variation of soil property, but almost all of the study only surveyed the variation at the soil surface. Many research studies use a 2-D design of soil maps to address a 3-D problem (Oliver & Webster, 2006). Meirvenne et al. (2003) analyzed the three dimensional variability of soil nitrate in an agricultural field by the three dimensional ordinary kriging method. But these types of study are quite few in soil science.

There is need for high quality three-dimensional earth data for environmental assessment studies, precision agriculture and water quality simulation modeling (Grunwald et al, 2003). We can think of several reasons why pedometricians have

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been reluctant to study soil properties in three dimensions at the field scale. One of the difficulties is visualization. How do you display the results of three-dimensional interpolation? Soil variation at different depth in profile or at one direction was presented by slice model only (Nash, 1988; Liu, 2002). Soil was shown as a non-continuum in these types of visualization results. Meirvenne et al. (2003) made some improvement. A ‘grid’ model was built to presenting the 3-D variability of soil nitrate. However, it won't be enough in the 3-D visualization.

Virtual Reality Modeling Language (VRML) is a computer language developed for 3-D graphics applications, which is suitable for stand-alone or browser-based interactive viewing. It had been widely used in other subject disciplines, such as Geology, Architecture, and so on. Grundwald and Barak (2003) presented a 3-D soil landscape using VRML. Application of virtual reality to soil variation will make possible the precise recognition of the distribution of soil salinity.

So, the objective of this study was to investigate the use of VRML, to create 3-D soil landscape models for presenting the soil salinity variation in a costal saline land.

2 Materials and Methods

2.1 Study Area

The land in the coastal zone of Zheijang province south of China's Hangzhou Gulf of the Yangtse delta is formed of recent marine and fluvial deposits. The soil is dominantly light loam or sandy loam with a sand content of about 60%. It is also saline, with large concentrations of Na and Mg salts (in many places >1%). Over the past 30 years much of this zone has been enclosed and reclaimed for agriculture under a series of projects. For this study we chose a field of 2 ha in the north of Shangyu City that was reclaimed in 1996 and used for paddy rice. Its coordinates are 30°90´N, 120 ° 48´W (Fig. 1).

2.2 Sampling

56 soil profiles were collected after the rice was harvested in December 2006. Each site was geo-referenced using a Trimble Global Positioning System (Fig. 1). Ninety-six EM38 readings were taken at each site: the receiver end of the EM38 was aligned in the four directions of the compass *(N, NE, S, and SE)* in both the horizontal (EM_H) and vertical (EM_V) coil-mode configurations and at heights of 0, 10, 20, 30, 40, 50, 60, 75, 90, 100, 120 and 150 cm above the soil surface.

2.3 VRML Method

VRML is a programming language and library for 3-D computer graphics and has many functions. VRML 2.0 was published in August 1996 by the International Standards Organization's (ISO) JTC1/SC24 committee and was accepted as the current ISO standard under the name 'VRML 97' (Carey and Bell, 1997).Virtual reality modeling language is a 3-D analog to Hypertext Markup Language (HTML), an open-standard 3-D graphics language, which uses the object-oriented paradigm. VRML code is hierarchical, portable and modular. It can be integrated into any World Wide Web (WWW) browser using VRML plug-ins. Within the VRML-capable browser, the user

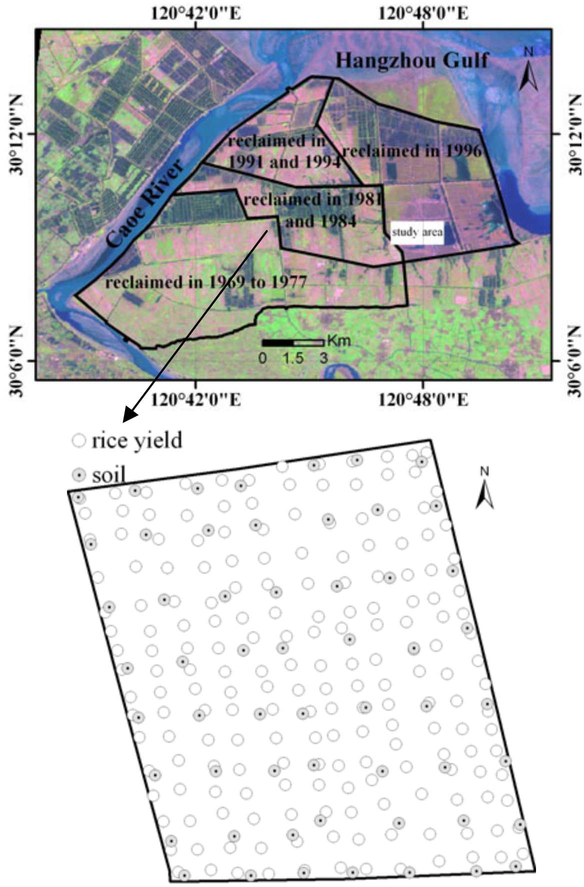


Fig. 1. The study area and spatial distribution of soil sampling sites

can move around these VRML 'worlds' in three dimensions, scale and rotate objects and the view updates in real-time. The capabilities of VRML include 3-D interactive animation; 3-D worlds (scenes) comprising of several different 3-D objects; scaling of objects; material properties and texture mapping for 3-D objects; setting of different viewpoints and use of light sources and much more (Lemay et al., 1999).

The key elements of the VRML language are nodes that describe shapes, colors, lights, viewpoints, how to position and orient shapes, animation timers, interpolators, etc. and their properties in a world.

In VRML, 3-D objects are models extending in three dimensions. A VRML object has a form or geometry that defines its 3-D structure (Ames et al., 1997). Coordinates of objects are defined using a 3-D coordinate system with x, y and z-axis. The Shape node specifies the 3-D geometry of an object.

The VRML uses the RGB (red (R), green (G) and blue (B)) classification system to specify the amount of red, green and blue light to mix together to produce a color. The color field of the *IndexedFaceSet node* and *Material node* specifies RGB values as three floating-point values, each one between 0.0 and 1.0.

2.4 VRML and Visualization Procedure

The process of ECa variation 3-D visualization was shown in Fig. 2.

(1) The linear model with the inverse procedure was adopted to predict the depth electrical conductivity of the 56 sites at the depth of 5, 15, 25, 35, 45, 55, 67.5, 82.5, 95 and 110 cm. That's not we are interested in, the author had finished in his past research (Li et al., 2008). The ECa profiles were selected as the datum resource of 3-D variation and 3-D visualization.

(2) A 3-D anisotropic variogram was constructed which consisted of an isotropic nugget effect and three spherical models by the help of Gslib 2.0. Also, the author had finished in his past research (Li et al., 2010).

(3) We used Environmental Visualization Software (EVS Standard Version; Huntington Beach, CA) to export the geometry of 3-D objects. Surfaces were created using 3-D ordinary kriging (Li et al., 2010). The 3-D model was converted to VRML format.

(4) The VRML program was reedited in the software VrmlPad 2.1. The parameters of background, viewpoint, rotation, and transform can be changed if necessary.

(5) Our VRML soil salinity models were loaded into the Internet Explorer 7 (and higher) with Cortona VRML Client 5.1.

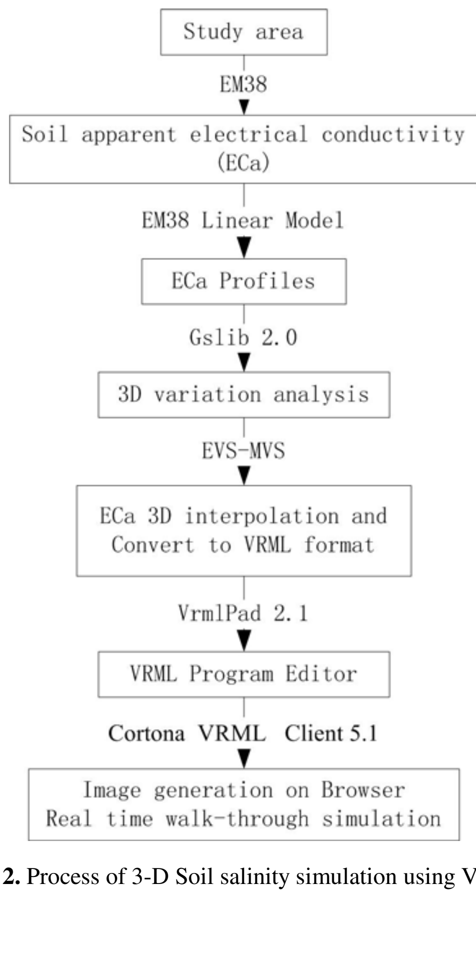


Fig. 2. Process of 3-D Soil salinity simulation using VRML

3 Results

3.1 Visualization of Virtual Environment

To show the x, y, and z dimension of VRML soil salinity models, we should build a 3-D coordinate system model. A polyhedron model was used to express the border of the study area, and the *IndexedLineSet* node was used to build the prototype. The coordinate was defined by the *Coordinate node*, and the values of the 3-D coordinate were set by the Field point. At last, for move, zoom in, zoom out, and rotate the prototype conveniently, a Transform group node was redefined. Part of the code as fellow:

```
DEF box Transform {
 translation 0 0 0
     scale 1 1 1
     rotation 0 0 1 1
 children [
           Shape {
appearance DEF box_app Appearance {
 material Material {emissiveColor 1 1 1 } }
               geometry IndexedLineSet {
              coord Coordinate {
                  point [
                    224.25  578.50  -57.62,
                    406.84  578.50  -57.62,
                    406.84  750.25  -57.62,
                          ......] }
                  coordIndex [
0, 1, -1,
                    2, 3, -1,
                    4, 5, -1,
                          ......] }}]}
```

The virtual environment of the coordinate system was shown in Fig. 3. Since the VRML code is hierarchical, portable and modular, the model can be used in the fellow ECa visualization.

3.2 Visualization of ECa Profiles

The linear model inversed ECa at the depth of 5, 15, 25, 35, 45, 55, 67.5, 82.5, 95 and 110 cm is the datum resources of 3-D variation. The sphere prototype was designed to

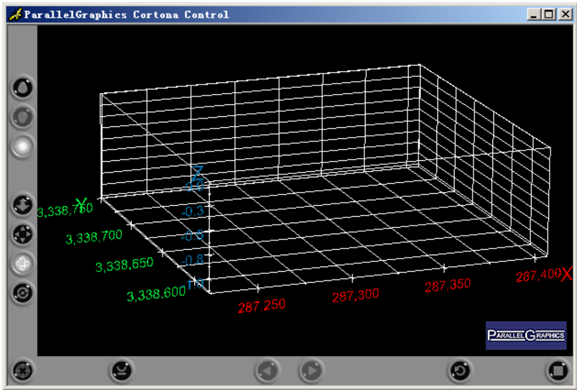


Fig. 3. Virtual environment of coordinate system

express these 460 inversed sites. One site was defined by one Transform node. The Shape node was component by several fields, such as appearance Apperance, geometry, and Sphere_s. The ECa value was rendered by the color, and the *diffuseColor field* which decided by three values was used for the visualization of soil ECa models. In addition, the settled value of *diffuseColor field* is same as the legend value which versus the same ECa. Part of the code as follow:

```
DEF post_samples_Samples Transform {
 translation -6.98522 -8.18395 25.6605
 scale 0.0381559 0.0381560 0.0381559
 rotation -0.98782 0.10516 0.11465 1.2187
 children [
  Transform {
   translation 321 740.5 -2.5
   children [
    Shape {
     appearance Appearance {
      material Material {
       ambientIntensity 0.301
       diffuseColor 0 0.028 0.7
      }      }
     geometry DEF _s Sphere {
     radius 2
     }    }   ]    }
......}
```

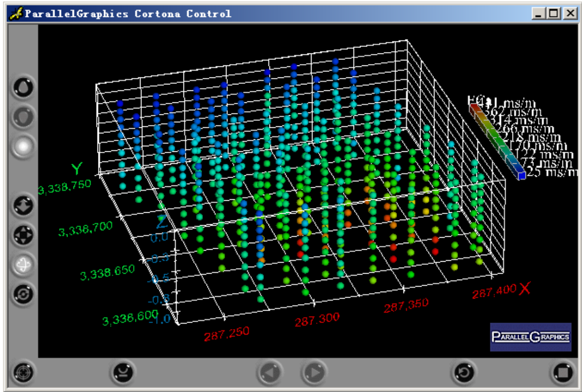


Fig. 4. Visualization of ECa profiles

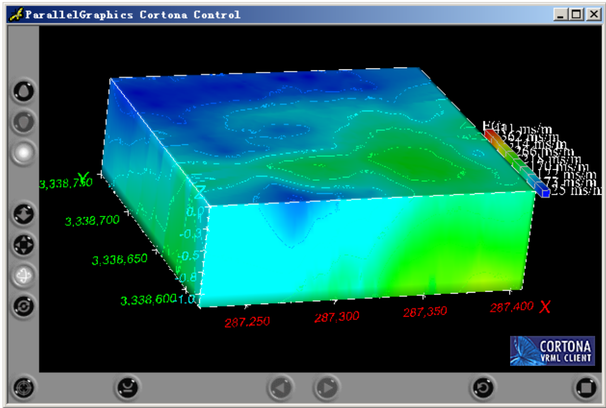
The ECa profiles were shown in Fig. 4. The disturibution of ECa can be seen more clearly in 3-D space. The higher ECa, the higher the salinity is. The deeper the depth is, the larger the soil average ECa is. The map of ECa displayed a spatial distribution with a high salinity level in the east corner and low salinity level in the west and northern corner of the field. Obviously, the salinity in the bottom of southeast is relative high in this study area.

3.3 Visualization of ECa 3-D Variation

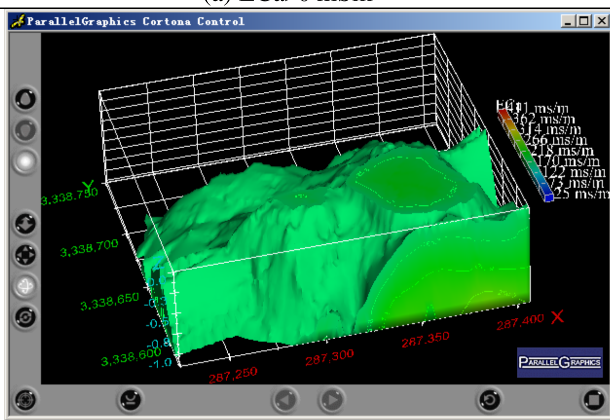
The plume model was adopted to express the 3-D ECa variation. The *Indexedfaceset node* was used to establish the surface of the plume. The same as the ECa profiles model, the ECa value was rendered by the color, and the *diffuseColor field* was used for the visualization of soil ECa models.

Fig. 5(a), (b), and (c) showed the volume of soil where the ECa was greater than 0 mSm^{-1}, 170 mSm^{-1}, and 300 mSm^{-1}, respectively. The Anchor node acts as the trigger, helping us analyze the ECa change dynamically. For example, if we click the Fig. 5(a), the screen was cut from it to the Fig. 5(b). Part of the code as follow:

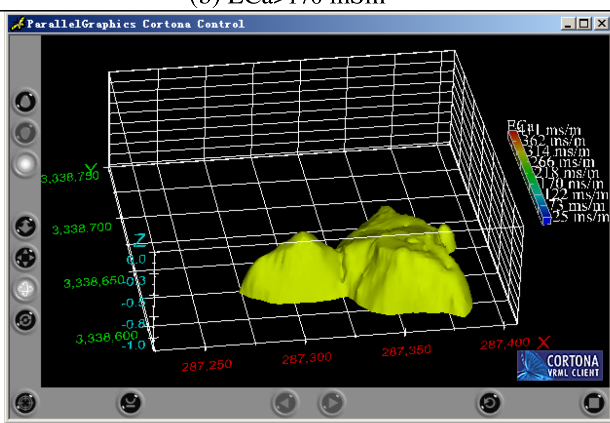
```
Anchor {
 url "EC170.wrl" # EC170.wrl is the VRML
#program file name of Fig.5(b).
 children [    ……  #The program code of Figure
                   #5(a) should be include into ‘[]’
 ] }
```



(a) ECa>0 mSm^{-1}



(b) ECa>170 mSm^{-1}



(c) ECa>300 mSm^{-1}

Fig. 5. Visualization of ECa variation

As expected, the prediction volume of soil shrinks as the specified ECa thresholds increased. This is a very important method which can be used to evaluate soil salinity in 3-D space. Obviously, the salinity in the bottom of southeast is relative high in this study area.

3.4 Communication on the WWW

The VRML programs made in this study were placed on a WWW server. The soil salinity model in this study can be opened and be accessed by anyone. Using WWW to transfer information to the public is considered as a very important and practical method, and the VRML soil landscape models are accessible via the WWW at http://agri.zju.edu.cn/vrml.html.

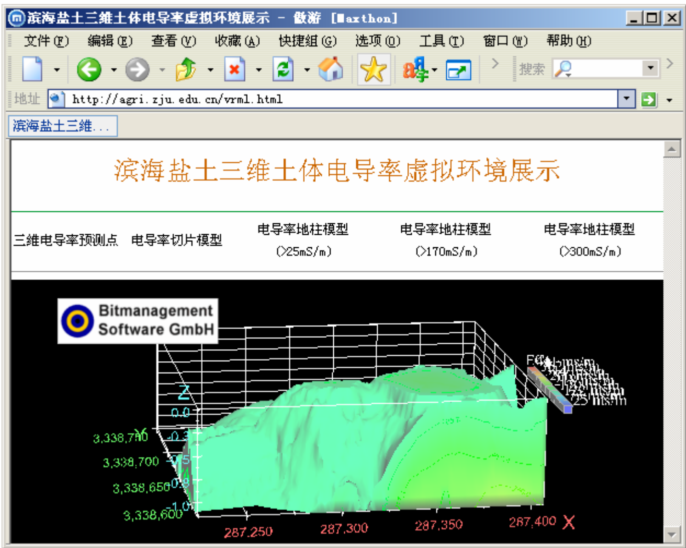


Fig. 6. Internet distribution interface of the ECa

4 Conclusions

In this study, it was summarized a procedure that from 3-D distributed sites to 3-D visualization salinity model.

The object-oriented 3-D graphics language VRML was used to create 3-D soil salinity models. The sphere and plume model was built for presenting the ECa sites and ECa variation, respectively. The VRML models presented a superior visualization of spatial distribution of ECa in 3-D space. It was shown that the field in the east corner and low salinity level in the west and northern corner of the field has a high salinity level. The salinity increased with the increase of the soil depth at the vertical direction.

VRML was so attractive for soil salinity modeling because: (1) it creates realistic 3-D virtual reality, (2) what is more important to us, the VRML models can be placed on the WWW. It is very convenient for the public to access the soil salinity information, and (3) soil salinity models have merit for soil information systems updating, helping for soil site-specific management.

We were able to create coherent 3-D ECa models using VRML. This study investigated relatively static ECa property; however, the potential to visualize 3-D transport processes within and on soils using animated VRML movie techniques is enormous.

Acknowledgements

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Towards Developing an Edible Fungi Factory HACCP MIS Base on RFID Technology

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Abstract. According to the low yield of edible fungus and the poor quality of edible fungi in factory, the production management situation in edible fungi factory was analyzed. Then the solution of edible fungi factory HACCP(Hazard Analysis Critical Control Point) MIS(management information system) based on RFID(Radio Frequency Identification) technology was presented. Edible fungi production process by the hazard analysis to determine the raw materials, burden mix materials and bottling, inoculation, culture, and growth as the critical control points. For each critical control points, respectively, to develop appropriate critical limits, clearly defined monitoring objects, methods, frequency and corrective measures, critical control point of information collection for the use of RFID technology. Through the implementation of HACCP MIS, edible fungi yield and quality have improved.

Keywords: edible fungi factory, HACCP, MIS, RFID.

1 Introduction

Edible fungi factory mode of production in the 1970s originated in Japan, it is a biotechnology, automation engineering, information technology, eco-technology, processing maintaining freshness technology in one integrated system [1]. Industrial production of edible fungi is a traditional agricultural and modern industrial production of a product of the combination with the characteristics of industrial production, production targets at the same time it is with life. Industrial production of edible fungi and the development of advanced scientific and technological progress, as well as the development of special equipment and use, making the form of the production of great changes have taken place to achieve seasonal hand from the original workshop production of the anniversary of the modern industrial-scale supply changes in production methods [7]. Since the 1990s, factory production of edible fungi in China have been developing rapidly and has now become in the world the biggest edible fungus producer country and exporter country [4], the edible fungus output value is situated sixth in the crop production [12]. Edible fungi production technology has

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brought production management to new issues and challenges: how to improve the quantity and quality of edible fungi products, ensure food safety.

The Pillsbury Company encountered this dilemma in the 1960s in its attempts to fulfill several food production contracts with the US Army and the National Aeronautics and Space Administration (NASA). NASA in particular had very stringent microbiological acceptance criteria, not wanting to risk the illness of an astronaut during a space mission (what an inopportune time for a ‘‘two-bucket’’ illness!). In essence, nothing short of 100% product testing could assure NASA that a particular packet of food was safe to consume. It was obvious to all involved that product testing could not be used to guarantee food safety. A much better system of food safety assurance was required.

Thus, the genesis of the HACCP concept, a joint development by The Pillsbury Company, the US Army, and NASA. Unlike QC systems, HACCP is a preventive system in which food safety can be designed into the product and the process by which it is produced. It is a system of product design and process control. The HACCP system of food safety is very active at controlling identified hazards. Most importantly, it does not rely upon product testing to assure food safety. Over the next three decades, the HACCP system spread into the food processing industry of the US, and into other countries [13].

At present, some Chinese edible fungi production factory have passed the HACCP system certification, but the lack of security on the impact of edible fungi of the various critical control points of information for automatic acquisition, quality control in artificial acquisition, the text records stage, the impact of the implementation of the HACCP system. It is therefore based on the RFID technology of production of edible fungi HACCP intelligent monitoring system, to improve production efficiency and produce safe and high quality agricultural products are of the significance.

RFID radio frequency identification technology is in the 1990s began to rise an automatic recognition technology, is a RF signal through spatial coupling (alternating magnetic field or electromagnetic field) implementation of the non-contact information is passed, and do pass it to achieve the objective recognition technology. In industrial automation control, the RFID technology has been widely used [8], it can meet modern industrial production in the process of information uniquely identifying the needs of article uniqueness, you can use to monitor the product in the various processes in the status of implementation of the total quality product tracking, mastering the operations of the finished records and parts of the installation of the record, after sales maintenance records for more information, such as refrigerator manufacturing [10], automobile production [11] and so on; you can start from the item the production process of instockroom per conjections data to be accurate, timely of acquisition and recording, processing, and timely feedback from instockroom to grasp items online, in products, methylpyrrolidine, outstockroom of State and location, and implementation of the item's track and on the implementation of the plan steps strict control.

HACCP MIS system and the integration of RFID technology can improve the real-time data acquisition CCPs, the HACCP MIS system to improve quality control on the credibility of the entire software system to improve sensitivity, improve data accuracy; also can be dynamically updated or rewritten in the packaging or the label information, that does not need manual intervention, or do not have to be completed in the visual environment of the scanning of product information, can provide the service process to further simplify and the automated tool [2,3].

2 Edible Fungi Factory Production Process

Edible fungi factory production process can be divided into pre-vaccination, inoculation and mycelial growth and fruiting the three links, respectively, corresponding to the places of production workshops, inoculation rooms and mushroom houses, the basic process shown in Fig 1. More edible fungi factory production, will every aspect of the final product quality and production of edible fungi have a decisive impact [11].

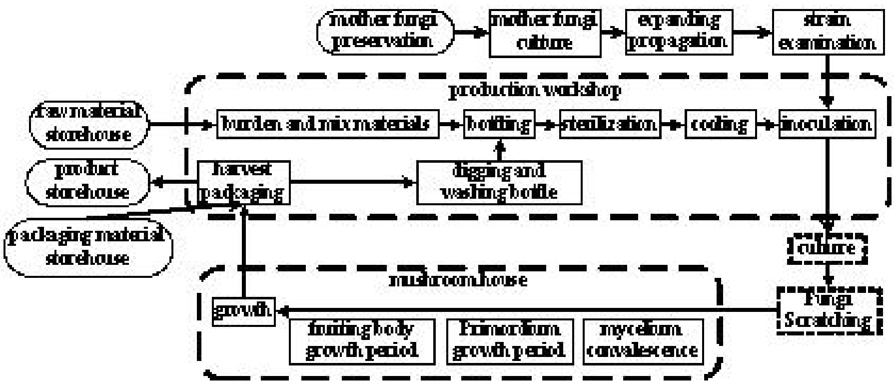

Fig. 1. Put a figure in a "Figure" style, followed by a "Figure Caption"

3 Edible Fungi Factory Production Quality Management Needs Analysis

Industrial production of edible fungi production and management of the main problems is rooted in the manual method of data collection, production workshop, inoculation room, mushroom house and other data mainly paper-based carrier, and its record is mainly manual records. Industrial production of edible fungi are widespread information and records management manual mass automatic access to environmental information and preservation of the issue cannot be matched, with advanced methods of data collection is to enhance the production of edible fungi factory management level of the principal means of RFID technology and its production and management systems in the following areas:

3.1 Real-Time Status of the Batch in the Products

Need to be able to achieve the quality of the real-time monitoring, the quality of automatically generated reports, the quality of statistics on the cause of the problem occurred and those responsible; to keep abreast of the current link in the production of products for each batch in the number of products, realizes the goods in process quantity report form accurate statistics.

3.2 On the Production Process to Achieve Monitoring and Correction of Deviation from the Threshold

Monitoring mixes the material and Culture Collection training and so on, need to know specifically what a batch of edible fungi in the growth of the current state of how the growth of environmental conditions, has deviated from the threshold, the need for corrective adjustment.

3.3 Real-Time Understanding Production Schedule

To keep abreast of current edible fungi production in every link of production, as well as each production link's to be whether balanced, personnel's of assignment is whether reasonable, whether needs to carry on the production scheduling and the follow up mission arrangement.

3.4 Reduces the Workshop and the Mushroom Room Management Workload

Realizes the management carefully, records each Production workshop and the mushroom room edible fungi production situation promptly, in order to carries on the contrastive analysis with the control system record's capacity for large real-time environmental data, realizes the prompt statistics to each kind of report form, reduces the workshop and the mushroom room management workload.

4 CCPS and Their Corresponding Threshold

Industrial production of edible fungi in the use of a large number of automation equipment, such as the automatic bottling machine, the vaccination machine, mushroom house control equipment, automatic air conditioning and humidifier, any equipment failures may affect the product quality and safety [9]. Shanghai Finc Bio-tech lnc. is mainly engaged in Hypsizgus marmoreus cultivation factory production, has been through ISO9001: 2000 certification, constructed the GMP Production workshop, has established the HACCP system, and Table 1 for the critical control points and the threshold. RFID based on the HACCP MIS factory production of edible fungi have been the whole process of monitoring, including information on raw materials, the operator, operation date, process technological parameter, deviation information, product character, products batch excellent rate, fraction defective and delivery inspection situation. Key to affect the product quality security the key aspect to set up corrected an error automatically the reset function, and the product entire production process prompt unmistakable record, to produce the superintendent to provide promptly the ideal management tool, also has provided the important basis for the product post-sale quality follow-up and the data analysis [1].

Table 1. Critical Control Point and the threshold

CCP No.	Name	threshold
CCP 1	Annual inspection of raw materials situation	Record
CCP 2	Bottled water	63%-65%
CCP 3	PH value of bottling	6-6.8
CCP 4	The average weight of bottling	625-650g
CCP 5	Mixing temperature	118-121℃
CCP 6	Sterilization time	10min
CCP 7	Culture contamination rate of the Housing	1%
CCP 8	Scratch fungi water	1cm
CCP 9	PH value of fungi to scratch	5.5-6.0
CCP 10	The ninth day reminder lei (sensory)	Record
CCP 11	Cover mushrooms tumor (incidence)	Record
CCP 12	Storage temperature	2-5℃
CCP13	Fresh air filter case	Record
CCP 14	Colony growth	Record
CCP 15	Uniformity (scratch bacteria first 16 days of total fruiting situation)	Record

5 Edible Fungi Factory Production Quality Management Needs Analysis

This According to the edible fungi factory production's characteristic, proposed based on RFID technical HACCP MIS solution. The system mainly carries on the quality control and the production schedule control, but also involves the productive plan management, the workshop management, the mushroom house management, the man management and so on, needs to carry on the massive essential data handle work. As shown in Fig. 2.

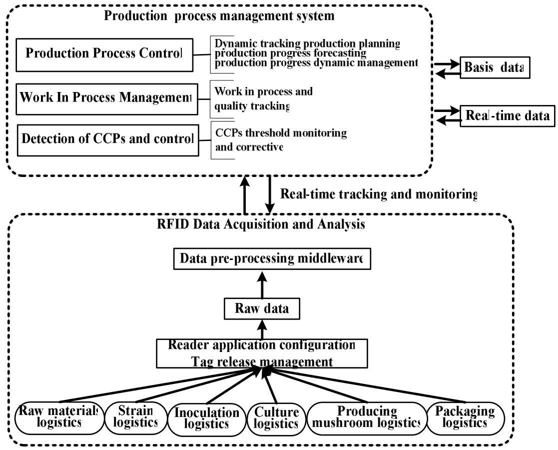

Fig. 2. Structure of edible fungi factory HACCP MIS based on RFID

5.1. RFID Application

The RFID applications are mainly located at the bottom of HACCP MIS; face the workshop level's production process, coupled with the sensor indicators on the threshold of CCPs for the collection and recording. It emphasized that the refinement and implementation of HACCP, controls the workshop production process, the management of products, protection of the quality and safety of edible fungi. The overall goal of RFID-based HACCP MIS is to enable enterprise managers and workers will be able to timely and accurate grasp of the production of edible fungi, edible fungi of the quality and safety of the situation, the main links are as follows:

5.1.1 RFID Tags Issued

In the beginning of links, for each batch of raw materials paid by an RFID tag, according to different sources of raw materials, different types, different quality standards and other information written to the RFID tags and database; the beginning of the mother fungi preservation of relevant information will be written into the RFID tag and the database; After the bottling, the turnover box as a unit for issuing an RFID tag, will each box edible fungi cultivation information write to the RFID tags and database, write the information, including production dates, types of raw materials, raw material batch, formula type, vaccination information, edible fungi scratching information, growth information.

5.1.2 Production Link Record

In workshop or a mushroom house access place establishment a long-range RFID reader, once the raw materials, mother fungi or the turnover box with RFID tags to get into the area, RFID reader will be able to automatically written to RFID tags and automatically recorded the beginning time and relevant information.

5.1.3 Production Process Information Record

In warehouses, burden and mix materials workshops, bottling workshops, sterilization room, inoculation room and so on, set of long-range RFID reader, when this place has the products in process with RFID tag enters, RFID reader will be able to automatic recording the time of completes the work in the database and the related information. Manually issuing RFID tags before the raw materials into the warehouses, and other links using a turnover box be fixed RFID tags, without additional manual operation, it can be achieved on the production process of the logistics and the quality monitoring, the monitoring granularity may achieve the box level.

5.2 The Edible Fungi Factory the CCPs Management and the Quality Control

HACCP system made a series of effects of edible fungi product safety, health, and quality control of CCPs, including requirements relating to the use of materials, water safety, production environmental conditions, such as heavy metal content of raw materials, process parameters temperature, humidity, CO_2 concentration , the water content of raw materials, pH and so on, real-time monitoring and controlling , product traceability records management, were all of the need for supervision, and the CCPs need to cyclical records, large data, through the complete record of man-made and often lags behind some of the information, the impact of the decision-making and the timeliness of corrective action.

HACCP MIS for the management of the various batches of product CCPs, including batch management, CCPs management, CCPs threshold, history records inquiry and so on functions. Users can set up in accordance with the lot numbers of products critical control points and control point threshold, automatic monitoring of control points, if in the production process, the control point value more than threshold, the system immediately report to the user, at the same time to start correcting control system automation. The system can reduce the workload of the quality of management, reduce the production and the quality control cost.

5.3 Quality Traceability

Through HACCP MIS application, in production management module establishment batches of product information management, in the software sorting each batches of product according to the production date, to the parameters of each process to monitor, record and statistics, and statistical data timely input into the system, simultaneously it the deviation which and the correcting an error event has in the production process, saves automatically to this product file, forms the complete production process file. This provides with convenient channels and the most convenient tool. And the realization of the production quality traceability, enhanced the product quality confidence level, but also lets the consumer be able to feel relieved.

5.4 Monitoring of Environmental Parameters

The environment parameter refers to edible fungi habitat each kind of parameter, including the temperature, the humidity, CO_2 and the strength of illumination and so on, the output result indicated by the concrete value and the curve diagram form, clear perspicuity. And may act according to the time selection historical situation parameter record, the early alarm management including the environment alarm range setting, the environment exceptionally reports to user, alarm record processing, alarm record inquiry. Moreover, this module also has the establishment to allow the environment parameter variation range, when the environment parameter variation surpasses the range scope or has the unusual circumstance, the system will report to the user. The environment monitoring reduced the manual monitor workload, avoids error which the manual control produces, enhances the early alarm the accuracy.

5.5 Production Environment Monitoring

The use of cameras will be the state of production and the environment in real-time photography, video streaming through the signal transmission to control room server, and in accordance with the actual situation in the production workshop, adjustment photography angle and focal distance. Through video monitoring, production management personnel may in the control room examine that each workshop the production situation, to reduce the scene contact's frequency, to reduce the workload, improve efficiency.

6 Conclusion

RFID technology has developed rapidly in recent years, the RFID technology's application was already getting more and more widespread, the RFID equipment technology mature and the cost reduced causes to use in the RFID technology Production enterprise's informationization managing massively into the possibility. The edible fungi production process management to the edible fungi yield, the quality and safety is critical [5, 15], but whether obtains the edible fungi production process related real-time data is the key.

The HACCP MIS based on RFID has been used in the industrial production of edible fungi, which monitor the process of production to ensure production stability, provide protection to increase productivity, the HACCP MIS development and the application has solved the agricultural product production quality security problem to a great extent, to improve the comprehensive competitiveness of agricultural products, increase agricultural productivity and reduce production costs.

MIS is composed of the human and the computer, to manage information collection, transmission, storage, processing, maintenance and use, the information acquisition method usually needs to be artificially auxiliary. This article studies is the establishment in management information system's foundation to the edible fungi production, has carried on the expansion to information acquisition's way, proposed based on RFID HACCP MIS solution, can real-time and automatic collect information, based on RFID technical management system carries on effectively all-the-way tracking and to plans the execution step to carry on the strict control, safeguards the edible fungi product safety and realizes the product quality safety to trace.

System in the application that there are imperfections, along with the deepening of the application, needs to make the adjustment unceasingly according to the edible fungi factory production actual situation.

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Toxicity of Cu, Pb, and Zn on Seed Germination and Young Seedlings of Wheat (*Triticum aestivum L.*)

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Abstract. Seeds and young seedlings of wheat (*Triticum aestivum L.*) under exposure to Copper (Cu), lead (Pb) and Zinc (Zn) were studied by employing a hydroponic experiment. Addition of Cu or Pb or Zn to the solution inhibited seed germination, plumule and radicle elongation. The toxic of metals to seed germination parameters can be arranged in the rank order of inhibition as follows: Cu > Pb >> Zn. This study showed the contents of chlorophyll and soluble protein in young seedlings of wheat were decreased after 4 d of all heavy metal treatments. Among the tested metals, the toxic of metal to young seedlings was found similar to seeds. All heavy metal concentrations in seedlings increase with their increase in the medium and the duration of treatments. On the other hand, the results demonstrated that the excess accumulation of Cu in leaf and roots could reduce accumulations of zinc (Zn); the excess accumulation of Pb decreased the levels of Cu or Zn in leaf and roots; the excess accumulation of Zn had no influence on Cu accumulations in leaf and roots.

Keywords: Heavy metals, Seed, Germination parameters, Seedling.

1 Introduction

Toxic heavy metals have no function to organism and can be highly toxic when their concentrations are exceeded threshold value. Other heavy metals at low doses are essential micronutrients for plants, but in higher doses they may cause metabolic disorders and growth inhibition for most of the plants species [4, 5]. Researchers have observed that some plants species are endemic to metalliferous soils and can tolerate greater than usual amounts of heavy metals [6]. Several studies have been conducted in order to evaluate the effects of different heavy metal concentrations on live plants [7, 8]. Most of these studies have been conducted using seedlings or adult plants. In a few studies, the seeds have been exposed to the metals [5]. All data shows heavy metals delay the normal growth periods of plants.

Seed germination is a process of crucial importance and as such it must be tightly regulated. In the plant's life cycle, seed is a stage that is well protected against various stresses. However, soon after imbibitions and subsequent vegetative developmental processes, they become stress sensitive in general. Therefore, seeds are equipped with

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sensing mechanisms that allow it to obtain the information required to assure that germination will only occur when environmental factors are favorable to complete developmental processed. The effects of metals in seed germination had been investigated. Li et al. [9] reported toxic heavy metals could significantly inhibit *Arabidopsis thaliana* seed germination, plumule and radicle growth.

The accumulation of metals, the content of total soluble protein, and chlorophyll in wheat seedlings were further examined in order to disclose the toxicity mechanisms of metals in plants. Thereafter, it could be helpful to improve the plant growth security in polluted soil.

2 Materials and Methods

2.1 Plant Materials and Heavy Metal Treatments

The heavy metals used in this study (Cu, Pb and Zn) were in the form of nitrates. Seven concentrations (between 0 and 250 mM) of each metal were used in this study. The selected concentrations of Cu, Pb and Zn were 0.5 1, 10, 50, 100 and 250 mM, respectively. For each treatment, the pH was adjusted to 6.5. Wheat seeds were purchased from a local seed market. The seeds were sterilized in 10% Na-hypochlorite solution for 20 min to prevent fungal growth, washed with distilled water for several changes.

A second hydroid culture experiment was performed to determine whether the supply of Cu, Pb and Zn would inhibit seedling growth (e.g. Chlorophyll and soluble protein content) or whether descend mineral nutrient metal uptake. Ten-day-old wheat seedlings were exposed to Cu, Pb and Zn (1 and 50 mM, respectively) and studied during 4 d.

2.2 Determination of Germination Parameters

Seed germination and shoot/root elongation test on filter paper was carried out in glass Petri dishes (90 × 15 mm) with three layers of filter paper on the bottom. Each dish contained 9 mL of metal solution or 9 mL of distilled water (control), and 100 seeds, covered by lid. Petri dishes containing seeds were incubated for 8 d in a dark chamber at 28 ºC ± 1 ºC. Number of geminated seeds was counted 3 d after the treatments. Radicle and plumule lengths were recorded at 4 d, 6d and 8d. Each treatment was in triplicate.

2.3 Determination of Metal Contents

The uniform wheat seedlings at 4 d after the treatments were immerged in ice Tris-Mes solution for 15 min, rinsed with demonized water thoroughly, and then plant material was dried at 70 °C for 2 d, weighed and then milled. Samples were digested in a 3 : 1 mixture of HNO_3 : $HClO_4$. The digests were used to determine cations, by ICP-OES. All measurements were repeated in triplicate.

2.4 Determination of Chlorophyll and Protein

Total chlorophylls were extracted with 80% acetone and estimated according to Arnon [10]. Total soluble protein content was determined by the method of Bradford [11] using BSA as a standard.

3 Results and Discussion

3.1 Effects of Heavy Metals on Wheat Seed Germination

The germination percentages of wheat seeds exposed to different concentrations of metals were given in Table 1. The seed germination rate over control decreased significantly with increasing metal concentration. The toxic of metals to seed germination parameters can be arranged in the rank order of inhibition as follows: Cu > Pb >> Zn. Germination inhibitory rate of Cu increased by 4.9%, 6.3%, 26.7%, 64.8%, 100% and 100% at 0.5, 1, 10, 50, 100 and 250 mM, respectively; the increase was 0.6%, 0.7%, 1.9%, 8.7%, 17.7% and 47.9% at 0.5, 1, 10, 50, 100 and 250 mM, respectively, for Zn; and the increase 5.3%, 9.7%, 13.9%, 53.7, 81.3% and 100% at 0.5, 1, 10, 50, 100 and 250 mM, respectively, for Pb. The seed germination rate was found no affected by Cu and Pb at lower concentrations of 0.5 and 1 mM, while significantly affected by Cu and Pb at higher concentration of metal ranging from 10 to 250 mM. Wheat seed was able to germinate at all Zn concentration evaluated, even at a concentration 250 mM in this study. Jadia and Fulekar [12] obtained similar results in a study using Cd, Cu, Ni, Pb and Zn on sunflower seeds. Salvatore et al. [3] also reported low metal concentrations were observed to have no effect on seed germination while the inhibiting effect of heavy metals on seed germination was tested at high concentrations, such as to reduce the germination percentage.

Table 1. Seed germination rate (%) compared to the control at different heavy metal concentration

Metal dose (mM)	Cu		Pb		Zn	
	Germination rate (%)	Inhibitory rate (%)	Germination rate (%)	Inhibitory rate (%)	Germination rate (%)	Inhibitory rate (%)
0	100.0 ± 5.6	0	100.0 ± 5.6	0	100.0 ± 5.6	0
0.5	95.1 ± 2.6	4.9	94.7 ± 1.5	5.3	99.3 ± 0.6	0.6
1.0	93.7 ± 1.2	6.3	90.3 ± 2.4	9.7	99.3 ± 0.6	0.7
10.0	73.3 ± 7.6	26.7	86.1 ± 1.2	13.9	98.1 ± 1.7	1.9
50.0	35.2 ± 5.1	64.8	46.3 ± 1.0	53.7	91.3 ± 1.5	8.7
100.0	n.d.	100	18.7 ± 6	81.3	82.3 ± 2.5	17.7
250.0	n.d.	100	n.d.	100.	52.1 ± 1.9	47.9

The data of seed germination rate are means s.e. from three experiments.

3.2 Effects of Heavy Metals on Seedling Growth

In the present experiment, the toxicological effects of metals (Cu, Pb, Zn) on the wheat seedling root and shoot growth were observed. The inhibitory effects of metals on the radicle and plumule lengths of young seedlings were evaluated (Table 2 and 3). Based on these values, metals can be arranged in a rank order of inhibition as follows: Cu > Pb >> Zn. The metal toxic rank of plumule elongation is similar with the result of radicle elongation; the only difference is the three metal concentrations which caused significant inhibition for plumule growth was much higher than that for radicle growth. That can be explained that metal accumulation in roots of wheat seedling was more than those of in leaves under the same metal treatment.

Table 2. Effect of metals on radicle elongation of wheat on filter Paper

Metal		4 d		6 d		8 d	
	Dose (mM)	Radicle length (cm)	Inhibitory rate (%)	Radicle length (cm)	Inhibitory rate (%)	Radicle length (cm)	Inhibitory rate (%)
Cu	0	3.7±0.9	0.0	7.6 ± 0.5	0.0	9.7 ± 0.3	0.0
	0.5	1.7 ± 0.5	54.1	1.8 ± 0.2	76.3	2.2 ± 0.1	77.3
	1.0	0.8 ± 0.1	78.4	1.2 ± 0.2	84.2	1.4 ± 0.3	85.6
	10.0	n.d.	100.0	n.d.	100.0	n.d.	100.0
	50.0	n.d.	100.0	n.d.	100.0	n.d.	100.0
	100.0	n.d.	100.0	n.d.	100.0	n.d.	100.0
	250.0	n.d.	100.0	n.d.	100.0	n.d.	100.0
Pb	0	3.7	0.0	7.6 ± 0.5	0.0	9.7 ± 0.3	0.0
	0.5	3.4 ± 0.2	8.1	6.4 ± 0.2	15.8	7.9 ± 0.5	18.6
	1.0	2.5 ± 0.1	32.4	5.9 ± 0.7	22.4	6.0 ± 0.3	38.1
	10.0	0.2 ± 0.0	94.6	0.1 ± 0.0	98.7	0.2 ± 0.1	97.9
	50.0	n.d.	100.0	n.d.	100.0	n.d.	100.0
	100.0	n.d.	100.0	n.d.	100.0	n.d.	100.0
	250.0	n.d.	100.0	n.d.	100.0	n.d.	100.0
Zn	0	3.7 ± 0.2	0.0	7.6 ± 0.5	0.0	9.7 ± 0.3	0.0
	0.5	4.5 ± 0.1	-21.6	5.0 ± 0.2	34.2	6.2 ± 0.4	36.1
	1.0	3.6 ± 0.1	2.7	4.8 ± 0.4	36.8	6.1 ± 0.7	37.1
	10.0	0.6 ± 0.0	83.8	0.7 ± 0.5	90.8	0.8 ± 0.2	91.8
	50.0	0.3 ± 0.0	91.9	0.3 ± 0.1	96.1	0.3 ± 0.1	96.9
	100.0	0.2 ± 0.0	94.6	0.2 ± 0.0	97.4	0.2 ± 0.0	97.9
	250.0	n.d.	100.0	n.d.	100.0	n.d.	100.0

The data of radicle elongation are means ± s. e. from three experiments.

Fargašová [4] reported mustard seedlings (*Sinapis alba L.*) exhibited some symptoms of metal toxicity (e.g. reduced growth, chlorosis). The toxicity effect of the trace elements on the mustard seedling growth was, in descending order of damage, Cu > Se > Cd > Zn >> Pb. Cu is introduced as very toxic metals to many plants [13] and this statement was fully confirmed during our experiments with wheat seedlings. A good agreement for the Cu inhibitory effect was found for the root and shoot elongation of wheat seedlings as compared with those reported by Fargašová [4] for mustard seedlings. However, the difference was in the position of Zn, which was for mustard introduced as more toxic than Pb. Zinc indicated the lowest inhibitory effect on the root and shoot elongation of wheat in our tests corresponds with the values introduced by Mahmood et al. [14]. Even, Zn at 0.5 mM concentration promoted the root growth over the control root size by approximately 22.9% at the 4 dth of treatment. The similar effect also was reported by Jadia and Fulekar [12].

Table 3. Effect of metals on plumule elongation of wheat on filter Paper

Metal	Dose (mM)	4 d Plumule length (cm)	4 d Inhibitory rate (%)	6 d Plumule length (cm)	6 d Inhibitory rate (%)	8 d Plumule length (cm)	8 d Inhibitory rate (%)
Cu	0	3.2±0.5	0.0	6.5±1.3	0.0	10.1±1.8	0.0
	0.5	2.9±0.5	9.4	3.2±1.0	50.8	6.8±0.8	32.7
	1.0	1.3±0.2	59.4	3.2±0.8	50.8	5.7±0.7	43.6
	10.0	n.d.	100.0	n.d.	100.0	n.d.	100.0
	50.0	n.d.	100.0	n.d.	100.0	n.d.	100.0
	100.0	n.d.	100.0	n.d.	100.0	n.d.	100.0
	250.0	n.d.	100.0	n.d.	100.0	n.d.	100.0
Pb	0	3.2±0.5	0.0	6.5±1.3	0.0	10.1±1.8	0.0
	0.5	2.9±0.4	9.4	4.5±0.7	30.8	8.6±1.3	14.9
	1.0	2.7±0.5	15.6	4.2±0.8	35.4	8.2±1.8	18.8
	10.0	0.6±0.1	81.3	2.3±0.7	64.6	4.0±1.0	60.4
	50.0	n.d.	100.0	n.d.	100.0	n.d.	100.0
	100.0	n.d.	100.0	n.d.	100.0	n.d.	100.0
	250.0	n.d.	100.0	n.d.	100.0	n.d.	100.0
Zn	0	3.2±0.5	0.0	6.5±1.3	0.0	10.1±1.8	0.0
	0.5	2.9±0.5	9.4	3.5±1.7	46.2	7.6±1.2	24.8
	1.0	2.1±0.3	34.4	2.7±0.8	58.5	6.7±1.0	33.7
	10.0	1.4±0.3	56.3	2.1±0.4	67.7	2.9±1.0	71.3
	50.0	0.7±0.1	78.1	1.1±0.2	83.1	1.7±0.5	83.2
	100.0	0.2±0.1	93.8	0.3±0.1	95.4	0.4±0.1	96.0
	250.0	n.d.	100.0	n.d.	100.0	n.d.	100.0

The data of plumule elongation are means ± s. e. from three experiments.

3.3 Cu, Pb and Zn in Wheat Plants

In general, all heavy metal concentrations in seedlings increase with their increase in the medium and the duration of treatments (Table 4). The heavy metals, Cu, Pb and Zn were taken up by shoot and root both; and all metal concentrations were found to be higher in roots. The heavy metals were untaken by the wheat plants in the following order: Zn > Cu > Pb. Jadia and Fulekar [12] demonstrated the heavy metals were accumulated by the sunflower plants in the following order: Zn > Cu > Cd > Ni > Pb and this rank order corresponds with the results obtained for wheat in here presented study. On the other hand, the results demonstrated that the excess accumulation of Cu in leaf and roots could reduce the level of zinc (Zn); the excess accumulation of Pb decreased the level of Cu or Zn in leaf and roots; the excess accumulation of Zn had no influence on Cu accumulations in leaf and roots.

Normal and phytotoxic concentrations of Pb, Zn and Cu were reported by Levy et al. [15], which were 0.5 - 10 and 30 - 300mg kg^{-1} for Pb, 3 - 30 and 20 - 100mg kg^{-1} for Cu, and 10 - 150 and > 100 mg kg^{-1} for Zn. In the present study, Cu and Pb were observed that they could interfere with the absorption process of Zn or Cu as nutrient element when heavy metal concentration in wheat seedling is higher than the normal or phytotoxic levels.

Heavy metals can bind strongly to oxygen, nitrogen and sulphur atoms. Because of these feature, heavy metals can inactivate enzymes by binding to cysteine residues and block the essential biological function of enzyme. Heavy metal can also displace the essential metal ions in bimolecular. Many enzymes contain metals in positions important for their activity. Therefore, the displacement of one metal by another will normally also lead to inhibition or loss of enzyme activities [16]. Goyer [17] introduced lead may interact metabolically with nutritionally essential metals and replace zinc on heme enzymes.

The displacement mechanism of toxicity is best explained by classification of the metal ions according to their binding preference, i.e. oxygen-seekong class A metals, nitrogen- or sulfur- seeking class B metals, and the bordenline metals show more or less the same preference of bonding to O-, S-or N-containing ligands [18]. The class B (Cu and Pb) metals readily displace either borderline (Zn) or class A (Mg or Ca) metals from essential binding sites through much more tenacious bonding mechanisms. Borderline metals become toxicants when they displace Class A metals from essential binding sites in biomolecular, bonding to these sites more strongly. Besides, they are the most effective binders to SH group and nitrogen containing groups at the catalytically active centers in the enzymes.

3.4 Effects of Metals on Total Soluble Protein and Chlorophyll (a+b) Content of Wheat

The alteration of total soluble protein level in leaves of wheat seedlings was presented in Table 5. Total soluble protein levels and the inhibition rate in leaves decreased significantly with increasing concentrations and treatment time of metals in solution. The toxicity effect of metal on total soluble protein was arranged in a rank order of inhibition as follow: Cu> Pb >Zn. There was a negative correlation between metal concentration and total soluble protein content in leaves of wheat seedlings.

The data of the chlorophyll content of the wheat seedlings exposed to differing concentrations of metals were also shown in Table 5. Heavy metals accumulation in plants can result in a decrease of the chlorophyll concentration in the leaves/stems [19]. In the present study, chlorophyll (a+b) content declined progressively with increasing concentrations of heavy metals. Cu accumulation showed a significant inhibitory effect on chlorophyll (a+b). An insignificant decrease in chlorophyll content in wheat seedlings was observed after Zn and Pb accumulation, especially Zn. The statement was supported by Shakya et al. report [20]. Zinc has long been considered to be one of the least toxic metals in the environment [21]. Compared with level of metal application, the toxicity of metals is distinguished from different applied concentrations. The most toxic metal among three metals is Cu at 1 mM dose. Pb is the most toxic metal at 50 mM, although, Pb accumulation in leaves is obviously lower than others metals accumulation after 4 d treatment. High concentrations of Cu are known to activate oxidative damage and alter cell-membrane properties by lipid peroxidation, thereby demonstrating the inhibitory effect on the enzymes involved in chlorophyll production. Lead can be toxic to photosynthetic activity, chlorophyll synthesis and antioxidant enzymes [22].

Table 4. Effect of metals on the accumulation of metals in leaves and in roots

Time (d)	Heavy metal accumulation (mg gDW^{-1})													
	Cu treatment (mM)				Pb treatment (mM)						Zn treatment (mM)			
	1		50		1			50			1		50	
	Cu	Zn	Cu	Zn	Pb	Cu	Zn	Pb	Cu	Zn	Cu	Zn	Cu	Zn
Leaves														
0	0.012 ± 0.002	0.089 ± 0.011	0.012 ± 0.001	0.089 ± 0.002	0.004 ± 0.001	0.012 ± 0.011	0.089 ± 0.031	0.004 ± 0.001	0.012 ± 0.004	0.089 ± 0.011	0.012 ± 0.001	0.089 ± 0.021	0.012 ± 0.004	0.089 ± 0.035
1	0.029 ± 0.013	0.105 ± 0.061	1.562 ± 0.101	0.071 ± 0.011	0.014 ± 0.006	0.017 ± 0.018	0.168 ± 0.009	0.021 ± 0.014	0.024 ± 0.009	0.229 ± 0.081	0.079 ± 0.031	0.282 ± 0.065	0.026 ± 0.011	4.693 ± 1.801
2	0.067 ± 0.021	0.108 ± 0.027	5.317 ± 0.206	0.218 ± 0.013	0.027 ± 0.008	0.041 ± 0.016	0.165 ± 0.081	0.034 ± 0.013	0.035 ± 0.011	0.170 ± 0.091	0.072 ±0.027	0.292 ± 0.078	0.025 ± 0.009	5.765 ± 1.105
3	0.114 ± 0.001	0.121 ± 0.001	6.546 ± 0.401	0.179 ± 0.043	0.056 ± 0.003	0.042 ± 0.011	0.206 ± 0.161	0.137 ± 0.051	0.017 ± 0.007	0.099 ± 0.044	0.031 ± 0.021	0.302 ± 0.032	0.032 ± 0.021	8.521 ± 2.563
4	0.373 ± 0.022	0.080 ± 0.021	7.670 ± 0.541	0.135 ± 0.031	0.065 ± 0.005	0.012 ± 0.034	0.088 ± 0.081	0.153 ± 0.042	0.013 ± 0.005	0.093 ± 0.034	0.016 ± 0.009	0.295 ± 0.034	0.031 ± 0.019	9.302 ± 1.536
Roots														
0	0.012 ± 0.007	0.089 ± 0.054	0.012 ± 0.001	0.089 ± 0.033	0.004 ± 0.001	0.012 ± 0.001	0.089 ± 0.041	0.004 ± 0.001	0.012 ± 0.001	0.089 ± 0.012	0.012 ± 0.001	0.089 ± 0.001	0.012 ± 0.014	0.089 ± 0.031
1	0.469 ± 0.032	0.332 ± 0.142	2.828 ± 0.931	0.071 ± 0.054	1.241 ± 0.912	0.038 ± 0.011	0.178 ± 0.013	1.347 ± 0.931	0.038 ± 0.007	0.597 ± 0.074	0.072 ± 0.037	1.129 ± 0.001	0.021 ± 0.011	14.539 ± 3.652
2	1.318 ± 0.873	0.449 ± 0.213	7.601 ± 1.032	0.156 ± 0.076	1.512 ± 0.986	0.027 ± 0.011	0.284 ± 0.073	1.699 ± 0.531	0.078 ± 0.015	0.575 ± 0.067	0.074 ± 0.023	1.567 ± 0.001	0.018 ± 0.005	19.155 ± 4.051
3	1.329 ± 0.972	0.371 ± 0.175	8.188 ± 2.043	0.129 ± 0.056	1.742 ± 0.838	0.045 ± 0.043	0.478 ± 0.053	2.263 ± 0.801	0.024 ± 0.013	0.303 ± 0.015	0.047 ± 0.017	2.100 ± 0.001	0.017 ± 0.001	22.514 ± 5.352
4	1.427 ± 0.874	0.334 ± 0.231	9.115 ± 2.045	0.125 ± 0.063	2.043 ± 0.971	0.036 ± 0.031	0.317 ± 0.034	3.123 ± 1.454	0.022 ± 0.009	0.273 ± 0.017	0.038 ± 0.012	2.663 ± 0.001	0.016 ±0.003	23.933 ± 6.432

The data of metal concentrations are means ± s. e. from three experiments.

Table 5. Effect of metals on total soluble protein and chlorophyll (a+b) content of the leaves

Metal	Time (d)	Dose (mM)							
		1				50			
		Chl (a+b) (mg/g FW)	Inhibitory rate (%)	Soluble protein (mg/g FW)	Inhibitory rate (%)	Chl (a+b) (mg/g FW)	Inhibitory rate (%)	Soluble protein (mg/g FW)	Inhibitory rate (%)
Cu									
	0	4.43 ± 0.03	0.0	1.26 ± 0.01	0.0	4.43 ± 0.03	0.00	1.26 ± 0.01	0.0
	1	4.33 ± 0.11	2.2	0.98 ± 0.02	21.6	3.95 ± 0.31	11.3	0.71 ± 0.07	43.6
	2	4.36 ± 0.09	2.5	0.88 ± 0.02	29.7	5.69 ± 0.21	-28.6	0.61 ± 0.03	51.6
	3	2.98 ± 0.06	33.3	0.82 ± 0.03	35.1	4.38 ± 0.25	1.5	0.39 ± 0.0	69.3
	4	2.94 ± 0.03	34.1	0.50 ± 0.06	60.1	2.96 ± 0.08	33.4	0.22 ± 0.06	82.5
Pb									
	0	4.43 ± 0.03	0.0	1.26 ± 0.01	0.0	1.26 ± 0.01	0.0	1.26 ± 0.01	0.0
	1	4.45 ± 0.32	0.0	0.92 ± 0.03	26.8	1.09 ± 0.09	13.1	1.09 ± 0.08	13.1
	2	4.42 ± 0.21	0.0	0.91 ± 0.06	27.3	1.06 ± 0.06	15.3	1.06 ± 0.05	15.3
	3	3.22 ± 0.15	27.2	0.92 ± 0.04	26.4	0.84 ± 0.05	33.4	0.84 ± 0.04	33.4
	4	3.59 ± 0.12	19.1	0.75 ± 0.05	40.1	0.78±0.03	37.6	0.78 ± 0.03	37.6
Zn									
	0	4.43 ± 0.03	0.00	1.26 ± 0.01	0.0	4.43 ± 0.01	0.00	1.26 ± 0.01	0.0
	1	3.66 ± 0.07	17.2	0.87 ± 0.03	30.6	6.45 ± 0.14	-45.2	0.65 ± 0.04	48.2
	2	3.04 ± 0.05	31.4	0.80 ± 0.07	35.9	5.21 ± 0.26	-18.4	0.76 ± 0.03	39.2
	3	3.22 ± 0.03	27.3	0.97 ± 0.03	22.4	5.11 ± 0.32	-15.4	0.39 ± 0.06	69.0
	4	4.57 ± 0.06	-3.1	0.62 ± 0.05	50.8	4.15 ± 0.17	6.5	0.55 ± 0.05	55.9

The data of chlorophyll and protein contents are means ± s. e. from three experiments.

4 Conclusion

In the present study, addition of Cu or Pb or Zn inhibited seed germination, plumule and radicle elongation. The toxic of metals to seed germination parameters can be arranged in the rank order of inhibition as follows: Cu > Pb >> Zn. All heavy metal concentrations in seedlings increase with their increase in the medium and the duration of treatments. The toxic of metals to young seedlings was found similar to seeds. And heavy metal treatments could reduce the contents of chlorophyll and soluble protein in young seedlings of wheat. On the other hand, the results demonstrated that the excess accumulation of Cu in leaf and roots could reduce accumulations of zinc (Zn); the excess accumulation of Pb decreased the levels of Cu or Zn in leaf and roots; the excess accumulation of Zn had no influence on Cu accumulations in leaf and roots.

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Using Data Grid Technology to Build MODIS Data Management System in Agriculture Application

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Abstract. MODIS data is the world's best remote sensing data of free receiving. It plays an important role in agriculture science and application. However, there is a serious problem about duplicated establishment of MODIS data receive station in China, and it has brought a tremendous waste of money. This paper presents research work on utilizing data grid technology to integrate heterogeneous distributed MODIS data sources. We studied and implemented a three-layer structure for data interoperation, and designed the extensible XML-based spatial data access language to support cross-border data computation. We developed the MODIS data catalogue service to facilitate users and improve system performance. The research helps to release the conflict between duplicated establishment of MODIS receiving station and less effectively data sharing.

Keywords: MODIS, agriculture application, data grid, data service.

1 Introduction

As the world's advance earth observation system, MODIS (Moderate Resolution Imaging Spectroradiometer) is a key instrument aboard the Terra and Aqua satellites. MODIS data has high spectral resolution, high spatial resolution and high time resolution, with a total of 44 kinds of image products [1]. Until now, it is the world's best remote sensing data of free receiving. MODIS data plays an important role in agriculture science and application, especially in crop yield estimation, drought and stalk burning monitoring, crop disease and pest monitoring [2][3].

However, there is a serious problem of duplicated establishment of MODIS data receiving station in China. China has constructed 50 MODIS station so far, and plans to establish 80 stations, which is much larger than the US and European countries. The redundant construction has brought a tremendous waste of money.

Using Data Grid technology could take advantages to integrate and share heterogeneous data. It helps to reduce the duplicated establishment cost, and eases the contradictions between data receiver and data user. Thus, it is meaningful to research and develop the MODIS data management and distribution grid system providing support for scientific applications.

This paper introduces a three-layer structure of data management system based on data gird technology, and describes how to design a uniform interface to facilitate access heterogeneous data, without any change to the original data achieve storage.

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The extensible XML-based spatial data access language, which promises the data interoperation, is discussed in a great detail. We use this method in Spatial Information Grid platform for case study, and discuss the MODIS data catalogue service finally.

2 MODIS Data Sharing Status

There is a serious problem of duplicated establishment of MODIS data receiving station in China now. The United States has 16 MODIS receiving stations, which acquiring data fully covered the whole country. Russia has 8 MODIS observation stations. Britain, Germany, France, and Italy have built one station of each, and they share data resources together. However, China has constructed 50 MODIS station so far, and plans to establish 80 stations. The quantity is far beyond the US and Europe. The expenditure of full set MODIS data receiving equipment for each station is about 1 million US dollars. China plans to import a total of 80 sets, and 30 sets have been completed at present.

Since there is not a favorable MODIS data sharing service system, large quantity of data is not take effectively use. The conflict between duplicated establishment of receiving station and less effectively data sharing becomes more and more obvious.

As a resource, the remote sensing data should be used constantly repeat. The research on integration of the existing data and building data sharing platform is a crucial approach to save expenditure and to return the huge investment.

On the other hand, with the strong needs to execute complex computation and cross-border joint data analysis in agriculture application field, it is very necessary to deploy research on geospatial data management and distribution system of scalability and interoperability. Utilizing data grid technology to build MODIS data management and distribution system is a favorable way to solve this problem.

3 The Architecture of MODIS Data Management System

The geospatial data management and distribution system play the role as a bridge to link the data providers and image users. The quality and efficiency of the system directly impact the data utilization and application performance [4].

Traditional spatial information management system mostly use web-based interface to provide services to users. Since the HTML language lacks semantics and not suitable for heterogeneous and distributed data storage, it is powerless when execute and embed distributed remote sensing applications. Open Geospatial Consortium (OGC) organization demonstrate a lot of research work on overcoming the obstacles of geospatial data distribution and heterogonous, by defining inter-operation of spatial information and standards of system framework [5]. However, OGC does not provide resolve strategy on technical means and implementation level. The system utilizing OGC specification not has strong ability to support complex data search and discovery, and difficult to use the interfaces effectively. Thus, it is very necessary to deploy research on building geospatial data system with scalability and interoperability based on Data Grid technology.

The purpose of building MODIS data management system is to provide a data service platform, and collaborate data sources in diverse types and stored across multiple sites. The infrastructure is three-layer architecture, including data source layer, data agent layer and interface layer.

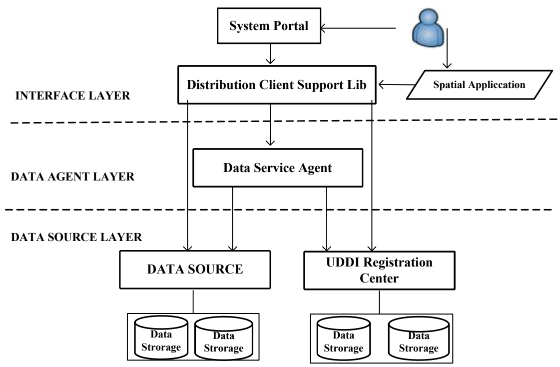

Fig. 1. Three-layer architecture of data distribution system

Data source layer includes data providers and grid resources UDDI[6] registration center. By invoking data service, this layer is defined to provide functions and logic operations as data discover and data access. It not restrict to the specific data providers, or forms of organizations. This layer is able to respond the extensible XML-based spatial data access language, which will give detail description in the following chapter, and to find request or download data. grid resources registration center facilitate data service agent or distribution client to search data image.

Remote sensing data agent can be regarded as a virtual data source. It does not store any remote sensing image, but users can achieve it on multiple data sources at the same time visit. Agent layer is not the necessary component of data distribution system. However, its role can not be underestimated. The information can be analysis, optimize and re-organize from the original data collections. Thus the distribution client can complete data query and access from variety data sources through a more simple and effective approach.

Interface layer include client support library, geospatial applications, user interface and other components. Client support library provide a set of interface easy to use for the development of geospatial applications. Through embedded and invoke client support library, users can discover and download data from different sources and types, and also facilitate the development of various MODIS data applications.

4 Scalability of Data Service Model

4.1 Layer Design of Data Service

The mission of data service is to provide logic support for all the distributed sources, and designed to act as middleware between data providers and users. As a data intensive grid, the capability of data service is essential for improving data discover and access [7].

By analyzing the data flow and control flow, the service processing procedure is decomposed and then composed into some function layers. For each layer, the request and response conditions are loosely defined. We design relatively standard language for data definition as well as parameter specifications, and all I/O parameters are based on XML. In addition, both query and access conditions are loosely defined, which decrease the dependence of specific spatial data storage organization. Therefore, the flexible mechanism and standard interface simplify the task of building applications to manage geospatial data sources, and the extensible capability of data service is ensured [8].

Table 1. Function layer descriptions of data service

Layer Name	Function Description
Application Layer	Grid applications call the data service with specific interface to query and access data information.
ServiceEngineLayer	In charge of allocation grid sources to support and schedule the processing and computing services.
Adapter Layer	Initialize configurations of related connections and environment. Determine the type of geo-data resource.
Geo-dataPartner Interface Layer	Provide wrapper methods for heterogeneous and distributed data sources.

4.2 Extensible XML-Based Spatial Data Access Language

The heterogeneous structure and distributed location are the main two characters of spatial data source which bring much obstacle for data sharing, and take much difficulty for MODIS data integration. Thus, the interface design of MODIS data management and distributed system must have sufficient flexibility and platform independent. The interface is implemented on SOAP and extensible XML based spatial data access language [9].

Typically, the main and most frequently used operations of remote sensing data are data query, access and image view. Based on the data service model we discussed in the above section, the XML Schema of the extensible data access language describes the grammar of data request and respond, as well as the application rules. By invoking the corresponding web service, the request will be transmitted to data sources, and then the analysis of the returning response is also achieved. Figure2 shows an example of MODIS data query.

According to the XML schema of the extensible data access language, data query function use the tag of <query>, <access>, <getCapability>, <getStatus> or <getResult> as the root element, which define the function of data search, download, metadata access and operational status access. The respond message use <response>, <status> and <result> as the root element, and describe the operation commands, status and result respectively. The workflow of data source operation is a three-step process, including sending request, check operational status and access result.

```
1)To send image request
<query>
  <conditions relation=”AND”>
       <condition op=”EQ”>
       <param>satellite</param>
                <value>MODIS</value>
         </condition>
         <condition op=”EQ”>
                <param>date</param>
                <value>2009-07-01</value>
         </condition>
   </conditions>
   <orders>
       <sortBy order=”ASC”>ID</sortBy>
   </orders>
</query>
2)To launch data discover operation and return result ID
<response>
    <operationID>001235864631</operationID>
</response>
3)Client access the processing status
<getStatus>
   <operationID>001235864631</operationID>
</getStatus>
4)Data source return the processing status
<status>
   <operationID>001235864631</operationID>
   <currentStatus>processing</currentStatus>
</status> <!---be in processing -->
<status>
      <operationID>001235864631</operationID>
   <currentStatus>finished</currentStatus>
</status> <!--- be finished -->
5)Client get the discover result
<getResult>   <operationID>001235864631</operationID>
</getResult>
6)Data source send back result info list
<result>
   <operationID>001235864631</operationID>
       <resultSet>
         <item>
              <id>0013256782</id>
              <spacecraft>MODIS</spacecraft>
              <senser>TERRA</senser>
                          ……
         </item>
         ……
         <item>
              <id>0020165784</id>
              ……
         </item>
   </resultSet>
</result>
```

Fig. 2. Example of extensible XML based spatial data access language

Firstly, the client program generate a request used <query>, <access> or <getCapability> as the root element, and send the parameters to data source through SOAP interface. After analysis and execute allocation, a unique code referring the operation will return to the client. Then, the client handles the request status through <getStatus> root element by using the unique code until the end of treatment. Finally, the client processes the results and completes a full course of operation by using <getResult>.

Data access process is similar to data query. The first step is sending the request through the <access> root element, and obtain the ID list and operation details. This processing workflow can be describe as a processing chain, which including the steps of image filter, image format transform and data packaging, etc. In the final step, one or a group of <dataURL> will return the information to client as the element of <result>.

The data source layer is the foundation of the spatial data management and distribution system. Because of the heterogeneous and distributed characters, all the data storage is organized by plug-in profile mechanism, provided by JAVA class. The profile designated the data source and call the related plug-in and parameters.

4.3 Data Catalogue Service

Besides grid application program and client, data agents also query and access the data source. Data agent is another implementation focus in MODIS data management and distribution system. It can greatly enrich the functions of the system, improve performance and facilitate system users. We develop a MODIS data image agent to collection information and set up image directory. This service is defined as spatial Data Catalogue Service.

By collecting various information of a number of different types of data storage, the agents federate the data sources and build the index according to a specific time interval. The catalogue service facilitates users to find, download and use a certain MODIS image in data federation from a multiple sources.

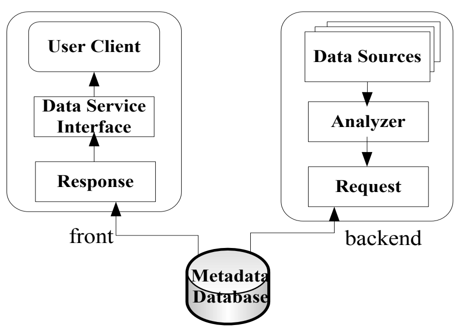

Fig. 3. MODIS Data Catalogue Service

The MODIS data catalogue service also based on SOAP and the extensible XML based spatial data access language. It includes two components. One is in charge of collecting and indexing data information from databases in the backend. And the other is respond to different user request and executes database operation in the front. They exchange information by sharing the same database.

5 Experiment and Conclusion

We present an effective architecture of seamless integration of distributed MODIS data while keeping the original data source robust. In order to facilitate user's interaction on MODIS data management and distributed system, we develop a web portal for integration and scheduling in Java, and apply this method in Spatial Information Grid for case study.

Users can discover MODIS data according to different query conditions, such as sensor type, data provider, and acquisition time or coverage range, etc. Furthermore, the result image can be accessed by different operations as check quick view, download archive metadata and designate target area. The figures below show some test examples of data operation through this portal deployed on Apache Tomcat.

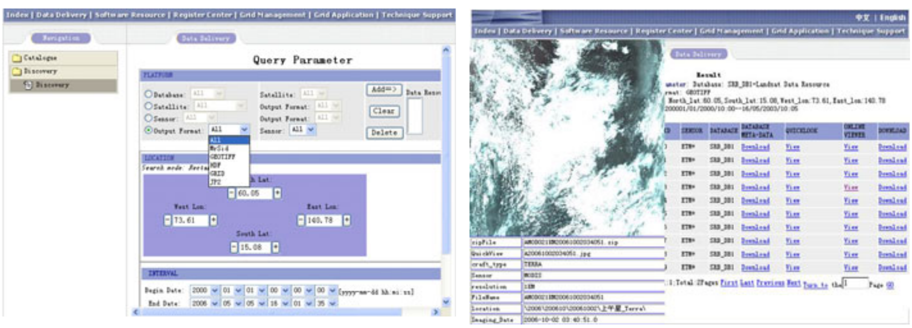

Fig. 4. The page of query condition input and result of quick view and data download

The experiment shows that using data grid technology to establish MODIS data management and distribution system could enhance the efficiency of MODIS data utilization. Users can search and process data by different functional requirements through a uniform interface. It preserves the advantages of heterogeneity and distribution of data sources, and keeps the original data archive providers operational and robust.

Since the data service infrastructure is extensible and platform independent, it is only to spend a half day to modify configuration files and made sources grid enable when add and load a new spatial data source node.

This research can greatly reduce the expenditure on duplicated building MODIS data receiving stations, provide a user-friendly approach to discover data and access abundant MODIS image products, expand user's choices, and federate the information integration to realize rapid processing for agriculture science and applications.

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Virtual Prototype Modeling and Simulating Analysis of Lotus Root Slicing Machine Based on ADAMS

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Abstract. Based on the lotus root slicing machine of crank-slider style designed by the authors, the virtual prototype model of slicing machine has been established by the software of PRO/E, and the kinematics and dynamics performances of the slicing machine were studied by utilizing ADAMS. At the same time, analyses were made on the changes of the cutting velocity and acceleration of blade, the force condition of cutting, the vibration condition of workbench based on the cutting force of sliced lotus root and inertia force of mechanism. The results show that the optimum period for the cutting was 0.15s~0.25s; The horizontal component with support reaction of crankshaft bearing was the major factor that affected the system vibration; The vertical component of the force acting on blade during the cutting was the main cause to lead the bevel edge in the piece of lotus root. The research results can provide a reference for the optimized parameters of the cutting mechanism of lotus root.

Keywords: Lotus root, Slicing machine, Virtual prototype, Simulating.

1 Introduction

The lotus root is a kind of vegetable with hollow inside, containing high rate of water and starch. At present, a large number of lotus food exported to Japan, Korea and other countries by the form of semi-finished lotus slice. The processing of the fresh-cut lotus slice mainly depends on manpower result in the high labor intensity, low efficiency and poor security. Therefore a crank-slider style lotus root cutting machine was designed to improve the efficiency and reduce labor intensity of Lotus root slicing[1],[6]. In this paper, in order to solve the problems in the designed lotus root slice machine, such as the large vibration, the unsatisfied cutting smoothness, effect hypotenuses and other problem, the virtual prototyping technology was used to establish the parametric model of the original physical prototype, Kinematic and dynamic simulation was carried on to identify the main factors that impact on the working performance, and then optimized the system design.

2 Virtual Prototype Modeling of the Lotus Root Slicing Machine

2.1 Structure and Working Principle of the Cutting Mechanism

The slicing machine of lotus root adopted crank-slider type cutting mechanism, which is shown in Figure 1. The slicer is installed on the slider. The lotus root is placed in

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the feeding guide. The horizontal cutting movement of the dicer is driven by the crank. According to the diameter size of the Lotus root, the parameters of the cutting mechanism are designed as follows: the length of the Crank is 115mm, the length of the linkage is 335mm, the stroke of the slicer is 230mm; the total width of the slicer is 830mm, so that the lotus root in four feeding guides can be cut at one time.

2.2 Virtual Prototype Modeling of the Slicing Machine

The 3D solid model design and assembly of parts were completed by using of Pro/E4.0 wildfire version according to the design parameters of the slicing machine, then established the virtual prototyping parameterized model of the Lotus root slicer. Completed the transformations of the 3D solid model by using of the Mechanism/Pro which is dedicated interface module of ADAMS and Pro/E. After the successful transformation of the model, added the constraints of the cutting mechanism and the whole machine in ADAMS, including kinematic pairs and constraints, driving force and the working load, as it is shown in Figure 1. The model contains 23 mobile bodies, 3 revolute joints, 1 translation joint, 19 fixed joints and 1 rotational driver. There are six degrees of freedom in the model.

Fig. 1. Virtual prototyping of the lotus root slicing machine

2.3 Flexible Treatment of the Bench

In Practical application, it is discovered that the bench vibrated when the slicing knife reciprocating, especially during the high speed cutting the vibration of the working bench is particularly significant. The main reason is that there exists imbalance inertia forces in the cutting mechanism, and the inertia forces effects on the working bench through the kinematic pairs and then to the ground.

As the model imported from Pro/E to ADAMS, all of the model components are defaulted as rigid body, while the bench structure virtually is stiffness and damping. Therefore, in order to improve the accuracy in analyzing the acceleration of the vibration, the working bench should be flexible treated before the vibration analyze. The flexible constraints was added by using of the dummy part in the AUTOFELX module in ADAMS [2],[3], then completed the flexible treatment of each angle iron, as shown in Figure 2.

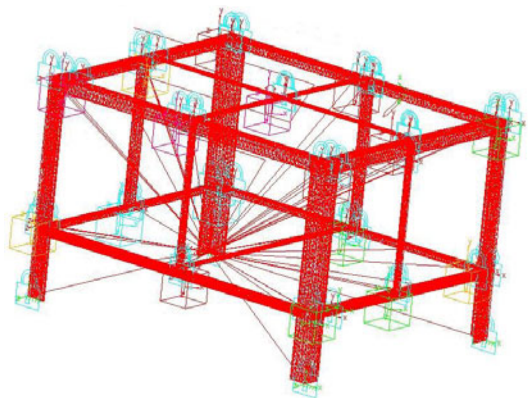

Fig. 2. The flexible body of the bench

3 Kinematics Simulation of Lotus Root Slicer

The cutting experiments show that the cutting quality and the breakage of the lotus root slices influenced by the cutting speed and the initial position of cutting point [6]. The change of the displacement, the speed and the acceleration of the slicing knife under different working condition can be found out by kinematics simulation of the cutting mechanism. Provided the reference for optimizing the cutting velocity and the cutting initial point. In the kinematics simulation of the cutting mechanism, the bench was connected onto the ground by fixed joint, merely simulation analyzing the kinematic relation between crank disk, connecting rod and slicing knife of the lotus root slicer [4],[5]. The curves of displacement, velocity and acceleration of the blade centroid under the condition of the crank in the 60~90r/min, as shown in Figure 3, Figure 4 and Figure 5.

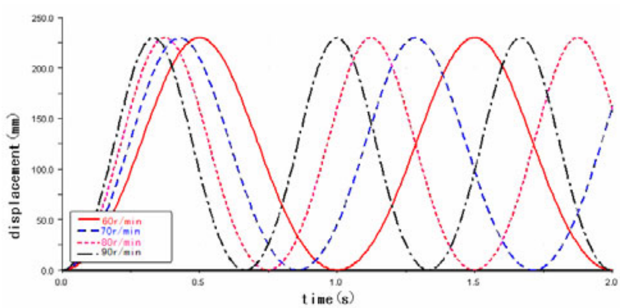

Fig. 3. The displacement curve of centroid of blade at 60~90r/min

As can be seen from Figure 3, when crank speed in the 60~90r/min, the displacement of the blade centroid has no change in the amplitude, while the movement stroke of the blade expressed that the distance from trough to crest, of which the value was 230mm, just was two times the length of the crank. It is coincided with the theoretical results.

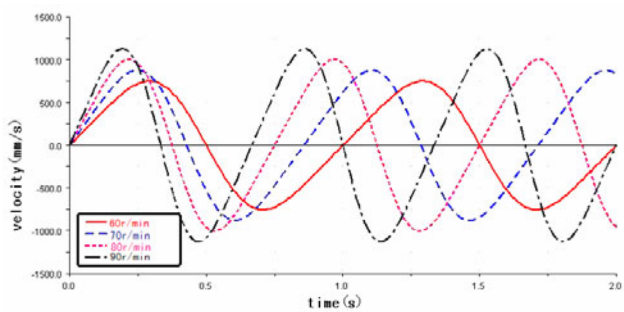

Fig. 4. The velocity curve of centroid of blade at 60~90r/min

As can be seen from Figure 4, the velocity of the blade centroid increased with the crank rotational speed increased. Calculated by one cycle, compared the period of time 0.2s to 0.3s with others, the running rate of the blade centroid was faster. According to the cutting request of the lotus root slice, the blade should have the high speed when cutting, therefore this time section was advantageous to the cutting process.

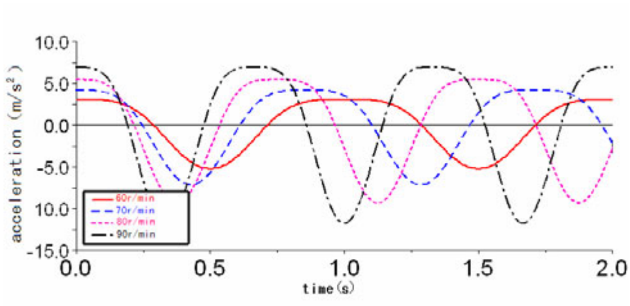

Fig. 5. The acceleration curve of the blade centroid at 60~90r/min

It can be seen from the acceleration curve, Figure 5 that compared the period of time 0.15s to 0.3s with others, the acceleration value of blade was relatively quite small in the four rotational speed of the crank. As the cutting mechanism was a crank-slider, slider fixed with the blade, if the acceleration of the reciprocating components was large, the resulting inertial force was also large, so the period of time when the acceleration values relatively small should be chosen for the lotus root cutting section. In order to improve the cutting quality of lotus root, the period of time 0.15s to 0.3s was selected for the cutting.

4 Dynamics Simulation of the Cutting Mechanism

Before the simulation, the average cutting resistance was measured by using of WDW30005 type micro-controlled electronic universal testing machine, and the result is 24.8N[1]. In the dynamic simulation, added the cutting force to the 3D model of the cutting mechanism by using the STEP function of ADAMS, the cutting force F = STEP (TIME, 0.25, 0, 0.3, 24.8) +STEP (TIME, 0.45, 0, 0.5, -24.8) [6~9].

4.1 The Reaction Analysis of Bearing Spider in Crank Place

According to the characteristics of slider-crank: when the slider for reciprocating motion, the imbalance inertia force of the bodies mainly supported by the crank bearings, so it was necessary to analysis the constraint reaction force at the crank bearings in the mechanism.

The bearing spider reaction force including X, Y two directions, Figure 7, Figure 8 respectively shown the simulation result at the crank rotational speed in the 60~90r/min. As the reaction force curve of X, Y direction can be seen, the influence that the reaction force of X direction is much greater than Y direction to the system, that is, the reaction force of X direction will be one of the main causes which caused vibration of slicer bench.

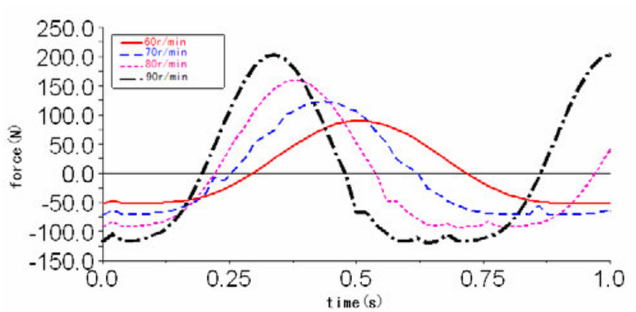

Fig. 6. The reaction of crankshaft bearing on X axis direction

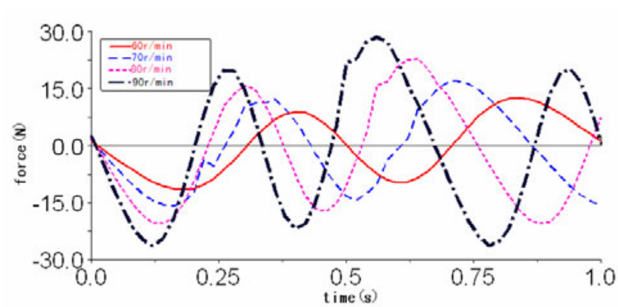

Fig. 7. The reaction of crankshaft bearing on Y axis direction

4.2 The Analysis of Forces of Links to Cutting Blade

The cutting blade and the slider of cutting mechanism was the same component, because there was a gap between the slider and guide, and a vertical direction force which would cause the blade slightly deformed in motion occurs existed in the forces of the linkage driving the slider movement, it caused the hypotenuse phenomenon of cutting lotus root.

When the crank speed was 60~90r/min, the forces of connecting rod on the slice knife in X and y direction, obtained from dynamics simulation on the virtual prototype, as shown in Figure 8~9.

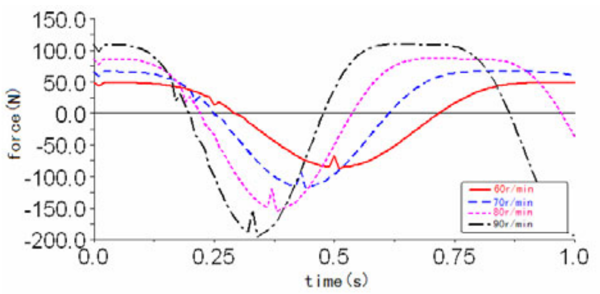

Fig. 8. The curve of horizontal component force

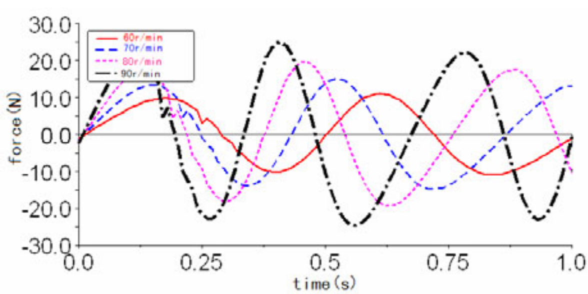

Fig. 9. The curve of vertical component force

Figure 8 reflected that the horizontal force of connecting rod on the slice knife increased with the speed of crank increased. The cutting of lotus root facilitated, for the change of the horizontal force was stability, during the time of 0s to 0.2s. Figure 9 reflected the changes of the vertical force. The conclusion obtained from figure 9 was that it was more detrimental to guarantee the cutting quality of lotus root, for the vertical force became bigger with the crank speed increased.

4.3 The Dynamics Simulation Analysis of Slicer Machine

Due to the imbalance inertial force existed in the cutting mechanism, so there was a certain vibration at work in the slicing machine, and the vibration in horizontal and vertical at the work surface had a direct impaction on the quality of lotus root cutting, therefore, it was necessary to study the dynamic characteristics of the slicer machine.

The acceleration curve in X, Y direction of the work surface in the crank speed 70r/min shown in Figure 10, 11. The vibration in the X direction was much bigger than the Y direction from the chart, further descript that the imbalance inertial force in the x direction was the main reason caused the vibration of slicer surface.

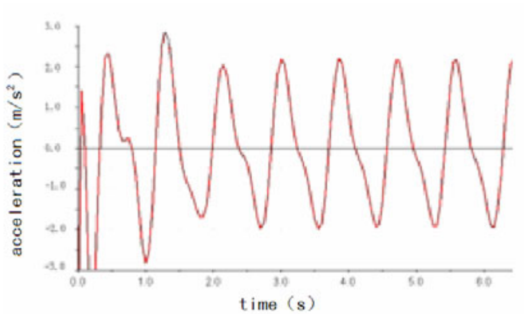

Fig. 10. The acceleration curve of workbench on X axis direction

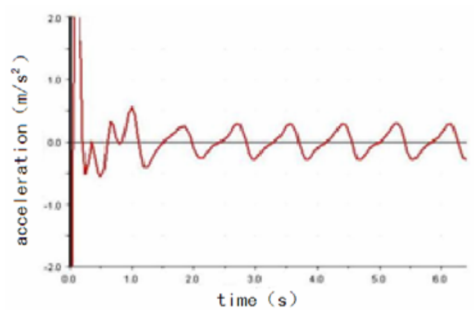

Fig. 11. The acceleration curve of workbench on Y axis direction

5 Conclusion

1. The best cutting time of lotus root was 0.15s~0.25s obtained from the kinematics simulation of the cutting mechanism. During that time, the cutting blade reached the speed needed by cutting lotus root and the acceleration was relatively stable, it was in favor of lotus root cutting. The simulation results provided the basis for determine of the initial position of the blade cutting points.

2. For the reaction force in the horizontal direction of Crank bearing spider was much greater than the vertical in the respect of the influence of the system vibration, the reaction force in the X direction of the crank bearing spider was one of the major causes caused the vibration of slicing machine surface, which had been verified in the dynamics simulation.

3. The main reason caused the hypotenuse of lotus root was that the vertical force of connecting rod to the blade in the cutting process. The stress situation of the horizontal and vertical direction at the hinge point was obtained by the stress analysis at the hinge point attached connecting rod and blade, as provided a basis for optimized the vertical force at the hinge point next.

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Virtual Reality and the Application in Virtual Experiment for Agricultural Equipment

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Abstract. The meaning and characteristics of the virtual experiment and the significance of applying virtual prototype into agricultural equipment were analyzed in this paper. Then a kind of virtual experiments system platform on agricultural equipments was founded by using MultiGen Creator, Vega Prime software and VC++ programming language. According to the functions of the virtual experiment system, the structure and all components of the system were introduced. Furthermore, the methods of network design, synchronous driving, image edge-blending and geometric calibration, and the key technologies such as tractors dynamics modeling, experiment reappearance and real-time test of virtual experiment were discussed. Finally, based on three-dimension geometry model and Vega Prime, the digitalization of tractor testing ground and real-time performance simulation were realized, which provides a new research means and technical method for the tractor performance testing. The test results show that the platform could make the observers immersed among the virtual environment to experience testing process directly and intuitively, and could achieve the real-time interaction between users and environment. This study proves stable operation of the system with reliability and validity, its velocity can reach 30 frames/s and the delay time is 0.025s.

Keywords: Virtual reality (VR), Agricultural equipment, Virtual experiment, Test repetition, Real-time test.

1 Introduction

Virtual reality is a kind of simulated environment which can create and experience the virtual world. It is simulation system as well as 3D dynamic scene fused multi-source information [1]. Using three-dimensional computer graphics, interactive devices, and high-resolution display, a virtual world can be realized in which imaginary objects can be picked up as if they are in the physical world. Therefore, virtual environment, immersion, tactile feedback (a response to user input) and interaction are the most important points during experiencing the virtual reality.

Indeed, the significance and advantages of rapid product development and cost saving have been recognized in recent years. For this, countries in the world are

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making a study of virtual reality and its applications, and many researchers have worked on developing various techniques while priority research areas were changed from technique at first to using VR at present and what VR can do for people at the same time. As a kind of practical technology, virtual reality is well-known and is currently investigated for practical use in various industrial fields such as computer graphics, CAD, CAM, CIM, robotics, medical/health care, architectural design, entertainment, education, multimedia, games and so on [2~5]. Many companies have launched commercial products which can be used for developing VR application systems. However, its application in virtual experiment for agricultural equipment is not widely used. The final objective of this study is to introduce VR technology and establish virtual experiment system for agricultural equipment based on VR.

2 Virtual Experiment for Agricultural Equipment Based on VR

2.1 What is Virtual Experiment

During virtual experiment, software is used to generate kinds of virtual environment instead of part or all of hardware in the computer system. In this condition, customers could complete all scheduled projects as if they are in the true environment, and the experimental results obtained from virtual experiment are close to real test results. As a matter of fact, there are several means of realization, such as computer simulation technology, virtual instrument technology and virtual reality technology [6].

Specifically, there are many advantages of virtual experiment, which can be roughly categorized into four areas: (1) overcoming danger and inconvenience during the real experiment; (2) avoiding destructive effect and property losses during using physical objects; (3) unlimited number of tests and repeatability of the results; (4) good interactivity between users and environment. Therefore, from the view of virtual prototype, as a typical VR application in design and manufacturing industry, virtual experiment could realize multi-mode virtual environment including audibility, visibility and sense of touch by VR technology with input/output device, while users could do experiments, operate machines interactively, and inspect or evaluate the product performance.

2.2 Significance of the Application in Virtual Experiment for Agricultural Equipment

In recent years, new models of agricultural equipment are invented continuously, but the tractor performance tests are always the same, just by using a real vehicle and analyzing data collected in physical test site. As a result, the tests in this way not only pollute the environment, but also consume a large amount of manpower and resources. Further more, it is liable to injure testing personnel during operating, and the test period is long relatively. In particular, the affects on test results caused by non-objective factors cannot be avoided during tests, for example, the skilled level of operators.

Consequently, the significance of applying VR technology into agricultural equipment experiment is great, especially for large-scale agricultural machinery, because of its complex structure, long period of production design and high cost. With VR in test, designers could simulate the performance and modify the products, while customers could understand the properties and functions of the products directly. In brief, virtual experiment for agricultural equipment, which helps to organize the preparation work for production, plays an important role in safe reliability, shortening product-manufacturing period, enhancing product quality, reducing product cost and tractor innovative design.

3 The Construction of Virtual Experiment System for Agricultural Equipment

3.1 System Function

Actually, agricultural equipment virtual experiment is a kind of performance simulation on various working conditions in virtual test scene, which maps the simulation data of the theoretical model or practical data obtained from operation to the computer screen and exports the result as the form of graphics and moving points. By means of various interaction methods of VR, researchers could feel tractor performance in different conditions, and they experience personally as if doing the actual test. Therefore, the system functions are as follows:

(1) visualization of physical model and testing grounding environment;

(2) response to collision or display and extraction of the tractor driving attitude or geographic coordinates in real time;

(3) point of view switch and input control with interactive devices;

(4) kinematics and dynamics analysis and calculation of tractor model, researchers could simulate traction, braking, and steering control performance according to the results;

(5) network communication interface so as to do real-time data transmission.

3.2 System Structure

According to the testing requirements and operating characteristics of the tractors, virtual experiment for agricultural equipment makes simulation with virtual prototyping technique and follows the principles of openness, extensibility and repeatability. Users could control the tractor models in a virtual environment and do some experiments during virtual tests. On the basis of the characteristics of tractor virtual test system, the system is divided into several parts as follows (Fig. 1), every part transmits information through interface parameters.

3.3 System Hardware Composition

This system adopts PC-driven and Client/Server system mode, which consists of one server, six IPC, three-channel passive projection system, stereo glasses, steering wheel, joystick, spaceball and other devices, and all of them are connected to a LAN. The projectors are controlled by the IPC, and each of two projectors displays the same channel, but one shows for left eye and the other for right eye through the polarizers. Observers look at the scene which is made up of six pictures by wearing the stereo glasses, so as to restoration the images to stereo effect, which are divided into three parts.

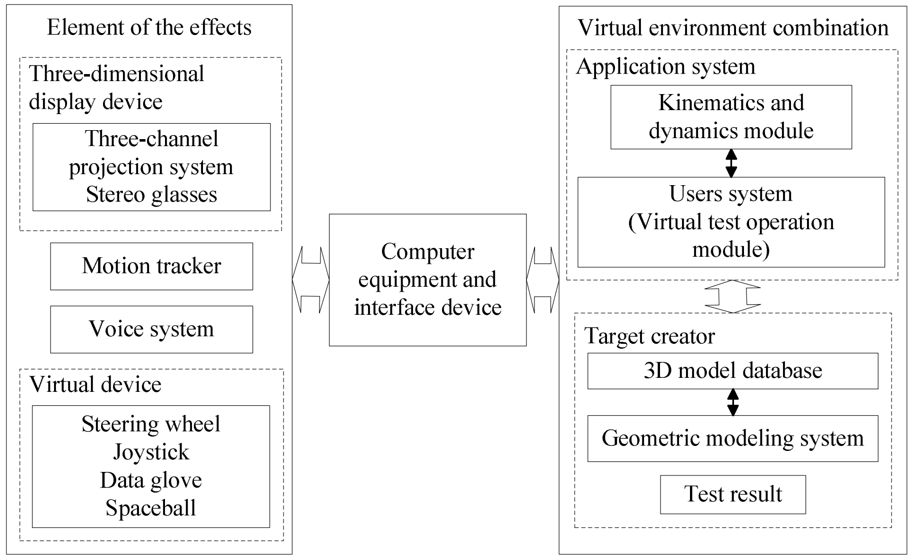

Fig. 1. Structural framework of virtual experiment system

4 Implementation of Virtual Experiment Visual System

4.1 Virtual Experiment Environment Modeling

Virtual experiment environment is created based on geometric model, which is computer-graphics-based. First of all, designers need to abstract the real scene so as to use polygons to construct the three-dimensional geometric model of the virtual landscape (including terrain, buildings, trees, etc.). Second, designers must finish the light and material of models in virtual environment. Third, it is necessary to set the control parameters and complete the texture mapping. Finally, researchers render the visual images in real-time by output devices in order to complete drawing the whole scene. Fig. 2 is the flow diagram by which the tractor virtual proving ground was constructed. In this system, several typical roads were set up in virtual proving ground, such as ring test track, alternating vibration road, farm road, driver's vision test road, washboard road and so on. All of the test roads are provided for tractor virtual experiment.

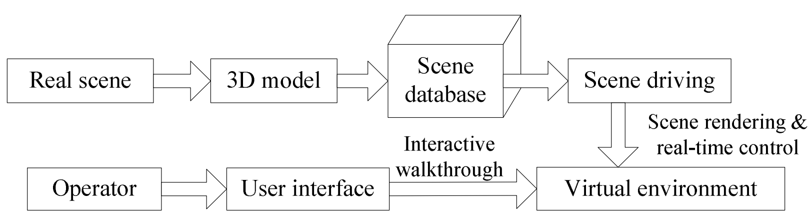

Fig. 2. Flowsheet of virtual environment based on geometric model

During modeling, visual effect and real-time performance should be given overall consideration. On one hand, the simple model will impact on the reality of the simulation, and on the other hand, complex environment will affect the system operation in real time. Therefore, by the premise of guarantee of system running, some critical technologies were used to set up the models as far as possible to meet the visual authenticity of scene model.

(1) Billboard: Billboard is to map a texture to a plane – a single polygon which rotates within the simulation, so that the image of the model always faces the eyepoint. When viewed from ordinary perspectives in a scene, such symmetrical models appear realistic enough, while using only a small amount of system resources so as to increase the running speed. The trees and signs were constructed on basis of the billboard technology in the system.

(2) Texture: Textures are bitmapped images that are mapped onto polygons. However, when the 2D texture is applied to a 3D model, the u and v coordinates of the texture image are mapped to the x, y, and z coordinates of the model. Creator provides seven kinds of texture mapping, such as three-point put tool, four-point put tool, surface project texture tool, spherical project texture, radial project texture tool, environment map texture tool and geo-put texture tool. With textures viewer will experience a photo-realistic appearance without increasing the polygon count. In this system, texture technology was carried through from beginning to end.

(3) Level of Detail: Levels of detail (LODs) are sets of models that represent the same object or terrain area with varying degrees of complexity. The real-time system selects one of the LODs to display, depending on the distance from the eyepoint to the LOD and the number of polygons the real-time system can process. If the eyepoint is far away from an object, the object is displayed as a low LOD, containing relatively few polygons. As the eyepoint moves towards the object, the real-time system replaces it with increasingly complex LODs. LODs play an important part in optimizing a visual scene for drawing, so it was used to render the terrain to improve operation velocity. The 3D scene in virtual experiment system is shown in Fig. 3.

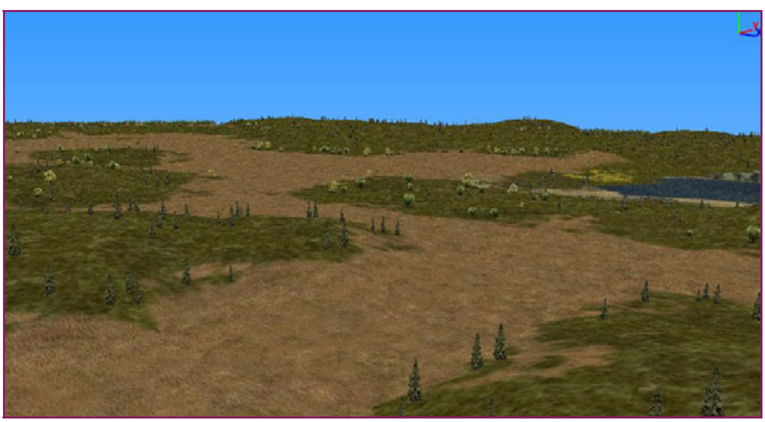

Fig. 3. 3D scene model in virtual experiment system

4.2 System Network Design

The system selected Master/Slave mode, because several PC were used in internet to drive the virtual environment. The server is Master node and IPC is Slave node. Fig. 4 is the flow diagram of network system.

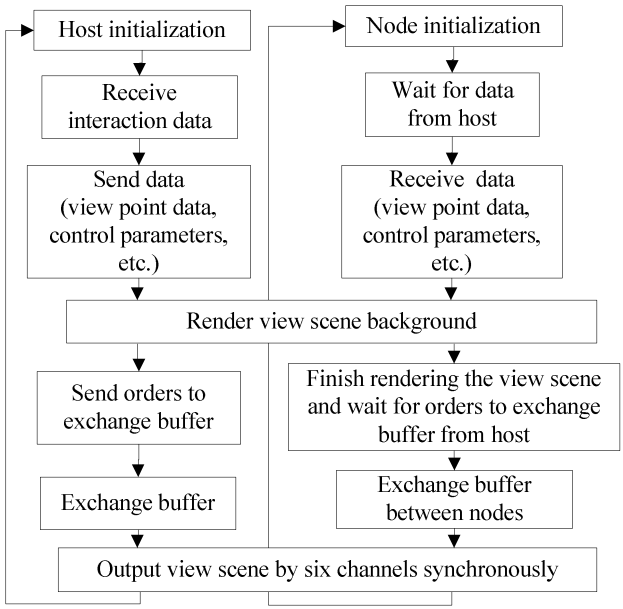

Fig. 4. Flowsheet of network system

This structure has the some features:

(1) Each of nodes has the same application program and data copy, the system only need to update the interactive information, control instructions and the scene change information in run-time.

(2) The Master node is responsible for receiving information, handling user interaction information, and transmitting threads, input (keyboard, mouse, joystick, etc.) and other user data to the slave applications.

4.3 Synchronous Driven in Real-Time

Distributed rendering utilities (drUtil) of VP were used in this system. The principle is to receive input from the server and to send rendering information and time-stamped data packets through drUtil in real-time, so as to respond to the control and synchronize the master's scene graph with the slave's scene graph among three channels. Main code:

```
// Set synchronous mark
vuDistributed::setSyncEnable(vuDistributed::SYNC_LABEL_
PRE_SWAPBUFFERS, true );
vuDistributed::setSyncEnable(vuDistributed::SYNC_LABEL_
POST_SWAPBUFFERS, false );
// Synchronize ACF
vuDistributed::setSyncEnable(vuDistributed::SYNC_LABEL_
ACF,true);
// Synchronize the time
vuDistributed::setSyncEnable(vuDistributed::SYNC_LABEL_
TIME,true);
// Synchronize window message
vuDistributed::setSyncEnable( vuDistributed::SYNC_LABEL
_MESSAGES, true );
```

4.4 Correction and Fusion

Geometric distortion correction is one of the key technologies in virtual reality projection system. However, a kind of geometric correction algorithm based on viewpoint locations and texture mapping was proposed in this system, so that the image distortion correction for single projection screen and alignment correction for multi- projection screen could be completed. The principle is shown in Fig. 5. Furthermore, in order to solve uneven brightness caused by overlapping area between two projectors, the method of color edge fusion based on weight was used, that is, each pixel in bright band is given a preset weight, and the color component gray value of corresponding pixels will multiplied by default weight while rendering the image, thus the high light parts in overlapping area between two adjacent channels are processed to smooth brightness.

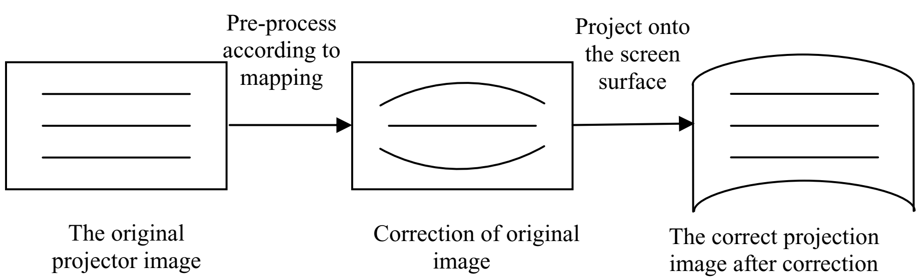

Fig. 5. Schematic diagram of image geometric calibration

5 Design and Development of System Software

The system used Visual C++.net of Microsoft company as integrated develop environment. The virtual experiment system for agricultural equipment runs on the

Multigen Creator and Vega Prime as modeling and visual simulation software, with OPENGL and other auxiliary software, and it fits for Windows XP operating systems.

5.1 Dynamic Model of Tractor

To realize the interactive control tractor in virtual experiment, the system established a tractor dynamic model of tractor for real-time simulation, including the whole vehicle model, engine model, transmission system model, brake system model, steering system model and tire model. In this model, driver, tractor and virtual environment constitute the closed-loop system, as shown in Fig. 6, in order to achieve steering, acceleration / deceleration, braking and other acts of simulated operation. As a result, the driver could control the tractor in real time and experience the control effects in a virtual environment.

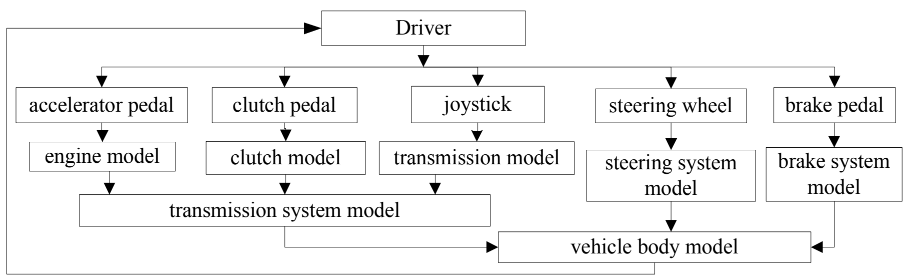

Fig. 6. Closed-loop of tractor dynamic model

5.2 Implementation of Tractor Virtual Experiment

The system calls VP class function in VC++.net so as to achieve the management and calls of the scene, view control, steering control, and texture control during virtual experiments. For example, the researchers could finish changing the position or rotation of the tractor model by class function called vpTransform in VP, whose getTranslate () function and getRotate () function mainly return the position and orientation information of controlled objects or motion models. Otherwise, if the information of *x, y, z* coordinates, *h* (heading angle), *p* (pitch angle), and *r* (roll angle) are changed during interaction process, setTranslate () function and setRotate () function will be used to set the new position and orientation. Therefore, the parameters change of tractor motion could be realized in virtual environment.

5.2.1 Test Repetition

In the part of test repetition, tractor performance was analyzed by virtual prototype, and the results were read by linked list to realize the test repetition. The linked list data structure of tractor components is defined as follow:

```
struct ReplayDataList
{
          double cog_ster[37]; //cog_ster [37] represents the time, x, y, z coordinates and h, p, r angle of the centroid component
          ReplayDataList *next;
          ReplayDataList()
          {
            for(int i=0;i<37;i++)
              cog_ster[i]=0.0;
            next=NULL;
          }
};
//Assign the data to tractor model after obtain the data from linked list
m_tractor->setTranslate(r->cog_ster[1],r->cog_ster[2],r->cog_ster[3],false);
m_tractor->setRotate(-r->cog_ster[4],r->cog_ster[5],r->cog_ster[6],false);
……
```

The system can reappear the tractor real experiment, such as braking performance, traction performance and steering performance. In addition, researchers can control playing speed and process depending on requirement, and display the speed - acceleration - time curve. The system operation interface is shown as Fig. 7.

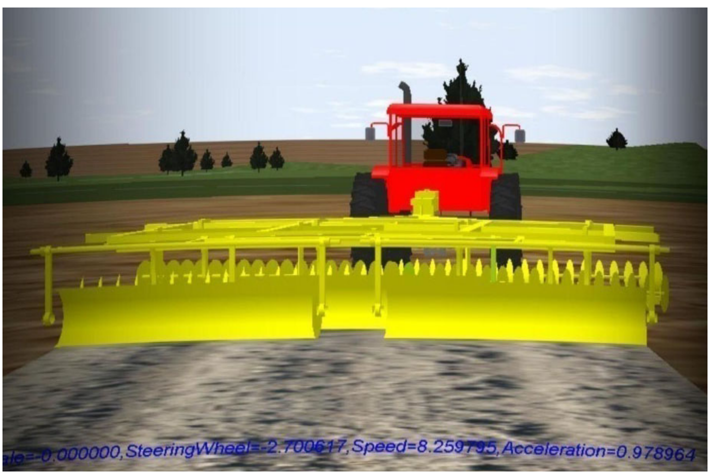

Fig. 7. Operation interface of experiment reappearance

5.2.2 Real-Time Test

In the part of real-time test, the operator can drive the tractor by interactive manipulation by switching the view point and using steering wheel, joy stick, spaceball and other virtual devices so as to simulate the field operations. During driving interactively, the driving attitude and the information about location coordinate of the tractor are shown and extracted. Otherwise, the system can response to collision detection when the tractor is moving.

Take the steering wheel turning as example and the concrete program codes are shown as follows:

```
/* Judge input device type*/
if(m_nRealTestInputType==1) // Judge whether the input device is tractor drive test-bed
m_strcDriveTracData=g_strcDriveTracData; // Transmit signal data
/* Read the sensor signals from tractor drive test-bed and calibrate the data*/
x=(BYTE)(Read_lpBuffer[In88+2]); // Read the steering wheel sensor signal from memory address
dFangxiang=360*x/240; // Convert the unit to degree
if(dFangxiang>648)dFangxiang=648;
else if(dFangxiang<-648)dFangxiang=-648; // Limit the range of signal from -648 to +648
dFangxiang=450*360*dFangxiang/240/648; //Limit the range of steering wheel from -450° to +450°
g_strcDriveTracData.m_Fangxiang=dFangxiang;
/* Find the node of steering wheel*/
vpObject* m_tractor; // Define the tractor as an object
m_tractor=vpObject::find("myObject_Tractor"); // Get the object of tractor
vsDOF *m_SteerDof; // Define the freedom of steering wheel
vsNode *myNode; // Define a node
myNode=m_tractor->find_named("steer"); // Get the node of steering wheel from tractor model
if(myNode&&myNode-
>isOfClassType(vsDOF::getStaticClassType()))
m_SteerDof=(vsDOF*)myNode;
/* Put the motion control onto the steering wheel*/
m_dSteeringAng=-tractordata.m_Fangxiang; // Get the information of steering wheel angle
m_SteerDof->setRotateH(m_dSteeringAng,false); // Update the information of steering wheel angle
```

Researchers test the virtual experiment system for agricultural equipment by carrying out a certain type of tractor virtual experiment. The simulation effect is shown as Fig. 8. There are three kinds of virtual scenes for selection, such as road test scene, field test scene and washboard road test scene. The current information, for instance, speed, acceleration and front wheel angle of the tractor, will be displayed on the interface dynamically. However, the experiment results will be stored in the database in order to process data and reappear the experiment. The experiment results show stable operation of the system with the reliability and validity and its velocity can reach 30 frames/s and the delay time is 0.025s.

Fig. 8. Operation interface of virtual experiment

6 Conclusions

In this study, virtual reality was applied into agricultural equipment by multi-channel immersive virtual reality technique and tractor kinetic theory was used as well based on traditional method of tractor performance testing in the system. It realized the three-dimensional display of the models and could drive the models in real-time to complete the experiment reappearance and real-time test of the tractor. The test results show that the virtual experiment for agricultural equipment, which achieves the real-time interaction between users and environment, could make the observers immersed among the virtual environment to experience testing process directly and intuitively. This research provides a new method to the tractor performance test, and this way plays an important role in safe reliability, shortening product-manufacturing period, enhancing product quality and production efficiency, avoiding the physical model-making, reducing product cost and tractor innovative design.

Acknowledgements

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Virtual Visualization System for Growth of Tobacco Root

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Abstract. Visualization study on the growth of virtual plant roots is of great significance to enhance the overall level of research on virtual plant growth. In this study, with the tobacco root as the object, its growth was divided by systematic analysis into three stages: root emergence, root growth, and root branching. Through the quantitative analysis of the morphological data of the tobacco root and in combination with results of previous studies, the tobacco root growth, branching and other models were established, and parameter values of the models were extracted. On this basis, computer graphics technology was applied to establish a virtual visualization system for tobacco root growth that should be capable of simulating root growth and computing indicators of roots including the number, length, density, etc. Results indicated that this system can do a better job of simulating the morphological features for the tobacco root and virtually displaying the process of tobacco root growth in a more realistic way.

Keywords: Tobacco, root, simulation model, virtual plant, visualization.

1 Introduction

With its rapid progress, the virtual plant study has become one of the frontier fields of research on agricultural sciences since the 1980s. Virtual studies have been successively carried out at home and abroad on corn, wheat, and rice [1-4]. The root is one of important integral organs. Diggle [5-6] established the first three-dimensional model of root age, location, and root segment orientation. Over 20 years of development, virtual root growth models of different plants were established through the L system, fractal method, reference axis technology, and method of three-dimensional reconstruction of plants [7-14]. However, these models have not taken the relationship between the root structure and its function into account. Simulation studies on roots have developed slowly because of the invisibility of the environment of root growth as well as the limitations in measurement techniques; the study on the tobacco root is even rarely reported. Tobacco is a special economic crop featured by the double-peak phenomenon in its root growth, which has a direct impact on the quality of tobacco. In

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this study, the experiment was designed with the rhizobox method to systematically investigate the morphological development of the tobacco root, and the model of tobacco root growth and development was established by summarizing previous results and analyzing test data of tobacco root morphogenesis. Based on the morphological model, a virtual growth system of the tobacco root was established with OpenGL in the Visual C + + platform. The visual expression of morphological characteristics in the process of tobacco root growth was initially realized, so as to provide a technological basis for virtual crop studies.

2 The Dynamic Model of Tobacco Root Growth

2.1 Root Emergence

The tobacco has a taproot system that consists of primary, lateral and adventitious roots. It is measured that the root begins to emerge when the effective accumulated temperature that is ≥10°C in the seedbed period comes up to 100°C, and the total number of roots is in an exponential relationship with the accumulated soil temperature. It is also known that there is a linear relationship between the accumulated soil temperature at 5 cm below the ground and the accumulated gas temperature in seedbed period, thus the number model of roots in seedbed period is shown as follows:

$$N_0 = 0.3397e^{(0.9303T+14.547)} \tag{1}$$

T represents the accumulated gas temperature from seed-sowing to some day.

2.2 Root Growth Model

Root growth is represented by potential growth rate dP_{ri}/dt and actual growth rate dR_{wi}/dt that are under the influence of the soil temperature, the sunshine duration, and the carbohydrate supply from above the ground. The potential root growth rate[15] could be described by a kinetic equation:

$$\frac{dP_{ri}}{dt} = R_{ci} \bullet R_{wgi} \tag{2}$$

In Equation (2), i represents the sequence of soil layers; P_{ri} is the root's potential growth ($mg \bullet cm^{-3} \bullet d^{-1}$) in the i^{th} soil layer; R_{wgi} shows the root's dry weight ($mg \bullet cm^{-3}$) of the i^{th} layer; R_{ci} indicates the rate constant of root growth in the i^{th} layer which depends on the soil temperature and sunshine duration.

$$R_{ci} = D_L(R_K \bullet T_d - R_b) + (24 - D_L)(R_K \bullet T_n - R_b) \tag{3}$$

Where, D_L represents the available sunshine hours (h); $R_b(1 \bullet d^{-2})$ is the soil constant; T_d and T_n represent the average temperature during the day and at night respectively, which could be obtained by the following formula:

$$\begin{cases} T_d = 0.55(T_{\max} - T_{\min}) + T_{\min} \\ T_n = 0.15(T_{\max} - T_{\min}) + T_{\min} \end{cases} \tag{4}$$

In Equation (4), $T_{\max}$ and $T_{\min}$ represent the maximum and minimum temperature in the soil, respectively. If CH is in abundant supply, the actual root growth rate is equivalent to the potential rate (dP_{ri} / dt); if the CH supply is insufficient, the actual root growth rate is calculated as follows:

$$\frac{dR_{wi}}{dt} = \frac{CH + CH_d}{\sum_i P_{ri}} \frac{dP_{ri}}{dt} \tag{5}$$

In Equation (5), CH_d is the part that is lacking in CH supply, i.e., the difference between CH required and CH actually provided. The actual CH supply to the root from above the ground within time Δt is shown as follows:

$$CH = f_{CH}(t) \bullet DMR \bullet \frac{\Delta DMA}{DM} \bullet \Delta t \tag{6}$$

In Equation (6), DM is the tobacco's amount of accumulated dry matter ($mg \bullet cm^{-2}$); DMR, the amount of accumulated dry matter within unit time Δt ($mg \bullet cm^{-2} \bullet d^{-1}$); ΔDMA, actual amount of dry matter growth within Δt; and $f_{CH}(t)$, the supply coefficient of the tobacco plant.

2.3 The Stretching Direction Model

Based on the model of root growth direction by Pages et al, environmental factors such as soil during root growth are set aside in this system. Under the hypothesis that the root grows in the homogeneous soil with the relatively superior growth environment and without serious environmental stress, the ultimate growth direction of the root within in current growth cycle depends on factors in three categories: the growth direction of the root in the previous cycle, geotropism, and random factors. Therefore, the stretching direction of new root tip D_N could be expressed as:

$$D_N = D_{N-1} + D_G + D_N' \tag{7}$$

Where, D_{N-1} is the growth direction of the root in the previous cycle, represented by the cosine function of the straight direction the root follows; D_G is the downward growth trend of the root, a vector pointing to the center of the earth; random factor D_N' is the deviation between the axial angle and the radial angle based on the original direction, represented by ϕ and θ whose value ranges from 0 to$30^{\circ}$and from -180° to180°, respectively.

2.4 The Root Branching Model

2.4.1 The Branching Locations of the Root

Because of apical dominance, lateral roots arise within a certain range on the mother root [16]. As shown in Figure 1a, the length of the non-lateral-root section at the lower part of the primary root was set as LB while that at the top part was LA, so lateral roots would only appear when the root axis was longer than the sum of LB and LA. Shown in Figure 1b, branching points B and C both occurred in root segment AD. The number of points similar to B and C determined the branching density of this root segment. Since B and C were assumed in the system to occur at any part on root segment AD, then if the coordinate of point D was known, then starting points B and C of the branching root axis could be determined with location coefficient

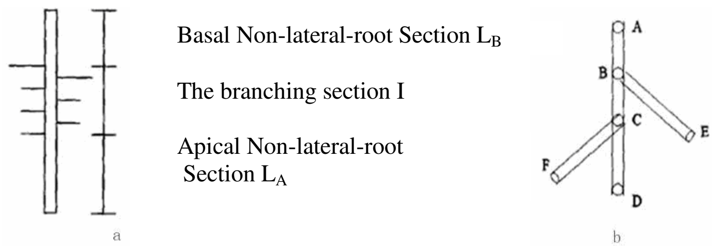


Fig. 1. Branching Locations of the Root Axis

ε and the coordinates of A and D. ε, a random quantity in [0,1], is defined as:

$$\varepsilon = \frac{|AB|}{|BD|} \tag{8}$$

In this way, the starting point coordinate of the root axis growing from B, any point on root AD, is as follows:

$$\begin{aligned} x_B &= (\varepsilon \bullet x_D + x_A)/(1+\varepsilon) \\ y_B &= (\varepsilon \bullet y_D + y_A)/(1+\varepsilon) \\ z_B &= (\varepsilon \bullet z_D + z_A)/(1+\varepsilon) \end{aligned} \tag{9}$$

2.4.2 The Root Branching Directions

The branching direction of the root is jointly determined by the axial branching angle β and the radial branching angle α. The direction vector of mother root $\vec{u}$ would change into $\vec{u}'$ through the axial rotation of angle β, and the new vector would become vector $\vec{u}''$ by the radial rotation of angle α, i.e., the new branching direction. α and β range from 0 to180 ° and from 0 to 90 °, respectively.

2.5 The Root Number and Length

The primary root grows rapidly after its emergence. When reaching a certain branching age, the primary root generates the primary lateral root, which produces the secondary lateral root at the branching age.

The number of primary lateral roots:

$$N_1 = \sum_{i=1}^{n} N_{1i} \tag{10}$$

where, number 1 represents primary lateral roots and i is their ordinal number.

The number of secondary lateral roots:

$$N_2 = \sum_{i=1}^{n} N_{2i} \tag{11}$$

in which number 2 represents secondary lateral roots and i is their ordinal number.

The total number of roots:

$$N = N_1 + N_2 \tag{12}$$

As regards to the root length, the lengths of all roots within the same level are calculated based on root levels. The formulas are as follows:

The length of primary lateral roots:

$$SL_1 = \sum_{i=1}^{n} SL_{1i} \tag{13}$$

The length of secondary lateral roots:

$$SL_2 = \sum_{i=1}^{n} SL_{2i} \tag{14}$$

Total root length:

$$SL = SL_1 + SL_2 \tag{15}$$

The length of root segment is calculated as follows:

$$sl = \frac{|z_2 - z_1|}{\sin\left(arctg(\frac{|z_2 - z_1|}{|y_2 - y_1|} \bullet \sin(arctg(\frac{|y_2 - y_1|}{|x_2 - x_1|}))\right)} \tag{16}$$

Where, x_1, y_1, z_1 and x_2, y_2, z_2 represent the coordinates of starting and ending points (points A and B of the root segment) respectively.

2.6 Determination of Model Parameters

The development of the tobacco root is under the influence of a number of factors, such as soil moisture, ground temperature, carbohydrate supply, dry matter accumulation, and its own characteristics. According to experiments and related literature [17] parameters that affect models of tobacco root growth and branching are shown in table 1.

Table 1. Parameters of root growth and branch models

module	Parameter	Value	Unit
Model of root growth	Soil parameter Rk	0.0125	$1\cdot d^{-1}\cdot ℃^{-1}$
	Soil parameter Rb	0.125	$1\cdot d^{-2}$
	Support ratio of tobacco fCH(t)	0.15	
	Root weight in the ith soil layer Rwgi	Rwgi=0.765/(1+exp(17.734-0.152t)) When i=0-10cm t≥80d Rwgi=0.495/(1+exp(10.146-0.088t)) When i=10-20cm t≥80d Rwgi=0.275/(1+exp(9.317-0.079t)) When i=20-30cm t≥80d Rwgi=0.136/(1+exp(11.589-0.094t)) When i=30-40cm t≥95d	$Mg\cdot cm^{-3}$
Model of root branch	Length of non branch on basis of main root LB	0.5	cm
	Length of non branch on top of main root LA	2	cm
	Length non branch on basis of first order root L1B	1	cm
	Length non branch on top of first order root L1A	5	cm
	Branch age of main root age0	3	d
	Length between branches on main root length0	0.1	cm
	Branch age of first order root age1	7	cm
	Length between branch on first order root length1	0.1	cm

3 Three-Dimensional Simulation of Tobacco Roots

3.1 Design Methods

Tobacco roots are considered as a group of branch axes, that is, the primary branch (primary lateral root) is connected to the primary root, and the secondary branch (secondary lateral root) is connected to the primary branch, etc. Everyday, there might be new branch axes, and the existing root axes might grow and branch. To determine the spatial location of roots, it is necessary to know enough spatial coordinates of points on roots. Suppose that root axis is composed of a series of linear root segments in different directions, since the root segments are developed from growing apexes' moving to the new locations in a limited period of time, two coordinates are enough to determine its spatial location.

During the simulation, the accumulated temperature cycle of root growth 1d is set as one step. Within each time step, all the survival root segments in each growth cycle are first updated, (three-dimensional correlation connections of root segments, branch levels, spatial coordinates, geometric sizes, branching sequences, etc.), according to the models of root growth and branching, and all the updated information serves as the basis of root parameters (root length, number, root length index, root length density, etc.) calculation. Then, based on the rule of mass distribution, the mass quality distributed to individual roots is obtained, and the potential demands of new roots' absorption are calculated based on soil resistance and temperature of the surrounding soil of the root segments. If the quantity available for absorption assigned to the roots is less than the potential requirements, then all the root segments would shrink back accordingly. Root simulation flow-process is shown in Figure 2.

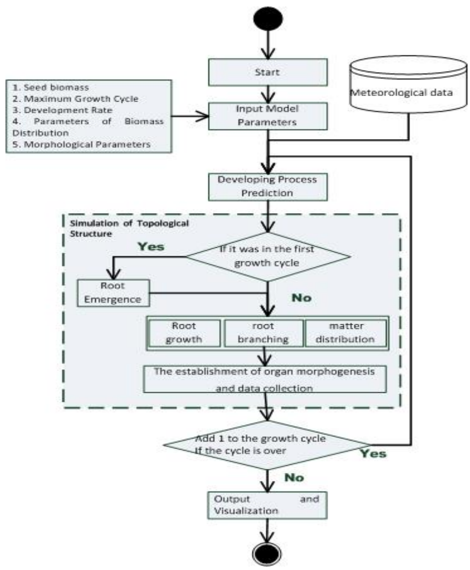


Fig. 2. Flow of Simulation of Tobacco Root Growth

3.2 Data Structure

Plant roots had a clear hierarchical relationship, which can be described with the tree structure. Each root is decomposed into multiple nodes, with each node representing a root segment. Stored in the form of structural element, the node carries the required information for root growth. The running program visits and links each node in the tree structure, thus the morphological structure of the root is obtained. The data structure is shown as follows:

```
struct rootdata   // The data structure to store the root data
{
      float  x1,y1,z1;// To store the starting point of root segment
      float  x2,y2,z2; // To store the ending point of root segment
      int phy_age;      // To store the physiological age of root segment
      int growth_age;         // To store the growth age of root segment
      struct rootdata *next;  // The pointer pointing to the next data in
                                 the linked list
      struct rootdata *pre;   // The pointer pointing to the pervious data
                                 in the linked list
      struct rootdata *f;     // The pointer pointing its father node
  }
```

Information contained in this data structure is: (1) the spatial coordinates of the endpoint of the root segment, with which the direction of root growth is determined; (2) the physiological age of the root, one of the root properties, through which the physiological age of the root or the root segment, parameters about the geometrical size of the root, branching conditions, the factor of geotropism during growth, and parameters of axial angles are correspondingly identified to determine the behavioral characteristics of the root; (3) the growth age of the root, reflecting the number of cycles the root axis has experienced since its emergence from the mother axis, which was primarily used to characterize that roots of the same physiological age have the same growth rate at different ages of growth; (4) data pointers, which are used to establish logical relations among data.

