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James J. (Jong Hyuk) Park
Qun Jin • Martin Sang-soo Yeo
Bin Hu *Editors*

Human Centric Technology and Service in Smart Space

HumanCom 2012

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Human Centric Technology and Service in Smart Space

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Welcome Message from the HumanCom 2012 General Chairs

On behalf of the organizing committees, it is our pleasure to welcome you to the 2012 International Conference on Human-centric Computing(HumanCom 2012), will be held in Gwangju, Korea on September 6–8, 2012.

This year the value, breadth, and depth of the HumanCom 2012 conference continues to strengthen and grow in importance for both the academic and industrial communities. This strength is evidenced this year by having the highest number of submissions made to the conference, which has resulted in our selective program. In addition, the publishing of special issues from six famous journals (*The Journal of Supercomputing, Cluster Computing, Multimedia Tools and Applications, Journal of Systems Architecture, INFORMATION, and International Journal of Sensor Networks*) make this conference stronger.

We sincerely thank all of our chairs and committee members, as listed in the following pages. Without their hard work, the success of HumanCom 2012 would not have been possible. We hope you find HumanCom 2012 enjoyable and please let us know if you have any suggestions for improvement.

Qun Jin, Waseda University, Japan
Martin Sang-soo Yeo, Mokwon University, Korea
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HumanCom 2012 General Chairs

Welcome Message from the HumanCom 2012 Program Chairs

Welcome to the 2012 International Conference on Human-centric Computing (HumanCom 2012), will be held in Gwangju, Korea on September 6–8, 2012.

The theme of HumanCom is focused on the various aspects of human-centric computing for advances in computer science and its applications and provides an opportunity for academic and industry professionals to discuss the latest issues and progress in the area of human-centric computing. In addition, the conference will publish high quality papers which are closely related to the various theories and practical applications in human-centric computing. Furthermore, we expect that the conference and its publications will be a trigger for further related research and technology improvements in this important subject.

For HumanCom 2012, we received a lot of paper submissions from more than 15 countries. Out of these, after a rigorous peer review process, we accepted some articles for the HumanCom 2012 proceedings, published by the Springer. All submitted papers have undergone blind reviews by at least three reviewers from the technical program committee, which consists of leading researchers around the globe. Without their hard work, achieving such a high-quality proceedings would not have been possible. We take this opportunity to thank them for their great support and cooperation.

We would like to sincerely thank the following speakers who kindly accepted our invitations, and, in this way, helped to meet the objectives of the conference:

- Juan Carlos Augusto, University of Ulster, UK
- Ned Kock, Texas A&M International University, USA

Finally, we would like to thank all of you for your participation in our conference, and also thank all the authors, reviewers, and organizing committee members.

Thank you and enjoy the conference!

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Welcome Message from the SKDM 2012 Chairs

The organizing committee of *the First FTRA International Workshop on Social Knowledge Discovery and Management (SKDM 2012)* will like to welcome all of you to join the workshop as well as the FTRA HumanCom 2012. Knowledge cultivation is considered as one of the most important social activities by all countries and governments, especially in the age of information exchange through the Internet. The development of social network and its technologies facilitate the, in both temporal and spatial, restrictions while delivering information and, in addition, enhance the channels for communications. This SKDM workshop aims to discuss new contributions as well as practical experiences using emerging information technologies. Especially, it looks at the differences of using and without using social technologies for knowledge discovery and management.

With the popularity of social media (e.g., Facebook, Twitter, Yahoo Answer, etc.), some sort of on-the-fly experience is learned and obtained by daily users. This type of experience can, in addition, be recognized as a particular way to cultivate domain knowledge. One typical instance is solution-finding. People rather search for the web (i.e., social environment) to see if someone who meets same, or similar, issues that he/she is dealing with and comes up with the solutions rather than find one in a traditional way. This not only reveals that the problems are about to be solved but the process that knowledge is discovered based upon the experiences from other publics. That is being said that the paradigms, such as social computing and multimedia networking, have changed the behaviors of human beings. In this context, knowledge discovery is the process of automatic extraction of interesting and useful knowledge from very large data, whereas knowledge management consists of a range of strategies and practices to identify, create, represent, distribute, and enable the adoption of novel insights and experiences for decision making. Issues regarding knowledge discovery and management become critical needs to be investigated. Various considerations should be carefully identified from both theoretical and practical perspectives to ensure the successful incorporation of these technologies. The program committee decided to accept 4 of them based on the paper quality and the relevancy. These papers are from Australia, China, and Taiwan. Each paper was reviewed by at least three program committee members and discussed by the program committee co-chairs before acceptance.

We would like to thank three FTRA Workshop Co-Chairs, Seung-Taek Ryu from Hanshin University, Korea, Elvira Popescu from University of Craiova, Romania, and Yuqingsun from Shangdong University, China, for their support and coordination. We thank all authors for submitting their works to the workshop. We also appreciate the program committee members for their efforts in reviewing the papers. Finally, we sincerely welcome all participants to join the discussion during the workshop.

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Welcome Message from PCT 2012 Chairs

On behalf of the 2012 International Workshop on Personal Computing Technologies (PCT 2012), we are pleased to welcome you to Gwangju, Korea.

The workshop will foster state-of-the-art research in the area of personal computing technologies. The PCT 2012 will also provide an opportunity for academic and industry professionals to discuss the latest issues and progress in the area of personal computing technologies.

Due to many high quality paper submissions and the lack of space in proceedings, the review process was very tough and we had no choice but to reject several good papers. Finally, we would like to sincerely express gratitude to all the people who have contributed directly or indirectly to make PCT 2012 a grand success. We would like to express our appreciation to all TPC members for the valuable time and their professional supports to this workshop. Particularly, we would like to thank the HumanCom 2012 steering chair (Prof. Jong Hyuk Park) and the HumanCom 2012 workshop chair (Prof. Seung-Taek Ryu) who allow us to hold this workshop in conjunction with HumanCom 2012.

Thank you.

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Welcome Message from the PSoC 2012 Chairs

It is my great pleasure to present the Personalized Service over Cloud (PSoC 2012) in conjunction with HumanCom 2012. This Workshop features topics beyond the main conference track to better cover all the emerging research areas of personalized service over clouds. Under the theme, there are 5 papers accepted from over 10 submissions. There is a rising tide of services over cloud; it is unlikely to disclose all of them. This workshop intends to identify those more personalized. But, we still only can cover few of them due to the grand scale of personalized services there as well. Nevertheless, the papers selected here serve as a good beginning for taping into the area. They cover underlying media conversion, service-oriented design as well as applications of tour recommendation, elderly care and e-learning. Meanwhile, they represent a substantial contribution through novel ideas and ongoing work to foster this emerging research field.

Nothing great can happen without the effort from those great people. As the chair of PSoC 2012, I wish to specially thank HumanCom 2012 conference workshop chairs who did an outstanding job in proposing, organizing workshops and attracting submissions. I also wish to thank the numerous program committee members and reviewers who ensured the high quality of accepted papers.

Welcome to the PSoC 2012 workshop and hope you participate in and enjoy the lively discussions!

Ray Yueh-Min Huang
Chia Nan University of Pharmacy & Science, Taiwan
National Cheng Kung University, Taiwan
PSoC 2012 Chairs

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An Activity Transition Based Fall Detection Model on Mobile Devices

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Abstract. Fall detection is a hot research issue in the field of pervasive computing and human-computer interaction. Its key difficulty is to build a fall detection model which obtains high detection accuracy and low false alarm rate simultaneously. In this paper, we propose a fall detection model based on activity transition. Firstly, our method segments continuous activity data based on activity recognition sequence, then extracts features from transition data between adjacent activities to build a fall detection model. Employing this model, we can detect the fall through recognizing abnormal activity transition. Tested on the real-world activity data set, our algorithm outperforms traditional methods.

Keywords: Fall detection, Activity transition, Extreme learning machine, One-class SVM, Accelerometer, Gyroscope.

1 Introduction

The fall is one of major health risks that diminish the quality of life among the elderly people, especially the independent living, which leads to many psychological problems, such as fear of movement, worry about living independent etc. [1]. Furthermore, the fall often causes serious physiological injuries [2-3], such as bleeding, fracture, and centre nervous system damages.

According to statistics [4], more than 33% of people aged 65 or elder have one fall per year, which indicates that the fall is one of very urgent and important phenomenon to be paid much attention nowadays. At present, fall detection methods can be mainly divided into three categories. The first is image analysis method based on video, which determines whether there is a fall occurred based on the variations of some image features. In [5], Hammadi et al. deploy several panoramic cameras on the roof and determine a fall occurs when the human body lies down in the inappropriate position for too long time. However, since the camera is usually installed in fixed locations, and the human body is an ambulatory, thus it is difficult to ensure this method's versatility. The second is acoustic based system which means detecting a fall via analyzing the audio signals. In general, this method is not well in precisions, and is often selected as an assistant way to the other methods. The third is wearable sensor based system that finds the occurrence of a fall based on the changes of some movement

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parameters. As long as one person wears such a sensor, he will be monitored anywhere, this method outperforms video based system.

However, traditional methods of the wearable sensor based system can't meet the high detection accuracy and low false alarm rate simultaneously. In this paper, we propose a fall detection model based on activity transition which can achieve the high detection accuracy and low alarm rate simultaneously. This method includes three components, continuous activity recognition, transition data extraction and abnormal activity recognition. In continuous activity recognition, features are extracted from normal activity data including staying, walking, running, upstairs, and downstairs, to train a multi-class classifier. In transition data extraction, the main task is to extract transition data from multi-class classifier's activity recognition sequence. In abnormal activity recognition, normal activity transition data is exploited to train a one-class classifier, then we can recognize abnormal activity transition to detect fall based on the trained one-class classifier.

2 Fall Detection Model Based on Activity Transition

2.1 The Flowchart of the Proposed Model

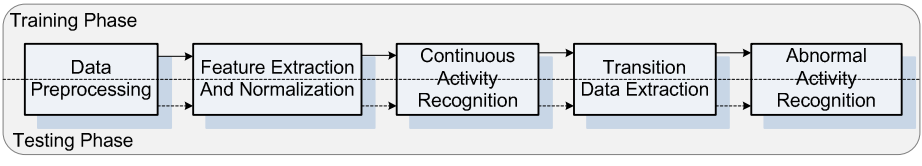


Fig. 1. The flowchart of the fall detection model based on activity transition

Figure 1 shows the flowchart of the proposed model. The implementation process has two phases: training phase and testing phase, which are showed as the solid arrows and the dashed arrows respectively. On the training phase, the readings of three axes are firstly synthesized into magnitude series to get rid of orientation dependence. Features are extracted from magnitude series of synthesized acceleration and gyroscope data, and these features are exploited to model a multi-class classifier. Then extract transition data from the activity recognition sequence. At last, employ the normal activity transition data to train a one-class classifier. On the testing phase, the testing samples are generated with the same approach as that used in the training phase, they are classified by one-class classifier and the classification result can be obtained.

2.2 Data Preprocessing

The accelerometer and the gyroscope both consist of 3-D readings, and are processed with the same way for their raw data. Without loss of generality, the following part only introduces the way to process the accelerometer data.

Each reading of accelerometer sensor consists of 3-D accelerations, which are a_x, a_y and a_z. In order to remove the affection of sensor reading errors and noises, a filter

is used firstly. In our model, we utilize a moving-average filter of span 5 to scale down (a_x, a_y, a_z) readings.

As a_x, a_y and a_z are the orthogonal decompositions of real acceleration, in order to deal with uncertainty of orientation of mobile devices, the magnitude of synthesized acceleration can be expressed as Equation(1).

$$a = \sqrt{a_x^{\,2} + a_y^{\,2} + a_z^{\,2}} \tag{1}$$

Where, a is the magnitude of real acceleration, which has no directional information. Therefore, the acceleration magnitude based activity recognition and fall detection model is orientation independent, and so does the gyroscope data preprocessing.

2.3 Feature Extraction and Normalization

Features are extracted from magnitude series of synthesized acceleration using a window size of 256 with 128 samples overlapping [6] between consecutive windows. This window size enables easy computation of Fast Fourier Transform (FFT) for calculating several features. At a sampling frequency of 100Hz, each window represents 2.56 seconds, and a fall generally happened within 2 seconds, thus select the window size of 256 is very reasonable to detect fall.

Eight features are extracted from a window of magnitude series of synthesized acceleration and they are processed into a single sample. These features are max, min, mean, standard deviation, energy, mean-crossing rate, spectrum peak position, and sum of frequency components between 0~5HZ. To eliminate the scaling effects among different features, all the features are normalized by using the z-score normalization algorithm. The same features are also extracted from magnitude series of synthesized gyroscope data, and the same normalization method is applied for them.

In order to reduce computation and improve accuracy, we select distinctive features from the feature set by using the correlation based feature selection method by the WEKA toolkit. WEKA toolkit is a piece of free software with the function of classification, clustering and feature selection, so we can employ it to help us select new feature set, where the new feature subset should contain highly correlated features within the particular class but are uncorrelated with each other.

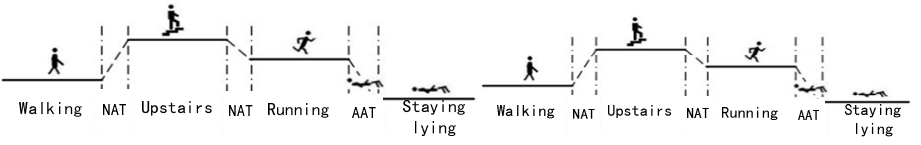
2.4 Continuous Activity Recognition

Multi-class classifier is used to accomplish continuous activity recognition. In this paper, five normal activities (including staying, walking, running, upstairs and downstairs) and an abnormal activity (falling) are defined. In order to accomplish our proposed method, we should extract transition data based on continuous activity sequence. Therefore, we employ a multi-class classifier which is trained by normal activities data to obtain continuous activity sequence, and the falling is also classified into the most likely class in the learned normal classes.

To highlight the good performance of our proposed model, we compare the performances of four multi-class classifiers, which are Decision Tree, Support Vector Machines, Extreme Learning Machine and K Nearest Neighbor.

2.5 Transition Data Extraction

During our research of fall detection, we found that the fall occurred at the transition or mutation of the activities, as shown in Figure 2. Therefore, detecting the activity transition can ensure the accuracy of fall detection. The data in the consecutive different activities is referred as transition data which contains normal transition data and abnormal transition data. We designed a method to extract the transition data.



(a) (b)

Fig. 2. (a) Fall occurred in the transition point between the different activity, (b) fall occurred in the mutation between the same activity, where NAT denotes Normal Activity Transition, and AAT denotes Abnormal Activity Transition

By employing the normal transition data to build the fall detection model, we can recognize the abnormal activity transition to detect fall based on the trained model. With the use of activity transition data to structure feature space, we can filter out large amounts of normal activity data and enhance the distinction ability of the model.

To clearly describe the method of transition data extraction, we assume that A, B, C, D, E represent five normal activities. According to the user's continuous activity sequence, we employ a window size of 3 with 1 activity overlapping between consecutive windows to extract transition data. Several cases are listed as follows:

Case 1: AAA When the three consecutive activities are all the same in the sliding window, there is no activity transition and no transition data need to be extracted.

Case 2: DEE When the second activity is identical to the third activity but different from the first activity, we can conclude the activity transition occurred between the first activity and the second activity. To extract the transition data, the raw data stream of the first activity and the second activity are divided into four equal parts, because there exists half of overlapping data when we extract features for continuous activity, therefore, the latter three parts of the first activity's raw data and the third part of the second activity's raw data are combined into a new data stream, then features are extracted from this data stream as transition data in this window.

Case 3: CCD When the first activity is identical to the second activity but different from the third activity, we can conclude the activity transition occurred between the second activity and the third activity. To extract the transition data, the raw data stream of the second activity and the third activity are divided into four equal parts, like case 2, the latter three parts of the second activity's raw data and the third part of the third activity's raw data are combined into a new data stream, then features are extracted from this data stream as transition data in this window.

Case 4: ABA/ABC When the first activity is identical to the third activity but different from the second activity or three activities are all different in the sliding window, we can conclude the activity transition occurred in the second activity. Thus we select the second activity's feature data as the transition data in this window.

2.6 Abnormal Activity Recognition

One-class classifier is used to accomplish abnormal activity recognition, which classifies the testing samples into the target class (known class) or the outlier class (unknown class). In one-class classification, only using the samples of the target class to build a classification model, which defines a boundary between target class and outlier class, so that the classification model minimizes the chance of accepting outlier samples while accepts the target samples as much as possible.

In our proposed method, we select one-class SVM algorithm to train our one-class classifier. We use the normal transition data as the training samples of the one-class classifier. According to the trained one-class classifier we can recognize the abnormal activity transition to detect fall.

3 Experiment and Results

3.1 Data Collection

This paper aims to propose a fall detection model based on mobile device. The device used in this paper is a white box made by our hardware engineer. An XSens MTx sensor which contains a tri-axial accelerometer and a tri-axial gyroscope is embedded in a white box. This device is only used for data collection. All data is transmitted to a PC and all the data preprocessing and analyzing are done on the PC. The sampling rate of device is set to 100HZ. Four participants with varying age and gender are recruited to perform five daily activities and an abnormal activity, which are staying still, walking, running, going upstairs, going downstairs and falling. During data collection, the sensor box is placed at two subject's chest pockets as shown in Figure 3.

(a) (b)

Fig. 3. Location information, (a) in the right chest of pocket,(b) in the left chest of pocket

We designed three types of data collection scheme. During data collection, all the participants carry out each activity in approximate frequency and intensity. In the first scheme we collect five typical types of normal activity data, there are 573 samples for staying, 534 samples for walking, 577 samples for running, 508 samples for going upstairs, 467 samples for going downstairs. In the second scheme we collect 48 samples of falling data. In the third scheme we collect normal continuous activity data, totally 806 samples are obtained.

3.2 Multi-class Classifier Performance Comparison

We select four multi-class classifiers, Decision Tree (DT), Support Vector Machines (SVM), Extreme Learning Machine (ELM) and K Nearest Neighbor (KNN). In order to compare their performances, we select five typical normal activity data as our dataset. Then 4-fold cross-validation is utilized for each classifier. During the test, each person data in turn taken out as test dataset and is classified while using the data of remaining three persons as training data to train the classifier.

In section 2.3, we have extracted 16 features. Of these features, some are useful and some may be noise. In order to eliminate the noise features and extract robust ones, WEKA Attribute Selection filters are used in our experiments. In 16 feature set, WEKA selected features including {accelerometer: max, min, standard deviation, energy, sum of frequency components between 0~5HZ; gyroscope: min, mean, standard deviation, mean-crossing, spectrum peak position} as new features set.

Table 1. Four classifiers comparison

Feature set	ELM	SVM	DT	KNN
16 features	81.46%	78.92%	77.36%	76.87%
WEKA select features	82.78%	81.58%	79.56%	78.50%

As can be seen from Table1, 1) When select 16 features, ELM obtains the highest accuracy among them, which is about 2.5%, 4% and 4.6% higher than that of SVM, DT and KNN, respectively; 2) We can easily find that the recognition accuracies of WEKA selected features are almost increased about 2% to 3%. This proves that WEKA Attribute Selection filters indeed eliminate some noise features and the extracted features are more robust than the original ones. Consequently ELM is adopted.

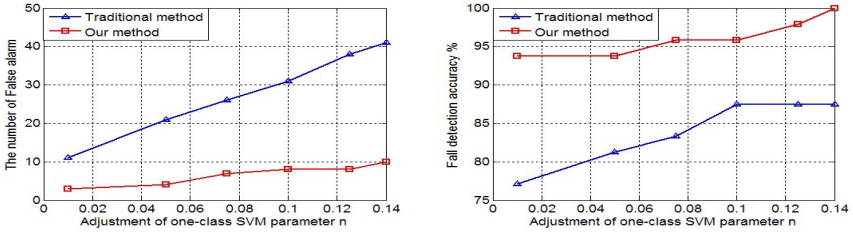
3.3 Detection and Classification Performance of the Proposed Method

In order to evaluate our proposed method, we firstly use the ELM classifier which is trained in section 3.2 to classify 806 samples of normal continuous activity data and 48 samples of fall data, then according to the result of the ELM, we extract the normal transition data and abnormal transition data to structure the dataset, the dataset contains 151 samples of normal transition data and 48 samples of abnormal transition data. Based on the dataset, 4-fold cross-validation is conducted to evaluate the classification performance of one-class SVM classifier. During the test, 48 abnormal transition data as testset1, each person's normal transition data is in turn taken out as testset2, then testset1 and testset2 are classified by one-class SVM classifier model which is trained by the remaining normal transition data.

In order to verify the superiority of our method, we apply the traditional method to conduct comparative experiment. In the traditional method, one-class SVM model is built on the normal activity data, then is used to classifier the new samples, if it is accepted by the one-class SVM model, it will be seen as a normal activity, or it is judged to be a fall. In this comparative experiment, we employ the same 806 samples of normal continues activity data and 48 samples of fall data instead of normal transition data and abnormal transition data to structure the dataset. Then 4-fold cross-validation is conducted to evaluate the classification performance of one-class

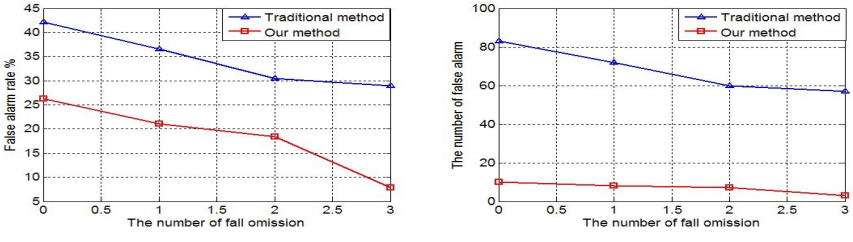
SVM classifier. During the test, 48 fall data as testset1, each person's normal activity data is in turn taken out as testset2, then testset1 and testset2 are classified by one-class SVM classifier model which is trained by the remaining normal activity data.

Seen from Figure 4, when the one-class SVM model selects the same parameter n, our proposed method has a higher fall detection accuracy and much less number of false alarm than the traditional method, thus we can conclude that our proposed method is easily to build a model with strong distinguish ability.



(a) (b)

Fig. 4. Comparison experiments, (a) the number of false alarm changes with the parameter n, (b) fall detection accuracy changes with parameter n



(a) (b)

Fig. 5. Comparison experiments, (a) false alarm rate changes with the number of fall omission, (b) the number of false alarm changes with the number of fall omission

Figure 5 shows that when the number of fall omission are same, our proposed method has a lower false alarm rate and less number of false alarm, which are about 12% and 20% lower than that of the traditional method, we can conclude our method is much better than the traditional method for fall detection. And our method can obtain 93.75% of the fall detection accuracy but only 7.88% of the false alarm rate at the same time from Figure4, which illustrates that our method achieves the high detection rate and low alarm rate simultaneously. Therefore, experimental results indicate that our method can be greatly applied to the practical application of fall detection.

4 Conclusions

In this paper, we have studied fall detection based on activity transition. This method can achieve the high detection accuracy and the low false alarm rate, simultaneously, especially bring a reduction to false alarm rate of running.

Our experiments are conducted on realistic activity data and experimental results show that 1) ELM multi-class classifier has the best detection performance in the continuous activity recognition; 2) WEKA Attribute Selection filters indeed eliminate some noise features and extracted features are more robust; 3) our proposed method outperforms the traditional fall detection method both in the high detection accuracy and low false alarm rate. These three aspects prove that our proposed method is an effective and efficient method for fall detection. In our future work, we will continue our research to reduce the impact which produced by varying locations of mobile device, because this will degrade the performance of fall detection model.

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User Experiences with Augmented Reality Advertising Applications: Focusing on Perceived Values and Telepresence Based on the Experiential Learning Theory

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Abstract. Augmented reality (AR) is of interest to the subject of a growing field of research. We investigate user experiences of AR advertisement, using experiments examining the perspective of a new ad type, AR ad. The study was designed to examine differences in the main features and telepresence between AR and 2-D advertising. Significant overall differences in entertainment and interactivity were found between AR and 2-D ad. The entertainment in 2-D ad was positively influenced on user's attitude toward product and the impact of the interactivity in 2-D ad wasn't significant. Conversely, the entertainment in AR ad wasn't significant and the interactivity was positively influenced on attitude. These findings are explained on the basis of experiential learning theory and helpful to offer guidelines of AR advertising applications and understand user's attitude.

Keywords: augmented reality, perceived values, telepresence, experiential learning theory.

1 Introduction

Augmented reality (AR) is an emerging technology that allows a real-world environment to be enhanced with computer-generated information such as text, sound, picture, video, or other data. AR is different from the virtual reality (VR) that replaces real-world experience with computer-generated information. For example, "3-D virtual objects are integrated into a real 3-D environment" [1]. AR has grown importantly in the new information workplaces and user applications including mobile applications [2]. AR can co-exist with customized applications by overlaying graphics into videos. Depending upon its application, thus, AR impacts communication in such areas as social media and advertising applications.

The characteristics of AR advertising (ad) may create new user experiences. The most important features of AR ad compared to 2-D ad is improved interactivity and personalization [3-4], which may have effects on preferences or satisfaction, positive attitudes and effective persuasion [5-6]. According to Zhu, Owen, Li and Lee (2004), for example, AR enables shoppers to personally inspect products because viewing objects in 3-D presents a richer virtual experience than that presented by printed ads,

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TV commercials and even 2-D images on the Web. Some studies have focused on virtual ads and web-based applications as communication models affecting user's attitudes toward ads, brands and products [7-10]. Also, previous researches usually showed about developing AR technique [1-2]. But we need the study about an application of AR technique. That is, little research has been performed to examine the user experience mechanism of AR ad. When users are exposed to the AR ad, we need to figure out how to conduct the information processing of user and evaluate it on the basis of perceived values of AR ad. Therefore, the objective of the present study is to understand how interactive AR experiences influence user's attitudes toward product. And that it will offer the guidelines for AR advertising applications about users' response.

2 Background

2.1 Perceived Values and Telepresence of AR Ads

Previous research in the field of human-computer interfaces has generally focused on three main features as perceived values - entertainment, informativeness and interactivity - as the most significant influences on attitude and behavioral intention toward websites and context [11]. Also, the perceived values are generally verified to users' evaluations of advertising and attitudes toward advertisings [7], [12].

The present study has connected these features with perceived values of AR ads. Namely, three main features have played the role as offered benefits of AR ads in the perspective of previous researches and on the basis of human-computer interface. Ads that are perceived to be entertaining exert a positive influence on users' attitudes toward those ads and their brands, and this leads users to purchase product [7], [13-14]. Also, AR ad transmits context-sensitive information, but it does so in a manner that provides users with an enjoyable interactive experience. And the informativeness is the quality wherein an ad effectively conveys helpful information to users and further as factors contributing to users' evaluations and attitudes [7]. Especially, as AR technology is merged into ads, more comprehensive processing of information is required. This includes interactive motion and forms of communication that convey the sensation of touching and feeling. These qualities differ radically from those associated with traditional 2-D ad. So, the influence of the entertainment and informativeness of perceived values depends on whether an ad is 2-D or AR. Perceived interactivity is defined as the degree of control over a communication process and mutual exchange roles between the human being and the computer. Previous research has shown that interactivity enhances user engagement and improves positive attitudes toward websites [15-16]. Li, Daugherty and Biocca (2002) found that the interaction experience in a 3D virtual world produces more active cognitive and affective activities than in 2-D user-messages. AR ad provides a more direct user-message and user-machine interactive experience than 2-D ad does.

User's experience in the AR approached the presence as an action-based process. That is, the most important characteristic and benefit of the AR is the "sense of presence" [17]. Especially, this study is investigated perceived telepresence defined "as the sense of being present or there in the remote environment, can simulate direct experience, and is useful for conceptualizing users' experiences in computer-mediated

environments" [18]. By the way, for occurring this sense, it needs the interactivity as an antecedent [19]. So the research investigated the impact of perceived values and telepresence related the interactivity of perceived values on users' attitude. That is, it needs to confirm the role of telepresence in AR ads compared to 2-D ad.

2.2 Experiential Learning Theory

Some research suggested that a simulated AR representation can be structured to minimize the cognitive load in translations between virtual spaces and the real world [20]. So, we can predict that AR ad would be more entertaining than 2-D ad. However, according to experiential and situated learning theory, it couldn't assert that the perceived entertainment in AR ad has always a stronger impact than in 2-D ad. Briefly, the experiential learning is the experience that plays in the learning process. In other words, it is the knowledge process derived from the combination of grasping and transforming experience and of cognitive learning and behavioral learning [21]. AR ad and environments give the realistic context and interactivity on the basis of experiential learning, which is how to learn, grow, and develop with interacting not working on individual displays [21]. Further, AR ad has an actual experience and a balance of immersion and real interaction. Therefore, it is to help remember well in AR ad because of stronger connections of previous knowledge [17].

This study suggested that this theory is related to the perceived values and teleprsence that impacted on attitude. Also, it needs to confirm and differentiate how much influence the characteristics on users' attitude in AR and 2-D ads. Based on a review of the literature, we predicted that AR ads would be more interactive and telepresence than 2-D ad, but not more entertaining because AR ad possess interactive features, such as active experiential content, that are not found in traditional ads. The informativeness is same between AR and 2-D ad based of experiential learning theory.

3 Methods

3.1 Participants

Ninety-five undergraduate and graduate students were recruited from a private university in Seoul, Korea. All participants volunteered for the experiment and received monetary reward which was about five dollars. Their mean age was 23.89 (SD =3.41), with a range from 18 to 39; 56.8 percent of the participants were female (males = 41, females = 54).

3.2 Design and Measures

The experiment used the advertising type (AR vs. 2-D) as a within-subjects factor. Independent measures were perceived values such as entertainment, informativeness, interactivity [10], [22] and perceived telepresence [18]. Dependent measure was user's attitude toward product. The sequence of the ad exposure was counterbalanced to control the potential confounding effects of the viewing sequence for the two ads. They were measured using four seven-point rating scales ranging from 1="strongly

disagree" to 7="strongly agree." The reliabilities measured using Cronbach's alpha were 0.89 for entertainment and 0.92 for informativeness and 0.90 for interactivity and 0.94 for perceived telepresence in AR ad. In 2-D ad, it was 0.88, 0.91, 0.88, and 0.93. The user's attitude toward product was measured four seven-point rating scales from [23-24]; "positive," "like," "favorable," "good." Its reliability measured as Cronbach's alpha was 0.94 for AR and 0.93 for 2-D ad.

3.3 Stimuli

This study used the watch campaign advertising from Tissot company that adopted a monitor-based AR technique. We chose this advertising because the brand was found to be unfamiliar to the target participants in this research based on our pilot study. Ninety-four percent of the participants reported they didn't have any familiarity with the brand (Mean=1.87, SD=1.34). Also, if we use real Ad ads, the experiment of this research is more accurate to assess advertising effectiveness than we make it inexpertly. With the AR ad, users could experience the Tissot watch using a printed-paper watchband and a web camera. The AR ad showed a 3-Dimensional image of the watch that allowed users to interact with the ads. Users may zoom in or out to examine the product, selecting the watch shape by clicking the categories provided on the ads. In contrast, the 2-D ads were a non-interactive video that showed another user's use of the same watch. And each ad was allowed to watch or interact for 3 minutes. The experiment participants had not exposed to the AR ad before the experiment. For the AR, brief navigation instructions were provided to explain how to use the paper bar code.

3.4 Procedure

This experiment was conducted in a computer laboratory setting in which each participant accessed a computer with a web camera. The experiment began with a short preliminary survey designed to collect the agreement forms on each participant. Once the survey was completed, individual participants were told that the purpose of the study was to collect their evaluations of the product. They were instructed to thoroughly examine their ads to determine what they thought and felt about the product. Then participants were randomly exposed to one of the two types of the ads and then the other. The sequence of the ads was counterbalanced. After experiencing each ad for 3 minutes, participants were asked to evaluate the ads for 5 minutes. Finally, participants were asked to complete the survey including demographic information after the main experiment. It took participants about 15 minutes to complete the entire session.

3.5 Results

A regression analysis was conducted on user's attitude toward product using as independent variables such as perceived values and telepresence in AR and 2-D ads. The model in AR ads was significant ($F=16.35$, $p<0.001$) and the R^2 was 0.42. The informativeness, interactivity, and telepresence were all significant. But entertainment was not significant as expected. Standardized coefficients are given in Table 1. They show that the most important variables in explaining attitude are the interactivity in

AR. For 2-D ads, the model was significant ($F=34.02$, $p<0.001$) and the R^2 was 0.78. The entertainment, informativeness, and telepresence were significant, but interactivity was not significant (Table 1). They show that the most important variables in explaining attitude are entertainment and that informativeness in 2-D.

Table 1. Regression Results (Standardized Coefficients)

	AR ad			2-D ad		
	Beta	T	p	Beta	T	p
entertainment	-0.01	-0.08	0.94	0.42	4.28	0.00
informativeness	0.22	2.11	0.04	0.26	2.61	0.01
interactivity	0.27	2.41	0.02	-0.05	-0.40	0.69
telepresence	0.28	2.29	0.02	0.24	2.06	0.04

∗ Dependent variable: user's attitude toward product.

These results could be predicted that the impact of entertainment in AR ads has disappeared because the interactivity of perceived values is more powerful influenced on user's attitude than other values on the basis of experiential learning theory. That is, in this experiment, the participant focused on interaction and immersion through the experience and behavioral learning of AR ads between computer and advertising. On the other hand, participants in 2-D ad just watched the video for advertising introducing AR ad. So, they think the introduction of the AR ad is interesting because of the new and unique type of advertising, although they couldn't experience the interaction with AR ads. Also, it is predicted that the perceived telepresence in AR ads is stronger than 2-D ads. But, the result has shown that the telepresence was positively influenced on attitude in both of them. This result could also bring to immersion in 2-D ads introduced new and unique type of advertising. We can add to explain that the t-value in AR ads is higher than 2-D ads as predicted. These results were seen interesting and can use the advertising strategy.

4 Discussion

This research investigated effectiveness of advertising from the perspective of the new technology, AR. In particular, we compared three features-entertainment, informativeness and interactivity- and perceived telepresence between the AR and 2-D ads. The findings of this study offer several implications for new AR ads. First, the interactivity is an important element of AR ad. Second, the entertainment of perceived values is influenced positively on user's attitude toward product in 2-D ad. This result is interesting and explained through experiential learning such as the knowledge process, immersion and interactivity in AR ad. Third, perceived informativeness and telepresence are positively impacted on user's attitude in AR and 2-D ads. It is the guidelines for making AR advertising applications through this result. That is, in AR applications, it needs to emphasize the interactivity with users and informativeness more than entertainment.

This study is to confirm and differentiate how much influence the characteristics on user's attitude toward product in AR and 2-D ads based on the experiential learning theory. The present study offers insights into user behavior with respect to interactive experiences through AR ad and their influence on information processing in the formation of user's attitude. Furthermore, this study contributes to AR research and its practical applications to communications or strategies and for implementing advertising system later. It presents an explanation of the psychological mechanism underlying the interactive experience and offers insights into the roles that main characteristics differences and perceived telepresence play in the formation of user attitude on the basis of experiential learning theory.

Some potential limitations of this research should be considered when interpreting the findings. It needs to attempt at measuring another value of application about user's responses such as perceived hedonic, utilitarian [25], and motivational value [26]. Actually it could connect the informativeness with utilitarian value and the entertainment with hedonic value. Also, the stimuli in this experiment are used of a company campaign, even though it used unfamiliar brand and advertising. Thus, further research might make a new advertising using AR techniques for controlling previous knowledge of product.

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Incorporating Virtual Forms into Traditional Things to Increase Their Values

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Abstract. Computing technologies allow us to enhance our daily objects by adding virtual forms to the objects. The virtual forms present dynamically generated visual images containing information that influences a user's behavior and thinking. In a typical way, adding a display to show visual expressions or projecting some information on an object offers visual forms on the existing daily objects. We have designed three case studies that add virtual forms to existing objects. The first case study is Virtual Aquarium, which offers a virtual aquarium that reflects a user's toothbrushing behavior. The second case study is Augmented Go, which projects additional information on the real Go board for making a better decision in the game play. The third case study is Augmented Trading Card Game, which adds virtual characters and special effects on the trading cards of the Nintento DS game in order to encourage and provoke more social play of the game.

In this paper, after presenting an overview of the three case studies that enhance traditional objects with virtual forms, we present six values that play an important role in the design of the enhanced objects. We believe that these values would be useful in the design of any other enhanced objects with virtual forms.

Keywords: Virtual forms, Augmented reality, Values, Gamification.

1 Introduction

Recently, daily digital objects are becoming more and more usual and widely sold commodities. For example, recently televisions developed in Japan have become cheaper and cheaper despite of their excellent product quality and rich functionality. Also, Android mobile phones are becoming popular and a wide range of models and functionalities is offered on the market. However, it is very difficult for the users to distinguish the differences in the phones and make a choice. The fact that the product quality does not become the value for many of us to buy the product shows that we need to consider another way to design daily digital objects. However, we found that new furniture and fashion goods attract us every year and they do not become commodities that are sold at cheaper prices with the time. The reason for this is the fact that they offer additional values to users. Especially, the prices for such products are kept high if the products offer the sense of rarity. Digital technologies are effective to make digital objects a usual commodity and as a consequence to make their prices cheaper, but these technologies are also effective to add more values to the products

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by customizing them for each user [5]. The customization may offer the objects more attractiveness, which might lead to the increase in their prices.

Virtual forms are realized by adding displays and by projecting information on the objects, and can be changed dynamically according to the current surrounding situation. This approach is promising to enhance daily objects, and offer more values on the objects. We have designed three case studies to augment existing objects with virtual forms. The first case study is Virtual Aquarium, which offers a virtual aquarium that reflects a user's toothbrushing behavior. The second case study is Augmented Go, which projects additional information on the real Go board for making a better decision in the game play. The third case study is Augmented Trading Card Game, which adds virtual characters and special effects on the trading cards in the Nintento DS game to encourage more social play of the game.

From the experiences with the design of the case studies, we have found six values to consider how to offer additional values in the enhanced objects with visual forms. The values can be used in the following steps. The first step is to identify the values in the traditional objects. Then, they can be used for discussing which values should be added or changed in the enhanced objects in order to increase their values. Finally, we consider what kinds of virtual forms can be suitable for making the objects richer and more enjoyable.

In this paper, we present a brief overview of the three case studies and identify the extracted values from these case studies. It is a future issue of our research how to use the values to design enhanced daily objects. In the future, we also consider the possibility to use these values in order to gamify various activities.

2 Three Case Studies

2.1 Virtual Aquarium

Virtual Aquarium is an object called a persuasive mirror [6] that has been developed and has the objective of improving users' dental hygiene by promoting correct toothbrushing habits. It is set up in the lavatory where it turns a mirror into a simulated aquarium as shown in Figure 1. Fish living in the aquarium are affected by the users' toothbrushing activity. If users brush their teeth properly, the fish prosper and procreate. If not, the fish become unhealthy and may even perish.

In *Virtual Aquarium*, we use a 3-axis accelerometer sensor that is attached to each toothbrush in a household. A user brushes his teeth in front of *Virtual Aquarium* using a brush with a sensor attached. Since toothbrushes are usually not shared and each sensor has a unique identification number, we are able to infer which user is using the object at a given time. Toothbrushing patterns are recognized by analyzing the acceleration data. The toothbrush is able to observe how the user brushes his/her teeth passively. This is the only interaction needed to use this object.

In this case, the ideal user's behavior model is defined as follows: 1) a user brushes his/her teeth at least twice a day; 2) one session involves at least three minutes of brushing; and 3) brushing involves patterns that ensure the teeth are properly cleaned. Each user's behavior is compared to the ideal one and translated into a feedback as described below. We believe that the existence of an aquarium in the lavatory is not disturbing and unnatural, but improves our daily life.

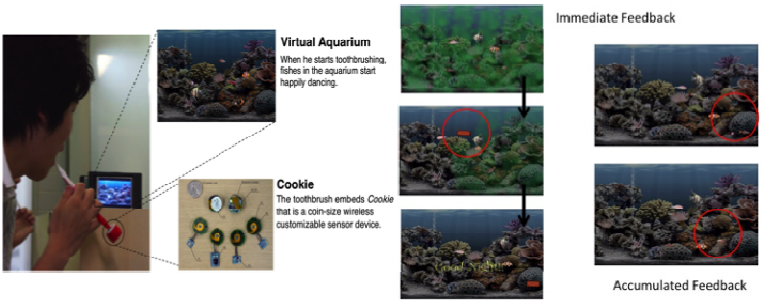

Fig. 1. Virtual Aquarium System

As shown in Figure 1, when a user begins to brush his/her teeth, a scrub inside the aquarium starts cleaning the algae off the aquarium's wall. At the same time, a set of fish associated with the user starts moving in the aquarium in a playful manner. When the user has brushed his/her teeth for a sufficient period of time, the scrub finishes cleaning and the fishes' dance becomes even more elegant. When the user finishes brushing, the fish end their dance and resume their normal activities. Both the activities of the fish and the movement of the scrub are designed in such a way as to give the user hints regarding the correct method of toothbrushing. However, if a user does not brush his/her teeth sufficiently, the aquarium becomes dirty, and the fish in the aquarium become sick. The feedback information is returned immediately according to the movement of the user's toothbrush. We call this feedback *immediate feedback*.

The health of the fish is visibly affected by how clean the aquarium is. If the user neglects to brush his/her teeth properly, fish health worsens. In contrast, faithful brushing may result in the fish laying eggs as shown in the right pictures of Figure 1. At first, the eggs are not very likely to hatch. If the user continues to brush consistently for a number of days in a row, the incubation ratio increases. This way, the long-term feedback gives clues to the correct behavior and attempts to maintain motivation over a period of time. The long-term feedback is called *accumulated feedback*.

While designing the object, we consider the association between a user's healthy lifestyle and the cleanness of the aquarium. Our design takes into account the fact that the user feels empathy for the virtual fish.

In our daily life, a mirror reflects our figure to show our appearance. The mirror allows us to know whether we are well or not, whether our makeup and clothes fit or not and so on, and has the power to make what is invisible from us visible. We believe that mirrors are adequate devices to reflect our current behavior that return immediate feedback on the current situation. *Virtual Aquarium* is a new type of mirror that reflects a user's current state, encourages him/her to change his/her behavior and motivates desirable lifestyle.

2.2 Augmented Go

Go is a traditional board game for two players, where the goal is to occupy a larger portion on the board than the other player. Black and white stones are used to control the territory and a board with a grid of 19 x 19 lines is used as the game field. The rules of Go are relatively simple, but the underlying strategies are extremely complex

and rich. As in chess and reversi, a numerous set of strategies have been invented to reduce the complexity, but studying them requires the player to actually understand the strategic concepts. Thus, it takes a long time for a beginner to play well with an experienced player and to feel pleasure during the play. *Augmented Go* [9] supports several gaming modes to play a game. The basic idea is to offer useful information to beginners without extra interactions and intrusive devices as shown in Figure 2. A virtual form in Augmented Go is superimposed onto the real Go board. Proactive feedback information is offered visually by superimposing guidance information onto the Go board by a projector. A web camera connected to a personal computer is used to detect the position of each Go stone. The OpenCV library is used for visual analysis and the core logic of the enhanced object generates information presented to the players according to the current game situation.

The system supports several gaming modes. As shown in Figure 2-(a), players can interact with the object by placing Go stones on a menu that is projected onto a board. We explain some of the modes and how players interact with *Augmented Go*.

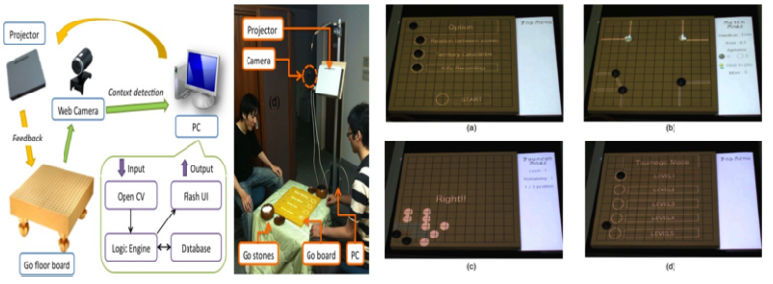

Fig. 2. Augmented Go System

Normal Play Mode: The normal play mode is the basic form of the Go augmentation. In this mode, two players play Go as usual, but useful information is projected on the board to help beginners recognize the situation and make better decisions. The rules of Go are simple, but the vast number of possible moves in each turn makes it hard for beginners to make decisions. Moreover, on the large 19x19 board, beginners tend to concentrate on localized fighting in a narrow region and lose the big picture. It is difficult to recognize invaded areas, since an invasion process gradually progresses as new stones are put on the board. For choosing good offense and defense strategies, recognizing the links between the Go stones is important, but it requires some skills. Moreover, the normal play mode visualizes the strength of links between the Go stones. As shown in Figure 2-(b), same-colored stones are connected with lines. If a dangerous situation occurs somewhere on the board, a warning message appears for the players to avoid losing the area. The sequence of stone moves is also recorded into the database, which facilitates replaying the game for self-training. Replaying allows us to review and analyze the play by projecting the stones on the board later.

Tsumego Mode: Tsumego is a type of exercise where the player is given a game board situation. The aim is to find the best sequence of stones' placement in a given board situation. In this mode, the positions of the stones are visualized on the board.

Players can try different moves by placing stones on the board, with the results and comments explaining key important points displayed as visual feedback (Figure 2-(c)). The Tsumego mode prepares questions for a player with different skill levels, and the level of difficulty can be selected in the menu.(Figure 2-(d)).

The advantage of our approach is to allow players to receive information through the normal interaction with the Go board and the stones. By superimposing information onto the board, players can concentrate on the normal play or self-training without fragmenting their attention by taking an instructional book and etc. into their hands. This is important to make it possible for the players to allocate enough cognitive resources for understanding the current situations in the game.

2.3 Augmented Trading Card Game

A trading card game is also commonly referred to as a collectible card game, a customizable card game, or CCG. For our purposes here, we will use trading card game (TCG) to refer to all the three varieties of games. In a nutshell, a TCG combines the collectability of trading cards with strategic game play. Typically a player purchases a starter set, containing a playable deck of cards and a manual that includes an explanation of the rules and the mechanics of the game in an introductory fashion. One of the biggest problems faced by any new TCG player is the need for an opponent to truly engage in the game play, as it is extremely unusual for any TCG to feature a solitaire mode. Players usually begin playing with a friend, at a particular location such as a hobby game store that offers organized gaming opportunities and includes a tutorial component, or via an online portal.

Computer-based TCG is also becoming popular, and in our project we make a comparison between the real TCG, and its virtual one running on Nintendo DS[1]. An important conclusion resulting from that comparison is that the computer-based TCG loses a lot of realities offered by the real TCG [7]. For example, the sense of real cards is essential for many TCG players since making and completing collections of cards is a significant fount of pleasure for them. The computer-based TCG also implies some communication limitations, because it allows a player neither to have an eye-to-eye contact, nor to look at or chat with the opponent player.

As described above, although most of the current computer-based TCGs lose the realities of the real TCG, we claim that ubiquitous computing technologies may help to recover these lost realities and encourage and attract players to enjoy the computer-based TCG in a very similar way to the real TCG. Moreover, adding special effects and virtual forms to the computer-based game might increase the excitement of the game even more than the real one.

Figure 3 shows Augmented Trading Card Game that is currently developed in our project. The system extends the trading card game running on Nintendo DS, where two players are usually located in different places while playing the game. In Augmented TCG, the opponent player is represented as a virtual character that is visualized using a tool called MikuMikuDance. The movement of the character is synchronized with the movement of the real opponent player by using MS Kinect, and

[1] In the paper, real TCG means that the game is performed using real trading cards on a real table, and two or four players play the game face-to-face.

the behavior of the character is determined by the information retrieved from a biosensor attached to the opponent player, i.e. the virtual character's behavior and emotions reflect the real player's behavior to some extent. In Augmented TCG, two virtual forms are used. The first form is superimposed onto the playing table to show the virtual trading cards and some special effects during the play. The second virtual form is installed on the wall to show a virtual character.

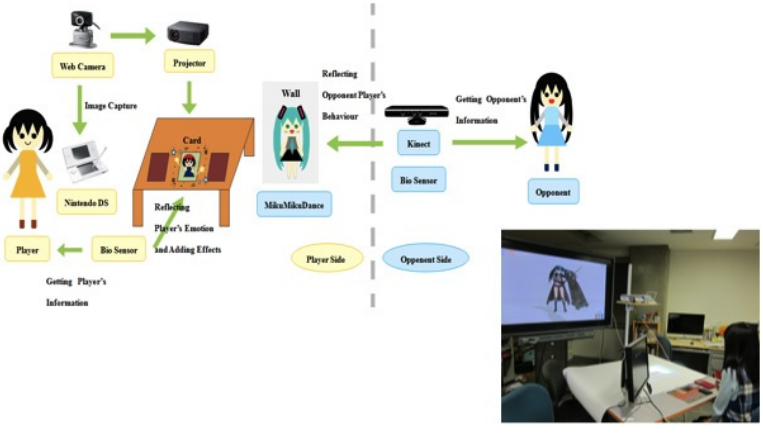

Fig. 3. Augmented Trading Card Game

The trading card itself is also enhanced in the system. Cards presented on the display of the Nintendo DS are retrieved by Web cameras and projected on a real table. The projected cards can be enhanced by adding special battle effects or empathetic effects to the characters shown on the cards.

In the original computer-based game, a player usually cannot see the opponent player. The proposed Augmented TCG enables us to recover this lost reality by adding a virtual character whose movement and behavior are synchronized with the movement and behavior of the real opponent. In addition, the virtual trading cards carry some special effects that increase the sense and the excitement of the battle. Similarly, if the character drawn on a trading card shows some empathic expressions, a player feels empathy with the character on the card, and feels more enthusiastic and committed to the game. These special effects compensate the lost realities of the real trading cards. Also, virtually attached rarity to the virtual trading cards brings a feeling of reality and encourages a strong will to collect virtual trading cards.

3 Design Implications

Baudrillard proposed that the consumption becomes more symbolized and additional values become more important than the products as materials [1]. For example, a brand offers significant additional values to fashion items, and a consumer feels the value on their virtual properties. On the other hand, adding values to virtual items

makes a user feel the items materialized. This means that real products are becoming more virtual, and virtual products are becoming more real.

From our experience with the case studies, we extract six values to be used in the design of virtual forms that augment traditional objects. The first value is the physical value that offers the tangibility to the objects. During the design of Augmented TCG, we compare the traditional trading card game and the game running on Nintendo DS. The comparison shows that many players prefer the feeling of the tangibility of the real trading cards while playing the game [7]. We believe that this value increases the reality when some objects exist in the virtual world [3]. The second value is the empathetic value. In Augmented TCG, the usage of this value in the virtual character increases the friendship with the opponent character when the player likes the character. The third value is the persuasive value that offers extrinsic motivation to a user. The transtheoretical model [8] defines five stages to change a user's behavior. This value is used in Virtual Aquarium, where a user continues to brush his/her teeth making fish in the aquarium healthy. Then, in the later stage, the cleanness of the aquarium is a metaphor of the cleanness of the user's teeth, and the metaphor is useful in order to make the user aware of the importance of toothbrushing. The fourth value is the informative value. The value is effective to make a better decision. In Augmented Go, some information that helps the player to choose the position of the next Go stone is projected on the real Go board. The next value is the economic value. The value is not directly used in the current case studies, but we discuss the importance of the value when designing the case studies. For example, a player might like to buy special effects in Augmented TCG in order to improve the play or increase the excitement of the game. Finally, the last value is the ideological value. The value represents the metaphor that shows the dream or expectation of a user.

The described values are useful to identify what the main values of the traditional objects are and how to add additional values to the objects for making the objects richer and more enjoyable. For example, in Augmented TCG, we found that the original game running on Nintendo DS has some problems. For example, since the player does not see the opponent player, he/she tends to easily cheat in the game. We believe that using the empathetic value to the virtual character of the opponent player will prevent from cheating in the game. Moreover, adding special effects to the trading cards are useful to motivate the players to win the game fairly.

During the discussion of the case studies' development, we consider the importance of the economic value. We consider that incorporating virtual items to be exchanged among users is a promising way to motivate users to use the enhanced object [4]. For example, if a user develops a new way of customization of an object, the other users might be interested to use the customization even if they need to pay some money for it. We believe that this kind of customization may offer an attractive business model to objects.

Aesthetics is an important concept to design the ideological value. Especially, in Japan, incorporating the ideological value in Japanese products is a promising way to sustain Japanese Economy [2]. Japanese traditional folkcraft represents the aesthetic value, and we need to investigate how to incorporate the aesthetic value into digitally enhanced objects.

4 Conclusion

The paper shows three case studies that add visual forms to enhance daily objects. From our experience with the design of the case studies, we extract six values that would be useful for the design of the future digitally enhanced objects.

