The Design and Implementation of Computer-Aided Chinese Medicated Diet System

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Abstract. Chinese Medicated Diet (CMD) which combines the properties of food and medicine not only prevents and cures diseases but also prolongs lives. It is becoming more and more popular in modern society and in great demand. Facing the shortage of medicated diet knowledge in common people, this paper focuses on the design and development of an online software system for CMD: Chinese Medicated Diet System (CMDS). The design and implementation of CMDS are discussed as key issues including persistence layer and database access. The proposed demo provides an efficient way to popularize and internationalize the CMD. It should be enriched step by step and apply in daily life in the future.

Keywords: Chinese Medicated Diet, Therapy, Computer-aided Analysis.

1 Introduction

Chinese Medicated Diet (CMD), which combines the properties of food and medicine as the treasure of the Traditional Chinese Medicine (TCM), is becoming more and more popular. The popularization and internationalization of CMD is put forward in "The State Council on Supporting and Promoting Development Certain Opinions" [1,2]. CMD originated in ancient is incorporated into TCM research by the national administration of TCM in 1985 [3]. Recently, as the improvement of life level, people have higher requirements in health maintenance and disease prevention and treatment. Because of not only CMD's edibility but also its usefulness for keeping the body healthy, it has gained much favor. However the development of CMD can't satisfy the growing needs about people's health because of some shortages, such as the single transmission way, passive acceptance by readers with the single form of books [4,5,6] and the limitations of Chinese description which is disadvantageous to promote the CMD to the world.

Some computer-aided systems for CMD have been put forward. Zhiyi Chinese Medicinal Diet System [7] provides diet therapy prescriptions through estimating

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user's physical by inputting symptoms. Zhang [8, 9] designs the system applied in restaurants and related to food service industry, by which users can choose seats, order and check out. Nevertheless it can't accurately provide diet therapy prescriptions just based on symptoms [7]. Chinese Medicated Diet System (CMDS) combines the results of computer-aided diagnostic terminal and the symptoms by user input as the basis of diet therapy prescriptions.

This paper is organized as following. The research idea of CMDS is introduced in section 2 including the computer-aided diagnosis and intelligent processing techniques based on the architecture of internet of things. CMDS requirement, the detailed design of structure and the core functions are presented in section 3. Demo is illustrated in section 4. Finally, the conclusions are given in section 5.

2 Original Intentions

The portable diagnostic equipment is becoming more and more popular, by which users' health status can be diagnosed from remote doctors. Sub-health state is always ignored therefore it becomes diseases in the near future. The computer-aided system for CMD not only provides auxiliary treatment for diseases and sub-health state, but also makes for the popularization of CMD knowledge [10].

Integrating computer-aided diagnosis and treatment system, the outputs of the computer-aided diagnosis system is taken as the inputting of treatment system that can increase the effectiveness of treatment. Based on the thought above [11], CMDS take the classification results from computer-aided diagnosis system and the symptoms by user's inputting as the basis of diet therapy prescriptions.

CMDS provides medicinal diet suggestion to guide the user's physiotherapy for health preserving, not to replace the prescription drugs and professional doctor. Combining the process of the classical Chinese medicine diagnosis and treatment, the relationship of the results of computer-aided diagnosis, symptoms, disease and diet therapy prescription are illustrated in Fig 1.

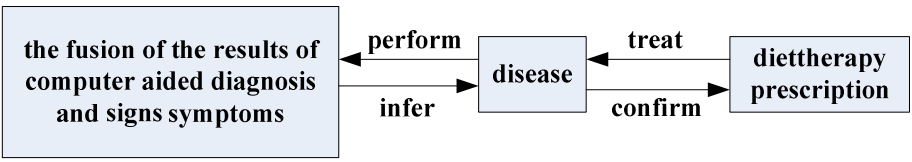

Fig. 1. the relationship of signs and symptoms, disease and diet therapy prescription

The results of computer-aided diagnosis, one of the inputting in CMDS, are critical for the effectiveness of diet therapy prescription. A real-time multi-parameter body signal acquisition and intelligent monitoring based on the architecture of internet of things (see Fig 2), which is being developed, consists of patient terminals, consultation terminals and server groups (including hospitals).