3.3 Data Structure

It is supposed that the root begin to grow at point (0, 0, 0), and the root growing out of the origin point is a primary root. In the general sense, if it is supposed that the current root is at level N; A is the starting point of the root; and D is the ending point, then another root growing out from this root (within the line segment BC) is in level N+1, and the root emerging at point B is in level N. With Figure 3b, the root information is determined as follows:

(1) The first root A1

$$A_1 \to x_1 = 0, A_1 \to y_1 = 0, A_1 \to z_1 = 0$$
$$A_1 \to x_2 = 0, A_1 \to y_2 = 0, A_1 \to z_2 = 0$$
$$A_1 \to age = 1, A_1 \to rank = 1, A_1 = radius = R_{\min}$$

(2) For roots of lower order, B2 and C2, in accordance with the aforementioned branching model, ε_{C2} and ε_{B2} are randomly generated, which, coupled with the range of radial angle α and axial angle β, randomly generate (α_{B2}, β_{B2}) and (α_{C2}, β_{C2}). Therefore, the branch location and direction of branching root B2 are:

$$B_2 \to x_1 = A1 \to x_1 \cdot \varepsilon_{B2} + A1 \to x_2 \cdot (1 - \varepsilon_{B2})$$
$$B_2 \to y_1 = A1 \to y_1 \cdot \varepsilon_{B2} + A1 \to y_2 \cdot (1 - \varepsilon_{B2})$$
$$B_2 \to z_1 = A1 \to z_1 \cdot \varepsilon_{B2} + A1 \to z_2 \cdot (1 - \varepsilon_{B2})$$
$$B_2 \to age = 2, B_2 \to rank = 2, B_2 \to radius = R_{\min}$$
$$B_2 \to x_2 = B_2 \to x_1 + v_2 \cdot \cos(\alpha_{B_2})$$
$$B_2 \to y_2 = B_2 \to y_1 + v_2 \cdot \cos(\beta_{B_2})$$
$$B_2 \to z_2 = B_2 \to z_1 + v_2 \cdot \cos(\gamma_{B_2})$$

Those of branching root C2 can be determined likewise.

(3) For root of the same level (root tip), D1, in accordance with the aforementioned root extension model, ϕ and θ are randomly generated, that is, the random rotation of A1 in the axial and radial direction.

$$D_1 \to x_1 = A1 \to x_2, D_1 \to y_1 = A1 \to y_2, D_1 \to z_1 = A1 \to z_2$$
$$D_1 \to age = 2, D_1 \to rank = 1, D_1 \to radius = R_{\min}$$
$$D_1 \to z_2 = D_1 \to z_1 + v_1 \cdot \cos(\theta)$$
$$D_1 \to x_2 = v_1 \cdot \cos(\theta) \cdot \cos(\phi)$$
$$D_1 \to y_2 = v_1 \cdot \cos(\theta) \cdot \sin(\phi)$$

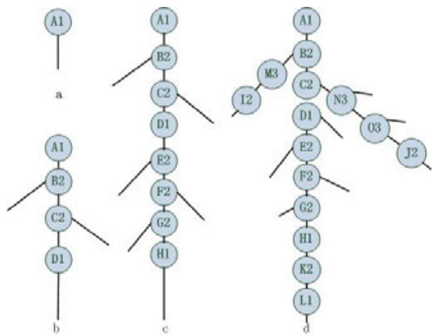
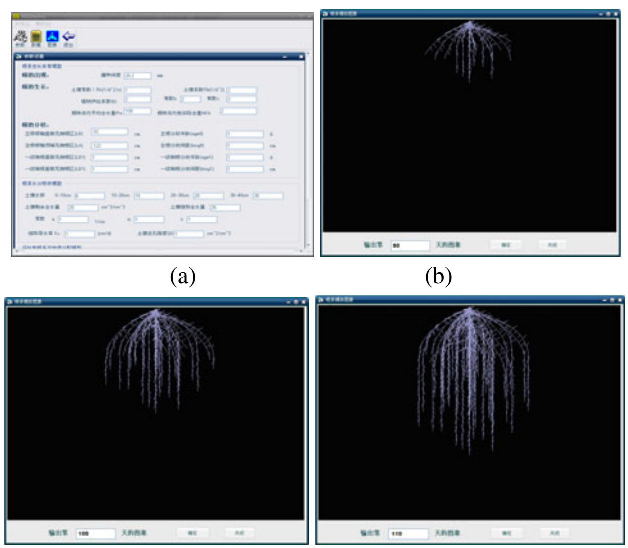


Fig. 3. Branching of Root Axis

4 System Implementation

Based on the model of tobacco root development, the virtual system of tobacco root growth was established with OpenGL in the Visual C + + platform. Functions of the



(a) (b)

(c) (d)

Fig. 4. Visualization of tobacco root growth

system mainly include: (1) the input of environmental parameters of root growth; (2) with the input parameters (sowing depth, soil constants, branching age, soil hydraulic conductivity, morphological parameters, biomass allocation, etc.) and meteorological data (sunshine duration, soil temperature, atmospheric density, atmospheric pressure, temperature, etc.), the system can output parameters about tobacco root growth at different stages (root length, root number, root length index, root length density, surface area, volume and water absorption as well as dry matter distribution, etc.) and three-dimensional visual results, allowing the examination of growth and distribution of tobacco roots from all angles. Figure 4a is the input interface of model parameters. Figure 4b, 4c and 4d are the visualization results of the tobacco root sown 80, 100, and 110 days respectively.

5 Conclusion

Based on observations and studies of the structure, growth and distribution of the tobacco root morphogenesis, as well as the results of previous studies, the method of systematic analysis was employed to divide the growth of tobacco root into three stages: root emergence, root growth, and root branching. According to the quantitative relationship between tobacco root development and the environment, the growth pattern of each stage and the correlation between different stages were elaborated. Based on these patterns, a virtual system of tobacco root growth was created with computer graphics. The system is able to simulate the three-dimensional dynamic growth of the root and calculate the root parameters at the same time. The result suggests:

(1) Since the relationships between tobacco root growth and the environment, nutrition supply of aerial parts and root growth, etc. are considered systematically, the model is systematic and universal.
(2) The simulation result is basically consistent with the growth and development of tobacco root, and reflects the pattern of tobacco root growth and development. Thus, the system could be utilized as a tool to study the growth and development of the tobacco root, and assist the digitalized regulation for high yield and quality of the tobacco.
(3) In the simulation, the information of root development quantity, length, distribution characteristics at any given time is stored in the root description file. The content recorded in this file is not only the current output, but also the input information for subsequent simulations, thus making it possible to continue the previously aborted simulation. Therefore, it is ideal to study the impact of different environmental backgrounds on the morphology of a partially developed root with this function.
(4) Although the model rather successfully simulates the dynamic change of root morphological characteristics, it still needs improvement in terms of simulating the impact of local soil's nutrition distribution on the roots as well as the interactions and competitions between adjacent roots.

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Winter Wheat Quality Inspection and Regionalization Based on NIR Network and Remote Sensing

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Abstract. In the crown of the year, inspection of wheat quality fast and accurate is very important for all of grain enterprises, farmers and governments. Governments would like to construct a fair and equitable market for grain transaction with explicit grain quality standard. Farmers would like to sell their high-quality grain at a high unit price for they have paid more attention and investment. Enterprises also would like to purchase high-quality grain with higher unit price for it can bring more profits. At the same time, generating regionalization map of wheat quality accuracy in time is very important on the grain enterprises' purchase strategy formulating and purchase region choosing. The authors collected 1200 NIR samples in 240 points (in other words, 5 samples per point) in 12 counties in the main wheat producing areas in China (Hebei, Henan, Jiangsu and Shandong), then analysis these samples by both GIS spatial interpolation method and RS inverse method. In contrast, RS inverse method can simulate the quality parameter more accuracy than GIS spatial interpolation method. In conclusion, RS inverse method is preferable to generate quality regionalization map with NIR network samples.

Keywords: Winter Wheat; Quality Inspection; Quality Regionalization; NIR Network; Remote Sensing.

1 Introduction

Near infrared (NIR) technology has been widely used in quality inspection in China and now only a single NIR instrument is usually used to inspect the sample which can evidently improve the efficiency of inspection [1]. However, a single NIR instrument lacks the universality and uniformity because its calibration model is the default model of producers or the model being generated according local samples. In this situation, all the instruments not in network only can inspect samples in the local Lab with higher reliability and higher accuracy; while the inspection results between different instruments may be have large difference (known as difference between instruments) [2].

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Grain Quality Inspection NIR Network can make up the gap to achieve the consistency and credibility of results between instruments by transferring calibration model to Client-Instrument from Host-Instrument through the server in Network Management Center. The stable calibration model provided by the unified analysis network can ensure all devices within the network producing the inspection results having the same accuracy and stability and make all devices not being influenced by the difference between the sample sources and the test environment. It's the important technology base of Grain Quality Analysis in large scale region to implement the inspection results of any instrument in the NIR network having the same accuracy and reliability with integrating with GIS or RS [3].

Remote sensing technology is widely used in crop growth monitoring, pests monitoring and quality monitoring since it has a natural advantage in the analysis of distribution and change of land cover on earth [4]. But we can't get the full crop growth information from RS data directly since RS data is comprehensive, namely the pixel value in the image is a comprehensive reflection of the features located in the certain region and the information in the image cannot completely be interpreted to the corps growth information [5].

From above can be concluded that NIR Network technology can inspect grain quality accurately, rapidly and reliably while RS monitoring technology can expand the accurate information of the earth's surface from point to plane by a reverse model. So we can generate the quality regionalization map for crop enterprise and government by combining these two technologies. The enterprise can purchase the appropriate and necessary crop with higher price according this map.

2 Material and Methods

2.1 The Structure of NIR Network

NIR network technology has been widely used in Europe and America. Now there more than 30 worldwide NIR grain quality analysis networks which are composed by nearly ten thousand NIR instrument running in the United States, Canada, Germany, France and Australia, etc [6]. More and more quality analysis of crop trading in Europe and the United States were inspected by NIR network. NIR Analysis technology has been certificated by a number of international organizations and national official, including the United States, Canada, Germany, France, Australia, etc [7].

The first NIR network for crop quality analysis in china was established by NERCITA consisting of a number of universities, research institutes and crop enterprises in Heilongjiang, Jilin, Hebei, Shandong, Jiangsu and Hunan [8].

NIR grain quality monitoring network is composed by Network Steering Committee, Calibration Center, Network Management Center and Client Users (As shown in Fig.1). The functions of every component are described as below:

Network Steering Committee's task is to determine to use the new calibration or adjust the existed calibration based on the statistics from the calibration center.

Calibration Center's task is to develop the application model for all instruments in network.

Network Management Center's task is to manage and maintain the network.

Client Instrument is the end-user of the network.

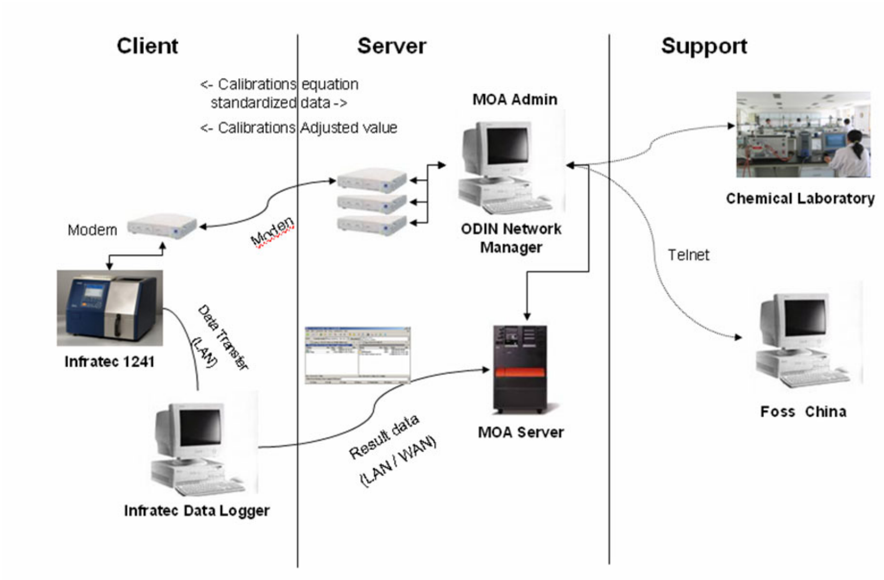

Fig. 1. The structure of the NIR network in NERCITA

2.2 Calibration Transferring and Instruction Standardization

Calibration transferring and instruction standardization can eliminate the model difference generated by the host and client instructions manufacturing tolerances [9]. The common method is to analyze a same group samples by host and client instruments, then to adjust the slope and intercept of calibration model of client instruments. The authors adjusted 7 instruments in the NIR network for Proton, moisture and wet gluten of winter wheat, the results are shown in Table 1 ~ Table 3, the instruments in the network are accuracy and consistent.

Table 1. The accuracy of calibration transfer and model adjustment for Protein

Instrument	RMSEP	Bias	Slope	Intercept	Correlation
Hebei-1	0.05	-0.03	0.98	0.40	1.00
Henan-1	0.07	0.00	0.97	0.42	1.00
Henan-2	0.10	-0.08	0.98	0.45	1.00
Jiangsu-1	0.03	-0.01	0.97	0.42	1.00
Shandong-1	0.11	-0.11	1.00	0.04	1.00
Shandong-2	0.07	0.01	0.97	0.37	1.00
Jiangsu-2	0.04	-0.02	0.96	0.56	1.00

Table 2. The accuracy of calibration transfer and model adjustment for Moisture

Instrument	RMSEP	Bias	Slope	Intercept	Correla-tion
Hebei-1	0.03	-0.02	0.97	0.36	1.00
Henan-1	0.14	-0.14	0.92	1.04	0.99
Henan-2	0.18	-0.18	0.93	0.97	0.99
Jiangsu-1	0.04	-0.02	0.92	0.98	0.99
Shandong-1	0.05	0.04	0.94	0.63	0.99
Shandong-2	0.02	-0.02	0.99	0.10	1.00
Jiangsu-2	0.04	-0.03	0.93	0.81	1.00

Table 3. The accuracy of calibration transfer and model adjustment for Wet Gluten

Instrument	RMSEP	Bias	Slope	Intercept	Correla-tion
Hebei-1	0.24	0.06	1.16	-5.43	1.00
Henan-1	0.93	0.53	0.69	9.73	0.98
Henan-2	0.49	0.40	0.96	0.77	0.99
Jiangsu-1	0.59	0.32	0.78	6.94	0.99
Shandong-1	0.41	-0.07	1.29	-9.42	0.99
Shandong-2	0.16	0.04	1.03	-1.17	1.00
Jiangsu-2	0.38	0.33	0.95	1.27	0.99

2.3 Samples Collecting

The samples were collected from 12 counties in Henan, Hebei, Shandong and Jiangsu, the main winter wheat belt of China. For every sample point, the authors recorded detail information including GPS location, wheat variety name, sample sizes and sampling time. On every site, the authors collected 5 samples-2 for the NIR network detection, 2 for chemical contrast and 1 for backup. The factors of detection included protein content, moisture content and wet gluten content.

Firstly, the Infratec Data Logger - a special soft for data collecting developed by FOSS - collected the inspection data from instrument to PC which connected with the Instrument by intranet. Then these data were uploaded to the server in network management center by a FTP synchronization software tools.

2.4 Methods

2.4.1 GIS Interpolation

In our research, an optimal space interpolation method-Kriging method- was used to analysis the moisture, protein and wet gluten in wheat for getting the spatial distribution map of the wheat quality class interpolation. The map can reflect the quality class of wheat.

The fundamental principles of Kriging method is similar to least squares method and its essence is to consider not only the general trend changes (statistical features) , but also the related changes and the random variations on the sample surface [10]. The general trend changes, the related changes and the random variations are respectively named the structured item, the relevant item and the random noise (as shown in Fig.2) [11]. The usual fitting function equation is as follows:

$$f(x, y) = f_1(x, y) + f_2(x, y) + C \tag{1}$$

Where $f_1(x, y)$ is the structured item, $f_2(x, y)$ is the relevant item and C is the random noise.

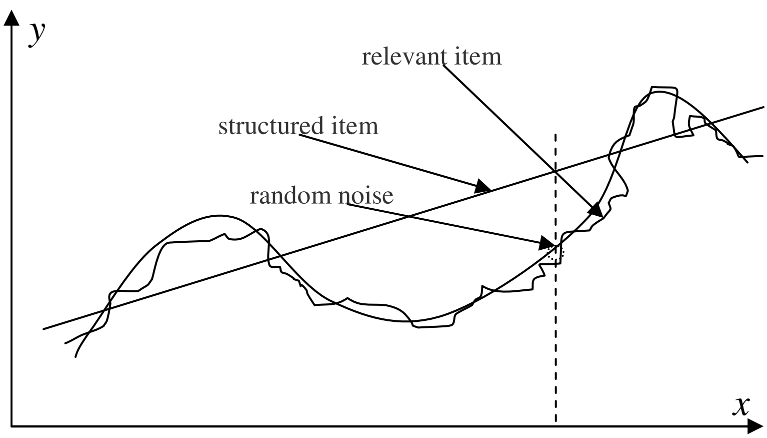

Fig. 2. The principle of Kriging interpolation method

2.4.2 RS Inverse Model

The basis method of RS inverse is to set up a correlation model between the RS information and the real system on earth [12]. Firstly the linear or non-linear relationship between the crop growth state index and the single phase or multi-temporal spectral vegetation index (VI) is analyzed; then based on the relevant relations the statistic model, including the single variable and the multivariate statistical models, is set up. In addition, there is the RS inverse method based on the priori knowledge, which mainly uses the Bayesian statistical method. Our research adopts the single variable statistical models and the formula of correlation coefficient between the crop growth state index and the vegetation index is

$$R_{xy} = \frac{\sum_{i=1}^{n}(x_i - \overline{x})(y_i - \overline{y})}{\sqrt{\sum_{i=1}^{n}(x_i - \overline{x})^2} \bullet \sqrt{\sum_{i=1}^{n}(y_i - \overline{y})^2}} \qquad (2)$$

Where Rxy is correlation coefficient value, Xi is the observed value of the crop growth state index of No.i sample point, Yi is the value of spectral vegetation index of No.i sample point, $\overline{x}$ is the average value of the observed value of the crop growth state index of all sample points and $\overline{y}$ is the average value of spectral vegetation index of all sample points.

3 Results and Discussion

3.1 Accuracy Analysis of NIR Network

The authors selected 240 sample points in 12 counties in the main wheat producing areas in China (Hebei, Henan, Jiangsu and Shandong, as shown in Figure 2.) in 2009. In every point, the authors got 5 samples, 2 for the near-infrared detection, 2 for chemical assay, the test results averaged. Comparison of detection of one protein results shown in Fig. 3:

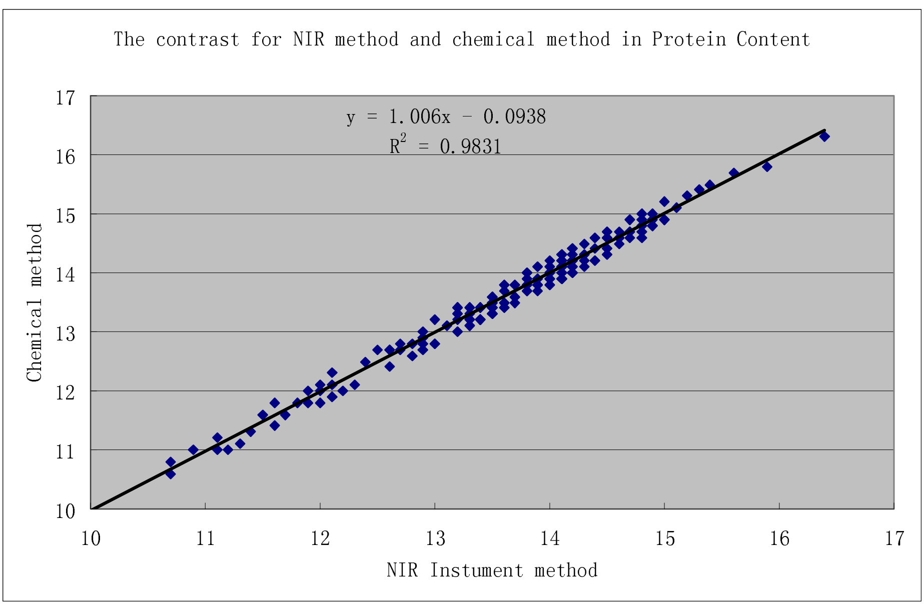

Fig. 3. The accuracy of NIR network contrast to Chemical method

3.2 Winter Wheat Quality Regionalization by Integration with GIS Interpolation

GIS technology is used in spatial analysis field widely. The GIS spatial interpolation map of samples points as shown in Fig. 4.

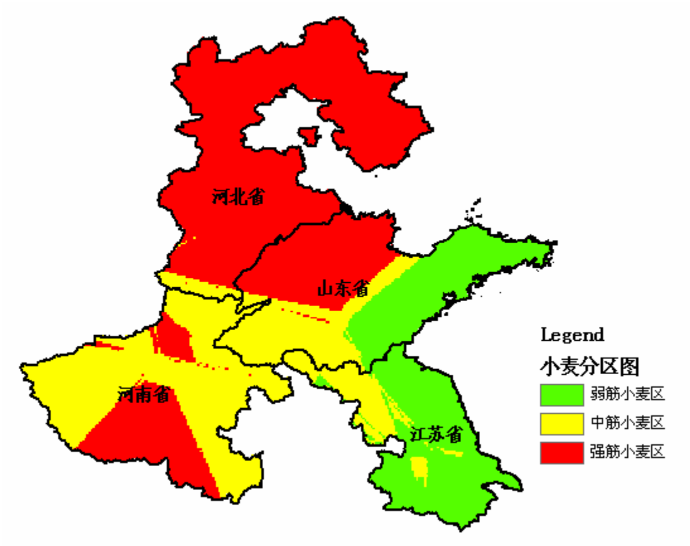

Fig. 4. The winter wheat quality thematic map generate by GIS spatial interpolation

Because the collection of samples are limited by regions, labors, date and others, it is difficult to collect samples at large-scale and on certain percentage. The thematic map generate by GIS technology is always not very accuracy and reliable for the lack of enough sample points.

3.3 Winter Wheat Quality Regionalization by Integration with RS Inverse Model

RS image is taken in a moment, so the information represented by its pixel value is steady and sequential. Some vegetation indexes (VI) generated by RS image can reflect the quality information of covered crop so the inverse model having a high correlation can derive the regional quality thematic map reliable.

The authors chose randomly 115 of the 240 sample points to build inverse model and the other 125 points to verify the model. The details are shown in Table 4. The inverse thematic map is shown in Fig. 5.

Table 4. Detail info of sample points assign and accuracy contrast between GIS method and RS method

	Hebei	Henan	Jiangsu	Shandong
Points for build Model	40	40	35	0
Points for verification	35	30	20	40
standard deviation of GIS	0.134	0.117	0.122	0.178
standard deviation of RS	0.048	0.055	0.054	0.102

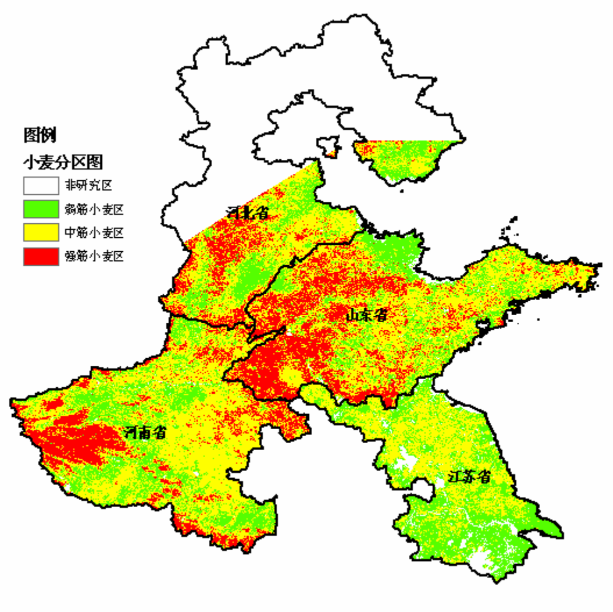

Fig. 5. The winter wheat quality thematic map generate by RS inverse model

4 Conclusion

By above comparison, the Quality Regionalization map generated by RS inverse model is more accuracy and reliable than by GIS spatial interpolation map. So we can conclude that Integration RS monitoring technology with NIR network to generate Quality Regionalization map is valuable for crop enterprise on making purchase policy and bringing interests to enterprises, farmers and governments at the same time.

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A Web-Based Monitoring System as a Measurement Tool in Greenhouses Using Wireless Sensor Networks

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Abstract. In this work, we propose a Web-based monitoring system using wireless sensor networks (WSNs) to measure plant parameters and environmental factors in greenhouses. To detect and send these variables, e.g. leaf temperature, air humidity, a ZigBee-based WSN collects data, which is transmitted by GPRS modules and the Internet to a central computer, and all information, including the dynamic topology of WSNs, can be published via the Web. The system provides flexible configuration options for sensor nodes and transport downlink commands, i.e. sensors can be added or removed flexibly in a node without changing the hardware interface and data center service software. Also, the variance of the received signal strength indicator and link quality indicator (LQI) under different distributions of the growing plants was considered to estimate the network link quality to ensure reliable data transmission in the WSNs. Experiments show that the system is reliable, flexible, convenient, and provides good real-time and scalability characteristics.

Keywords: monitoring system, WSNs, GPRS modules, received signal strength indicator, link quality indicator.

1 Introduction

When using a conventional wire-based automatic monitoring system in a greenhouse, an increased number of measurement points can dramatically increase the complexity and cost of the system. It should also be possible to change the location of the measurement points easily to meet different measurement needs, which depend on the particular plant, on possible changes in the external weather or the greenhouse structure, and on the plant placement in the greenhouse.

In recent years, wireless sensor networks (WSNs) have been used in several agriculture applications, e.g. regional and on-farm agriculture projects for irrigation[1,2]. Vivoni and Camilli[3] developed a wireless prototype system to acquire, store, display and transmit real-time, geo-referenced environmental data between multiple field

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teams and remote locations. Mahan and Wanjura [4] cooperated with a private company to develop a wireless, infrared thermometer system for in-field data collection. The system consisted of infrared sensors, programmable logic controllers and low power radio transceivers to collect data in the field and transmit it to a remote receiver outside the field. However, there has been little research into web-based WSNs for measurement of plant and environmental variables in greenhouses, and particularly to investigate the influence of plant growth on radio wave propagation in the WSNs. Also, there remains an engineering issue that requires further study to provide flexible configuration options for sensor nodes and transmit downlink commands to set up new parameters for nodes online during addition or removal of sensors without changing the interface and software.

From an engineering perspective, there remain many difficulties and challenges in measuring plant variables in the field or the greenhouse using WSNs. Our objective was to develop WSN hardware and software to provide functions for acquiring real-time measured data from the Internet, and displaying the RSSI and topology of the WSNs dynamically, and also for transmitting downlink commands to sensor nodes.

2 Remote Monitoring System Design and Overall Structural Framework

To explore the issues with the deployment of such a monitoring network related to plant growth in the greenhouse, a web-based remote sensing network architecture is depicted in Fig. 1. The system consisted of a ZigBee-based tree-topology WSN with 20 sensor nodes to obtain plant or environmental variables, e.g. leaf temperature, stem sap flow, temperature or humidity, plus 5 router nodes, and 1 coordinator node (sink node) deployed in the greenhouse, a GPRS module connected with the coordinator via the RS-232 serial port to transmit the received data to the remote monitoring center, and a web-based management sub-system for users to acquire and analyze the data via the Internet. To meet special applications of the system, the system can send commands to the wireless network to re-configure the node channel and set the sampling frequency.

2.1 Sensor Node

The sensor node functional module is shown in Fig. 2. Each sensor node can provide 8 analog channels with 14-bit resolution and multiple I/O channels, and therefore we can simultaneously connect up to 8 analog sensors and configure the channels flexibly. A node can access any sensor data without changing the hardware circuit and interface, simply using the upper flexible configuration. At the same time, all the network nodes send LQI and RSSI values to the coordinator for future operations by the data center. Sensor nodes collect the sensors' data periodically according to commands from the control center, and then send the data to the coordinator node. The coordinator node is connected with the GPRS DTU to send the data to the remote data center via the Internet.

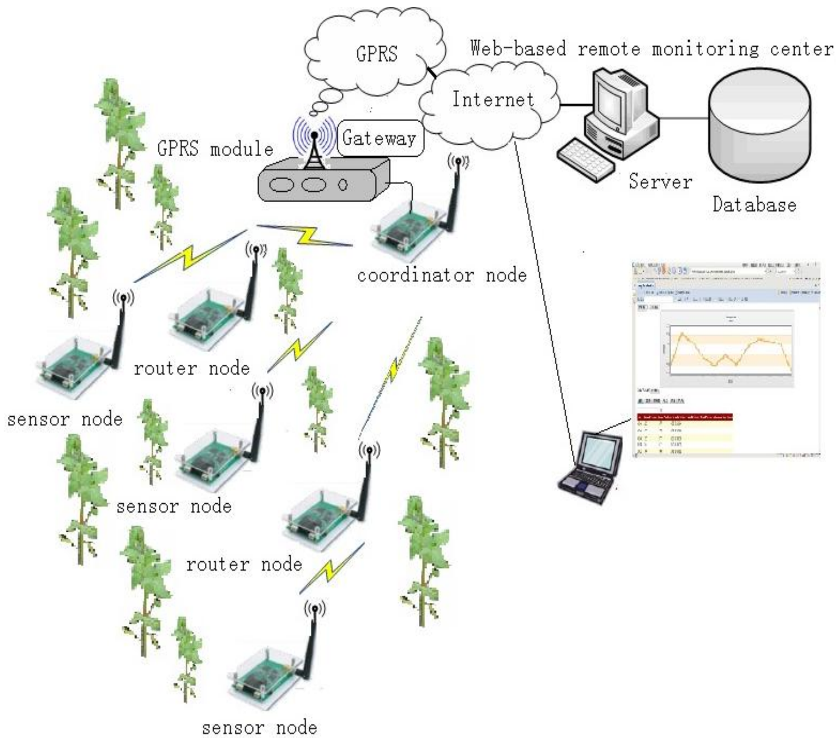

Fig. 1. Overall system architecture of the web-based remote sensing network

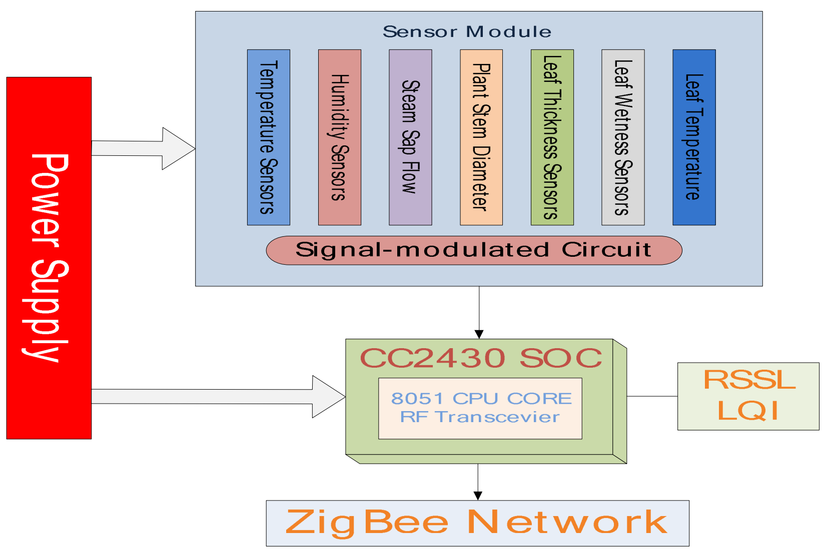

Fig. 2. Block diagram of the sensor node in ZigBee-based WSNs

3 System Software Design

3.1 Network Management Software Based on Z-Stack

The network application was written in C and designed to run on a CC2430 system-on-chip (SoC) solution specifically tailored for IEEE 802.15.4 and ZigBee applications. The code for each node was based on the Z-Stack supported by an Operating System Abstraction Layer (OSAL). OSAL is an event driven non-real-time operating system (for a detailed description see the documentation of Texas Instruments[4], Inc.). The components of the Z-Stack are implemented as separate tasks and information is passed inside the stack using the OSAL messaging system.

Using a tree-topology WSN, a coordinator is responsible for initiating and maintaining the network. After joining the network, the sensor nodes obtained 16-bit short network addresses, which identified data from each sensor node. Since the low LQI and RSSI indicated higher packet losses, we acquired LQI and RSSI to estimate performance for the WSN. In the Z-stack, LQI can be directly read from the receiving data packet, and assuming the structure is defined as pkt, then the LQI = pkt-> LinkQuality; the RSSI value was not directly allocated in the structure, and thus we need to read it from the underlying protocol stack, and then the application layer calls.

3.2 Monitoring Center Program Design

The monitoring center software was developed to receive and transmit TCP protocol packets, which communicated with GPRS terminals. Using a **CAsyncsocket** class provided by Visual C++, the software easily achieved socket communications. After data reception, the received data is stored in the database. According to the actual needs of the project, data centers permit users to conduct these operations, e.g. setting the acquisition cycle, selecting each channel for each node to be connected to the sensors, and transporting the downlink commands to the corresponding nodes in the network, and then sensor nodes periodically call the corresponding function based on the commands.

3.3 Web Data Release

As mentioned above, a method to view the data easily via a Web browser is very important. Here, data representation challenges arise when dealing with wireless sensors. First, the data must be packaged by the wireless sensor node and sent in an understandable manner over the WSN. The data must be interpreted by a computer that stores or displays the data, which includes the network addresses of nodes, the collected sensor data, and the RSSI and LQI values and power consumption. To make the data accessible by a large range of applications, efforts should be made to determine the best structures for storing the data in databases.

The client browser running on the Web page is based on a. Net framework development, development tools, mainly Visual Studio 2008, and SQL Server 2005. The web page is shown in Figure 3.

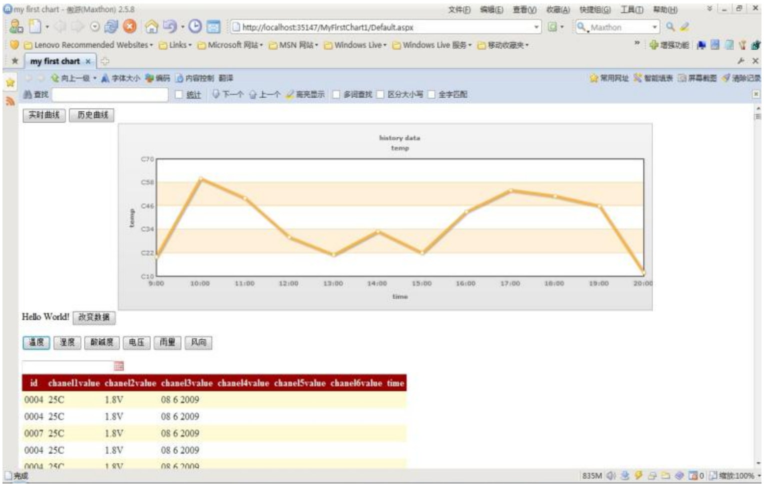

Fig. 3. Web data release

This Web page includes five main functions: real-time data, historical data, network topology and node deployment management, and user management. The real-time data module allows users to view real-time data from each sensor node; the historical data module allows the user to select the time range for acquiring data. Also, the network topology and deployment management functions permit the user to check the status of the network and the actual deployment of nodes, so that the user can see whether the need to replace batteries or re-deploy the nodes following the growth of the crops is indicated.

Fig. 4. Image of the devices in the greenhouse

Fig. 5. Channel configuration of each node using the monitor center

Fig. 6. Real-time data displays via the web

4 Results and Discussion

To verify the proposed system, we conducted experiments both in the laboratory and the greenhouse. In the first stage, a small ZigBee network with several nodes was deployed to collect data from SHT11 and infrared temperature sensors, in the light upper plane, and to add analog channel selection in the transformer, and experimental testing is conducted to verify the proposed hardware and software solutions. In the second stage, the WSN was deployed in the greenhouse to assess system performance, e.g. range, robustness and flexibility. Figure 4 depicts the experimental setup in the greenhouse.

As shown in Figure 5, we sent transport downlink commands from the remote server to nodes in the WSN, with a new configuration table for obtaining sensor data from the greenhouse. Figure 6 shows real-time data via the browser.

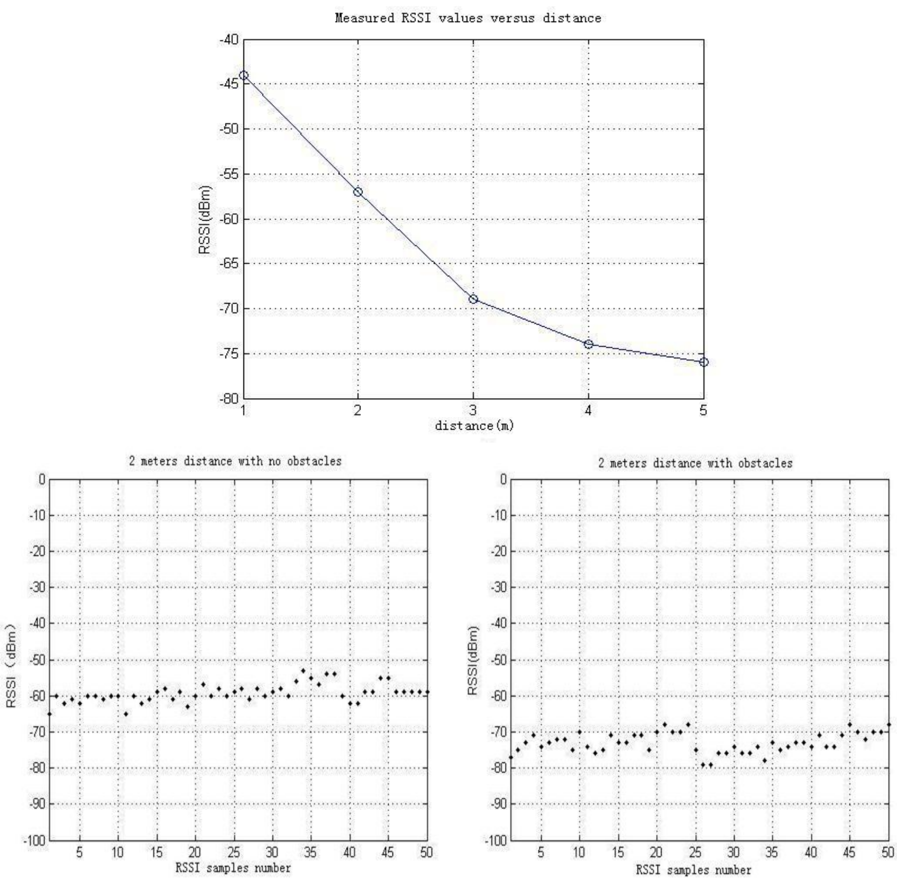

Fig. 7. RSSI measurement

When considering the deployment of wireless multi-hop networks in the greenhouse, we must evaluate basic performance parameters such as radio performance (e.g., received signal strength, coverage ranges and link failure probability) with growth of crops. RSSI and LQI are important indicators of the measurement for link quality. In this experiment, the RSSI value versus the change of distance and obstacles is depicted in Figure 7, indicating that obstacles had a major impact on link quality.

Also, the network nodes periodically upload their own network information and data collected, including topology information to the data center stored in the database. The data in the database dynamically updates every hour, and when the client queries the topology, the web server then searches the database and displays the network topology in the browser. The client can see which node has left the network because of energy depletion and other reasons via the topology view, and then can add new nodes and re-deploy nodes as needed, as shown in Figure 8.

Fig. 8. Network topology

5 Conclusions

The application of the WSN as a measurement tool in broad ranges for monitoring environmental and plant parameters has the obvious advantages of faster deployment, unlimited installation flexibility for sensors, and better mobility than wired networks.

Thus, the Web-based system has realized the display of the network topology, and the sensor data from the nodes. RSSI and LQI were important performance indicators for data transmission, and the system was able to obtain RSSI and LQI values with the growth of crops in the greenhouse. Also, the system offers flexibility, i.e. it is customizable in terms of replacing sensors to enable variations such as the type of sampling channel and the sampling frequency used.

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Analysis and Design on Decision Support System of Security Risk Management in Rural Power Network

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Abstract. The paper, according the investigation and research of the requirement of rural grid security risk management, designs a decision support system to assist decision-making of security risk management. System database and knowledge base were built, progress the model of security risk assessment. The application of methods of statistical analysis and reasoning, avoids, prevents and controls the security risk of rural power network effectively. Through system applying in Changchun rural power company, improved the quality and level of decision on security risk management.

Keywords: Decision support system, Security risk management, Rural power network.

1 Introduction

Security of risk evaluation is an important method of modern management. Promote the security of risk evaluation is a critical step to measure and to predict the system of security risk and control the incident. The implementation of security of risk evaluation can pre-control system of risk, as well as make security management more scientific and increase the technology content of safety management.

With the development of information technology, the construction of information technology in rural grid system has been tremendous development, but information of security of risk management is still in a relatively weak aspect. By designing and applying the decision-supported system of security of risk evaluation, one can avoids, prevents and controls the security of risk in rural grid effectively, and also improve the quality and level of decision of security of risk management.

2 Summary of Decision Support System

The conception of decision support system is proposed firstly in 1971 by M. S. Morton, whom comes from the United States. Decision-supported system is a integrated system, which aims decision-making for dealing with problems; it uses decision-making

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resources (data, models, knowledge, etc) to combine and to integrate, builds solutions as well; it is also gradually access the decisions through model calculations, knowledge inference, multidimensional data analysis and program modification.

Decision support system includes traditional decision-supported system, intelligent decision support system, new decision support system and integrated decision support system. Traditional decision-supported system is an aided decision-making system which combined model base and database, and it is the first of decision support system; intelligent decision support system is an aided decision-making system which uses expert system and data mining and based on the traditional decision-supported system; new decision-supported system is a decision support system which uses warehouse of data, online analytical and data mining; integrated decision support system is a more advanced decision support system, it is also the direction of future research in the area of decision-supported system. Decision support system has a wide range of applications in production, management and other aspects, such as agriculture, resource management, business management, manufacturing in production and management, decision-making management of e-government, etc.

3 System Design

3.1 Design Goals

The system uses the methods of work environment, protection of equipments and machines, quality of personnel, workplace management, integrated production of safety, to assist safe managers to evaluate the security of risks and improve the quality and levels of decision-making.

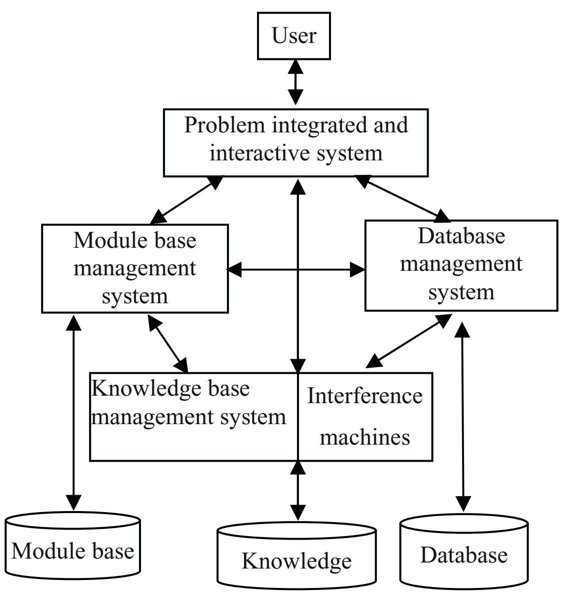

Fig. 1. System Structure

3.2 Structure and Function

3.2.1 Structure of System

The structure of the system is consisted of the data of database, knowledge base and module base, the data is reasoned by inference machines and analyzed in the management system of knowledge base, then the result is outputted to human-machine interface, it plays an aided role in the step of decision making for users.

3.2.2 System Function

The system is designed for four modules, namely database management system, knowledge base management, model base management decision-aided support.

(1) Database management system. The module managed the basic information of work environment, protection of equipments and machines, quality of personnel, workplace management and integrated production safety.

(2) Knowledge base management system. The module included transport evaluated criteria, transform evaluation criteria and distribution evaluation criteria.

(3) Model base management system. The module includes hazard identification model and safe evaluation model.

(4) Decision-aided support system. This module can aid policy-makers to make decisions by periodic safe and risk assessment and real-time safe and risk assessment.

3.3 Database Design

The system chooses Microsoft SQL Server 2005 as the management system of database for backstage, including the design of database, knowledge base and module base.

Database is an important resource of the decision-supported system, a basic part of module base, knowledge base and interface of human-machine. The safe and risk evaluation of management of the power companies are mainly dealt with the evaluation in five aspects: work environment, protection of equipments and machines, quality of personnel, workplace management, integrated production of safety, the module of database management will manage the data together.

Knowledge base is a combination of knowledge, which is stored according to some regulations in the computer, the reliability of decision support system is depend on the quality of knowledge which is stored in the knowledge base. The knowledge base of this research is on the basis of grid standardized regulations of safe management, accompanying with experience of working in many years and against with the actual situation of grid in rural areas, which can also be divided into three aspects: power transport, power transform and power distribution. Each kind of work is classified and given the ID number of everyone, which as the only mark for the task. Every work is listed by the procedure of safe production: before work, work and after work, these procedures evaluate varieties of potential danger as corresponding of ratio and evaluate every procedure for its corresponding mark as well, also, the data will be the critical depends of safe production evaluation. Table 1 is the structure for standard of marks.

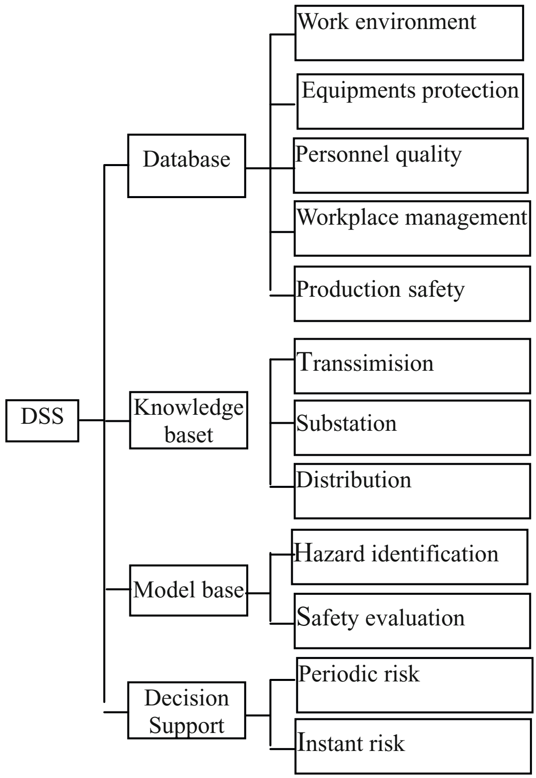

Fig. 2. System functions

Table 1. Table of evaluating marks

Name of Field	Description of Field
StdNumber	Number of Evaluation
StdItem	Project of Evaluation
StdMethod	Standard and Method of Evaluation
StdGrade	Mark of Standard
Weight	Ratio
Method	Measure of Evaluation
Scope	Range of Using
Cycle	Period of Evaluation
StdSource	Resource of Project Standard

Module base is the critical part of decision-supported system, involves database of module and management system of module database. There are two main modules in this system: identified module of dangerous resource and module of integrated evaluation. Identified module of dangerous has important position in the system of management evaluation in safe risk area, which directly affects the exact extent of safe evaluation. The system through the method of LEC to identify the dangerous resource, LEC is also called the line-evaluated method of working condition, its module is $D=L\times E\times C$. The size of risking value depend on L, which represents feasibility of accident-happened, as well as E(it is the frequency of exposure in the dangerous environment) and C(it is related to the results affect by the existed accident). The module depends on the value of LEC as the evaluation of working in risk conditions, and then takes corresponding steps. Module of integrated evaluation use the method of lined, ratio and average, its module can write as

$$T = \sum_{i=1}^{p} \{\sum_{k=1}^{M} [\sum_{j=1}^{k} F_j \bullet Q_j / N] W_k\} \bullet X_i \tag{1}$$

P represents the category of project with the system of evaluated value; M is the number of evaluated key element, which is related to the standard of evaluation in the order of i; N is the number of person whom attend the evaluation; W_k is the ratio of standard of evaluation in the order of k in the category of i; F_j is the evaluated mark which evaluated by the standard of the order of k; Q_j represents the ratio of evaluation standard in the order of k by the person's order of j; X_i is the ratio of standard of evaluation in the order of i. By using this method, people can give marks of all kinds of parameters in the safe risk management.

4 Inference Engine

Inference Engine gives its judge according to the marks of the former system.

The instant evaluation can not only check all the projects as a whole, but can check single project, the formula is

$$\rho = \frac{\sum_{k=1}^{n} s_k * w_k}{S} \tag{2}$$

ρ is the level of safety; S_k is the single mark of safety; W_k represents single ratio; S represents the sum-number. In this way, we can calculate the safe level of working:

Safe and controllable（$\rho \geq 0.9$）
Low risks（$0.9 > \rho \geq 0.75$）
Risks（$0.75 > \rho \geq 0.6$）
High risks（$0.6 > \rho \geq 0.4$）
Safety is out of control（$\rho < 0.4$）

Period evaluation is a method of statistics and analysis in each work unit. The method can integrated count and analyze the work environment, protection of equipments and machines, quality of personnel, workplace management, integrated production of safety, and then give a result in the period of safe risk evaluation. Managers of production can make decisions by using the data and instruct production. The mark for formula of single task is

$$\bar{s} = \frac{\sum_{k=1}^{n} s_k * w_k}{n} \tag{3}$$

$\bar{s}$ is single work's average mark; s_k is mark of single safety; w_k represents single ratio; n represents number of working. The sun-mark of evaluated result can calculate by the task mark of single work, its formula is

$$\bar{S} = \sum_{k=1}^{n} \bar{s}_k * w_k \tag{4}$$

$\bar{S}$ represents the sum-mark of evaluated result; $\bar{s}_k$ is the task mark of single work; W_k is single ratio. In this way, we can count the sum-mark in the period and obtain the result of single work.

As immediate evaluation has a dynamic wave of data, evaluate once cannot reflect the actual condition objectively, so we need to results of evaluation in many workplace. According to the result of evaluation, decision-makers can analyze the immediate work and safe risk of working in the period. finally, they can make newly decisions.

5 Conclusion

This essay analyze the security of grid and the risk management of decision-supported system in rural areas, by combining periodic and real-time evaluation method, simultaneously, by using the method of linear model ratio, which can provide the data of risk evaluation for decision-makers and make the data increasingly exact, and prevent the security of grid in safe risk management, as well as improve the level and quality of grid of risk evaluation in rural areas.

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Analysis on the Factors Causing the Real-Time Image Blurry and Development of Methods for the Image Restoration

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Abstract. The blurred images will make image processing difficult and be hard to get high image solution for recognition, which will lower the precision of a variable rate spray system in pesticide application. In this paper, Radon transform in frequency domain is used in this work to test the blur angle and blur length in different tractors speeds and camera heights. Four image restoration methods in terms of the shape, color, texture and computing time were compared. The results showed that the speed of tractor and the height of camera played an important role on the blur extent of real-time image. A mathematical model corresponding blur angle and blur length with the speed of tractor and the height of camera is established, which would provide a theoretical basis for reducing blur and improving the quality of real-time image.

Keywords: Machine vision, Real-time, Blurred image, Radon transform, Image restoration.

1 Introduction

The images captured by the variable rate spraying system based on machine vision are often blurry in some extent due to the relative move between camera and objects as well as the vibration of the system in the field [2, 3, 5-10]. Motion blur will make image processing difficult and be hard to get high image solution for recognition, which will lower the precision for the system to adjust the spray volume in terms of the practices of the crops [4, 11, 12]. As the variable rate spraying system in the actual operation, how to reduce the blur of real-time image captured and restore the blurred image is crucial.

In the imaging process, image always appears blur due to the relative move between camera and objects, Imaging equipment with external interference and inherent defects, The vibration and light scattering of the camera, and noise interference [6]. The blurring needs to determine the point spread function, it can be expressed as:

$$h(x,y)=\begin{cases}1/L & \sqrt{x^2+y^2\le L}, x/y=-\tan(\theta)\\ 0 & others\end{cases} \tag{1}$$

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Where L is blur length, θ is blur angle, they are two important parameters of motion blur [7]. The main methods of detecting blur angle and blur length are divided into differential method and frequency spectrum. Differentiation is the calculation of the direction of the process of differential reference only to two adjacent pixels of the gray value, not well reflect the changes in the gray image areas, and the result error is relatively large. Spectrum method is based on computation of the power spectrum of the image in the frequency domain, and the error is relatively low [8].

The image restoration methods have been matured, which are then based on deconvolution methods such as iterative Lucy–Richardson and Blind deconvolution or non-iterative Wiener algorithms and Regularized filter [9]. However, these real-time image restoration method to evaluate the need for restoration effect. Common image evaluation methods are: Mean Absolute Error(MAE), Mean Square Error (MSE), Normalized Mean Square Error (NMSE), Signal to Noise Ratio (SNR) and Peak Signal to Noise Ratio(PSNR) [10]. However, these methods are based on reference image quality assessment, and not meet the interest in evaluation of machine vision.

In this paper, mathematical models established for blurred image analysis through testing blur degree at the different speed of tractor and the height of camera, which provide a theoretical basis for reducing motion blur in images. Comparison of the four kinds of classical methods of image restoration such as Wiener filter, Regularized filter, Lucy Richardson (L-R) and Blind algorithm already in use and some which have been recently proposed in the literature for finding a restoration method suitable for real-time image.

2 Experimental Materials and Methods

2.1 Experimental Equipment

Real-time image acquisition system was based on a small four-wheel system DFH tractor as the carrier, and pre-high-resolution color camera for the OK_AC1300 RGB camera, 230 frames / second. Image acquisition card was OK_RGB10B RGB color component capture card. Lenovo notebook computer with Pentium4 / 2.6G processor, 512M memory was used. Speed sensor was DJRVS11 made by Spraying System Company, USA.

2.2 Image Acquisition

We had a trial in the experimental base for China Agricultural University in early June 2010, Cotton as the experimental object, which was seedling growth period and its height between 10~20cm. This was orthogonal experimental design, the heights of Camera were 50cm, 80cm, 110cm, 140cm and 170cm, tractor speeds were 2km/h, 4km/h, 6km/h, 8km/h, 10km/h and 12km/h of 6 speed. We used real-time image acquisition system for image acquisition on cotton leaves, each collection was repeated 3 times, and stored the image acquainted through image acquisition card in the computer. Image acquisition card comes with the package can choose from 7 different image resolution for storage.

2.3 Motion Blurring Parameters Estimation

When the gradient of such a blurred image is transformed into the frequency domain by the Fast Fourier Transform (FFT) a regular structure is contained within the power spectrum in the frequency domain. This regular structure has a relationship to the length and the direction of the blur. The distance between neighboring stripes is related to the length of the motion blur. The relationship between blur length L and the distance between neighboring stripes d can be simply expressed as: $L= a/(d+b)$. The main ideas of the finding blur parameters process are illustrated in Fig. 1.

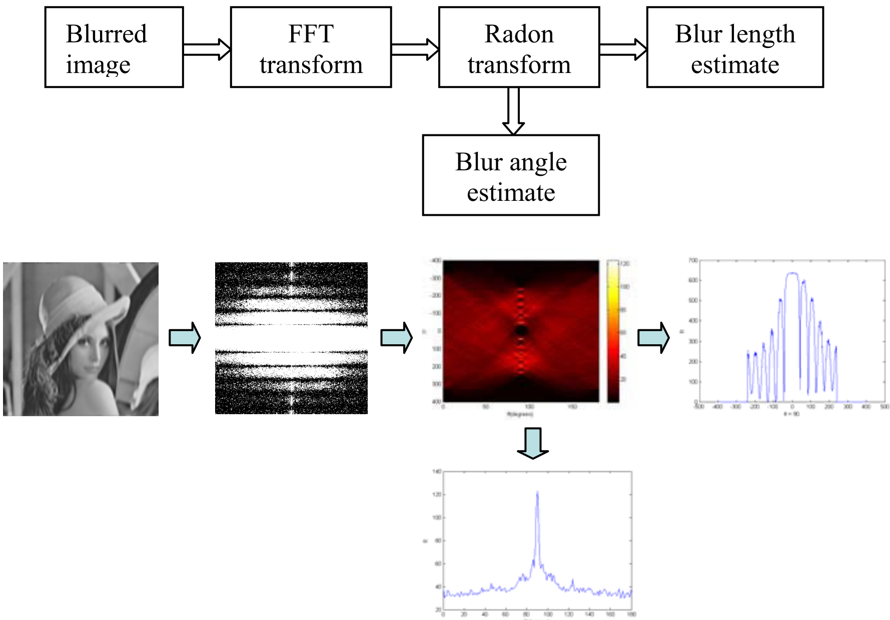


Fig. 1. The process of finding blurring parameters

2.4 Image Restoration Methods

(1) Wiener filter

The Wiener filter seeks to minimize the following error function:

$$e^2 = E\left\{(f - \hat{f})^2\right\} \tag{2}$$

Where E denotes the expected value operator, f is the undegraded image and $\hat{f}$ its estimate. The solution to the thereof arising optimization task can be written as follows in the frequency domain:

$$\hat{F} = \left[\frac{1}{H(u,v)} \frac{|H(u,v)|^2}{|H(u,v)|^2 + S_\eta(u,v)/S_t(u,v)}\right] B \tag{3}$$

Where H(u,v) is the PSF in the frequency domain, $S_\eta(u,v)$ the power spectrum of the noise and $S_t(u,v)$ the power spectrum of the undegraded image *F*.

(2) Regularized filter (reg)

This algorithm [15] is based on finding a direct filter solution using a criterion *C*, which ensures optimal smoothness of the image restored. Therefore the filter construction task is to find the minimum of

$$C = \sum_{u=1}^{M}\sum_{v=1}^{N}\left[\nabla^2 f(u,v)\right]^2 \tag{4}$$

$$\left\| b - h * \hat{f} \right\|^2 = \left\| n \right\|^2 \tag{5}$$

In the frequency domain the solution to this problem can be written as follows:

$$\hat{F}(u,v) = \left[\frac{H^*(u,v)}{\left|H(u,v)\right|^2 + \gamma\left|P(u,v)\right|^2}\right] B(u,v) \tag{6}$$

Where γ is the parameter which has to be adjusted to fulfill the constraint *C* and *P*(*u*,*v*) is the Laplacian operator in the frequency domain.

(3) Lucy–Richardson deconvolution (L-R)

This algorithm was invented independently by Lucy [14] and Richardson [15]. Its usage is further outline din [16]. The L-R algorithm is an iterative restoration algorithm that maximizes a Poisson statistics image model likelihood function. As summed up in [17] the RL algorithm consists of one initial and three iterative steps:

Step 1: A first approximation of the restored image $\hat{f}_0$ must be made, typically the constant average of all pixel values in the blurred image *b*.

Step 2: The current approximation is convolved with the PSF:

$$\varphi_n = h * \hat{f}_n \tag{7}$$

Step 3: A correction factor is computed based on the ratio of the blurred image and the result of the last step:

$$\phi_n = \overleftarrow{h} * \frac{b}{\varphi_n} \tag{8}$$

Where $\overleftarrow{h}$ denotes the PSF in reverse order and b/φ_n a “pixel-by-pixel” division.

Step 4: A new approximate is composed out of the current one and the correction factor:

$$\hat{f}_{n+1} = \hat{f}_n \cdot \phi_n \tag{9}$$

(4) Blind deconvolution (Blind)

Blind deconvolution algorithm restores the original blurred image with estimating PSF. The solution improved through iteration, the likelihood of that increases in the number of iterations, eventually converge with the greatest likelihood of Solutions Division. The advantage of the algorithm is able to achieve the blurred image of the recovery operations, in the case of no prior knowledge [20].

3 Experimental Results and Analysis

3.1 Analysis Blurred Factors of Image

To minimizing the blur extent, need for analysis of blur factors. Tractor speed and the camera above the ground as the factors, we made the analysis of blur angle and blur length with 90 images, which were detected by Radon transform in frequency domain. We established the relationship between blur angle and tractor speed with camera height shown in Fig. 2, and the relationship between blur length and tractor speed with camera height shown in Fig. 3.

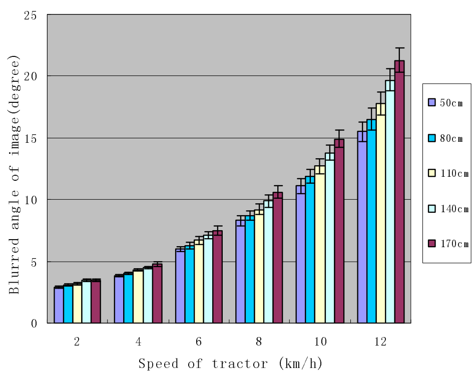


Fig. 2. The relationship of between tractor speed and blur angle

As can be seen from Fig. 2, engine vibration amplitude became larger and more increase degree of body bump with the increase of tractor speed. Therefore, Angle of deviation from the center line of tractors and the blur angle of image acquisition increased. Average blur angle increased from 3 degrees to 16 degrees as tractor speed increased from 2 to 12. As the camera away from the higher ground, its body was shaking with the more severe. Therefore, with the increase of the height of camera, the image blur angle became more. Moreover, camera height greater impact on blur angle of image with tractor traveling increase, the average blur angle expand 0.6 degrees with camera height increase from 50cm to 170cm at the speed of 2, while the average blur angle expand 5.2 degrees with camera height increase from 50cm to 170cm at the speed of 12km/h.

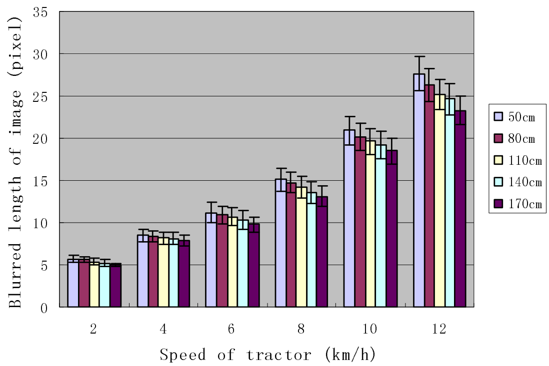


Fig. 3. The relationship of between tractor speed and blur length

Blur angle increased with tractor speed and height of camera increase, the related mathematical model can be expressed as

$$\theta = a_0 + a_1 V + a_2 H$$

Where *a0* is constant, *a1*, *a2* is coefficient, V is tractor speed, H is height of camera.

Table 1. Parameter value and significance of blur angle

	Coefficient	t Stat	P-value
a_0	-3.52089	-3.97802	0.000469
a_1	1.471714	19.61055	1.68E-17
a_2	0.021111	3.49414	0.001658

Table 1 shows that tractor speed and camera angle has an impact on the blur of image with p value of a1 and a2 less than 0.05. The value of a1 was more than those of a2, which show that tractor speed has more impact on blur angle than height of camera. The regression equation can be expressed as:

$$\theta = -3.52089 + 1.471714V + 0.021111H$$

Which correlation coefficient R2 = 0.94.

As can be seen from Fig. 3, blur length of image increase with tractor speed increase for the increase of tractor distance in exposure time. Therefore, blur length increased from 5 pixels to 25 pixels while tractor speed changed from 2 to 12. However, the decrease of shooting range of camera is made when height of camera increased, which cause blur length of image decrease and this trend is evident as tractor speed increase. Therefore, average blur length decrease 0.7 pixels while the height of camera changed from 50 to 170 at tractor speed of 2, but average blur length decreased 4.3 pixels at the speed of 12.

Image blur length increase with the increase of tractor speed, but decrease with the increase of camera height, the correlation model can be expressed as:

$$L = b_0 + b_1 V + b_2 H$$

Where b_0 is constant, b_1, b_2 is coefficient, V is tractor speed, *and* H is height of camera.

Table 2. Parameter value and significance of blur length

	Coefficient	t Stat	P-value
b_0	1.805778	2.049102	0.040284
b_1	1.971714	26.38732	8.18E-21
b_2	-0.01556	-2.58583	0.015432

The table 2 shows that tractor speed and camera angle has an impact on the blur length of image with p value of b_1 and b_2 less than 0.05. The value of b_1 is more than those of b_2, which show that tractor speed has more impact on blurring length than height of camera. The regression equation can be expressed as:

$$L = 1.805778 + 1.971714V - 0.01556H$$

Where correlation coefficient R2 = 0.96.

In order to obtain maximum reduction of blur image, we must adjust two parameters of tractor speed and camera height. According to the regression equation of blur angle and blur length has obtained, we establish two trend lines. The one trend line is between blurring angle and length with the increase of tractor speed shown in Fig. 4(a), the other line is between blurring angle and length with the increase of camera height shown in Fig. 5(b).

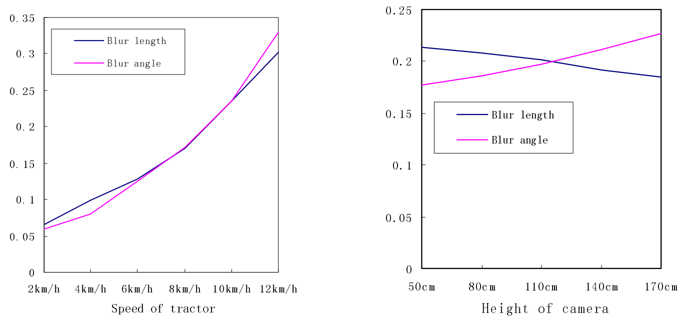
As can be seen from Fig. 4(a), blurring angle and blur length increased while tractor speed became faster, but there is a significant turning point at tractor speed of 8km/h. The growth of blur angle and blur length as speed of tractor less than eight is less than growth of those as speed of tractor more than 8km/h .

As can be seen from Fig. 4(b), blur angle is increased with the increase of height of camera. On the contrary, blur length is decreased when height of camera increased. There is a point of intersection at 115cm heights of camera, which is the lowest point of the sum of blurring angle and blurring length. Therefore, if the height of camera were 115cm, the image acquisition would keep in lower blur extent.

Based on the above analysis, speed of tractor and height of camera have a significant impact on blur angle and blur length, but speed of tractor has a more significant impact on those than height of camera. In order to obtain maximum reduction of blurred image, tractor speed should not exceed 8km / h and camera height should be around 115cm.

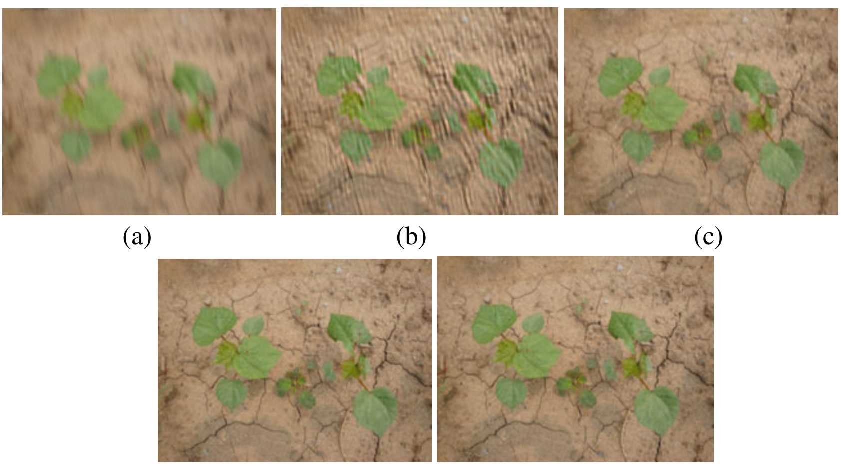
3.2 Blurred Image Restoration

The images captured by the variable rate spraying system based on machine vision are often blurry in some extent. Fig. 10(a) is the blurred image captured by the camera



(a) (b)

Fig. 4. The trend of tractor speeds and camera height with blurring length and angle



(a) (b) (c)

(d) (e)

Fig. 5. Blurred cotton image and recovery image by 4 kinds of algorithms, (a is blurred cotton image, b is image recovered by Blind Algorithm, c is image recovered by L-R algorithm, d is image recovered by Reg algorithm, e is image recovered by Wiener algorithm)

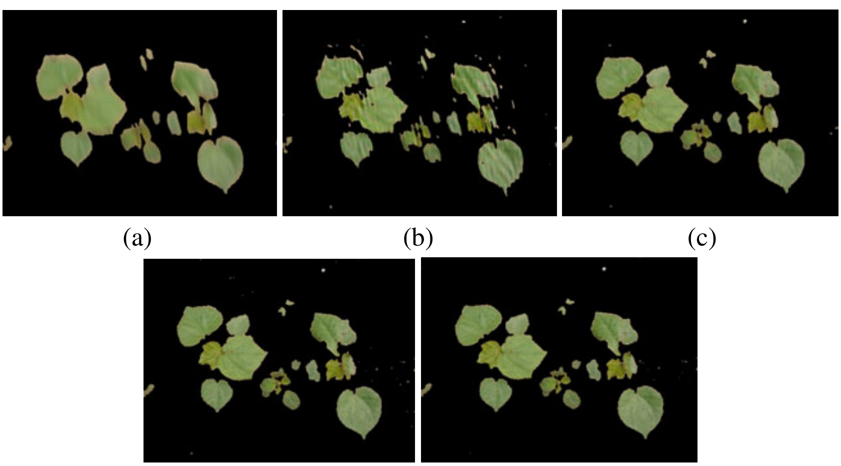
with a velocity of 8km/h and 110cm up to the ground, which has 8 degree blur angle and 15 pixel blur length measured by Radon transform. Taking Fig. 10(a) as an object, a comparison is made among the 4 recovery method on the basis of MATLAB7.0, two of them are nonlinear iteration recovery (Blind algorithm and L-R algorithm) and the other two are linear recovery (Reg algorithm and Wiener algorithm). We want to find a proper recovery method to image processing in real-time from recovery effect and calculation time.

Blind Algorithm, L-R algorithm, Reg algorithm and Wiener algorithm four restoration methods Used to recover blurred image Fig. 5(a), among which the iteration frequency of Blind Algorithm and L-R algorithm is 15, the recovery results shown in Fig. 5. The results show that the recovery effect of Reg algorithm and Wiener algorithm is better than Blind Algorithm and L-R algorithm, a clear image of cotton fields had been recovered by Reg algorithm and Wiener algorithm. On the contrary, inordinately ripple and circular whorl appeared in the images which were recovered by Blind Algorithm and L-R algorithm for iteration. Therefore, their definition is no better than those of Reg algorithm and Wiener algorithm.

Background segmentation is used to separate the cotton leaf from field soil in the recovery image, which is able to analyze shape and color of cotton leaf after recovery. The image space is transformed from RGB to HSI space, and based on H variables Otsu threshold algorithm image segmentation is used, which results shown in Fig. 6.

The results of comparison of cotton leaf shape shows that cotton leaves connected, some leaf shape deformed and image distortion is serious in the blurred image. The effect of RL algorithm, Reg algorithm and Wiener algorithm were better than Blind algorithms due to the leaves recovered by which had less linked together and leaf contour clearly. among these three methods, RL algorithm is better than Reg algorithm and Wiener algorithm in noise suppression, so RL algorithm is the best method in recovery of cotton leaf shape.

The results of comparison of cotton leaf color shows that cotton leaf edge section contains a large number of earth colors, which made the error would more if this color were picked up as characteristic variable in the blurred image. After recovery, there were less earth colors on cotton leaf edge in Blind Algorithm and L-R algorithm, while there were no earth colors in Reg algorithm and Wiener algorithm. So Reg algorithm and Wiener algorithm is better than Blind algorithm and L-R algorithm in the recovery effect of cotton leaf color.



(a) (b) (c)

(d) (e)

Fig. 6. Blurred cotton image and 4 kinds of algorithm recovery image after background segmentation

The results of comparison of cotton leaf texture shows that the texture information of blurred images which are made by Prewitt operator on background segment image shown in fig. 7 is lost basically and there is no way to extract its texture information as

Feature variable. Part of leaf texture is recovered by Blind Algorithm in image, but which is changed and appear some ripple and circular whorl. L-R algorithm is better than Blind algorithm in leaf texture, it recovered the leaf vein normally and there is still some recovery of leaf texture unfinished, while Reg algorithm and Wiener algorithm recovered the texture information completely, leaf vein and rough grain of leaf surface is apparent in image. Reg algorithm and Wiener algorithm is the best in texture.

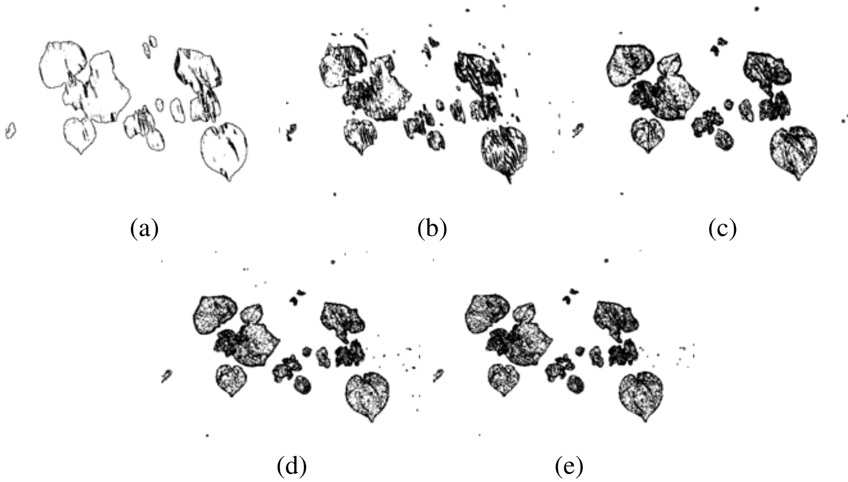


Fig. 7. Blurred cotton image and 4 kinds of algorithm recovery image after contour extraction

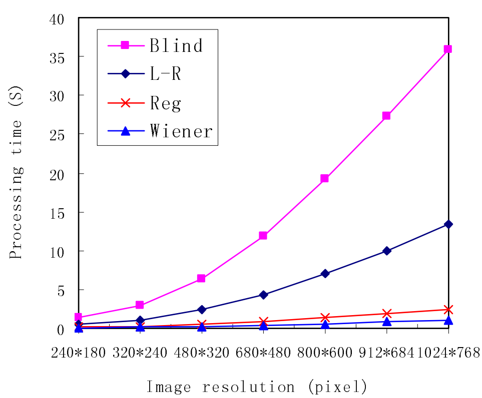


Fig. 8. Computing time of recovery algorithm

The results of computing time on cotton images that computing time of four algorithms increased in some extent with the increase of Image resolution seen from Fig. 8. Computing time of Blind algorithm and L-R algorithm which are belong to non-linear methods increased multiply from 1.3s and 0.51s to 35.89s and 13.35s respectively, while computing time of Reg algorithm and Wiener algorithm which are belong to linear methods increased slowly from 0.12s and 0.05s to 2.42s and 1.04s respectively. In comparison from the same resolution such as 480 * 320, Wiener algorithm which had a top velocity is 0.19s, Reg algorithm is 0.50, while Blind algorithm and L-R algorithm is 6.6s and 2.3s respectively. Therefore, make a comparison on computing time, Wiener algorithm is at a distinct advantage among the four algorithms.

The test had compared the restoration effect of four recovery methods from color, shape and texture, and compared processing speed from computing time. The results of appraising the four algorithms from the above four aspects with 5 points for each are shown in Table 3. As we can see from the table, the two nonlinear algorithms of Blind algorithm and L-R algorithm got lower points were 7 points and 16 points, while the two linear algorithms of Reg algorithm and Wiener algorithm get higher points were 18 points and 19 points. From the overall evaluation results, Wiener algorithm is the most suitable algorithm for real time image recovery.

Table 3. Appraisal results of image recovery methods

	Blind	L-R	Reg	Wiener
Shape	2	5	4	4
Color	3	4	5	5
Texture	1	4	5	5
Time	1	3	4	5
Total	7	16	18	19

4 Conclusion

According to the practical need of Real-time in the variable rate spraying system, we obtained two groups through this experiment.

The one hand, the speed of Tractor and the height of camera have a important role on the blur extents of real-time image Acquired, and a Regression equations of blur angle and blur length with the speed of tractor and the height of camera is established, which obtained a result that blur degree of real-time image at low levels if the speed of tractor below 8km/h and the height of camera about 115cm.

The other hand, we compared Wiener algorithm, Reg algorithm, R-L algorithm and Blind algorithm in terms of the shape, color, texture and computing time. The results of comparison show that R-L algorithm got highest scores in the shape for good shape of cotton leaves and less noise. Because of the edge of leaf color no soil color and leaf texture is Recovered Absolutely in image, Reg algorithm and Wiener algorithm is good at the recovering of color and texture. Wiener algorithm on the processing time had obvious advantages, which is much smaller than the other three kinds of image restoration algorithm. Through the above four aspects of evaluation, the result show that Wiener algorithm most suitable for real-time image restoration.

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Application Analysis of Machine Vision Technology in the Agricultural Inspection

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Abstract. With the development of agriculture technology, people not only pay more attention to increase agricultural production, but ask more requirements for agricultural products' quality. It promotes all kinds of detection technology applied in agriculture, in which machine visual technology is used widely in the inspection of agricultural products. As the corresponding technology of new sensor is developed, machine visual technology applied in inspection of agricultural products will affect traditional inspection pattern[1]. The current status of machine visual technology applied in inspection of agricultural products will be analyzed in this text. Parts of problems in practical application will be summarized and its future develop direction will be discussed here.

Keywords: machine visual technology, Inspection of agricultural products, application.

1 Introduction

China is a large agricultural country. Agriculture is paid more attention since ancient. Our ancestor has invented a lot of new ways to create the splendid agricultural civilization. With the development of agriculture technology, agricultural modernization raises new requirement for agriculture development, for which the progress of industry offer new technical support. Newly-typed agriculture has changed former whole man-made working style and promoted agriculture to develop toward automation and intelligence[2]. A workman must sharpen his tools first if he is to do his work well. To make the land a large output growth and high quality of crops, we must grasp detection. However, former traditional detection methods have not satisfied the requirement of modern agriculture, which promotes new detection technology applied. Among them machine vision technology can provide efficient and reliable products detection approach. It has prospect in many of the testing technology application in agricultural products.

2 Machine Visual Technology Characteristics

2.1 System Structure and Work Principle

Machine Vision actually replaces the human eye to do the measuring and judging. Machine vision system is to be up taken by the visual sensor object, which is converted

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into an image signal, then passed to the image processing system, according to the pixel signal distribution and collection brightness, color and other information, image signal will be converted into digital signals; system will operate the signal features and compared with the data stored in the database, then estimate and determine the relevant features of the results. Characterized increases production flexibility and automation extent, and releases people from some danger, monotony, any error in the liberation of the working environment, and easy to integrate information, easy to implement the system intelligent[3].

A typical industrial machine vision systems including: lighting (Halogen light, LED light source, high frequency fluorescent source, flash source, other special light source), optical lens (CCT camera, microscope head), cameras, image processors, image video capture card, image processing software, monitors, communication / input and output units and so on. The working requirements of machine visual are as follow. One hand, lighting is the key factor to effect the input of machine visual system, which influences the quality of imaging machines and application effect. How to make the light stable in a certain extent is the problem to need to resolve in practical process. On the other hand, ambient light might affect the quality of the images, so adding protective screen is used to reduce the effect of the environmental impact of light. And the requirements of industrial lens: (1) the focal length (2) Target height (3) Image height (4) amplification factor (5) the distance to the target image (6) center/node (7) distortion; According to the different application condition, different resolution cameras are chosen, photographic equipment of different camera. A video capture card is only one component of completed machine vision system, which should be selected according to the interface requirement of camera. Visual processor is the combination of capture card and processor. The processing ability of computer was weak in the past time. It usually needs visual processor to accelerate visual processing tasks. Video capture card now images can be quickly transmission to memory, and computer image processing capacity has greatly improved, so now generally use general-purpose processors and processing software can be realized, the working principle of machine vision as shown in figure 1.

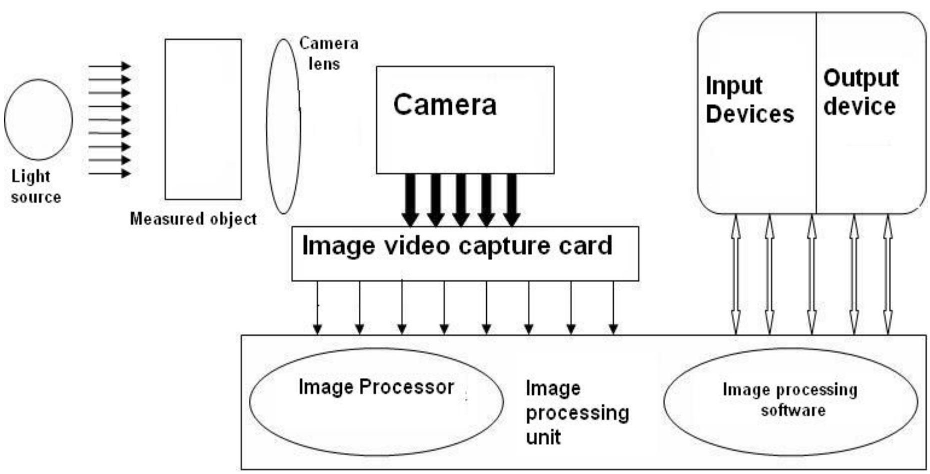

Fig. 1. Current analysis of agriculture products inspection

2.2 The Advantages of Machine Vision

(1) High precision: such measurements do not need to touch, so there is no dangerous and wear on the fragile parts.

(2) Continuity: visual system make people suffer from fatigue. Multiple systems can be set to run separately.

(3) Cost-effective: With the sharp decline in the price of the computer processor, the visual system operating and maintenance costs are much low.

(4) Flexibility: the visual system can carry out a variety of measurement. When the application changes, the softwares change or simply up grade to meet the new demands.

Machine vision systems have better adaptability than optical sensors or machines. They enable automatic machines to have the diversity, flexibility and reconfigurability. When you need to change the production process, on machine vision for the "tool to replace" just change the software, not to replace expensive hardware. When the reorganization of the production line, visual system often can be reused.

3 Currently the Main Agricultural Products Inspection Includes Safety, Quality and Quantity Inspection

The main agricultural products safety inspection is mainly on pesticide residue (organophosphorus pesticide and carbamate, chrysanthemum ester) and veterinary drug residue (malachite green and nitrofuran, sulfa, chloramphenicol), prohibited additives (lenobuterol hydrochloride, shrek dopamine), the harmful elements (arsenic, the cadmium, lead, mercury), to ensure its safe to eat. The main products quality inspection aims at crop appearance, YanZe, brix, acidity, soft pulp and external damage, the internal defects, grotesque, nutrition, etc chemical index physical parameters testing. The detection rate of agricultural products mainly guarantee for high quality and high value-added products, good technical level is the main high-tech agricultural, have very good market prospect. Agricultural production testing mainly tells from agricultural economic benefits on macroscopic.

As an important test of agricultural products, a link to the quality inspection is to guarantee the international competitiveness of agricultural products in the market at home and abroad, the important research institutions and equipment manufacturers all focus on the research of this field. In the early time, applying machine visual technology on the research of agriculture products quality has started abroad. Good effect has got in fruits, vegetables and quality detection, which achieve intelligent degree. Detected in the fruit, In 2001, DM Bulanon invented apple picking machine such as hand-machine vision navigation system, analyzed the brightness of the apple and red color difference histograms, guessed the ultimate classification of image segmentation threshold Apple value using the best way. In 2002, Zhao Yan, such as virtual instruments such as basis, pears were detected using machine vision technology pilot study of external quality. Detected in vegetables, in 2004, K. Ninomiya and so developed a three machine vision system consisting of eggplant automatic classification system. In 2004, Zhang Yane machine vision technology for applications such as diagnostic method of nutritional status of greenhouse crops[4]. In 2005, Wang Shuwen such comprehensive use of computer vision technology, BP algorithm, the image of the characteristics of tomato, by eight characteristic parameters of BP algorithm using the new multi-layer feed forward neural network to classify the damage on the tomato.

4 Machine Vision in Agricultural Products of the Specific Applications

4.1 Investigation on Grading of Machine Vision to the Apples' Non-destructive Testing

In 1986, U.S. scientists used surface crushing machine vision inspection of apples, while Apple's standards based on their classification, was developed using machine vision to defect detection and classification of apple processing equipment, and verify that the machine vision technology used for the feasibility of damage detection of fruit grading. Current nondestructive testing machine vision fruit grading methods are mainly the following aspects[5]. People using computer vision technology to detect bruising of fruit, according to fruit shape and characteristics of bruising bruising area of measurement established a mathematical model in order to achieve detection of fruit bruising; people use machine vision to the image shadow correction and image segmentation, for no apparent edge of the scratch using near-infrared image recognition; people first use of computer graphics technology for automatic detection of decayed fruit and fruit surface color distribution on the fractal dimension of research.

4.2 Color Machine Vision Inspection and Grading Applications for Agricultural Products

The color of agricultural products is one of the important signs of quality. It can tell the fruit ripeness, growth, colour and lustre, etc accurately by machine visual technology. Color test application of general use outdoor natural classification under the condition of the images filmed crops and establish a brightness color information using color information of color image recognition of crop model; It can also use indoor machine vision system for agricultural products, fruit color images in the analysis of the characteristics of agricultural products based on color, with appropriate hue under shaded area percentage of total value of classification method of color.

4.3 Applications in the Agricultural Shape Size Detection Grading

Agricultural appearance not only can affect the size of its appearance and size of the agricultural growth of judgment and knocked wounded and defects, is now in the detection of popular agricultural research direction. Testing analysis of agricultural system mainly includes machine vision hardware platform and software[6]. The processing software flowchart analysis mainly include the following: image input, image preprocessing, feature extraction and recognition, output four varieties. As figure 2 shows, test process is an important link of us to the original image acquisition process, including the grey-scale conversion and threshold image analysis is specified approach is analyzed, the contour of key products. Size shape, The work is mainly based on the gray image processing and database are calculated or image data were compared, and the shape and size of agricultural products to analyze the results. In the field of strong LabVIEW test data acquisition, also it for most function of support, good camera with its Vision of visual development module, a method can realize many functions. Therefore we used with mathematical tool calculates LabVIEW Matlab joint development of realizing detection image analysis. Another part of using VC + + series image processing software development, the industrial production manufacturers are given camera VC setups. There are many open-source library's support, such as OpenCV OpenGL, etc., and its weakness is ShouMan, programming, slightly complex maintenance etc[3].

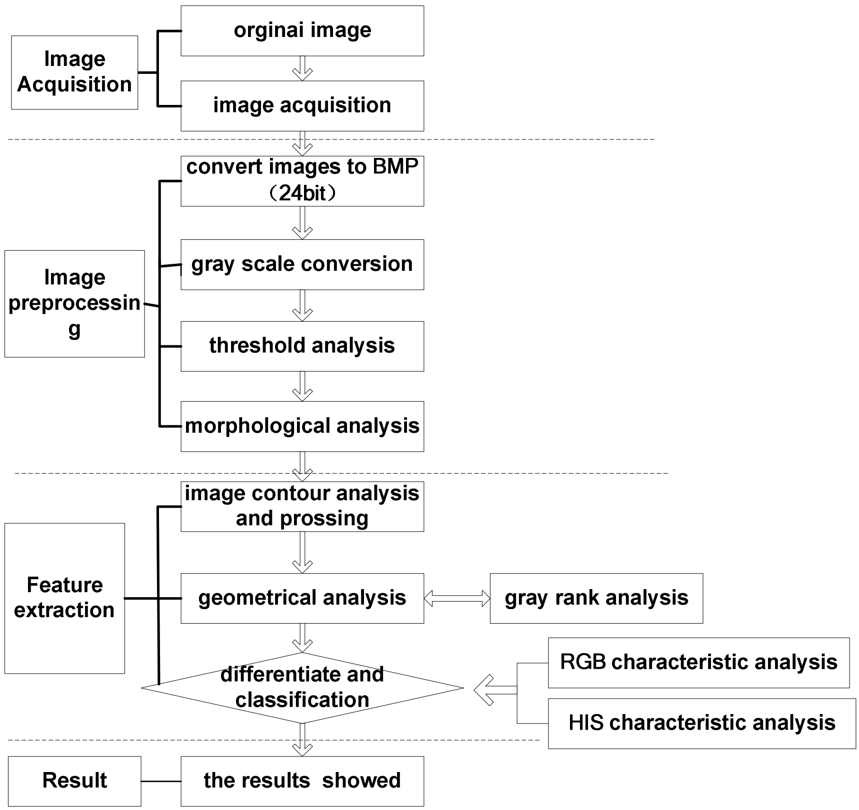

Fig. 2. Detection flowing chart of agricultural products'dimensions

5 Existing Problems and the Development Trend

(1) The agricultural research is static or slower. The accuracy of detection is low generally. To extract useful information from rapid movement of agricultural products, to strengthen the multi image processing method and the hardware structure of identifying algorithm is the main direction of future research in order to solve the problem of low detection and accuracy in existing research[7].

(2) The testing technology combined with nearly infrared technology, technology and image processing GLS, which is used to form a composite products quality inspection and grading and agricultural growth analysis related aspects of the automation management[7].

(3) Computer image processing technology is applied in agricultural grading test research in domestic later than in overseas. There is a large disparity between domestic and overseas whether on hardware or on software. We need references based on the international newest research, to explore the new theory and method, suitable for China's national conditions of agricultural products in automatic detection system, improve the level of agricultural modernization.

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Comparative Study of Methods of Risks Assessment in Rural Power Network

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Abstract. The key to security risks assessment in rural power network is hazards assessment, it is very important to select a proper assessment methods. Based on comparative study of characteristic, applicable condition and application scope of operating conditions hazard assessment method(LEC), risk assessment code method(RAC), Fault type and effect analysis (FMEA), Event Tree Analysis(ETA) and etc, the paper propose that LEC and RAC are appropriate methods for security risks assessment of rural power network, the example shows its applicability and effectiveness. The conclusions offer a reference for security risks of rural power network.

Keywords: Rural power network, Security risks assessment, LEC, RA.

1 Introduction

According to power enterprises own characteristics, it should establish and implement a standardized, scientific, and Systematic safety management system, to make the reasonable choice of hazard and risk assessment methods, execute the risk identification and risk assessment systematically, develop practical and reliable risks control measures to enhance safety management level and the scientificity of security precautions.

In the actual operation process, each risk assessment method of hazard exist certain flaws. For instance, fault Model and Impact Analysis(FMFA) only commonly involves in the risk failure analysis, wasting time and without considering the comprehensive factors during the actual operation; Event Tree Analysis (ETA) cannot analysis parallel results, therefore the analysis results are not detailed enough; Fault Tree Analysis(FTA) constitutes the large tree, which is not easy to understand and is different to the flowchart of the system, so it's difficult to convert, meanwhile there is not a single answer in mathematics, and its logical relationship is complex, it isn't applicable to grass-roots workers. Facing the actual situation of the power system in China, namely lack of the actual data about failure rate of the power equipment and error probability result from people, it's difficult to quantitatively analyze. The operating conditions hazard assessment method (LEC) is

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appropriate for the risk assessment of personal injury, and the quantitative evaluation of the size of the risk, through the multiplication of the three factors associated with system risk, of which L (the possibility of accident happening), E (the frequency degree of exposure to the dangerous environment) and C (the consequences caused by an accident). risk assessment code method(RAC) is applicable to all kinds of damage and loss evaluation (including property and equipment), which considers the two factors: the possibility of an accident to happen and the consequences caused by an accident. Therefore in the power system, due to complexity of systems, many of equipments, the poor environment and other characteristics, LEC and RAC are often used for the risk assessment of hazard.

2 Operation Conditions Hazard Assessment Method (LEC)

2.1 Brief Introduction of LEC Method

Operation conditions hazard assessment method, also known as LEC, the model is:

$$D = L * E * C \tag{1}$$

The size of the D value at risk depends on L, the possibility of accident happening, E, namely the frequency of exposure to dangerous environment and C, the possible consequences once the accident happened. This assessment method is simple to operate, and another characteristic is that its division of danger level is clear. But because it is mainly based on experience to determine the score of LEC, there exist certain limitations. It is a kind of semi-quantitative evaluation method. Therefore in the risk assessment it is required that the personnel who participate in the risk assessment should have the certain experience and make evaluation objectively and fairly.

2.2 The LEC Score and Description

L is the score and description about the possibility of accident happening, E is the score and description about the frequency of exposure to dangerous environment, C is the score and description about the consequences caused by an accident. The score D can be obtained by formula (**1**). Which state the risk of operation is on can be evaluated, so corresponding measures can be taken.

The purpose of this kind of treatment is to face a certain concrete hazard, according to the risk levels of it, and security levels are limited after preventing and controlling. Such as extremely dangerous hazard, although the preventing and controlling measures are perfect, the risk level is also huge even in the best condition; for a dangerous or general dangerous hazard even without prevention and control measures, the most terrible conclusion is risky and can not upgrade a higher risk level upgrade, which is truthfulness.

3 Risk Assessment Exponent Matrix Method (RAC)

Severity shall be divided into seven levels, and the possibility of pernicious events shall be divided into five levels. (Table 1 showed below). Severity of the pernicious events act as column items of the table, the possibility of pernicious events record as row items of the table, such a two-dimensional form is made into, and qualitative Taiex is given on the intersection of the rows and columns, all the Taiex form a matrix, which is called RAC. It is a kind of qualitative evaluation method.

By the LEC method, the possibility of accident happening and the frequency of exposure to dangerous environment are related, when exposures frequently occur, the possibility of accident will increase, so we can form a level table about the possibility of pernicious events through the relationship between them (as table 1).

Table 1. Possibility Levels of harmful events

Score	Description
A	When frequent exposure to dangerous environment, danger is quite likely to happen
B	Expose to working time everyday, danger is probable
C	Once a week,or expose by chance, Possible, but not often
D	Expose once a month,Possibility is small, absolutely accident
E	Expose With years of cycle,Quite impossible, can imagine

Table 2. Levels of the Severity

Levels of the Severity	Explanation of levels	Description
Ⅰ	Catastrophe	Many people die
Ⅱ	Disaster	Many died
Ⅲ	Very serious	One died
Ⅳ	Serious	Serious injury
Ⅴ	major	Cripple
Ⅵ	Mild	Compelling and need for ambulance
Ⅶ	Slight	Personnel injuries and system damage is lighter

Table 3. Risk assessment exponent

Levels of the Severity	Ⅰ	Ⅱ	Ⅲ	Ⅳ	Ⅴ	Ⅵ	Ⅶ
A	1	2	3	4	5	7	13
B	2	5	6	7	8	9	16
C	4	6	8	9	10	11	18
D	8	10	11	12	13	14	19
E	12	5	12	13	15	17	20

The elements in matrix are Taiex, also called the Risk assessment exponent. Corresponding risk assessment exponent matrix is below:

$$\begin{bmatrix} 1 & 2 & 3 & 4 & 5 & 7 & 13 \\ 2 & 5 & 6 & 7 & 8 & 9 & 16 \\ 4 & 6 & 8 & 9 & 10 & 11 & 18 \\ 8 & 10 & 11 & 12 & 13 & 14 & 19 \\ 12 & 5 & 10 & 12 & 17 & 17 & 20 \end{bmatrix}$$

Risk assessment exponent is determined by combining the possibility and severity of pernicious events, risk index, the highest risk index is usually intended to be 1, corresponding pernicious events is that danger and catastrophe occur frequently; The lowest risk index is intended to be 20, corresponding pernicious events occur almost impossibly and consequences are slight accidents. The division of number grades is arbitrary, but it is convenient to distinguish the risk levels. It is not convenient to risk assessment whether the division is too meticulous or too rough. So it is required to decide according to the concrete object.

The size of the index in matrix will be divided into categories by acceptable degree, forming risk acceptance criteria or judge criteria. Among them: the 1 ~ 5 index for unacceptable risks is unable to bear for the organization; 6 ~ 9 for unwanted need to be decided whether to accept by the organization; 10 ~ 17 is conditional acceptance, which can be accepted after the judgments by the organization, 18 ~ 20 can be accepted without judging, thus forming the qualitative risk level.

4 Cases Comparative Analysis of the LEC Method and RAC Method

Two kinds of methods are compared based on the transformer in transformer maintenance work for risk assessment of events. Operating risks: high risk of falling objects, causing staff smashed casualties, here refers to the equipment, tools, lifting. In addition, through the analysis of the actual operation, we can work out the real working hours of the staff. Following the work principles, the chances of dangerous situation will be reduced. However, once the accident happened, it may appear the danger of smashing workers and their death.

In general, using the method of LEC to evaluate the events, the occurring of such events will be reduced. So the frequency E is 0.5, L is 1, C is 15. All these are based on the formula (**1**) $0.5 * 1 * 15 = 7.5$. If the result is slightly less than 20, it will be in danger. We should prevent the danger happening, making it become an appropriate figure.

Using exponential matrix method can also evaluate such events. Comparing the harmfulness evaluates events in the table; we can see if the level is in the correct implementation rules, such events can be avoided. Thus, we should choose Grade E in the table. Comparing the Severity rating table, we know that once the high sinkers events are very serious, therefore Grade Ⅲ is our choice. As the element in matrix is Taiex, we can get 12, belonging to the risk of conditional acceptance risk, which is needed to confirmed by the organization.

According to the two methods, we learn that the two methods are similar in the following aspects: both of them need to choose corresponding level or grade based on the specific situations; both of them need to give real value by the operators according to the facts. To some extent, exponential matrix method is deformation of LEC. It combines L value with E value to form the grade table of the dangerous events, making the grade C corresponds to the table Levels of the Severity. Exponential matrix method is more intuitive. It can directly read the evaluation index from the matrix form. Which kind of methods will be applied depends on actual operation assignments in the process of concrete operational practice.

5 Conclusion

There are many assessment methods of Hazard risk, but we should choose which kind of evaluation method based on the nature of the object, the complexity of the hazard and the ability of the personnel engaged in the hazard. For the basic operation personnel, they should choose relatively simple methods, such as LEC. For the technical and managerial personnel and risk assessment team members, they should choose relatively complex evaluation methods such as RAC method. Only using a variety of methods comparing the application of the same operation to get the comprehensive safety evaluation result, we can get the expected results to achieve the accurate assessment aim.

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A Circuit Module and CPLD Laser Ground Controller Based on RS485

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Abstract. The function of the controller is to adjust the rise and fall of the ground shovel constantly according to the signal of positional deviation transmitted from the laser receiver, and remove or fill in the soil of the farmland, thus reaching the aim of smoothing the farmland. So the controller is the core component of the laser-control-ground system. The speed of response and the control algorithm of the controller are in relation to the stability and work efficiency of this system. This research uses the RS485 module to transmit, enhancing the interference immunity of the system, raising the stability when it works in severe environment, replacing SCM with CPLD to carry out the function of logical control, cutting down the power consumption of the system. It interferes manually in the hydraulic control automatic mode via software, thus improving the stability and flexibility of the system. The function of adjusting the duty cycle of the controller output signal is added, making the controller able to work both in paddy field and dry land.

Keywords: RS485 Circuit, CPLD, Laser Ground Controller.

1 Introduction

The purpose of designing the controller is to achieve the matching of the controller with different types of hydraulic systems, and improve the controller's response to hydraulic actuator, carrying out the ground operation in different landforms (paddy field of dry land) [1]. Through the summary of large amount of previous ground operation, this research made some improvements upon the original controller. The signal transmission between the controller and receiver uses RS485 bus transfer mode instead of the previous current transfer mode, adding the function of manual interference in the rise and fall of the ground shovel under the automatic mode, carrying out the function of manual and automatic interlocking via software instead of the previous interlocking relying on gate circuit, simplifying the circuit's area and raising the circuit's stability; adding the function of adjusting the duty cycle of the controller output signal, thus adapting to different hydraulic mechanisms and different working landforms [2].

2 System Design for Hardware

Figure 1 is the hardware structural of the controller. The receiver's signal is transmitted to the MAX485 circuit module of the controller via RS485 bus; MA485 converts the 485 electrical level to TTL level, then transmits it to CPLD to process; CPLD

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processes the position signal, then puts out the pilot lamp driving signal and hydraulic driving signal; the pilot lamp driving signal controls the on and off of the pilot lamp through the lamp driving circuit, displaying the level changes of the position; the hydraulic driving signal drives the hydraulic system to work via controlling the relay switch, adjusting the rise and fall of the ground shovel. Users can choose between the automatic mode and manual mode for the system via the mode-selecting module.

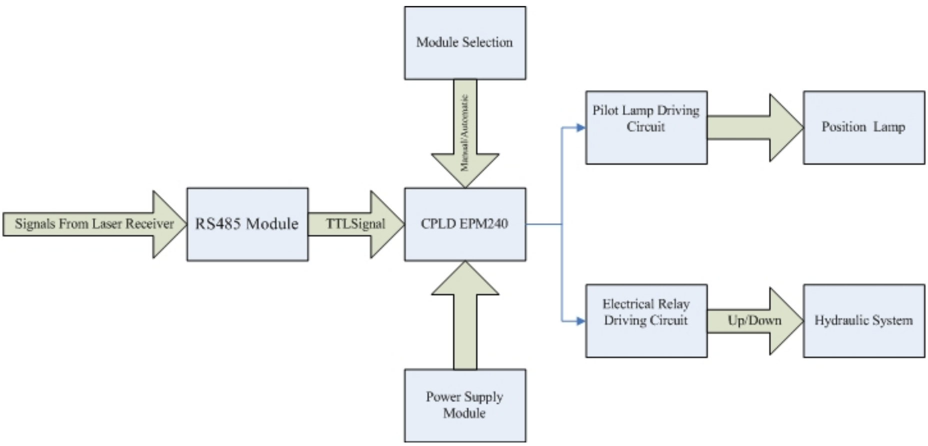
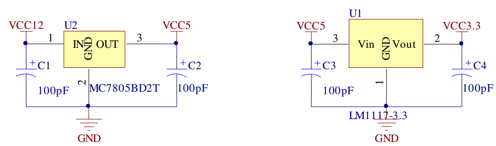


Fig. 1. Hardware Structural of Controller

3 Main Control Unit and Peripheral Circuit Design

This research uses the CPLD Chip EPM240T from Alteral Company as the main control chip. This chip has 240 logical units, 8K-bytes flash with the instant system programming function (ISP), making it very convenient to modify the system's function. The chip supports 300M clock frequency at the most; the maximum time delay between pins is 4.5 ns, providing more advanced property for users; 100 pins TQFP with smaller volume; 3.3V system voltage and 1.8V core voltage with lower power consumption [13]n. CPLD programs' parallel processing is faster compared with 51 SCM, and the programs won't overflow; eliminating the peripheral devices like the Watch Dog, raising the stability and reliability of the system. Its inner unique structure fits well for disposing complicated combination logic circuit and sequential logic circuit. The power supply for the controller is from the tractor battery, with the voltage of 12V. The CPLD inside the controller needs a working voltage of 3.3V, and most chips like the pilot-lamp-driving circuit and the relay-driving module need a voltage of 5V, so it requires the power-supply-changeover module to convert the voltage from 12V to 5V and 3.3V. This research uses LM2575 power-supply-changeover chip to achieve the change from 12V to 5V, and uses LM117-3.3 to achieve the change from 12V to 3.3V. The power-supply-changeover circuit diagram is Figure 2. LM2575 is a kind of switching voltage regulator, with the features of small volume, high working efficiency, low heating value, etc. The maximum output voltage is 40V, maximum output current 1A, maximum voltage-stabilizing error 4%, with limiting-current circuit and overheating-protection circuit inside, etc. LM117-3.3 belongs to switching power-supply-changeover chips, with the features of heavy output current, high accurate output voltage, low ripple coefficient, etc. A tantalum capacitor of about 10u needs to be added to the outlet end of the power-supply-changeover when it is working, in order to filter the AC component in the direct voltage. And this research uses the electric relay to control the on-off of the power supply. VCC in Figure 3 is the power supply provided by the tractor's battery. When the switch S0 is on, the relay's normally open contact is on, out1 and out2 on, and the tractor's power supply accessed the controller.



(a) 12V to 5V Circuit (b) 5V to 3.3V Circuit

Fig. 2. Power Convert Module of Controller

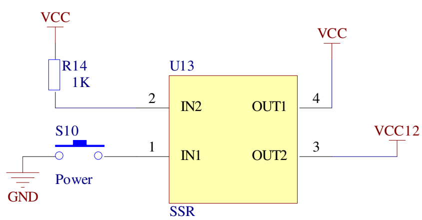


Fig. 3. Power Switch of Controller

3.1 RS485 Circuit Module Design

RS-485 works in the way of half-duplex, with one sending and the other receiving. The position signal of the receiver is sent to the controller by RS-485 bus [14]. RS-485 uses the way of differential-level-receiving to raise the capability of anti-interference, fit for working under severe condition. The baud rate of the serial communication is 9600bit/s, and the data format is composed of 1 start bit, 8 data bits and 1 stop bit. The CPLD system uses MAX485 chip to accomplish the communication between the controller and receiver. As the system voltage for CPLD is 3.3V, MAX3485 is used to achieve the RS485 level changeover, and MAX3485 working under the power supply of 3.3V is a RS-485 changeover chip. As Figure 4 shows, Port A and B of MAX485 are linked to resistances, forming the differential voltage input; RO is the input end, and signals run into CPLD via RO when CON485 is linked to high electrical level. DI is the output end, and signals run out via DI when CON485 is linked to low electrical level. As the controller only receives signals from the receiver, there is no need to send signals to the receiver, thus DI is not used. The MAX3485 chip has 8 pins, and their functions are as follows:

RO: Output end of the receiver, if A is 200mV higher than B, RO is high level; if A is 200mV lower than B, RO is low level.

RE: Strobe end of the receiver output. If RE is low, RO is effective; if RE is high, RO is in high-impedance state.

DE: Strobe end of the driver output. If DE is high, the driving output A and B are effective; if DE is low, they are in high-impedance state.

DI: Output end of the driver. If DI is low, it will force the output low; if DI is high, it will force the output high.

GND: Ground terminal.

B: Input of inverting receiver and output of inverting driver.

A: Input of inphase receiver and output of inphase driver.\

VCC: Positive electrode

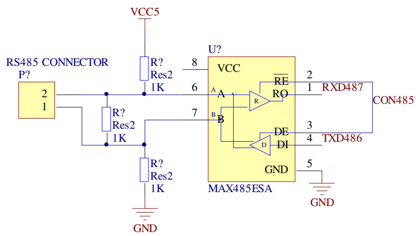


Fig. 4. RS485 Communication Module

3.2 Hydraulic System Driving Circuit

The magnetic valve of the hydraulic system is controlled by the relay. One end of the normally-open-contact of the relay is connected with the electrical source, the other end with the magnetic valve. In order to improve the reliability of controlling the hydraulic system, this research uses solid state relay as the component for driving the hydraulic system. The solid state relay has a long operational life with high reliability. It is able to work under the circumstance of heavy impact and shock, because there is no mechanical part inside. At the same time, the solid state relay dose not have a input coil or contact arc or rebound, thus reducing the electromagnetic interference [15].

Figure 5 is the circuit of solid state relay driving hydraulic magnetic valve. CPLD controls the on-off of the relay via controlling the on-off of the transistor, thus carrying out the function of controlling the on-off of the hydraulic magnetic valve. For example, when the up port is high level, the Transistor Q1 is on; the Relay U11's normally open contact is closed (Port 4 and Port 3 are on), supplying power for the hydraulic system magnetic valve and driving the hydraulic system to lift the ground shovel. Likewise, when the down port is high level, the hydraulic system will lower the ground shovel. To prevent an excessive dash current when the relay is switched on, R3 is added as a current-limiting resistance. At the output end of the relay, an RC absorbing circuit is added, which can effectively restrain the transient voltage added to the relay and the exponential growth rate of the voltage. Also a piezo-resistor with given clamp voltage is linked to the output end, thus protecting the relay effectively [16].

3.3 Position Pilot Lamp Driving Circuit

The position pilot lamp can show the level of the ground of the time, which is convenient for users to conduct ground operations correctly accordingly. The controller makes judgment according to the information about position transmitted from the laser receiver, and then drives the transistors on or off, thus control the pilot lamp on or off. Figure 6 is the position pilot lamp driving circuit. The transistors used here are NPN 9013 low power transistors; the maximum working current of the collector is 500mA; the working temperature is from -55℃ to 150℃; the voltage drop between collector and base is around 0.3V when it is working in saturation region. The operational principle of the driving circuit: when the land level is higher than the reference plane, the receiver sends the position signal of the area to the controller; then the controller sends electrical level to HighLight port, Transistor Q6 conducted and LED5 on. There are 3 pilot lamps representing high, middle and low. So the information of the land level can be shown though the 3 lamps, providing the base of judgment for ground operation for users.

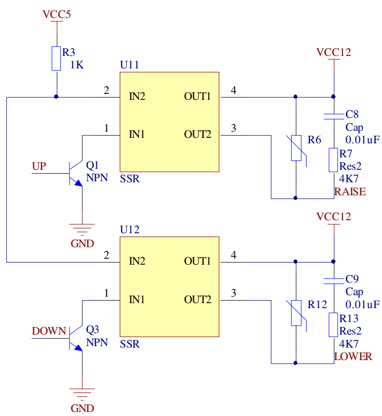


Fig. 5. Hydraulic-System-Driving Circuit

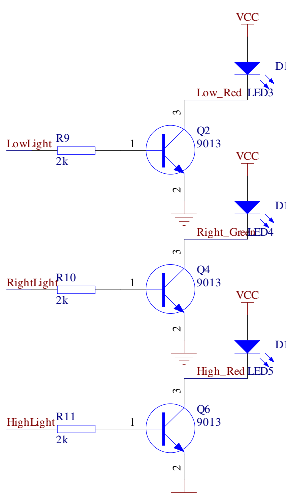


Fig. 6. Position-Pilot-Lamp-Driving Circuit

4 Software Design Framework

This research uses VHDL hardware description language to program CPLD. The main functions of the controller are as follows: in the automatic mode, disposing according to the signals from the receiver, outputting driving signals for the hydraulic system and pilot lamp; in the manual mode, checking the signals from the rise button or the fall button, outputting controlling signals for the hydraulic system. The difficulty in the software design is to carry out UART serial function via hardware logical unit, receiving the serial data from the receiver, outputting hydraulic controlling signals whose duty cycle are adjustable, raising the speed of response and stability of the hydraulic system; the duty cycle of the hydraulic controlling signals from the controller can be selected artificially so that the controller can match different hydraulic systems and different ground shovel devices.

The receiver uses 36 photocells in all that are divided into 4 rows; each row includes 9 photocells, with 5 groups of signal inputs. The 5 groups of signals are amplified and reshaped through the circuit, and then are sent to Pin P2.0-P2.4 of the SCM; The SCM encodes the input signals, sends the data to Chip MAX485 through the serial interface, and to the controller through the signal wire after changing the TTL electrical level to 485 electrical level. The controller uses Chip MAX485 to transform the sent signals to TTL electrical level, and then sends it to CPLD to deal with.

In the laser receiver, every two contiguous photocells are 1.5mm apart, so there are two photocells at most receiving laser signals at the same time, thus there are 9 effective states for the 5 groups of input signals. Table 1 is the signal codes for effective states of the laser receiver and the controlling signals' frequencies and duty cycles from the controller to the hydraulic system.

Table 1. Signal State of Receiver and Controller Ports

Input Signal Number	State of Ports Code of Signal P2.4～P2.0	(Hex)	Output Signal of Controller PulseWidth (ms)	Duty Cycle (%)
01	1 1110	0X1E	100	80
02	1 1100	0X1C	100	70
03	1 1101	0X1D	100	60
04	1 1001	0X19	100	50
05	1 1011	0X1B	100	0
06	1 0011	0X13	100	70
07	1 0111	0X17	100	80
08	0 0111	0X07	100	90
09	0 1111	0X0F	100	100
10	Others	0	0	

4.1 Software Control Flow

Figure 7 is the flow chart of software control of the controller. The controller begins to work upon power-on, and the circuit begins to check whether the position signal sent from the receiver is effective or not (no input is regarded as ineffective). When the signal is effective, the controller judges whether the working mode at the moment is automatic or manual. If it is the manual mode, the artificial direct intervention in the output of hydraulic controlling signals is allowed; if it is the automatic mode, the controller disposes the input effective signals, outputting controlling signals to the hydraulic system and driving signals to the pilot lamps.

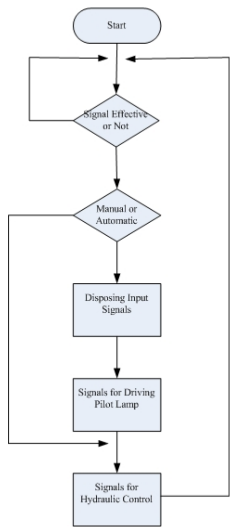


Fig. 7. Software-Control Flow Chart of Controller

5 Controller VHDL Software Module Design

5.1 UART Module Design

Basic UART communication only needs two wires to transfer information; one is the RXD signal wire, and the other TXD wire. Its working mode can be full-duplex mode. TXD is the sending end of UART, outputting signals; RXD is the receiving end, inputting signals. The basic principle of UART is shown in Figure 8:

Through the schematic diagram, we can see that UART is mainly composed of four parts: baud-rate generator, sending module, receiving module and comparing module. The baud-rate generator generates a local clock signal that is higher than the baud rate, sampling RXD constantly, making the receiver and the controller keep pace with each other. The receiving module of UART receives the serial signals from RXD and transforms them into parallel data. The sending module transforms the parallel data to be output into TXD serial-output signals according to the basic frame format [17].

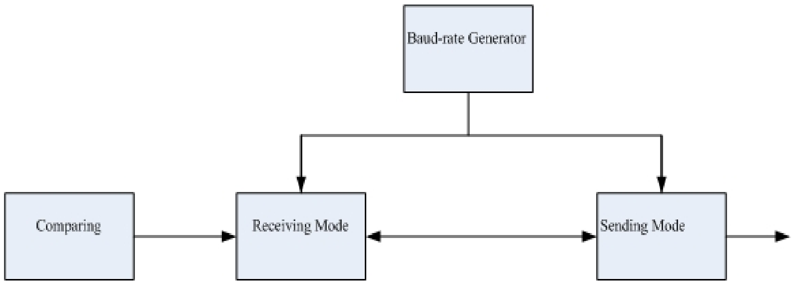


Fig. 8. Basic Principle Diagram of UART

1. Baud-rate Generator Module
The baud-rate generator is actually a module that divides the frequency of the system clock. After frequency division, it outputs the clock signal of sampling RXD [18]. The clock frequency of the External Crystal Oscillator used for CPLD in this research is 3.6864MHZ, and the baud rate of asynchronous serial communication is 9600bit/S, so it needs to divide the frequency of the system clock to get a clock of 9600HZ. In order to improve the fault-tolerance disposal of the system, it requires the output clock of the baud-rate generator be N times of the baud rate of the actual serial data, and N can be 6 、16、32、64. In this design, N is 16. Figure 9 is the logic diagram of baud-rate generator. Clkin is the clock-input end, and clkout is the clock-output end, outputting clock signals whose frequencies have been divided. Figure 10 is the schematic diagram of created RTL after synthesizing the VHDL codes of the baud-rate generator.

2. Asynchronous Receiving Module
The logic diagram of the asynchronous receiving module is shown in Figure 10. In the Figure, clk is the clock-input end; RX is the serial-data-receiving end; Sig1 is the sign of receiving interruption; After RX module has received one frame of data, Sig1 is loaded 1 automatically; q[7..0] are parallel-data-output end.

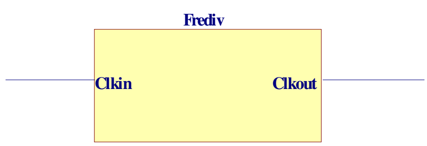


Fig. 9. Logic Diagram of Baud-rate Generator

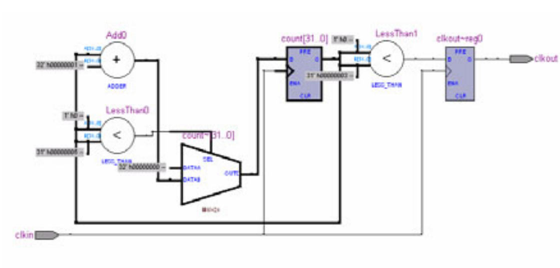


Fig. 10. Synthesized Diagram of Baud-rate Generator

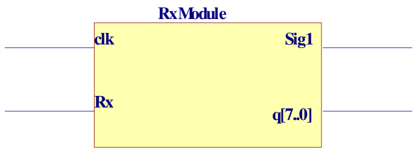


Fig. 11. Logic Diagram of Synchronous Receiving Module

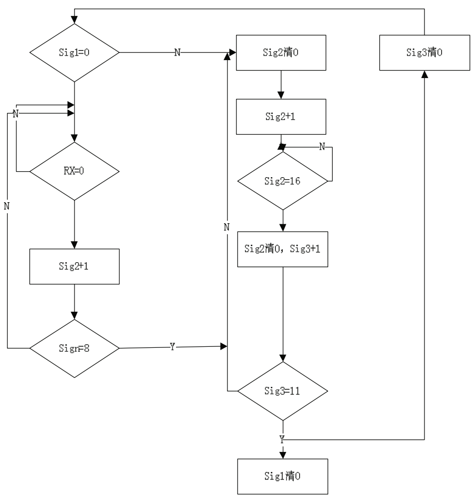


Fig. 12. Flow Chart of Asynchronous Receiving Module

Figure 12 is the program flow chart of the asynchronous receiving module: sig1 is the sign of receiving interruption; when sig1 is in low electrical level, it indicates that the receiving process has not been started up, thus checking the electrical level of RX. When RX is in a low electrical level, sig2 begins to count; if RX is in low electrical level in consecutive 8 times of sampling, it indicates that this is the start bits, thus starting up the receiving process, receiving one bit of data every 16 receiving clock until it completes receiving all the 11 bits. The parallel-output end is a serial-to-parallel end, and the output data will change as the bits shift because it does not have the latch function [19].

3. Asynchronous Sending Module

The logic diagram of the asynchronous sending module is shown in Figure 13. In the module of Tx Module, indata[7..0] are the 8-bit data-input end. CS is the chip-selection signal, which is effective in low electrical level. Wr is the output-permission, which is effective in high electrical level. Clk is the clock-input signal, providing clock signals for sending data. Txd is the serial-sending end for sending serial data. Ti is sending-interruption signal, which means sending when it is in high electrical level, and unused in low electrical level.

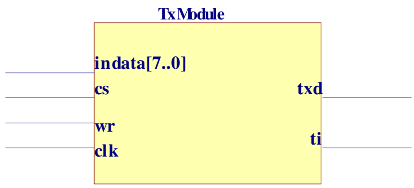


Fig. 13. Logic Diagram of Asynchronous Sending Module

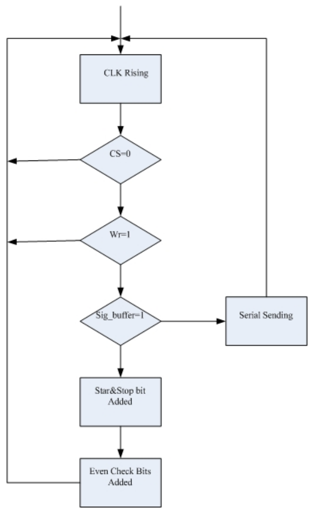


Fig. 14. Software Flow Chart of Asynchronous Sending Module

The program flow chart of this module is shown in Figure 14. When the rising edge of the clock signal comes, if CS is in low electrical level, it will check whether the signal written into wr is effective. If wr is effective, it indicates that the asynchronous sending module has data to be sent; if sig_buffer is 0, it means that the sending is not busy, and it can continue reading in data; if sig_buffer is 1, it indicates that the asynchronous serial-sending module is sending data right now, which is unable to respond to the order from the controller, and the control has to wait.

5.2 Adjustable-Duty-Cycle of Hydraulic Controlling Signal Module

The adjustable-duty-cycle of hydraulic controlling signal module outputs PWM signals of different duty cycles mainly according to the different ground modes and different position signals chosen by users. Figure 15 is the logic diagram of this module. Sig[4..0] receive position signals from the receiver; Mode is the ground-mode-selecting-input end, and users can select hydraulic controlling signals of different duty cycles according to different conditions of ground work (paddy field or dry land). Clk is the clock-input end; Clkdown is the falling-signal-output end after frequency division, and ClkRaise is the rising-signal-output end after frequency division.

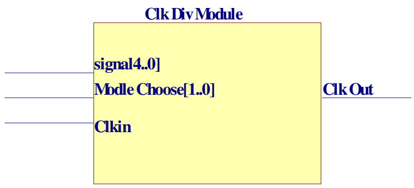


Fig. 15. Logic Diagram of Adjustable-duty-cycle of Hydraulic Controlling Signal Module

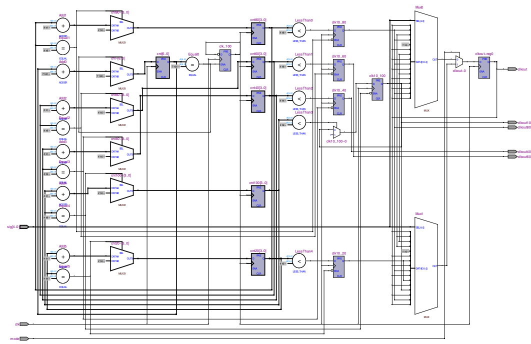


Fig. 16. Adjustable-duty-cycle of Hydraulic Controlling Signal Module

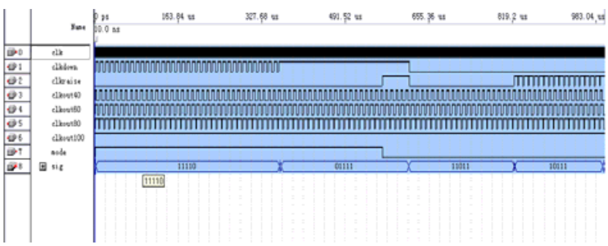


Fig. 17. Sequential Simulation Diagram

Figure 16 is the RTL diagram after synthesizing the adjustable-duty-cycle of hydraulic controlling signal module, and the simulation diagram is shown in Figure 17. RTL is a created gate-level net list after translating the hardware description language (VHDL), and a crucial step in transforming the high-level description to hardware circuit. In the simulation diagram, sig[4..0] are the position-signal-input end; clk is the clock-signal-input end; Modle Chose is the mode-selecting-input end, and 1 means dry-land mode, 0 paddy-field mode. Clkdown and clkraise are hydraulic-controlling-signal-output end. From the simulation diagram, when mode=1 (dry-land mode) and the position signal is 11110 (high-level land), Clkdown outputs a falling-control signal with the duty-cycle of 60%. When mode=0 and the position signal is 01111 (low-level land), Clkraise outputs a rising-control signal with the duty-cycle of 100%.

5.3 Mode-Selecting Circuit

The mode-selecting circuit is mainly used to judge whether to control the hydraulic system in automatic mode or in manual mode. The mode-selecting function of this circuit is achieved mainly through the CPLD software, and the function of manual intervention in the up and down of the ground shovel in the automatic mode is added, providing some convenience for users to operate according to the practical situation. Figure 18 is the RTL diagram of the logic-judgment module. There are 6 input signals in the circuit. Figure 19 is the sequential simulation diagram of this module.

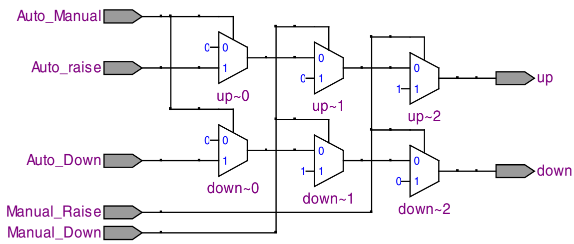


Fig. 18. Integrated Result of Logical Judgment

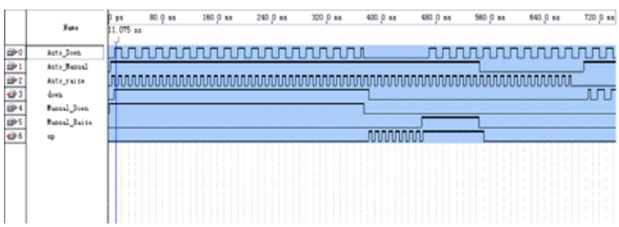


Fig. 19. Sequential Simulation Diagram

6 Conclusion

This essay firstly introduces the overall design and the hardware structure design of the controller. Then it respectively aims at the controlling unit, the power convert module, the pilot-lamp-driving module, the hydraulic-driving module, the RS485 communication module, and makes some designs for these hardware circuits. Finally it tries some optimum designs for the software of the controller, using the hardware description language VHDL to carry out UART module, and developing the mode-selecting module and duty-cycle-adjusting module. The controller can choose proper hydraulic-controlling signals according to different landforms so as to fit in with both paddy field and dry land. The main results is:

1. CPLD was used as the logic control chip of this system. It enhances the system's ability to control. Its control capability is better than existing controller with MCU and its power consumption is further reduced.