Our approach to add virtual forms to existing objects makes it possible to gamify the use of the objects and make it more enjoyable. Gamification [10] recently becomes a popular way to make daily and business activities more attractive. We hope that the proposed values would be helpful for the successful gamification of these human activities.

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The Effect of User Experience Factors of Tablet Devices on Behavioral Intention to Purchase in the Experience Zone

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Abstract. As a place where users experience products and make decisions, the experience zone has become an interesting location. In this research, to analyze user experience (UX) in the experience zone, three user experience factors (readability, mobility and telepresence) and two mediating factors (usability and usefulness) are developed and tested as a user experience model. Also, to predict user behavior, behavioral intention to purchase is added to the model. The model and experiment were constructed to explain how users of a tablet device experience, perceive, and finally, purchase a device via functions and UX factors of the tablet device. To analyze the model, structural equation modeling was used. The results generally supported the suggested model for UX and the experience zone of tablet devices. Empirical and theoretical implications were discussed.

Keyword: user experience, mobility, telepresence, readability, usability, usefulness, behavioral intention to purchase.

1 Introduction

What factors should we consider to understand and design tablet devices? The question might be one of the most important questions among many designers, engineers and researchers. While the Apple's iPad have been sold humongous amounts, other manufacturers desperately find the way to be like the Apple or another market to sell their devices, which have been estimated still 'followers'.

In this study, to provide partial answer of the question, several user experience factors and the effect of them are investigated. To achieve the goal, a user experience model including behavioral intention to purchase, three user experience (UX) factors and two mediating UX factors are built and tested. Especially, this research investigated mobility, telepresence, readability as three UX factors and usability and usefulness as mediators.

According to Schmitt (1999), experience marketing emphasis on the experience of users and strictly performed based on an actual moment of purchase [1]. Recently,

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manufacturers not only display their products (tablet devices), but also let people use and experience their product freely. Therefore, the 'well-made' quality of products and how to display products well are both important now. We call this interactive place as the 'experience zone'.

The experience zone is a part of the experience marketing, which is set by researches of user experience and purchase environment. In this context, the experience zone has users maintain positive images and experiences by repeated inspiration, to get their own identity. Thus, through positive experience, recognition and memory, the zone makes good impression to users [2]. Therefore, companies are able to stimulate and impress users to imprint images of companies in the new way by building the experience zone.

As investigated, the experience zone is an important space where offers two different experience; user experience of tablet device's own and company's integrated marketing experience [3]. In the experience zone, users can use the device and determine how it affects their life or should they purchase it.

However, in this research area, most of the recent articles are not based on quantitative experiments, and show lack of perspectives to user experience itself [4-6]. Comparing to the active researches on user experience area, the short of experience research in marketing is the base of this research. Moreover, considering the huge gap between sales of iPad and other tablet devices, the intense 'competition of hardware' may be ended. Instead, the importance of UX and Contents should be considered. Therefore, designers and engineers may focus on UX design as well as hardware design.

In this paper, therefore, many distinctive approaches are tested on the experience zone, which have not been studied well despite its importance. Firstly, three different user experience factors are newly focused, which have discovered to connect UX and user behavior. Then we will combine those factors with behavioral intention to purchase in a user experience model of the experience zone directly or indirectly via mediators.

2 Theoretical Background

2.1 The User Experience and Its Adaptation

In traditional user experience researches, one of the most popular theoretical models is technology acceptance model (TAM). TAM is developed from TRA (theory of reasoned action), which explains human behavior is determined by intention and the intention is affected by attitude and subjective standards. This model explains how users use certain technology and accept it. The schematic of TAM is shown in Figure 1 [7].

After release of Davis' research, many studies are established according to technology's development. However, interesting aspects of TAM researches are limited use of TAM factors [8]. In other words, the main factor of TAM have been studied constantly, other environmental features, such as marketing or many of user experience factors, have not been studied abundantly.

There were many attempts that extend TAM or adopt TAM to other area. In these attempts, new factors were added or basic factors were modified or even deleted.

Interesting part of these new factors is usability, which is redefined as 'usability' based on the context of using tablet devices, and usefulness. In tablet use, usability and usefulness are considered having more importance than other devices [9]. Therefore, considering the importance, we assumed that these two factors mediate most of user experience factors.

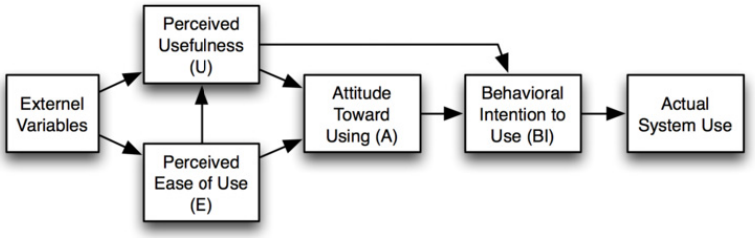

Fig. 1. Schematic of TAM

2.2 User Experience and Its Adaptation for the Experience Zone

The user experience, suggested by Donald Norman, is defined by ISO (international organization for standardization) as "a person's perceptions and responses that result from the use or anticipated use of a product, system or service". As its definition says, it has wide and various meaning. However, until now, most of the researches on user experience focused on minor aspects of it. Especially, most of researches concerned application, service design and webpage interfaces [10-11].

Thus, the number of studies concerning how user experience connected with user behavior is very small. For instance, Kim and Biocca (1997) showed interaction between telepresence and buying intention in television viewing environment [12]. Also, Mallat et al (2006) suggested a model of relation between TAM and buying intention and mobility [13].

In this research, to fill the gap between user experience and user behavior, we found important three kinds of user experience factors and use these factors as predictors of user behavior.

Recent survey on tablet usage patterns gave a hint to establish UX factors. According to the survey, people who have tablet use gaming mostly. Reading and writing, other entertainment activities (watching video and listening music), SNS service and blogging is below the reading activity in this order [14]. These usage patterns are able to explain user experience abstractly. Thus readability for a effective reading and writing experience, telepresence for intensive immersion to games and music and lastly mobility for portable aspects of tablets are finally selected as essential UX factors.

The research model is constituted in three modules that describe effect of user experience and mediation of usability and usefulness toward behavioral intention to purchase of users. In the study, to explore the role of usability and usefulness, two factors are used as mediators. The entire model is hypothesized that UX factors are

directly correlated with, or indirectly have positive effect on, via usability and usefulness, behavioral intention to purchase (BIP).

3 Hypothesis

3.1 Mediating Factors

Abundant studies have established the role of satisfaction in several contexts. Cronin et al. (2000) supported the effect of users' satisfaction on behavioral intentions [15]. Also, Liaw (2007) empirically validated that perceived satisfaction is directly and positively correlated with behavioral intention of using e-learning [16]. Given that usability is key factor of overall satisfaction of the e-book [17], it can be tested and hypothesized as below.

H1: Usability has positive effect on behavioral intention to purchase

Usefulness has been also tested on several areas, including Technology Acceptance Model and its modified version of theories. Also, usefulness is well-known for being one of the antecedents of behavioral intention [18]. With the importance and popularity, usefulness is hypothesized as one of the mediators of the model.

H2: Usefulness has positive effect on behavioral intention to purchase

3.2 Mobility

Mobility refers to degrees to which a person perceives a certain device can be used with or without concerning the place the person is. As the importance has been increased since tablet devices are obtaining popularity, the importance of mobility also increased. [19] Also, Kakihara and Sorenson (2001) showed that the concept of mobility has been broadening [20]. In other words, mobility is considered to have various roles in use of tablet devices in this study.

According to Mallat et al., mobility has a positive correlation with behavioral intention to purchase in mobile commerce context [21]. Similarly, Lim and Lee (2006) empirically validated that behavioral intention to purchase is positively and indirectly affected mobility of mobile commerce and the environment [22].

H3: Mobility while using tablet devices has a positive effect on behavioral intention to purchase.

Also, Rodriguez et al. (2007) indicated that mobility has a positive correlation with satisfaction of handheld device in hospital situation based on empirical experiment conducted for nurses [23]. Analogously, Perez (2006) showed positive correlation between mobility and user's satisfaction. As mobility has shown a strong belief in overall satisfaction of mobile device, it can be tested in tablet devices [24].

H4: Mobility while using tablet devices has a positive effect on usability

Another perspective that mobility can affected is usefulness. Various researches have studied the perceived usefulness in human-computer interaction (TAM) context since Davis (1989) started and established technology acceptance model (TAM) [7]. For example, Huang et al. (2007) empirically showed that perceived mobility value is positively correlated with perceived usefulness in mobile learning context [25].

H5: Perceived mobility has a positive effect on usefulness

3.3 Text Readability

Text readability refers to a complex concept of the measures to how readable a certain text is, according to the shape, alignment and appearance of the text. As multimedia learning theory of Mayer (2002) depicted, even though tablet devices are multimedia platform, including most of current media form such as video, picture, sound and text, for better understanding of contents, text and readability might not be an optional factor [26].

Dyson and Kipping (1997) showed that there is positive correlation between text readability and usability in reading of on-line publication [27]. Another empirical validation of readability-satisfaction of text correlation is research of Chaparro et al (2005) [28]. In this study, participants showed significant difference in satisfaction of reading between enhanced page layout and poor page layout.

H6: Text readability has a positive effect on usability

Also, Khedr et al. (2010) empirically showed that learner interface design, including legibility (or readability) positively associated with perceived usefulness in e-learning context [29]. Additionally, it was validated that e-learning system or a web-page with harmonious format of color has a positive effect on usefulness of the system in several researches [30-32].

H7: Text readability has a positive effect on usefulness

There are few studies concerning relationship between readability and intention to purchase. Lee and Kozar (2009) showed empirically validated results that there is a positive correlation between readability and behavioral intention to purchase indirectly [33]. Also, in Hall and Hanna's study (2003), even though the correlation between readability and behavioral intention is insignificant, considering inter-factor correlation, it can be hypothesized that there is indirect and positive correlation [34].

H8: Text readability has a positive effect on behavioral intention to purchase

3.4 Telepresence

The telepresence is firstly defined by Csikszentmihalyi (1997) in his study about the Flow model [35]. In the Flow model, telepresence is confined as "experience of presence in an environment by means of a communication [36]"

Bulu empirically validated that telepresence has positive effect on satisfaction in virtual reality context [37]. Another aspect that telepresence has positive correlation indirectly is presented by Joo et al. (2011). The researchers showed that two different types of presence (teaching and social) also have positive correlation with satisfaction [38].

H9: Telepresence has a positive effect on usability

Novak et al. (2000) conducted a research concerning user experience in online environment, and showed empirical evidence of positive correlation between telepresence and usefulness [39]. Additionally, Kwon and Wen empirically, validated that telepresence has a positive and an indirect effect on usefulness while people use social network service [40].

H10: Telepresence has a positive effect on usefulness

Finally, Fiore et al. (2005) empirically established the positive effect of telepresence toward BIP based on online shopping environment, which raise relative hypothesis [41]. Additionally, as corresponding research, Hoffman and Novak revealed the role of telepresence as an antecedent of flow state while finding variables that related with flow in online context, which has direct effect on BIP [42].

H11: Telepresence has a positive effect on behavioral intention to purchase

Therefore, the research model was built as follows (figure 2):

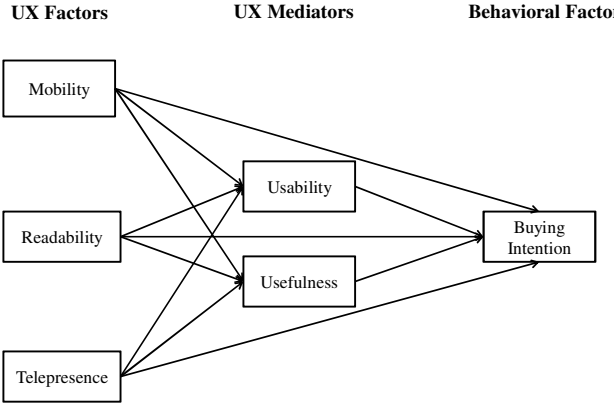

Fig. 2. Schematic of research model

4 Method

4.1 Overview of the Experiment

These hypotheses are built based on many situations in the experience zone. The participants performed tasks that reading three kinds of articles in three different devices in random order. After reading, responses for each factor are recorded.

4.2 Definitions of Variables

Table 1. Factors of User Experience in the Experience Zone

Factors	Reference
Mobility	Huang et al (2006). "Elucidating user behavior of mobile learning"
Readability	Quinn (2008). "Readability of scanned books in digital libraries"
Telepresence	Novak et al.(1998) "Measuring the Flow Construct in Online Environments : A Structural Modeling Approach"
Usability	Quinn (2008). "Satisfaction of scanned books in digital libraries"
Usefulness	Davis, F. (1989). "Perceived usefulness, perceived ease of use, and user acceptance of information technology"
Buying Intention	Davis, F. (1989). "Perceived usefulness, perceived ease of use, and user acceptance of information technology"

4.3 Participants

Total 217 adults (Mean=22.82, SD=2.23) were participated in the experiments. Most of the participants were undergraduate school students and part of them was graduates. Every participant had no problems to read text in Korean and use the devices. The gender difference was balanced (Males=108, Females=109). The recruiting was held via internet flyers and online registration board.

There was no one who experienced the stimuli intensively in advance. Also, in the pre-experience of the devices, most of the participants have barely experienced three devices. 2 participants had used the iPad few times. However, the experience period was too to affect the results.

4.4 Apparatus

The Galaxy Tab of Samsung, the iPad of Apple and Biscuit (e-book reader) of domestic brand, Interpark are used in the experiment. The Screen size of each tablet device was 7, 10 and 6 inches. To neutralize interference, the experiment was performed in concealed lab with comfortable chairs and desks. The light was fluorescent light, which is common type of light in the experience zone.

4.5 Stimuli

To provide actual usage of tablets, three popular genre is selected to be read; a novel, an essay about music history and a scientific article about health. A news article is ruled out because of biased news perception based on the participants' background. Some candidates to participants couldn't participate in the experiment because their major might affect the result (prior knowledge).

Procedure

Before reading, researchers asked about prior experience of reading stimuli and the devices. Also, informal questions about their reading habits (reading frequency, subjective reading speed and favorite genre) and handedness

Then researchers informed the participants that they should read each article for 5 minutes and after reading, they should answer questions about the article and the devices. The posture was not limited. Resting time between the reading and the answering was 1 minute.

The form of questionnaire was online survey that contains questions about each experimental factor in theoretical model. Every time after answering, free statement about reading and the device was asked.

5 Result

5.1 Structural Paths and Hypotheses Tests

To analyze model structure, the hypothesized paths were tested. Nine hypotheses were supported and two were abandoned. The results summarized and depicted in Table 2, 3 and Figure 3. The results generally support the proposed model, showing mediating effect of two factors (usability and usefulness) and effect of user experience factors on user behavior. Direct effects of readability and telepresence on behavioral intention to purchase may not be significant (H8, CR = 0.69 and H11, CR = -0.61).

On the other hand, mobility showed significant direct effect on behavioral intention to purchase. This may implies, as supposed, that usability and usefulness play a role as mediators. The results imply that readability may influence BIP indirectly via usability (H6, CR = 20.23), in turn, toward BIP (H1, CR = 2.89). Accordingly, the influence of telepresence goes through usability (H9, CR = 2.08) and finishes at BIP (CR = 2.89). In the same manner, readability may influence through paths via usefulness (H7, CR = 5.33), in turn, on BIP (H2, CR = 9.72). Also, telepresence showed similar mediating effect via usefulness (H10, CR = 3.08) toward BIP (CR = 9.72). Mobility showed similar mediated path via usability (H4, CR = 3.04) and usefulness (H5, CR = 5.35). Interestingly, unlike other UX factors, mobility showed direct and significant effect on BIP (H3, CR = 2.03). This may imply that, as suggested, the role of mobility is more globally affecting factor than other UX factors in tablet device use.

Table 2. Summary of hypothesis tests

Hypothesis	Standardized coefficient	SE	CR	Support
H1: Usability → BIP	0.25	0.09	2.89**	Yes
H2: Usefulness → BIP	0.55	0.06	9.72**	Yes
H3: Mobility → BIP	0.11	0.06	2.03*	Yes
H4: Mobility → Usability	0.12	0.04	3.04**	Yes
H5: Mobility → Usefulness	0.31	006	5.35**	Yes
H6: Readability → Usability	0.79	0.04	20.23**	Yes
H7: Readability → Usefulness	0.32	0.07	5.33**	Yes
H8: Readability → BIP	-0.05	0.11	-0.61	No
H9: Telepresence → Usability	0.08	0.46	2.08*	Yes
H10: Telepresence → Usefulness	0.18	0.07	3.08**	Yes
H11: Telepresence → BIP	0.04	0.07	0.69	No

* values are critical ratios exceeding 1.96, at the 0.05 level of significance.
** values are critical ratios exceeding 2.32, at the 0.01 level of significance.

Table 3. Fit statistics for structural model (n=217)

	RMR	GFI	AGFI	NFI	RFI	IFI	TLI	CFI
Values	0.05	0.99	0.87	0.98	0.88	0.99	0.90	0.99

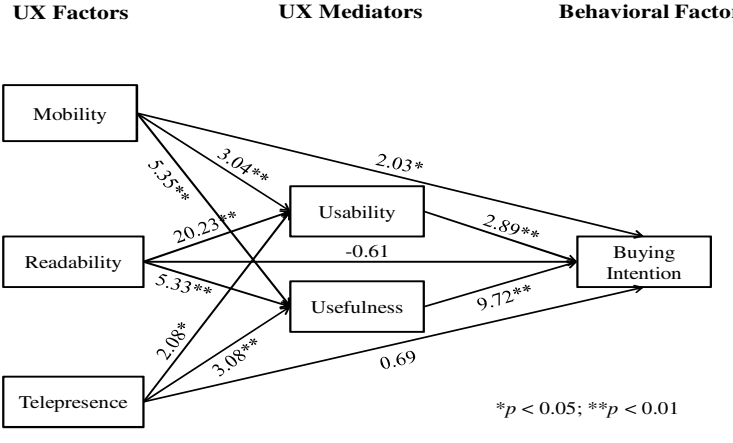

Fig. 3. Result of the research model

6 Discussion

6.1 Goals and Implications

The goals of this study was 1) to define roles of several UX factors (mobility, readability and telepresence), 2) to understand mediating role of UX mediators (usability and usefulness), 3) to give a guideline for manufacturers to make better design of tablet devices based on user's experiences.

With the supported suggestion, it is considered that the first two goals were achieved. Based on new development of three UX factors and finding of UX mediators, not only experience zone design, but also design process of tablet devices can be improved. Therefore, the third goal is also considered as an achieved point.

The study was designed to find and analyze new factors of UX in tablet use and combine those factors into well known theoretical structure, TAM, which is modified and reconfigured to be adapted in new environment. With including BIP, this study explored the role of UX factors, which have effects on BIP. This approach may establish new perspectives that considering possibility of combining marketing and human-computer interaction aspects. Also, the mediating roles of two factors (usability and usefulness) might be able to be adapted and used in other academic fields.

Therefore, the clear theoretical implication of the study is that revealing fresh viewpoint for tablet devices and interaction research. Also, the results might imply that UX factors can be considered as effective players, which can affect user's behaviors. Therefore, the engineers as well as marketers should have broad focus on UX design.

6.2 Limitations and Future Studies

Several limitations are found and may confined findings of the study. First of all, established UX factors that were found are not selected based on highly logical process. In order to find those factors, several statistical data was analyzed, however, scientific research should have supported the findings. Therefore, future studies should consider rational reasoning that empirically supports each selected factors by reviewing appropriate literatures.

Another limitation is that paths among UX factors were neglected, which was to build a model with smooth explanation and to prevent interference between each part of factors. However, to validate as an advanced study, future study should consider effects among UX factors.

Additionally, to anticipate user behavior and explore antecedents of UX factors, future studies will be suggested including variables that are used in marketing area such as brand perception or attitude toward products and brands. By doing this, the study may develop sophisticates in the insight of user behavior.

Acknowledgements. This study was supported by a grant from the World-Class University program (R31-2008-000-10062-0) of the Korean Ministry of Education, Science and Technology via the National Research Foundation. Also, this work was supported by Hi Seoul Humanities Fellowship funded by Seoul Scholarship Foundation.

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An Algorithm of Users Access Patterns Mining Based on Video Recommendation

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Abstract. Due to the substantial growth of IPTV video users, the weak characteristics of terminal "Set-Top-Box + TV" lead to a great difficulty for users to search required videos, and effective recommendation has an important influence on improving VOD quality. In this paper, the Forecast algorithm is proposed, which is based on the sequential pattern method, consider timeliness features of the videos, convert user watch history into relative access value, then do personalized recommendation. It has strong response speed, can basically meet the needs of real-time video recommendation on IPTV. The algorithm is easy to understand, has good recommend result.

Keywords: Recommend on video, Sequence, Access mode, Data mining.

1 Introduction

IPTV unite multiple fields such as broadcast network, telephone network and Internet. It takes advantage of the computer and the terminal of "Set-Top-Box + TV". A good recommendation system can excavate the potential demand of users and cause interest of watching, promoting the users potential viewing needs turn into actual viewing behavior. It can recommend videos targeted to viewers consistent with their personal interests. Therefore, effective for customers personalized recommendation will gradually become the key of IPTV provider to enhance their competitiveness.

Most of the current video recommend algorithms mainly use explicit rating [1] to process the rating results. The score matrix is sparse resulting from the user explicit score and score not accurately reflect real user interest, as well as the recommended model ignores the factor of time, resulting in the recommendation results deviate from the objective reality. Also, in pattern mining stage, the association rules recommendation algorithm[2] does not consider the sequence of user behavior, therefore, recommend result are not accurate.

Sequential pattern mining [3] is to analyze time series data, which can find the interesting pattern. In addition, Apriori algorithm [4] is one of the most influential

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association rules mining algorithm, a lot of algorithms about mining association rules frequent itemsets[5] are evolved by it. Apriori algorithm does not consider the influence of time sequence on rules mining, it is not suitable for association rules mining based on video access record. Many algorithms related to patterns mining are based on webpage[6], video has inherent attributes such as: long time, large amounts of data etc, so the previous algorithms do not necessarily suitable for video recommendation.

User's preference to video can be measured by browse time, whether repeated viewing and other factors. This paper puts forward a novel algorithm which is named Forecast, construct the access matrix as a continuation of the current user records, obtain the most reliable patterns in lots of user access patterns, enhance personalization of video recommend and solve the problem of low efficiency of online video recommend. It has good recommend result and easy to understand, can also reduce multiple scan of data set by traditional sequence patterns algorithm effectively.

2 User Access Sequence Algorithm——Forecast

Sequential pattern mining refers to mining high frequency mode in relative time or other mode.

The object of algorithm Forecast is users watching history, hereinafter referred to as log, it is defined as follows:

$$log =< VID, Vname, StartTime, EndTime, Duration, UID, VCategory > \quad (1)$$

Wherein, they are: video's ID, video's name, the start time when the user is watching it, the end time when user close it, the total time of the original video(recorded in second), the watched user ID , the category of the video.

User access matrix M is constructed based on the log, each element representing the relative number of users who accessed the video sequence. On the basis of current video sequences, you can find the corresponding value in matrix M, can then get the candidate video set - the videos user may watch after the former sequence. In candidate set, we have two indicators to select the optimal video and then recommend to the customer. The algorithm process can be divided into four steps: Construct M matrix; Find the current video sequence; Get the candidate video set; Recommend.

3 Realization of Forecast

3.1 Construct M Matrix

M matrix is a good tool for us in the algorithm. Each element in the matrix represents the relative number of users who accessed the video sequence.

$$\mathrm{M} = \{M[i,j] | 1 \le i \le n, 1 \le j \le n\} \quad (2)$$

$\mathrm{M[i,j]} = \mathrm{k}$, Refers to the relative number of people who watch video j after video i. Table 1 shows a simple example of matrix M.

Table 1. Store mode of matrix M

Video's ID	…	j	…
…	…	…	…
i	…	**k**	…

The number in every cell of M concerned with many factors, for example, the duration time ratio of the latter video *j* etc. The initial value of matrix M is the actual number of user who watch the latter video j after watching the former video *i*, following process is based on the initial value:

Variables Related to Video *j* (the Latter Video)

The Watching Quality of Video j:.

The so called watching quality is "watching time / total video time ", it reflects the user interest degree to video, can be expressed with $M_1[i,j]$. If watching quality is over 50%, indicating that the user is interested in the video, $M_1 = M_0[i,j] \times \theta_1$; If watching quality is less than 50%,$M_1 = M_0[i,j] \times \theta_2$.

The Watching Times of Video j:.

If the user watch the *j* video again for n times, he has a strong interest in it, can be expressed with $M_2[i,j]$, $M_2 = M_1[i,j] \times n$ (n is the watching times of video *j*)

After the variables related to the latter video, $M_3[i,j] = M_1[i,j] + M_2[i,j]$.

Variables Related to Relation between *i* and *j*(the Former and the Latter Video)

Whether i and j Are Continuous Watched:.

Whether there are other videos between them: This reflects the relevance between *i* and *j*, if users do not watch other videos between them, there may be a definite relevance between them, a continuous access is needed.

If continuous access, $M_4 = M_3[i,j] \times \theta_3$; otherwise $M_4 = M_3[i,j] \times \theta_4$.

How Long between the User Watched Video i and j:.

For one day, $M_5 = M_4[i,j] \times \theta_5$; for three days, $M_5 = M_4[i,j] \times \theta_6$;for a week,$M_5 = M_4[i,j] \times \theta_7$.

The process above can reflect the unique characteristics of video in the algorithm. The values of the variable θ would be later defined by the experiment.

3.2 Find the Current Video Sequence

Recently accessed videos can better reflect the preference of the user, we want record the recent videos user accessed, so 'sliding window', we call it W, is introduced to this algorithm. Situation does not occur frequently when browsing sequence identical, so set default size of the W is 3, which only record 3 accessed videos recently. If a suitable patter cannot be found, then reduce the size of W till 0.

3.3 Candidate Video Set and Recommend

Matrix M and slide window can represent the sequence access number and the current video sequence of the current user respectively. Based on them, we can get the candidate video set, indicating the probable videos user may watch after the current video. The way is to find whose value in M is not 0 related to the former sequence. However, not every video in candidate set is our recommendation to user. We also defined decide method to choose recommend videos- Support and Confidence:

$$\text{Support}(\text{A} \rightarrow B) = \text{P}(\text{A} \cup \text{B}) \tag{3}$$

Stand for the probability of entire candidates set contains$A \cup B$.

$$\text{Confidence}(\text{A} \rightarrow B) = \text{P}(A|B) \tag{4}$$

Stand for the probability of entire set of candidates contains A and B.

3.4 The Flow Chart and Example

Input: Matrix M; Sliding window of current user: eg, $W =< V1, V2, V4 >$; Minimum support threshold "min-support" and minimum confidence threshold "min-confidence"; The actual user number T;
Output: Videos recommended to current user after he watched the video V4

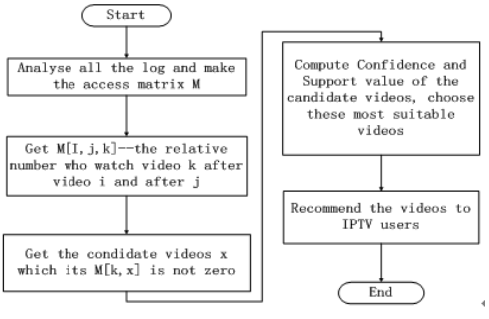

Fig. 1. Flowchart of Forecast

For example, our purpose is to find the recommended video after user watched $< V1, V2, V4 >$. $M_{1\text{-}2\text{-}4}$=30, and after watching V4, $M[4,3]$, $M[4,5]$, $M[4,6]$ are not 0, so $\{V3, V5, V6\}$is our candidate video set, and the total user is T=500.

$$Support(< V1, V2, V4 > -V3) = \left(\frac{M_{1-2-4-3}}{T}\right) \times 100\% = \left(\frac{20}{500}\right) \times 100\% = 4\%$$

$$Confidence(< V1, V2, V4 > -V3) = \left(\frac{M_{1-2-4-3}}{M_{1-2-4}}\right) \times 100\% = 66.7\%$$

The way to get values of V5,V6 is the same to V3. If we firstly defined min-support = 2% and min-confidence = 40%, V3 can be the recommend video. So dose to V5 and V6, the V5 should be abandon. In this way, the algorithm can avoid generating a large

number of candidate sets and has strong response speed, combine kinds of video feature , meet the needs of real-time video recommendation basically.

4 Experiments

In the experiment, we collect VOD data from March 1st to March 31th , 2011. We have 96,102 users, 8,134,188 logs, 42,685 videos.

Firstly, we clear noise like advertise from data set. And then, experiment shows that users who watch 10 times or less are useless to the result, so remove inactive users who watch 10 times or less, they are about 40% of the logs.

For the particular user, we have S=15 days to set the time span of access mode. The construct of matrix M is to analysis the first 15 days logs. Firstly, determine several variables related to matrix M.

Table 2. The influence of θ_1 and θ_2' modify on the recommend result

θ_2 \ θ_1	1.3	1.2	1.1	1.0
0.8	29.9%	29.9%	28.6%	28.7%
0.7	***30.4%***	30.1%	29.7%	28.6%
0.6	28.5%	29.8%	28.6%	28.1%

For example with θ_1 and θ_2, the values in Table 2 show proportion of the user who has recommended result of all users on different variation of θ_1 and θ_2. The biggest impact is the times user watching video j, and we can define the variables as follows: $\theta_1 = 1.3$; $\theta_2 = 0.7$; $\theta_3 = 1.5$; $\theta_4 = 0.6$; $\theta_5 = 1.3$; $\theta_6 = 0.8$; $\theta_7 = 0.5$.

For all users, Fig.2 shows proportion about users who have recommendation results, about 31% users have recommendation results.Fig.3 shows 21% users watched the videos as we predict in the training set. Among the 21% users, 40% videos are TV play, this is because there is stronger relationship between this series than in other kinds of videos, user will watch the next episode subconsciously.

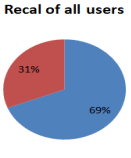

Fig. 2.

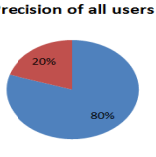

Fig. 3.

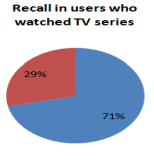

Fig. 4.

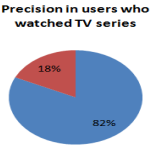

Fig. 5.

From the Fig.4 and Fig.5 above, we can see that the proportion in TV series is the same as in all kinds of videos and users, and have a better result than that in Fig.2 and Fig.3, so our algorithm is also useful in data set which has potential relation.

According to the experimental results, the following conclusions can be obtained: A, Forecast algorithm is available to find access patterns in a large amount of data analysis; B, The set of sliding window size is 3, we do not consider that sparse impact

on the experimental results temporarily, but can be identified, this effect must exist; C, The data in this paper is recorded from the "set-top box",it is a public equipment to a family, there is limitation to mining a single user access mode, therefore, it is possible that not each user has recommended results, experience results of Fig.2 and Fig.4 are acceptable.

5 Conclusions

The paper combines video characteristics like viewing time, playback and others, put forward a method to mining user access patterns and then recommend videos to users through analysis of user browsing history. This method is practical, simple, and eliminating the redundant generated by traditional sequential pattern mining algorithm, and has a good experimental result.

In the future, there is much to improve. The experimental data is sparse, if can run this algorithm on user mobile phone terminal, you can get single user access mode preferably. The timeliness of video also has a great influence on analysis, it is said that the value of the project is usually at maximum on entrance in the new system, then reduce gradually, therefore, we can do interest attenuation operation gradually. For example, we can be divided them into: practical news program recommend, real-time broadcast video recommend, general video recommend.

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Evaluating Multisensory Learning System for Teaching English Intonation

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Abstract. In recent years, the focus of English pronunciation teaching has been moved toward suprasegmental features including intonation. Despite of its importance, it is not easy for adult second language (L2) learners to adjust to second languages' intonation. A system was designed using vibration motor and micro-controller for suggesting multisensory stimuli. To establish the learning effect of system, multisensory stimuli, visual, sound cue and vibrotactile stimulus were suggested to help acquisition of English intonation. Visual and vibrotactile stimuli were manipulated. The vibrotactile device is design to express the change of intonation of sentences with 2 levels of intensity. Visual cue is suggested as picture of waveform analyzed by Praat program. Participants were divided into four group depending on suggested stimuli; control, vibrotactile, visual and vibrotactile-visual group. Participants' responses are recorded and analyzed by Praat, the sound analysis program. Participants' intonation changes are measured and compared.

Keywords: English intonation, intonation teaching, vibrotactile, multisensory.

1 Introduction

As a global communication tools, English speaking has its important position among other language skills. In this point of view, it is now crucial to speak fluently for all the second language (L2) learners. For the fluent speaking, pronunciation is one of the most important keys. In recent years, the focus has shifted to include a broader emphasis on suprasegmental features, such as stress and intonation [1, 2]. Regardless of the importance of intonation, it is not easy to learn English intonation especially for adults. Children would easily acquire the intonation of foreign language [3]. On the other hand, adults tend to apply their intonation pattern of mother tongue when they speak foreign language [4] so that they hardly change their intonation [5].

As technological improvement, methods used in English learning have been varied and the researches on multi-sense using this uplift have been activated. Even though there has been researches about intonation teaching using multimodal stimulus[6], there are not plenty studied for L2 learners because the researches with tactile or multimodal stimulus are focused on people who have hearing impairments.

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1.1 Intonation Learning and Computer-Aided Language Learning(CALL)

Intonation is a complex of various prosodic features. The most important features among those features are tone, pitch range and loudness [10]. Intonation plays a key role in communication because not only it influences one's pronunciation but also it delivers the meaning of spoken sentences. Hence, if someone speaks with wrong intonation, it would provoke serious problems [5, 11-13]. Another reason why intonation is important is that suprasegmental features such as intonation have a decisive effect on understanding the utterance of English learners to people whose mother tongue are English [14].

The traditional way to learn language had been static methods (e.g. audio tapes) before computer aided language learning (CALL) appeared. CALL has human-machine interfaces that people can be provided more natural interactions [7]. Sometimes students are afraid of speaking out in class [8] and they can be offered more comfortable environment to practice their target language [7] and feedback for mispronunciations using speech recognition technology for developing speaking ability [9].

In spite of this methodological and technical improvement, intonation learning is still hard to acquire, especially for adult L2 learners.

1.2 Multisensory Approach

There are four sensations; visual, auditory, kinesthetic and tactile. Multisensory approach is a teaching method using these sorts of sensations to accelerate the development of a spoken language and it is closely related to learning style [15]. Multisensory Structural Language Education method, a typical example of the method using multisensory to language, used visual, auditory and tactile-kinesthetic modality for language acquisition [16].

A research investigated the native speakers' perception of English intonation under 3 conditions; Visual-Alone, Visual-Tactile, and Tactile-Alone [6]. Another tested hearing and deaf adults' ability to identify sentential stress and intonation from vibrotactile pitch contours [17]. Performance across groups was generally similar, with some examples of poorer performance among deaf adults.

Multisensory approach is a method of guidance for children who have low motivation and feel hard to learn spellings, so it is necessary to use every possible sensory path. It is possible to connect several teaching theories such as language experience approach, natural approach and whole language approach and they emphasize multisensory approach which uses multimodal materials as a learning strategy. Also, students recognize new materials and techniques through their senses during their learning process and they more like sensory things above all the others [18-20].

Finally, the goal of this study was to figure out whether multisensory intonation learning system which we developed is effective for learning intonation.

2 Multisensory Learning System for English Intonation Teaching

To examine usefulness of multisensory stimuli in intonation learning, we developed intonation learning system. This system use 2 types of vitactile stimuli, the intensity of vibration and the location of motors. The intensity of vibration was controlled by pulse-width modulation (PWM). The vibration motors used in the experiment were operating in the frequency range of 150Hz to 200Hz and were controlled by a micro-controller (ATmega128). A host program was developed to be used in the experiment. The host program was written in C++ and ran on the laptop computer. The program was designed to show the sentences, play the speeches, and transmit the vibration information to the micro-controller.

In this paper, developed system was used with the intensity of vibration and added visual stimuli to improve this system.

3 Methods

Participants. 40 undergraduate and graduate students participated in the experiment. All participants' mother tongue was Korean and they had experienced English education more than once. Also, they did not have any problems for sensing vibration, listening or seeing experiment sentences. They were all randomly and equally divided into four groups.

Conditions. There were four groups depending on the exposed stimuli types; control group which there was any manipulated stimuli, vibration group which was presented to vibration, visual stimuli group which was presented to manipulated visual stimuli and vibro-visual group which was experience vibration and visual stimuli.

Materials. Total 60 sentences for training session were extracted from English books related to accent or pronunciation. The sentences were consisted 4 words to 12 words. 6 sentences were selected among these 60 sentences and they suggested at Table 1.

Table 1. Sentence List

	Sentences
1	I waited patiently for them.
2	Would that be okay?
3	Chicago is the city in the Midwest.
4	Either you or he has to go.
5	The meeting's in November, isn't it?
6	The little dog was sitting on the sidewalk.

The vibrotactile device used the intensity of vibration to express the pattern of English intonation and it was located at participants' wrist as Figure 1. Actuator was attached in the middle of the Velcro band.

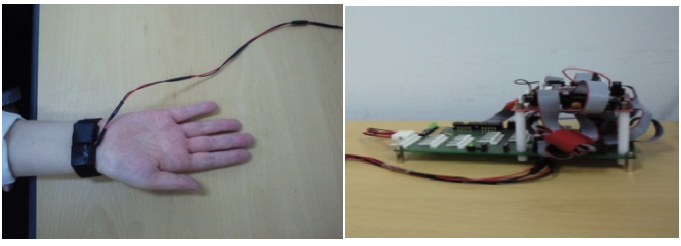

Fig. 1. Vibrotactile device

Manipulated visual stimuli were suggested as Figure 2. In the display, there was the analyzed pitch line and the target sentence was located below the line. In the program to show and control the visual stimuli, there were "next sentence button" which could move to next sentence and "start practice button" which participants pressed at the beginning of learning session.

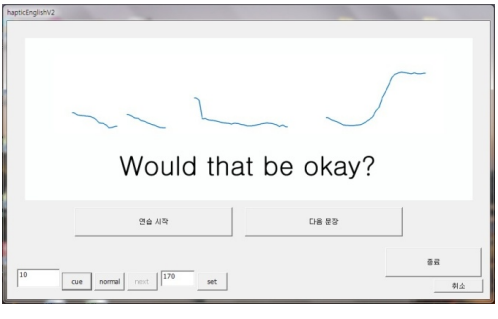

Fig. 2. The screenshots of displays with manipulation of visual stimulus

Procedure. A between-participants experiment was conducted and its procedure was consisted with 3 steps; 1) pre-test session, 2) training session and 3) post-test session. Above all, participants were noticed about matters that required attention such as they should read the sentences that displayed at monitor after the stimuli were suggested. In this step, participants' demographic information including age, gender, grade, official English test scores was gathered. Participants were counterbalanced with official English test scores among these information to avoid the contaminations by their own English competence. In the training session, participants were exposed to the stimuli depending on the conditions and they repeated after the stimuli suggested. In the post-test session, 10 same sentences were recorded for comparing. Participants had a time to read the 10 sentences recorded in the pre-test and post-test session.

The used intonation learning system was installed at personal laptop and Samsung SHS-100V headset was used to play sentences and record the utterance of participants. Recorded voice file was analyzed using Praat program.

Analyzing Method. To analyze the change of participants' intonation, calculating methods were used. Firstly, to make sure the effect of the intonation learning system, pitch range, difference between lowest and highest, was compared. The pitch Range was derived the equation; Highest pitch of sentence minus Lowest pitch of sentence. Secondly, to confirm the effect difference among conditions, participants and native speakers' pitch range was compared. At this time, the pitch range already derived was used; Native speakers' pitch range minus Participants' pitch range. Lastly, to see the participants' improvement in each condition, pitch range difference of Pre and Post test was get. The equation for getting this was Pitch range difference of post test minus Pitch range difference of pre test. The method that we calculated these values equations that suggested at Table 2 were used.

Table 2. Calculating methods for analysis

	Calculating Methods
Pitch Range	[Highest pitch of sentence] – [Lowest pitch of sentence]
Pitch Range Difference	[Native speakers' pitch range] – [Participants' pitch range]
Pitch Range Difference of Pre and Post test	[Pitch range difference of post test] – [Pitch range difference of pre test]

4 Result

To identify the learning effect of English intonation learning system, two contents were analyzed; 1) overall learning effect of the system, 2) effect difference among conditions.

Improvement. The improvement for intonation learning is illustrated at Figure 5. One-way repeated-measures ANOVA was showed a significant learning effect of multisensory intonation learning system, $F(1, 39) = 7.84$, $p = .01$.

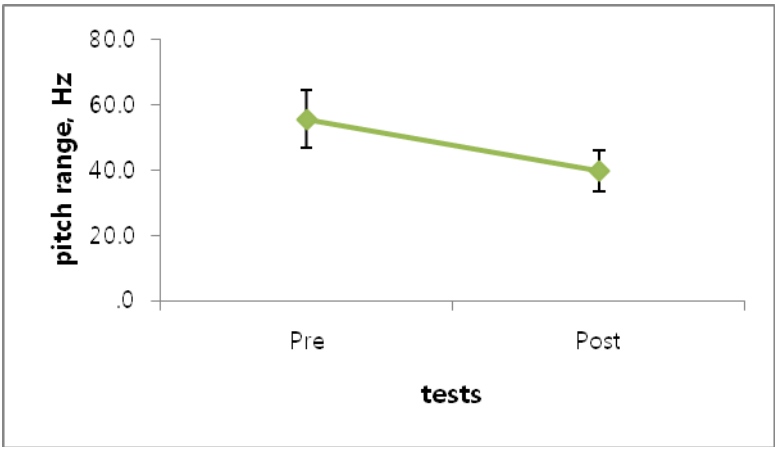

Fig. 3. Means for pitch range for pre and post tests with standard error bars

One-way ANOVA with all four conditions yielded a significant different among conditions. Participants in the vibro-visual condition (M = -43.33, SD=45.29) showed the biggest improvement among all four conditions and vibration condition (M = -11.50, SD = 27.18) showed somewhat of improvement while visual condition (M = - .16, SD = 39.44) showed almost no improvement and even negative effect was shown in control condition (M = 6.60, SD = 36.38, see Figure 6).

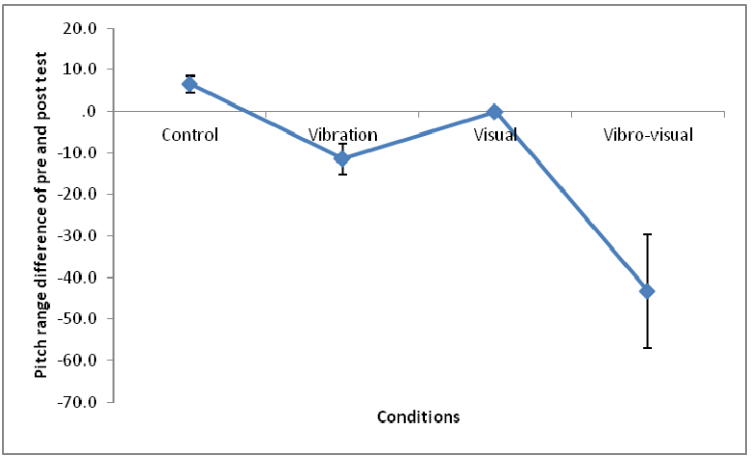

Fig. 4. Means for pitch range difference of pre and post test with standard error bars

Since the difference among conditions were significant, there were Bonfferoni post-hoc test. The result indicated that only control and vibro-visual conditions are significantly different (p=.03).

5 Conclusion

In this research, whether Korean English L2 learners could improve their intonation through developed multisensory intonation learning system which provides visual and vibrotactile stimuli and learning session with the system was discussed. Also, their utterances were recorded in the pre and post test session and the changes of pitch range were analyzed.

It appeared that the difference of pitch rage in pre and post test session was significant; the developed system was helpful for learning intonation. Furthermore, the differences among conditions were also significant, especially between control and vibro-visual condition. In this research, it is safe to say multisensory stimuli are better for intonation learning than no stimuli. These results clearly support the previous researches; the research about the native speakers' perception of English intonation under 3 conditions [6], the improvement of English intonation pattern recognition using vibrotactile device and its effect on intonation learning[18]. Although it is necessary to see if the result of this research could transfer to actual communicating

situation, the result of short training with developed system brought a positive effect on participants' English intonation shows immediate and affirmative effect of intonation teaching.

6 Future Work

Yet experimental sentences were not divided by intonation patterns, so it needs to be analyzed whether there are differences among intonation patterns. Also, the training session held one time. Therefore, it is necessary to design long-term and repeatable learning steps using developed intonation learning system so that we could verify the continual and long-term effect learning effect.

Although, this study has its limitation, there are some practical implications. Firstly, as growing importance of English speaking, this study about intonation teaching from newer approach using multisensory system would suggest a fine way to improve English speaking skill. So, it would be a milestone for strengthening national competitiveness. Secondly, if technical issues are supported, the multisensory intonation learning device would implanted learner smart devices such as tablet PCs, mp3 players or smart phones. Through this improvement of the way of learning intonation, learners would experience comfortable enough environment for intonation practice since they could practice their speaking or intonation wherever they feel safe and relaxed.

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Augmenting Trading Card Game with Empathetic Virtual Characters

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Abstract. In this paper, we present *Augmented Trading Card Game* that enhances remote trading card game play with virtual characters used in the stories of popular animations and games. We show some observations about the way players use the system, realizing the game, and what their feelings and impressions about the system are. The obtained results are useful to consider how to use empathetic virtual characters in the real world's activities for future information services.

Keywords: Virtual characters, Empathy, Game design, Ideological metaphor.

1 Introduction

Virtual characters are widely used in our daily life nowadays. For example, famous Disney characters like *Mickey Mouse* and *Donald Duck* provoke our empathetic feelings easily anytime and anywhere, and *Kitty* and *Pokémon* are now found all over the world [1].

In animations and games, each virtual character has its own personality and story, which can be used as a medium to convey special information and messages to other people. If people are familiar with the story of an animation or a game, then they recall the leitmotif of the story with a little information by performing some action/interaction with the character. We believe that this observation is very important while considering how to use virtual characters in various future information services in the real world.

In the contemporary Japanese society, for example, several posters for public service announcements have adopted the idea to use virtual characters from recent popular animation stories. *K-ON!* has been used for promoting a national survey in Japan [10]. In the story of *K-ON!,* high school girls try to realize their dream with cooperative efforts among them. This becomes a persuasive message conveying the meaning that everyone's participation is important for the national survey. Also, NFGD that promotes guide dogs' training has created two posters using characters from *Puella Magi Madoka Magica* [12]. The girl that has been used in the first poster is a rebellious, but considerate to her friends, girl. The other girl that has been used in the second poster feels her friend in her mind even though the friend lives far away. These girls are admired by many young girls at the present time. If people want to imitate these magic girls, then the posters contain the strong persuasive message that becoming a puppy walker is one of the ways to become like them.

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LNEE 182, pp. 51–58, DOI: 10.1007/978-94-007-5085-2_7,

This paper presents *Augmented Trading Card Game* (*Augmented TCG*) for playing the *Yu-Gi-Oh! Trading Card Game* (*Yu-Gi-Oh! TCG*) between two players who are located in different places. The system, realizing the game, supports the remote trading card game play against virtual characters. In this system, we consider two possibilities and approaches to use virtual characters. The first one is to show a virtual character representing the opponent player. The second approach is to include a virtual character, drawn on one of the player's cards, that communicates with the player, and encourages him/her to win the game. We conducted a user study in which we observed the participants' behavior during the play, and interviewed them after that.

There are several other systems that support remote TCG play. *Duel Accelerator* [9] is an online-based *Yu-Gi-Oh! TCG* where each player chooses an avatar that identifies him/her from the other players. Also, the *Skype duel* uses Skype to show each player's card on the opposite player's display and the voice communication between the two players is possible as well. *Augmented TCG* uses 3D virtual characters that are shown to the players and move according to the opponent's current play and behavior. In this research we are interested in what is the impact of the behavior of the 3D virtual characters on the player's emotions and feelings, and the play of the game.

In *Augmented TCG*, we use popular virtual characters that have been used in Japanese animations and games. Especially, the *Yu-Gi-Oh! TCG* has been originally introduced in the *Yu-Gi-Oh! comic* and *animation*. One of the reasons why *Yu-Gi-Oh! TCG* is popular in Japan is the fact that almost all young people have first enjoyed the animation and comic story and then learnt how to play the game from the story. Moreover, the story teaches some important ideological concepts such as the importance of justice, friendship, bravery, positivity, and thoughtfulness. That is why we believe that the characters of the animation story can be used to enhance the playing style of the game through the stories they carry and recall.

2 Yu-Gi-Oh! Trading Card Game

The *Yu-Gi-Oh! TCG* [14] is a trading card game based on the Duel Monsters game that is portrayed in the popular *Yu-Gi-Oh! comic*. *Yu-Gi-Oh! cards* are categorized into three types: *Monster*, *Spell* and *Trap* cards. A *Yu-Gi-Oh! TCG*'s player structures his/her own original deck by selecting his/her favorite cards from the several thousands *Yu-Gi-Oh! cards*, currently released. This leads to each user having his/her own unique original deck that reflects his/her own personality and taste.

Yu-Gi-Oh! TCG is a turn-based game, which is played in a one to one or two to two manner. We call the battle with *Yu-Gi-Oh! cards* a *duel*. Each player starts the game with a certain number of points called *life points* and performs the duel by summoning his/her monsters, battling against the opponent with his/her monsters or using spells and traps. Depending on the action taken and the outcome of it, the Life Points decrease or increase. If the *life points* of the opponent player become 0 or the opponent player cannot draw cards from his/her own deck, then the opponent player loses the duel and the game ends.

The *Yu-Gi-Oh! TCG* involves various sources of pleasure besides just playing, such as completing collections of cards, structuring decks, communicating with the opponent players, trading, battling, as well as establishing different links to *Yu-Gi-Oh! TV animations* and *Yu-Gi-Oh! comics*. Moreover, although computerization has

advanced a lot currently, the version of *Yu-Gi-Oh! TCGs* that does not use a computer but paper cards is still very popular among players.

3 Augmented Trading Card Game

3.1 Overview of Augmented Trading Card Game

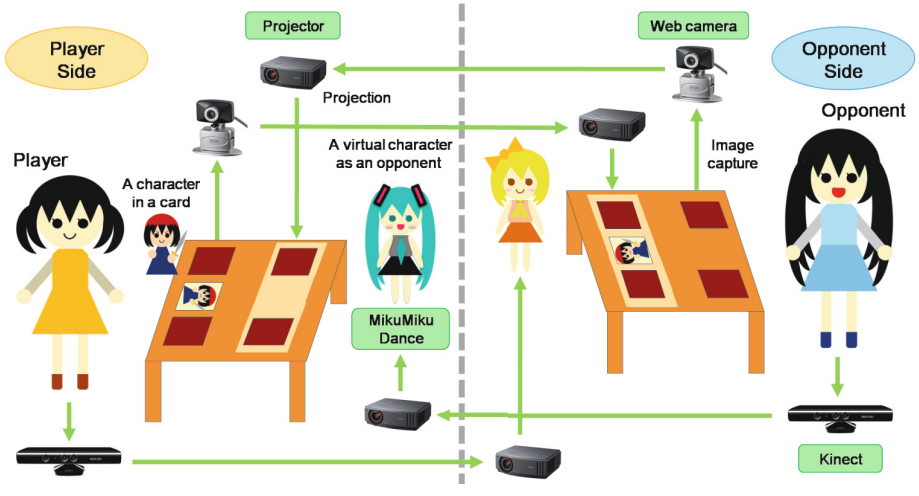

Fig. 1. Augmented TCG System

Augmented TCG enhances the remote trading card play performed by two persons. The basic design approach is similar to the augmented reality games introduced in [6]. As shown in Figure 1, the two players are located in different places. Each player's cards in his/her duel field on the table in front of him/her are captured by a camera and projected on the opponent player's table. Also, each player is represented as the 3D model of a virtual character used in popular animations and games, and this character is shown to the opponent player. In the current implementation, *MikuMikuDance* [11] is used to show the 3D models of virtual characters. *MikuMikuDance* is free software for creating 3D movies by using virtual characters. The virtual character is controlled using *MS Kinect*, its movement is synchronized with the movement and the behavior of the opponent player. In the current *Augmented TCG*, a player can choose one of three virtual characters that are *Yugi* and *Kaiba* from the Yu-Gi-Oh! *animation* story, and *Link* from The *Legend of Zelda*. In the *Yu-Gi-Oh! animation* story, *Yugi* is always surrounded by many friends and his winning success is a result of his strong bonds with his friends who love the trading card game. *Kaiba* is a lonely hero and he always seeks the strength in the game, but he does not accept other person's help even if he is in a critical situation. However, he also finally understands the importance of friendship. Most young boys want to follow either of these two characters because they have very typical ideal personalities that are very attractive to most boys. The reason to choose *Link* as the third character in our experiment is that we would like to investigate how a favorite character from another unrelated to TCG story affects the attitude of a

player. Also, while playing the game, another virtual character depicted on one of the player's cards appears on a small display near the player once that card is drawn out of the deck, and supports and encourages him/her to win the game until the end of the game. Moreover, the two players can communicate with each other via Skype if desired, and thus it is possible for them to introduce each other directly instead of using virtual characters. This option will allow us to compare the case of the players communicating with each other through virtual characters and the case of the players directly communicating with each other.