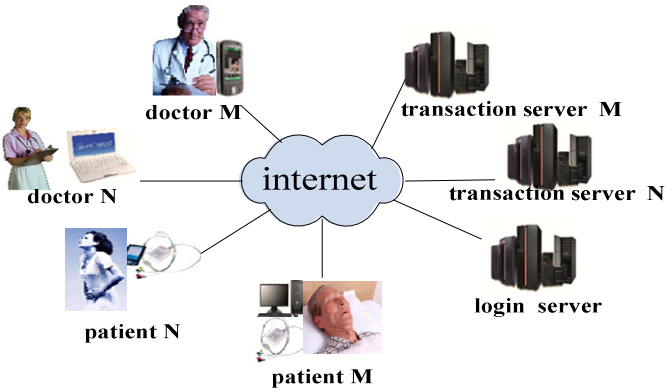

Fig. 2. An internet of things' application on real-time multi-parameter body signal acquisition and intelligent monitoring

Patient terminals, multi-parameter simultaneous acquisition for Electrocardiogram (ECG), respiration, body temperature, blood pressure, physical activity, body position and pulse signals, transmit the multi-parameters to mobile phones or computers by Bluetooth or USB. Dealing with kinds of operations related to monitoring, it is up to the server groups, such as patient information acquisition, case acquisition, diagnosis request and so on. Consultation terminals, acquiring multi-parameters information from patient terminals, take the intelligent algorithm as the core part, which make the doctor's diagnose more easily.

Algorithm research needs a lot of data and accumulation. Because of the problems existing in ECG's algorithm research, Chinese Cardiovascular Disease Database (CCDD) [12] and its management tool have been completed, in which the ECG data has been increased. Some methods for ECG classification have been attempted [13,14]. The accuracy of ECG classification can be improved by the method based on expert's experience and morphological characteristics by some experiments [15,16]. The algorithms fusing ECG, respiration, temperature, blood pressure, action and other parameters are being investigated. These are the foundation of the CMDS.

3 The Design and Implementation of the CMDS

The users get diet therapy prescription suggestion based on the classification results from computer-aided diagnosis system and the symptom input by user in CMDS. CMDS also realizes user participation functions, such as evaluation questions and so on. The function of the system is as shown in Fig 3.

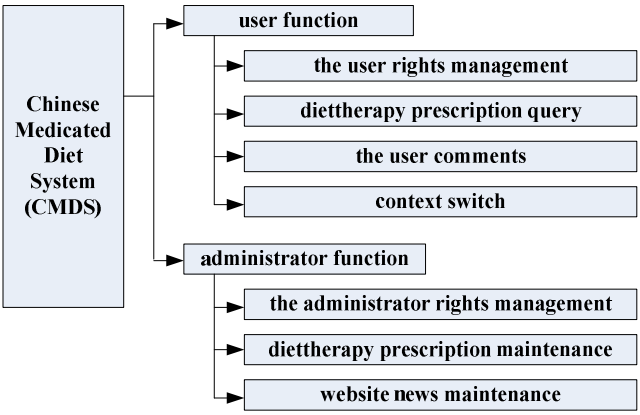

Fig. 3. The functions of the system

3.1 The Core Functional Requirements

Based on the analysis of its functions, there are two core functions in CMDS:

Case name: Diettherapy Prescription Suggestions
Executor: the user of CMDS
Pre-conditions: none
Post-conditions: none
The basic path:
1. CMDS Provides a series of disease signs and symptoms to the users.
2. The users choose one or more signs and symptoms.
3. The users confirm to start to query.
4. CMDS shows one or more disease names matching signs and symptoms and displays one or more diettherapy prescriptions.
5. Providing diettherapy prescriptionSuggestions is over, the user come back to step 1.

Alternative path:
3a. Signs and symptoms re-election.
3a1. 1) The users add one or more signs and symptoms.
2) Remove one or more signs and symptoms selected.
3a2. CMDS update signs and symptoms sets.
3a3. Come back to step 3.
4a. Inappropriate diettherapy prescriptions in CMDS.
4a1. CMDS prompt no diettherapy prescriptions to show.
4a2. Come back to setp 5.

Fig. 4. Cases description of diet therapy prescription suggestions

Firstly, CMDS offers suggestions of CMD according to signs, symptoms and the classification results from computer-aided diagnosis system. For the diagnosis and treatment of common disease, both traditional Chinese and western medicine theory support premises: the same disease has the similar symptoms on different patients; the same prescription is effective for different patients with the same disease. Cases description is described in Fig 4.

Secondly, CMDS provides kinds of languages to satisfy users' needs in different countries and regions. The internationalization of CMDS could make the software remain unchanged when it is transplanted to other regions with different language. The international task in CMDS contains two parts: interface internationalization and data internationalization. Interface internationalization supported by international module of Struts2 is realized only by a locale class and a resource pack. Base on accomplishing Struts2 international functions, data internationalization provides options for switching language, judges the current selected language and accesses the data of corresponding language by context.