2. The online changing ability of CPLD could enable quick update of the function of the controller, therefore makes it possible for the users to choose the most suitable software for the terrain, therefore maximize its efficiency.
3. Within CPLD, by programing with software, the interlock of automatic mode and manual mode is realized, therefore decreases the magnitude of the circuit and increases its stability.
4. Transmission by RS-485 can bus increases the stability and reliability of the working process.

Acknowledgement

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Design of Decision Support System for Mechanical Conservation Tillage

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Abstract. This paper designed decision support system for mechanical conservation tillage, which includes three subsystems, such as subsystem of development potential estimation, subsystem of optimum model or suitable models selection, and subsystem of economy benefit estimation. In different area, it is necessary to alter, increase or decrease some evaluation index to accommodate the agricultural production. This decision support system is based on the ordinary technique such as .NET Framework and SQL Server 2005, which includes three kinds of function and four levels.

Keywords: decision support system, subsystem, evaluation index.

1 Introduction

Mechanical conservation tillage is a new agricultural production mode [1-2], and the development of this tillage is becoming the national economy and the people's livelihood issues stage by stage. How to spread mechanical conservation tillage effectively in China is a difficulty. As an assistant decision-making means [3-4], the decision support system for experimentation model of mechanical conservation tillage is focused by the relative organizations. According to the characteristics of investigation area, production practices, projection pursuit, fuzzy comprehensive evaluation and dynamic estimation of economic benefits [1,2,5], this paper designed the experimentation model system for mechanical conservation tillage and develops the decision support system. With the help of the decision support system, it is much easier to finish the estimation of spreading, the selection of experimentation model and the dynamic estimation of economic benefits with low cost and high efficiency.

2 Demand Analysis

In the program of popularization and actualization of new tillage, the decision support system is an available tool to solve some problems. The details are as follows.

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(1) The design of system is an available approach to the popularization or farm examination of mechanical conversation tillage in the double-crop one year regions;

(2) In the system, it is necessary to construct the databank, model bank and knowledge bank, which are the foundation of memory, query, renovation and management;

(3) The system is useful to conform the degree of difficulty in the program of examination or popularization of the mechanical conservation tillage;

(4) The system is helpful to conform the suitable model of the optimum model by comparing the situation of field, technology, and tillage approach;

(5) The system is available to analyze the sensitivity and estimate the economic benefits dynamically;

(6) The functions the decision support system, such as renovation of databank, extension of system and improvement of model, should be convenient and rapid.

The decision support system for mechanical conservation tillage in the double-crop one year regions is an effective and assistant tool to solve some problems, and the system includes the following three levels, the first level provides some relative data and information to the decision-maker and analyzes the data and information, the second level is focus on the decision problems and draw out the decision program, the third level is to analyze and estimate the decision program by the human-computer interaction.

3 System design [6]

In the program of designing the decision support system, the designer should abide by the following three principles. Firstly, practicability is the basic principal of the system, which makes the system functions and decision demand matching. Secondly, the system is easy to learn and use, and the friendly human-computer interaction is required. Thirdly, the favorable expansions and maintenances of system should be taken into account.

3.1 System Structure

Agricultural production involved many factors and the randomicity of some indexes determined the complexity of the system. This paper designs a decision support system, which is a visual software and includes some functions, such as data analysis, potential evaluation, adaptability estimation and model selection, economic benefit estimation and sensitivity analysis, and so on. Fig. 1 describes the main structure of the system.

3.2 System Flow

The decision support provides the basic function, such as file management, information query, statistics analysis, user management, system help, result output and printing, etc. In this paper, the author designs the system according to the project theory, and the system development flow is described in Fig. 2.

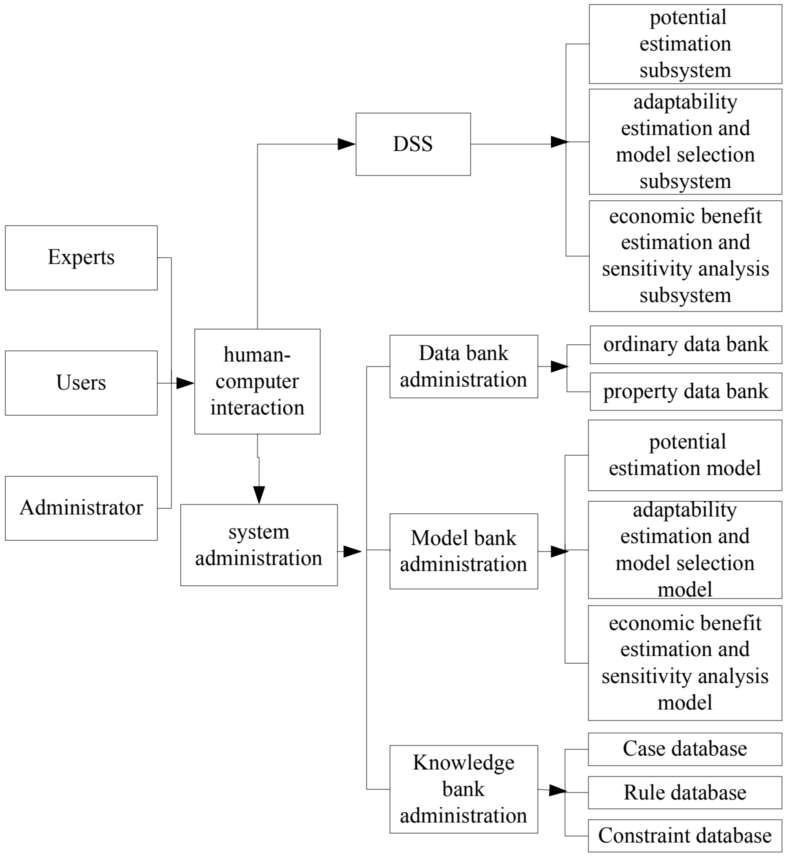

Fig. 1. Structure of decision support system

3.3 System Frame

The decision support system is on the bases of data collection and science management, and the large volume of data and the complex interface are difficult problems in the program of constructing the system successfully. Reasonable system structure ensures the decision support system for mechanical conservation to be practiced. The system frame includes data layer, logic layer, component layer and function layer, and its details are in Fig. 3.

3.4 System Development Platform

This decision support system is developed on the platform of.NET Framework 2.0 and SQL Server 2005, which integrates three models, such as potential estimation model based on projection pursuit, adaptability estimation and model selection model based on fuzzy comprehensive evaluation, economic benefit estimation and sensitivity analysis model based on the time value of money.

.NET Framework includes two main components: common language runtime library and class library. common language runtime library is a software engine used to load applications, confirm them to run without any errors, verify the security license, execute them and clear them when work is finished, and NET framework class library is a reusable type set that tight integrated with common language runtime library[7].

SQL Server defined an xml data type that could be used either as a data type in database columns or as literals in queries. SQL Server introduced a method of allowing usage of database connections for multiple purposes [8]. And it can be used to monitor the health of a server instance, diagnose problems, and tune performance. For relational data, SQL Server has been augmented with error handling features and support for recursive queries with common table expressions.

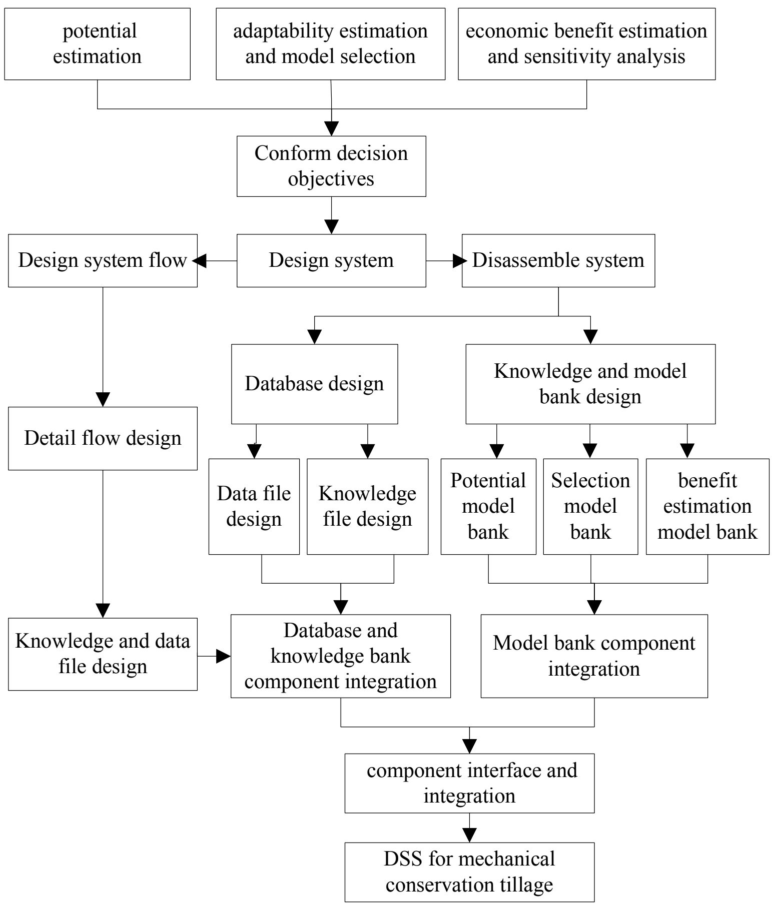

Fig. 2. Flow of decision support system development

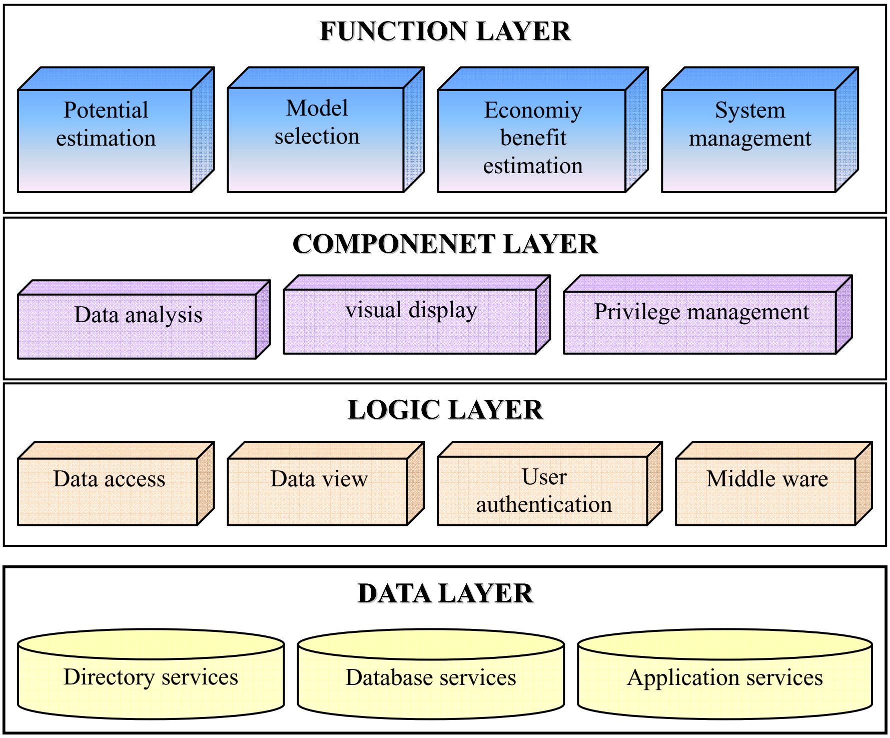

Fig. 3. Frame of decision support system

4 Conclusion

According to the above methods and steps, the author researches and develops the decision support system for mechanical conservation tillage, which is an available assistant tool to analyze data and information for the decision-maker. The system adopts .NET+ SQL Server which satisfies the demand functions, and the platform is in common use and easy to learn.

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Experimental Study on the Quality of Dutch Cucumber in Storage

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Abstract. The quality of Dutch cucumbers in storage was investigated by four kinds of storage technique, especially such as weight loss, soluble solid content, firmness and their appearance. The results indicates that the quality of the Dutch cucumbers stored after pre-cooling is very near that of those stored after preheating, while they are higher than that of those primarily stored. And the quality of those stored in room-temperature. The quality of Dutch cucumbers with preservative film excels that of those without it by the same technique. Therefore it is a good way to precool or preheat the cucumbers and latter to pack them with preservative film before their storage to sustain the fresh quality of Dutch cucumbers.

Keywords: storage technique cucumber quality weight loss soluble solid content firmness

1 Introduction

Cucumber (Cucumis sativus L) is a chilling sensitive commodity. It is very welcomed for its delicious brilliance and high nutrition. But it goes bad in a short time after harvest. Some key qualities of cucumbers such as weight, soluble solid content, firmness and their appearance decreases soon. It is very concerned to keep cucumbers fresh after harvest all the along. Jennifer R. DeEll , etc[1] studied water temperature for hydrocooling field cucumbers in relation to chilling injury during storage. Abdul Hakim, Albert C. Purvis, and Ben G. Mullinix [2]pointed out differences in chilling sensitivity of cucumber varieties depends on storage temperature and the physiological dysfunction evaluated. Rob E. Schouten, L.M.M. Tijskens, Olaf van Kooten[3]Predicted keeping quality of cucumber fruit based on a physiological mechanism. Pan Yonggui[4,5] etc studied effects of Intermittent Warming on cucumber storage. Hou Jian-she etc[6] investigated effects of prestorage treatment on chilling endurance and free radical biology. The objective of this study was to find a new economic technique to sustain the freshest possible quality of cucumbers in longest possible shelf life. Weight loss, soluble solid content, firmness and appearance of cucumbers were used to assess the effects of storage.

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2 Materials and Methods

2.1 Materials

Freshly harvested field cucumbers were obtained from Tianjin farming demonstration center during May12, 2005. All of them were carried to the preservative cold-storage at once after harvest. Marketable cucumbers of similar size, color and color but without mechanical damage and insect pest were selected for the experiments.

2.2 Quality Measurement, Instruments and Storage Techniques

2.2.1 Quality Measurement and Instruments

1) Loss weight in storage

It was measured by JA5003H, 1/1000 scale made in Shanghai precise instrument plant, China.

2) soluble solid content in Dutch cucumber

It was measured with WYT saccharimeter made in Chengdu optical plant, China.

3) Dutch cucumber firmness

It was measured by GY-1 hardmeter made in Mudanjiang mechine research institute, China.

4） Dutch cucumber appearance

Dutch cucumber appearance was assessed by eye-measurement.

2.2.2 Storage Techniques

Experimental cucumbers were randomly sorted to 4 groups, as follows:

Group a

Cucumbers were directly stored in 25℃， 70%RH.

Group b

Cucumbers were directly stored in 4℃， 95%RH.

Group c

Cucumbers were stored in 4℃， 95%RH after being precooled to 4℃.

Group d

Cucumbers were stored in 4℃， 95%RH after being preheated to 4℃ and sustaining for 24 hours.

Each group is classified to two kinds as follows:

Group *1 means cucumbers stored without preservative film and Group *2 means cucumbers stored with preservative film, where symbol * stands for a, b, c, or d.

3 Results and Discussions

3.1 Effects of Different Techniques on Weight Loss of Dutch Cucumbers

Weight loss of cucumbers is affected by many factors. On the one hand, it is related to physical construction of Dutch cucumbers themselves, such as specific surface areas, surface histology, cell retention ability and cell gap length. Specific surface areas indicate areas per gramme cucumber. Surface histology means the natural duct and cuticle layer. The natural duct is made up of gas porosity and cortical pore which is open in the surface of cucumbers. Water diffusion in cucumber was affected by cuticle layer. Cell retention ability is expressed by the content of soluble substance and hydrophilia colloid in the cell. Cell gap affects the drag force of water diffusion. On the other hand, weight loss was also affected by external factors, such as temperature, relative humidity, air speed, light and air pressure. Weight loss per time and per surface areas is calculated as equation (1).

$$dm/dt = -k \tag{1}$$

Given a constant temperature, equation (2) is obtained

$$m = m_0 - kt \tag{2}$$

Where m is the mass at time t, m_0 is the initial value of m.

Therefore, weight loss ratio $\dot{m}$ is obtained as follows:

$$\dot{m} = \frac{m_0 - m}{m_0} = pt \tag{3}$$

where p is constant.

Relations between weight loss ratio of cucumber and storage time is described in Fig. 1. After 16 days of cucumbers storage, it is concluded that the four close values among 1.4-1.9 of weight loss ratio of cucumber with preservative film in the 4 different groups show powerful ability of preservative film to control weight loss ratio. Preservative film not only provides a high humidity condition to prevent the water evaporation from the surface of cucumbers but also decreases the metabolism of them. Without Preservative film, weight loss ratio of group a was the biggest, amounting to 11.81%, where cucumbers looked wilt. The one of b group took second place, the value of which is 7.11%. The one of c group and the one of d group are very nice, respectively 4.71% and 4.02%, and the cucumbers in these two groups looked fresh.

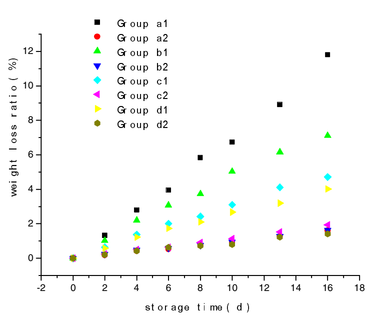

Fig. 1. Relations between weight loss ratio and storage time

According to Fig. 1, the fitting value of p in equation (3) was obtained as Table1.

Table 1. The fitting values of p

Groups	a1	a2	b1	b2	c1	c2	d1	d2
p	0.70764	0.09674	0.47007	0.09957	0.30706	0.09957	0.257	0.0902
s.e	±0.0120	±0.00179	±0.01083	±0.00212	±0.00524	±0.00194	±0.00557	±0.00261
R^2	0.99295	0.99174	0.984	0.98767	0.99164	0.99315	0.98561	0.97551

3.2 Effects of Different Techniques on Soluble Solid Content of Dutch Cucumbers

There is different for soluble solid content in different position, for example, the higher soluble solid content for cucumber head, the lower for behind-of-center and almost zero soluble solid content for cucumber tail and it is difficult to measure the soluble solid content. The soluble solid content value is given by the mean value of soluble solid content in 6-7 points for different position. Soluble solid content of cucumber is 4.5-4.8% in experiment beginning.

It is shown from Fig. 2 and Fig. 3 that soluble solid content of cucumber decreases significantly with the storage time increasing for all experiment data, i.e., the property of storage cucumber is worse obvious than that of experiment beginning. Comparing the different experiment groups, it can be observed that the soluble solid content of

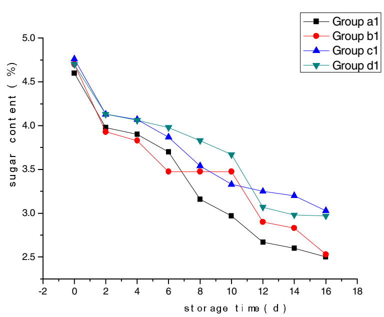

Fig. 2. Soluble solid content of cucumber with time except the preservative film

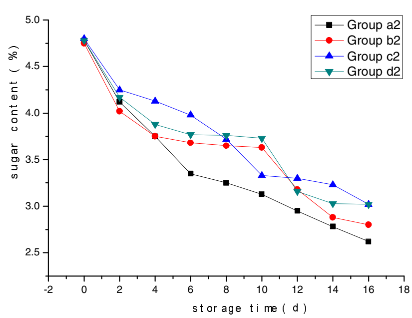

Fig. 3. Soluble solid content of cucumber with time by the preservative film

cucumber by precooling and preheating treating groups is higher than that of the direct cool storage and room-temperature group. The property of the first two groups is better than that of other two groups. On the whole, the soluble solid content of cucumber in the preservative film is higher than that of the corresponding contrast group. It is shown that the better storage result is obtained by using the preservative bag.

3.3 Effects of Different Techniques on Firmness of Dutch Cucumbers

Cucumber firmness is different for different position. Generally, it is soft for cucumber head and hard for cucumber tail. So 7~8 points in different position are chosen for measuring and the mean value is considered as the cucumber firmness. The changes of cucumber firmness with time for different treating groups are shown in Fig. 4.

As observed in Fig. 5, the cucumber firmness for experiment groups decreases with time, i.e., the property of storage cucumber is worse than that of experiment beginning. But on the whole, the storage results for three cold-storage groups are better than that of room temperature groups. The effect of preservative bag package for cucumber firmness is not significant and the former result is a little better than that of the latter. The difference is between 0.6 and 1.1.

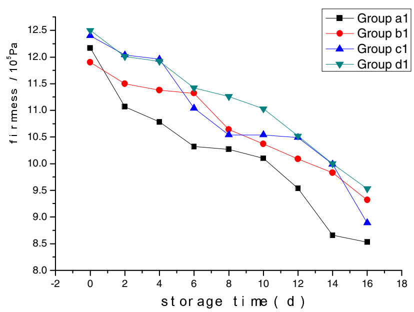

Fig. 4. Storage cucumber firmness with time except the package film

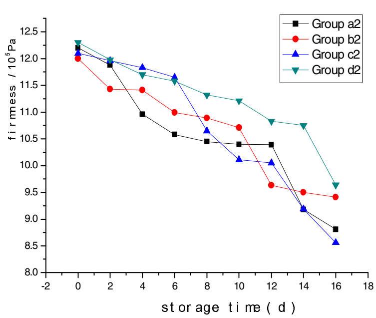

Fig. 5. Storage cucumber firmness with time by the package film

3.4 Effects of Different Techniques on Appearance of Dutch Cucumbers

The observed results for appearance of cucumber are shown in Table 2. The appearance for room temperature storage except the preservative film decreases quickly, the appearance with the preservative film by precooling is equivalent to that of preheating treatment. The appearance by precooling and preheating is best for all treating condition and that of direct cool storage is in the middle.

Table 2. Appearance contrast for different experiment group cucumbers

Time(d)	Group a1	Group a2	Group b1	Group b2
0	Fresh cucumber	Fresh cucumber	Fresh cucumber	Fresh cucumber
2	Froth appearance in surface	The same with that of the nearest above	The same with that of the nearest above	The same with that of the nearest above
4	Froth and macula, appearance in surface, coarseness	The same with that of the nearest above	The same with that of the nearest above	The same with that of the nearest above
6	Froth appearance in 80% surface	Little froth appearance in surface	The same with that of the nearest above	The same with that of the nearest above
8	Froth and macula, white in cucumber	The same with that of the nearest above	The same with that of the nearest above	The same with that of the nearest above
10	serious froth appearance in 90% surface, white in cucumber, no sweet	Fresh green in cucumber, sweet	The same with that of the nearest above	Little chilling injury appearance
12	serious froth appearance in all surface, complete white in cucumber,	Froth appearance in almost surface, green in cucumber	Half chilling injury, more serious	chilling injury appearance, little thickness in surface
14	Little yellow appearance in froth position, soft	The same with that of the nearest above	Serious chilling injury, surface thicker	chilling injury in 40% surface, more serious surface thickness
16	Yellow appearance in froth position, very soft	The same with that of the nearest above	chilling injury in 75% surface, surface thickness	more serious chilling injury

Table 2 (*Continued*)

Time(d)	Group c1	Groupc2	Group d1	Group d2
0	Fresh cucumber	Fresh cucumber	Fresh cucumber	Fresh cucumber
2	The same with that of the nearest above	The same with that of the nearest above	The same with that of the nearest above	The same with that of the nearest above
4	The same with that of the nearest above	The same with that of the nearest above	The same with that of the nearest above	chilling injury appearance
6	The same with that of the nearest above	The same with that of the nearest above	The same with that of the nearest above	The same with that of the nearest above
8	The same with that of the nearest above	The same with that of the nearest above	The same with that of the nearest above	The same with that of the nearest above
10	The same with that of the nearest above	The same with that of the nearest above	chilling injury appearance	The same with that of the nearest above
12	chilling injury appearance, surface thickness	White thickness liquid appearance	chilling injury appearance, surface thickness	White thickness liquid appearance
14	chilling injury in 50% surface, surface thickness	Little chilling injury	50% little chilling injury, surface thickness	Little chilling injury
16	more serious chilling injury	The same with that of the nearest above	The same with that of the nearest above	The same with that of the nearest above

Experiment finishing, the photos of cucumbers in all groups are shown in Fig. 6~9.

Group a:

They are shown in Fig. 6. Group a2 lies in nearest above /up and group a1 right /down.

There is an amount of froth in the cucumber surface of group a1 and the surface has become yellow too. There is only the froth in the surface of group a2. Comparing the section, it can be seen that the inside of group a1 has become white and group a2 green.

Fig. 6. Appearance and cross section in group a

Group b

They are shown in Fig. 7. Group b1 lies in right /up and group b 2 nearest above /down.

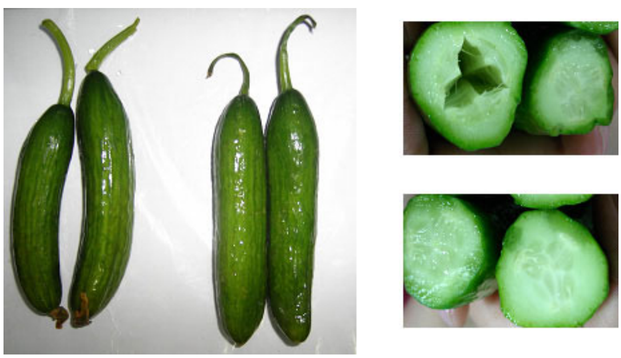

Fig. 7. Appearance and cross section in Group b

From the surface, the storage quality for cool storage group is better than that of the room temperature group but the chilling injury is obvious. The cucumber tail has withered and cucumber inside has be empty. It can be seen from the group 1. So the cucumber quality of group 2 is better than that of group 1.

Group c

They are shown in Fig. 8. Group c1 lies in right /up and Group c 2 / nearest above down.

The surface symptom for precooling groups and preheating groups is almost the same. There is the chilling injury (due to no aseptic treatment before storage). Comparing the second group and the first group, the storage quality for the second group is better than that of the first group.

Fig. 8. Appearance and cross section in group c

Group d:

They are shown in Fig. 9. Group d1 lies in nearest above /up and Group d 2 right /down.

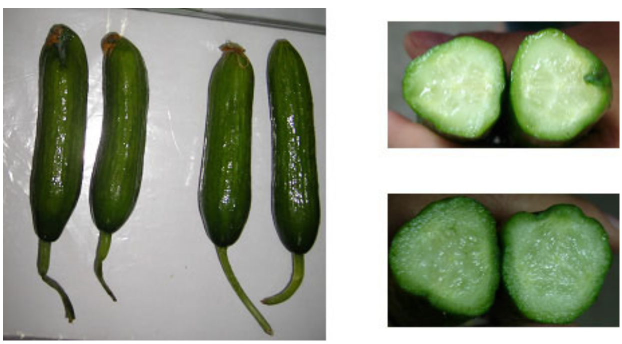

Fig. 9. Appearance and cross section in group d

From the surface, the storage quality for preheating group is better than that of the room temperature group. There is chilling injury appearance for the two preheating groups(due to no aseptic treatment before storage). Comparing the two groups, the chilling injury for group 1 is more obvious and the cucumber tail of group 1 has withered. But the cucumber tail of group 2 is good.

As a result, it is observed that different states are gained for different groups cucumbers by 16 days storage. So the property for different pretreatment methods and storage forms is directly shown from the phenomena.

4 Conclusions

From the experiment results, it is concluded that it is important for Dutch cucumbers storage to adopt low temperature and high humidity. The low temperature reduces the cucumber metabolism and the high humidity keeps the moisture content of cucumber so as to keep the cucumber refresh. It is an important means to maintain the fruit and vegetable quality by pretreatment. The suitable precooling and preheating treating can improve the storage quality of cucumber. The better quality can be gained by using the preservative film based on the pretreatment, especially its controlling the cucumber dehydration preferably and preventing soluble solid content from decreasing so as to keep the cucumber fresh and essential saccharinity. But preservative film has little effect on firmness of the cucumbers during storage.

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GIS-Based Evaluation of Soybean Growing Areas Suitability in China

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Abstract. In this study, the suitable areas for soybean in China were presented by GIS-based Multi-Criteria Evaluation (MCE) approach. We collected datas of environmental conditions and soybean growth associated factors, then, by the GIS technology we established spatial database of regional weather, topography, and soil conditions. Using the Spatial Analyst, the Spatial Interpolation, the Reclassification and the Weighted Overlay of ARCGIS9.2 operated to the database. Then the suitable criteria map of soybean in China was created, and the potential suitability of soybean planting areas was evaluated. The results showing 5,960,271 km^2 of areas are fit for spring soybean and 5,286,643 km^2 of areas are fit for summer soybean in the Northeast Plain, the Huang-Huai Plain and the Yangtze River Delta, in addition, there are lots of scattered suitable areas for soybean cultivation. This present study was aimed to provide some value references for Government formulating policies on the adjustment of industrial structure, and some reasonable guidance for farmers cultivating the agricultural products, more importantly, to achieve the purpose of utilizing natural resources reasonably.

Keywords: soybean; MCE; GIS; Suitable Level.

1 Introduction

China has the longest history of the cultivation of soybeans, which is over 5000 years [1]. The distribution of soybeans in China is extremely extensive, and before the 1950s, China had been the world's leading soybean producer all the time, not only having a surplus in self-sufficiency but with large quantities of soybeans exported abroad [2]. However, since 1996, China's import of soybeans has been increased year after year, having currently developed into the largest soybean importer in the world [3]. Because soybeans are of high nutritional values and healthcare functions, they are increasingly appreciated by the public, resulting in a boost in the demand [4]. While the current situation of the soybean in China shows that the soybeans are of low oil extraction rate and yield but of high cost, having difficulty in the competition with the imported soybeans. It can be said that Chinese soybeans are now "besieged on all sides and involved in trouble."

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When digging into the reasons, it's found that the real shock to Chinese soybeans is the development of Chinese agriculture which is of low production input and productivity as well as poor competitiveness. Meanwhile, China is seriously lacking in the investment in soybean research and the promotion of soybean technology. Although the breeds of corn, rice and wheat have been updated dozens of times throughout the country, many farmers in the main producing areas of soybeans are still cultivating the old soybean breed of many years ago [5].

Currently, the soybean research in China is mainly focused on its nutrition and healthcare, in addition to the study of physiology, breeding and other aspects. Since there's a lack of macro research, it's necessary to develop the soybean mapping. In this research, the Multi-Criteria Evaluation (MCE) of GIS will be adopted to evaluate the potentially suitable planting areas for Chinese soybeans. The so-called MCE-GIS method is to employ reference standard and its weights in the assistance of the decision-maker to select the most appropriate option and solve a practical problem (objective) with an evaluation matrix [6]. In addition, the result could be visualized. This combination of MCE and GIS has been widely used in the evaluation and decision analysis of breed suitability. And in the central Mexico, the potential producing areas of corns, potatoes and oats have been assessed in the adoption of MCE method [7]. In this research the MCE method is carried out across the county to evaluate the potentially suitable planting areas of the crops, and to assess the potential producing area of Chinese soybeans. It is hoped that the research result could provide a visual guidance to the reasonable cultivation and the distribution planning of soybeans in China, helping to solve the existing cultivating problems of Chinese soybeans and to improve the efficiency of land use. This would also facilitate the instruction of farmers on agricultural production, increase the decision efficiency of the government and eliminate the blindness in agricultural investment, to further boost the investment incomes and the living standards of the farmers.

2 Methods

The main steps in the evaluation of the potentially suitable planting areas of Chinese soybeans are as follows: (1) to select the climate and soil factors that are essential to the growth of soybeans in reference to the opinions of the experts and relevant literature [8-15]. (2) to establish a database for the factors selected nationwide. In ArcGIS9.2, using spatial analysis module and Kriging spatial interpolation module to convert the raw data of each impact factor into raster layer. (3) to re-classify the raster layers of all the variables with re-classification module in the integration of the experts' opinions so as to get the suitable hierarchy map of each factor that affecting the growth of soybeans. (4) to adopt Analytic Hierarchy Process (AHP), in which all the factors will be compared and scored by agriculture expert in pairs to calculate the weight of each impact factor. (5) to carry out weighted superposition of the suitable hierarchy map of each factor in the use of the weighted superposition module in ArcGIS9.2, and finally adding in the information of land use/ land cover, together with the national province boundaries to develop the map of the potentially suitable planting areas of soybeans across China.

2.1 Research Area and Research Object

The research area covers the approximate 9.6 million square kilometers of the entire land area of China, which stretches out to the north of the center of Heilongjiang at the town of Mohe (53°31′N), to the south of the South Sea Island (4°15′N), to the west of the Pamirs (73°40′E), and to the east of the confluence of Heilongjiang and the Ussuri (135°05′E). In this research, soybeans are divided into summer soybeans and spring soybeans according to different time of sowing and harvesting in order to improve the accuracy of the experiment.

2.2 Selection of Evaluation Factors

The selection of evaluation factors mainly conforms to the following principles: a. dominance—the selection of major factors that affect the growth of soybeans; b. difference—the selection of factors that have significant difference and could create critical value; c. incompatibility (independence)—the selected factors shouldn't have correlations; d. operability—the relevant resources of the selected factors should be easy to get [16].

On this basis, the selection of factors that affect the distribution of soybeans includes: accumulated temperature at the whole growth period (≥10℃), precipitation at the whole growth period, sunshine duration at the whole growth period, the lowest temperature at the whole growth period (May), the highest temperature at the whole growth period (August), PH value of soil, field moisture capacity and type of soil.

2.3 Establishment of Database

2.3.1 Topographic Database

The national 1:250 thousand contour data are provided by the National Mapping Bureau, and the national digital elevation model (DEM) is developed in ArcGIS9.2. Firstly, the original contour data are converted into Triangulated Irregular Network (TIN) in ArcInfo, and then further into DEM to draw elevation information. Finally, the grid size is confined to 1000m×1000m in the use of Albers projection.

2.3.2 Meteorological Database

The multi-year average climatic data at 749 stations across China are provided by the Central Meteorological Bureau, recorded from 1971 to 2008. Making vectorization of the climatic data in ArcGIS9.2 could get the vector data of the coverage at the nationwide 749 stations. And then making spatial interpolation of these vector data in ArcMap and inserting the climatic data at the research area to get raster layers of each factor. Finally, the grid size is confined to 1000m×1000m in the use of IDW interpolation (Inverse Distance Weighted) and Albers projection.

Before the vectorization of the original data, origin7.5 is used to obtain a multiple regression equation of longitude, latitude and altitude, which is used to calculate the climatic data at each weather station and its difference with the original climatic data.

Table 1. Specific level per factor for the spring soybean

Factor	Level of suitability				
	Very High	High	Medium	Low	Very Low
Accumulate temperature(⩾10℃)	3300-2400	2400-2200	2200-1900	>4000	<1900
Precipitation(mm)	540-370	370-320 or540-1000	320-250 or>1000	320-180	<180
Minimum temperature(℃)	22-20	20-18	18-10	10-4	<4
Maximum temperature(℃)	25-22	22-18	18-16	16-4	<14or>25
Sunshine hours (h)	750-700	750-1200	1200-1350	1350-1700	<700
field water capacity	0.80-0.80	0.7-0.5	0. 5-04	0.4-0.2	<0.2
Soil type	Loam	Sandy/Clay/Silt loam	Sandy/Silt clay	Other class	Sandy
Soil pH	6.0-6.5	6.5-7.0	7.0-7.5	7.5-7.8	<6.0 or >7.8

Table 2. Specific level per factor for the summer soybean

Factor	Level of suitability				
	Very High	High	Medium	Low	Very Low
Accumulate	3400-2800	2800-2400 or>3400	2400-2000	2000-1000	<1900
Precipitation(mm)	650-360	650-1000	360-250	>1000	<250
Minimum temperature(℃)	30-20	20-15	15-10	10-8	<8
Maximum temperature(℃)	28-25	25-22	22-18	18-16	<16
Sunshine hours (h)	750-700	750-1200	1200-1350	1350-1700	<700or>1700
field water capacity	0.80-0.80	0.7-0.5	0. 5-04	0.4-0.2	<0.2
Soil type	Loam	Sandy/Clay/Silt loam	Sandy/Silt clay	Other class	Sandy
Soil pH	6.0-6.5	6.5-7.0	7.0-7.5	7.5-7.8	<6.0 or >7.8

And this difference should be vectorized. Then the regression coefficient will be adopted in the Spatial Analyst module of ArcGIS9.2 to make grid computing, the result of which will be overlapped with the vector data. In this way, the impacts of longitude, latitude and altitude are all taken into consideration, so the interpolation would be more accurate.

2.3.3 Soil Database

The national 1: 1 million soil type data are provided by Nanjing Institute of Soil Science. Firstly, the data are sampled into 99034 point data, to which spatial Kriging interpolation are carried out in ArcGIS9.2, and in this way the raster layer of soil is obtained. Then in combination with *Soil Species of China*, soil texture, soil PH value and other information about different types of soil are extracted, which are then used in ArcGIS9.2 to create the raster layers of each type of soil. Finally, the grid size is confined to 1000m×1000m in the use of Albers projection.

2.4 Re-Classification

On the basis of the established database, the suitability of climatic and soil data is divided in accordance with the growing conditions of soybeans into five categories:

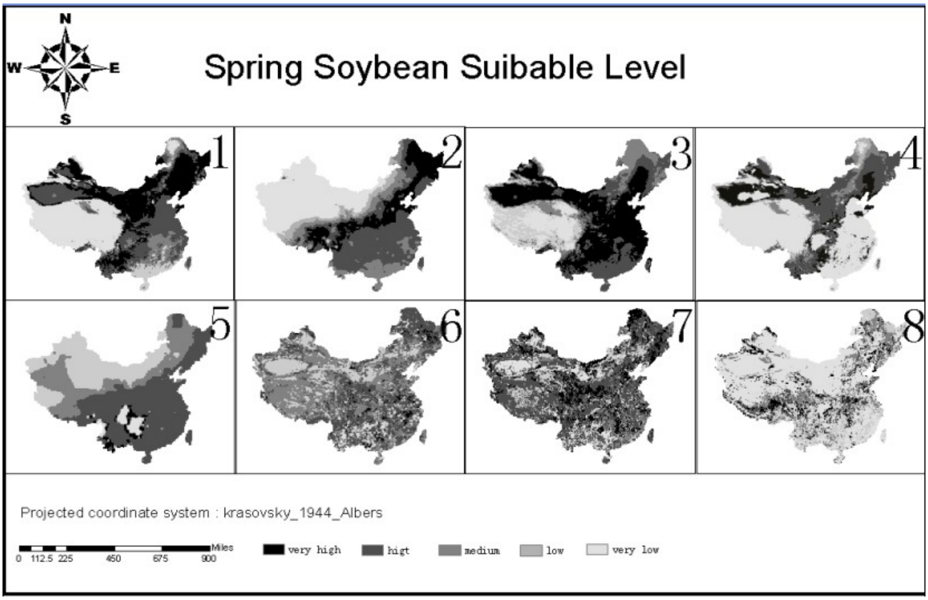

Fig. 1. Factor map for spring soybean, including suitability levels for each factors: 1=Accumulate temperature(≥10℃); 2= Precipitation; 3= Minimum temperature in growing season (℃); 4= Maximum temperature in growing season (℃); 5= Sunshine hours (h); 6= field water capacity; 7= Soil type; 8= Soil Ph

highest, high, medium, low and minimum (five standards as shown in Table 1, Table 2). And then the map of the suitability of soybean factors is created through the re-classification in ArcGIS(Fig. 1, Fig. 2).

2.5 Multi-criteria Evaluation (MCE)

The relatively mature methods adopted in the confirmation of evaluation factors include DELPHI, AHP, regression analysis, grey relation degree, principal component analysis and so on. In this paper, AHP method is employed. It is a kind of paired comparison method put forward by Saaty (1977) in the context of decision making [17]. This simple, flexible and practical MCE method can be used in the quantitative analysis of qualitative problems. Firstly, agriculture experts are asked to compare and score the relative importance of factors at the same level in pairs (see Table 3), then the results will be calculated in MATLAB2006 to obtain the weight value which represents the relative importance of factors at the same level, and finally the relative weight value of all factors will be computed and rearranged according to the general ordering of all levels.

The calculated weight coefficients respectively are: accumulated temperature of 0.2657, precipitation of 0.2744, the lowest temperature of 0.1396 at the whole growth period, the highest temperature of 0.1633 at the whole growth period, sunshine duration of 0.0505, field moisture capacity of 0.0410, soil PH value of 0.0328 and soil texture of

0.0328. The weighted superposition should be carried out on these eight factors in the use of weight coefficients to obtain the hierarchy map, which should then be overlapped with the land use map that has deducted the areas of water, sand, desert and high cold wasteland to get the potentially suitable planting areas of soybeans in China (Fig. 3, Fig. 4).

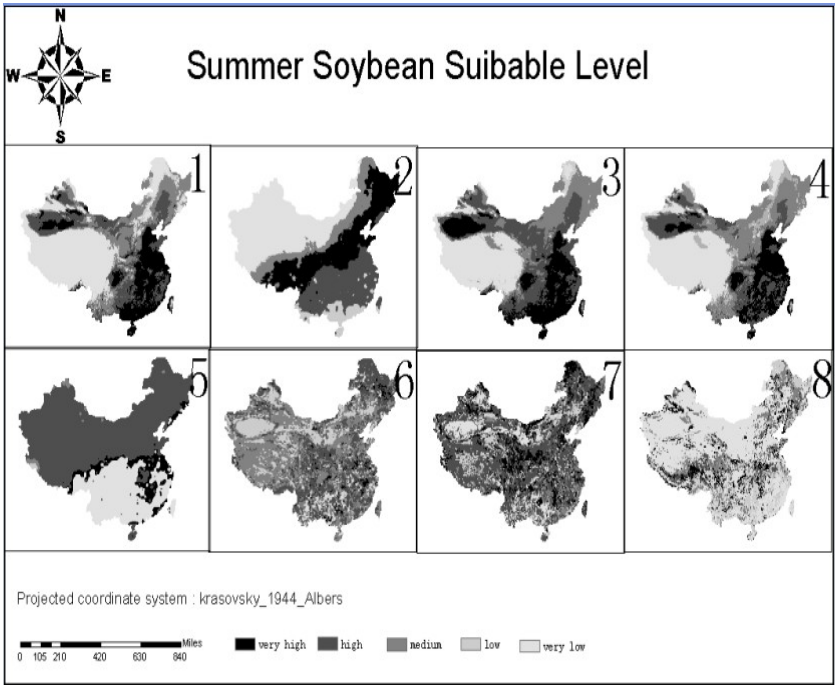

Fig. 2. Factor map for summer soybean, including suitability levels for each factor: 1=Accumulate temperature(≥10℃); 2= Precipitation; 3= Minimum temperature in growing season (℃); 4= Maximum temperature in growing season (℃); 5= Sunshine hours (h); 6= field water capacity; 7= Soil type; 8= Soil pH

Table 3. Analysis of system-level indicators and the results of the comparison: AT = Accumulate temperature(≥10℃), PR = Precipitation, MI = Minimum temperature(℃), MA = Maximum temperature(℃), SH = Sunshine hours, WC = field water capacity, ST = Soil type, pH = Soil pH

	AT	PR	MI	MA	SH	WC	ST	PH
AT	1	9/8	3/2	6/5	6/1	7/1	8/1	8/1
PR	8/9	1	4/3	75	7/1	8/1	9/1	9/1
MI	2/3	3/4	1	23	2/1	3/1	4/1	4/1
MA	5/6	5/7	3/2	1	3/1	4/1	5/1	5/1
SH	1/6	1/7	1/2	1/3	1	7/6	9/6	9/6
WC	1/7	1/8	1/3	1/4	67	1	9/7	9/7
ST	1/8	1/9	1/4	1/5	6/7	7/9	1	1
PH	1/8	1/9	1/4	1/5	6/7	7/9	1	1

3 Results and Discussions

Potential distributing areas for Soybean as show as Fig. 3. If the levels of Very high, High and Medium are chosenas the suitable planting areas, the overall suitable area of Chinese springsoybeans is 5,960,271 km2, taking up 79% of the total area and summer soybeans is 5,286,643 km2, taking up 70% of the total areas.

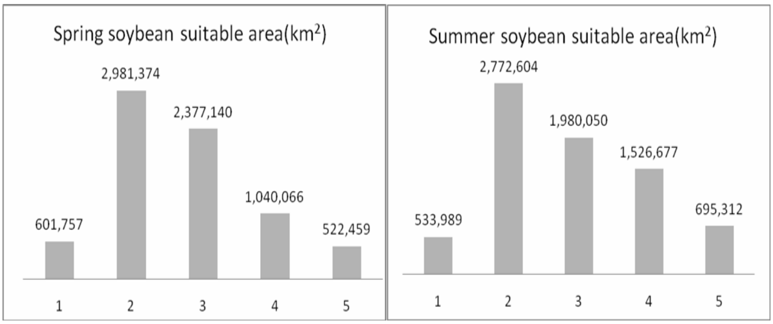

Fig. 3. The potential distributing area for soybean in China(1= Very High, 2=High, 3=Medium, 4=Low, 5=Very Low)

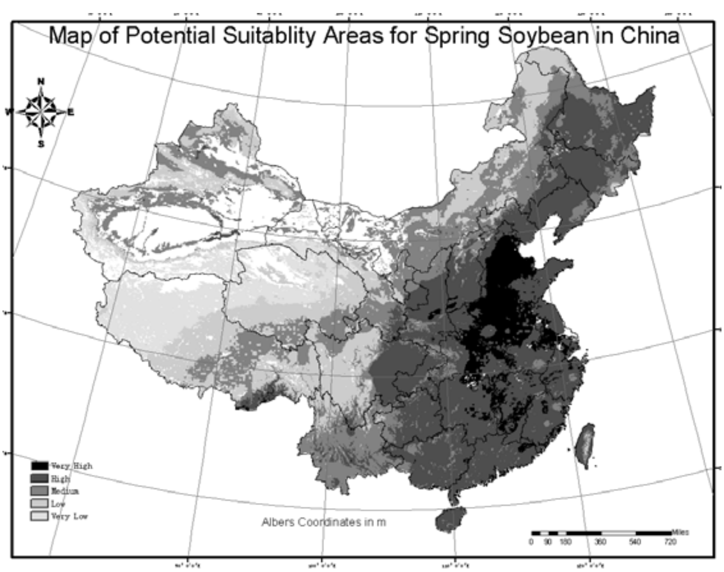

Fig. 4. Suitability map for spring soybean in China

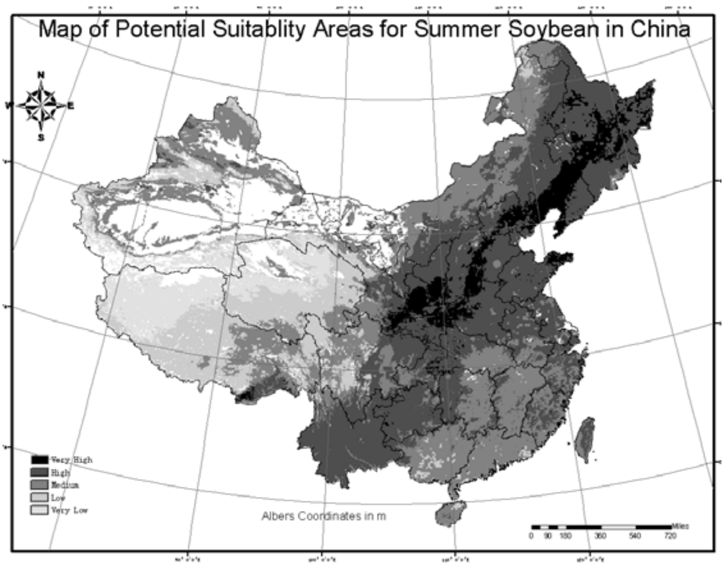

Fig. 5. Suitability map for summer soybean in China

As shown on Fig. 4 and Fig. 5, the most suitable planting areas of spring soybeans mainly distribute zonally over Heilongjiang, the central plain of Jilin, the southwest of Liaoning, the southeast of Shanxi, the central section of Shannxi, the southeast of Gansu, the west of Henan, the north of Hebei, Shantung Peninsula, Beijing and some parts of Hubei. While the most suitable planting areas of summer soybeans principally spread over the south of Beijing, Tianjin, the south of Hebei, south and north of Shantung, the east of Henan, the west of Shanxi, the north of Anhui, the central section of Hubei, south Jiangsu and some parts of Hunan, Chekiang, Fujian and Guangzhou, mainly the regions of abundant precipitation and sunshine in the Northeast Plain, the Huanghuaihai plain and the Middle and Lower Yangtze Valley Plain.

The optimum planting area for spring soybean in China is zonal distributed from northeast to southwest, mainly found in arid, semiarid, sub-humid-semiarid areas of China, for these areas have an arid climate and a long time sun light exposure. Meanwhile, these areas are the agriculture-pasture transition zone in north China, and most of the areas with extremely high suitability and high suitability are overlapped with the ecotone of China. Summer soybean is centered in costal humid, sub-humid zone where have many plains and abundant rainfall. It is mainly affected by the restrictions from accumulated temperature, sunshine duration and amount of precipitation which are just the primary factors to the soybean growing.

Since this is basically in line with the actual distribution of the cultivation of soybeans, it is demonstrated that this method is applicable to the division of the suitable planting areas of soybeans.

The evaluation of the potentially suitable planting areas of soybeans is an indispensable part of Chinese crop map system, having realized the visualization of the potentially suitable planting areas of Chinese soybeans and the suitable hierarchy. After the completion of the entire crop map system in the future, the internet would be should to provide visualization information about the distribution of crops in the provinces even in the counties and countries across China, filling the vacancy of online system of Chinese crops.

4 Problems and Prospects

The suitable planting areas of soybeans in this research are a kind of potential distribution, for the actual evaluation of the suitable planting areas of soybeans is likely to be affected by the micro topography, economic level, living tradition and other factors. Although there's a slight discrepancy between the potential distribution and the actual distribution, this research has roughly simulated the potentially suitable planting areas of soybeans in China.

In the next step of work, market demand and supply, price fluctuation and other factors will be further studied to consummate the distribution map of the suitable planting areas for soybeans; in addition, the yield model would also be integrated in the evaluation of the potential production capacity of soybeans. Meanwhile, the influence of climatic change on the distribution of the suitable planting areas of soybeans is also investigated. At last, this research evaluates the formation process of the components of yield, input, resource utilization, environmental load, potential pollution and so on, and it could also combine the economical analysis module to carry out marginal utility analysis of input and output, to form strategies that can replace the management measure and decision-making consultancy.

Chinese soybeans have the advantage of containing non-genetically modified ingredients, which confirms to the international consumption trend and should be made full use of to develop more effective cultivation planning, in the hope of boosting the yield of soybeans and improving China's production capacity of soybeans as well as the comprehensive competitiveness.

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Goal-Driven Workflow Generation Based on AI Planning

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Abstract. The success of an enterprise heavily depends on its ability to respond to changes in its environment in an effective and dynamic way. To cope with emerging business trends, automatic workflow generation provides a significant competitive advantage .This paper presents a goal-driven workflow generation, which is pattern-oriented and knowledge-based. First, a process pattern is proposed as a vehicle for knowledge representation. Then, a heuristic intelligent planning algorithm is deployed to construct a workflow automatically according to the goal specified by the users and the business context.

Keywords: goal-driven, pattern oriented, HTN planning, workflow generation.

1 Introduction

Process-driven workflow systems are used to configure and control structured business processes from which well-defined workflow models and instances can be derived [3, 9]. Because all information needed in the execution stage is specified, this method is also called full-ahead plan [11]. However, since most business environments are complicated and changeable, it is difficult for users to know all the details for defining the process specification. And the process definitions often need to be modified during execution for the unexpected and developmental change in the business processes being modeled and the deviations from the prescribed process model at runtime [8].

Obviously, the traditional "full-ahead" [12, 13] workflow scheduling can't meet the complex and flexible enterprise. Automating the workflow generation process as much as possible is the main point. Ideally, the user just need to specify what they want the workflow to achieve (instead of how to achieve it) and what the constraint is. The workflow management system should then be able to generate an appropriate workflow and execute it successfully.

Presently, some research has focused on the workflow system that integrates AI planning techniques for automatic workflow construction or workflow generation. This method applying AI planning to dynamic workflow creation sacrifices the advanced features: Firstly, high availability is possible by enabling users to represent the workflows at an abstract level without needing to worry about the particulars of the target execution systems. Secondly, robustness is possible by generating a replaceable process when exception occurs. Because when the failure happens, real-time planning will find a new resolution to deal with the exception. But high scalability is required

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for the present planning algorithms usually limit to a specific application domain. Pegasus [3, 10] is a typical example which uses AI planning to workflow system in Grid environment.

Our work is different from the current practices in two aspects: the first is that a new workflow modeling method based on a pattern is proposed to specify a goal-driven workflow correctly. The second is that we adopt the heuristic evaluation algorithm and pattern-oriented HTN planning algorithm to knowledge representation and workflow planning, which enables the use of domain heuristics in problem solving and automatic workflow composition thus speeding up the planning process and improving the planner's performance. And it will lead a more effective way of exception handling and workflow simulation.

2 Goal-Driven Workflow

2.1 Process-Driven Workflow

Process-Driven Workflow largely takes the decision-making responsibility for the flow of documents, information and tasks out of the hands of the user, leaving it to an automated business process rules engine [4].

Process-Driven Workflow is a pre-defined workflow .Where the user should

* Understand and control the processes in detail.
* Identify the metrics and objectives for the key processes.
* Model and automate key business processes.
* Identify the participants who are involved in the process.
* Innovate continuously to keep pace with business change.

Usually, process-driven workflow functions well in a small-scale, centralized, homogeneous environment.

2.2 Goal-Driven Workflow

Goal-Driven Workflow is a more flexible workflow, where the boundary between workflow build-time and run-time is eliminated. Instead of defining a workflow process in advance, users just specify a goal and then workflow management system (WFMS) will, with or without users' intervention, decompose it into some sub-tasks according to the resources and knowledge possessed and fulfill the coordination and scheduling function necessary to achieve the specified goal. The decomposition procedure can be executed several times on the fly, making it possible to tolerate and/or adapt to the changes and exceptions encountered during the execution time [6].

Goal-Driven is more applicable in large-scale, distributed and heterogeneous environment. The users don't need to know the detail of process. They just need to describe what to be achieved.

2.3 Process-Driven Workflow vs. Goal-Driven Workflow

Table1 shows the differences between Process-Driven workflow and Goal-Driven workflow. Goal-Driven workflow has more advantages in real applications.

Table 1. Process-Driven Workflow vs. Goal-Driven Workflow

	Process-Driven Workflow	Goal-Driven workflow
style	full-ahead workflow	automatic construction, dynamic
application	special application domain	domain independent
definition	user based(understand the detail)	knowledge based
robustness	low	high
cost	low cost, multiple invest	single invest, knowledge maintenance

3 Goal-Driven Workflow Generation

3.1 Process Pattern

Patterns originally come from architectural domain to describe a problem which occurs over and over again in our environment, and then describes the workflow solutions to that problem, in such a way that you can use this solution a million times over [1].

Similarly, Process Pattern refers to the experiences and knowledge within business domain. It comprises three parts----Goal, Context and Solution which described as a triad:

$$\text{Process Pattern} = \langle \text{Goal, Context, Solution} \rangle \qquad (1)$$

Goal describes the target of business, whose properties include id, name and domain. Context describes the condition, whose properties include relevant data, positive factors and negative factors. Solution gives the guideline or solution to reach the

```
<ProcessPattern id="..." type="..." name="...">
    <Goal id="..." name="..." domain="...">
    </Goal>
    <Context>
        <RelevantData> ... <RelevantData/>+
        <Positive term="..." factor="..."/>+
        <Negative term="..." factor="..."/>+
    </Context>
    <Solution>
        <Activities>
            <Activity id="..." type="..." name="" ... />+
        </Activities>
        <Transactions>
            <Transaction from="..." to="..."... />+
        </Transactions>
    </Solution>
</ProcessPattern>
```

Fig. 1. Process Pattern in XML

business goal. For the same goal, different context or scenario leads to different solutions. And each goal can be decomposed into several sub-goals. In the same way, sub-goal has its appropriate process pattern.

3.2 Goal-Driven Workflow Generation

Workflow generation means the automatic construction of workflow definition. In more detail, it includes the construction of definition, the refinement and the re-planning in execution. Goal-driven workflow generation is based on process pattern. It can construct a workflow automatically according to the goal specified by the users and the business context.

The procedure of Goal-Driven workflow generation is shown as Fig. 2:

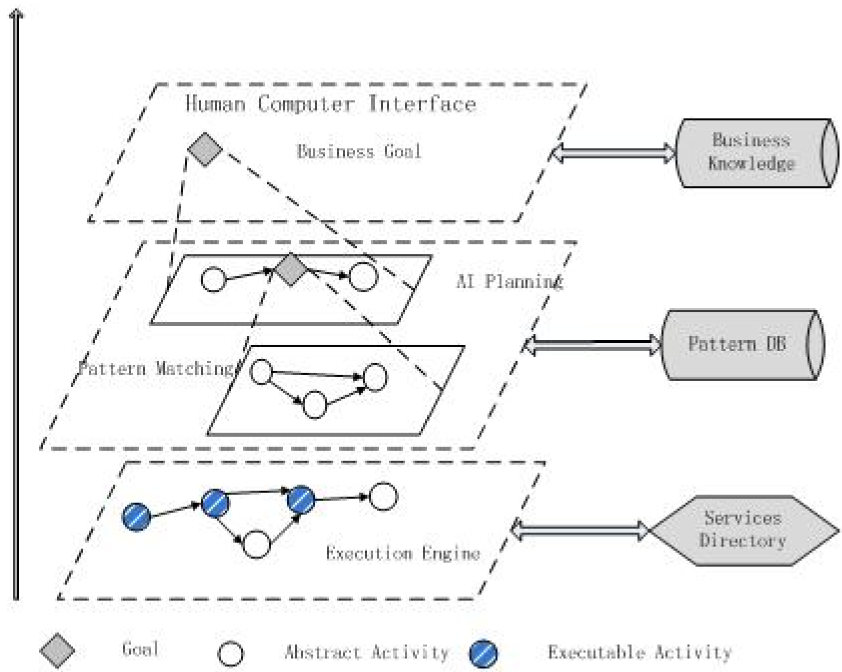

Fig. 2. Goal-Driven workflow generation

When modeling, the business process will be divided into a serious of process segments which can be represented with process pattern. All of these patterns are saved as knowledge. Once the user input the goal, workflow generation process starts. Then AI planner constructs a planning tree composed with patterns which are selected through goal matching and pattern matching. Continually, all of these tree nodes are arranged into a whole process definition according to the connection between patterns. Finally, the Execution Engine maps the identified process steps to the physical services and coordinates their execution.

4 AI Planning

4.1 HTN Planning

In HTN planning a planning problem is represented by sets of tasks (task networks). Methods decompose non-primitive tasks into sub-tasks until a level of primitive tasks is reached, which can be solved by operators [7]. HTN planning decomposes high-level tasks into simpler ones until eventually all tasks have been decomposed into actions. This feature makes HTN planning a promising means to realize Goal-Driven workflow generation. Because the Goal-driven workflow generation is based on process pattern, which can describe knowledge at different levels of abstraction resolved to various levels of detail.

As illustrated in the last section, Goal-Driven workflow generation allow user-defined process segments which named Process Pattern, and then use AI planner automatically to search appropriate patterns and auto-assembly to form the segments to a complete solution for the goal. A Heuristic intelligent planning algorithm is deployed to complete automatic workflow generation.

4.2 Heuristic Intelligent Planning Algorithm

Once user input the Goal and Context information from the human computer interface, heuristic intelligent planning module starts. The system finds the best solutions through goal matching, context matching and pattern matching. And then automatically assemble the process fragments into a complete workflow process. Fig. 3 shows the flow chart of the intelligent planning algorithm.

As shown in Fig. 3, HTN planning algorithm is described as follows:

Step 1: Input a planning problem G
Step 2: If G contains only primitive tasks, then return the result
Step 3: Choose a goal task g in G in depth-first search traversal method
Step 4: Choose an expansion for g, using the heuristic evaluation algorithm
Step 5: Replace g with the expansion

Go to step 2

HTN planning decomposes tasks until a plan consists only of primitive tasks. Expanding each non-primitive task (step 3-5) is done by choosing an appropriate reduction, which specifies one possible way of accomplishing that task. Reductions are stored as solutions or process, which associate non-primitive tasks or goals with task networks. In step 3, we have adopted a depth-first traversal method to expand the nodes to form a final complete solution. The algorithm is sound because a heuristic evaluation algorithm is used in the step 4.

The heuristic evaluation algorithm is an artificial neural network algorithm optimized by genetic algorithm.

Artificial Neural Networks (ANNs) are computational tools that have found extensive utilization in solving many complex real-world problems. The attractiveness of ANNs comes from their remarkable information processing characteristics pertinent mainly to nonlinearity, high parallelism, fault and noise tolerance, and learning and generalization capabilities [5].

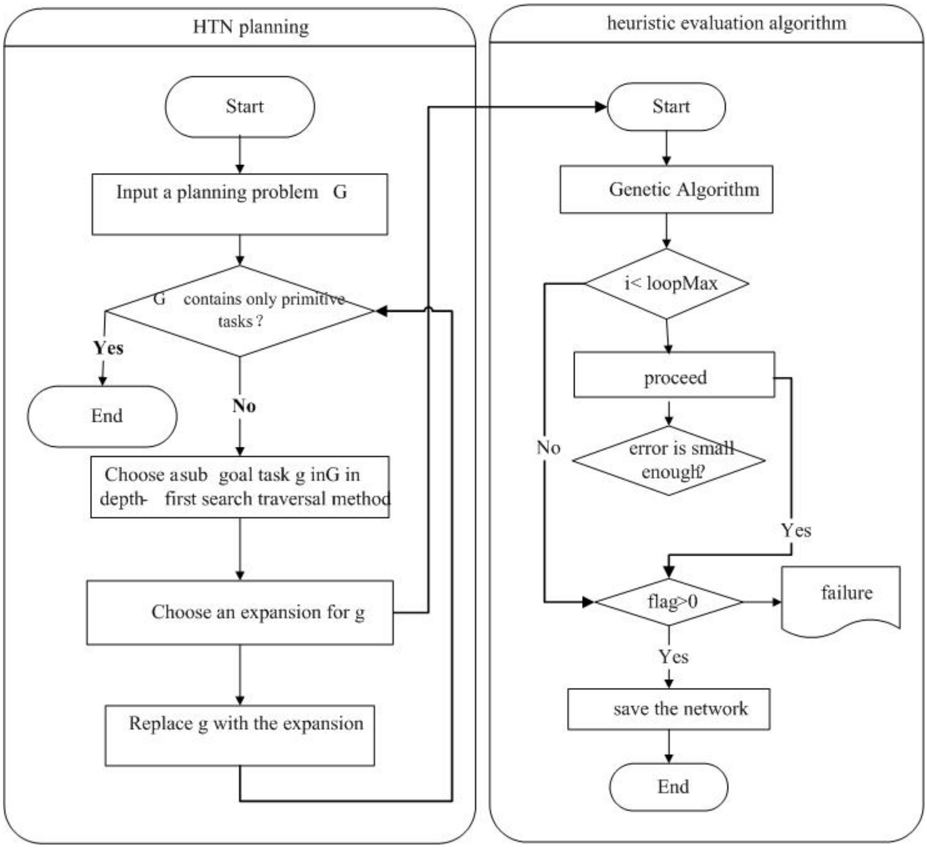

Fig. 3. Heuristic Intelligent Planning Algorithm

Artificial Neural Network algorithm is a kind of human brain simulation of the physical structure. That is to say, it uses computer methods to simulate the human brain from physical structure to make the system intelligent. Among the ANN models, multi-layer feed-forward neural network model is the most widely used model and often be trained by use of back-propagation learning algorithm (BP algorithm for short) . BP algorithm has the advantage of simple and plastic, but the BP algorithm is gradient-based method, which slow the convergence rate, and often affected by the local minima problem. Genetic Algorithm can get out of this predicament.

The following is the description of the heuristic evaluation algorithm:

Step 1: Use Genetic Algorithm to train Artificial Neural Network weights with reasonable cases set up by experts and spread the signal
Step 2: end the training if errors meet the condition and jump to Step 6
Step 3: the training error back-propagation
Step 4: modify network weights based on the results of the error back-propagation and jump to Step 2
Step 5: save the network weight and put it into use

In step1, the Genetic Algorithm was used to train ANN weights. The procedure includes:

Step 1: randomly generate initial population
Step 2: access and sort the initial population
Step 3: cross-operating
Step 4: assess and sort population pairs
Step 5: choose the best stocks of the NUM as a new parent population form Father and Son
Step 6: carry out mutation operation
Step 7: end if meet the training requirements and save the best results, otherwise, jump to Step 3

5 Remarks and Related Works

Heuristic Intelligent Planning we proposed in this paper is based on application-level knowledge .It can be extended to solve the general business problems. Since a Goal has many solutions, it is very important to choose the best one. Heuristic evaluation algorithm helps the user to choose an optimal implementation. Heuristic evaluation algorithm based on Genetic algorithm is a machine learning algorithm. It capture the experience gained during process planning and execution so as to enrich pattern library. And it can reduce the costs of business knowledge.

Pegasus [2, 10] uses heuristic to search for an effective operator of the semi-ordered set in order to convert the current state to the target state. However, its planner and knowledge used for planning are tightly bound to a specific application domain. In our work, explicit knowledge representation (process patterns) is deployed to make workflow planner domain-independent.

The optimization method for process pattern proposed by Zhang Shaohua is based on the artificial neural network. As mentioned above, slow convergence and local minimum is a problem. We use the artificial neural network algorithm optimized by genetic algorithm to get out of this trouble.

6 Conclusion

Compared with process-driven workflow, goal-driven workflow generation based not on proprietary process definition frameworks, but on accepted ideas of how people actually work. And because the AI planning techniques had been integrated with workflow construction, goal-driven workflow generation enhanced the flexibility and adaptability of workflow system.

In this paper, a new workflow modeling method based on the process pattern is proposed to specify a goal-driven workflow correctly. This approach simplifies the logic and verification of the standard model, since process pattern is easier to understand and less complex to build. To avoid the users' intervention, a heuristic intelligent planning algorithm based on AI planning and genetic algorithm is deployed in this paper to generate workflow automatically. It provided a lightweight, efficient and cost-effective way to introduce knowledge into workflow composition.

Our future work will concentrate on the following topics. The first one is to investigate algorithms to refine the undetermined elements during execution. The second one is to investigate re-planning algorithm and trace back method to handle the exception. The last one is to perfect machine learning algorithm to capture the experience gained during process planning and execution so as to enrich domain knowledge.

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Mobile Phones of 3G Era in Small and Medium-Sized Agricultural Production and Application Prospect

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Abstract. The arrival of the era of third-generation (3G) mobile phone will cause earth-shaking changes, as a kind of new communication technologies will play in the fields of estimation. The rapid development of electronic technology and information technology, which had brought about a revolution of control and management of agricultural, mobile 3G era will give the agricultural revolution fueled, and bring a new era of agricultural productivity liberation. Mobile phones of 3G can achieve the real-time monitoring and control of agricultural through automatic control and electronic computer technology and communication technology, but also can get rid of the remote control and regional restrictions. Mobile phones of 3G realize the agricultural field of remote real-time automatic control through video image processing and fast speed of technology.

Keywords: mobile phones of 3G agricultural production automation medium and small enterprises.

1 Introduction

China is a large agricultural country, but the level of agricultural production is still in the hand-cultivation, not to achieve a large area of mechanized mass production situation. It is required a considerable period of time that achieve large-scale mechanized production because of China's economic system and the geographical features. Therefore based on China's national conditions, the development of small-scale automated production should be present a fresh development trend of agricultural production which difficult to implement joint large-scale operation situation because of Contracting by an individual. Our agricultural production may be contracted to individuals which results in a region the land under the area of fragmented, together with mountainous and hilly region, which brings large-scale machinery to some trouble. Combined with China's national conditions and characteristics of China's agricultural production patterns, it is necessary to achieve the implementation of small-scale automated production of Chinese in agricultural machinery automation.

Along with fast development and compact combination of both electronics technology and communication technology ,a person may be have more than a cell phone in average .With entered into an age of 3G, using a mobile phone deal with information is the exception ordinary daily life. Mobile communication terminal as a microprocessor controlled intelligent sensor automatic production mode.

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3G, full name of the third Generation. It enhanced voice and data in transmission speed based on previous data. It can be better in the global seamless roaming, and process images, music, video streaming and other forms of media, provided various services including web browsing, conference calls, e-commerce and other information services. Wireless network can support different data transfer rate, for example at least were 2Mbps (megabits / second), 384kbps (kilobits / second) and 144kbps transmission speed indoor, outdoor, and driving environment. With high-speed 3G network to download opens up a new era of mobile multimedia, mobile phone is bound to be another PC.

As rapid development of electronic information and communication technology, agriculture has been basically achieve modernization and automation. using of 3G mobile phone and electronic information and communications technology to simplify and automatic agricultural control, agricultural production must be brought to the rapid leap. 3G mobile phone technology as the core of the control will adapt to the scale of agricultural production, promote small and medium agricultural production in China, show the extraordinary in all aspects of the function.

2 Automated Irrigation Control

60 years of New China, the Chinese effective irrigation area expanded from 2.4 million hectares to 8.77 million mu, accounting for the world's total 1 / 5, ranking first in the world. China to account for 48% of the irrigated land area, produces 75% of the country's total output of grain and 90% cotton, vegetables and other cash crops. At present the existing embankments, small pumping stations, motor-pumped wells, ponds, cellars and other small-scale water conservancy projects and the independent operation of more than two million, medium-sized irrigation channels to the end of class, small irrigation channels of nearly 3 million kilometers fixed, fixed at about 1.8 million kilometers of irrigation channels , the corresponding supporting structures close to 7 million, countless field projects cover nearly all of irrigated farmland.

Can see from the above data, our small-scale irrigation systems in a dominant position, to achieve small-scale irrigation which automatic irrigate and monitor is essential. As the motor-pumped wells and ponds occupy a vast cellar rate in the small-scale irrigation, Therefore, the establishment of 3G mobile phone system as the core of the automation of irrigation means which is a automation project of easy to be afforded and implemented. It is composed of the core of 3G mobile phone, Sensor data in real-time measurement of the field and the SCM system to accept delivery system consisting of wireless, The system limit the use of fuzzy criteria to achieve the simplification of small and medium irrigation, which meet the educational level of farmers limited. Using of the project to control pump motor starts and stops, irrigation canal gate opening and closing to achieve automatic irrigation of farmland, The function of System are real-time control, real-time data acquisition and preservation, on-site real-time video surveillance capabilities, unmanned operation of the field, which achieve real-time monitoring of the situation but no field operations. That is the advantage of 3G mobile phones has a strong transmission capacity, to ensure real-time agriculture and automation.

3 Livestock Breeding Automation

In order to increase rural incomes, farmers increase the breeding livestock during agricultural production. The problems is Automatic feeding and automatic watering for farmers while agricultural production.

As the farmers economic conditions, small line of automation systems to be a star which build of sensor technology and 3G mobile communications technology, In recent years, with the prices of live pigs and breeding conditions of randomness, greenhouse pig become a new means of building up a fortune. Using 3G mobile phone integrated automation system, monitoring of pigs could be the case anywhere, automatic feeding, automatic watering according to real-time detection of ambient temperature and humidity, to adjust necessary conditions for pig. Automated system for 3G mobile phone adapt to individual small-scale farming in rural China, emancipate the productive forces, which accelerate the income of farmers, meet the basic requirements of the State.

4 Greenhouse Automation

Greenhouse provides a new modern production environment to agriculture, and achieved good economic and social benefits. It can raise the income of countrymen, improve the industrial level and the ability to withstand natural disasters to extend the time for crop growth, increase crop yields, and so on. With the continuous development of the economy develop simultaneously on the greenhouse temperature, humidity, carbon dioxide and other automated monitoring and control has also been a corresponding development, thus improving income. using of electronic and information technology monitoring and control of greenhouse climate change data, such as temperature, humidity, illumination time and intensity, wind direction and wind speed and other factors, then back to the 3G mobile phone, to judge by artificial simple, once again sent through mobile phones order to plant growth requirements under the automatic adjustment. For example the temperature and humidity control. If the temperature is too low or too high, can be furnace heated up or can exhaust or otherwise deal with. If the humidity is too low, you can start the sprinkler system, when the humidity is too high can exhaust fan out of the air humidity is too high. At the same time can be CO2, light, irrigation and other automatic control. According to different crops, different times, 3G mobile phones to set different commands, using different control targets and control modes.

5 Conclusion

3G mobile phone communications technology combined with sensor technology to realize the automation of small and medium agricultural production, reduce labor input to achieve the implementation of the monitoring of real-time control and remote control can be achieved, without geographical restrictions, thereby bringing agricultural labor simplify the automation, improved economic efficiency, reducing labor.

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Research of Dynamic Identification Technology on Cotton Foreign Fibers

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Abstract. Due to the low efficiency, large errors and other practical issues of manual sorting selection method, a new cotton foreign fiber analysis instrument was developed. After fully-smashing by the ginned cotton machine, the uninterrupted uniform cotton layer was formed, and then the image of the flow cotton layer was collected by line scanning camera. Firstly the gray-scale processing is carried on to the original cotton foreign fibers image. Moreover, some other treatment such as adaptive threshold method, filter technique and enhancement processing, are used to complete the image segmentation in order to obtain clear binary image; then hollowed inner point method and neighborhood search method are used to extract the contours in order to obtain the characteristic parameters of foreign fibers. Finally the category identification and weight statistics of foreign fibers is completed based on rough sets theory. It's proved by experiments that the detection speed of this new instrument can achieve 40m/h and the recognition precision of this analyzer can achieve 90%.

Keywords: Foreign fibers; Image processing; Contour extraction; Rough sets.

1 Introduction

Foreign fibers are inevitable in cotton due to the mainly rely on manual picking cotton in China. The foreign fibers in cotton is non-cotton fiber and non-nature color fiber, such as chemical fiber, hair, silk, bast, plastic film, plastic film and chromonema, which are mixing with the cotton and have serious influence on the quality of cotton and its product. Foreign fiber has serious impact on textile products even the quantity is very small. Once the fiber is mixed into cotton fiber, it will not only affect the textile spinning capacity, but also form color spots in dyed fabric which may seriously affect the appearance of the fabric and make a great damage to the cotton textile industry.

Generally two methods are used to check and remove the foreign fibers in the worldwide cotton textile industry. First one is optical inspection, which scans the cotton flow in high speed by CCD (high speed camera) in the panel and the results

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can be obtained through real-time processing the scanned information by the equipment of image processing. Second one is using capacitive sensor and microelectronics technology to measure, test, and check processed cotton layer. Germany, Switzerland and Italy are the leading countries in the field of rejecting foreign fibers, such as the SCFO foreign fiber testing and detaching equipment of Trutzschler, the Cotton Sorter of Loepfe and the Sorter foreign body detecting machine of Loptex. China's equipment manufacturers and research institutes have gradually involved in this area recent years. There come out some products after years of extensive research, such as IE, DG-200OA a foreign cotton detecting facility made by Mingzheng Company in Taiwan and BARCO cotton sort machine of Zhide Company. But both domestic and abroad facilities at present have some limitations like expensive, poor clear up and lack of clarifying and calculating weight foreign fibers, which cannot meet the need of accurate measurement of foreign fiber in the cotton fiber content quality evaluation test, and it is still a blank in this research field.

Based the basis of previous studies, the authors developed an instrument for analyzing foreign fiber in cotton. It provides an effective method for check-and-stat via identifying foreign fiber and calculating its weight·

2 Overall Structure of the Foreign Fiber Identification System Design

The foreign fiber analyzing apparatus mainly included image acquisition system and processing systems. The overall structure of the system is shown in Fig.1.

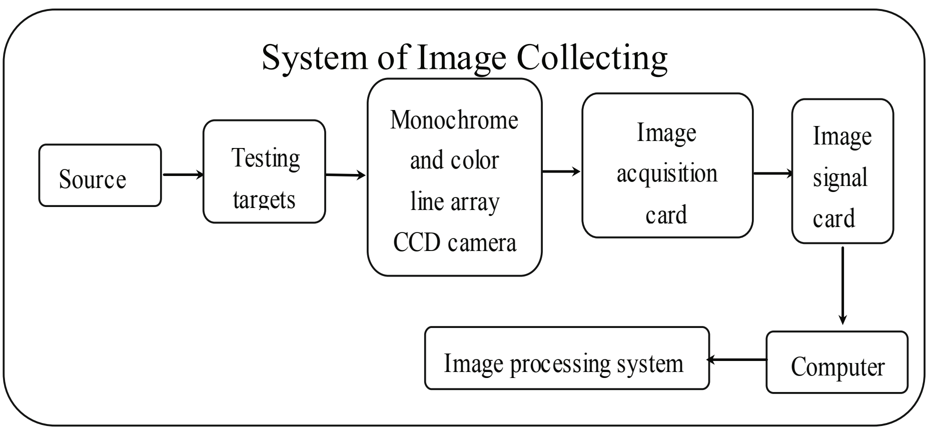


Fig. 1. System structure diagram

Firstly collect the image of foreign fiber in cotton through line scanning CCD under appropriate light source. Secondly segment and filter process the image by DSP (digital signal processing system) system to achieve image binaryzation. Then the lineament of foreign fiber is extracted. At last characteristic parameter of the foreign fiber is anglicized to carry out the classification and calculation of foreign fiber.

3 Image Processing of Cotton Foreign Fiber

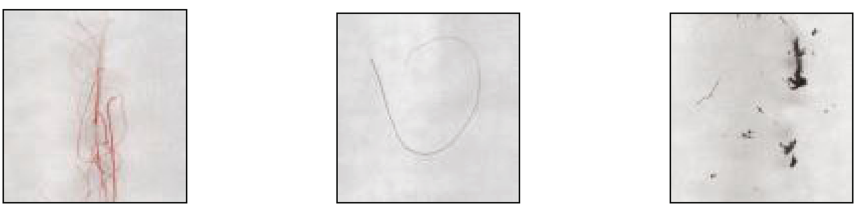
3.1 Experimental Materials

Totally 7 kinds of foreign fibers, each 10 samples were chosen for this study, black plastics cloth (50mg), blue silk (100mg), red silk (100mg), hemp rope (100mg), hair (100mg), red polypropylene fiber silk (50mg) and feather (20mg). Sufficient lint without foreign fiber was prepared in the time of collecting pictures. The cotton was opened sufficiently by lint opener, and continuous uniform cotton layers were formed, then different foreign fibers were mixed in the process of cotton opening. We scanned the flowed cotton layer by linen camera with the testing speed of 40m/h. Shot 300 pieces of 24-bit bitmap images for each sample as the material for testing.

3.2 Image Segmentation Algorithm Based on Mean-Shift

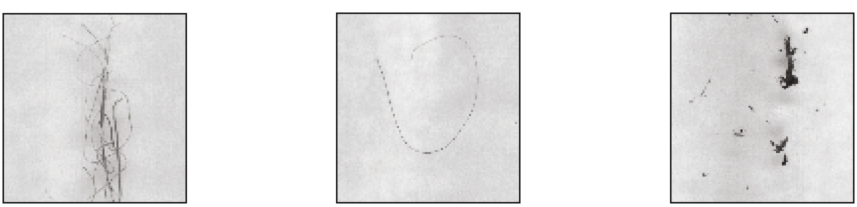
The image segmentation is one of the key elements of image processing and machine vision, and it is a prerequisite for image analysis and pattern recognition. The purpose of image segmentation is to extract the characteristics of the target through dividing the image into meaningful connected region.

In the image processing, the 24-bit bitmap image is converted into 256 grade gray-scale image. Then histogram of gray-scale image is obtained. The image of red polypropylene fiber silk, human hair and black plastic flake are chose as examples of image processing. And its original image, gray image and gray histogram are shown in Fig. 2-4.



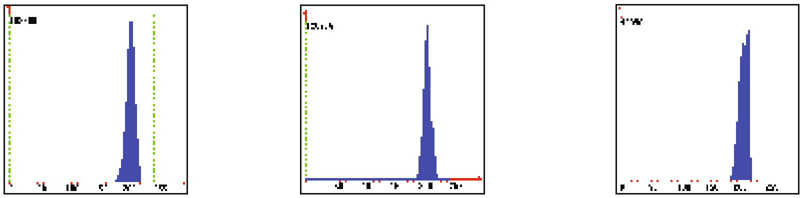
Silk Hair Plastic

Fig. 2. Original image



Silk Hair Plastic

Fig. 3. Gray image



Silk Hair Plastic

Fig. 4. Gray histogram

The gray value of cotton layer fiber and cotton foreign fiber are mixed according to studying on the histogram. And the background of cotton layer fiber takes an absolute advantage in the whole distribution of image pixels, while the foreign fiber image only a minimal part image. The gray value range of cotton background is approximately at 230 - 255 and the gray value of foreign fiber is mostly about 230. The image object segmentation cannot be done by using the traditional threshold segmentation technique. After taking into account of foreign fiber's gray distribution, Mean-shift adaptive threshold segmentation technology is used for image segmentation.

Based on Parzen window method of pattern recognition of estimation of probability density function, Mean-shift process is a method of kernel density estimation. Corresponding to the window function $\varphi(x)$ of Parzen window method， define kernel function $K(x)$：

$$K(x) = C_{k,d} k(\| x \|^2) \tag{1}$$

$C_{k,d}$ is a normalization constant which making integral of $K(x)$ is 1.
Take Gaussian kernel function for example:

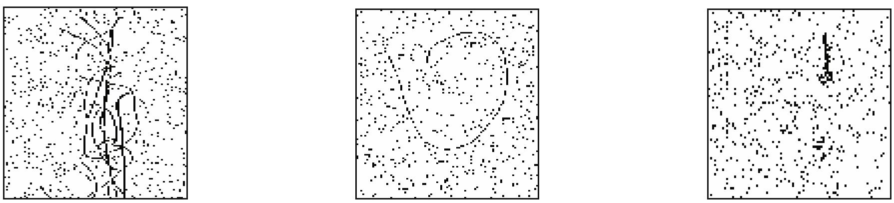
$$K(x) = (2\pi)^{-d/2} \exp\left(-\frac{1}{2} \| x \|^2 \right) \tag{2}$$

Obtain a convergence recursive formula and a Mean shift vector:

$$y_{i+1} = \frac{\sum_{i=1}^{n} x_i g\left(\left\| \frac{x - xi}{h} \right\|^2 \right)}{\sum_{i=1}^{n} g\left(\left\| \frac{x - xi}{h} \right\|^2 \right)} \tag{3}$$

$$m_{h,G} = \frac{\sum_{i=1}^{n} x_i g\left(\left\|\frac{x - xi}{h}\right\|^2\right)}{\sum_{i=1}^{n} g\left(\left\|\frac{x - xi}{h}\right\|^2\right)} - x = y_{i+1} - y_i \tag{4}$$

Image processing results by using Mean shift technology are shown in Fig.5.

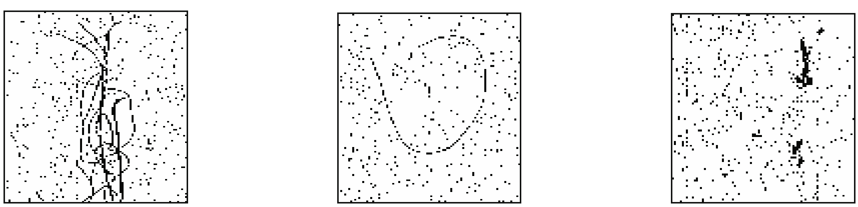


Silk Hair Plastic

Fig. 5. Effort image

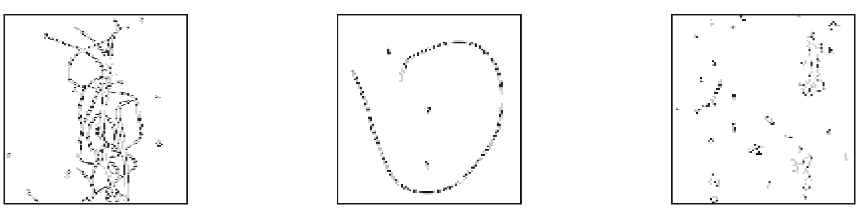
3.3 Contour Extraction

It has some salt-pepper noise after image segmentationof original image. After practice test the image need twice a 7 × 7 median filter processing, resulted a clear binary image. The effects of binary are show in fig.6. Based on the binary image, all contour profiles are extracted by the method of tunneling internal points. Contour extraction image are showing in fig.7.



Silk Hair Plastic

Fig. 6. Binary image



Silk Hair Plastic

Fig. 7. Effort image

After all contours of foreign fibers are extracted, extract every object contour of foreign fiber by the method of 8-neighborhood search. And the object contour images are showing in fig.8-10.

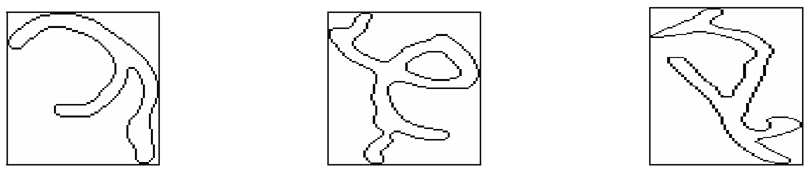


Fig. 8. Object contour image of the red polypropylene silk

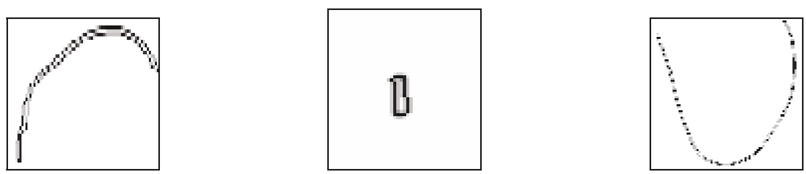


Fig. 9. Object contour image of the hair

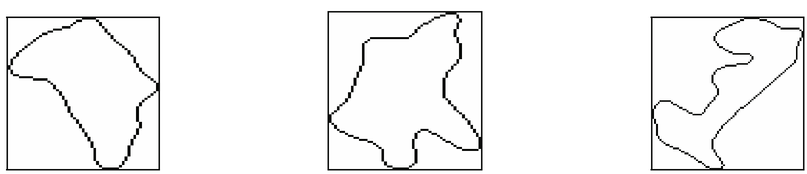


Fig. 10. Object contour image of the black plastic piece

4 Cotton Foreign Fiber Taxonomy Based on Rough Set Theory

The purpose of rough set theory is dividing the currently studied domain according to currently available knowledge about it and determining each domain's level of support to some concept. The basic rough set theory includes two aspects, namely knowledge express method and Rough Reduction Method.

4.1 Knowledge Expresses Method of Rough Set Theory of Foreign Fibers

Knowledge based on rough set theory is mainly expressed by means of information table, an effective knowledge express system. The information table summarizes the characteristics of the studied objects, which including specified object's characteristics and the corresponding eigen values. The table derived from the contour image of cotton foreign fiber of taking one sample of each kind of foreign material is listed as belows.

Table 1. Knowledge table of foreign fiber

Sample of foreign fibers	Hair	Hemp rope	Feather	Red polypropy-lene fiber silk	Blue silk	Red silk	Black plastics cloth
Contour moment	0.020	0.115	0.075	0.075	0.098	0.101	0.168
Appearance ratio	2.921	3.987	5.635	3.489	5.980	3.370	4.509
Duty ratio	0.060	0.189	0.158	0.456	0.198	0.175	0.780
Similar circle degree	386	296	153	226	257	248	16
Red channel mean	204	195	121	214	203	205	208
Green channel mean	206	207	116	207	222	226	224
Blue channel mean	192	203	98	198	225	227	226
Corner mean	16	27	24	32	39	28	36

4.2 Rough Sets Reduction Theory of Foreign Fibers

The Knowledge tables of foreign fibers after reduction process treatment, removing the corner property, corner detection are low-level image processing methods, as the complexity of different fiber image, the average of corner point can not be classified as an effective feature, so the corner mean column is removed. Contour moment, appearance ratio, duty cycle, similar circle degree and RGB (red, green and blue channel mean) attributes column are kept. Since contours of torque directly relevant to the area and perimeter, they are used as the first layer classification criteria and classify the foreign fibers into silk classes, strip classes and film classes. Appearance ratio reflects the rectangular outline of the target contours, duty cycle to reflect the substantial degree of the target area, and similar circle degree may reflect the roundness of the target circle， these three features are used as the second layer of classification criteria. Because mean RGB is the color information of the foreign fibers, which could not been used for classification in the global properties, but it could be used as local classification, and it can only be used as a low-attributes classify parameter.

5 Experimental Analyses

5.1 The First Layer of Classification

With hair, polypropylene fiber, polypropylene fiber, hemp rope, colored lines, feathers, cloth, tape and plastic film 8 kinds of different fibers as a research object, total 64 contour samples were used for further analysis. The results of distribution of foreign fibers torque profile are shown in fig.11.

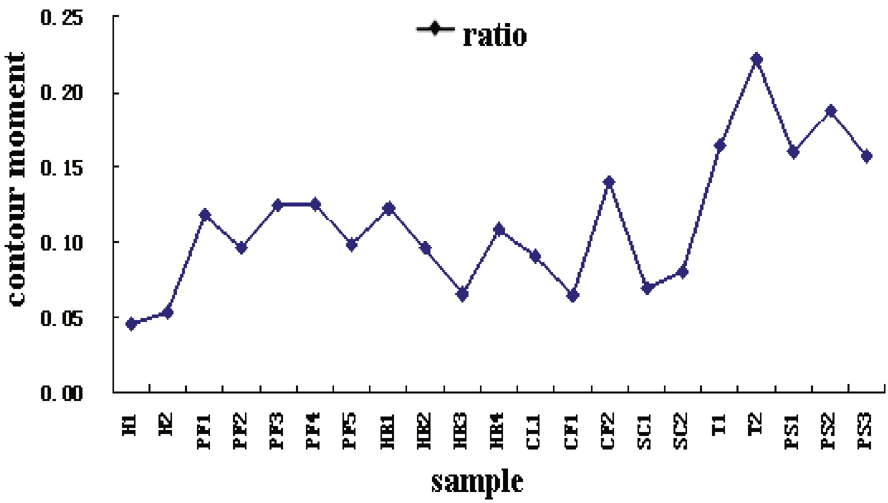
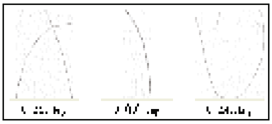


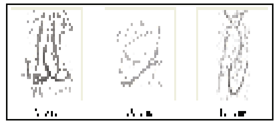
Fig. 11. The distribution map of contour moment. H: hair. PF: polypropylene fiber. HR: hemp rope. CL: colored lines. CF: chicken feathers . SC: strips of cloth. T: tape. PS: plastic sheet.

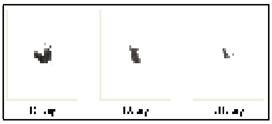
From the figure we can see that: 1) the contour moment of hair is found in between 0.04-0.06; 2) the contour moment of polypropylene fiber, hemp, colored lines, feathers, and strips of cloth are distributed between 0.06-0.15; 3) tape and plastic film moments are located between 0.15-0.225; and 4) There is a clear trend that the plot has three-step distribution, which is corresponded to silk class, sheet class and film class .The results are showed that by using contour moment as the first layer of classification standards, foreign fiber could be identified into silk class, sheet class or film class, and the accuracy can reach 96%.

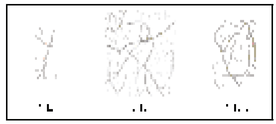
5.2 The Second Layer of Classification

For the stripes of blue silk, red silk, hemp rope, feathers and red polypropylene, they can be effectively identified by using features like the appearance ratio, duty cycle, roundness and RGB from the information table The foreign fiber classification results as shown in Figure 12, the individual who can not be identified is classified as other classes. 50 target images from each foreign fiber samples were used to do precision test, classification precision of test results as shown in table 2, and recognition rate is over 90%.

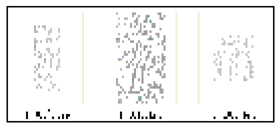

(1) Hair

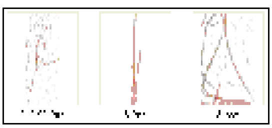

(2) Feather


(3) Black plastic sheet


(4) Hemp rope


（5） Red Silk


(6) Blue silk


(7) Red polypropylene fiber

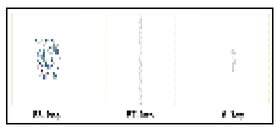

(8) Others

Fig. 12. Classification results of foreign fibers

Table 2. Accuracy test result

Foreign fiber samples	The actual number	The Identify number	Recognition rate (%)
Hair	50	50	100
Hemp rope	50	48	95. 3
Feather	50	46	92. 5
Red polypropylene	50	45	90
Red Silk	50	48	95
Blue silk	50	47	94
Black plastic sheet	50	48	96. 3

5.3 The Building of Weight Statistical Model

Based on the known weight and groups of foreign fibers, about 20000 images were processed, and the foreign different fiber areas were collected Then the largest samples and the minimum sample were removed and valid samples were selected. The average weights of each foreign fiber in unit area were calculated and results as shown in Table 3.

Table 3. Average weight per unit area

Foreign fiber samples	Average weight per unit area(mg/mm^2)
Hair	4.005
Hemp rope	6.006
Feather	1.652
Red polypropylene	2.351
Red Silk	0.735
Blue silk	1.175
Black plastic sheet	5.166

6 Conclusions

A cotton foreign fiber analyzer was developed in this research and seven kinds of foreign fibers were chosen as the study material and this research completes the category identification and weight statistics of foreign fibers based on rough sets theory.

Firstly the framework of foreign fiber identification system was designed and images of foreign fiber were collected. Then the algorithm of foreign fiber image was designed and then characteristic parameters of foreign fibers were extracted. By using rough sets theory, the category identification and weight statistics of foreign fibers was completed. It's proved by experiments that the detection speed of this analyzer can achieve 40m/h and the recognition precision of this analyzer can achieve 90%.

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Research on Acquisition Methods of High-Precision DEM for Distributed Hydrological Model

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Abstract. Compared with the traditional lumped hydrological models, distributed hydrological model, considering the effects of the uneven spatial distribution of watershed land surface on the hydrological cycle, has the characteristic of physical mechanism. Seeing from overall structure, there are two types of distributed hydrological model, which are runoff and convergence. The establishment of convergence network is on the basis of calculating reservoir routing convergence, at present, converged networks are constructed on the grounds of DEM, the resolution of DEM directly affects the result of convergence network construction, for now, due to confidentiality rules, it is very difficult to obtain high-resolution DEM. With the development of GIS and RS, it is more convenient to acquire data from distributed hydrological model, which has been developing rapidly. SRTM is completed by the National Aeronautics and Space Administration (NASA), National Image Mapping Agency (NIMA) and the German and Italian space agencies. The current publicly available data resolution is 3 arc seconds (1 / 1200 of longitude and latitude), and its length is equivalent to 90 meters. The publication of this data set is an important breakthrough in geographical science and application, which has important application value. However, because of the limitations on using radar technology to obtain surface elevation data, there are many problems in the original SRTM DEM data, such as missing more regional data, existing many abnormal points, and so on. This article, which takes Xue Ye reservoir area as example, studies the methods of processing SRTM data and obtained high-resolution DEM data of the region.

1 Problems Proposed

Distributed hydrological model are applied widely because it can comprehensively consider variety of factors such as the vegetation of watershed, soil, terrain impact on hydrological processes, and spatial difference existing in these elements can more accurately reflect the factual hydrological movement. DEM (Digital Elevation Model) is the basis for establishing a distributed hydrological model, and we can extract some basic information required on modeling such as river network, slope, aspect and catchment area based on DEM. Extracting accuracy depends on the quality of data and extraction algorithms, in particular the quality of data impacts on the results greatly. If the quality of DEM data itself is not high, then no matter how perfect algorithm is, it is difficult to obtain satisfactory results. Therefore, it is the current problem to be solved acquiring DEM data of higher quality which makes it more practical.

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Despite of obtaining some higher results on investigating the topographic map, currently, it is still hard for the general user to obtain terrain map data of high precision for various reasons. Although we can obtain High-resolution DEM data in the specific region by using field measurements or other ways, the cost is very high by these ways. In addition, there are a lot of methods and means to access the DEM data for many researchers, however, DEM data sources which we can get are relatively scarce in the actual process of research. For these reasons, it is significant to promote study on distributed hydrological modeling technology and digital hydrology how to gain high-resolution DEM data in large areas relatively easily. In recent years, the development of spatial remote sensing technology provided a golden opportunity for the resolution to this issue, and SRTM (Shuttle Radar Topography Mission) mission generates high-resolution DEM data of most regions of the world by radar interference. The release of data is so important that the hydrological study can make the public acquire DEM data of a resolution of 3 arc-seconds for free.

2 SRTM Data Sources and Problems

2.1 SRTM Data Sources

SRTM is completed by the National Aeronautics and Space Administration (NASA), National Image Mapping Agency (NIMA) and the German and Italian space agencies, and it gets three dimensional radar data whose data amount is up to 12TB and which covers 80% area of the land surface from 60 ° north latitude to south latitude 56 ° on the surface of the Earth, through global operations of nearly 10 days by the imaging INSAR loaded in the "Endeavour" Space Shuttle, and then generates high-precision DEM of 30m resolution by dealing with received radar signal. SRTM is the world's first high-resolution elevation model, the current available data resolution in public is 3 arc seconds (1 / 1200 of longitude and latitude), and its length is equivalent to 90 meters. The publication of this data set is an important breakthrough in geographical science and application, which also has important application value.

The products of SRTM digital elevation includes DEM data of three different resolutions: The coverage area of SRTM1 only includes the continental United States, and the spatial resolution is 1 arc seconds; The date of SRTM3 covers the whole world, and the spatial solution is 3 arc seconds; The date of SRTM30 also covers the whole world, and the spatial solution is 30 arc seconds. The distribution of SRTM data goes by the agreement between NASA and NIMA, but the full resolution data (spatial resolution of 1 arc sec) outside the United States are controlled by the NIMA, and NASA can only provide the public with the date of a resolution of 3 arc seconds (equivalent to 90m).

Obtained SRTM data now include two kinds of quality data, which is "Research" level and "Finished" data. Because of the limitations on using radar technology to obtain surface elevation data, there are many problems in the original SRTM DEM data, such as missing more regional data, existing many abnormal points, and so on, NGA does a certain amount of post processing on the SRTM data produced by JPL to be "Finished"

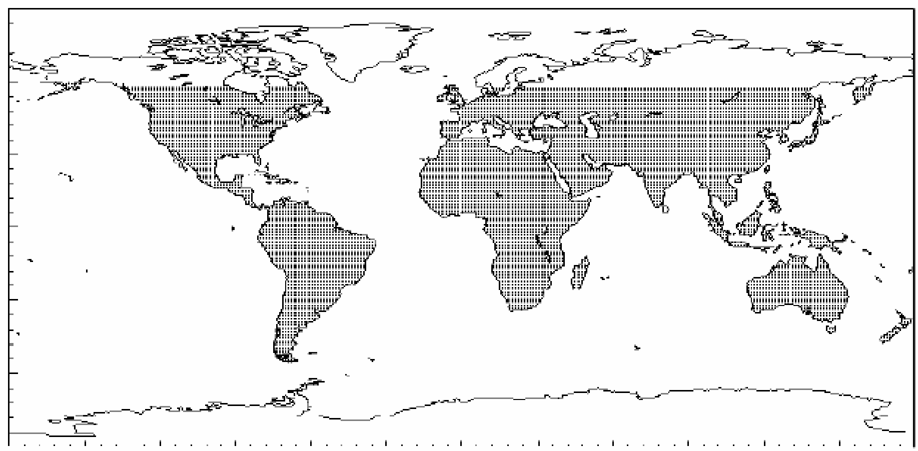

Fig. 1. Schematic Diagram of SRTM Data Coverage

version of the data. In the processing procedure, they have eliminated the data outliers different from the surrounding elevation up to 100m, set the sea level elevation to 0, set the lake elevation to a constant, and treated on the rivers and islands correspondingly, besides, they also have dealt with pixel of data elements on the edge to ensure the accuracy of the data mosaic, and filled non-data area less than 16 consecutive data points through interpolation methods. Compared with the original SRTM data, processed SRTM data has been greatly improved in the data quality, and studies show that the accuracy of terrain elevation fully meets or even exceeds regulatory requirements (vertical accuracy less than 16 m, horizontal accuracy less than 20 meters).

Judging from the current study situation, SRTM data have attracted wide attention, and many researchers have successfully applied the SRTM-related research in the field related[1][2], while for the SRTM data they focused on the following two aspects in their research: Firstly, although there are data validation results showing that the SRTM data are of very high precision, for lack of time to acquire data, they still need to do further in-depth study on the SRTM data quality and the influence for analysis results on some practical problems in more of the region, which has been the key issue of study on SRTM data in recent years[3][4][5][6]; secondly, though non-data area less than 16 consecutive data points are filled with interpolation methods in the "Finished" version of the SRTM data, because there is no better processing way for some larger invalid data region, they still remains in data sets, which is undoubtedly a major obstacle in SRTM data applications. How to fill the no-data-area? It is an important research question of studying on the SRTM data, which has aroused the concern of many scholars at home and abroad [7][8][9].

2.2 Major Problems of SRTM

SRTM digital terrain data is the best current situation, highest resolution global digital terrain Data so far. However, there are also several deficiencies of SRTM [10]:

(1) There are so many "invalid" area of SRTM. In the waters, high mountains and the gorge, the quality of SRTM-3 data is poor, there are vacant spots and blank areas often in small pieces of data in these areas. In addition, there are many lands of poor confidence level, where are mainly in the larger waters, or in the ups and downs, in the very narrow, deep valleys and marginal area of high mountain areas in the above-mentioned data area. These are mainly because of quality problems caused by the radar echo. According to research, data volume of these areas is 0.23% of total data SRTM-3. The study area of distributed hydrological model have a considerable number of this region, therefore, how to process "invalid" area, is the key issue that SRTM data should be applied in distributed hydrological model and the outcome directly affects the accuracy of hydrological simulation.

(2) SRTM-3 data set is a digital surface elevation model (DSM), such as tree tops, roof, etc., instead of a digital elevation model of the ground. So the difference between SRTM-3 in some areas and the actual DTM is often not an accidental error, but a systematic bias related with the characters of ground features in the regions. Therefore, in the dense forest vegetation area and Residential area, DSM of SRTM-3 minus real DTM is positive; while in the snow-covered area, and radar beam of SRTM has a certain ability to penetrate, then DSM of SRTM-3 minus the actual DSM is presented as negative (the other explanation for negative: the real DTM relative to the DSM of SRTM-3, the former was much earlier for the time of getting the elevation data, as global is getting warming and the ice layer is getting melting, the snow height of the SRTM-3 shows as negative growth).

In fact, at present, many scholars have carried out substantive research on the second aspect of the problem and have obtained a satisfactory conclusion. For the settlement in "invalid" area, although a number of ways processing these invalid data regions are made [11], the processing methods for the SRTM data applied in distributed hydrological model are relatively small.

3 Methods of Processing Data

3.1 Analysis of Invalid Regional Data

To analyze the apply effects of SRTM in distributed hydrological model, the following takes Xue Ye reservoir area in Lai Wu City, Shandong Province and its surrounding areas for example as a test to verify the quality of the SRTM data. Xue Ye reservoir is a large reservoir, with control drainage area of 444 square km, total reservoir storage capacity of 221 million cubic meters, useful storage capacity of 112 million cubic meters, dead reservoir capacity of 2.8 million cubic meters. The position of Xue Ye reservoir is shown in Figure 2. SRTM data adopted as the data of the "Finished" version are downloaded from http://datamirror.csdb.cn/, and corresponding processing are done with the raw data after download by Arc / Info software, we obtain DEM data with a spatial resolution of the 90m, UTM projection of finally. In addition, the resolution of DEM purchased from the center of geographic information in Shandong Province is 25m. The whole study area is 14, and per one is of 742 lines site and 749 columns in total.

Figure 3 is a schematic diagram of the SRTM data in the study area, in which white patches show the invalid data regions. Statistics show that, because of the characteristics of using radar technology to produce DEM date, the distribution of invalid data area are closely related with terrain, which is mainly in the high mountains of complex

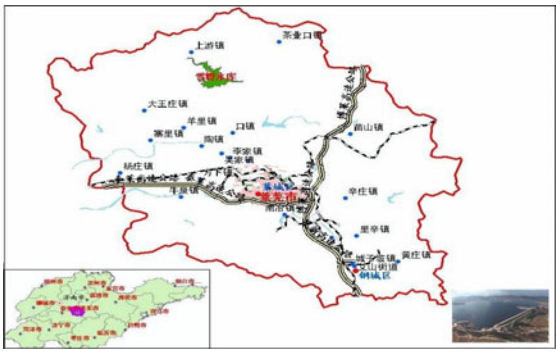

Fig. 2. Schematic Drawing of Xue Ye Reservoir Position

Fig. 3. The Location of Study Area and SRTM Data, White Areas Indicating Invalid Data Region

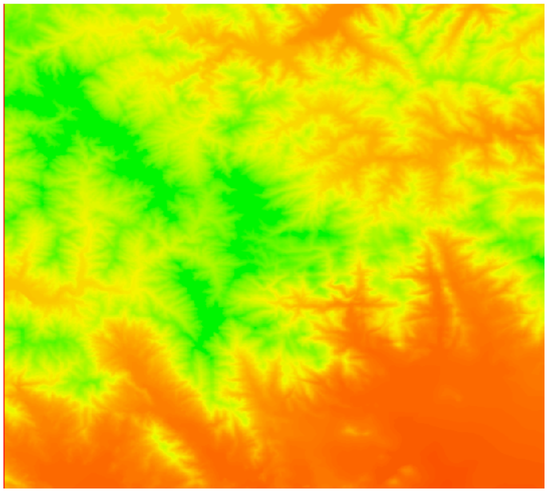

Fig. 4. DEM of 25m Resolution

terrain, valleys region and the flat region in the large lakes or water bodies [12]. For hydrology studies, there probably is more complex terrain condition in the upstream region of many basins, and thus there are more no-data-regions.

The study area belongs to the above situation, with the study area of complex terrain. Seen from Figure 3, the distribution of the invalid region is relatively regular, most of the invalid regions are distributed on the regions of the large gradient, that is, river distribution along the valley leads to channel discontinuity. Obviously for the hydrology study, these no-data-regions cause great inconvenience for practical application of SRTM data, which needs to be processed. Ways to deal with Invalid region will later be introduced in detail, following in the first compares the SRTM data and 25mDEM. From the figures we can see the two kinds of data reflect the same characteristics of terrain, but large differences are still existed between the two on the level of detail for reflecting the terrain. In contrast, Figure 4 appears smoother than the SRTM data, while SRTM data can reflect more topographic details than the DEM data.

From the above we can see, SRTM data has a high accuracy itself. Compared with adopted DEM data of 25m resolution, SRTM date can reflect more topographic details, but there are still some systematic errors in the SRTM data for needing more careful analysis and processing.

In general, filling methods of the invalid regions of SRTM date is divided into three types: a. Filled with correspondent other high-resolution DEM data directly; b. Filled by spatial interpolation methods; c. filled under other supplementary data sources (such as the global digital elevation model GTOPO30). In contrast, the last two methods are applied in a wide range, however the data used to populate is not "real" elevation values, but calculated by interpolation, so the accuracy is somewhat limited; More accurate results are obtained in the first way, but in practice it is difficult to obtain the correspondent high-resolution data, and ASTER [13] data provides an golden opportunity to solve the problem.

3.2 Data Processed Based on ASTER

ASTER (Advanced Space bone Thermal Emission and Reflection Radiometer) is a high-resolution satellite imaging device released cooperatively by NASA and METI, launched carrying EOS- AM1 (Terra) platform of NASA in December 1999. Compared with other optical remote sensing system, ASTER has an important characteristic that it can also access images using subsystem of ASTER VNIR, accordingly it can get the three-dimensional relative data of 3N and 3B used to generate the DEM products.

The absolute and relative DEM data whose spatial resolution is 30m can be produced by the ASTER stereo relative data, and the production of the absolute DEM data need GCP (Ground Control Point), while the production of the relative DEM data don't need GCP. In practical application process, the users can produce their own DEM data using ASTER data and related software directly, and they can also present the production request of ASTER DEM or download archived DEM data through requested System of the NASA (http://edcimswww.cr.usgs.gov/pub/imswelcome). As the production of absolute DEM data needs users provide considerable numbers of ground control points data, while control data is relatively difficult to be available, ASTER DEM data available for download are is a relative DEM data in the majority so far. The following discusses the method of filling SRTM invalid region data with ASTER relative DEM data.

Before filling SRTM invalid data area with ASTER data, we first download archived ASTER data of study area or present the request of producing date through date requested System of the NASA. Figure 6 shows part of the data downloaded. Seen from the chart, due to the impact of clouds and shadows, there are invalid data region in the DEM data generated by ASTER. However, because the generation of these invalid regions and the generation of SRTM void areas are for different reasons, and ASTER data can be repeatedly observed in the same area, as long as enough data are acquired, ASTER data can get all the elevation data of the invalid regional location for SRTM data.

Found in practical work, ASTER relative DEM data often appear coordinate offset, the offset can reach hundreds of meters, so before filling SRTM invalid region data with ASTER Data, we first have carried on the working of registration, registering ASTER data to the SRTM data. Integer grid shift in the x, y two directions of ASTER data is considered in this study, registering image by calculating the spatial correlation of the two kinds of DEM datum. As There are different spatial resolution between the ASTER data and SRTM data (ASTER to 30m, while the SRTM to 90m), after moving a grid position (30m) of ASTER data each time, when calculating the spatial correlation coefficient between the two DEM data, the ASTER data have to resample, to be converted to the same spatial resolution (90m) as SRTM data.

In the calculation process, ASTER datum of the entire track are not registered, but were calculated respectively (specific methods are described below) when constructing buffer area under the SRTM invalid data. The calculation results show that the two kinds of DEM datum are with high correlation, maximum correlation of 0.991, minimum 0.913, while the coordinates offset of ASTER date the maximum is the 270m for X direction, 360m for Y direction.

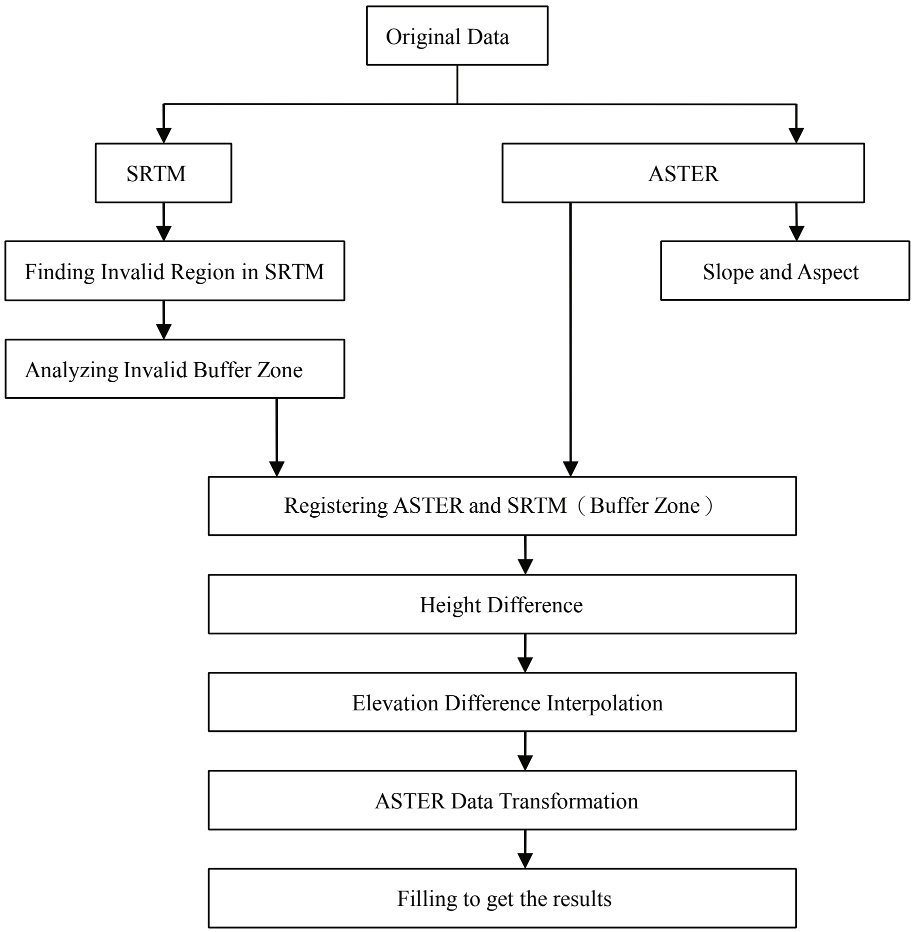

Fig. 5. Flow Chart of Filling SRTM Invalid Region Data with ASTER Relative DEM Data

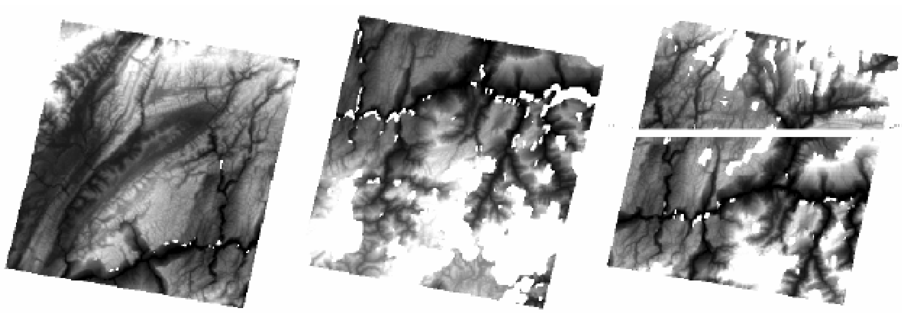

Fig. 6. Part of Original ASTER DEM Data Downloaded (Void data area for the white areas)

After registration from the ASTER data to the SRTM data, the filling date work can be carried on the next. As the adopted ASTER data is the relative elevation value, and the DEM data obtained by using different data sources usually have different characteristics, ASTER data elevation values need a certain transform before filling. Commonly used method is to establish the statistical regression equation between two DEM elevation data firstly, and then after transforming filled data (ASTER) using the regression equation to conform to the characteristics of the data (SRTM) filled with, to fill the deletion region of the original data, at the same time in order to avoid existing apparent phenomenon of discontinuous date on the edge of the data missing area, usually after filling fill boundary need smoothing.

The above-mentioned method has been realized by a lot of software, also gets good results. However, when transforming filled date by the method, not making full use of spatial information of the two kinds of datum, and so as to ensure the smoothness of the edge, missing regional elevation values of original data have been changed. In response to the above-mentioned problems, this paper presents a filled method based on DEM data elevation errors for spatial analysis.

Assumed that H^1 means the original elevation data needing filling (SRTM), H^2 is the data used to populate missing region of original data (ASTER). In general, because it is different for accessing time, treatment method, data features and so on, there are large differences between the two kinds of datum. Using filled data directly to replace the missing data region in the original data will bring bigger error, then firstly filled data must be processed. Therefore, the key issue needed solving is how to transform filled data, making the transformed elevation data more in line with the characteristics of the original data.

The relations between original data and filled data can be simply expressed as:

$$e_{(i,j)} = H^2_{(i,j)} - H^1_{(i,j)} \tag{3-1}$$

$$H'^2_{(i,j)} = H^2_{(i,j)} + e_{(i,j)} \tag{3-2}$$

In the formulas, $H^1_{(i,j)}$ indicates the original data elevation in the location (i,j), $H^2_{(i,j)}$ indicates elevation value of the filled data in the location (i,j), $H'^2_{(i,j)}$ indicates elevation value of transformed filled data in the location (i,j), $e_{(i,j)}$ indicates the value of elevation difference between the two kinds of datum in the location (i,j). Obviously in the location of the original data and the filled data both existing elevation data, we can get the state distribution of $e_{(i,j)}$, while in the area of the original data existing the missing data, there is no way to get $e_{(i,j)}$. Analyzing the problem from another point of view, if we can obtain distribution state of error $e_{(i,j)}$ between the two kinds of data in the data deleted regions, we can transform filled data using the relations (3-2), accordingly eliminating the differences between the two kinds of data.

In order to eliminate the elevation difference between H^1 and H^2, the traditional method first makes statistics of elevation values corresponding to the two kinds of elevations, establishing the statistical regression equation between two kinds of elevation data, and then transforms on filled data in the case of the smallest root mean square error. Obviously, during the time of the above-mentioned transformation, it doesn't take space distribution of data difference into account to do the same transformation on elevation values of all filled data, however in fact, the variation between the two kinds of data are not the same in any spatial location, but with the geographic location. Traditional statistical regression methods does not take the characteristics of this space into account, so after transformation the edges of missing data region must also be smoothed to avoid the discontinuity of the elevation, which will affect the transformation accuracy. In fact, due to the characteristics of DEM data itself, there are often some spatial distribution features in this elevation differences between the two kinds of data (such as elevation differences between SRTM and TOPDEM have a greater correlation with slope and aspect), Considering the relevance of space on this elevation difference would undoubtedly improve the accuracy of elevation change. Therefore, the task of filling the data changes into the work of analyzing the spatial characteristics of data error, that is, how to use the information contained in two sets of DEM data (raw data and interpolated data) to estimate the space differences between the two sets of data in missing-data-region. If you can accurately estimate error spatial distribution in the missing-data-region of the DEM data, it is easy to get the actual data of H^2 from formula (3-2).

In order to obtain spatial distribution of elevation differences in missing-data-regions, a simple method is to carry on the spatial interpolation of elevation differences on the missing region of original data through the spatial interpolation method, using the known elevation differences. Meanwhile because of the characteristics of DEM data itself, DEM data error usually has greater relevance with other topographic parameters such as elevation, slope, aspect, and so on. Therefore, this paper makes the spatial interpolation on elevation differences between two sets of data, on selecting the slope and aspect as the two auxiliary factors, and using CoKriging interpolation method finally.

4 Experimental Result and Analysis

Adopting the above-mentioned method of data fusion to fill void-data-area in the SRTM data of Xue Ye reservoir, figure 7 for the final processing results:

For making quantitative analysis on the effectiveness of the above-mentioned methods in development, we have carried out on the flood simulation in Xue Ye Reservoir through extracting river network and a series of processes. Table 1 shows the tables of simulation results under different resolutions of DEM. Table 1 is with DEM data of two different resolutions for 25m, 90m inputs.

Overall, despite on all indicators of the deterministic coefficient, the relative error of peak discharge, the relative error of runoff, the time difference between current peaks and so on, the simulated results for indicators of 90m resolutions are significantly lower

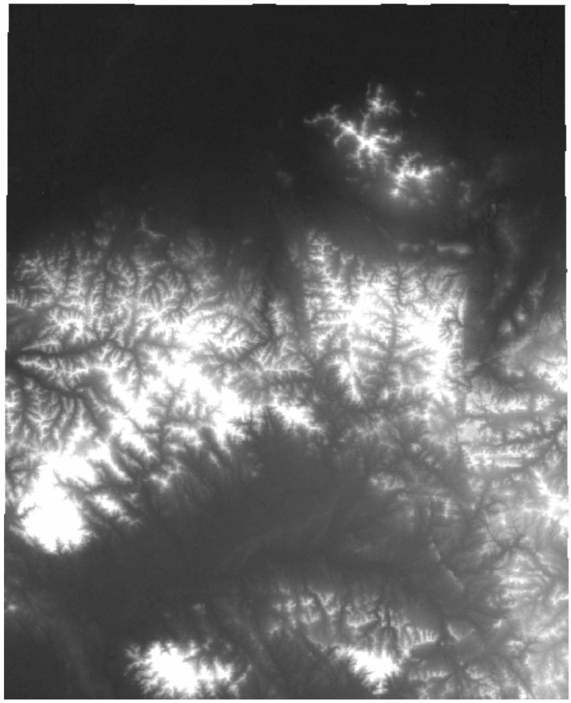

Fig. 7. Final Processing Results of SRTM in Xue Ye Reservoir

Table 1. Comparison of results in Flood Simulation

Number of Flood	Deterministic Coefficient		The Relative Error of Peak Discharge (%)		The Relative Error of Runoff (%)		time difference between current peaks	
	25m	90m	25m	90m	25m	90m	25m	90m
20040615	0.86	0.81	-9.66	-11.53	9.47	11.53	-2	-2
20060730	0.89	0.67	9.20	14.88	4.04	9.47	-2	-2
20080815	0.82	0.73	11.26	-13.76	2.34	6.6	-2	-3
20020831	0.91	0.85	12.81	16.22	-2.6	5.75	1	1
20040815	0.94	0.83	14.35	18.86	4.75	8.3	-2	-4
20050804	0.85	0.78	-7.9	13.12	4.6	8.61	1	1
20060729	0.94	0.77	-10.4	19.6	14.49	23.23	2	2
20070818	0.86	0.80	-10.01	18.24	3.44	11.05	-2	-2

than the 25m resolutions, a majority of deterministic coefficients are higher than 75%, runoff errors are also less than required 20% in the state flood control except 20060729, reaching the forecast levels of B, which can be applied in the actual forecast.

5 Discussion

The development of distributed hydrological model not only requires the support of the hydrological physical mechanism in unit, but also needs the support from a lot of watershed spatial data. Current distributed hydrological models developed at home and abroad are all based on digital elevation model (DEM), combining the hydrological physical model or a conceptual model with geographic information system (GIS) to extract a number of important hydrological characteristic parameter information in basin, such as slope, aspect, department of drift-net grid, watershed borders. With the rapid development of computer technology, DEM will be more widely applied in hydrological sciences, and also create the necessary preconditions for the development of distributed hydrological model.

From the above analysis we can see that SRTM DEM data downloaded freely is with a high data accuracy now, although there are still some systematic errors in the data, and existing invalid data area is an obstruction of the data collection applying in hydrology, we present filling algorithm of SRTM invalid data region, namely filling method of using high-resolution ASTER data and basing on spatial analysis of elevation error. Analysis shows that the height values obtained by this method filled are with high accuracy, and the extracted digital river network is also more consistent with the actual river network, which can meet the requirements of the follow-up study.

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Research on Image Classification Algorithm Based on Artificial Immune Learning

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Abstract. On the basis of analyzing immune learning mechanism, by modeling for image classification, we can solve the problem of remote sensing image classification by using the basic principles of the use of immune learning. We have realized a classification algorithm with a function of the immune learning. Classification algorithm divides each major category into a number of small categories and the antigen population evolutionary process of each category is considered separately, therefore the convergence time is greatly decreased. When classifying, we use a variety of different ways to discriminate and introduce artificial priori knowledge to improve the classification accuracy. The results show that the algorithm can be well applied in remote sensing image classification.

Keywords: Image Classification, Artificial Immune Learning, Remote Sensing.

1 Introduction

Classification is the primary means of using remote sensing images [1]. Traditional non-supervised classification approach requires adequate ground information to iterate which often be hindered classified or without high classification accuracy as lacking of enough calibration information. As the traditional supervised classification methods always consider too much about the local characteristics, it is easy to fall into local optimum but difficult to obtain high precision requirements [2,3].

Immune learning is an important characteristic of the immune system. When the immune system meets a certain antigen at the first time, the system will adjust its composition and structure to identify the antigen better [4,5]. The optimal antibody will be saved as memory after identified [6]. When the immune system meets the same or similar antigen again, the speed of the identification to it will be faster and the accuracy will be higher as the system already has the memory of it [7].

If we regard the surface feature to be classified as antigen and the characteristics of corresponding surface feature as antibody, we can achieve a supervised classification algorithm used for remote sensing images based on the immune learning mechanism of artificial immune system to improve the computation speed and classification accuracy [8-10].

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2 Modeling of Remote Sensing Image Classification

2.1 Description of the Problem

It supposes that the images to be classified have b bands totally and a class of surface feature in a certain band has only one range of gray value. For the class c, we use li and hi to express the lower bounds and upper bounds on its gray value, then its center mi is:

$$m_i = l_i + \frac{(h_i - l_i)}{2} = \frac{(h_i + l_i)}{2} \tag{1}$$

Definition 1: Class center feature vector. The vector formed in the center of all the bands by a certain class is called the class center feature vector.

$$m=(m_1,m_2,\ldots,m_b)^T \tag{2}$$

We use ri to represent the corresponding allowable error radius of band I. The value of ri is |hi-li|/2. If all the bands' errors are organized in order, it will form an effective radius vector as definition 2. Actually, this vector is the maximum permissible error of this class in every band.

Definition 2: The effective radius vector. For a category, the vector composed by the maximum permissible error vector in each band is called the effective radius vector:

$$r=(r_1,r_2,\ldots,r_b)^T \tag{3}$$

Every component indicates the absolute value of the error from corresponding wave band to the centre vector.

Definition 3: Mode. The binary group like (4) composed by a central feature vector of a class and the effective radius vector is called the mode of this class.

$$p=<m,r> \tag{4}$$

For pixel x that supposed to be divided into class c, comparing the distance between the gray value of each wave band and the central feature vector of the corresponding component one by one. If the distance does not exceed the corresponding allowable radius, then pixel x belongs to class c certainly.