Fig. 2. Current Prototype Configuration

Fig. 3. Encouraging a Player by a Virtual Character

One of the authors has more than 10 years' experience in *Yu-Gi-Oh! TCG* and has more than few thousands *Yu-Gi-Oh! trading cards*. For the experiments presented in this paper, she has created a special deck as the participants have used the cards in a controlled manner and the rules have been simplified for making the duels shorter. She is also very familiar with the animation story, and knows how each character structures the deck and uses the cards in the animation. So, the deck used in the experiment has been structured depending on the character that the player has chosen to play with. However, in the current experiment, the virtual character's behavior does not reflect the real behavior of the opponent player exactly. Another person imitates the behavior of the opponent player and this behavior is sometimes over-reacted in order to be closer to the actual character's behavior in the animation.

Figure 2 shows the current prototype configuration for a participant. On a large display, a virtual character which behavior is synchronized with the behavior of the person who imitates the opponent player is shown. A camera is setup behind a small display near the participant, and captures the image of the cards. The opponent player's cards are projected by a projector that is installed on the table. A small display shows the other virtual character depicted on one of the player's cards, which in this case is the one of most powerful cards in the participant's deck.

Currently, we recruited five participants for our experiments, and they played all the experiments with the same setup. This means that they used the same predefined deck for controlling their plays in a predictable manner. Also, an opponent player is one of authors, and she has deep knowledge to control the game in the experiments. Most of the

young participants have more than three years' experience in *Yu-Gi-Oh! TCG* and they know the characters that appear in the animation stories very well. During the experiments, we observed each participant's play and conducted interviews with them after their plays. Before the experiments, none of the participants knew about *Augmented TCG*, and they were told how the rules were simplified right before the experiment.

3.2 Playing against a Virtual Character

We did two experiments for playing *Augmented TCG* against a virtual character representing the opponent player. In the first experiment, participants could choose either *Yugi* or *Kaiba* according to their preferences.

After the play, we interviewed the participants. One of them said: *"I could feel I am playing against Yugi, but Yugi used in the experiment does not offer enough reality"*. Especially, the movement of the character was sometimes not like the real movement of *Yugi*. He said: *"I will definitely enjoy more the game against Yugi, and would like to win the game if the movement is more realistic"*. However, another participant said: *"The face expression of the character is poor and it is a very important issue while playing a game against a real person"*. Also, one of the players told us: *"The voice should be the same as the actor's voice of the character in the animation story"*. Especially, if the opponent player was a female, some participants felt strange since both *Yugi* and *Kaiba* were male characters.

In the animation story, players usually play TCG while standing, that is why we choose that the characters are always standing during the play, but in the real situation, a player usually sits down on a chair. Some participants feel the unreality on the behavior of the characters, but if the characters just sit down all the time, the participants also feel the inconsistency with the *Yugi* and *Kaiba*'s personality.

In the second experiment, *Link* from *The Legend of Zelda* [13] was used as a character representing the opponent player. The results in this case were completely different depending on whether the participants liked this character or not. If the participants were not interested in *Link*, they usually did not care about the presence of *Link*, but if *Link* was their favorite character, then they found playing the game with *Link* more enjoyable. One of the male participants also told us: *"If the character is a pretty girl, I may be more excited to play the game"*. Also, a female participant told us: *"I feel that Link is my boy friend, so playing against him increases my pleasure and positivity"*.

Finally, we also compared the effect of using a virtual character with a real person. In the experiment, *Augmented TCG* shows the figure of an opponent player directly using Skype. The result of the experiments will be discussed in the next section.

3.3 Encouraging a Player by a Virtual Character

In the experiment, a small display on the table shows the virtual character depicted on one of the cards used by the participant as shown in Figure 3. We have selected *Dead Master* from *Black★Rock Shooter* [8] as a character to be depicted on the card because we feel that the character does not contradicts with or violate the atmosphere of *Yu-Gi-Oh!*. *Black★Rock Shooter* has two worlds. *Dead Master* is an enemy of *Black★Rock Shooter* in another dimension world, but in the daily world, they are very

close friends. This becomes a persuasive message conveying the meaning that players need to keep and develop their friendship even if they fight seriously in a game.

In this experiment, we structured a special deck in advance, and all participants used the same deck. Then, in the duel, the participant always drew the card depicting *Dead Master* at the beginning of the game. Once that card has been drawn out of the deck a small display next to the player showed *Dead Master* that remained present until the end of the duel. *Dead Master* supported and encouraged the player during the game by using a body gesture for encouraging people and its behavior was controlled by a person who operated *MS Kinect*.

After the experiment one of the participants said: "It is desirable that the card depicting Dead Master does not lose from the attack of the opponent player". However, another player who was not interested in the character told us: "It is more enjoyable if the participant's favorite character encourages him". One of the other participants said: "I feel that the character does not encourage me enough using only gesture. It is better that the character talks or advises me". He also told us: "It is desirable that the character behaves like a cheerleader". Dead Master is a serious character, so if that character just behaves as a cheerleader, some players may feel the unreality due to the loss of the consistency with its animation story. Also, another participant told us: "The encouragement should be like the one in the animation story". Most participants said: "The presence of the character increases the pleasure, but it is hard to consider winning the game just from that encouragement". The participants' comments showed that they were aware that exactly the character depicted on one of their cards appeared on the small display without them being informed in advance about this feature of the system.

4 Design Implications

Most of the participants who have watched the *Yu-Gi-Oh! animation* story feel that adding popular virtual characters from the animation makes the game more enjoyable. The desire to follow and imitate these characters becomes also an incentive for the users to change their behavior. A negative feedback may be used to achieve moral play, but changing a user's attitude in general is not easy [4]. The most important insight is that there is a possibility to use a virtual character as a metaphor that recalls the story of the character in the player's mind while gaming, and in this way the story may convey the leitmotif containing ideological concepts like the importance of friendship, honesty, thoughtfulness and so on. This approach would have the power to change the player's attitude.

Reality is an important criteria to evaluate a design [5]. In our case, the virtual character's behavior should be consistent with the character's behavior in the animation story and this is of significant importance to feel the reality in the game. For example, cards that are not used by the character in the animation should not be used in the game as well, and the movement of the virtual character should be consistent with its typical movement in the animation. The number of cards owned by the character should be consistent with the real game situation. A gap between the reality and the virtuality may cause the uncanny valley problem [3].

In the second experiment, the chosen virtual character is not well known to the participants but it may cause a feeling of incongruity in the players while playing

Yu-Gi-Oh! TCG if they are aware that the character appears in another animation story that is unrelated to TCG. Also, we believe that participants would be more excited to play the game if a character drawn on a card used in the player's favorite deck is shown to the player. However, the results are different according to the player's gender. A female player usually likes a card depicting a pretty or beautiful girl. In this case, encouraging the player is more natural and meaningful. On the other hand, a male player usually likes a powerful card that may depict a strong monster. In this case, the special effect to show the superior ability of the character is effective to motivate the player.

When playing against a virtual character, the player also tries to mimic the character in the animation story. This is very useful to teach how to improve the player's gaming skills. If players are immersed in a virtual world to play agaist a character in the story, they can concentrate more on the game. Of course, a skillful friend is a good coach for improving a player's skills, but if there is no good coach near the player, he/she needs to learn by himself/herself. Also, a player feels high credibility on coaching by a skillful character. Thus, he/she becomes enthusiastic to learn new skills from the character.

We also compare the case of the player directly seeing his/her real opponent player with the case of using a virtual character to represent the opponent player. From the interview we have found that if a participant knows the opponent player well, the real person view is more preferable and increases the reality of the game, but when the opponent player is a stranger, some of the participants claim that using virtual character is preferable because they do not feel comfortable either showing themselves or seeing the opponents. This is an important issue because the difference in the personalities may cause different results. Designing social information services always needs to take into account the differences in the personalities in order to satisfy a larger number of users.

In our experiments, we could not find the rigorous evidence that the stories of the virtual characters could strongly affect the attitude of the players. One of the reasons is that in our current research we focus on a game. For most people, the purpose of a game is just for fun. Of course, the duel against *Yugi* and *Kaiba* makes players play the game more seriously, but it is hard to make players braver when *Link* is shown as an opponent players. *Link* is a character in an RPG game, and a male player considers that the character is just like his avatar in the game, so his story does not have strong ideological messages in the game. Also, the presence of *Dead Master* does not have a strong impact on a player, since the character itself is very popular, but its story is not so well known yet. This means that well known stories that contain strong ideological messages and characters that have strong and distinctive personalities are important to make virtual characters be used as metaphors. We also consider that the music used in the well known stories could also become a metaphor for the stories because in Japanese animations, their music sometimes becomes more popular than their characters. We are interested to enhance the framework to design values in products and services [5]. We believe that designing metaphors that use the popular stories in animations and games is a promising future direction to convey complex ideological messages to people without presenting a large amount of information to them.

One of the problems in using virtual characters is their copyright issues. There are many free 3D models for *MikuMikuDance*, but some of them are deleted on the Web due to the copyright issues. However, freely available models offer new possibilities to

enhance games because the models can be easily customized. In Japan, it is a popular culture to create new characters and stories from existing ones. Using a customizable virtual character in *Augmented TCG* may create a new playing style of TCG, and the new stories of the character can be used to enhance its role as a metaphor.

Many Japanese animation stories emphasize on the importance of positivity, which is very useful to make our life more meaningful [2]. Thus, the characters in the stories can be used as metaphors to increase human's positivity while playing a game. It is one of the most important roles of a game to teach solutions to typical serious problems in our life.

5 Conclusion

This paper presents some observations on the usage and the design of *Augmented TCG* that enhances remote trading card game play agaist empathetic virtual characters.

Our approach is also useful to enhance gamification [7] with virtual characters. The current gamification design focuses on how to offer incentives by using game mechanics. Such approach is useful to increase extrinsic motivation, but it is hard to increase intrinsic motivation. Our finding is that a virtual character can be used as a medium to convey ideological concepts efficiently, and this can be used to change a user's attitude to keep his/her obtained good habits for a long time.

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Identifying Students' Writing Styles by Using Computational Linguistic Approach

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Abstract. The purpose of this study was to identify stable writing styles of students for implementing the cognitive learning system of writing education. According to the previous research, writing styles of writers could be reflected by the linguistic features of writing such as ambiguity, cohesion, lexical diversity, and syntactic complexity. This study explored the method of capturing students' writing styles by investigating the similarity of linguistic features between drafts and comments written by the same students in a peer review system. The computational linguistic tool, Coh-Merix, was used for analyzing the linguistic features of drafts and comments produced by 41 undergraduate students. The results of this study showed that there was similarity between drafts and comments in the measures of ambiguity, lexical diversity, and syntactic complexity, whereas there was difference in the measures of cohesion.

Keywords: cognitive learning, computational linguistic, linguistic feature, writing style, peer review.

1 Introduction

Peer review system has been adopted in education to improve student writing [1]. Peer review can elicit writing improvement by facilitating cognitive learning process such as self-explanation and self-regulation [2]. Generating comments may increase students' writing knowledge by "writing about writing" and facilitate the reviewers to apply the knowledge to their own drafts [3, 4]. In the peer review system of writing education, students have two roles: writer and reviewer. Students as writers write drafts following their own writing styles and students as reviewers write comments on peer drafts. According to the previous studies [5, 6], writing style of writers has strong relationship with writing quality. Identifying status of students' writing style would be important to implement cognitive learning system of providing customized learning service for students [7].

In peer review system, there are double chance to measure students' writing styles by analyzing drafts and comments written by the same students. If the writing styles of students do not change according to different requirements of roles as writers and reviewers, it would indicate that students have stable writing styles. The writing outcome of students would be predicted better by the stable writing style than the unstable writing style. If the system predicts writing performance with reliability, instructor

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and students would get benefits by the prediction [8]. Thus, the purpose of this study was to identify stable writing styles that students adopted across writing drafts and comments.

According to the previous studies [7, 9], the writing styles could be captured by analyzing the linguistic features of writings. The researchers of the previous study found that three well-known writers (Kipling, Wodehouse, and Dickens) had their own linguistic features of writings like cohesion [9]. The researchers used a computational linguistic tool to analyze the linguistic features of writing automatically. Computational linguistics approaches have been applied to capture the linguistic features of drafts that students produced in writing education [10, 11]. However, computational linguistics approaches have not been used to analyze linguistic features of written comments produced by the students in a peer review system for writing education.

Analyzing linguistic features of comments automatically by computational linguistic approach has benefits for writing education. Firstly, if the system provide the information of writing styles of students by analyzing drafts and comments of the same students as feedback, the student writers might understand their writing styles better [9] and reflect the feedback repetitively leading to self-regulation process for writing improvement [12]. Secondly, students would be more satisfied with detailed and various indexed feedback of their own writing styles than the general evaluation provided by instructors [13]. Thirdly, if the system provide feedback in real time by quick and dirty analysis of computational linguistic tool, the students would be more satisfied by the system than feedback after time consuming evaluation by human [13]. Lastly, instructors can make appropriate plans of customized learning for writing improvement according to the status of student characteristic [14]. Thus, different from the previous studies of writing education, analysis of linguistic features of comments was included in this study.

2 Method

2.1 Participants

Data including drafts and written comments of students were collected from 41 undergraduate students (17 males and 24 females) in the U.S. All of the students were Native-speakers of English. Most of them (78.1%) were under the two years at the university (M = 1.63 years, SD = 0.89 years). The instructor provided them writing assignment with general laboratory reports format of five sections: Abstract, Introduction and Theory, Experimental Setup, Data Analysis and Results, and Conclusion.

2.2 Procedure

All students submitted their own writings about the theme “Sonar resonance” and reviewed four drafts of peers during a week as home works. All students provided comments on peer drafts by using the designated text input screen in the peer review system, SWoRD system [15]. The ‘Introduction and Theory’ and ‘Conclusion’ section of drafts were analyzed in this study. “Experimental setup” and “Data analysis” section which contained many numbers, tables, and figures were excluded in the analysis, because they were not proper for capturing the linguistic features. “Abstract”

section was excluded as well, because it might confound results by tautology. All comments were merged into a unit of analysis for each student as a reviewer, because each comment of the student was too short to analyze linguistic features such as cohesion and syntactic complexity. The linguistic features of drafts and comments of users were computationally evaluated by Coh-Metrix [16].

2.3 Measures

According to previous research using Coh-Metrix [10, 11], the measures of Coh-Metrix capture different aspects of the linguistic features of data. Various indices were selected in this study, because the results of Coh-Metrix might differ across indices even within the same concept.

1) Ambiguity. The ambiguity of writing was calculated by hypernymy. Two types of hypernymy measures were used in this study: mean hypernym values of nouns and mean hypernym values of verbs.

2) Cohesion. Causal cohesion was calculated as the ratio of causal verbs to causal particles. Coreferential cohesion was calculated by LSA (Latent Semantic Analysis). Positive-additive connectives and negative-additive connectives were selected.

3) Lexical Diversity. The measures of lexical diversity were the number of words, the proportion of content words, and Type-Token ratio.

4) Syntactic Complexity. The measures of syntactic complexity are as follows: the number of words before the main verb and the sentence structure overlap.

3 Results

To investigate common writing styles between drafts and comments, the correlation analysis of similarity of linguistic features was conducted by using SPSS v.18. The Pearson correlation coefficient which is sensitive only to a linear relationship between two variables was adopted in this study, because it has strength to investigate the relationship of linguistic features of drafts and those of comments simply. Correlation between mean hypernym values of nouns in drafts and those in comments indicated that students who wrote their drafts with ambiguous nouns tended to generate comments with more ambiguity than those who did not (Pearson's $r = .37$, $p < 0.05$).

Table 1. Correlation results of ambiguity measures

Measure	Drafts		Comments			
	M	*SD*	*M*	*SD*	*r*	*p*
Hypernym values of nouns	5.07	0.20	4.72	0.17	.37	.02
Hypernym values of verbs	1.58	0.10	1.30	0.09	.08	.60

There was no significant correlation result in any cohesion measures as shown in Table 2. Students did not have similarity of cohesion between their drafts and comments.

Table 2. Correlation results of cohesion measures

Measure	Drafts		Comments			
	M	*SD*	*M*	*SD*	*r*	*p*
Causal cohesion	0.16	0.09	0.80	0.29	.26	.11
Coreferential cohesion	0.34	0.11	0.10	0.04	-.12	.44
Positive-additive connectives	35.24	25.66	38.93	7.53	.10	.55
Negative-additive connectives	4.60	5.07	10.61	4.39	.25	.11

However, there were significant results in lexical diversity measures. The results indicated that students who wrote drafts by using different words tended to write comments with diverse words (Pearson's $r = .40$, $p < 0.05$)..

Table 3. Correlation results of lexical diversity

Measure	Drafts		Comments			
	M	*SD*	*M*	*SD*	*r*	*p*
The number of words	1,417	526	1,329	558	.30	.06
Proportion of content word	1.908	498	3.375	654	.30	.06
Type-Token ratio	0.48	0.06	0.48	0.08	.40	.01

There was a significant result in syntactic complexity measures: the number of words before the main verb (Pearson's $r = .32$, $p < 0.05$). The results showed that students who wrote many words before the main verb in their drafts tended to generate their comments by writing more words before the main verb.

Table 4. Correlation results of syntactic complexity

Measure	Drafts		Comments			
	M	*SD*	*M*	*SD*	*r*	*p*
words before the main verb	4.86	1.38	3.50	1.03	.32	.04
sentence structure overlap	0.13	0.12	0.10	0.02	.10	.55

4 Discussion

The results of this study showed that students wrote drafts and comments by using common writing styles. For example, students who wrote drafts with abstract nouns, diverse words, and structurally complex sentences, tended to write abstract nouns, diverse words, and structurally complex sentences in their comments. Because ambiguity, lexical diversity, and syntactic complexity were not changed according to assignments of writing drafts and comments, those features might be used for predicting students' own stable writing styles.

There was difference in the measures of cohesion in this study. This result was contrary to the result of previous study that analyzed only drafts to find authors' writing styles could be distinguished by cohesion [9]. Different from the previous study, cohesion of comments was analyzed as well in this study. The content of comments might be dependent on the content and quality of peer drafts rather than the authors' own writing style. Thus, it needs to test the effect of peer drafts in the future study before concluding cohesion would not be included in the measures of stable writing styles.

This study has many implications. First, the stable writing styles of students might be tracked automatically by computational linguistic approach. The measures like ambiguity, lexical diversity, and syntactic complexity can be used to predict linguistic features of future writings of students. Second, the analysis data of computational linguistic tool can be used to provide students feedback in real time. The students might be more satisfied with the detailed and real time feedback of their performance [17]. Third, the system of writing education would be developed to be consistent with cognitive learning model [8]. If the system has information of writing scores of students and of writing styles of them altogether, the system can facilitate students to monitor their own writing styles and give them feedback to develop their writing styles consistent with writing improvement.

Although there are many implications, this study has some limitations. First, this study explored the possibility of finding the stable writing styles of students based on the correlation analysis. Thus, it needs to be careful not to interpret the results of this study that students' writing styles in writing drafts determined writing styles of their own comments. Second, students writing styles were not matched with writing quality of students writing in this study to investigate the relationship between writing style and writing improvement. Thus, it is not obvious that to have the stable writing styles is good for writing improvement. It needs to test this possibility in the future study.

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Challenges for the Realization of Ambient Intelligence

(Extended Abstract to the Keynote on)

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Abstract. A decade after the ISTAG report, Ambient Intelligence is still not a concept which is widespread in industry and even less in society. This is not a surprise, nobody working in this area claimed it will be a trivial process or that can be achieved in a couple of years. There are still formidable challenges to be tackled by the scientific community and there is no guarantee we will solve all of them, but the more progress we make on some of those the closer we will be from a stage where some of the initial aims are adopted. This talk will highlight those challenges, explain why they are important and put forward the idea that we can possibly do significant progress exploring those avenues for innovation.

Keywords: Ambient Intelligence, reliability, interaction, privacy.

1 Introduction

For centuries humans have witnessed scientific and technological leaps that changed the lives of their generation, and those to come, forever. We are no exception. In fact, so many of those advances are occurring now, in a more or less unperceived way. Slowly and silently technology is becoming interwoven in our lives in the form of a variety of intelligent devices which are starting to be used by people of all ages.

Advances in miniaturization of microprocessors have made possible a significant development for Ambient Intelligence. Computing power is now embedded in many everyday objects like home appliances (e.g., programmable washing machines, microwave ovens, robotic hovering machines, and robotic mowers). Intelligence travels with us outside the home (e.g., mobile phones and PDAs), and they help guide us to and from our home, safely and economically (e.g., car suspension and fuel consumption and GPS navigation). The greening of Information Technology has delivered computers that require reduced power, virtualization of servers, cloud computing and network protocols that actively manage power to conserve energy (e.g. Bluetooth 4.0). These technological developments have merged with advances in the areas of ubiquitous and pervasive computing which in turn were complemented by other existing areas of computing (for example artificial intelligence, HCI, and networking) into one new and exciting are which aims at providing digital environments which support people in their daily lives by assisting them in a 'sensible' way [1].

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Having the necessary technology, however, is not enough for an area of science to flourish. Experiences of people with computers over recent decades have created an interesting context where people's expectations of these systems are growing and their fear of using them has decreased. Concomitantly with this difference in the way society perceives technology there is also a change in the way services are handled. Technology is being adopted by all generations, now including older people, exemplified by the 'baby boomers' who have begun to embrace new technological advances.

More than a decade after the European Commission took a visionary step in requesting analysis of the potential of Ambient Intelligence [2]. In the intervening decade the area of Ambient Intelligence and related concepts like Smart/Intelligent Environments have been explored to assess the extent they can be successfully deployed and integrated into our society [3–6]. The realization of Ambient Intelligence requires the engineering of technological solutions which are helpful to people, transparent, reliable and affordable.

This article provides an overview of the Keynote offered at HumanCom2012 which is focused on a critical analysis of the area focusing on potential barriers for the realization of Ambient Intelligence. We believe this will help to focus efforts on the elements that will have a higher impact on realizing the concept of Ambient Intelligence into 'real, deployed' applications which change positively the way people interact with technology in their daily lives.

2 Inherent Challenges

The very nature of the area means we need to accept a number of serious challenges which make our work at the same time difficult and interesting. This section lists some of the most important and core challenges.

2.1 Users

The areas which have developed under the names of ubiquitous computing, pervasive computing, people centred computing, ambient intelligence, smart environments and Intelligent Environments are all closely related, arguably with more in common than differences. One of those common aims of all these areas is that one of putting humans at the very centre of the system and on empowering them:

> *"…the human is the master and the computer the slave and not the other way round." [7].*

These systems should be able to help people of all ages and educational backgrounds (crucially those who do not have IT knowledge). So many of the systems built on labs today are more for the personal gratification of the ego of the researchers than to provide real support to real people or to answer a request from users. Unobtrusiveness and transparency of services were advocated from the very beginning [8] as core

concepts to be respected. Still, so often these features are forgotten and other aims become more relevant, e.g., having a system 'working'.

System-Oriented (Importunate) Smartness is more often achieved but it has been correctly advocated that People-Oriented (Empowering) Smartness [9] is rather what is needed.

Systems also have to be resilient enough to cope with: users which will try to use the system in unexpected ways and with the richness and variability of human's behaviour on a daily basis. [10]

2.2 Environments

We can define an environment as "the area (physical space) that the sensors can sense". One classification of environments is in:

- closed spaces with relatively well defined boundaries (e.g., houses, hospitals, classrooms, and cars)
- open spaces which do not have well defined boundaries (e.g. streets, bridges and car parks, fields, and sea).

They are usually rich, complex, unpredictable, possibly generating substantial 'noisy' data, unstructured and sometimes highly dynamic.

2.3 Perception

All these systems are embedded in a world they have to act upon. Sensors allow the system to perceive what happens in a place without a human being necessarily being there. Perception is as good or bad as the sensing network. This sensing network informs but at the same time oversimplifies reality.

3 Current Limitations

Inherent Challenges cannot be solved, they are part of the rules of the game we accept to play. Current limitations are problems we can realistically aspire to work on (achieve better results and hence increase user acceptance). Next we list some of the problems awaiting solution.

3.1 Accurate Context-Awareness

Intelligent environments deal with massive amounts of data and highly complex situations. As a result, they also need to make decisions based on insufficient, incomplete and noisy data samples.

3.2 Preferences vs. Needs

Preferences and needs distinguish us from one another. We change them often due to unforeseen circumstances or to our own decision. It will be unpractical to design each

system from scratch in an ad-hoc manner for each person but a "one size fits all" approach will be unacceptable.

3.3 'Mindreading'

Some users may not be willing to speak or to use any keyboard or device to explicitly indicate how they feel. Is there any way a system can understand whether the user is in more of a receptive or introverted mood?

3.4 Coping with Multiple Occupancy

Identifying users in an unobtrusive, reliable and affordable way is still a challenge for all systems. Following users as they move is a further complication. Delivering services in shared spaces where there are conflicting preferences/needs, e.g., air conditioned in a car, T.V. settings in a living room, message boards in public spaces.

3.5 Deploying Reliable Systems

Systems fail. The more complex, the more often. Systems grow in complexity and responsibility. Still, humans tend to trust systems after seeing them working well for a while more consideration on what to do when systems fail to assist and people is left alone.

3.6 Ensuring Ethics and Privacy

Many of these systems which are human-centred can collect fantastic amounts of data from users and their lifestyles. How to make sure this stays private and is not misused?

4 Conclusions and Reflection

Applications of pervasive and embedded computing have been an important driving force on the materialization of a society supported by information. Such applications are at the core of fundamental areas such as healthcare and transportation. As a relatively new and developing area there are still important barriers for optimal development and widespread acceptance and adoption. The problems are big enough to require more community approach (instead of isolated efforts).

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Electronic Cane for Visually Impaired Persons: Empirical Examination of Its Usability and Effectiveness

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Abstract. Although various types of electronic mobility aids for visually impaired persons have been developed as alternatives to the conventional white cane, users still have much doubt on the effectiveness and usability of these newly introduced aids. To identify ways to improve usability and effectiveness of electronic cane, a task performance study was conducted to examine the usability level of electronic canes using performance metrics (based on time-consumption and error rates). 20 visually impaired persons with and without prior experience using a white cane participated in a 2x2 factorial mixed-design experiment, in which they used two types of cane (white vs. electronic). Results showed that an electronic cane was more effective in avoiding obstacles than a white cane for both experienced and inexperienced users, and previous experience with a white cane was found to be beneficial for timely task completion.

Keywords: visually impaired persons, electronic cane, white cane, usability, task performance.

1 Introduction

Although there are more than 246 million visually impaired people worldwide and the number is steadily growing [1], there have not been many variations in the type of mobility aids for providing safe, independent mobility. Since a white cane (Fig. 1) was introduced in the early 1940s, it has been the most commonly used mobility aid other than guide dogs [2] for the visually impaired, thanks to its inexpensive price and lightweight, portable body [3]. However, white cane's limited detection range (i.e., one meter) leading to potential collision risks and inability to detect obstacles above knee level are problematic. A recent survey [4] conducted on 300 people with visual impairments revealed that 50% of the respondents experienced falling accidents at least once a year even with a white cane.

To remedy these problems, many electronic mobility aids for visually impaired persons have been developed as alternatives to the traditional white cane since World

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War II [5]. Despite efforts to design effective electronic mobility aid, replacing the conventional white cane with a more functional electronic aid has not been successful. Roentgen et al. [2] also maintained that electronic mobility aids need to improve for the needs of the visually impaired, which has motivated many researchers to continue their search for possible solutions. The present study attempted to find ways to improve the electronic cane by examining usability and effectiveness of the electronic cane over the conventional white cane.

Fig. 1. Conventional white cane (top) and electronic cane (bottom)

Electronic canes with sensors (i.e., ultrasonic, laser, or infrared sensors) obtain information about the area surrounding the user, which enable detection above chest and in an extended rang [6]. Electronic canes detect obstacles even above knee-level and distances over two meters, although detection capabilities depend upon sensor quality. However, both laser and infrared sensors for obstacle detection have some limitations; laser sensors detect only narrow ranges, so should examine the area from side to side [7]; infrared sensors have problems with detection obstacles outdoors [6]. On the other hand, ultrasonic sensors can work effectively outside and usually detect obstacles over a wider range. Many electronic canes use ultrasonic sensor which are effective for obstacle detection [8].

In general, the electronic cane provides the visually impaired with essential advantages: For example, first, the advance alerts of an electronic cane give the visually impaired additional time to prepare for physical obstacles, whereas the white cane cannot. It might reduce collision frequency. Users are not required to continuously tap the ground ahead of them due to capabilities of obstacle detection over a wide range (approximately 30 degrees) [7]. Considering that any kind of conscious effort decreases in speed of walking [3], using an electronic cane might help the visually impaired increase walking speed. In addition, users are likely to run into fewer obstacles due to the advance warnings and the increased detection range for safety. This reasoning leads us to propose the first research question for study:

- **Research Question 1:** For visually impaired people, will the type of cane (electronic vs. white) have effects on users' collision frequency and time required to go the destination?

Familiarity is considered a critical design principle for creating new products because users heavily rely on their previous experience in using certain interfaces [9] and greater familiarity generally leads to increased efficiency [10]. In addition, familiarity helps users adopt and learn new, yet similar, products more effectively [11]. Familiar features are more intuitive and easier to use; thus, users' performance and satisfaction

are improved when interacting with familiar products [12]. By extension, users with previous experience in white cane may find it easier to use and get familiar with electronic cane even though they have never used one before. In order to empirically investigate this possibility, the present study poses the following question:

- **Research Question 2:** For visually impaired people, will previous experience in the conventional white cane have effects on users' collision frequency and time required to go the destination?

2 Method

2.1 Experimental Design and Participants

A within-subjects experiment was conducted, with four conditions representing the type of cane (conventional white cane vs. electronic cane) and participants' previous experience in white cane (with experience vs. without experience). Data were analyzed from 20 participants with visual impairments (8 males, 12 females, mean age=61, SD=8.2). All participants had never used the electronic cane prior to the experiment, but 14 participants had experience with the conventional white cane.

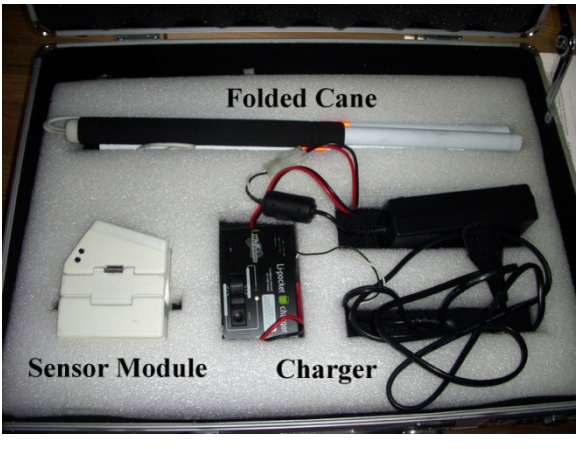

Fig. 2. Electronic cane and its parts

2.2 Material

A conventional white cane (length= 126 cm, weight=176g) and an electronic cane (length=126 cm, weight=176g) were prepared. The electronic cane was equipped with a vibrotactile actuator that provides tactile feedbacks on the handle when it detects an obstacle within two-meter range above knee level. The full operating package of the electronic cane weighed about 500g, including the cane itself, ultrasonic sensor module, and batteries (Fig. 2).

2.3 Experimental Setting

The experiment was conducted in a rectangular shaped hall (Fig. 3) with randomly placed obstacles. 12 objects of different sizes and shapes (e.g., buckets, toys, hats) were placed on the floor level. Two additional obstacles (e.g., shirts, towel) were placed above knee level to make it relatively difficult to detect with a traditional white cane.

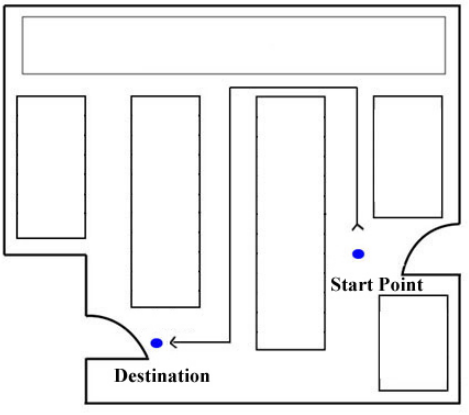

Fig. 3. Experimental setting

2.4 Procedure

Participants were provided with instructions on both canes, along with an opportunity to get familiar with them for five minutes. After the training, participants were asked to navigate through the hall from the starting point to the destination (Fig. 3), using the electronic cane first. Participants took a short break, and then started the same navigating task using the conventional white cane. While participants were navigating, two experimenters recorded the number of collisions (i.e., collision frequency) participants made and the navigation time (i.e., task completion time), which are the dependent variables. At the end of the experiment, all participants were debriefed, paid $17, and asked not to discuss the experiment with others.

3 Results

A two-way repeated-measures analysis of variance (RM-ANOVA) was conducted with the cane type as the within-subjects factor and participants' previous experience as a between-subjects factor. In response to Research Question 1, results from the RM-ANOVA showed a significant effect of cane type on collision frequency (Fig. 4 left). Regardless of participants' previous experience with the conventional white cane, participants with the electronic cane (M=6.55, SD=1.90) exhibited significantly lower collision frequency than those with the white cane (M=7.95, SD=1.19), $F(1, 18) = 7.54$, MSE=19.51, $p = .01$.

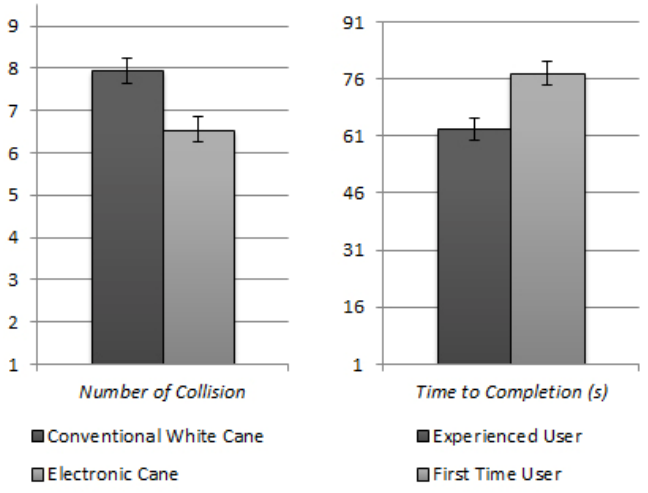

Fig. 4. Effects of cane type (left) and previous experience in white cane (right)

In response to Research Question 2, the analysis further revealed a notable effect of participants' previous experience on task completion time (Fig. 4 right). Regardless of the cane type, participants with previous experience using the conventional white cane (M=62.79, SD=15.44) arrived at the destination significantly faster than those without the experience (M=77.45, SD=15.44), $F(1,18)=4.10$, $p=.05$. However, no interaction effect was found between the cane type and previous experience with white cane.

4 Discussion

It is crucial to give the opportunity for independent mobility for visually impaired persons who can perform simple daily tasks on their own and thereby enhance their quality of life. Our study shows that, compared to the traditional white cane, the electronic cane provides the visually impaired with many advantages. An electronic cane is more useful for avoiding obstacles than a white cane, regardless of the level of previous experience with canes, implying that an electronic cane is easy to use and useful in avoiding obstacles. This finding is even more remarkable when one considers that the participants used the white cane for the same task after completing it with the electronic cane. In general, such a procedure would favor better performance given the immediately preceding rehearsal. However, the poorer performance with the white cane suggests that any such advantage was negated by the higher expectations resulting from the use of the clearly superior electronic cane.

Yet, the habitual use of the white cane has its advantages, as borne out by the main effect on task completion time. Experience suggests familiarity [12], can help us accomplish tasks more quickly [13]. A design implication is that a cane-like form, because of its greater familiarity among the visually impaired, would be more appropriate for future electronic mobility aids than other forms such as wearable or

handheld interfaces. It seems that white cane users would not face a big challenge in switching to a smart cane because of the similarities between the white and electronic canes.

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IPS vs. AMOLED: Effects of Panel Type on Smartphone Users' Viewing and Reading Experience

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Abstract. The present study conducted a 2x2 between-subjects experiment and examined whether users' viewing and reading experience are affected by the type of display panels (i.e., IPS, AMOLED) that they are exposed to when watching videos and reading text. Despite panel manufacturers' claims, results from the experiment revealed that users' oculomotor comfort, enjoyment, perceived display quality, viewing satisfaction, presence, text readability, reading comprehension, and reading satisfaction were not affected by the panel difference. Regardless of the panel type, video watching elicited greater oculomotor comfort, enjoyment, and purchase intention. Implications and directions for future research are discussed.

Keywords: IPS, AMOLED, mobile device, display panel.

1 Introduction

Recent emphasis on mobile display technologies has raised a question whether users should consider display panel type such as IPS and AMOLED an important choice factor, as integral as brand reputation, exterior design, and operating system (e.g., Android, iOS, WinMobile). Manufacturers have initiated aggressive marketing campaigns focusing on the panel type (Fig. 1), arguing that their unique display panel offers greater video fidelity, text readability, viewing angle, and contrast ratio than their competitors. In other words, display panel type is seen by manufacturers as largely determining users' enhanced, interactive viewing and reading experience on mobile devices.

But, does panel type of mobile devices really matter for users? While much emphasis has been placed on technical and manufacturing distinctions between the panels (e.g., power consumption, panel thickness), psychological effects of different panels on user experience have not been sufficiently examined in prior published research. The goal of the present study, therefore, is to investigate the psychology of mobile device users engaging in video watching and text reading on a smartphone

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with either IPS or AMOLED panel – the two major mobile display panels available in the market. We were guided by the following research question:

- **Research Question:** For smartphone users, when watching a video or reading text, controlling for content and time spent on the device, what are the effects of the panel type (IPS vs. AMOLED) on users' viewing and reading experience?

Fig. 1. AMOLED vs. IPS

2 Literature Review

2.1 IPS vs. AMOLED – Technical Difference

IPS (In-Plane Switching) is one of the TFT-LCD (Thin Film Transistor-Liquid Crystal Display) technologies that provide an improved, alternative solution to the earlier TN (Twisted Nematic) LCD panel's limited viewing angle, color reproduction, and contrast ratio [1, 2]. First introduced by Hitachi in 1996, the IPS technology was developed to change the physical behavior of the liquid crystal layer by making the nematic liquid crystal molecules respond to the electric field in parallel to the TFT, which resulted in significantly improved viewing angle and picture uniformity [2, 3]. LG Display further advanced the original IPS technology, and introduced S-IPS (Super In-Plane Switching) and AH-IPS (Advanced High Performance In-Plane Switching) panels in 2001 and 2011 respectively, providing even further enhanced viewing angle and contrast ratio [1]. As a leading manufacturer of both IPS panels and mobile phones, LG is now actively promoting the advantages of the IPS technology by adopting the IPS panel on their latest smartphone display.

Another panel technology gaining increasing popularity in mobile display is AMOLED (Active Matrix Organic Light Emitting Diode). Primarily manufactured by Samsung Mobile Display, AMOLED panels consist of thin, multi-layered organic films that emit light when electricity is applied, and it is considered "an environmentally robust display technology" because, unlike TFT-LCD panels, it does not require a backlight that consumes much power [4, 5]. Although AMOLED has shorter

lifetime, limited sunlight readability, and higher production cost than TFT-LCD panels [6], it offers bright and slim display panels with fast response time, wide viewing angle, and high contrast ratio [5]. Samsung has released high-tech smartphones featuring their AMOLED series panels, advertising the superiority of AMOLED over LG's IPS technology.

2.2 IPS vs. AMOLED – Psychological Effects on Users

While much emphasis has been placed on these technical differences between the panels from an engineering perspective, only a couple of studies have examined the psychological effects of display panel type on users' viewing experience. In their experiment examining the role of LCD monitor panel type (i.e., S-IPS vs. S-PVA vs. TN panel) in facilitating enhanced interactive viewing experiences, Kim and Sundar [7] found that users preferred the S-PVA panel over the S-IPS or TN panel types in terms of enjoyment. For both gaming and movie watching, users of an LCD monitor with the S-PVA panel perceived a higher level of enjoyment than their counterparts in the S-IPS and TN panel conditions. In a similar study, Park, Lee, and Ha [8] presented seven images on TFT-LCD and AMOLED panel screens, and asked users to rate the vividness and naturalness of the displayed images. Users perceived the TFT-LCD panel as being more effective in natural color reproduction while they found greater clarity and depth in AMOLED panel displays.

By extension, IPS and AMOLED panels used on smartphones may also provide users with different qualities of viewing and reading experiences. The present study intends to examine psychological effects of panel type, particularly in video watching and text reading, given that these are the two most predominant communication modalities through which information is delivered on smartphones [9].

3 Method

3.1 Experimental Design and Participants

A between-subjects experiment was conducted, with four conditions representing a fully-crossed factorial design featuring two types of screen panel (IPS vs. AMOLED) and two types of task (video watching vs. text reading). Data were analyzed from 60 college students (24 males, 36 females). Participants' age ranged from 20 to 37, with a mean of 24.18 years (SD=2.99).

3.2 Apparatus

Two mobile devices (Fig. 2) with a LG IPS panel and a Samsung AMOLED panel (both with 4.0" screen, 800x480 resolution, and 50% brightness level) were prepared in a laboratory. The devices' brand logos and exterior features were masked in order to avoid potential effects of manufacturers' brand reputation and participants' brand/interface-specific familiarity. In addition, the devices' default home screens and

user interfaces were replaced with an Android application called "LauncherPro" so that both devices had identical background theme, color, menu, and user interface. Identical video player and text viewer applications were installed on both devices.

Fig. 2. AMOLED panel (left) and IPS panel (right)

3.3 Stimulus Material

Ten respondents participated in a pretest for selecting a neutral stimulus material to minimize story-specific and emotional effects. The experimenters chose four video clips with mediocre content, and the respondents watched the clips and then completed a questionnaire on a 7-point Likert scale measuring the neutralness of each clip. Based on this procedure, one clip rated as having the most neutral content was selected and used as the stimulus material for the video condition of the experiment. The literal transcript of the selected video was used for the text condition.

3.4 Procedure

Upon arrival in the laboratory, participants were randomly assigned to one of the four conditions. Participants in the video condition were told that they were going to watch a video clip for five minutes on a smartphone. In the text condition, participants were told that they were going to read a story on a smartphone and given instructions on using the scroll down function (page turning) on the device. All participants were instructed not to change any configurations on the device and or to lift or move the device from its original position. Participants were seated in a way that they were not able to see the other device assigned to participants in other conditions.

After watching the video/reading the transcript, participants completed a post-experiment questionnaire on a 7-point Likert scale (1="not at all," 7="very much so"), which included validated items from prior research assessing their viewing and reading experience. Participants were then debriefed, paid five dollars, and asked not to discuss the experiment with others.

3.5 Measures

To examine participants' viewing experience, *perceived display quality* (e.g., During the video, I was distracted by the motion blur; I was able to view the images displayed on the screen without any distortions or discolorations), *viewing satisfaction* (e.g., The visual display quality distracted me from focusing on the video clip; I was satisfied with the overall viewing experience provided by the device), and *presence* (e.g., I felt I could interact with the displayed environment; I felt like the content was "live") scales were adopted from [12, 14] and used as dependent variables.

To assess participants' reading experience, *text readability* (e.g., I was able to read the text well; I was able to read the text quickly), *reading comprehension* (e.g., I identified the author's purpose; I activated relevant background knowledge for reading), and *reading satisfaction* (e.g., I was satisfied with using the device for text reading; The device I used was adequate for text reading) scales were adopted from [11, 12] and used as dependent variables.

For both viewing and reading, *oculomotor comfort* (e.g., I felt comfortable while I was reading the text/watching the video; I felt tired while I was reading the text/watching the video) scale from the Simulator Sickness Questionnaire [13] was adopted to measure participants' perceived level of general discomfort (e.g., fatigue, eyestrain, blurred vision). *Enjoyment* (e.g., I find watching the video/reading text enjoyable; I had fun watching the video/reading the text) [14] and *purchase intention* (e.g., I have an intention to use a device like this for reading/viewing purpose; I will probably buy a device like this for reading/viewing purpose) of a similar device [15, 16] were also measured as dependent variables.

Familiarity (e.g., Do you often use your smartphone?; Are you familiar with handling mobile devices?) with using mobile devices [17] was measured as a covariate.

The reliability of the measures was established by calculating Cronbach's alpha for the internal consistency of the items. As shown in Table 1, all alpha values were above the recommended level of .7.

4 Results

A series of analyses of covariance (ANCOVAs) was conducted with two manipulated independent variables (IV1: IPS vs. AMOLED panel; IV2: video watching vs. text reading) and one covariate (familiarity with using mobile devices).

Results from the analyses revealed a significant effect of the panel type on purchase intention. Participants exposed to the IPS panel reported that they were more likely to purchase a similar mobile device for viewing/reading purpose than those exposed to the AMOLED panel, $F(1,55)=4.51$, $p<.05$. As summarized in Table 1, however, we found no effect for panel type on any of the other dependent variables.

However, the modality variable had significant effects on oculomotor comfort, enjoyment, and purchase intention. As reported in Table 2, participants who watched the

video experienced greater oculomotor comfort ($F(1,55)=83.97$, $p<.0001$) and enjoyment ($F(1,55)=83.97$, $p<.0001$), and they were more likely to purchase a similar mobile device for viewing/reading purpose than those who read text, $F(1,55)=83.97$, $p<.0001$.

Table 1. IPS vs. AMOLED: Mean (standard deviation)

Dependent Variables	Cronbach's α	IPS	AMOLED	p-value
Oculomotor Comfort	.94	3.60 (1.74)	3.42 (1.65)	.55
Enjoyment	.90	4.23 (1.60)	3.97 (1.56)	.40
Purchase Intention	.94	3.49 (1.51)	2.81 (1.57)	.04*
Display Quality	.74	5.91 (1.00)	5.77 (0.79)	.67
Viewing Satisfaction	.82	5.75 (0.78)	5.59 (1.24)	.68
Presence	.93	5.91 (1.21)	5.77 (1.10)	.63
Text Readability	.86	3.73 (1.22)	3.71 (1.11)	.96
Reading Comprehension	.88	4.30 (1.32)	4.57 (1.30)	.58
Reading Satisfaction	.95	3.11 (1.35)	3.01 (1.91)	.87

Table 2. Text vs. video: Mean (standard deviation).

Dependent Variables	Text	Video	p-value
Oculomotor Comfort	2.31 (1.33)	4.72 (0.98)	<.0001*
Enjoyment	3.08 (1.01)	5.13 (1.34)	<.0001*
Purchase Intention	2.21 (1.15)	4.12 (1.32)	<.0001*

Familiarity with using mobile devices, however, did not emerge as a significant covariate.

5 Discussion

Despite panel manufacturers' claims, the present study found no effect of the IPS vs. AMOLED panel type on smartphone users' perceived levels of oculomotor comfort, enjoyment, display quality, viewing satisfaction, presence, text readability, reading comprehension, and reading satisfaction. This finding, however, does not guarantee a confident statistical conclusion that the panel type has absolutely no psychological effects on users. Considering that purchase intention was higher among IPS panel users, it is possible that panel type could have effects on other domains of user perceptions that were not examined by the present study. Although its effects are not as strong as advertised, the panel type may still be considered "one of many" choice factors for smartphone users.

Consistent with findings in a recent mobile-based experiment [9], video watching elicited greater enjoyment (and thus higher purchase intention) than text reading,

regardless of the panel type. Video watching was also key to greater oculomotor comfort, particularly given the mobile environment. Considering the recent, evident move toward larger screens for mobiles, panel engineers should consider shifting emphasis from video fidelity to greater text readability afforded by screen-size. Optimus Vu (Fig. 3), the latest smartphone released by LG Mobiles, for example, demonstrates the manufacturer's attempt to enhance users' reading experience by adopting a 4:3 screen ratio instead of the conventional 16:10 or 16:9 ratio. However, critics argue that the 4:3 ratio is now jeopardizing users' video fidelity. This means that prospective buyers need to decide whether they need a device specialized for text reading or video watching, and manufacturers may want to avoid such a trade-off situation by putting more effort on developing display technologies that can enhance both reading and viewing experiences.

Fig. 3. 4:3 ratio adopted for greater text readability

Future research on this topic may benefit from experiments that employ a within-subjects design in which participants are exposed to both IPS and AMOLED panels and allowed to make direct comparisons between the panels. Areas of user perceptions that were not examined by the present study, such as perceived realism, naturalness, and ease of use, could be taken into account as additional dependent variables. Lastly, the domain of display quality may be divided into subcategories such as contrast ratio and viewing angle, as we begin to pinpoint which specific attributes are affected by panel type and how they may influence user experience of smartphones.

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A Model for Knowledge Elicitation, Organization and Distribution in the Cultural Entertainment Sector

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Abstract. In the past museums have been slow in fully utilising new technologies, but in the last decade this situation has changed dramatically. The need for more support to visitors and more collaboration between experts and between museums has led to the exploration of how new technologies can extend the traditional museum. In this paper a new concept of such an extended museum is presented, with particular attention to gathering, organization and consumption of knowledge.

1 Introduction

A museum is a place where objects with permanent cultural value are displayed. Cultural and leisure events are prepared by some experts: the curators. Over time, audio guides and extended content were provided to visitors in order to enrich their experience, but the narratives are still dominated by curators.

Many other people can provide knowledge about the exhibits, moving the source of information from curators to experts to everybody. Experts provide the knowledge coming from their researches and studies and have the capability to group objects in meaningful collections and paths inside exhibitions. Even other people can have some specific knowledge on the objects, like teachers and people with great interest in the topic. Moreover everyone can contribute sharing emotions he felt during the museum experience and providing his personal collections and paths, created following personal criteria. In this way, conversations on the objects where everybody can participate are created. People usually are willing to share their emotions when they feel it as valuable, like it happens on the walls near Giulietta's balcony in Verona.

In museums, not only the information provided can be improved, together with its source, but also the location and time characteristics can be expanded. Museums can overcome the barrier of its building and become regional. An example is the exhibition that is in development in Trentino for the first centenary of the First World War.

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Fig. 1. Love messages near Giulietta's balcony

People will be guided to the visit of war ruins on mountains around Trento. Elders that lived the war and their descendants can attach their photos and memories to the place they refer to. This is a very important resource for this exhibition.

Historical museums already provide knowledge of past events, but they usually take care of a particular time period. They can be extended in time by allowing them to cover the complete history of an area. For example, an exhibition could show the history of a city from its birth till now, collecting all important events happened in its all life. Again elders and citizens are a great source of information because they can provide photos of the city in last decades and memories of important events of their life or handed down by their elders.

In this paper we concentrate on the gathering, organization and consumption of museum-related knowledge. The main issues to be faced are the shyness of people in sharing and the filtering of information in order to make it easy to find interesting content. We model the extended museum, identifying which different types of users are involved and how to represent their knowledge in such a way that it is easy to be collected, organized and consumed.

Section 2 shows the other projects developed in last years in order to improve the museum experience, while Section 3 presents the model we built. A prototype is under development following such model, providing a proof of its applicability (Section 4).

2 Related Work

In last years many attempts to use mobile devices to improve museum visits have been done. Some projects focused more on the social aspect of the visit, allowing people to access the multimedia information together and without isolating themselves with earphones ([1], [2]). Others concentrated on providing more information ([3], [4], [5]).

Thanks to the spread of smartphones, many new technologies are nowadays available and many applications using them for enhancing the museum experience have been developed in last years. RFID[1] and its standard NFC[2] started to be used in 2005 ([6], [7], [12]) and recently have been applied in smartphone's applications like in the Museum of London[3] and in Capitoline Museums in Rome[4].

[1] http://en.wikipedia.org/wiki/Radio-frequency_identification
[2] http://en.wikipedia.org/wiki/Near_Field_Communication
[3] http://www.nfcworld.com/2011/08/16/39129/museum-of-london-adds-nfc/
[4] http://romeinfo.wordpress.com/tag/capitoline-museum/

Augmented reality[5] is an alternative for providing extra information augmenting the object. It started with some intrusive devices [8], till the use of smartphones that have a minor impact in the visit (Terracotta Warriors[6]).