3.2 CMDS Architecture

CMDS based on the frame of Struts2, complies with the model of Model, View and Controller (MVC). MVC, which is low coupling, high reusability and easy to rapid deployment and maintenance, compels to keep the application's inputting, processing and output apart. MVC is divided into three core components (Model, View and Controller) to deal with their respective tasks. In CMDS implementation, JSP and JSP Tags are as the Views; the Controller is Action inheriting Struts2; and the Model are composed with the domain objects realized by persistent object (PO), Service components maintained by Spring frame and the entity of persistent object (See Fig 5).

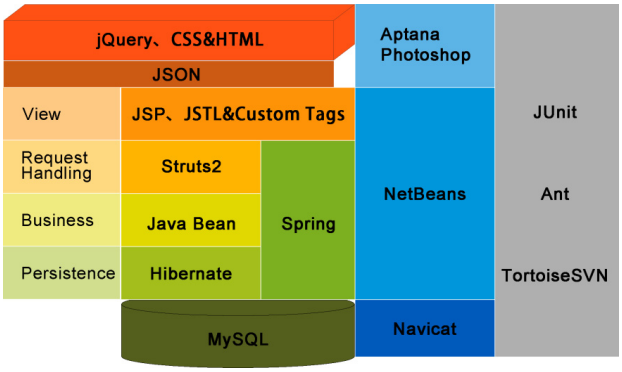

Fig. 5. CMDS architecture

The data flow diagram in Fig 6 shows execution paths of user requests passing parts of the system and creating the responses finally. User requests sent by the browser arrive at filter and interceptor, which realizes an agency model in Servlet standard and

Structs2 frame, respectively. User requests after performing preprocessing get to the response handle: Action, in which legitimacy is verified. According to the request parameters, session object and configuration parameters in System, Action calls Service component to execute business logic. During the execution process of Service component, DOA coordinates the completion of data access. The results of Service component execution received by Action are converted to the transmission format. Users need to return to the browser though choosing appropriate View Result by Action. So far the responses of user requests are completed.

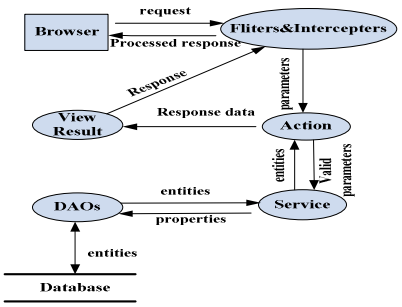

Fig. 6. Processing a typical user request

3.3 Database Access Design and Implementation

In consideration of the shortcoming of Java Data Base Connectivity (JDBC)[17], CMDS uses Object/Relation Mapping (ORM), Hibernate frame and Java persistence API (JPA). The biggest advantage of ORM is providing a simple and easy way for database interaction [18]. Hibernate could reduce the workload of the database operation and the code of data extraction. JPI has a standard interface which is easy to use and owns strong flexibility.

Fig 7 shows the database table structure. It is mentionable that there are only a surrogate keys in some tables, which is unreasonable in the common database design. For example, in the table Recipe Entity, there has only one field id. Since only one table can replace some fragmentary data table with JPA describing the inheritance relationship between entities, seemingly unreasonable tables are kept for subsequent development needs.

The relationships between classes are showed in Fig 8. In the right of Fig 8, Abstract class AbstactEntity extracts out common attributes of all objects. Abstract class MultilangEntity defines basic attributes of international objects. At last, an Entity class inherited from the AbstractEntity or MultilangEntity corresponds with the same table or field in the same table by annotation in Java to map object relational database. In the left, Interface AbstractDAO makes the basic Create, Read, Update and Delete (CRUD) method standard. DAOImpl implements the interface. DAO interface offers convenient access methods with hidden database details. Separating DAO class interface and

implementation decouples Hibernate implementation and upper level system, and reflects that JPA is neither a kind of standard nor the implementation.