Through the above analysis, a remote sensing image classification problem can be divided into the following sub-problems:

Determine the categories and subcategories needed distinguished;

Determine the mode of each category one by one;

Classify according to the determined mode.

2.2 The Function of Affinity Discriminant

Affinity discriminate function is the function to judge the degree of similarity between antigen and antibody, antibody and antibody. The higher is the affinity; the better is the approximation of both.

Euclidean distance is a commonly used function to judge the similarity in remote sensing image classification, but the traditional Euclidean distance believes that all the bands' influence on distance is equivalent. As different bands play different roles in classification, we should quantify them by a certain rule to get a weight sequence: (w_1, w2, …, wb) and improve the Euclidean distance to make the formula (5) as the affinity calculated function of two feature vectors.

$$affinity\ (x, y) = \frac{1}{\sqrt{\sum_{i=1}^{b} w_i (x_i - y_i)^2}} \tag{5}$$

3 The Remote Sensing Image Classification Algorithm Based on Immune Learning

3.1 The Symbol of Algorithm

The classification of remote sensing image based on self-determination Evolution, CRSSE proposed by this article is based on immune learning mechanism. In the process of achieving the immune learning, it is believed that the antigen will cause the immune response without considering the decomposable process of antigen. As both the antigen and antibody are the feature vectors of pixel, the antibody will variety and generate new antibody directly in the algorithm. First of all, we define the symbols used in the algorithm**:**

b: the wave band number that participate the classification actually;

C: sets of classification. Each element represents a category determined in advance and each category contains several sub-categories. Symbol Ci represents category i and Cij represents the sub-categories j of i. c represents a certain category.

Q: linear classifier set. Each linear classifier represents a mode. The symbol Qi represents all the linear classifier sets of category i and Qij represents the corresponding linear classifier of category i’s sub-category j. If there is only one element in the set Qj, Qj is equal to Qj1. q represents a linear classifier;

q.mc: represents the classification property of linear classifier and mc.mc$\in$ C;

q.sc: represents sub-category property of linear classifier;

q.cp: feature vector of class center, which is a b-dimensional feature vector;

qr: effective radius vector (the maximum permissible error vector), which is a isomorphic vector with vector cp. Each component represents the maximum deviation of element corresponding weight value of the same type in the class central feature vector;

q.times: the times scale factor, which magnifies the actual identification radius and changes into q.r;

AB: the antibody set (population). ab represents a single antibody and ab$\in$ AB. AB corresponds to the set of feature vectors, while ab corresponds to a specific feature vector. In the description of algorithm, in order to correspond to the noun of biological immune system conveniently we also use MC to represent AB when it mentions to the set of immune cells.

AG: a set of all antigen, in which we use ag to express a single antigen. In the classification algorithm, it represents a pixel to be classified or the pixel’s feature vector in the sample.

Rh: empirical parameter, which is used to control the number of cells generated in a variation.

d: After a clone, the number of memory cells which removed from the current MC set.

w: a b-dimensional vector, which the number i component represents the classifying contribution of the number i wave band.

Affinitymin: affinity threshold.

DN_imin, DN_imax: The minimum and maximum of the number i band in all samples when we train a sub-category.

3.2 Training Process

It needs to train each type separately in the training. After the train, the training results will be saved into q as a basis for classification in the future. Now we describe the training process of sub- category Cij.

(1) We do the unitary processing of the feature vectors to make the distance values all in the area from 0 to 1.

(2) CRSSE tries to find the memory cells which are most similar to ag in the memory cells MC for the antigen ag transfused. Because the algorithm CRSSE uses the antibody to vary directly, this step is actually to find the most similar antibody ab in AB.

$$ab_m = \begin{cases} ag & \text{MC=null} \\ ag & \text{Max (Affinity (ag,ab}_\text{i}\text{)< Affinity}_\text{min} \\ ab_i & \text{Affinity (ag,ab}_\text{i}\text{)>Affinity}_\text{min} \end{cases} \tag{6}$$

Affinity (ag, abi) represents the affinity of antigen ag and antibody abi. Here, the distance is calculated by (5).

(3) Population updating. Population updates in three ways.

(A) Clone the obtained abm. In the view of immunology, the number of antibody clone cells is not only determined by the affinity of antibody and antigen, but also determined by the concentration of the antibody. When the antibody concentration is too high, the cloning process of antibody will be inhibited[11-12]. Therefore, the clone number of each antibody is calculated by the following way:

Calculate the concentration of antibodies abm. To each antibody to be calculated, it's concentration:

$$Con(ab_i) = \frac{\sum_{j=1}^{total-1} Si}{total - 1} \tag{7}$$

Among them, total is the total number of the antibody within species and Si is a scalar function. Determine their values as following way:

$$s_i = \begin{cases} 1 & \text{If the similarity of ab}_\text{m}\text{ and antibody ab}_\text{j}\text{ is less than a given threshold} \\ 0 & \text{Others} \end{cases} \tag{8}$$

If the concentration of abm is lower than the given threshold Conmax, we determine the number of variation according to the formula (9) and else by the formula (10).

$$Nc = \sum_{i=1}^{n} round(\frac{Rh * N}{i}) \tag{9}$$

$$Nc = round(Rh * N * \frac{1}{Con(ab_m)}) \tag{10}$$

(B) Cell variation. Cell variation is to increase the diversity of the population and the number of variable cells is mainly depended on the affinity of the antibody to the antigen. The antibody with higher affinity can produce more variable cells, while the lower may produce less.

(C) Randomly generated antibody with the same number of the variation added into the population is to improve the diversity of the species groups.

(4) Species competition.

(4-1) Calculate the sum of population resources. First calculate the stimulation level of each antibody and do the unitary processing. Stimulation level Si of antibody abi is calculated as the following way:

$$Si = \frac{affinity \ (ab_i)}{\sum_{j=1}^{t} affinity \ (ab_j)} \tag{11}$$

Calculate each antibody resources as the following way:

$$\mathrm{Re}source(ab_i) = \mathrm{S(ab_i)} * Nc_i \tag{12}$$

Sum all of the antibody resources as the total resources of the population. If the summation of resources is above the given threshold Resourcemax, first remove the least stimulated antibody and its resources until it meets the requirement.

(4-2) Calculate the average stimulation level of the current population and judge whether it is above the given average threshold Stimulatemax. If it is not more than the given threshold, the evolution is end and then we prepare to determine the candidate memory cell, otherwise, compete again.

(5) For each antigen transfused, repeat steps (2) - Step (4) until the entire antigen are processed completely.

(6) Calculate the average affinity of each memory cell to the entire antigen and select the immune cells (antibodies) of best affinity.

(7) Take the feature vector of immune cell as the centre feature of class into q.

For each sub-category to be learned, repeat step (1) - (7) until complete all the categories process.

3.3 Image Classification

After training, we will get a corresponding linear classifier to each sub-category. We can classify to the element with using the linear classifier. In the classification, consider each element to be classified as antigen ag. To element ag, the classification process is:

(1) The initial classification. Initial classification is mainly used for classifying the more "pure" pixel and then we seek out these pixels which cannot be classified currently.

(1-1) Calculate the absolute distance between ag and each component of category central feature vector in all sub-categories. If for a certain Cij, ag and its absolute value in each band are both less than the corresponding distance of the maximum limits of errors, then record it into queue LC and LC represents that all the sub-categories that may contain ag.

(1-2) For each sub-category in LC, calculate the distance between ag and center feature vector of this class separately and select the biggest in c then classify ag into this class.

(1-3) If LC is empty, it may be caused by the maximum effective radius little. According to the formula (2.21), we can calculate the Affinity between ag and all class feature vector and select the biggest affinity Cij. If Affinity is bigger than Affinity-min, we classfy ag into Cij and revise the corresponding q.r again.

(2) Repeat the first step until complete the process of all the elements.

4 The Analysis of Experimental Results

4.1 Data Source

The data source used in the experiment is ETM + image with a resolution of 30m and eight bands totally. The area of the image of which size is 1500 pixels *1200 pixels and the acquisition time is on the May 31, 2009 is Xueye Reservoir, in laiwu of Shandong province. As is shown in the Figure 1.

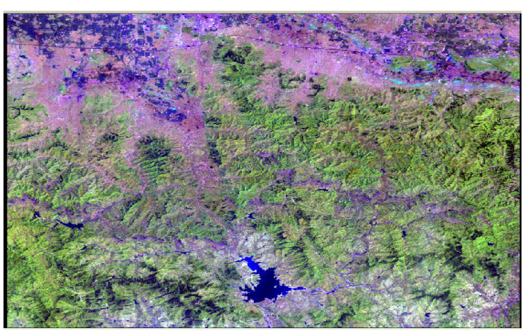

Fig. 1. (a) ETM + image

4.2 Sample Data

After a manual interpretation the image, it is due to be divided in four categories: water bodies, vegetation, bare land and field. Figure 2 shows the chart of spectral curve.

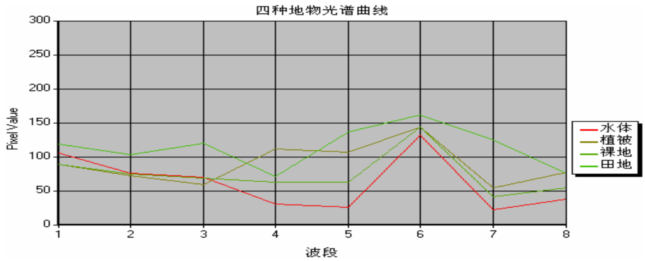

Fig. 2. The spectrum curve of the four classes

We can see that each category is too close in the band 6 and band 8 in the spectrum curve chart. As the difference is not clear, we used band 1 to 5 and the band 7 to classify in practical application. We choose the spectrum sample of four categories training sample region as the initial antigen sample population of the algorithm. The sample of each type feature is shown in the Table 1.

Table 1. Object classes and the number of samples in experiment

Name of object classes	Samples
Water bodies	1302
Vegetation	3086
Bare land	5793
Field	4766
Total	14937

4.3 Experimental Condition

When experimenting, the value of each parameter in CRSSE algorithm is as follows:

times: 1; Rh: 0.1; Aberrance: 0.2; d: 0.2; w: All the components take the average value of 1/b, we think that all the bands has the same right; Resourcemax: 50; Stimulatemax: 0.9; Affinity max: 0.8;

For the convenience of comparison, we give the classification results of parallelepiped classification method, the minimum distance from the average classification method, K nearest neighbor method, maximum likelihood classification method and the classification of BP algorithm. Among them, k takes the value of 19 in the K nearest neighbor algorithm. BP algorithm uses a hidden layer and the number of hidden layer nodes is 20, while the learning rate is 0.3. The classification results are shown in the Figure 3.

We can see from the Figure 3 that there are always many wrong classification phenomena with using parallelepiped classification method. Through the investigation and interpretation, this method divides a number of land surface features into vegetation and fails to classify water bodies correctly with a result of a part little water body having not been recognized. When we use the minimum distance classification method, the identification of vegetation is better, but the mixed classification

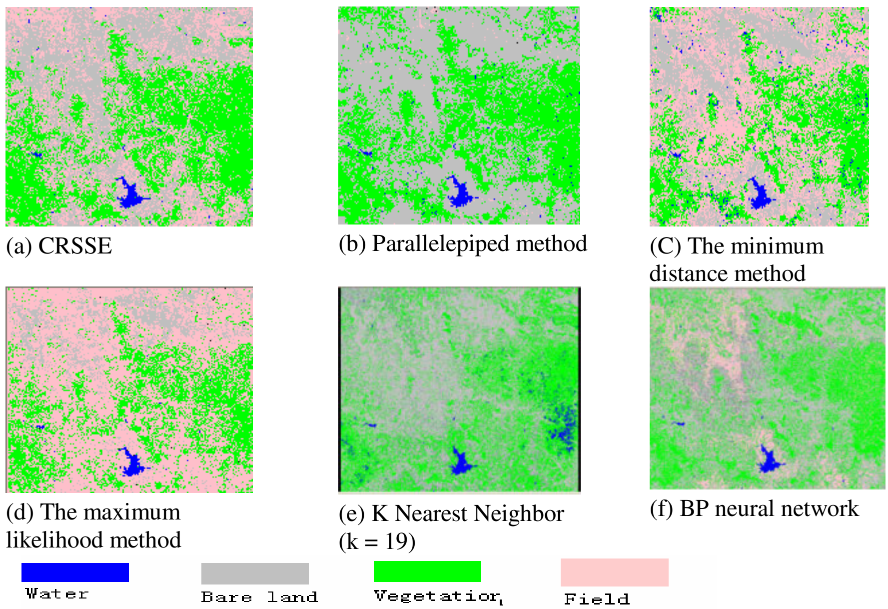

Fig. 3. Classification Results

Table 2. Comparison results of the Classification method

method	Parallel pipeline method	Minimum Distance method	Maximum likelihood	K Nearest Neighbor (k=19)	BP(1 Hidden layer)	CRSSE
Total accuracy	73.00%	81.00%	81.00%	81.77%	84.22%	87.00%
Kappa coefficient	0.6520	0.7133	0.7422	0.7867	0.8023	0.8306
Time (s)	24	25	56	123	1202	346

phenomenon of bare land and field is quite serious. The maximum likelihood method classifies water body better, but there are more wrong phenomena when classifies the vegetation and bare land. K nearest neighbor method can distinguish water bodies and field better, but cannot distinguish vegetation preferably. BP neural network method has better effects on the classification of each category, but there is still any vegetation not distinguished. When using CRSSE classification method, it can classify water body, vegetation and bare land with greater accuracy and the result of classification is satisfactory through the investigation and interpretation. Therefore, we can see that CRSSE has a better classification result from manual visual interpretation and compared with the original image and investigation, its classification is improved in accuracy from the traditional classification methods.

To further verify the correctness of this classification method, we compare CRSSE method with traditional remote sensing image classification methods in classification accuracy. We use a common total precision and Kappa coefficient as the comparative evaluation indicators and count the computation time required for different algorithms meanwhile. The results is shown in the Table 2.

As can be seen from Table 2, the overall accuracy and Kappa coefficient of CRSSE are all better than the conventional methods with overall accuracy of 91.33% and Kappa coefficient of 0.891. The other followed are BP neural network, maximum likelihood, K nearest neighbor method, the minimum distance from the average value and the parallelepiped method. The calculating time of CRSSE is longer than the maximum likelihood method, but its accuracy is significantly higher. Almost each index of RLCRSI is better than the traditional classification methods. It is mainly because parallelepiped method and minimum distance from the average method only consider partial characteristics during the process of training and classification, so it always falls into local optimum in the training process, which will result in the wrong sub-classification of images. While the premise of the maximum likelihood method is that the probability density distribution function of each class is the normal distribution. If the sample data deviates from the normal distribution too much, it will affect the classification accuracy of maximum likelihood method greatly. BP neural network requires more computing time. Because the CRSSE classification method with high classification accuracy has the characteristics of self-organizing of artificial immune system and self-learning ability, the requirements of the conditions on the sample distribution is not too high.

5 Summary

According to immune learning theory, we have built model for the classification problem of remote sensing image and put forward remote sensing image classification algorithm based on immune learning. The algorithm divides each big category into a number of small categories and the evolution process of each category's antigen population is considered separately, thus it can greatly reduce the convergent time to make it more suitable for processing remote sensing image. We use various methods to determine categories' property to improve the classification accuracy in the classification. Compared with traditional method, CRSSE has higher classification accuracy and can be well applied in remote sensing image.

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Short-Term Load Forecasting Based on RS-ART

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Abstract. This paper presents a short-term electric load forecasting method based on Autoregressive Tree Algorithm and Rough Set Theory. Firstly, Rough Set Theory was used to reduce the testing properties of Autoregressive Tree. It can optimize the Autoregressive Tree Algorithm. Then, Autoregressive Tree Model of Short-term electric load forecasting is set up. Using Rough Set Theory, the attributes will be reduced off; whose dependence is zero, through knowledge reduction method. It not only avoids the complexity and long training time of the model, but also considers various factors comprehensively. At the same time, this algorithm has improved the prediction rate greatly by using automatic Data Mining Algorithms. Practical examples show that it can improve the load forecast accuracy effectively, and reduce the prediction time.

Keywords: Rough Set (RS), Autoregressive Tree Algorithm (ART), Short-Term Electric Load Forecasting, Data Mining.

1 Introduction

Short-Term Load Forecasting is a system load forecasting before one day or one week, and an important work of electricity production department. It has great significance in power system operation and design. Power system security and economic operation are based on Short-Term Load Forecasting. Load forecasting has very close relations with generation companies, power companies and transmission companies under electricity market. For generation companies, load forecasting can make plans, maintenance plans and offer a basis of quoted price. For power companies, load forecasting can provide the basis to develop power purchase plan for the power suppliers. For transmission companies, load forecasting is the basis to develop plans and keep safe, reliable, economic operation. Load forecasting plays an important role in electricity market decision support systems.

Short-Term Load Forecasting has many traditional prediction algorithms such as single regression method, multiple linear regression and Fourier Component Method, etc. Although these algorithms are mature and simple, these algorithms are linear model methods. When they meet non-linear problem, they appear problem. This article proposes Autoregressive Tree Algorithm based on Rough Set Theory (the RS-ART Algorithm), which can overcome the shortcomings of traditional algorithm. ART algorithm uses the piecewise linear regression mode, which can meet non-linear problem effectively. The Rough Set Algorithm can reduce the attribute of Autoregressive Tree. And it can increase the forecasting precision and reduce forecasting time.

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Using RS-ART Algorithm not only can meet non-linear problem effectively, but also can enhance forecasting precision and reduce forecasting time.

2 Short-Term Forecasting Model Based on RS-ART Algorithm

2.1 Autoregressive Tree（ART）

The most common type of model used for time-series analysis is the linear autoregressive (AR) model. A linear autoregressive model of length *p*, denoted *AR (p)*, is described by Equation 1:

$$f\left(y_t / y_{t-p}, \cdots, y_{t-1}, \theta\right) = \prod_{i=1}^{L} \left(m_i + \sum_{j=1}^{P} b_{ij} y_{t-j}, \sigma_i^{\,2} \right) \phi_i \tag{1}$$

Where $N\ (\mu, \sigma^2)$ is a normal distribution with mean μ and variance σ, and $\theta = (m, b_1 \ldots b_p, \sigma 2)$ are the model parameters.

An Autoregressive Tree *(ART)* Model is a piecewise linear autoregressive model in which the boundaries are defined by a decision tree, and the leaves of the decision tree contain linear autoregressive models. An *ART (p)* model is an ART model in which each leaf of the decision tree contains an *AR (p)* model, and the split variables for the decision tree are chosen from among the previous *p* variables in the time series. Supposes each leaf node is l_i and related target function is φ_i, then (*ART (p)*) model can be described by Equation 2:

$$f\left(y_t / y_{t-p}, \ldots, \theta\right) = \prod_{i=1}^{L} N \left(m_i + \sum_{j=1}^{P} b_{ij} y_{t-j}, \sigma_i^{\,2} \right) \phi_i \tag{2}$$

2.2 Rough Set（RS）

Rough Set Theory is one kind of data analysis theory which is raised in 1982 by Professor Z.Pawlak in University of Technology in Poland. It is a kind of new mathematical instrument that processes fuzzy and the uncertain knowledge. Its main idea is that classifying is invariable under premise. It derives the decision or the classifying rule of the question by knowledge reduction. The smallest condition attributes subset which is obtained by attribute reduction may replace the original policy-making table condition attribute set, and it does not affect the classifying ability of the policy-making table. The application of Rough Set in the data mining can enhance the analysis and study ability of incomplete data in huge database. And it has widespread application prospect and the use value.

2.3 RS-ART

This method contains two processes: one uses RS to do attribute reduction and construct a new study and test sample, another one uses ART to complete the duty of forecasting. Firstly historical data is used, which contains all characteristic parameters to create decision-making table S, its condition attribute set is C and policy-making attribute is D. Secondly all attributes are separated, which are in the policy-making table to standardize expression way, dependence of all conditional attributes are calculated in the current environment. Thirdly conditional attributes are removed, whose dependence is 0, a new study sample set of ART obtained. Fourthly ART is studied and trained again, test input data, which is reformed and combined from reduced attribute set C_1 and corresponding primary data to complete forecasting task. RS-ART to forecast is as follows:

At the beginning, the n study sample is determined, which only contains reduced attribute set C_1. Then reduced data is preprocessed. Bayes technology is used to train model data. Finally, ART algorithm is used to carry on the forecasting.

3 The Algorithm of Short-Term Forecasting Based on RS-ART

3.1 Attribute Reduction Based on RS

According to historical data, decision-making table is created to decide attribute value $S=<U,C \cup D>$, which C is weather information (including wind speed w, temperature t, humidity h, weather condition s and barometric pressure p and so on) and D is the load value in forecasting day, the step reduced the attributes is as follows:

(1) Discrete All Attribute In Policy-Making Table

As we known, Temperature range is [-1, 20] in October in Shenyang. The range is divided into 6 parts. [-1, 0] is marked 0, [0, 4] is marked 1… [16, 20] is marked 5. Wind speed and humidity are the same as temperature. Weather condition is divided (including fine, cloudy, rainy day) into 0, 1, and 2. That barometric pressure is divided with the method is the same as the above. Load data from high to low can be divided into 2, 1, and 0.

(2) Calculate Dependence of All Conditional Attributes

D to C dependence is as follows:

$$r_c(D) = \frac{card\ (POS\ (D))}{card\ (U\ )} = 1 \tag{3}$$

It shows that policy-making table is completely coordinated. To W is:

$$r_c(D) - r_{c-\{W\}}(D) = 0 \tag{4}$$

Likewise, calculate the rest conditional attributes.

(3) Remove Attributes Dependence is 0

Remove wind speed, humidity and barometric pressure etc., whose dependence is 0.

(4) Obtain Final Attribute Reduction Set

Through the attribute reduction, final attribute reduction set C_1 {temperature, weather condition} is obtained.

3.2 Preprocess Reduced Data

During gathering process of load forecasting historical data in electrical power system, because of various kinds of reason, there are many unusual data such as erroneous data, flaw data and so on. The identification and revision of these unusual data is the foundation of forecasting model to do perfect forecasting.

According to the type of unusual data, the different processing method is used in this article. The steps to process these unusual data are as follows:

(1) Erroneous Data Processing

The erroneous data is filtered through assigning value scope of these data. For example, set temperature value scope, - 1℃~20℃.

(2) Flaw Data Processing

Flaw data is generated from primary data and filtered data. When the time span of the flaw data is not too large, Linear Interpolation Method can be used to process. For example, data n, n+1, n+j are as known as:

$$T_{n+j} = T_n + \frac{T_{n+j} - T_n}{i}, 0 < j < i \tag{5}$$

When the time span of the flaw data is large, the next day data can be used to fill.

(3) Incompatible Data Processing

Existing load data is 1 each minute, but meteorological data is 6 each hour. Therefore, transforming the data density is needed. All data become 4 each hour. The concrete plan is that 4 load data are extracted each hour and meteorological data are used by Linear Interpolation Method to fill.

3.3 Load Forecasting Based on ART Algorithm

The task of forecasting is calculation of the distributions of decision tree for future observations in the sequence. The posterior distribution for the variable Y_{T+1} is a function of a single leaf node in the tree. Using the conjugate priors, each leaf in the tree has a conditional t-distribution for this variable. Using the normal distribution f_t (y_t/y_{t-p}... yt-1, θ) evaluated at the value of θ_i, the data are most likely given as the maximum a posteriori (MAP) value:

$$\tilde{\theta}_i = \operatorname{argmax} \prod_{x^t\, atl^i} f\left(x^t{}_{p+1} \big/ x_1{}^t, \cdots, x_p{}^t, \theta, s\right) P(\theta_i / s) \tag{6}$$

Then t- distribution is gotten to make the final forecasting. Using this formula iteratively, whether forecast is more than one data in the future.

4 Case Study

24 hour integral point load data and meteorological data are used in October, 2007 in Dongling, Shenyang. The first 2/3 data is used to train, and the rest to test and verify.

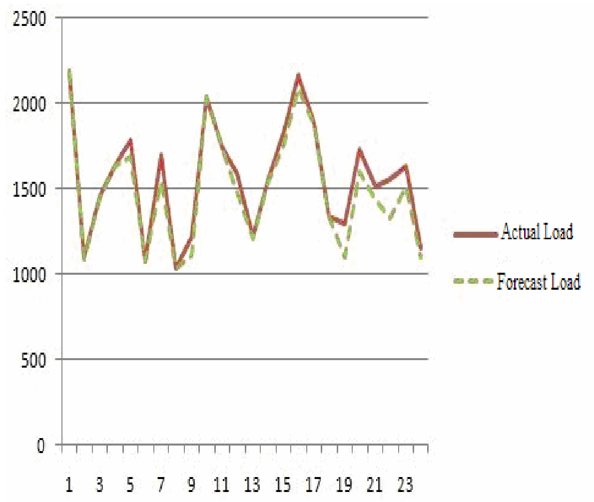

Fig. 1. Forecasts Curve and Measured Curve

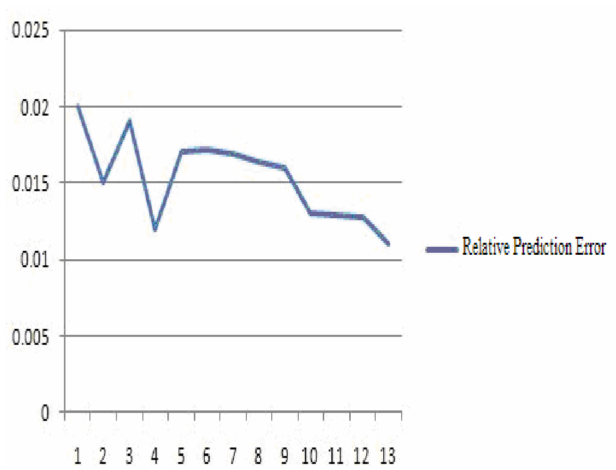

Fig. 2. The Relative Prediction Error Curve

The RS-ART model above is trained to achieve the certain forecasting precision without fitting too much. Use well trained model to forecast 24 hour load in October 15, 2007 to get corresponding forecasting result. Figure 1 is Forecasts Curve and Measured Curve figure, in which solid line is Actual Load Y Curve and dashed line is Forecast Load Y_d Curve. Figure 2 is Relative Prediction Error Curve.

As the forecasting result indicates, the relative error and the average error of RS-ART Algorithm are 2% and 1.89%.

5 Conclusion

This article proposes an ART Algorithm based on Rough Set. This algorithm has all advantage of ART Algorithm. And Rough Set can be used to do the attribute reduction completely. Practical examples show that it can improve the load forecast accuracy effectively, and reduce the prediction time.

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Study on Delineation of Irrigation Management Zones Based on Management Zone Analyst Software

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Abstract. For more efficient field operation and management of precision irrigation, Management Zone Analyst (MZA) software was used to delineate irrigation management zones. MZA is a simple and fast software for subfield management zone delineation on the basis of fuzzy c-means clustering algorithm. The measured soil physical properties of Chahayang Farm in Heilongjiang Province were taking as data source in the paper. Principal component analysis was firstly used to eliminate the multiple correlations of the data and MZA was then performed to delineate irrigation management zones of the study area. The results indicated that the study area was divided into two irrigation management zones by MZA, and soil physical properties had high uniformity in each subzone and significant difference between subzones which confirmed the partition. The delineation of irrigation management zones based on MZA had high precision and could make up the deficiencies of higher theoretical level and hard mastery of other clustering algorithms. The delineation results based on MZA can provide the basis for decision making of precision irrigation practices.

Keywords: irrigation management zones, principal component analysis, MZA, geostatistics.

1 Introduction

Management zone is a subzone with similar crop production potential, soil nutrient, water use efficiency and environmental effects caused by similar landscape or soil conditions (Li Yan et al., 2007a). Scientific and rational delineation technique of management zone is the efficient means of conducting variable rate fertilization and irrigation in precision agriculture and has become a hot spot of precision agriculture at home and abroad. Ostergaard et al. (1997) have used the data of soil type, yield, terrain, aerial photograph and farmers' experience etc. as qualitative analysis indexes to delineate management zones. Fleming et al. (2000) have delineated management zones of a certain region by using overlapping method (a qualitative analysis) to superimpose the aerial photograph of bare land and terrain map of the region and

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integrating the management experiences of farmers. Li Yan et al. (2007b) have taken NDVI, soil salinity and crop yield as data sources and used fuzzy c-means clustering to delineate management zones. Li Xiang et al. (2007) have used fuzzy k-means clustering algorithm to divided the study area into four management zones based on the data sources of two soil nutrients (available phosphorus and available nitrogen). Jiang Qiuxiang et al. (2010) have used the data source of soil moisture and colony clustering algorithm to delineate site-specific irrigation management zones. Wang Zilong et al. (2008) have studied the delineation of soil nutrient management zones by using attribute means clustering based on particle swarm optimization algorithm.

Experiential method and clustering method are the main methods to delineate management zones in the above studies. Experiential method has a low resolving precision for clustering analysis is not performed on the data of delineating management zones. However, clustering method demands that the users have a certain mathematical basis, especially the clustering methods that are too theoretical and have elaborate calculation procedures are hard to be used in productive practices. Management Zone Analyst (MZA) software written by Fridgen et al. (2004) on the basis of fuzzy c-mean clustering algorithm is a simple software. Users just need to input data into the software and will obtain results quickly. Thus, MZA software was conducted in the study to delineate precision irrigation management zones, which can provide a new train of thought for management zone delineation.

2 Materials and Methods

2.1 Site Description and Soil Sampling

The study was conducted on a dry field of 1ha in the dry cultivation techniques demonstration area of Chahayang Farm, which is in the western semiarid region of Heilongjiang Province. It is located in the cold temperate zone, continental monsoon and semiarid agricultural climate region. Thus study on precision irrigation in the area is significant. A 10m×10m grid-sampling scheme was performed on the field to collect 300 soil samples from three layers in the topsoil (0-30cm) in the autumn of 2006 after crop harvesting. One representative sample was collected at the center of each grid and geo-referenced using a global positioning system (GPS). Four indices, including field moisture capacity (FMC), saturated moisture content (SMC), wilting point (WP) and soil dry bulk density (SDBD), were measured by conventional methods (Soil Physics Research Office, Institute of Soil Science, Chinese Academy of Sciences, 1978) for three layers soil samples in each sampling position, and the means of them was considered as values of the parameters at the location.

2.2 Management Zone Analyst Software

For quickly creating management zones and ascertaining the rational number of zones, Fridgen et al. (2004) developed a software program called Management Zone Analyst (MZA) by using Microsoft Visual Basic 6.0. MZA can assist researchers, consultants and producers in creating management zones using quantitative soil, crop and/or site information. MZA calculates descriptive statistics, performs the unsupervised fuzzy classification procedure to delineate management zones. The advantages of MZA are that it provides concurrent output for a range of cluster numbers and two performance indices [fuzziness performance index (FPI) and normalized classification entropy (NCE)] to aid in deciding how many clusters are most appropriate for creating management zones, which can help the users obtain management zones simply and quickly (Fridgen et al., 2004).

The fuzziness performance index (FPI) is a measure of the degree of separation between fuzzy c-partitions of data matrix (X) and is defined as:

$$FPI = 1 - \frac{c}{(c-1)}[1 - \sum_{k=1}^{n}\sum_{i=1}^{c}(u_{ik})^2 / n] \tag{1}$$

where $u_{ik}\,(1 \le i \le c, 1 \le k \le n)$ is the membership that the kth sample (x_k) of X belongs to the centroid of cluster i (v_i) of the cluster centroid matrix (V); c and n are the number of cluster centroid and the number of observations, respectively.

The NCE models the amount of disorganization of a fuzzy c-partition of X. The classification entropy (H) is defined by the function:

$$H(U;c) = -\sum_{k=1}^{n}\sum_{i=1}^{c} u_{ik} \log_a(u_{ik}) \Big/ n \tag{2}$$

where logarithmic base a is any positive integer.

Then, the NCE can be expressed as follows:

$$NCE = H(U;c)/[1-(c/n)] \tag{3}$$

The values of FPI and NCE close to 0 mean the small membership sharing and large partition component, indicating the good classification results (Bezdek, 1981). The best number of classification can be obtained when both FPI and NCE have the minimum values at the class. The additional verification is required to determine how many clusters to be used for creating management zones when both performance indices have different number of zoning (Fraisse et al., 2001).

2.3 Data Processing Procedure

Soil physical properties being provided with spatial variabilities and heterogeneous spatial distributions is the important prerequisite for delineating site-specified irrigation management zones. Thus, first of all, geostatistical analysis software called GS+ 5.3 was performed to analyze the spatial variability and structure of soil physical properties in the study. Then, the heterogeneities of spatial distributions for all the soil physical properties were judged by their spatial distribution maps drawn in ArcGIS 9.1 by using the kriging interpolation method. Next, for correlations existed among soil physical properties, principal component analysis (PCA) was used to eliminate data correlations and extract comprehensive indexes before delineating management zones. Finally, management zone was delineated in MZA by using the comprehensive indexes as input.

3 Results and Discussion

3.1 Spatial Variability Structure Analysis

Analysis results of spatial variability structure for all soil physical properties were listed in Table 1. The nugget values (C_0) of all soil physical properties measured in the study were less than their structural variances (C), which indicated that the spatial variability of the soil physical properties was mainly arisen by structural or inartificial factors (such as soil parent material, terrain and climate). The nugget/sill [$C_0/(C_0+C)$] ratios for all soil physical properties ranged from 20.64% to 22.92%. The spatial variability of the properties was weak [when $C_0/(C_0+C)<25\%$] but close to moderate degree [when $25\%<C_0/(C_0+C)<75\%$]. Fig. 1 showed the spatial distribution maps of the soil properties and all their spatial distributions were heterogeneous. WP had sheet

Table 1. Models and parameters of semivariograms for the regional variables

Regional variable	Theoretical model	Nugget (C_0)	Structural variance (C)	Sill (C_0+C)	Nugget/sill ratio [$C_0/(C_0+C)$](%)	Range (m)	Coefficient of determination
FMC	Spherical	0.57	2.06	2.63	21.49	23.4	0.938
SMC	Spherical	4.80	18.39	23.19	20.70	19.1	0.878
WP	Spherical	0.11	0.42	0.53	20.64	94.2	0.934
SDBD	Spherical	0.001	0.004	0.005	22.92	19.2	0.829

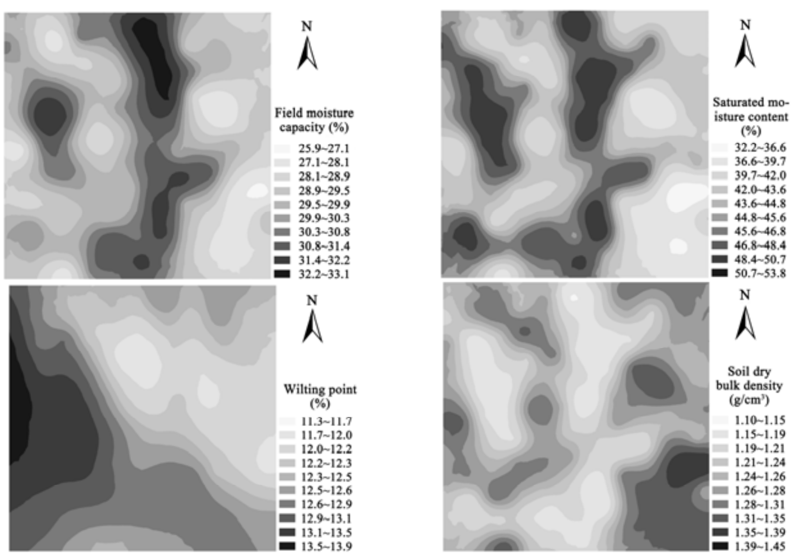

Fig. 1. Spatial distribution maps of soil physical properties

spatial distribution, while the spatial distributions of FMC, SMC and SDBD were all zonal. The spatial characteristics of all the soil physical properties accorded with the prerequisite of delineating site-specified irrigation management zones. Thus, the four soil properties could be used to delineate management zones.

3.2 Analyzing Correlation and Extracting Comprehensive Index

The results of correlation analysis were shown in Table 2. The correlation coefficient of SDBD and SMC and that of SDBD and FMC was -0.982 and -0.858, respectively. FMC and SMC also had strong relation with a correlation coefficient of 0.851. All the properties showed extremely significant correlations (P<1%). Thus, principal component analysis was conducted to eliminate the correlation and extract the comprehensive index of the properties before delineating irrigation management zones, and the results were listed in Table 3 and Table 4.

Table 2. Correlation analysis of soil physical properties

Item	FMC	SMC	WP	SDBD
FMC	1			
SMC	0.851*	1		
WP	0.104	0.179	1	
SDBD	-0.858*	-0.982*	-0.117	1

Note: * is $P<0.01$.

Table 3. Eigenvalues and cumulative contribution ratios of principal components

Principal component	Eigenvalue	Variance contribution ratio (%)	Cumulative contribution ratio (%)
F1	2.82426	70.61	70.61
F2	0.973909	25.35	95.96
F3	0.185477	3.64	99.60
F4	0.0163508	0.40	100

Table 4. Load matrixes of principal components

Principal component	FMC (X1)	SMC (X2)	WP (X3)	SDBD (X4)
F1	-0.9289	-0.9802	-0.2114	0.9777
F2	-0.1017	-0.0255	0.9772	0.0892

Among the four principal components extracted from original indexes by PCA, the cumulative contribution ratio of F1 and F2 approached 95%, which illuminated that the information of the four indices could be superseded by F1 and F2 at a precision of 95%.

By calculating the load matrices of F1 and F2, they can be expressed as:

$$F1 = -0.9289X1 - 0.9802X2 - 0.2114X3 + 0.9777X4 \quad (4)$$

$$F2 = -0.1017X1 - 0.0255X2 + 0.9772X3 + 0.0892X4 \quad (5)$$

The principal component is a comprehensive variable compounded linearly by the original variables. The compounding coefficient suggested the correlation between the original variable and the comprehensive variable. The coefficients of X1, X2 and X4 in the first principal component (F1) were relatively large, indicating that F1 was the comprehensive variable affected jointly by FMC, SMC and SDBD. However, in the second principal component (F2), X3 had a relatively large coefficient suggesting that WP played a decisive role on F2. The two comprehensive variables not only contained the four original indices but also had no correlation between them. Thus, F1 and F2 were used as the clustering variables for delineating irrigation management zones.

3.3 Delineating Irrigation Management Zones

Comprehensive variables (F1 and F2) were calculated based on the data of the measured soil physical properties and regarded as the input data of MZA software. The fuzziness performance index (FPI) and normalized classification entropy (NCE) when the clustering number was 2, 3, 4, 5 and 6 respectively were obtained from MZA and shown in Fig. 2. FPI and NCE achieved the smallest values at the same time that the number of management zones was 2, namely, the classification effect was best when the study area was partitioned into 2 irrigation management zones. The irrigation management zones map was obtained from ArcGIS software with the input data of the best classification values and shown in Fig. 3. The spatial distributions of the two subzones were banded and interlaced mutually. And the areas of the two subzones were basically the same with the area of Zone I of 4933 m^2 and with the area of Zone II of 5067 m^2.

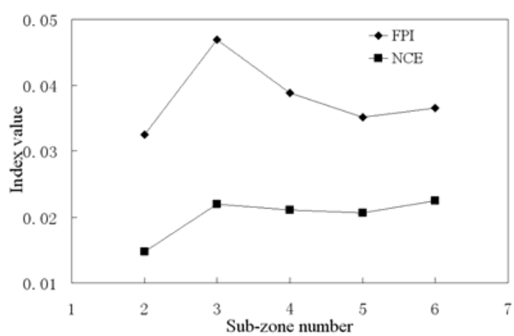

Fig. 2. Changes in two performance indices with increasing number of management zones

Fig. 3. Optimal precision irrigation management zones for the study area

3.4 Effect Assessment of Management Zones Delineation

To more intuitively characterize the differences in subzone and between subzones, classical statistics and one-way ANOVA were conducted on all the soil physical properties in each subzone and the results were listed in Table 5 and Table 6. The coefficients of variation of the properties in the two subzones were all smaller than that of the whole study area, which suggesting that the difference in the subzone decreased and the homogeneity increased. The differences between subzones for the properties were extremely significant according to the results from one-way ANOVA. The analysis results indicated that the soil physical properties were relatively homogeneous in each subzone and were obviously heterogeneous between subzones after the study area was partitioned into two irrigation management zones by using PCA method and MZA software. Thus, the delineation of irrigation management zones for the study area was reasonable.

Table 5. Coefficients of variation for soil physical properties in subzones

Subzone	FMC	SMC	WP	SDBD
Zone I	2.61	3.64	3.33	2.32
Zone II	2.35	5.25	3.44	2.41
Whole area	3.83	7.75	3.57	4.01

Table 6. Results of one-way ANOVA for soil physical properties among subzones

Variance analysis	FMC	SMC	WP	SDBD
F	1217.36	1827.79	38.77	1727.78
Pr >F	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Criterion of significance	Very significant	Very significant	Very significant	Very significant

Table 7. Mean values of soil physical properties in each subzone

Subzone	Area (m^2)	FMC (%)	SMC (%)	WP (%)	SDBD (g/cm^3)
Zone I	4933	30.61	46.69	12.68	1.207
Zone II	5067	28.88	41.13	12.50	1.288

The mean values of the soil physical properties in each subzone were calculated and listed in Table 7 for the sake of finding out the differences between subzones. The mean values of all soil physical properties except SDBD in Zone I were larger than that in Zone II, which illuminated that Zone I with smaller SDBD had stronger soil carrying capacity and drought-enduring capacity than Zone II. Thus, proper water retention measures were proposed for Zone II.

4 Conclusions

According to the spatial variation structure analysis of soil physical properties, all properties had spatial variability and heterogeneous spatial distribution, which satisfied the preconditions of delineating site-specified irrigation management zones. For strong correlations among the soil properties, PCA was performed to eliminate the correlations and two principal components were extracted as comprehensive indexes for delineating management zones. The study area was partitioned into two irrigation management zones, and the differences between subzones and the homogeneities in each subzone were all enhanced. Zone II had weaker soil water carrying and drought-enduring capacity than Zone I, so water retention measures were necessary for Zone II.

Using easy-operating MZA software in the study to delineate management zones reduced study requirements of basic theories for operators and overcame the disadvantages of high theoretical level and hard mastery of quantitive analysis. Strong scientificalness, high precision and fast speed are the characteristics of this method which provides a simple and quick way for the delineation of site-specified irrigation management zones.

Acknowledgements

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Study on Irrigation Regime of Double Cropping of Winter Wheat with Summer Maize

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Abstract. Winter wheat and summer maize were important grain crops in China, and winter wheat-summer maize continuous cropping was the main tillage method in north China. According to field experiment datas, Jensen models of winter wheat and summer maize were established respectively in this article. To pursue the biggest overall efficiency as object function, the partition of the finite water between wheat and maize were optimized, the optimal irrigation scheduling of continuous cropping of the two crops were confirmed in different hydrological years on different incoming water condition. This paper provided an efficient approach for promoting the reasonable use of agricultural water resources and enhancing water use efficiency in north China.

Keywords: Winter wheat, Summer maize, Continuous cropping, Irrigation mode.

1 Introduction

The double cropping of winter wheat with summer maize is the main irrigation pattern in North China plain. It is very important to full utilization of light resource and water saving. Many scholars researched the irrigation model of winter wheat and summer maize in the area of continuous double cropping [1-4], but most of them are also take winter wheat and summer maize divided and consider them respectively, which was unprofitable to water saving and increase the water utilize efficiency. Dynamic programming is a common method to make crop irrigation scheduling optimal, which was used to many researches [5-7]. Henan is a major grain-producing provinces of china, and the north area of Henan is the high quality area, Based on the meteorological many years data of Xinxiang in north Henan province, the water of different hydrological years was distribute the water of different hydrological years between crops and the growth stages optimal by using dynamic programming method, furthermore, the efficient irrigation model of north Henan province was put forward in this paper.

The research is very necessary for water-saving irrigation of the water resource utilization and reduction in the produce cost of winter wheat and summer maize, and the study of the efficient irrigation mode will supply the scientific decision basis and decision scheme for Henan province to choose the right water-saving irrigation technical and scientific management method for agriculture water resource, and promote the scientific popularize and the spread of water-saving irrigation agriculture, and also has the important application value of increasing the irrigation management level of crops.

D. Li, Y. Liu, and Y. Chen (Eds.): CCTA 2010, Part III, IFIP AICT 346, pp. 428–439, 2011.

2 Dynamic Programming Principle

Dynamic programming(DP) is a mathematical method to solve multistage decision process optimization which could break down into some interrelate stages with time sequence, we can obtain the whole optimal effect through making a decision in each stage, the decisions of all the processes is a decision series called multistage decision problem. According to its characteristic, it could be solved one by one through shifing into a series of single session inter-relative problems which are similar or the same. And according to the specific problem, we could also disperse the continuous time parameter of the multistage decision process into several time periods by actual requirement, and then make a decision for each period and thus make the whole process obtain the optimal. Therefore, the problem of water distribution in different growth stages of the crop could be solved by dynamic programming method.

The fundamental principle of the dynamic programming, namely the optimality principle [8] is no matter what the state and decision are in the past, the remaining decisions must form the optimal decision for the state made in the stage before as the optimal decision of the whole process. Usually we use the reverse recursion and sequential decision to resolve a determinacy dynamic programming problem. And if the index of the whole process with its sub-process is the format of continued product for the index of each stage that processes contain, then the fundamental equation for the reverse solution of the dynamic programming is as following:

$$f_i^*(s_i) = \underset{u_i \in D_I(s_i)}{opt} \left[Be_i(s_t, u_i)^* f_{i+1}^*(s_{i+1}) \right] \qquad i = 1, 2, \cdots, n \tag{1}$$

Where *opt* indicates the optimize, take *min* or *max* according to the need, $Be_i(s_i, u_i)$ is the index function of the i^{th} stage. $f_i^*(s_i)$, $f_{i+1}^*(s_{i+1})$ are the most optimized sub-policy of all sub-policies in the after sub-procedure that the original state is s_i, s_{i+1} respectively, $f_i^*(s_i)$ is the optimal strategy of the whole process. $u_i(s_i)$ is the decision variable that the current state is s_i of the i^{th} stage and is the function of state variable. $D_i(s_i)$ is the allowable decision set that set out from state s_i of the i^{th} stage. When the original state is definite, the decision of the process would be definite i^{th} stage, and the optimal value of the index function is also determined.

2.1 Distribution of the Finite Water for Growth Stages

The mathematical model of dynamic programming of water distribution as follows:

(1) Objective function

Use the *Jensen* model and make the max yield per unit area as objective:

$$F = Max(\frac{Y_a}{Y_m}) = Max\prod_{i=1}^{n}(\frac{ET_{ai}}{ET_m})^{\lambda_i} \tag{2}$$

Where Ya, Ym and ETai have the same meanings as before. ETmi and λ_i are the potential evapotraspiration(m3/acre) and water sensitive index of the ith stage respectively.

(2) Constraint condition

1) Decision constraint: $0 \le d_i \le Q_i$ (i=1, 2, 3, 4, 5, 6), d_i is the irrigating water quota, Q_i is the water which could be distributed in the i^{th} stage.

2) Finite water constraint: $\sum_{i=1}^{n} d_i = M$, M is the water which could be distribute in the whole growth period, namely irrigation quota.

3) Evapotraspiration constraint: $0 \le ET_{ai} \le ET_{mi}$, and when $ET_{mi} \le W_i + P_{ei}$, d_i=0.

4) Soil water content constraint: $W_{wp} \le W_i \le W_f$, and when $W_f \le W_i + P_{ei}$, d_i=0.

Where W_{wp} , W_i , W_f , P_{ei} are soil wilting moisture content, actual moisture content, field capacity and effective rainfall respectively, the units of them are all m^3/hm^2. Soil water content could take for the constraint as $\theta_{wp} \le \theta_i \le \theta_f$ in specific calculate, and the θ_{wp} , θ_i , θ_f are the soil water content of W_{wp} , W_i , W_f respectively.

(3) Initial condition

1) θ_0 is the initial soil water content of crop, then when i=1, the initial available soil water is:

$$W_i = 1000 H \gamma (\theta_0 - \theta_{wp}) / \gamma_{水} \tag{3}$$

Where H is the depth of designed moisting layer of soil [m], γ is the dry density of soil[g/cm3], θ_0 is the initial soil water content, calculates as the percentage of dry soil weight, $\gamma_{水}$ is the unit weight of water[g/cm^3].

2) The 1st time-period initial water which could be distributed, namely irrigation quota: d1=M.

(4) State transition equation

1) Water distribution equation: $Q_{i+1} = Q_i - d_i$, where Q_i is the ist time-period initial water which could be distributed of the ithstage [m3].

2) Soil water balance equation: $W_{i+1} = W_i + P_{ei} + d_i - ET_{ai}$, consider the irrigative water and effective rainfall only, but not the deep leakage and the increment of ground water.

(5) Recurrence equation

Because of the two state variable and two decision variable, Successive approximation approach(DPSA) could be used to reduce the dimensions and the calculate.

When use the approach to resolve two dimension dynamic programming, the recurrence equation are the disperse two one-dimensional recurrence equations of the state variable Q_i and $W_{i,}$ respectively, from the formula (1) we can get the fundamental equation of reverse solution as follows:

1) For the state Q_i:

$$f_i^*(Q_i) = \underset{d_i \in Q_i}{opt}\,[Be_i(Q_t, d_i)^* f_{i+1}^*(Q_{i+1})] \qquad i = 1,2,\cdots,n \tag{4}$$

Where $Be_i(Q_i, d_i) = (ET_{ai} / ET_{mi})^{\lambda_i}$ is the current stage benefit in state Q_i when the decision is d_i. $f_{i+1}^*(Q_{i+1})$ is the optimal value from stage $i+1$ to the last, in the last stage, $f_i^*(Q_i) = (\frac{ET_{ai}}{ET_{mi}})^{\lambda_i}$.

2) For the state W_i:

$$f_i^*(W_i) = \underset{ET_{ai} \in W_i}{opt}\,[Be_i(W_t, ET_{ai})^* f_{i+1}^*(W_{i+1})] \qquad i = 1,2,\cdots,n \tag{5}$$

Where $Be_i(W_i, ET_{ai}) = (ET_{ai} / ET_{mi})^{\lambda_i}$ is the current stage benefit in state W_i when the decision is ET_{ai}. $f_{i+1}^*(W_{i+1})$ is the optimal value from the $(i+1)^{th}$ stage to the last, in the last stage, $f_i^*(W_i) = (\frac{ET_{ai}}{ET_{mi}})^{\lambda_i}$.

Using DPSA to resolve two dimension dynamic programming, we take a state variable as fixed firstly,then inverted sequence optimization and Sequential Solution aiming at another status variable, and then rotationally fixing until it reaches the required date.

The step of the DPSA method to resolve this dynamic programming is:

1) Fixing the state variable W_i as the virtual path firstly, make $W^{(0)} = \{W_1^{(0)}, W_2^{(0)} \cdots W_n^{(0)}\}$ ($W_i^{(0)}$, $i = 1,2,\cdots,n-1$, stands for the available water in soil planned moisture layer in the initial of each stage respectively. $W_n^{(0)}$ is the soil moisture content at the end of the period), the first state variable Q_i and decision variable d_i are dispersed to several levels as the step length $\Delta = 600m^3/hm^2$, this is one-dimensional dynamic programming, the convention dynamic method as equation (4) could be used to calculate the optimal result. Given the result is

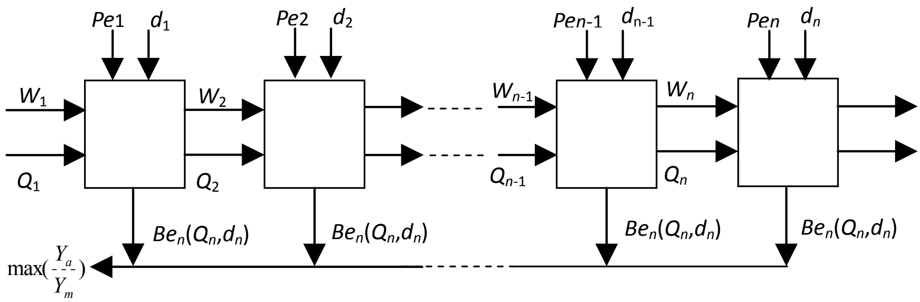

Fig. 1. Relationship between state change and decision of system

$d^{(0)} = \{d_1^{(0)}, d_2^{(0)} \cdots d_n^{(0)}\}$ which is the optimal irrigation water of each stage, and $W^{(0)} = \{W_1^{(0)}, W_2^{(0)} \cdots W_n^{(0)}\}$ which is the total irrigation that could supply in the initial of each stage.

2) Fixing the $Q^{(0)}$ and $d^{(0)}$, the optimal value of the soil available water W_i and the actual evapotraspiration ET_{ai} of each growth period are seeked in the initial condition. Second state variable is dispersed to several levels from wilting moisture content to field capacity as the step length $\Delta = 1\%$, then get the optimal result $\{W_i^*\}$ by equation (5).

3) Compared the virtual track of the soil moisture content in the first step with the optimal result of the soil moisture content in the second step, if the virtual track of the first step and the optimal result of the second step does not match with the limiting condition of the prediction, then the optimize processes above until the two state variables have the same objective function value and irrigation decision series values which is the optimal result that we need. The relationship between state change and decision of the system shows in figure 1, and the program of reverse algorithm of dynamic planning shows as figure 2.

In Fig. 2, s_{-i}, s_{+i} stand for the higher and lower limit value of state variable s_i respectively.

And in the actual calculation process, s_i could be replaced to state variable Q_i and W_i respectively.

The left-component of the block diagram is the optimal function value and stage decision value searched reversed in stage, and the right-component of the block diagram is the optimal objective function value $f_1^*(Q_1)$ which is $Max(Y_a / Y_m)$ and optimal decision value series d_i^* which is the optimal irrigation quota of each stage that decided orderly of the whole process. Pe stand for the raifall of different typical years in Fig. 3.

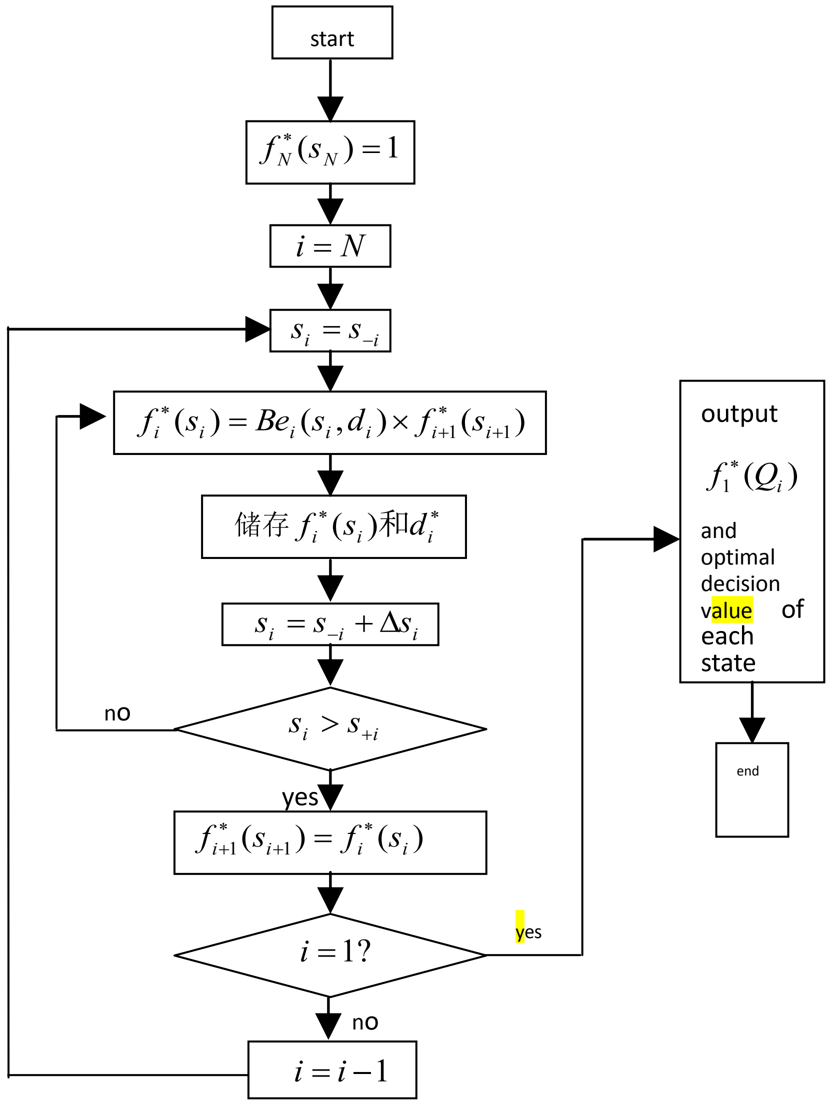

Fig. 2. Program of reverse algorithm of dynamic planning

2.2 Partition of the Finite Water between Crops

Based on the optimal distribution of finite water between different crops growth stage, using the DP method, the limited whole irrigation water(Qc) is distribution between different crops. The mathematical model as follow:

1) Stage variable: the time factor is introduced and each crop is regard as a time stage, then i=1, 2…n, stands for the crop that should consider respectively.

2) State variable: the total water Qci which could be distributed to each crop in the initial of each stage.

3) Decision variable and state transition equation: decision variable is the net irrigation water d_{ci} that is distributed to each crops, state transition equation is $Q_{ci+1} = Q_{ci} - d_{ci}$.

4) Objective function: take the largest total benefit of each crop as the object,

$$B_c^* = \max\left\{\sum_{i=1}^{n} f(Q_{ci}) \times A_i \times Y_{mi} \times P_{mi}\right\} \tag{6}$$

Where $f(Q_{ci})$ is the benefit when distribute water Q_{ci} to crop i, A_i[hectare], Y_{mi}[kg/hm^2] and P_i[yuan/kg] are the plant area, potential yield and unit price respectively.

5) Initial condition: $Q_{ci} = Q_c$, which stands for the distributed water of the initial of the first stage equals to the finite total irrigation water.

6) Constraint condition: $0 \le d_{ci} \le Q_{ci} \le Q_c$, $\sum_{i=1}^{n} d_{ci} \le Q_c$, Q_c is the total water of the irrigated area which could be utilized.

7) Recurrence equation: the reverse recursion and sequential decision is adopted, the recurrence equation as follow:

$$B_{ei}^*(Q_{ci}) = \max_{d_{ci}}\left\{f(Q_{ci}) \times A_i \times Y_{mi} \times P_i + B_{ei}^*(Q_{ci+1})\right\} \quad i=1,\ 2\ldots n \tag{7}$$

Where $B_{ei}^*(Q_{ci})$, $B_{ei+1}^*(Q_{ci+1})$ are the optimal benefit of the i^{th} and $(i+1)^{\text{th}}$ stage respectively, $f(Q_{ci})$ is the index function of the i^{th} stage, and the other symbols have the same meanings as before.

3 Analysis Results

3.1 Relevant Parameters

3.1.1 Rainfall of Typical Years

Based on the diurnal rainfall data from 1984 to 2003, the sum of the rainfall of each month was worked out. The experience cumulative frequency curve could be drew out according to the data as shown in figure 3, and also could get out the rainfall in different typical hydrological year（25%, 50%, 75%, 95%）as shown in table 1.

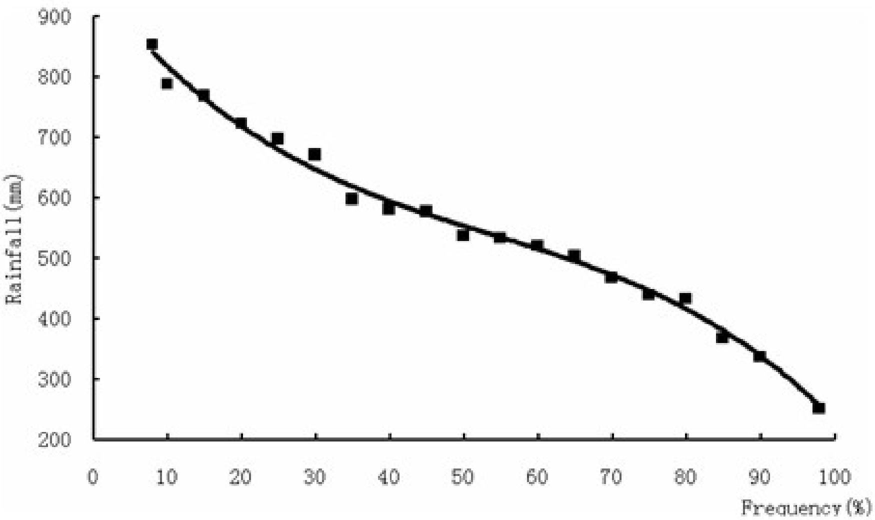

Fig. 3. Experiential cumulative frequency curve

Table 1. Rainfall of different typical hydrological years (mm)

25%	50%	75%	95%
700	560	450	320

Table 2. Monthly average rainfall of different hydrological years (*mm*)

Hydrological year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total rainfall
25%	5	6	20	24	66	70	243	209	86	46	12	5	792
50%	6	12	22	38	67	83	158	112	39	43	31	6	617
75%	10	4	13	13	17	67	150	127	46	38	9	11	504
95%	6	5	29	14	80	57	55	57	43	28	7	7	386

According to the water of different hydrological year, the four year rainfall which stand for the four hydrological years were elected as objects of study. The related datas as shown in table 2. Furthermore, according to the start and end date of different growth stage, the rainfall in the growth stage of winter wheat and summer maize could be determined as shown in table 3 and table 4. Thus provides the basis of rainfall data for partition of the finite water between each growth stage of crops.

Table 3. Rainfall of winter wheat each growing season of different hydrological years

Crop	Hydrological year	Seeding stage	Winterovering period	Reviving stage	Jointing stage	Booting stage	Seed filling stage
Winter wheat	25%	11	13	10	26	16	58
	50%	25	20	11	36	21	59
	75%	13	18	7	15	6	15
	95%	9	13	15	24	15	70

Table 4. Rainfall of summer maize each growing season of different hydrological years (*mm*)

Crop	Hydrological year	Seeding stage	Jointing stage	Earring stage	Seed filling stage
Summer maize	25%	128	197	105	176
	50%	108	124	56	89
	75%	95	121	64	102
	95%	56	46	29	64

3.1.2 Relevant Parameters of Crops

The relevant parameters of winter wheat and summer maize are showed in table 5.

Table 5. Relative parameters of crops

Crops	Potential yield(kg/hm^2)	Plant area(hm^2)	Unit price-(yuan/kg)
Winter wheat	6327.9	10	1.46
Summer maize	9465.9	10	1.16

3.2 Optimization Results

The optimal irrigation regime of different hydrological years and water supply conditions for winter wheat and summer maize by using dynamic programming method is shown in Table 6 and 7. According to many times irrigation experiment results, the step length of decision variable di was confirmed, namely 600m3/hm^2 which was easy to carry out and propitious for increasing degree of homogeneity of irrigation. Table 8 is the optimal irrigation regime of winter wheat and summer maize from Oct. 2003 to Dec. 2004, the rainfall of these two growth stages are both about 716mm which was tantamount to the hydrological year of 25%. Three times were irrigated in the growth age of winter wheat and no time of summer maize, it can been seen that the result is in accord with table 6 and 7.

Table 6. Optimal irrigation regime of different hydrological years for winter wheat

Hydrological year	Available irrigation water (m^3/hm^2)	Stage and irrigation age(m^3/hm^2)						Y / Y_m
		Seeding ～ Winter overing	Winteroverin g ～ Reviving	Revivin g ～ Jointing	Jointin g ～ Bootin g	Booting ～ Seed filling	Seed filling ～ maturation	
25%	600	0	0	600	0	0	0	0.8217
	1200	600	0	0	600	0	0	0.9311
	1800	600	0	0	600	0	600	0.9934
50%	600	0	0	600	0	0	0	0.7489
	1200	600	0	0	600	0	0	0.8476
	1800	600	0	0	600	0	600	0.9207
	2400	600	0	600	600	0	600	0.9625
75%	600	0	0	600	0	0	0	0.6754
	1200	600	0	0	600	0	0	0.7805
	1800	600	0	600	0	600	0	0.8653
	2400	600	0	600	600	0	600	0.9402
95%	600	0	0	600	0	0	0	0.6537
	1200	0	0	600	0	600	0	0.7642
	1800	600	0	600	0	600	0	0.8487
	2400	600	0	600	600	0	600	0.9201

Table 7. Optimal irrigation regime of different hydrological years for summer maize

Hydrological year	Available irrigation water (m^3/hm^2)	Stage and irrigation age (m^3/hm^2)				Y/Y_m
		Seeding ～ Jointing	Jointing ～ Earring	Earring ～ Seed filling	Seed filling ～ maturation	
25%	0	0	0	0	0	0.9913
50%	0	0	0	0	0	0.7342
	600	0	600	0	0	0.9078
75%	600	0	600	0	0	0.7524
	1200	600	0	600	0	0.8951
	1800	600	600	600		0.9652
95%	600	0	600	0	0	0.5435
	1200	600	0	600	0	0.7363
	1800	600	0	600	600	0.8834
	2400	600	600	600	600	0.9315

Table 8. Irrigation regime of double cropping of winter wheat with summer maize (2003-2004)

Irrigation time	Nov. 5th	Mar. 10th	May 10th
Irrigation water(m^3/hm^2)	600	600	600

The optimal distribution results of different finite water for winter wheat and summer maize in each hydrological year are showed in table 9.

Table 9. Partition of water for crops of different hydrological years

hydrological year	Total water （m^3）	Water that optimal distribute to crops （m^3）		Total benefit （ten thousand yuan）
		Winter wheat	Summer maize	
25%	12000	12000	0	13.87
	24000	24000	0	22.36
	36000	36000	0	23.91
50%	12000	12000	0	14.71
	24000	20000	4000	18.35
	36000	28000	8000	19.8
75%	12000	3000	9000	10.56
	24000	24000	0	15.81
	36000	33000	3000	18.95
95%	12000	0	12000	7.7
	24000	16000	8000	11.92
	36000	21000	15000	16.39

4 Summary

(1) Based on the diurnal rainfall data from 1984 to 2003, the experiential cumulative frequency curve was protracted, the precipitations of the four typical hydrological years were confirmed, the precipitation of each growing stage during the representative hydrology years were calculated.

(2) The partition of the finite water between the growth stages and the crops were optimized, the irrigation scheduling of wheat and maize were confirmed, with the dynamic programming method and the model of yield and water consumption of each growing stage.

(3) The partition of the finite water between the growth stages and the crops were optimized, the irrigation scheduling of wheat and maize were confirmed, with the dynamic programming method and the model of yield and water consumption of each growing stage.

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Study on Model of Risk Assessment of Standard Operation in Rural Power Network

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Abstract. Operation risk is the primary risk to rural power company, and it is also an important part of security risk management. The paper establishes a model to assessed risks of standard operation in rural power network, based on Job Risk Analysis (LEC). The example and application of the model in rural power network security risk management system shows that it can realize the real-time assessment of standard operation risk, the model use is simple and the assessment result is accurate. This study has important reference value to practical application of rural power security risk assessment.

Keywords: Model of risks assessment, Standard operation, Rural power network, LEC.

1 Introduction

Security risk assessment management is an important part of modern business management and it also is an effective means to ensure production safety. In recent years, rural power companies are carrying out risk assessment based on its own contents and standards of risks assessment. In these standards, some are cyclical; others are real-time. But they do not give a clear and workable approach to achieve real-time assessment that combine with the standard operating. Hazard identification and control measure is the core of real-time assessment, and the model is the key to achieve real-time evaluation for standard operating. This paper proposes an assessment model that is based on method Job Risk Analysis (LEC) and has been improved and perfected, so that it can be a good combination with the risk level of security risk assessment. The model can quantify the hazard level and the effect of prevention measures, and then calculate the risk level of this operation. Based on these reminders and descriptions of various risk factors leading to the likelihood and severity of accidents, operators can effectively prevent accidents.

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2 Background and Platform

2.1 Background

Security risk assessment management has been widely used in finance, insurance and other industries. In November 2008, based on drawing and absorbing the international advanced management concepts and methods of security, State Grid Corporation arranged and compiled “The Security Risk Assessment Norm to Power Supply Enterprises” and “Supply Enterprise Security Risk Identification and Prevention Operations Manual”. From the standpoint of the company production safety conditions, quality of personnel, scene management, general management, the systematic assessment of enterprise security management, the norm that mainly prevents personal injury and man-made accidents evaluates enterprise security risk rating and guides enterprise to carry out security management.

The risk calculation formula of security risk assessment:

Scoring rate = Σ the actual score of items having been checked / Σ total score of all the items.

Table 1. Risk rating of security risk assessment

scoring rate x	risk rating
x≥0.9	Security controlled
0.9>x≥0.75	Low risk
0.75>x≥0.6	Medium risk
0.6>x≥0.4	High risk
X＜0.4	Out of control

2.2 Platform

In order to carry out security risk assessment management quickly, ChangChun Suburb Branch Company develop the "security risk assessment management system". The system development objective is to achieve security risk assessment scientific, convenient in the application, reliable, cost-saving effect, and provide comprehensive statistical data to decision-making to policy-makers. The system is designed and realized by ASP.NET2.0 techniques as well as the SQL 2000 back-stage database based on the higher prevalence WINDOWS platform. System assessment is divided into two parts: real-time assessment and periodic assessment. Periodic assessment is entirely based on “The Security Risk Assessment Norm to Power Supply Enterprises”; real-time assessment combining with standardized operation is a good complement to periodic assessment. Real-time assessment model based on LEC method been improved and perfected can quantify the hazard level and impact of control measures, and then calculate the risk level of this operation and effectively prevent accidents.

3 LEC Method

3.1 Introduction of LEC Method

LEC method is also named Job Risk Analysis. It's mathematic model as follow:

$$D= L*E*C. \tag{1}$$

Value of D depends on the risk possibility (L), the frequency (E) and the possible consequences (C). This assessment method is straightforward and risk level is clear. But the scores of LEC is determined based primarily on experience, so the stuff who join the assessment work must have experience and can make a fair and objective evaluation of risk control measures.

3.2 LEC Scores and Description

Table 2 shows the possibility of an accident (L) and description.

Table 2. The possibility of an accident (L) and description

score	description
10	Entirely possible
6	Very Likely
3	Possible, but not often
1	completely unexpected
0.5	envisaged
0.2	Highly unlikely
0.1	Impossible

Table 3 shows frequency of exposure to hazardous (E) and description.

Table 3. Frequency of exposure to hazardous (E) and description

score	description
10	Continuous
6	per day
3	Once a week, or occasionally
2	Monthly
1	Several times a year
0.5	Very rare

Table 4 shows that accident may result in the loss of the consequences (C) and description.

Table 4. Score C and description

score	description
100	Disaster, many deaths
40	Disaster, several fatalities
15	serious, one death
7	Serious injury
3	Major accidents, disability
1	Small accident, minor injuries

4 Real-Time Assessment Models

4.1 Assessments Model

First, calculates the risk value D_i for each hazard, and then sum total of this assignment as the risk value, and prompts to the operator. There are many hazards prevention and control measures for each hazard. The score of prevention and control measures will be multiplied by the effect of e_j, divided by the total risk value of risk sources. With reference to table 1, the system reaches the safety risk assessment risk rating. The mathematical model can be described by Equation 2:

$$\sum_{i=1}^{n} (\sum_{j=1}^{k} e_j D_i (a_i - b_i) m_j \% + D_i b_i) / \sum_{i=1}^{n} D_i \tag{2}$$

Table 5 shows the value of a_i and b_i.

Table 5. Relation of a_i , b_i and D_i

D_i	Level of risk	a_i	b_i
＞320	Extremely risk	0.6	0.0
160～320	High risk	0.75	0.4
70～160	Significant risk	0.9	0.6
20～70	General risk	0.95	0.75
＜20	Slightly risk	1	0.85

The effects of a_i and b_i is that for a specific hazard, based on level of risk, risk rating of security risk assessment can be limited in scope. For example, the value of D_i is >320, so the level of risk is extremely risk. For this hazard, even if the operator take protective measures is perfect, in the best case the risk level of this job is the high risk. On the other hand, the level of risk is slightly risk, even if the operator take no protective measures, in the worst case the risk level of this job is the low risk. Meanwhile, the models combine the level of risk and risk rating of security risk assessment well.

Where $m_j\%$ means the percentage level of protective measure's control effect to a specific hazard, and for hazard with k- prevention measures, equation is given by Equation 3:

$$\sum_{j=1}^{k} m_j \% = 1 \tag{3}$$

Where k is the count of prevention measures. After that, the operator can easily score on the prevention measures to avoid the uncertainty scores.

Where e_j means the effect of protective effect to a specific hazard, and $e_j \in [0,1]$. When a hazard with the appropriate control measures can be prevented, then the value of e_j is great; else the value of e_j is small.

4.2 Experimental Data

For example, cutting trees, the system calculate level of security risk based on mathematical model.

Table 6. Parameter values of cutting trees

Hazard	D	a	b	e
Traffic accident	60	0.95	0.75	0.8
falling	84	0.9	0.6	0.8-0.9
Electric shock	135	0.9	0.6	1
Hurt by fallen trees	90	0.9	0.6	0.8-1

The description of hazards prevention measures for each hazard is no detail. According by parameter values of table 6, the system Calculates scoring rate of security risk assessment : (54.6+72.4+117.45+76.68) / (60+84+135+90) =0.87, With reference to table 1, conclusion is Low risk. Result value of 0.87 close to the 0.9 is realistic.

5 Conclusion

Real-time risk assessment plays an important role in the production. The models combine LEC method and risk rating of security risk assessment well. By adjusting the value of each parameter, their corresponding relationship is flexible. With the models, operator can view the level of hazard risk, and know the effect of prevention measures that will be taken, then gain risk level of this job. For primary operator, all information can be warned before work, so accidents can be prevented obviously. At the same time, large amounts of date from routine work can also serve as the basis for statistical analysis and offer reference and decision service to policy makers.

The value of coefficient largely depends on experience with professional staff according to different operations, different circumstances to determine, and the final value needs further study, standardization to make assessment more objective and reasonable.

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Study on Refrigeratory Compressor with Frequency Conversion and Its Economical Efficiency

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Abstract. The energy regulation on the refrigeratory compressor is described. Both the energy-saving principle and performance of conversion compressor are discussed in detail. Two different modes of the control for compressor, frequency conversion cooling and full-frequency run, are compared here. It is concluded that frequency conversion is better than full-frequency on energy-saving. The energy saving and the most economical way of the conversion technology in refrigeration system are demonstrated by an example. Rate of return on investment is higher to apply frequency conversion for compressor in cold storage.

Keywords: Compressor, Frequency Conversion, Refrigeratory, Energy-saving.

1 Introduction

It is essential that the quality of fruits and vegetables is sustained by pre-cooling and cold storage. Compressor in cold storage is the most energy-consuming unit in the refrigeration system, which consumes 30% of the input power of the electric machinery[1]. The property of the compressor is the most important in the whole refrigeration system. Now more researchers focus on frequency conversion applied on compressor, and propose better advice[2]~[5].Those compressor are mainly applied on air conditioning, some on electric refrigerator. There are few literatures about cold storage with frequency conversion. Now the main mode for temperature control is on-off full-frequency in pre-cooling and cold storage. The control precision of temperature and humidity by full-frequency is less than that by frequency conversion, even more energy is wasted[6]. In the paper, energy-saving by frequency conversion on compressor is discussed in pre-cooling and cold storage and its prospect is analyzed in detail.

2 Energy-Regulating and Energy-Consuming

The choice of compressor is based on the refrigerating output. The environmental temperature of the refrigeration system is between the extreme high one in summer

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and the extreme low one in winter. It fluctuates more than that of the air conditioning system. It is shown by literature [7] that cold container works in its partial condition during most time. There is a great difference between actual application and ISO criteria for cold container. The common cold storage is even so. So it is necessary to regulate energy in order to match the refrigerating output with thermal loading and make the compressor serve the more conditions.

Table 1. Regulating means and its energy-consuming

Regulating means	Feature	Power-consuming rate at 60% load (%)
On/off	simple structure, low price, low accuracy control, commonly used in compact units with partly thermal loading, and much energy-consuming at enablement.	63%
cylinder off-bear	Step regulation, used in units with several cylinders and low efficiency at partly thermal loading	-----
inspiration throttle	stepless regulation, simple structure, regulation range limited, and low efficiency	70%
hot gas by-pass	stepless regulation, complicated construcure, and low efficiency	100%
frequency conversion	stepless regulation, simple constructure, high accuracy control, high efficiency, and high cost	60%

There are several regulation means for compressor to control the energy-consuming, such as On/off, inspiration throttle, cylinder off-bear, hot gas by-pass and frequency conversion. Refrigeration compressor in cold storage mostly depends on On/off to control the energy-consuming. When temperature in cold storage is higher than that of the upper limit set, compressor starts to decrease the temperature. While temperature in cold storage is lower than that of the low limit set, compressor stops. Therefore, temperature in the cold storage fluctuates between the low limit set and the up limit set. On/off is suitable for the thermal loading fluctuating little. In fact, thermal loading of cold storage varies much due of the season. In addition, the load of the portable cold storage and the cold container is influenced by the climate in different place. The compressor works in varying condition, enables and closes down frequently. This results in energy-consuming and leads to reduction of service life of the compressor at the same time. So On/off has much limitation. With the development of frequency conversion, it is widely used in air conditioning compressor, which provides much information to apply it on refrigeration compressor in cold storage. The features[5][7] of stepless regulation, simple construction, high accuracy control and high efficiency of frequency conversion make frequency conversion have a good prospect in application on cold storage.

3 Theoretical Analysis of Energy-Saving of Compressor with Frequency Conversion

Given a certain condition, refrigerating output is ratio to mass flux of refrigerant. The basic theory of frequency conversion is based on rotating speed of compressor to obtain different mass flux of refrigerant and to gain refrigerating output expected.

Energy-consuming is obtained by theoretical analysis as follows:

$$N = \frac{Q}{\eta_1\eta_2}\frac{1}{\varepsilon} = \frac{Q}{\eta_1\eta_2}\frac{H_2 - H_1}{H_1 - H_4} = QK \tag{1}$$

$$K = \frac{1}{\eta_1\eta_2}\frac{H_2 - H_1}{H_1 - H_4} \tag{2}$$

$$Q = Cn\lambda q_v \tag{3}$$

where K-effective power consumption per refrigerating output

C-structural coefficient of compressor
Q-refrigerating output
q_v-refrigerating output per volume
λ-transfer coefficient ε-EER
n-number of speeds $H_{1\sim4}$-enthalpy
η_1-mechanical efficiency η_2-adiabatic efficiency

It is concluded from the equation (1)-(3) that power consumption is related to both K of effective power consumption per refrigerating output and Q of effective power consumption per refrigerating output. When the thermal loading decreases, rotating speed of compressor is reduced by transducer. It can be seen from Fig. 1. This leads to the reduction of mass flux. So the condensing temperature of refrigerant increases, the evaporating temperature of it decreases, the value of (H2-H1)/(H1-H4) decreases, and the refrigerating output decreases. On the other hand, it is showed in Fig. 2 that reduction of rotating speed will lead to the reduction of friction work and increase of adiabatic efficiency. It decreases K. The power consumption is greatly reduced by decreasing rotating speed of compressor at partial loading. The power consumption versus mass flux of refrigerant is nearly linear[8][9]. Conclusions can be drawn from Fig. 3 that EER is 40%~90% of high rate of rotating speed. The effect of energy-saving is very obvious.

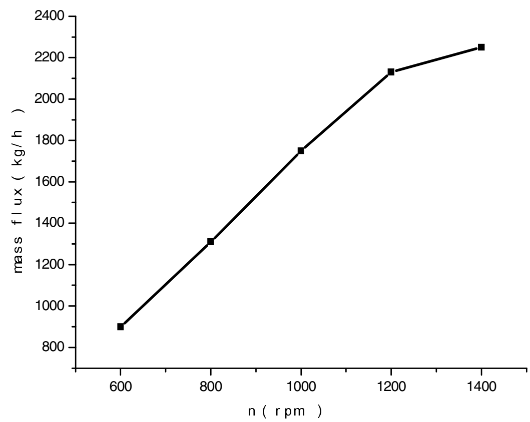

Fig. 1. Relations between mass flux and rotating speed

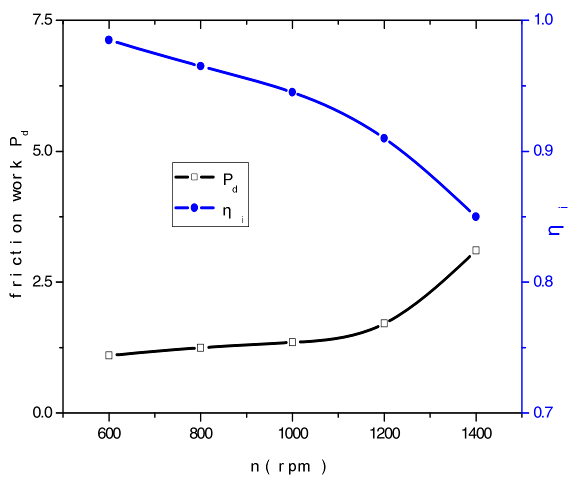

Fig. 2. Relations between friction work, adiabatic efficiency and rotating speed

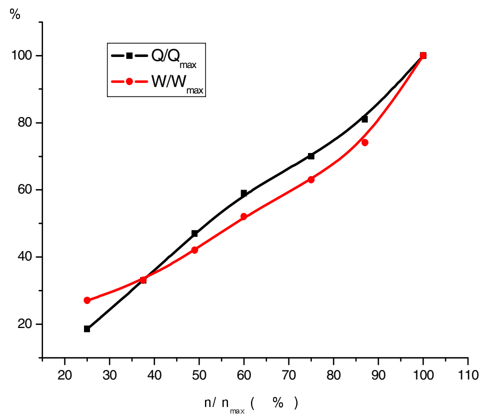

Fig. 3. Relations between the rates of refrigerating output, power consumption and rotate speed

4 Analysis of Energy-Saving of Frequency Conversion and Its Economical Efficiency

The portable cold storage is examined in the fruits and vegetables place of origin. There are two compressors in a cold storage. The power of one compressor is 2.2kw, air exhaust of it is 9.38m3/h, and rotating speed of it is 2950rpm.

4.1 Thermal Loading of the Portable Cold Storage

1 Thermal loading from cold storage wall

The surrounding T1 is 40℃, the extreme high temperature, temperature T2 is 0 in cold storage, and the thermal conductivity λ of the cold storage wall with 100mm is 0.032W/(m·K) ,the heat transfer area A is 46m^2, and the inner volume V of the cold storage is 15.625m3 The thermal loading q1 is 563w, which is obtained according to Fourier equation as follows:

$$q1=\lambda\times A\times(T1\text{-}T2)/\ \delta=0.032\times 44\times 40/0.1=563(w) \tag{4}$$

The thermal loading q2 caused by gas exchanger for fresh air in cold storage is 50w.

2 Thermal loading of fruits and vegetables

It is presumed that specific heat of grapes is 3.6kJ/kg•℃ and density is 300kg/m^3. It is supposed that the body temperature decreases from 30 of T3 to 0 of T4 within 8 hours and the capacity coefficient of the cold storage is 0.4, which demonstrates the ratio of volume of grapes to volume of cold storage. Thermal loading q3 of fruits and vegetables is 7031w, which is calculated as follows:

$$q3=C\times\rho\times 0.4\times V\times(T3\text{-}4)/t=3600\times 300\times 0.4\times 15.625(30\text{-}0)/(8\times 3600)=7031w \tag{5}$$

3 Thermal loading caused by respiration of grapes

At 30℃, the coefficient q40 of respiration heat is 420kJ/(T·h) The overall thermal loading q4 caused by respiration of grapes is 218.75w, which is calculated as follows:

$$q4=\rho\times0.4\times V\times q40= 300\times0.4\times15.625\times420/3600=218.75(w) \tag{6}$$

4 Total thermal loading q5 calculates as follows:

$$q=q1+q2+q3+q4+q5=563+50+7031+218.75=7862.75w \tag{7}$$

The total thermal loading is taken to be 8000w.
The power of compressor is 4.4kw if EER is 2.

4.2 Energy Calculation and Economics Analysis

Table 2. Thermal loading and energy-consuming

thermal loading(%)	energy-consuming of compressor(w.h)		energy-saving rate(%)
	Frequency conversion	ON/OFF	
20	300	522	43
30	496	687	28
50	886	1016	13
70	1277	1345	5
80	1472	1509	2
100	1863	2200	0

According to Table 2, power-consuming in a month between frequency conversion and ON-OF is compared after initial stages of pre-cooling at the total thermal loading 20%.

The amount of electricity is saved by 94376.8 w·h of H_s,

$$H_s=2\times(522-300)\times30\times24\times2200/1863=94376.8(w.h) \tag{8}$$

The weight of grapes being pre-cooled in a cold storage, W

$$W=300\times15.625\times0.4=1875(kg) \tag{9}$$

If the weight of grapes is 20000kg, the total amount of electricity will be saved by H_t.

$$Ht =94376.8\times20000/1875/1000=1006.686(kw.h) \tag{10}$$

The profit of ￥503.3 will be obtained in a month considered the common electricity price of ￥0.5/(kw.h). A common transducer is ￥2000-3000.

So rate of return on investment is higher to apply frequency conversion for compressor in cold storage.

5 Conclusions

The energy regulation on the refrigeratory compressor by frequency conversion is better than that by full-frequency. On/off is suitable for the thermal loading fluctuating little. It is favorable for compressors by frequency conversion to work in varying condition, which can enable and close down frequently. The most economical way for energy-saving are demonstrated by an example. Rate of return on investment is higher to apply frequency conversion for compressor in cold storage.

High efficiency and energy-saving, environmental protection, stepless regulating, and little noises will be the future features of the refrigeration compressor in cold storage. Compared with other means for energy regulation, frequency conversion application has a new broad prospect because of its features.

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Study on the Parameters' Acquisition Method of Distributed Hydrological Model Based on RS

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Abstract. Parameters' acquisition is a key step for the distributed hydrological model when simulating a basin. Based on remote sensing technology, this article proposed a parameters acquisition method of distributed hydrological model. That is extracting the important ground objects' information from the images to obtain some parameters of the model. This article also used the hierarchical classification principle, and introduced the extraction method of several ground objects. At last, by means of TopModel, we simulated the Xueye Reservoir, Laiwu City in Shandong Province. The experiment shows that this method can effectively improve the accuracy of model simulation.

1 Presentation of Questions

Distributed hydrological model is a kind of hydrological model, the model's advantage is able to take into account vegetation, soil, topography and other factors' impact on the hydrological processes in the watershed, and the spatial differences that existent in these elements can more accurately reflect the actual movement of hydrological [1]. So this model has been widespread concern in actual production. However, parameters used in distributed hydrological model generally have physical meaning, using the usual means of obtaining these parameters is more difficult, it limits the application of distributed hydrological model. As the improvement of remote sensing technology, now we can easily access remote sensing image of high-resolution and high spectrum, obtaining the soil, vegetation, geomorphology, topography, land use and other information underlying surface based on remote sensing become an effective mean.

At present, there hasn't formulation of parameters' acquisition method on the distributed hydrological model, the parameters' acquisition only exists as necessary stage in the process of hydrological modeling. In the study of watershed distributed hydrological model based on spatial information technology, Ling Feng referred to the parameters' acquisition of distributed TOPMODEL, mainly obtained the ground cover and soil data. Based on remote sensing technology, this article studied the parameters' acquisition method distributed hydrological model.

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2 TopModel

TOPMODEL is short for Topography Based Hydrological MODEL. It is a terrain-based semi-distributed hydrological model, proposed by Beven and Kirky in 1979. TOPModel uses terrain space as the main structure, use terrain information (topographic index ln(α/tanβ) or Soil - topographic index ln (α / Totanβ), α represents the drainage area of the unit contour length, tanβ represents the ground slope, T represents the soil permeability coefficient) to describe flow trends, based on the role of gravity drainage runoff along the slope movement principle, to simulate the runoff process [2]. Since proposed, the model has been widely used.

2.1 The Basic Structure of the Model

TOPMODEL's calculation structure is shown in Figure 1, Model divide the watershed into vegetation root zone, unsaturated zone and saturated soil zone three levels. In the vertical direction, first, rain enter vegetation root zone through infiltration, some of the moisture that reach the region is lost through evapotranspiration, while the rest continue to filter down to reach the unsaturated soil zone; The moisture that reach the region first enter the saturated groundwater area at a certain rate, and then form soil midstream through lateral flow, and move in the form of soil midstream; If the water surface of saturated groundwater zone rise constantly, the stream that enter this part will show out the ground in the low-lying area, which will form the overland flow.

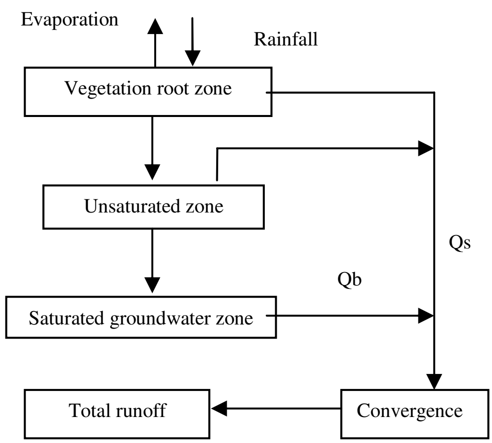

Fig. 1. Structure frame diagram of TOPMODEL

According to the production flow theory of TopModel, soil midstream Q_b and saturated overland flow Q_s together constitute the total runoff of watershed. The main calculation is as follows:

(1) Calculation of evapotranspiration. The model believes that evapotranspiration only occurs in vegetation root zone, evaporation E_a is calculated as:

$$E_{a,i} = E_p \left(1 - \frac{S_{rz,i}}{S_{r\max,i}} \right) \tag{2.1}$$

In this formula, $S_{rz,i}$ is the volume of water shortage of vegetation root zone of point i; $S_{r\max}$ is the biggest water capacity of root zone; E_p is the evaporation capacity.

(2) Calculation of infiltration rate. The model believes that moisture of unsaturated zone finally enter the saturated zone at a certain rate, which mainly depends on soil structure and the current water storage situation. Equation (2.2) gives the calculation method of infiltration rate at point i:

$$q_{v,i} = \frac{S_{uz,i}}{SD_i t_d} \tag{2.2}$$

In this formula: $q_{v,i}$ represents the infiltration rate at this point, $S_{uz,i}$ is the current Soil Moisture; SD_i is the biggest storage capacity, in the actual calculation, SD_i is always replaced by z_i, which is the depth between the groundwater and surface; t_d is a time parameter.

(3) Calculation of saturated groundwater. Model first proposed three assumptions: interflow always in a steady state, that is, the rate of interflow is equal to the rate of the upstream; the hydraulic gradient of saturated groundwater is equal to surface local slope; soil hydraulic conductivity can be expressed by negative exponential function of saturated ground water zone's water depth, on this basis, use the following method to calculate the depth of surface water:

$$Z_i = -S_{zm} \cdot \ln \left(\frac{\alpha_i \cdot R}{T_0 \cdot \tan \beta_i} \right) \tag{2.3}$$

(4) Saturation overland flow. Saturation overland flow will form when the depth between the saturated ground water and surface is negative, calculated as:

$$Q_s = \frac{1}{\Delta t} \sum_i \max \left\{ \left[S_{us,i} - \max (z_i, 0) \right], o \right\} A_i \tag{2.4}$$

Δt is the time step, A_i is the effective runoff area.

(5) Interflow.

$$Q_b = \int_L q_i \, dL \tag{2.5}$$

(6) Confluence. Confluence's calculation contains confluence's calculation of slope and confluence's calculation of riverway, the delay time that associated with distance is used to calculate slope confluence, and a method that based on average

flood wave velocity is used to calculate river confluence. Formula (5.6) is used to calculate the needed time from one point to the watershed's outlet:

$$t = \sum_{i=1}^{N} \left[x_i / \left(v \bullet \tan \beta_i \right) \right] \tag{2.6}$$

In the formula, x_i is a length, Tanβi is the slope of I in the N section flow path, v is a speed parameter, as a constant. In the actual calculations, we can use a dimensionless distribution function curve that is similar to unit normal to calculate the output process of runoff, assume the runoff is equal in the entire watershed, and then divide the main channel into different levels for confluence.

2.2 The Needed Parameters in TopModel's Calculation

In TopModel, the main parameters used are in the following:

SZM: the parameter of index conduction function;
T0: when the soil reach saturated, T0 is the natural logarithm of soil effective conductivity;
Td: time parameter of gravity drainage;
SRmax: maximum water storage capacity of vegetation root zone;
SRinit: initial soil moisture initial value of vegetation root zone;
RV: the effective rate of surface overland flow;
ChVel: the effective rate of convergence of the main river.

3 The Parameters' Acquisition Method of Hydrological Model Based on RS

3.1 The Data of MODIS and ETM

MODIS is the main detector of EOS-AM1 satellite. It belongs to a kind of high spectral sensor, whose band is discontinue, (spectral range from 0.4 to 14.5), and ground resolution is very low (the resolution is 250m, 500m, 1000m). The resolution of ETM + data is very high, but the number of bands is small (only 8 bands). Table 1 gives the characteristics of each band.

Table 1. ETM data characteristics table

Wave band	Type	Spectral range (um)	Ground resolution (m)
1	Blue-Green	0.450-0.515	30
2	Green	0.525-0.605	30
3	Red	0.630-0.690	30
4	Near IR	0.775-0.900	30
5	SWIR	1.550-1.750	30
6	LWIR	10.40-12.50	60
7	SWIR	2.090-2.350	30
8	Pan	0.520-0.900	15

3.2 The Technology of Image Fusion

Image fusion is a process that the multiple remote sensing images according to certain algorithms, in the prescribed geographic coordinate system, generate a new image. Through data fusion, on the one hand, we can remove the useless information pertinently, eliminate redundancy, and reduce data processing dramatically to improve the efficiency of data processing; on the other hand, we can also gather the useful information in the massive multi-source data to facilitate all kinds of information facilitate all kinds of information, and exert respective strengths to get more useful information. In this study, the MODIS data and ETM + data was fused to make the experimental data to reach the purpose of simple and information complementary.

In this study, the fusion wavelet transform-based, main steps are as follows: suppose A, B as the two original images, F is the fused image. First, transform each source image separately, to establish the small towers shape decomposition of the image; second, fuse each decomposition layer, different frequency components of each decomposition layer can be fused with different fusion operator, and finally get the fused wavelet pyramid; at last, carry out inverse wavelet transform on the fused wavelet pyramid (that is, the image reconstruction), the reconstructed image obtained is the fused image. Figure 2 is the fused image.

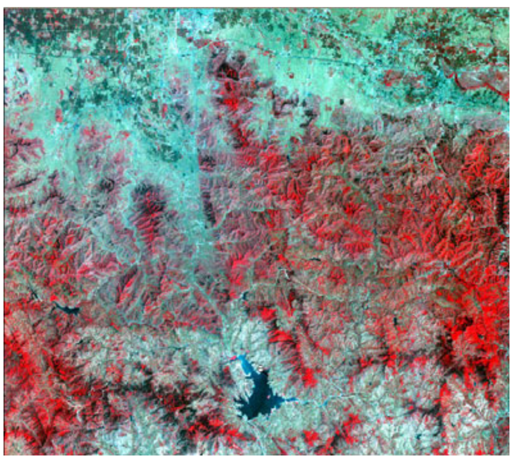

Fig. 2. The fused image

3.3 Hierarchical Classification Structure

In the application of multi-band remote sensing data, selecting a reasonable band combination or band operation to extract information is an important means to improve the classification accuracy and work efficiency. According to remote sensing Classification theory, each kind of ground objects can be characterized by spectral curve to show its unique internal features. In practice, due to a variety of sample imaging environment, makes the spectral information on images complex and changing. But for most remote sensing images, there are also several kinds of ground objects on a leading position, such as water, vegetation, rocks and soil. From the view of spectrum, these features of the ground objects can be characterized uniquely, the information that decides the basic types of images is always referred as a spectrum of information. Starting from the characteristics of remote sensing, we can use the Figure 3's hierarchical structure to express the classification information.

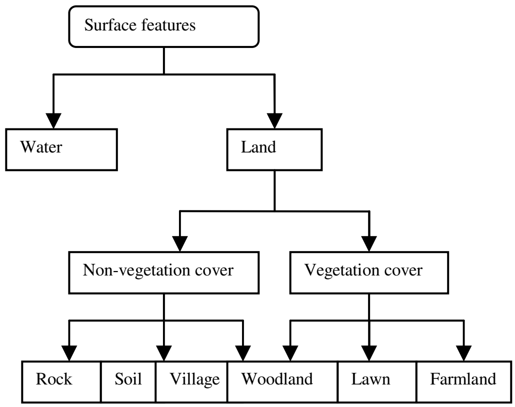

Fig. 3. The hierarchical classification chart

3.4 The Feature Space of Water Body and the Main Background Ground Objects

Water nearly absorbs all of the primary energy in the near infrared band, so the reflected energy in this band is very little, while plants and soil absorbed little energy in this band, so with a high reflectance characteristics. This makes water has significant difference between vegetation and soil in this band. In this band, the water shows dark tones, while the soil and vegetation is able to show relatively bright colors. However, when in the mountains, this might change because of the effect of the shadow of the mountain, for short infrared, the reflection in the shade is very low, which makes the shadow region in the image also has a clear dark tone, thereby makes it difficult to correctly distinguish water bodies and shadows.

Table 2. The spectrum brightness value of Water and the background ground objects

	Band 2		Band 3		Band 4		Band 5		Band 7	
	Values of samples	Mean	Values of samples	Mean	Values of samples	Mean	Values of samples	Mean	Values of samples	Mean
Water	28,26,27, 30,34	29	3,0,0,9,14	5	13,12,12, 15,15	13	6,6,8,5,6	6	5,1,2,1,3	2
Woodland	24,26,30, 25,25	25	1,3,0,2,5	2	53,50,55, 59,49	53	47,43,48, 56,49	49	15,14,12, 15,18	15
village	31,32,29, 29,31	30	14,17,14, 10,19	15	28,31,30, 26,32	29	30,41,58, 42,54	45	17,24,32, 26,31	26
Farmland	39,36,36, 36,38,33	36	41,32,37, 40,31	36	59,54,49, 54,49	53	105,84, 93,103,82	95	57,43,47, 53,43	47
Shadow	21,21,22,2 0,22	21	0,0,0,0,0	0	13,17,19, 17,20	17	10,7,13, 9,11	10	2,2,4,3,4	3

In remote sensing images, we select typical pixels for water body and the background ground objects such as woodlands, residential areas, farmland and shadow, and statistic the spectrum brightness values, as shown in Table 2.

From the table we can see, in the band 2, water bodies can't easily distinguish with village and farmland; while easily distinguish with shadow and Woodland. In band 3, the water and farmland has significantly difference, while has some confusion with Woodland and shadow. In band 4, the water body and other background ground objects all have obvious differences. In the band 5 and band 7, the water can distinguish with Woodland, village and farmland, but easily confused with shadow. According to sampling points of the same ground objects in the same wavelength, we can do the mean statistics, and make objects spectrum diagram, as is shown in Figure 4.

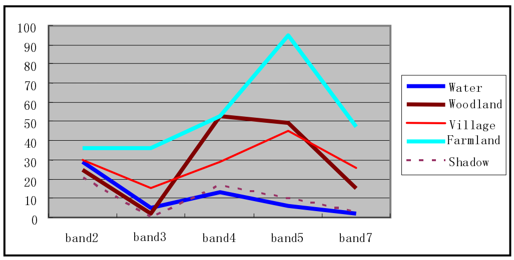

Fig. 4. Object Spectrum Chart

As we can see from the spectrum chart, the gray of water and shadow in the band 5 was significantly less than the band 2, while other background objects are the opposite. In the band 2 and 3, the gray value of water is generally greater than the shadow's gray value. While in the band 4 and 5, the gray value of the shadow is generally greater than the water's gray value, add the two bands, you can increase the difference between water body and shadow. Add the band 2 and 3, add band 4 and 5, the enhanced spectrum chart is shown in Figure 5.

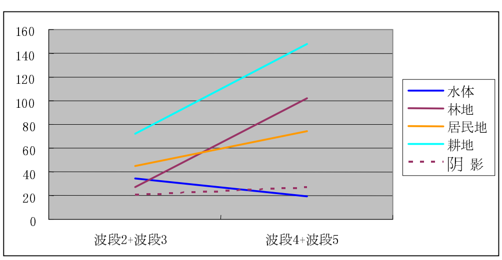

Fig. 5. The enhanced spectral chart

As we can see from the above chart, after the band combination, water and other background ground objects can distinguish more obviously. So, we can use the spectrum value of the combination of band 2 + band 3, band 4 + band 5 to compose feature space to extract water, woodland, village, farmland and shadow.

3.5 Parameters' Acquisition

Remote sensing data (aerial photographs and satellite images) can provide information on spatial characteristics of watershed, is the most feasible method to describe hydrological variability, especially in the absence of regional ground-based observations. In distributed hydrological modeling, the application of remote sensing data can be summarized as follows: used as the input data and parameter estimation of the model, there are seven specific areas: 1) rainfall intensity's observation and spatial pattern; 2) the calculation of evapotranspiration and soil moisture retrieval; 3) snow cover; 4) groundwater; 5) land cover and land use classification; 6) water feature; 7) vegetation parameter extraction [6].

For each basin, because the condition of underlying surface is different, when carries on the simulation of the basin, different basin's model parameter ought to be able to reflect under the pad surface condition spatial variation. However, in practice, in addition to the differences in the terrain can take advantage of each basin's terrain exponential distribution function, model parameters that reflect the vegetation, soil conditions can not are difficult to obtain through actual measurements, you can only use hydrologic data to rate parameters.

The biggest storage capacity of vegetation root area SRmax is a pattern parameter, soil parameters can obtain by referring to elated content of the AGWA [6] model. The parameters related to soil is soil saturated hydraulic conductivity T_0 and soil hydraulic conductivity along with depth of soil change coefficient of attenuation M, the soil saturated hydraulic conductivity determined according to the soil texture:

$$T_0 = P_{clayey} \times T_{0clayey} + P_{sand} \times T_{0sand} + P_{silt} \times T_{0silt} \tag{3.1}$$

In the formula: P_{clayey}, P_{sand} and P_{silt} represent the percentage of clayey sand and silt in the soil, if the basin contains many kinds of different types the soils, then we can calculate by area weighted average of different soil types; $T_{0clayey}$, T_{0sand} and T_{0silt} represent the saturated hydraulic conductivities of the three material, and need to rate through the actual material.

4 Experimental Results and Discussion

4.1 Experimental Area and Data Source

The experiment was carried out in the Xueye Reservoir, Laiwu City in Shandong Province. Xueye reservoir is one large reservoir of Shandong Province, controls the drainage area of 444 square kilometers, has a total capacity of 221 million cubic meters, has useful storage capacity of 112 million cubic meters, and dead storage of 2.8 million cubic meters. The location of Reservoir is very superior, and the materials are very rich, which provide a favorable condition for the experiment. Figure 6 is the position diagram of Xueye Reservoir.

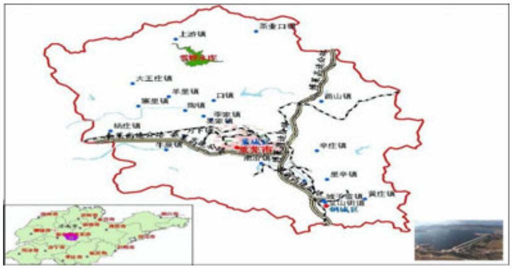

Fig. 6. The position diagram of Xueye Reservoir

MODIS data is downloaded from the Global land cover Fund web, the resolution is 30m, ETM + data is the image data including Xueye Reservoir Basin with eight-band.

4.2 Watershed Simulation

In order to verify the validity of the above parameters acquisition method, according to the extracted results, this article used TopModel and the actual data of Xueye Reservoir, carried out the simulation on Xueye Reservoir basin.

According to the classification rules of Chapter III, we extracted the fused image using the supervised classification methods in REDAS, and got the information of 6 kinds of ground objects. The result is as follows:

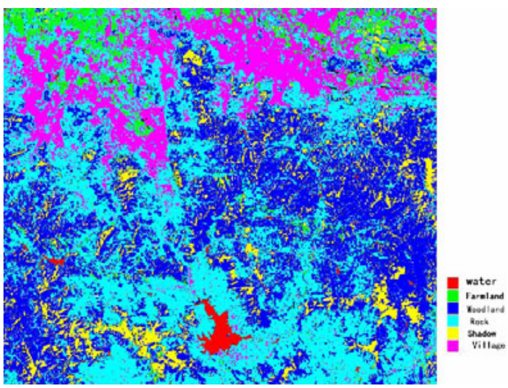

Fig. 7. Classification Results Chart

According to the results of classification to caculate model parameters.

Then we selected the eight years' flood from 2001 to 2008, and carried out the simulation. According to hydrological norms, we introduced the certainty factor DC, the relative runoff error Er, relative peak error of Eq, and peak time error t, these parameters are the evaluation indexes in a screening flood. The process of simulation is as shown from Figure 9 to Figure 15, table 3 gives the evaluation index.

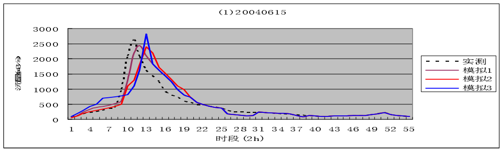

Fig. 8. The flood simulation situation of No. 20040615

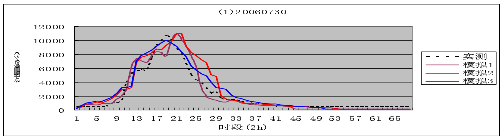

Fig. 9. The flood simulation situation of No. 20060730

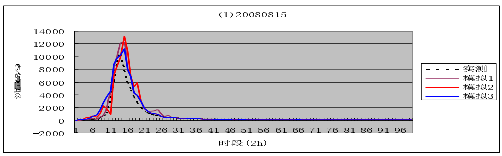

Fig. 10. The flood simulation situation of No. 20080815

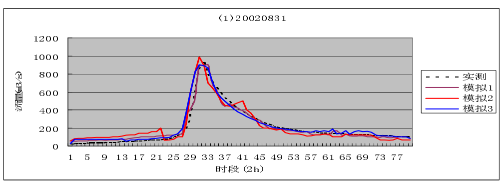

Fig. 11. The flood simulation situation of No. 20020831

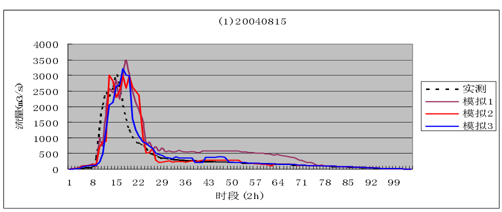

Fig. 12. The flood simulation situation of No. 20040815

From the simulation results we can see, besides the No. 20060730 flood, the uncertainty factor is all higher than 75%, and besides the No. 20060729 flood the runoff error is all smaller than the required 20%. The result reaches the B level, and we can say the method can be applied to practical production.

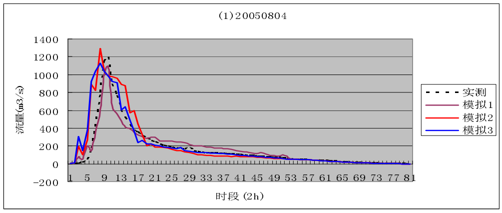

Fig. 13. The flood simulation situation of No. 20050804

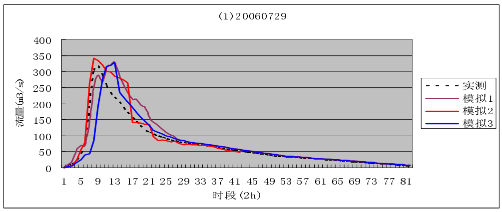

Fig. 14. The flood simulation situation of No. 20060729

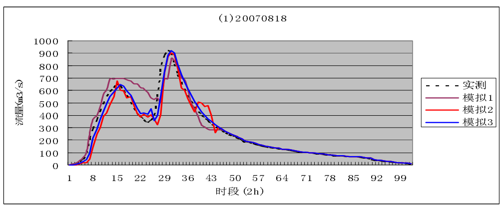

Fig. 15. The flood simulation situation of No. 20070818

Table 3. Parameter calibration case

Flood NO.	DC	$E_R(\%)$	$E_q(\%)$	$\tau(\%)$
20040615	0. 88	25. 24	0. 81	0
20060730	0. 67	-26. 32	-33. 37	-1
20080815	0. 74	25. 5	-17. 1	1
20020831	0. 71	28. 51	-20. 75	1
20040815	0. 9	-3	-14. 3	1
20050804	0. 93	-9. 31	1. 91	0
20060729	0. 78	-17. 89	-27. 67	0
20070818	0. 78	36. 47	-10. 91	1
Mean	0. 8	7. 4	-15. 17	

5 Conclusions

Based on the hierarchical classification principle, this article studied the classification problem of remote sensing images, and finally proposed a parameters' acquisition method of distributed hydrological model. The method is to extract information that is relevant to distributed hydrological model parameters from remote sensing images. Compared with traditional methods of parameter determination, the method that using RS to obtain hydrological model parameters is more convenient [3]. At last, this article used TOPMODEL to simulate Xueye Reservoir, the result shows that the method has some practical value.

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The Design and Implementation of Halal Beef Wholly Quality Traceability System

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Abstract. In recent years, there are many food quality problems have happened. And they have had a serious effect on people's physical and mental health. The quality tracing of livestock products have arrested the intensively attention of the society of different parts. In NingXia, which is as the main living place of Hui National people, the industry of Halal beef and mutton is one of the leading industries for the development of local agriculture. Based on the requirement of agricultural informatization of NingXia and other similar regions in the West of China, according to the HACCP and GMP management concept, we have developed a feasible system to trace the Halal Beef quality during the whole production process. Details are as follows: realizing the information collection about beef farming process, and establishing the quality information database of the Halal beef products, and integrating the application of the RFID、EAN/UCC-128 barcode, Pdf417 2-D barcode, GSM technology and Internet technology at the same time. The system makes it possible that the customer can trace the whole production process of the beef through SMS, Telephone, Internet, and scanning the barcode with smart phones or others means after shopping the beef. And the system realizes the whole quality tracing and Muslim tracing of the beef during the process of the farming, slaughtering and logistics. So the design and realization of the system are important technical basis of Islamic meat quality and safety for NingXia and other similar regions in the West of China.

Keywords: Beef, Quality tracing, Halal tracing, Rfid, Barcode.

1 Introduction

Along with the enhancement of living standards and the changes in the dietary concept, the pursuit of high nutrition, high protein and green meat has become a trend. According to the analysis, it is predicted that 70% of our animal food demand will depend on the development of animal husbandry in the western region, which will provide a huge market space for the cattle and sheep industry of western region includes Ningxia. And for the epidemic of "mad cow" in European, China has become the first choice market for Europe and the United States to import beef and mutton. In

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recent years, the export quantity of high-grade beef and mutton has increased year by year in our country. And the future market space of high-grade beef and mutton will be more extensive.[1]

For Ningxia, which has been planned as the production place for high quality beef according to the government layout for new round of national dominant agricultural products, the cattle industry is the advanced and distinctive industry. When Ningxia meet the demand of high-quality beef in the Northwest, it also expands the market to the Muslim market of Central Asia and the Middle East. Ningxia, which is as the only Hui Autonomous Region in China, has the advantage of abundant resources and brand to develop Halal beef industry.

But over the past decade, the break out of animal epidemic situation (for example: the mad cow disease, foot and mouth disease, avian flu) and the safe food accidents ("clenobuterol hydrochloride ", water injection meat , rubbish pig) occur frequently, which have brought great threat to people's body and psychological health and have stricken the consumer’s confidence to livestock products heavily[3] [4]. Safe problem of the livestock products has aroused the intensively attention of public. European Union, USA, Australia and other developed countries have set up laws and regulations to fix the compulsory request to guarantee the traceability of the quality safety of beef products [5] .

Currently the production management in large-scale cattle farm is mainly based on traditional methods. The disadvantage of traditional methods is lack of complete information in breeding, feeding, migration, epidemic prevention, slaughter and processing, marketing and other aspects. So it is difficult to achieve safe, high quality, efficient and the requirement of sustainability [5]. Though Ningxia's Halal animal products have certain characteristics, the whole scale is not large, and it is also lack of strict Halal certification program from product source to logistics of the Halal animal products, and lack of origin quality tracing in the whole process, which has seriously restricted further development of Halal Industry.

The aim of the design and implementation of Halal beef wholly quality traceability system is to meet the demand of the agricultural informatization of NingXia and other similar regions in the West of China. On the basis of the equipments in hand of the farming-zones and the slaughtering and processing corporations, according to the requirements of the users and the HACCP(Hazard Analysis Critical Control Point) and GMP(Good Manufacturing Practice） management system, we have researched and developed a series of valuable design and implementation of Halal beef quality traceability system. Details are as follows: realize the collection of the information of beef farming process, and establish the database of the Halal beef products' important quality information. Meanwhile, integrate the technology application of the RFID, EAN/UCC-128 bar code, Two-dimensional barcode, GSM technology and Internet technology all together.

The design and implementation of this system is helpful for standardization of the farming of Halal livestock husbandry, the standardization of the slaughtering and the informatization of the management processing in NingXia and other areas in the West. And it provides the advanced technical supports for popularity of Ningxia Halal livestock brand and the improvement of the brand international competitiveness.

2 Overall Structure of System

Through the research and analysis, this paper proposes a solution for the Halal beef wholly quality traceability system based on the Internet of things. In the farm, in order to identify each domestic animal, we can wear RFID tags to each cattle. Then related information can be recorded through the RFID identification, which includes the purchase, breeding cycles, use of forage, veterinary drug name for therapeutic use and epidemic prevention, quarantine, transport, being out of market and other sectors. Establish breeding records and collect data to the central server through the RFID reading and writing device. In the abattoir, the operator can read cattle ear tag by the handheld device. If the quarantine meets the requirement of standard, the operator will transfer ear code to the product label. Then the slaughter of the cattle is released and the information of beef products can be input into back-end database. The system prints quarantine certificate and bound the label on the cattle carcass; in the process of the division, prints the EAN/UCC-128 back yards and two-dimensional PDF417 security barcode and pastes them on the package, and collects data to the central server to enable consumers to get back yards after buying beef products. Then the consumers can date back to the key information of product by SMS, Internet and phone. The system hardware architecture is shown in figure 1.

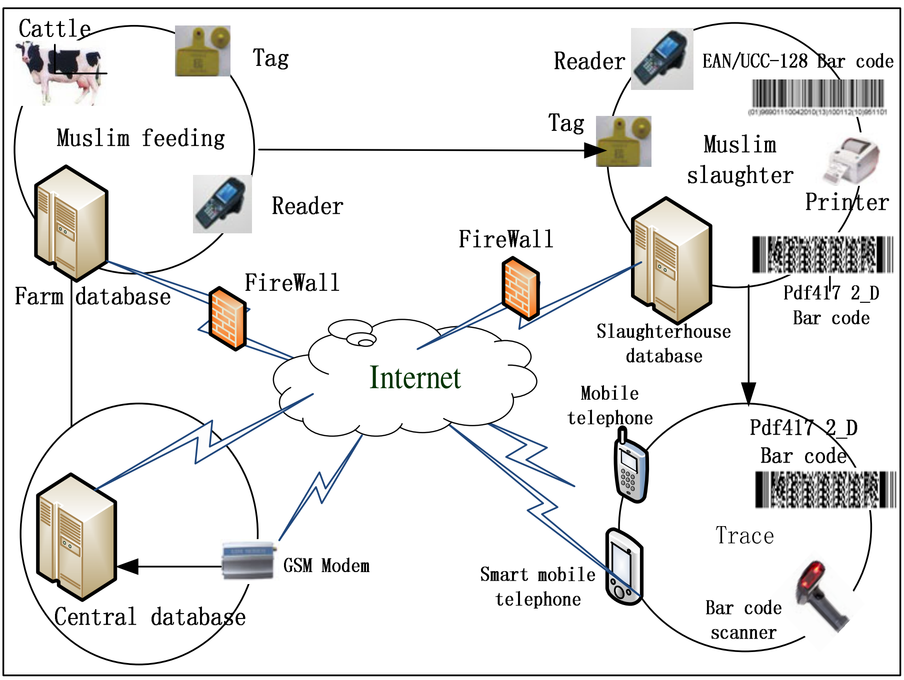

Fig. 1. Overall structure of system

3 Main Technologies

3.1 Cattle Identification Code Design

According to the requirements of "Animal identification and breeding records management practices" of Ministry of Agriculture, the implementation of a livestock animal identification must be one code only for one animal and the code must be unique. Animal identification code consists of a total of 15-digit serial number including the livestock and poultry species code, county administrative code and identification sequence number [6]. The composition of special bar code is shown in Fig. 2.

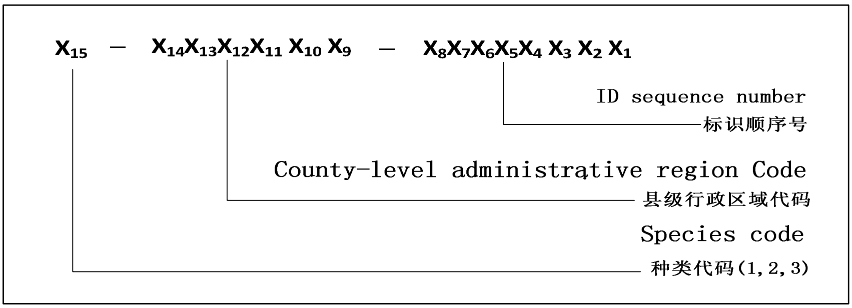

Fig. 2. Labeling codes expression for a single livestock

Among them, the first digit shows the species of the animal. And species codes of pigs, cattle, sheep are respectively 1, 2, 3. The next 6-digit is on behalf of area code of the county (city) level administrative where farms or farmers are in, which following the rule of GB/T 2260-1999 standard; next 8 digits from the eighth to fifteenth represents the sequence number of the same species of livestock in the same administrative region. For example the code "264, 010, 500, 003, 268," it expresses that the type of animal is cattle, that the cattle is fed in Xixia district of Yinchuan city of Ningxia (administrative region code is 640105) and that the sequence of the designated cattle in Xixia is 00003268.

3.2 The Scheme of RFID Applications

RFID is the abbreviation for Radio Frequency Identification. It identifies the target and gets relevant data automatically by its radio frequency signal and it can work in a variety of harsh environments without human intervention. Basic RFID system is composed of Tag, Reader and Antenna. RFID technology can identify fast moving objects and can also identify several tags at the same time and is easy to be operated. [7] The application of this system which uses RFID is shown in Figure 3. The passive tags on cattle can be read though fixed readers and handheld readers, so the cattle can be identified and tracked easily.

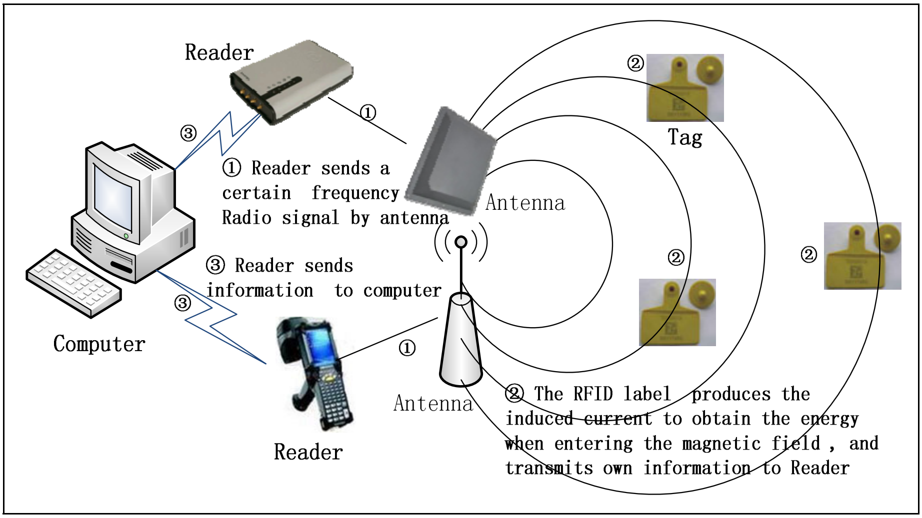

Fig. 3. The scheme of RFID applications

3.3 EAN/UCC-128 Trace Code Design

EAN-128 code is come from the information which has been changed into the bar code symbols according to the definition of EAN/UCC-128 standards. And it uses the logic 128 yards and has the characteristic of integrity, compactness, connectivity and high reliability. Based on the requirement of amount of the tracing information for beef products, and the existing experience as the reference, the research selects EAN/UCC-128 barcode as back yards of beef products and uses corresponding application identifier in the standard of GB/T 16986-2003 "EAN • UCC system application identifier" [8] . The code is shown in Fig. 4:

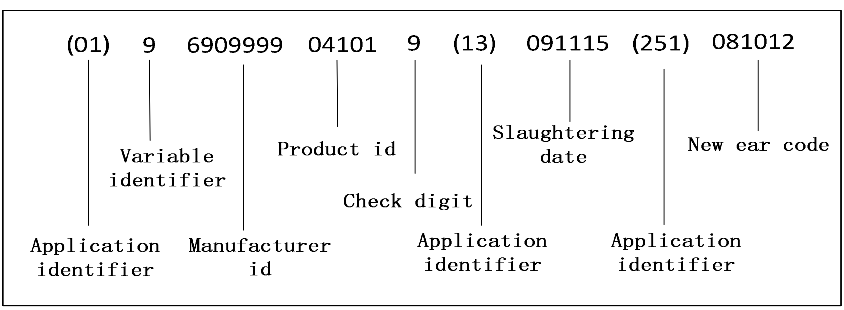

Fig. 4. Encoding Structure of EAN/UCC-128

The trade item identifier AI (01) is used to identify the beef product identification code; the production date AI (13) is used to identify the production date; the entity reference with the source code identifier AI (251) is used to identify the number of cattle in slaughterhouses (the original 15 cattle code is changed into the new 6-bit slaughterhouse code). Among them 14 digits of beef product identification consist of four parts, which are a variable identifier, seven manufacturers identification code + 5-bit product item code (or 8-bit manufacturer identification code + 4-bit product item code) and the last one for the parity bit.

3.4 PDF417

PDF is the abbreviation for portable data file. The symbol character of each barcode is consisted by four bars and four empty forms. If the composition of the most narrow bar or space is called a module, then the total number of the above four bars and four empty is 17, so it is called 417 yards or PDF417 code. Two-dimensional code PDF417 is a high-density, high throughput portable graphics data file and one of the ideal means of carrying and passing information and security [9].

3.5 Data Synchronization

Embedded databases usually use a data replication model (upload, download or mixed mode) and the server map database to meet the requirement of accessing any data in any location and any time. Because of data replication, in the system it could need all kinds of necessary controlling processes between the front-end and back-end server, even some or all front-end and intermediate data of the application should be synchronized [10]. In this paper, the merge replication in SQL Server CE data synchronization technology is adopted to realize data synchronization between hand-held readers and computers.

4 Architecture of System Function Module

Through the research and analysis, this study dives Total Quality Traceability System into four subsystems (Fig. 5).

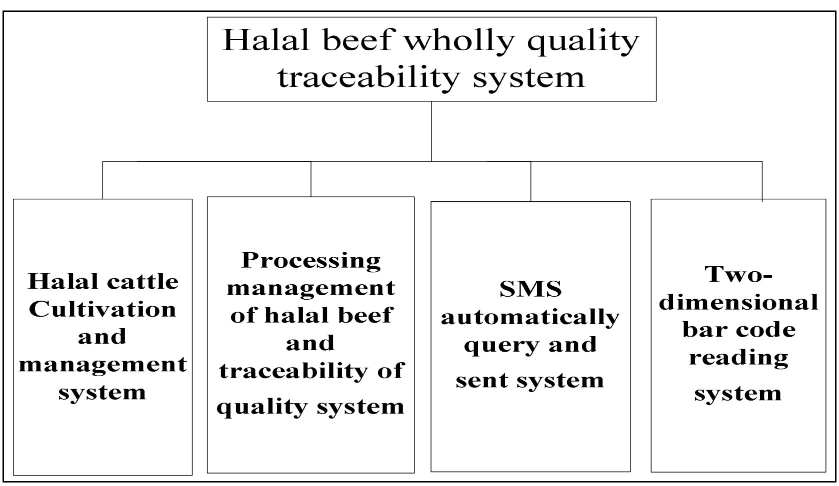

Fig. 5. Function of system modules

4.1 Halal Cattle Cultivation and Management System

It is supported by RFID technology, database technology and computer network technology, and based on basic data from farm cattle and breeding records, to conduct electronic management from purchasing cattle into the field, feeding, disease prevention to the quarantine and other production processes, to monitor all aspects of production to ensure scientific and standardized breeding. And the system ensure Islamic requirements from the source of cattle breeding by monitoring forage, drug manufacturers at the same time, which is not only to meet the needs of its daily management, but also to lay a foundation to realize the Halal products' traceability .

4.2 Processing Management of Halal Beef and Traceability of Quality System

It is supported by data synchronization and EAN/UCC-128 barcode technology. It manage the production process of the slaughter by electronic management such as admission cattle, cattle ear tag conversion, cattle quarantine, slaughter to packing, outbound and other production processes. During the slaughtering process, the system monitors slaughter methods and operator to ensure that products meet the requirements of Muslim consumption; at the same time the system adopts HACCP mechanism and GMP control systems to control the production process and the environment in the slaughter and processing strictly in order to ensure high standards and quality of all aspects in the processing; system uses the B/S structure and consumers can trace the product when entering the bar code of beef products they've purchased in web page.