Social aspect in visits is very important but rarely supported. A first project that allows people interact sharing their emotions was built for the Amsterdam Rijksmuseum [16]. It is very common today for museums to organize special events that make the visitor interact actively with the museum, playing some scavenger hunt ([13], [9]) or mystery solving ([10], [11], [12]) games dedicated mainly to children, but not only. But visitors could participate even more in the museum life, leaving their mark on interesting artefacts and annotating real objects [14]. What is missing is a model that captures collaborative annotation of real objects giving different levels of expertise. Knowledge Spaces is a project that supports the collaboratively gathering of information, comments and tags and could be adapted to the museum environment [15].

3 Liquid Galleries Model

In this section we describe our notion of extended museum and present a model that captures the required structure and empowers the overall experience.

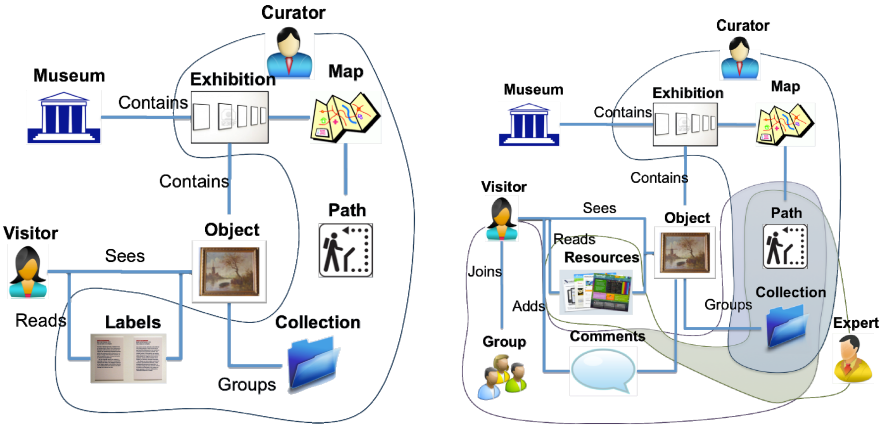
3.1 The Traditional View

A **museum** can be a big entity, usually bounded by a building, and can tell different stories: each story is described by a smaller group of objects grouped in a smaller space or available for only a specific period defined by an **exhibition**. Displayed **objects** can be artefacts, like paintings, ornaments, scientific tools, or other kind of objects, like fossils or plants. Each object has a specific role in the story presented by the exhibition in which it is placed. Some of them have an important role as a **collection** and they are shown grouped in cases. Exhibitions can be experienced following **paths**, consuming objects in a specific order predefined by the **curators**. In order to understand the exhibits, visitors can read **labels** and explanatory panels, listen to audio guides or have a guided tour of the exhibition. All this is captured by the model in Figure 2a.

All these opportunities provide visitors a portion of the knowledge related to the object in the context of the exhibition, hiding to the user all other interesting information that research discovered. The *lack of knowledge* is due to the limit of space and time during museum's visits. In fact, it is not possible to fill the museum with explanatory panels or spend 30 minutes listening the explanation for each single object. But still this knowledge must be accessible to visitors, that must also be able to select only what is *interesting* to them.

[5] http://en.wikipedia.org/wiki/Augmented_reality

[6] http://www.techgoondu.com/2011/06/16/artefacts-come-alive-on-an-iphone-museum-app/



a. Traditional museum. b. Extended museum.

Fig. 2. Conceptual models

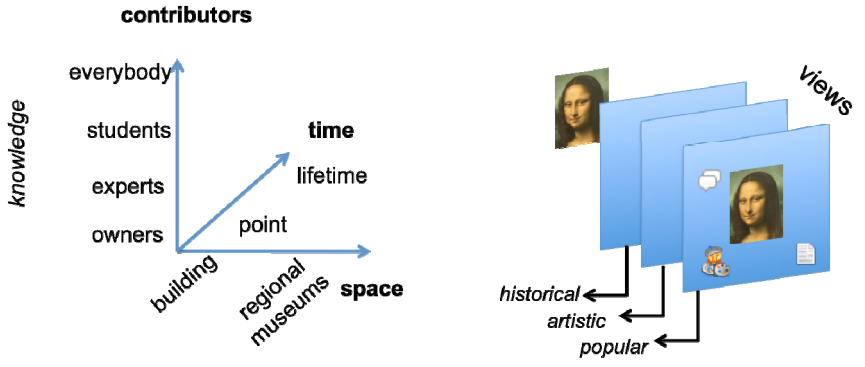
3.2 The Extended View

Thanks to the Internet, a large amount of knowledge can be accessed without space limits, but which kind of information needs to be collected and shown? First of all, the basic information about objects, like title, author, period and materials, are already collected in museum's catalogues. The need of a common place where these data can be collected and shared among museums is very strong. A deeper knowledge on the meaning of objects, their history and all details about them can be collected from researches conducted by **experts**. For example, a painting can have some information about what the author meant with it (i.e. its meaning), about the techniques used for painting it, but also the author's life situation when he decided to paint it (i.e. historical context) and the history of the painting (some of them had a very turbulent "life", with thefts and retrievals). All this different aspects of the objects are interesting and visitors should be able to access them. In our model, this implies extending the **time dimension** from one point in time to the entire history (see Figure 3a).

Experts have deep knowledge about objects, but also **visitors** can provide content that future visitors are willing to consume. In particular, **feelings** and **comments** on the experience they have looking at an object are important to be collected and create interest in future visitors, giving them hints on how to organize their visit inside the museum allocating time accordingly to the interest an object has excited before. Figure 2b shows how the traditional model is extended with the knowledge provided by experts and visitors.

Allowing experts and visitors to give their contributions result in a great amount of information evolving with time, always updated. On the other hand, it is important for people to be able to find easily what is considered interesting, so there is the need of a good organization. For this reason, comments and emotions by visitors are kept separated from the resources added by experts, that are then grouped by point of view

(as in Figure 3b). In this way, users can decide to read only the subset of resources that talk about the exhibit from the point of view they find interesting. To this end, the model extends the **participation** from only curators to experts to everyone.



a. Extension in time, space and contributions b. Knowledge views

Fig. 3. Extended museum explained

Some organization is needed also at a higher level, between cultural objects. For example, people interested in Egyptian culture would like to find all Egyptian objects very quickly, even if they are shown in different exhibitions. This service is provided with generic **collections** that, as opposed to traditional collections, can be created by everyone and can group objects with specific similarities (same period, same author, same technique) or for more personal reasons (the artefacts that made a user feel happy). In alternative, users can even create personal **paths** they plan to follow in next visits or they want to suggest to friends or all future visitors. In this way, visitors are involved in the creation and management of services consumed by them, feeling important in the community.

Expressing their feelings, visitors reveal their interests and they can form groups where they can talk and keep updated about their objects of interest. They can share collections, paths and favourite objects, organizing them by content and making them easier to find. Thank to these groups, new networks are built, creating a communication channel between visitors with same interests, experts in the same field and, the most important one, between visitors, experts and museums organizers. Having the possibility to read thoughts and comments by visitors, museum organizers have a better understanding of visitors' expectations and how to build more exciting exhibitions.

4 LiquidGalleries Platform

The model presented before has been implemented in LiquidGalleries. Figure 4 shows the architecture of the project.

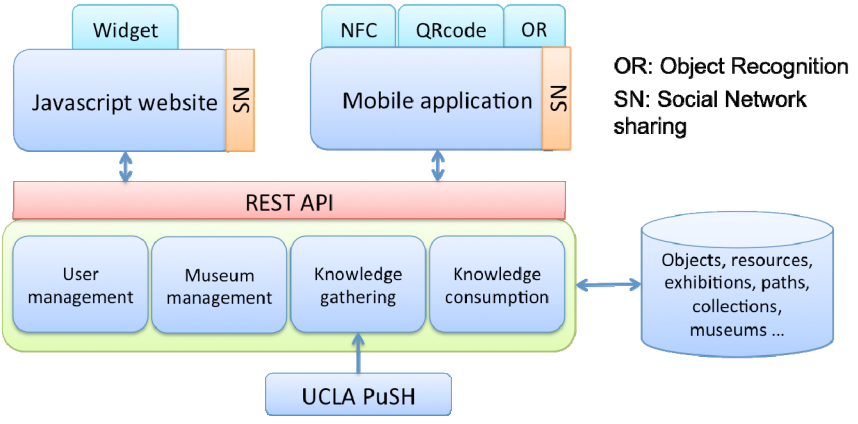


Fig. 4. LiquidGalleries architecture

Starting from the top, two different interfaces are built. The website provides access to the full functionalities of the platform and is meant for all management activities and for support before and after the visit. Together with the website, a widget is available, that provides access to LiquidGalleries right in the museum's website. A screenshot of this application is shown in Figure 5.

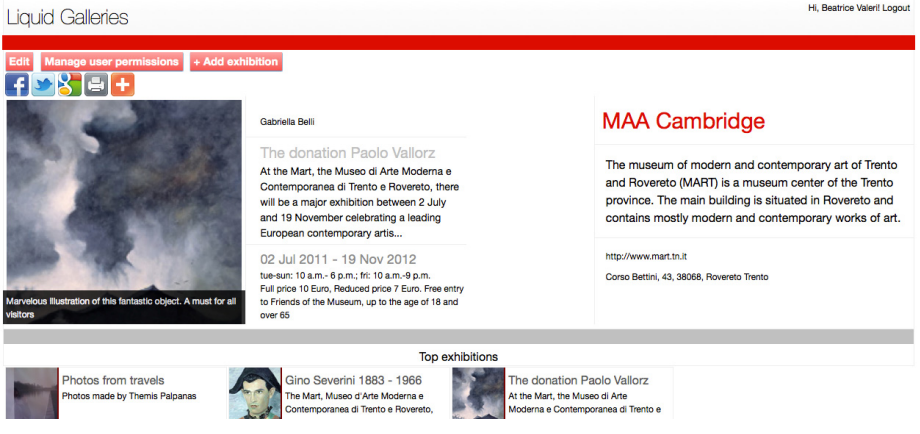


Fig. 5. Screenshot of the LiquidGalleries web application

The mobile application, instead, is thought to be used mainly inside the museum, providing fast access to information while experiencing the related object. The choice of the smartphone application is due to the new technologies that make very easy to interact with the world through a smartphone and to the spread of such devices. For

example, Near Field Communication, QR codes and object recognition allow the user to request the information of a specific object with a simple movement.

These interfaces works on top of the backend, which is implemented in Java and provides a REST interface that allows it to provide all needed functions. A database stores all the needed information about users, museums, exhibitions, objects, collections and paths. The user management module takes care of users' login in the application and manages the private area of each of them. For example users can bookmark interesting objects and access them quickly from their personal area.

A particular section is dedicated to museum's managers and curators, where they can create new exhibitions, insert new objects and get statistics on user's usage of LiquidGalleries for what is related to their museum, just to name some of the available functions provided by the museum management module.

The knowledge-gathering module contains the functions that allow experts and visitors to contribute with their expertise in the filed they are interested in. Experts share their knowledge on the Internet and then link it to objects as URL, so they can publish how they want and in the format they prefer. Visitors can share their emotions and experience leaving comments and grouping objects in collections and paths. Also museums catalogues' data are collected, thanks to the UCLA PuSH project [17]. This is a National Science Foundation (NSF) funded project based at the University of California, Los Angeles (UCLA), and its goal is to meet the need for museums to share their catalogues' information. LiquidGalleries uses this particular channel for adding in an automatic way all the vast knowledge collected by museums.

The last part, the knowledge consumption, is the most important one, allowing visitors and all users to consume all the collected and organized knowledge and share the interesting one.

The website is available[7] and only the Android version[8] of the mobile application has been built, with the intention to develop an iOS version as soon as it will support NFC. A video showing how LiquidGalleries is used is available on YouTube[9].

The project has been developed in collaboration with the Museum of Archaeology and Anthropology of the University of Cambridge and had good feedback from the museum field.

5 Findings

In this paper, a model for an enhanced museum experience has been presented. Collecting knowledge from experts and feelings from visitors, organizing them and allowing a fast and easy access to them at any time, people are supported in both social and learning dimensions of museum. Moreover, the use of mobile technologies during the visit allows people to concentrate on the exhibits, collecting links to interesting content for a later access. The model has been presented to experts in the

[7] http://test.liquidjournal.org/LiquidGalleries/

[8] https://play.google.com/store/apps/details?id=org.liquidpub.lgmobile

[9] http://www.youtube.com/watch? v=Lo5gK9xFPSI

museum field, receiving positive feedback, and it is implemented in a platform, demonstrating its applicability improving the museum experience.

A first test of the prototype, now under development, will take place in Kettle's Yard, University of Cambridge, where the project has already been presented to director and curators arousing a big interest.

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Efficient Mining Frequently Correlated, Associated-Correlated and Independent Patterns Synchronously by Removing Null Transactions

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Abstract. Market basket analysis techniques are useful for extracting customer's purchase behaviors or rules by discovering what items they buy together using the association rules and correlation. Associated and correlated items are placed in the neighboring shelf to raise their purchasing probability in a super shop. Therefore, the mining combined association rules with correlation can discover frequently correlated, associated, associated-correlated and independent patterns synchronously, that are extraordinarily useful for making everyday's business decisions. Since, the existing algorithms for mining correlated patterns did not consider the overhead of 'null transactions' during the mining operations; these algorithms fail to provide faster retrieval of useful patterns and besides, memory usages also increase exponentially. In this paper, we proposed an efficient approach for mining above mentioned four kinds of patterns by removing so called 'null transactions'; by which not only possible to save precious computation time but also speeds up the overall mining process. Comprehensive experimental results show that the technique developed in this paper are feasible for mining large transactional databases in terms of time, memory usages, and scalability.

Keywords: Associated patterns, correlated patterns, associated-correlated patterns, independent patterns, transactional database, null transactions, market basket analysis.

1 Introduction

Data mining is defined as the process of discovering significant and potentially useful patterns in large volume of data. One objective of association rule mining is to discover correlation relationships among a set of items. One difficulty is how to select a proper interestingness measure that can effectively evaluate the associated degree of patterns, as there is still no universally accepted best measure for judging interesting patterns [6]. The well-known algorithm for finding association rules in large transaction databases is Apriori [12]. On the other hand, correlation mining is much more effective because of the large number of correlation relationships among various kinds of items. However, an independent pattern might have a much more probability

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than a correlated pattern to be a novel paired or grouped items even if they have the same support for the sake of the downward closure property of independence [1, 13]. In the recent market the concept of super shop is very popular among the peoples since, these shops keep almost everything according to customers preferences and very often these super shops (i.e. Home Plus in Korea) has lots of branch around a country so, the number of transaction and purchase is huge; hence to predict e-shoppers or customer's purchase behavior changes with times. An organization's management first identifies target e-shoppers who share similar preferences for products and looks for those products that target e-shoppers are most likely to purchase. The purchase transactional records of e-shopper are used to build e-shoppers' profile describing his or her likes and dislikes. A set of e-shoppers known as neighbors who have exhibited similar behavior in the past, can be found through calculating the correlations among e-shoppers [14]. In this paper, we proposed an efficient approach for mining correlated, associated, associated-correlated and independent patterns synchronously by removing null transactions; which not only saves the mining time and memory usages but also speeds up the overall mining process.

The rest of this paper is organized as follows. Section 2, describes related works and the motivation behind this research. Section 3, represents the problem formulation. Section 4, represents our proposed approach and the 'ACAI' algorithm. In section 5 we devised some experimental results. Conclusions are presented in section 6. In this paper we used the term 'itemsets' and 'patterns'; 'database' and 'datasets' interchangeably.

2 Related Works and Motivations

2.1 Related Works

Many research works have been done in the field of correlated frequent pattern mining. Most of them first generate frequent itemset then uses these frequent itemset to mine correlated patterns. Including many of these algorithms are Apriori based [14, 15], for this reason is not scalable and is impractical for many real-time scenarios. FP-growth mining algorithm [9], offers better performance than Apriori algorithm as the former does not depend on candidate generation. Also, the database is fully scanned just twice. However, FP-tree algorithm does not drop the so called *'null transactions'* for subsequent scanning of conditional databases. Also, when the patterns are too long and redundant, it is impractical to construct a main- memory based FP-tree. Algorithms based on mining maximal frequent itemsets performs better than FP-tree based algorithms since, they avoid redundant patterns [16]. However, the maximal frequent itemset mining does not give complete information on the frequent itemsets, unlike algorithms based on closed frequent itemset mining. Also, they consider *'null transactions'* for mining, which is avoidable. The stream based algorithms uses FP-tree for representing all frequent itemsets which is obtained by scanning all transactions, including null transactions [14, 17, 18]. Transactions which contain just a single itemset can be avoided from the scheme of things even in stream data since; it cannot help in representing any pattern. Zhun et al. [19] have proposed a modified FP-tree which is built obviously by scanning every transaction

including null transactions. This approach however requires all transactions to be considered for mining.

On the other hand, Miccinski *et al.* [4], introduced three alternative interestingness measures, called any-confidence, all-confidence and bond for mining associations for the first times ever. Later on, Y.K Lee *et al*. [3, 11] used all-confidence to discover interesting patterns although both of them defined a pattern which satisfies the given minimum all-confidence as a correlated pattern. B. Liu et al. [2], used contingency tables for pruning and summarizing the discovered correlations etc. In this paper, a new interestingness measure corr-confidence is proposed for correlation mining. After that, Z**.** Zhou [1], mines all independent patterns and correlated patterns synchronously in order to get more information from the results by comparing independent patterns with correlated patterns. An effective algorithm is developed for discovering both independent patterns and correlated patterns synchronously, especially for finding long independent patterns by using the downward closure property of independence. In the literature [13], Z. Zhou, combines association with correlation in the mining process to discover both associated and correlated patterns. A new interesting measure corr-confidence is proposed for rationally evaluating the correlation relationships. This measure not only has proper bounds for effectively evaluating the correlation degree of patterns, but also is suitable for mining long patterns. Actually mining long patterns is more important because a practical transactional database may contain a lot of unique items. However, these works built obviously by scanning every transaction including null transactions.

2.2 Motivations and the Screening of Null Transactions

A null transaction is a transaction that does not contain any item-sets being examined. Typically, the number of null-transactions can outweigh the number of individual purchases because, for example, many people may buy neither milk nor coffee, if these itemsets are assumed to be two of the frequent itemsets. So, it is highly desirable to have a measure that has a value that is independent of the number of null-transactions. A measure is null-invariant if its value is free from the influence of null-transactions. Null-invariance is an important property for measuring association patterns in large transaction databases [9]. From the previous section we observed that a lots of good works have been proposed and developed [1, 2, 4, 11, 13], but the performance degrades drastically especially when the transactional datasets are sparse due to the presence of null transactions. Unfortunately, above mentioned works do not have the null-invariance property. Since, large data sets typically have many null-transactions, it is important to consider the null-invariance property when selecting appropriate interestingness measures for pattern evaluation. In this proposed approach an attempt has been made to eliminate the null transactions thereby, attempting to reduce the processing time for finding frequent *k*-itemsets. Finding null transactions and later eliminating them from future scheme of things is the initial part of this proposed framework. Consider for instance that, an electronic shop has 100 transactions of which, 40% are null transactions. FP-tree method of mining or any other related method in that case would scan all the 100 transactions while, our proposed approach attempts to reduce the transactions to 60% by considering just the valid 60 transactions after screening the 40 null transactions. This saves a lot of

precious computation time 9]. Besides, an attempt has been made to find null transactions by using vertical data layout format [20]. It is quite possible to find the null transactions by finding those transactions that don't appear against any frequent single-itemset with this representation.

3 Problem Definition

In this section, we first define the problem of correlated, associated, associated-correlated and independent patterns mining and then present some preliminary knowledge that will be used in our algorithm adopted from literature [1, 13] *et al.* Suppose we have a transactional database DB in table 1 the problem is that mining the complete set of correlated, associated, correlated-associated and independent pattern efficiently.

In statistical theory, A_1, A_2 ….A_n are independent if $\forall k$ and $\forall 1 \leq i_1 {}_2 \leq \ldots < i_k \leq n$,

$$P(Ai1Ai2 \ldots \mathrm{Ai}k) = P(Ai1)P(Ai2) \ldots P(Aik) \tag{1}$$

1. If a pattern has two items, such as pattern *AB,* then,

$$\rho(AB) = \frac{P(AB) - P(A)\,P(B)}{P(AB) + P(A)\,P(B)} \tag{2}$$

2. If a pattern has more than two items, such as pattern X= $\{i_1, i_2 \ldots i_n\}$, then

$$\rho(X) = \frac{P(i1i2 \ldots in) - P(i1)\,P(i2) \ldots P(in)}{P(i1i2 \ldots in) + P(i1)\,P(i2) \ldots P(in)} \; where\; n \geq 1 \tag{3}$$

From (2) and (3), we can see that ρ has two bounds, i.e. -1≤ρ≤1. Let ∂ be a given minimum corr-confidence, if pattern *X* has two items *A*, *B and* if $|\rho(AB)| > \partial$, then *X* is called a correlated pattern or *A* and *B* are called correlated with each other, else *A* and *B* are called independent. If pattern *X* has more than two items, we define a correlated pattern and an independent pattern as follows:

Definition 1: Correlated pattern- Pattern *X* is called a correlated pattern, if and only if there exists a pattern *Y* which satisfies $Y \subseteq X$ and $|\rho(AB)| > \partial$; where ∂ is a predefined value of ρ.

Definition 2: Independent pattern- If pattern *X* is not a correlated pattern, then it is called an independent pattern. Now we define the associated patterns,

Let T= $\{i_1, i_2, i_{3\ldots} i_m\}$ be a set of m distinct literals called items and *D* be the set of variable length transaction over T. Each transaction contains a set of items, $\{i_{j1}, i_{j2}, i_{j3} \ldots. I_{jk}\} \subset T$. Pattern X is a subset of T. Let P(X) be a power set of pattern X. The interestingness measure all-confidence denoted by α of a pattern X is defined as follows:

$$\alpha(X) = \frac{Sup(X)}{Max\_item\_Sup(X)} \quad (4)$$

Definition 3: Associated pattern- A pattern is called an associated pattern, if its all-confidence is greater than or equal to the given minimum all-confidence threshold.

Definition 4: Associated-correlated pattern- A pattern is called an associated-correlated pattern if it is not only an associated pattern but also a correlated pattern. Let pattern *X* be an associated-correlated pattern, then it must have two subsets *A* and *B* which satisfy the condition that the sale of *A* can increase the likelihood of the sale of *B*.

Example 1. For the filtered transactional database in Table 3, we have α (*AC*) =3/4 and α (*CE*) = 3/4. We also have,

$$\rho(AC) = P(AC) - P(A)P(C) / P(AC) + P(A)P(C) = 1/5 \quad \text{and}$$
$$\rho(CE) = P(CE) - P(C)\,P(E) / P(CE) + P(C)\,P(E) = 1/17$$

Let, the given minimum all-confidence set to be 0.35 and the given minimum corr-confidence set to be 0.10, then both *AC* and *CE* are associated patterns. However, pattern *AC* is a correlated pattern and pattern *CE* is an independent pattern. Therefore pattern *AC* is an associated-correlated pattern and pattern *CE* is an associated but not correlated pattern.

Table 1. A Transactional Database

TID	Items
10	A, B, C, F
20	C, D, E
30	A, C, D, E
40	A
50	D, E, G
60	B, D
70	B
80	A, C, E
90	A, C, D
100	B, D, E

4 Proposed Approach

4.1 Work Flow of the Proposed Approach and the ACAI Algorithm

We mine all frequent correlated, associated, associated-correlated and independent patterns in two steps. First, we discover all frequent patterns using FP-growth [9], and then test whether they are correlated, associated, associated-correlated and independent patterns or not based on constraints defined by definition 1 through 4.

For this we us two level pruning. For level 1 pruning we perform it by removing 'null transaction' and minimum support threshold. On the other hand level 2 pruning is performed by the constraints defined by definitions 1 through 4.

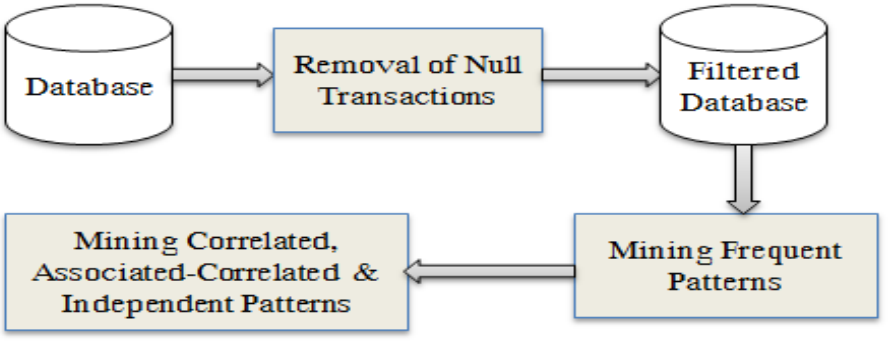

Fig. 1. Workflow of our proposed approach

The ACAI Algorithm

Input: i) A transactional database ii) min_sup, iii) min_corr_conf, and iv) min_all_conf.

Output: Complete set of frequently correlated, associated, associated-correlated and independent patterns from that database.

Step-1: Scan the original dataset then remove 'null transactions' and 1-infrequent itemsets.

1. Represent the dataset using vertical layout format.
2. Find & remove null transactions from the dataset.

Step-2: Scan the filtered dataset and apply the modified FP-growth to generate the frequent itemsets.Suppose X is a frequent itemset.

1. Prune frequent 1-itemssets.
2. If X has 2 or more items and $S(X) \geq min\_sup$ X is a frequent pattern. //Candidate patterns

Step-3: Find the complete set of frequent correlated, associated, associated-correlated and independent patterns. Suppose X is a frequent pattern.

1. If ($\partial(X) > min\_corr\_conf$)
   X is a correlated pattern
2. Else If ($|(\alpha(X))| > min\_all\_conf$)
   X is an associated pattern.
3. Else if ($\partial(X) > min\_corr\_conf$ && $|(\alpha(X))| > all\_conf$)
   X is an associated-correlated pattern
4. Else
   X is an independent pattern.

Fig. 2. The ACAI Algorithm

4.2 An Example

Now, consider the vertical layout format representation of the same database given in table 2. Here, transaction 10 and 50 are supposed to be the '*null transactions*'; also from table 1 transactions 40 and 70 are null transactions and are already not been considered for mining. It is clear that, the null transactions containing just 1-itemsets are not significant since these itemsets do not have contribution while mining correlated patterns or association rule mining, hence, have been removed prior to mining.

Table 2. Vertical layout format of the example database

Items	TID Sets
A	10, 30, 80, 90
B	60, 100
C	20, 30, 80, 90
D	20, 30, 50, 60, 90, 100
E	20, 30, 50, 80, 100
F	10
G	50

Also, itemsets F and G do not satisfy the minimum support count of 2, and is hence, avoided for mining. For the ease of the reader we just showed the corresponding filtered transactional database in table 3 of the original database given by table 1. Let, the given minimum all-confidence is set to be 0.45 and the minimum corr-confidence is 0.10.The resultant FP-tree formed from the dataset given in table 3 is shown in figure 1. Since, our objective is to mine frequently correlated patterns family; hence intentionally we avoided the details of mining frequent patterns from the FP-tree. It is to be noted that, our proposed algorithm will not consider transactions 10, 40, 50 and 70 while scanning the dataset (Table 2) for the second time to construct the FP-tree since, they are null transactions. The figure 2 shows the formal algorithm of our proposed work and fig 3, shows the support count of 1-itemsets and resultant FP-Tree. And table 4 shows the resultant frequent patterns with their corresponding supports. And we applied the constraints defined by definition 1 through 4 to mine the correlated, associated, associated-correlated and independent patterns and have shown in figure 4.

Table 3. The Filtered Database of the original database presented in table 1

TID	Items
20	C, D, E
30	A, C, D, E
60	B, D
80	A, C, E
90	A, C, D
100	B, D, E

Items	Support
A	3
B	2
C	4
D	5
E	4

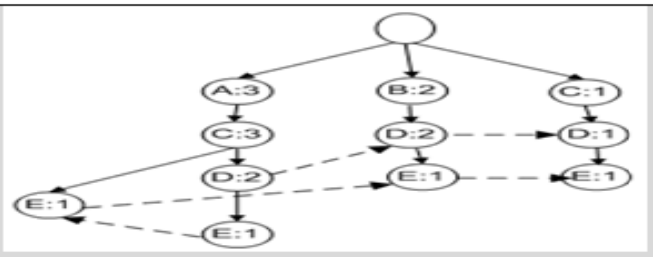

Fig. 3. Support count of 1-itemsets and resultant FP-Tree

Table 4. Frequent Patterns and Their Support from the FP-Tree

Frequent Pattern	Support	Frequent Pattern	Support
AC	3	CE	3
AD	2	DE	3
AE	2	ACD	2
BD	2	ACE	2
CD	3	CDE	2

Frequent Pattern (X)	| ρ(X)|	α(X)	Correlated	Associated	Associated- Correlated	Independent
AC	0.2000	0.75	√	√	√	
AD	0.1200	0.40	√			
AE	0.0000	0.50		√		√
BD	0.0909	0.40				√
CD	0.0715	0.60		√		√
CE	0.0600	0.75		√		√
DE	0.0715	0.60		√		√
ACD	0.0435	0.40				√
ACE	0.2000	0.50	√	√	√	
CDE	0.0527	0.40				√

Fig. 4. Correlated, Associated, Associated-correlated and Independent Patterns

5 Experimental Results

All programs are written in Microsoft Visual C++ 6.0 running on Windows XP. And the Hardware configuration is as follows: Processor-Intel Core 2 Duo 2.4GHz, Main memory-4GB, and Hard disk space-500GB. Our experiments were performed on real data sets as shown in Table VI. Gazelle comes from click-stream data from http://gazelle.com and pumsb is obtained from http://www.almaden.ibm.com. On the other hand the Connect-4 dataset has been downloaded from website http://rchive.ics.uci.edu/.The gazelle is rather sparse in comparison with pumsb, which is very dense so that it produces many long frequent itemsets even for very high values of support. Table 5 shows the characteristics of these datasets.

Dataset	# Transactions	# Items	ATL/MTL**
Gazelle	59602	497	2.5/267
Pumsb	49046	2113	74/74
Connect-4	135,115	6500	8/35

Fig. 5. Characteristics of the datasets. ** Here, ATL is average transaction length & MTL is max transaction length.

We compared our results with existing algorithms [1, 4, 13]. We not only mined the frequent correlated patterns but also mine correlated, associated, associated-correlated and independent patterns synchronously. We named the algorithm presented at [1] as LAP2; LAP1 for [13] respectively; and CoMine for [4]. In the first experiment we observed the execution time of our ACAI algorithm on Connect-4 datasets (Fig. 6). In the second experiment we performed the execution time comparison between our ACAI algorithm, LAP1 [13] and CoMine algorithm [4] respectively. Fig 7(a) compared the execution time between CoMine and ACAI algorithm; on the other hand Fig 7(b) compared the execution time between our ACAI and LAP1. In the third experiment, we observed the execution time with change of min_corr_conf and min_sup (Fig 8(a)); and with change of min_all_conf and min_sup (Fig 8(b)) respectively on Connect-4 dataset. In both cases our ACAI algorithm outperforms LAP2.

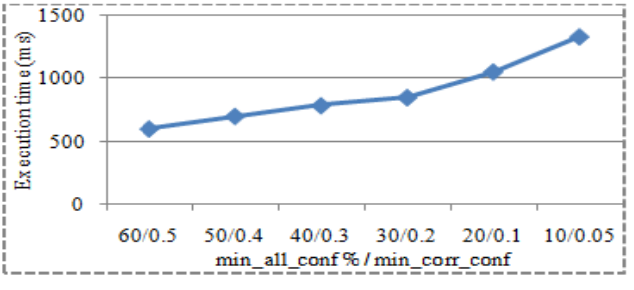

Fig. 6. Runtime with change of minimum corr-confidence and minimum all-confidence on Connect-4 when min_sup=0.1%

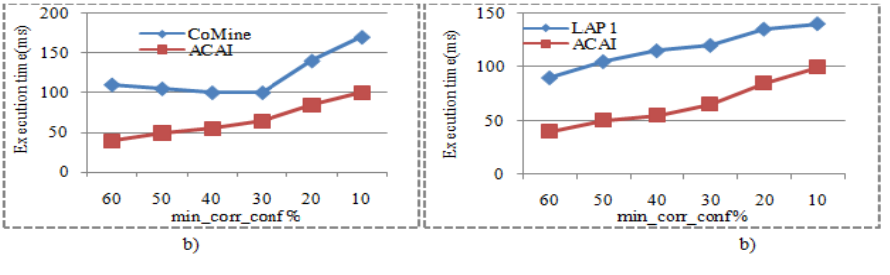

Fig. 7. a) Runtime with change of minimum support on Gazelle b) Runtime with change of minimum support on Pumsb dataset; where min_sup=0.1%.

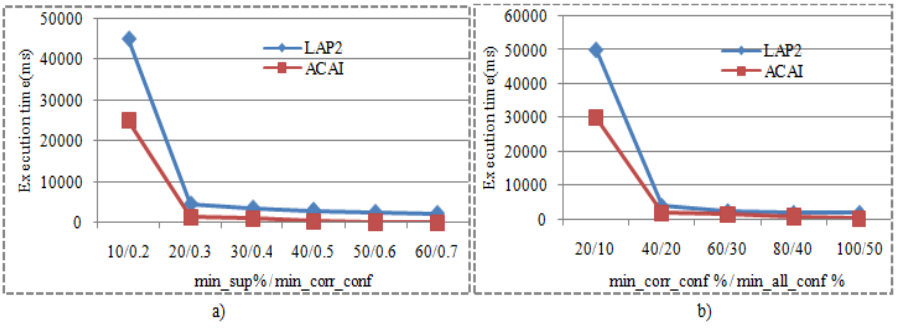

Fig. 8. a) Runtime with change of min_corr_conf and min_sup b) Runtime with change of min_all_conf and min_sup; on Connect-4

6 Conclusion

In this paper we proposed an efficient "ACAI algorithm" that effectively mines the correlated, associated, associated-correlated and independent patterns synchronously. We also reduced the execution time as well as memory usages by removing the so called *'null transactions'*. Experimental results show the correctness and scalability in terms of increasing load. We also showed how correlated pattern mining can be performed on the top of an implementation of the FP-growth algorithm. In future we intended to extend this work by considering different parameters and factors of the market basket.

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Reliability and Efficiency Improvement for Trust Management Model in VANETs

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Abstract. In VANETs, how to determine the trustworthiness of event messages has received a great deal of attentions in recent years for improving the safety and location privacy of vehicles. Among these research studies, the accuracy and delay of trustworthiness decision are both important problems. In this paper, we propose a road-side unit (RSU) and beacon-based trust management model, called RaBTM, which aims to prorogate message opinions quickly while thwart internal attackers to send or forwarding forged messages in privacy-enhanced VANETs. To evaluate the reliability and efficiency of the proposed system, we conducted a set of simulations under alteration attacks and bogus message attacks with various adversary ratios. The simulation results show that the proposed RaBTM is highly resilient to adversarial attacks and performs at least 20% better than weighted vote (WV) scheme.

Keywords: VANET, RSU-aided, Trust, Safety.

1 Introduction

With vehicular ad-hoc networks (VANETs), vehicles are able to communicate with each other via vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) wireless communications. In order to enhance drive safety, many VANETs safety applications require vehicles to periodically broadcast single-hop messages to other vehicles. These periodic broadcast messages are called beacon messages. In addition to beacon message, vehicles also broadcast event-driven warning messages, such as Electronic Emergency Break Lights (EEBL), and Post-Crash Notifications (PCN) etc. [1], to neighboring vehicles. These event-driven warning messages are called event messages. If these event messages were abused, however, it may raise new safety risks for the whole transportation system [2].

To overcome the safety threats of VANETs mentioned above, one common method is message authentication. For ensuring the integrity of transmitted messages, cryptographic mechanisms have been widely employed to protect VANETs against unauthorized message alterations. However, the message authentication method can only ensure that messages are sent from legitimate senders, but cannot prevent a legitimate sender from broadcasting bogus or altered messages malevolently to other

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vehicles. These bogus or altered messages not only decrease the transportation efficiency, but also in the worst cases, they may cause accidental events that can threaten human life. Another common method to treat the safety threat of VANET is to establish trust relationships and detect malevolent behavior in VANETs [3], this method enables vehicles to distinguish trustworthy vehicles or messages from untrustworthy ones, therefore reducing the risk of vehicles being misguided by other malicious vehicles. However, there is still a big challenge for the success of this method. If adversaries do not alter original event message but just forward opposite opinions faster than the trustworthy vehicles do, a vehicle will be misled due to more malicious vehicles forward and provide their opinions to support the bogus messages or opposite the normal messages.

To overcome the problems encountered by above methods, in this paper, we propose a novel RSU and Beacon-based trust management model called RaBTM. With RSU's assistance, the proposed system can perform reliably and efficiently with high malicious vehicle rate. We have conducted a set of simulations. All simulations considered different attack models, including alteration attacks and bogus message attacks. The simulation results show that the performance of the proposed RaBTM is at least 20% better than that of WV method [4], and the decision delay is reduced by more than 22%.

The rest of this paper is organized as following: Section 2 describes the related work. Section 3 depicts the RSU aided trust management model. Section 4 describes the evaluation methods and simulation results of the proposed system, and Section 5 presents our conclusions and future work.

2 Related Work

In VANETs, entity trust is the traditional notion of trust. Dotzer *et al.* [3] proposed a distributed entity-centric reputation system named VARS, which can share trust opinions among neighboring vehicles in VANETs. In their proposed system, every message forwarder appends their opinion about the vehicle's trustworthiness to the message. However, VARS is not suitable in an ephemeral environment for the message size will become larger and larger due to the piggybacking of opinions. Based on the assumption that most vehicles are honest and will not endorse any message containing false data [5]. Ostermaier *et al.* [4] proposed a simple and straightforward voting scheme to evaluate the plausibility of received hazard messages. Lo and Tsai [6] also proposed an event-based reputation system to prevent the spread of false traffic warning messages in VANETs. They introduced a dynamic reputation-evaluation mechanism to determine the trustworthiness of the event messages. In order to overcome the dependence of slow-to-change entity trust, Raya *et al.* [7] proposed a data-centric trust management model for VANETs. In their proposed system, data trustworthiness would focus on data per se, such as position and timestamp of event message, rather than merely on the trustworthiness of the data-reporting vehicles. They also evaluated some decision logic, such as voting, Bayesian inference (BI) and the Dempster-Shafer Theory (DST). Their model, however, focuses only on the data and they do not leverage the trustworthiness of sender or forwarder of event messages.

Existing researches on reputation systems [3-7] for VANETs mainly collect event-based messages for decision-making, while neglecting beacon messages, which are also useful in determining the trustworthiness of event messages in reputation systems. To remedy this shortcoming, we propose an RSU-aided hybrid trust mechanism, which allows both OBUs and RSUs to construct entity trust by cross-checking the plausibility of event messages and beacon messages. Although, Wu *et al.* has also proposed an RSU-aided scheme, named RATE [8], the data delivery delay was a major problem. This delay comes from three phases of RATE process, which includes data collection phase, data analysis phase and the data dissemination. In our proposed system, we overcome this delay problem by leverage the RSUs' fast opinion trustworthiness calculations. In the next section, we will introduce our proposed method in detail.

3 Methodology

3.1 RSU Aided Trust Management

In trust management model, neighbor vehicles' opinions are still very important for a vehicle to make decision. However, as mentioned above, how to deal with the large volume of fast responded opposite opinions is still a big challenge for existing researches, which only rely on V2V communications. To deal with this challenge, we adopt both V2V and V2I communications. Generally, RSU plays an important role in VANETs applications. They are responsible for providing more reliable trustworthiness information or assisting in forwarding messages to other vehicles within transmission radius. RSUs are always placed on the roadside that OBUs can exchange messages with them. Messages transmitted from RSUs are much more trustworthy than those from other vehicles [8]. As shown in Fig. 1, when a vehicle is on the road, it periodically disseminates beacon messages that can be gathered by the near RSUs, along with event messages. If RSUs can provide trustworthiness information regarding the vehicles near it, this will be very helpful for vehicles' to decide which message is trustworthier. However, not every RSU can collect enough information to give its opinions to neighboring vehicles, and in worse case, some RSUs may be cheated by malicious vehicles. Take Fig. 1 as an example, vehicle *S* has a traffic accident and immediately transmits a PCN event message to other vehicles. After vehicle *S* broadcasts the PCN event message, vehicles *A, B, C, D, E,* and *F* will receive this PCN message. If vehicles *D, E,* and *F* recognize that this message will not influence other vehicles, they will not forward the event message and drop it. Assuming that vehicles *A* and *B* are honest one, and vehicle *C* is an attacker. When honest vehicles *A* and *B* forward the PCN message with their positive opinion to vehicle *R*, malicious vehicle *C* may forward this PCN message with the opposite opinion to disturb vehicle *R*'s decision. In the RSU-aided scheme, vehicle *R* can receive forwarded indirect event messages with their opinions from both RSU_2 and RSU_5. Assuming that when a RSU is closer to the original event message sender, it is more likely to collect more helpful

information and to reduce the likelihood of being cheated. In the example of vehicle R, the received opinion message from RSU_5 is more useful than that of RSU_2. This is because the distance between message sender S and RSU_5 is much closer than the distance between S and RSU_2. To give a more quantitative measure for a vehicle to evaluate the opinion confidence of RSUs, we propose a distance-based RSU opinion confidence calculation method. Here, the confidence of RSU's opinion O_{rsu} , which can provide the OBUs with relevant information to decide about the transmission of the result in the network, is calculated as:

$$O_{rsu} = \sum_{r \in R}^{|R|} T_{devt}^{r,s} \frac{(D_{tot} - d_{r,s})}{D_{tot}(|R|-1)} \tag{1}$$

R is the set of RSUs that receive the original event message and $|R|$ is the number of elements in the set R. T_{devt} is the direct trust value of vehicle r and s which calculated by Tanimoto coefficient to get the similarity between historical beacon message and received event message [9]. D_{tot} is the total distance from sender s to all of the RSUs positions. $d_{r,s}$ is the distance between the RSU_r and the position of the event message sender s. To avoid being cheated by malicious vehicles, in our proposed scheme, RSUs only give opinions to the original event message and forward them to other vehicles.

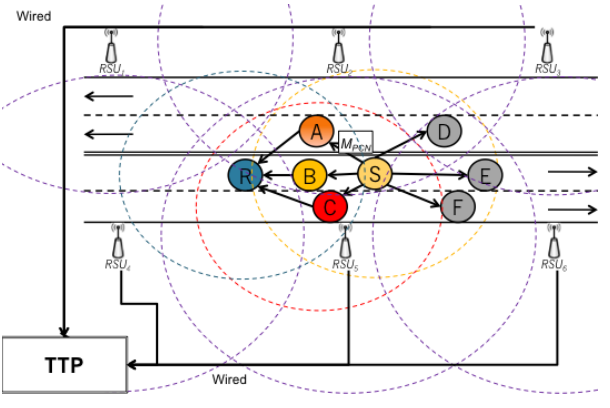

Fig. 1. Illustration of the relation of vehicle's OBUs and RSUs

Due to the infrastructure cost, it is difficult to cover the full area of roads with a large number of RSUs. [10] In some areas having low-density deployment of RSUs, such as suburbs or areas with sparse populations, may prevent some vehicles from receiving RSUs' opinions of event messages. To take this circumstance into consideration, we define (2) to resolve this problem.

$$T_{oval}(e) = \begin{cases} (1-\gamma)T_{ds} + \gamma O_{rsu} \ , if\ (|R|>0) \\ T_{ds} \ , otherwise \end{cases} \tag{2}$$

As shown in (2), if an observation vehicle can receive event opinions from RSUs, the overall event trust value T_{oval} is composite with T_{ds} and O_{rsu} with γ where γ is a constant. Otherwise, if an observation vehicle does not receive any event opinions from RSUs, it uses the T_{ds} for the overall event trust value to make its forwarding decisions and opinions. After the observation vehicle calculates the overall event trust value T_{oval} from data sources. It will make a decision based on the threshold of trust degree T_{thld}.

3.2 Trust Combining

When a vehicle receives direct event message or indirect event message opinions transmitted from multiple vehicles, an effective method to combine these received opinions of is needed. VANETs are ephemeral and fast-movement networks, in which there is not always a fixed infrastructure available to support security mechanisms. Besides, event messages may be lost due to the high uncertainty of the VANET. Thus, vehicles have to organize the trustworthiness of each vehicle and implement security protection schemes themselves. The Dempster-Shafer evidence combination method provides a convenient numerical computing method for aggregating multiple pieces of data [11]. In addition, DST does not require prior probability to compute the posterior probability of an event message, something that is difficult to determine in practice [12]. Hence, DST is more suitable for dealing with the problems of uncertainty, and it minimizes the performance downgrade introduced by node mobility. In this paper, in order to accommodate the nature of uncertainty of VANETs, we adopt DST for opinion combination. The combined trust value T_{ds} corresponding to an event is represented as in (3):

$$T_{ds}(i) = \bigoplus_{n=1}^{|N|} m_n(H_i) \tag{3}$$

where N is the set of vehicles that are the forwarders or senders of the received message, and $|N|$ is the number of vehicles in N.

4 Performance Evaluation

4.1 Adversary Model and Evaluation Method

In this paper, we consider an adversary to be a vehicle equipped with an OBU in a certain area of the VANET. The attacker can actively participate in the network and violate the integrity of messages, such as by broadcasting or forwarding malicious messages. Focused attack models are alteration attacks and bogus message attacks [13]. In alteration attacks, malicious vehicles modify or forge the opinion and trustworthiness of a multi-hop event messages, and then forward this message to others. In Bogus message attacks, malicious vehicles can generate and broadcast malicious event messages to other vehicles in the vicinity. In order to simulate the different adversary models in our proposed scheme, the attack behavior of an attack vehicle can be simulated through the assignment of attack functions. Three function parameters δ, ε, ω have been used in the adversary models: δ is the rate of

misbehavior vehicle, and ε is the alteration attack rate, and ω represents the bogus message rate.

In this paper, we adopt F-measure (denoted as F) [14], as shown in (4) to measure the overall performance of the proposed scheme. It is important to evaluate precision and recall in conjunction, owing to the easiness of optimizing either one separately. The F-measure is a weighted combination of precision, and its value ranges from 0 to 1.

$$F = \frac{2 \times Precision \times Recall}{Precision + Recall} \tag{4}$$

We simulate the proposed system using ns-2 with the MAC layer parameters of IEEE 802.11. For each simulation, vehicles are randomly generated with random trip on paths routed across the street map. We then set out large-scale simulation with larger map to 5x5 street map. Then roads set to 3 lanes and maximum vehicle number set to 300 vehicles. In the comparison experiments, we take the performance of the WV method as a comparison baseline. In addition to WV, we also take our previous work BTM [9] into this comparison. Besides, in order to evaluate the detection delay of the proposed system, we also evaluate the time delay between the first event message received time and the decision making time.

4.2 Simulation Results

Effect of Detection Result

We evaluate the performance of the proposed scheme for different rates of misbehaving vehicles δ with $\varepsilon=0.5$ and $\omega=1$ under FSP with a beaconing interval of 1 second. As shown in Fig. 2(a), with a higher rate of the adversary vehicles, the detection results worsened. However, we can also see that the proposed RaBTM system can perform better than WV and BTM. The overall results for F are still more than 0.7 with an adversary ratio of up to 90%. The average F value of the proposed system is greater than 11.8% in comparison with the WV method. Furthermore, RaBTM is also outperforms than our previous work by almost 2.6%. In addition to the misbehaving vehicle rate, we also simulate with different densities. In Fig.2(b), we simulate with different number of vehicles on the same topology, ranging from 30 to 300 vehicles. The greater the number of vehicles on the road is, the higher the density of the topology is. In Fig. 2(b), we can see that the influence of the detection rate on density will degrade the RaBTM and BTM scheme more than WV scheme. However, RaBTM can still perform better than the BTM and WV schemes. The average detection rate in RaBTM is higher than that of WV by about 14.1%. This could indicate that our proposed system can still suit a high-density environment.

Effect of Detection Delay

As shown in Fig. 2(c), we can observe that the decision delay of the proposed system is still shorter than those of the WV and BTM schemes. Although the detection delays are get shorter due to the low delay in disturbing malicious event messages, RaBTM

can also provide shorter detection delays without degrade decision rate than other schemes. And as shown in Fig. 2(d), the decision delay of the proposed system can still show low latency in low-density circumstances. This is because that when a vehicle receives a RSU's opinion, it can quickly make a decision because the reliability is much higher than in other vehicles. Although there are fewer event opinions in low-density circumstances, a vehicle can still get assistance from RSUs to make decision. We can also see that in low-density circumstances, RaBTM has lower detection delay than other schemes. In Fig. 2(d), take 30 vehicles as an example, the detection delay is shorter than other schemes by over 100 milliseconds a performance improvement of about 50%.

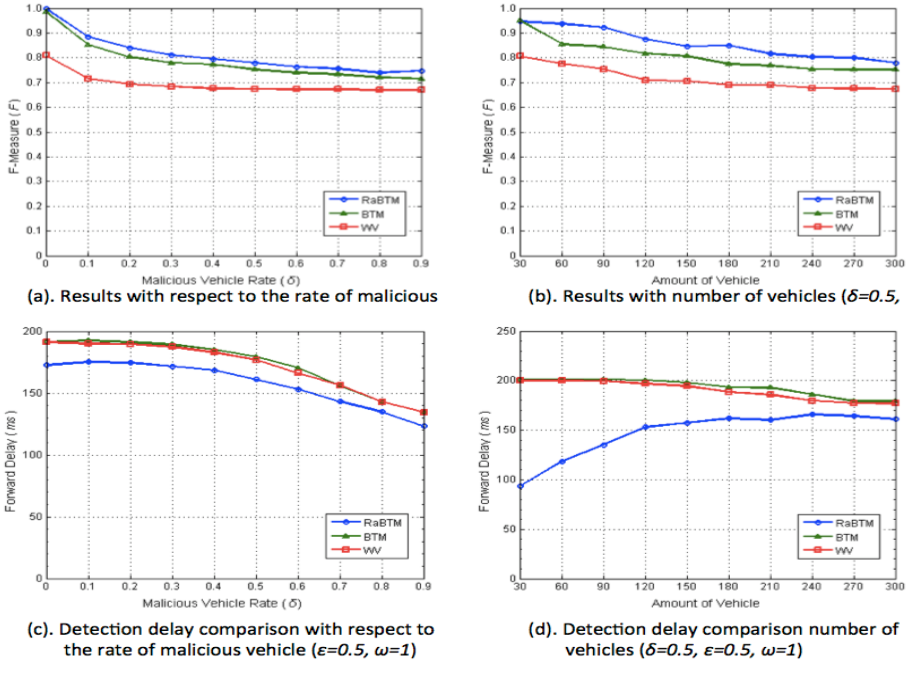

Fig. 2. Simulation results on detection performance

5 Conclusion

In this paper, we propose an RSU and beacon-based trust management model called RaBTM that aims to quickly make decisions and thwart internal malicious attackers more precisely in location privacy-enhanced VANETs. In this system, a vehicle cannot only utilize beacon messages and event messages to determine the trustworthiness of event messages from VANETs but also get assistance from RSUs' reliable opinions. The simulation results show that the proposed system is highly resilient to various attacks, such as alteration attacks and bogus attacks. Another important

contribution of our proposed system is that it can make decisions quickly and give opinions with a short delay. In our evaluation, the average F-measure value of the proposed system is 20% greater and the detection delay is 22% shorter than those of the WV method. Thus, we can conclude that the proposed RSU and beacon-based trust management model can not only withstand trust attack models, but also perform with higher efficiency than the WV and BTM schemes.

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Taxonomy of Emotion Engineering: Lessons from Mobile Social Game Business

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Abstract. Based on observation of the revenue-generating engines in feature-phone-based mobile social games, the author proposes a taxonomy for emotion engineering. This provides a systematic approach for next-generation Internet service engineering with focusing on the relatively unexplored engineering domain in the human factor and business model studies.

Keywords: emotion engineering, mobile social games.

1 Introduction

Gamification is a theory that uses game design techniques in non-game-related application domains. Games use many techniques to attract users and reinforce actions that lead to no economic benefits. Game design, mechanisms and dynamics encourage users to play games for hours, or crossing day-boundaries.

Saito proposes the concept of Gamenics theory for parsing the core know-how of how to turn users into game addicts. Gamenics theory is rooted in the massive know-how compiled in developing Nintendo videogames.

In this context, Gamification has a greater flexibility in tuning games according to user behaviors. This is a distinct advantage over console games. Social stream mining provides a promising method for tuning games in order to maximize satisfaction in game-playing.