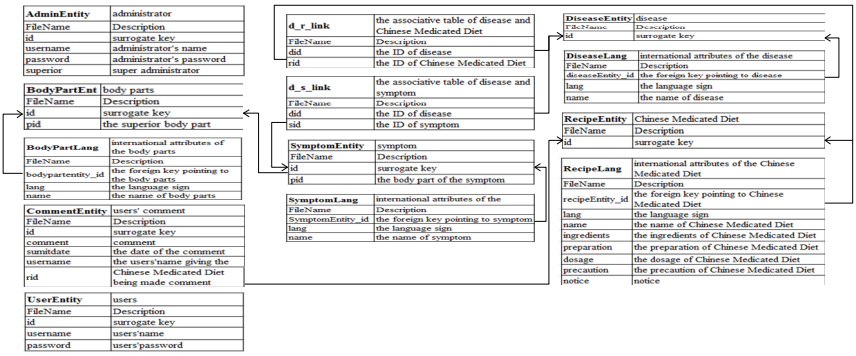

Fig. 7. Database table structure

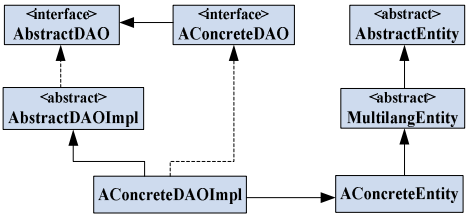

Fig. 8. Persistence layer diagram

The user interaction design based on jQuery frame [19] follows principles of using Ajax technology [20] to load the page data, reduce page jump and make interface concise.

4 CMDS Demo

With "thoracic spinal deformity" and "bone itch" symptoms of male user as an example, the functions and the user operations are demonstrated. (i) Choose sex in gender selection page, and then click the choice men. (See 1 in Fig 9). (ii) Choose specific organs from menu after click the body parts corresponding with thoracic spinal deformity symptom: chest. (See 2 in Fig 9). (iii) Checked corresponding symptoms in the popup page of all possible symptoms as 3 in Fig 9, then click on the "OK" button. (iv) Repeat step ii to iii, choose the second symptom: bone itch. The result is as 4 in Fig 9. (vi) Click on “Began inquires”. The system diagnoses user with osteoporosis very likely, and recommends the corresponding diet therapy prescription: carrots porridge (see 5 in Fig 9), then show formula content by clicking (see 6 in Fig 9). After viewing the "Carrots porridge", users can comment on the contents of the formula for future reference of the other users.

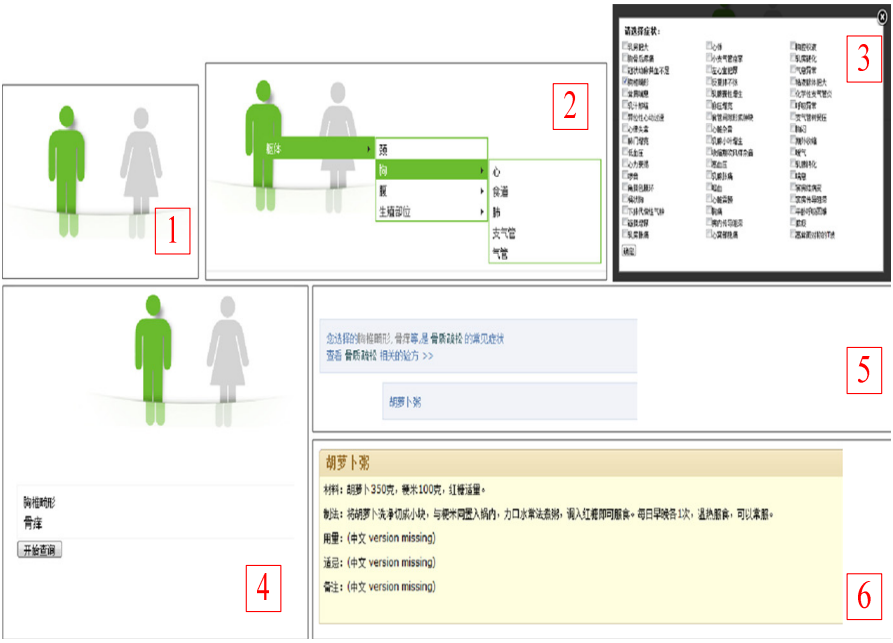

Fig. 9. CMDS Demo

5 Conclusions

This paper introduces the design and implementation technologies of CMDS in detail, such as persistence layer's design, database access's implementation and so on. CMDS has two key problems to be solved in the future. One is sorting and translating diet therapy prescription. The other is the inspection of CMDS in the realistic environment. Based on the original intentions of CMDS, a lot of works will be done for integrating computer-aided diagnosis and treatment system. In the future, we will not only try to solve above problems in CMDS, but also try to improve the accuracy of computer -aided diagnosis system.

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