4.3 SMS Automatically Query and Sent System

Using GSM Modem and mobile communication technology, It can sent the query message of cattle farming to the mobile automatically according to the database of cattle numbers after it receives a query text message. Farming field can also send related information of the specified cattle to a designated mobile phone by the system.

4.4 Two-Dimensional Barcode Reading System

Software can drive the two-dimensional bar code scanning module on smart phone to identify encrypted two-dimensional PDF417 code, and parsing the information on beef products. Consumers need to download two-dimensional bar code reading system from *Processing management of Halal Beef and Traceability of Quality System* and copy it to the smart phone which has the function of two-dimensional code recognition. Then they can trace back the quality of beef production information and Islamic information in real-time via scanning labels of beef. At the same time management and business enterprises can quickly identify if the products and the packaging are fake.

5 Software Development Environment of the System

Based on the requirement of collecting information during the process of beef production, processing and distribution, and the requirement of tracing the quality and Halal information through the network, messaging, mobile devices and other means, this study adopts the current mainstream Microsoft. NET 2005 platform to develop breeding management system of cattle breeding and SMS automatically query delivery system, it selects C# language as the development language and selects cross-platform Java language to develop Online Halal beef processing standardization and quality traceability information systems; the two-dimensional barcode reading system on smart phones is developed by Microsoft VC++ which adopts SQL Server 2005 CE as embedded database. The operating system is the most popular system with most users-- Windows XP. The SQL Server 2005 is used for unified database.

6 Conclusion and Outlook

This research object of the study is to realize the traceability of Halal and quality of the beef product's, to established a critical information database for Halal beef product's quality by using RFID, EAN/UCC-128 barcode, two-dimensional barcode, GSM technology and Internet technology. This system realizes the function that the consumer can trace the beef production information after they purchased the beef through SMS, telephone, network and a smart phone which has the bar code scanning function and other methods, and that the whole quality and the Muslim information from breeding, slaughter processing to the logistics can be traced.

Beef cattle industry is the advantageous industry in the national economy in Ningxia, so it has been the government and enterprise's consensus to develop the halal beef industry and halal beef brand. It is imperative to research and develop a set of Halal animal quality traceability system. The study method adopted by this research, the product and the result's demonstration are beneficial for enterprises to ensure the product's quality safety, to guarantee the products to meet the requirement of Muslim food and to strengthen the confidence of consumers. At the same time they provide an effective means for product technical anti-counterfeiting and technical support for shaping a better enterprise brand image, and enhancing competitive ability of the Hahal products in the Halal markets of domestic and overseas and in the area of high-end consumption.

Acknowledgements

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The Development of Remote Labor Training System for Rural Small Towns Based on MVC Model

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Abstract. In view of the characteristics of the rural labor force in China, a remote training system for small towns is developed based on B/S architecture and MVC model by using object-oriented and JSP technology on the Java J2EE platform. The system is designed to be used by administrator, training enterprise and individuals. The administrator can manage the website, permission assignment and maintain database. Training enterprise can use the system as their working operation platform. They can release their business information, manage their training materials and maintain their own data in the database. A registered individual user can access the information within his respective authorities, take study online, take part in the test online, question online, etc. By means of UML, the system is analyzed and both the database and class structure are built. By using Filter, Struts and Hibernate technologies, the system is developed with the characteristics of crossing-platform, better expansibility and maintainability.

Keywords: Remote rural labor training system, MVC, JSP, B/S, UML.

1 Introduction

With China economic and cultural development, 3-issues concerning Chinese agriculture, rural areas and farmers are increasingly becoming the critical factors which restrict the development of overall national strength. It is the key to solve the issue of farmers by reasonable transferring the rural surplus labors to urban. An investigation showed that china mobile population had reached 21.1 billion in 2009, the average age at about 27.3 and 78.7% of them come from rural and they mainly engaged in low wages or dangerous industries [1]. This condition made serious challenge to national strategic planning, social management and public services, and in the meantime, it is becoming a social instability problem. Hence it is the essence way to address the problem of migrant workers' employment by increasing their professional skills, enhancing their operational qualities and improving their knowledge structure and quality.

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Y. J. He et al [2], W. C. Qin [3], W. L. Wang et al [4], Z. H. Tian [5] and W. Huang [6] analyzed the forming reasons and status quo of china rural labor resources quality, and brought forward many constructive views. Since the rural labor force in China has a number of large, strong mobility and relatively unenlightened knowledge structure, D. R. Zhong et al [7], Z. H. Han et al [8], D. X. Fu [9], X. Liu et al [10], Z. H. Han et al [11], S. Y. Wang et al [12], A. H. Xi et al [13] and J. X. Guan [14] have taken great effort to do large-scale research and in-depth investigation. Then they drew the same conclusion that it is the only right way to solve the problem of farmers by taking a road of orderly and stable training transfer.

However, it is impossible to organize the farmers to learn together because they are scattering in various places and various fields. C. H. Pan et al [15], Y. C. Wu et al [16], Y. Chen et al [17], H. W. Luo et al [18], X. J. Huang et al [19] made out a solution for the vocational education status quo, that is, remote training by means of internet platform.

With the spread of the computer and internet, it is becoming possible to delivery tele-educational materials through internet. A practical remote training platform for both training organizations and rural surplus labors should be very much helpful and widely needed. It can help the training organizations mapping out their training plan according to the labor force supply and market demand, and changing timely. And on the other hand, it can help the rural surplus labors finding a right and convenient way to learn knowledge and skills and lead them to apply a suitable urban job. And on a long view, it might help the government to adjust the industry positioning, to transfer rural surplus labor force reasonably and orderly, to maintain social stability and healthy development, so as to solve the facing three rural issues finally.

2 System Design

In response to the knowledge level and features of the rural surplus labor force, the remote labor training system was designed as B/S structure, and developed on J2EE platform by using object-oriented technology based on MVC model. The software developing environment included IE6.0, Tomcat 6, JDK 1.4.2, SQL Server 2000, Eclipse Galileo with struts 2 and hibernate.

2.1 System Function Analysis

The system was designed as multi-user system, which included system administrator, enterprise user, personal user and its son-class of register personal user. Fig. 1 shows the use case diagram of the system.

For administrator, the completed background management function was provided by the system. It comprised user management, item bank management, materials management, common training information management, common data maintenance, etc.

For enterprise user, a multi-user platform was built by the system. The registered training company could achieve its training business management by means of this platform, which consisted of training and interview information releasing, new trainees enrolling, training materials delivering and its maintaining, item bank maintaining and online training.

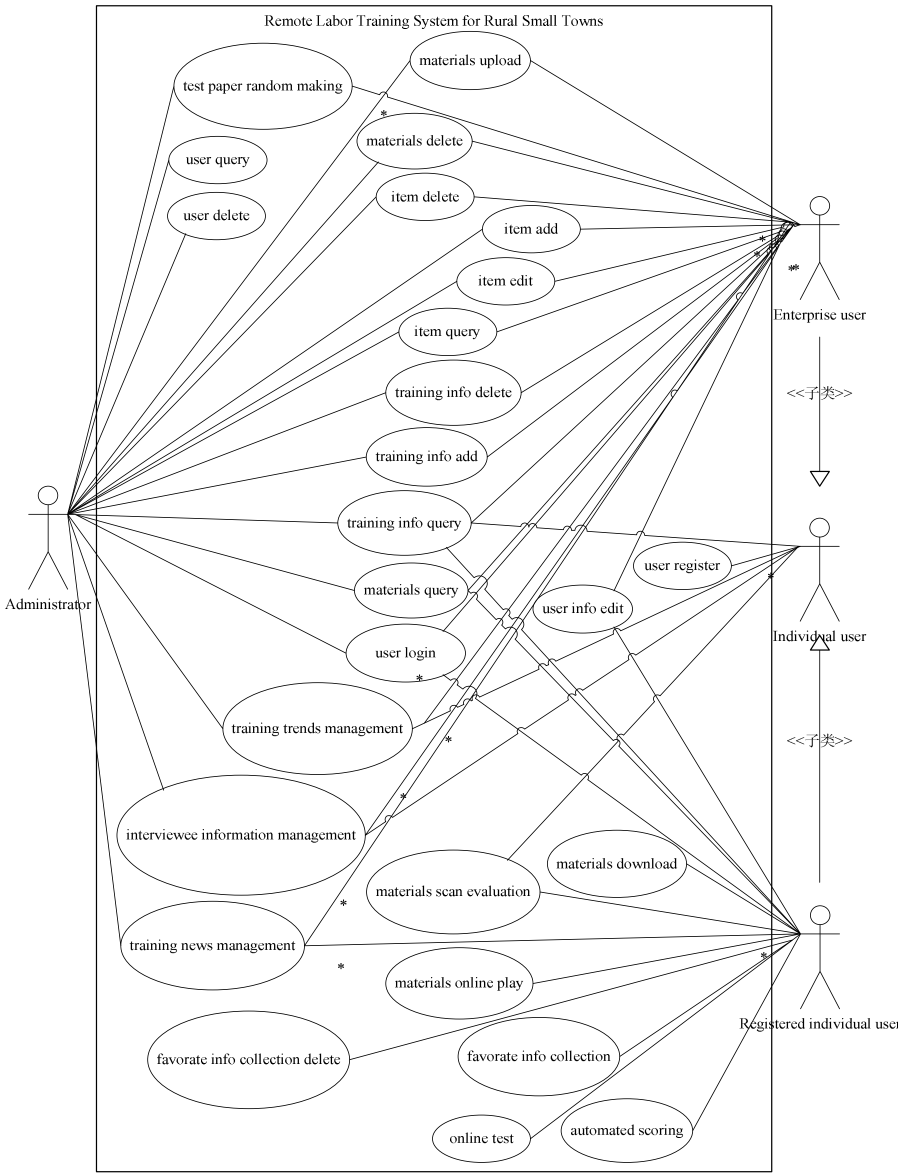

Fig. 1. Use case diagram of the remote labor training system for rural small town

For registered individual user, a plenty of powerful and convenient functions were provided by the system. If the individual user chose a training institution to register as its trainee, the services of that company would become available to him. Trainees could choose a suitable training project for his professional study. Then he could inquiry the relevant information, download training materials, join in the online training, question and get answers online, take online test, submit the examination paper and retrieve the answer sheet and check the test point and item analysis. On addition, trainees could collect the favorite information to their bench which provided by the system, advertise his job application form, etc.

And an ordinary user was allowed to browse the common information of the site.

2.2 System Module Design

According to the function analysis of the system, ten modules as well as their sub-modules contained by the system were drawn out. The whole module structure of the system is shown as Fig. 2.

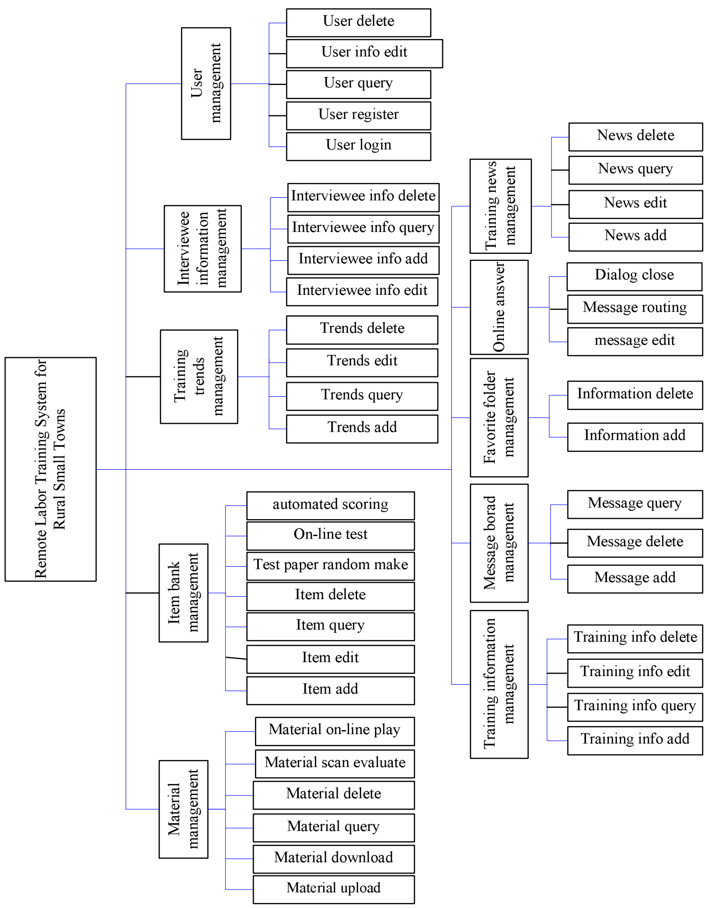

Fig. 2. The module structure diagram of the remote labor training system for rural small town

They were user management, material management, item bank management, favorite folder management, online answer management, training news management, interview information management, training trends management, training information management and message board management. Each module included its sub modules, such as, the module of material management comprised material upload, material download, material query, material delete, material scan evaluate and material online play.

Various sub modules were developed tally with high cohesion and would be called by the relevant invoker with their corresponding rights. For the above example module, the sub-modules of material upload and material delete were assigned for the administrator and registered enterprise user. Thereinto the administrator could upload and delete the common materials, and the registered enterprise user could upload and delete his own training materials; The sub-module of material download was assigned for the registered individual user, who could download the common materials from administrator as well as the materials from the belonged training institution; The sub-module of material query was designed for all of users but with different query conditions respectively, i.e. the administrator could retrieve the materials uploaded by himself and any other enterprise users, the registered enterprise user could only access the materials uploaded by itself, and the registered individual user could only query the common materials or the materials from the training company which he belonged to; The sub modules of the material scan evaluate and material online play were assigned for the registered individual user who could release his comments about the materials; And at the mean time, the materials such as *.doc, *.xls, *.ppt, *.swf, *.avi, *.wmv, *.mpg, etc. could be played or opened online.

2.3 System Database Design

To a B/S web application system, designing and building a correct and proper database is the key to success. Bolstered by the powerful functions of MS SQL Server2000, a relational database which meets the third normal form for the remote labor training system is designed and established based on object-oriented data analyzing.

2.3.1 Logical Design of the Database

By investigating the entities and the relationship between them elaborately, the E-R diagram of the system was obtained. And it is shown in Fig. 3.

2.3.2 Physical Design of the Database

According to the logical design of the database, fifteen base tables are established in terms of the third normal form. Table 1 shows the main information of all the tables.

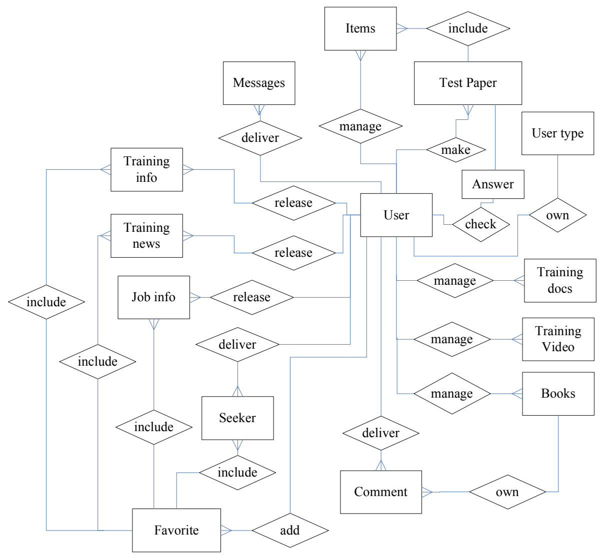

Fig. 3. The E-R diagram of the remote labor training system for rural small town

Table 1. The information of the base tables

table	Primary key	Foreign key	Field number
tb_user	ID/username	Usertype	12
tb_usertype	ID		2
tb_docs	ID	username/usertype	8
tb_test	ID	username/usertype	17
tb_comment	ID	Username/usertype/Book_ID	7
tb_books	Book_ID	Username/usertype	8
tb_favorite	ID	Username/usertype	6
tb_news	ID	Username/usertype	6
tb_leaveword	ID	Username/usertype	6
tb_traininginfo	ID	Username/usertype	9
tb_exampaper	ID	Username/usertype	16
tb_seeker	ID	Username/usertype	10
tb_video	ID	Username/usertype	7
tb_job	ID	Username/usertype	10

2.4 System Class Design

According to the E-R diagram and data analysis, seventeen entity classes were built. Fig. 4 shows the classes and their relationship.

By using Struts framework, fourteen action classes were established to acquire the data from forms and transmit them to the business logic layer. And then the JavaBeans were called to fulfill the main performances or to forward HTTP requests to JSPs. In addition, seventeen DAO classes inherited from Hibernate SessionFactory were built to implement the persistent layer; Two classes implementing Filter interface were used to filtrate character set encoding and login request; Three Servlet classes were used to control online questioning and answering; Several other classes were built to implement the common functions or to assist to implement some function.

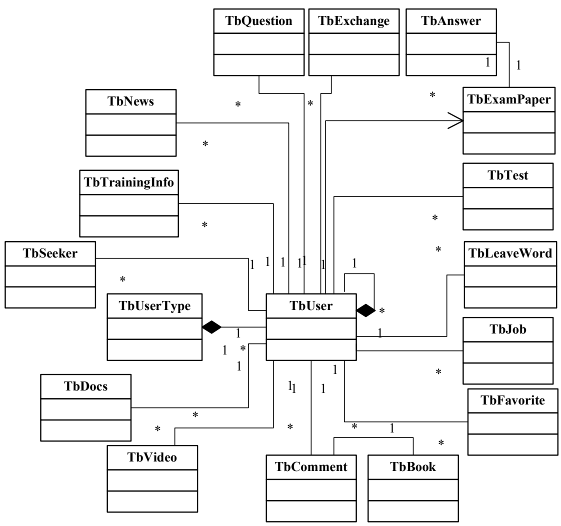

Fig. 4. The class diagram of the remote labor training system for rural small town

3 System Implementation

By using Tomcat as the J2EE application server, adopting Struts, Hibernate and Filter as the developing technologies, the data logic layer and business logic layer were established, in which the entity beans were used to implement the system data tier, and action beans were used to implement logical tier. The architecture diagram is shown as Fig. 5.

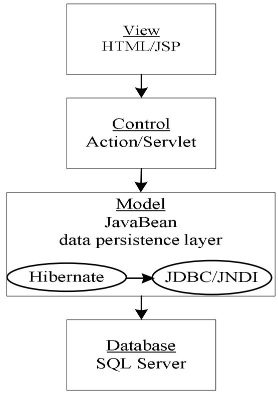

Fig. 5. The architecture based on Hibernate and struts

The remote labor training system mainly consisted of ten modules. Among them, the subscriber management module included user registration, user login/query/delete and user information edition. Question bank management module consisted of add/delete/edit/query question. Training examination management module included random test paper auto-formation, online testing and automatic scoring. Materials management module included upload training materials, query/edit/delete training materials, download general materials, video online play and materials evaluation message. Online Q&A module was tailor-made for rural training participants, and it consisted of online question, online answer and online exchange. A hundred and seventy five web pages were made in the system. Fig. 6 is the homepage of the registered individual user.

Fig. 6. The homepage of the registered individual user

4 Conclusions

With the step of new socialist countryside building, Chinese government is improving rural communication infrastructure construction gradually. Therefore, remote vocational education is becoming realistic. A suitable and practical teletraining system for small cities and towns can provide convenient service for those rural surplus labors and help them to solve their facing employment problem.

Based on the object-oriented methodology, by means of java developing platform, by using Struts, Filter and Hibernate technologies, the remote labor training system for small rural towns was built with a good man-machine interface, rich applications and easy to operate. It is highly cohesive, loosely coupled, highly credible, easy to maintain and extend.

The system's commissioning showed that it could meet the needs of rural labor remote training service. It is time-saving, low cost, efficient and practical. And it will be helpful for the government to transfer rural surplus labor force to urban cities in an orderly management, so as to untie the facing three rural issues finally.

Acknowledgments. This research was financially supported by the National High Technology Research and Development Program of China (2006BAJ07B02).

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WEB-Based Intelligent Diagnosis System for Cotton Diseases Control

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Abstract. Diseases control is always an issue in cotton production, the timely detection and effective control of diseases depend on, in most cases, an effective diagnosis system. Based on the distribution of cotton diseases in the main yielding areas of China in recent years, the main species and characters of cotton diseases were listed classified in the study and a database was established for this purpose. BP neural network as a decision-making system was used to establish an intelligent diagnosis model. Based on the model, a WEB-based Intelligent Diagnosis System for Cotton Diseases Control was developed. An experiment scheme was designed for the system test, in which 80 samples, including 8 main species of diseases, 10 samples in each sort were included. The result showed the rate of correctness that system could identify the symptom was 89.5% in average, and the average running time for a diagnosis was 900ms.

Keywords: Cotton, Diseases, Intelligent Diagnosis System.

1 Introduction

Cotton is playing a crucial role in the national agricultural economy of China. Cotton diseases and insects are the two main causes of damage on both quantity and quality of the cotton production. A timely detection of the pests and feasible controlling measures are cure to the effective cotton protection.

The researches concerning disease diagnosis systems for agricultural products started from the late seventies of the last century. The first disease diagnosis system, the soybean disease diagnosis expert system (Plandds), was developed by the University of Illinois (1978). Some additional work, the integrated expertise system for soybean pest control (SOYBUG) [6], the expertise system for orchard management and pest control (POMME) were developed in the state of Florida. Japan has also conducted a lot of researches on disease diagnosis [3-5]. Comax-Cossym (Cotton Production

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Management System) developed by the Crop Simulation Center from Agricultural Research Service in the United States Department of Agriculture (USDA) is the most successful agricultural expertise system in the world, which improved the U.S. cotton production management [9-10] significantly.

The related researches in China are developing rapidly since last eighties. The Cotton Pests Management Expertise Decision Support system (COPMEDS) developed by the Institute of Zoology at Chinese Academy of Science was in the leading place [11]. Liang and Shi (1997) developed a cotton pest diagnostic system based on the BP neural network, which enhanced the running speed of the system by simplifying the neural network model [13]. Jiang et al. (1998) developed the Prototype of rule-based cotton pest management expert system by utilizing the expertise system development tool KA3 [14]. Zhang et al. (2005) designed the knowledge-model-based decision support system for cotton management .This system used system analysis and mathematical modeling to solve the issue of the overly-spread information in a huge knowledge data base, enabling decision-making processes to be more rapidly and simplified [15]. Wang et al. (2008) designed a cotton fertilization expertise system based on Geographical Information System (GIS) in XinJiang. The system presented extensive research and discussion on the application of GIS technology to cotton fertilization expertise system [16]. Liu, etc. (2009) designed a Web-GIS-based expertise system to forecast agricultural diseases and pests [17].

The work presented in this paper is based on the description of the pattern of the cotton diseases, and the identification of the type and characteristic of the major disease problems during the recent years in China. A Cotton Disease Intelligent Diagnosis and Decision Model was established, and a WEB-based Intelligent Diagnosis System for Cotton Diseases Control was developed with the BP neural network as the decision support system.

2 System Overview

The yield and the quality of cotton are affected significantly by the disease, which means farmers' great financial loss. As the lack of basic knowledge of cotton diseases detection and protection, the cotton farmers are longing for the guidance from experts since the occurrence of new and large variety of diseases. However, such experts are not always available for the emergencies. A diagnosis system is therefore considered effective in helping cotton farmers.

A Web-based Intelligent Diagnosis System for Cotton Diseases Control could realize the querying, diagnosing and online consulting of the main diseases during the whole growing process. Multiple users could access the system simultaneously. The system also could facilitate experts to input, update, modify and search data, information and rules associated with cotton intelligent diagnosis system knowledge and database.

Web-based Intelligent Diagnosis System for Cotton Diseases Control was consisted of four separate modules: Query module, Diagnosis module, Management module, and Expert online. The scheme of the system is shown as figure 1.

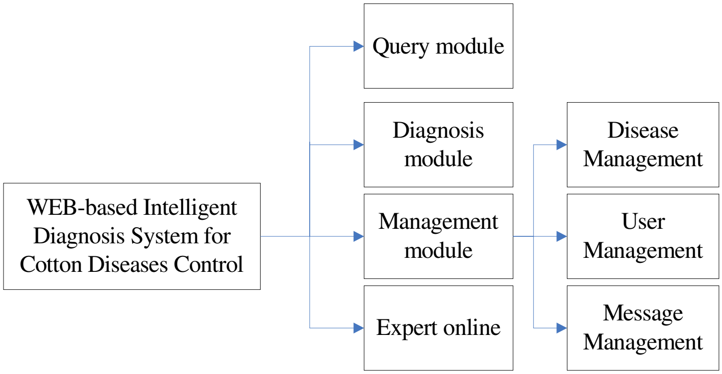

Fig. 1. Scheme of the system function

Where:

1. Query module: information could be queried from the cotton disease database by the keywords imputed in the query interface by users.
2. Diagnosis module: inference engine of the system provided diagnosis results and corresponding control methods by the disease factors chosen by users in the diagnosis interface.
3. Management module: serviced for the system back-stage management, which was divided into three parts: disease management, message management and user management.
4. Expert online: the communication bridge between experts and users.

3 System Design

The system was a three-layer model with "data layer / application layer / interface layer". Where: Data layer was the bottom layer of the system, which was used for the storage of information needed by the system, and was consisted of database and knowledge base. Database was used to store the basic facts of cotton disease, description of problems, intermediate and final results during the diagnostic process, etc. Knowledge base was used to store knowledge and experience of cotton disease experts.

Application layer which included Web inference engine and application server could realize the inference and explanation functions of the system diagnosis. The BP neural network technology was used to execute the knowledge inference and diseases diagnosis based on the symptoms supplied by users.

Interface layer enabled the interaction of users and system. There were two types of users, ordinary and administrator, in the system. Ordinary users could query disease and input the required information by selecting disease factors, and the disease diagnosis and appropriate control methods were given to users in the form of interface. Administrator users managed the knowledge base and database.

The structure of cotton intelligent diagnosis system is shown in figure 2.

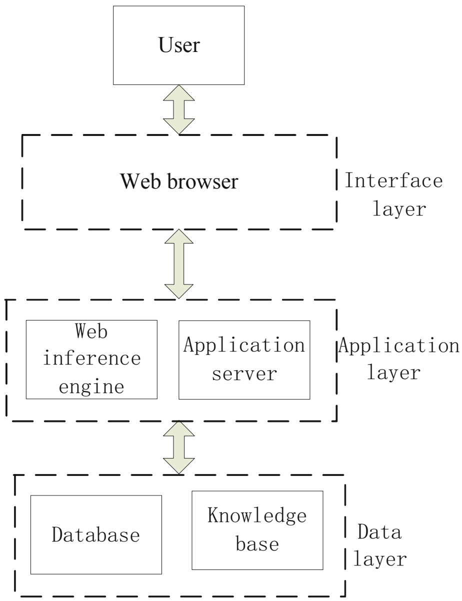

Fig. 2. Structure of cotton intelligent diagnosis system

3.1 Cotton Disease Database

The database designed in this paper included the disease table, disease picture table, user table and message table, which has played an important role in the development of Intelligent Diagnosis System for Cotton Diseases Control.

The structure of diseases table is as follows:

Table 1. Structure of disease table

List	Data Type	Non-empty	Notes
dis_id	Int	Yes	Keyword
name	Varchar(20)	Yes	Name
region	Varchar(80)	No	Geographical place
Pathogen	Varchar(160)	No	Pathogen
law	Varchar(1000)	No	Occurrence
prevention	Varchar(1000)	No	Control methods
germ	Varchar(300)	No	Germ

3.2 Knowledge Base of Cotton Diseases

Knowledge base was used to store basic knowledge and practical experience of cotton disease experts. Based on the investigation of the occurrence and the distribution of cotton diseases in recent years, there were more than 20 kinds of main cotton diseases in the main yielding areas of China. 8 kinds of diseases as the major disease of cotton were identified, such as, Cotton anthracnose, Cotton damping-off, Cotton Red rot disease and Cotton wilt, etc. Based on the analysis and summary of cotton disease symptoms, 5 categories and 32 symptoms were summarized, and which were numbered, so that each symptom of each category corresponded to a number.

Table 2. Cotton disease factor

Diseases period		Disease location		Lesion shape		Lesion color		Lesion state	
Factor	Symptom	Factor	Symptom	Factor	Symptom	Factor	Symptom	Factor	Symptom
a1	Seeding stage	b1	Cotyledons	c1	Semi-circular or circular	d1	Brown	e1	Dot
a2	Bud stage	b2	Stem	c2	Near circle	d2	Dark brown	e2	Water stains
a3	Boll stage	b3	Leaf	c3	Irregular	d3	Red-brown	e3	Grease-like
		b4	Boll	c4	Polygon	d4	Tan	e4	Physalospora black Dots
				c5	Spindle	d5	Pink	e5	Slime
						d6	Yellow	e6	Mold, Floc
						d7	Dark green, black	e7	Fold Withered
						d8	Gray, white	e8	Mycelium
						d9	Deep blue	e9	Dwarf, Withered
						d0	Dark red	e0	Color changed, Reticulated

Based on the diseases factors listed in table 2, the factors corresponding to different diseases and the causalities of diseases were listed in the diseases table.

3.3 Inference Engine of Cotton Diseases

The core of the cotton disease diagnosis system was the inference engine. Most of the existing reasoning models carried out the forward and backward reasoning by constructing a database of disease recognition features and using a standard query language

Table 3. Disease

Name	Diseases period	Disease location	Lesion shape	Lesion color	Lesion state
Cotton anthracnose	a1 a2 a3	b1 b2 b3 b4	c1 c2 c5	d2 d8 d0	e4 e5
Cotton Rhizoctonia	a1 a2	b1 b2 b3	c3	d1 d4 d6	e7 e9 e0
Cotton boll rot disease	a1 a3	b1 b2 b4	c1	d1 d5	e6 e7
Cotton Hongfen disease	a1 a3	b1 b4	c1	d1 d5	e6
Cotton wilt	a1	b1		d6	e0
Cotton phytophthora boll rot	a1 a3	b1 b4		d7 d8	e2 e8
Cotton angular leaf spot	a1 a2	b1 b2 b3	c4	d7	e3
Cotton damping-off	a1 a3	b2 b4	c1	d1 d6 d8	e2 e6 e7

(SQL). The process of knowledge acquisition and mimic expert reasoning for these models has grown an over-reliance on expert knowledge and experience, the practicality was poor and also with limitations.

Neural network was a massively parallel processing and self-learning, self- organizing, nonlinear dynamic system, which was particularly suited to complex non- deterministic causal reasoning, judging, identification, and classification problems. It had the self-learning function and cuold constantly enrich the content of the knowledge base. Therefore, BP neural network was used as the inference engine of cotton diseases in this system.

BP neural network was constructed as a disease inference engine based on the analysis and summary of cotton disease symptoms. There were 32 input nodes which were corresponding to 32 diseases in the BP neural network. According to empirical formula $N = \sqrt{mn}$, the number of nodes N in the hidden layer was obtained as N=16. Then by errors comparison, the optimal number of neurons in the hidden layer was determined.

There were 8 output nodes which were corresponding to 8 major diseases of cotton. The BP neural network was trained and validated by using *Matlab* in the article. The hidden layer transfer function was s-type tangent function *tansig*, the output layer transfer function was *purelin*, and the training method was *Levenberg-Marquardt* with the training function *trainlm*. Gradient descent momentum learning function *learngdm* was used as the learning function, and the performance function was *mse*.

By experimental verification of the system with 8 kinds of diseases (each with 10 samples), the average diagnostic accuracy was 89.5% and the average diagnosis time was 900ms.

4 Conclusion

A web-based intelligent diagnosis system for cotton diseases control was developed in this article. Based on the research of cotton disease occurrence in recent years and on the analysis of the cotton diseases characteristics, a corresponding database was established and disease factors for the description of various diseases were obtained then. BP neural network combined with the Web technology was used as the disease inference engine in the system, so that the diagnostic accuracy and intelligence as well as the ability to solve the uncertain and ambiguous problems were enhanced. Modelling results showed that the diagnosis system was high-accuracy and high-speed. The system was effective and easy to operate with the friendly interface. It was expected to show the high feasibility to the field situation by more practical tests.

Acknowledgements

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Wetland Information Extraction from RS Image Based on Wavelet Packet and the Active Learning Support Vector Machine

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Abstract. Wetlands which are the planet's most important ecosystem have high scientific research -value and will bring us both social and economic benefits. However, duing to various natural and man made factors, more and more wetlands have converted to agricultural land and urban land. Now, the changes in wetlands' area and quantity have caused public's widespread concern. And wetland's management and protection will benefit from the improvement of the wetland information abstraction's precision. Improving the classification precision of the RS image is a difficult problem because of the small scale of remote sensing images. This paper which is about the wetland remote sensing images extraction is based on the LANDSAT ETM remote sensing data, and the result of the Wavelet Packet reconstruction will be used as the sample set of the Active Support Vector Machine .At the end of this paper, a comparative analysis of the experimental results will show between the single classification (SVM, BPNN) method and the solution which is proposed in this article. This method can be proved to obtain very good classification results through many experiments on remote sensing image classification I've done. Experimental results show that this algorithm's classification accuracy is better than the single classification's. Moreover, in the active learning process, the bad influence of the image's isolated and intersection points on the classification is avoided, and the number of training samples are reduced greatly.

Keywords: Wavelet Packet, ASVM, wetland classification, remote sensing, information extraction.

1 Introduction

In recent years, with the development of RS technology, remote sensing images' classification methods which use traditional manual visual interpretation and parametric statistics have been difficult to meet the classification requirements of the multi-source remote sensing data. Wetlands are usually situated between land and water, and traffic conditions there are very poor. Sometimes it is not easy to go deep into the

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wetlands field for survey. Therefore, extract wetland information with the help of RS data is very necessary [1]. There are a number of isolated points or noisy points in RS images, and the existence of these pixels severely affected the classification precision of wetlands from RS images. Therefore, we must find a method which can reduce the manual workload, speed up the computation, improve the wetlands' classification accuracy of remote sensing.

In the process of wetlands classification in remote sensing image, the artificial neural network, in particular BP neural network, has been relatively widely used. Neural network becomes a classifier through self-learning ability to obtain the weights. It is not a stable classifier and applicable to solve small data sets most of the time. Using BP algorithm to classification wetland in RS image requires long training time, and has a low convergence efficiency.

SVM (Support Vector Machine) was first proposed in 1995 by Corinna Cortes and Vapnik [2]. SVM is based on structure risk minimization principle to find the best compromise between the model's complexity and learning ability using the limited-sample information. And these limited samples called SV (Support Vector) which contain the necessary information in the classification. International experts have done a lot of research on SVM in remote sensing image for the wetland classification. This method can overcome the weakness of maximum likelihood method and neural network, and it suits the classification to non-linear, higher dimension and complex data. But in the process of sampling the remote sensing image using this method, the samples' manual labeled workload is heavy.

Wavelet packet algorithm provides a more precise and accurate processing analysis method for the signal frequency band. And non-support vector of SVM has no effect on classification. So, we can remove or reduce the non-SV from sample subset, and retain SV as much as possible .Therefore, the active support vector machine (ASVM) is derived. In order to solve the problems proposed in the above text, this paper based on MATLAB7.0 and ENVI4.4 software platform, using wavelet packet algorithm to preprocess remote sensing images, doing with the ASVM algorithm to realize the classification of wetlands, to improve these two problems in the RS image classification process in practical application. In recent years, ASVM's application gradually becomes research focus at home and abroad. Literature [3] proposed an active learning strategy of support vector machine via optimal selection of labeled data. And the workload of the sample tag was greatly reduced through the combination of unsupervised clustering method and active learning method. Literature [4] proposed a simple heuristic active support vector machines and it greatly improve the classification learning rate.

2 Wavelet Packet Algorithm

2.1 The Definition of Wavelet Packet

Wavelet packet analysis method is the promotion of multi-resolution wavelet analysis, simply, it is a function family. First, the two-scale relations of the orthogonal scaling function $\phi(t)$ and wavelet function $\psi(t)$ are as follows:

$$\phi(t) = \sqrt{2}\sum_k h_{0k}\varphi(2t-k) \tag{1}$$

$$\psi(t) = \sqrt{2}\sum_k h_{1k}\psi(2t-k) \tag{2}$$

(h_{0k} and h_{1k} , the filter coefficients of multi-resolution analysis).

Promotion the two-scale equation above, define the following recurrence relation [5]:

$$\omega_{2n}(t) = \sqrt{2}\sum_{k\in z} h_{0k}\omega_n(2t-k), \tag{3}$$

$$\omega_{2n+1}(t) = \sqrt{2}\sum_{k\in z} h_{1k}\omega_n(2t-k), \tag{4}$$

When n = 0, $\omega_0(t) = \phi(t)$; when n=1, $\omega_1(t) = \psi(t)$.

The set of functions $\{\omega_n(t)\}, n\in z$ defined above is the Wavelet packet identified by the $\omega_0(t) = \phi(t)$. Thus, wavelet packet is a set that has some relation functions including the scaling function $\omega_0(t)$ and mother wavelet function $\omega_1(t)$.

2.2 Wavelet Packet Decomposition Diagram

Wavelet Packet Analysis can do further decomposed to high-frequency part. So, wetland's edge feature is enhanced through the Wavelet Packet decomposition and we can accurately find the RS image's effective information point which is easily overlooked. As shown in Figure 1, it is the diagram of wavelet packet decomposition.

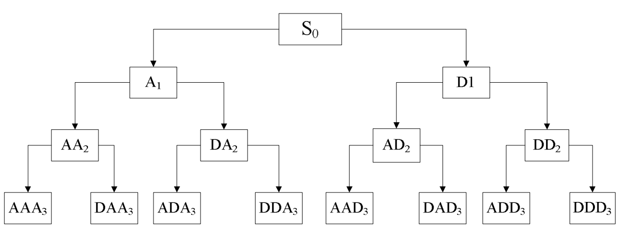

Fig. 1. Diagram of Wavelet Packet Decomposition

3 Support Vector Machine

3.1 Support Vector Machine

SVM [6] has been successfully applied in many areas, its main idea is to create a hyperplane as a decision surface that make positive samples and negative samples isolated between the maximize marginalized. As shown in Figure 2, it is the most simple linear separable classification hyperplane.

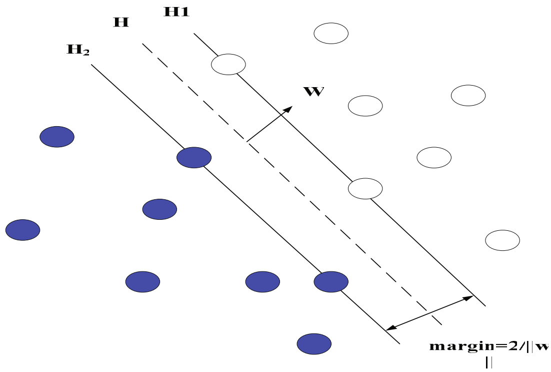

Fig. 2. Optimal Separating Surface (hyperplane) and SV

Generally, seeking the optimal hyperplane always through the establishment of Lagarange function and the introduction of Lagarange multiplier, that is, tansforming the original problem into the dual problem. As follows:

$$\max\ Q(\alpha)=\sum_{i=1}^{N}\alpha_i-\frac{1}{2}\sum_{i=1}^{N}\sum_{j=1}^{N}\alpha_i\alpha_j y_i y_j x_i^{T}x_j \tag{5}$$

$$\text{s.t}\ \sum_{i=1}^{N}\alpha_i y_i=0,\alpha_i\ge 0 \tag{6}$$

For nonlinear problems, the general solution is to use kernel functions which is satisfied Mercer conditions replacing the xi, xj in the above equation. That is, using this kernel function to set the low-dimensional space vectors mapping in a high-dimensional feature space, transforming the nonlinear problem into a linear problem.

3.2 Active Support Vector Machine (ASVM)

The main idea of ASVM: Selecting the most uncertain unlabeled samples (the samples nearest from the current hyperplane) from the candidate sets to improve the classification hyperplane.

4 Experimental Data

4.1 The Area of Yinchuan Plain

Climate in the Yinchuan Plain is a typical temperate continental climate. The main climatic characteristics: four distinct seasons, late spring and short summer, early autumn and long winter, large temperature difference between day and night, rare rain and snow, strong evaporation, dry climate, strong wind and more sand. Yinchuan Plain is the alluvial plain which is developed on the basis of the Cenozoic rift basin. Yellow River runs through Yinchuan plain vertically. Yinchuan Plain have a relatively abundant wetland resources which mainly including river wetlands and lake wetlands this two categories. The wetlands most locate at both sides of the Yellow River. Now, Yinchuan Plain's existing lakes have large shrinked surface and reduced water depth. And marsh plant community occupied considerable waters [7] of this area.

4.2 Data Preparation

As the remote sensing data is too large, a part of Yinchuan plain will test in this paper (area of Yinchuan plain in Yinchuan District). This article uses the Landsat ETM+ data in September 2006 as the basic data information. This year, the total rainfall in June to September (wet period) was lager than previous years and the vegetation coverage rate was higher too. So the data used in this paper has a better overall quality. The ETM+ is the Enhanced Thematic Mapper carried by Landsat satellite and its spatial resolution of reflectance band is 28.50m, panchromatic band is up to 14.25m. This thematic mapper applied for agricultural applications has relatively highly ground-based observations precision. On the basis of the research content, the researcher selects the present land-use map of Yinchuan Plain, the province administrative area map, traffic maps, soil maps, water conservancy maps of Ningxia in 2006 as auxiliary information. And the researcher makes a comprehensive analysis of the climate, topography, vegetation types and socio-economic factors of Yinchuan Plain to interpret remote sensing image for wetland.

4.3 The Establishment of Yinchuan Plain's Information Classification System

According to wetland classification standards that established by the National Survey of Wetland Resources and Procedures of Detection Technology and the actual situation of the Yinchuan Plain, based on the study purpose, this paper uses secondary classification standard to develop a wetland classification system which is consistent with national wetland classification requirements and can reflect the wetland characteristics of the region. As Table 1 shows:

Table 1. Wetland Interpretation Signs of Yinchuan Plain

Type	Color	Shape	Distribution	Hue
River/lake	blue	banded, block	natural	even
River wetland	brownish-red	banded, curved	natural	even
Lake wetland	yellow	block	natural	even
swamp wetland	aquamarine	obvious	sporadic	uneven
tidal flats	green	banded,curved	Coastal, along the lake	uneven
pond	pink	obvious	natural	even

4.4 RS Image Interpretation Signs of Yinchuan Plain

The interpretation signs of the Yinchuan Plain established based on field survey and full use of the spectral reflectance characteristics of surface features and a variety of Yinchuan plain's maps and documents. As Table 1 shows:

5 Experimental Data Preprocessing and Algorithm Flow

5.1 Data Preprocessing

Some bands' fusion of Lansat (band4, band5 and band3) not only fit for the analysis of soil moisture and vegetation but also suit for the identification of inland waters and land/water boundary. Therefore, data processing and information extraction in this paper mainly depend on these three bands. First of all, the researcher decomposites this three bands by wavelet packet algorithm in order to extract more refined time-frequency information, and then reconstructs the image and using the reconstructed results as the candidate sample set.

5.2 Information Extraction by Active Learning Strategy

In this paper, an unsupervised clustering method isodata is used to tag little samples to get a small amount of initial training sample set, and then using those taged samples to train a classifier. After the training, some strategies is utilized to re-updated the classification model, cycle update the classifier until the candidate set is empty or up to certain conditions.

The algorithm proposed in this paper is described as follows:

① Using DB2 wavelet and wavelet packet algorithm to decomposite the remote sensing image into 3-layer. And then, extracting each layer's all frequency components of the signal characteristics.

② Construction the optimal wavelet tree;

③ Quantized each wavelet packet coefficients, and reconstructed the wavelet packet according to the lowest level wavelet packet decomposition coefficients and the quantized coefficient ;

④ Take the reconstructed data set as a candidate sample set. Using Isodata algorithm to initially cluster the samples and producing k categories. Taking the centers of these K class as the initial training samples, denoted as A0, identified as labeled sample set. And the samples which are not selected is identified as unlabeled sample set, denoted as U0.

⑤ Constructed the initial classifier. Using the sample set in step ④ to train SVM can obtain the initial classifier, the optimal hyperplane and support vectors.

⑥ Finding the optimal separating hyperplane and support vector through the i-th active learning based on the labeled sample set, in the identification based on the sample set .Select the m sample points that are nearest from the optimal separating hyperplane, and then labeled these m sample points.

⑦ Terminating the learning process when the unlabeled data set is empty or meet the required conditions. Otherwise, return step ⑥.

6 Experimental Results and Analysis

6.1 Comparison of Experimental Results

The 6 figures (Figure 3-8) below are the experimental results based on the algorithm proposed by this paper, SVM algorithm and BP neural network algorithm. Figure 4,6,8

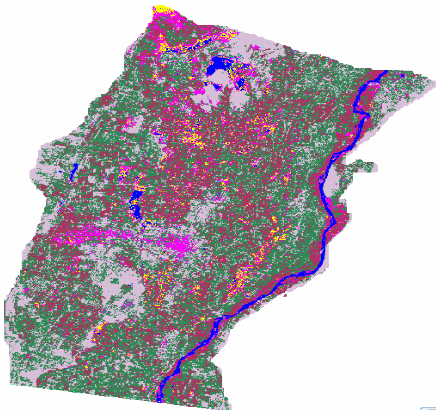

Fig. 3. Extraction results got by the algorithm proposed in this paper

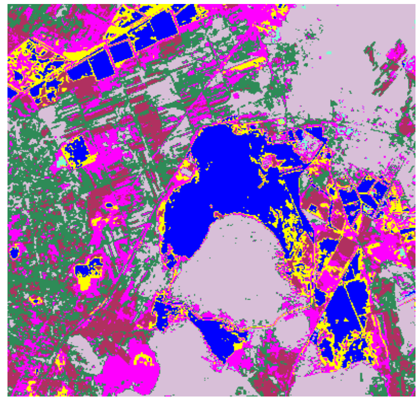

Fig. 4. Figure 4 Extraction results got by the algorithm proposed in this paper (Area of Shahu)

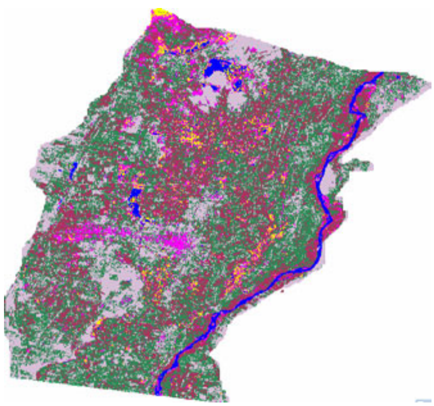

Fig. 5. Extraction results got by SVM algorithm

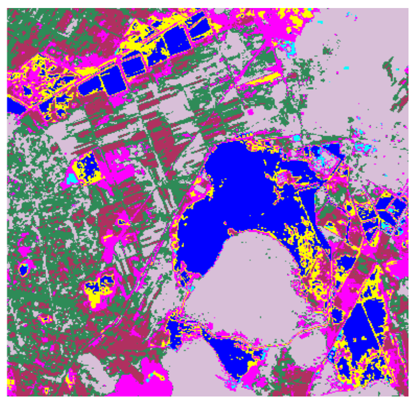

Fig. 6. Extraction results got by SVM algorithm (Area of Shahu)

are cut off from figure 3,5,7 and they display the area of Shahu in Yinchuan, so readers can clearly see the differences and advantages and disadvantages of experimental results.

6.2 Results Analysis

Through the 6 figures in chapter 5.1, we can see the classification results of every methods, and the results all have relatively clear boundaries, but have differences in the classification accuracy. Through the three pictures of Shahu area, it is obvious that the algorithm proposed in this paper and SVM algorithm get the similar classification results, and BP algorithm get a relatively rough classification result. The classification accuracy of this method is 83.39%, SVM algorithm's accuracy is 82.14%, and BP

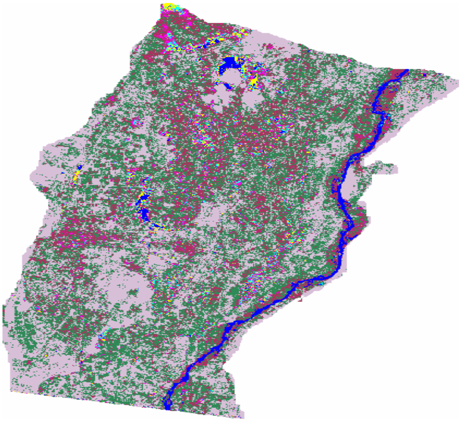

Fig. 7. Extraction results got by BP algorithm

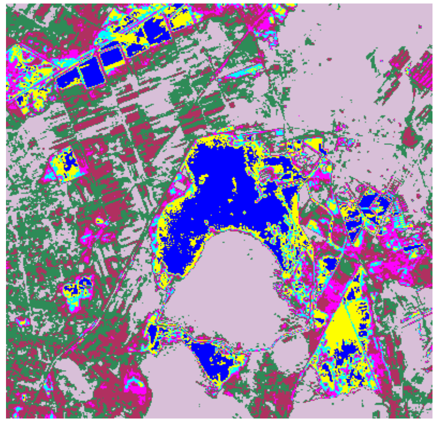

Fig. 8. Extraction results got by BP algorithm (Area of Shahu)

algorithm's classification accuracy is74.63%. This paper's algorithm is superior to SVM on the learning speed in classification and avoid a lot of manual work marked. Before the end of the experiment, the author and members of the research group made a surface sample survey (survey results are as follows in Table 2), in which this paper's algorithm and SVM algorithm both gets a high sampling precision and the precision is similar, but the BP algorithm gets a low sampling precision.

Table 2. Results of the surface sample survey

Position number	Actual type	Classified type		
		This algorithm	SVM	BP
1	lake wetland	lake wetland	lake wetland	lake wetland
2	swamp	swamp	swamp	tidal flats
3	tidal flats	tidal flats	tidal flats	tidal flats
4	lake wetland	lake wetland	lake wetland	lake wetland
5	swamp	swamp	tidal flats	swamp
6	pond	pond	swamp	pond
7	lake wetland	lake wetland	lake wetland	lake wetland
8	tidal flats	lake wetland	tidal flats	tidal flats
9	river wetland	river wetland	river wetland	river wetland
10	pond	pond	pond	swamp
11	swamp	pond	pond	pond
12	tidal flats	tidal flats	tidal flats	tidal flats
13	river wetland	river wetland	river wetland	tidal flats
14	lake wetland	lake wetland	lake wetland	lake wetland
15	pond	pond	pond	pond

7 Conclusion

Using SVM to process the RS image needs large samples and will consume lots of manual labor, and the existed interferences of image noise, isolated points and the intersection points bring a lot of practical difficulties. To solve the above problems, we proposed an ASVM learning strategy. And it is eliminated the isolated points well, improved the accuracy of information classification , avoided a lot of manual marking work and solved the problem of slow classification rate in the process of learning.

Through the wetland information extraction of Yinchuan Plain in Yinchuan District, the results show that the degree of the artificial wetlands in the region is obvious and the natural wetlands are subjected to damage that we should take measures to strengthen the wetlands protection.

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A Research to Construct the Interactive Platform for Integrated Information of Agricultural Products in China Xinjiang

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Abstract. Xinjiang is located on the northwest border of China, which is an important agricultural production and export base. In order to establish integrated management of agricultural products and service information system, China put forward the "Golden Agriculture Project" program in 1994, whose construction development is still insufficient because of the backward informatization level in Xinjiang. This article uses the management theory to analyze the shortcomings of the current three information platforms for agricultural products, based on the current situation of the Xinjiang's informationization and the different demand for information of each node on the supply chain of agricultural products. Proposing an interactive platform for integrated information of agricultural products which combines farm production, supply and marketing of Xinjiang agricultural products. This will help the information platform to play the role of information collection and distribution, and to improve the efficiency of the circulation of Xinjiang agricultural products.

Keywords: Xinjiang, Agricultural Products, Interactive Platform for Integrated Information.

1 Introduction

Agriculture is the foundation of the national economy, and the vicissitudes of agriculture related to the whole national economy. With the advent of information age, the agricultural industry is using modern technology to produce scientifically instead of the traditional production mode. Meanwhile, many scholars have been paying attention to issues on the flow of the agricultural products. Frank and Henderson thought that recent researches on the flow of agricultural products had focused on the vertical coordination, ignored the vertical integration (Frank and Henderson, 1992). Zhang, a domestic scholar, whose research combined with the theory of agriculture economics, believed that the flow of agricultural products was a link of production, purchase,

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transportation, storage, and the information activities of agricultural products, etc (Qian Zhang, 2003).

With the unceasing enhancement of agricultural production efficiency, the agricultural product circuit problem is highlighted gradually. A healthy development of agriculture needs a nice basement that every entity on agriculture industry chain has good cooperation (Yuheng Zhao, 2006), and information sharing is the key point to ensure the coordination in the agricultural industry chain (Song Zhou *et al.*, 2007). Therefore, various countries built many kinds of agricultural product information platforms. As the strongest electronic information industry country in the world, United States has completed the world biggest agriculture computer network system AGNET (Xingong Li, 2003). Because of regional reason, Japan paid more attention to informationization construction of agricultural product circulation, which promoted the separation between physical distribution and the commercial interchange, and accelerated the smooth flow of goods (Chunyi Cao, 2008).

China joined the Internet in May 1994, as the 71st national-level network. In December, China proposed the plan named “Golden Agriculture Project” in the third conference of “national economy informationization joint conference”, which aimed to accelerate agricultural and rural agricultural information, and established the integrated management information system and services (Hengyou Yang, 2007). In 2005, "thousands of villages" market engineering was sponsored by the Department of Commerce, which was combined with developing of rural information, building the new system of the agricultural products circulation, and solving the problems such as the circulation of primary agricultural products. Now our agricultural information platforms are still lagging behind, especially in the mid and western agricultural provinces. The information technology worked inefficiently to play the role of agricultural products circulation (Chunyi Cao, 2008).

Xinjiang is situated at the northwest border region of China, the land area accounts 1/6 of the national total area. At the end of 2008, the total cultivated area was 4124.56 thousand hectares in Xinjiang, which accounted 3.39% for the nation total cultivated area - 121715.9 thousand hectares. The number was situated national 14th. The average cultivated area per person is 2.9 Chinese acres, situated national 4th[1]. In China, Xinjiang agriculture has advantages of large-scale and intensive compared with other areas. At present, Xinjiang agriculture has a "three pillars" pattern, featuring the farming, the animal husbandry and fruit horticulture. Therefore, Xinjiang is building an agricultural integrated information platform; will play an important role to accelerate agricultural development and products circulation.

2 The Significances and Functions of Constructing an Interactive Platform of Integrated Information for Agricultural Products

Interactive platform of integrated information is a website that set the information of agricultural production, supply, and marketing for the whole. It can play important role in speeding up the circulation of agricultural products, promoting the process of agriculture informationization, and accelerating development of agricultural.

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[1] The data originate from "China Statistical annual" (2009), the partial data obtain through the data computation.

The characteristics of a small population and vast land in Xinjiang enable its agricultural development to have certain formalization superiority. In 2008, the cotton output in Xinjiang was 302.6 million tons and beetroots was 438.9 million tons, ranked 1st in China; the output of fruits, oil-bearing crops, food foodstuff were 855.0, 56.8 and 930.5 million tons respectively, were separately situated the 7th, 13th, 21st in China[2]. In recent years, rapid development of agriculture expanded agricultural export. Table 1 shows the total exports were 7.9 billion dollars in Xinjiang by 2009, which declined 43.9% but was almost the same as 2008. Therefore, the exports of agricultural products have become a major part of Xinjiang foreign trade boost.

Table 1. Xinjiang agricultural exports Unit: billion dollars

Year	Xinjiang's agricultural exports	Xinjiang's total exports	Percentage of total Xinjiang's exports (%)	National agricultural exports	Percentage of total national exports (%)
2006	4	71.39	5.6	160.7	2.49
2007	5.97	115.03	5.19	370.1	1.61
2008	8.12	193.99	4.19	404.9	2.01
2009	7.9	108.2	7.3	395.9	2

Data sources: From *Xinjiang Statistical Yearbook 2009*, *China Agriculture Yearbook,* The People's Republic of China Central People's Government Network, China Agricultural Information Network and *Hunan Agricultural Science and Technology*.

However, exports of agricultural products in Xinjiang are mostly fruits and other primary agricultural products, and they are affected by the seasonal factor seriously. In addition, Xinjiang locates at a special geographical position and the relatively backward transport is a disadvantage in its distribution and export of agricultural products. Therefore, building an integrated information interactive platform for agricultural products in Xinjiang has an important role in the circulation of agricultural products.

Firstly, building agricultural information interactive platform can provide a intercommunion platform for the agricultural product, supply and sales, speed up the flow of the agricultural product information, promote agriculture informationization development in Xinjiang, and accelerate circulation of the agricultural products (Yuheng Zhao, 2006), atone the insufficiency from the geographical position and backward transportation condition, as well as avoid backlog of agricultural products.

Secondly, the establishment of interactive platform of integrated information will strengthen the relationship between farmers and agribusinesses, agribusiness enterprises and agribusiness enterprises, enterprises and their clients, as well as between government and the enterprises combined with farmers. In addition, the transaction cost t caused by asymmetry of information can also be reduced to this construction. Furthermore, from that we can strengthen the communication between the two agribusinesses horizontally, deepen the communication among the agribusiness, customers and governments vertically, and eventually construct a perfect products circulation system on the whole.

[2] The data originates from "China Statistical Yearbook" (2009).

3 The Problems on the Current Interactive Platform for the Agricultural Products Information in Xinjiang

3.1 A Brief Introduction to the Current Interactive Platform for Agricultural Products Information in Xinjiang

At present, the agricultural website is an effective, quick and common platform for agricultural information interaction. Xinjiang has three well-know agriculture websites: Xinjiang Xingnong Website (http://www.xjxnw.gov.cn), Xinjiang agricultural information network (http://www.xj-agri.gov.cn) and Eight Acres of Xinjiang (http://www.bamudi.com/xinjiang/Default.html).

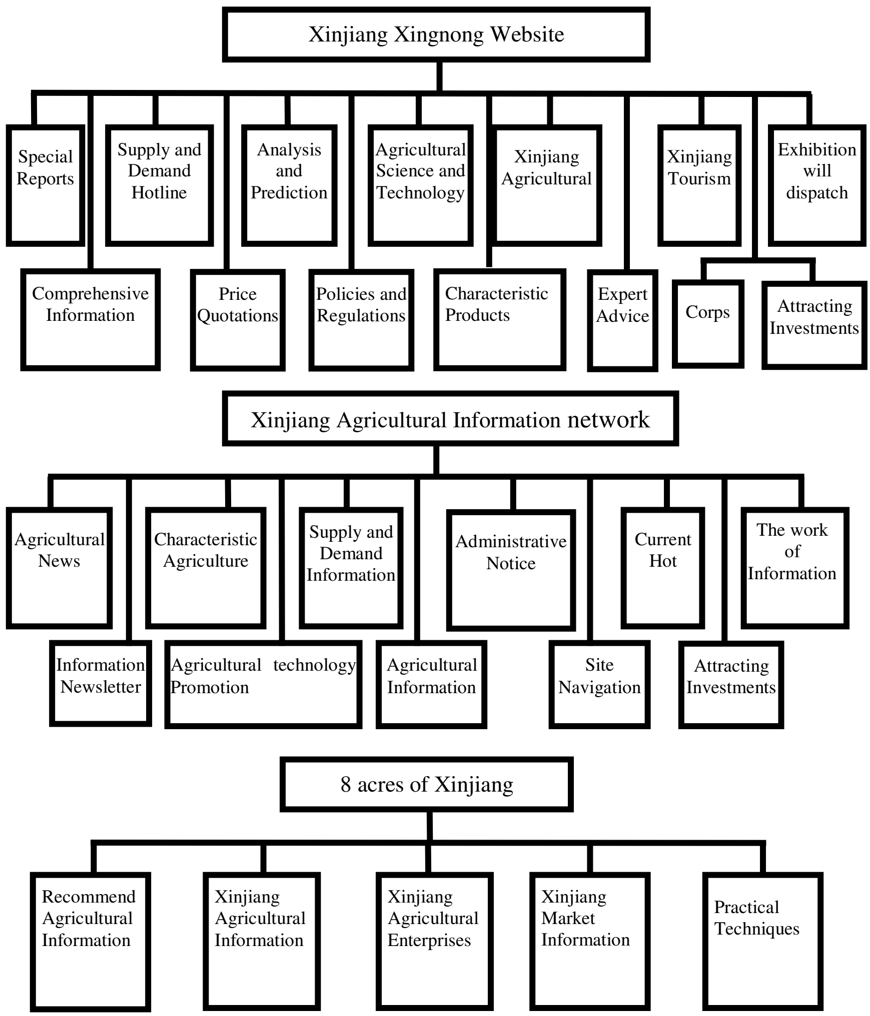

Fig. 1. The main Structure of Agriculture Website in Xinjiang

Xinjiang Xingnong Website is sponsored by Xinjiang Uygur Autonomous Region Meteorological Bureau, and Urumqi Municipal Meteorological Bureau undertakes its construction. It is an agricultural service website including information collection, editing, processing, and distributing. It is also the central website of the integrated information network system of Xinjiang agriculture. Figure 1 shows an example; Xinjiang Xingnong Website collected many aspects of information including agriculture, forestry, animal husbandry, meteorology, tourism, ecology, economy and environment etc.

Xinjiang agricultural information network is sponsored by Department of Xinjiang Uygur Autonomous Region, which is undertaken by the department of agriculture information center. Figure 1 show that Xinjiang agricultural information network focuses on agriculture policies issues, which helps farmers and agribusinesses understand new policies, also introduces the dynamic characteristics of Xinjiang agricultural products.

8 acres of Xinjiang is a self-service information interactive platform. It is a rural Internet information service platform, mainly collects information about agricultural consultation, enterprise exhibition, products promotion and user interaction. This platform joined the enterprises database, make up for the insufficiency of Xinjiang agricultural information interaction platform, and solved information sharing between production and supply.

3.2 The Shortcomings of the Current Interactive Platform for the Agricultural Products Information in Xinjiang

Although Xinjiang has established some agricultural information interaction platforms, these platforms still have many problems about construction and design.

3.2.1 The Constructor of the Platform is Single

As revealed in Figure 1, the subject of Xinjiang agricultural information interaction platform is mainly governmental, but industry, enterprise and others are not actively involved, which will affect the platform’s effectiveness, reliability and comprehensiveness. The main reason is government obtained information is secondhand information, and their energy and time are limited, so information it collected is also limited.

3.2.2 The Design of the Platform Has Problems

Xinjiang Xingnong Website has already formed three levels of agricultural comprehensive economic information network but not established its own enterprise databases and professional logistics database from the platform design. There is very limited supply and demand information published on website. While the main agricultural products in Xinjiang is fruit, which are affected by seasonal factor seriously. Therefore, this website is actually not agriculture enterprise information exchange center.

Without enterprises information, Xinjiang agricultural information network cannot attract the agricultural enterprise's attention. On the platform, farmers cannot find useful information about agriculture enterprises, and cannot achieve information sharing goal of the production, supply, and sale.

8 acres of Xinjiang network does not resolve the problems either, those in the same platform, agribusinesses can obtain and share information from the purchase to sell agricultural products.

Looking from the platform designs, Figure 2, the Xinjiang agricultural products circulation pattern shows the agricultural information platforms provide the supply and demand information. It plays certain but not significantly role to seek partner for agricultural products. Firstly, the information interaction platform lacks of subsystem about agriculture enterprise information, and it is disadvantage of enterprise to receive the production information. Secondly, three platforms only supplied source of goods information for the agricultural enterprise and the sales enterprise, but did not combine agricultural material sale with logistics service[3], and did not established information sharing mechanism about distribution, processing, procurement, and diversification etc.

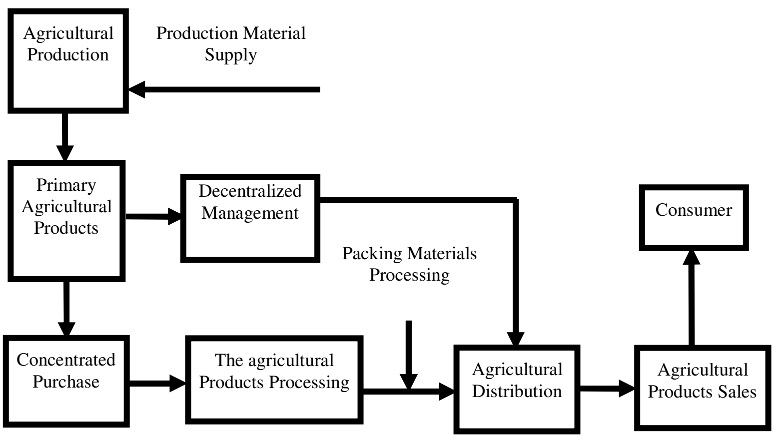

Fig. 2. Xinjiang Agricultural Circulation Pattern

3.2.3 Insufficient Use of the Platform

The purpose of constructing agricultural information is to transmit the related information. However, the current situation in Xinjiang shows these platforms were not fully used. Visiting information platform needs some equipments and skills, but famers, who are the main body of the agricultural products, are not involved well. It is due to the capital and own quality reason (Lining Gong, 2009). All of these leads to a contradiction that famers who are one of the main service objects cannot enjoy the convenience and benefits brought by the platforms.

[3] The department of commercial affairs had promulgated in March 10, 2008 《about Speeds up Our country Current distribution realm Modern Physical distribution Development Instruction Opinion》 (business changes sends [the (2008)53 number)] to propose.

4 The Construction of the Interactive Platform of Integrated Information for Xinjiang's Agricultural Products

4.1 The General Idea

The Interactive Platform of Integrated Information for Xinjiang's Agricultural Products is a collection of agricultural products information from production to sale. It can satisfy every node's demand of information in the supply chain of agricultural products, consequently optimize the whole process of the supply chain. Therefore, the construction of the platform should take the market demand as guidance, obey the principle of overall planning, develop step by step, and continuous improve and make the enterprise as the main form (Baiqing Diao, 2003). The formation of the interactive situation should take the platform constructed by the regions of developed informationization as guidance, and support participation of the regions of less developed informationization (Xuedao Wan, 2008). The construction of the platform should also focus on publicizing and brand.

4.2 Function of the Platform

To achieve the goals of spreading the information of every node in the production, supply and sale of the agricultural products, the function of the platform should be:

(1) **Function of publishing graphic and text information.** Much information is published in the form of picture and text, including policies and regulations, production technology and work trends, etc. Farmers are the main users, so their understanding ability of the information should be considered. Thus, the information of the platform should be easily understood for all kinds of people.
(2) **Function of data exchange.** The information demander should easily get electronic data from the platform. The platform should also have the function of data input and output, upload and download, as well as file printing spreading varied file format, such as the XML, TXT and EXCEL.
(3) **The retrieval functions.** Some necessary databases should be established to make users get their information through searching by keywords.
(4) **VOD function.** Users could get some video resources about the demonstration of the agricultural production technology, agricultural training courses, expert lectures and so on.
(5) **Communicating function.** Platform should provide communication function to farmers, enterprises, customers and related government departments (Kliebenstein and Lawrence, 1995).

4.3 Software and Hardware Requirements

The construction of the platform needs some hardware, mainly including network equipments, host and storage devices, network security equipment, etc (Tao Yin, 2006). In terms of software, to establish the database of agriculture information with search function, the construction of the digital information resources should be strengthened. In terms of the content of the database, it should include the database of the agricultural resources information, the agricultural factors of production information, the agricultural technology information, the market information of agricultural products, the agriculture policies and rules information and the agriculture agency information, etc. In terms of the type, the resources of the database should include picture data, text data, interspaces data and the analyzed data, etc. Therefore, the construction of the database of the platform should obey the principle of centralization, unification, criterion and efficiency, i.e. central construction, unified compatibleness, resource sharing, efficient appliance to form a centralized and regulated system of database (Ming Lu, 2009). The construction of the information resources of the platform should be unified planning. The collection and classification of the information and the exploitation of the database and item should use uniform criteria.

4.4 The Design of the Platform Content

The platform constructed in this article added the subsystem of the corporation information and information exchange to the original platform. It started with the whole life cycle of the agricultural products, and constructed data sharing platform for the production, supply and sale of the Xinjiang agricultural products and the regulators to decrease the cost of every section in the supply chain to get information.

The platform consists of three levels: the service layer, the information sharing layer and the basic function layer (Figure 3 shows the details) (Xiaohui Liu, 2007). The service layer provides various services to the users of the platform. The information sharing layer is the external manifestation, namely the web interface of the platform. The basic function layer are the various function which supported by the background database.

The background database includes the foundation of the agriculture information resources database, the policies and rules information database, the agricultural science and technology information database, the rural public information database, the agriculture work trends information database, the information exchange system database, the products information database and the enterprise information database. The functions of each database are as follows:

(1) The foundation of the agriculture information resources database introduces the administrative planning, the status of the economic and social development and the natural resources of Xinjiang, such as the climate, the animal husbandry, the output of the main crops and the proportion of the land and the cultivated land.

(2) The subsystem of the policies and rules consists of the agriculture-related legal and regulatory information, the rural security information, the emergency procedures of public events information and the government public information issued by the supervise department. It can help farmers know the current agriculture-related policies and assist farmer and manufacturing enterprises to make decisions with the market trends.

(3) The agricultural science and technology information database provides the practical science and technology for the production of the agriculture and animal husbandry according to different climates and production environments. It offers assorted technical support to the production, pest control, daily management in the planting, animal husbandry, fruit and vegetable gardening industry. Meanwhile, it introduces new products and technology to agricultural production enterprises and assists the production department of producing agricultural goods to plant scientifically.

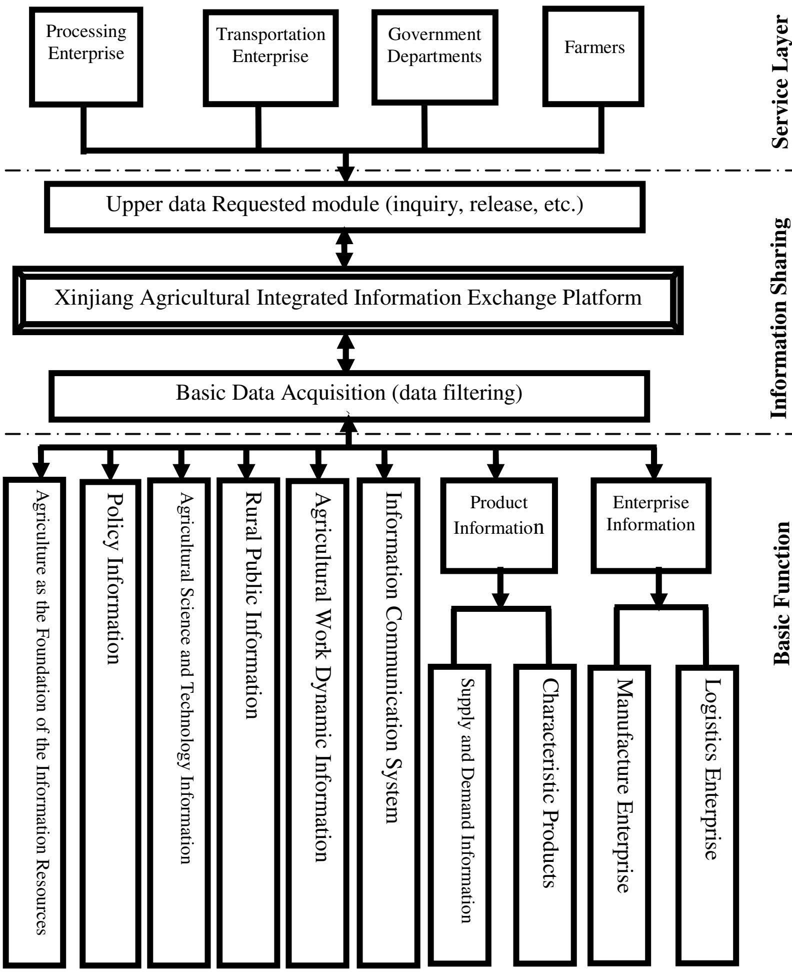

Fig. 3. The Xinjiang Agricultural Interactive Platform

(4) The rural public information database focuses on the construction of the rural social culture, the grass-roots party and the service on the medical and health service. It provides the public service on the rural information around the construction of the new rural construction and the harmonious society.

(5) The agriculture work trends information database reports the work trends of the agriculture sector at all levels, introduces the agricultural work experience of different regions, publicizes the achievement of the new rural construction and shows the success of the agricultural work.

(6) The information exchange system database provides a platform for information exchange for farmers, agricultural production and processing enterprises, logistics companies and government departments to carry out the information exchange and sharing. Farmers could gain the technical guidance by consulting experts online.

(7) The products information database issues the demand and supply information and introduces characteristic agricultural products. It provides a platform for farmers to issue the demand and supply information. It supplies the wholesale price, demand and supply information of all regions in Xinjiang, reduces the cost of getting information each other and to speed up the circulation of agricultural products. The information of characteristic agricultural products is about the advantageous agricultural products in the region. It publicizes and recommends the characteristic agricultural products by pictures and texts though the platform.

(8) The enterprise information database consists of the agriculture-related manufacturing and the logistics enterprises. It expands the awareness of the agriculture-related enterprises through showing on the platform. It avoids the trouble in searching related information on different platforms by providing the information of the transportation and storage to the agriculture-related enterprises and the separated farmers. So they can deal with the problem of the supply, sale, transportation and storage of the agricultural products in the same platform.

5 Several Issues Should be Paid Special Attention on the Construction of the Platform

5.1 The Relevant Laws, Regulations, Policies and Standards Should be Improved

The construction of the platform should conform to the *Informationization Regulations of Xinjiang*. Rules and regulations on the information collection and updating, the information exchange and sharing, the management of the network and website and the management of the project should be improved continuously. The informationization criteria should be instituted and carried out. Especially the application of the criteria should be strengthened during the construction of the platform.

5.2 The Government's Consciousness of Services Should be Strengthened

The tenet of the platform construction is to provide public information service to the agriculture production and the agricultural products circulation. So governmental departments at all levels should attach importance to the construction of the platform. The construction of the platform should base on the principle of resources integration, relative concentration, servicing farmers, and facilitating enterprises, take the informationization as means (Songhai Yuan, 2009), and set the goals to speed up the circulation of the agricultural products (Cheng Wang, 2006). The vertical and horizontal contact should be strengthened to share the information through linking and exchanging the information.

5.3 The Participation of the People of All Circles Should be Encouraged

The construction of the platform could help the demander and supplier to gain related information, and it could also speed up the informationization development in Xinjiang, so the participation of the people at all sectors of the society should be encouraged. For example, the government would encourage the large-scale agribusiness and the agricultural cooperative organizations to develop and construct the platform, and those who produced a marked effect can receive tax incentives and other related incentives (Songhai Yuan, 2009).

5.4 The Information Quality and Security Should be Noted

The ability of the users to discriminate the information is limited, so the information quality and safety should be noted. Information quality includes the reliability of the information, namely the information is true and credible, and easily understanding, which means that farmers diathesis is lower and their understanding abilities of the information is limited, and the information should be easily to understand. Information security means malicious modification should be prevented; information security monitoring system should be established and improved continuously (Paulson, 2002).

6 Conclusions

In summary, the existing information platforms of Xinjiang agricultural products have shortcomings, so, this article attempts to build an interactive platform for integrated information of agricultural products in Xinjiang to satisfy the demand for information of each node on the chain of the farm production, supply and marketing the Xinjiang agricultural products, to achieve the purpose of information sharing, thereby to reduce the transaction costs, to promote the circulation of agricultural products, to decrease the risk, and to increase the income of farmers and enterprises. It can also help the government to regulate the agricultural products market effectively, and to maintain the order of the agricultural products market.

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Modeling Spatial Pattern of Precipitation with GIS and Multivariate Geostatistical Methods in Chongqing Tobacco Planting Region, China

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Abstract. Precipitation is important factor affecting vegetation and controlling key ecological processes. In order to quantify spatial patterns of precipitation in Chongqing tobacco planting region, China, under ArcGIS platform, three multivariate geostatistical methods including cokriging, small grid and regression kriging, coupled with auxiliary topographic factors extracted from a 1:100000 DEM were applied to predict spatial distribution of precipitation for January (the least month), June (the richest month) and the whole year. The results showed that cokriging was the best for prediction precipitation of January, which could explain 58% of the total variation. Small grid simulation with IDW interpolation exhibited higher accuracy for both June precipitation and annual precipitation, which explained 72% and 61% of the total variation respectively. Generally, multivariate geostatistics accounted for most of the spatial variability in mean precipitation and especially could exhibit great improvement for estimating precipitation in areas where topography has a major influence on the precipitation.

Keywords: Modeling spatial prediction, GIS, Cokriging, Small grid simulation, Regression Kriging.

1 Introduction

Precipitation is a very important climatic characteristic used in determining site suitability for agricultural and forest crops [1, 2], and it is also important in parameterizing the habitat of plant species and determining the patterns of vegetation zonatio [3].However, accurate precipitation data only exist for point locations, the meteorological stations, as a result of which values at any other point in the terrain must be inferred from neighboring stations or from relationships with other variables [4]. Therefore, spatial modeling of precipitation is of importance for understanding and supporting agricultural sustainability development.

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Over the past decades, a number of methods have been proposed for modeling the spatial distribution of precipitation. The simplest approach is Thiessen polygon method which amounts at drawing around each gage a polygon of influence with the boundaries at a distance halfway between gage pairs [5]. Although the Thiessen polygon method is essentially used for estimation of areal rainfall, it has been applied to the interpolation of point measurements [6]. Meanwhile inverse distance interpolation that makes unknown rainfall depth as a weighted average of surrounding values and the weights being reciprocal to the square distance from the unsampled location is also widely applied in many regions [6, 7]. However, for both Thiessen polygon method and inverse distance interpolation weighting method, they do not consider topographic variables such as elevation, altitude or latitude influences on precipitation, which rather is believed to be important factors especially in mountain regions with complex terrain. In order to overcome this deficiency, some researchers develop the relationships between precipitation and a range of topographic variables and used regression analysis and GIS techniques to model rainfall spatial pattern [1, 8-10].But the method heavily depends on the accuracy of regression model and rarely consider spatial relationships among sample points.

Multivariate Geostatistics which is based on the theory of regionalized variables [11], is recently increasingly preferred because it allows one to capitalize on the spatial correlation between neighboring observations to predict attributes values at unsampled locations, and also can be complemented by ancillary attributes [7, 12, 13]. Several authors have shown that the multivariate geostatistical prediction provides better estimates of rainfall than conventional methods or single ordinary kriging.For example Goovaerts [8] used cokriging for incorporating elevation to predict mean monthly rainfall spatial distribution of Algarve, Portugal and compared that with Thiessen polygon, inverse square distance as well as ordinary kriging, found that cokriging could achieve better estimation results. Lapen [3] used regression kriging to spatially model the total precipitation normals in the Great Lakers. Hussain [14] interpolated precipitation during monsoon periods in Pakistan. Ouyang [15]incorporated altitude, latitude, elevation, slope, aspect components and used small grid interpolation to calculate annual precipitation distribution of Beijing mountain area, china and the result showed the error tolerance was within 40mm.

Chongqing tobacco planting region, which locates in the southwest China and mostly is covered by hilly and mountains. Understanding the spatial pattern of precipitation especially increasing the accuracy of spatial prediction would be very important for local tobacco planting precise plan and management. In this study, we present an application of cokriging, small grid interpolation, regression kriging respectively for modeling precipitation in January (least), June (most) and the whole year of this region. Topographic variables including elevation, altitude, latitude, slope and aspect were used as auxiliary data. Mean squared error (MSE) and root mean squared standardized effect (RMMSE) as performance evaluation indicators were investigated to determine which approach is appropriate for predicting regional precipitation spatial distribution within different periods.

This paper is organized as follows. Following the introduction, some theory and methods used in this study are described in Section 2 .The study area and data resources are depicted in Section 3. In section 4, results and discussion are illustrated. Conclusions are finally made in Section 5.

2 Theory and Method

2.1 Cokriging

Multivariate geostatistics comprise a set of techniques and estimators which use the spatial variability, multivariate variables and correlation of a continuous spaced-distributed phenomenon to predict unsampled locations. In this section, we briefly introduce three methods used in this paper.

$$\gamma_{uu}(h)=\frac{1}{2}\left[\{z_u(x)-z_u(x+h)\}^2\right] \tag{1}$$

Where h is a vector, the lag. For v also, the expected difference is zero and its autovariogram is $\gamma_{vv}(h)$.The two variables have a cross-variogram $\gamma_{uv}(h)$, defined as

$$\gamma_{uv}(h)=\frac{1}{2}E\left[\{Z_u(x)-Z_u(x+h)\}\{z_v(x)-z_v(x+h)\}\right] \tag{2}$$

Which describes the way in which u is spatially related to v.

To compute the usual cross-variogram, there must be sites where both u and v have been measured. The experimental cross-variogram $\hat{r}_{uv}(h)$ can be estimated by

$$\hat{\gamma}_{uv}(h)=\frac{1}{2m(h)}\sum_{i=1}^{m(h)}\{z_u(x_i)-z_u(x_i+h)\}\{z_v(x_i)-z_v(x_i+h)\} \tag{3}$$

Where z_u and z_v have been measured at sites x_i and x_i+h, and $m(h)$ is the number of pairs of data points separated by the particular lag vector h.

The cross-variogram can be modeled in the same way as the autovariogram but there is an added condition. Any linear combination of the variables itself should be a regionalized variable, and its variance must be positive or zero. This is ensured if we adopt the linear model of coregionalization. For any pair of variables u and v, the variogram is

$$\gamma_{uv}(h)=\sum_{k=1}^{k}b_{uv}^{k}g_k(h) \tag{4}$$

Where the b_{uv}^k represents the variances, for example the nugget or sill variances. $g_k(h)$ is the spatial autocorrelation function which must be the same for both analyzed variables.

The ordinary punctual cokriging prediction of the primary variable $\hat{Z}_{\mathrm{u}}$ is obtained from the linear sum

$$\hat{z}_u(x_0) = \sum_{i=1}^{V} \sum_{i=1}^{n_l} \lambda_{il} z_l^{ok}(x_i) \tag{5}$$

Where there are V variables, $l = 1,2,...,V$ of which u is the one to be predicted and the subscript i refers to the sites of which there is n_l in the search neighborhood where the variable l has been measured. The λ_{il} represents the weights, which in the case of 'classical 'cokriging (Goovaerts, 1997) satisfy

$$\sum_{i=1}^{n_l} \lambda_{il} = \begin{cases} 1, & l = u \\ 0, & l \neq u \end{cases} \tag{6}$$

There are non-bias conditions and the weights λ_{il} which minimize the estimation variance of $\hat{z}_u$ for a point x_0 are found by solving the kriging system for all $v = 1,2,...,V$ and all $j = 1,2,...n_v$. The weights λ_i are inserted into Eq. (5) to estimate $\hat{z}_u(x_0)$.

2.2 Small Grid Simulation

Small grid simulation is based on a linear regression between a target variable such as certain climatic property (Z) and a secondary or third variable such as elevation or slope (Y_i).The regression model so obtained is used to predict Z to the locations of the prediction grid at which Y_i is known. The residuals from the regression ε are interpolated deterministically to the prediction grid. Since there is still no any deterministic interpolation proved to fit all variables. In this paper, we used IDW and Spline respectively and determined the proper one by calibration and comparison. The predicted values $\hat{z}_R$ and the interpolated values of the residuals $\hat{\varepsilon}$ are summed to give the predicted values of the target variable $\hat{z}$.

$$\hat{Z}(x) = \hat{Z}_R(x) + \hat{\varepsilon}(x) \tag{7}$$

2.3 Regression Kriging

Odeh et al [16] described three types of regression kriging: model A, B and C which are the developments of the general theme. In this study, we used model C. Like small grid simulation, the method is also based on a linear regression between a target variable and a secondary or third variable. But the residuals from the regression ε are kriged stochastically to the prediction grid using the variogram computed from the residuals. The predicted values $\hat{z}_R$ and the kriged values of the residuals $\hat{\varepsilon}_{ok}$ are then summed to give the predicted values of the target variable $\hat{z}_{RK}$. in the author index.

$$\hat{Z}_{RK}(x) = \hat{Z}_R(x) + \hat{\varepsilon}_{ok}(x) \quad (8)$$

2.4 Performance Evaluation Indicators

In order to evaluate the performance of different multivariate geostatistical methods, mean squared error (MSE) and root mean squared standardized effect (RMSSE) in this paper, are used as performance measure indicators.

The mean squared error (MSE) is expressed as

$$MSE = \frac{1}{l}\sum_{j=1}^{l}\left[z_1(x_i) - z_2(x_i)\right] \quad (9)$$

The root mean squared standardized effect (RMSSE) is expressed as

$$RMSSE = \sqrt{\frac{1}{1}\sum_{i=1}^{l}\left[z_1(x_i) - z_2(x_i)\right]^2} \quad (10)$$

Where $z_1(x_i)$ is standardized site true value and $z_2(x_i)$ represents standardized site prediction value, l is the number of validation sites. When MSE is more close to 0 and RMSSE more approaches 1, the accuracy of prediction is regarded better.

3 The Study Area and Data Source

3.1 The Study Area

The study area is located in the east part of Chongqing between north latitude 28°09′and 32°12′and east longitudes 106°23′and 110°11′(Fig. 1).The landform of this

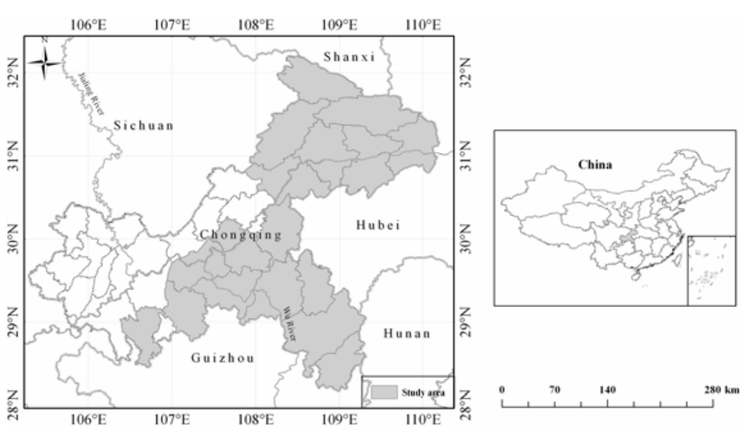

Fig. 1. Location of the study area

area is dominated by hills, low mountains and medium mountains. Generally, it is undulating with slopes ranging from 0 to 84 °and altitudes within the range from 100 to 2750.92 m. Due to weak transportation and poor economy development, tobacco planting has been one of local dominant crops productions.

3.2 Data Sources

Precipitation data were obtained from 34 meteorology stations of the Chongqing Meteorological Institute monitored monthly from 1977 to 2006, and 13 additional stations belonging to other organizations, irregularly dispersed throughout the whole region. From the observations, 10 sites randomly selected, were kept aside for validation. As precipitation of this region is strongly seasonal (Fig. 2.), and in this study we just model mean monthly precipitation for the least rainfall (January), the richest rainfall (July), as well as the whole year.

A DEM was constructed using ArcMAP Version 9.2 (ESRI).50×50m DEM data were derived from automated image matching of scanned panchromatic aerial photograph based on AUNDEM. Primary topology attributes including elevation, slope and aspect. Latitude and longitude were available by Binary ACCII interpolation.

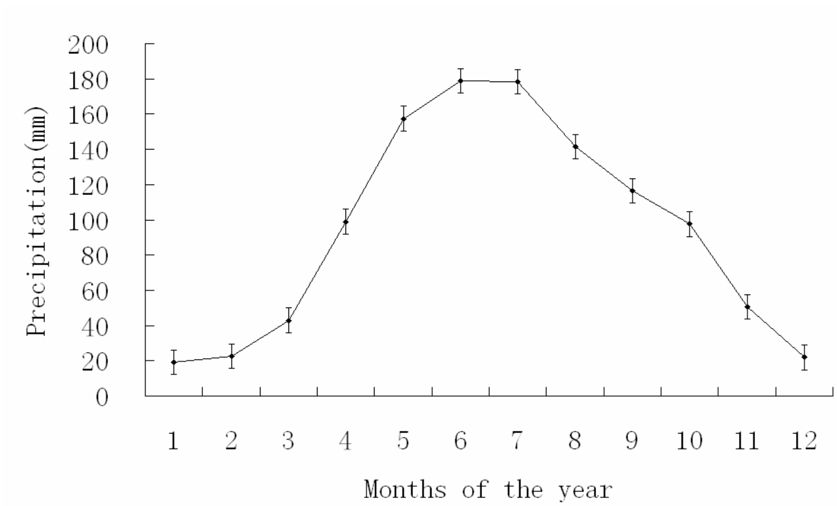

Fig. 2. Mean monthly precipitations of the stations over past thirty years in study area

4 Results and Discussion

4.1 Exploratory Data Analysis

The Pearson correlation coefficients were calculated between precipitations and the independent topographic variables to determine the influence of different terrain elements on rainfalls. It was shown in Table 1. For precipitations within three different periods, they were all related to elevation and aspect. And precipitation generally increased with elevation, but aspect otherwise inversely. For longitude, only annual precipitation showed strong positive correlation and both precipitation in January and that in July rather showed negative correlation whereas annual precipitation is likely to be indirect. Except precipitation of July, the precipitations of other periods had no obvious links with slope.

Table 1. Bivariate correlations between the independent topographic variables and precipitation data within different periods

	January	July	Annual
Longitude	-0.086	0.233	0.461(**)
Altitude	-.693**	-.401*	-0.212
Elevation	0.521**	0.466*	0.415*
Slope	-0.03	-0.381*	-0.021
Aspect	-0.471*	-0.416*	-0.423*

4.2 Cokriging

Experimental cross- and auto-variograms were obtained by applying Eq. (4) using the longitude, altitude, elevation, slope and aspect at the observation sites for precipitations. It was shown as in Table 2.

Table 2. Variogram model parameters with longitude, altitude, elevation, slope and aspect of different precipitations

Item	Variable	Model	Nugget	Sill	Range(km)
	Longitude	Linear	1.2	-	-
	Altitude	Exponential	0.7	0.9	141.16
January	Elevation	Gaussian	1.2	1.2	320.60
	Slope	Linear	1.2	-	-
	Aspect	Spherical	0.7	0.8	118.19
	Longitude	Linear	1.4	-	-
	Altitude	Exponential	0.7	1.1	320.67
June	Elevation	Exponential	0.6	0.8	117.37
	Slope	Spherical	1.2	1.3	340.70
	Aspect	Exponential	0.6	0.8	117.37
	Longitude	Gaussian	0.7	0.9	116.19
	Altitude	Linear	0.9	-	-
Annual	Elevation	Exponential	0.6	1.0	121.04
	Slope	Linear	0.7	-	-
	Aspect	Spherical	1.1	1.4	326.70

It was indicated that the two sets variograms of elevation, aspect for precipitation within different periods were all bounded and were fitted by Gaussian, Spherical and Exponential, Exponential, Exponential as well as Spherical respectively. The variograms of longitude for precipitation of January and June were both unbounded, whereas it was bounded for annual precipitation with the range set to 116.19 km. The variogram of slope was bounded for precipitation of July whereas it was unbounded for both June and Annual. Under the ArcGIS platform, altitude, elevation and aspect were associated as covariances for precipitation of January and altitude, elevation, slope as well as aspect were associated as covariances for precipitation of July. Longitude, elevation and aspect acted as covariances for the spatial prediction of annual precipitation. The whole prediction maps were shown in Fig. 3.

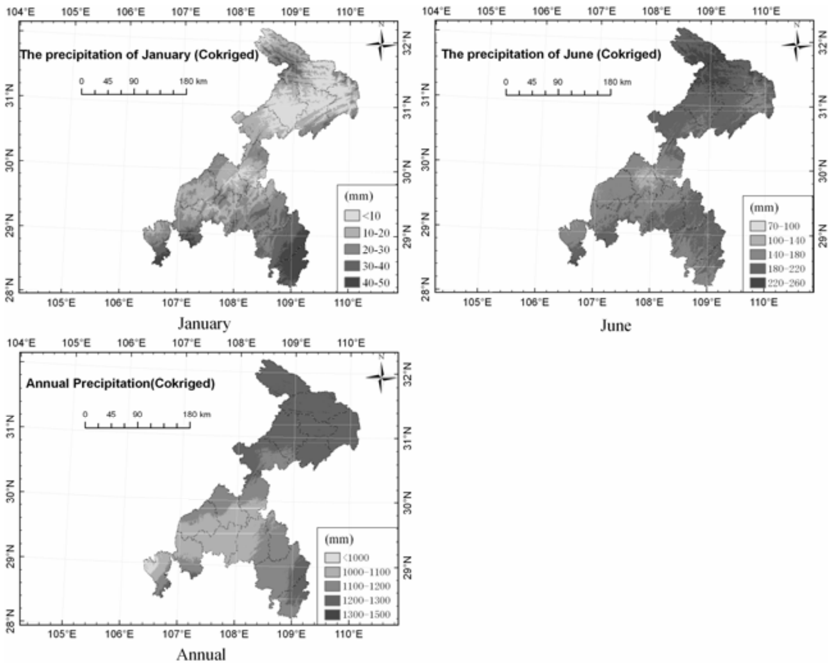

Fig. 3. Spatial predictions for precipitations within different periods with cokriging

4.3 Small Grid Interpolation

Linear regressions of precipitations of January, July and Annual were done. The equations were depicted as follows:

$$y_1 = 1.124\alpha - 4.888\beta + 0.008\lambda - 0.167\phi + 0.005\varphi + 41.881 \quad (r^2 = 0.790)$$

$$y_2 = 8.246\alpha - 14.542\beta + 0.009\lambda - 0.339\phi - 0.004\varphi - 272.081 \quad (r^2 = 0.638)$$

$$y_3 = 45.520\alpha - 30.698\beta + 0.118\lambda - 2.938\phi + 0.059\varphi - 287.142 \quad (r^3 = 0.573)$$

Where y_1, y_2 and y_3 represents precipitation of January, July and Annual respectively, $\alpha, \beta, \lambda, \phi, \varphi$ represents longitude, altitude, elevation, slope and aspect.

The residuals of regression models calculations were interpolated by IDW and Spline respectively, and then summarized with regression predicted values. The whole spatial prediction maps were displayed in Fig. 4.

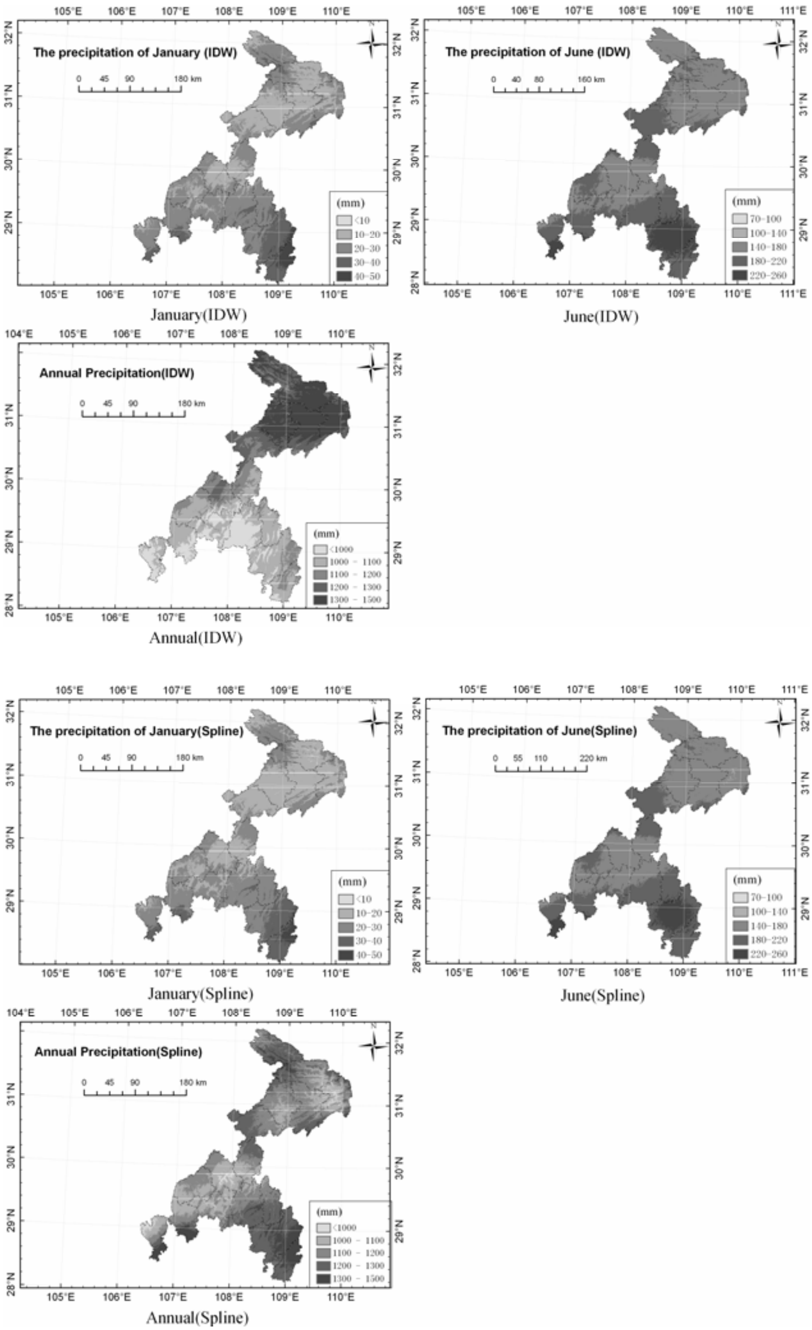

Fig. 4. Spatial predictions for precipitations within different periods with small grid simulation

4.4 Regression Kriging

Regression modeling is the same with small grid interpolation, and an experimental variogram was computed on the residuals of precipitations within different periods from the regressions at each site. It was shown in Table 3.

Table 3. Parameters for the fittest residuals theoretical models of precipitation within different periods

Item	Model	Nugget	Sill	Range(km)	R^2
January	Spherical	0	0.093	411.1	0.631
	Exponential	0	0.079	411.1	0.652
	Gaussian	0.011	0.107	411.1	0.724
June	Spherical	0.002	0.014	388.9	0.713
	Exponential	0.001	0.014	411.1	0.762
	Gaussian	0.004	0.016	358.3	0.714
Annual	Spherical	0.004	0.009	354.8	0.841
	Exponential	0.001	0.009	411.1	0.784
	Gaussian	0.003	0.010	301.6	0.843

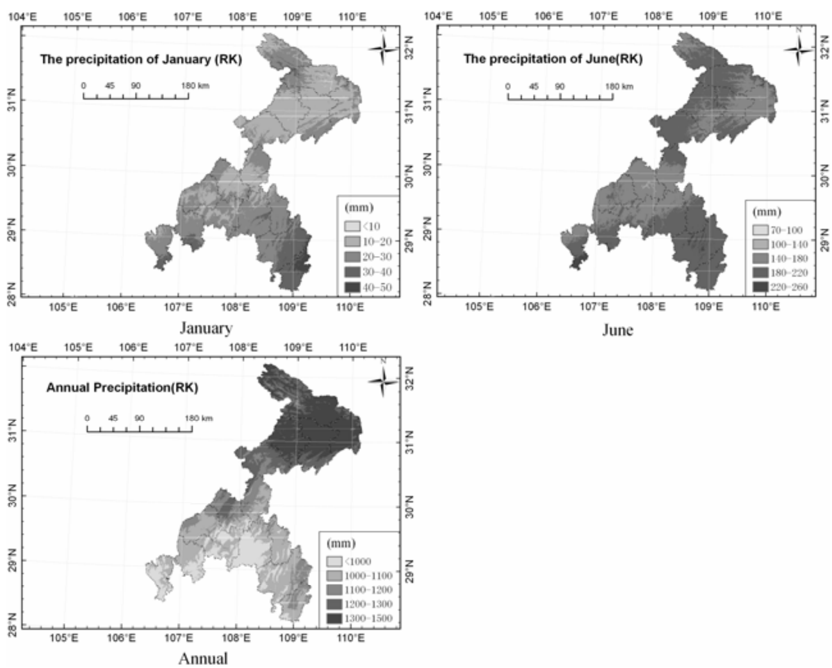

Fig. 5. Spatial predictions for precipitations within different periods with regression kriging

It was found that the highest determined coefficient (R^2) existed in Gaussian, Exponential and Gaussian model for precipitation of January, June, Annual respectively. The whole spatial prediction maps were displayed in Fig. 5.

4.5 Discussion

The prediction residuals and MSEs as well as RMMSEs for the precipitations of January, June and Annual were given in the Table 4 for each method of spatial prediction.

In terms of prediction residuals, for precipitation of January, cokriging was the smallest, followed by the small grid (Spline interpolation), small grid (IDW interpolation), and last was the regression kriging. And cokriging could explain 58% of total variation. The MSEs Variation for different methods showed same trend. The RMSSE of being close to 1 was ranked by cokriging, small grid (Spline interpolation), small grid (IDW interpolation) and regression kriging. Fig. 3, Fig. 4 and Fig. 5 have showed the spatial prediction maps with different methods. Generally, the major patterns of variation were evident but the detail was different.

Table 4 showed that small grid (IDW interpolation) was the most accurate method of prediction for precipitation of June, which could explain the 72% of total variation, followed by small grid (Spline interpolation), cokriging. And the regression kriging was the worst in this spatial variability of January, June and Annual mean case. The less accurate predictions from regression kriging probably reflected regression model less good determined coefficient.

For annual precipitation, the prediction accuracy rank showed similar pattern with June but the least accuracy method was cokriging and the explained percentage of total variation by small grid (IDW interpolation) simulation was 61%.

Table 4. Prediction accuracy at validation points

Item		Cokriging	Small Grid (Spline)	Small Grid (IDW)	Regression Kriging
January	TSS[a]	10947	10947	10947	10947
	SSR[b]	4598	5255	5692	6568
	MSE	0.074	0.087	0.092	0.093
	RMSSE	0.891	0.851	0.871	0.832
June	TSS[a]	961037	961037	961037	961037
	SSR[b]	451687	374804	269090	470908
	MSE	0.034	0.031	0.027	0.072
	RMSSE	0.911	0.952	0.973	0.897
Annual	TSS[a]	32921134	32921134	32921134	32921134
	SSR[b]	17448201	15143722	12839242	16131356
	MSE	0.065	0.051	0.042	0.057
	RMSSE	0.872	0.897	0.925	0.887

[a] TSS represents the total sum of residuals.

[b] SSR represents the sum of squares of residuals.

5 Conclusion

Understanding the spatial variation of climatic factors is very important for crops planting planning and management. Increasing the accuracy of the spatial predictions of precipitation with the aid of available ancillary data is quiet environmental typically in complex terrain mountain areas, where topographic factors usually have influence on precipitation spatial pattern. This study predicted the spatial distributions of precipitations within different periods with three multivariate geostatistical methods including cokriging, small grid and regression kriging in Chongqing tobacco planting area. And the methods showed good advantage which enabled us to describe 58-72% of the precipitation. However, it should be noted that although ancillary data have been proved to contribute to improving prediction results, there is still no single optimal method for all regions. The coregionalization and the relations between the deterministic components of the variation still should be carefully examined before deciding on the most appropriate methods of prediction.

Acknowledgments

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Prediction of Freight Ability in Country Base on GRNN

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Abstract. Developing the country's economic is a hot topic in Chinese society, and then the freight ability is a value that show the development of the local economic. The prediction of freight ability in country is benefit to the planning of country's transport. This article choose suited input first, and then make up the GRNN model, at last, predict the ability of the freight.

Keywords: Prediction, Freight ability in Country, GRNN.

1 Research Background

Perfect transportation is key guarantee for country to solute "Three Rural Issues". Accelerating the development can efficaciously help to deal with problem about circulation of agricultural products, strengthen the agricultural integrated produce ability and improve the adjustment of industry structure in country. Besides, it can also widen developing idea, improve the investment environment and achieve the goals of agricultural development and income rising; what's more, smooth transport could resolve those predicaments about sale and buy, stimulate the growth of rural consumption and shrink the distance among regions.

Perfect transportation plays a supporting role in development of urban and rural, construction of harmonious society. Convenient communication of labor and goods will effectively change the binary pattern contacted with employment, income, education, medical resource and so on. Rural transport is the important component and the end of integrated transportation network. Just like the capillary in body, rural road network builds bridge between aorta of the whole nation and great channel of special regions, and is the symbol show the width and depth of transport. We must take measures to speed up the development of transport network in rural regions, so as to arouse its skeleton effect, and keep the whole network development coordinately and proportionally.

Woeful condition of transport infrastructure is one of the key reasons leading to poverty of rural regions, which play objectively inciting role in development of country economy. The success of rural transport plan partly lies on the prediction of freight ability in country, which prepensely and preparedly carries on program for rural transport for related workers when they face interrelated works, to meet the need of the rural economy development [1].

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2 GRNN

The common freight volume prediction contains time series, regression analysis, grey prediction and composed prediction integrating kinds of methods. These methods almost concentrate in the analysis on Regression Model and Time Series Model toward its causality, these models cannot predict the inner structure and complicated character of these predicted dynamic data comprehensively and constitutionally, as a result, many the amount of information are missed. As a kind of parallel calculation model, Artificial Neural Networks holds many advantages surpassing traditional modeling methods, and is more effective for nonlinear mapping. ANN don't need too much experienced knowledge about modeled objects, such as the structure, parameter and dynamic character, only demanded is working out objects' output data and input data, and then input/output mapping will be easily reached through network' own learning function.

Prediction of freight volume can use BP net and RBF net, which, however, owns some weak point such as low convergence speed and much too tiny parts. So, unfortunately, the result is not absolutely desirable when the sample is not enough and unwanted sound is crowded. Compared with BP net and RBF net, GRNN have a strong advantage in approximation capability, category capacity, learning speed. Net will finally converge to optimal regression surface which contains more samples, get better predict result even when the sample data is in shortage and in unsteadiness. Hence, I will attempt to build prediction model to predict rural freight volume by the help of GRNN [2].

2.1 GRNN Introduction

Structure of GRNN is shown as Figure 1:

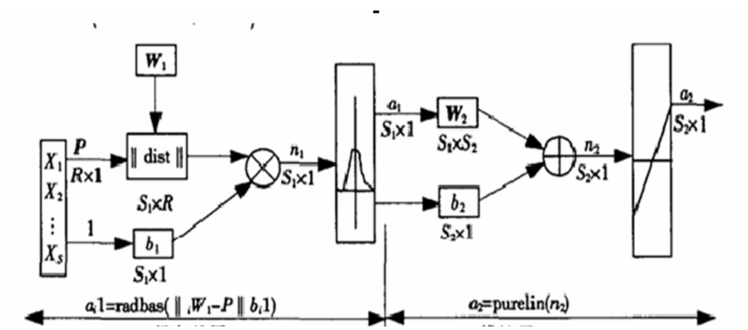

Fig. 1. The picture of GRNN net's conformation

The first layer is hidden layer of Radial basis, the amount of neurons equals that of training samples. In this layer, weight function is Euclidean distance function, whose function is calculating the distance between data in computing network and the first weights $IW_{1,1}$, b^1 stands for threshold in this hidden layer. Mark "g" expresses the relation between data from $\| dist \|$ and b^1. Transfer function in this layer is RBF, and the Gaussian function is regarded as transfer function:

$$R_i(x) = \exp\left(-\frac{\| x - c \|}{2\sigma_i^2} \right) \tag{1}$$

In addition, σ_i decides the shape of basis function in the first hidden layer, the larger it is, the smoother the basis function is, so σ_i is also called smoothing factors.

The second layer is linear output layer, whose weights function is standardization dot product weight function, been used to calculate the vector n^2, α^1 multiply each line element in $LW_{2,1}$, then divided by the sum of every factor of α^1, we can obtain every element. And the result n^2 will be offered for transfer functions [3] :

$$\alpha^2 = purelin(n^2) \tag{2}$$

Study modification of GRNN connection weights also use BP Algorithm. Basis function in network hidden layer nodes chooses Gaussian function. As that above can show, this kind of network has capacity of local approximation, which just is the reason leading to quicker study programs. In addition, there are little personal adjusting parameter, only one threshold, and all the network study depend on data sample, which bring up the ability preventing prediction result from being affected by those personal and subjective presumption to the utmost extent. Compared with BPNN, GRNN demands less parameter need to be adjusted and has one smoothing factor, so can find proper forecast network quickly, and holds more advantage in calculation.

2.2 Construction and Training of Network

(1) Choose impact factor

The analysis on impact factor of rural freight volume contains human, wealth, objects. Adopted in this paper have some impact factors, which is regarded as network output as follow.

① Transport instrument. For water transport in the whole freight is extremely small, the main transport instrument is motor vehicle and railway. Adopt rural freight cars number to indicate(x1) and the number of freight train(x2).

② Mileage of transport route. water transport take up bitterly little. So adopt mileage of rural highway(x3) and Railway(x4).

③ Number of practitioners on transport. The amount of those people own driver's license and driving permit in rural region(x5).

④ Level of local economy development. Local GDP (x6)and agriculture, animal husbandry and fishery value(x7) will be chose.

⑤ Tax on rural transport. Total tax of local transport can reflect the ability of rural transport macroscopically.

(2) Choose output factors.

Make the freight mileage in the country(x10)、railway freight traffic (x10) and the highway freight traffic(x11) as the output factors, which is called the network output amount.

Building GRNN after choose impact factor and output factors. Because smoothing factor may affect the capability of network, so it is necessary to try again for the best result.

According to the output factor and input factor being determined above, make one rural region's historical statistics from 2001~2007 as training sample of network, and regard historical statistics between 2008 and 2009 as extrapolation of test samples. Input sample and target sample is as follow table.

Table 1. The sample data between 2001 to 2009 in a country area (input sample)

Year	x(1)	x(2)	x(3)	x(4)	x(5)	x(6)	x(7)	x(8)
2001	21.30	1349.41	0.97	0.32	23.1	707.58	109.73	80.5
2002	20.93	1484.05	1.10	0.32	28.6	821.40	123.68	94.5
2003	21.88	1616.93	1.27	0.35	30.8	900.99	148.18	87.5
2004	22.85	1767.14	1.51	0.36	31.9	947.97	163.63	91
2005	24.63	1910.76	1.79	0.36	34.1	993.01	183.19	91
2006	26.07	2062.04	2.05	0.37	36.3	1081.78	195.27	98
2007	27.85	2191.44	2.34	0.37	39.6	1160.79	214.17	98
2008	29.56	2353.32	2.49	0.39	42.9	1267.96	231.90	105
2009	31.85	2504.06	2.74	0.39	45.1	1412.00	250.62	105

Table 2. The sample data between 2001 to 2009 in a country area (goal sample)

Year	x(9)	x(10)	x(11)
2001	1241.08	633.62	559.64
2002	1507.50	735.93	680.56
2003	1800.38	837.96	815.08
2004	1967.07	966.26	945.80
2005	2257.76	1109.06	1095.63
2006	2490.93	1205.58	1194.97
2007	2741.84	1329.33	1241.02
2008	2972.20	1458.85	1346.21
2009	3189.50	1577.57	1456.31

First, take normalization with those data, after it the data are as follows:

Combine the two figures above and examine the result, we can find that smoothing factors closely decide the approximation performance of network sample, and express to be positive correlation. When smoothing factors is 0.1, the deviation will be small for not only approximation performance and forecast performance. As the addition of smoothing factor, the deviation will accordingly increase.

Table 3. The data between in a country area after normalization

Year	x(1)	x(2)	x(3)	x(4)	x(5)	x(6)	x(7)	x(8)	x(9)	x(10)	x(11)
2001	0.034	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2002	0.000	0.117	0.073	0.000	0.250	0.162	0.099	0.571	0.137	0.108	0.135
2003	0.087	0.232	0.169	0.429	0.350	0.275	0.273	0.286	0.287	0.216	0.285
2004	0.176	0.362	0.305	0.571	0.400	0.341	0.383	0.429	0.373	0.352	0.431
2005	0.339	0.486	0.463	0.571	0.500	0.405	0.521	0.429	0.522	0.504	0.598
2006	0.471	0.617	0.610	0.714	0.600	0.531	0.607	0.714	0.641	0.606	0.709
2007	0.634	0.729	0.774	0.714	0.750	0.643	0.741	0.714	0.770	0.737	0.760
2008	0.790	0.869	0.859	1.000	0.900	0.796	0.867	1.000	0.888	0.874	0.877
2009	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

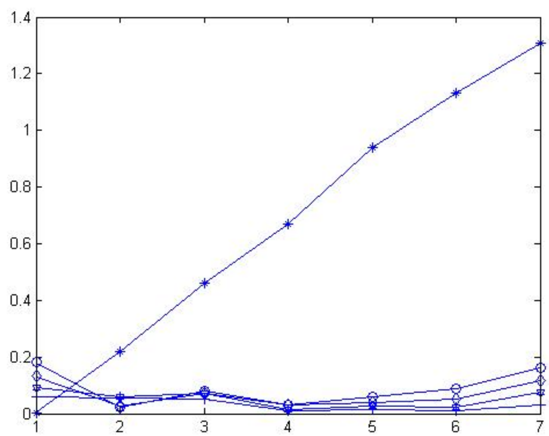

Fig. 2. The error of closing into the net

When smoothing factors is 0.1, the test output is:
yc=
0.7702 0.7802
0.7370 0.7570
0.7599 0.7799

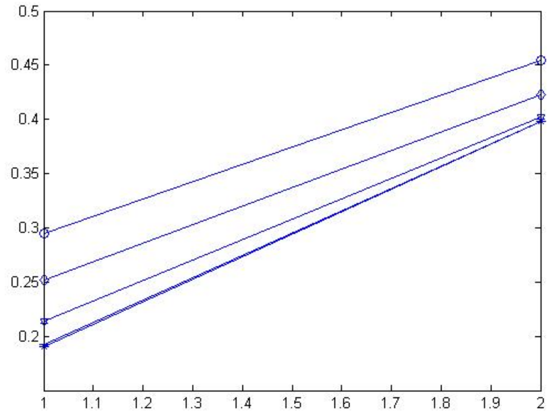

Fig. 3. The error of forecasting of the net

Deal with these data by Inverse normalization, and then inverte the Matrix, the result are as follows:

Table 4. The data between the true value and predicted value

Year	x(9)		x(10)		x(11)	
	True value	Predicted value	True value	Predicted value	True value	Predicted value
2008	2972.20	2741.74	1458.85	1329.31	1346.21	1240.98
2009	3189.50	2761.22	1577.57	1348.18	1456.31	1258.40

Consequently, prediction error is more obvious, for the reason that the increasing degree between 2008 and 2009 is bigger, and these dates are far away from those training data, it is hard to reason. Besides, the number of the training sample is less, so the forecasting precision is not well. Taking into account these, the result of forecasting can be accepted.

3 Conclusion and Analysis

Basis on the analysis of influencing factor and predict character of rural freight volume, this paper predict the rural freight volume through GRNN. The testing and analysis of prediction consequent prove that the GRNN is valid for predicting rural freight volume. The guiding ideology and calculate method also need to be perfected, though this paper provide a reference for the prediction of rural freight volume in a certain sense. The result consequentially plays instructing role in rural transport and rural economy.

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Research and Application of Modern Information Technology in the Forest Plant Protection Machinery

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Abstract. Forest pests and diseases is very important to forest because it not only restricts the development of forest, but also causes huge economic. Chemical pesticides control the pests and diseases effectively and pollute environment seriously. How to reduce the amount of pesticide is the research hotspot in the field of plant protection. Forest plant protection machinery is the most important way to spray chemical pesticides. With the development of various modern information technologies, forest plant protection machinery has entered the electronic age in developed country. There are many modern information technologies which are applied in forest plant protection machinery, such as database, 3S technology, and sensor technology and so on. In this paper, a large number of relevant scientific literatures have been analyzed and compared in order to summarize application of modern information technology in the forest plant protection machinery. As the wide forest range, forest plant protection machinery should base mainly on large-scale spraying. 3S technologies, database technology, computer control technology and a variety of detection techniques should be effectively combined together and applied in forest plant protection machinery in order to meet environmental safety requirements and improve the efficiency.

Keywords: Forest, Plant Protection Machinery, Pests and diseases, Information Technology.

1 Introduction

Forest is essential resource for human being. Forest resources protection is comprehensive measure which includes the reasonable usage of soil, water and other renewable resources, improving the ecology environment, supporting social and economic sustainable development and so on. Precision forestry is purposed to meet the strategy of developing forestry production science, and realize the change forestry production from extensive to intensive. The basement of precision forestry is to collect all kinds of forestry information quickly and accurately, and detect and manage forest objects

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effectively. However, forest object detection and management are bottleneck for precision forestry because forest objects are various and forest is a random variable environment. The forest pests and diseases become more and more serious for global warming, severe weather occurring frequently and inter-regional trade. Forest pests and diseases cause significant economic losses. Chemical pesticides are the important measure to control the forest pests and diseases. However, chemical pesticides also pollute environment seriously. To improve chemical pesticides utilization and reduce environmental pollution, forest plant protection machinery became one of important application directions of precision forestry.

Modern society is changed from industrialization to information. The global wave of information technology is droved by modern information technologies which are included computer technology, communication technology, network technology, multimedia technology, 3S technologies, and sensor technology and so on., modern information technologies are widely used modern forestry, especially for forest plant protection machinery.

In this paper, a large number of relevant scientific literatures have been analyzed and compared in order to summarize application of modern information technology in the forest plant protection machinery. The prospects of application and development of modern information technology in plant protection are discussed in this paper.

Modern information technology refers to access, process, transmit and utilize the information by computer and modern communications technology. Modern information technology is interdisciplinary science that includes computer technology, communications technology, multimedia technology, network technology and so on. The modern information technology develops rapidly and brings great economic and social benefits.

In order to find the development of modern information technology, the published academic papers are searched Engineering Index Database and Science Citation Database with the key words of modern information technology (such as databases, remote sensing, image processing and so on) for nearly 20 years (1990~2010). The results show that the research and application of all kinds of modern technology has become more popular since 1998, especially since 2004, the modern information technologies developed rapidly. Plant protection is taken as the joint keyword to search again. The research and applications of a variety of modern information technology in the plant protection began to increase from 1999. The trends are consistent with the development of modern information technology. It can be concluded that, with the rapid development of information technology, its application in plant protection has also been widespread concern. For example the number of published academic papers which are related with remote sensing is shown in Fig .1.

The pests and diseases are controlled effectively by chemical pesticides. The plant protection machinery is the machine to use chemical pesticides effectively. Plant protection machinery also protects the security of agriculture and forestry production. At the same time, it is a strong guarantee of protecting the ecological environment and natural resources. Intelligence, automation and green plant protection machineries become trends with the rapid development of modern information technology. How to reduce the amount of pesticide was the research hotspot in the field of plant protection machinery. A solid technical foundation is provided by the variety of modern information technology (such as 3S, control technology, image processing, pattern recognition, decision support systems and databases, etc.) for the realization of plant protection machinery.

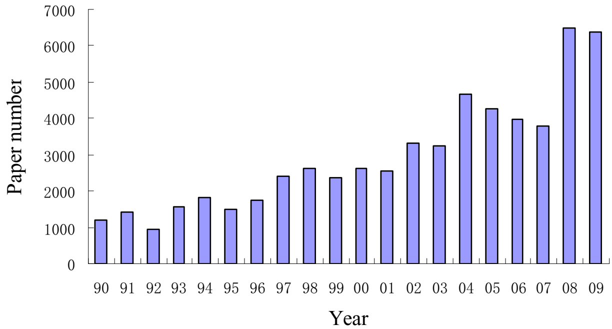

Fig. 1. The number of published academic papers related with remote sensing

2 Research Overview

There are many modern information technologies which are applied in the forest plant protection machinery, such as database, 3S technology, and sensor technology and so on. The application of main modern information technologies are discussed as following.

2.1 Database Technology

Database technology is an important component of the modern information technology and the core of the data processing and information management system. Database technology can organize and store massive data efficiently for the information processing. Database technology can reduce the storage redundancy, safe sharing, and efficient processing. Database technology is widely used in pest management, especially in combination with expert system.

Data are the study foundation of the plant protection machinery. There are a variety of data which include observational data (such as meteorological data), historical data (such as beginning period, the disease index of forest pests and diseases in recent years and so on), empirical data (such as various of plant protection machinery application, operating conditions, etc.), experimental data (such as plant protection machinery control efficacy data, etc.) and a variety statistics data for pests and diseases and so on. It is important to effectively analysis and manage these data for plant protection machinery.

The management information system of ornamental plants diseases and pests was established [1].The system was included the ornamental diseases and pests database. Ornamental plants diseases and pests could be searched and distinguished in this system quickly and accurately. Forest disease remote consultation system was established [2]. The system was based on natural language understanding technology, database and network technology. The forest disease and insects could be remote diagnosed in this system. The inspection and forecast system of the forest plant diseases was build [3]. The developer tool and the structure design of database were introduced.

All relevant data could be effectively organized by database technology and formed independent data set for the application program. The strategic reference forest pest control could be provided by the independent data set. Pesticides could be sprayed accurately and effectively with the plant protection machinery.

A database set for intelligent plant protection machinery was build [4] which included the meteorological database, forest pests and diseases management database, plant protection machinery database, chemical application decision making dataset and plant protection machinery decision making dataset. The database set provided a case study showing how to prevent and control forestry pests and diseases effectively by using proper climate conditions, proper sciences and technologies. Database technology is mainly applied in pest management especially the expert system of plant protection. With the rapid development of plant protection and integration, database technology must be an important component of plant protection machinery.

2.2 3S Technology

There are three parts of 3S technologies, which include Geographic Information Systems (GIS), Global Positioning System (GPS) and Remote Sensing (RS). Global Positioning System is global, all-day, continuous and real-time navigation, positioning system. Spatial location information is obtained in forest plant protection machinery in order to provide the spatial location of various types of sensors (such as CCD camera) and the delivery platform (such as vehicles, aircraft, etc.) rapidly. The forest plant protection machinery works according to the prescription map. The data, which is relative with geographical distribution of Earth's surface, is stored, managed, analyzed and described in Geographic Information System. The geographical location and attributes are associated together organically in GIS. At the same time, the spatial and attribute information are output accurately as a map according to user need. The spatial and attribute information are from a variety of sources in the forest plant protection system. The information is stored, managed, analyzed effectively, and mapped. GIS is a platform for forest plant protection system. Remote Sensing is the Earth observation technology with multi-platform, multi-band and high-resolution. The spectral information of natural target on Earth surface are obtained and processed by remote sensing in order to understand the natural world. Remote sensing is used to access the information of the environment and conditions of tree and update the GIS data timely in plant protection of forest.

Research was initiated on map-driven variable rate sprayers [5] using GIS or remote sensing information. A real time GPS-guided vehicle was the mapping of the spatial distribution and density of weeds combined with herbicide application with variable rate technology [6]. Through a learning community approach led by the Upper Midwest Aerospace Consortium [7], information was shared among scientists, agricultural producers, and data providers. SHI [8] discussed the controlling theory of the three kinds of variable rate spraying system and their advantages and disadvantages. The variable rate spraying system was based on GPS and GIS. Development of the SDSS for Medfly control in Israel, also known as MedCila, was described [9].The MedCila was integrated into a GIS environment. Working with the MedCila would enable the coordinator to make decisions for only around half of the plots. Cotton insect pests can be controlled early season using spatially variable insecticide applications [10]. Technology was developed for using GIS-based map. A spatially sensitive map could be developed that could drive a spatially variable insecticide application for the control of the insect pest. Farmers throughout the world are constantly searching for ways to maximize their returns. Remote Sensing, Geographic Information Systems, and Global Positioning Systems may provide technologies needed for farmers to maximize the economic and environmental benefits of precision farming. However, most farmers do not have the skills to utilize these technologies effectively. The positioning accuracy measurement of GPS in the forest was discussed [11]. It was put forward that the more concentrated positioning point, the higher positioning accuracy, otherwise the lower positioning accuracy.

One of the objectives of precision forest is to minimize the volume of herbicides that are applied to the plants through the use of site-specific plant management systems. RS, GIS and GPS may provide the technologies needed to maximize the economic and environmental benefits of precision forest. It is the inevitable trend that the plant protection machinery integrated with 3S technologies for the complex forest object.

2.3 Sensor Technology

It is an importance problem for the development of intelligent plant protection machinery to detect the object effectively. A great variety of plant protection objects are changeable and complicate. It is an important bottleneck for the development of plant protection machinery to detect the plant protection object effectively. With the rapid development of various sensor technologies, the various sensors were widely used in various fields. The sensors, which are widely used in plant protection machinery, are optical sensor, ultrasonic sensors, and infrared sensors and so on.

Optical sensors can be used for recognition of plants and discrimination between plant species by utilizing image analysis methods and/or multi-spectra information. These types of sensors and processing methods have been developed intensively during recent years. Because the optical sensors have many advantages, it becomes the main sensor to apply in the intelligent plant protection machinery. The optical sensor-based plant detection systems [12] can detect all the green plants (weed and crop plants) and spray only on the plants. A machine vision guided precision band sprayer for small-plant foliar spraying [13] demonstrated a target deposition efficiency of 2.6–3.6 times that of a conventional sprayer, and the non-target deposition was reduced by 72–99%.A precision spraying system called micro-spray was developed [14]. Micro-spray was designed for intra-row weed control. Herbicide is applied to the weed plants, only, and not to the crop plant and the soil. For high-value crops, high-accuracy machine vision and control systems have been studied for outdoor field applications in California [15]. The smart sprayer, a local-vision-sensor-based precision chemical application system, was developed and tested [16]. An automatic computer vision-based approach for the detection and differential spraying of weeds in corn crops was described [17]. A weed recognition method based on Support Vector Machine was presented [18].