In order to build a systematic design blueprint of mobile social games and their revenue-generation engines, it is important to provide a taxonomy of emotion engineering. Today's social games are a combination of stage-based game design and the effective operation of time-limited events to entertain users in a complicated manner. The author provides a taxonomy of emotion engineering based on observation of mobile social games in Japan.

2 Background

2.1 Purpose of Research

The aim of this research is to identify a taxonomy of emotion engineering in mobile social games to help clarify the priority of emotion targets during the design of a game framework.

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2.2 Related Works

Item purchasing in virtual goods has been an active agenda item for Internet business model engineering. Nojima analyzed and conceptualized the relationship between pricing models and motivations for MMO (Massive Multiplayer Online) play [1].

Hong et al presented the desire to be unique as the driving factor for mobile content revenue [2].

Kazemzadeh et al discussed a method for developing a socially-constructed theory of emotions to analyze emotion terms [3]. McGonigal discussed happiness hacks based on the implications of recent progress in positive psychology and how to apply game techniques to improve the solutions of real-world problems. [4].

The author discussed emotion engineering as a means for parsing the revenue-generation engines in mobile social games in Japan [5].

In spite of the an increasing awareness for the role of emotion in social games, the past literature did not provide a systematic methodology for dealing with emotion from the perspective of revenue-generation.

The originality of this paper lies in its examination of a taxonomy of emotion from the perspective of revenue-generation engines in mobile social games.

3 Observation

3.1 Rise of Emotion Engineering

Emotion is a basis for constructing attitudes and behaviors. The influence on behavior from emotion is larger than from logics. The item-purchasing business models of mobile social games depend on management of human emotions such as revenge, gratitude, competitiveness, and satisfaction of achievement. The direct management of emotion using time-dimensional control, game mechanisms, and game dynamics, has opened up huge revenue-generating opportunities in mobile social games.

Human beings are social beings. Therefore, the hook, retention and monetization phases have direct links to social contexts. The impact of these social contexts provides reinforcement by raising emotions.

Emotion also works as a justification of payment.

3.2 Issues

Emotion has been a neglected field in computer science. Emotion is considered to be an irregular, uncontrollable, situated and arbitrary property of human beings. The relationship between emotion and engineering has not been covered well.

Many emotions are complicated and invoked in a delicate and social context that is difficult to identify. Emotion, especially interpersonal emotions are difficult to analyze quantitatively. Also, emotion management is difficult to turn into a scalable service.

3.3 Method

In order to build a base for the systematic engineering of emotion in the context of the revenue-generating engines of mobile social games, the author attempts to analyze the relationship between emotion and game mechanisms in mobile social games. The method is as follows:

- examine a dimension to build a taxonomy of emotion engineering
- identify a framework according to the selected dimension
- observe revenue-generating engines of mobile social games from a perspective of taxonomy of emotion-engineering
- construct a taxonomy of emotion engineering

4 Analysis of Emotion Engineering

4.1 Observation

Examples of emotion engineering in "Kaito-Royale" are depicted in Fig. 1.

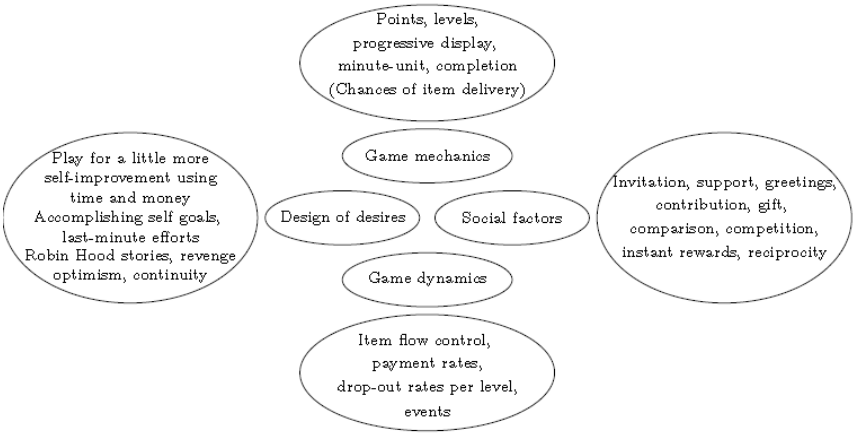

Fig. 1. Examples of emotion engineering in "Kaito-Royale"

Game mechanics are used to visualize, and provide feedback for micro-management goals in the game. Game dynamics are used for a _ne-tuned control of the in-game economy in order to maximize the continuation rate and event (e.g. battle) participation.

In order to increase user satisfaction, the elicitation of user desires and their fulfillment are embedded in the game design.

Social factors can leverage each phase of the hook, retention, and monetization phases of mobile social games. They are sometimes used in simple invitations to enhance the outreach of a game. At the same time, social factors work for a wide spectrum of emotion engineering including revenge, jealousy, pride, winning, achievement, and reciprocal supports in many game contexts. Implications from gamification and positive psychology are depicted in Table 1.

Table 1. Implications from gamification and positive psychology

Aspect	***Description***
High-stakes work	Hard work is more fun than leisure.
Emotional high	Satisfaction from achieving due to hard work is high.
Promising optimism	Focus productive optimism where we can believe the positive future with endeavor.
Self-motivated work	Self-motivated achievement is more fun than forced achievement.
Intrinsic rewards	Intrinsic rewards are more motivating than external rewards.
Clear goals and satisfying work with visible results	With clear goals and full feedback, people are more motivated.
Positive future	With better odds of success, people are more engaged.
Stronger social connectivity	With stronger social bonds and lead to more active social networks, we obtain pro-social emotions.
Epic win	Feeling of being a part of a greater cause makes players happy.

Using empirical observations in game-play of mobile social games in Japan, the author lists examples of emotion-based game mechanisms. Examples of emotion-based game mechanisms are depicted in Fig. 2.

Many factors in social game design have universal implications beyond each game context. An exploration of the universal framework is presented in the next chapter.

5 Taxonomy of Emotion Engineering

After reviewing multiple emotional aspects of mobile social games, the author proposes a classification framework for emotion engineering, mechanisms toward satisfaction and mechanisms toward charging.

In order to provide a systematic methodology, it is necessary to build a taxonomy of emotion engineering. Dimensions for building a taxonomy of emotion engineering are depicted in Fig. 3.

Today's neuroscience has advanced to the pint of linking emotions to brain activity. However, it is not applicable from the perspective of revenue-generation.

Emotions have causal relationships because they are in cause-perception relationships. However, this fact is not applicable from a revenue-generation perspective because the focus is not on perception but on the dynamism of engagement. In order to build a systematic methodology, the author follows the behavior dimension approach. Common emotion categories of emotion such as fear,

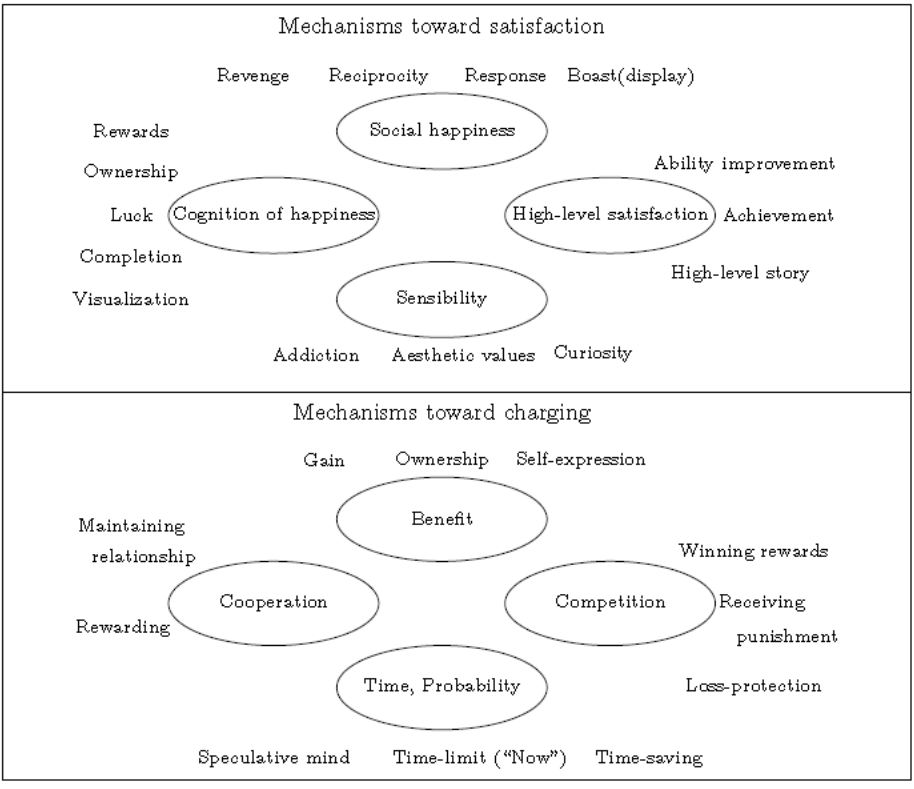

Fig. 2. Examples of emotion-based game mechanisms

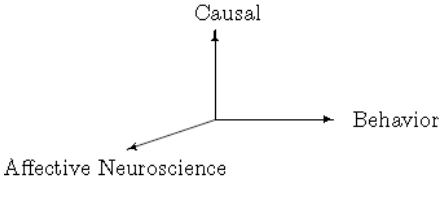

Fig. 3. Dimensions for taxonomy

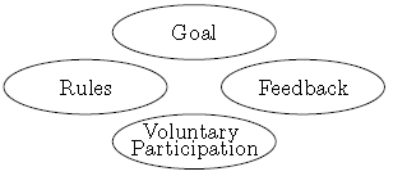

Fig. 4. Framework of a game

happiness, anger, surprise, sadness and disgust are not applicable because it is difficult to bridge engagement with negative factors such as fear, anger, sadness and disgust.

The framework of a game is depicted in Fig. 4. In this framework, voluntary participation is a strong background factor for games and engagement, however, it is not used in building the framework for a taxonomy. Feedback is also important, but

all goals and rules have feedback to guide the user. Therefore, it is not used for the following discussion. In order to parse taxonomy of emotion engineering, the goal and rules are further analyzed to build a basic framework.

A good social game combines these five different components; routine work, skills, lottery, tactics, and social interactions.

Routine work is important to accelerate game addiction and change of pace. Skills are needed to make users feel their own improvement. A lottery is used to leverage unexpected happiness. Tactics are generally in games to lead users to a goal by following the game rules over the long run. Social factors work as background factors for self recognition, interactions, competition, reciprocity etc.

Using this five-fold perspective, the author attempts to build the framework for taxonomy. From empirical observation of game-play in mobile social games, the author summarizes emotion engineering as depicted in Table 2.

Table 2. Taxonomy of emotion engineering in mobile social games

Category	*Item*	***Description***
Intrinsic emotion	Achievement	Feeling a sense of achievement (from a combined consumption of time and money)
	Completion	Feeling joy through the completion of a game
	Increased ownership	Feeling joy through increased inventory of some-thing
	Growth (improvement) and empowered self-recognition	Positive feeling of improvement of capabilities and social recognition of that
Responsive emotion	Lucky feeling	Joy of unexpected win or underdog win
	Aesthetic value recognition	Feeling with aesthetic values
	Growth (improvement) and empowered self-recognition	Positive feeling with satisfying curiosity, unexpected newness
Positive social emotion	Thanks	Joy of giving and receiving gratitude
	Social recognition	Joy of being recognized by other members and people
	Social recognition of self-expression	Joy of expressing something to members and people
	Social recognition of contribution	Joy of being accepted as a contributor
	Role-playing	Joy of role-playing
	Support	Joy of receiving supports
Competitive social emotion	Competition	Joy of winning in a competition
Negative social emotion	Revenge	Joy of successful revenge
	Neglect	Sadness of being neglected
	Disconnection	Sadness of being isolated

6 Discussion

6.1 Advantages of the Proposed Approach

The low latency mobile broadband network and 24-hour availability of mobile phones enables enhanced emotion engineering in mobile social games. Emotion engineering is a relatively new field of research.

The author provides a taxonomy of emotion engineering based on the observation of revenue-generation engines in mobile social games. It facilitates a systematic method of exploring the emotion engineering in mobile social services. The taxonomy of emotion engineering is aimed at systematic game design for mobile social games with a mainstream business model of item-purchasing.

In emotion engineering, there is a contrast between perception and engagement as depicted in Fig. 5.

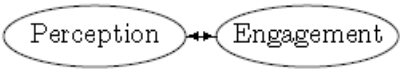

Fig. 5. Contrast between perception and engagement in emotion engineering

The engagement side is important for increasing the stickiness of social games.

The author presents a three-dimensional model to capture emotion engineering and follow the behavior dimension to present a taxonomy of emotion engineering of social games. This provides the ground work for providing a systematic methodology to manage engagement in the emotional domain of mobile social games.

6.2 Limitations

This paper is based on observation of revenue-generation engines in mobile social games. It is a descriptive work and lacks quantitative analysis. Further research models and verifications of them remain for further studies.

Emotion engineering may lead to further cultural or regional analysis. Such differentiation in the observation samples is beyond the scope of this paper.

7 Conclusion

Gamification applies a wide range of game techniques and dynamism to improve user engagement in applications. It leverages user engagement using implications from positive psychology in order to “hack” into and increase user happiness.

This trend is even more visible in the rise of revenue-generating engines in mobile social games.

The author proposes a taxonomy of emotion engineering based on the observation of the impacts of the revenue-generation engines in mobile social games. It provides a

starting point for creating a checklist of emotion engineering in the design of these revenue-generation engines.

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An Exploratory Analysis of KPI in Mobile Social Battle Games

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Abstract. The mobile social game business has gained a position in the mainstream of the mobile service industry during the last couple of years. Social battle gaming has become one of the more popular domains and plays a leading role in the revenue-generating engines of mobile social games. Social games are like living creatures and in order to keep them healthy, it is crucial to make daily optimizations through an intensive Plan-Do-Check-Action (PDCA) cycle. However, the key performance indicators of social games are hidden as company secrets. In this paper, I attempt to parse the KPIs of the mobile social games in order to build systematic approach toward mobile social game business engineering.

Keywords: KPI, mobile social games.

1 Introduction

Social games are defined as games that are played and distributed on Social Networks. They have become a digital gaming phenomenon.

The number of Facebook users reached 845 millions by the end of 2011. Facebook and other major social network service (SNS) providers have used an open strategy of opening their application programming interfaces (APIs) to third-party software developers in order to maximize the benefits of SNS users. This enables hundreds of millions of users to play social games worldwide.

Mobile social games have gained a mainstream position in the IT business in Japan since their OpenSocial-based launch in late 2009. High growth and high profitability have attracted many players from game and non-game businesses.

Mobile social games are different from legacy console games because they focus on micro-management and direct feedback systems. They rely less on game world views than legacy console games. The dependency on micro-management has led to a new PDCA-based daily tuning of game mechanisms and game dynamism.

Past literature has been focused on studying viral invitation and diffusion. It lacked the design patterns of revenue-generation engines because they are industrial secrets.

In order to provide an efficient PDCA cycle, it is crucial to identify the appropriate key performance indicators (KPIs) for managing the game dynamism.

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These sets of KPIs are usually hidden away as company secrets. Therefore, in this paper, I attempt to identify these KPIs based on exploratory analysis.

2 Background

2.1 Purpose of Research

The aim of this research is to identify a set of KPIs for mobile social battle games in order to provide a systematic design methodology for mobile social games.

2.2 Related Works

Social games are dynamic, therefore, it is important to manage and tune a game using data mining techniques. Whitehead discussed retention engineering and viral user acquisition using data mining [1].

The large-scale data of Massively Multiplayer Online Games (MMOG) have caught the attention of researchers. Kriegel et al discussed the challenges of managing and mining spatial temporal data in MMOGs [2].

Lewis et al discussed the mining of the publicly accessible web services of World of Warcraft in order to accelerate the quantitative research of games [3]

Iosup presented an infrastructure for supporting data mining in MMOG using cloud techniques [4].

Yamakami has discussed the quick transition to strong revenue-generating patterns in mobile social games in Japan [5]. These revenue-generating engines are supported by intensive data mining to manage the KPIs of social games.

Although past literature has dealt with viral diffusion and tools for analysis, it has lacked analysis of the key control factors in game activities such as the KPIs of social games.

The originality of this paper lies in its examination of KPIs that identify the principle factors in the daily PDCA cycle of mobile social game design.

3 Observation

3.1 Industrial Landscape

Mobile social games have provided strong revenue-generation engines for the IT business in Japan since their OpenSocial-based launch in late 2009. Their enormous success raises important academic questions about game design and business model engineering. In September 2011, The Morgan-Stanley Mitsubishi UFJ provided a market forecast for the subsequent three years, as depicted in Table 1.

Growing competition has brought about a shorter time to market. Motif-changed Social games that duplicate core mechanisms and only change the motif are popular in the industry. This underlines the need to identify the KPIs for the efficient dynamic tuning of social games.

Table 1. Market Forecast for Mobile Social Games in Japan

Year	*Monthly ARPU (Thousand Yen)*	*Number of Paying Users (Million)*	Market Forecast (Billion Yen)
2011	3.8	5.27	23.8
2012	4.6	6.10	33.9
2013	5.5	6.26	41.4

3.2 Challenges for KPI

Fig. 1 depicts the basic design patterns of mobile social games.

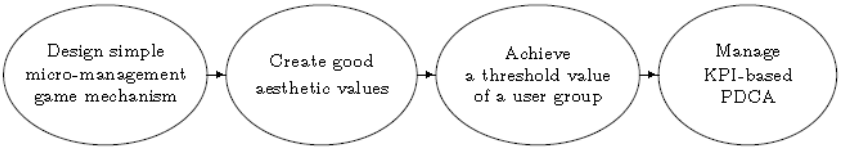

Fig. 1. Basic design pattern of a mobile social game

For a simple micro-managed game without a major game world view, it is crucial to manage its KPIs. The basic KPIs are depicted in Table 2.

Table 2. Basic KPIs of mobile social games

Item	*Description*
Continuation ratio per user level	Continuation is defined as the user with two consecutive active weeks. Continuation ratio is a ratio of users with continuation. Usually, when a user gains a level, he/she has a tendency to increase continuation. Therefore, continuation ratio per user level is important to analyze the difficulty and satisfaction of each user level.
Pay ratio	Ratio of users who pay.
Average revenue per user	Amount paid per user.

The structure of the KPIs in mobile social games is depicted in Fig. 2.
There are game dynamics KPIs, external KPIs (diffusion), and revenue-generating KPIs. The ultimate goal is to manage revenue-generating KPIs, however, they are closely-bound to game dynamics KPIs such as economy KPIs (circulation) and activity statistics. In order to increase the values in activity statistics, it is crucial to identify KPIs in the economy (circulation) domain.

The relationships between KPIs are depicted in Fig. 3.

Social battle games are one category of the games that have a straight-forward KPI relationship to revenue-generation. In that sense, this type of game has better correlation with the data mining-based dynamic tuning of mobile social games.

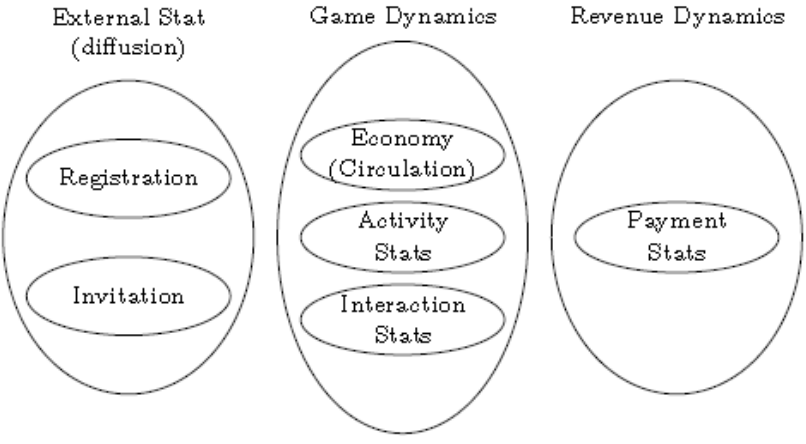

Fig. 2. Structure of KPIs for mobile social games

Fig. 3. Relationships between KPIs in mobile social battle games

In battle games, users battle together to secure pieces of treasure. The distribution management of treasure pieces is key. DeNA, the content provider of Kaito Royale, described two examples of distribution management failures at CEDEC2011, as depicted in Table 3.

Table 3. Examples of KPI that failed in Kaito Royale

KPI	*Reason for failure*
Distribution quantity per user	High dependency on time of day.
Gain quantity per battle	High dependency on quality of battle.

They described how they discovered a successful KPI, which is a company secret, that is optimized to be between 30 % and 40 %. Ever since this discussion, the identification of this KPI has become one of the hottest topics in the industry.

It is a principle factor in managing the daily PDCA cycle in order to maximize user satisfaction. It is linked to maximizing revenue-generation through sale of battle-related paid items.

4 Operation-Oriented Value Creation

One lesson we can learn from the business development of mobile social games in Japan is that operation-oriented value creation is critical for facilitating revenue generation. They generate huge revenues not because they made good games, but because they successfully enclosed a critical-mass numbers of users from which they could learn how to tune these games. McGonigal suggested that there is a threshold of 10 thousand users for ensuring the success of social games.

It is difficult to enclose mobile users with a complicated game scheme, especially for feature phones. The game framework is simple to encourage the user to play another game. On the other hand, its simplicity may lead to an early departure due to a lack of satisfaction.

In order to solve this dilemma, many social game vendors perform daily, or even hourly game-tune-ups for their games.

5 Exploratory Analysis of KPI

The item-completion system is depicted in Fig. 4.

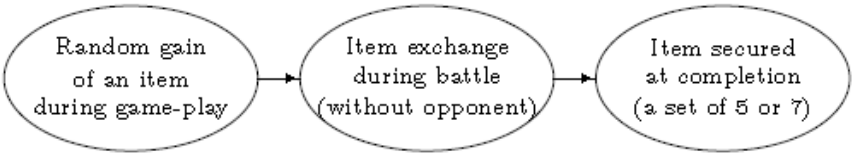

Fig. 4. Item completion system in a mobile social game

How can we maximize the number of battles, which are both activity indicators and satisfaction indicators for game users?

The possible KPIs are as follows:

- Distribution quantity per peak hour
- Completion Ratio
- Ratio of items that are retained by the initial user by the completion or by end of an event

There are three clues for parsing this:

- If it approaches 0 %, it will discourage users,
- If it approaches 100 %, it will also discourage users,
- The optimum value is less than 50 %, therefore, if it is more than 50 %, it will also discourage users.

It is important that battle-based stealth does not work when a certain number of items are completed by the opponent. This factor can even accelerate a battle when items

are nearly completion. In this game, a friend can present items as gifts, however, the last two items in a set cannot be gained through gifting. Therefore, there is no all-gift based method of completing a set. At least two items in a set must be earned through the player's own efforts.

From the three requirements identified based on 30−40 % as the optimum value, I make the following assumptions:

- The value shows the uselessness of battles when it approaches 0 %,
- The value shows the uselessness of battles when it approaches 100 %,
- The battle represents the user efforts to increase it from below 50 % to above 50 %.

I performed an exploratory analysis of each KPI candidate. The result is shown in Table 4.

Table 4. Initial qualitative evaluation of KPI candidates

Item	*Fit*	*Evaluation*
Distribution quantity per peak hour	It is still questionable how it is linked to battles because the initial distribution time does not directly lead to the battle factors	Not good
Completion ratio	It is not clear how a low completion ratio like 30 % directly contributes to the number of battles	Good

From these assumptions, I conclude that the KPI is the ratio of the final possession of items gained. The reasoning for the three assumptions is depicted in Table 5.

Table 5. Reasoning behind three assumptions based on conclusion that KPI is the final possession ratio

Item	*Description*
Low satisfaction near 0 %	If this KPI approaches 0 %, it leads to the fact that the initial gain is basically meaningless. It also shows that it is difficult to keep an item even when it is gained through a battle. Battles are exhaustive and difficult to identify as fun.
Low satisfaction near 100 %	If this KPI approaches 100 %, battles are useless. There are too many occasions that can be completed without battles.
Motivation to raise above 50 %	When it is above 50 %, the initial gains are meaningful. Battles are users' efforts to increase their perceived values.

In the long run, the number of battles won and the number of battles lost are the same from the overall total. However, a value of less than 50 % value accelerates the attitude toward winning battles and toward revenge battles against previous losses. This seems to be a reasonable explanation of this KPI that can be applied to a wide range of social battle games.

6 Discussion

6.1 Advantages of the Proposed Approach

The proposed approach leads to an exploratory identification of a KPI using externally observable characteristics. The final conclusion still needs to be examined through quantitative verification. However, the identification of this KPI is an important step forward considering the fast growth and high profitability of battle-oriented mobile social games.

The external observation approach is weak because it is not based on any real-world data. It is difficult to make a successful social game due to increasing competition. Many social games fail to attract a critical-mass of users, and die.

Also, it is difficult to make a simulation of mobile social games because social games are living creatures that require daily tuning. Static simulation data is unable to satisfactorily support the dynamism of mobile social games.

External observation of successful social games can overcome the two draw-backs above.

6.2 Limitations

This is a descriptive and qualitative study based on assumptions without quantitative verification. Quantitative verification based on real social games or on simulations is beyond the scope of this paper.

KPIs for maximizing the number of battles are one group of the indicators to manage the dynamism of mobile social games. KPIs for other activities are not covered in this paper. Different game mechanisms require different KPIs. KPIs other than those related to battle games are beyond the scope of this paper.

7 Conclusion

Social games have become a digital gaming phenomenon that is a high growth and high profit domain and impacts the social aspect for many game users. It is known that the PDCA cycle of game tuning is key for managing a mobile social game. However, the past literature did not well cover what the KPIs are very well.

In this paper, I attempted to identify a KPI for battle-oriented social games from the externally observable prerequisites. Based on the externally-observable characteristics of a KPI, I draw the assumption that one KPI of a certain type of battle game is the retention ratio of items that were gained.

In the past literature, data mining in social games dealt with viral diffusion patterns and tools for analyzing massive game data. It lacked the identification of core indicators for game design and dynamics.

This is an exploratory study and it requires further examination as to whether this is the right KPI or not, using supporting quantitative data. However, it is an important step-forward for researchers studying the data mining of mobile social games because the external analysis can identify the KPI of game mining.

Facebook has reached 845 million users worldwide, by the end of 2011. The increasing availability of smart phones is expected to accelerate further penetration of mobile social games. This study is an important step toward building a systematic methodology for social game design because the identification of KPIs and management of daily PDCA cycles are key for mobile social game design.

It is also possible that a mobile social game may be derived from a combination of KPIs and motifs. The existing approach flows from the initial game design to the identification of KPIs. In order to facilitate efficient game design, this order can be reversed. For example, a social game can be derived by mapping a general KPI to possible motifs. The exploration of this type of new game design framework also remains for future work.

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Gateway Analysis of Nine Success Factors in Mobile Social Games: Lessons from Mobile Social Game Business

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Abstract. Revenue-generating engines in mobile social games have been high profile in the mobile industry since its OpenSocial-based launch in late 2009. The ratio of paying users in mobile social games is higher in Japan than ones in other social network service-based games. The author makes an attempt to identify the unique factors of mobile social games in Japan in order to parse the driving factors of high revenue-generating capability. The author identifies success factors, then performs a gateway analysis of the dependencies of these success factors.

Keywords: success factors, mobile social games.

1 Introduction

Revenue-generating engines in mobile social games have been high profile in the mobile industry since its OpenSocial-based launch in late 2009.

The ratio of paying users in popular mobile games is in the range of 15–20 %, which is significantly higher than ones in other SNS-based games worldwide. The author comes to recognize how the identification of unique factors in mobile social games leverages the core competence of the mobile social game business.

This core competence can be reinvented worldwide in order to explore emerging revenue opportunities in mobile social games.

The author attempts to identify the unique factors of mobile social games in Japan in order to parse the driving factors of its high revenue-generating capabilities. Then, the author performs a gateway analysis to provide a systematic methodology for cross-region business engineering.

2 Background

2.1 Purpose of Research

The aim of this research is to identify unique factors that contribute to the successful revenue-generation in mobile social games in Japan.

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2.2 Related Works

Mobile social games have evolved since their OpenSocial-based launch in late2009. The author discussed a three-stage view model of architecture evolution of mobile social games in Japan [1]. The author also discussed the business model engineering in the era of human interaction networks [2].

As massively multiplayer online games have emerged, the question of how to design usability for gamers from diverse cultural has gained increasing attention. Zaharias discussed the usability of massively multiplayer online games from a holistic view including functional, social and affective dimensions for relationship between gamers' cultures and usability [3].

It is widely known that Japanese mobile services have multiple region-specific factors. However, there is not much literature to provide an in-depth review of the region-specific factors that have contributed to the high profile success of mobile social games.

The mobile social game business is rapidly growing rapidly worldwide, but the speed and dynamism of this growth makes systematic analysis difficult.

The originality of this paper lies in its examination of the factors that have contributed to the region-specific success of mobile social games.

3 Industrial Landscape and Contributing Factors

This strong growth of mobile social game revenue was received with much surprise in the mobile content business. The majority of it comes from item- purchasing in games that are free to play. Until 2009, the majority of revenue came from that of feature-phone-based games. Japanese mobile social game users are in the middle of transitioning from feature-phones to smart-phones, such as the iPhone and Android phones. GREE's flagship game "Doliland" user structure is depicted in Fig. 1.

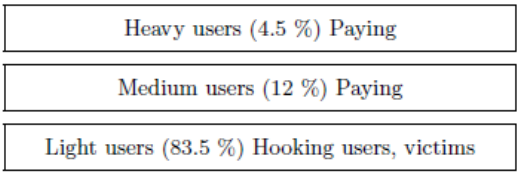

Fig. 1. GREE Doliland user structure(GREE talk in September 2011 at CEDEC2011)

Heavy users contribute the majority of game revenue. Medium users also contribute to the revenue, but the significance is smaller than that of heavy users. Most light users usually spend almost no money, however they serve as hooking points through friend invitations, and as victims for paying users.

The high payment ratio is supported by a strong positive attitude toward payment of the mobile social game users in Japan. Zynga has not disclosed its game-by-game revenue, however, it is estimated that the payment ratio for Facebook games is one magnitude of order lower, or about, 1−2 %. Another major SNS provider, DeNA (the provider of Mobage), claimed in its 2011 IR (investor relations statement) that the ARPU (average revenue per user) for Mobage is 15 times more than that of Zynga, and 30 times more than that of Facebook.

This uniqueness is supported by the nine factors, depicted in Table 1.

Table 1. Nine factors for high revenue-generating engines in mobile social games in Japan

Factor	***Description***
Mobile Web access	Mobile Web access has been widely accepted since massiv mobile Internet launch at 1999.
Mobile broadband availability	99.5 % of wireless users subscribed the 3G network in October 2011.
Mobile SNS	Two of the three major SNSs had their origins in mobile SNS. The other one with a PC origin has had more mobile access than PC access since 2007.
Positive attitude towards micropayment	Micropayments have been positively received through the experience of the micro-browser-based carrier-hosted service access over a decade.
Data flat-rate	The majority of wireless users subscribed data flat-rate services.
Positive attitude toward game payment	Item-purchasing in free mobile games is widely accepted.
Enclosing effects of feature-phones	Feature-phone-based mobile web accommodates enclosing effect, which captures a user in a single service context.
Gamification-affinity	Gamification in mobile social games has been widely accepted, where the majority of users use fake IDs on mobile SNSs. A 2010 survey showed that 70 % of SNS users in Japan answered their reason for joining an SNS was to play games.
Economic status	With economic maturity, payment on virtual goods has been widely accepted.

First, mobile Web access is vital for generating revenue from mobile social games. To encourage users to “play a little bit more”, mobile social games use fine-grained time management in their game designs. This is supported by the high ratio of mobile access, i.e. not PC access. Since i-mode launched in 1999, Internet access from the micro-browsers in mobile handsets has become widely accepted in Japan.

Second, mobile broadband access is crucial. In particular, low latency is key. In 2010, Mobage discouraged content providers from using Amazon Web Services,

because the US-hosted cloud service could not provide sufficient latency for mobile gaming. Amazon started hosting a Tokyo-based cloud service later, however, this shows the criticality of maintaining a low latency with a high quality mobile network for mobile social game business.

Third, mobile social games are based on the installed base number of mobile SNS users. Two of the major SNSs in Japan, Mobage and GREE are of mobile-origin. The other SNS, mixi, is of PC-origin, but reported that accesses from mobile phones (feature-phones) outnumbered those from PCs as early as August 2007. Since then, the majority of traffic comes from mobile mixi. A wide-spread mobile SNS is key for business success.

Fourth, mobile social games rely on an item-purchasing business model with free game-play. This business model needs the support of a positive user attitude toward micropayments with mobile handsets. Low acceptance of micropayments and poor usability of micropayments both severely hinder the revenue-generation. Games use time-limited competitions to generate revenue. Instant micropayments best fit this revenue-generation engine.

Fifth, wide acceptance of a data-flat-rate pricing structure is key. Mobile social games require high bandwidth with frequent data transfer. High aesthetic value is important for supporting item-purchasing. Low quality graphics will discourage users from paying items in game contexts.

Sixth, a positive attitude toward game payment is crucial. Social games require a collective culture that accepts item-purchasing, even though the majority of users do not pay.

Seventh, the enclosing effect of feature-phones is important. Mobage, one of the top SNS providers in Japan, has a joint service with Yahoo! Japan on the PC Internet. The boundary between feature-phone and PC is low in Japan because a decade of evolution has provided a powerful rich-media standard of feature-phone. This helps ease the transformation of feature-phone-based games to the PC Internet. However, the low acceptance of paid content on the PC Internet provides a rough road for PC-based social games in Japan. Also, on the PC Internet, users have multiple windows, where many game techniques for playing a little bit more through payment does not work. Users simply switch to another context to wait for another moment without paying.

Eighth, cultural property of gamification-affinity is important. Social games require a collective culture with a positive attitude toward gaming. It works in multiple phases, hook, retention and monetization. Japanese social networks are supported with technology-supported identities not real-world identities. Social networks require identification, otherwise, single-person-directed conversations, flaming, slander, false rumors, etc will damage the quality of social interaction. In a PC-based social network, the real-world identity supports the trust system of social networks. In Japan, a weak identity system bound to a handset hardware identity has been used widely. It is not very strong, however, it is sufficient to support game-play.

Ninth, economic status is important. Paying during game-play requires an economic surplus in order to pay for high-level user satisfaction. Also, gamification theory shows that virtual-world satisfaction is sought when there is little real-world satisfaction. The maturity of the economy contributes to the success of mobile social games. Economic status does not just refer to income. When society has more technological stress and uncertainty of jobs, users tend to escape to find game-based happiness. As gamification research shows, games are artifacts that create the hope to reach accomplishment through executable actions. Non-full-time workers and workers with irregular working hours tend to spend more in mobile social games.

The nine factors are not independent. The author analyzes the types of each factor and provides a view model of the nine factors, depicted in Fig. 2.

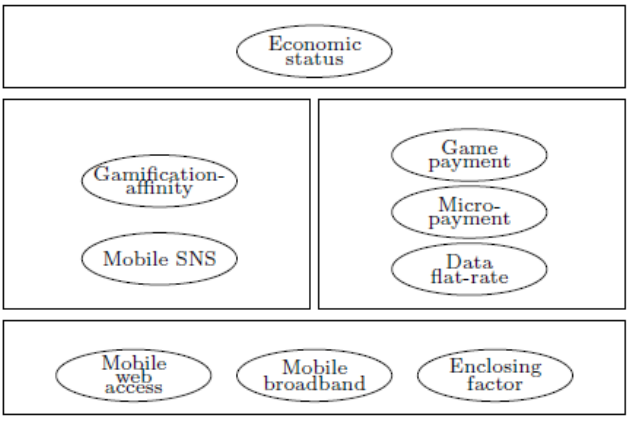

Fig. 2. View model of nine success factors of mobile social games

As seen in many mobile business cases, it is clear that the success factors depend on different stake holders in the mobile business. The five major stake-holders are shown in Fig. 3.

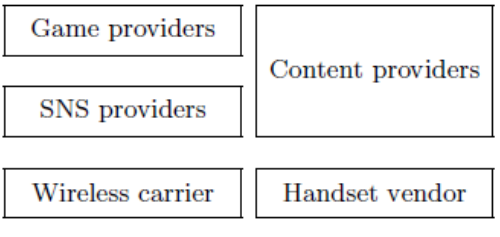

Fig. 3. Layered view of five major stakeholders in mobile social game business

Each stakeholder's role in the success factors are depicted in Table 2. The three gateways in the dependency map of the success factors in mobile social games are shown in Fig. 4 as G1, G2, and G3.

Table 2. Stakeholder roles in success factors

Success factor	*Major contributor*
Mobile Web access	Carrier (with handset vendor)
Micro-payment	Carrier (with content provider)
Mobile broadband	Carrier
Data flat-rate	Carrier
Mobile SNS	SNS provider (with carrier)
Gamification-affinity	Game provider
Game payment	Game provider
Enclosing factor	Handset vendor
Economic status	N.A.

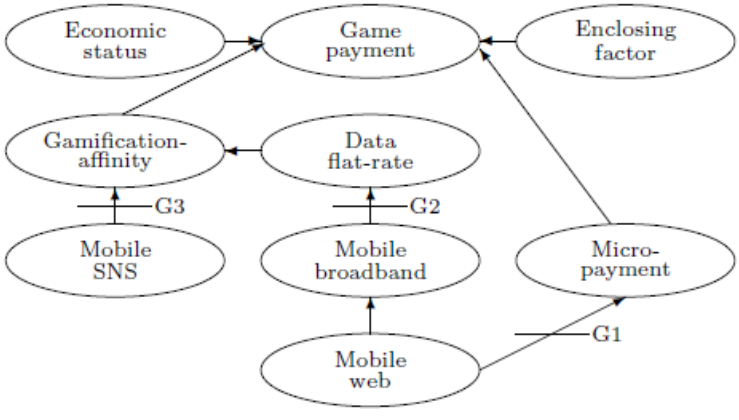

Fig. 4. Three gateways in dependency map model of 9 success factors of mobile social games

Passing these gateways require the user's awareness and conscious acceptance of new services in mobile communication. Explicit user acceptance is the hard part of service engineering, particularly when it includes payments. It could be debated whether we should set G3 at game-affinity or at game-payment. In the Japanese case, when users widely accept social game-play, it is not difficult to turn them into paying users through various monetization techniques. It is applicable only when the G1 gateway has been passed in advance.

The order of passing the three gateways in Japan is depicted in Fig. 5.

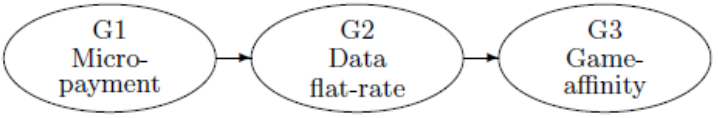

Fig. 5. Order of passing gateways in Japan

This could be simply Japan-specific. However, it is highly possible for micro-payment to precede data flat-rate because micro-payment does not depend on the broadband bandwidth. Also, it is possible for data flat-rate to precede game-affinity because games may be not the primary content for mobile broadband in many regions. From these characteristics, it is natural to assume that the order from G1 to G3 is likely to occur in other regions as the same as in Japan.

It should be noted that the first two gateways are out of the control of game vendors. This represents a clear measure of social game business engineering to help determine when to start.

4 Discussion

4.1 Advantages of the Proposed Approach

The proposed approach identifies the region-specific success factors of mobile social games in Japan. This facilitates a basis for cross-region analysis of the success factors in mobile social games. The leverage of cross-region analysis based on a systematic methodology provides clues for identifying universal success factors in mobile social games.

Mobile social games are quickly becoming a major revenue-generating engine in Internet business worldwide. This research provides bases for design and evaluation criteria for revenue-generating engines in mobile social games. It also serves as a litmus test of decision making for porting successful mobile social games to other regions.

Dependency and gateway analysis of the success factors provide systematic measures to determine the maturity of mobile social business opportunities. This provides a starting point for exploring a systematic methodology for mobile social business engineering.

The strong revenue-generating engines in mobile social games created significant revenue opportunities in Japanese mobile business from 2010 to 2011. As the viral diffusion is quickly nearing saturation, Japanese mobile game vendors plan to extend their businesses to worldwide. They expect the worldwide social game business to grow with the diffusion of smart-phones. It is difficult to predict when and where the mobile social game business opportunities will mature. However, this gateway analysis provides a starting point for such analysis.

4.2 Limitations

This paper is based on observation of revenue-generation engines in mobile social games. It is a descriptive work and lacks the quantitative analysis. Further research models and verifications of them are for further studies.

Revenue-generation engineering may lead to further cultural or regional analysis. Such differentiations on the observation samples are beyond the scope of this paper.

Other technology deployments may impact the success factors. WiFi may be replacing the factors of mobile broadband and data flat-rate in other regions.

5 Conclusion

Strong revenue-generating engines in mobile social games have created significant revenue opportunities in Japanese mobile business since 2010. They expect the worldwide social game business to grow even more with the diffusion of smartphones. So, it is difficult to predict when and where the mobile social game business opportunities mature. To understand and begin to address this difficulty, the author analyzes the success factors in mobile social games in Japan.

Then, the author provides a dependency map of the success factors. Finally, the author performs gateway analysis on those dependencies.

Gateway analysis provides the starting point of a systematic methodology for mobile social game business engineering. The worldwide proliferation of SNSs such as Facebook is expected to provide a growing business opportunities for mobile social game providers. The conversion from feature-phones to smart-phones such as the iPhone and Android phones provides a better infrastructure for rich media social games. This will create global competition in the mobile social game business. This paper presents a starting point for exploration of the systematic methodologies that will be required for this business.

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A Ubiquitous Community Care Model for Pediatric Asthma Patients

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Abstract. In order to achieve the best outcomes, pediatric patients suffering from chronic illness require support from a variety of caregivers. In this paper, we introduce a social care model for pediatric asthma patients, named the ubiquitous community care model. This model enables community members to monitor and care for children with asthma using technology. The model consists of three sub-models. First, Ubiquitous Care model specifies how caregivers can care the children every day and everywhere. The second component, Blackboard Communication, allows caregivers to 1) share information about their asthma symptoms, 2) store and analyze the communication data among caregivers, 3) increase education by allowing the network to share information, and 4) get smart services such as routine reminder. The final component, Community Care, allows people to play the role of caregivers by monitoring and caring for the child when they need help. This model is based on the findings from the interview data with pediatric asthma patients and their caregivers: their parents and care providers. We contend that our model and findings can be utilized for building ubiquitous monitoring caring systems for pediatric asthma patients. Furthermore, our model can be applied to other chronic conditions such as diabetes and obesity with little modification for their specific features.

Keywords: Model, Chronic Illness, Asthma, Ubiquitous Care, Blackboard Communication, and Community Care.

1 Introduction

Chronic conditions such as asthma and diabetes require long-term treatment, thus self-management is very important. Self-management refers to "understanding of one's disease, effective management of symptoms using a plan of action, medication, and appropriate psychological coping skills" [1]. Pediatric asthma patients have

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difficulties in managing asthma by themselves because 1) they are too young to know how to manage it, 2) they cannot control their desire (for example, playing with their friends) even though they have asthma exacerbation symptoms, and 3) sometimes asthma attack happens so fast that they requires emergency treatment. Therefore they require the support from their family and sometimes community members such as teachers, nurses, and even neighbors. Furthermore, Gallant [2] revealed that disease- or regimen-specific social support has a greater positive influence on chronic illness.

Our team has been engaged in understanding the role that technology can play in pediatric asthma [4-7]. In this paper, we introduce the Ubiquitous Community Care Model for pediatric asthma patients, which is a variation of social support management that utilizes ICT. This model is about how community members can help children with asthma, and what features ICT systems should have for monitoring and caring for the children. This model consists of three parts: Ubiquitous Care, Blackboard Communication, and Community Care. Ubiquitous Care argues that caregivers should have some devices that allow them to access the asthma care system from anywhere and at any time. Blackboard Communication enables caregivers to share children's asthma related information and co-operate with each other to manage their asthma. Community Care enables people in a community to play the role of caregivers by monitoring the children and caring for them to protect them from asthma attacks. This model is based on seven findings, which are elicited by re-analyzing the interview data of our previous work [5].

In this paper we make four contributions to area chronic illness management. First, we introduce a ubiquitous care model for asthma, which utilizes the combination of human efforts and ICT systems for monitoring and caring the patients. This is a new and practical model compared to the existing care models [3,8,14], which are mostly concerned about broader social system or self-management programs. Second, Community Care is similar to Social Network Services (SNS) and it has the potential possibilities of the combination of SNS and chronic illness treatment. Third, Blackboard Communication allows caregivers to communicate and share data in efficient ways with respect to effort and time. Fourth, our model can be applied to other chronic conditions including diabetes and obesity with little regimen-specific modification.

2 Related Work

In the United States asthma is the most common chronic disease among children, and pediatric asthma rates have increased from 8% in 2009 to about 10% in 2011 [9]. According to a survey [11], asthma caused 10.6 million physician office visits and 1.7 million emergency room visits in the United States, in 2006. Its morbidity and mortality rates are highest among the most disadvantaged populations. However, asthma management is very important because "although asthma cannot be prevented, its symptoms and adverse effects on children can be controlled [12]." Asthma's prevalence is not limited to the United States; it is a worldwide trend [10].

Related work in the literature can be categorized into two groups: pediatric asthma management and chronic care models. Most of work on pediatric asthma management is about understanding the current situation: asthma self-management [3], medication

adherence [8], and effectiveness of self-management teaching program [14]. This research approach is because we do not know much about asthma and asthma management yet. According to Dalheim-Englund [13], pediatric asthma management is an ongoing process of activities including avoiding asthma triggers, monitoring a child's respiratory status, taking medications every day, and communicating with other caregivers about the child's status. Compared to the existing asthma related work, our work is unique because it is a care model utilizes technology to mediate and facilitate the care of pediatric patients among community members.

There has been research on care models for chronic conditions two examples are the Chronic Care Model [16] and Extended Chronic Care Model [15]. These models cover most aspects of caring for patients with chronic disease: from medical care to policies. However, these models do not mention how technologies can be involved or what role the technologies play. Once again, our contribution is that we place technology utilization as a central component of our model for chronic care management. We contend that technology can facilitate ubiquitous monitoring and caring by a community of caregivers.

3 Findings from Interviews

In the previous study [5], we interviewed seven low-income families (seven parents and eight children with asthma aged seven to thirteen) and six providers (a pediatric pulmonologist, an allergist, a nurse, a respiratory therapist, a physician assistant, and a certified asthma educator who was a school nurse). We re-analyze the interview data and gathered new findings that are related to social support and self-management.

F1. Caregivers' providing treatment in a timely manner is very important. A grandmother who cares for her asthmatic grandson puts it this way:

> *"Sometimes we can catch it in time that it won't get so bad but sometimes we can't catch it in time and it gets really bad where he can't breathe and we go to the hospital."*

This leads us to three important factors: constant monitoring, early detection of asthma exacerbation, and early intervention. If caregivers detect the child's asthma symptom early and make him/her take medication or use inhaler in time, the child may be OK, but if they fail, he/she may have to visit the emergency room. Staying off an asthma attack is critical because asthma related deaths are not related to the severity of the asthma. Thus, even a child with mild asthma can die during an asthma attack.

F2. Asthma attacks can happen anywhere and at any time, therefore people around the child should be able to help him/her. A mother of a child with severe asthma said:

> *"one week we had maybe four attacks...She had two at home and two at school. She had a minor attack on the bus."*

F3. The patients' asthma status changes constantly and it means that they may have to take different type of medication and different medication doses when they have asthma exacerbation. Therefore, they visit their doctors regularly (every three to four months according to their asthma severity), and doctors may change the child's

medication routine or prescriptions (also known as their "asthma action plan") according to their asthma status. This constantly changing clinical regiment causes confusion, and hinders schoolteachers and other caregivers from caring for them properly.

F4. Maintaining routines is important for asthma management. Children with asthma may have to take medicine or check their status and lung capacity every day, so that there are some needs for convenient mechanism to serve as a reminder of their routines. A parent provides an example:

"He [usually] takes the Advair, Flonase rescue medicine [everyday], but this may change."

F5. Parents and children with asthma try to avoid their asthma triggers: smoking, dust, temperature, humidity, and pollen count. Families regularly tune into their televisions or radios to hear about weather forecasts and pollen counts information. Therefore, there are needs for a system that monitors these changes in environmental triggers and warns people about them. Thus, caregivers can effortlessly have access to this important information.

F6. By re-analyzing the interview, we found four categories of communication: getting medical information, cooperating to care for the asthmatic child, exchanging information, and psychological relief. The first type is home-hospital communication, and it primarily deals with getting medication information. The second type of communication happens usually within the home or home-school. At home, family members cooperate to care for a child with asthma. For example, the father may ask the mother: "Did you give Sally her medicine this morning?" This happens verbally but may happen via written or digital message (e.g, text). For home-school communication, parents and schoolteachers send messages using phone calls, email, or notes. The third type of communication happens in informal relationships (e.g., among friends). Here caregivers exchange some useful information for asthma management. The fourth communication type is for psychological relief. We found that sharing asthma status and experiences with others made caregivers feel better.

F7. Parents want to be educated about the best practices for managing their child's asthma. We found that they acquire most of their knowledge from clinical sources or from professionals that teach courses about asthma. However, sometimes they get information from friends, neighbors, or other parents of children with asthma.

4 Ubiquitous Community Model for Pediatric Asthma Patients

4.1 Ubiquitous Care

According to findings F1 and F2, asthma management should be ubiquitous around the child with asthma. In our model, a caregiver is better able to 1) help the asthmatic child avoid asthma triggers, 2) continuously monitor the child's symptom and 3) handle asthma exacerbation in timely manner. While caregivers may not have the knowledge to handle the three aforementioned scenarios, they should be able to get the information through a special device including asthma action cards [2], cellphones [6], Smart Asthma Box [4], sensors [7] which monitor environment and/or the child's symptom, or other devices.

Fig. 1 shows our ubiquitous care model. It consists of an external information store and a "care circle", which includes a caregiver, a child with asthma, and a device. The "care circle" is the parameter where a caregiver is able to monitor or/and help the child. Within the range, there is at least one device or a mechanism that enables caregivers to access the information that is required to help the child.

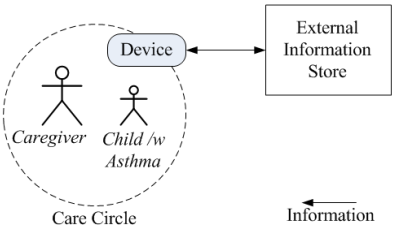

Fig. 1. Ubiquitous Care

In our model, the external information store keeps the child's information including his/her current status, asthma triggers, medication information, and other asthma related information. The caregiver can be his/her parents, schoolteachers, neighbors, or any person around the child. The caregiver's roles are to 1) help the child on his/her exacerbation, and 2) monitor and report the child's asthma symptoms. The caregiver can get the proper information through the device in the "care circle". The device in the "care circle" is very important and it plays three important roles: 1) the device is ubiquitous by being carried by the child or the caregiver, or by being embedded everywhere; 2) it provides the child's current status information not outdated one; and 3) it allows the care and/or symptom information to be updated.

4.2 Blackboard Communication

According to F3, F4, F5, F6 and F7, communication is a central aspect of pediatric asthma management. Our interview analysis shows that caregivers were able to communicate with each other, but we also found at least five limitations in the communication. Fist, in the current practices, communication happens between two caregivers (e.g., parent and teacher), and the information is not shared with other caregivers. To share the communication with others can be very helpful in asthma management. For example, the child is coughing in school, so the teacher sends an e-mail to the parent. However, the child has a babysitter after school. Thus it would be helpful for the babysitter also to get the message (and be able to give the child additional medication). Second, the communication is not recorded or stored. Thus the parents cannot remember or talk to the clinician what have happened for last three months to the child during medical office visits. Third, the communication and the messages passed during the communication are not analyzed. This problem mainly depends on the second problem, because it is not possible to analyze data that are not stored. Fourth, the communication happened through various media such as phone calls, emails, and sticky notes, and it was not integrated. The diverse media prevent the caregivers from storing and analyzing the communication messages. Fifth, the communication was not so "smart" and it was initiated by human beings manually.

For example, weather information in the Internet could be useful for caring the child, but the information could not be provided to the caregivers automatically.

In order to overcome these problems, we introduce the Blackboard Communication mechanism (see Fig. 2). It is a metaphor of the backboard in school. In the classroom, everybody can leave messages, and everybody can also read the messages. In our Blackboard Communication, we put a centralized message processing system, and every communication between caregivers should go through the system. It keeps the child's asthma related information including asthma action plan, his/her current status, and his/her symptom records, and allows caregivers to access the information. It also stores or records any communication between caregivers. Furthermore, it allows caregivers to report the child's symptoms and other caregivers to access the asthma action plan or other required information for emergency handling. The stored data can be analyzed and used by doctors in determining his/her asthma severity or finding out his/her asthma triggers. It can also add other smart modules to help caregivers. For example, weather information module can provide weather information to caregivers of weather sensitive children, and reminder module can make sure the child take medicine every day.

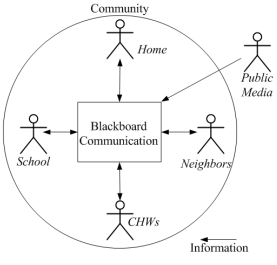

Fig. 2. Blackboard Communication

4.3 Community Care

Findings F1, F2, F4, and F5 inform us that caring the children with asthma requires the social support from the local community. Fig. 3 shows our Community Care model. It is an integrated model of Ubiquitous Care and Blackboard Communication.

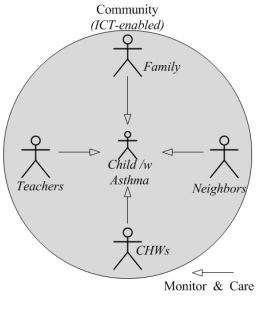

Fig. 3. Community Care

People within "care circle" of the child with asthma are aware of his/her asthma, monitor his/her status, and report his/her symptoms through Blackboard Communication with the device of Ubiquitous Care model. They also care for him/her by accessing the most up to date information through the Blackboard Communication. Thus people play the role of both human sensors that watch his/her asthma status, and also caregivers who help the child.

4.4 Ubiquitous Community Care Model Scenarios

The following usage scenario will reveal how our care model works. This is a scenario of monitoring and helping the child with asthma at school:

> *At school, John (child with asthma) has a bad cough, so his homeroom teacher requests his asthma action plan from the Blackboard and checks his status. According to his asthma action plan, he has to take a specific medication, so she takes him to the school nurse and leaves a message about his status on the system for other caregivers: his parents and his after school basketball coach. And the school nurse gives him the medication, and she also leaves a message to his parents, "Make sure he brings his medication to school tomorrow", because his medication almost runs out.*

In this scenario, the schoolteacher was the caregiver. She sensed his bad cough, checked his asthma action plan, and cared him by taking him to the school nurse. If she did not sense or did not check his status, she might ignore his cough, and it might cause an emergency situation. This scenario shows various type of communication: getting John's asthma action plan, reporting his asthma status and the fact of taking medication, and school nurse's communication with his parents. After checking his status, his basketball coach will pay more attention to his asthma symptom or let him take rest.

5 Conclusions

Pediatric asthma is a widely prevalent chronic illness, and it requires management strategies that include community members into care support system, support monitoring and caring the children, and mediate communication among caregivers. In this paper we proposed a ubiquitous community care model for pediatric asthma patients. Our model is targeted to monitoring and caring for children with asthma in daily life with information and communication technology. Our model has three unique features. First, our model is targeted to managing and helping pediatric asthma patients. There have been chronic care models, but there has been no pediatric asthma management model as far as we know. Second, our model involves information and communication technology in the chronic care model. Therefore, our model can be implemented as an ICT-based system more easily than other care models. Third, we showed how ubiquitous care of pediatric patients is possible in daily life through our model.

The model is based on findings elicited from interviews with pediatric asthma patients, their parents, and care providers. We contend that our model can be applied

to caring for a variety of population where communication between caregivers must be established. This includes the elderly and patients with other chronic illnesses such as diabetes and obesity. The ICT-based system we propose in this paper is currently under development and user studies will be forthcoming.

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Smart Sensor Based Total Quality Management Service Design in Production Process

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Abstract. Product manufacturing sites have being changed the production paradigm into introduction of smart sensor technologies to manage supply chains considering entire product lifecycle. However, due to introduction for simple inventory control without consideration for technological specialties of smart sensors and business processes of enterprises, it has not reached the diffusion stage. Therefore, this paper implements a space applying smart sensors optimized for business processes of enterprises and a system utilizing it. In detail, it analyzes a current collaboration process for refractory manufacturing, and designs a process to build a collaboration system by sharing information with cooperative firms from calculating accurate requirements through introduction of smart centers.

Keywords: Smart Sensor, Supply Chain Management, Business Process.

1 Introduction

The purpose of SCM (supply chain management) is to secure visibility in logistics and distribution for reducing uncertainty of forecasting market demands and integrated management. Therefore, it could be said that SCM is an optimization process to seek solutions optimized for strategic objectives to manage supply chains, which the flow of materials, funds and information is complicatedly involved, in terms of overall resource management. However, it is very difficult to forecast demands of consumers exactly. And there is a drawback that transit time is not certain for products transported in logistics and distribution. In addition, there are problems of mechanical failures and delays etc. in manufacturing processes. In order to remove this uncertainty, it should efficiently integrate and manage suppliers, manufacturers, warehousemen and retailers.

Technologies applied in the existing manufacturing site support computerization of manufacturing sites and collaboration in production processes. Because they have a difficulty for entire product lifecycle and customer's participation, however, it is time to need to cope with changes of the production paradigm. To solve such a problem, every enterprise shows willing to introduce smart sensor technologies. However, due to introduction for simple inventory control without consideration for technological

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specialties of smart sensors and business processes of enterprises, it has not reached the diffusion stage. Accordingly, this paper would like to design and implement a quality control service with smart sensors throughout the entire production process cycle. It would like to implement a space applying smart sensors optimized for enterprise's business processes and a system utilizing it.

2 Related Studies

2.1 Concepts and Features of Smart Sensors

A smart sensor is an active system to autonomously provide data collected from sensor nodes to users. It shares information via networks by attaching sensors to objects, which are desired to exploit, to actively find information of the corresponding objects and surrounding environment. And it could use the collected information to finally provide information services suitable to the current situation.

A smart sensor is composed of smart sensor node hardware, sensor node platform software, networks infrastructure and service server. The smart sensor node hardware consists of general hardware sensors, which detect surrounding environmental information, and sink nodes and gateways that are interface nodes to interwork with external networks, particularly Internet. Because the hardware sensor is difficult to maintain and should operate during from a few days to several years once after deploying it, there is a feature that it should have a robust structure and be designed as low power. It may become very different according to its application area and have flexibility and modularity to be used effectively even for any structure, so that it could attach a diversity of sensors and easily replace with hardware suitable to its purpose. The sensor platform software is to efficiently support effective operation of sensor nodes and networks and implementation of application services based on smart sensors. It could divide into node middleware, which is for sensor node itself, and network middleware for providing and managing the sensor platform's service. The node middleware has functions such as reprogramming of sensor nodes, support of network changes, local processing of sensed data and event processing. The network middleware has functions such as network directory, monitoring of sensors and networks, context collection and contextual information processing, service-connected open API (application programming interface), filtering of sensed information, integration and analysis.

2.2 Smart Sensors for the Supply Chain Management

The supply chain management is required to meet a capacity for product flows. Because supply chains are difficult to forecast, they have certain buffer stock for balancing supply and demand, so there is an inefficient and nonproductive factor. Many enterprises have invested greatly in the supply chain planning program to reduce such a factor. From a short-sighted viewpoint of the plan, the supply chain planning program providers achieved partial communications of analyzing supply chains, that is, partial effects for better demand forecast and collaboration, however, the supply chain planning program could not result in transparent and clear supply chains. Because

uncertainty of supply chains makes real-time planning and implementation difficult, it could not have a perfect effect on the supply chains, therefore, a technology is required to obtain information arisen from real-time events.

As the supply chain management with smart sensors could track and monitor the whole process from manufacturing to shipping, loading, delivery, sales of products as well as simple transaction information through smart sensors, detecting sensors and wireless network communication technologies etc. in real time at anytime and anywhere, it manages the flow of every resource within an enterprise. By using smart sensors, it could improve efficiency and have an effect on cost reduction in overall supply chains. In addition, it changes the existing business process and creates new competition rules by improving visibility of suppliers and customers in the supply chains.

3 Design of Logistics Quality Control Services for Refractory Manufacturing

3.1 Analysis on Requirements of Logistics Quality Control for Refractory Manufacturing

To form product categories in the same 'Lot' unit due to properties of products in the refractory manufacturing, it manually records working details and carries out transport and loading in the 'Pallet' unit for the manufacturing process such as grinding, drilling, molding, drying, sintering, processing and packaging. Consequently, there is a problem difficult to control inventory because it is difficult to exactly identify locations of goods in the 'Pallet' unit due to errors caused by manual labor and the large storage space (warehouse).

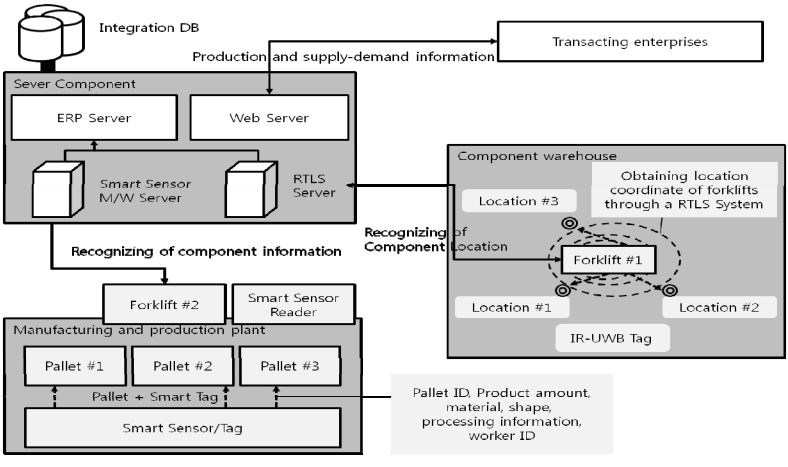

Fig. 1. Schematic diagram of recognizing and sending refractory's locations through forklifts

For this reason, it is difficult to control inventory exactly and decreases accuracy of production planning, so it makes difficult not only internal work orders but also charging plans by supply and demand of raw materials, therefore, there are many difficulties for the procurement collaboration system with suppliers. This study would like to improve accuracy of inventory through manufacturer's inventory control for each refractory 'Lot' and exact location management by designing a quality control service based on smart sensors. And it would like to increase accuracy of production planning and work orders by establishing correct production plans connected with exact inventory and demand information. In addition, it would like to build a collaboration system by sharing information with cooperative firms through calculating exact requirements.

3.2 Analysis on the Quality Control Process of Logistics in Refractory Manufacturing

The process for producing manufacture logistics in refractory manufacturing is composed of areas such as sales plan, production plan, purchase, production, half-finished products warehouse, finished products warehouse, orders and shipping. The detailed process is as Fig. 2. Examining general problems of the logistics quality control process in this refractory manufacturing, they are as follows. In refractory manufacturing, inventory control is difficult due to its large product size and extensive warehouse, and it is more difficult than other industries for inventory control because of different kinds of products. And it controls inventory by 'Lot' unit even for the same product, and the first-in first-out management is essentially required on the basis of it, however, it is difficult to manage it manually.

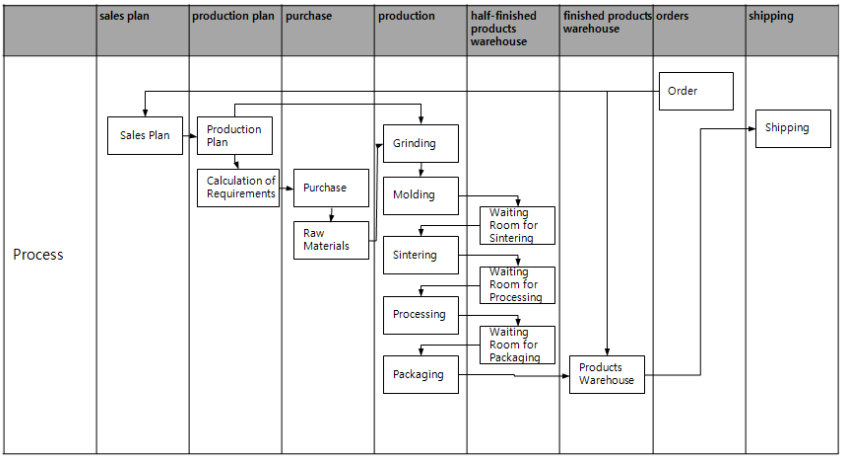

Fig. 2. Refractory manufacturing, Current (As-Is) manufacture logistics process

In addition, because it manages the product 'Pallet' and loading locations by memories or manual labor of forklift workers, it is difficult to understand location information of products exactly and quickly, so there is a risk to arise additional work orders even though the product is in stock. And it exactly manages inventory control by 'Lot' to carry out correct shipping by the first-in first-out, however, it is impossible to carry out the first-in first-out because it could not manage its correct location information. The productivity is decreased due to production history management by worker's manual labor, goods could not conform, and it is difficult to manage the lifecycle exactly. Finally, there is a problem that it is difficult to efficiently manage forklifts because locations of them in operation could not be understood in the plant.

3.3 Design of Improved Logistics Quality Control Service in Refractory Manufacturing with Smart Sensors

It would like to design an improved process that deploys smart sensors at the appropriate locations for the logistics quality control service in refractory manufacturing. After production, it automatically recognizes manufacturer's information attached to the 'Pallet' through a recognizer installed on the forklift, and enters information on loaded freights (products) such as 'Pallet' ID, amount of products, material, shape, processing information, worker ID etc. into ERP via wireless networks. Based on the received information, the ERP manages the warehousing history and inventory control automatically by the system to minimize errors resulted from manual labor. Because it could exactly understand inventory and manage locations based on inventory and product information collected in real time, the first-in first-out could be carried out. In the parent company, it is applied to a purchase process in the purchase area,

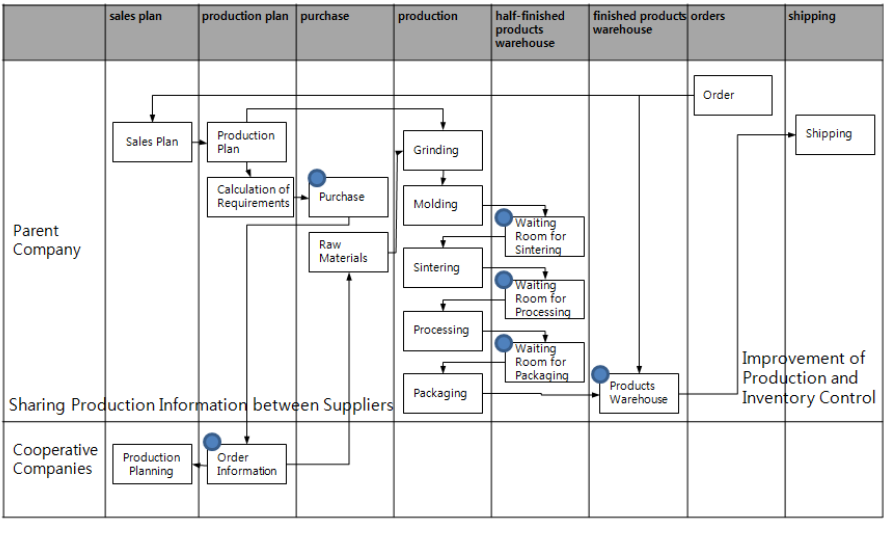

Fig. 3. Refractory manufacturing, Improved (To-Be) manufacture logistics process

sintering/processing/packaging waiting room process in the half-finished products warehouse area, products warehouse process in the finished products warehouse area. And, in the cooperative companies, it is applied to an order information process in the production planning area.

As the forklift moves to a certain location, the forklift's recognizer understands the location of refractory products attaching the manufacturer's smart sensor. It merges loading information of the 'Pallet' recognized by the forklift with location information of the forklift to deliver it to the neighboring server, and workers and managers could understand product information for each location through terminals.

4 Expected Effects of the Logistics Quality Control Service with Smart Sensors in Refractory Manufacturing

By analyzing the process of refractory manufacturing utilized inefficiently, it built an improved logistics quality control service with smart sensors in refractory manufacturing as Fig. 4. It has expected effects as follows. Qualitative expected effects are reduction of stocks through the real-time inventory control, enabling to establish systematic production plans connected with business activities, quick decision making through the system, reduction of spaces and cost for management by decreasing goods in stock, reduction of purchasing costs for raw materials through the systematic supply and demand plan for raw materials, and increase of customer satisfaction by shortening the period of delivery etc. Quantitative expected effects are enabling to manage time of understanding and controlling

Table 1. Expected effects of the logistics quality control service with smart sensors in refractory manufacturing

Expected Effect Areas	Expected Effect Items	Expected Effect
Qualitative	Inventory Control	Inventory Reduction
	Space and Cost	Decrease
	Purchasing Cost for Raw Materials	Reduction
	Period of Delivery	Reduction
	Decision Making	Quickness
Quantitative	Understanding and Management of Stocks	Real time
	Inventory Cost	Decrease by 25%
	Productivity	Improvement
	Accuracy of Stocks	100%
	Accuracy of Production Plans	98%
	Calculation of Requirements	99%

stocks in real time, decreasing of inventory cost by 25%, improving of productivity (collection of stocks and creation of cards), accuracy of stocks (100%), accuracy of production plans (98%), improving accuracy of calculating requirements (99%) etc.

5 Conclusion

The purpose of SCM (supply chain management) is to secure visibility in logistics and distribution for reducing uncertainty of forecasting market demands and integrated management. And, the technologies applied in the existing production sites supported computerization of the production sites and collaboration of product's manufacturing process. Because they have a difficulty for entire product lifecycle and customer's participation, however, it is time to need to cope with changes of the production paradigm. To solve such a problem, every enterprise shows willing to introduce smart sensor technologies. However, due to introduction for simple inventory control without consideration for technological specialties of smart sensors and business processes of enterprises, it has not reached the diffusion stage. Accordingly, this paper implemented a space applying smart sensors optimized for enterprise's business processes and a system utilizing it.

It analyzed a current collaboration process for refractory manufacturing, and designed a process to build a collaboration system by sharing information with cooperative firms from calculating accurate requirements through introduction of smart centers. By obtaining real-time sensor information for refractory products that a systematic inventory control is not carried out currently for the products, it is expected that there would be an effect of about 2.3 times compared to investment for product's inventory costs and raw materials' reduction costs by interworking with the existing production management system. In addition, since the plants, where manufacture large-size products, need to manage locations because they manage half-finished products using an empty space, it is considered that it could expand application of the service into the similar working environment.

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Disruption Management Framework in a Global Logistics

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Abstract. Global Logistics is concerned with both material distribution into the production process and product distribution to the customers across country borders. In particular, global logistics involves many trading partners including exporters, forwarders, truckers, customs, carriers, and importers. Disruptions in global logistics are the major contributor to the large average and variance of transit time. These disruptions are due to the limited visibility of milestone events to the trading partners resulting in inaccurate tracking of materials. The main consequence is that the supply chain partners are forced to hold more buffer-stock and to expedite reproduction and transportation of extra materials. In this paper we propose a two stage framework to recover efficiently and effectively from global logistics disruptions thereby streamlining the flows of goods. As a first phase, for the discovery of global logistics disruption, the framework of testbed is developed to provide a virtual logistics environment. And then, for the recovery of global logistics disruption, the simulation approach is proposed.

Keywords: Disruptions, Global logistics, testbed, simulation.

1 Introduction

Accompanying the globalization of business, companies in global supply chain face the inevitable challenge to evaluate and renovate their production and distribution systems. Due to its heterogeneity, which is definitely the most important challenge for globalization, global supply chain becomes very complex and has resulted in global logistics becoming more vulnerable. With the trends and developments within global logistics, since the supply chain may be stretched to its breaking point, the company's best intention to become a fierce competitor can cause the vulnerability. Ideally we should strive to identify and manage known vulnerabilities by analyzing questions such as [1]:

- What has disrupted operations in the past?
- What known weaknesses do we have?
- What 'near misses' have we experienced?

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Global logistics caters to the efficient and effective movement of goods from the suppliers to the manufacturers to the retailers to the end customers. The goods may dwell at several designated storage places and transport devices in the course of its journey. In particular, global logistics involves many trading partners including exporters, forwarders, truckers, customs, carriers, and importers. Significant disruptions in global logistics can reduce company's revenue, cut into market share, inflate costs, send over budget, and threaten production and distribution. Such disruptions also can damage the credibility of a company with investors and other stakeholders, thereby driving up cost of capital. Global logistics is one of the key success factors in global business.

The objective of this research is to develop the discovery and the recovery methodology to enable 1) intelligently foresee and predict potential disruptions based on available information; 2) quickly identify and locate the causes for the disruption when it occurs; 3) analyze the impact of observed or predicted disruptions to the downstream partners and notify the relevant partners; and 4) form alternative plans for quick recovery of the normal supply chain operations. For the discovery of global logistics disruption, the framework of testbed is developed to provide a virtual logistics environment for two purposes; 1) to test the information visibility among all participants in logistics and 2) to analyze the expected disruption situation. Vulnerable points for the information visibility of logistics are detected by the testbed approach. The recommendations for vulnerable points are proposed by the experts of testbed and logistics. For the recovery of global logistics disruption, the simulation approach is proposed. From the result of testbed analysis, the simulation model can be generated and from the logistics experts, the recovery alternatives of simulation model can be generated. Through the simulation with the disruption occurrence situation, the best recovery alternative will be evaluated and selected.

The remainder of the paper is organized as follows. Section 2 presents the taxonomy of disruption in global logistics. Section 3 introduces the proposed discovery and recovery framework. Section 4 outlines the conclusions that can be drawn from the current research efforts, and discusses future directions.

2 Taxonomy of Disruption Control

The benefits of global sourcing and supplier consolidation can carry a hidden cost: increased exposure to the risk of supply-chain disruption. Overseas sourcing increases risk exposure by introducing distance and creating complexity; consolidation increases exposure by concentrating the risk of failure among fewer suppliers. To take full advantage of their sourcing strategies both domestically and abroad, companies need supply chains that are not only flexible, predictable, and efficient but also insulated from disruption.

The major characteristic of disruptions in global logistics is that it cannot be predicted but be prepared for them. Global Logistics requires the coordination of all participants and technologies to ensure performance. Since it is all about the links among all participants, understanding the inter-relationships across a global logistics is important. According to the previous researches [2-4], there are four categories in logistics disruption as shown in Table 1.

Table 1. Four types of logistics disruption

Disruption	Definition
Delayed	Delivery of securities later than the scheduled date.
Wrong	Goods that are delivered are different from the order or the contract.
Undelivered	Shipments that cannot be delivered to its address on the day it reaches the arrival service point due to various reasons (the addressee does not pick up the phone notified shipment or absence of the addressee at the specified address, etc) and that must be picked by the addressee within maximum 6 days from the service points.
Stolen or damaged	Entire goods or the part of goods are pilfered or stolen / Shipment of goods arrived with damage.

To overcome the logistics disruption problem, many consulting firms have provided the systemic approaches for the logistics disruption management [5-8]. With careful investigation about the management strategies for global logistics, there are many issues; network optimization, warehouse management, ERP for logistics, secure logistics, information management, etc. Among these issues, the most important issue must be the information visibility in logistics related with the tracking and trace of the logistics flows. Since many participants such as exporters, brokers, trucks, customers, carriers, and importers, are involved in the global logistics; their support systems are complex and heterogeneous in nature. Presently, because the traditional approaches for the information visibility of logistics supports system cannot handle such complex system, the participants encounter recurring problems of logistics disruption

3 Overall Framework to Discover and Recover from Logistics Disruption

Fig. 1 illustrates the proposed framework for discovery of and recovery from logistics disruption. Both activity model and conceptual model can be identified through

supply chain design for logistics. The activity model describes interrelated tasks among trading partners with inputs and outputs such like order, status, goods, etc. It should depict the response of a logistics system or component to a specific input or event, identifying the actions it takes in response to the stimulus and the results those actions produce. It can be represented as a partially-ordered graph. The conceptual model describes the meaning of concepts and the correct relationships among them in some universe of discourse. The experts and the specialist related to the logistics systems should extract the conceptual model.

Two stages are engaged: 1) Diagnosis stage with testbed approach – to discover what goes wrong, where it comes from, and possible recommendations, and 2) Recovery stage with simulation approach – to build recovery strategies from the disruption.

First, in the diagnosis stage, test requirements and problems are defined. To this end, Business-to-Business (B2B) collaboration systems are considered in terms of three-layered standard protocols: 1) Messaging infrastructure standards ranging from transport level (e.g., HTTP, SMTP) to higher-level messaging protocols with reliability and security (e.g., ebXML, SOAP extensions), 2) Message choreographies including business choreographies (e.g. UMM business transaction patterns) as well as lower level message exchange patterns (e.g., BPML standards), and 3) Business document standards including industry-specific documents (e.g., high-tech industry's XML schemas) as well as vertical supply chain-related documents (e.g. automotive logistics metadata). For example, a "purchase order number" should appear consistently across several business documents such as "purchase order", "advanced shipment notice", and "packing list". Once test problems are defined, test materials including test inputs, test execution conditions, expected results need to be identified. The test results will include disruption profile and resolution recommendations which will be provided for the simulation engine.

Second, in the recovery stage, simulation models are constructed with the activity diagram and a set of recommendations for disruption discovery; the logistics simulation n model can be generated from the activity diagram and the alternatives for the recovery countermove can be suggested by disruption profiles and resolution recommendations from first phase. In particular, since there are four categories of logistics disruption, four disruption situations will be analyzed for all participants in global logistics. For instance, if delayed shipment situation is occurred, each cause of delayed shipment by all participants is listed (i.e. the ocean carriers by extreme weather, the supplier by strikes, etc). Then, the later participant from the ocean carriers or the supplier should prepare the fluctuation of the delayed shipment. According to the recommended scenarios from the logistics experts, the activity diagrams as recovery alternatives are generated and evaluated to choose the best alternative.

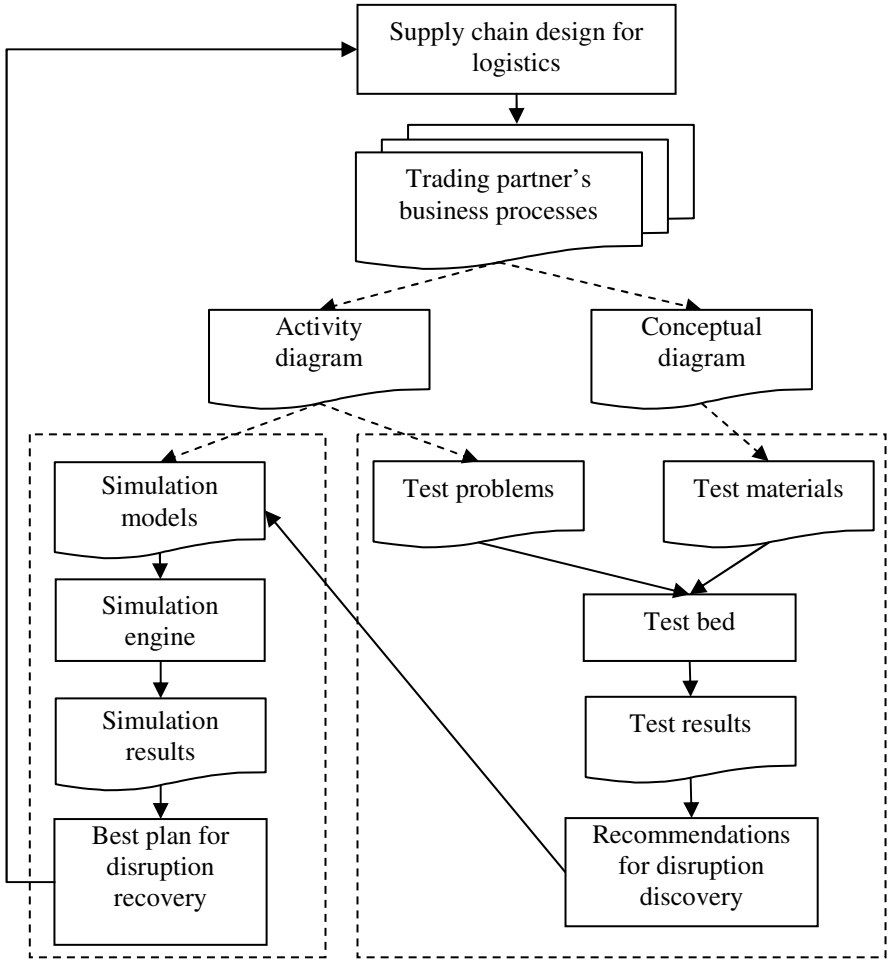

Fig. 1. Logistics disruption management framework

4 Conclusion

The framework of logistics disruption management is introduced to enhance the discovery and the recovery of disruption situation. Since the proposed framework is based on the business process development, it can be straightforwardly applied from the design phase of global logistics to the monitoring and improvement phase. There are two missions as a future work. Due to the heterogeneity of supply chain, stage, scenario-driven interoperability testbed should be investigated for the disruption discovery stage. Furthermore, for the recovery stage, the prototype of supply chain simulation model should be developed.

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A Review of Value Creating Motive and Business Model in Smart Technology

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Abstract. Many countries, including the US, Europe and Korea, are eager to conduct diverse researches and projects in relation to such smart technology in the hope of utilizing those opportunities, and domestic universities and research institutes also are active to implement relevant researches. Yet, smart technology has rarely been conceptualized, with only superficial studies about it conducted. In this paper, I studied value creating motive and literature review for development of business model to be applied to actual business, based on characteristics of smart technologies.

1 Introduction

As 'Smart Technology' is rapidly growing in recent days, off-line and on-line are being integrated into a single space, creating a totally new concept of space and more business opportunities utilizing it. Many countries, including the US, Europe and Korea, are eager to conduct diverse researches and projects in relation to such smart technology in the hope of utilizing those opportunities, and domestic universities and research institutes also are active to implement relevant researches. Yet, smart technology has rarely been conceptualized, with only superficial studies about it conducted. In addition, relevant studies have been excessively focused on its hardware, resulting in only case studies through scenarios.

Service scenarios applying enabling technologies, application systems, and simple enabling technologies in business can bring technical innovation, but they do not last long. In this paper, I studied value creating motive and literature review for development of business model to be applied to actual business, based on characteristics of smart technologies.

2 Literature Review

2.1 Ubiquitous Technology and Environment

"Ubiquitous" is a Latin word meaning "Being or seeming to be everywhere at the same time." In terms of IT, this refers to an environment where you can easily use

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the computer in any place anytime. You can access specialized, context-aware services, which are subject to change with place and time, by sensing or tracking pervasive computing. [8]

Table 1. Definition of Ubiquitous Technology

Researchers	Definition
Mark Weiser	The calm technology, that recedes into the background of our lives.
N.R.I	Today's information appliance-based computing environment accessible to the Internet through wire/wireless network
Hong Joo Lee	All objects in real space are equipped with information devices and connected to one another through network

In the respect, it is of significance to take 'technical feasibility' into account in establishing a business model based on smart technology such as ubiquitous technology.

2.2 Business in Smart Technology

There are broad discussions being carried out on new business in smart technology environment, as well as partial, fragmentary discussions on a certain aspect. Table 2 shows business phenomena mainly suggested in prior literature for years.

Table 2. Phenomenon of New Business

Global Networking[15]	A weaving together of our lives, minds, and artifacts into a global scale network
Frictionless interaction and coordination[5]	Interaction is almost free so that if is no longer a constraint to business
Positive feedback and Increasing returns[4]	The tendency for that which is ahead to get further ahead, for that which loses advantage to lose further advantage.
The experience Economy[6,10,14]	Own and design their experience, not their products. Be responsible for the total experience of customers, not a Fragment of it
Mass customizing and Presumption[18]	Offering should be tailored one on one for each consumer. A consumer designs her own product.
New economics of Information[7]	The traditional trade-off relationship between the richness and reach of information no longer holds.
Value at linking[18]	Value is generated at linking as well as at manufacturing

Considering those phenomena occurring in new business environment, it is critical to figure out business proper for technology environment and analyze individual's needs, in deriving business factors appropriate to new technology environment and develop business models [11].

2.3 Research on Business Model

The business model refers to a company's business method and structure, that is the company's overall design about how to create values in which market, based on which activity mechanism, and with which products [2]. While a strategy means a specific activity plan in a certain sector, a business model is a systemic whole of individual strategies [1,3]. New business phenomena are giving rise to fundamental changes in business method and structure. Traditional business models based on the physical value chain are being replaced with new business models. Here, the business model means a strategic means needed to perform persistent business while generating revenue [16,18]. A business models appropriately designed will bring competitive advantage in the industry, as well as more profits.

Therefore, the business model should have answers to such questions as which value should be provided for users, which strategy should be applied to provide users with differentiated value, and what benefits the company can gain by providing the value [18].

2.4 Business Revenue Models and Value Creating

The revenue model is related to how each company can create revenue within the context of a business model [17]. The key to studying business models is discussions on which role the individual entity plays in the business model and which revenue it can create through the process. The business model and revenue model are connected in two steps.

First, a conceptual model for corporate revenue-creating is developed based on roles and functions of a company within the business model.

Second, a specific revenue-creating form is examined within each value-creating relationship structure, such as chains, shopping malls, marketplace, and communities, based on the conceptual model for revenue-creating [15]. Revenue-creating can be defined as seeking a role worthwhile to pay compensation for business entities (customers) [18]. Companies create revenue based on this definition, as seen in Table 3.

Table 3. Revenue-creating method

Revenue-creating Method	Definition
Execution driven revenue	Revenue resulting from companies' business activities (ex: How efficiently companies operate, how much active the corporate culture or business structure is, etc.
Relationship structure driven revenue	Revenue through value-creating relationship structure

2.5 Value-Creating Motives

Value of a business model depends on which value-creating motive works in designing and realizing the model [12,13].

Thus analyzing value of the business model begins with figuring out how the business value-creating motive appears. Value-creating motives of business models can be reviewed in light of technology and business. In technical aspect, the value-creating motive is triggered by technology.

With enabling technology foundation allowing new business methods, how to utilize business opportunities and enabling effects provided by the technology in the company's value-creating is analyzed.

On the contrary, the value-creating motive in the business aspect is promoted by business considerations, therefore overall business motives. Such as which goods/market should be chosen or which business method should be designed, are considered. The technical motive and business motive are related to each other, however, and give rise to diverse value-creating motives in combination. Previous researches suggest that value-creating motives of business models originate from 4 sources.

First, the motive originates from technology's enabling effects. Second, the motive originates from characteristics of technology business. Third, the motive originates from morphological characteristics of value-creating relationship structure. Fourth, the motive originates from functional characteristics of value-creating relationship structure.

3 Conclusions and Future Works

This study was aimed at value creating motive and developing business models in smart environment. In this paper, I analyzed value of the business model begins with figuring out how the business value-creating motive appears. And I studied those value-creating motives of business models can be reviewed in light of technology and business. With enabling technology foundation allowing new business methods, how to utilize business opportunities and enabling effects provided by the technology in the company's value-creating is analyzed.

On the contrary, the value-creating motive in the business aspect is promoted by business considerations, therefore overall business motives. However, in applying the results to actual business, customers' needs for advanced business model should be examined as well.

As technology is continuously evolving, business models and customers' needs are also changing. Therefore, there should be continuous research conducted on development of proper business models. Following this study, it is one of urgent tasks to present a research system for producing business factors, complying with new technology environment, and ultimately developing proper business models.

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Modeling Eating Disorders of Cognitive Impaired People

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Abstract. Millions of people all around the world suffer from eating disorders, known as anorexia nervosa, bulimia nervosa, pica, and others. When eating disorders coexist with other mental health disorders, eating disorders often go undiagnosed and untreated; a low number of sufferers obtain treatment for the eating disorder. Unfortunately, eating disorders have also the highest mortality rate of any mental illness, upwards of 20%. This paper focuses on monitoring eating disorders of cognitive impaired people as patients with the Alzheimer's disease. The proposed approach relies on the application of Ambient Intelligence (AmI) technologies and a new method for the detection of abnormal human behaviors in a controlled environment.

1 Introduction

An eating disorder is an illness that causes serious disturbances to your everyday diet, such as eating extremely small amounts of food or severely overeating. A person with an eating disorder may have started out just eating smaller or larger amounts of food, but at some point, the urge to eat less or more spiraled out of control. Severe distress or concern about body weight or shape may also characterize an eating disorder [1]. Eating disorders can lead to major medical complications, including cardiac arrhythmia, osteoporosis, infertility, and even death. The mental anguish of an active eating disorder is tremendous, and persists beyond the medical consequences. Suicide, depression, and severe anxiety are common during the active illness and treatment.

In addition to such social effects, eating disorders represent also a large cost for national healthcare services. Hospitalizations for either a primary or secondary eating-disorder diagnosis showed a dramatic increase of 24 percent from 1999 to 2009, according to a report from the Agency for Healthcare Research and Quality [2].

In this paper we focus on eating disorders related to cognitive impaired people, specifically patients with Alzheimer's disease. We propose a methodology for the monitoring of eating in a controlled environment. Ambient Intelligence and Situation-Awareness are the technologies and paradigms adopted for our study. The main contribution of this paper, however, is a new method for the modeling and detection of abnormal human behaviors. Such method relies on the specification and runtime verification of correctness properties. The violation of one of such correctness properties indicates an anomalous behavior of the monitored patient. Behaviors are specified by means of a first-order logic, namely *Situation Calculus*, and violations of correctness properties are detected by intelligent agents.

The rest of the paper is structured in the following paragraphs. Section 2 describes potential situations of eating disordes. Section 3 presents *Situation Calculus*. Section 4

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describes the proposed approach to molding and reasoning on anomalous eating behaviors. A prototype system is introduced in section 5. Next, section 6 concludes the paper dealing with potentials and limits of the proposed approach.

2 A Situation of Eating Disorders

To detect eating disorders in a smart environment, we refer to the Situation-Awareness paradigm. With such an aim, it is important to clarify some aspects of sensing and analysis of data. Indeed, data collected from sensors may be processed in a smart environment at different semantic levels. As suggested by [3], we should distinguish between Context and Situation-Awareness. Indeed, authors propose the following definitions: *Primary context* is the full set of data caught by real and "virtual" sensors; *Secondary context* concerns with information inferred and/or derived from several data streams (primary contexts) and an important kind of secondary context is activities performed within the environment; *Situation* is, instead, an abstract state of affairs of interest for designers and applications, which is derived from context and hypothesis about how observed context relates to factors of interest. Situation-awareness includes rich temporal and other structural aspects, like: *time-of-day*, a situation may only happen at a particular time of the day; *duration*, it may only last a certain length of time; *frequency*, it may only happen a certain times per week, and *sequence*, different situations may occur in a certain sequence.

Let us now focus on a situation of normal eating. We can assume the parameters reported in table 1 apply. It is quite normal to eat three times a day; thus, three time frames can be defined, within which the patient is supposed to eat. The duration of eating may be considered, with a certain degree of approximation, an indication of the amount of food ingested. Finally, eating may be defined as a sequence of basic activities performed iteratively a certain number of times. For the rest of the paper, we assume to have a system, e.g. video analysis, able to provide us second-order context information; i.e. it is able to identify such basic actions and indicate start eating and stop eating events.

Table 1. A situation of normal eating

Parameter	**Value**
Frequency	3 times a day
Time-of-Day	$F_1=[T_{1Min}\text{-}T_{1Max}]$; $F_2=[T_{2Min}\text{-}T_{2Max}]$; $F_3=[T_{3Min}\text{-}T_{3Max}]$
Duration	Δ_b, Δ_l, Δ_d
Sequence	1. Approach food to mouth; 2. Bite; 3. Chew, 4. Swallow

Table 2, instead, reports several cases of anomalous behaviors. It is important to note, however, that one of such anomalous behavior does not directly imply an abnormal behavior. For example, considering the anomalous behavior of *eating outside a temporal frame*, does not automatically lead to a situation of *overeating* if it happens just once. On the contrary, this event should be repeated several times a day or/and for more consecutive days before deducing an abnormal behavior such as *overeating*.

A possible set of parameters for a situation of overeating *Abnormal duration of breakfast* ($\Delta_{abnBreakfast}$), *Abnormal duration of lunch* ($\Delta_{abnLunch}$), *Abnormal duration of dinner*} ($\Delta_{abnBreakfast}$), *Abnormal duration of daily meals* ($\Delta_{abnDailyMeals}$).

Such a situation is supposed to occur when the duration of one of the main meals is grater than some thresholds, or when the total time spent in a day eating (thus also considering eating outside regular time frames) is greater than another threshold.

Table 2. A situation of normal eating

Anomalous behavior	**Potential effect**
Start eating outside a temporal frame	Overeating
Not eating in a temporal frame	Undereating
Eating too much	Overeating
Eating too little	Undereating
Try eating non-nutritive substance	Poisoning

3 Situation Calculus

The basic *Situation Calculus* (SC) is due to John McCarthy [4] and has been adopted to model dynamically changing worlds. Three basic sorts in SC are: **Actions**, which can be performed in the world and can be quantified; **Fluents**, that describe the state of the world (these are predicates and functions whose value may change depending on situation); and **Situations**, which represent a history of action occurrences.

A dynamic world is modeled through a series of situations as a result of various actions being performed within the world. It is important to note that a situation is not a state of the world, but just a history of a finite sequence of actions.

The constant S_0 denotes the initial situation; whereas, *do(a,S)* indicates the situation resulting from the execution of the action a in situation S.

The dynamic world is axiomatized by adding **initial world axioms**, **unique names**, **preconditions**, effect axioms, and **successor state axioms** [5] do the *situation calculus*' **foundational axioms**.

The **initial world axioms** describe the initial status of the environment, its objects, their position into the environment, their properties, etc. A **unique name axiom** for situations states that if the execution of actions a_1 and a_2 respectively from a_1 and a_2 leads to the same situation, then, necessarily, $a_1 = a_2$ and $S_1 = S_2$. Unique name axioms also define the set of basic actions that can be performed within the environment.

A **precondition** is formalized using the binary predicate symbol *Poss(a,S)*, which describes a condition that must hold in order to execute the action a in situation S. An effect axiom, instead, describes the effect on a fluent (e.g. *F(x,S)*}) caused by the execution of an action in a specific situation (*F(x,do(a,S))*). Unfortunately, effect axioms are not sufficient to describe the changing world. It must be specified for each fluent not only the effect of each affecting action, but also the non-effect of the other actions. This is a well known problem, the frame problem, that entails the specification of $2*A*F$ axioms being A the number of actions and F the number of fluents. To reduce such a problem, we refer to **success state axioms** [5] of the form:

$$F(\boldsymbol{x}, do(a, S)) \equiv \gamma_F^+(\boldsymbol{x}, a, S) \vee (F(\boldsymbol{x}, S) \wedge \neg\gamma_F^-(\boldsymbol{x}, a, S)) \quad (1)$$

where γ^+_F(x,a,S) is a first-order formula- with free variables among x, a, and S -that makes the F's truth value changing to true. Analogously, γ^-_F(x,a,S) is a first-order formula that makes the F's truth value changing to false. Intuitively, it is possible to state that a fluent's truth value is true after executing an action *a* if, and only if, the action has the effect to make the fluent true or, the fluent was already true before executing *a* and the action has not the effect to make it false. In such a case, only F successor state axioms must be formalized.

Such a set of axioms represents a *basic action theory*.

It is finally important to note that under certain conditions (Clark's theorem), an executable prolog program is directly obtained by appling Lloyd-Topor transformations to the basic action theory. This can be interpreted by a Golog interpreter and represent an intelligent agent for the detection of anomalous and dangerous situations.

4 Modeling Anomalous Eating

This section defines a basic action theory for the modeling and reasoning on anomalous eating behaviors. A subset of the theory axioms is reported. In accordance with table 1, axioms 2, 3, and 4 defines three timeframes for the 'normal' breakfast, launch and dinner. Axioms 5 and 6 identify some food and drinks in the scene, axiom 7 defines a poisoning substance, and axiom 8 establishes what is not food or drink.

$$\mathbf{isT_{breakfast}(t)} \equiv t \in [T_{bMin}, T_{bMax}]; T_{bMin} = 7.00.00 \wedge T_{bMax} = 9.00.00 \quad (2)$$

$$\mathbf{isT_{lunch}(t)} \equiv t \in [T_{lMin}, T_{lMax}]; T_{lMin} = 12.00.00 \wedge T_{lMax} = 14.00.00 \quad (3)$$

$$\mathbf{isT_{dinner}(t)} \equiv t \in [T_{dMin}, T_{dMax}]; T_{dMin} = 19.00.00 \wedge T_{lMax} = 21.00.00 \quad (4)$$

$$\mathbf{isFood(x)} \equiv x \in \{meat, fish, salad, pasta, bread, fruit, cake\}; \quad (5)$$

$$\mathbf{isDrink(x)} \equiv x \in \{water, milk, tea, wine, beer\}; \quad (6)$$

$$\mathbf{isPoison(x)} \equiv x \in \{acid\}; \quad (7)$$

$$\mathbf{isObject(x)} \equiv \neg isFood(x) \wedge \neg isDrink(x); \quad (8)$$

A minimal set of human's actions related to eating is described by axiom 9; whereas, those reported by axiom 10 are technical actions executed by an artificial agent to reset fluent's values as described later.

$$a_h \in \{\mathbf{startEating(x,t)}, \mathbf{stopEating(x,t)}, \mathbf{startDrinking(x,t)}, \mathbf{stopDrinking(x,t)}\} \quad (9)$$

$$a_s \in \{\mathbf{resetAnomalousBreakfastDuration(t)}, \mathbf{resetAbnormalBreakfastDuration(t)}, \mathbf{resetDangerousEating(t)}, \mathbf{resetAbnormalOvereating(t)}\} \quad (10)$$

We suppose that all such actions are always executable. Fluents (bold words in axioms [11-18]) describe the status of the word in situation *S*. The possibility of change of the truth's value of any fluent is specified by means of the successor state axioms [11-18]. For the sake of brevity, we did not report all the needed fluents and successor state axioms, but the missing ones are similar to those presented.

In detail, *isEating(S)* becomes true (axiom 11) if the current action *a* is *startEating* something. Moreover, if the fluent were already true, it would not change its truth's value unless the current action is just *stopEating*. Fluent *isEating(S)*, instead, concerns

a specific substance *x*. Fluent *isAnomalousEating(x,S)* represents a correctness property for the identification of an anomalous and potentially abnormal eating behavior. Indeed, the successor state axiom 12 triggers whenever the patient tries to eat a nonnutritive substance. It is important to note that this event may, or may not, represent an abnormal eating behavior. We can assume it is abnormal in case of patients with the Alzheimer's disease (see axiom 15), whose behavior is likely to cause hallucinations. In contrast, in case of another disease like pica that causes just the continuous eating of nonnutritive substance, we know that such a kind of illnesses is diagnosed only when this anomalous eating is repeated for at least one month [6]. Such a condition may also be dangerous in case of ingestion of poisoning substances (axiom 18).

The fluent that detects the starting of eating outside a regular timeframe is: *isAnomalousStartEating(x,S)*; whereas, *isAnomalousBreakfastDuration* and *isAbnormalBreakfastDuration*, respectively, detect a situation of anomalous or abnormal duration of the breakfast, where the difference consists just in the value of the threshold. Finally, the fluent *sAbnormalOvereating* denotes a situation produced by an excessive eating during all the day.

$$\begin{aligned}&\mathbf{isEating(do(a,S))} \equiv\\ &\{\exists(x,t).(a = startEating(x,t))\} \vee\\ &isEating(S) \wedge \neg\{\exists(x,t).(a = stopEating(x,t))\}\end{aligned} \tag{11}$$

$$\begin{aligned}&\mathbf{isAnomalousEating(x,do(a,S))} \equiv\\ &\{\exists(t).(a = startEating(x,t) \wedge isObject(x))\} \vee\\ &(isDangerousEating(x,S) \wedge\\ &\neg\{\exists(t).(a = stopEating(x,t)) \vee \exists(z,t).(a = startDrinking(z,t))\}\end{aligned} \tag{12}$$

$$\begin{aligned}&\mathbf{isAnomalousStartEating(do(a,S))} \equiv\\ &\{\exists(x,t).(a = startEating(x,t) \wedge \neg isT_{breakfast}(t) \wedge \neg isT_{lanch}(t) \wedge \neg isT_{dinner}(t))\} \vee\\ &(isAnomalousStartEating(S) \wedge\\ &\neg\{\exists(x,t).(a = stopEating(x,t)) \vee \exists(x,t).(a = startDrinking(x,t))\}\end{aligned} \tag{13}$$

$$\begin{aligned}&\mathbf{isAnomalousBreakfastDuration(do(a,S))} \equiv\\ &\{\exists(x,t).(a = stopEating(x,t) \wedge \sum_{Breakfast}^{i}(T^i_{stopEating} - T^i_{startEating}) > \Delta_b)\} \vee\\ &(isAnomalousBreakfastDuration(S)) \wedge\\ &\neg\{\exists(t).(a = resetAnomalousBreakfastDuration(t))\}\end{aligned} \tag{14}$$

$$\mathbf{isAbnormalEating(x,do(a,S))} \equiv \mathbf{isAnomalousEating(x,do(a,S))} \tag{15}$$

$$\begin{aligned}&\mathbf{isAbnormalBreakfastDuration(do(a,S))} \equiv\\ &\{\exists(x,t).(a = stopEating(x,t) \wedge\\ &\sum_{Breakfast}^{i}(T^i_{stopEating} - T^i_{startEating}) > \Delta_{abnBreakfast})\} \vee\\ &(isAbnormalBreakfastDuration(S)) \wedge\\ &\neg\{\exists(t).(a = resetAbnormalBreakfastDuration(t))\}\end{aligned} \tag{16}$$

$$\begin{aligned}&\mathbf{isAbnormalOverEating(do(a,S))} \equiv\\ &\{\exists(x,t).(a = stopEating(x,t) \wedge\\ &\sum_{DailyMeals}^{i}(T^i_{stopEating} - T^i_{startEating}) > \Delta_{abnDailyMeals}\} \vee\\ &(isAbnormalOverEating(S) \wedge \neg\{\exists(t).(a = resetAbnormalOverEating(t)))\}\end{aligned} \tag{17}$$

$$\begin{aligned}&\mathbf{isDangerousEating(x,do(a,S))} \equiv\\ &\mathbf{isAbnormalEating(x,do(a,S))} \wedge isPoison(x) \vee\\ &(isDangerousEating(S) \wedge \neg\{\exists(t).(a = resetDangerousEating(t)))\}\end{aligned} \tag{18}$$

5 System Architecture

The prototype architecture that we are realizing for the monitoring of eating disorders in case of patients with Alzhaimer's disease is shown in figure 1. It consists of three subsystems: the *Messaging Subsystem*, which interacts with the user in the environment, the *Activity Recognition Subsystem* that offers functionality for the primary and secondary context-awareness; and, the *Behavior Detection Subsystem* for the situation awareness and behavior analysis. The *Messaging Subsystem* has been derived from *Uranus*, which is an open source middleware platform for AAL applications [7]. The *Activity Recognition Subsystem*, instead, is under construction. Such a functionality will be realized using modern RGB-D depth cameras that present opportunities for object recognition systems, thanks to the possibility of combining color- and depth-based recognition [8].

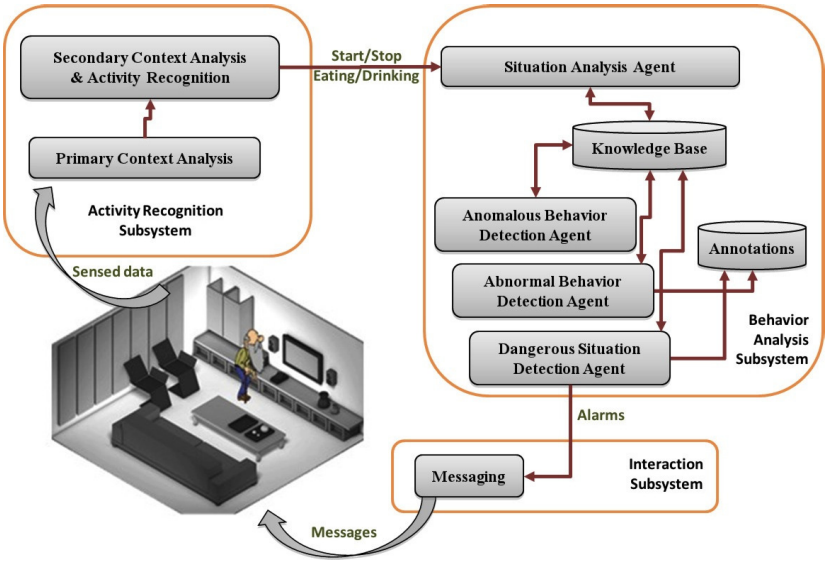

Fig. 1. Prototype architecture

The rest of the architecture, instead, is completely new and consists of four intelligent agents realized by means of *Golog*, the prolog interpreter for *Situation Calculus*. The *Situation Analysis Agent* is the one that updates the current situation as the patient executes actions within the monitored environment. The *Anomalous Behavior Detection Agent* monitors the truth values of fluents dedicated to anomalous events and axioms [12-14]. The *Abnormal Behavior Detection Agent*, instead, recognizes abnormal behaviors and annotates them for the assessment of the disease by the clinician. Finally, the *Dangerous Situation Detection Agent* detects dangerous situations and behaviors like the tentative of ingestion of poisoning substances and alerts the patients. Figure 2 shows a piece of a trace of events produced by the behavior analysis

subsystem having been solicited by an emulator of the activity recognition module. In this trace, the fluent *isAnomalousStartEating* becomes true as soon as the patient starts eating outside the time frame. *isAnomalousBreakfastDuration*, instead, detects an anomalous amount of food eaten (based on the duration of the activity) at the end of the third cycle of eating. Two cycles of eating may be separated by a brief pause or because the patient starts to drink something. Finally, in this test there is not an abnormal duration of the breakfast because the related threshold has not been reached.