Intelligent Automatic Targeted tree sprayer with ultrasonic sensors can identify the distribution of trees (with tree or no tree) to do real time monitoring and make a decision whether to spray and how much to spray. Some work to verify the suitability of an ultrasonic sensor as a plants detector for a Mobile Robot was described [19]. An ultrasonic recognition system which was installed in the orchard crop spraying aircraft was developed by Taiwan Chung Hsing University. The Results showed that the proportion of pesticide savings of 57% compared with traditional spraying methods. Ultrasonic sensors to continuously detect the presence or absence of target trees; in regions where a sparse target is detected, spray output is modulated; when no target is detected, spraying is ceased.

The research challenge is to process the image timely and accurately for the application optical sensor in the plant protection machinery. The research hotspot is the image processing algorithm.

3 Conclusion

Forest plant protection is to protect and expand the forest resources. Forest plant protection machinery is an effective means to control forest diseases and insect pests. There are two major issues of plant protection machinery: how to improve efficiency of pesticides utilization and reduce the impact of pesticides to non-target organisms and the environment. With the development of various modern information technologies, forest plant protection machinery has entered the electronic age in developed country. The most important international plant protection machinery productions are Europe and the United States. Its products cover the world's major markets while its technology and equipment represent the highest level in today's world. As the wide forest range, forest plant protection machinery should base mainly on large-scale spraying. 3S technologies, database technology, computer control technology and a variety of detection techniques should be effectively combined together and applied in forest plant protection machinery in order to meet environmental safety requirements and improve the efficiency.

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Research on Information Sharing Pattern of Agricultural Products Supply Chain Based on E-Commerce Technology

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Abstract. Taking Xinjiang's tomato industry as an example, this paper analyzes the management of agricultural supply chain and the sharing pattern results of supply chain information under the atmosphere of E-commerce both at home and abroad, illustrates problems and solutions of current tomato industry supply chain information sharing in Xinjiang, demonstrates the implementation necessity and feasibility of supply information sharing based on E-commerce technology for Xinjiang's tomato industry, and then constructs effective information sharing pattern which can improve the efficiency of Xinjiang's tomato supply chain.

Keywords: E-commerce technology, Supply chain, Sharing mode, Tomato.

1 Introduction

With rapid development of society and economy, particularly after China's accession to WTO, the traditional agriculture is facing severe challenges. Compared with other countries, there is no advantage of many agricultural products in both price and quality in China. Therefore, changing the current backwardness of agricultural production methods, improving the quality of agricultural products and reducing the high price of agricultural products have become the urgent need for the development of modern agriculture (Benhai Yu et al., 2006). Meanwhile, with the rapid development of electronic commerce, the development space of traditional supply chain management is widened and its meaning is broadened. Electronic commerce has changed the enterprise operation pattern and evoked the understanding of supply chain management. Development of network communications and information technology in electronic age led to the rapidly and efficiently progress of the storage, analysis, and transfer of the production and market information. To a large extent, information flow in supply chain management is no longer limited by time and space constraints. Customer, retail

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dealer, distribution merchant, manufacturer and supplier can share information directly. All of these greatly raised the comprehensive profit evaluation of agricultural products (Xin Liu, 2008).

Xinjiang Uygur Autonomous Region (Xinjiang for short) is located in northwest of China, which is the largest province and an important agricultural production area in China. But affected by the reason of location and economic development, its supply chain management is still defective. The great change affected by the development of e-commerce technology has resulted in the substitution of electronic commerce for traditional business activities and changed the traditional pattern of agricultural products supply chain. How to effectively and efficiently improve supply chain and how to get competitive advantages in the competitive environment of e-commerce for agricultural enterprises in e-commerce and supply chain management becomes a problem that agricultural production enterprises have to face.

Taking Xinjiang's tomato industry as an example, this paper studies how to promote the optimization of supply chain management based on e-commerce technology and supply chain management, and how to promote the information sharing of Xinjiang's agricultural supply chain.

2 Existed Information Sharing Pattern of Tomato Industry Supply Chain in Xinjiang

2.1 Existed Foundation and Conditions

In recent years, a number of enterprises of Xinjiang's tomato industry realized the role of supply-chain management, absorbed the ideas of supply chains in process of organization and management in enterprises, and had the ability to integrate supply chain management. With the continuous development of information and e-commerce technology, many companies awarded that the enterprise informatization can enhance their competitiveness and increase economic efficiency. Therefore, current Xinjiang's tomato industry has already cumulated many achievements in the information sharing of supply chain management. The continuously improved macro-environment and micro-environment provide effective support to the promote supply chain management and the efficiency in tomato industry (Jian Yu, et al., 2002).

(1) IT has been applied in Xinjiang's tomato supply chain management. Bar code technology, electronic data interchange (EDI), application identifiers are being applied, and some large tomato processing enterprises created more advanced enterprise network by using Intranet and Extranet, basically achieved information exchange and data sharing among different parts and enterprises.

(2) Leaders and staffs of tomato business improved the realization of advanced technology and improving enterprises by advanced technology. And leaders improved the cognition about staff training and the action principle of motivating mechanism.

(3) Development of supply chain management and changing of policy environment improved the conditions to develop e-commerce for Xinjiang's tomato enterprise. These years, Chinese government strongly supported the implementation of supply chain management for company and established a series of support policies. Since

1997, e-commerce has gradually become a hot topic in Chinese social and economic activities, and the e-commerce technology and applications changed greatly as well. It creates a favorable condition to implement supply chain management based on Electronic Commerce.

(4) The outside microcosmic environment related to tomato supply chain management was improved. In recent years, the distribution, chain retail industry, retail business, warehouse and transportation business in Xinjiang have certain development. Meanwhile, the commodity logistics distribution center also developed very quickly in Xinjiang's tomato industry, which improved the link of information and kind between logistics supply chain link and terminal logistics in Xinjiang's tomato process industries.

2.2 The Information Sharing Problems of Xinjiang's Tomato Industry Supply Chain

Because the information sharing model of supply chain in tomato industry development is in its beginning stage, there are still many information sharing problems in the current tomato industry supply chain, as following four areas:

(1) Lack of sharing information, the overall information level is low. Because of lack of unified plan and design of information systems of the tomato market in Xinjiang, current supply chain of tomato industry had many problems: the channel of information transmission is too long, members of nodes were distributed, lost of the unified information network platform, incomplete of primary agricultural information, the development of communication network and information technology between regions is unbalance. So the informationization about the supply chain between nodes has great difference and level of information sharing is low, which leads to the low level of information sharing in whole supply chain (Hua Song, 2003).

(2) Seriously bullwhip effect and inefficiencies supply chain. At present, the problems of node enterprises are impeded information flow and isolated information. Every node enterprise in tomato supply chain arranged to maximize their own profits by respective situation and supply and order information from down-stream enterprises. In this decision mode, the node enterprises could not consider sufficiently about the status quo of tomato supply chain. The decision-making often aggravates the bullwhip effect, increases the stock of tomato products in supply chain, and decreases the overall efficiency of the supply chain system.

(3) Low integrated level inside the supply chain. Information integration means knowledge exchange between supply chain partners. This is a deeper relationship which can reduce opportunistic behavior, weaken the bullwhip effect and improve the efficiency of information. Practice indicates that information integration requires partners' deep trust, but the reduction in opportunistic behavior can enhance the trust between enterprises. In other words, reduction in opportunistic behavior is beneficial to promote the information integration, and information integration can reduce the two-way relations of opportunistic behavior (Hua Song, 2003).

But the problem of information asymmetry in the tomato supply chain has not been solved. Therefore, the possibilities of having opportunism increase, which will impact trust on relationship, reduce the degree of internal integration in the supply chain, and form an expansion vicious circle about opportunistic behavior.

(4) Lack of funds. In order to share information, companies must invest a lot in management information system and hardware equipment, and the related personnel training, process improvement, and the readjustment of product structure will also bring high transfer cost. Moreover, data capture and data elaboration also increase the cost. Generally speaking, the higher the degree of information shares, the higher cost will be. Therefore, they need invest a large of capital in incipient stage of information sharing. It is difficult for most tomato enterprises in Xinjiang to pay such high cost for the present situation of Xinjiang's tomato industry. So the financial matter may be the problem of information sharing, although the value of information sharing is considerable.

3 Information Sharing Construction of Xinjiang's Tomato Industry Supply Chain Based on Electronic Commerce Technology

3.1 The Principle of Pattern Construction

(1) The principles of openness and absorption. Firstly, an opening pattern of agricultural information sharing should be constructed. It provides a condition that node enterprises can share information (they are suitable for exchange and sharing) with other enterprises. Secondly, it must continually rich information storage and timely track, absorb and utilize knowledge outside the supply chain.

(2) Keep balance between security and sharing. In order to realize the goal that each of chain members can share information based on protection of their core information, core competencies and competitive advantage, members can obtain new information from sharing and intercommunion and enrich their own information database. Members must determine which information needs to be kept secretly and which can be shared, and then share the information with other nodes based on this conduction.

(3) The principle of coordination. In order to maintain the high efficiency of supply chain movement, supplementary ability is requested among various members. In the field of information storage, coordinated ability in the learning capability and creation ability of information is necessary. In the aspect of enterprises' culture and the management idea, the sharing mode should have the uniformity in information sharing and communication.

3.2 The Constructing of Pattern

The tomato industry supply chain is not only the distribution chain, the information chain and the fund chain joint tomato supplier to consumer, but also a supply chain appreciated from processing, packing and transportation. So tomato supply chain is a rising value chain and can bring profit for related enterprise. The tomato supply chain's node enterprises must maintain synchronization, coordination, and information flow unimpeded, all of which are premise of realized rise value. Electronic commerce can realize information sharing about tomato on the whole supply chain, and take the smallest cost to provides the greatest value and the best service for the tomato consumer, which will increase operating efficiency and economic gain about tomato supply chain (Xiaolin Chen et al., 2007).

Meanwhile, the advanced information network technology is a powerful detachment to achieve the supply chain information sharing. This technology can enhance the combinative possibility of farmers, suppliers, retails and costumers, and it is an advantage to the track, active control and the entire management about agricultural product distribution, and achieves the goal of resource and information sharing. At present, overseas agricultural product supply had used many advanced information technology. The practice indicated that the production enterprise, the department of government monitors and the third party logistic can issue and inquire related information thought Internet.

In addition, information is the neural elements of the logistics of agricultural products, only in agricultural products before, during, and even to post-storage, transportation, processing and marketing, each link also has a timely and accurate logistics information processing capacity of the premise can accurately respond to market changes. But now, because information network Xinjiang's tomato industry is not perfect, the communication channel is not smooth, and the peasant household are lived disperses, it is difficult to collect and transmit many information which seriously influenced the efficiency of Xinjiang's tomato industry supplied chains. Therefore, tomato supply chain should wildly use information network technology. Constructing management system of logistics information about Xinjiang's tomato industry should combine information technology with acceleration of the system of logistics and using of the electronic commerce. Only in this way can Xinjiang achieve information sharing of tomato supply chain.

According to the present development situation, the supply chain condition, the supply chain information sharing condition and the factors of influence supply chain information sharing of Xinjiang's tomato industry, we can construct the pattern of the information sharing about supply chain in Xinjiang's tomato industry. Main patterns are shown in Figure 1, 2, 3, 4, 5 and 6.

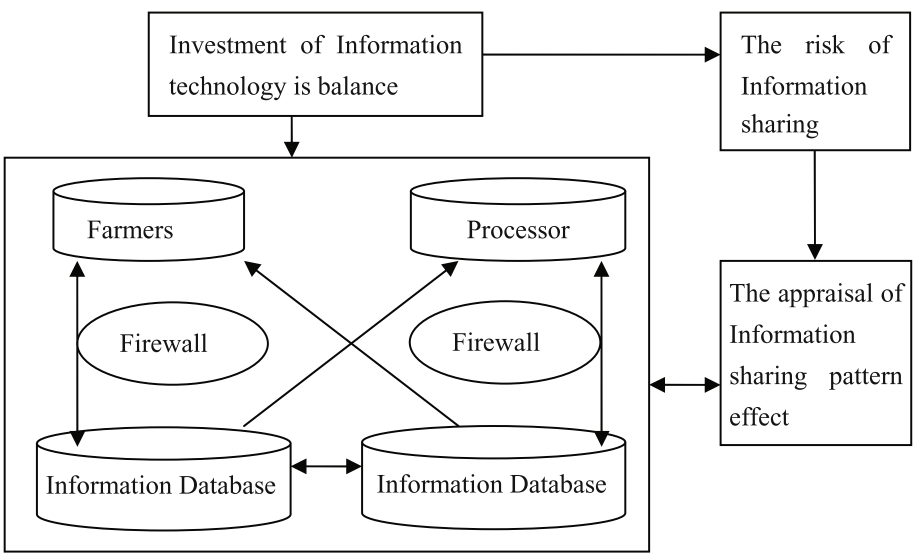

Fig. 1. Information Sharing Pattern

As shown in Figure 1, establishment and information sharing of the two mainly databases: under governmental help, peasant household established the information database of tomato stock, origin and price. Tomato processing industry established the information database of tomato processing, demand, and quality specification. The information sharing is the data interface pattern of the point-to-point pattern between them. The peasant household and processing industry collect and transmit information from the interior and exterior of enterprise based on the Internet technology, and they use the service system visit each other's internal database, control the pattern of supply, produce and sell.

As shown in Figure 2, because most products of process tomato in Xinjiang are export, the peasant household and the overseas distributor have clear information need. The EDI pattern uses the same data standard. The output information of peasant household is the input information of overseas distributor, and they have highly accuracy and security. Therefore, the peasant household and the overseas distributor's information sharing use the EDI pattern.

As shown in Figure 3, this pattern also applied for the EDI pattern of information sharing. The information sharing of the tomato processor and the overseas distributor use the EDI special line connects with each other.

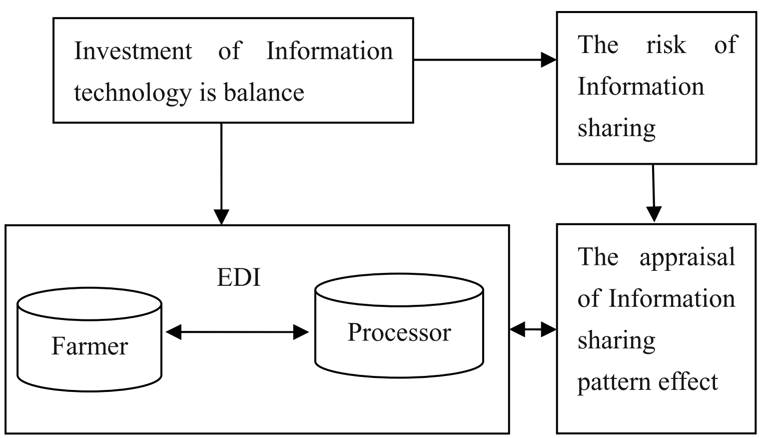

Fig. 2. Information Sharing Pattern

As shown in Figure 4, the peasant household and the tomato retail merchant share information with the EDI pattern based on their clear information need, and this pattern is highly accurate and secure.

As shown in Figure 5, this EDI pattern is used in information sharing of processor and the retailer. The EDI special line is used in the information sharing of the tomato processor and the retailer.

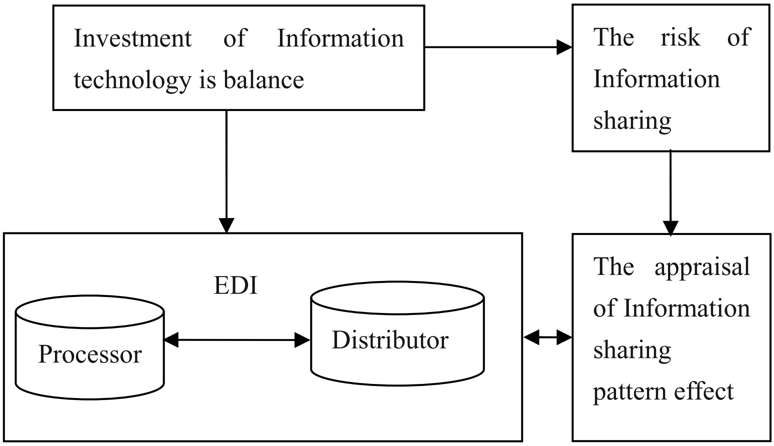

Fig. 3. Information Sharing Pattern

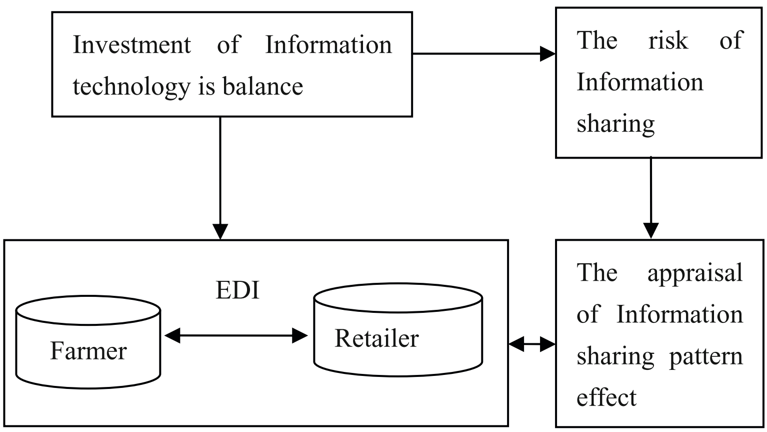

Fig. 4. Information Sharing Pattern

As shown in Figure 6, establishment and information sharing of the two mainly databases: the oversea distributors establish the database in the information of stock, price about tomato is under the government's help. The overseas retail merchant provides the tomato demand and forecast information. Information sharing between them is the data interface pattern of the point-to-point pattern.

3.3 The Pattern's Merit

The supply chain pattern of the tomato information sharing is based on supply chain E-business information sharing on information network. It takes the elements together including agricultural products production, processing, circulation and consume. Suppliers, farmers, industry and commerce, distributors and retailers come to be an operation of the production, supply and marketing by information sharing. By using of

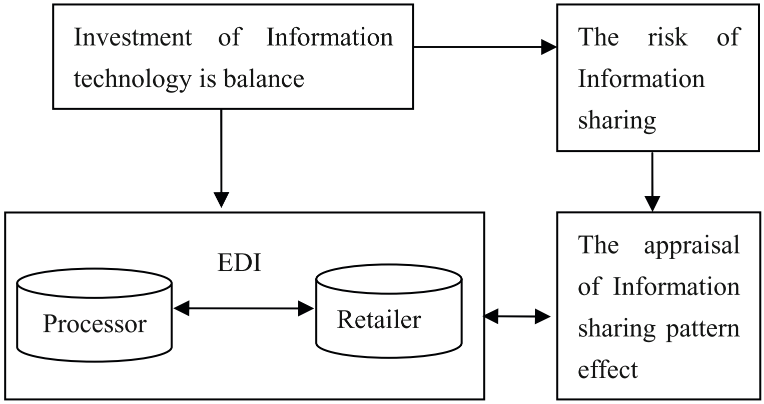

Fig. 5. Information Sharing Pattern

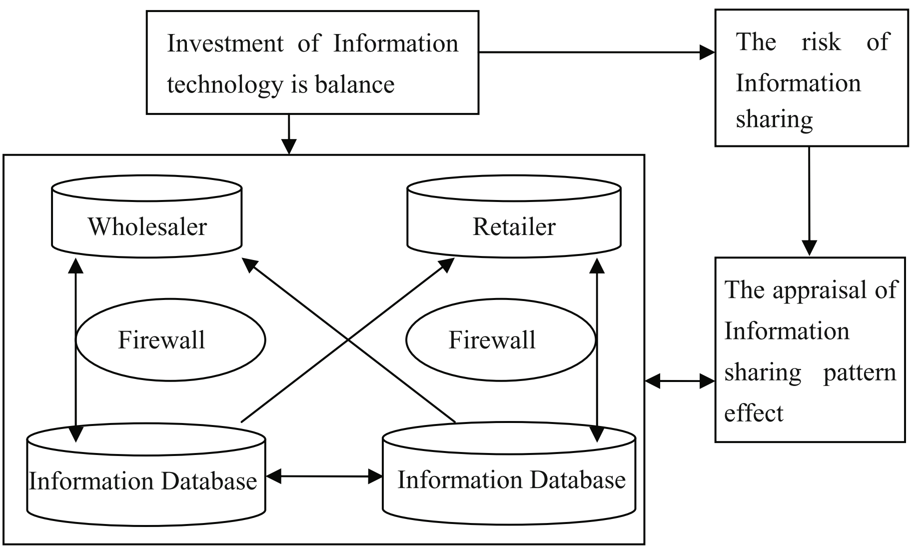

Fig. 6. Information Sharing Pattern

information sharing, growers know the production processing, the market access and quality and safety of tomato. Meanwhile, other node enterprises can promulgate the international and domestic standards about tomato in order to guide actual production (Xingdong Jiang, et al., 2006). Customers can inquire quality and safety of tomato, retrospect to grow area through the termination of information platform, in order to guarantee the consumer's rights and interests, and also be propitious to foundation and the protection of the brand about tomato. Tomato processors can share information provided by distributor and retailer through the information sharing. The processors can also transmit information about product for upstream enterprises and purchase tomatoes through order sheet. It can reduce blindness of peasant produces and guarantee tomato sale, not only reduce the distribution cost of tomato products and tomato loss, but also advantage to the agricultural industrial production. The tomato product supply chain can realize the advanced trading mode of on-line auction through the information platform. It also realizes on-line payment if it connects to customs and bank. There are lots of merits that information sharing pattern about tomato supply based on the environment of electronic commerce.

(1) The full supply chain information sharing, visibility throughout the supply chain The dovetail of the information systems about farmers, processor of tomato products and distributor, enhanced the flexibility of the chain management, reduced the cost and the risk of logistics management, promoted the need information about the tomato marketing arriving to node enterprise accurately and timely. In this way, agricultural production is scheduled, reduces farmer's market risk, and enhances the farmers' income.

(2) Through coordinate the information flow in supply chain, reduce the transaction cost of agricultural product circulation. Information sharing reduces tomato loss in product circulation, cycle of tomato product production, but raises the efficiency of transaction and reduced the distribution cost.

(3) Growers, processor and distributors can obtain more profit. Consumers can eat secure tomato product, and it is the material base for the development of "the order form agriculture".

(4) It improves the service quality and customer relationship. The tomato supply chain has completely collaborative management according to the consumer-customer demand. The chain uses commercial intelligence technology include DW, DDM to develop customers' knowledge, strengthen effect of marketing, optimize the service flow, improve the efficiency of working, promote customers' degree of satisfaction and loyalty, establish the long-term customer relationships and enhance the enterprises' brand.

4 Conclusions

The application of Xinjiang's tomato industry supply chain information sharing based on the electronic commerce technology solved the limit in time and space of tradition supply chain management, dovetailed the information systems about farmers, processor of tomato products and distributor, enhance the flexibility of the chain management, reduced the cost and the risk of logistics management, avoided the high transaction cost in the agricultural product circulating, and raised the efficiency of transaction.

It strengthened the close cooperation among the inside departments in enterprise, the enterprise and supplier, accelerated turnover rate of materials, reduced stock, lessened the fund of stock, and raised the economic effectiveness of the agricultural product enterprise.

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Study of Intelligent Integrated Modeling and Development of Agricultural Post-Project Evaluation*

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Abstract. Post-evaluation for agricultural project (PEAP) is an important indispensable aspect of agricultural project cycle management. Based on the comparison of the virtual situation and in advanced anticipation of the investigation, PEAP can be used to determine the variation and find the improving method through analyzing the reason, feedbacking the information, and summarizing the lessons, so as to bring economic benefit as much as possible. The post evaluation, especially intelligent integrated agricultural post-project evaluation, started relatively late in our country and has no its own theoretical system. Now days, modeling and development of agricultural post-project evaluation can not fulfill the requirement of social development. The study of intelligent integrated modeling and development of agricultural post-project pvaluation has the important realistic meaning and theoretical value.

Keywords: Post-evaluation, Agricultural project, Intelligent integrated.

1 Introduction

China is at a stage of rapid economic development. Agricultural projects are more and more important in social and economic life. Post-evaluation for agricultural project (PEAP) is an important indispensable aspect of agricultural project cycle management. Based on the comparison of the virtual situation and in advanced anticipation of the investigation, PEAP can be used to determine the variation and find the improving method through analyzing the reason, feedbacking the information, and summarizing the lessons, so as to bring economic benefit as much as possible. The post evaluation, especially PEAP, started relatively late in our country and has no its own theoretical system but just follows investment project evaluation right now. Thus PEAP can not fulfill the requirement of social development. The PEAP study has the important realistic meaning and theoretical value.

The investment performance of the agriculture project is characterized with instability, regionalism, and dependency. In the past several decades, the contents of

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PEAP have switched from simple post-evaluation for finance or national economy to broader field including finance, national economy, environment, and society. Meanwhile, the every aspect of evaluation has greatly developed in both depth and width. However, because the PEAP's contents are so complicated and extensive, the restrictions of some factors like concept, regime, and intellectual system have curbed the development of the post-evaluation theory in its research and practice. PEAP has shown some obvious shortages: the faulty contents, the difficulties of choosing assessing index, this limits the application of the post-evaluation for economy, environment and society. There are also many nonlinearity and complex problems in PEAP, which cause it very difficult to establish mathematics' model with accuracy. On the other hand, all information applied in PEAP research has the characters of uncertainty, inaccuracy, and incompleteness. So more systematic and completed theories and methods are required for evaluation. Accordingly, nowadays to introduce Artificial Intelligence (A.I.) would become the main trend in PEAP studies although it is not easy to do so.

2 The Development of Intelligent Integrated Modeling

With the rapid of development of computer science, artificial intelligence and microelectronics, people has its own understanding of the mechanism. In 1971, the United States Fu (Fu Jing Sun) proposed the intelligent control concepts based on the combination of theory and artificial intelligence. Intelligent modeling method refers to the industrial process modeling approach which includes expertise in methods, neural networks, fuzzy logic methods, pattern recognition methods. Genetic Programming methods and methods based on genetic algorithms and the most widely used method is the three kinds of intelligent modeling method.

Domestic research shows that intelligent modeling method has been widely used, but it is seldom used in post-project evaluation. CHEN Xiang-gui: Through fuzzy-classified measure, data of permeability modeling on Pb-Zn sintering process are classified into low-temperature subspace and high-temperature subspace. Two neural network models with same structure and algorithm are built and integrated. Lu Liang, etc. Research of intelligent integranted autegrated automotive sensor system based on memes. Along with rapid development of the automotive sensors and the farther research of MEMS technology, the automotive sensors based on MEMS have extensive applied foreground. WU MIN., etc: The features of the lead-zinc imperial sintering process include strong nonlinearity, time variance, large time delay, and so on. A soft-sensor model of the burn-through point (BTP) was developed.

3 Theory of Agricultural Intelligent Integrated Assessment

Modeling is a scientific method of understanding objective things that based on the long-term practice. As the objective world is a real system, it is complexity and diversity, and the forms of the building model forms are vastly different.

Definition 1: Intelligent integrated modeling refers to two or more methods of the actual process and at least one of these methods to artificial intelligence is neural network, fuzzy logic, expert reasoning and intelligent method of genetic algorithms. The most widely used method is the expert reasoning, neural networks and fuzzy logic methods.

Expert subjective judgments base on the "Score", "index '," ordinal "," reviews "., and rely on the experience from the experts and knowledge workers. They can deal with qualitative and heuristic knowledge and information. The expert system has strong explanatory function, but there is expert system knowledge acquisition "bottleneck" problem, and the type of precision is low. However, because the traditional evaluation algorithm relies on the expert's knowledge and experiences excessively, the result of the agricultural post-project evaluation is usually less accurate.

Fuzzy comprehensive evaluation is a decision-making process that it is based on the fuzzy environment, and the fuzzy set theory can make a comprehensive quantity evaluation on a system restrained from many uncertain factors. Factors of fuzzy comprehensive evaluation are vague and subjective. AHP fuzzv is an effectiive rnethod, which directly eonstructs the judgment rnatrix in analytic hierarchy process accoording to the fuzzy relative rnernhership degree rnatrix of single evaluation index. In a single-level fuzzy comprehensive evaluation, mistakes often occur when there are excessive evaluation factors. Meanwhile, the overabundant evaluation-set elements will result in difficulties in admeasuring the weights rationally.

Neural network is a characteristic to simulate biological neuron and neural network, through simplifying, summing up and refining a kind of parallel running network summarized. Artificial neural network (ANN) is a rising borderline science. Compared to the mathematical statistics, artificial neural network doesn't need exact mathematical model and it can solve some problems that traditional statistical methods failed to resolve. Artificial neural network (ANN) is a powerful tool for multivariate and nonlinear analysis, and offers an alter-native to traditional statistical methods for optimal monitoring and determination of dynamic systems. It has already become an important method that the data have excavated. But the neural network has its limitation: there are a few defects. For instance, it is slow to disappear, easy to converge to the local extreme point. BP is difficult for the function to get out when it gets into a local extreme point. Too many nodes in the hidden layer will lead to the long time of network learning, even the failure of convergence. An overfit phenomenon exists in the BP network.

Fuzzy comprehensive evaluation depends on experts' opinions strongly, and the weights given by different expert are different slightly. Just like talking above, whether fuzzy comprehensive evaluation or neural network, it can not meet the needs of the agricultural post-project evaluation. Support Vector machine (SVM) is a kind of special small sample theory which is invented by v. n. Vapnik professor who created statistical learning theory SVM is one kind method that has the strict theoretical foundation of computer learning new method, it has already used in pattern recognition and computational intelligence, forecast fields at home and abroad, the extensive attention.

Therefore, if we can combine fuzzy comprehensive evaluation or neural network, SVM with other agricultural post-project evaluation methods, the effect will be far more satisfactory.

4 The Steps Intelligent Integrated Assessment of Agricultural Post-Project Evaluation

Intelligent Integrated modeling theory in the agricultural post-project evaluation based on the request of the existing modeling problems in complex agricultural process, characteristics. The model will apply the theory of agricultural integrated modeling with the actual agricultural processes and the steps is as followings:

4.1 Clear Dirty Data and Determine the Modeling of Object Modeling

There are a number of dirty data in agricultural observation data set derived from agricultural post-project evaluation system. Thus, the data must be carefully and reasonably processed before they are used for agricultural post-project evaluation. Our aim is to establish an intelligent pre-processing algorithm for cleaning to improve convergence and stability of a data filter for agricultural post-project evaluation.

Agricultural integrated modeling is a modern agricultural process control and decision-making, fault diagnosis, system characteristics and effectiveness evaluation of the basis for modeling purposes. Because different models needed to describe the nature of the agricultural process. Agricultural integrated modeling can be determined the corresponding model object.

4.2 Model Variables

Model variables include input variables, output variables and intermediate variables that is also called state variables. According to the purpose and object modeling, usually determine the output variables. Then according to some analysis, the factors that affect the output variable, and initially identified the input variables can be understood. Sometimes the relationship between the input variables and output variables is very complex, and we can make use of intermediate variables to refine this complex relationship.

4.3 The Intelligent Integrated Modeling of Agricultural Post-Project Evaluation to Determine

Two key factors effected the intelligent integrated modeling of agricultural post-project evaluation. First, the process information that has been collected established model

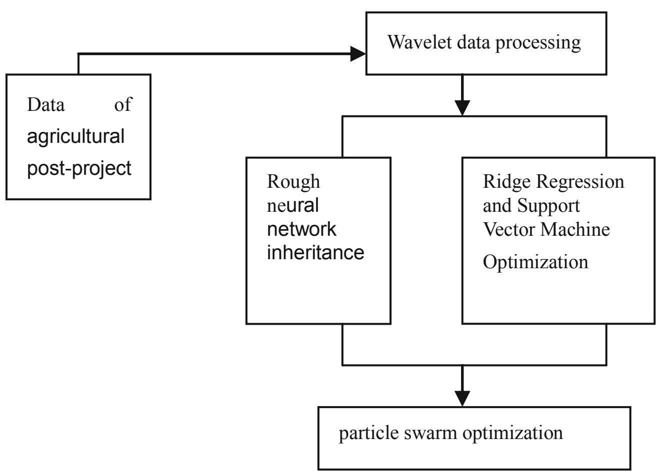

Fig. 1. Model for Integrated form

primitives. Second, how to integrate the model primitives. The better intelligent integrated modeling of agricultural post-project evaluation is that it can reflect the process mechanism and the model accuracy as high as possible. The methods or fuzzy techniques, neural network, the expert reasoning, and other method are used in the system to analyze the data, and to build the intelligent integrated modeling of agricultural post-project evaluation.

Here, we put forward he SDN (support vector machines dempster neural network) intelligent integrated assessment model. First, we use wavelet analysis of the data to remove noise data. Second, ridge regression, support vector machine, rough neural network ,and particle swarm optimization are ensembled, and we conducted a special agricultural post-project.

4.4 The Model Checking

This is the final step in modeling of agricultural post-project evaluation. It is used to test whether the model meet the modeling goals and requirements of agricultural post-project evaluation. If you meet the requirements, then that model has been completed; otherwise, you will return to the third step, to further improve the model until a satisfactory model. Through the above steps, get used to the smart integration model of agricultural post-project evaluation.

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Study of Optimal Operation for Huai'an Parallel Pumping Stations with Adjustable-Blade Units Based on Two Stages Decomposition-Dynamic Programming Aggregation Method

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Abstract. Two-stage decomposition-dynamic programming aggregation method has been first proposed and introduced to solve the mathematical model of daily optimal operation for parallel pumping stations with adjustable-blade units. Taking minimal daily electricity cost of single pump station as objective function, the water quantity pumped by each station as coordinated variable, by means of the type of the pump units this model is decomposed into several first-stage sub-model of daily optimal operation with adjustable-blade for single pump station. Then taking minimal daily electricity cost of single pump unit as objective function, the water quantity pumped by each unit as coordinated variable, the first-stage sub-model is decomposed into several second-stage sub-model of daily optimal operation with adjustable-blade for single pump unit which takes the blade angle as decision variable, the discrete values of water quantity pumped by each unit as state variable, and is solved by means of dynamic programming method. The constructed aggregation model takes daily water quantity pumped by each pump unit as decision variable, the discrete values of water quantity pumped by parallel station group as state variable, and is also solved by dynamic programming method. The aggregation process replaces the traditional method of constructing equations. This method has first solved the optimal operation issues for multi-units of parallel stations with various operation modes, time period division and daily average head of each station, and also provided theoretical support for the study on optimal operation of multi-stage pumping stations. Taking Huai'an No.1, No.2, and No.4 parallel pumping stations as a study case, a series of optimization results have been obtained.

Keywords: parallel pumping stations, decomposition, aggregation, dynamic programming, optimization, adjustable-blade.

1 Introduction

The parallel pumping stations have a huge energy consumption in operation because of containing a large number of pump units, which makes it necessary to develop the study of optimal operation method for multi-units of parallel pumping stations. At

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present, the major study methods of optimal operation for parallel pumping stations contain decomposition-coordination method and decomposition-aggregation method. The former would bring tedious combinations while more pump units exist. And the latter always establishes regression equation while in aggregation process, which would affect the solution precision of optimization model. Therefor, two-stage decomposition-dynamic programming aggregation method has been proposed and applied to the study. Taking No.1, No.2 and No.4 Huai,an Pumping Station as a study case, we divide one day into several time periods according to the inlfluence of peak-valley electricityity price and the demands of not high frequency start-up/shut down operation, by which to search the optimization benefit carried out by optimal operation of multi-units with adjustable-blade in parallel pumping stations operation.

2 Optimal Daily Operation Model and Its Solving Method for Multi-units with Adjustable-Blade in Parallel Pumping Stations

In order to be convenient for discussion, a series of definitions have been made which are as follows:

(1) Operation mode

Operation with fixed blade angle and constant speed: The pump units are operating with rating speed and the blade angle at the designing degree.

Optimal operation with adjustable-blade: The pump units are operating with constant speed and adjusting the blade angle in each time period according to operation conditions in order to obtain the minimal water pumping cost.

(2) Full load, 80% load, 60% load

The operation of pump units lasting 24 durative hours is called full load operation. 80% load operation and 60% load operation respectively represents the pump units are operating with 80% and 60% of water quantity pumped by the units while they are operating with full load at fixed blade angle and constant speed.

(3) Beginning time and the combination between length of time period and peak-valley electricityity price

Considering peak-valley electricityity price and the demand of avoiding high frequency of start-up/shut down operation, we choose beginning time at 17 :00 and divide one day into 9 periods. The time length and the electricityity price in each of period is shown in Table 1.

2.1 Optimal Model of Daily Operation for Multi-units with Adjustable-Blade in Parallel Pumping Stations

Taking minimal daily electricity cost of entire parallel pumping group as objective function, the time period as stage variable, the blade angle of each pump unit in each time period as decision variable, the water quantity pumped in definite time period and power of electromotor equipped in station as the constraint conditions, the optimal mathematical model of daily operation for multi-units with adjustable-blade in parallel pumping stations has been construced as follows :

Table 1. Time period division and peak-valley electricity price of each time period

Serial number	Time division	Length of time period/h	Electricityity price/yuan· kW^{-1}·h^{-1}	Serial number	Time division	Length of time period/h	Electricityity price/yuan· kW^{-1}·h^{-1}
Ⅰ	17:00～19:00	2	0.978	Ⅵ	07:00～09:00	2	0.978
Ⅱ	19:00～21:00	2	0.978	Ⅶ	09:00～11:00	2	0.978
Ⅲ	21:00～23:00	2	0.587	Ⅷ	11:00～14:00	3	0.587
Ⅳ	23:00～03:00	4	0.276	Ⅸ	14:00～17:00	3	0.587
Ⅴ	03:00～07:00	4	0.276				

Objective function: $$G = \min \sum_{k=1}^{BZ} G_k = \min(\sum_{k=1}^{BZ}\sum_{j=1}^{JZ}\sum_{i=1}^{SN} \frac{\rho g Q_{kji}(\theta_{kji}) H_{kji}}{\eta_{z,kji}\eta_{mot,kj}\eta_{int,kj}} \Delta T_{ki} P_{ki}) \tag{1}$$

Water quantity constraint: $$\sum_{k=1}^{BZ}\sum_{j=1}^{JZ}\sum_{i=1}^{SN} Q_{kji}(\theta_{kji})\Delta T_i \ge W_e \tag{2}$$

Power constraint: $$N_{kji}(\theta_{kji}) \le N_{kj0} \tag{3}$$

Where G is the minimal daily electricity cost of the entire parallel pumping group. G_k is the daily electricity cost of the k-th pumping station. BZ is quantity of pumping stations in the parallel pumping group. JZ is quantity of pump units in each single station. SN is the quantity of time periods divided in one day. ρ is water density and g is acceleration of gravity. H_{kji} and $Q_{kji}(\theta_{kji})$ which is corresponding to the blade angle θ_{kji} respectively represent the average daily head and flow of the j-th pump unit in the k-th pumping station and in the i-th time period. $\triangle T_{ki}$ and P_{ki} respectively represent the time length and the peak-valley electricity price of the i-th time period in the k-th pumping station. $\eta_{z,kji}(\theta_{kji})$, $\eta_{mot,kj}$, $\eta_{int,kj}$ respectively represent the efficiency of equipment, electromotor and transmission of the j-th pump unit in the k-th pumping station. Among them $\eta_{z,kji}$ is relative to the flow and average head of the i-th period. $\eta_{mot,kj}$ could be regarded as constant when the load is over 60%, while in large electromotor the $\eta_{mot,kj}$ could be regarded as 94%. Also we considered 1 as the $\eta_{int,kj}$ value in direct joint unit. W_e is the objective water quantity pumped by the whole parallel pumping group in one day. And $N_{kji}(\theta_{kji})$ is the actual electromotor power of the j-th pump unit in the k-th pumping station and in the i-th time period while the pump unit is operating under the blade angle θ_{kji}, which should be less than the rating power of N_{kj0}.

2.2 Two-Stage Decomposition-Dynamic Programming Aggregation Method

2.2.1 Large-Scale Two-Stage Decomposition

2.2.1.1 First-Stage Decomposition. Taking water quantity pumped by each pumping station as the coordinated variable, we decompose eq. (1)~(3) into BZ first-stage subsystems according to the type of pump unit with the assumption that the units have the same type in the same pumping station. Then the optimal mathematical model of daily operation for multi-units with adjustable-blade for single pumping station is obtained which is shown from eq. (4)~(6). This model takes minimal daily electricity cost of single pumping station as objective function, the blade angle of each pump unit in each time period as decision variable, the water quantity pumped in definite time period and power of electromotor equipped in station as the constraint conditions.

Objective function: $$F = \min \sum_{j=1}^{JZ} F_j = \min\left(\sum_{j=1}^{JZ}\sum_{i=1}^{SN} \frac{\rho g Q_{i,j}(\theta_{ji}) H_{ji}}{\eta_{zi,j}(\theta_{ji})\eta_{mot,j}\eta_{\text{int},j}} \Delta T_i P_i\right) \quad (4)$$

Water quantity constraint: $$\sum_{j=1}^{JZ}\sum_{i=1}^{SN} Q_{ji}(\theta_i)\Delta T_i \geq W_k \quad (5)$$

Power constraint: $$N_{kji}(\theta_i) \leq N_{kj0} \quad (i=1, 2, \ldots, SN; j=1, 2, \ldots, JZ) \quad (6)$$

Where F is the minimal daily electricity cost of single pumping station. F_j is daily electricity cost of the j-th pump unit. W_k is the objective water quantity pumped by single pumping station in one day Meanings of other variables could be obtained by analogy according to eq. (1)~(3).

2.2.1.2 Second-Stage Decomposition. Taking water quantity pumped by each pump unit as the coordinated variable, eq. (4)~(6) is decomposed into JZ second-stage subsystems according to the quantity of pump unit in one single station. Then the optimal mathematical model of daily operation for single pump unit with adjustable-blade is obtained which is shown from eq. (7)~(9). This model takes minimal daily electricity cost of single pump unit as objective function, the blade angle of each pump unit in each time period as decision variable, the water quantity pumped in definite time period and power of electromotor equipped in station as the constraint conditions. The blade angle is chosen at integer degree in order to be convenient for practical operation.

Objective function: $$M = \min F_j = \sum_{i=1}^{SN} \frac{\rho g Q_{i,j}(\theta_i) H_i}{\eta_{zi,j}\eta_{\text{mot},j}\eta_{\text{int},j}} \Delta T_i P_i \quad (j=1,2,\ldots JZ) \quad (7)$$

Water quantity constraint: $$\sum_{i=1}^{SN} Q_{ji}(\theta_i)\Delta T_i \geq W_j \quad (i=1, 2, \ldots, SN; j=1,2,\ldots JZ) \quad (8)$$

Power constraint: $$N_{ji}(\theta_i) \leq N_{j0} \quad (i=1, 2, \ldots, SN; j=1,2,\ldots JZ) \quad (9)$$

Where M is the minimal daily electricity cost of single pump unit. F_j is daily electricity cost of the j-th pump unit. W_j is the objective water quantity pumped by single pump unit in one day. Meanings of other variables could be obtained by analogy according to eq. (1)~(3).

2.2.2 Optimization of Second-Stage Subsystem

Eq. (7)~(9) are typical one-dimension dynamic programming model whose stage variable is i(i=1, 2, …, SN) and decision variable is the blade angle θ_i. Also we could know from eq. (8) that the water quantity pumped in each time period is the state

variableλ. Making use of dynamic programming method to solve this model, a series of F_j values corresponding to objective water quantity W_j could be obtained. The solving details of this model have been shown as follows:
Stage 1:

$$M_1(\lambda_1) = \min \frac{\rho g Q_1(\theta_1) H_1}{\eta_{z1}\eta_{\text{mot}}\eta_{\text{int}}} \Delta T_1 P_1 \tag{10}$$

The stage variable λ_1 is discrete within its feasible region: $\lambda_1 = 0, W_1, W_2, \cdots, W_j$. The decision variable θ_1 is discrete within its feasible region for example: -4°, -3°, -2°, -1°, 0°, +1°, +2°, +3°, +4°. Also the condition $Q_1(\theta_1)\Delta T_1 \geq \lambda_1$ should be satisfied. According to the performance curve of pump device, the flow and equipment efficiency η_{z1} corresponding to each θ_1 and H_l could be obtained.
Stage i:

$$g_i(\lambda_i) = \min\left[\frac{\rho g Q_i(\theta_i) H_i}{\eta_{zi}\eta_{\text{mot}}\eta_{\text{int}}} \Delta T_i \cdot P_i + g_{i-1}(\lambda_{i-1})\right] \tag{11}$$

λ_i and θ_i are discrete in the same way as above. Also $Q_i(\theta_i)\Delta T_i \geq \lambda_i$ should be satisfied. According to eq. (8), the state transition equation is as follows:

$$\lambda_{i-1} = \lambda_i - Q_i(\theta_i)\Delta T_i \ (i=2, 3, \ldots, SN\text{-}1) \tag{12}$$

Stage SN:

$$g_{SN}(\lambda_{SN}) = \min\left[\frac{\rho g Q_{SN}(\theta_{SN}) H_{SN}}{\eta_{zSN}\eta_{mot}\eta_{\text{int}}} \Delta T_{SN} \cdot P_{SN} + g_{SN-1}(\lambda_{SN-1})\right] \tag{13}$$

Where $\lambda_{SN} = W_j, W_{j+1}$; θ_{SN}=-4°, -3°, -2°, -1°, 0°, +1°, +2°, +3°, +4°

The state transition equation: $\lambda_{SN-1} = \lambda_{SN} - Q_{SN}(\theta_{SN})\Delta T_{SN}$ ($\lambda_{SN} \geq W_j$) (14)

With the assumption that BZ pump stations are contained in one parallel pumping group and the pump units contained in each pumping station have the same type with no performance difference while the pump units in different stations have different types, each pumping station has one kind of performance curve of pump unit. Each pump unit has a blade angle corresponding to the maximal flow within the power constraint under the average head of each time period. After taking a definite water quantity step to disperse the total water quantity $W_{j,\max}$ which corresponds to the maximal blade angle of all time periods, the optimal mathematical model of daily operation for single pump unit with adjustable-blade could be applied to calculate the minimal daily cost of single pump unit $F_{j,m}$ (m =1, 2, …, max) which respectively corresponds to each water quantity $W_{j,m}$.

With the fact that the pump units in one station have the same type with no performance difference, each pumping station only needs one optimal solution. Therefor, BZ groups of optimal solution should be done in one parallel pumping group, after which W_{kjm}~$F_{kjm}(W_{kjm})$ relationship could be obtained.

2.2.3 Dynamic Programming Aggregation of Large-Scale System

After a series of W_{kjm}~$F_{kjm}(W_{kjm})$ relationships are obtained by means of the second-stage submodel solutions (k=1, 2, …, BZ; j=1, 2, …, JZ ; m=1, 2, …, max), eq. (1)~(3) could be transformed into the following aggregation model.

Objective function:
$$G = \min \sum_{k=1}^{BZ} \sum_{j=1}^{JZ} F_{kj}(W_{kj}) \tag{15}$$

Water quantity constraint:
$$\sum_{k=1}^{BZ} \sum_{j=1}^{JZ} W_{kj} \geq W_e \tag{16}$$

Power constraint:
$$N_{kji}(\theta_{kji}) \leq N_{kj0} \tag{17}$$

Taking BZ pump stations as a suppositional station with AZ pump units ($AZ=JZ\times BZ$), eq. (15) ~ (17) are also one-dimension dynamic programming model whose stage variable is n (n=1, 2, …, AZ), the decision variable W_n is the daily water quantity pumped by each unit, and the state variable λ is the discrete value of water quantity pumped by all units. Applying dynamic programming method to solve the model above, the minimal daily electricity cost of entire parallel pumping group correspon-ding to the objective water quantity W_e could be obtained, by which the optimal water quantity of each pump unit W_n^* (n=1, 2, …, AZ) could be obtained. The solving details of this model are similar to Chapter 2.2.2.

After getting a series of W_n* values (n=1, 2, …, AZ), by means of the results of solving the second-stage subsystem which is the optimal mathematical model of daily operation for single pump unit with adjustable-blade, we could get a series of optimal operation schemes of each pump unit which is the optimal blade angle θ_{in}^* (i=1, 2, …, SN; n=1, 2, …, AZ) in each time period corresponding to each W_n* (n=1, 2, …, AZ).

2.3 Analysis of Optimal Operation for Multi-units with Adjustable-Blade in Huai'an Parallel Pumping Stations

2.3.1 Basic Informations of Huai'an Parallel Pumping Stations

The basic information of No.1, No.2 and No.4 Huai'an Pumping Stations which are the second stage stations in the Eastern Route of the South-to-North Water Transfer Project is shown in Table 2. During the optimization process, one standby unit contained in No.4 Huai'an Pumping Station is not considered.

Table 2. Basic information of No.1, No.2 and No.4 Huai'an Pumping Stations

Pumping station	Type of pump unit	Unit quantity	Impeller diameter /mm	Rated speed /r·min^{-1}	Match motor power /kW	Rated blade angle/°	Range of adjustable-blade
No.1	Axial-flow pump	8	1640	250	1000	0	-4°～+4°
No.2	Axial-flow pump	2	4500	100	5000	0	-4°～+4°
No.4	Axial-flow pump	3	2900	150	2500	0	-4°～+4°

The upstream and downstream rivers of Huai'an parallel pumping stations have a big enough cubage, which makes the daily head has a small change scope. Therefor, with the assumption that the daily average head has a constant value, and within the feasible domain of parallel pumping stations, we disperse it into 6 average daily heads which are 3.13m, 3.53m, 3.93m, 4.13m, 4.53m and 4.93m. In each of daily average head, full load, 80% load and 60% load of water quantity corresponding to operation with fixed blade angle and constant speed are considered as the optimal objective water quantity. Taking use of two-stage decomposition-dynamic programming aggregation method, we could get the electricity cost per 10^4m^3 water quantity corresponding to minimal daily electricity cost of entire parallel pumping group under each daily average head and operation load.

2.3.2 Optimization Results of Optimal Operation Model for Muilt-units with Adjustable-Blade in Huai'an Parallel Pumping Stations

Making use of the method above, the optimal operation scheme of No.1, No.2 and No.4 Huai'an Pumping Station under each daily average head and operation load could be obtianed. Taking the daily average head of 4.13m, 80% load for example, the optimal operation scheme is shown in Table 3 whose electricity cost per 10^4m^3 water quantity is 79.84 yuan/10^4m^3. Fig. 1 shows the electricity cost per 10^4m^3 water quantity of optimization under each operation load. And Fig. 2 shows the optimal water quantity allocation among all pmup units respectively under full load, 80% load and 60% load while the daily average head is 4.13m.

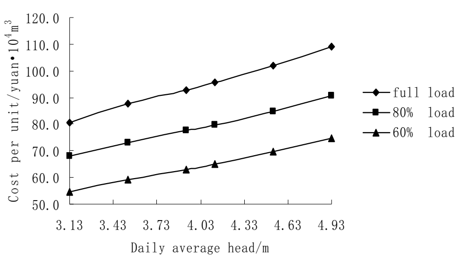

Fig. 1. Unit cost of water pumping under the optimal operation with adjustable -blade

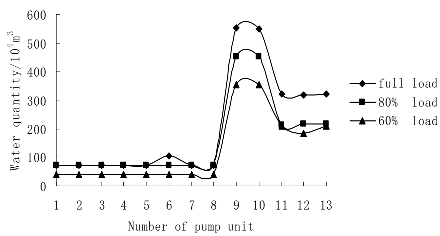

Fig. 2. Optimal water quantity allocation among units under different loads and daily average head of 4.13m

2.3.3 Discussion of Optimization Results on Optimal Operation of Multi-units with Adjustable-Blade in Huai'an Parallel Pumping Stations

Analyzing upon the figures and tables obtained from the optimization on multi-units with adjustable-blade in Huai'an parallel pumping stations by two-stage decomposition-dynamic programming aggregation method aiming to each daily average head and operation load, following results could be obtained.

(1) Average electricity cost per 10^4m^3 water quantity of all daily average heads corresponding to full load, 80% load and 60% load operation are respectively 94.60yuan/10^4m^3, 78.98yuan/10^4m^3 and 64.37yuan/10^4m^3.

Table 3. Optimal operation schemes of 80% load with adjustable-blade under daily average head of 4.13m considering peak-valley electricity price

Pumping station	Time period / Unit number	1	2	3	4	5	6	7	8	9
No.1	Unit 1	Stop	Stop	0°	+1.5°	+1.5°	Stop	Stop	-2°	-2°
	Unit 2	Stop	Stop	0°	+1.5°	+1.5°	Stop	Stop	-2°	-2°
	Unit 3	Stop	Stop	0°	+1.5°	+1.5°	Stop	Stop	-2°	-2°
	Unit 4	Stop	Stop	0°	+1.5°	+1.5°	Stop	Stop	-2°	-2°
	Unit 5	Stop	Stop	0°	+1.5°	+1.5°	Stop	Stop	-2°	-2°
	Unit 6	Stop	Stop	0°	+1.5°	+1.5°	Stop	Stop	-2°	-2°
	Unit 7	Stop	Stop	0°	+1.5°	+1.5°	Stop	Stop	-2°	-2°
	Unit 8	Stop	Stop	0°	+1.5°	+1.5°	Stop	Stop	-2°	-2°
No.2	Unit 1	+2°	+2°	+4°	+4°	+4°	Stop	Stop	+4°	+4°
	Unit 2	+2°	+2°	+4°	+4°	+4°	Stop	Stop	+4°	+4°
No.4	Unit 1	Stop	Stop	+2°	+4°	+4°	Stop	Stop	+1°	+1°
	Unit 2	Stop	Stop	+1°	+4°	+4°	Stop	Stop	+2°	+4°
	Unit 3	Stop	Stop	+1°	+4°	+4°	Stop	Stop	+2°	+4°

(2) Optimization results show that shut-down periods always appear in the period of high electricity price (0.978 yuan/kW·h) and while in operation period the high price corresponds to small blade angle of pump unit and vice versa. In the meantime, it is necessary to increase the shut-down periods instead of operating at the minus blade angle in order to save the electricity cost. That means there is a preferential consideration of controlling the number of operation units, after which the adjustable-blade measure would be taken.

(3) Fig. 2 shows that as a result of higher unit performance of No.2 Huai'an pumping station, the water quantity distributed to No.2 station is more that the others, which reflects efficiency priority principle.

(4) As the two-stage decomposition-dynamic programming aggregation method firstly takes optimal operation calculation for single pump unit with adjustable-blade by means of dynamic programming, after which the general coordination of water quantity by means of the aggregation model is taken, we could obtain optimal operation mode under the different blade angles of each pump unit in the same time period. Therefore, this method is suitable for solving the optimal daily operation problems of parallel pumping stations with different daily average heads, different time period divisions and different adjustable mode of pump unit in each pumping station.

3 Conclusion

Two-stage decomposition-dynamic programming aggregation method is first put forward to solve the optimal mathematical model of daily operation for multi-units with adjustable-blade in parallel pumping stations, by which the notable optimization results could be obtained. This method has a general guiding significance for the optimization problems of complex nonlinear mathematical models which are similar to eq. (1)~(3), and could solve the optimal daily operation problems of parallel pumping stations with different daily average heads, different time period divisions and different adjustable mode of pump unit in each pumping station. Besides, a set of optimal operation schemes of parallel pumping stations under different daily average heads and operation loads have been established by means of calculatiing typical parallel pumping stations, which could offer references for the optimal operation of parallel pumping stations with small daily average head amplitude, and also make the study basis for the optimal operation for multi-stage pumping stations.

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TBIS: A Web-Based Expert System for Identification of Tephritid Fruit Flies in China Based on DNA Barcode

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Abstract. Tephritid fruit flies (Diptera: Tephritidae) include serious agricultural insect pests in the world. Besides causing severe damage to fruits and vegetables, this kind of pests could enter countries or regions with international trade easily. Strict trade quarantine measures are imposed in many countries or regions in order to prevent their introduction and spread. Thus accurate and rapid identification is regarded as an essential component of plant quarantine. Traditional expert systems for assistant identification of agricultural insect pests are based on their morphological characteristics. Compared with the morphological identification, however, molecular identification has more advantages especially for the identification of the immature samples which are intercepted more frequently. Among the molecular identification methods, DNA barcoding is very effective and has been selected by the taxonomists in recent 5 years. In view of the above, a network expert system based on the DNA barcode, Tephritid Barcode Identification System (TBIS) was developed with ASP.NET and C# to improve the molecular identification of fruit fly pests in China. The system was supported by Microsoft SQL server 2008 database. Three functions were provided such as molecular identification based on DNA barcode, information browse and inquiry. DNA sequence similarity alignment dynamic programming algorithm served as the inference mechanism. Molecular identification knowledge was obtained from the public database on the Internet and Plant Quarantine Laboratory of China Agricultural University, which contained about 400 COI sequences of nearly 150 species of fruit flies. Moreover, detailed information such as morphological description and pictures of adult, hosts, and geographical distribution are presented in this system. Mixed with molecular, morphological and distributional data, the system can be used as an identification tool both for quarantine technicians and for educational purposes in China.

Keywords: Expert system, Pests identification, DNA barcode, SQL server, Tephritidae.

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1 Introduction

Fruit flies (Diptera: Tephritidae) include some of the world's most serious agricultural pests. Of the nearly 4,500 species of 500 genera currently known worldwide, over 150 species are considered as pests [1] which cause the loss of billions of dollars in production to a wide variety of fruits, vegetable and flower crops such as citrus, apple, mango, and sunflower. They can easily enter many countries through international trade. At present, over 47 species of fruit flies have been introduced to many countries for purpose or unintentionally by human activities, which lead to a broader distribution of fruit flies. As a result, they limit the development of agriculture in many countries or regions because of the strict trade quarantines imposed to prevent their introduction and spread [2-3]. For example, there are 10 species or genera of fruit flies in the 'list of plant quarantine pests for entry in the People's Republic of China'promulgated in 2007, such as *Anastrepha* Schiner, *Bactrocera* Macquart, *Carpomya incompleta* (Becker), *Carpomya vesuviana* Costa, *Ceratitis* Macleay, *Dacus spp.* (non-Chinese distributed species), *Monacrostichus citricola* Bezzi, *Myiopardalis pardalina* (Bigot), *Rhagoletis spp.* (non-Chinese distributed species) and *Toxotrypana curvicauda* Gerstaecker.

Accurate and rapid identification is important for any pest species and especially necessary for fruit flies because this group of pests like fruit flies occupies an important place in the plant quarantine worldwide. Identification of flies (Diptera), particularly fruit flies, is primarily based on morphological characters of adults. Larvae or pupae intercepted generally need to be raised to adults for identification [1]which necessitate an integrated means to identification of fruit flies that is accurate and rapid for virtual emergency of detecting fruit flies for pest control and management. With advancement in molecular biology and genomic technology molecular approaches offer a effective alternate means for tephritid identification in plant quarantines with greater advantages, such as the superiority to distinguish among related species, complex species, subspecies, biological types, and geographical populations that look alike; can identify all stages of life; can identify a species from bits and pieces; can avoid being affected by individual developmental instars and environmental conditions [4-5]. Therefore researchers are trying to use the molecular biological methods to complete the rapid identification for various instars of fruit flies. Among the molecular identification methods, DNA barcoding is very effective and has been selected by the taxonomists in recent 5 years. DNA barcoding employs sequence diversity in short, standardized gene regions to aid species identification and discovery in large assemblages of life. A 648-bp region of the cytochrome c oxidase I (COI) gene forms the primary barcode sequence for members of the animal kingdom [6-7]. A much smaller fragment MINI COI and ND6 also can be used for species identification. By the way, the Consortium for the Barcode of Life (CBOL) was launched in May 2004 and now includes more than 120 organizations from 45 nations [8].

Expert System is an important branch of Artificial Intelligence, using knowledge and inference to solve problems that only an expert can solve. Originated from the 1960s, through 40 years' development, with rapid expansion of application area, expert systems have been applied to many aspects in plant protection, involving assisted identification of pests, integrated pest management, prediction and forecasting, monitoring and early warning and so on [9-11]. Technology and application of the traditional expert system for pests identification based on morphology have been well developed. With the development of the molecular identification especially the DNA barcoding, it is not only possible but also a trend of biological identification to use the molecular identification due to the advantages of the molecular identification. The Barcode of Life Data System (BOLD) based on the DNA barcode emerged in time. BOLD is an informatics workbench aiding the acquisition, storage, analysis and publication of DNA barcode records. There are three functional units now available on BOLD such as the Management and Analysis System, the Identification System and the External Connectivity System [8]. Up to now (June 20, 2010), there are 73,592 formally described species with barcodes in BOLD, including Animals, Fungi, Plants and Protists. The number of fruit fly specimens with barcodes is 2,157, distributed in North America, South America, Oceania, Africa, Europe and Asia, among which only 3 specimens in China. There are 517 species of fruit flies with DNA barcodes in the BOLD, however, only 113 species with 344 public sequences which can be downloaded. Considering fruit fly identification in China, the BOLD has limitations as follows: the number of fruit flies without public sequences is 404, almost accounts for 80% of the fruit flies with barcodes; there are no ink drawings which is important for the identification; also there is no basic information such as Chinese name, synonym, host, geographical distribution and morphological characteristics [12]. Up to now, no fruit flies identification systems based on DNA barcode was reported in China.

Considering the reasons mentioned above, Tephritid Barcode Identification System (TBIS) was developed with ASP.NET and C# to improve the identification of fruit fly pests in China. Supported by Microsoft SQL server 2008 database, three functions were provided, such as identification based on DNA barcode, information browse and inquiry. DNA sequence similarity alignment dynamic programming algorithm served as the inference mechanism. Identification knowledge was obtained from the public database on the Internet and Plant Quarantine Laboratory of China Agricultural University, and then represented in the knowledge base of the expert system which contained about 400 COI sequences of nearly 150 species of fruit flies. Moreover, detailed information such as morphological description and pictures of adults, hosts, and geographical distribution were presented in the system.

2 The Knowledge Acquisition

The translation of the knowledge possessed by the experts into a knowledge base is the bottleneck in the process of knowledge acquisition [13-14]. For the system based on molecular biology, knowledge acquisition is also an important problem. By consulting the relevant foreign systems, books and scientific publications, we got the barcode information and basic information of the fruit flies involved in this system.

2.1 Barcode Information Acquisition

As identification knowledge the barcode sequences had been obtained from BOLD and Plant Quarantine Laboratory of China Agricultural University, standardized to certain length, and then represented in the knowledge base of the expert system which contained about 400 COI sequences of nearly 150 species of fruit flies.

2.2 Basic Information Acquisition

Detailed information used to confirm the identification results such as morphological description and pictures of adults, hosts, and geographical distribution were collected from the 'Identification Atlas for Important Pest Fruit Flies' wrote by Dr. Jiajiao Wu and the DELTA database (http://delta-intkey.com/ffa/index.htm).

3 TBIS Expert System Design and Development

Three basic functions such as identification based on DNA barcode, information browse and inquiry, together with two secondary functions such as notice and basic knowledge for identification are provided. The general structure which designed according to the functional requirement is shown in Fig.1.

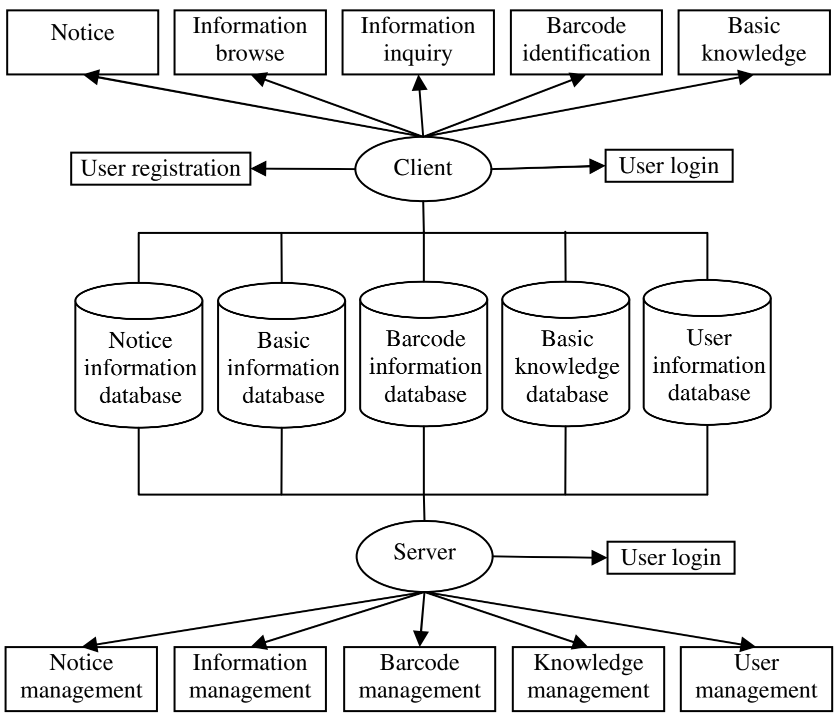

Fig. 1. System structure of TBIS

3.1 Development Software Selection

Since a web-based system can facilitate the data delivery, TBIS was designed to run on the internet to realize the remote access and real-time data sharing. Supported by Microsoft SQL server 2008 database, the system was developed with ASP.NET, C# and HTML. Besides, Dreamweaver 8, Fireworks 8 and Flash 8 were used to design the interface.

3.2 Inference Process

DNA sequence similarity alignment dynamic programming algorithm served as the inference mechanism [15]. Fig.2 shows the inference process. Start from the barcode identification, first, the users should choose the type of the barcodes. At present, there are three types such as COI, mini COI and ND6, and the most common barcode type used in the identification of fruit flies is COI. Second, input the barcode, simply by copy and paste. Third, submit the barcode, the system will show users the identification result after the similarity alignment between the barcode users input and the barcodes stored in the database by using the DNA sequence similarity alignment dynamic programming algorithm. The identification result is represented in the form of similarity values ordered from high to low. In almost all cases, users can find only one species' similarity beyond 98.00%, and when the similarity value between two DNA sequences is more than or the same as 98.00% we can infer that the two DNA sequences belong to the same species, so it is the final result. However, it is possible that users find two or more species' similarity values beyond 98.00%. For example, when it comes to complex species, you have to do the further identification by the DNAMAN, a kind of software used to create tree map. The barcode sequences of the complex species have been collected into one file folder, users can create a tree map based on the barcode sequences of all the complex species or just choose the similarity values beyond 98.00% ones to save time. Moreover, when there is no species' similarity value beyond 98.00%, maybe it is because the system does not store the species users want to indentify or users' barcode sequence is not a standard one. Here we want to notice users

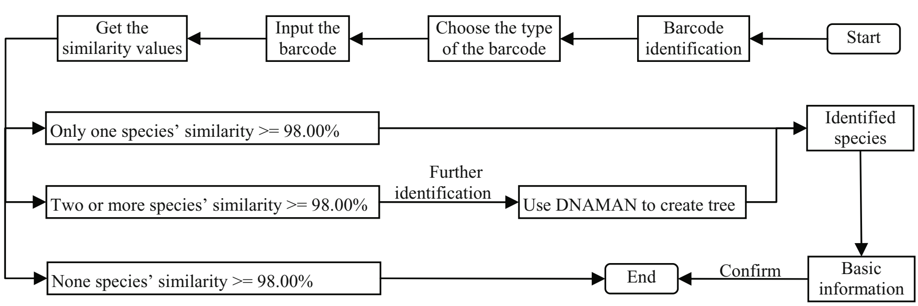

Fig. 2. TBIS inference process

that one species often has more than one barcode sequences from different geographical populations, and these sequences may have different similarity values. At last, users can browse the basic information such as the morphological description and pictures of adults, hosts, and geographical distribution.

3.3 Users Interface

With abundant combinations of textual information and images, the interface of this system was designed to be easy to operate and user-friendly. There are three main options: information browse, information inquiry and identification based on DNA barcode. On the 'information browse' page, the system displays a list of fruit flies and the user can inspect detailed information related to a specific species after choosing its 'browse' link. If the user clicks the 'information inquiry' option, the system provides an array of inquiry items for users to input keywords. Boolean logical operators ('or', 'and') and inquiry formats ('not exact match', 'exact match') are provided for users to get more suitable results.

As it is shown in Fig.3, the 'identification based on DNA barcode' page firstly offers three barcode types such as COI, MINI COI and ND6 for selecting. If one of the types is selected, the system will access to the database which stores that type of barcodes.

Fig. 3. The identification based on DNA barcode page of TBIS

Fig. 4. The identification result page of TBIS

Here we chose ‘COI’ and inputted the COI sequence of the *Bactrocera (Bactrocera) correcta* (Bezzi) collected from Yunnan, China. Fig.4 shows the identification result. Users can further check the detailed information of the identified species by clicking on the Chinese names.

4 Conclusions and Future Development

The system was originally conceived to improve the identification of fruit fly pests, the identification of which is very difficult for there are so many species and many of which are extremely similar. Mixed with molecular, morphological and distributional data, the system can be used as an identification tool both for quarantine technicians and for educational purposes in China.

TBIS is different from traditional expert systems based on morphological identification. DNA sequence similarity alignment dynamic programming algorithm served as the inference mechanism. The system contained about 400 COI sequences of nearly 150 species of fruit flies with detailed information such as morphological description and pictures of adults, hosts, and geographical distribution to confirm the identification results in some ways. Moreover, TBIS is a web-based system so it is accessible to Chinese with a computer and internet connection.

Due to the advantages of the molecular identification, it is the trend to use molecular identification with the assistant of the morphological knowledge. However, we should consider the further improvements to make the system more useful. The accuracy of the molecular identification depends on the number of the species and sequences stored in the database as well as how typical and standard the sequences are. Therefore, more species and sequences should be added. What's more, to use different types of DNA sequences at the same time also helps to confirm the identification result, so considering the system' extension, since we have already designed three types of barcodes that can be used for the identification of fruit flies, we need to collect more sequences belong to that three types of barcodes.

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TPPADS: An Expert System Based on Multi-branch Structure for Tianjin Planting Pest Assistant Diagnosis

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Abstract. At present, green plants exist in all aspects of our lives. And statistics shows that the pest species of green plants is very large. Thus accurate and rapid diagnosis is regarded as an essential component of green plant protection. Moreover, we couldn't find relevant information easily. That is why pest diagnosis is difficult and inefficient for technicians and farmers. In view of the above, the expert systems have been widely used in pest identification. However, most of traditional expert systems for assistant diagnosis of green plant pests are based on dichotomous structure. They are not flexible enough and only equal the electronic dichotomous keys. Compared with dichotomous structure, the system based on multi-branch structure has more advantages for accurate and rapid diagnosis. This paper describes the design and development of a web-based green plant pest expert system as part of Tianjin science and technology cooperation project. Based on user needs, Tianjin Planting Pest Assistant Diagnosis System (TPPADS) was developed with ASP.NET, C# and Microsoft SQL server 2008 database. It can show many features simultaneously. Meanwhile, data maintaining is also very easy and simple as same as the Microsoft Windows Explorer. The system included about more than 300 species of green plant pests. Diagnosis knowledge was obtained from Tianjin Institute of Plant Protection. TPPADS can be used as a diagnosis tool and information database both for plant protection professionals and farmers. We believe its application prospect should be well.

Keywords: green plant, expert system, multi-branch structure, pest diagnosis.

1 Introduction

At present, green plants exist in all aspects of our lives. And statistics shows that the pest species of green plants is very large. There are about 500 kinds of pests, who can harm green plants in Tianjin, which is one of the supper cities in China. Identification of pests is very difficult for farmers and technicians. Not only pests' information is not enough to

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meet the needs of farmers and technicians, but also the expert resources of green plant pest are very scarce. Usually, human experts are needed to provide the diagnostic knowledge, however, in some areas, pest management experts are not readily available to carry out disease diagnosis or insect identification [1]. Meanwhile, Lack of database or expert system is one of the reasons for this situation. They find information difficulty, such as biological characteristics, control method, pest images, etc.

Expert systems (ES) are a branch of applied artificial intelligence (AI), and were developed by the AI community in the mid-1960s. The basic idea behind ES is simply that expertise, which is the vast body of task-specific knowledge, is transferred from a human to a computer [2]. The essence of an expert system is to mimic expertise and distribute expert knowledge into non-experts' hands. This can be enhanced significantly by using the Internet. ES solutions are based on reasoning by using problem domain knowledge and heuristics. Hence, ES approach is the most suitable methodology for simulating human experts. Most of the ESs for ship design is aimed at development of assistance to deal with the complex characteristics of design problem [3].

Expert systems have been applied in agriculture from 1980s [4-20]. Most of them are developed for crop production and pest management [21-26], animal husbandry and aquaculture[27-30]. At the same time, ESs are also widely used in forestry, medicine, industry etc[31-33]. Some are stand-alone early [34-37], many of them are web-based at present [38-41]. Some ESs also began to integrate mobile communication systems, GIS technology etc [42-44].

This paper discusses our experience in developing and evaluating a web-based expert system for identification of green plant pests, named as TPPADS (Tianjin Planting Pest Assistant Diagnosis System). The system included about more than 300 species of green plant pests. It has been developed by China Agricultural University and Tianjin Institute of Plant Protection. TPPADS could be used as a diagnosis tool and information database both for plant protection technicians and farmers.

2 Users' Needs and Knowledge Acquisition

2.1 Users' Needs

Efficient identification work is a vital to help to make a decision about the pest control measures. When applying an expert system for technicians and farmers, it is necessary to investigate both their attitudes toward that the system. Essentially, understanding their perceptions toward the tool is a crucial issue for enhancing effect of green plant protection. In order to meet the requirements of Tianjin Institute of Plant Protection work, we had several meetings to discuss the system requirements, and careful analysis. The needs analysis report shows that:

- Need of basic information in a large number of pests. Technicians and farmers couldn't find relevant information easily.
- Need of assistant diagnosis system. Accurate and rapid diagnosis is regarded as an essential component of green plant protection. That is why pest diagnosis is difficult and inefficient for technicians and farmers.

- Friendly interface and easy operation. One of the most important design considerations behind the system was that a system should be as user friendly as possible. Understanding of the user's cognitive structure and the users' task is a critical component in the development of user-centered interface design. A good interface will enhance user/expert system interaction and task performance [45]. Simple operation allows users to easily use the system.
- Interactive Consulting. Users can get experts' answer about some problems through interactive consulting on-line.

2.2 Knowledge Acquisition and Information Collection

Knowledge acquisition (KA) is the process of transferring knowledge from the knowledge source to knowledge engineer (or expert system builder). To acquire the required knowledge, we followed the KA procedure discussed in Morpurgo[46] (Morpurgo et al., 2001) and Wada etc [47].The knowledge, symptom descriptions and the rules from domain experts, i.e. entomologist and psychopathologists.

Pest information (e.g. species' morphological characteristics, biology, geographic distribution, etc.) were acquired from experts interviews and literature such as textbooks, primary and secondary literature, papers, etc. We also collected a large number of pictures by photographing. it's about 300 species of green plant pests in Tianjin.

3 System Design and Development

3.1 Software and Database

TPPADS was designed to run on the internet. Its development was based on the use of internet techniques and SQL programming languages. It was developed with ASP.NET and C#. The server database played a very important role in developing TPPADS. It was used to sort all the information and knowledge which was needed to actualize every function of the expert system. In TPPADS, there are 5 databases including a user information database, basic information database and identification knowledge database etc. They were all designed using MS SQL Server 2008 Database.

3.2 Inference Process

Amongst the different methods for representing the knowledge [48], production rules are the most frequently used for diagnostic expert systems [14,17]. A rule is composed of a list of IF conditions and a list of THEN and ELSE statements about the appropriate solution to the problem. A disadvantage of a rule-based system is that the knowledge is not organized in a real structure [49]. Most of traditional expert systems for assistant diagnosis of green plant pests are based on dichotomous structure which is rule-based. They are not flexible enough and only equal the electronic dichotomous keys. However, hierarchical structure provides a natural structure for the knowledge and allows the building of expert systems that can be easily modified and adapted. In hierarchical structure, knowledge is organized in a decision tree, with nodes at different

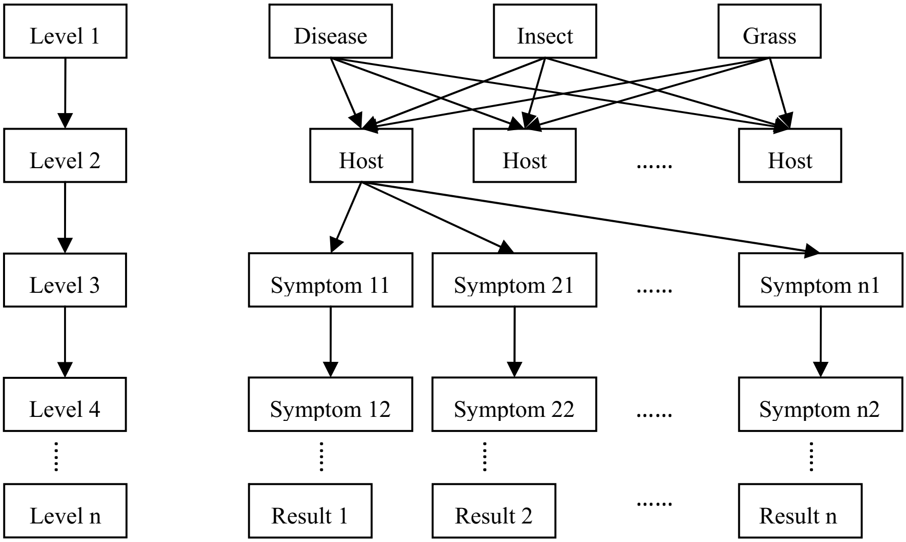

Fig. 1. The Inference diagram of multi-branch structure of TPPADS

Fig. 2. The diagnosis page of TPPADS

levels. The knowledge is distributed among many nodes [50]. Compared with dichotomous structure, TPPADS based on multi-branch structure or is another form of hierarchical structure has more advantages for accurate and rapid diagnosis (Fig. 1).

3.3 Users Interface

User interface is the direct media between users and computers. To best meet the different users' need, designers should insist on friendly principle. In another word, they should consider all users' knowledge level and ensure the interface complete, compact and easy (Fig.2). Meanwhile, data maintaining is also very easy and simple as same as the Microsoft Windows Explorer.

4 Discussion

Although ESs may respond faster and be more available than a human expert, are steady, unemotional, and give complete response at all times, they also do have the following disadvantages [51]:

- Some applications are difficult to use by another person who has not generated the knowledge-base.
- Some systems are very slow when compared to the human expert.
- The knowledge systems' ability tends to end abruptly.
- Sometimes, it is difficult to extract knowledge from an expert and to put it into a format that the ES can deal with and the size of the ES domain must be limited.
- The inability of ESs to exhibit common sense limits the effectiveness of present ES applications.

For expert systems, effective organization of expert knowledge has a great influence on the functions of the expert system. If it use rule-based structure, then adjusting of knowledge base becomes very difficult and the system's adaptive capacity be reduced greatly. TPPADS adopts the multi-branch structure design, which is more suitable for various needs and the flexible adjusting to changing demands. Thereby, it may save the cost of software development and reduce maintenance difficulty.

Further work includes that increasing of pest species involved, expanding the scope of application. Secondly, we should train technicians and farmers for using of the system. However, conceptually expert systems should not be considered absolutely valid or absolutely invalid, as the overall system evaluation is a continuous process and an ongoing endeavor helping to ensure maximum usage of the developed expert system [22]. So we must publicize the system as possible as more people can know and use it. The system included about more than 300 species of green plant pests. Diagnosis knowledge was obtained from Tianjin Institute of Plant Protection. TPPADS can be used as a diagnosis tool and information database both for plant protection professionals and farmers. We believe its application prospect should be well.

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Study on the Demands for Agricultural and Rural Informationization in China and Its Strategic Options

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Abstract. China is at a critical stage of transformation from traditional to modern agriculture and its agriculture and rural economic sector faces severe challenges of shortage of natural resources, environmental degradation, agricultural disasters, sluggish income growth of farmers and widening disparity between urban and rural areas. The fundamental solution to these problems lies with the advancement of agricultural science and technology. China's agricultural and rural informationization has entered the comprehensive development stage, in which informationization is no longer a pure technical but complex systematic matter, involving natural, technological, economic and social issues, with impact on the country's food security, environmental protection and sustainable development. Based on analysis of agricultural and rural economic development, this paper thoroughly examines the demand for information technology in the drive of new socialist countryside construction and modern agriculture development and tables strategic options for agricultural and rural informationization in China.

Keywords: modern agriculture, new socialist countryside, informationization, needs analysis, strategic options.

1 Introduction

At late 90's of the last century, China's agricultural development entered a new stage; the supply of agricultural products has changed from shortage to an overall equilibrium of supply and demand while surplus has been maintained in years of good harvest; the structure of agricultural production has been gradually optimized; transition from traditional agriculture featuring monopoly crop farming to modern agriculture with overall development of agriculture, forestry, animal husbandry and fisheries has been achieved. Agricultural production has become increasingly commercialized, specialized and market oriented. In the national economy, it has transited from agriculture supporting industry to industry supporting agriculture and urban area leading the

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development of rural area. The development and innovation of rural economy of China have not only done away with the backwardness of rural China, but also provided strong support to industrialization and modernization of the country.

1.1 Significantly Improved Agricultural Comprehensive Production Capacity and Transition from Traditional to Modern Agriculture

Since reform and opening, agricultural infrastructure facilities nationwide have been significantly improved. Farmland irrigation, agricultural mechanization and facility agriculture developed rapidly; the equipment level, disaster resistant capacity and resource utilization efficiency also improved remarkably. As a result, agricultural comprehensive production capacity has greatly improved. In 2008, the total power of agricultural machineries reached 822 million KW and the mechanization level of farmland plowing and crop planting and harvesting reached 50.8%. The gross output value of agriculture reached 5.83 trillion RMB Yuan, the added value of primary industry reached 3.4 trillion RMB Yuan. Total grain output attained 528.5 million tons and the per capita grain output reached 400 kg, providing strong foundation for national food security. The development objective of agriculture is changing from "providing sufficient food and clothing" to "high quality, high yield, high efficiency, ecological-friendliness and safety". The industrial system of agricultural sector is shifting to the establishment of modern agricultural industrial chain. Different operational models of agricultural development such as those led by dragonhead enterprises through "company + farmer households", by intermediary organizations through "cooperative + farmer households" and "specialized association + farmers households" and led by specialized markets have flourished. The process of market-oriented commercialization and specialization of agricultural production has accelerated, laying solid foundation for modern agricultural development.

1.2 Continuous Optimization of Agricultural and Rural Economy Structure and Gradual Improvement in Quality and Result

At present, the structure of agriculture, forestry, animal husbandry and fisheries has achieved transition from traditional agriculture featuring monopoly crop farming to modern agriculture of integrated development of agriculture, forestry, animal husbandry and fisheries. The share of crop farming decreased while the shares of forestry, animal husbandry and fishery increased significantly in the total output value of agriculture, forestry, animal husbandry and fisheries. In 2008, the gross output value of agriculture reached 3.4 trillion RMB Yuan, an increase of 5.5% on the basis of last year in comparable terms. Crop farming accounted for 53.3% of the total output value, forestry for 4.4%, animal husbandry for 29.4% and fisheries for 9.4%.

In the sub-sector of crop farming, the ratio of sown areas to grain, cash and other corps has changed from 89.2:9.0:1.8 in 1952 to 68.3:27.8:3.9 in 2008, with significantly increased proportion of cash crops. In the structure of animal production, the output of pork declined from 94.2% in 1952 to 63.5%% in 2008, while beef and mutton increased from 5.74% in 1979 to 13.6% in 2008. Poultry meat also rose from 5.80% in 1985 to 22.9% in 2008. Egg and milk production has witnessed rapid increase and their share in animal products also went up by a big margin.

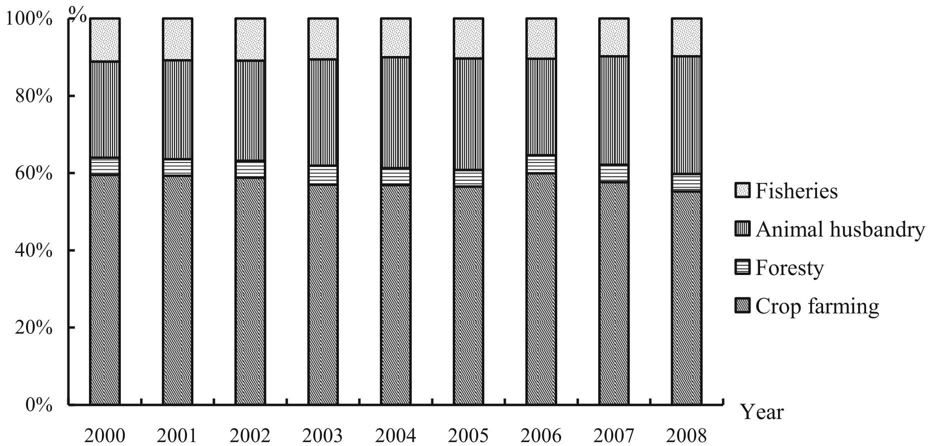

Fig. 1. Composition of value added by agriculture, forestry, animal husbandry and fisheries 2000 to 2008

Data resources: Analysis and Forecast of China's Rural Economic Situation (2008-2009), Rural Development Research Institute of Chinese Academy of Social Sciences and Rural Social and Economic Department of National Statistics Bureau of China: Social Science Literature Publishing House, 2009.

At the same time, rural economic structure has also changed from being dominated by agriculture to coordinated development of the three industries. According to statistic data of the Second National Agricultural Census, China had a total number of 239,000 agricultural enterprises engaged in various industries of agriculture, forestry, animal husbandry and fisheries at the end of 2006. In 2008, the added value of primary industry accounted for 29.1% of the total added value, a drop of 19.4% on the basis of 1997. Correspondingly, the added value of secondary and tertiary industry was 54.6% and 16.3% respectively, representing an increase of 10.1% and 9.3% on the basis of 1997. In the past two years, due to the impact of global economic slowdown, demand decline and changes in domestic economic environment, the development of township enterprises slowed down significantly and secondary and tertiary industries experienced the same pattern of decline. However, the overall trend of coordinated development of the three industries will not change.

Data resources: Analysis and Forecast of China's Rural Economic Situation (2008-2009), Rural Development Research Institute of Chinese Academy of Social Sciences and Rural Social and Economic Department of National Statistics Bureau of China: Social Science Literature Publishing House, 2009.

1.3 Significantly Improved Farmers' Livelihood and Great Success in New Countryside Construction

The 17th National Congress of the Chinese Communist Party proposed for the first time the "acceleration of social development focusing on improving people's livelihood". From 2003 to 2008, the total expenditure in "agriculture, rural areas and farmers" from the central government finance reached 2.2 trillion RMB Yuan, which

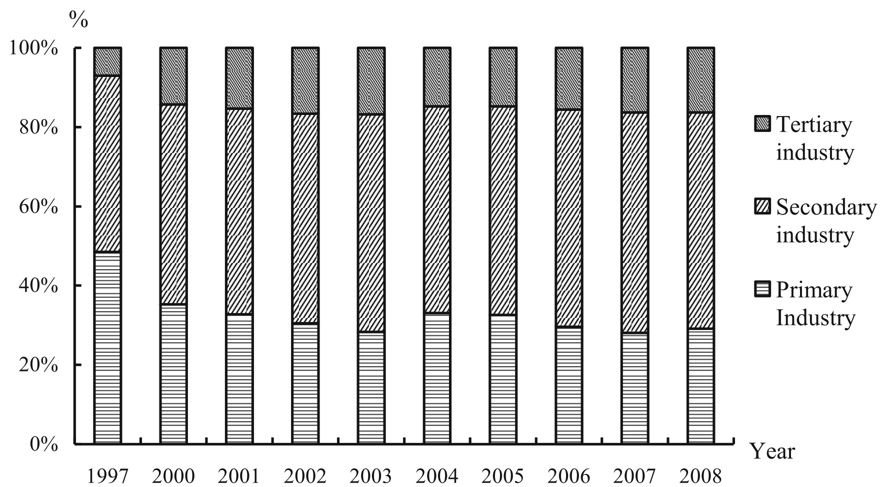

Fig. 2. Composition of value added by sectors of rural areas from 1997 to 2008

resulted in significant improvement of the livelihood in rural areas. Rural power grid transformation program has provided electricity to more than 5.3 million households of about 24 million people who had no access to power otherwise; rural safe drinking-water program benefited 130 million rural residents. The proportion of administrative villages in the country with access to road, telephone, electricity and television signal accounts for more than 95% of the total and more than 80% townships have postal services. Education, sanitation and medical service in rural areas have improved substantially; farmers' income and consumption have both increased. In 2008, the per capita net income of rural residents reached 4,761 RMB Yuan, which was 34.6 times higher than that in 1978, presenting an average annual growth rate of 12.7% and 7.1% after deducting price factors. The number of farmer households with per capita net income over 5,000 RMB Yuan accounted for 39.3% of the total farmer households, of which 9.3% garnered more than 10,000 RMB Yuan in per capita net income. A historic leap from subsistence to moderate prosperity has been achieved in the livelihood of rural residents and it is advancing towards the goal of well-off society in all-round manner.

Even though farmers' income has been increasing rapidly, the urban-rural gap is also widening, which has expanded from 2.6:1 in 1978 to 3.3:1 in 2008 (with the income of rural resident as 1); the gap in absolute amount expanded to 11,020 RMB Yuan. Because of the dual-tier economic and social structure established long time ago, the urban-rural gap will remain for certain period of time.

1.4 Increased Impact of Agriculture and Rural Economic Development on the Growth of National Economy

At present, China is at the middle stage of industrialization. In 2008, the per capita GDP exceeded 3,000 USD, while the ratio of output value of primary industry in GDP dropped to 11.3% and the employment size of primary industry made up only 39.6% of the entire society; urbanization rate reached 45.68%; indicating that industrialization and urbanization of China have already entered a new stage. The complementarities and interactions in development between rural and urban areas have been enhanced. Agriculture and rural economy is increasingly integrated with industrial and urban economy. The impact of agriculture and rural economy on the national economy has increased significantly. Particularly, during current international financial crisis, China's central government staged up investment in rural areas and stimulated rural residents' consumption, which is an important way of expanding domestic demand. Through implementation of programs such as getting household electric appliances, motorcycles, building materials and vehicles to rural areas, the government aims at achieving new momentum of economic growth pulled by increased consumption in rural areas, which provided important foundation to achieving the objective of "maintaining growth".

1.5 Severe Challenges in the Development of Agriculture and Rural Economy

The 5th Plenary Session of the 16th Central Committee of the Chinese Communist Party proposed the mission of building new socialist countryside. The key of building socialist new countryside is to promote the development of modern agriculture. For the time being, China is at the critical stage of transiting from traditional to modern agriculture and its agriculture and rural economic development faces severe challenges of natural resource shortage, ecological environment degradation, frequent agricultural disasters, low labor productivity, sluggish income growth of farmers and widening urban-rural gap.

In China, the situations of water resource shortage and low-efficiency use exist at the same time. At present, water use for agricultural irrigation accounts for 70% of total water use of the entire society. Due to problems in water transportation, irrigation, on-farm irrigation infrastructure facilities, farming system and farming practices, agricultural water use efficiency in China is still low, the grain production efficiency of unit net water consumption is less than 1kg/m3, which is far behind 2-3kg/m3 in developed countries. Agricultural irrigation water use in the Yellow River basin accounts for 92% of the total water consumption, but almost 80% of the farmland is irrigated through gravity flooding and only 20% or about 22.76 million mu is irrigated through water-saving techniques.

The deterioration of arable land quality and the degradation of soil environment have become the bottleneck to the development of agricultural production, which is also a technical problem that must be addressed for sustainable agricultural development. According to statistics, the total arable land area in China is 1.827 billion mu, 1.39 mu per person, which is less than 40% of the world average. Desertification area in the country is about 2.63 million km2, accounting for 1/3 of the total land territory; sandification area is 1.73 million km2, accounting for 1/5 of the total land territory. The declining trend of arable land quality is also obvious, which is mainly reflected in shortage of organic matter in soil. When examining the organic matter content of arable land of China, it is about 1-3% for most of paddy soils; upland with less than 1% of organic matter content accounts for 31.2% of the total upland cropland.

The agricultural productivity and labor production rate are not high. Farming in most parts of the country is still done by hands and draft animals. Mechanized plowing accounts for only 55% of the total arable land area, mechanized sowing for 24.9% and mechanized harvesting for 10%. Low level of mechanization and artificial intelligent control in agricultural production directly resulted in low return rate of agricultural labor and small margin of farmers' income growth.

2 Demand for Information Technology Triggered by Substantive Changes in Agricultural Production Patter in China

2.1 Scale Production of Agriculture Needs Automated and Intelligent Machinery and Equipment

Scale operation, intensification and informationization are not only the features of modern agricultural production, but also important ways for transiting from traditional to modern agriculture. Currently, China has built up an agricultural mechanization development system in consistent with China's national condition. The level of agricultural equipment and mechanization achieved leap development. In 2008, the comprehensive mechanization level of farmland plowing, crop planting and harvesting reached 50.8%. Field machineries with high performance and power and the corresponding farm implements increased rapidly; therefore, agricultural mechanization has entered the intermediate stage of development. Along with the development of science and technology in the globe as well as the development of computer technology, remote sensing and detecting technology, information processing technologies, controlling technology and global positioning technology, the performance of agricultural machineries has been greatly improved. In case of harvester for example, with the application of grain flow-sensing unit, the quality of grain harvested per second can be rapidly detected. With the use of grain moisture sensor, the humidity of the grain harvested and stored can be measured and monitored on-line. Agricultural robot that depends on artificial intelligence technique to sense crop species and environment change can work under extremely hot, humid or noxious environment and easily accomplish production-related works such as picking, sorting and application of pesticides. The utilization of those advanced techniques has greatly increased the efficiency and safety of farm operations[1]. At present, the first GPS-based intelligent variable seeding, fertilizer application and rotary plowing machine with independent intellectual property rights has been successfully developed and used in Maoxin Farm of Songjiang of Shanghai. The first domestically made GPS harvester has been released by Foton Heavy Industries. The application of new and high technologies represented by information technology is the key for modern agriculture to become a technology-intensive industry of scales [2].

2.2 Industrialization of Agriculture Needs High Efficiency and Convenient Channel of Information Communication

Agricultural industrialization is a complete industrial chain that links the various stages of pre-production, production and post-production. Informationization is the fundamental requirement of industrialization and the important means of industrial development. It provides not only sufficient information resource and convenient communication channel, but also effective technical means for industry integration and management enhancement in agricultural production [3]. Through computer management and decision-making support system, it can help simulate and make decisions in the process of industrialization and lower the cost and risk. Through networking, market and policy information can be timely obtained, hence products can be identified for production and marketing in line with market demand. Agricultural product tracking system can track and identify products, which can safeguard quality and safety of farm produces. Informationization has significantly changed the traditional production and marketing approaches and provided greater opportunities for further development of the traditional industry.

2.3 Precision Management of Agriculture Needs Digital and Precise Agricultural Information Resources

Precision management refers to the use of programmed, standardized, digitalized and informationized means to achieve precise, efficient, coordinated and sustained operation of each organization and management unit. Since agricultural resources are dispersed, changeable and uncertain, over 85% of agricultural information resources are related to spatial position. Therefore, the application of 3S technique, database technique, MIS technique, networking technique and decision-making support technique in the management of agricultural resources to dynamically monitor agricultural resources can efficiently promote optimized resource allocation and improve resource utilization efficiency[4]. Let's take agricultural resource management and decision-making support system as an example. Based on agricultural resource database, the system through integrating professional models and expert systems can implement various analysis and decision-making as rational utilization of water, cropping structure adjustment and fertilizer application tactics[5]. Digitalization and informationization are important features and means in the transition from extensive to intensive agriculture.

3 Social Development in Rural Areas Needs Information Technology

3.1 Orderly Transfer of Rural Labor for Employment Needs Communication Platform of Demand and Supply of Labor

Along with ever sharpening contradiction of less land and large population in rural areas and protracted urbanization, more and more rural surplus labors are moving to urban areas. At present, rural surplus labor accounts for 1/3 of the total rural labor force of the country and less than 1/2 of the surplus labors can be effectively transferred to urban areas. In order to prompt the orderly transfer of rural labors and optimize the deployment of labor resources, it is essential to build and improve rural service platform for labor supply and demand to realize dynamic management of basic information of labors and employers, such as timely releasing, inquiring and communicating of employment information. Meanwhile, the development of Internet technology enables farmers to expand their information capture and provides farmers with opportunities to access employment information of urban areas, which can help expand channels of employment.

3.2 Serving the Improvement of People's Livelihood Needs Information Technology to Speed Up Social Development of Rural Areas

The fact that information can benefit people's livelihood and network can help build harmony has become a consensus of the globe. Through informationization, farmers can better access essential information and services needed in daily life, such as those related to culture, education, medical care and social security. The programs of "broadcasting outreaching villages" and "live satellite coverage outreaching villages" implemented by the State Administration of Radio, Film and Television have greatly improved the coverage of broadcasting and television and enriched the spiritual and cultural life of farmers. In the field of medical care, disease monitoring information system is beginning to demonstrate its usefulness. The application of rural cooperative medical care management information system is catching more and more attention and gaining stronger development. Explorations and trials of modern distance medical service have been carried out in some areas. The service facilities as "Digital Homeland", "Agricultural Information Courier Station" and "Agricultural Information Service Station" of Beijing have delivered information to the doorsteps of farmers, providing convenience to the life of farmers[6]. The establishment and improvement of socialized service information system in rural area is an important means to achieve coordinated urban-rural development and reduce urban-rural gap.

3.3 Standardization and Enhancement of Rural Management and Service Need the Support of E-government Platform

According to the survey of UNESCO, 89% of countries are about to promote e-government and have set it as an important national agenda. At present, the large amount of governance affairs in rural areas compounded by poor management means and obscurity in information disclosure is the important cause of instability of farmer-cadre relationship. Through the establishment of administrative management system in rural area, government functions can be transformed and village management can be improved[7]. The daily work of grassroots government can be achieved via Internet and this paperless work style can greatly reduce procedures and enhance the efficiency of work. The development of e-government increases farmer's political participation, safeguards their rights to be informed of village affairs and improves their sense of being masters of their own and ultimately promotes institutionalized and standardized administration of rural areas.

4 Agricultural and Rural Informationization Is an Important Means of Achieving Leap Development in Productivity

4.1 Informationization Promotes the Shift from Extensive to Intensive Economic Growth

The mechanism of turning information technology into economic growth is that, with the innovation of information technology, the cost of manufacturing and prices of information products and equipment fall rapidly, which stimulates investments in information technology by various economic sectors, forming the so-called IT capital deepening. It not only improves the productivity of the sector, but also gains spillover effect onto other sectors in terms of behavior and productivity, hence it promotes technology progress and organizational change of economic sectors, thereby fosters the transition of the entire economic growth pattern.

As an intrinsic element of the productivity system, agricultural information plays certain role in agricultural economic growth through labor tools, labor and object of labor, such as various intelligent agricultural machineries and implements, agricultural production decision-making support system, expert system and monitoring and control system [8]. With extensive application of information technology, large-scale innovation has appeared in agriculture and rural industry, significantly improving technical performance of tools, upgrading technical qualification and operational skills of labors, optimizing the objects of labor and saving resources. Therefore, agricultural production has changed from mainly relying on increased input to improving the production efficiency of elements to achieve output increase, which has promoted the change from extensive economic growth pattern driven by quantity to intensive pattern driven by quality.

4.2 Informationization Reduces Energy and Material Consumption in Agricultural Production and Alleviates Pressure of Economic Development on Population, Resources and the Environment

Traditional industrialization and economic growth pattern of "high investment, high consumption, high pollution, low output, low quality and low efficiency" has caused global resource shortage, environment pollution and ecological deterioration. Statistic data of the Ministry of Agriculture shows that the annual chemical fertilizer application in China is 47 million ton, while the effective utilization rate is only 35%; the annual pesticide use is more than 1.4 million ton while the effective utilization rate is about 30%, irrigating water utilization efficiency is only 45%. Large amount of livestock manure is not fully used as resources and its contribution of methane to greenhouse gases is 21 times of $CO2$. Energy conservation and emission reduction in agriculture not only plays decisive role in achieving the national goal of energy conservation and emission reduction, but also bears great significance in developing modern agriculture and safeguarding food security of the country.

Technically, informationization provides the possibility for the emergence of modern productivity of low resource consumption [9]. Through integrating remote sensing GIS, GPS, communication and network technologies and automated technologies with geography, agronomy, ecology and soil science, precision agriculture has achieved real-time monitoring of crop and soil in macro and micro dimensions during the whole production process. Thus, rational utilization of agricultural resources, improvement of ecological environment, reduction of resource and energy consumption and increase the quality of agricultural product can be materialized [10].

4.3 Informationization Brings about Incremental Benefits of Agricultural Structure Adjustment

Industrialization is an important way of promoting agricultural structure adjustment and an effective measure of increasing farmers' income. However, at present stage, because of small-scale operation and geographic dispersion, the circulation of agricultural products is slow and the overall integration of agriculture is not high either. Market is the center of information, from the perspective of market system, agricultural operation mainly relies on timely and accurate market information to deploy agricultural and rural industrial resources to achieve the goal of optimization and operation of high efficiency.

On the other hand, with gradual improvement of agricultural informationization, information industry in rural area will become an emerging service industry. In the future, profit oriented exchange of agricultural information service and agricultural information products in rural market system will become important elements. With the development of rural information industry, more and more people will engage in information service, including collection and processing of information, software development, marketing of information products and consultation.

5 Conclusion

This paper has demonstrated the demand for information technology in the drive of new socialist countryside construction and modern agriculture development. To guarantee the effect of agricultural and rural informationization, we proposed several strategic options as follows.

5.1 Institutional Innovation: Organizational Guarantee of Informationization

Promoting the application of information technology in agriculture and rural area is the foothold of informationization; it is also the inevitable way of developing modern agriculture and constructing new socialist countryside. As the user of informationization, farmers are not highly enthusiastic about the use of information technologies due to constraints of knowledge and concepts and the impact of low income and high cost of accessing information and information technologies, which severely hinders the process of agricultural and rural informationization. In order to resolve the problem, it is a must to innovate the mechanism of informationization. Firstly, there is the need to innovate a subsidy system of agricultural information. Through subsidizing modern technologies (equipment) and lowering the economic access requirements to modern information technology, it is to support large farmer households, intermediary agents and farmer cooperative organizations to actively use modern information technologies. The demonstration and leading role of these actors should be fully tapped to promote agricultural industrialization through informationization. Secondly, there is the need to innovate diversified investment system. The guiding role of government’s agriculture-supporting and benefiting funds should be fully used to usher credit and capital investment of the society in agriculture and rural information development, building a financing system integrating government’s input, capital investment of the society and farmer’s contribution. An effective organization and coordination mechanism should be established among agricultural and agro-sectors. Close cooperation mechanism should be established among the telecommunication operators, IT enterprises, civil organizations and farmers [11].

5.2 Science and Technology Innovation: The Driving Force of Informationization

Science and technology is first productivity. Agricultural science and technology innovation is extremely important to a developing country like China that is short of agriculture resources. In the research field of rural informationization, efforts should focus on the demonstration, application and large-scale use of mature technologies, such as "the integration of the three networks" in rural areas, mobile broadband connectivity and its service, LAN data exchange technology based on power distribution network, sharing of rural information resources, network information discovering and intelligent analysis technology, cloud calculation platform and cloud service model and public information and management service platforms in rural areas. In rural informationization research area, priority should be given to monitoring and management of water and soil resources, early warning of epidemic diseases of intensive livestock farming environment, long distance monitoring of biological environment of facility horticulture industry, monitoring of agricultural production environment and transportation process, long-distance dispatch and diagnosis service of large agricultural machineries [8].

5.3 Capacity Building: Human Capacity Support to Informationization

Along with the advancement of economic globalization, the competition for talents becomes increasingly fierce. The upgrade of national comprehensive strength increasingly relies on science and technology progress and the fostering of talents. Since the 1990's of the 20th century and with the continuous innovation of information technology, informationization has become an important stage of modern agricultural development and new countryside construction. And the key to realize informationization lies with the setting up of human resource structure that meets the needs of agricultural and rural informationization and provides human resources to rural informationization. Therefore, efforts must be made to build up human resource capacity for rural informationization. On one hand, based on innovations, with independent intellectual property rights, of domestic first class universities and colleges as well as research bases, it is to realize innovation from the source of core technique to product equipment and foster innovation-oriented talents. On the other hand, high-level information-oriented personnel with good command of modern information technologies and agricultural production operations in the grassroots of rural areas should be fostered, so as to realize popularized application of new technologies and products in grassroots.

5.4 International Cooperation: An Accelerator of Informationization

Along with accelerated development of science and technology, global and regional cooperation is unfolding. No country in the world can resolve all development problems on its own and international cooperation has become an important way of addressing developmental issues. Through international cooperation, strategic cooperation with information and technology enterprises of developed countries should be strengthened to introduce into the country more advanced technologies to promote leap development and re-innovation. Priority should be given to research subjects that can help attract international cooperation funds or foreign advanced technology, equipment and advanced method. Joint application with strong overseas establishments for R&D of key technologies should be encouraged.

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Study on the Near Infrared Model Development of Mixed Liquid Samples by the Algorithm of OSC-PLS*

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Abstract. The orthogonal signal correction of Wold algorithm was introduced in this thesis, which was combined with the partial least square algorithm. Calibration model of five components of benzene, methylbenzene, chlorobenzene, benzaldehyde and acetophenone in the mixed liquid samples were developed and validated by the method of independent . The result indicated that the calibration models of the components of benzene, methylbenzene, chlorobenzene and benzaldehyde will be developed well after the 1-dimension OSC filter; while a good calibration model of the component of acetophenone will be acquired after the 2-dimension OSC filter.

Keywords: Orthogonal Signal Correction, Partial Least Square, Calibration Model, Near Infrared Spectroscopy, Liquid Samples.

1 Introduction

Near-infrared (NIR) spectroscopy is a kind of non-destructive [1], rapid [2] and environmental friendly analysis method, with the characteristics of easy-acquirement optical source, abundant spectral information and strong penetrability. NIR spectroscopy analysis has been applied in the fields of quality analysis of agricultural products [3-5], petrochemical industry [6], pharmaceutical analysis [7-9] and so forth.

However, the high-strength and complicative background exists in NIR spectroscopy analysis. With the characteristics of serious overlapping band, there are non-correlative information with the target component and the information of the instruments in NIR spectra, which will influence the precision of thecalibration model.

The common multi-signal calibration methods have the risk of eliminating the information correlated with the specified values from spectra, which may decrease the precision of the calibration model.

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The Algorithm of Orthogonal Signal Correction (OSC) was raised by Wold [10] in 1998 firstly, which is a method of signal processing. The basic idea of OSC is that the non-correlative part of the spectral matrix (X) to the specified values matrix (Y) was eliminated by the mathematical method of orthogonality, after which, a new matrix Xnew was acquired. The calibration model will developed by the matrix Xnew, in order to acquire robust calibration model. Since OSC algorithm eliminated the orthogonal part of the specified values, the valuable information will be kept in spectra matrix, in addition, it may simplify the calibration model for the complicative system.

After Wold raising OSC algorithm, many scholars raised the improvement to OSC. Tom Fearn [11] improved the OSC algorithm in 2000. Johan A. Westerhuis [12] et. al. raised the Direct-OSC algorithm. Robert N. Feudale [13] et. al. raised the Piecewise OSC algorithm. OSC algorithm has been applied in the calibration of NIR data successfully at present [14, 15].

In this thesis, OSC-PLS algorithm will be applied in the calibration model of the NIR spectra of 30 mixed liquid samples. The filtering effect of different dimension of OSC was compared.

2 Experiment

2.1 Instrument and Reagent

Instrument: FT-NIR spectrometer (Spectrum One NTS, Perkin Elmer, U.S.);

Reagents: Benzene (A.R.), methylbenzene (A.R.), chlorobenzene (A.R.), benzaldehyde (A.R.), acetophenone (A.R.).

2.2 Procedure

30 mixed liquid samples, including benzene, methylbenzene, chorobenzene, benzaldehyde and acetophenone, were made up. The information of the samples was shown in Table 1.

The range of NIR spectra collected was 10000 cm^{-1} - 4000 cm^{-1}. The air was regarded as reference in order to collect the background spectrum.

Table 1. The information of the components in the liquid mixed samples

	Benzene	Methylbenzene	Chlorobenzene	Benzaldehyde	Acetophenone
Max (%)	50.0	30.0	10.0	10.0	5.0
Min (%)	1.0	1.0	1.0	0.5	0.1
Mean (%)	9.9	19.4	5.3	4.3	2.0
Std	12.3	8.6	3.0	3.0	1.7

2.3 Data Processing

Software: Matlab v6.5, preprocessing and OSC-PLS program written by self.

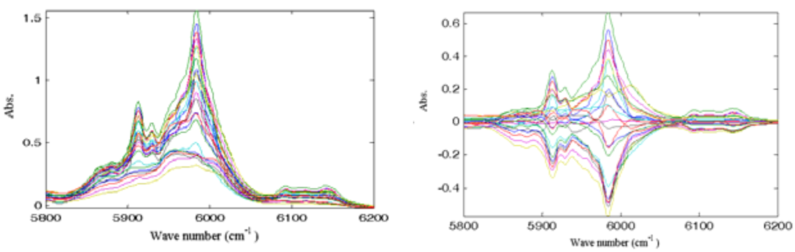
Calibration method: Independent validation, of which, 6 spectra selected according to the concentration gradient were regarded as the validation set for each component;

smooth by Savitzki-Golay (with the width of 5); data normalization method: SNV; OSC-PLS regression.

3 Result and Discussion

3.1 OSC Filter

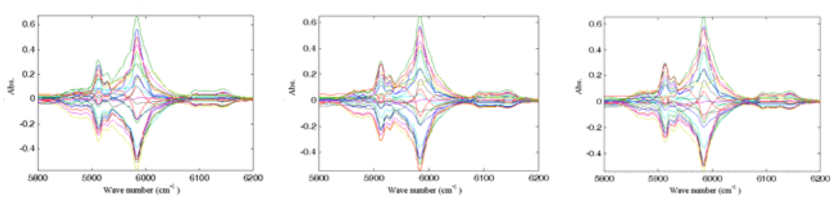
Take the specified values of benzene for example, Fig. 1A is the raw spectra of the 30 mixed liquid samples in the range of 6200 cm^{-1} -5800 cm^{-1}, which is the 1st overtone of C-H group. Centralization of the spectra was done, as is shown in Fig. 1B.



A B

Fig. 1. The raw spectra (A) and the spectra after centralization processing (B)

After the spectra having been processed of centralization, OSC filter with 1-, 2- and 3-dimension was applied to the spectra data. The spectra after OSC filter were shown as Fig. 2.



A B C

Fig. 2. The spectra processed by OSC filter with the specified values of benzene, OSC dimension: 1(A), 2(B), 3(C)

3.2 The Calibration Models of the 5 Components in the Mixed Liquid Samples

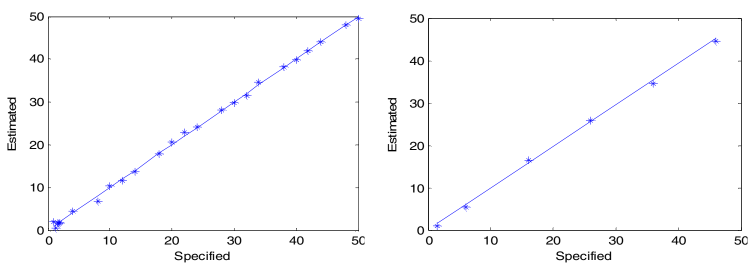
Partial Least Square (PLS) regression was applied to the specified values of benzene and the spectra filtered by 1-, 2- and 3-dimension OSC with the specified values of benzene, the result of which was shown as Tab. 3, in which, R^2_c represents the determination coefficient of the calibration set, while R^2_v represent the determination coefficient of the validation set.

Table 2. The calibration result of benzene after 1-, 2-, 3-dimension OSC filter

OSC dimension	1	2	3
R^2_c (%)	99.90	99.90	99.90
R^2_v (%)	99.69	99.69	99.69
RMSEC	0.54	0.54	0.54
RMSEV	0.97	0.97	0.97
Model dimension	2	2	2

It can be seen from Table 2 that there is no remarkable difference among the results of 1-, 2- and 3-dimension OSC filter. The calibration after 1-dimension OSC filter had the enough precision.

Fig. 3 is the correlation of the estimated values and specified values of the calibration set (A) and the validation set (B) of benzene after 1-dimension OSC filter.



A B

Fig. 3. The correlation of the estimated and specified values of benzene, calibration set: A, validation set: B

It can be seen from Fig. 3 that a high precision can be acquired for benzene after 1-dimension OSC filter and PLS regression.

The calibration result of the other 4 components after 1-, 2- and 3-dimension OSC filter and PLS regression were shown as Table 3.

Table 3. The calibration result after each OSC filter

	Methylbenzene			Chlorobenzene			Benzaldehyde			Acetophenone		
N_{OSC}	1	2	3	1	2	3	1	2	3	1	2	3
R^2_c (%)	99.75	92.89	92.89	99.45	94.23	94.23	99.94	95.55	95.55	99.78	99.78	99.78
R^2_v (%)	99.42	97.10	97.10	96.34	91.45	91.45	84.94	78.15	78.15	97.47	97.97	97.97
RMSEC	0.52	2.65	2.65	0.23	0.74	0.74	0.09	0.66	0.66	0.09	0.09	0.09
RMSEV	0.77	1.71	1.71	0.55	0.84	0.84	1.17	1.41	1.41	0.3	0.27	0.27
N_C	4	2	2	5	4	4	8	3	3	5	5	5

In Tab. 3, NOSC represents the dimension of OSC filter, NC represents the dimension of calibration model.

It can be seen from Table 2 and Table 3 that 1-dimension OSC filter is good for the components of benzene, methylbenzene, chlorobenzene and benzaldehyde since RMSEV is minimum among 1-, 2- and 3-dimension of OSC filter; while 2-dimension OSC filter is good for the component of acetophenone since RMSEV is minimum among the three dimensions of OSC filter but will not decrease when 3-dimension OSC filter being applied.

4 Conclusion

OSC-PLS algorithm was applied to benzene, methylbenzene, chlorobenzene, benzaldehyde and acetophenone in the mixed liquid samples in this thesis. The result indicated that OSC is a good filter for PLS, which can extract the useful information efficiently and acquire precise calibration model.

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Design and Realization of Information Service System of Agricultural Expert Based on Wireless Mobile Communication Technology

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Abstract. This paper elaborates the detail of designing of agriculture service platform system, which revolutionized agriculture information delivery in rural and underserved areas. Based on mobile wireless protocols, the platform allows mobile phones to capture and send data for an agricultural information and links farmers with agronomist for real-time decision support.

Keywords: SMS, Mobile communication, Service system, Agriculture.

1 Introduction

1.1 Background of the Project

The 2009 Investigation Report on the Development Status of Internet In Rural Areas of China" released by China Internet Information Center indicated that the rural netitzens in China has reached 106.81 million by the end of December 2009, the rural surfing population by mobile phone was about 71.89 million, it increased more than 30 million compared with 2008 and the annual growth rate reached 79.3%, which is considerable higher than the overall growth rate of the rural netizens.

The report shows that less rural netitzens are using desktop computer as their visiting terminals, and the proportion drops to 68%, while the proportion of surfing by mobile phone increases by nearly 20% and the utilization rate reaches 67.3%; among the 277 million urban netizens, 160 million of them are using mobile phone to surf, and the utilization rate reaches 57.5% the mobile phone has become the main visiting terminal of the rural netizens, and also it is an importance motivity in activating the development of Internet in rural areas.

1.2 Function and Innovation of the System

The Short Message Service (SMS) is an important service of GSM; it can transfer data information with limited length through the GSM network. Depending on the SMS of GSM, this system can transfer inquiry instruction and inquiry result between

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the user and the system, and thus realize the mobile inquiry of the Information service system of vegetable experts. The paper analyzes the database access technology based on the SMPP, SGIP, and CMPP3.0 protocol. It puts forward a SMS agricultural information inquiry scheme, wherein the inquiry means to become the specific agricultural scientific & technical Information into abstract data information, and provide guidance and solution on this basis. Through this method, the system can provide inquiry demand which is easy and fast for search. The innovative functions of the system include:

The data background supports fuzzy search and automatic classification & matching. The character processing adopts the keywords take-out technology, a keywords database is set up to make automatic matching of the keywords according to the keywords; It can mark the various vegetable diseases and insect pests information and automatically classify and match them according to the keywords to look for the corresponding research experts.

Automatic and active update of the database: The system will create automatically a new question if there is no solution in the database and get answer from the experts. This change the database from passive update to active update, and the contents of the original database are enriched.

Dynamic statistic, analysis and processing decision of the vegetable diseases and insect pests: with the increasing visit to this system, the type, time and other rules of the questions raised by the farmers can be counted in a dynamic way, which can be utilized for making scientific choice in the prevention and treatment of the diseases and insect pests.

2 System Design

2.1 Design Principle of the System

This system utilizes the latest wireless network and software technology and follows the advanced development design standard, it mainly depends on the SMS system, the traditional experts E-mail and phone support system and WAP are the secondary means. The system pays equal attention to the social benefits and economic benefits. The following is the design principle of this system:

Practical
The overall design of the system fully considers the information system and experts resources of Zhengzhou Vegetable Research Institute, and the increasing importance of the mobile phone in rural area, also it considers the economic status of the rural farmers, this agricultural experts information service system is thus set up on the basis of the wireless mobile communication technology to provide expert solution for more farmers.

Adaptable
The system pays enough attention to the adaptability, and shall be easy for the various farmers; the system response shall be in accordance with the operation habit of the farmer, such as the fuzzy matching and dialect matching and so on.

Compatible
During the research and development stage of the SMS application system, full consideration has been given to the CMPP protocol and SGIP protocol; this system is compatible with the SMS gateway interface protocol of China Mobile and China Unicom.

Safe
The system is completely safe in hardware, network, database and the power limit of data, application operation and user identification, the system has strong safety prevention measures and can stop the illegal access or destruction either in hardware, software, or service flow and so on.

2.2 System Overview

Farmers: They use handset to access the WBAEISS via the Wireless Base Station, they can send SMS to WBAEISS or they can also use on the WAP service of the WBAEISS. The farmer can ask different kinds of questions to the WBAEISS; include vegetable disease problem, pest problems and other agricultural related problems.

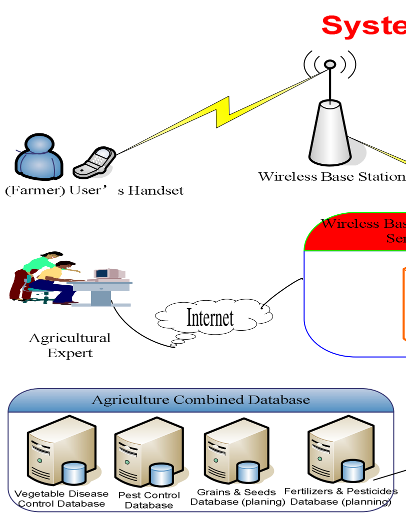

Fig. 1. The overview of the system shows the all participant: the actors, the network, the Database and Wireless Based Agricultural Expert Information Service System (WBAEISS).

Agricultural Experts: If there is no answer for some of farmers' questions in the current knowledge database of WBAEISS, the agricultural experts will receive e-mail or SMS from the system, they can use the system via web browser, such as IE, to add new answer to the knowledge database. The can also use the system to do some analysis/statistics work, base on the analysis/statistics results they make an expert decision to send some forecast on vegetable disease or pest control to farmers.

System Administrators: The system administrator use the web browser, such as IE, to do some maintenance work on WBAEISS, create new user, add new expert, back up database/log, and so on.

2.3 Design Architecture

This chapter is focus on the design architecture. The design architecture of the system consists of four Layers and two kernel modules as the following System Architecture.

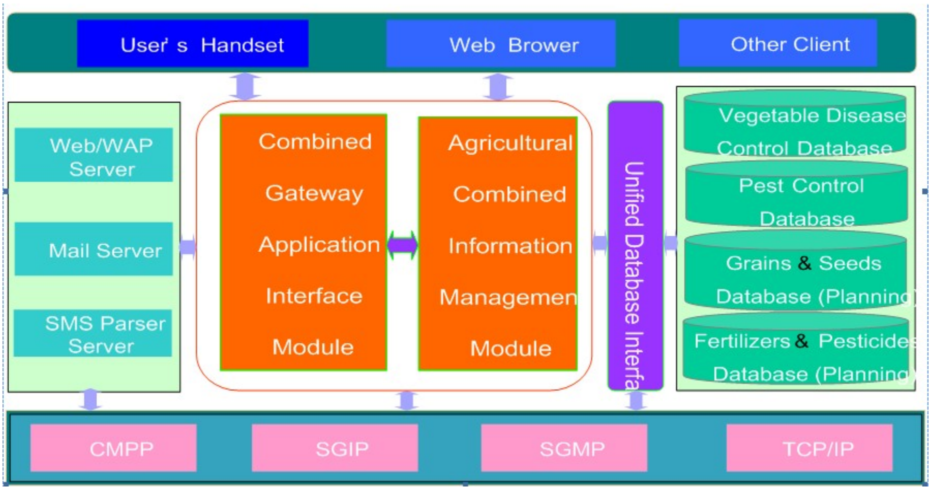

Fig. 2. System architecture

The Present Layer: This layer provides the GUI to the final users of the WBAEISS, including user's handset, web server and so on.

The Application Layer: This layer fulfils the WBAEISS system requirements, including the 2 kernel modules and 3 application servers.

Combined Gateway Application Interface Module: It is a unified interface to deal with the request from the different communication Medias: e-mail channel, SMS channel and web channel.

Agricultural Combined Information Management Module: Deal with the main business logic of the WBAEISS, including the request from the agricultural experts, the system administrator and the Combined Gateway Application Interface Module, and it also communications with the Unified Database interface.

Persistent Layer: This layer provides the unified database interface to storage, organization and retrieval of structured data, provide concurrency, data integrity and data sharing of the Agricultural combined database.

Communication Layer: This layer provides a module to support different protocols by different service providers, such as CMPP3.0 by China Mobile, SGIP by China Unicom, and SMGP by China Telcom…

3 System Functions Introduction

This chapter introduces the main features of WBAEISS, as showed in the following figure, including 2 main function groups: agricultural combined information management and system management.

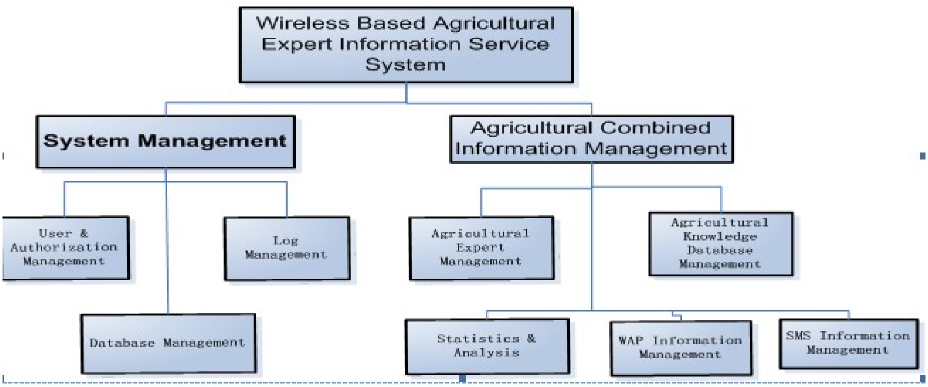

Fig. 3. System Function Structure Diagram

3.1 Agricultural Combined Information Management

Agricultural combined information management includes the following 5 features:

Agricultural Expert Management: The WBAEISS can add/delete different major agricultural experts, such as experts for pest, experts for vegetable disease and so on.

Agricultural Knowledge Database Management: The WBAEISS can gather new Agricultural Knowledge from the network, also from the answer to the farmers' question and so on. It also supports batch import and export. To make sure all the knowledge are correct, all the new answers/solutions must be checked by the agricultural experts.

Statistics and Analysis: The WBAEISS can help agricultural experts get statistics & analysis results base on the questions of farmers by different time internal, day, month and year; by different question type, pest or vegetable disease… by different area, province, and city … this module support customization.

SMS Information Management: The WBAEISS has a guide and workflow to help farmers to get the solution/answer they need, ie. The farmer sends "tomato, disease", the WBAEISS will response as
"tomato disease1, symptom 1"
"tomato disease2, symptom 2"
…
And according to the selection by the farmer, the WBAEISS will give the right feedback that the farmer needed. The WBAEISS also supports some dialect, such as "fan qie" is tomato in the dialect of Henan province.

WAP Information Management: The WBAEISS provides a WAP server for farmer to search their needed agricultural questions. The WBAEISS supports similar search and second search.

3.2 System Management

System management includes user & authorization management, log management and database management.

User and Authorization Management: The WBAEISS supports add/edit/delete users; different type of users will have different authorization. Such as only System administrator can backup/resume the database.

Log Management: The WBAEISS can record the log of those delivery failure SMS and the system operation log.

Database Management: The WBAEISS also provide the database backup/resume features, and WBAEISS also provide a feature to batch import/export the Database information.

4 Conclusion and Future Work

This service system supports more than one service providers, it can be accessed to several SPs, the Mobile, Unicom or Telecom, the only work is to add the configuration. It supports the various service items, and the module design of the system is convenient for the development of the new service. This system has been applied in the actual value-added SMS service, the connection to the gateways of China Mobile or Unicom shows good stability, which can satisfy the requirement of the system communication application Since the system was set up, it has been made known to the whole country through the nationwide vegetable business network, it receives thousands of SMS consultation every month, and it has become a common system for the breeding experts of vegetables, the vegetable growers and the distributors of agricultural commodities.