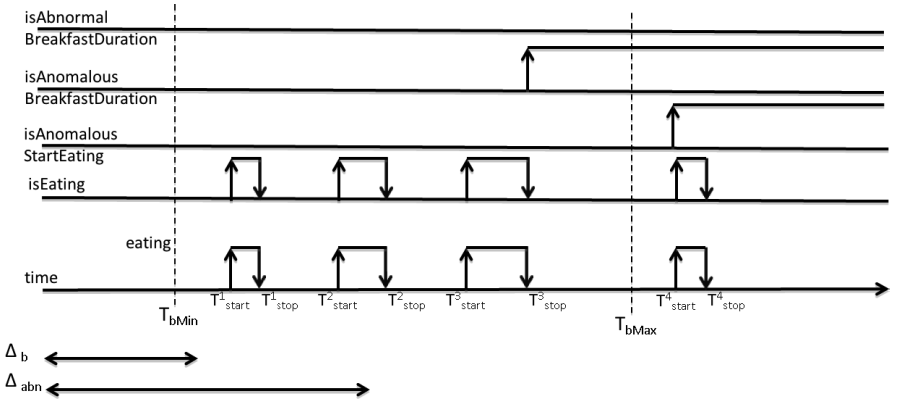

Fig. 2. A trace of the events produced by the monitoring agents

6 Discussion

This paper has presented some of our results on handling anomalous and abnormal eating behaviors of cognitive impaired patients in monitored environments. Handling such behaviors mainly requires four activities: 1) *detection*; 2) *identification*; 3) *recovery*; and, 4) *prevention*. Although simple, the case study has demonstrated that the proposed approach can support detection. Indeed, having specified all necessary fluents; anomalous, abnormal, and dangerous behaviors occur when, respectively, fluent of kind *isAnomalous*, *isAbnormal*, and *isDangerous* change their truth's value to true. A partially automated identification can be performed by analyzing the sequence of actions that have led in the current (dangerous/anomalous) situation. Recovery and prevention have not been considered yet.

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Federated Mobile Activity Recognition Using a Smart Service Adapter for Cloud Offloading

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Abstract. Mobile based activity recognition is gaining importance with the ever increasing sensing, communication and computational power of smart phones. Our work addresses the current key challenges in the field of mobile sensing - how to make continuous sensing mobile applications both efficient and scalable. We motivate our work with a smart context-aware e-health application. Activities of daily living are modeled using a hidden Markov model and the classified activities are used to adapt sensing and feature extraction to decrease the energy consumption on the mobile. We present a federated context-management framework for activity recognition which implements a smart service adapter to offload execution to the cloud to achieve scalability and efficiency.

Keywords: activity recognition, hidden Markov model, Markov decision process, remote processing, cloud computing.

1 Introduction

Ambient Intelligence (AmI) is a user centric paradigm where smart devices can sense, anticipate and react to the needs and preferences of its users [1]. As today's smart phones come with an increasing range of sensing, communication, storage and computational resources they can play a special role in realizing true human-centric AmI. For example, a smart phone can be used for monitoring human activities in smart home/health domains, or for receiving various location based services (personalized ads, discount deals) in smart shopping/city scenarios. As mobile based activity recognition applications grow, a key challenge is to continuously sense and process the available raw data to infer the high-level activities of the users without depleting the resources (battery, communication bandwidth and computational resources) for the normal functions of a mobile phone. Another major concern is to hand-tune the behavioral models for each user. Although community based generalized learning techniques have been proposed to address the issues with training data, most of the existing statistical models are not scalable [2]. Right now, despite continuous improvements in mobile technology, the smart phone is still resource poor as compared to static hardware. Therefore, computation on a mobile

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device will always involve compromises as mobile phones cannot be overloaded with continuous sensing commitments that undermine the performance of the phone. Delegating some of the context processing and activity recognition to the cloud with nice scalability properties may be part of the overall solution.

Our work in progress fits within the frame of the FP7 BUTLER[1] project and addresses the above concern in a specific domain of interest - personal health care - where we propose a smart context aware diary with activity recognition for diabetes patients. Diabetes, a chronic disease of growing concern, is a condition where the human body does not produce or utilize insulin. Frequent blood testing for glucose levels is highly recommended and people must monitor their carbohydrates intake and utilization during exercise [3]. Our application exploits smart phone sensors to continuously monitor the physical activity intensity combined with other user inputs such as recommended base insulin dosage and nutritional intake to recommend personalized insulin dosages.

The main contribution of this paper is a mobile-cloud based framework for context and activity recognition that is both energy and computationally efficient for the mobile and is scalable by leveraging the cloud. A hidden Markov model (HMM) is used to model the physical activity levels of the user (standing, sitting, walking, using stairs and running). Based on the battery level, the communication bandwidth and other computational resources, we use a context-aware strategy to reduce mobile resource usage by leveraging a cloud infrastructure. The sensing components and interaction capabilities remain with the mobile device. The cloud infrastructure is used to both free the local device from computationally intensive tasks as well as to make the system scalable.

The remaining part of the paper is structured as follows. Section 2 explains the motivating use case and scenario for our work. Section 3 gives a detailed overview of the federated context management framework for activity recognition with a smart execution adapter for code offloading to the cloud. Section 4 gives a short overview on related work and section 5 ends with a conclusion and planned future work.

2 Motivating Use Case and Scenario

This section briefly describes the health application and major research challenges in context-aware, efficient and scalable implementation of the application. As shown in the Fig. 1 the health application has four major components, (1) a user interface to gather personal details and the nutritional intake of the user, (2) an accelerometer based activity recognition system to detect the current physical activity level of the user, (3) a recommender engine to compute the advice for the patient and (4) a diary of the significant events in the system over time.

Calorific intake calculations are done deterministically based on the manual input from the user whereas energy expenditure is automatically calculated based on the

[1] http://www.iot-butler.eu

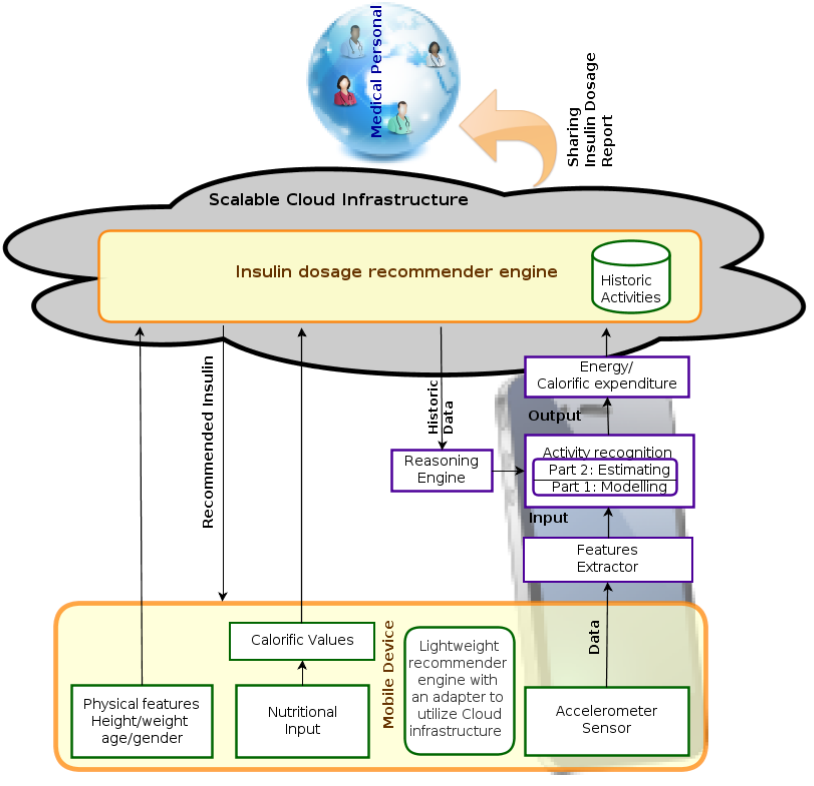

Fig. 1. The context and activity processing diagram of the diabetes application

stochastic accelerometer data. Once the activities of the user are estimated, the energy expenditure is calculated by a simple deterministic function based on activity details such as stride length, step count, distance walked/run and other physical characteristics of the user [4]. Also, a diary of significant events (nutritional intake, energy expenditure and recommended insulin dosage) is maintained for enabling case-based reasoning as well as for future reference. Evidently, activity recognition is the most significant as well as the most resource consuming task of the system. Our system utilizes the built-in tri-axial accelerometer to do opportunistic sensing. Although the energy efficiency of the accelerometers has increased over the years, continuous sensing at high frequencies and onboard processing of these data streams have proven to rapidly drain the battery of mobile devices [5]. Hence, the major challenges with sensing are to determine the optimal sampling frequency and extracting the suitable features depending on the other available context information. Despite using opportunistic sensing, precise labeling of the training data is a significant challenge as most models require extensive training data for good classification accuracy. This problem worsens as the scale of this system increases. Therefore, the primary motivation of this paper is to build a scalable activity recognition system for mobile devices with intelligent hybrid sensing, inference and learning that can leverage the resource rich environment of the cloud.

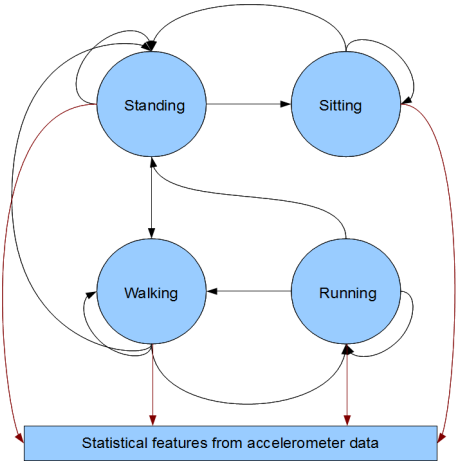

Fig. 2. Hidden Markov model for activity recognition

Suppose the set of accelerometer observations is $A_t = \sum_{x,y,z,t} a(t)$, then the task is to extract a set of features F(x,y,z,t) and to use it to estimate the current physical activity of the user, P_t = {Standing, Sitting, Walking and running}. Estimating the current activity P_t can be sub-divided in to two parts. First, build a model M and its parameters λ based on F(x,y,z,t) and then to estimate a sequence of activities, P_t over time using the model (M, λ) and observations F(x,y,z,t). Now, given the activity of the user P_t, activity intensity details such as step count, speed and energy expenditure can be calculated from features extracted from the raw accelerometer data like zero-crossings [4]. Later, the estimated activity intensity is used along with the calorific intake of the user to recommend an optimal insulin dosage.

3 Federated Context Management Architecture for Activity Recognition

Our activity recognition framework exploits the tri-axial accelerometer readily available in smart phones. As the sampling rate has an impact on the battery life time, we propose a context aware switching of the sampling frequency between 5Hz, 16Hz, 50 Hz and 100Hz (each accelerometer sample being a float of 64 bits) depending on the intensity of the current user activity (as Android APIs are restricted to these 4 discrete values [5]). Higher sampling rates are used for either high intensity activities or when the current activity of the user is unknown. The sampled data is used to extract different statistical features that can be used to estimate body postures or to differentiate dynamic from static activities. After the gravity component is filtered from the motion component of the raw data using a low-pass filter, a sliding window of size 4 seconds with 50% samples overlapped is used to extract features such as mean, variance, signal magnitude areas (SMA), axis angle and accumulated variety (AV). As shown in [6], a quantized 16 bit representation of these features is sufficient to estimate the activity intensity level, body postures and activity transitions.

3.1 Modeling Activities with an HMM

As shown in Fig. 2, a discrete time Hidden Markov Model (HMM) with Gaussian distribution is used to model the activities of the user. The four user activities to be classified are modeled as hidden states with sparse transition probabilities based on the domain knowledge (limitations of the human body due to kinematic constraints). The Baum-Welch algorithm is used to train the model efficiently as the number of states is known in advance. Similarly, the Viterbi algorithm that is used to infer the optimal state sequence can be improved by using prior knowledge on state transition (obtained from SMA) to reduce the computational complexity.

3.2 Offloading to the Cloud with an MDP

In addition to the above intelligent inference algorithm, we introduce a smart context-aware service that utilizes the cloud infrastructure to take advantage of extended memory and computation resources to achieve scalability. A service adapter runs on the mobile to dynamically offload the processing to the remote cloud infrastructure. Mobile devices have two alternatives for code offload: use either 3G or Wi-Fi. Although 3G provides near-ubiquitous coverage, recent studies have shown that round-trip times over 3G are lengthy, bandwidth is limited, and more energy consumption. A lightweight recommender engine and activity recognition module is also deployed on the mobile device to overcome offload failures due to connectivity issues. The service adapter uses cost models (CPU, memory, storage, communication) of each of the components to decide when to offload execution to the cloud. Once the execution is offloaded to the remote feature extractor, activity recognition and energy utilization services provide input to the recommender engine. This engine sends back the results to the mobile device interface. The historic data in the diary with nutritional intake, energy expenditure and the recommended insulin dosage are also part of the recommender engine on the cloud infrastructure and implemented as a scalable Software as a Service (SaaS) interface for activity recognition for any sort of application that is based on accelerometer data.

A key research challenge in implementing the smart service adapter is to choose a non-trivial function that decides when to offload execution to the cloud. We model this as a Markov decision process (MDP) to learn the best offloading policy given the current availability of computational, communication and energy budget available for our application without compensating the classification accuracy. Our goal is to achieve 90% classification accuracy with battery budget of 15% over 24 hours and 5% of its communication bandwidth. As most users also have monetary budget limits for using 3G, we prefer secured Wi-Fi whenever possible. The Markov decision process is represented as a tuple {S,A,P,R} where S is the state space, A is the action space (i.e. when to switch to remote processing), $P(S) = Pr(S = s|S = s',A = a)$, is the transition probability depending on the action A = a and R(s,a) is the reward function for performing action a when in state s. The state space of the MDP consists of complex states containing the current activity of the user, available battery budget, current time, available communication channels and corresponding budget. Also, a simple reward function (a weighted function of different state variables) is used. The reward function co-efficient can also be set by the user according to his resource

preferences. Now, the optimal policy - i.e. the best possible mapping between states and actions sets given the reward function is computed from the Bellman equation [7]. The results are stored in a table for use by the smart adapter on the mobile device for deciding to offload to the cloud.

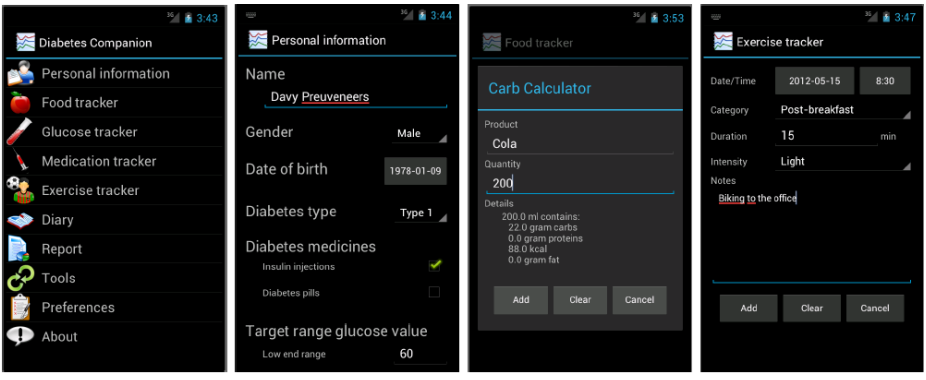

Fig. 3. Screenshots of the Diabetes Companion application for Android

3.3 A Preliminary Evaluation

The development of the diabetes management application is still a work in progress, but the core functionality has been implemented (see screenshots in Fig. 3). The algorithms to process the accelerometer values are also in place, but due to a known issue with the Android OS since version 2.x, the accelerometer does not produce updates when the screen is turned off. We have run experiments with the screen on but dimmed, but it still skews the results for energy consumption significantly. We are currently looking at other technical solutions (external accelerometer sensors) to circumvent this problem.

Let's assume the worst case scenario. If the accelerometer is sampled at the highest possible rate (100 Hz) continuously for 24 hours, it would be 1658880000 bits of data (and the best case of sampling at 5Hz would need 82940000 bits) whereas after pre-processing it would require only 691200 bits. As we assume four different states, once HMM based inference is done only 172800 bits are required to communicate the activities of the user over time. This simple exercise already makes clear that simply sending all the raw accelerometer data will require a significant amount of data to be communicated to the cloud, and that part of the initial pre-processing and filtering will have to be carried out on the phone.

4 Related Work

Despite the advances in the field of computing and artificial intelligence, human activity recognition is still an open and challenging problem. Most related work is based on video/ image based activity recognition where the gait energy image or silhouettes or the position of different body parts are processed by sequential

statistical models [8]. Although cameras can give easy access to rich contextual information, many people would have privacy issues especially with such intrusive sensors. Alternatively, many non-invasive sensors such as accelerometers, gyroscopes, GPS, light sensors have been used to monitor activities of daily living. Despite their enhanced situational awareness and task efficiency, wearable sensors are not preferred [9] for continuous monitoring as they might impede user mobility in day to day activities. Given the availability of cheap embedded sensors to enhance the user experience and the networked nature, smart phones have become an indispensable choice for monitoring activities of daily living unobtrusively. Until recently, mobile based continuous sensing required special mobile platforms or hand tuning of the models for each user [10]. Also, as shown in the related works study of [11], little work has been done in using HMM for activity recognition based on accelerometer data. Although, our work is very similar to other works in the domain of ubiquitous health care such as UbiFit Garden [12], we are primarily concerned about efficient sensing and inference considering various resource overheads. Architecture presented in [13, 14] are similar to our approach of utilizing the cloud infrastructure for mobile execution but they don't consider context for remote processing. In [15] the authors have presented a software as a service solution for context management in the form of services, whereas our remote infrastructure to manage the context is tailored to activity recognition.

5 Conclusion and Future Work

Mobile applications combined with cloud computing are a powerful tool to achieve pervasiveness in a flexible and scalable way. The diversity and heterogeneity of technologies are a barrier to achieving seamless interoperability. Our work proposes a novel federated architecture for mobile based human activity recognition with a smart service adapter for code offloading to the cloud.

We motivated our work with a diabetes healthcare application that leverages context-aware activity recognition. Resource utilization for activity recognition is a major concern due to continuous sensing and complex computations. Clearly, smartly adapting accelerometer sensing rate and executing the processing of this data elsewhere by offloading it to the cloud when necessary can increase the efficiency of context management and activity recognition, and at the same time improve the battery life of the mobile device.

In the future, we would like to do a detailed evaluation by monitoring various other resources like CPU usage and suitability of the available data in the cloud for multi-user training. Also, we plan to extend our system by integrating other sensors such as GPS which would lead to more sophisticated inference algorithms with multi-modal sensor data and multi-sensor fusion.

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A Bayesian Network (BN) Based Probabilistic Solution to Enhance Emotional Ontology

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Abstract. Recognizing an emotional context created using human bio-signals has gained traction in contemporary applications. The current emotional ontology however cannot handle probabilistic information in the emotion recognition process. The primary goal of this research is to utilize a Bayesian Network into the study of EEG-based emotion recognition to address the probabilistic context data. The work is based our previous emotion ontology prototype 'Emotiono'; the EEG dataset for evaluating its performance being extracted from 'DEAP' which an open multimodal database for emotion analysis. With 10-fold data in validation the average classification rate using the posited method reaches 86.8 % for Arousal and 85.9 % for Valence in the two dimensional emotion recognition processes.

Keywords: emotion, emotion recognition, Ontology, Bayesian Networks.

1 Introduction

During the last decade emotional context-awareness has dominated the Affective Computing field; especially for the assessment of emotional states. After rapid development, a mature model which can be generally accepted is described in [1]. Ontology-based context modeling (OBCM) enables: the representation of contextual information in a diverse domains, share knowledge as a set of concepts (generally expressed as Classes), and define semantic relationships between concepts. Additionally, OBCM incorporates the ability to: draw inferences from pre-existing (a priori) data and implement affective modeling naturally [2]. Related physiological signals describe and define emotional contexts. The developing emotion ontology advances the definition and modeling of emotional 'states' [27] [30]. While the research has addressed a number of challenges as discussed in later section there are outstanding challenges and open research questions.

In documented research addressing emotion in terms of physiology and psychology 'states' emotion has certain and uncertain characteristics; the emotional state being very difficult to determine with high confidence level. Dimensions such as

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responsibility, control, motive consistency, pleasantness, and certainty provide important distinctions among emotions [4]. In the literature processing functions the difficulty in capturing incomplete, partial, or uncertain knowledge has been shown to be a difficult challenge. This is particularly apparent where OBCM is used to conceptualize an application domain or to achieve semantic interoperability among heterogeneous systems. Our approach is designed to manage uncertainty in emotion recognition [5] [6].

Trends in context-aware systems research has considered modeling of uncertainty; in our research to address uncertainty we propose the Bayesian Network model implement reasoning based on our ontology, simplify the logical framework, and optimize processing. The results of our research have demonstrated the potential to address the use of bio- signal semantic OBCM and promote probabilistic context as a common extension of emotion ontology.

The remainder of this paper is structured as follows: section 2 describes the framework of uncertainty ontology, the BN methodology along with the Bayesian Network Method and emotional modeling under uncertainty. Section 3 presents the structure of the ontology, data collection and preprocessing, and feature extraction and selection. The paper concludes with results, a discussion, conclusions, and open research questions.

2 Modeling the Probabilistic Emotional Ontology

EEG data is used for assessment of emotion and to build the 'Emotiono' ontology. Following the processing on the EEG data the BN is applied to manage uncertainty based on the probabilistic ontology. The initial step is to modify the 'Emotiono' ontology into a new ontological framework which can be populated with the relevant probability. We then use the dataset of EEG features to evaluate the emotion classification results and efficiency of BN-based classification. This section explains how method works in the first step.

2.1 The Bayesian Network Method

Bayesian Networks or belief networks were suggested by Pearl in 1988, who found the theoretical basis of BN. To improve the shortcomings of existed approaches such as Logic-based methods, BN can present and compute the conditional probability value between different entities. BN have nodes representing random variables, arcs representing causal relations and any variables independent of all other non-descendent variables. BN are also similar to an OWL graph structure because both BN and OWL are directed acyclic graph (DAG), and both apply semantic representation. With the rapid development of BN in recent years, it has a rich set of efficient algorithms for learning and reasoning.

Consequential posterior probabilities can be computed when multiplying a priori probability using condition probability. Furthermore, when types of probabilistic knowledge are stored in the related ontology the BN connects with the ontology naturally. Current probabilistic ontology research addressing BN such as BayesOWL,

OntoBayes, and PROWL [9] [10] have demonstrated that the use of probabilistic ontologies represents a potentially promising research direction.

2.2 Modeling of Emotional Uncertainty

A generally accepted definition of emotion is: a conscious mental reaction (as anger or fear) and is frequently used to describe short-term variations, subjectively experienced as strong feeling usually directed toward a specific object and typically accompanied by physiological and behavioral changes in the body [11].

With the indefinite and abstract emotional concepts, the existed researches have specified and constructed the model of emotion. Research in this field has focused on two basic dimensions of affective model, Arousal and Valence [12]. Arousal represents the variable to measure intensity of emotion encoded as calm or excited; Valence represents positive or negative level of emotion encoded semantically as for example 'happy' or 'sad'. This affective model has been applied to "Emotiono" based on the experimental material IAPS in which the scales of two dimensions are from 1 to 9. Our previous study adopts four quadrants (HVHA, HVLA, LVLA, and LVHA) to divide Arousal-Valence model. Three different emotional classes were represented in the model: Calm (LA), Exciting positive (HVHA) and Exciting negative (LVHA).

The Arousal-Valence space model incorporates uncertainty factors which influence the accuracy and ontology expression of emotion. Emotion contains many affective states such as happy, sad, curios, stressed, and neutral. After the processing of EEG a decision can be reached identifying the subjects 'state' and then express the state(s)s. However, emotion is complicated, and an affective state expressed by subject can integrate several affective states. In actuality the subject's affective state is dependent on the dominant state. [13] Emotion, when combined with multiple affective states generates uncertainty in emotion assessment. Therefore the use of a probabilistic method represents a viable solution. After data processing, the emotion is assessed by probabilistic values which represent the weights of relevant affective states.

2.3 The Structure of Probabilistic "Emotiono"

The introduction of probability into "Emotiono" has resulted if further changes. In addition to adding probability values into OWL documents we have also simplified and increased the speed of the framework. The probability values and variables could stand for possibility whether or not the emotional procedure and affective status of subjects occur.

The preceding section has considered the theoretical basis for the posited approach; this section addresses the emotional modeling which employs 3 steps: (1) the first step is the simplification of the ontology to facilitate the addition of the probability values into OWL files, (2) the second step is BN structure learning and estimation of parameter which can compute the relevant probability values. And (3) the third step is the population of the ontology with the probability values to facilitate reasoning under uncertainty. The first step is discussed in this section; steps 2 and 3 are addressed in the subsequent section.

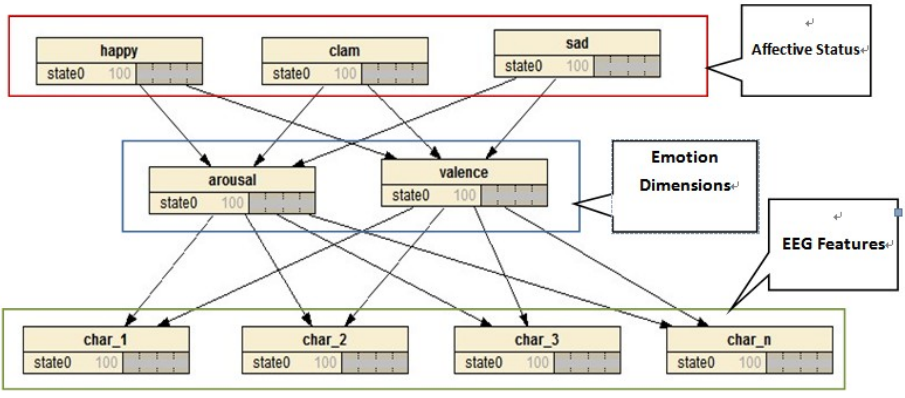

Fig. 1. Modeling Emotion Assessment BN

Investigations by Zhongli Ding and Yi Yang [9] [10] have identified the benefits of a structured rule approach to convert the ontology into a BN. Fig. 1 (edited in Netica Toolkit [25]) shows the 'Emotiono' relevant BN; we focused on the three levels to represent the method for emotional assessment. The top level contained affective status, and it could be expanded to contain multiple states. The middle level showed the commonly used emotional dimensions. The bottom level contained EEG features which had been selected. The CPT (Conditional Probability Tables) would be computed by BN classifier. The W3C Web Ontology Language (OWL) [17] has been used to represent the 'Emotiono' by using the Protégé 4.2 editor [18].

3 Data Driven Probabilistic Ontology Evaluation

3.1 Data Collection and Preprocessing

The DEAP (Database for Emotion Analysis using Physiological Signals) is a publicly available dataset for the analysis of human affective states. The dataset consists of three parts: The participant ratings, participant questionnaire, the physiological recordings and face video of an experiment. There is electroencephalogram (EEG) and peripheral physiological signals of participants. Each of them watched 40 one-minute long excerpts of music videos, and then rated each video in terms of the levels of arousal, valence, like/dislike, dominance and familiarity. For a more thorough explanation of the dataset collection and its contents, refer [19] [20].

Corresponding work to the participant rating is to select the Arousal and Valence dimensions rating. Subsequently, we randomly selected data from three subjects (s1, s18, s19) of DEAP, to compute an experimental result. Past experience has shown that the dataset has utilized 5 pre-processing steps. First, the data sampling rate was set at 128Hz. Second, the data was segmented into 60-second trials and a 3 second pre-trial baseline. Third, the trials were reordered from presentation order to video (Experiment_ID) order. Then, we used a Wavelet Algorithm to remove EOG artifacts. Finally, a Bandpass frequency filter from 4.0-45.0Hz was applied.

3.2 Feature Extraction and Selection

The features were extracted by sliding 4second windows with a 2second overlap between consecutive computations. Using general practice [3] we extracted typical statistical values, linear and nonlinear measures which computed on 32 channels. Overall 700 EEG features were extracted from all electrodes. The original ratings of arousal and valence were ranged from 0 to 9. Corresponding to four quadrants of the two-dimensional emotion model, the ratings were divided into two parts (above 5 or below).

For efficient analysis [22] we repeated the Decision Tree (C4.5 algorithm) [21] method using it for feature selection in this work. Retaining a previous methodology we used the J48 classifier (a Java implementation of C4.5 Classifier) in the Waikato Environment for Knowledge Analysis (WEKA) [24]. The generated decision tree is depicted in Fig. 2. Following the arrow, the routing is down the tree and the leaf is assigned HA (or LA, HV, LV) to represent the affective state. However, the generated tree displayed an unanticipated result: nodes of each subject's tree are only one feature from different electrodes. The tree generated by integrating data from three subjects showed the similar result. The feature "Absolute_Power_Beta / Absolute_Power_Theta" divided high or low rating observably.

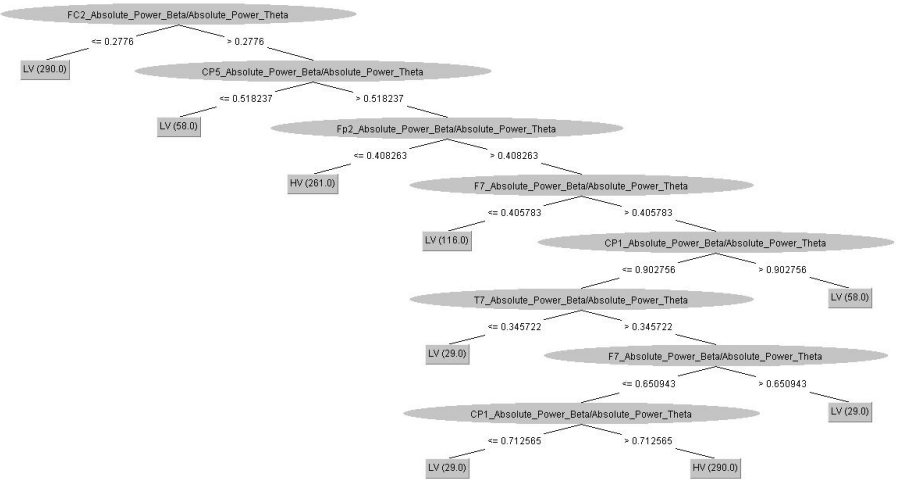

Fig. 2. A simple Rule-based Decision Tree to select feature

Following a review the choice was made to select the features shown in the decision tree generated from the data generated by the 3 subjects. The "Absolute_Power_Beta / Absolute_Power_Theta" (APB/APT)feature from 31 electrodes (FP1, AF3, F3, F7, FC5, FC1, C, T7, CP5, CP1, P3, PO3, O1, Oz, Pz, Fp2, AF4, Fz, F4, F8, FC6, FC2, Cz, C4, T8, CP6, CP2, P4, P8, PO4, O2) except P7 electrode (which was not generated in the Decision Tree).

3.3 Bayesian Network Classification

We chose the open-source data mining platform WEKA 3.6 to perform this work. Prior to beginning the Bayesian Network classification [23] the preprocessed APB/APT features are all continuous variables. It is preferable if the variables are discretized. The number of discretized bin was set to 10. The effect of discretization is shown in Fig 3.

Fig. 3. Discretize APB/APT value on FP1

The distribution of APB/APT discretized feature on P7 electrode was unnatural. Therefore in response the decision tree does not incorporate the node "APB/APT on P7".

Bayesian network learning is a two stage processes: (1) initially the network structure is learnt, and (2) secondly the probability tables are learnt. Classification is divided into two groups for the emotion dimension variable Arousal and Valence. In practice, the structure of the network is identified by data experts (see Section II), not by a machine. We used the search package: 'weka.classifiers.bayes.net.search.local.K2' and the estimator: 'weka.classifiers.bayes.net.estimate.SimpleEstimator' to finish these two stage processes.

In both tasks, parameters were set by initial conditions. The test mode is 10-fold cross-validation, which was designed to reduce classification errors and update features which are less important.

Finally, the Naïve Bayesian network of variable "arousal_class" and "valence_class" was trained successfully in real-time. We could see the probabilistic relations between user's emotional state and related 31 EEG features. The results are presented in the following section.

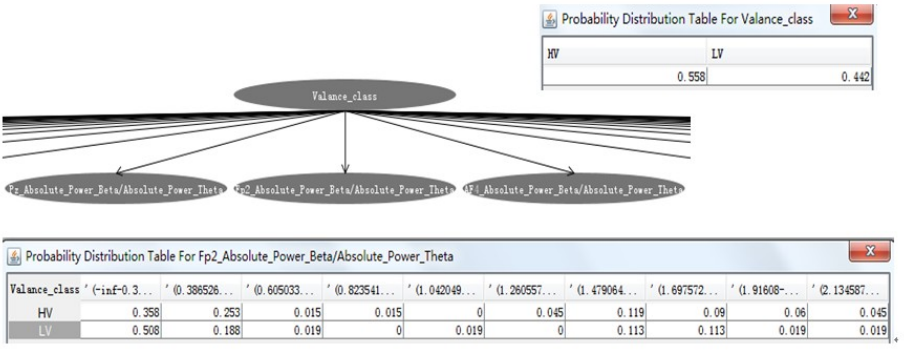

Fig. 4. Part of "valence_class" Bayesian Network (Structure, CPT)

3.4 Results of Classification

As we have mentioned earlier, a BN provides a flexible framework for reasoning under uncertainty. The developed model relates two primary dimensions of emotion, and represents the connection between EEG features and emotional state. After 10-fold cross validation method training and testing, the index of BN Classification is acceptable, and the average accuracy of classification reaches 86.8 and 85.9 (Arousal and Valence). In specific, Table 2 indicates the percentage of correctly classified items (true positive rate). Similarly, we can see the percentage of the emotional instances which were wrongly classified as items of the class under consideration (false positive rate) [26]. Moreover, these precision data detailed accuracy for each dimensional condition.

Upon these classification indexes, we could assign the relevant probability values to the ontology OWL files. In the experiment process, we found the number of discretized bins can impact the accuracy rate. If we set the bins to 3, the average accuracy of classification would decrease obviously. For instance, the class of valence, the average accuracy can reach 85.9 % in 10 bins, but can just reach 75.6 % in 5 bins. It can explain the limitations or weaknesses of Bayesian Network, the BN handle the continuous variables poorly. Moreover, the discretization of continuous variables must result in drop of average accuracy.

Table 1. Summary of BN classification

Index / Class	Correctly Classified Instances	Incorrectly Classified Instances	Kappa statistic	Mean absolute error
arousal_class	3021 86.8 %	459 13.2 %	0.7107	0.155
valence_class	2989 85.9 %	491 14.1 %	0.7176	0.161

Table 2. Detailed accuracy by class

Class-Index	TP Rate	FP Rate	Precision	Recall	F-Measure
HA	0.921	0.223	0.877	0.921	0.898
LA	0.777	0.079	0.851	0.777	0.812
HV	0.824	0.097	0.915	0.824	0.867
LV	0.903	0.176	0.802	0.903	0.85
Weighted Avg.	0.856	0.144	0.861	0.856	0.857

Although some aspect of this method should be deliberated, in general, we found an uncertain method to enrich the ontology for emotion uncertainty assessment. In fact, the feature selection method: Decision Tree (C4.5 algorithm) dealing effectively with the feature selection for emotion. In actuality the population (test instances) used in the experiment is arguably too small to be representative and a larger population is required to better present the performance of the posited approach. Notwithstanding this reservation the uncertainty method may achieve improved performance in reasoning than standard traditional methods. A real-time system needs a larger dataset to assess and evaluate the proposed approach.

4 Discussion and Future Work

We have proposed a method that can effectively assess emotional states using an EEG-based Bayesian Network classification. Our research has improved the traditional structure, and our method has improved the labeled data classification with its abundant semantics. Finally, we have integrated the classifiers and the EEG-based emotional ontology to build a real time emotion assessment system.

To effectively combine actual data we need to use a larger dataset to train the Bayesian Network and evaluate the ontology effectively and compare the other methods to classify the affective status. The multimodal dataset should be represented to "Emotiono" and integrate the standard method and uncertainty method. For the goal of 'Emotiono' research, the environment facts need to be regarded as indispensable. The framework integrating ontology and BN should be improved to enable automatic rule-based procedures to convert the ontology into a BN.

This paper has described our approach of representing and assessing emotional contexts under uncertainty. The study has focused on modeling uncertainty assess emotional states. Our work is part of an ongoing research into ubiquitous Affective Computing. While the research has addressed a number of issues there remain significant challenges which include: it had better combine more user context with Bayesian Network for emotion assessment, ontology is known as a model which is easy to add new concept and rule, the relations of ontology also can be self-defined, but the causality of BN will limit the relation pattern and switching process from ontology to BN; it needs more dataset to consolidate robustness of the uncertainty method model. From statistics sense, the generated probability rule would be more stable and meaningful if they were computed by abundant data; we suggest a way to achieve the aim, however we had better search more method to improve the process or provide

reference for this study. These challenges is not considered to be trivial, addressing them represents open research questions which for the basis for future work.

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Network Relationships and Individual Creativity between Members within a Small Group: Trust in Leader Moderating Effect of the Comparison

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Abstract. This study was studied network and individual creativity relationships between members within a small group from social network point of view. In particular, the trust in leader was considered as moderating variable in social network and creativity relationships. Furthermore, studied was figured out there are differences effective for individual creativity by considering individuals' way of working (exploitation vs. exploration). For this, we have assigned the same task for the university students who are taking the same subject, and asked them to make the group to solve that assignment. And we surveyed them about the network among the group members that is formed in the process of carrying out the assignment. There were total 56 teams and analyzed 308 valid questionnaires data. After analysis, closeness centrality of a member in that small group was take advantage of the exploitation of existing knowledge and information on positive effect, which promotes individual creativity, but, to pursue exploration of new knowledge or information did not have a significant influence. On the other hand, when trust in leader is high, closeness centrality was the important affecting factor for exploration, but when it was low, closeness centrality rather affected exploitation significantly. In each case, it was a positive outcome for individual creativity.

Keywords: Individual creativity, Closeness centrality, Exploitation, Exploration, Trust in leader.

1 Introduction

There is continued interest of the creativity for the human race in many areas. There are constant efforts of human to get a better life, ranging from daily life to development of technology by creating a new idea beyond the current situation.

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This study is a kind of creativity-related research, which is effect to individual creativity how to set network between group members in small group from social network point of view. Still creativity studies of small groups are still insignificant state, and even existing social network study can qualify only that at the level of individuals or companies with limited effort. On the other hand, this study was investigated role of trust in leader to identify these impacts in relationship. Usually, there is hard to get a good communication when lack of belief and trust exist. Even if the other party is right, he/she thinks there is a hidden bad intention behind because of that lack of trust. This phenomenon, especially when leaders communicate with subordinates, should be more careful it. In this context, this research is focusing on the trust, especially the trust in leaders which was considered as a moderating variable within social network and creativity relationship of small group.

The goal of this study can be summarized as follows. First, analyze how the individual creativity that will evaluate impact by social network within members of the small group. Second, among exploitation and exploration in the small group's case, we will show which way is more helpful for increasing individual creativity. Especially, we will analyze how these working styles could affect creativity depending on the degree of trust in leader.

2 Research Hypotheses

Social network analysis has a many different fields exist, but one of the most important is the centrality. Centrality is expressing the unique value in a social network of central connections. In other words, centralization can easily make internal communication by incorporating subunits and also better make exploitation of knowledge within organizations. As a result, discover new knowledge within one part of the organization found, that can be able to spread rapidly the other part.

With the importance of "social network" conception, the related studies have been increasingly and rigorously performed. For instance, Brass [4] introduced the idea that social networks, particularly weaker relationships, may have some influence on creativity. Zhou *et al.* [21] showed that an optimal number of weak ties related to elevated levels of creativity only when actors placed little importance on conformity, a personal value likely to coincide with reduced levels of openness.

In addition, network researchers have investigated the effects of social capital and network structure on exploitation and exploration. For example, Vanhaverbeke *et al.* [18] researched the influence of direct or indirect ties on exploration and exploitation. Using an agent-based simulation, Miller *et al.* [14] identified the importance of decentralized interpersonal learning and emphasized exploitation rather than exploration to overcome the potential rigidity of organization. Based on existing literatures, we have set the following hypotheses.

H1: Between members, closeness centrality have a positive impact on exploitation.
H2: Between members, closeness centrality have a positive impact on exploration.
H3: Between members, closeness centrality have a positive impact on individual creativity.

On the other hand, since March [13] was using terms of "exploitation" and "exploration" in 1991 on seminal paper, Levinthal and March [11] define exploration as "the pursuit of new knowledge, of things that might come to be known" and exploitation as "the use and development of things already known." In such a perspective, Audia and Goncalo [2] has divided creativity into two concepts: divergent creativity and incremental creativity. They also explained the divergent creativity and incremental creativity in relation with exploration and exploitation respectively. He and Wong [10] investigated whether the interaction between exploratory and exploitative innovation strategies is positively related to firm performance by examining 206 manufacturing firms. Based on these studies, we suggested that exploration and exploitation might stimulate individual creativity, and we proposed the following:

H4 : Exploitation influences exploration positively.
H5 : Exploitation positively influences individual creativity.
H6 : Exploration influences individual creativity positively.

The concept of trust is that the willingness to accept vulnerability, based on positive expectations of the intentions or behaviors of another [12]. In organization, employee's perceived ability of leaders is essential factors to trust them, in other words, employees not willing to trust in their leader unless they expect him/her be capable of fulfilling expected role [19].

On the other hand, the characteristic of a leader is one of the important variables affecting to individual creativity and innovation in the organization. From power organization relationship point of view, the role of leader is very important, such as encourage the creation of ideas, load to generate the ideas and practices spread to other members. For instance, Scott and Bruce [17] told that idea creation very close to support and trust of leader and autonomy granted. Amabile and Gryskiewicz [1] told that encouragement and recognition of leader is work environmental factors related to individual creative result. Burnside [5] told that positive encouragement and support is more increase creativity than leader's strong authority performance. Furthermore, these encouragement and support can be influence positive impact on the member creativity and performance.

There is common consensus that trust seems to arise under more open and supportive leadership in the most studies [6]. However, despite the general idea that reciprocal trust is a one of the success factor for innovations, prior research on the influence of trust on creativity remains largely inconclusive [3]. For instance, some researchers examined trust's role to contribute team creativity positively, however other recent studies did not find that there is positive impact of trust on team creativity [7], thus we need to investigate the role of trust on employees' creativity which do not fully studied their relationship. Based on these studies, we suggest following hypothesis:

H7 : Depending on the level of trust in leader, exploitation can be impact on exploration will be different.
H8 : Depending on the level of trust in leader, exploitation can be impact on individual creativity will be different.

H9 : Depending on the level of trust in leader, exploration can be impact on individual creativity will be different.

3 Research Methodology and Results

This researches studies about how the network relationship in a small group, in other words closeness centrality and exploitation and exploration, which is the personal working style, affects individual creativity. For this, we have assigned the same task for the university students who are taking the same subject, and asked them to make the group (min 4 ~ max 7 people) to solve that assignment. And we surveyed them about the network among the group members that is formed in the process of carrying out the assignment. As a result, the effective analysis sample was 56 teams, 308 people in total.

We developed questionnaire item by adapting existing measures in prior researches. At first, in this research, individual creativity means the production of novel and useful ideas(or products) and it is the transformation of the concept of Zhou and George [20] for the research purpose. Exploitation and exploration means using existing and new knowledge and information for carrying out the given assignment. The measurement has been taken in the adaptation of the concept that was used in Prieto *et al.* [16] for the situation that the students carried out the assignment. Trust in leader is the concept that measures how much members trust their team leader for the given assignment. We have modified the questionnaire used in the research of Nyhan and Marlowe's research [15] to the situation of the students carrying out the assignment in the consideration of the research purpose.

We have divided all respondents into highly trusted group and lowly trusted group with the median(=5.25) of the average value of 8 questions that measured the degree of trust in leader. To analyze the theoretical research model and our own research hypotheses, we used SmartPLS 2.0, a type of partial least squares (PLS) software. PLS is a structural-equation model that uses a component-based approach for estimation, it places minimal restrictions on the sample size and residual distribution [9].

3.1 Measurement Model Analysis

In the evaluation of the validity of measurement model using PLS, convergent validity is evaluated by the Cronbach' α or composite reliability and if each construct's α score and composite reliability value is greater than 0.7, it means that variable can be used in the structural model research. In this research's case, Cronbach' α score and composite reliability of all constructs turned out to be greater than 0.7 and therefore we could conclude that there is enough convergent validity. Next, we can measure the discriminant validity of each construct using average variance extracted (AVE). We have made the table with the calculated values of AVE of each construct in the <Table 1>. In addition, since the square root of AVE is greater than the correlation coefficient of other constructs, we can say that the discriminant validity is also confirmed according to the standrard of Chin [8].

Table 1. Reliability and Validity Analysis

Construct		Cronbach' α	Composite Reliability	Correlation			
				Exploration	Exploitation	Ind.	Centrality
Entire Group	Exploration	0.713	0.823	**0.751**			
	Exploitation	0.845	0.890	0.580	**0.787**		
	Ind. Creativity	0.826	0.939	0.675	0.543	**0.796**	
	Centrality	1.000	1.000	0.107	0.127	0.112	**1.000**
Highly trusted group	Exploration	0.805	0.873	**0.796**			
	Exploitation	0.830	0.880	0.544	**0.771**		
	Ind. Creativity	0.926	0.939	0.689	0.510	**0.797**	
	Centrality	1.000	1.000	0.151	0.060	0.124	**1.000**
Lowly trusted group	Exploration	0.762	0.793	**0.727**			
	Exploitation	0.806	0.865	0.558	**0.750**		
	Ind. Creativity	0.913	0.929	0.598	0.476	**0.770**	
	Centrality	1.000	1.000	0.105	0.222	0.111	**1.000**

3.2 Structural Model Analysis and Implications

The verification of 6 research hypotheses about all groups set in this research using PLS is shown in the following <Fig. 1>.

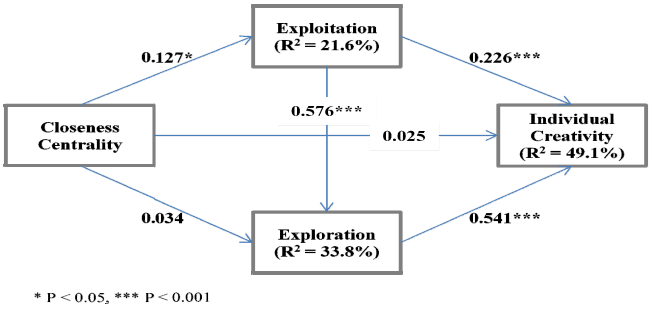

Fig. 1. Test results for all participants

In the result of verification, among the hypotheses of H1~H6, all the hypothesis except H2 and H3 were turned out to be significant. One interesting fact is that closeness centrality had a significant effect on exploitation, which is using the existing knowledge for carrying out the assignment, but it did not significantly affected exploration, which is the activity that purses new knowledge for carrying out the assignment.

Especially, we have carried out indegree centrality analysis, which is showing how many times an individual is nominated by other people and therefore the most important index that represent the individual's effect and power, information and resource accessibility and availability. Therefore, it shows that when indegree closeness centrality increases, the possibility of using existing knowledge and information rather than putting new effort for carrying out the assignment increases.

On the other hand, closeness centrality did not have the direct significant effect on individual creativity. This means that the creativity at individual level cannot simply

be said not to be affected by the centrality on social network. Also, H4, which states that exploitation would have the positive effect on exploration, had the path coefficient of 0.576 at the 99.9% confidence level and therefore it was accepted with significance. This means that, considering the experiment environment that carries out the assignment in the relatively short period, exploitation using the existing knowledge have the significant positive effect on exploration that pursues new information and knowledge.

Lastly, H5 and H6 which states that exploitation and exploration would have the positive effect on individual creativity were accepted at 99.9% confidence interval and the path coefficient for them is 0.226 and 0.541 respectively. Such a result is similar to the research result of Audia and Goncalo [2], therefore we could find out that the activities using existing knowledge and searching for new knowledge have the significant effect on individual creativity.

On the other hand, another important concern is that exploitation and exploration, which is the individual's working style depending on the level of trust in leader, have the moderating effect in the relationship with individual creativity respectively. To analyze this, we have carried out the analysis by dividing the highly trusted group and the lowly trusted group with the median of the average value of 8 questions that measured trust in leader.(see, <Table 2>) .

Table 2. Results of hypothesis testing

Hypotheses		Highly trusted group (N=170)	Lowly trusted group (N=138)	Result
H7 Exploitation --> Exploration	Coefficient	0.537	0.562	Accept
	Standard Error	0.067	0.072	
	t-Value	-2.999*		
H8 Exploitation --> Ind. Creativity	Coefficient	0.192	0.203	Reject
	Standard Error	0.082	0.093	
	t-Value	-1.049		
H9 Exploration --> Ind. Creativity	Coefficient	0.581	0.483	Accept
	Standard Error	0.066	0.093	
	t-Value	10.032*		

* P<0.01.

When trust in leader is high, unlike the entire group, the closeness centrality significantly affected exploration (path coefficient = 0.118) whereas it had low effect and it was not significant statistically (path coefficient = 0.060). This was different from the group with low trust in leader. That is, when trust in leader is high, closeness centrality was the important affecting factor for exploration, but when it was low, closeness centrality rather affected exploitation significantly.

This may be due to the fact that the amount of the effort put in exploitation and exploration is different. That is, when individuals put some efforts to carry out the assignment, it would require much more effort when they try to search and use new information and knowledge than when only use the existing knowledge. Therefore, when trust in leader is high, there would be the tendency for individuals to carry out the assignment with more effort as the benefit in return. On the other hand, when trust in leader is low, the motivation to put such effort relatively becomes weak and therefore it could be said that there is the tendency to put less effort in the exploitation activity.

4 Concluding Remarks

This research, in the point of view of social network, has taken a thoughtful consideration on how the network among members affect their working style and finally have some kind of causality with individual creativity. Especially, by considering trust in leader as the moderating variable, which is one of the important factors that decides the organization's performance, we gave more practical significance to this research.

The results of this study and implications can be summarized as follows.

First, the indegree-closeness centrality of a member in small group is positive impact on the exploitation which takes advantage of existing knowledge and information and then increase individual creativity. However, indegree-closeness centrality did not significantly affected exploration, which is the activity that purses new knowledge for carrying out the assignment. Therefore, practically, managers would have to take some time to think about whether the nature of task requires more exploitation or more exploration and the structure of network must be decided based on this consideration. Second, the high level of trust in leader case, closeness centrality is the important factor to exploration. However, in low level, closeness centrality is the more important factor to exploitation. In each case, the positive effect it has on individual creativity. Therefore, in the situation of low trust in leader, the probability that members do more exploitation increases, since it requires relatively less effort. So, when the manager of an organization is required to carry out the creative assignment, more effort has to be put in to increase the level of trust in leader so that members can do exploration by themselves.

Despite these findings and implications, but still, this study has the following limitations. In other words, to study the subject of creativity, the questionnaire analysis method of traditional survey has been used. Such a method is to take statistical treatment on the survey result from the survey respondents at a particular point. This one is being supported by many good existing studies, but the problem is that creativity is very dynamic and uncertain factors inherent in many ways. So, this survey analysis is difficult to analyze process creative expression comprehensively. Therefore, the creativity research in the future needs more detailed and logical analysis with strengthened research method which can reflect the dynamic characteristics of creativity revealing process apart from the existing survey analysis such as Multi-Agent Simulation.

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The Effect of Organizational Trust, Task Complexity and Intrinsic Motivation on Employee Creativity: Emphasis on Moderating Effect of Stress

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Abstract. This research builds a theoretical model linking organizational trust, intrinsic motivation and task complexity with individual creativity. For the empirical test and special emphasis on the moderating effect of job stress level, the subject were divided into a higher stress group (N = 200) and lower stress group (N = 165) on the basis of the median value of job stress. The PLS method was applied to survey data gathered from employees working in Korean ICT companies. The result of analysis revealed that intrinsic motivation, task complexity and trust in organization is positively influencing employee creativity in this order among in the total group. On the other hand, comparative analysis of two groups based on the job stress level found that intrinsic motivation and task complexity were influencing employee creativity in same order in the both group; however the task complexity showed the second greater influence on the employee creativity in the lower stress group. Intrinsic motivation showed the greatest effect on employees' creativity in the both group with statistical consistency.