Depending on the Zhengzhou Scientific Data Sharing Project, it is planned to expand the contents of this system by adding the following: the database of scientific & technical achievements and the database of scientific & technical literatures.

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Design of a New Soil-Tuber Separation Device on Potato Harvesters

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Abstract. A new soil-tuber separation device on potato harvesters has been developed. It mainly comprises a linear motor, a rectangular screen, a frame, four supporting springs and four dampers. It is the first time to propose that the soil-tuber separation device is driven by the linear motor. Forces acting on the rectangular screen are found. A differential equation for describing the forces is set up. An equation for evaluating exciting force of the linear motor has been derived from the solution to the differential equation. An equation of the factors affecting on the device resonance has also been obtained. Additionally, an equation for evaluating the deformed magnitude of the damping springs in the dampers has been derived. And finally a motion simulation experiment for the rectangular screen on a potato harvester has been done with the Matlab/Simulink module. The experiment expressed that the method is feasible.

Keywords: Potato harvester, Soil-tuber separation, Separation device, dynamics analysis.

1 Introduction

Many methods were used to separate soil from potatoes. However, field separating operation caused most damage to potatoes. Curl (1978) invented a tuber harvester having a primary bed and a secondary bed. The secondary bed is encompassed by a devining chain [1]. Hyde et al. (1983) suggested this type of tuber harvester could be equipped with a system for controlling the depth of material on the primary chain by automatically adjusting chain speed. The system provides uniform flow of material from the primary to the secondary chain over a wide variety of field conditions and ground speeds [2]. Another similar potato harvester was described by Welp (1989). It comprises a screening conveyor belt and an elevator disposed after the screening conveyor belt. The elevator is formed from a double conveyor having an internally rotating bar-type conveyor belt with narrow openings and an externally rotating bar-type conveyor belt with wide openings [3]. In order to improve soil elimination, shaking of the conveyor chain (bed) in a vertical or horizontal direction was applied to

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the potato harvesters (Woodruff et al., 1984) [4]. In addition, a pressure belt mechanism operating on the surface of the primary conveyor was proposed (Misener et al., 1989) [5]. However, due to friction between chain (bed) or soil and potatoes, the potatoes were greatly damaged. A simple mechanical separator was developed by Feller et al.(1985) . The machine utilizes the difference in the restitution coefficient between potatoes and soil clods.Both potatoes and clods are dropped from a feed conveyor onto a revolving steel roller where the resulting trajectories cause the potatoes to end up at a more remote location than the clods. The separator can not be used to separate stones from the potatoes [6]. Gan-Mor et al.(1986) used a appropriate elastic plate for reducing the restitution coefficient of stones without changing that of the potatoes or clods so that the stones were separated [7]. However, the impact between the steel roller or plate and potatoes caused damage to potatoes. Bouillon (1983) proposed another potato harvesting apparatus. Its separator has three primary cylindrical cages, followed by three secondary cylindrical cages and then three rubber-coated cylindrical cages. The separator can remove most of the dirt and break up the dirt clods [8]. However, much of mechanical injury was caused by the conveyor equipment. In addition, great power required to drive the separator was consumed. Misener and McLeod (1989) also tested a mechanism which consists of a combination of disc-shaped clod rollers and cylindrical brushes. The mechanism essentially eliminated the loose soil and, on the average, 60% of the stones and 47% of the clods [9].

The objective of this research is to develop a new soil-tuber separation device on potato harvesters. The device can reduce potato damage, reduce the power required to separate soil from potatoes, and improve the separation efficiency.

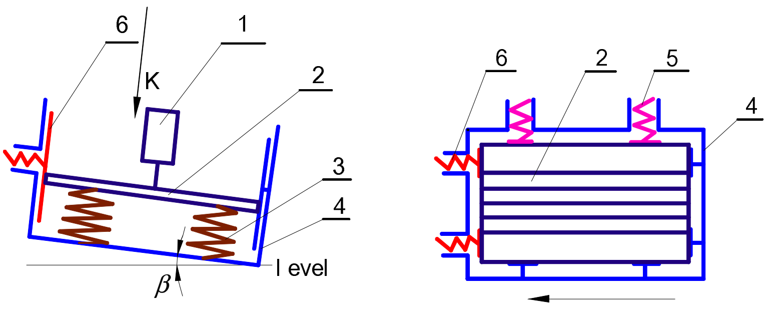
Specific work is divided into three parts:

(1) Model of soil-tuber separation device.
(2) Dynamics analysis for soil-tuber separation device.
(3) A motion simulation experiment for a rectangular screen.

2 Model of Soil-Tuber Separation Device

A model of a soil-tuber separation device on a potato harvester is shown in Fig. 1. The device mainly comprises a linear motor, a rectangular screen, a frame, four supporting springs (two of the supporting springs aren't shown in Fig. 1), and four dampers. The rectangular screen consists of equidistantly spaced bars at the center and a connecting plate on each side of the bars. The frame has four inside slideways and two bottom supporting plates. The motionless part of the linear motor is held onto the frame by connecting components (the connecting components aren't shown in Fig. 1). The motion part of the linear motor is attached to the connecting plates of the rectangular screen by another connecting components (the connecting components aren't shown in Fig. 1). The rectangular screen is connected to the supporting plates of the frame by the four supporting springs. The frame is equipped with the four dampers each of which has a spring, a guide, and a spring cover (the spring cover isn't shown in Fig. 1).

The angle between the datum plane of the device and the level is β. When the device works the rectangular screen driven by the motion part of the linear motor vibrates up and down in inclined direction along the four slideways of the frame and the four guides of the dampers.



(a) (b)

Fig. 1. A model of a soil-tuber separation device: (a) front view; (b) K direction view except the linear motor .1-linear motor; 2-rectangular screen; 3- supporting springs; 4-frame; 5-dampers; 6 -dampers. Arrow denotes direction of travel.

3 Dynamics Analysis for Soil-Tuber Separation Device

3.1 Evaluation of Exciting Force

The forces exerted on the rectangular screen in vibrating direction are (Fig. 2): exciting force of the linear motor acting on the top of the rectangular screen, F ; supporting force of the supporting springs acting on the bottom of the rectangular screen, N ; damping due to surface friction from the motion of the rectangular screen, F' ; and component of gravitational force of the rectangular screen that includes the tuber and soil on it, $mg\cos\beta$.

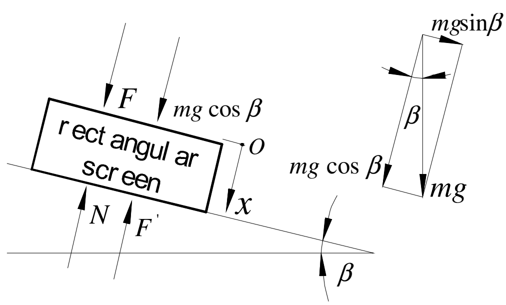


Fig. 2. Forces acting on a rectangular screen in vibrating direction

Using vibrating direction as x axis and putting the stagnation point O at equilibrium position (Fig. 2), the supporting force in the x direction may be described as follows:

$$N = iK(x + \lambda_s). \quad (1)$$

Where i is number of the supporting springs, K is stiffness of the supporting springs ($N\ m^{-1}$), λ_s is the deformed magnitude of the supporting springs at equilibrium position(m), x is the distance of the rectangular screen from the equilibrium position (m).

The exciting force is defined by:

$$F = F_0 \sin \omega t. \quad (2)$$

Where F_0 is amplitude of the exciting force (N), ω is angular frequency of the exciting force ($rad\ s^{-1}$), t is the exciting time (s).

The damping may be expressed as follows [10]:

$$F' = \gamma_e\ \dot{x}. \quad (3)$$

Where γ_e is damping coefficient ($N\ s\ m^{-1}$).

Based on Newton's law of motion the differential equation for describing the forces acting on the rectangular screen is:

$$F + mg\ \cos\beta - N - F' = m\ \ddot{x}. \quad (4)$$

Where m is mass (kg), g is acceleration of gravity ($m\ s^{-2}$), β is the angle between the datum plane of the device and the level ($\deg$.).

At equilibrium position $$mg\ \cos\beta = i\,K\,\lambda_s. \quad (5)$$

Substituting equation (1),(2),(3),and(5) into equation (4) and rearranging terms gives:

$$m\ddot{x} + \gamma_e\ \dot{x} + i\,K\,x = F_0 \sin \omega t. \quad (6)$$

If we define $2n = \dfrac{\gamma_e}{m}, \quad p^2 = \dfrac{i\,K}{m} \quad and \quad q = \dfrac{F_0}{m}$

then equation (6) becomes:

$$\ddot{x} + 2n\,\dot{x} + p^2\ x = q \sin \omega t. \quad (7)$$

A particular solution to equation (7) is:

$$x(t) = B \sin(\omega t - \psi). \quad (8)$$

where

$$B = \frac{q}{\sqrt{(p^2 - \omega^2)^2 + 4n^2\omega^2}}. \quad (9)$$

and
$$tg\,\psi = \frac{2n\omega}{p^2 - \omega^2}. \tag{10}$$

Rearranging equation (9) yields:

$$B = \frac{q}{p^2} \cdot \frac{1}{\sqrt{\left[1 - \left(\frac{\omega}{p}\right)^2\right]^2 + \left[2\,\frac{n}{p}\,\frac{\omega}{p}\right]^2}}. \tag{11}$$

If we define $B_0 = \frac{q}{p^2} = \frac{F_0}{i\,K}$, $\lambda = \frac{\omega}{p}$ *and* $\zeta = \frac{n}{p}$

then equation (11) becomes:

$$B = \frac{B_0}{\sqrt{\left(1 - \lambda^2\right)^2 + \left(2\,\zeta\,\lambda\right)^2}}. \tag{12}$$

or
$$F_0 = iKB\sqrt{\left(1 - \lambda^2\right)^2 + \left(2\,\zeta\,\lambda\right)^2}\,. \tag{13}$$

If we define $\theta = \frac{B}{B_0}$

then equation (12) becomes:

$$\theta = \frac{1}{\sqrt{\left(1 - \lambda^2\right)^2 + \left(2\,\zeta\,\lambda\right)^2}}. \tag{14}$$

Differentiating equation (14) with respect to λ and setting the derivative equal to zero, we obtain:

$$\lambda = \sqrt{1 - 2\,\zeta^2}\,. \tag{15}$$

or
$$\omega = \sqrt{p^2 - 2n^2}\,.$$

$\because$
$$2n^2 << p^2.$$

$\therefore$
$$\omega = \sqrt{\frac{i\,K}{m}}. \tag{16}$$

Equation (16) is the requirement of occurring resonance for the device.

Based on damping theory the damping coefficient is [10]:

$$\gamma_e = \frac{4F'}{\pi \omega B}. \tag{17}$$

Substituting equation (17) into $2n = \frac{\gamma_e}{m}$, $p^2 = \frac{iK}{m}$ *and* $\zeta = \frac{n}{p}$, rearranging terms gives:

$$\zeta = \frac{2F'}{\pi \omega B \sqrt{iKm}}. \tag{18}$$

Substituting equation (15)and(18) into equation (13) yields:

$$F_0 = \frac{4F'}{(\pi \omega)^2 mB} \sqrt{(\pi \omega B)^2 iKm - 4F'^2}. \tag{19}$$

Equation (19) is used to evaluate the amplitude of the exciting force. Equation (2), (16) and (19) is applied to evaluate the magnitude of the exciting force.

3.2 Analysis of Damping

The forces exerted on the rectangular screen at the plane perpendicular to the vibrating direction are (Fig. 3): composite pressure force of the two 5-dampers, N_1; composite pressure force of the two 6-dampers, N_2; reacting forces of the frame, N_1' and N_2'; and component of gravitational force of the rectangular screen that includes the tuber and soil on it, $mg \sin \beta$.

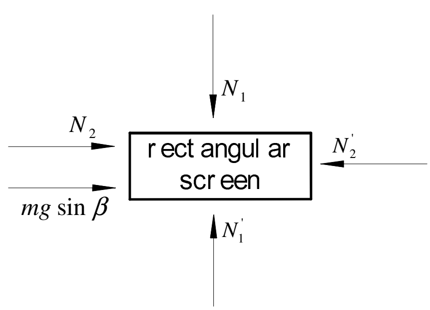


Fig. 3. Forces acting on a rectangular screen at the plane perpendicular to the vibrating direction

The composite pressure force of the two 5-dampers is determined as:

$$N_1 = 2\,k_1\,x_1 . \tag{20}$$

Where k_1 is stiffness of the spring in the 5-damper ($N\,m^{-1}$), x_1 is the deformed magnitude of the spring in the 5-damper (m).

The composite pressure force of the two 6-dampers is determined as:

$$N_2 = 2\,k_2\,x_2 . \tag{21}$$

Where k_2 is stiffness of the spring in the 6-damper ($N\,m^{-1}$), x_2 is the deformed magnitude of the spring in the 6-damper (m).

The reacting forces may be expressed as:

$$N_1' = 2\,k_1\,x_1 . \tag{22}$$

$$N_2' = N_2 + mg\sin\beta . \tag{23}$$

The damping may also be evaluated by:

$$F' = \mu N_1 + \mu N_1' + \mu N_2 + \mu N_2' . \tag{24}$$

Where μ is friction coefficient between the 5-damper or the 6-damper and the rectangular screen . It is also the friction coefficient between the slideways of the frame and the rectangular screen .

Substituting equation (20),(21),(22),and(23) into equation (24) and rearranging terms gives:

$$F' = 4\mu(k_1\,x_1 + k_2\,x_2) + \mu mg\,\sin\beta . \tag{25}$$

From equations (25)

$$k_1\,x_1 + k_2\,x_2 = \frac{F' - \mu m g \sin\beta}{4\mu} . \tag{26}$$

Equation (26) is applied to evaluate the deformed magnitude of the damping springs in the four dampers.

4 Results and Discussion

A motion simulation experiment for the rectangular screen on a potato harvester has been done with the Matlab/Simulink module. The parameters of the experiment are:

(1) $i = 4,\ m = 300\,kg,\ B = 0.05\,m,\ \omega = \pi\ rad/s,\ F' = 80\ N$.

(2) $i = 4,\ m = 500\,kg,\ B = 0.05\,m,\ \omega = \pi\ rad/s,\ F' = 80\ N$.

(3) $i = 4,\ m = 800\,kg,\ B = 0.05\,m,\ \omega = \pi\ rad/s,\ F' = 80\ N$.

The exciting force F was calculated in equation (2), (16) and (19). The simulation result was as shown in Fig.4. We could see that the motion trail of the rectangular screen is correct.

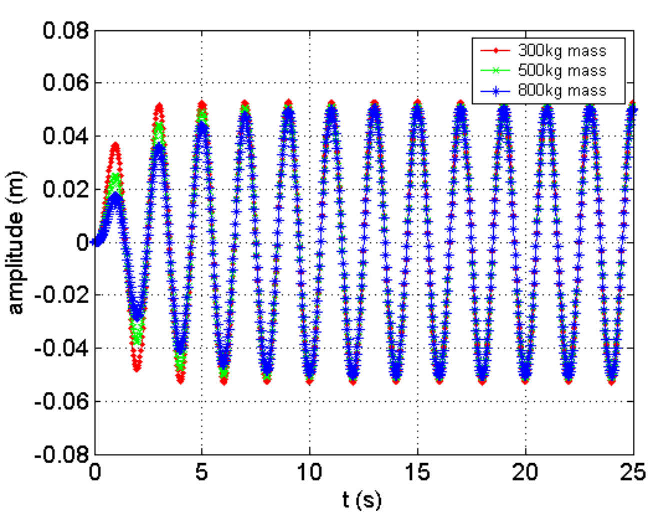


Fig. 4. Displacement-time curve for the rectangular screen on a potato harvester

In practice, the stiffness k_1, k_2 and the deformed magnitude x_1, x_2 of the springs in the dampers could be adjusted. Therefore the appropriate damping F' could be obtained in equation (25). The motion simulation experiment expressed that the method is feasible.

5 Conclusions

(1) A new soil-tuber separation device on potato harvesters has been developed. It is the first time to propose that the soil-tuber separation device is driven by the linear motor.

(2) Forces acting on the rectangular screen are found. A differential equation for describing the forces is set up. An equation for evaluating exciting force of the linear motor has been derived from the solution to the differential equation. An equation of the factors affecting on the device resonance has also been obtained. Additionally, an equation for evaluating the deformed magnitude of the damping springs in the dampers has been derived.

(3) A motion simulation experiment for the rectangular screen on a potato harvester has been done with the Matlab/Simulink module. The experiment expressed that the method is feasible.

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Fast Discrimination of Nanfeng Mandarin Varieties Based on Near Infrared Spectroscopy Technique

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Abstract. The potential of visible and near infrared (Vis/NIR) spectroscopy was investigated for discriminating the varieties of Nanfeng mandarin fruit nondestructively. The spectra were collected by a spectrophotometer in the wavelength range of 600–1040 nm. Relationship between the spectra and Nafeng mandarin varieties was established using principal component analysis (PCA), supervised independent modeling of class analogy (SIMCA) and backward propagation neural network (BPNN). By comparison the best result was obtained by BPNN with recognition rate of 97.5%. The results suggested Vis/NIR spectroscopy combination with BPNN was a new approach to discriminate of the varieties of Nanfeng mandarin fruit nondestructively.

Keywords: Vis/NIR spectroscopy, Nafeng mandarin fruit, varieties, SIMCA, BPNN.

1 Introduction

Visible and near infrared (Vis/NIR) spectroscopy combination with chemometric techniques provides a powerful tool for monitoring the variation of processes for quality control purpose. The fact that samples requires virtually no treatment, and the expeditiousness with which spectra can be obtained, have made NIRS a preferred choice over traditional techniques involving lengthy sample conditioning procedures.

The characteristics of the absorption bands in Vis/NIR spectra are dictated both by the chemical composition of the sample and by physical properties such as color, firmness, size and defect. As a result, the Vis/NIR technique can be used to discrimination both internal and external quality, however, it is difficult to detect accurately and stably. In order to obtain accurate and simple calibration models, one can be used mathematical pretreatments to minimize unwanted spectral contributions in determining the quality of the samples.

These appealing features of the Vis/NIR technique have been fostered its use in a variety of fields including the meat, fruits and vegetables, grain and grain products, dairy products, oils, fish and fish products industries (Huang et al. 2008).

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Nanfeng mandarin is popular for its high internal and external qualities with respect to sweetness, vitamin C, color, shape. But the quality is different to different varieties, and Vis/NIR has been applied to discrimination varieties, such as Chinese bayberry (Li et al. 2007), fruit vinegars (Liu et al. 2008), finishing oil (Blanco et al. 2002), tea (Chen et al. 2006) and transgenic tomatoes (Xie et al. 2007), which are important to quality control and customer choice.

The objectives of this work are to evaluate the use of Vis/NIR in discriminating the varieties of Nanfeng mandarin fruit including Daguoxi, Xiaoguoxi, Guihuadixi and Zaoshuxi, and the methods of principal component analysis (PCA), supervised independent modeling of class analogy (SIMCA) and principal component analysis-back propagation neural network (PCA-BPNN) are attempt to discriminate varieties accurately.

2 Materials and Methods

2.1 Nanfeng Mandarin Fruit

A total 320 Nanfeng mandarin samples were harvested from a local orchard in Jiangxi province. There were four varieties of Daguoxi, Xiaoguoxi, Guihuadixi and Zaoshuxi. The varieties of Daguoxi, Xiaoguoxi and Guihuadixi are cultivated in Nanfeng, Jiangxi. Zaoshuxi is cultivated in Xunwu, Jiangxi. By comparison, Daguoxi is heavier than other varieties, fruit index of Xiaoguoxi is different from others, and the maturity of Zaoshuxi is earlier. Guihuadixi is a variety mutated from Xiaoguoxi. The Statistics of physical and chemical properties of four varieties are listed in Table 1. Base on these features, it is possible to discriminate the four varieties using destructive

Table 1. Statistics of physics and chemical properties of four varieties of Nanfeng mandarins

Varities	Producing Area	Number	Physics properties								
			Weight(g)			Fruit Index			Color(ΔE)		
			Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.
Daguoxi	Nanfeng, Jiangxi	80	45.08	64.26	30.39	0.68	0.76	0.58	78.69	80.97	72.00
Xiguoxi	Nanfeng, Jiangxi	80	23.16	33.47	15.68	1.17	1.51	0.81	78.09	81.05	74.52
Guihuadixi	Nanfeng, Jiangxi	80	27.35	38.23	20.77	0.70	0.78	0.60	78.70	80.63	69.01
Zaoshuxi	Xunwu, Jiangxi	80	23.59	32.90	17.16	0.68	0.75	0.59	76.54	78.87	74.27
Varities	Producing Area	Number	Chemical properties								
			Souble Solid Content (^{O}Brix)			Titration Acidity (%)			Vitamin C (mg/100g)		
			Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.
Daguoxi	Nanfeng, Jiangxi	80	13.28	17.00	9.60	0.42	0.74	0.22	13.05	28.29	4.09
Xiguoxi	Nanfeng, Jiangxi	80	14.46	19.90	11.80	0.56	0.68	0.31	18.00	25.42	7.53
Guihuadixi	Nanfeng, Jiangxi	80	13.59	15.20	10.40	0.50	0.68	0.32	17.91	26.01	10.30
Zaoshuxi	Xunwu, Jiangxi	80	18.00	19.80	15.60	0.51	0.64	0.39	15.39	22.78	11.94

Fruit Index is defined as the ratio between horizontal and vertical diameter of fruit.

$\Delta E = \sqrt{(L^2 + a^2 + b^2)}$ (CIE Lab 1976) method, and NIRS is a rapid, accurate and stable tool to discriminate varieties nondestructively. Then 240 samples were selected to establish or train models including 60 samples of every variety, and others were for prediction.

They were placed in airtight polyethylene bags and stored in an ice filled refrigerator to keep at cold temperature (4±1℃). All fruit samples were allowed to equilibrate to room temperature (20℃) before NIRS measurement.

2.2 System Set Up and Transmission Measurements

The system was consisted of a tungsten halogen lamp (24V/50W), CCD spectrometer (USB4000), an optical fiber (SMA905), USB data line and PC. The CCD spectrometer was 3648 pixel photodiode array. The wavelength range of the spectrometer was 400-1040nm with a 0.2nm sampling interval. The angle was about 30º between the lamp axis and the vertical line. The horizontal distance was about 150mm between the center of lamp and fruit hold.

Vis/NIR spectra were collected and transformed by OOIBase32 software (Ocean-optics INC., USA), from three positions marked with a circle beforehand on each mandarin around equatorial position. The data was analyzed by 'Unscrambler v9.5' software (CAMO AS, Trondheim, Norway) and Matlab 7.0 software (Mathworks, Natick, USA).

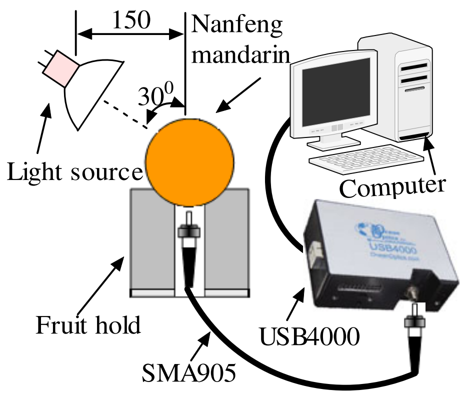

Fig. 1. The schematic of Nanfeng mandarin NIRS acquisition device

3 Results and Discussion

3.1 PCA Classification

PCA was performed to examine qualitative differences between the four kinds of Nanfeng mandarins by the raw spectra of 600-1040nm. Fig. 2 shows the three dimensional (3D) principal component score plot using first three score vectors, PC1, PC2, PC3 derived from raw spectra of samples. The initial three factors, which account for the most spectral variations 98% (77%, 19%, 2% for the first three principal components, PC1, PC2, PC3, respectively) related to the characteristic and indicated as positive or negative, are used to make differentiation clearer. From this figure, we can find that the samples are divided into two groups. One group is Xiaoguixi Nanfeng mandarin, others are Daguoxi, Guihuadixi and Zaoshuxi Nanfeng mandarins which overlapped each other. It can be assumed that the samples can be differentiated by using PCA in term of varieties. PCA gives very important information about the basic data structure regarding a potential capability of separation of objects. The result suggests that four varieties could not be separated clearly by PCA method. So SIMCA and PCA-BPNN were attempted to improve separation.

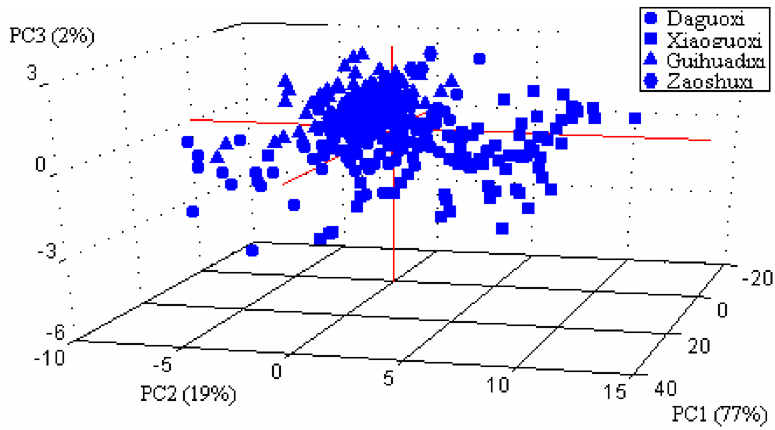

Fig. 2. Three dimensional score plot of the first three principal components for four varieties of Nanfeng mandarins

3.2 SIMCA Classification

When building SIMCA model, the four classification models are built by PCA analysis, respectively, including Daguoxi, Xiaoguoxi, Guihuadixi and Zaoshuxi Nanfeng mandarins. The samples of test set was selected randomly, the assignment of the samples can be seen for Table 2. The appropriate number of principal component factors would be concerned in building SIMCA model. In our study the number of PCs is selected by root mean square error of cross validation, and the appropriate number of PCs is 3 for four varieties, respectively (Fig. 3). At 99% confidence level, the best results of identification are achieved, that Zaoshuixi and Guihuadixi could not be discriminated well, So PCA-BPNN method is applied to improved separation.

Table 2. The results of classification by SIMCA

varieties	Sample numbers	PCs	The identification rate in test set			
			Daguoxi	Xiaoguoxi	Guihuadixi	Zaoshuxi
Daguoxi	20	3	18(90%)	0	0	0
Xiaoguoxi	20	3	0	15(75%)	0	0
Guihuadixi	20	3	0	0	19(95%)	0
Zaoshuxi	20	3	0	0	6(30%)	20(100%)

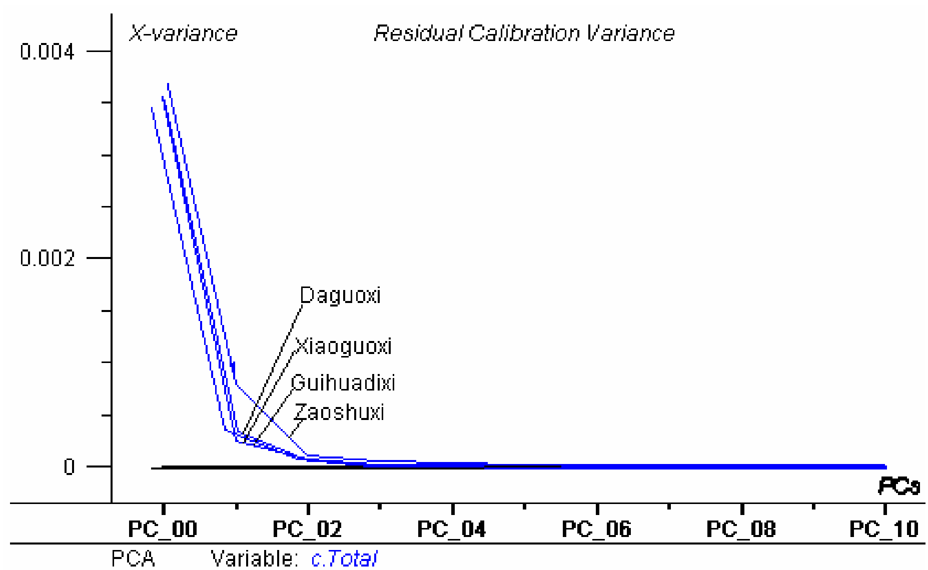

Fig. 3. The relationship between RMSECV and principal in model

3.3 PCA-BP Classification

As show in Table 3, the first seven PCs are considered to explain the original variables. And these variables are not interacting from each other. The first seven PCs, which can explain the 99.881% of variables, were selected as the input vectors to build the PCA-BPNN model. The output vectors of these samples were assumed to be 1, 2, 3 and 4. And 1 was denoted as Daguoxi mandarin, 2 was denoted as Xiaoguoxi mandarin, 3 was denoted as Guihuadixi mandarin and 4 was denoted as Zaoshuxi mandarin. Adjusting by many times, the optimal nodes of the hidden layer of neural network came up to 9. Therefore the seven PCs as the input neurons were connected with 9 hidden neurons randomly; the node of output neuron layer was defined as a vector of [1, 2, 3, 4]. The transfer function of hidden layer was tansig function. The transfer function of output layer was purelin function. The train function was trainlm, the threshold value was 0.08. The whole samples were separated randomly into train and test set (240:80) randomly.

Table 3. The statistics of PCs and accumulative reliabilities

PC	PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8	PC9	PC10
Ar(%)	77.585	95.468	98.078	99.670	99.796	99.845	99.881	99.896	99.906	99.915

PC: Principal component; Ar: Accumulative reliabilities.

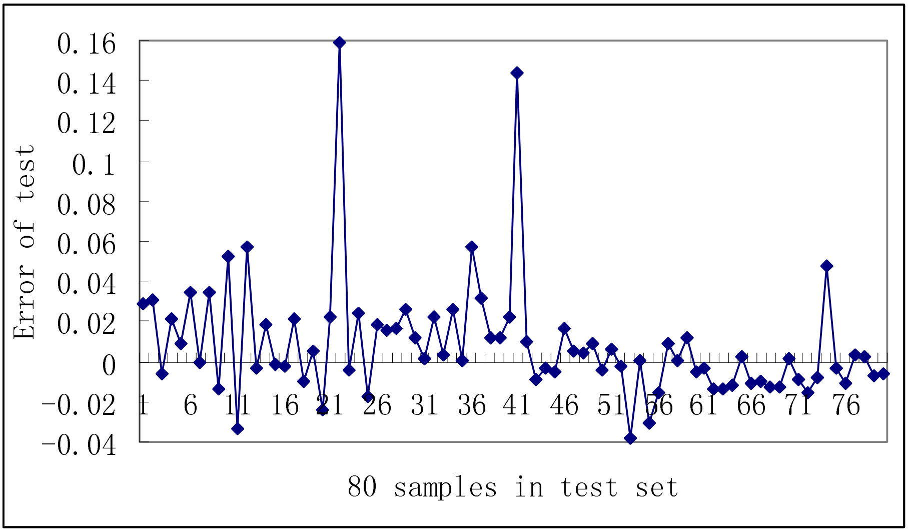

Fig. 4. Error of the model in the test set

Fig. 4 is the plots of the prediction errors of the 80 samples in the test set. The abscissa represents the 80 samples in order. The ordinate represents the error between the test output vectors and standard vectors of these samples. It can be found that the error of almost all samples was be close to zero, expect the NO.7, 15, 35 and 54 samples. The error of the No. 7, 15, 35 and 54 were -0.00017, -0.00118, 0.000126 and 0.000844 respectively. The threshold value was 0.06, so two samples was classified inaccuracy. The total recognition rate is 97.5% for the test set.

4 Conclusions

The contribution of this work is to present a rapid and non-destructive approach for discriminating different varieties of Nanfeng mandarin. In this research, quantitative analysis for varieties of Nanfeng mandarin fruit was carried out. By means of PCA, SIMCA and PCA-BPNN techniques, a relation was established between transmission spectra and varieties of Nanfeng mandarin fruit. The PCA-BPNN shows a better data prediction performance. And the recognition rate of 97.5% achieved. It is proved to be appropriate and successful for species discrimination. This study lays a foundation for further research to develop a portable apparatus in discriminating the different species.

Acknowledgement

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Purity Identification of Maize Seed Based on Color Characteristics

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Abstract. In order to identify miscellaneous seed from maize seed accurately and rapidly, maize seed purity identification method based on color extracted from the images of both the maize crown and the maize side was proposed for improving maize seed purity. Firstly, segmentation and single extraction were carried on the original image; secondly, the color models RGB and HSV were used to extract multidimensional eigenvectors from the maize crown and the maize side; finally, multidimensional eigenvectors were projected into one-dimensional space through applying Fisher discriminant theory and K-means algorithm was carried on the new color space. The experimental results show that K-means algorithm based on one-dimensional space received through Fisher discriminant theory can effectively identify maize seed purity, and the recognition rate was over 93.75%.

Keywords: maize seed, purity identification, color features, Fisher discriminant theory, K-means algorithm.

1 Introduction

Maize seed purity is one of the fundamental questions affect maize yield. It is estimated that the yield per hectare will decrease about 135 kg if the maize hybrid seed purity drop 1% (Li Liu et al.,2000).At present, there are many methods to identify the maize seed purity, such as the morphology method, seedling morphology, field planting and electrophoresis analysis, etc. These methods require appraiser must have professional quality and the cycle is too long, so they cannot be applied to maize seed circulation field better. The main factors which influence the maize seeds purity are the hybrids from female parent self-cross, impure hybrid seeds and other maize varieties, etc. (in this article, all these impure seeds are all called miscellaneous seeds). Among which the hybrids from female parent self-cross have the largest proportion and their harm is the biggest, so they not only increase the difficulty for field management, prevention and treatment of disease, but also they seriously affect the yield and the quality of maize seeds (ZhongJun Zhang et al., 1997). The impure hybrid seeds and other maize varieties are more easily identified, but the hybrids from female

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parent self-cross are impossible to be identified by the naked eye due to their color and morphological features are almost the same as normal hybrid seeds.

Image processing technology, to a certain extent, has overcome the above defects; the applications of computer image processing in the fields of maize seed purity test effectively improve the technical level of the seed purity identification. From the 1980s, the researchers at home and abroad used image processing technology to study maize morphology (Tao Song et al.,1996; Liao K et al.,1992; Ni- B et al.,1997; Zhixing Shi et al.,2008), crack(Wenxue Zhu et al.,1998; Junxiong Zhang et al., 2007; L1ao K et al., 1993) and color(Liu J et al.,2000; Xiao Chen et al.,2010), and these methods are mostly dominated by morphology, supplied by color, so far, there are no reports about identifying maize purity only with color characteristics. According to the situations, this paper puts forward a method with color space HSV (Hue/Saturation/Value) and RGB (Red/Green/Blue) as multidimensional eigenvectors which were projected into one-dimensional space through Fisher discriminant theory, and K-means algorithm was used to identify maize seed purity.

2 Feature Extraction

2.1 Machine Vision System

The main body of the paper contains image acquisition system and the image processing system. Image acquisition system is composed of CCD camera, light, shelf and computer, etc. they are shown in figure 1. Image processing system included two parts: image preprocessing, feature analysis and classification.

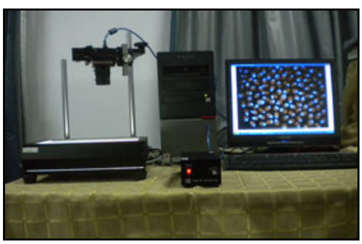


Fig. 1. Machine vision system

Take normal hybrid seeds 100 and miscellaneous seeds 100 from each species to do the experiment. Figure 2 shows original image of the jundan20 normal hybrid seed.

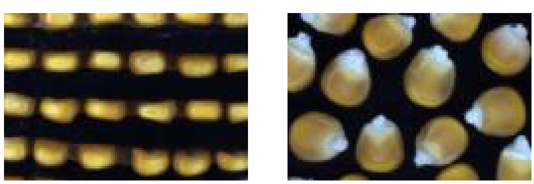
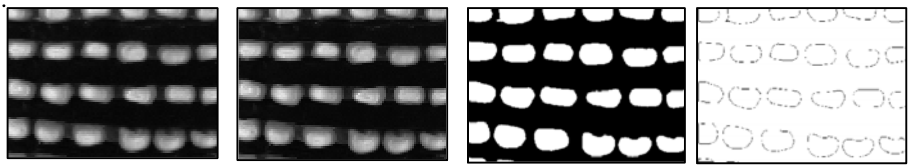


Fig. 2. Original image

2.2 Image Preprocessing

Firstly, 24-bit BMP images were changed into 256 BMP gray image, median filters was used to complete the image enhancement; then the R plane was used for segmentation. Any pixel with $R>55$ was considered as a pixel representing a corn kernel, otherwise, it was considered as a background pixel. Finally, contour labeling was used to extract each seed and display with a color image. Take crown image of Jundan 20 normal hybrid seed as examples, preprocessing results are shown in figure 3.



(a) (b) (c) (d)

Fig. 3. Preprocessing results image: (a) Gray image. (b) Enhanced image. (c) Background segmentation image. (d) Contour labeled image.

The extracted maize crown and no-germ side of the single seed are shown in figure 4.

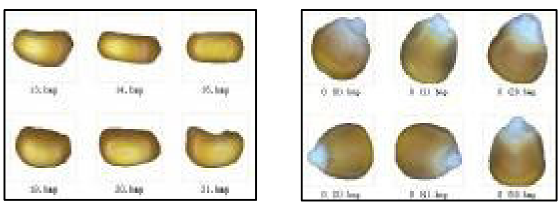
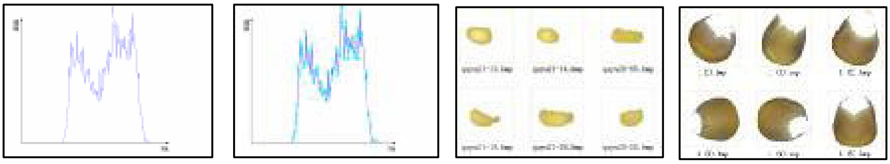


Fig. 4. Image of single seed

2.3 Region Extraction

Crown center region extraction was completed with regional growing based on gray distribution striving corner detection. Firstly, grayscale histogram and the corresponding gray gradient image were obtained from each seed; secondly, each strong corner on the map gray gradient image was marked and its gray value T_i (i=0, 1, 2, 3…n) was calculated; then the common values T_i strong corner which the 60% seeds contains were found out; finally, the strong corner values were sorted from big to small, T_0 andT_1 as optimal threshold for regional growing to segment maize crown into three parts. Namely the region where its threshold was greater than T_0 was the crown center region. The color crown center region can be obtained through comparison of the gray image coordinates and color image coordinates.

The B plane was used to delete white areas of maize seeds, any pixel with $B<T$ was considered as a pixel representing yellow region. Otherwise, it was considered as white region. Take jundan20 as examples, gray gradient image, inflexion image, center region image and lateral yellow region are shown in figure 5.



(a) (b) (c) (d)

Fig. 5. Corner detection and region extraction image: (a) Gradient image. (b) Corner detection image. (c) Crown center region image. (d) Lateral yellow region image.

2.4 Color Feature Extraction

In this paper, *H, S, V, B, G, R* plane as the color feature were extracted. RGB space is easy for hardware and HSV space is the most suitable for people's vision mechanism. Each plane represented mean of the color features. Due to the range of the *S* is 0～1, which is not able to reflect the change rule, it will be enlarged 100 times in the figure.

3 Characteristics Analysis and Identification

The space HSV is evolved by the space RGB, which bring about overlap between H, S, V and B, G, R, and each component make contributions to final result of the classification, so if simply to use these color components to classify, it will be difficult to achieve good results. But if the multidimensional color components can be unified one-dimensional space to form a straight line and this line which can integrate each contribution of the components makes each component effect to the maximum; the recognition rate will certainly increase. The flowchart of the characteristics analysis and identification of maize seed is shown in figure 6.

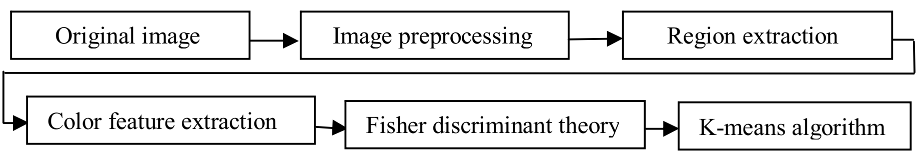


Fig. 6. Flow chart of maize seed feature analysis and identification

3.1 One-dimensional Function Establishment

According to the above analysis, discriminant function based on Fisher discrimination theory is the line which is required. The basic thought of Fisher discriminant analysis theory is projection. High-dimensional data points are projection to the low-dimensional space, so the data points become more intensive, which can overcome the "dimension curse" arising from the high dimension(Richard A.,et al.,2002). Discriminant analysis theory can not only classify something, but also can analyze the force magnitude of specific results affected by various factors.

The purity identification in this paper is two types of questions. M dimension characteristic vector was extraction from each class. The general expression straight line is given below

$$y=\sum_{q=1}^{m}c_q x_q + c_0 \text{, (q=1, 2... m; m=1, 2... 6)} \tag{1}$$

Where x_q is color vectors, c_q is coefficient and c_0 is constant. The function $y=\sum_{q=1}^{m}c_q x_q$ is the discriminant which is obtained through Fisher discriminant theory.

In order to get center of mass $\bar{y}_1$ and $\bar{y}_2$, all the sample observations are taken to discriminant formula.

$$\bar{y}_1=\sum_{q=1}^{m}c_q \bar{X}_{1q}, \quad \bar{y}_2=\sum_{q=1}^{m}c_q \bar{X}_{2q} \tag{2}$$

Where $\bar{X}_{1q}$,$\bar{X}_{2q}$ are the mean of the classification, $\bar{X}_{kq}=\frac{1}{n_k}\sum_{i=1}^{n_k}x_i$; $(k=1,2)$, n_k is a one-dimensional feature vector contained the number of data. In order to separate two samples as soon as possible, characteristic analysis function y is established, and the key of the function is how to find a correct projection direction in which the maize seeds are separated best to get a group of appropriate coefficient $c_1, c_2, ..., c_q$ that could project multidimensional space vector *H, S, V, B, G, R* into a one-dimensional space, and in this direction the maize seeds are separated best. This is the key to solve characteristic analysis function. In order to obtain this correct projection direction, it must make sure that $D=\bar{y}_1-\bar{y}_2$ which is the difference between classes is the maximum and $V_k=\frac{1}{n_k}\sum_{i=1}^{n_k}\left(y_{ki}-\bar{y}_k\right)^2$ which is the difference in class is the minimum.

According to the Fisher criteria, the constructor $F=\frac{D}{V_1+V_2}$ must reach maximum. The points that make F obtain maximum are the solutions of the equations set which its first-order partial derivatives equal to zero based on the multivariate function for extremum principle and method. Therefore, the following equations can be exported:

$$\begin{cases} s_{11}c_1+s_{12}c_2+...+s_{1m}c_m=d_1 \\ s_{21}c_1+s_{22}c_2+...+s_{2m}c_m=d_2 \\ \dots\dots\dots\dots\dots\dots\dots\dots \\ s_{m1}c_1+s_{m2}c_2+...+s_{mm}c_m=d_m \end{cases} \tag{3}$$

$$d_q = \beta t_q, t_m = \bar{X}_{1q} - \bar{X}_{2q}, \quad (q=1, 2\ldots m) \tag{4}$$

$$s_{qj} = \sum_{i=1}^{n_1} \left(x_{in}^{(1)} - \bar{X}_q^{(1)}\right)\left(x_{ij}^{(1)} - \bar{X}_j^{(1)}\right) + \left(x_{in}^{(2)} - \bar{X}_q^{(2)}\right)\left(x_{ij}^{(2)} - \bar{X}_j^{(2)}\right), \ (q, j=1, 2, \ldots, m) \tag{5}$$

Where $\beta = \frac{1}{F}\sum_{q=1}^{m} c_q t_q$ is constant, which magnifies the solution of equations set β times. Coefficient values can be solved through the equations set. Take β =1 in actual application.

The following are characteristic analysis functions obtained by the Fisher discriminant theory:

$$y_1 = -0.062H + 0.326S + 0.054V + 0.226B - 0.197G + 0.097R - 17.439$$
$$y_2 = 0.052H + 0.71S - 0.139V + 0.06B - 0.15G + 0.164R + 3.803$$
$$y_3 = -0.012H + 1.092S - 1.365V + 1.093B + 0.508G - 27.295$$
$$y_4 = -0.104H + 0.314S - 1.166V + 0.618B + 0.598G + 6.828$$

Where y1, y2, y3 and y4 respectively represent the characteristic analysis functions of nongda108, ludan981, zhengdan958 and jundan20.

In order to prove that the characteristic analysis function obtained through Fisher discriminant is effective, take zhengdan958 as an example: normal hybrid seeds 87 and miscellaneous seeds 16. The color image without Fisher discriminant projection (Fig. 7) almost can't see any difference; however, after projection, it is obviously divided into two sections (Fig. 8), which provide strong guarantee for the next step of corn seed purity identification.

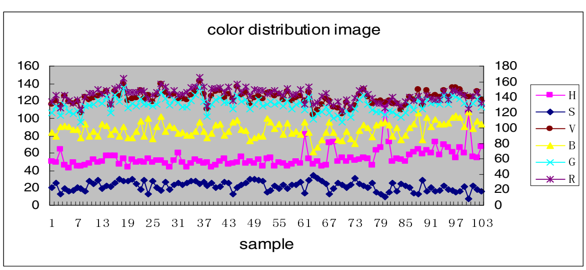


Fig. 7. Color distribution image before Fisher discriminant projection

3.2 K-means Clustering

Eigenvector represented by characteristic analysis functions was as the last classification feature. Due to multidimensional eigenvectors were projected into one-dimensional space through Fisher discriminant theory, then k-means algorithm which carried on clustering on the one-dimensional space is simple, intuitive and easy to implement; in addition, the k-means clustering algorithm has the following advantages: k-means algorithm which is a kind of unsupervised statistical method does not

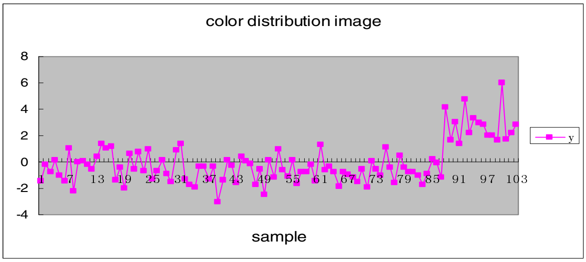


Fig. 8. Color distribution image after Fisher discriminant projection

need training sample, it makes sample clustering by executing iterative algorithm, its purpose is to make the objective function obtain the minimum. The key to use this method lies in: the data which was obtained through Fisher discriminant has obvious character of classification. The following is the objective function:

$$J = \sum_{j=1}^{k} \sum_{i=1}^{n} \left\| x - c_j^{(t)} \right\|^2 \tag{6}$$

Where $\left\| x - c_j^{(t)} \right\|$ is the distance between data points x and point cluster center $c_j^{(t)}$ .Specific steps are as follows:

- Take K = 2 initial center of mass C1, C_2.
- All the samples which were obtained in the iteration $t \geq 1$ with the similar assigned to the cluster. Methods: if $\left\| x - c_1^{(t)} \right\| \geq \left\| x - c_2^{(t)} \right\|$, $x \in G_2^{(t)}$, where $G_2^{(t)}$ are the samples by $c_2^{(t)}$ for clustering center; otherwise, $x \in G_1^{(t)}$, where $G_1^{(t)}$ are the samples by $c_1^{(t)}$ for clustering center.
- Update clustering center $c_1^{(t+1)}$、$c_2^{(t+1)}$ of the clustering $G_1^{(t)}$、$G_2^{(t)}$ obtained in step 2, which make $J = \sum_{j=1}^{k} \sum_{i=1}^{n} \left\| x - c_j^{(t+1)} \right\|^2$ (j=1, 2) get minimum value.
- For all the j = 1, 2, if x = y, iterative end; otherwise, t = t + 1, turn to step 2.

4 Results and Discussion

Some maize seeds (e.g. jundan20, nongda108, zhengdan958, ludan981) were used to verify the experimental method which was proposed in this paper, the results were shown in Table 1. It can be seen from Table1 that the recognition rate is over 93.75%and different varieties have different rate. The reason for the different rate lies in: firstly, the individual differences of corn seed itself is larger: such as the maize crown is full or depression and uneven distribution of color, etc; secondly, the height of the maize crown caused by artificial placing maize seeds is not uniform that causes the differences of the information extracted from the image; finally, clustering features selected in experiments is not perfect, they still need further research. All of these influence region extraction and characteristics analysis in different degree.

Table 1. K-means algorithm analysis

Samples	Actual seeds	Miscellaneous seeds	Recognition seeds	Recognition rate/%
Ludan981	100	36	34	94.4
Nongda108	100	32	32	100
Zhengdan958	100	35	34	97.14
Jundan20	100	32	30	93.75

In this paper, a quick and simple method for identify maize seed purity is proposed and the Conclusions obtained through experiments are as follows:

- The purity recognition rate of this method proposed in this paper based on multi-dimensional eigenvectors *H, S, V, R, G, B* which are projected into one-dimensional space through Fisher discriminant theory and then K-means algorithm is used to cluster analysis is over 93.75% for nongda108, ludan981, zhengdan958, jundan20.
- The crown center region extraction is completed with regional growing based on gray distribution striving corner detection, this method uses the first two strong corner values which the 60% seeds contains as optimal threshold of regional growing and the B plane is used to extract the yellow region. Results show that the areas extracted through the two methods can meet the identification requirements.
- The key of this method lies in how to choose the correct projection direction and the right maize crown center region. In order to verify the validity of this method, a large number of experiments are carried on the other varieties: such as liaoyu19, jinhai601, jinhai702, lainong3, etc., the experimental results are satisfactory.

Acknowledgments

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Reconstructing Vegetation Temperature Condition Index Based on the Savitzky–Golay Filter

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Abstract. Vegetation temperature condition index (VTCI) is a near-real-time drought monitoring approach which is derived from normalized difference vegetation index (NDVI) changes in a given region to land surface temperature (LST) changes of pixels with a given NDVI value. It can be physically explained as the ratio of temperature differences among the pixels which have the same NDVI values. Due to the noise in the NDVI and LST, results of VTCI have much deviation. The Savitzky–Golay filter, a weighted moving average filter as a polynomial of a certain degree, is applied to smooth out noise in NDVI and LST time-series. VTCI were taken into Guanzhong Plain of Shaanxi Province of each 10-days from March to May in 2007 and 2008 as the study data. In order to reconstruct VTCI space-time (temporal and spatial) series data, the Savitzky–Golay filter was used to reconstruct the VTCI time-series of each pixel in remote sensing images. Then, the results were extended to the surface from the point. The results show that the Savitzky–Golay filter could improve the quality of VTCI and could get a better drought monitoring result.

Keywords: Savitzky–Golay filter,VTCI, drought monitoring.

1 Introduction

Drought is a long-term, gradual change natural disaster and occurs slowly and complexly. Drought is always induced by water shortage. Drought causes the most yearly economic loss among all natural disasters in China. Thus, drought monitoring plays a very important role in understanding the level and distribution range of drought, which could help in putting forward the measurements against drought in time.

Remote sensing technology could monitor a wild range surface using information of spectroscopy, time, space and direction in objects' surface. On the basis of the multi-spectral characteristics of image, the high spatial resolution and the periodicity of remote sensing information, the research of vegetation and ground coverage become more extensive and more intensive as compared with before. Currently the drought monitoring models are established by vegetation index.

Based on the regional distribution of the scatter diagram of remotely retrieved normalized difference vegetation index (NDVI) and land surface temperature (LST) present like triangular, vegetation temperature condition index (VTCI) is developed for

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monitoring drought occurrence at a regional scale by Wang Pengxin [1]. VTCI is applied in the drought monitoring of Guanzhong Plain of Shaanxi Province and the excellent result has been obtained.

However, residual noise in the NOAA—AVHRR remote sensing image will be remained into the computation of VTCI, though strict pre-processing is applied. The further analysis will impeded and un-correct results might be generated. In this model, the 10-days Maximum Value Composite (MVC) products is used, however, there is much noise in the data sets used in computing VTCI, which may affect the further analysis. Before taking the data to the research, the noise in the data needs to be smoothed out. Lu Linlin used Savitzky–Golay filter to reconstruct NDVI time-series in analyzing the extraction method of winter wheat phonology [2], and it smoothed out noise in the data and loosed less information in the original data.

The phonology information, gotten from NDVI fitted by Savitzky–Golay filter, was more similar with the realistic phonology. The 10-days maximum value composite (MVC) SPOT-VEGETATION dataset was used as main remotely sensed data from 1999 to 2005 in Gu's research [3]. The Savizky-Golay filter, which could improve the representation of the growth curve of winter wheat growth by NDVI time-series curve, was used to eliminate the noise. Gong Pan used the Savizky-Golay filter to smooth the 10-days compositing data and the results indicate that the time-series data has better correlational relationship with the vegetation growth [4].

This study was intended to introduce the Savizky-Golay filter into VTCI data. The objectives were: To smooth out noise before computing VTCI and to reconstruct NDVI and LST time-series with Savitzky–Golay filter. Thus, more accurate results of drought monitoring could be obtained.

2 Methodology

2.1 Study Area and Data

For this study, proper research region is needed. The region with large range of vegetation coverage and soil surface water content from wilting water content to field capacity are needed for drought monitoring with VTCI. Thus, Guanzhong Plain is selected for the study (Fig.1). Guanzhong Plain is located in the center of Shaanxi province and between Qinling Mountains and Shanbei Plateau. Guanzhong Plain is a graben structural plain, flat and fertile, and is one of the most important wheat and cotton growth areas.

NOAA—AVHRR images day transited from March to May in 2007 and 2008 were choosed. Firstly, geometric correction was done in two steps: (1) revising the distortion of pixels; (2) using a traditional geometric correction method —polynomial correction method. The size of the pixel of AVHRR image after resembling with bilinear interpolation is 1.1 km×1.1 km. The projection method is Lambert equal area projection. By using AVHRR data through atmospheric correction, radiometric correction and calibration, we can transform data of band 1 and band 2 into the surface reflectivity and data of band 3, 4 and 5 into the surface radiance. Then we can calculate the brightness temperature of band 3, 4 and 5 by center wavelength technology. Lastly, NDVI and LST can be calculated severally.

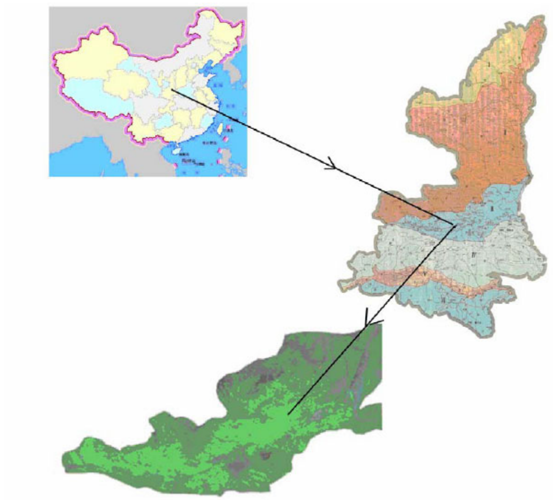


Fig. 1. The study area

2.2 Vegetation Temperature Condition Index

Wang Pengxin proposed the concept of vegetation temperature condition index (VTCI) for monitoring drought [5]. The index can be used to monitor drought occurrence at a regional level for a special period (e.g. 10 days) of a year, and to capture spatial variatious of drought occurrence within the region. The new drought monitoring index is not only related to NDVI changes in a region, but also give emphasis on land surface temperature changes of pixels which have the same NDVI value. The index can be defined as [1]:

$$VTCI = \frac{LST_{NDVI_i \cdot \max} - LST_{NDVI_i}}{LST_{NDVI_i \cdot \max} - LST_{NDVI_i \cdot \min}} \tag{1}$$

There into,

$$\begin{aligned} LST_{NDVI_i \cdot \max} &= a + b \cdot NDVI_i \\ LST_{NDVI_i \cdot \min} &= a' + b' \cdot NDVI_i \end{aligned} \tag{2}$$

In the formula, $LST_{NDVI_i \cdot \max}$, $LST_{NDVI_i \cdot \min}$ are maximum and minimum of land surface temperature when $NDVI_i$ is equal to a particular value; LST_{NDVIi} is land surface temperature of a pixel when the value of NDVI is $NDVI_i$; a, b, a', b' are undetermined coefficients. In this research, we can get the coefficients approximately in formula (2) in the scatter diagram of NDVI and LST of the study area.

The value of VTCI is from 0 to 1.The lower value of VTCI, the heavier the drought occurrence is. The index is site-specific and time-specific.

2.3 The Savitzky–Golay Filter

The Savitzky–Golay filter, called SG filter for short, is a simplified least-squares-fit convolution for smoothing and computing derivatives of a set of consecutive values, proposed by Savitzky and Golay in 1964 [8]. It can be understood as a weighted moving average filter with weighting given as a polynomial of a certain degree. This polynomial is designed to preserve higher moments within the data and to reduce the bias introduced by the filter. This filter can be applied to any consecutive data when the points of the data are at a fixed and uniform interval along the chosen abscissa, specially the time-series data. The general equation of the simplified least-squares convolution for time-series data smoothing can be given as follows[9]:

$$Y_i^* = \sum_{j=-m}^{j=m} C_j Y_{j+i} \tag{3}$$

where Y is the original time-series data value, Y* is the resultant time-series data value, C_i is the coefficient for the ith time-series data value of the filter (smoothing window).The index i is the running index of the original ordinate data table. The smoothing array (filter size) consists of 2m+1 points, where m is the half-width of the smoothing window.

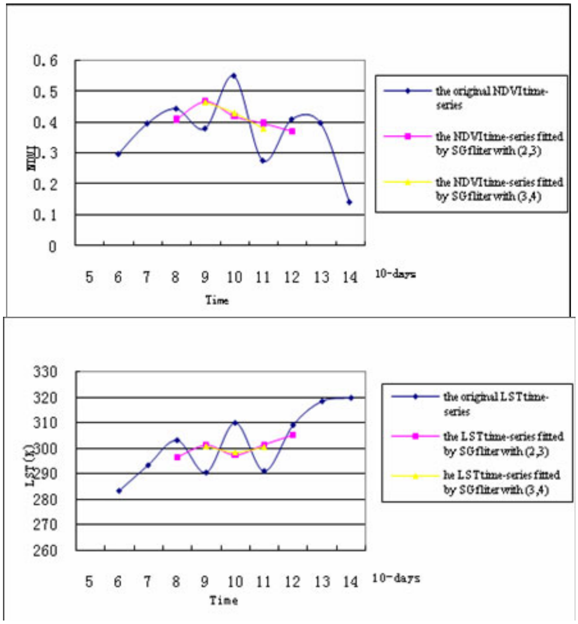
There are two parameters that must be determined according to the time-series data observations, when the filter is applied. The first parameter is m, the half-width of the smoothing window. Usually, a larger value of m produces a smoother result at the expense of flattening sharp peaks. The second parameter is d, the degree of the smoothing polynomial. A smaller value of d will produce a smoother result but may introduce bias. And a higher value of d will reduce the filter bias, but may over fit the data and give a noisier result.

3 Experimental Results

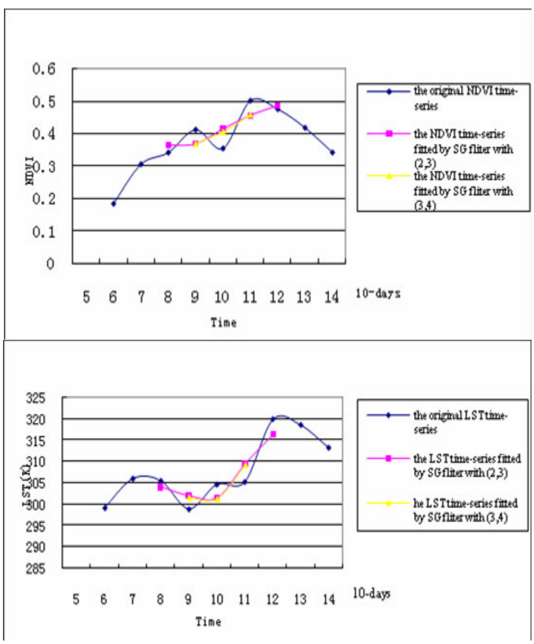
3.1 Reconstruct Time-Series

Select a pixel in Xi'an, whose geographic coordinate is (108°56′E,34°18′N). The parameters are set to (2, 3) and (3, 4). Fig.2 shows the change of the NDVI and LST time-series fitted by the Savitzky–Golay filter with different parameters in contrast. Obviously, the flitted time-series could pass through the original time-series and remove the low value in the original time-series. A certain extent, the Savitzky–Golay filter plays a role in eliminating noise.

From the comparison, it shows that the results of two different parameters are very close, the difference is not significant. The result got from parameters (2, 3) is little larger than the result got from parameters (3, 4). However, noise usually depress time-series value. The top value may keep more realistic information. Sun Wei et al. monitored drought of Guanzhong Plain in each early ten days of May in recent five years and the result show that VTCI is close to the amount of precipitation in recent 20



a. Comparison of time-series before and after fitting by the Savitzky–Golay filter with different parameters from March to May in 2007



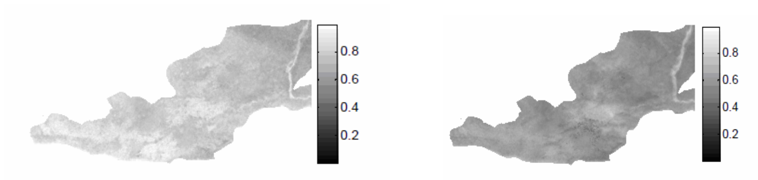
b. Comparison of time-series before and after fitting by the Savitzky–Golay filter with different parameters from March to May in 2008

Fig. 2. The change of time-series before and after fitting by the Savitzky–Golay filter with different parameters

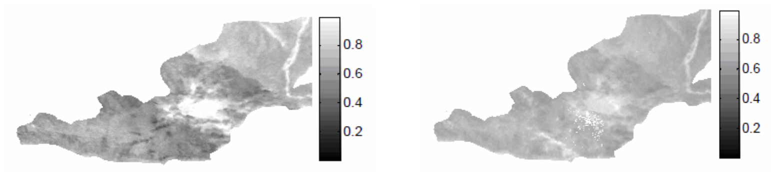
days[6], indicating that the VTCI is a near-real time drought monitoring approach. When there is little difference in the results of two parameters, when m is set as 2, more data could be gotten. Considering that, when fit the NDVI and LST time-series by the Savitzky–Golay filter, the parameters set as (2, 3) in the study.

3.2 VTCI Image

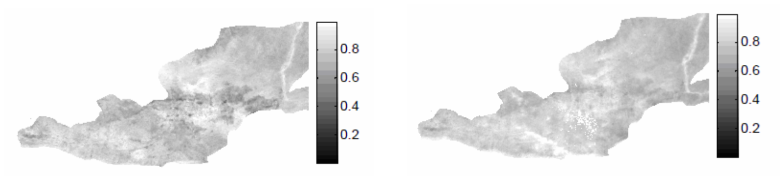
Based on formula (1), when VTCI is computed with NDVI and LST is fitted by the Savitzky–Golay filter, images were generated. Comparative results are in fig. 3 and fig. 4.



a. the original VTCI image and the fitted image in the early ten days of April,2007



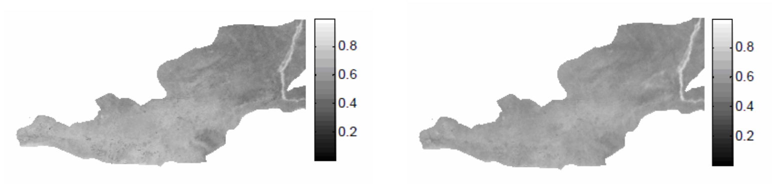
b. the original VTCI image and the fitted image in the middle ten days of April,2007



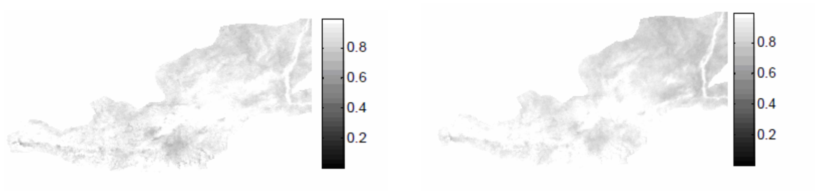
c. the original VTCI image and the fitted image in the early ten days of May,2007

Fig. 3. Comparison of VTCI images in 2007 on the base of the agricultural weather data of Shaanxi Meteorology

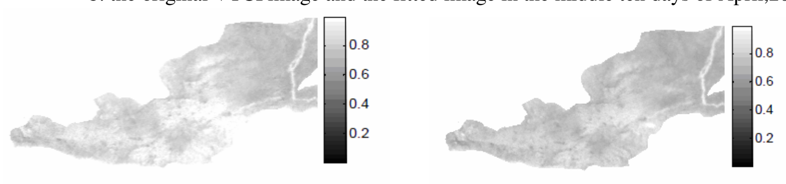
By the data from the agricultural meteorological station of Shaanxi Meteorology Bureau, from the last ten days of March to the middle ten days of May in 2007, most areas of Shaanxi province showed higher temperatures. Compared with the average year, the amount of precipitation decreased about 20% to 70%. The entropy in soil loosed fast and the development of drought is continuous. The drought area of Guanzhong Plain extended from east to west gradually. The study area had precipitation in the early ten days of April, though it was not enough for releasing drought, it helped in increasing the water content of the soil surface. Fig. 3 shows that VTCI images fitted by the Savitzky–Golay filter could get a better monitoring result.



a. the original VTCI image and the fitted image in the early ten days of April,2008



b. the original VTCI image and the fitted image in the middle ten days of April,2008



c. the original VTCI image and the fitted image in the last ten days of April,2008

Fig. 4. Comparison of VTCI images in 2008

From March to May in 2008, the average temperature of Guanzhong Plain was a little higher than average year. The total rainfall amount of the midwest of Guanzhong Plain was 50--100mm, less than average year[12]. Guanzhong Plain has irrigation conditions that could help in releasing drought. VTCI images fitted by the Savitzky–Golay filter could get a better monitoring result (fig. 4). There was a larger process of precipitation in the middle of April, which increased the water content of the land. So, the value of VTCI of monitoring results increased.

Guanzhong Pain has higher probability of spring drought and summer drought. And the drought in the east is worse than in the west. Based on this trend, the VTCI images fitted by Savitzky-Golay filter could reflect this better.

The noise usually depresses the value. The Savitzky-Golay filter could smooth out the noise more or less and remove the low value. The VTCI images fitted by the Savitzky-Golay filter are more close to the truth.

4 Conclusion

The Savitzky–Golay filter is a simplified least-squares-fit convolution and a weighted moving average filter. The time-series data fitted by the Savitzky–Golay filter can smooth out noise in time-series, specifically that caused primarily by cloud contamination and atmospheric variability. The experiment with NOAA images from March to May in 2007 and 2008, indicate that the VTCI calculated with the NDVI and the LST time-series fitted by the Savitzky–Golay filter, can improve the quality of VTCI and get a better drought monitoring result.

Selection of parameters is extremely important when use the Savitzky-Golay filter to reconstruct NDVI time-series. That affects the accuracy of the results directly. Selection of parameters in this study was determined by the study data and taken into the actual situation on the ground. Subject to the limitations of the data, we just use the Savitzky-Golay filter simply in the study. If there are the whole year VTCI data, higher accuracy VTCI data could be gotten in the fitting iteration process with the Savitzky-Golay filter.

VTCI is a real-time approach, and has a certain correlation with the soil water content. When there is a precipitation, even it's not enough to release the drought completely, but it increases the soil water content. The results obtained through remote sensing monitoring show no drought happen. That affects the accuracy of the results. It's worth to study how to reduce the influence. At the same time, it's a research direction that fills the missing data within the region through the Savitzky-Golay filter.

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Research and Implementation of Agricultural Science and Technology Consulting System Based on Ajax and Improved VSM

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Abstract. In order to overcome the disadvantages of inconvenience and low accuracy of keywords spitting search, and artificial answer delay for the online messages in the current agricultural consulting system, this paper proposes a solution which complement the advantages of automatic question answer with expert real-time answer. Firstly, vector space model was improved by semantic extension and feature item weight modification. And then, based on the agricultural technical information database and expert team, an agricultural science and technology consulting system was developed by the Ajax. To the simple natural language questions, the system answers it automatically through improved vector space model in automatic question and answer. To the complicated question, the agricultural experts gave answer immediately after chatting with inquirer on line in expert real-time answer. The experiment show that the system has features of accurate and rapid reply, professional answer and high satisfactions. It can better meets the need of agricultural production techniques.

Keywords: automatic question and answer, expert real-time answer, vector space model, Ajax.

1 Introduction

Agricultural sci-tech information service is important to spread agricultural technology, transform the achievements into actual productivity, and increase the income of farmers. The general agricultural consulting service system solves problems by keywords searching. It has shortcomings of needing farmer split keywords by themselves. It lacks a full understanding of the question, and always misses the correct answers for word machine-matching. It is also very difficult for farmer to identify the right answers from the large mount of results which were feedback by keywords searching. Besides, users also find help from artificial answer by leaving message. It is easy to use, and also can give a accurate answer for the

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complex question. But it requires the user to log on again to get the reply. Answer delay affects service effectiveness greatly.

To solve those problems, using improved vector space model (VSM) and Ajax, an agricultural consulting system was developed based on “automatic question answer complement with expert real-time answer”. The automatic question answer (automatic Q&A) based on improved VSM can understand natural language and provides enquirers with the most suitable answer. In expert real-time answer, the farmer can describe questions clearly by chatting with expert. then, the expert gives an accurate answer immediately after getting more background information from web conversation. It integrated the advantages of both to meet the needs of agricultural production technology instantly and effectively.

2 Materials and Methods

2.1 Technical Scheme

There are two major modules of automatic Q&A and expert real-time answer in this system. To the simple questions, it uses the former module answers automatically. To the complex question, it uses the latter module answers directly by web chatting. When the consultant is unsatisfied with the feedback results from automatic Q&A, they can seek help from expert real-time module. The system adopts a parallel strategy of two methods. Flow chart is as follows:

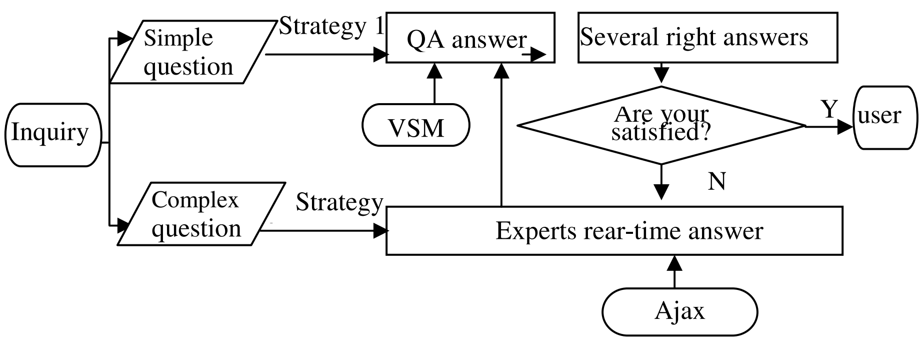

Fig. 1. System Scheme

2.2 Computational Model and Key Technologies

2.2.1 VSM Improvement

As a classic model in textual retrieval, VSM is mostly widely used in auto Q&A [1-2]. The similarity computation is the key to achieve automatic answer. However, VSM assumes that key words in the document are independent of each other with orthogonally hypothesis. Its assumption is difficult to satisfy in agricultural application. Big error was existed between computational results and the actual results. So, in this part, we consider the characteristics of agricultural application, and then, improve it to get better results.

Conventional VSM assumes that the meaning of a sentence and a document can be represented by a set of words used in them. The words sequence is represented by vector. Suppose the document is d, the query sentences are q, their vector and word weight computational formula are as follows:

$$d = \left(W_1^d, W_2^d, \ldots, W_i^d, \ldots W_n^d\right) \qquad q = \left(W_1^q, W_2^q, \ldots, W_i^q, \ldots W_n^q\right) \tag{1}$$

Wi =TF*IDF=（t/c）* log（N/ni）

Here, i (1<=i<=n) is the number of feature items which are used to represent the meanings of the sentences. In general, the key words in text are used to represent feature items. TF is the frequency of feature item t repeating in question. N is the total amount of documents in answer set, ni is the total amount of document which contain feature item t.

The similarity between q and d can be measured by computing cosine of their corresponding vector with the following normalization function:

$$\begin{aligned} sim\left(d_i\,,\ q_j\right) &= \frac{d_i \times q_j}{\left|d_i\right| \times \left|q_j\right|} \\ &= \frac{\sum_{i=1}^{t} W_{ij} * W_{iq}}{\sqrt{\sum_{i=1}^{t} W_{ij}^{\ 2} * \sqrt{\sum_{i=1}^{t} W_{iq}^{\ 2}}}} \end{aligned} \tag{2}$$

Some improved methods are as follows:

Semantic extension. Word matching is an important process in similarity computation. Sometimes, there are words of different form with the same meaning in agriculture. For example in Chinese, the “碳酸氢铵” is called “碳铵”, and also is written as “NH4HCO3”. If somebody wants to search the reasonable application methods of “碳铵”, the document about NH4NO3 and “碳酸氢铵” will not be retrieved for the different form. So, in this part, extend the feature item in the question to full understand user intent. The processing is as given below:

Question: 怎样施用碳铵?

Feature item extraction: {施用 ； 碳铵}

Semantic extension: {使用/施用；碳铵/碳酸氢铵/ NH4HCO3}

Weight modification in document. In conventional VSM, feature word weight was calculated by formula (1). Which often repeats in one document and rarely appears in answer set will get high weight [3] Professional words make big contribution to the subject in agriculture. However, according to this principle, some professional words which appear vary often both in single document and in answer sets will have low weight. To solve the problem, this study modifies the weight as follow:

$$MW=a*TFi*IDFi \tag{3}$$

Here, a is the weighting coefficient, it indicates the contribution degree to the subject. Test shows that, when professional word a=1.0 and general word a=0.7, the identification ability of correct answer is obvious.

Weight modification in question. Conventional VSM assumes that wherever the feature word is, they have the same contribution to the subject. Actually, the words in the heading are more relevant to the subject than in the body. So, a modification is given according to the distribution of query words as below:

$$MSim(d\ ,\ q)=\begin{cases}\lambda_1 sim(d\ ,\ q)T_i \in heading\\ \lambda_2 sim(d\ ,\ q)T_i \in (heading\ \ and\ body)\\ \lambda_3 sim(d\ ,\ q)T_i \in body\end{cases} \tag{4}$$

λ is weighting coefficient of words distribution. ti is the query word which is extracted from query sentence. Test shows that, when λ1=1.0, λ2=0.6, λ3=0.2, it has the best result.

Optimization of computational efficiency. Similarity computation is between high dimension feature vectors which are in sparse matrix. The amount of calculation is very large. To solve this problem, in the session of answer document pretreatment, it uses full-text index, and calculates the weight of feature words, generates feature vector in advance, to reduce the workload of foreground process. In the session of similarity computation, it selects answer documents which contain query feature words as candidate set to reduce the useless computation.

2.2.2 Ajax Application

Ajax is composed of multiple technologies such as XHTML, CSS, DOM, XSTL and JavaScript etc. It is a development patter which used to create interactive web application [4-5]. The main feature of Ajax is that the transmission, reading and writing data on the server don't need to refresh the page. It can significantly shorten the waiting time.

According to the statistics from literature [6], if the visitor doesn't get satisfied information, 90% of them will not choose E-mail to contact service staff, 70% of them will not repeat visit. So, it is extremely important of providing users with artificial answers immediately to enhance the service effect. However, in traditional web applications development, each time the user submits the instruction, web page must be refreshed. It leads to data loss and a long time waiting. Ajax is very suitable for the application of frequent interaction, reading and writing.

2.3 System Design and Implementation

2.3.1 System Architecture Design

It is a three-tier architecture which contains presentation layer, business logic layer and the data layer. Presentation layer provides users with interfaces which can enter into the tow main module. Using Ajax engine and Web/XML server, business logic layer extracts the technique information from database to the client. Data tier is mainly used to manage the agricultural technology information and expert information. Artificial answering team is composed of experienced experts who major in vegetable production, fruit processing, aquaculture, animal husbandry and veterinary.

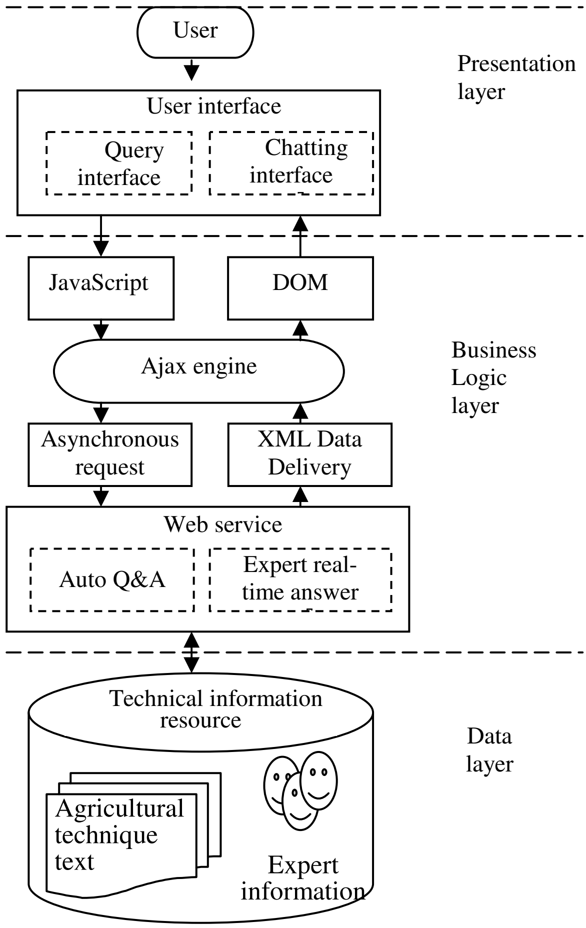

Fig. 2. System architecture

2.3.2 Automatic Question and Answer

The realization process is divided into the following five steps:

Step 1: Pretreatment of technique text. It intent to extraction feature vectors by words segmentation, stop words removing. And then, uses formula (3) to calculate the weight of feature item. All of this prepare for calculating with the query sentence.

Step 2: Query sentence understanding. It understands user natural language question by words segmentation, stop words removing and semantic extension. Duo to the same operation with the technical text pretreatment, the program use a public class file which was named as "CommonClass1.cs" to enhance the code reusability and improve the development efficiency.

Step 3: Selection of candidate answer set. By means of semantic extension, a query expression of query feature vector is constituted. Then, taking Boolean model as selection method, choose the document set which contain query word as candidate answer set.

For example in Chinese:

The query feature vector after semantic extension is:

{番茄/西红柿, 栽培/种植}

In feature word reverse index table, the IDs of documents which contain the feature item are:

番茄：{5,8,9,20}

西红柿：{25,27,30,102}

栽培：{8,30,45,130,150}

种植：{4,19,20}

According to the query expression-(番茄 ∪ 西红柿)∩(栽培∪种植)， the candidate answer set which can meet the requirement is {8, 20, 30}.

Step 4: Similarity computation. Within candidates answer set, similarity is calculated between query feature vector and candidate answer feature vector using formula (2). Then, according to the distribution of query words in the text, modify the weight using formula (4).

Step 5: Answer display. Order the value of similarity in decent, and gain the result set that the similarity value is greater than given threshold β. The candidate answer with the maximum similarity is showed directly. Other answers are listed to display. If there is no any answer, pop-up a message to inform the user to log on the expert real-time answer module to seek help.

The main code to calculate feature item weight is as follow:

```
   public string WordTFIDF(double N,string[] a)
     { … … // Variable definition
        … … // Database connection
   StringBuilder vector = new StringBuilder();
            word=a.Length;
            count=0;
            Hashtable Dealword = new Hashtable();
            for (int i = 0; i < a.Length; i++)
        { if (Dealword.Contains(a[i]))
                  continue;
             else
             {
              SqlCommand  com  =  new  SqlCommand("select
count(*) from aiarticle where contains(content ,'" + a[i]
+ "')", con);
             SqlDataReader dr = com.ExecuteReader();
                 dr.Read();
                 n = dr.GetInt32(0);
                 dr.Close();
                 for (int j = 0; j < a.Length; j++)
                     if (a[i] == a[j] && (i <= j))
                         count += 1;
                if (n == 0)
                n = 1;
 tfidf = (count / word) * System.Math.Log(N / n);/
```

```
                tfidf = System.Math.Round(tfidf, 5);
                count = 0;
                Dealword.Add(a[i], tfidf);
                vector.Append(a[i]);
                vector.Append('•');
                vector.Append(tfidf);
                vector.Append(' ');
            }
        }
             foreach (DictionaryEntry de in Dealword)
        {
            temp = Convert.ToDouble(de.Value);
            denominator += System.Math.Pow(temp,2);
         }
    denominator      =      System.Math.Sqrt(denominator);
vector.Append('+');
  vector.Append(System.Math.Round(denominator,5));
        return vector.ToString();
        con.Close();
    }
```

2.3.3 Expert Real-Time Answer

The database mainly involves consultant table, user information table, visitor state table and chatting table etc. The field "answer" in visitor state table is used to show if the chatting message was displayed. The program can avoid repeat display by judging the state of the field. Field "dialogued" in chatting table is used to distinguish different dialogue. It also can help the program to find a entire conversation published by one person immediately. Field "isConsultantReceiver" indicates that if the expert receives this message. According to this field, the client chatting box will only show the latest message which isn't accepted.

Embed Ajax engine in logic programs to monitor database changes regularly. When the farmer consults with expert, it triggers the event handle function which can save the two sides talk to data table 1 second interval, data monitoring program scans the table. If there are new messages, show it to the chatting box of client. Ajax hides the whole process of the update operation. It achieves "face to face"communication between farmers and experts with no awareness.

The key code to show the consultation content is as follow:

```
private void ShowMessage()

{… … // Connect the database

SqlDataAdapter da = new SqlDataAdapter("select * from
message where (sender='" + Session["user"].ToString() +
"' and receiver ='" + Session["expertname"].ToString()
+ "') OR ( sender='" + Session["expertname"].ToString() +
"' and receiver ='" + Session["user"].ToString() + "')
ORDER BY CreateDate ASC", con);

DataSet ds = new DataSet();
```

```
da.Fill(ds, "ChatMessage");
con.Close();
if (ds != null)
{
DataView dv = ds.Tables[0].DefaultView;
dv.RowFilter= string.Format("CreateDate>='{0}'", DateTime.Parse(ViewState["StartDate"].ToString()));
StringBuilder sbMessage = new StringBuilder();
foreach (DataRowView row in dv)
{
string singleMessage = row["sender"].ToString() + "说：" + row["createDate"] + "\n";
singleMessage+="  " + row["body"].ToString() + "\n";
sbMessage.Append(singleMessage);
}
this.tbChatMessage.Text = sbMessage.ToString();
}
}
```

2.4 Test Materials and Experiment Design

The data source of the system is derived from “Beijing Agricultural Digital Resource Center". We take it as test materials.

According to users concern, take precision, reaction time and satisfaction as evaluation criterion to test the system. Precision is the ratio of right answer to all feedback answer. Reaction time is from submitting question to obtaining answer. Satisfaction is the ratio of praise to all visitors. Participants involved in testing are composed of 10 internal staff and 10 external farmers. Each one asks 5 questions in auto Q&A and 5 questions in expert real-time answer.

3 Results

The average value of test results in table 1:

Experiment shows that the precision increases, and the reaction time is shorter than auto Q&A based on conventional VSM. It indicates that the improvement for agricultural application and optimization of system efficiency are effective. The satisfaction is also increased with the solution improvement. It indicates that, complementary with expert real-time answer, the service patter is more welcomed by the agricultural-related users.

Table 1. Comparison of different solutions

solutions	Precision		Reaction time	Satisfaction
	Inner staff	External farmer		
Auto Q&A based conventional VSM	70.2%	55.4%	0.42376	
Auto Q&A based improve VSM	82.2%	79.5%	0.01087	65%
Auto Q&A based improve VSM and expert real-time answer	89.6%	86.2%		85%

Meanwhile, to the precision, the test results of inner staff are better than the external farmer of practical application. The reason lies that the internal staff are more familiar with the technical resources. Their query expression is similar to the existing answering text, so the retrieval accuracy is higher. External farmers ask question entirely in accordance with their own language. Some dialect is not included in our vocabulary in the short term. It lead to the system can't understand users question fully. In addition, as the matter of limited time, the coverage of agricultural technical resource is not enough. All of these affect the search results to some extent. Therefore, it also suggests that with further improvement of vocabulary, expansion the scale of the technical information resource, the system effectiveness will be more apparent.

4 Discussion and Conclusion

In this study, the solution of auto Q&A combined with expert real-time answer was applied into agricultural sci-tech consulting system. It has the advantages of simplicity to use, immediate and accurate response and professional answer. It provides agricultural related user with a new tool to solve problems. This study mainly has the following characteristics:

(1) Users can use their own expression to ask question in system. They don't need to split the sentence. It is easy and convenient for farmer acceptance and application. The strategy of answers sorting and recommendation helps users locate the required information quickly in large mount of information resources.

(2) The improved VSM abstains a better precision by consider the application characteristics in agriculture fully. At the same time, using the optimal design of candidate set selection, the weight of feature words presorting ,it reduce the workload of calculation of foreground and also ensured the efficiency of the system.

(3) Adopting expert real-time answer, it not only shared the expert intelligence resources, but also response to consumer enquiry quickly and accurately. It better improve the user satisfaction with the consultation.

(4) Using Ajax brushless technology to hide the chatting process in the background, it makes up the shortcoming of low execute efficiency in B/S structure

caused by frequent submission, and also brings the farmer and experts with good conversation experience.

Agricultural consultant service for root area farmer is required easy operation and accurate real-time response. In auto Q&A, the study will make a more detail exploration in the integration of semantic, syntactic similarity calculation to further improve the accuracy of the query. In expert real-time answers, for the code of Ajax script is open, improving system security and stability also require further research. Full use the advantages of the two modules complement each other to provide a better service to agricultural production.

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Empirical Study on the Relationship between ICT Application and China Agriculture Economic Growth

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Abstract. In recent years, Chinese government attaches great importance to information and communication technology（ICT） application in agriculture. Driven by market profits and financial privilege, information and communication enterprises, agricultural enterprises, research institutes, universities and relative associations have actively involved in ICT application in agriculture for many years. Therefore, study on relationship between ICT application and China agriculture economic growth is of significance. This paper established a new model on agriculture economic growth and using panel data made an empirical study on the relationship between ICT application and china's agriculture economic growth.

Keywords: information and communication technology application; agriculture; economic growth; panel data; regression.

1 Introduction

Although there are few research results on the relationship between ICT application and agriculture economic growth, scholars have achieved some important results on the relationship between ICT application and economic growth, the methodology of which is also applicable. Studies on the relationship between ICT application and economic growth followed two directions. The first direction is from the perspective of industrial economics. Representative studies include: Marc U, Porat (1997) divides information sector into primary information sector and secondary information sector, using input-output table method, he measures the size of the U.S. information economy [1]. The second direction is from the perspective of production function, which deems ICT application as an economic input factor. Representative studies include: Gurmukh Gill, etc（1997）collects data in 11 cross-industry areas from 1983 to 1993 of 58 industries of United States and uses production function analyzing the contribution of information technology [2]. International Telecommunication Union in 2006 published "World Telecommunication/ICT Development Report" (2006) which demonstrates the information and communication technologies can greatly improve productivity and made an conclusion that the true potential of information and communication technology is not its direct impact on the economy, but the indirect impact on the whole economic system [3]. Welfens (2002) decomposed scientific and technological

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advances into information technology advances and non-information technology advances [4]. Formula 1 shows the relationship between technological progress, information technological progress and non-information technological progress:

$$A = A_0 Z^{\gamma} \tag{1}$$

In formula 1, Z stands for the level of information technology advances. γ stands for the output elasticity of information technology advances. A_0 stands for the advances of non-information technology.

In china, researches on the relationship between ICT application and economic growth are also followed the two directions, noteworthy studies includes: Zhu Youping (1996) uses C-D production, in which the dependent variable is China's real GDP and the independent variables are physical capital, labor force and informatization factor, collecting data from 1980 to 1992 to do regression analysis and finds out that the informatization factor makes the largest contribution of china's economic growth [5]. Tao Changqi (2001) does correlation analysis among information technology and equipment manufacturing, information services and traditional industry and finds out that correlation coefficient is of significant [6].

Researches on the relationship between ICT application and agriculture economic growth are comparatively few. Noteworthy studies include: Zhang Hong, Zhang Quan (2006) firstly uses the method of "information technology index in Japan" to measure China's rural information and then construct a model which seems rural informatization as a new factor. Further more, they conduct an empirical study on Chinese agricultural development from 1993 to 2002 and find out rural informatization plays an important role in china's agricultural development [7].

Although these studies mentioned above are useful, we can find out that there are still some limitations: firstly, most index system for measurement of ICT is not suitable in china, because some important indicators are not covered in china's statistics. Secondly, there are huge differences of ICT application level in different regions of china, most studies taking china as a whole without hypothesis testing to find out the relationship between ICT application and agriculture economic growth is inaccurate. This paper measures ICT application level in a different way, in which consumption and investment on ICT application is used as indicators of ICT application level. Then, this paper collects data in 30 provinces of china and using panel data analyzes the relationship between ICT application and agriculture economic growth.

This paper is organized as follows: Firstly, this paper makes a literature review on the relationship between ICT application and economic growth and put forward the research outline of this paper. Secondly, based on system engineering and information economic analysis, this paper established a new model, which sees ICT application as a new factor, on agriculture economic growth and makes an interpretation about the variables. Thirdly, using panel data from 1999 to 2006 in 30 provinces, this paper made an empirical study on the relationship between ICT application and china's agriculture economic growth. At last, this paper puts forward some suggestions on ICT application in china's agriculture.

2 Model and Variables Selection

2.1 Model Construction

Based on the research results mentioned before, the agriculture economic growth model of this paper is built on three hypotheses. First, ICT application is a new independent factor of agricultural economic system; second, ICT application has a positive externality on agriculture economic growth; third, ICT application factor is an endogenous variable of agricultural economic system. Based on these three hypotheses, the form of agriculture production function can be expressed as follows:

$$Y=F\ (A_{0,} K, H, I) \tag{2}$$

In the model, Y stands for the total agriculture economy output, A_0 stands for scientific and technological progress removing elements of the agricultural and rural information, K stands for physical capital investment, H stands for human capital investment, I stands for ICT application.

For the specific form of production function, this study uses Cobb – Douglas form. Put the time variable into the model, the model used in this study is showed as follows:

$$Y_t = A_0 K_t^{\alpha} H_t^{\beta} I_t^{\gamma} \tag{3}$$

After necessary mathematical treatments of model 3, model 4 deduced from Model 3 is the statistical model to use:

$$Y_{it}' = C + \alpha K_{it}' + \beta H_{it}' + \gamma I_{it}' + \sum_i \mu_i y_i + \xi_{it} \tag{4}$$

2.2 Variables Selection and Data Procession

Dependent variable Y: In this study, the total agricultural production was used to measure the output of the agricultural economy. The data can be collected from the item "primary industry of gross domestic product" (GDP) of "China Statistical Yearbook". In order to eliminate the impact of price factor, with 1990 prices as base year, "the first industrial GDP index" of "China Statistical Yearbook" was used to adjust the nominal value of primary industry of gross domestic product into actual values.

Physical capital K: In this study, the stock coming from fixed assets investments on the primary industry was used as a measure of agricultural physical capital. As there is no direct statistical data on agricultural physical capital stock in the country, this study as a common way used the perpetual inventory method to calculate it, the formula is: $K_t = (1\text{-}\delta)\ K_{t-1} + I_t$. In the formula, K_t and I_t stand for the capital stock and new investment in t year respectively, δ stands for the depreciation rate. According to some research results, δ is assumed to be 5%. For agricultural investment, I_t can be collected from the fixed asset investment data on agriculture, forestry, animal husbandry and fishery of "China Rural Statistical Yearbook". This study uses the methods developed by Hall and Jones (1999) and Young (2000) to calculate the base period capital stock, the formula is: $K_0 = I_0/(g + \delta)$, in which, I_0 stands for the investment of the base period, g stands for the annual average growth rate for investment. In order to eliminate the impact of price factor, this study, with the prices of 1990 the base year, used the investment index of each region to adjust the nominal value into actual value.

Human capital H: As this study uses the human capital indicators, rather than the labor force, thus it needs to translate different types of labor force into human capital stock. The method of is give different human capital equivalent coefficients to people of different educational levels. The human capital equivalent coefficients used in this study are coming from research results by Zhou Xiao, Zhu Nong (2003) [8]. Human Capital equivalent coefficients of all levels of education are shown in Table 1.

Table 1. Human Capital Coefficients

Illiteracy	Primary school	Junior school	High school	Secondary school	College school and above
1	1.07	1.254	1.1308	1.45*	1.624

ICT application factor I: ICT application factor can be measured by the sum of consumption and investment on ICT application, which are more direct and accurate. The investment data on ICT application comes from three items, which are investments on “Information transmission, computer services and software”, “Education” and a part of “Culture, Sports and Entertainment” in “China Rural Statistical Yearbook”. The consumption data on ICT application comes from two items, which are investments on communication expenses from “Transport and communication expenses” and “Cultural and entertainment products and services expenditure”. In order to determine the percentage of the investment on “Culture, Sports and Entertainment” and the consumption on “Transport and communication expenses”, this study conducted surveys in 30 provinces and made estimates on the partial. In order to eliminate the price factor, the data of investment on ICT application and the data of consumption on ICT application were adjusted by “investment index” and “consumption index”. As the same, this study adopted the perpetual inventory method to calculate the ICT fixed asset stock in each province.

3 Empirical Study and Results

In order to analyze the impact of ICT application on agriculture economic growth, this paper made a comparative study. Model 5, which is a classical economic growth model, does not include ICT application factor, while model 6, which is constructed in part 2, includes ICT application factor. Model 5 and Model 6 are shown as follows:

$$Y_{it}' = C + \alpha K_{it}' + \beta H_{it}' + \sum_i \mu_i y_i + \xi_{it} \tag{5}$$

$$Y_{it}' = C + \alpha K_{it}' + \beta H_{it}' + \gamma I_{it}' + \sum_{i} \mu_i y_i + \xi_{it} \tag{6}$$

For model 5, the dependent variable is the real GDP of agriculture department. Through correlation analysis, it can be found that these three independent variables including the stock of physical capital, human capital stock, ICT application factor and regional dummy variable exists strong autocorrelation, therefore, the regional dummy variable was excluded. Model 6, with the same reason, also excluded the regional dummy variable. Because the impact of ICT application lags behind the investment and consumption, so ICT application variable data lag a year in both model 5 and model 6. Using the data in 30 provinces of China form 1999 to 2006, this paper conducts an empirical study on China's agricultural economic growth. Through the F test and Hausman test, both models should use time fixed effects, common cross-section coefficients model to do regression analysis. It should be note that cross-section weighting was used both in model 5 and model 6. In this paper, the software which is used is Eviews5.0. Regression results of model 5 and Model 6 were shown in Table 2, 3.

In model 5, the R-square, Adjusted R-square are 0.999746, 0.999736 respectively. F-statistic value is 100678.4 and the Probability of F-statistic value is 0.000000. Durbin-Watson statistic value is 0.54. The elastic coefficients of physical capital, human capital element are 0.49,0.46 and the sum of them is 0.95 approximately equal to 1, indicating that for each additional unit of regional physical capital, human capital input can stimulate agricultural growth 0.49, 0.46 units, which basically consistent with the assumption that constant returns to scale. Reference to relevant literature, the regression results is consistent with other studies: the elastic coefficient of physical capital is lager than human capital. However, the results show a new feature that the elasticity of human capital is relatively high, indicating that human capital plays a growing role in the agricultural economy growth at this period.

Table 2. Model 5 Regression Analysis Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	6.327534	0.142652	44.35655	0.0000
K1?	0.491837	0.014703	26.65073	0.0000
H1?	0.459361	0.015842	28.99651	0.0000
Fixed Effects (Period)				
1999--C	0.055869			
2000--C	-0.066871			
2001--C	0.176475			
2002--C	-0.055995			
2003--C	-0.069044			
2004--C	0.035609			
2005--C	-0.013762			
2006--C	-0.053886			

Table 3. Model 6 Regression Analysis Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.693355	0.152987	37.21457	0.0000
K1?	0.452439	0.017724	19.88461	0.0000
H1?	0.533188	0.023175	23.00680	0.0000
ICT?(-1)	0.154849	0.023945	6.466894	0.0000
Fixed Effects (Period)				
2000--C	-0.062033			
2001--C	0.175993			
2002--C	-0.043696			
2003--C	-0.048470			
2004--C	0.059661			
2005--C	0.016271			
2006--C	-0.046159			

In model 6, the R-square, Adjusted R-square are 0.999871, 0.999866 respectively. F-statistic value is 172870.6 and the Probability of F-statistic value is 0.000000. Durbin-Watson statistic value is 0.62. The regression result is interesting. First, ICT application factor past through the 1% significance hypothesis testing, which means that ICT application has become one of the elements of agricultural economic growth. Second, compared to model 5, the elasticity of physical capital is almost unchanged, while the elasticity of human capital is increased to be larger than the elasticity of physical capital and the sum of them, which is 0.99, still approximately equal to 1. Third, the elastic coefficients of physical capital, human capital, ICT application factor are 0.45, 0.53, 0.15 and the sum of them is 1.13 larger than 1, indicating that for each additional unit of regional physical capital, human capital, ICT application factor input can stimulate agricultural growth 0.45, 0.53, 0.15, which means some increasing returns to scale and ICT application factor increases returns to scale.

Comparing Model 6 and Model 5, on the one hand, we can see that there is a strong consistency of the two models. First, the regression results of the two models are constant in estimates of the elasticity of physical capital and human capital, which the differences between them are comparatively small and the sum of them approximately equal to 1. Second, the regression results of the two models are constant in estimates of time fixed effects. The meaning of time fixed effects is clearly, apart from the factors including scientific and technology progress, physical capital input and human capital input, it should be natural conditions and the effects of the policies. According to model 6, the time fixed effects from 2000 to 2006 were -0.062033, 0.175993, -0.043696, -0.048470, 0.059661, 0.016271, -0.046159, which are reasonable and can be explained by natural conditions and policies. According to the actual agricultural production, 2001 is a favorable weather year in China and this year's agricultural production made a great growth. 2005 is a great time for Chinese farmer, in March 2005, there had been 26 provinces (autonomous regions and municipalities) announced the abolition of agricultural tax, which stimulates agriculture output growth. On the other hand, there are differences. First, we know that the constant item in model 5 stands for scientific and technological progress, while the constant item in model 6 stands for scientific and technological progress excluding ICT application factor. From the results, it can be seen that the constant item in model 5 is lager than the constant item in model 6, which is reasonable. Second, the ICT application factor has changed the input-output structure of the agricultural economy. The ICT application factor has become one independent element in the agricultural economic system and increases the contribution of human capital investment to agriculture economic growth. By comparing the results, it can be concluded that both model are reasonable, but model 6 holds more truth.

4 Discussions

Through the analysis of agricultural economy growth, we can draw three important conclusions: First, ICT application has become an important factor in agriculture economic growth. Second, ICT application has changed the output elasticity of physical capital and human capital, which reinforces the role of human capital, therefore changed the way of economic growth in agriculture. Third, ICT application has improved the agricultural economic growth rate returns to scale and has become the source of economies scale increment of agriculture. Therefore, In order to, accelerate the development of agricultural economy, the decision-makers should not only to consider the physical capital investment, human capital investment and technological progress in agriculture fields, but attach great importance to promote agricultural and rural informatization development.

Meanwhile, it can be seen that the impact of ICT application on physical capital investment is not obvious. Therefore, in the agricultural informatization construction process, we should pay more attention to develop intelligent equipment, which can directly improve the efficiency of agricultural production, and agricultural informatization construction. There is a need to encourage scientific research institutions, information technology, companies and agricultural enterprises to make efforts to improve the intelligence level of Chinese agricultural production tools and facilities, therefore promote agricultural growth.

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The Research of the Agricultural Technology Transfer

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Abstract. This research looks on the technology metastasis as an important link in the innovative chain. It analyses the factors of the agricultural technology metastasis, and studies the interplay and correlation of technology itself, institute, enterprise and environment on the basis of defining the agriculture technology product and technology metastasis attribute and the connotation, aiming to give a forceful support for the construction of agriculture. The results show that the agricultural technology transfer is a multivariate sophisticated system. No positively optimal solution exits and there are only relatively suboptimal states under some certain conditions.

Keywords: Agricultural Technology, Technology Transfer, Mechanism, Factor.

1 Introduction

The impact of technology transfer for our country technological innovation and economic growth has undergone profound changes. During the past years, the agricultural science technology has brought the important effect into the agriculture development in China, which promotes the agricultural technology innovation.

However, the resource advantage has not been changed into the competitive edge. The input of science and technology has not been transformed into new product or new estate, and the ration between input and output has not overtaken the one abroad. The proportion of the technology that has been put into practice to the total agricultural science and technology is small. It is important to increase the rate of agricultural research achievement conversion.

Agriculture technology transfer is a complicated process, which is related with technology itself, technology supplier, technology receiver and environmental force, etc. The study studies agriculture technology transfer from the factors above.

2 Technology Itself

The characteristic of technology itself is an important element, which is confirmed by many researchers before.

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Tacitness, complexity, accumulation and uncertainty are the main features of technology itself. This paper divides technology into two parts, which are high technology and low technology, as is shown in table 1.

Table 1. Characteristics classification of technology itself

	Tacitness	Complexity	Accumulation	Uncertainty
High Tech	High	High	High	High
Low Tech	Low	Low	Low	Low

The higher the technology is, the stronger the tacitness is. Complexity, accumulation and uncertainty are similar with tacitness. Moreover, the transfer is more difficult, one of which is knowledge representation. The transfer is based on researchers' comprehension to the agriculture technology, and accumulation and uncertainty are also displayed in the interactive learning process.

3 Technology Supplier

Colleges, especially agriculture colleges are the main agriculture technology suppliers. Besides traditional functions of teaching and researching, there is a third responsibility which is to transfer the knowledge, technology and achievement into the social services, in order to realize the market value of the agriculture technology.

The third function is classified into two parts in this paper, which are the strong one and the weak one. It is analyzed from the ability of R&D, the ability of judging the commercial value of the technology, the facility and the degree of opening up, as is shown in table 2.

Table 2. Characteristics classification of the technology supplier

	R&D	Judging	Facility	Opening Up
The Strong One	Strong	Strong	Strong	Strong
The Weak One	Weak	Weak	Weak	Weak

Strengthening the third function also means increasing the degree of the opening up to some extent, and more collections between colleges and companies emerge gradually. While the interaction between colleges and companies is reinforced, the third function will show out great effects, and moreover, the ability of R&D, the ability of judging the commercial value of the technology and the facility will give impetus to the third function gradually.

4 Technology Receiver

Generally, agricultural enterprises are the main receivers of agriculture technology transfer.

There are two methods of obtaining technologies. One is to research on their own internally, and the other is to seek out outwardly. It costs less to get technologies in the first way usually; however, the second method will work out when the cost of the first way is large or companies are unable to study by themselves.

There are several aspects of the technology receiver that have influence on the effect of the technology transfer:

- The core technological capabilities of enterprises. The capabilities include the technical capacity, the technical learning ability, the technical assistance capacity, the quality of human resources and the level of R&D. In the interaction between colleges and enterprises, the stronger the core technological capabilities are, the more superior situation the enterprises will be in.
- The development strategy. If the technology that will be transferred is important to the enterprise, the enterprise will tend to control the technology completely, which will influence the mode of the technology transfer.
- The preference. If enterprises expect to acquire the technologies rapidly and effectively, they are likely to take the mode of purchasing. If enterprises pay attention to the price, they may adopt the mode of participation and cooperation which is cheaper relatively.
- The scale of the enterprise. When the scale is extremely large, the structure of the organization may become rigid frequently, and it may lead to the shortage of the ability and innovation. The enterprise has to take the mode of participation and cooperation in the technology transfer.
- The geographical distance between colleges and enterprises. Generally, the smaller the distance is, the more likely the interaction will happen between technology receivers and suppliers.

5 Environmental Force

The external conditions constitute the environmental factors in the interactive relationship. Colleges, research institutes, public organizations, intermediaries and financial institutions are the main behavior actors. Establishing a regional innovation network which is relatively stable and energetic, has a significant impact on the agricultural technology transfer.

The regional innovation network includes three parts, which are organization network, information network and learning network.

The organization network is an organic institution network, which contains the behavior actors above. The information network contains two networks. One is the visible shared network based on computers, and the other is the invisible social network on the basis of the first one. The learning network is an invisible ubiquitous network based on the organization network and the information network. The learning network is also a special competitive and cooperative cultural environment where there exits knowledge exchange and inspiration.

The environmental force is classified into two sections according to the level of the regional innovation network and it is analyzed from the point of the organization network, the information network and the learning network in the research, as is shown in table 3.

Colleges and enterprises are not only the main participants, but also the important nodes on the regional innovation network. There will be more connections between colleges and enterprises while the level of the regional innovation network rises. With the expanding and deepening of cooperation, the boundary of colleges and enterprises will be indistinct gradually, which contribute to the penetration and diffusion of information and knowledge. Therefore, the emergence and development of the regional innovation network establish conditions and support for the agriculture technology transfer.

Table 3. Characteristics classification of the environmental force

	Organization Network	Information Network	Learning Network
High Level	More Contacts	Ample Information	Great Learning Ability
Low Level	Less Contacts	Impeded Information	Weak Learning Ability

Besides, the policy factor is a particularly important aspect of the environmental forces in the course of the mode chosen of the agriculture technology transfer, especially in China, where the policy leading effect is more prominent.

6 Conclusion

In this study, the interactions and relations of the components of the agricultural technology transfer are discussed in view of the content and characteristic. Some important conclusions are brought through the research.

- ♦ The agricultural technology transfer is a complex system. Moreover, it is verified to be a systemic process variable.
- ♦ The technology itself, the technology supplier, the technology receiver and the environmental force are the main elements of the agricultural technology transfer. Each aspect includes several factors that have influences on the final transfer effects.
- ♦ There is no positively optimal mode in the agricultural technology transfer process. What to seek out is a relatively suboptimal condition, under which the technology itself, the technology supplier, the technology receiver and the environmental force reach to a best dynamic match with contingency.

This study has been carried out from the factors of the agricultural technology transfer forwardly. The future research may be focus on the outcomes of the transfer, and discuss the performance evaluation in order to investigate the agricultural technology transfer reversely and quantitatively.

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Research on the Collaboration Service Mechanism for Pig Diseases Diagnosis Based on Semantic Web

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Abstract. Distributed knowledge resources for the pig diseases diagnosis have the characteristics of heterogeneous, autonomy and difficult to be shared among different systems. Based on the web-based ontology modeling language, a descriptive model to describe the heterogeneous knowledge resources of the pig diseases diagnosis and a formal model to express the decision services of pig diseases are proposed in this work. Based on the two models, a complex decision task can be automatically divided into many dependent simple decision fragments. The relationships between different fragments, the mapping relationships between each fragment which can be dynamically adjusted according the divided fragments and its distributed knowledge resources can be formally described. The models form a mechanism for cooperative decision for pig diseases diagnosis. The method is proposed by achieving the balanced decomposition of decision task and intelligent schedule of knowledge resources. The method is verified in a pig diseases collaborative diagnosis system. The result shows that the method is superior to the traditional intelligent decision-making method.

Keywords: semantic web; context awareness; collaborative decision; pig diseases diagnosis; agricultural intelligent system.

1 Introduction

Nowadays, along with the application of intelligent information techniques in agricultural information systems, the amount of knowledge resources of raising pig in the process of monitoring, production, operation and management grows rapidly [1]. However, these knowledge resources belong to different owners and they are heterogenous in type and representation. The dispersed diagnostic knowledge which has some incomplete issues inevitably reduces the efficiency of knowledge service. Collaborative decision-making is the decision-making process or ability of coordinating different data resources, knowledge resources, terminal devices, applications [2],[3]. The purpose of collaborative decision-making service in the field of pig diseases diagnosis which has heterogeneous knowledge is rapidly positioning associated knowledge resources and making decision. As a result, it can achieve the semantic interaction between providers and users of knowledge resources based on function and application of quality.

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2 The Semantic Description of Decision-Making Services Knowledge Resources

Distributed environment is the basis environment of achieving resource sharing and collaborative decision-making. A wide range of agricultural knowledge resources, the representation model, location, underlying communication mechanism are different. To realize collaborative service in distributed agricultural resources, the paper puts forward a semantic description model that can support the multiple type, shield heterogeneity and adapt to dynamic environment. This model uses OWL as the agricultural knowledge ontology expression language [4], [5], [6] and explains the related agricultural sharing concept model. Additionally, it provides basic terms and relationship for agricultural knowledge resource model and makes up the extension rules and complex definitions using those relationship and terms. This mechanism realizes the concept system of classifying and describing the agricultural mass knowledge. It is the basic for collaborative knowledge resource organization and management and information exchange.

3 Ontology Description of Decision-Making Services of Agriculture Knowledge

Semantics heterogeneity brings on differences of understanding the agricultural knowledge resources, described by using same descript mode, between agriculture knowledge resources of providers and users. This will affect the effect of the collaborative decision-making. In order to solve semantic heterogeneity problem, this paper introduces the semantic ontology quaternion group to describe the decision-making service of agriculture knowledge:

$$\mathrm{KR} = \{<\mathrm{kobject}>, <\mathrm{relation}>, <\mathrm{owner}>, <\mathrm{constraint}>\} \tag{1}$$

'kobject' is the agricultural knowledge atom, which is the smallest knowledge resources unit in the entire descriptive model. Expressed as:

$$\mathrm{kobject} = \{\mathrm{ra}_\mathrm{i} | 1 \le \mathrm{i} \le n, ra \notin \Phi, ra \in \Omega\} \tag{2}$$

'Ra' is the knowledge atom in the field of agricultural knowledge resources; 'relation' means the collection that has reciprocity and affects among the knowledge atom and knowledge entities. Namely:

$$\mathrm{relation} = \{\mathrm{r}_{\mathrm{ij}}(\mathrm{ra}_\mathrm{i} + \mathrm{ra}_\mathrm{j}) \vee \mathrm{r}_{\mathrm{ij}}(\mathrm{rm}_\mathrm{k}, \mathrm{rm}_\mathrm{j}) | 1 \le \mathrm{i}, \mathrm{j}, \mathrm{k}, 1 \le \mathrm{n}, \mathrm{r} \notin \Phi\} \tag{3}$$

'Rm' means a knowledge entity which is constituted by agriculture knowledge resources.

$$\mathrm{rm} = \{\sum \mathrm{ra}_\mathrm{i} \cdot ra_j \vee \prod \mathrm{ra}_\mathrm{i} \cdot ra_j | 1 \le i, j \le n \,; \mathrm{ra}_\mathrm{i} \cdot ra_j \notin \Phi, \mathrm{ra}_\mathrm{i} \cdot ra_j \in \Omega\} \tag{4}$$

'rij (rai+raj)' means the connections among knowledge atoms of agricultural knowledge resource. rij (rmk, rmj) means the connections among knowledge entities. Owner is the identifying information that marked the agriculture knowledge resources owner and application quality. It reflects knowledge resource owner and application effect under the distributed environment. Constraint is resource constraints of agricultural knowledge. It includes some labels of agricultural knowledge entities and related resources, rules or operation collection that is generated by relations among knowledge atoms or entities [7].

4 The Model of Agricultural Knowledge Resources

According to characteristics of agricultural knowledge resources and core idea of collaborative services in complex system, we made the unified description and expression of the agricultural knowledge resources model and defined the model as the seven BNF sub determinant: knowledge pattern, meta-knowledge, rule set, quantitative model, resource label, Ontology Bridge, external link extension. These basic hierarchic group of sub determinants form more complex models of agricultural knowledge resources. Some BNF are shown in Figure 1.

```
<Agricultural knowledge resources model> ::=< knowledge pattern>l<meta-
    knowledge>l<rule set>l <quantitative model>l<resource label>l<ontology
    bridge>l<external link extension>
  <Knowledge pattern> :=< frame pattern>l<production rule pattern>l<example
      pattern>l <descriptive pattern>
  <meta-knowledge>:= <knowledge domain>l<knowledge owner>l<knowledge
      module>l <decision-making item>l<decision-making data item>
 <Rules set> ::=< rule name>l<rule definition>l< rule mark>
 <Quantitative model> ::=< model name>l<model class>l<model expression>
 < Resources label>::=< resources type>l< resources class>l<resource
      owner>l<resources ontology mark>;{< resources ontology marking sentence>;}
 <Ontology bridge> ::=< atom of knowledge resources>l< relation of
      atoms>l<ontology owner>l< resources ontology marks>;{<resources ontology
      marking sentences>;}
 <External link extension> ::=< resources label> ;{< plain text>l<multi-media>l
      <HTML>l<GIS>l <remote sensing image>l<database> ;}
```

Fig. 1. BNF fragment of agricultural knowledge resources model

Knowledge pattern is mostly used to determine the type of knowledge expression. In process of collaborative decision-making, meta-knowledge, rule set and quantitative model mostly are used to establish the generalized mapping relationship between items of rule antecedent facts and conclusions facts, such as these four basic types:'part of', 'kind of', 'instance of', 'attribute of'. Otherwise, pattern matching relationship, include certainty, uncertainty, fuzzy matching, or the accessibility relation that based on the generalized mapping relationship also can be used. This two unit mode separately finished the qualitative analysis and model calculations in the decision-making process.

By OWL mapping between ontology and ontology, between ontology and the information sources, between ontology and knowledge representation methods, Ontology Bridge solve the semantic heterogeneous problem of agricultural knowledge resources naming, attribute and extension. For example, OWL: equivalentClass and OWL: equivalentProperty are used to solve the problem of naming heterogeneity that different information sources denote the same concept according to multiple languages. Rdfs:subPropertyOf is used to solve the problem of attribute heterogeneity. Owl:equivalentClass and owl:equivalentProperty are used to solve the problem of equivalence element and owl:intersectionOf is used to solve the problem of crossed element. Rdfs:subClassOf and rdfs:subPropertyOf are used to solve the problem of contain elements in ontology syntax.and owl:unionOf in global ontology are used to solve the problem of disjoint elements. The solutions of these problems achieve the unified description of knowledge representations that have many types such as production rules, examples, and semantic web. These solutions also can convert variety of types of knowledge to the personalized knowledge representation required by collaborative decision-making [8].

Resource label and exterior extension are made use of combining the information resources and the knowledge resources. It includes plain text, multi-media, HTML, GIS, remote sensing images, database and other resources marks. Moreover, it realizes the knowledge integration of frame, production rule, example, description and other models of knowledge expression.

According to the composition of agricultural knowledge resources and the definition of semantic description system, knowledge resources of agricultural collaborative decision-making service is divided into three layers, decision-making problem layer, correlative information layer, knowledge model layer. Decision-making layer includes definition of atom of agricultural knowledge resources. Such as, decision-making facts, concepts, fact attribute those related to agricultural knowledge rules and the relations among the concepts. Correlative information layer mostly includes related information of different decision-making model, resources label information that related to decision-making project; the efficiency of resource reference, etc. Knowledge layer includes meta-knowledge of agricultural knowledge resource model and related index of model, index of decision-making problem, index of resource correlation. By means of related index, it can accurately locate the related model, decision-making problem, related information resource of each node in a distributed environment [9].

5 The Representation Formalism of Decision-Making Service Problem

5.1 Description of Decision-Making Problems List

In the semantic description model of decision-making service knowledge resources, decision-making layer provide users with a description of their required decision-making service and the abstract of actual decision-making data item, to realize the analysis of decision-making problem requirement. It means an expression of decision-making problem requirement.

$$\begin{aligned} & R_{dec} = R_s \wedge R_{d1} \wedge R_{d2} \wedge \cdots \wedge R_{dn}, \\ & R_d = (\text{UID}, \text{RO}, \text{RA}, \text{RC}, \text{RF}, \text{RU}) \end{aligned} \tag{5}$$

R5 means initial limit of decision-making goals. Rd means the restriction of decision-making premise data items. UID is the unique identifier of the decision-making service users. RO is the domain limit of knowledge or resources. RA is the restriction of functional properties of agricultural knowledge. RC means the explanation of the initial value of agricultural knowledge. RF is the restriction of information resources. RU is the memory of decision-making service.

There are a large number of agricultural knowledge resources. These knowledge resources provide decision-making knowledge service for problem of decision-making service. Based on the decision-making goal of decision-making user and the model of agricultural knowledge resources, the formalism representations of decision-making service problem identify the interaction in each step progressively.

$$RU_{UID} = \{Rxt, (< k_1 >, Rxt_1), (< k_2 >, Rxt_2), \cdots, (< k_n >, Rxt_n)\} \tag{6}$$

'Ki' means the node identification of decision-making problem flow. 'Rxti' is the node information set of decision-making service problem. When collaborative decision-making occurred, the description of problem and the context information are stored in RU as a unique identification. It provides the problem list that interacts with the user for collaborative decision-making services.

Firstly, according to the domain type, content, owner of knowledge resources, property, states of obtained decision-making services goal,the limited value is initialize and then the decision-making knowledge resources are obtained to calculate the decision-making problem list.

5.2 Matching of Decision-Making Problem and Knowledge Resources

It is the key that to determine the knowledge resources related to decision-making problem in the distributed environment and achieve the representation formalism of decision-making service problem. The semantic matching between knowledge resource and user decision-making problem is determined by the matching degreen of the concepts similarities of description terms and functional property constraint.

The concepts similarity is gained by calculating the semantic distance between problem description and description terms of context knowledge resource. The similarity of functional property is get by calculating the problem description and context knowledge resource property [10-12]. The calculate method of concept similarity is as follows:

$$\begin{aligned} & \text{Sim\_question}(\text{Qterm}, \text{Kterm}) = \sum_{i=1}^{n} \omega_i \times \text{Cd\_sim}_i(\text{Qterm}, \text{Kterm}) \\ & + \sum_{j=1}^{n} \omega_j \times \text{Ca\_sim}_j(\text{Qterm}, \text{Kterm}) \end{aligned} \tag{7}$$

Additionally, 'Cd_sim(Qterm ,Kterm)' is the distance similarity of semantic concept. 'Ca_sim(Qterm, Kterm)' is the concept property similarity. 'Qterm' represents the problem description. 'Kterm' is the description of knowledge resources.

$$\mathrm{Cd\_sim_i(Qterm\ ,Kterm)} = \begin{cases} 1\ , \text{Qterm、Kterm before the i - with the same parent class} \\ 0\ , \text{Qterm、Kterm before i not accompanied by a parent class} \end{cases}$$

$$\mathrm{Ca\_sim_j(Qterm\ ,Kterm)} = \begin{cases} 1\ , \text{Qterm、Kterm before the j - with the same parentclass} \\ 0\ , \text{Qterm、Kterm before j not accompanied by a parent class} \end{cases} \tag{8}$$

'N' is the maximum depth of 'Qterm' and "Kterm" in description model of agricultural knowledge resource ontology. ω is corresponding weight coefficient. $\sum_{i=1}^{n}\omega_i + \sum_{j=1}^{n}\omega_j = 1$.

The functional property constrain matching of agricultural knowledge atoms is decided by the domain of knowledge atom and the decision-making service premise data items constrain. The value of constrain is related to the initial value of agricultural knowledge atom. So the constrain value of decision-making problem need to be converted to the interval form. 'C(Qterm)' is the value range of problem description sub-constrain. 'C(Kterm)' is the value range of knowledge description sub-constrain. μ_k is the weight coefficient of matching degree of constraint. Then the calculating method of similarity degree of functional property is as follows:

$$\mathrm{Fmatch} = \begin{cases} 1\ , & C(Qterm) = C(Kterm) \\ \sum_{k=1}^{n} \dfrac{\mathrm{P_k}(C(Qterm) \cap C(Kterm))}{P(C(Kterm))}\mu_k\ , & C(Qterm) \cap C(Kterm) \neq \Phi \\ 0\ , & C(Qterm) \cap C(Kterm) = \Phi。 \end{cases} \tag{9}$$

'Fmatch' is weighted sum of 'Amatch' and 'Sim_question'.

$$\mathrm{Amatch} = \mu 1 \times \mathrm{Sim\_question}(\mathrm{R_s}, \mathrm{R_d}) + \mu 2 \times \mathrm{Fmtach}\ (\ \mathrm{R_s}, \mathrm{RA}\ ) \tag{10}$$

In above formula, $\mu 1$, $\mu 2$ means the correspond weight of each type matching degree. And $\mu 1 + \mu 2 = 1$.

6 Agricultural Cooperative Decision-Making Service Mechanisms

The completion of specific agricultural cooperative decision-making service needs multiple process fragments. In the collaborative decision-making process, it's necessary to achieve task decomposition of distributed decision-making services, matching of knowledge resources and intelligent invocation of agricultural cooperative decision-making tasks based on the user demand for services, the context memory of agricultural decision-making service problem flow and the message of user interaction decision-making premise items.

Agricultural cooperative decision-making service module has two main functions: the matching of decision-making problems' knowledge resources and the task decomposition of decision-making services [13-16]. The steps are as follows:

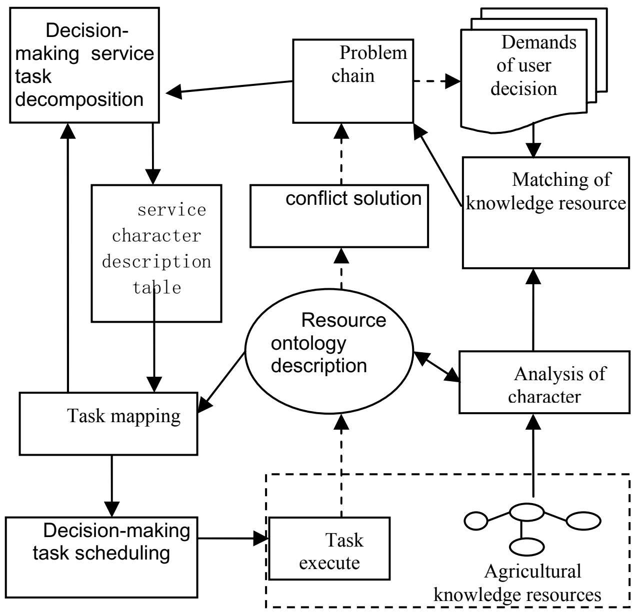

Fig. 2. The collaborative service model of agricultural knowledge resources

Step 1. Matching of decision-making problem knowledge resources based on the demands of user's decision-making. Model of knowledge resource ontology description can analyse the agricultural knowledge resource, calculate the matching degree of knowledge resource and create a "decision-making service problem chain".

Step 2. According to the content of "decision-making service problem chain", decision-making task decomposition modules analyses the type and class degree of service to determine the character of the agricultural knowledge decision-making service and achieve mapping scheduling of decision-making task. Agricultural knowledge service can be divided into compute-intensive knowledge service, communicate-intensive knowledge service and compute-communicate relative equilibrium knowledge service. By analyzing class degree of knowledge service, the number and character of parallel task is determined and each node's application quality of service resources is obtained. Finally, the analysis results are published regularly.

Step 3. The decision-making task mapping module divides knowledge service into many sub-tasks, using "service character description table". These sub-tasks include some dependent or preferred constrain relationship and are mapped as some task sets that adapt to different machine characters and service characters. The goal is to make sure the sub-task can be carried out at suitable node.

Step 4. Agricultural collaborative decision-making service task scheduling module based on the result of task mapping, send task to specific node service queue and schedule the decision-making of distributed nodes to execute decision-making task.

Step 5. In the end the result returns. The conflict resolution is finished and the results return to user.

7 Analysis and Application

Based on the agricultural coordination decision-making service mechanism, we use J2EE platform to develop pig diseases collaborative diagnosis system. As the result of the great variety diseases of live pig symptom, although knowledge databases of various nodes follow the unified regulations, the knowledge engineers of system establishment are different, Therefore, the attention points on diagnosis knowledge are different and there are differences on symptom antecedent, the consequent as well as authentication. For this reason, the pig sickness main body is constructed, and by modeling the policy-making service knowledge resources' semantic description, the existing knowledge, the data, the multimedia resources are labeled. So the integrated applications of pig sickness diagnosis knowledge rules and related disease symptom, prevention method and so on are realized in Beijing, Tianjin, Hebei, Sichuan and other providence.

The system not only can recommend users more semantically related concepts based on knowledge of swine, but also can complete collaborative coordination of different expertise for the same diagnosis, and provide various results with recommendations for the diagnosis and disposal program. It’s difficult for the traditional agricultural expert system to finish.

Fig. 3. Collaborative decision-making of swine diseases

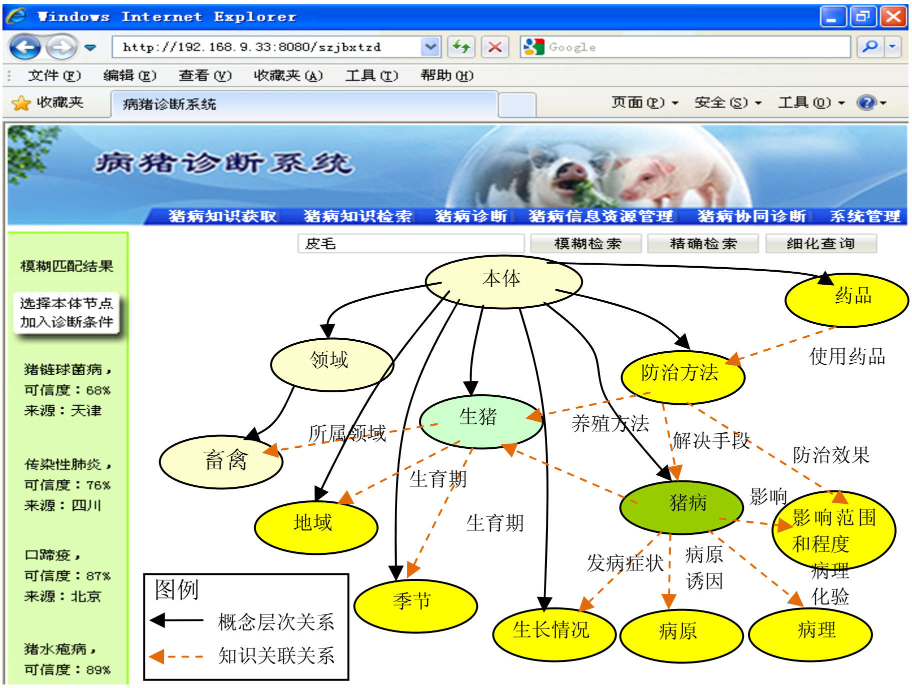

Fig. 4. Ontology-based Collaborative decision-making of swine diseases

Take 4 swine diseases expert systems as the example; take 20 initial symptoms as the example to deduction, the inference experimental result as shown in Table 1. Comparing collaborative decision-making system based on semantic WEB to traditional expert system, the former has remarkable enhancement on the inference conclusion gain rate, the inference conclusion authentication mean value and the inference efficiency. Such as Rg increases 12.5%, Cn increases 14% and Rc improved 13.3%.

Table 1. Results of reasoning test

System	Kb	R(Gbit)	Rn	Cn	Rg	Rc
Beijing	450	1.8	16	87	80	83.5
Tianjin	347	0.7	14	79	70	74.5
Hebei	512	0.9	17	81	85	83
Sichuan	401	1.1	15	82	75	78.5
Coordination	1710	4.5	19	89	95	92

All the knowledge regular strip counts Kb; Amount of connection resources R; Integer Rn in view of 20 initial symptom's inference conclusions (confidence level threshold 60%); Inference conclusion gain rate Rg= Rn/20*100; In view of confidence level of 20 inference conclusion mean values Cn; Inference efficiency Rc= (Rg +Cn) /2.

8 Conclusion

In the application service of distributional knowledge resources, how to realize the knowledge resources coordination decision-making service is important. Based on the semantic WEB technology, the paper, proposed a kind of agriculture decision-making service knowledge resources semantics description model which supports the multi-types, shield isomerism, adaptation dynamically. It defines agricultural knowledge resources semantics description as 7 minor BNF. Based on this foundation, the formalized expression method of policy-making question is studied and the demands of agricultural coordination decision-making service are decomposed into many policy-making parts, according to the agricultural decision-making service question class context memory and user's interactive decision-making premise information. As a result, the match between distributional decision-making service task decomposition and the knowledge resources and the intelligent dispatch service of agricultural coordination decision-making task are realized, enhancing the using efficiency and inference efficiency of agricultural knowledge.

The collaborative service of agricultural knowledge resources is a complex engineering system. The collaborative decision-making service based on semantic WEB proposed in this paper took the semantic main body as the foundation of coordination service. The relationship of the quality of coordination service and the competition of ontology library is high. The future research will focus on the update of the increment of agricultural knowledge resources ontology and the resolution mechanism of coordination service conflict.

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Prediction of Vegetable Price Based on Neural Network and Genetic Algorithm

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Abstract. In this paper, the theory and construction methods of four models are presented for predicting the vegetable market price, which are BP neural network model, the neural network model based on genetic algorithm, RBF neural network model and an integrated prediction model based on the three models above. The four models are used to predict the Lentinus edodes price for Beijing Xinfadi wholesale market. A total of 84 records collected between 2003 and 2009 were fed into the four models for training and testing. In summary, the predicting ability of BP neural network model is the worst. The neural network model based on genetic algorithm was generally more accurate than RBF neural network model. The integrated prediction model has the best results.

Keywords: genetic algorithm, neural network, prediction, vegetables price.

1 Introduction

There is a fashion to say:" food is the god of people, Vegetables is the half of it" .Vegetables industry plays an important role in providing abundant fresh agricultural products. It is also an important source of peasant's income. Vegetables price is unstable and change fast. The prediction is difficult. All those became the main obstacle factors to promoting the sustained and steady development of the vegetable production. Use the scientific method to excavate the change law of the vegetables price. And forecast the trend immediately and accurately. All those works have great significance to vegetable production, government regulation and vegetable industry stabilization. In the current research, non-linear prediction methods such as neural network and genetic algorithm are used widely, and also make certain results. For the complexity of vegetable price forecasting, BP nerve network model, the neural network model based on genetic algorithm, RBF neural network model are set up separately. And on the basis of them, an integrated prediction model is established to provide the price of agricultural production with a reference of accurate prediction.

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2 Materials

Market prices of agricultural products are affected by many factors such as climate, supply and demand etc. The prediction is more complicated than commercial products. It is vary difficult to collect the data of impacting factor accurately and timely. Therefore, in this study, take the vegetable price as experimental materials. The daily price of Lentinus edodes is obtained in Beijing Xinfadi wholesale market from 2003 to 2009. After it was weighted, the monthly price is gain to prepare for forecasting.

3 Experimental Methods

3.1 Construction of BP Neural Network Model

Artificial neural network model (abbreviations is ANN) can deal with some problems that background information is not clear and inference rule is uncertain. In theory, it can achieve arbitrary nonlinear mapping from input to output. So, it is widely used in complex nonlinear prediction, such as electricity prices and stock prices[1,2], and crop pests[3,4]. BP neural network (abbreviations is BPNN) is a kind of ANN which weight adjustment use back propagation learning algorithm. It has three layers which contain input layer, output layer and hidden layer. Connections are between upper neurons and lower neurons. But there is no link within the same layer.

In this paper, take vegetable price data of a certain phase as input, the others as output to construct the BPNN.

The number of neurons in hidden layer is important for forecasting. For the own characteristics of neural network, there is not a formula to determine the number of neurons in hidden layer. Practical experience shows that, with the increase of the neurons, the amount of computation is large, the simulation is better, but the generalization ability is poor. For complex matters, too few neurons can not reveal the variation. Generally, the number of neurons is more appropriate between 5 and 30. The exact number needs designer's experience and experiments to determine.

The conversion from input layer to hidden layer is realized by the function of tansig(), and from hidden layer to output layer is realized by the function of purelin(). For the BPNN has the shortcoming which is easy to local minimums, the training algorithm of Levenberg-Marquardt is used to improve the optimization for efficiency.

3.2 Construction of Neural Network Model Based on Genetic Algorithm

Genetic algorithm (abbreviations is GA) was proposed by Holland professor in 1975. It is an optimal method based on natural selection and evolution in high dimension space. For the ability of global optimization, it was widely used in model optimization. Complement of GA, the BP neural network can solve the problems of falling in local minimums. Lots of literature used the method to forecast, such as soil salt distribution, electricity price, and so on [5-7].

Taking the monthly market price of Lentinus edodes which is from 2003 to 2007 as experimental data, the neural network based on GA is constructed. Its structure is similar to BPNN. The main process of using GA for optimization of neural network model is as follow:

(1) Gene Encoding. According to the BPNN, gain its weight number. Every weight is on behalf of a gene. All of them structure a chromosome.

(2) Initial chromosome group generation. Choose the number of chromosome in initial population. To each chromosome, generate weights randomly in the given range to construct the initial group.

(3) Individual fitness computation. Use training samples to train the individual chromosome which is on behalf of an ANN, and then, calculate the individual learning error E. The formula is as follow:

$$E = \sum_{i=1}^{n} E_i \quad , \text{ there into,} \quad E_i = \sum_{l=1}^{m} (y_l^i - c_l^i)^2 / 2 \tag{1}$$

Here, n is the number of training sample, m is the number of output unit. $y_l^i - c_l^i$ is the difference between actual value and expected value of l-output when it takes i-sample to train. Fitness function fs is as bellow:

$$fs = 1/E \tag{2}$$

(4) Selecting operation. Select the individual taking roulette wheel and retain the best individuals.

(5) Crossover operation. Assume x1 and x2 is parents, its children y1 and y2 after crossover is gained by the formula as bellow:

$$y_1 = \alpha x_1 + (1-\alpha)x_2, y_2 = \alpha x_2 + (1-\alpha)x_1 \tag{3}$$

Here, α is an parameter which changed with the evolution algebra.

(6) Variation. Take Gaussian approximate variance to improve the local search performance of GA on key search area. During the variation, using a random number of normal distribution which average is $\overline{P}$ and variance is P2 instead of original gene.

(7) Fitness value of chromosomes group is calculated again.

(8) If it meets the stop search criteria, output the result. Otherwise, go to step (4).

3.3 Construction of RBF Neural Network Model

Radial basis function network (abbreviations is RBFN) is a kind of neural network. The ability of function approximation, patter recognition and classification is better than BPNN [8-10], and is also used in lots of forecasting fields. Its structure is similar to BPNN. Input layer nodes only pass the signal to hidden layer. Activation function in hidden layer is radial basis functions. Generally, activation function in output layer is a simple linear function. In RBFN, input layer is mapped to a new space and achieves a linear combination. Adjustable parameters are the weights of linear combination and parameters which control the shape of the basis functions. The learning algorithm of RBFN has three parameters to solve which are the center of function, variance and the weights from hidden layer to out layer. In the phase of self-organizing learning, solve the center of basis function and variance in hidden layer.

On instructor learning stages, solve the weights which are between hidden layer and output layer. Specific steps are as follow:

(1) Determination of basis function center C based on K-mean clustering

1) Network initialization. Training samples are selected randomly as the clustering center ci (i = 1, 2 ..., h).

2) Training samples grouping. In accordance with the Euclidean distance between the training samples xp and the center ci, distribute the xp to cluster set ϑ_p (p=1, 2, … P) of input samples. Here, P is the total number of samples.

3) Re-adjustment of cluster centers. Calculate the average of training sample in crusting set ϑ_p to gain the new clustering center ci. If the new clustering center does not change any more, the ci is the final center of the basic function. Otherwise, go to step 2).

(2) Variance σ_i Solution

The basic function of RBFN is Gaussian. So, the variance solution formula is as follows:

$$\sigma_i = \frac{c_{\max}}{\sqrt{2h}} \qquad i=1,2\ldots,h \tag{4}$$

Here, cmax is the maximum distance among selected centers.

(3) The weight calculation between hidden layer and output layer

The weights between hidden layer and output layer are calculated by least square method, the formula is as follow:

$$w = \exp\left(\frac{h}{c_{\max}^2}\left\|x_p - c_i\right\|^2\right) \qquad p=1,2\ldots,P;\ \ i=1,2\ldots,h \tag{5}$$

3.4 Integrated Prediction Model Construction

The above models provide a new method for the prediction of agricultural production market price. However, one model more or less has shortcomings. If integrate multiple models, prediction process can be reflected from different sides to gain a accurate result. For the complexity of vegetables market price, It is difficult to describe the price variation rule using single model. So, the relationship between different forecasting model and final result is described by ANN to obtain the optimal forecasting result.

Firstly, predict the market prices of vegetables through separate model. Secondly, construct a three feed forward neural network model taking forecasting results as input value and actual result as output value. Finally, train the model using GA. When it is applied in real prediction, follow the same steps above. The training steps of integrated prediction model is the same with 3.2

4 Results and Discussion

4.1 Simulation and Prediction Analysis of BPNN

Take the former four month data of Lentinus edodes as input and the latter one month date as output. Code the program in Matlab. Construct BPNN. Use the data of 2003 – 2007 to train the model. The number of the hide neurons is 20. Circulation is 3000. Optimization target is 0.1. After training, the model simulates the price of 2003-2007, and predicts the price of 2008-2009. The results are as follow:

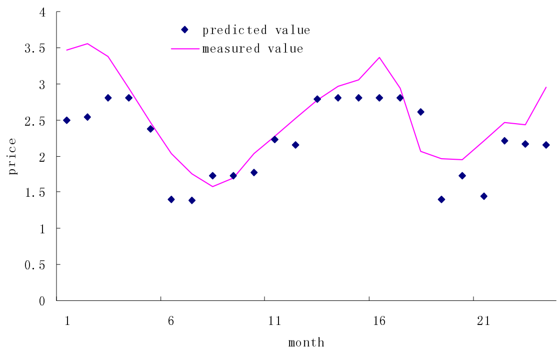

Fig. 1. Prediction result of BPNN

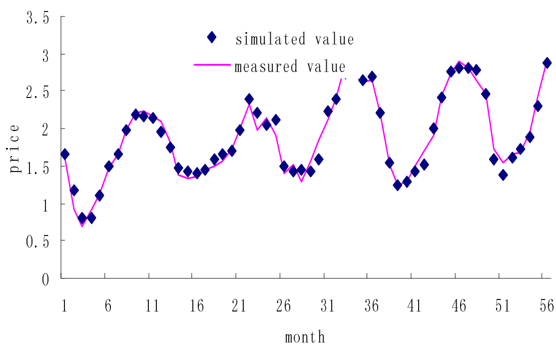

Fig. 2. Simulation result of BPNN

Calculate the mean absolute error (MAE) between measured value and simulated value, predicted value. In the figure above, the MAE of simulation is 0.046%, the MAE of prediction is 0.15%. Beside few point has greater error, on the whole, it is accurate on price trend prediction. It also indicates that BPNN has the reference value for the price prediction of Lentinus edodes.

4.2 Simulation and Prediction Analysis of Neural Network Based on Genetic Algorithm

In this model, the chromosome group is 30, optimization goal is 0.5. Optimization algebra is 3,000. Its input value and output value are the same as BP neural network. The number of hidden layer is 15. Code the program in Matlab. Use the data of 2003 – 2007 to train model and the data of 2008-2009 to predict. The results are showed in fig. 3 and fig. 4:

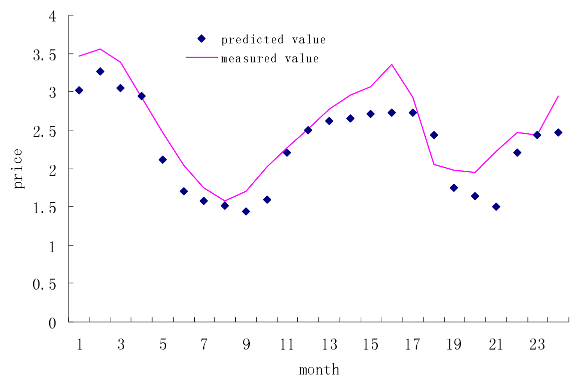

Fig. 3. Prediction result of neural network based on GA

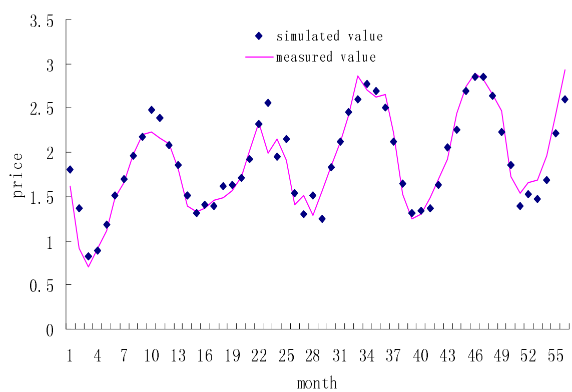

Fig. 4. Simulation result of neural network based on GA

As can be seen from the figure above, the simulation results of neural network based on GA is worse than BP neural network. Its MAE is 0.075%.The prediction result of neural network based on GA is better than BPNN, the MAE is 0.114%.It shows that the simulation ability of neural network based on GA is worse than single ANN. However, its generalization ability is stronger than the neural network model, and with good results in forecasting.

4.3 Simulation and Prediction Analysis of RBFN

The input value and output value of RBFN is similar to BPNN. The number of hidden layer neurons is 50. Optimization goal is 0.1.Code the program in Matlab. Use data of 2003 – 2007 to train model and the data of 2008-2009 to predict. The results are showed in fig. 5 and fig. 6:

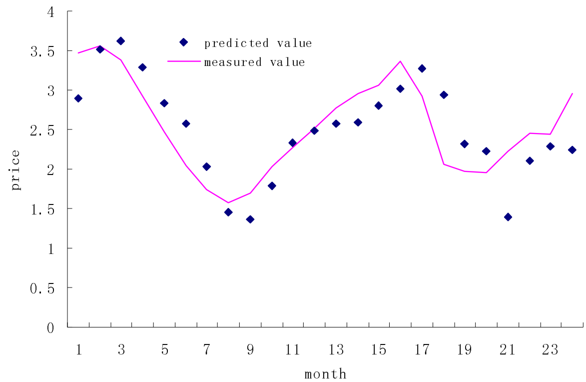

Fig. 5. Prediction result of RBFN

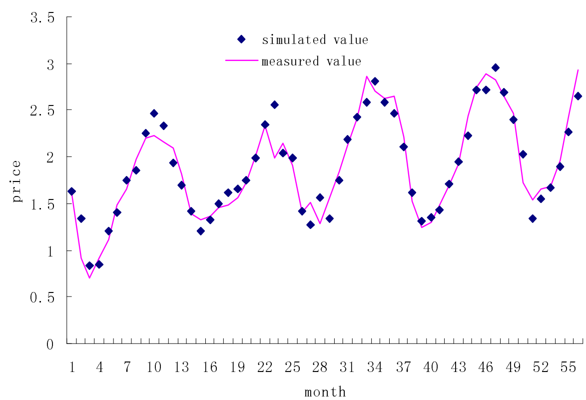

Fig. 6. Simulation result of RBFN

In the figure above, the simulation results of RBFN is worse than BPNN and near by neural network based on GA. Its MAE is 0.071%. Its prediction result is closed to BPNN and worse than neural network based on GA. The MAE of prediction is 0.144%.

4.4 Simulation and Prediction Analysis of Integrated Prediction Model

Use the data of 2008 to train model and the data of 2009 to predict, the result is as below:

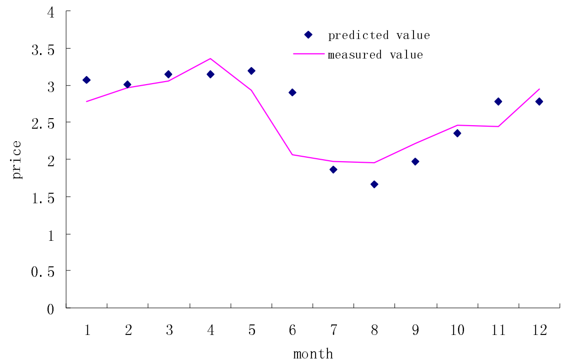

Fig. 7. Prediction result of integrated prediction model

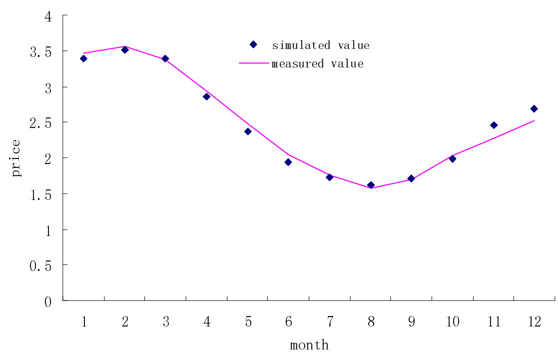

Fig. 8. Simulation result of integrated prediction model

The result show that, using integrated prediction model, the MAE of simulation is 0.059%. It is better than neural network based on GA and RBFN, and worse than BPNN. The MAE of prediction is 0.106%. It is the best of all models.

Apply the four models to predict the market price of Lentinus edodes in 2009, the absolute error is showed in the fig. 9:

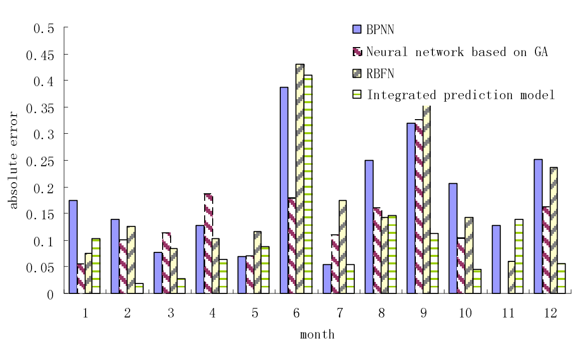

Fig. 9. Absolute error of four models

The percentage of the number which predicting absolute error is greater than 20%, 15%, 10%, in the total predicting number, is displayed in table 1:

Table 1. Comparison of predicting absolute error distribution of different model

model	>20%	>15%	>10%
BPNN	33.3%	50%	75%
Neural network based on GA	8.3%	41.6%	75%
RBFN	25%	33.3%	66.7%
Integrated prediction model	8.3%	8.3%	41.6%

As can be seen from the table, whenever in prediction, the results of integrated prediction model is equal or better than other three models. And then, the neural network based on GA is followed by. The performance of RBFN is worse than the neural network based on GA. BPNN is the worse of all.

5 Conclusions

To the vegetable price of Beijing wholesale Market, three models which are the BPNN, neural network based on GA and RBFN are established separately. Based on that, an integrated prediction model is constructed. Take Lentinus edodes price as experiment data, some conclusions is as follows:

(1) BPNN is good at simulation, but relatively poor at prediction. On the whole, it has accurate prediction on the trend of vegetable market price, and can offer a reference to prediction of Ledodes market price.

(2) The simulation ability of neural network based on GA is worse than BPNN. But its generalization ability is good, predicting accuracy is better than BPNN.

(3) The RBFN has a similar simulation capability with neural network based on GA. Its forecasting result is better than BPNN, and worse than neural network based on GA.

(4) The integrated prediction model utilizes the advantage which is provided by single predicting method, obtains the best prediction accuracy. It can improve the performance of agricultural market price prediction effectively.

The application based on the theory of ANN and GA can offer a good result for the agriculture production price predicting. In this paper, the price data itself is only considered to construct models. Further research is required for improving the accuracy of prediction. For example, more influential factors need to be considered, and the influence percentage of each factor needs more investigation.

Acknowledgements

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Research on the Application Integration Model for the Agricultural Enterprise of Integrative Production and Marketing

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Abstract. To integrate application systems under heterogeneous environments has gradually become a pressing demand for most agricultural enterprise. The vast diversity of implementation technologies increases the complexity of applications integration. With the aim of facilitating the development of integration solutions, we propose the specification of application integration. To achieve this, we analyzed the current situation of information, the environment of application systems, and the specific requirements of integration. We also studied the integration technologies. And then the ESB-SOA model for the agricultural enterprise of integrative production and marketing was proposed on the basis of a number of advanced technologies, such as ESB, SOA, EAI and Web Service. Based on ESB and SOA technologies, the model is able to utilize and integrate effectively various service resources on the geographically distributed computing environments. And through intelligent agent technologies, it supports cooperation and coordination mechanisms for the service activities. To exemplify and validate the profile, a case study is presented in which the proposed profile is used.

Keywords: agricultural products; production and marketing integration; management; information; heterogeneous environment.

1 Introduction

With the extensive application of information technologies, the information of agricultural enterprises that integrative production, process, circulation and marketing have also entered a new phase. For a long time, different departments in different production processes applied different information systems, resulting in the heterogeneous environments that a variety of hardware devices, operating systems, databases, network protocols coexist. Due to lack of standardization and compatibility, it is difficult to share information resources and there are many "information islands", applications integration has become an urgent demand for enterprise development [1]. How to use advanced information technologies to share resources in all production

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processes is a common problem for many enterprises of integrative production and marketing. In addition to study application systems under the heterogeneous environment in integrated production and marketing agricultural enterprises, an integration model is presented based on ESB (Enterprise Service Bus) and SOA (Service-Oriented Architecture).

2 Enterprise Application Systems Analysis

The integrative production and marketing of agricultural products refers to "on the professional basis, agricultural products production and marketing departments are integrated into a unified whole in the economy and organization, that is, the production, marketing, processing, storage and transportation of agricultural products are united in a joint operation in large enterprises, so that the whole process completely reach organic integration and coordinated development" [2].

However, the lack of planning, distributed disorder, departments division, there are a variety of information systems coexist in the integrative production and marketing enterprise. Among information systems, the development platforms, data storage, network protocols and operating environment are heterogeneous, which resulted in duplicate construction, waste of resources, information block of enterprise systems, and so on. For example, as shown in Fig.1, there are a variety of information systems that are independent of each other coexist in a vegetables enterprise of integrated production and marketing.

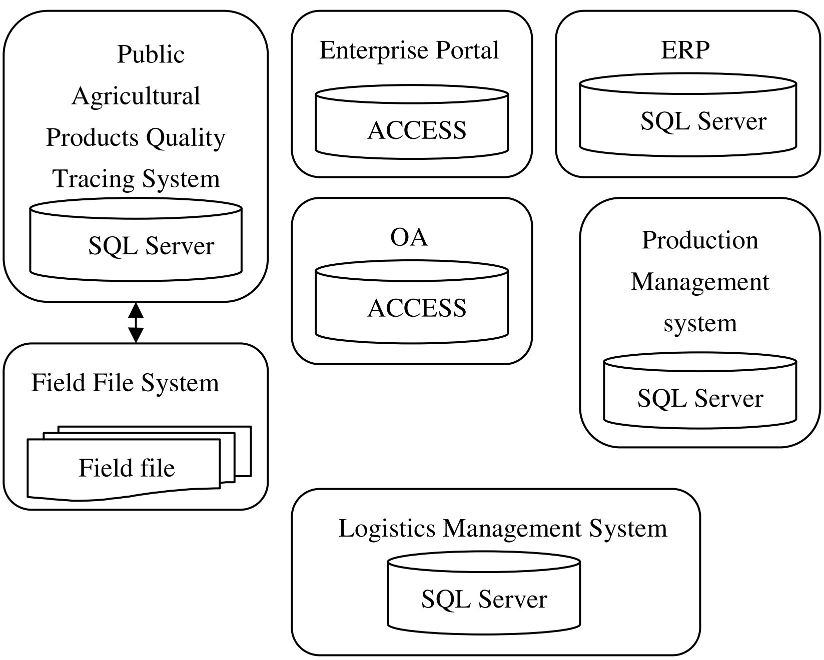

Fig. 1. Information Systems in an enterprise of integrated production and marketing

Whether within or between internal and external systems, each system is basically independent of each other. In this way, the following problems are inevitable: (1) The same type of data spread across multiple systems, not a single application can access to all data; (2) There is no unified data model, business personnel can not get a global data view; (3) Different applications can't share data and services, this will result in duplication of development; (4) System can only provide data in accordance with fixed demand, when the user needs a particular type of new data, the system can not automatically adapt [3].

Referred to above present "information islands" problems for most integrative production and marketing agricultural enterprise are facing, this paper propose a enterprise application integration model based on SOA and ESB. The model is used to complete the task that the system can not complete alone, and to solve the information integration and exchange problems in some cross-system and cross-databases. Thus, more comprehensive services are provided to the various departments of agricultural enterprises.

3 Applications Integration Model Design

Service Oriented Architecture is an architectural paradigm for components of a system and interactions or patterns between them. A component offers a service that waits in a state of readiness. Other components may invoke the service in compliance with a service contract [4].

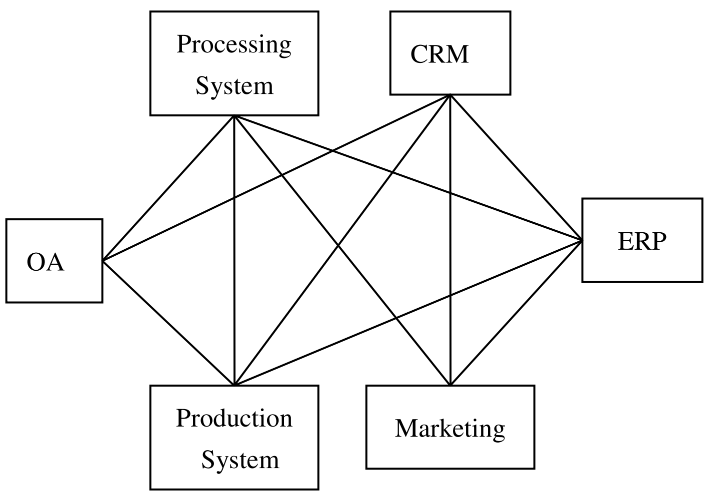

Fig. 2. Point-to-Point service integration

Suppose all IT resources are refined into service and published, and services can call each other, so that you can call .Net service in the J2EE environment, but this also can be done without SOA. As long as the two IT systems recognized each other's way, it also enables that point to point interconnection even if there is no public or uniform service interface. So we have to admit, if we own service, but the requestor and the service providers are still in need of such the explicit call of point to point between them, then this is not a typical SOA framework. The participation of both services still have to establish the link one to one, this does not meet our scalability, flexibility requirements [5]. As shown in Fig. 2.

Facing continuing expansion, a tool to manage these services is necessary to simplify the deploying and accessing of services in the system integration process. ESB (Enterprise Services Bus Enterprise Service Bus) is generated in such demand which is popular in the System Integration currently. Whether internal or external users to access various data sources at the time based on point to point manner. Truly reflects the concept of SOA, everything is service, service bus (BUS) in an equal position. And it has good scalability. The concept model of ESB-SOA is shown in Fig. 3.

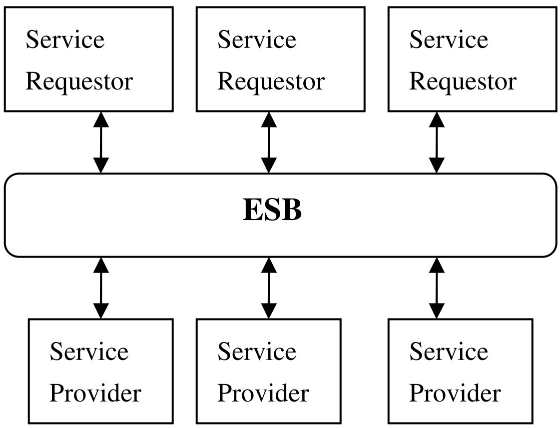

Fig. 3. Enterprise Service Bus Concept model

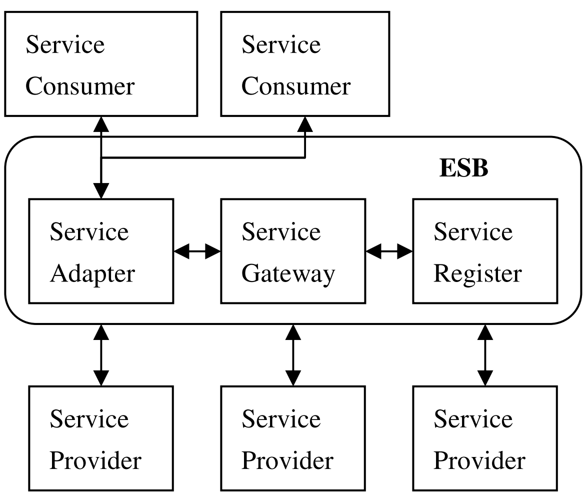

Fig. 4. Enterprise Service Bus architecture

ESB is composed primarily of by three main parts: the service gateway (Service Gateway), service adapter (Service Adaptor), service registries (Service Register) [6].

1. Service Gateway is a core component in ESB. Its main role is responsible for such as routing and interactive of services.
2. Service adapter is an important part of ESB, which bears the protocol conversion of message and services to implement different protocol formats of the interaction between services.
3. ESB also needs some service registry to provide help for service routing. However, SOA may still have a separate business services directory, its most basic form may be the services directory in designing, and it's used to achieve the reuse of services in development activities.

3.1 Service Adapter

The function of service adapter is to find, bind, and call web services, and so on. So that the client calls web services in back without knowing the details, and accesses to local or remote web service transparently. Fig. 4 describes the implementation of principles of Service Adapter. The Service Adapter consists mainly of three major processing units.

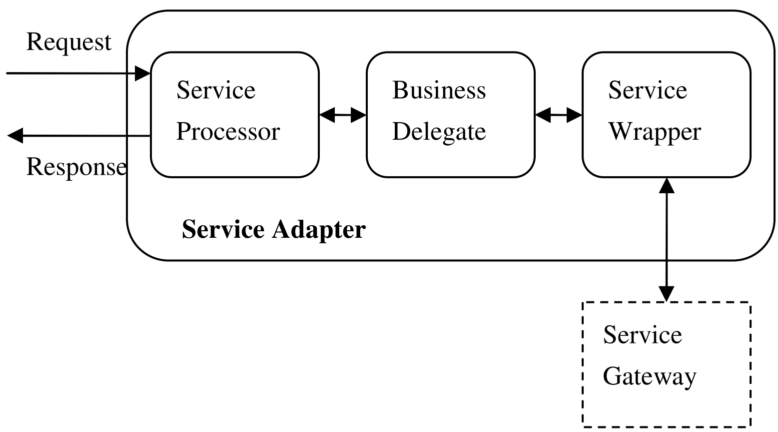

Fig. 5. Service adapter schematic

1) SP (Service Processor): It is used for receiving and parsing SOAP messages passed over the TA (transmission adapter), processing security, such as digital signatures and encryption.
2) BD (Business Delegate): It is used for controlling the business calling. All business requests are completed through calling for service wrapper.
3) SW (Service Wrapper): It wraps the discovery, binding, calling web services in a unified package, thus to shield the details of various web services.

Service adapter first receives the SOAP message from the transmission adapter (TA), and then parsing SOAP messages for security processing (such as SOAP digital signatures and encryption, etc.), then the SOAP message are passed to the business agent, business agent get corresponding semantic descriptions of each web service WSDL address by looking up the corresponding semantic function, and resolve the semantic description.

3.2 Service Gateway

Service Gateway design is shown in Fig.6 includes the following components:

1. Service Processor: It operates the message in security and transmits it to the business agent to deal.
2. Business Agent: It is used for controlling the business call, all business requests are completed through it calling for service manager.
3. Service Manager: It wraps the discovery, binding, calling web services in unified package, thus to shield the details of various web services.

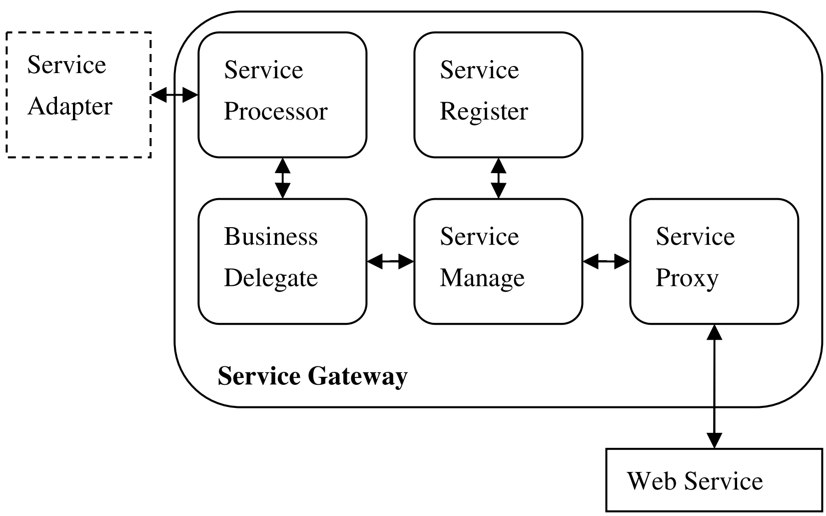

Fig. 6. Service Gateway

The following is a comprehensive description of the Service Gateway:

1. Service consumer sends a request to Enterprise Service Bus (ESB).
2. In ESB, Service Adapter completes protocol conversion. Then, the converted request is send to Service Gateway.
3. The request is parsed in Service Gateway's Service processor and Business Delegate and passed to Service Manage.
4. The request parameters, and important data in the Service Manage have been resolved will be stored in a service-oriented types data.
5. Service Manage gets the binding information and the relative position of service by querying in Service Register. If there is no appropriate information of services, an error message is returned to service consumer.

6. Query results are returned to Service Manage, and then the result as a parameter saved in the Data Window together with the request parameters will be passed to Service Proxy module.

7. Service Proxy module is responsible for calling the appropriate service implementation, and to call the results back to the Data Window and reset the parameters.

8. Service Manage returned the response results to the service processor and Business Delegate.

9. Service Processor will return response back to Service Adaptor, and then returned to service requester by Service Adaptor.

In summary, the dynamic service discovery and routing are achieved through Service Manage, and seamless integration of applications is achieved using Service Proxy.

3.3 Service Registry

Service is resisted and discovered through the service registry UDDI (Universal Description Discovery and Integration). UDDI uses XML to describe the service provider and the provided of web service, dynamic bind and call service.

In ESB-SOA, the core class of the service registry is “serviceBusportal”, using the “plug-in - Service” configuration file defines the name of the service and location to achieve the service's registration.

Service registration: users publish their own services to the ESB-SOA system registry. The released service of should have service information and service provider information.

Service discovery: the client user sends queries commands and the command is transferred to the class “serviceBusPortal” in center for registration, and then the service will be found according to the location of service defined in “Plug-in-service” configuration file.

Service binding: After found the service, “ServieeBusPortal” load the corresponding service dynamically.

The relationship between them is shown in Fig. 7:

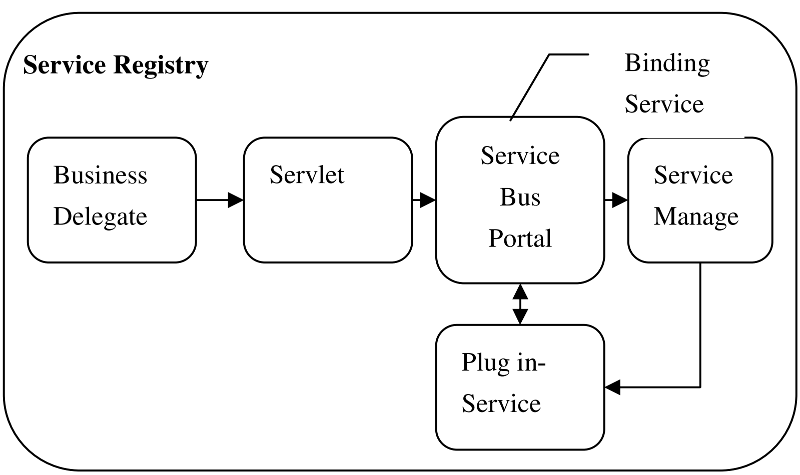

Fig. 7. Service registry

3.4 Log Management

Log service management model is based on Message Service, and uses asynchronous approach. When you need to register log, processing component calls for the API of recording information provided by log service, and then log information will be insert into the log queue by the API. Because it is asynchronous approach, so insert the log information to the log queue to get the response message will not be blocked. Message Service monitor log queue listens from time to time, when log information is inserted into the log queue, Message Service listener extract log information from the log queue and write to back-log database by Log Adapter in accordance with the standard format, and then delete the log queue processed log information. When query log, the APIs of log services access the log database through the Log Adapter, and get the specified level of log information. Log management implementation is shown in Fig. 8.

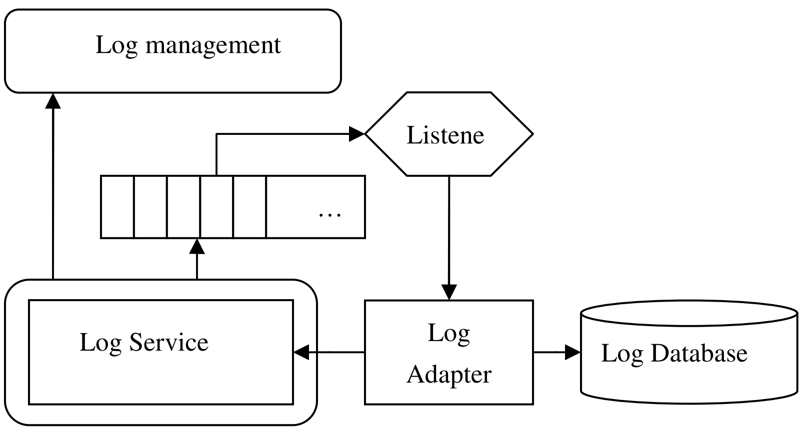

Fig. 8. Log management

4 Model Application

Beijing Tian An Agriculture Development Co. Ltd is a production and business-oriented vegetable agricultural enterprises, after years of information establishment, several information systems have been established, such as ERP, Field Record Management System, Vehicle Transportation Control System, Enterprise portal, OA. However, each of them is independent relatively. And it is hard to share data because of the difference in development language, database. Meanwhile, the current system is mainly used in the enterprise, but the field planting, terminal marketing and sales are not managed in the way with information.

According to the actual needs of Tian An Com., we built enterprise application integration platform based on the above proposed ESB-SOA enterprise application integration model, and developed a mobile sales management system, sales management system, mobile production management system, production management systems, and integrated systems by applications integration platform. The application integration logic structure of Tian An Com. is shown in Fig. 9.

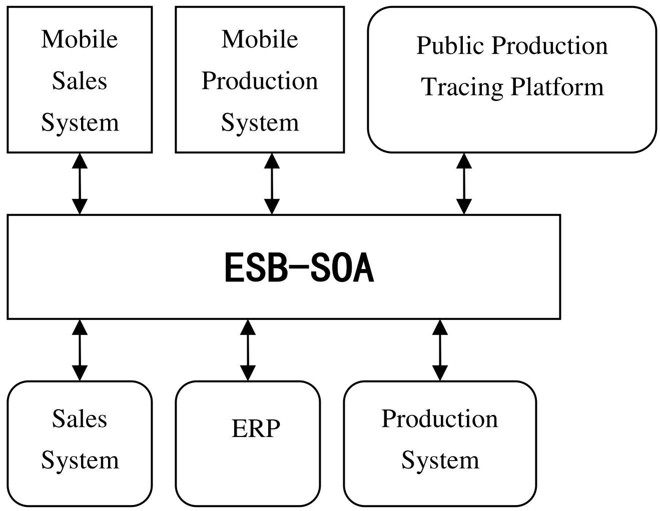

Fig. 9. Application Integration Logic Structure of Tian an Com

4.1 Production Application Integration

The production management of Tian An Com. is mainly related to the record of the field plant. On the one hand, the field record is sent to the enterprise's production management system, and then summit to the public quality tracing platform. Through the ESB-SOA platform, production management system registers records management services to Service Registry, mobile production systems sends a request to the ESB-SOA, the ESB-SOA finds production management services upon request information, and then the service calls for APIs to submit field file information to the service of production management system in the server. On the other hand, public quality tracing platform registers services to the ESB-SOA Service Registry, enterprise production management system sends a request to the ESB-SOA to submit a field record to the public quality tracing platform. Field records management flowchart is shown in Fig. 10, system implementation is shown in Fig. 11 and Fig. 12.

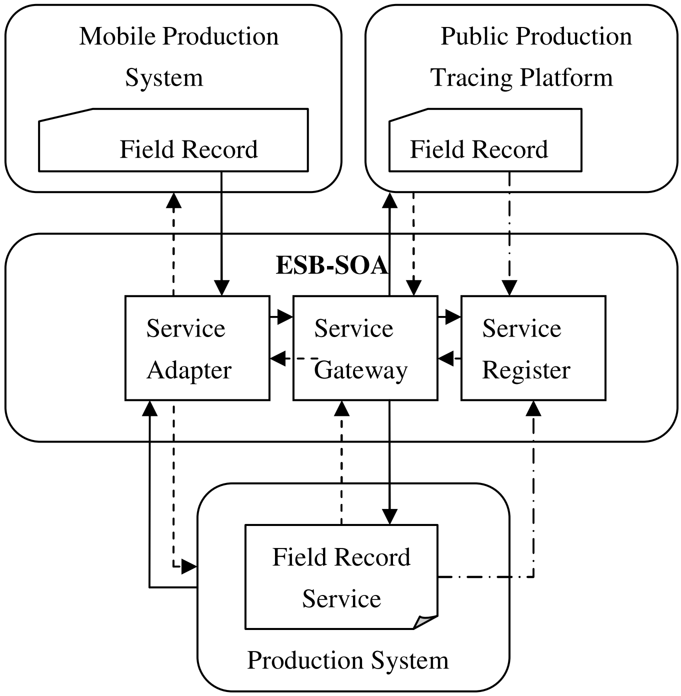

Fig. 10. Field Records Management Flowchart

Fig. 11. Mobile Production System

Fig. 12. Production System

4.2 Sales Application Integration

According the sales information need of Tian An Com., a mobile sales system and sales management systems in server are implemented. At the same time, sales management

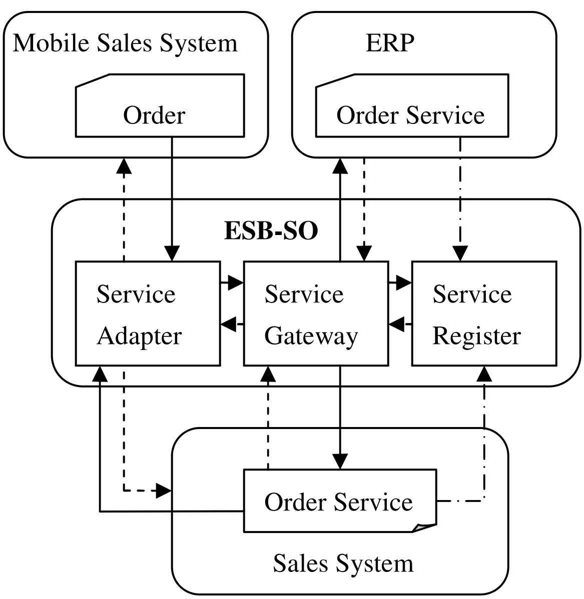

Fig. 13. The flowchart of sales management

Fig. 14. Mobile Sales System

Fig. 15. Sales System

system and ERP registered to Service Registry in ESB-SOA platform. Thus, mobile client sends request to the ESB-SOA to call for services to submit the order, and then the sales management system on the server sends request to the ESB-SOA to call for ERP service to submit the order. The flowchart of sales management is shown in Fig. 13, systems implementation is shown in Fig. 14 and Fig. 15.

5 Concluding Remark

Because of many production process and loose management, the agricultural enterprise of integrative production and marketing has special requirements for information. Based on the analysis of systems application status in the agricultural enterprise of integrative production and marketing integration, an ESB-SOA model of application integration is proposed based on SOA and ESB technologies. And on this basis, an application integration platform was implemented in Tian An Com. according to the ESB-SOA model. Thus, different departments in Tian An Com. could share data resources through the platform and interoperability among systems become possible. Moreover, information management is extended to plant record management in field and order management in supermarket. More important is that ESB-SOA has good scalability, and it is easy to plug and play for new application.

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A SaaS-Based Logistics Informatization Model for Specialized Farmers Cooperatives in China

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Abstract. The logistics informatization of Specialized Farmers Cooperatives (SFC) plays an important role in the development of agriculture, and Software-as-a-Service (SaaS) is the development trend of information technology (IT). Firstly, the state-of-the-art of IT on SFC and the enlightenment SaaS to the IT application in logistic are introduced. Then, analyzing of the characteristics of logistics management system for SFC based on SaaS, we explore a SaaS-based logistics informatization model for SFC in China, and some key technologies to model application are also discussed, such as software architecture, system security and data modeling. Finally, some suggestions are put forward for a large-scale promotion of the model.

Keywords: Informatization, SaaS, Model, Specialized Farmers Cooperatives, Logistics.

1 Introduction

Along with the continuous development of SFC and agriculture, as the intermediary organizations that connect the markets and farmers, cooperatives play an increasingly significance affect in agricultural logistics [1]. The application of information technology has improved the logistics management level of SFC .It also has brought about the healthy development of the cooperatives. However, information talent shortage, information infrastructure imperfect and high information costs become the bottleneck of information technology for SFC at this stage.

SaaS is a new kind service mode of Software that provides a new strength for informatization construction for SFC [2]. The products based on SaaS have some prominent advantages and characteristic, such as good expansibility, easy extensibility, strong flexibility and low using threshold [3]. To solve the existing problems in the process of IT construction, we will explore the service model of logistic information suitable for SFC based on SaaS. The feasibility and implementation plan of realizing agricultural logistics information on SaaS mode is studied in this paper according to the agricultural logistics management system for SFC.

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2 Status of Logistics Informatization for SFC

As the main implementing subject of agricultural information, SFC is also the most important link in the agricultural informatization chain [4]. By the end of 2009, there are 246.4 thousand farmers' cooperatives with 21 million households (accounting for 8.2% of total households) registered in the industrial and commercial management department accordance with law. The services expand gradually from the production area to the circulation and processing integration business. Information technology builds an important platform for improving the logistics management level, the service level and the marketing ability of SFC to meet the unceasingly scale expansion and functional improvement and service quality improvement of SFC. The IT in logistics can provide real-time logistics information for SFC. It can help cooperatives make a scientific decision to reduce blindness in logistics and improve the efficiency and economic benefit, etc. Anyhow, the construction of IT for logistic can accelerate the development of SFC.

Agricultural products logistics information is an important content of the SFC of informational management. It can promote the farmers' cooperatives, as well as can be good for the mode of informatization and scientific management of cooperatives [4]. Introducing a modern management mode of enterprise logistics to SFC can make the logistics management of cooperatives more standard and scientific. Agricultural products logistics management system for SFC can not only apply the information technology into cooperatives but also be extended to the information from production to marketing to realize information management.

Currently, the study on the IT for SFC logistics has carried out with a lot of achievements. However, in the process of IT construction there are a lot of questions as follows. Firstly, we are lack of information knowledge and talent even we have a stronger information consciousness. Secondly, information infrastructure is equipped perfectly, but access to information and information interaction are imperfectly. Thirdly, lack of funds became an obstacle to improve the level of logistics information. Lastly, stronger logistics information service demand but backward information service means, etc. The reasons are the underlying causes that restrict the IT construction for logistics has not been thought about deeply and the service model for logistic information hasn’t been explored. So, we have not gain the maximum efficiency of IT and the service model for logistic information hasn’t been explored.

3 The Enlightenment SaaS to Logistic Informatization of SFC

3.1 SaaS

SaaS is a unique and innovative hosting type application service. It also is a software application mode as the development of the internet technology and software. The main features of SaaS service mode is SaaS service providers purchase IT infrastructure and deploy IT environment, and enterprise purchase software services. Service providers deploy the software in his uniform. Then, customers can order the software services via the Internet according to their actual needs and get the service from the Internet, and pay fees via the Internet according to the service they ordered.

Service providers can ensure every enterprise data security and confidentiality through effective technical measures [5].

3.2 The Superiority of SaaS Applied in Logistics Informatization of SFC

Compared with the traditional software, SaaS has four prominent advantages such as low construction cost, low maintenance, low threshold and low investment risk applications. That is why it can cover a logistics information market. SaaS service mode applied in the construction of IT for logistics of SFC has the following advantages.

3.2.1 Low Level Demands

The demand of SFC to logistics informatization is low level, which accords with the concept of SaaS, as configurable, customizable and extensible concept [6]. Logistics informatization of SFC is mainly to the underlying basis of information. That needs the information products can immediate access to data, respond quickly to market, improve decision making and seize the opportunities before us. Because of the small business coverage, SFC doesn't need the large and comprehensive information products. SaaS makes SFC purchase and expand its modules online, and enjoys information good results with muti-function and low cost to minimize the "chicken ribs" effect that traditional software produces [7].

3.2.2 Regional and Diversification Needs

Logistics of SFC serves farmers and members. It needs automation and active service in order to ascend cooperatives' logistics service ability and reduce cost [8]. This is a primary problems that the construction of IT for logistic of SFC to solve. But the traditional software system cannot adapt to rapid market changes and maintain advancement of the present situation of information technology. This is determined by the traditional software model. The system framework of SaaS follows the configurable, extensible, customizable features of open architecture. According to the market and the demand on logistics services, cooperatives may order the corresponding software services to reconfigure system from the service provider to serve market and farmers better. It also can customize individualized function according to the logistics business to support a rapid development of logistics business.

3.2.3 Comprehensive Services

SaaS mode will make it possible that different stages of the supply chain and different types of SFC provide services collaboratively. Currently, the SFC has a smaller coverage, mostly just involving a small portion of content in agricultural industrialization chain. As a single type of service providers, cooperative itself is unable to finish all the service requirements throughout the supply chain. Many services require other cooperatives for collaborative operation. While traditional software system flow is hard to breakthrough the border among cooperatives. There would be a lot of the repeated work because of the information in a large share on the supply chain link. The logistics efficiency and service capacity of cooperative cannot have a fundamental improvement. Therefore, SaaS has a good applicability to the cooperative with logistics service function.

Presently logistics business of SFC mainly embodies the characteristics of low concentration in the cooperation, the low degree of logistics information and the low output of IT construction for a shortage of funds and so on. But all of these are very conducive to the development of the SaaS in cooperatives. SaaS mode makes cooperatives in logistics information process can enjoy lower investment returns, and reduce the high difficulty in the logistics information to help cooperatives build an information era in a short time. It will bring into a greater profit, and play the logistics service function fully.

4 SaaS-Based Logistics Informatization Model for SFC

Analyzing of the characteristics of logistics management system for SFC on SaaS, we explore a SaaS-based logistics informatization model for SFC. The model full considers the features of logistics management system, such as individuation, integration, differentiation, etc. The key technologies for model application, as software architecture, system security and data modeling have also been explored. The structure of the model is shown in figure 1.

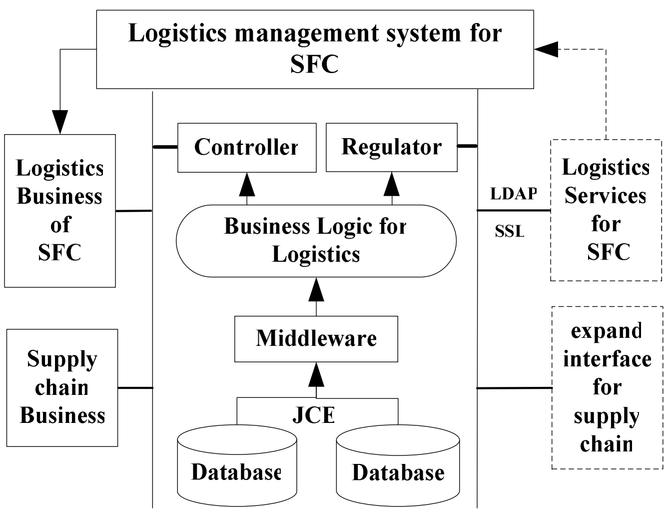

Fig. 1. SaaS-based logistics informatization model for SFC

4.1 Model Analysis

The emergence of SaaS to SFC opened a road leading to the information. But there are some difference between the characteristics of information product in SaaS mode and traditional mode. The model firstly extracts logistics business process, and then screens and integrates services through the controller and regulator, finally generates logistics information product. The model takes agricultural logistics business of SFC as a prototype with the following features.

4.1.1 Various Complexity and Individualized Multi-user Interface

The main business of farmers' cooperatives involves agriculture, forestry, animal husbandry and fishery, covering many fields of farm products production, storage, processing, marketing, etc. Different types of agricultural logistics management system have more than one difference in logistics links, logistics subject, logistics packaging and logistics information mark, etc. Fully considering logistics demand in different main business model of cooperatives, the model provides a multi-user interface to cooperatives with personalized and free. Cooperatives can distribute characteristics of agricultural logistics management and logistics information subject, according to different kinds of agricultural logistics. For some cooperatives with more complex business in agricultural varieties, the model offers a variety of different complexity system interface. The agricultural logistics management system based on the model can satisfy the concern and emphasis of different types of cooperative.

4.1.2 Expanding Business Logic

With the cooperation of a chain logistics link to the full extension, narrow supply is becoming to general logistics. So, the whole process and scientific management of agricultural products supply chain will become the most important content of the operation mode and cooperative information. The model should first meet the need of the application of IT for logistics, and then, should have the business expansion logic function, allowing the system based on the model can be extended to the information along industrial production management and marketing.

On the basis of the supply chain, production and sales of agricultural products, the model hold on the basic information of the system from the production links to the sales link. The integrated logistics supply construction management system based on the model to realize the full information management, supply and the industrialized operation of agriculture, production, circulation, processing and sales link organically, effectively solve the cooperatives in industry production and marketing problem.

The range of logistics management system on SaaS can be extended to the production before, during and after the process, and have online transactions and real-time management etc. The system also can monitor each loop from manufacturing to market sales, and will largely enhance the ability of driving and marketing.

4.1.3 Flexible Data Structure

The most challenge that different cooperatives use the same software system installation examples in SaaS is how to create multi-user data model, and to support the different data structure. Cooperatives order their logistics management software according to their management way and the system execute the business absolutely with a bigger difference way. Different business process requires different data structure. For the characteristics of Cooperatives for dispersive location, main business involving multiple fields, no unified standard features and so on, the model achieve several sets of data structures support through the corresponding relationship of real data structure and logical data structure. A logistics management system which constructed for farmers' cooperatives based on this model is very flexible software.

4.2 Model Application

Considering the main and expansion of business that the model application may involve, the applied mode and realization technology of the model are discussed. The structure of the model application is shown in figure 2. The point a logistics management system in SaaS to apply successful is the system architecture, service oriented architecture and data safety. One isolate design according to the key problems is given below by the model.

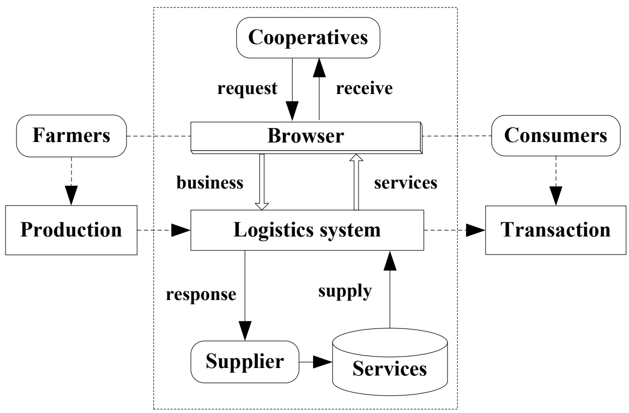

Fig. 2. The structure of the model application

4.2.1 Service Oriented to Build Software

The system architecture of SaaS is based on service-oriented architecture. The business process is decomposed into service components. And then it builds various service modules by the specific implementation technology [9]. First, the design of business-driven can more quickly meet logistics management requirements of different main business of cooperatives. Second, it can improve system reusability according to the logistics demand for change quickly and low price update service. Third, it can integrate the service of the logistics management system for SFC and other services in the supply chain, and finally realize the integration of brands.

4.2.2 Multilevel Security Architecture Design

The responsibility shift of data management on SaaS mode makes safety priority higher in the software architecture. In data security, secure socket models use secure socket layer (SSL) [10] to protect data transmission in order to ensure the safety, reliability and safety, under the premise of minimizing the safety factor of influence on system performance. On safety design of authentication and authorization, in order to improve the system integration and user authentication efficiency, the model uses lightweight directory access protocol (LDAP) to unified manage user authentication information. On data security, the model makes use of Java cryptographic key data extensions (JCE) to implement encryption and decryption.

4.2.3 Adaptive Data Isolation Strategy

Procedures and databases are requested by SaaS mode to build in multi-user models and make independent between cooperatives [11]. Middleware provides a new concept for SaaS mode [12]. It can effectively shield in different database system access method and the user interface, also provide users with a public interface of distributed database access of heterogeneous platform. The model design which based on middleware according to the characteristics of a business, can make the logistics business of SFC logic layer to handle database data with unified way, and make the data more flexible. Cooperatives that have a low safety requirements and a small amount of data will use a shared database. And the exclusive one will be used for safety requirements.

5 Conclusion and Suggestion

The informatization for SFC is of great significance for the rapid development of cooperatives and the promoting of IT in agriculture. The paper analyzes the characteristic of agricultural logistics management system for SFC and explores the construction of IT technical scheme for SFC. But because of the later of starting, narrow range of logistics business scope, low level of IT for SFC, and the application status of SaaS in agricultural logistics field, the model of large-scale applications needs to consider long-term strategic objectives. It should be used in a certain types of cooperatives, such as greenstuffs. Along with the continuous development of logistics business of SFC and the gradually complete of SaaS mode, the logistics information products for SFC based on SaaS will have broad development prospects.

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Study on Acoustic Features of Laying Hens' Vocalization

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Abstract. In this paper, vocalizations of laying hens (Hyline Brown) were focused. An experiment was designed to obtain acoustic features of laying hens with different ages: 35days-old, 95days-old and 125days-old. Vocalizations were recorded by the microphone MPA201. Analysis was done by some analytical software in order to gain time-domain features and frequency-domain properties of laying hens' sound. The duration time, pitch frequency, formant track and spectrums of vocalizations were all included. Results showed that some characteristics of vocalizations of laying hens with different ages were dissimilar when under given state. It was proved that the vocalization of laying hens could be recognized and identified.

Keywords: vocalizations, spectrums, laying hens, time structure.

1 Introduction

Vocalization is a common response to the emotional state of an animal, which could be used to attract the opposite sex, search companions, look for food, convey danger signal, play and communicate with each other. Study on the vocalizations of animals is not just to identify wild animal species, but also the physiological state of livestock and poultry can be monitored (He et al., 1996; Jiang et al., 2003). The characteristics of animals' sound were concentrated, especially the time-domain features and frequency-domain properties (Sanvito et al., 2007). Which could provide a theoretical basis for the establishment of voice-based animal welfare assessment system and health warning system by deep study of animals' vocalization.

Vocalizations of laying hens are quite different when under distinct patterns. Laying hens were thought to express an expectation of a rewarding event through a specific vocalization, which could serve as an indicator of laying hens' welfare (Zimmerman et al., 1998; Manteuffel et al., 2004). Vocal expressions of 50 chicks were analyzed during step by step social isolation. Results showed that vocalizations of laying hens were strongly dependent on social contacts and could be changed when under different degrees of social deficits (Marx et al., 2001). Pecking behavior in individual and social condition was compared in two lines of laying hens at ten

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different ages. Vocalizations were recorded as well to measure the response to isolation in the test (Rodenburg, et al., 2003). This study was to analyze the acoustic features of vocalizations of Korean native cows and to examine the differences between estrus and feed anticipating vocalizations (Seong, et al., 2006). The fear reaction of three different genetic strains of laying hens to a simulated hawk attack in a free-range system was tested. It was concluded that they were similar in the behavior or vocalizations (Christina et al., 2005; Zeltner, et al., 2008).

At present, research to the relationships between vocalizations of laying hens and their living behavior were studied more. But the characteristics of laying hens (Hyline Brown) were not focused so much. Here was illustrated a simulation of flat breeding model of laying hens in laboratory. An experiment designed was to obtain the acoustic features of vocalizations of laying hens (Hyline Brown) to find the changes with different ages.

2 Materials and Methods

2.1 Animals and Data Collection

The amount of animals used in this experiment was 30 laying hens. The breed was Hyline Brown (U.S. standard). Ten were 35days-old, 95days-old were ten and the others were 125days-old. They were housed in a 1.5×1.0×1.0m (length× width× height) breeding pen respectively. The temperature inside the pen ranged from 20 to 30℃ at a relative humidity between 35 and 45%. Laying hens were placed under 8h light/16h dark (lights on 09.00) using a 25W incandescent electric bulb in each pen (Christina et al., 2005; Seong et al., 2006). They were free to drink and eat. Vocalizations of laying hens were recorded from November to December in 2007. Every record lasted 0.5h with half-hour interval from 09.00 to 17.00 each day. All vocalizations were collected using a microphone (MPA201, Bswa Technology Ltd, P.R. China) set at the top of the pen.

2.2 Sound Measurement

Sound was sampled by the PXI test platform (PXI-1050, National Instruments Ltd, USA) at a rate of 44.1 kHz using a 24 bit sound acquisition card (PXI-4472B, National Instruments Ltd, USA). The sound files were analyzed using Cooledit Pro 2.1 (Syntrillium software, 2003) and Praat4.6 (Boersma P & Weenink D, University of Amsterdam, The Netherlands). Cooledit was used to edit the sound files which served for the analysis of vocalizations by Praat (Zimmerman et al., 1998; Marx et al., 2001). Main algorithm in the acoustic field developed by Praat which can be used to obtain time-domain features and frequency-domain properties of vocalizations of animals.

2.3 Statistical Analysis

All statistical analysis was performed using SPSS 16.0 for Windows (SPSS Inc., 2005).

3 Results and Discussion

Vocalizations of animals are similar to human language, which have complex changes and different meanings (Chen et al., 2009). But animals can't speak out by themselves like human. So it is very important for people to understand what meaning of the vocalization of animals. Voice processing technology can also be used for animal research.

Generally, sound of laying hens is mainly composed of monosyllabic tweet. The syllable frequency of the sound of laying hens will be changing when under different stage ages. Digitalizing the vocalizations of laying hens need to treat the monosyllabic tweet as an identification unit (Wang et al., 2005; Mair et al., 2000). In data processing, vocalizations of laying hens with different ages were randomly selected to execute syllable segmentation. Four-hundred and fifty calls were selected in order to get the acoustic characteristics of laying hens.

3.1 Time Structure

Wave and frequency of laying hens on 35days-old, 95days-old and 125days-old were shown below. Spectral envelope curve of laying hens' vocalizations were typical. The pitch frequency of laying hens was not less than 5000Hz.

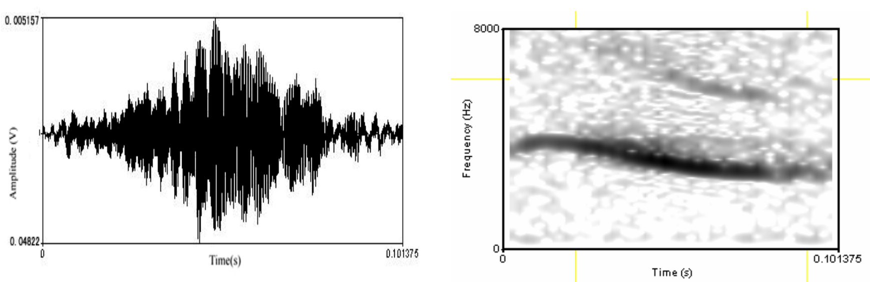

Fig. 1. Wave and frequency of laying hens on 35th day

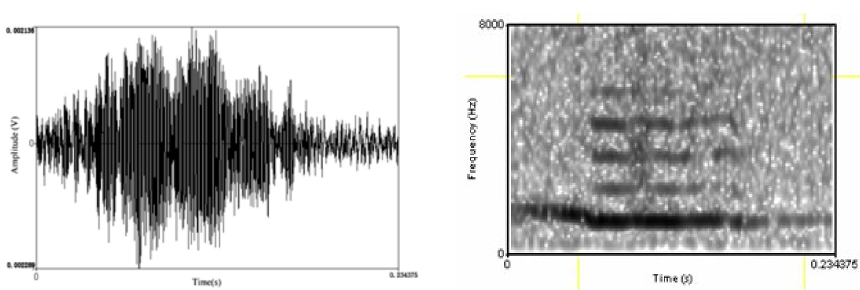

Fig. 2. Wave and frequency of laying hens on 95th day

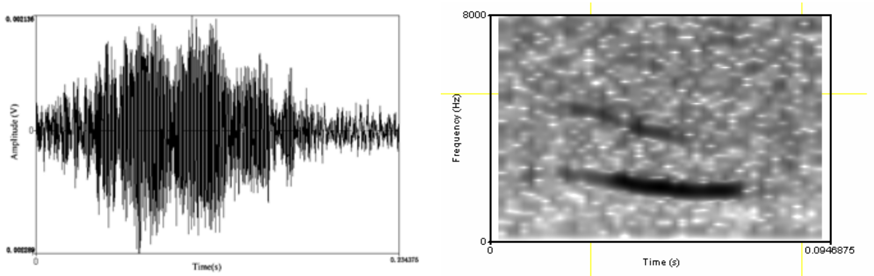

Fig. 3. Wave and frequency of laying hens on 125th day

The syllable duration of laying hens was distributed between 50ms and 200ms. The durative time of vocalization with 125 day old and 95 day old was significantly less than 35 day old. No distinct differences were found between 95days-old and 125 days-old of laying hens.

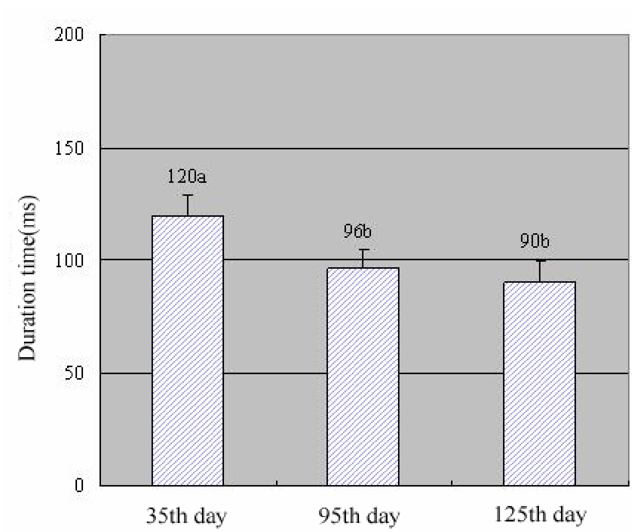

Fig. 4. Duration time of laying hens under different days

3.2 Spectrums

The following chart revealed the spectrums of laying hens with different ages. From the illustration we can inform that the spectrums of laying hens were relatively simple. The composition of each syllable slightly differed. But there were significant differences among the energy center on sound of laying hens under different days. The frequency of energy center of laying hens were more than 2000Hz, on 125th day was the highest, 35days-old was lower, and the last one was 95days-old. It is possible to judge which growing period of laying hens through analyzing the energy center frequency of their vocalizations.

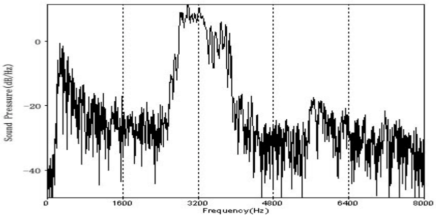

Fig. 5. Spectrums of laying hens on 35 th day

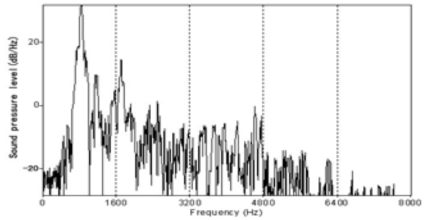

Fig. 6. Spectrums of laying hens on 95 th day

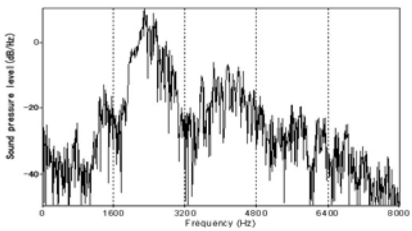

Fig. 7. Spectrums of laying hens on 125 th day

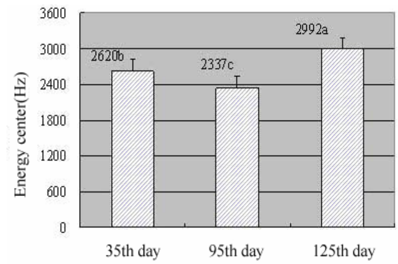

Fig. 8. Energy center on sound of laying hens under different ages

4 Conclusion

In this paper, vocalizations of laying hens (Hyline Brown) with different ages were analyzed and compared. From this, we could grasp the variation law of the basic characteristic parameters of laying hens' vocalizations. The results showed that the duration time and energy center on sound of laying hens existed with different ages under normal feeding; even the trend of variation was not the same. Therefore, we could understand the growing period of laying hens from the analysis of their vocalizations. But if we want to achieve automatic identification and classification, the representative acoustic feature parameters must be extracted. There provides as a theoretical basis for the establishment of voice-based animal welfare assessment system and body health warning system to improve animal welfare.

Acknowledgements

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A Study on Pig Slaughter Traceability Solution Based on RFID

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Abstract. Due to an assembly line production and poor environment conditions in pig slaughterhouses, collection of slaughter tracing information is not a simple thing. Based on the UHF radio frequency identification (RFID) technologies, this study designed a RFID tag for carcass, a RS232-PS2 data conversion line and some data norms such as the RFID carcass tag and partition meat label norm, and developed online reading and writing system for RFID tags, accomplished RFID identification for carcass and automatic identification on the slaughter line. Through identifying ear tags at the pig heading process, fixing RFID carcass tags at the half-carcass process, printing partition labels at pork exclusive stores, the study were able not only to collect, transmit and deal traceability information for pig slaughter in the key processes of the whole pig slaughter line, but also print a set of commercial cutting meat tags of 1D bar code based RFID carcass tag in the sales store. This study has been applied for demonstration in Tianjin and explored any possibility for application of RFID technology in pork quality traceability system from both technology and application links.

Keywords: Pig, RFID, Traceability, Automatic Collection.

1 Introduction

Since a case of the Bovine spongiform encephalopathy (BSE) occurred in Britain in 1986, zoonosis (BSE), highly pathogenic avian Influenza (HPAI) and food quality safety problems such as Sudan red powder, inferior milk powder happened occasionally and so have been paid wide attention[1-2].The first quality traceability system for animal products in China was the animal immune identification system began in 2002[3]. Following Animal Industry Act in 2005, the ministry of agriculture has promulgated “The measures on the administration of animal identification and farming files” (“the administrative measures”) [4], which put in effect on July 1, 2006. Implementing the administrative measures begins mainly to construct the animal quarantine traceability system and gradually to establish the traceability system of animal products quality and safety. The animal quarantine traceability system, the demonstration project of the ministry of agriculture, mainly adopted 2-D barcode technologies to identify animal individuals, took IC cards as mobile data carriers for animal quarantine, conducted identification in the cold-chain transportation,

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subdividing and packaging links and collection, transmission and switching of the traceability data by the GPRS communication, PDA identification devices and the remote central database[5-8]. This program mainly solved how to establish electronic farming files in the pig farming link, how to take the supervision and collect data in transportation of live pigs. But systematic official regulations for information collection in the swine slaughter link and the pork sale link was not found due to different administrative departments. Therefore, technically to explore reliable identification technologies of intermediate-to-end pork products such as the slaughtering link and data collection technologies such as core technologies about internet of things is an important content of constructing comprehensive tracking and traceability system for animal products, especially pork products in China.

Radio frequency Identification (RFID) is a contactless automatic identification technique and can identify target object automatically via radio frequency signal and obtain relative data. Based on the working frequency, it is divided into: low frequency system (LH,124～134KHz) with the characteristics of stable technical performance, strong penetrability and diffraction, cheap cost, but short reading distance; High frequency system (6～13.56 MHz) with a weak penetrability and diffraction, a long recognition distance, a better anti-collision ability, identification speed quicker than LH, bigger environmental impact; Ultrahigh frequency (UHF, 840~960MHz) RFID system with a good anti-conflict ability, strong penetrability, many times reading and writing, big memory capacity, low cost for passive tags, small volume, high reliability and long life, tolerance of poor environments, and convenient for using in assembly line[9-10].In practical applications, the earliest reports were respectively LF RFID chip implanted in piglets until the sale[11], or identifying pork carcass[12], UHF RFID (13.56MH z) applied in the slaughter link in a beef traceability system[13]. But, as to most of present assembly lines in pig slaughterhouses, environments were often worse than beef processing slaughtering line, such as dark and damp, and workers with a low cultural level were difficult to ensure entirely corrected identification if bar code identification was used and more manual intervention required. As for a LF or HF system, an effectively automatic identification and data collection system was not found up to now because of special characteristic of the slaughter line. Thus, this paper developed an UHF RFID data collection system being able to identify pig carcass and to get identification data automatically and continuously, and a pork quality traceability platform with the collection of identification data in the pig slaughter link, and realized an association with the breeding files record system in the pig breeding link and the data query system in the sale link, in order to build a tracking and tracing platform for the quality and safety of pig, and to explore a high efficient, reliable data collection solution in the pig slaughter link based on internet of things.

2 Material and Methods

2.1 Study Object

This study took pig slaughterhouses in Tianjin as a study model, pig and products as study objects and explored the collection solution of the slaughter traceability information of commercial pigs.

2.2 Traceability Ear Tag

According to the administrative measures stipulated by the ministry of agriculture, all pigs are required to wear a traceability ear tag with a unique identification number in the first vaccination, and establish breeding files (electronic or paper files) in the farm. When commercial pigs were purchased by pig slaughterhouses, traceability ear tags, the original area quarantine card and the vehicle disinfection certificate card were all checked. Only qualified pigs were purchased.

Identification code number According to the administrative measures, the unique identification number for pig consists of 15 digits, in which the first digit represents the type of animal, namely 1 for pig, 2 for cattle, 3 for sheep. The following 6 digits represent the administrative division code which division pig breeding farmer is located in and in line with the GB T2260-1999 (Dec 31, 2006)[14]. 8 digits from eighth to 15th represent an individual sequence number of the same type of animal breeding in the same administrative division. For example, a code number as "1 120111 00006008" means that breeding animal type is pig and the breeding administrative division is Xiqing district (120111), the sequence number of the individual pig is 6008. If the last number is not 8 digits, it should be supplemented to 8 digits by zero in order to make the code number up to 15 digits.

Traceability Ear tag Based on the above code rules, the type of ear tag as figure 1 was designed. A kind of special 2D barcode is engraved on top of the ear tag, which is identified by the special code reader. On both sides of the 2D barcode figure, there are code digits being able to be identified by eyes. On the top of ear tag is a 30mm^2 of circle area, the distance from the circle area at the top to the small round cone at the bottom is 25mm. The area of 2D barcode figure is 12×12mm^2.

Fig. 1. The special 2-D bar code tag used in China

Traceability devices for the ear tag The ear tag is key identification information for breeding information, moving information and monitoring information during pig production, and accurately collecting the pig ear tag information is required in order to make an association between the pig slaughter traceability information and the former pig breeding information.

Traceability Device for ear tag: Although digits on the traceability ear tag can be seen by eyes, 2-D bar code can only be identified by the special reader device with the 2-D decoding procedure. Two intelligent mobile PDA devices are authorized by the animal traceability administrative, the ministry of agriculture by the public bidding, which can identify the traceability ear tag for pig with a camera (fig. 2) [5]. The left PDA is based on Microsoft Windows mobile 6.0 and the right on Linux system. Information of ear tags can not only directly upload, but also temporarily save in the IC inserted into PDA devices.

In the fig. 3, there is a barcode scanner identifying 2-D barcode on the tracing ear tag, fit for the workplace with a computer terminal. Ear tag information identified not only saved in the connecting computer terminal, and also uploaded to a server database by the intranet. Its identifying speed and effect are better than that of the former two mobile intelligent PDA.

Fig. 2. Two types of PDA with reading camera

Fig. 3. Barcode scanner identifying the special 2-D barcode tags

2.3 RFID Carcass Tag

Pork carcass is intermediate products in the pig meat production chain, is a connecting link between pig individuals (pig breeding) and pork partition products (pork sales). Reasonably to identify carcass is a key part of realizing the whole pork production traceability.

RFID code number the cod number is 20 digits, the first 6 digits is the administrative code, 2 digits from the 7th to the 8th represent the sequence number of pig slaughterhouse in the administrative district, the following 8 digits show the date digit (yyyymmdd), the last 4 digits are the serial number of the same batch of slaughtering pig in the slaughter house. The most number of each batch slaughtering pigs is 9999. For example, as for 320021 01 20100327 0001, “320021” is the administrative code, “20100327” means that the slaughtering date is march 27,2010, “01” and “0001” respectively for sequence number of the slaughterhouse in the administrative district and pig individual in the slaughtering batch.

RFID tag Because there is an assembly line production in the pig slaughterhouse and the processing work is also in worse environments, adopted tags are required to be waterproof and to be able to read and write quickly. RFID tags was finally designed after many times of write and read test and waterproof test. In order to ensure write and read quickly in the line production, size of RFID chip was required to be considered. At the top of the tag was a rectangle hole for fixing tags.

RFID reader and antenna UHF RL9001 RFID reader this RFID reader as shown in fig. 4 (left) is able to write and read electric tags according to ISO-18000-6B and EPC CLASS1 G2, which is widely used in data collection system for animal tracking and tracing, monitoring and controlling of logistics, manufacturing automation management. The reader adopts aluminum alloy shell and is able to install in indoor enclosure or outdoor protective box with good ventilated, dustproof and rainproof condition. Its working frequency is 902MHz - 928MHz, the effective read distance is more than 5 meters and the write distance more than 3 meters, reading and writing time each single-byte is respectively 6 ms and 50 ms.

UHF RL9021 RFID flat reader As shown in fig. 4 (right) is developed for pork sales counters in pork product traceability system, data communication interface with built-in antennas is RS232, the distance for reading tag is less than 10 cm, the writing distance is less than 5 m. In order to cooperate with printing the pork partition label, RS232-PS2 data conversion line has been developed, by which data information collecting by RFID reader transmits to the partition printer named as "Dingjian" to print 1-D barcode partition label corresponding with RFID carcass tags.

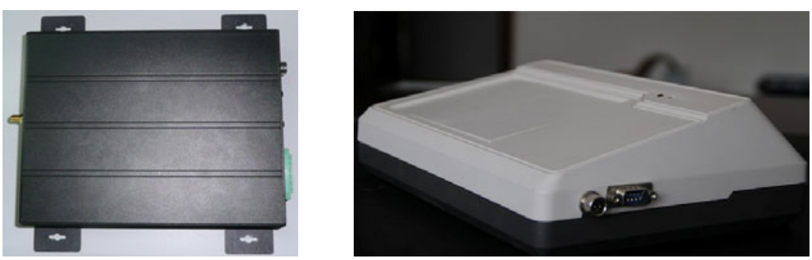

Fig. 4. UHF RFID reader

2.4 Partition Tag

Partition tags mainly include tag information at the top of the tag, products description information at the middle including product name, batch, date, company, carcass barcode and visible digits, traceability style prompt at the bottom. In the above tag, carcass code firstly identified by UHF RFID reader and then transmits to barcode printer through RS232-PS2 data conversion line, finally the printer print out 1-D barcode and digits according to carcass code number. "Product name" is usually selected and then print out partition labels through the manual buttons.

2.5 Software Architecture for Slaughter System

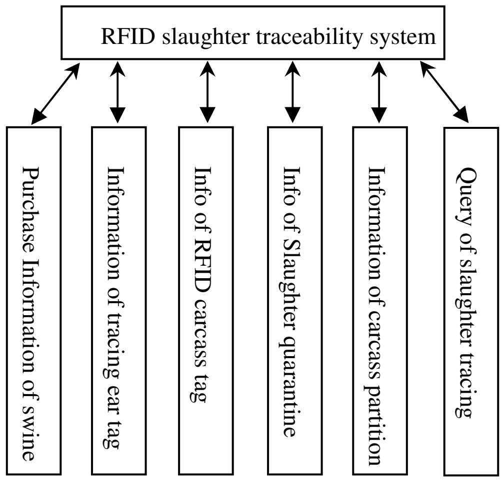

Fig. 5. Framework of slaughter system based on RFID

2.6 System Development Tools

System development is based on Microsoft Windows Enterprise Server 2003, main tool soft wares are respectively Microsoft Visual Studio 2005, Windows Mobile 6.0 SDK, Microsoft ActiveSync 4.5, Microsoft SQL Server 2005, Microsoft Visual Basic 6.0, etc.

3 Results and Discussions

3.1 Collection of Traceability Ear Tag Information

A computer furnished with "Slaughterhouse ear tag information collection system" (fig. 6) and a 2-D bar code scanner (fig. 3) were arranged at the heading process on the slaughterhouses line and connected to the slaughter traceability database by the intranet.

The worker at the heading process uses the scanner to identify barcode information with ear tags and upload to the slaughter traceability data center while heading and cutting off ear tags.

During scalding process, ear tags sometimes lose. In order not to impact normal running of the slaughter assembly line and to ensure integrity of tracing information, the ear tag information system produces an alternative ear tag code for the pig lost its ear tag and upload to the slaughter tracing data center [15]. Because any pig slaughterhouse slaughter in turn based on suppliers of commercial pig during purchasing and slaughtering commercial pigs, the accuracy of information for origins or owners of commercial pigs will not be affected.

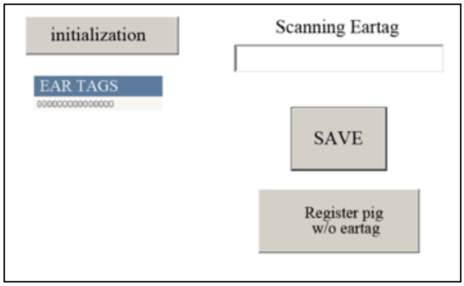

Fig. 6. Interface for Writing UHF RFID

3.2 Fastening Carcass Tag

Fixing RFID tag is located at the half-carcass process, where a computer with "RFID tag read and write system" (fig. 7), UHF RFID reader and antenna are assigned. The computer connects to the slaughter tracing center by the intranet.

Before slaughter, the antenna is first adjusted to suitable location, then the computer is turned on and "read and write system for RFID tag" is automatically started. The system obtains ear tag numbers in sequence from the slaughter tracing database and generates RFID tag number according to RFID carcass metadata norm. During slaughtering, the worker firstly put RFID tag in front of the RFID antenna and makes the tag code written, then fixes it in the front-end of the half carcass and finally put the carcass on half partition machine to make it into the half carcass. Lashing used is a hard plastic belt with tooth and ring by one head fastening with the other one through the tag hole and round the small hole in the front-end of the carcass.

According to requirements of the slaughterhouse, the relationship of ear tags with carcass tags is not only 1 to 1, but also 1 to 2. Due to ensure reading and writing speed for tags and decrease potential errors, only 20 digits of RFID carcass tag is written into RPC district of RFID tag in the system and the others all into the slaughter tracing database.

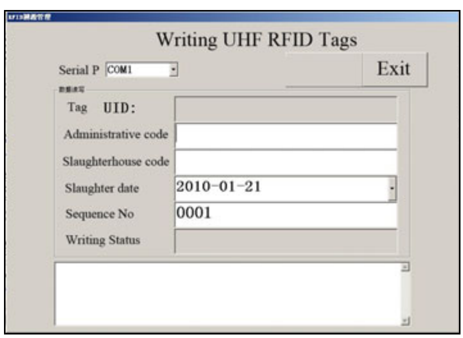

Fig. 7. Interface for Writing UHF RFID

RFID tags are made by two ways: one is that RFID carcass tags are written by date and sequence before slaughter, and fastened on the carcass in turn during slaughter. The other is that RFID carcass tags are written and fastened during pig slaughter.

In general, after slaughter, the official veterinary or quality supervisor at the slaughterhouse firstly check in information for ear tags, carcass tags and carcass quarantine and then submit all information the pork traceability center. While submitting, a slaughter event for every carcass is produced according to the slaughter tracing metadata standard and then uploads to the pig traceability database center.

3.3 Partition Label and Query

According to systematic design, an ultrahigh frequency (UHF) flat RFID reader, a “Dingjian” barcode printer and a touching screen query machine are arranged in the pork exclusive store. During the process, the RFID carcass tag hung on the half carcass is red at first by the flat RFID reader. And the carcass tag information obtained (20 digits) is transmitted to the barcode printer for carved meats on time by the RS232-PS2 conversion data line, then select pork carving classification and type “printer” button, the printer can print 1-D barcode label based on the RFID tag, which includes pork position, 1-D image and visible digits for the carcass code and name of sale company for the products. Pork classification in this study consists of lean meat, soup bone, vertebra bone, marbled meats with skin, the front shoulder meat with skin, the ear leg meat with skin, whole lean meat, shoulder butt, pig elbow, west steak, pork chop, pork spare rib bone and so on.

When a partition label is put in front of the scanner on the touch screen query machine and scanned, the tracing query system searches on the pork quality tracing center. If the relative pig ear tag and carcass tag are existed, information for pig breeding farm, pig slaughterhouse and official supervisions is respectively shown on the screen. This study developed various query styles of query and short message service based on mobile devices such as PDA, mobile phone and so on, which is greatly convenient for pork consumers’ right to know.

4 Conclusion

Quality traceability of pork products begins with pig breeding until dining-table of consumers and involves many segments. Influencing factors are complicated; a variety of data is required to be collected and perceived. At present, it is very difficult to collect and carry out whole traceability information. Therefore, only information for ear tags at removing ear tags and RFID carcass tags at halving pig carcass process is collected based on analysis of traceability key points, especially on intermediate slaughter processes. That is, the study not only collected wholly and normatively processed slaughter traceability information, and also made one–one relation between pig breeding process information and terminal sales information according to the systematic design, realized the traceable query of pork quality and safety. This study is a subsystem of the traceability system for quality and safety of swine products, mainly to reduce or avoid phenomenon that easily occur or make mistakes between material chain and information chain in tracing system for animal products’ quality by things internet technologies, i.e. UHF RFID, that not only ensures the integration of tracing information and improves the effectiveness of tracing information query [5-7]. Now, this data collection system for slaughter link has applied to the traceability platform for quality and safety of swine products in Dongying city in Shangdong province, Tianjin city and Hebei province [15-18].

Collecting solution of key data in slaughter link is all responsible by the official veterinarian. Data may be collected and uploaded by the slaughterhouse technologist who must be authorized by the official vet responsible for the authenticity. Obviously, this mode combines present official veterinarian and meat quality traceability system, which is currently a temporary solution without an independent third-party certification. Expected effects have obtained through some cities' demonstration. However, the responsibility, right and interest need to be solved by institutional construction.

Application of RFID technology in slaughterhouses traceability system, helpful to ensure automation, reliability and validity of collecting pig slaughtering traceability information during the pig slaughter process, solved technical challenges of information collection in a harsh environment of pig slaughtering and reached technical effects better than the low frequency and high frequency RFID technology. This shows that UHF RFID technology has wide application prospects in the slaughtering link for pig slaughtering and other animal slaughtering. But there are still some problems to pay attention[9].

The first is how to unity articles coding and frequency. If code or frequency applying in food supply chains is disunity, it must result in a lot of inconvenience for arrangement of reading and writing devices, query, tracking and tracing. Because so called ultra high frequency is actually involved with a wider scope of frequency interval, i.e. 860～960MHz [19-20], which specific frequency is used need discuss extensively and avoids conflicting with other industries. The second is the cost and recycle of RFID tags. If every single product, including immediate products such as pork, beef , is able to use RFID tags, this will inevitably require that price of tags is reasonable, tags is able to recycle, the identifying cost every carcass reduced to a certain acceptable degree for all pig slaughterhouses. Passive chips used in this system adopted the imported inlay chip and its price is relative high, so it is just for a small demonstration application. Once substantive demonstration put in effect, price of tags require reduce to an acceptable balance.

Although large-scale application of RFID tags in food safety field has a long way to go, with the rapid development of digit and information technology, the tendency that identification means based on RFID and the global unity of coding system together with HACCP system are applied in food safety and traceability system, is invariable. For example, EU has a regulation early, all beef products in EU markets must have electronic identification since 2005 [1-2]. Therefore, to save something for a rainy day, to start with new technology research as early as possible, to provide better service for control and supervision of food safety, to supply more safety and relieved food for consumers is the only way.

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Study on Application of Location Algorithm Base Multidimensional Spatial Information in the Situation Analysis of Natural Ecology*

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Abstract. In this paper, the algorithm was designed of quad-tree spatial search based on spatial information multi-dimensional features, the traditional quad-tree algorithm has been improved to a specific spatial attribute value binding in the quad-tree leaf nodes, a large number with a specific operation irrelevant attributes are excluded, to the effect of finding targets. This algorithm is applied in the natural ecology protection system, it can locate the region which pollutes quickly in the map, provides the scientific basis for the government in carrying on the ecological environment and using the resources environment sustainable.

Keywords: Spatial search, Quad-tree, Ecological equilibrium, Attribute binding.

1 Introduction

As a result of the urbanized advancement aggravating, the ecology uses the quantity large scale reduction moreover the quality also obviously to reduce, not only destroyed the ecosystem balance, also causes the human survival environment the worsening, thus cay, the society, the ecology development not to be uncoordinated. Therefore, in our country economic society fast development, the environmental protection and the ecology construction idea strengthened, the ecology construction unceasingly today which needed to strengthen continually to the national territory resource management, the ecological environment protection question already in relief comes out. The ecological environment information has the multi-domains, the multi-professions, the multi-varieties and so on the complex characteristic.

At present, has some specialized software to carry on processing to these information, if the GIS software aims at the geography information, because the geography information has the complex spatial attribute, pays attention to the hot spot to the spatial geography information fast search into people, this article proposed one kind based on Quad-tree search algorithm, can remove effectively the non-correlated information, locates fast to is interested the attribute special characteristic[1], [2].

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2 The Design of Quad-Tree Location Algorithm

Quadtree is a suitable algorithm in two-dimensional picture localization pixel. Because in the two-dimensional space, the plane pixel may be divided into four parts repeatedly, the depth of three is determined by the figure, the memory and the complexity of the figure. As an auxiliary multi-dimensional data structure of spatial index, quadtree lies between spatial operation algorithm. Many spatial objects which are independent of special spatial are excluded through its screening, and it enables the spatial operation to access operation object fast, thus enhances the efficiency of spatial operation[4].

Taking the ID=0 of layer as element as example:

A. Readout the element numbers and its border which layer contains by shapefile, the rectangule of figure 1 is the tree root node;

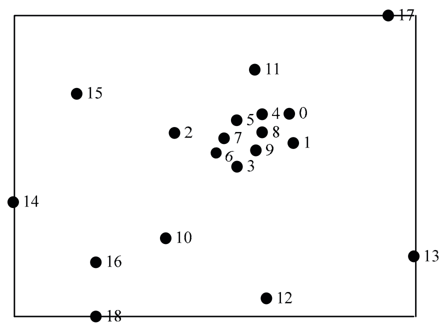

Fig. 1. The quadrant division when the point's depth is 1

B. Determine the max depth of tree according to the elements' total number.

C. Readout the border and ID number of every element circularly, build quadtree; using the rectangular overlap skill to avoid excessively too much elements distributing in the boundary in MapServer; recursive by the above algorithm until every element is assigned into the quadtree which is generated at last. Figure 2 is the quadrant division when the element point depth is 3.

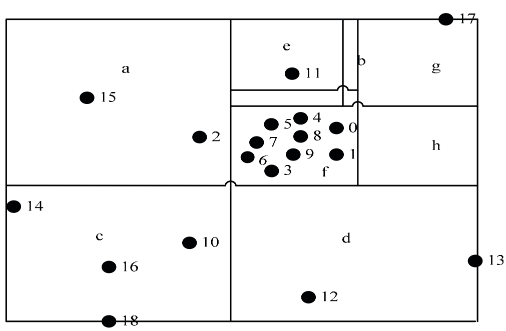

Fig. 2. The quadrant division when the point's depth is 3

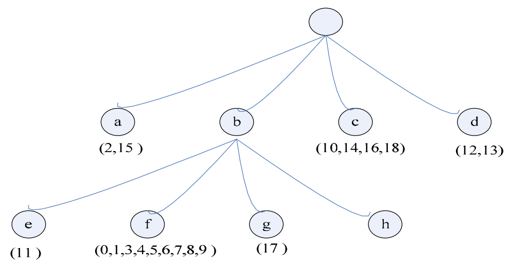

Fig. 3. Generating quadtree

3 Application Example

Using Quadtree search algorithm, may in the comprehensive analysis ecological environment each kind of data, help the establishment environmental effect appraisal model. Because the GIS information has the multi-dimensional structure, may carry on the different environmental effect calculates and superimposes. In the region environment quality present situation appraisal work, may environment essential factor and so on geography information and atmosphere, soil, water, noise monitor data unifies in together, uses the GIS software the spatial analysis module, carries on objectively, the comprehensive appraisal to the entire region environment quality present situation, reflected in the region the degree as well as the spatial distribution situation which pollutes. If through the superimposition analysis, uses Quadtree search algorithm to be possible to locate in fast this region the air pollution butut, the noise distribution map; Through the buffer analysis, may demonstrate the source of pollution influence scope and so on.

4 The Efficiency Analysis of Mobile Map Search Algorithm

This algorithm used in the Mobile Map Search system base on MMS. The recall ratio and precision ratio efficiency are better. A new assessment index named comprehensive assessment rate F (the factor of satisfaction) is obtained by considering the recall ratio and precision ratio comprehensively. The formula for calculation [3] is as follows:

$$\mathrm{F} = \frac{precision \times recall \times 2}{precision + recall} \tag{1}$$

In this experiment, www.google.cn and www.baidu.com are setup as under-layered search-engine for meta-search. 2319 documents (1560 documents from Google, 759 documents from Baidu and delete the same document) related by the public infrastructure construction and development of Chengdu city are obtained from the Internet. These documents will be divided into five categories artificially including public transportation information, railway information, flight information, tourist sites and customary snacks. The vector space dimension of different categories of documents is obtained by characteristic word segmentation processing [3].

The dataset used in the experiment as follows: public transportation information: 235, railway information: 450, flight information: 209, tourist sites: 602, customary snacks: 823.

Two comparison experiments are done to the 2319 documents:

(1) Take advantage of traditional search-engine stochastic querying the dataset, statistic the recall ratio and precision ratio, and then calculate the factor of satisfaction (F).

(2) Use the query vector of the first experiment and the mobile map search algorithm that the paper proposed, statistic the recall ratio and precision ratio, calculate the factor of satisfaction as the return result.

The factor of satisfaction of traditional search-engine is about 46 percent, and the result of the factor of satisfaction which the Mobile Map Search Algorithm which this paper proposed returns is about 53.27 percent, and the precision ratio heightens. Therefore, the efficiency of Mobile Map Search Algorithm based on Quad-tree can be fit with the mobile search characteristic of shortcut and precision.

5 Conclusion

Along with information technology development, geographic information system technology, from two-dimensional to three dimensional development, from the static state data processing to the dynamic development, has the succession data-handling capacity, how uses the existing information infrastructure condition and the geography space data resources, the union numeral city, the electronic government affairs and so on serves well for the user, has become technological development and so on current geographic information system key contents. Based on Quadtree search algorithm to lay the foundation for the next generation GIS technology. In this paper, the quad-tree algorithm has been improved to a specific spatial attribute value binding in the quad-tree leaf nodes, a large number with a specific operation irrelevant attributes are excluded, to the effect of finding targets. This algorithm is applied in the natural ecology protection system, it can locate the region which pollutes quickly in the map, provides the scientific basis for the government in carrying on the ecological environment and using the resources environment sustainable.

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A Water-Quality Dynamic Monitoring System Based on Web-Server-Embedded Technology for Aquaculture

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Abstract. Water-quality monitoring technology has been taken a great attention in aquaculture because of increasing aquatic products and impact of food safety vicious incidents. In order to meet the technology requirements of water-quality monitoring in multi-parameter, dynamic, and networked monitoring, a water-quality dynamic monitoring system was developed to monitor multi-parameter water-quality variables such as water temperature, pH, dissolved oxygen, electrical conductivity, oxidation reduction potential dynamically, and communicate with remote information servers in a high security. As result of a two-years testing experiment in a seawater aquiculture company, relative errors of each water-quality parameter measured by the instrument were less than 5%, data lost percentage of remote communication was less than 3%, and power energy consumption was less than 13W. Therefore, the water-quality dynamic monitoring system as a node infrastructure of wireless sensor networks can be used to achieve a distributed water-quality network monitoring system in a large-scale aquaculture farm, or to construct a distributed water-quality monitoring network system in multipoint of different cities for aquaculture farm and administration section.

Keywords: Dissolved oxygen, Electrical conductivity, Infrastructure, Oxidation reduction potential.

1 Introduction

Aquatic products play an important role in agricultural products. Farmed aquatic products reached the proportion of the total output of aquatic products 66.5% in China [1]. Aquaculture has becoming to an important industry in agriculture and the monitoring of water quality is an important issue for improving the aquatic production and quality. Effective water-quality monitoring systems are required to apply in aquaculture to measure and control water temperature, pH, dissolved oxygen, and other important water quality parameters in abroad [2-6]. Water quality was regulated by

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physical, chemical and biological methods to organize the aquaculture production by utilizing hazard analysis and critical control point (HACCP) operating rules in Europe [7]. The computer-based process control technology proposed by United States for intensive aquaculture system can be used in marine fish's growth environment control [8]. Water-quality monitoring instruments and systems are trended to be smaller, more automatic and intelligent, and multi-functional automation [6, 9, 10]. Although water-quality monitoring technology has been researched in China at this decade, there are still many problems such as the unstable sensor performance, less real-time monitoring parameters of water quality, low level of networked monitoring, and single system network monitoring [11-13]. In recent years, many researches utilize new technology such as GPRS and neural networks to improve water quality monitoring level in China [14-15].

The pollution of aquaculture water, aquatic production and quality issues, and the establishment of food-safety traceability system make constructing effective dynamic monitoring network to obtain multi-parameters of water quality become an important issue in aquaculture. Distributed networking, real-time remote monitoring, the dynamic controlling of water quality using web-server-embedded technology and the sensor node technology are future trend development for intensive aquaculture [16]. In this study, a water-quality remote dynamic monitoring system was developed based on web-server-embedded technology. The information of water quality was transported safely using wireless communications technology based on CDMA services, WiFi and virtual private network (VPN) technology.

2 Materials and Method

2.1 System Configuration

The water-quality dynamic monitoring system is composed of water quality dynamic monitoring devices and a remote information server. The water quality dynamic monitoring device consists of sensor module, data monitoring module, communication module, and power module. The sensor module is composed of a water flow cell and sensors. The sensors include pH (ED201, Suzhou Han-star CO., China), electric conductivity (EC) (DJS-1T, Suzhou Han-star CO., China), dissolved oxygen (DO) (ED012, Suzhou Han-star CO., China), oxidation-reduction potential (ORP) (PC312, Suzhou Han-star CO., China), and temperature (STWB-1000, Beijing Saiyiling CO., China). The water flow cell was made of polyvinyl chloride (PVC) with diameter of Φ55 mm. The data monitoring module utilizes a web-server-embedded chip (PICNIC2.0, TriState Co., Japan) to obtain water-quality information and environment from different sensors. The communication module is composed of a Wi-Fi module (AirStation-J54, Buffalo Co., Japan), and a CDMA module with IPSec-based VPN function (InRouter210C, Beijing Inhand Co., China), for establishing wireless local area network and achieving remote communications and data transmission. The power module consists of a power control device, and a power division device for 12V DC power supply and 220V AC power supply. The remote information server consists of an ADSL modem (DSL-300, D-Link Co., China), a VPN router (BV-601, NESCO Co., China), and an information server (Fig. 1). The VPN router and information server connect to the Internet via ADSL service. After the VPN router and the CDMA of the water-quality dynamic monitoring device are connected to the Internet, VPN connection is established via IPSec authentication. The information server is the terminal equipment which could be a personal computer, portable computer, or a large/medium size server to achieve the real-time remote capture of the water-quality parameter and environmental parameter of the aquiculture.

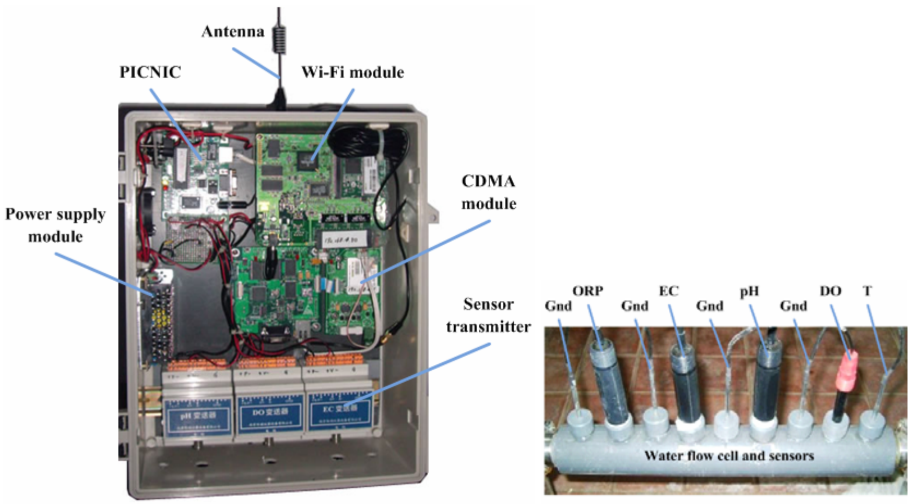

Fig. 1. The water-quality dynamic monitoring system

2.2 Topological Architecture

The water-quality dynamic monitoring system is an isolated local area network. As a sensing network node, it is connected to Internet via CDMA service of China Unicom. That means the system can be constructed to a large-scale wireless sensing network under CDMA signal covered areas. In this system, the two monitoring devices establish communication via Wi-Fi technology because of the short distance between them. The system is easy to increase by 255 monitoring devices at most, and the monitoring device is also easy to increase sensor channels. Water-quality data and environmental data are transported by TCP/IP protocol and identified and stored by the remote information server. The CDMA module will be dynamically connected to the remote information servers via IPSec-based VPN security technology. In order to identify the specified remote information servers, the remote VPN router have to use a dynamic domain or a fixed global IP to support the remote VPN calling. The monitoring systems deployed anywhere will become a local network connection if the IPsec-based VPN tunnels were connected. Within the network, the information captured by all devices could be used as a local information network to conduct secure access. Therefore, authorized users could visit or manage the remote sensing devices anywhere and anytime under Internet environment. In this testing, the Beijing information server is using a dynamic domain.

2.3 Testing Environment

Two water-quality dynamic monitoring systems were installed respectively in inlet and outlet of a workshop in Fengzeyuan aquafarm, Dongying Shandong Province, which adopts seawater and semi-circle mode for intensive aquiculture. Wi-Fi module was used in one of the devices, while Wi-Fi module and CDMA module with IPsec-based VPN function were used in another. In this testing, one remote information server with an IPsec-based VPN router is deployed in the China Agricultural University located in Beijing city. The testing experiments were conducted for two years.

Fig. 2. The water-quality dynamic monitoring systems installed in a practical aquaculture

3 Results and Discussion

3.1 Water-Quality Data Monitoring

The water-quality data including pH, DO, EC, and water temperature throughout a week were dynamically storied or issued in webpage or Extensible Markup Language (XML) file by a special JAVA applet program in the remote information server (Fig. 3). The 10-bit analog signals of the sensors were obtained by the web-server-embedded chip without storage device.

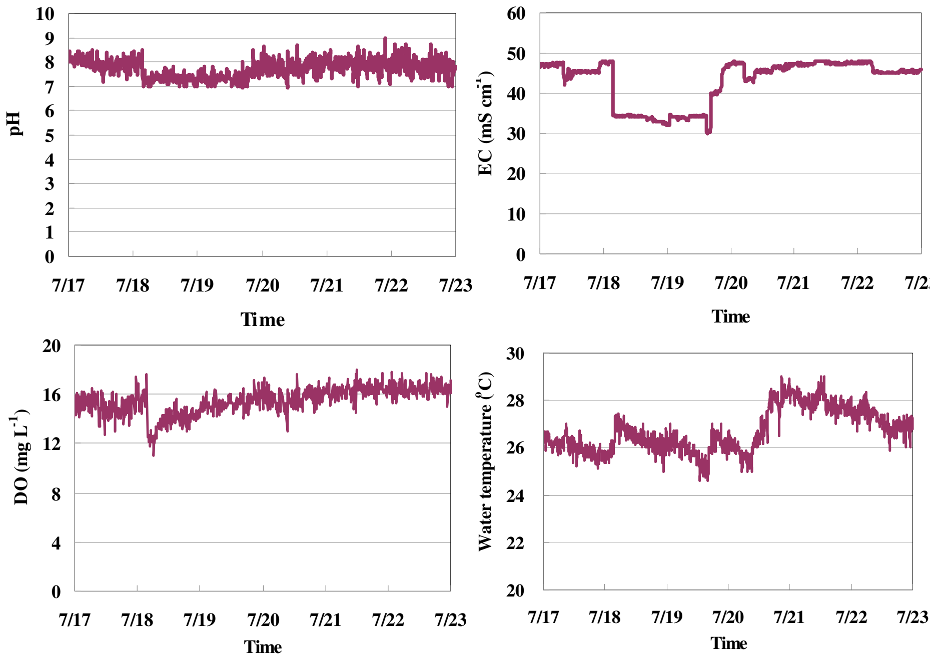

Fig. 3. Water-quality data measured by the water-quality dynamic monitoring system. These figures demonstrate the pH, EC, DO and water temperature data recorded within 6 days.

3.2 Network Communication and Electronic Consumption

The water-quality dynamic monitoring systems were communicated with the remote information server in Beijing by a 20-30Kbps access speed with over 26-30 signal quality level of CDMA services. One can access the CDMA device via LAN to inspect VPN status and network signal values. Also, other one can obtain real-time information of the system, including DNS and Public Network IP by viewing the logs. It is easy to fulfill local PC access to Internet by outside hanging a PC, setting IP address in the Subnet and DNS as the server detected by CDMA. Under normal processing of Internet, randomly select 6 days data to make research, we found that when setting the testing frequency for 1 min each time, that is 1440 sets per day, the average packet loss rate is between 1.7% to 2.3%. Thus, this system has fulfilled real-time dynamic data acquisition and meets the needs in trust worthiness and safety of automatic network transmission.

The power controller of the water-quality dynamic monitoring system used 12V DC power supply with 2A electric current. The nominal voltage of pH, dissolved oxygen, electric conductivity, temperature and oxidation-reduction potential transmitters used 12V DC power supply with 0.11A measured electric current. The PICNIC and Wi-Fi need low consumption, the power of CDMA device is 4W and the nominal voltage of fan is 12V. According to actual measurement of voltage and current on field devices, the average power is 12.9W.

4 Conclusion

Information server of the water-quality dynamic monitoring system utilizes the value-added services of mobile telecommunication and the database management system based on web-server technology to conduct remote data transportation. The authorized users can obtain the monitoring water-quality data of the sensing network under any Internet environment. The results of two-year testing experiment shown that the water-quality dynamic monitoring system can remotely and dynamically monitor multi-parameter of water-quality such as temperature, pH, EC, DO, and ORP. The system is operated well with 13W power energy consumption. Therefore, this water-quality dynamic monitoring system can be used to construct a distributed water-quality monitoring network in multipoint of different cities for aquaculture farm and administration section in high reliability and security.

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A Study on Operation Strategies of Unclogging Container-Trailers Enterprises at Shenzhen Port

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Abstract. It is investigated that nearly 86% containers were transferred by roads connection transport at Shenzhen port with the high-speed developing steps of Chinese economy. For a long time, Shenzhen container-trailer enterprises have provided essential and efficient logistics service for every dock. However, problems as operated by many bodies, small scale, decentralized business and poor competitiveness, etc. was universally existed. Because the port, big international logistics enterprises, policies, environment, competitors, customers, insurance companies and maintenance companies have great affection on the cost and income of container-trailer enterprises, this paper conducts a comprehensive analysis on operating environment of these enterprises by using the dynamic game theory of incomplete information to study some useful running modes of high efficiency and low cost operation, and also some feasible measures have been proposed.

Keywords: Container transport, Shenzhen Port, SWOT Analysis, Gaming, Operation, Strategy.

1 Preface

In the world today, along with the global economic integrative development, leading by harbours served both as seaport and airport, relying on the logistics garden and top logistics industries as carrying bodies, modern logistics fulfilled a sustaining, rapid and sound development. A modern type of transport using containers as unit for cargo transportation was widely adopted increasingly. Container transport has many advantages as safety, environmental protection and punctually etc.

With the rapid growth of throughput of Shenzhen port in recent years, about 86% evacuation containers were transferred by road connection transport. Anyhow, the operation of road containers transport enterprises was not as good as people has expected. For external environment, as the lower threshold of market access on the one hand, the increasing of transportation capacity completely became enterprise or personal behavior. With the steadily increasing of enterprises and trailers and the oversupply of transportation, the market competition becomes fiercer. The head-on competition also lowers the freight rate while the continuously soaring of the price of oil, insurance expenses, tire, vehicle-use special oil and fittings, the running cost of

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logistics business remained high and the profits became small. On the other hand, under the influence of international financial crisis, resources stipulation and economic structure, etc., the import and export trade of the Zhujiang Delta was drop-off.

From business enterprise itself, many medium and small scaled roads container enterprises are poor at internal management with narrow business scope, simple profit model, low utilization of logistics information and poor combination of road transport and comprehensive logistics mode, the traditional road container transportation enterprises lacks core competencies on the opening logistics market.

2 Overview of Road Container Transport Enterprises of Shenzhen City

Compared with other port cities in China, the road connection transport ratio of Shenzhen port is the highest and the road container-trailers in Shenzhen is also the most.

The road container transport industry in Shenzhen was started in 1994. It has increased rapidly since its market was released in 1999. From 2005 to 2008, the capacity of road container transport increased continuously along with the increment of port throughput. The biggest increase was in 2007 and the trend became slowly since 2008.

(1) Business model

The road container transport industry has numerous business models, it can be divided into enterprise owned vehicles and non-enterprise owned vehicles. The business model of enterprise owned vehicles is mainly operated as self-support and cooperative operation (contractual leasing, a kind of non-employment relationship). The business model of non-enterprise owned vehicles is usually a kind of affiliated operation. Concretely, it is mainly divided into simple affiliation and business affiliation. The simple affiliation is operated at owner's expense, owners will pay certain amount of management fee to the enterprise and enterprise will pay all of tax and insurance fee for them together. The business affiliation is enterprise will manage business and financial affairs for owners and drivers.

(2) Scope of business

Three kinds of business are mainly conducted by logistics enterprises: General freight business, seaport subdividing business and airport subdividing business, including:

① Transporting sea-borne International containers from port to inland and related hand-over, storage, dismounting, clean and maintenance of containers, storage and distribution of cargo within inland transit station.

② Transporting local railway containers from station to consignor or consignee's warehouse, workshops and stock yards, cargo packing and unpacking agency.

③ Transporting water transported containers along the coast or river to inland, transit transport and short distance door-to-door transport.

④ Container direct transport through highway between cities.

⑤ Container transport between Inland to Hong Kong, Macau and other frontier seaports, connection transport and mainland bridge transport.

3 SWOT Analysis of Road Container Transport Enterprises of Shenzhen City

SWOT analysis is synthesizing and summarising all internal and external environmental conditions to analyse advantage factors (strengths), weaknesses, opportunities and threats for the enterprises. On the basis of this, matches all opportunities and risks resulted from internal resource factors and external factors reasonably and effectively, makes out excellent strategies to seize external opportunities and avoid threats. Take a road container transport enterprises for example, the matrix of SWOT analysis is showed as follows:

Table 1. The matrix of SWOT analysis of a road container transport enterprise

Advantage(S)	Weakness(W)
S1 Regional Advantage： There are more than 70 international lines docked at this port regularly, its service was over most main ports of counties and regions of America, Europe, Mediterranean, Southeast Asia, North Asia, Middle East, South Africa and Australia. S2 Inland economic advantage： with adequate cargo resources as near the biggest export machining base of Zhujiang Delta. S3 Transportation advantage： Shenzhen has formed a multi-modal transport center as “one zone, three axes” connecting the home abroad, also linking the Zhujiang Delta. S4 Policy and system advantage： Logistics has already became the pillar industry of Shenzhen City	W1 Weak position W2 obvious Low-end feature W3 Bad resource structure W4 Bad evacuation system, time for waiting if too long. W5 Increasing insurance fee, insured claim is very difficult to settle. W6 Low informationization degree and high no-load ratio. W7 Many hit-and-run drivers and always hide a goose in ones sleeves. W8 Lack of professional talent person
Opportunities(O)	Threaten (T)
O1 Political environment： Policy supports of the nation and local government. O2 Economic environment： Advantages of strong export-oriented economy of Zhujiang Delta O3 Social environment： Concerns of Society. O4 Technical environment： The organization and operation of the logistics enterprises was greatly changed by IT theories and its application.	T1 Oversupply and low price T2 Continuously increased oil price and disordered markets. T3 Mixed maintenance factories T4 Lots of fake-licensed cars ， unfair competition T5 Longer funds chain T6 Threaten of foreign large logistics enterprises T7 Intensifying service competition of cities around T8 Lacking and aging drivers.

4 Gaming Analysis of Unclogging Trailer Enterprises

Those involved in the operation gaming of unclogging trailer enterprises are mainly included served ports, maintenance enterprises and oil enterprises related with trailer enterprises, etc. An analysis of this kind of gaming is listed below:

4.1 The Analysis of Cooperative Gaming between Trailer Enterprises

At present, the scale of most trailer enterprises in Shenzhen is generally small, all faces the situation of port monopoly, and the competition between trailer enterprises is very fierce. There will be gaming where competition exists. There are two kinds of competition strategies of those enterprises: cooperative strategy and non-cooperative strategy. This formed four strategic combinations of trailer enterprises such as ((co-operation, cooperation), (cooperation, noncooperation), (noncooperation cooperation), (non- cooperation, noncooperation).

To maximize the profit, which kind of strategy will be adopted under some certain circumstance? The continuous analysis will make further analyse to above problems.

4.2 The Gaming Analysis between Ports and Trailer Enterprises

Under the situation of repeating gaming, no matter who have the advantageous position, manufacturer or supermarket or even it is a fine match, the final result will be (cooperation, cooperation), an equilibrium solution because both parties can adopt a tooth for a tooth strategy to protect themselves.

First of all, we have made it clear that repeating gaming appears under what circumstance, it is very important. If the number of supermarkets that a manufacturer of certain product can choose is numerous, the gaming will be only for once, static and the equilibrium result will be (non-cooperation, cooperation) because the manufacturer can continuously change to some new supermarkets. For the same reason, if the number of supermarkets that a manufacturer of certain product can choose is much, and the number of supermarkets that can sell such kind of product is few, the gaming will be also only for once, and the equilibrium result will be (cooperation, non-cooperation) because the supermarket can continuously choose some new manufacturers. Only when the manufacturers of certain product are less while supermarket can be chosen is also less, in other words, the manufacturers and supermarkets have the same opportunities to threat the other party, and all have to choose the other party as its cooperative partner in future, then their cooperation will be for many times and the gaming between them is repeated gaming.

5 Study on Operation Strategy of Unclogging Container Trailer Enterprises

5.1 Cooperative Competition Strategy with their Profession

① Form a strategic alliance to promote its business position

With global logistics chain becomes closer and closer gradually, the market economy is the model of gaming and win-win, competition exists in the same business. Not in this way, the business will be proved. However, the same business also has to depend on each other to exploit market together.

② Quicken the industrial upgrading and optimization

Relying on the supply chain manage, new technique application and information-based construction, carry out the function integration and service extending; to build a green logistics system, propose green transport construction. To develop product and package, waste recovery logistics to promote recycling and economizing the resources.

③ Developing integrative logistics

The road container transport industry gained a scale benefit and logistics efficiency though cooperation with other transporting industries. Different enterprises can con-transport goods of different enterprises by adopting same method. When the logistics scope is close by and the logistics amount in a certain time is less, it is obviously uneconomical for some enterprises carry out logistics operation in the meantime. So, the phenomenon appears that an enterprise transporting its goods with some of other enterprises.

The union of road container transport enterprises shall specify the management system inside the industry and ask all the enterprises to sign labour contract with drivers, specify the employment relationship, explicit benefits relationship and salary distribution method; take labour protection measures for the driver, take insurance and social ensure for them to ensure drivers' personal safety; specify the relationship with affiliated ones, execute contract with them to reduce labour dispute. Transport enterprises are not allowed to transfer its risk to drivers. Strengthening communication to build up a bilateral and multilateral mechanism to solve dispute and ensure social stability.

5.2 Win-Win Strategy with the Enterprises (The Owners of the Commodities)

With the integration of global economy, No any enterprise can be the most outstanding one in all business, all have to unite enterprises in the upper and down streams; form an industry supply chain connected economic benefits and close business relationship for complementary strengths, take the advantages of all available resource to get well with the competition environment of great socialization production, improve the competitiveness in the market. So, the internal supply chain must be extended and developed to the one for the whole industry and the resources of management from inner part to exterior part.

The road container transport enterprises have to strengthen the cooperation and communication with large-size manufacturers and makes them change their operation principles to get out from the mis-conceptions of "big and comprehensive" and "small and comprehensive", to farm out the logistics business, to establish a supply chain style management and service system of Industry segmentation, intensive resource and quick response. By cooperation to participate the competition with integrative advantages of the supply chain, to achieve mutual benefit; to look for strategic cooperation with core enterprises and become a long-term and stable strategic partner of core enterprises.

5.3 Coordinative Strategy with the Government

The road container transport enterprises have to strengthen the coordination and communication with government, deal with the relationship of government and enterprise, ask local government to supervise the market and specify market behavior positively, get the support of industrial supervisor on the policy of logistics planning, land, information construction etc. and give their support and favour in funds, bank load and tax ...etc.

The key task of the government is to establish and maintain an "information service platform". This "Information service platform " is basic, public, service and functionality, the government should coordinate and push the key logistics information project, devote their major efforts to integrate projects such as the public information platform of road container transport, maritime network, logistics customs information system of Qianhaiwan tariff-free area in Shenzhen, the customs clearance project of tariff-free logistics center (type B) at Shenzhen airport, international information center project of Yantian, aviation logistics information platform of Shenzhan City, the public information platform of Qianhaiwan logistics garden, the public information platform of Sungang logistics garden to a powerful information service platform of wide coverage, to make it have the function of port certificate, identity identify, information collection, auto toll and quick customs clearance...etc. and business as container reservation, to improve its level of modernized management.

5.4 Cooperative Strategies with International Container Wharf

How to cooperate the road container transport enterprises with wharf to improve efficiency of entire logistics system is a critic problem need to be solved immediately.

Container-trailers have to go through the lock gate to transport the containers, information have to be inputted, documents have to be checked by drivers according the application. Because driver and trailer are integrated, the phenomenon of a long queue for waiting in wharf is very usual. This has already become the bottleneck of the pass capacity of container ports. For the trailer enterprises, the longer they waits, the greater influence will be, this also lower the service level for their customer; deduced the throughput of unclogging port as while as lower the competition ability of wharf.

To solve this problem, the port should carry out cooperation with trailer enterprises and government to establish a "information service platform". All the information of import and export containers, trailer enterprises and trailer drivers should be put into this "information service platform (system)" to build a systematic reservation service system for container-trailers.

In other words, all the information of road container transport enterprises or container-trailer drivers have to be inputted into the service system by phonetic system or network by advance. The lock gate staff have to check all the data to make sure all are completed and in effect, and feedback to trailer drivers for the time and place information for connection transport the containers, then, drivers should transport the containers according to the reserved time and place. When enter the lock gate, they should check the waiting time, they can get the CMC directly to enter the stock yard after finish the checking, shown as figure 1.

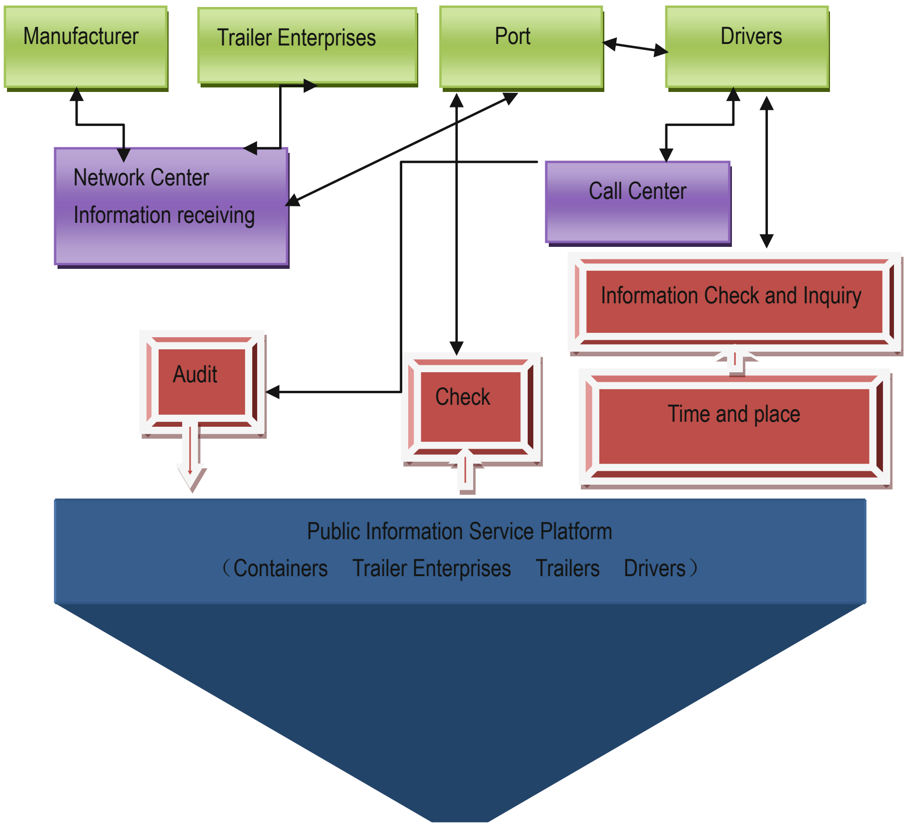

Fig. 1. Diagram of Container-Trailer Reservation System

The container trailer reservation system withdraw the customer's transport information in advance without a fixed time, this make trailer enterprises and drivers to arrange their time accordingly. It improves the cooperative abilities of related enterprises and reduces the waste, raises the mutual competition abilities of cooperative enterprises.

6 Conclusion

To manage the current operation problems of road container transport enterprise, the enterprise should actively develop cooperation with related enterprise and the government. Only by this way, the enterprises can get rid of current operation dilemma. And the cooperation can get away with strong information-based and network support. Without information-based technical means, the cooperation cannot go further. In the meanwhile, information construction need the support of government, only when above problem is solved, container transport enterprises then can be really get rid of current operation dilemma and support the development of local economy.

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