Keywords: Organizational trust, intrinsic motivation, task complexity, individual creativity, job stress.

1 Introduction

Recently, creativity is being considered as a competitive advantage for the company's growth and intangible management function for continuing competitive advantages. Thus, the individual creativity as well as team creativity has attracted organizational researchers and practitioners increasingly. Since Amabile rigorously discussed

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creativity in the organizational context [1], abundant of studies have explored the antecedents of individual creativity and their influence; [2][3] found that effective leader-member exchange relationships are positively associated with employees' creativity; [4] found that intrinsic motivation is a major influencing factor. In such researches, some precedents directly affect creativity, others have mediating effect of factors, and factors moderating those relationships are also tried to be found. Given that there are comparatively abundant studies about direct and mediating factors on creativity, fewer studies have been conducted about the moderating effect.

Alongside prior researches, we propose a model consist of trust in organization, intrinsic motivation, task complexity with employee creativity, concurrently, mediated by perceived job stress. Our main purpose of research is to reveal the influence of inclusive factor like trust and moderating effect of stress in the proposed model. For the empirical analysis, we surveyed more than 300 ICT companies in Korea, since employees' creativity is particularly indispensible to develop innovative service and to produce novel software consistently in ICT industry. Moreover, we specially emphasized on the moderating effect of job stress by conducting test with two groups based on stress level. Thus, for these purpose of study, this paper is organized as follows. In section 2, we briefly overview of related theories and works suggested in our model and suggest research hypotheses. In the Section 3, the method of this study and statistical analysis is reviewed. Finally, results and concluding remarks are discussed in the last sections.

2 Theoretical Background and Hypotheses

2.1 Organizational Trust, Task Complexity and Creativity

There haven't been plenty of studies about the influence of organizational trust and employee creativity. In the study of [5], trust is introduced as one factor of CCQ (Creative Climate Questionnaire) theoretically supporting individual creativity and innovation. More recently, [6] insisted that there isn't positive impact of trust on team creativity; however, [7] insisted that the influence of trust remain largely inconclusive. On account of these controversial results, we propose the organizational trust as a precedent to investigate meaningful implication in the model of employee creativity.

The relationship between task complexity and employee creativity has been tried to reveal in the early study of [8]. The author found that intuition is more effective when the task is more complex. [9] (1996) supported a direct positive influence of task complexity on employees' creativity. More recently, [4] suggested that complex job inspires employee to feeling their job more valuable and raising their excitement for doing job. [10] found that task complexity positively effect on intrinsic motivation and also directly on employees' creativity. Thus, according to these researches we suggest following hypothesis.

Hypothesis H_1: The trust in organization has a positive influence on employee creativity

Hypothesis H_2: The task complexity has a positive influence on employee creativity

Hypothesis H_4: The task complexity has a positive influence on intrinsic motivation

2.2 Intrinsic Motivation and Individual Creativity

Intrinsic motivation refers to the desire to expend effort based on one's interest and enjoyment of work being performed [1]. It is insisted that intrinsic motivation as one of the most important and powerful influence on employee creativity [11]. Likewise, intrinsic motivation enhances psychologically engaging and building energy for sustaining effort, then increasing time spending to work on their tasks spontaneously [12]. In addition, [10] reveal that the mediating effects of intrinsic motivation among precedents and employee creativity. According to the prior researches, we propose the following:

Hypothesis H_3: The trust in organization has a positive influence on intrinsic motivation

Hypothesis H_5: The intrinsic motivation has a positive influence on employee creativity

2.3 Moderating Effect of Job Stress

Job stress is conceptualized as an employee's feeling of anxiety, uncertainty and even being threatened when workload exceeds his/her capacity to overcome [14][15]. Employees feel they were losing control and never escaping in the environment. According to distraction arousal theory or the view of cognitive strategy, stresses decrease creativity by taking cognitive resources from those are available for creative thinking through allocating limited cognitive resources to stressors, consequently, fewer resources are available for others tasks [16][17]. Conversely, there are opposite researches insisting that stresses increase creativity. According to their claims, when stressors increase arousal, people think creatively and are motivated to derive solutions [18]. As a result, they may focus on problem-solving strategies and accelerate creativity [19] through cognitive stimulation as well as motivating for creative thinking [20]. Considering those controversial researches, we propose hypotheses that the level of stress has moderating effect on the relationship between creativity and its precedents like followings:

Hypothesis H_6: The trust in organization has greater influence on employee creativity in the higher stress group in the lower stress group

Hypothesis H_7: The intrinsic motivation has greater influence on employee creativity in the higher stress group in the lower stress group

Hypothesis H_8: There in no difference in the influence of task complexity on the employee creativity between different levels of job stress

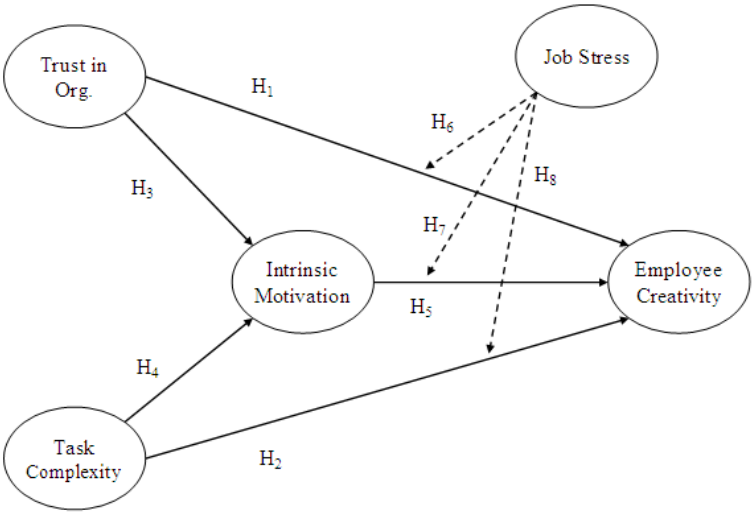

Fig. 1. The Research Model

3 The Structural Model Analysis and Result

The population of our research comprises employees working in the ICT companies. We surveyed employees from more than 3 hundreds Korean ICT companies for data gathering. The numbers of valid respondents are 365 (n. male=191, female=58). The Partial Lest Squares (PLS) analysis was adopted to examine the data. We started to analyze the reliability and by analyzing factor loadings, composite reliability (CR), and average variance extracted (AVE). Fist of all, there were no items below 0.5 of any items consisting constructs in the data [21][22], and the values of Cronbach's alpha of all indicators were greater than 0.7 exceeding the recommended value of 0.6 [23]; therefore, overall measurement item loadings have adequate reliability. Additionally, the smallest of the composite reliabilities were 0.889 and the AVEs (Average Variance Extracted) were greater than 0.764 which is supposed to be greater that 0.5 [24]. Then, we assessed discriminate validity test by comparing the correlation between two factors and the square root of the AVE value of each factor and the result showed the square roots of average variance extracted for each construct was greater than the level of correlation involving construct. Furthermore, all the correlations are sufficiently below than 0.7 which is under the cutoff value 0.8 [25] to suspect the presence of multicollinearity. Thus, data in our experiments were reliable and valid (see Table 1).

Table 1. Reliability and validity analysis

Construct		Cronbach' α	Composite Reliability	Correlation			
				Creativity	Motivation	Complexity	Trust
Full Group	Creativity	0.945	0.952	**(0.780)**			
	Motivation	0.872	0.907	0.658	**(0.814)**		
	Complexity	0.854	0.902	0.539	0.369	**(0.835)**	
	Trust	0.871	0.911	0.488	0.291	0.402	**(0.848)**
High Stress Group	Creativity	0.940	0.948	**(0.764)**			
	Motivation	0.860	0.899	0.645	**(0.800)**		
	Complexity	0.834	0.889	0.467	0.391	**(0.817)**	
	Trust	0.870	0.910	0.494	0.280	0.450	**(0.848)**
Low Stress Group	Creativity	0.950	0.957	**(0.798)**			
	Motivation	0.883	0.915	0.670	**(0.826)**		
	Complexity	0.872	0.912	0.622	0.373	**(0.850)**	
	Trust	0.874	0.913	0.490	0.305	0.373	**(0.851)**

Note: Values on the underlined diagonal are the square roots of the AVEs.

To verify the structural model of hypotheses, we examined the explained variance of the constructs (R^2) and the standardized coefficients (β). The verification found that the five hypotheses are all significant. Trust in organization, task complexity and intrinsic motivations are all significantly influencing on individual creativity. In addition, the coefficient of intrinsic motivation to individual creativity is the highest (β = 0.492) supporting the rigid examinations of the prior researches. Further more the path coefficients of trust and task complexity are also significantly influencing on the intrinsic motivation, tough the higher coefficient is found in the path from task complexity (see Table 2).

Table 2. Structure Model Analysis Results (Total)

Hypotheses	Path	Coefficient	t-value	result
H_1	Trust in Org.→Employee Creativity	0.240	5.319	Accepted
H_2	Trust in Org.→Intrinsic Motivation	0.170	2.849	Accepted
H_3	Task Complexity→Employee Creativity	0.261	5.128	Accepted
H_4	Task Complexity→Intrinsic Motivation	0.300	4.831	Accepted
H_5	Intrinsic Motivation→Employee Creativity	0.492	10.142	Accepted

Furthermore, job stress was found to have moderating effect on the relationships among trust in organization, task complexity, intrinsic motivation and employee creativity, which supported all the hypotheses on moderation effects of job stress. Specifically, in the event of higher job stress, the trusts in organization and intrinsic motivation have higher path coefficient. The path coefficient of trust in organization in

the high stress group (β = 0.290) is significantly higher than that in the lower stress group (β = 0.209). The path coefficient of intrinsic motivation to employee creativity (β = 0.511) also significantly greater in the high stress group comparing with the lowest coefficient in the lower stress group (β = 0.469). However, the path coefficient of task complexity to the employee creativity in the high stress group (β = 0.137) shows the lowest, whilst it shows the second highest influence in the low stress group (β = 0.370) (see Table 3).

Table 3. Comparison of Path coefficient

Number of Hypothesis	Description	High Stress Group	Low Stress Group	Test of Hypothesis
H_6 (Trust in Org. → Individual Creativity)	Path Coefficient	0.290	0.209	Accepted (High Stress Group)
	Std. Error	0.053	0.040	
	Sample Size	200	165	
	t-value	15.86***		
H_7 (Intrinsic Motivation → Individual Creativity)	Path Coefficient	0.511	0.469	Accepted (High Stress Group)
	Std. Error	0.047	0.050	
	Sample Size	200	165	
	t-value	8.16***		
H_8 (Task Complexity → Individual Creativity)	Path Coefficient	0.137	0.370	Accepted (Low Stress Group)
	Std. Error	0.056	0.042	
	Sample Size	200	165	
	t-value	-45.16***		

4 Result

This paper addresses trust in organization, task complexity and intrinsic motivation that affect individual creativity working in Korean ICT industry using the PLS. We specially try to emphasize on the moderating effect of perceived job stress. From the statistical analysis, we reached the following results.

First, in all level of group, our basic hypotheses were significantly supported (all p-values < 0.01). Trust in organization, task complexity as well as intrinsic motivations were good indicators affecting individual creativity in the total group (R^2 = 0.537). In addition, both trust in organization and task complexity positively affect intrinsic motivation (R^2 = 0.160). Thus, trust in organization and task complexity is successfully inferred good indicators as precedents of individual creativity.

Second, there are notable differences between two levels of stress groups with influences on employee creativity. In other words, there are significant differences among precedents' coefficients of individual creativity between groups of job stress levels. Particularly, in the higher stress group, trust in organization and intrinsic motivation influence on employee creativity grater than those in low stress group. In other words, we asses that when employees are under high level of job stress, their trust in organization or intrinsic motivation has stronger

positive influence on their creativity comparing when they have less job stress. For this reason, job stress is supposed to be positive moderator in our research model.

Third, although task complexity has significant positive influence on employee creativity in all level of stress group, it has less strong influence on individual creativity in the high stress group. When employees are under low level of job stress, the more tasks are complex the further employees are creative. This result gives us implications that although task complexity has positive influence on individual creativity, job stress has negative moderating effect on the relationship between task complexity and employee creativity.

On the whole, we proposed research model based on comparatively well known factors such as task complexity and intrinsic motivation, in addition, less attracted factor like trust in organization, finally job stress as an inconclusive factor. From the results of the empirical tests with survey data, we found the significantly positive effects of all precedents of employee creativity in accordance with prior researches. In addition, moderating effect of job stress was found from the comparative tests in the divided groups of stress level. From these results in the given model, we conclude that employees are more creative when employees have high trust in organization and intrinsically motivated regardless of stress level; however task complexity has less effect when employees have higher stress. We hope these finding and further study on the job stress will help better understanding the influence of job stress not only for researcher of creativity but also for organizational practitioners in the ICT industry managing task complexity and job stress.

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Using a Wiki-Based Past Exam System to Assist Co-writing Learning Assessment with Social Network

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Abstract. The social network has been a very popular research area in the recent years. Lot of people at least have one or more social network account and use it keep in touch with other people on the internet and build own small social network. Thus, the effect and the strength of social network is a very deep and worth to figure out the information delivery path and apply to digital learning area.

In this age of web 2.0, sharing knowledge is the main stream of the internet activity, everyone on the internet share and exchanges the information and knowledge every day, and starts to collaborate with other users to build specific knowledge domain in the knowledge database website like Wikipedia. This learning behavior also called co-writing or collaborative learning. This learning strategy brings the new way of the future distance learning. But it is hard to evaluate the performance in the co-writing learning activity, researchers still continue to find out more accurate method which can measure and normalize the learner's performance, provide the result to the teacher, assess the student learning performance in social dimension.

As our Lab's previous research, there are several technologies proposed in distance learning area. Based on these background generation, we build a wiki-based website, provide past exam question to examinees, help them to collect all of the target college or license exam resource, moreover, examinees can deploy the question on the own social network, discuss with friends, co-resolve the questions and this system will collect the path of these discussions and analyze the information, improve the collaborative learning assessment efficiency research in social learning field.

Keywords: Social Learning, Social network, Wiki, past exam, co-writing, collaborative learning, assessment.

1 Introduction

'Wiki' is the Hawaiian word for 'quick'. Broadly, wiki is a open and convenient editing tool for participants to visit, edit, organize and update website. The most well-known public wiki is Wikipedia [9] , which is an online encyclopedia. The most

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distinguished feather of wiki is that anyone can create knowledge on wiki at any time anyplace, and the intelligence of more creators is much greater that individual creators, it offers multidirectional Communications among creators[8].

After Web2.0 technology has been proposed, wikis have been widely used in the realm of education, and serve as a medium for collaborative learning. In a scenario of wiki-based collaboration, students are divided into groups and assigned tasks. [1], and, everyone who use internet service in the world usually have one or more accounts of social network site in recent years, social network behavior in cyber world is become more and more important part in peoples life, if we can combine these two different but have same basic ideas web service, apply on blended learning to improve the learning efficiency.

In Taiwan, the higher education's examinations past question just provide the questions but without answers, so the examinees must calculate the answer by itself. Or spend lots of money to join the tutorial, even search the answer on Wikipedia, also can not understand the problem solving process and learning with friends. Thus this MINE wiki service provide a community and customized edit tool to help examinees discuss and discover, make sure the answer and record the

The main method we apply in this research is based on the Prof. Trentin's research[5], this paper is focus on the evaluation of collaborative learning project, he design a formula to calculate the contribution of each student in the learning group, also use the Wiki-like system to do the experiment, but most of this evaluation procedure needs the manual assessment by teacher. So there are many procedures can be improved, like system assist data mining, recording and calculating, reduce the assessment time for teacher, and help the student to learn the co-writing skill in social dimension then assess the contribution correctly.

In this study, we describe a Wiki Based Web system which provide online past exams about admission of master's degree or PhD degree. And apply the co-writing assessment theory provide by [5] in this system to help other user understand which answer is the best one of the questions, is not learning in the group, but to use the social network, Students may search and have discussion with other register users in this system, if users doesn't know how to resolve some questions, he or she can deliver to own social network to other friends who maybe know the answers or forward this message to their own social network until the question is resolved.

2 Related Work

In this section, we will discuss the past research about social learning or the system use wiki-based system to enhance distance learning.

In Web 2.0, one of the emerging visions is the "collective intelligence" where the folks are motivated to contribute their knowledge to solve common problems or to achieve common goal [7].

A Wiki is a type of social software that allows users to write, share and edit content real-time, with only rudimentary skills in web page creation. Anyone can edit and

manage the content of Wiki, coordinate and create knowledge in collaboration with other members. The essence of Wiki consists of opening up, cooperation, equality, creating, and sharing. As a collaborative authoring platform or an open editing system, the most fundamental characteristic of Wiki is the teamwork and open editing [6].

In Marija's research , He described and evaluated two consecutive trials of the use of wiki technology as a support tool for curriculum delivery and assessment, as well as for students' learning[2]. The common characteristic of all trials was that they were based on weekly wiki (MediaWiki) updates by studentsthat were triggered by tutor-set questions and assessed.The details of the assessment strategy for wiki contributions have been discussed in [3].

Wiki is considered the latest web innovation on content management and sharing [5]. Using any web browser, a user can visit a Wiki site — a web site running Wiki software, and by using simple Markup text, the user can create new pages, edit existing pages, or restructure page hierarchy and links. The simplicity and flexibility of Wiki make it an appealing tool for content sharing and online collaboration.[4].

In Binbin Chang's research[9], a case study is based on an optional curriculum called social technology and tools in Beijing Normal University. The participants are fresh students or sophomore students with various majors. There are totally seventy-five students participating in this activity. This study is based on the open software 'Mediawiki'. They also choose a definite subject for this activity which is 'google products', and providing several different products for the students to choose which one they intend to edit. [8]

Research on using computers to assess and support the development of social and emotional skills has focused on a range of populations including children with particular needs[12],and a major purpose of fully collaborative writing is to ease the dysfunctional anxiety of the individual solitary student when confronted with a blank piece of paper [10]. Traditional learning hopes student can learning spontaneously, but ignored the social dimension, but how to evaluate the individual contribution of each student is the first question we must surmount, but the assessment method of this area still not have enough related research can fully support the teacher to evaluate the students contribution automatically or more conveniently.

In view of these related researches, we can comprehend the collaborative learning and Wiki-based learning process or framework can help leaner improve their learning efficiency through collaborative learning; social network also can integrate with wiki service to promote the scale of social learning.

3 System Designs

In this section, we will present the system designs of this Wiki-based past exam system.

$$P_{total=}\sum P_{norm}=P_{forum,norm}+P_{peer\text{-}review,norm}+P_{links,norm}+P_{content,norm} \quad (1)$$

The main assessment formula we applied in this system is shown above, it is from the G. Trentin's research [5], and the system will accord this method and the assessment data table but improve the scoring process from manual to the system automatic, try to exclude the human factor from the teacher or other users, the main scope of this study is assess the separate contribution of each question through this method and display it to other users,

The MINE Wiki site is built by Mediawiki: the open source wiki-site software, as shown in figure 1, is the portal page of MINE wiki, when the user access the web site, the main pager will shows the broadcast message in middle of the windows, and the navigation area on the left side , can allow users access into the main page to start the learning sequence .

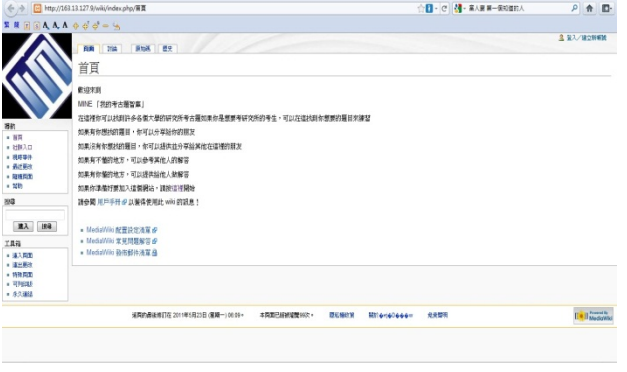


Fig. 1. The Portal page of MINE Wiki

If the user is a unregistered, the user only can allow to search and watch the past exam questions, can not edit or deliver any answer on the page and wiki, even user was invited by register user, still need create an account in this wiki.

when user login the community of MINE Wiki, the first page entered was the list of the four regions in Taiwan, in this research , MINE Wiki's default content we provide is the every universities in Taiwan , in other words , this site have the all past examination question file about Master degree and PhD. Degree's admission , users can search all examination's file in this wiki , in Taiwan, the higher education's examination's past question just provide the questions but without answers, so the examinees must calculate the answer by itself.

After user choose the region , it will enter the university select list page, when user choose an university, the system will navigate to the collage list page shown in figure 4, this page shows the whole colleges in this university.

When user selects the college, as shown in figure 2, system will list the all subject in this collage at least past five years, user may choose any subject which he needs here.

Fig. 2. Subject select page

The most important part in this wiki based site, is the past examination papers, as shown in figure 3, the PDF files will shows in the middle of the page, users can not watch the questions in this page, and tag or mark the specific question in this file, also will save in user's learning profiles, allow users to share or take down. the bottom of this file, is the message board , any users who ever access this files and leave the question, answers or messages all will save in this place to modeling the learning process of this past examination paper.

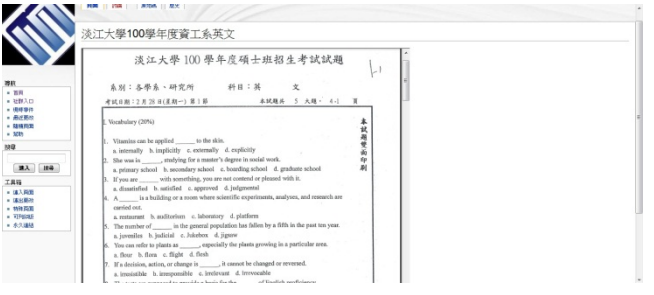


Fig. 3. Past examination paper

The last part of this site, shows in figure 4 and 5, the ELGG social site, a open source social network website, just like the Facebook , in our Lab., we use this open source software to build a social network learning website, test and collect the social learning data to analyze the learner's learning efficiency.

The MINE Wiki also merge this social network website, when users can't figure out the answers in the Wikis, he may publish the message to the wall in ELGG , the friends of the users will see the issue in their wall, if anyone know the answers or meet someone who may have a direct thinking way to the right answers, just need to link or forward to other friend's walls, the system will record this path of spread, build a social learning model in this Wiki.

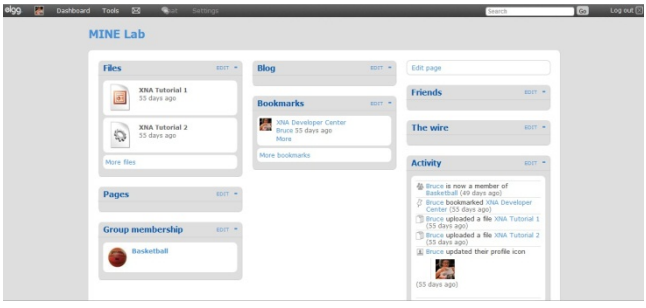
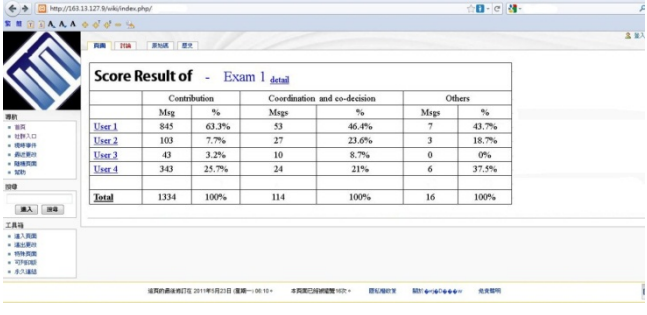


Fig. 4. ELGG social site

Figure 5 shows the assessment result of each past exam paper, the system will record the contribution and the interact with other users, this result will save in the account profile, every user can access the contribution made by the user in each past exam subject, teacher also can according this result to evaluate the student performance in this social co-writing learning process.



Score Result of - Exam 1 detail

	Contribution		Coordination and co-decision		Others	
	Msg	%	Msgs	%	Msgs	%
User 1	845	63.3%	53	46.4%	7	43.7%
User 2	103	7.7%	27	23.6%	3	18.7%
User 3	43	3.2%	10	8.7%	0	0%
User 4	343	25.7%	24	21%	6	37.5%
Total	1334	100%	114	100%	16	100%

Fig. 5. Assessment result

4 Conclusion

In this study , we proposed a Wiki-based past exam System which can provide examiners search and discuss with other people in the website, this Wiki system provide lots of past exam questions of all Taiwan University's Master Degree admission, if user can not find the past examination questions which he need , user can upload any question PDF files by himself, and build the wiki page about these questions, then deploy to his own social network website like Facebook , twitter ,pluk, Elgg…etc. to ask friends who can resolve the questions or join the discussion ,even they are all can not figure out the answer , they still can deploy to their own social network to ask another friends, use the strength of the social network, extend the co-writing learning field to the internet.

The system will record this process, and build a learning process of this past examination questions file, analyze the efficiency of learning. Construct the analyze result to the teacher or other users, allow teacher to use these resource to understand

what kind of skills and gain student learned during this co-writing learning activity, it also can let other users can understand their knowledge contribution turn into normalization numbers, compare with others, comprehend their knowledge level they reach.

Our future work includes: a) find out more appropriate user model or education theory to support this wiki based web service even blended social learning; b)after build a robust user model of this learning process , we may design a assessment mechanism with strong education background support to evaluate users learning efficiency more accurate.

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General Pattern Discovery for Social Game on Facebook

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Abstract. With the population of social platform, such as Facebook, Twitter and Plurk, there are lots of users interest in playing game on social platform. It's not only the game style they want to play, but also high interaction with other users on social platform. Hence, the development of social network makes social games as a teaching tool becomes an emerging field, but in order to use the social network games for teaching, it needs to understand the game flow as an appropriate reference to be judged. In this paper, we use simulation games and social utility games of Facebook as examples. Using the flowcharts and the triangulation methods theory to analyze the characteristics of the flows by finding verbs and goals, and obtaining the differences by comparing social behavior, accumulate of experience, items collection system and tasks.

Keywords: social game, flowchart, simulation game, social utility game.

1 Introduction

Web 2.0 application, such as Facebook and Twitter, have dramatically increased within the last five years for social purposes. The provision of common channel for increasing social interactions has revealed the major attractive issue, The survey [quote the related papers] also presents that the entertainment part (e.g. add-on games) has the potential for raising the interactions.

We found many attractive features in social games. But how to use the advantages of online social network for education? And how to use social games as a new game-based learning method? It is still an untapped research issuse. However, there are many types of social games in social community. If we want to find out the developing prototype in various of social games which consistent with the educational purposes, we need to comprehend the process in different type of social games first.

In this paper, we use simulation games and social utility games from Facebook as examples, and generalize the game frameworks of the two types we mentioned before. Finally, we make analysis and comparison. Facebook is one of the emerging social websites in recent years. A social network is a set of clustered nodes (group of people) or single nodes interconnected to transmit the information from one cluster or node to another. If we compare Facebook with other social websites, we can find

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LNEE 182, pp. 215–220, DOI: 10.1007/978-94-007-5085-2_28,

that Facebook offers many services and applications. And one of the popular application and service is social game. Because of the information transformat and sharing functions in social networks are cooperative, social games are designed to use the way of cooperative games [8]. In this contention, author consider that social games have the social property of interaction and cooperation.

2 Related Works

2.1 Triangulation Method

Aki Järvine proposeda Verbs – Goals – Network play model of triangulation, which helps to define 'game mechanics' [2]. The verbs as mechanics are linked with the goals of the game, which are the means to reach the ends. In social network games, the system of the social network is as a whole, consisting of the service, individual players, and the community. The dynamic within these elements can be conceptualized as a triangle with the three elements, around the user experience that start to emerge as play:

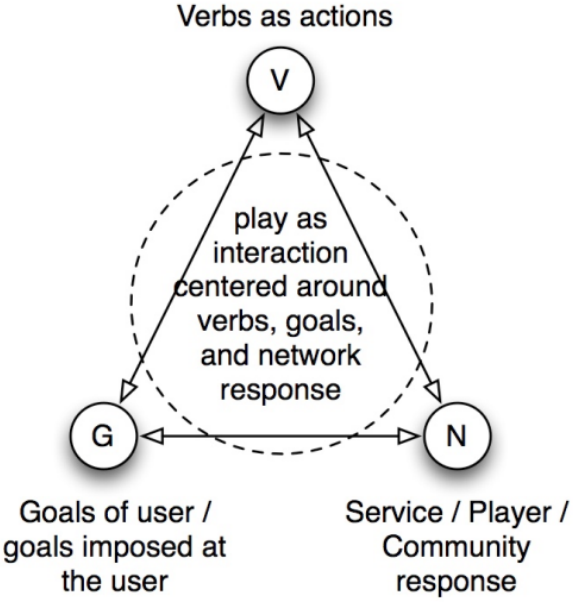

Fig. 1. Verbs – Goals – Network play model

This paper refers to the model as the method which analyzes the features of the game process. On social platform, we only focus on Facebook which is the most popular social platform in social community. Then looking for the commonality among player's actions or behaviors in flowcharts, sort out the corresponding verbs to reach

the goals. Verbs and goals are the basis in this research which use to judging whether game processes are similar or not.

3 Features of the Games

Since the current game types are becoming more and more composite. The basis for subjects' selection in this study is selecting the games which do not mix with the elements in other game types significantly. This paper selects three simulation games: Restaurant city, My Fishbowl, Happy Harvest, and three social utility games: Hugged, Give Hearts, The King of Kidnappers, to be the subjects of this study We use those selecting games to sort out their own game flowcharts, extracts common features and compares them.

3.1 Simulation Games

The following contents are the three simulation games which we select in this paper

- Restaurant city

Restaurant city is a restaurant simulation game, players open their own restaurant, and find some ways to collect ingredients, increase their menu and keep the operation of the restaurant. When the level up, it increase the scale of the restaurant gradually.

- My Fishbowl

My Fishbowl is a fish raising game. Players can see their own fishbowl when login to the game, and obtain treasures in the process of raising fish or access friends' fishbowls to steal treasure. Treasures in the game can be sold into money for buying more kinds of fish or fish feeds, which continue to operate their own fishbowl.

- Happy Harvest

Happy Harvest is a farming game, players' main work is planting crops and selling them into money. They can also go to friends' house to steal crops or hinder crops grow. The money can be use to buy items needed for farm operation.

3.2 Social Utility Games

The following contents are three social utility games which select in this paper.

- Hugged

Hugged is a simple game to communicate emotions with friends. Players select their friends and send them a type of hug. And the receiver will receive the hug and the associated picture by message.

- Give Hearts

Give Hearts is a game of heart gifting, players select hearts and gift to their friends. In the game, we can see the types of hearts he collect and the ranking of hearts number friends' get.

- The King of Kidnappers

The King of Kidnappers is a game of kidnapping and rescuing friends. Players use all kinds of funny ways and tools to kidnap their friends. Players may become captives by their friends, and use the way which guess the hiding place to escape or rescue friends.

3.3 Features of the Games

- The use of currency

The reason why virtual currency is developed have been mentioned by Hui Peng and Yanli Sun.Then main reason is mentioned as below: 'The demands of virtual economy development', 'Technical progress and internet development', 'Demands from users', and 'The profit maximization of issuers' [4]. Those games are developed on Facebook platform. It will certainly be developed and use virtual currency due to the demands from users and issuers, with sufficient support of network technology.

- Social behavior

The nature of social networks is built during play [3]. Because the games are developed on the social networking platform, spontaneously be inseparable with community interaction. But they stressed that the players interact with the user must have any relationship with other users (such as friends). This means that social games have some standard to the scope of relationships between interaction players and the user. Only players who have a certain relationship with the user can participate. This can avoid unacquainted players allot the incomes which get from interactions in the games (steal resources). Nabeel Hyatt has pointed out how social network games can 'rely heavily on social context (namely school, department, and residence loyalties) to provide a framework for alliances, game playing and motivation' [5]. Social context is the interpersonal relationships in the player's real life, and social networking platform extends the relationships into the games. This also becomes the main scheme of the interactions in simulation games.

According to Aki Järvinen's argument, game design techniques are needed to integrate competition, challenge, and tension into those acts of socializing, and mostly of the integration would improve the playfulness of the games [2]. The competition in social games are established in the interactions with friends, but maintain the idea of non-zero-sum games basically, with certain risk control. Friends can compete with each other, but don't come to win or lose directly; friends can steal each other's resources, but there are certain quantitative restrictions, this protects the players' incomes.

- Accumulate experience points to upgrade and get reward

B. Kirman, S. Lawson, and C. Linehan have mentioned that in Fighters' Club and Familiars, player score (Street Credit in FC) is a function of the social behavior of the person within the game [3]. This paper considers that in most social games which use experience points, one of the sources of experience points is also a function of the social behavior of the person within the game. In addition, the experience points are also the incomes of a player's labor in the game. As the same with score, the more a player works, the more experience points he will gets.

Valentina Rao lists fast rewards for player actions, abundance of positive feedback, no negative consequences for exploration [7]. Experience point is an income in fast rewards, which won't be reduced by player actions. This encourages players to act in the game positively. The value of the experience points that player gains will enhance his status and reputation in social network games. As the triangulation method mentioned, this cyclic process of development plays the core mechanics of the games [2]. The incomes of the players' operations will reach the goals. Social behavior such as visiting friends, is one of the source of experience points, and in this process, exchange and compare with friends will be spontaneous.

- Item collection system

Kim has identified certain core game mechanics, i.e. player actions, such as collect and exchange [6]. Those actions promote the games to run. Both of the items collected and accumulated are experience points that are incomes from players' actions in the game, the difference is that items collected in some games may burden risk because the players cannot always keep in the game, for example, goods are stolen by friends, but experience points cannot be stolen by using any channel; This is the difference between item collection and experience points accumulation.

Item collection also led the need to add features to the game. Hence, it would evolve with players' needs, achievements in the form of different badges, new types of cars, etc [2].

- Task

Task has a feature that is various situations. No matter how many changes are in the form of the tasks, generally around the verbs, goals theories of triangulation method, simply changing the way of the tasks to add more fulfillment.

4 Conclusion

In recent year, social network issues have become very popular and the application of social network also play an important role on related research issues.

In this paper, we used the flowcharts and triangulation method theory to analyze and compare the characteristics of simulation games and social utility games in Facebook. As a contribution, the discovered pattern can be applied onto the design of social learning games by integrating customized factors. The result will be provided

as suggestions when developing the related social games with educational purposes. In the future, we will focus on more social game on Facebook or other social platform, and analyze the flowchart of game and show the compare results of different games in similar categories.

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A Topic-Oriented Syntactic Component Extraction Model for Social Media

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Abstract. Topic-oriented understanding is to extract information from various language instances, which reflects the characteristics or trends of semantic information related to the topic via statistical analysis. The syntax analysis and modeling is the basis of such work. Traditional syntactic formalization approaches widely used in natural language understanding could not be simply applied to the text modeling in the context of topic-oriented understanding. In this paper, we review the information extraction mode, and summarize its inherent relationship with the "Subject- Predicate" syntactic structure in Aryan language. And we propose a syntactic element extraction model based on the "topic-description" structure, which contains six kinds of core elements, satisfying the desired requirement for topic-oriented understanding. This paper also describes the model composition, the theoretical framework of understanding process, the extraction method of syntactic components, and the prototype system of generating syntax diagrams. The proposed model is evaluated on the Reuters 21578 and SocialCom2009 data sets, and the results show that the recall and precision of syntactic component extraction are up to 93.9% and 88%, respectively, which further justifies the feasibility of generating syntactic component through the word dependencies.

Keywords: Text Understanding, Topic-oriented Parsing, Syntactic Component Extraction, Text Modeling, Natural Language Understanding.

1 Introduction

With the rapid development of internet, a large volume of contents resulting from various network applications have been created, while the existing information processing models could not fully handle the information extraction in natural

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language processing. In business domain, traditional business surveys costing a lot of manpower and resources is used to retrieve market trends and customer opinions; however, it is often hard to get a high sampling coverage. Therefore, companies aim to directly understand and obtain the customer's intention and find the product demand and potential market from user feedbacks to improve the products and. These business surveys with the intention of forecasting tasks can be attributed to the topic-oriented understanding in text. The core concept within this context is the topic of concern to find the distribution pattern of information from the collection of the specified text to achieve at some kind of trend forecasting. The central idea of the "topic" generally refers to not only a conversation, a lecture or discourse, but also the talking about the theme, or a concern of a specific object. The "topic" in this paper is especially concerned about a specific event, resource or action. A topic can be reflected by one or a certain amount of the textual information.

The data source in topic-oriented understanding is the massive user-generated content on the target site, and it is usually a short form of natural language text. A piece of text is an ideological expression recorded in the form of human natural language and its processing requires the application of natural language understanding technology.

The topic-oriented natural language understanding deals with the "analysis and forecasting" which aims at using computers instead of human beings to process the large amount of text, define the extraction models from the viewing point of semantic formalization, and thus the induce the thematic distribution information from the extracted information, interpret the current observation and predict the future trend via statistical approaches.

The core of topic-oriented information extraction model is the derivation of the pattern of "Subject – Description". The "Subject" refers to the objects, events and activities. "Description" covers the advices, comments, evaluation, intents and demands made on a specific topic. The "Subject" and "Description" extracted from the text have a clear meaning for the syntactic elements. Syntactic elements play a structural role in the organization of words, phrases or sentences, typically including the "subject" (the subject of a statement by the sentence) and the "predicate" (used to describe which action the subject does the action or at which state it is on) and so on.

In understanding systems we need to conduct syntactic analysis, and then choose the desired syntactic component from it. Syntactic analysis is to model the internal structure of the sentence by using word as the basic elements, to reveal the relationship between words (such as: dependency, the Lord from the phrase), the attributed role a word or phrase plays in a sentence, as well as the structural characteristics (such as: complex and compound sentence) and other information.

In summary the whole framework of a topic-oriented understanding system is shown in Figure 1.

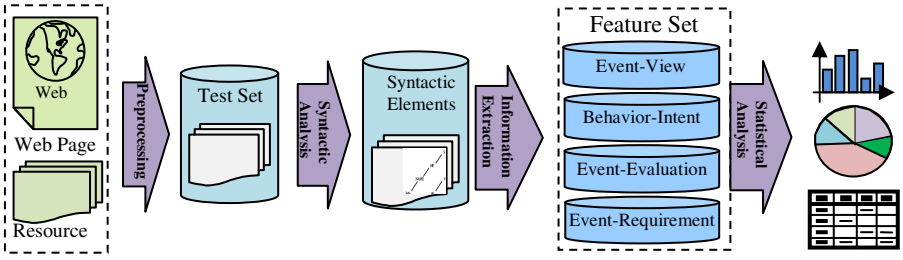

Fig. 1. The framework of Topic-oriented Understanding System

The whole framework consists of four steps: First, crawl and preprocess the text from the web and resource, and form the text collection based on the single content unit; secondly, analyze the text collection, annotate syntactic elements contained in the text; thirdly, based on the requirements of the different understanding tasks, extract specific syntactic elements, standardize them and form the feature sets from the information; at last, conduct statistical analysis on the feature sets of information, and present the results in the statistical form of charts and tables.

In this framework, the text pre-processing part is realized by the use of conventional crawling and text processing tools commonly used in text processing systems, the statistical analysis is well studied in database and statistics. However, there are still open questions to extract feature information for syntactic component generation. It is not only because of the capability of effective natural language processing and understanding; but also the requirement that the derived syntactic components could be used in the topic-oriented understanding of extracted information.

In this paper, our main contributions are to:

- propose a reduced syntactic component extraction model to guide the syntactic analysis of text to generate syntactic elements, which can be used for information extraction;
- devise an algorithm of mapping the extracted components with the targeted syntactic component; and
- implement the syntactic component generation algorithm based on existing POS tagging and parsing techniques, and validate the effectiveness of the proposed model and algorithm by experiments.

The remainder of this paper is organized as follows. In Section 2 we discuss the related work. Section 3 introduces the reduced syntactic component extraction model, and then Section 4 proposes the Framework of the Model and Algorithm. Section 5 reports the evaluations of the experiment. Section 6 concludes the paper.

2 Related Works

The research for the formal grammar theory begins with Chomsky [1]. In the Chomsky's "Syntactic Structures" discusses the syntax of the language in the form of rules of composition and structure of the rules, priority rules. The first rule is rewritten as S (sentence) NP (noun phrase) and VP (verb phrase), the following rules further

to rewrite the NP and VP, until the formation of the final lexical items and grammatical elements combination. Generate results can be used with the syntax name (NP, etc.) to demonstrate the type of graph is called a labeled tree labeled trees.

Lucien Tesnière is the the founder of the modern dependency grammar and valence theory. He consists the fundamental elements of 'Structural syntax'[2], which is known as dependency grammar, and the main theoretical schemata, with price and interdependence. He stressed that "understanding a sentence, is to identify the linkages between the various words in the link sentence." Structural links are established dependencies between words.

For the Syntactic component analysis, the "subject – description mode" is the one kind of information organization, and there're different expressions for the various languages. If we use the "Subject – Predicate" structure to analysis the Chinese, the syntactic rules of language instance perhaps only 50% [3].

3 Syntactic Component Reduced Extraction Model

3.1 Framework of the Model

Syntactic component extraction model is the process to help transform from the natural language to extractable information features. Thus, the model should not only be able to satisfy the syntactic generality of the structure coverage of the target text, but also meet the requirements of topic-oriented information extraction.

The model is divided into two parts: the syntactic composition model and the reduced extraction model. The syntactic composition model is responsible for parsing the text, and the goal is to, without the change of semantics, to transform the natural language expressions in different syntax and diverse expressions into the symbolized components of sequence or tree forms, as the basis of information extraction. Semantic represents the inherent content meaning to express. The reduced extraction model will extract the required components according to the different requirements of topics from the syntactic component. The framework of the model is shown in Figure 2:

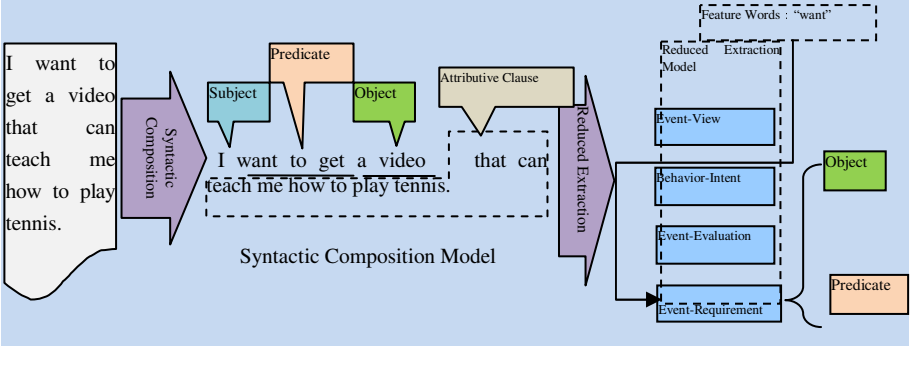

Fig. 2. The Framework of the Model

3.2 Syntactic Component Model

Syntactic component model is to carry out the dual tasks of syntactic coverage and information extraction. It includes three aspects: The first is able to handle the trunk syntax of component extraction and semantic capture; the second is the function of the complete description and the primary-secondary component separation of syntactic elements and; and the third is the summarization of complex sentences.

3.3 Reduced Extraction Model

The syntactic component extraction model should get the core backbone sentence, combined with modified ingredients, covered the complex sentence, and compound a variety of sentence patterns. The reduced extraction model for syntactic components consists of two parts: the first describes the mapping between the trunk sentence structure and the "subject – description mode"; and another part is the description of the guidance of how to extract required components from the analyzed syntactic components. The so-called term "reduced" reflects the process that when dealing with the mapping only the trunk sentence structure is mainly concerned.

4 Algorithm and Implementation

In this section we describe the details of Syntactic Component Reduced Extraction Model (SCREM) algorithm and its implementation.

4.1 Syntactic Preprocessing

We integrated the NLP program package [4] toolbox provided by the NLP research Group at Stanford University into our main system to complete sentence separation, word segmentation, POS tagging and dependency relationship recognition. This results in the collection of textual instances expressing the dependency relationships between the words.

The dependency is the triples describing syntactic relationships between a pair of words. For example, "nsubj (play, boy)" denotes the subject "(nsubj)" of "play" is "boy". The Stanford's NLP package defines 53 typs of dependency [5], covering the majority of syntactic elements.

4.2 Generating Syntactic Graph

The sentence trunk model is a tree structure with root of subject. Therefore, we can generate the syntactic component based on the dependency between randomly ordered words. The strategy of generating syntactic graph is extending from the root to its branch layer. Via iterative traversals over the derived word dependency relationships we can extract the demanded syntactic components within the sentences in a sequence such as "Subject - Predicate", "Subject - Verb – Predicative", "Predicate - Object", "Predicate - Complement", "Clause" and other syntactic component relationships. Three main syntactic component generation algorithms developed for sentence

trunk model are generation algorithms of “Subject - Predicate”, recovering algorithm of “Subject - Verb – Predicative” and generation algorithm of “Predicate - Object”. Due to the limitation of length, we won’t give the detailed description of these algorithms.

4.3 Merging Word Sequence

Each node in the SCSEM graph represents a syntactic component, a node can contain a few words, there’re three kinds of it: 1) for the predicate node, the auxiliary words in passive voice sentences, the negative words in negative sentences, modal verbs, modal particles and other components incorporated should be combined into the predicate node; 2) for the noun phrase, the article should be added before the noun node; 3) for a fixed phrase, it needs to be merged into the same node.

The edges of the SCSEM graph are constructed by the relationship between syntactic components which contain more than one word in the syntactic component. While traversing the dependency relationships, it needs to merge the words belonging to the same identified node. The merging of words is realized by referring to the attribute belongingness of the “pre-word” and “post-word”. We implemented the merging of words by a data structure of bi-directional linked list.

4.4 Graph of Output Syntax

We implemented a prototype system by integrating the above algorithms with the Stanford NLP-core package, called “Syntactic Component Builder V1.0”. The system is developed on the eclipse 3.4.2 integrated development environment, and the user interface is manipulated by the use of the Java Swing-based framework and the JUNG package is utilized to generate the SCSEM graph output. In later experiments, we carried out evaluations with this prototype system.

5 Evaluations

We have utilized two measures which are commonly used in information retrieval, namely Precision and Recall to evaluate the system. They are defined as Precision = the number of correctly identified syntactic components / the total number of identified syntactic components; and Recall = the number of correctly identified syntactic components / total syntactic components contained within the original text.

5.1 Experiment Datasets

We selected 3 articles from SocialCom2009 Proceedings [9] and Reuters-21578 [10] news dataset respectively to form the experimental datasets. For the articles from proceedings dataset, we remove the contents of the title, charts and equations to prepare paragraphs of test sets containing around 1000 words. As for articles from news datasets, we remove the special punctuation, symbols, and other information to

truncate paragraphs of about 200 words. The statistics of test sets is shown in Table 1. The predefined 1330 syntactic components is able to preliminary meet the experimental requirements for statistical significance and coverage. And the experiments are carried out upon the syntactic component collection rather than the articles themselves.

Table 1. Dateset Descriptions

No	Source	Reference Description	Number of Sentence/ Words	Number of Syntactic Elements
1	SocialCom2009	SC-1[6], Introduction	5/1296	409
2	SocialCom2009	SCA-31[7], Introduction and the first 5 paragraphs in Chapter 2	42/1204	330
3	SocialCom2009	SIN-8[8], Abstract, Introduction	37/1106	367
4	Reuters-21578	ID:7019, Full Paper	9/229	61
5	Reuters-21578	ID:12377, Full Paper	9/241	86
6	Reuters-21578	ID:15125, Full Paper	11/236	77
	Total		**160/4312**	**1330**

5.2 Result of Experiment

We use the Syntactic Component Builder described in section 4.6 to conduct text parsing and statistical analysis. The statistical results of all text syntactic extraction precision and recall rate are shown in Figure 3. We can see that the average extraction precision can reach up to 88% and the recall rate 93.9%.

Table 2. Analysis of Experimental Results

No	Syntactic Elements	Identified Elements	Correct Elements	Precision	Recall
1	409	485	392	80.8%	95.8%
2	330	347	302	87.0%	91.5%
3	367	366	347	94.8%	94.6%
4	61	69	60	87.0%	98.4%
5	86	89	78	87.6%	90.7%
6	77	78	71	91.0%	92.2%

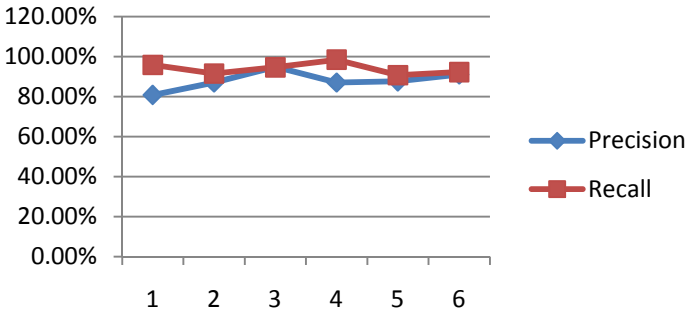

Fig. 3. Precision and Recall of Experiment Results

We get the precision of 80.3% by utilizing the Stanford open source packages to derive the dependency relationship with a small sample of 10 sentence test. We believe that the improvement of precision and recall is mainly due to the focus on the syntactic components and the increased granularity of syntactic component. After further analysis, we find that the error of syntactic precision and recall rate is arising primarily from the annotation mistakes of dependence identified.

6 Conclusion

In this paper, we summarize the main difference between the topic-oriented text understanding and the traditional reasoning-based natural language understanding. We propose the framework containing the syntactic analysis, information extraction and the characteristic analysis process. The whole framework is based on the "subject - Description" information extraction pattern and the main technical contribution is the syntactic component reduced extraction model.

We analyze, design and implement the topic-oriented syntactic component extraction model. The use of syntactic phrases as syntactic elements can prove the model is able to overcome the contradiction between the simple consistency and syntactic diversity of information extraction.

It is found that the syntactic component is corresponding to the semantic segment in language organization, which could be phrases but not to be limited to words. The use of syntactic analysis techniques, in particular, the syntactic dependencies between words, can effectively generate the syntactic elements for information extraction. We also conclude that by increasing the granularity of syntactic elements, the words become phrases, which can certainly improve the precision of the syntactic component extraction.

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One-to-One Complementary Collaborative Learning Based on Blue-Red Multi-Trees of Rule-Space Model for MTA Course in Social Network Environment

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Abstract. It has become increasingly important that applies and develops an intelligent e-learning system in a social network environment. In this paper, we used the combination of Rule-Space Model and multi-tree to infer reasonable learning effects of Blue-Red multi-trees and their definitions through analyzing all learning objects of MTA courses. We can derive one-to-one complementary collaborative learning algorithm from previous definitions. Finally, a MTA course is used to the analysis of Rule-Space Model, and the definition and analysis of learning performance for the MTA Course. From this MTA course, they can create twenty-one learning effects of Blue-Red multi-trees and recommend those specific Blue-Red multi-trees that satisfy one-to-one complementary collaborative learning group algorithm and analyze these learning performances of all Blue-Red multi-trees. They will be the basis of verification for one-to-one complementary collaborative learning.

Keywords: Rule-Space Model, Blue-Red Multi-Tree, Social Network, Collaborative Learning, Complementary Collaborative Learning.

1 Introduction

Tatsuoka and her associates come from cognitive psychology, artificial intelligence, and psychometrics has developed assessment methods for diagnosing students' misconceptions [1]. In 1983, Tatsuoka K. [2] proposed the Rule-Space Model to design and suggest carefully for the small-scale learning knowledge. They expect that they can make a diagnostic measurement by applying the model to progress small testing and evaluation. After drawing these relative concepts of knowledge as a tree structure, they are expressed as the Concept Matrix by using the relationship between nodes and

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nodes. Then the nodes of the Reachability Matrix are inferred from the Concept Matrix. Therefore, we can derive all learning paths of the Incidence Matrix from a tree structure, and discover that not all learning paths are applicable to the Incidence Matrix. We remove unreasonable learning paths within the Incidence Matrix and create the Reduced Incidence Matrix. Finally, the Reduced Incidence Matrix is transformed into the Ideal Attribute Matrix. We again analyze all ideal paths of the test response matrix and evaluation through the Ideal Attribute Matrix to generate the Ideal Item Response Vectors. Therefore, [3] used the methods of Tatsuoka's Rule-Space Model, and classified clearly the order of learning objects from binary trees of learning concept map, and diagnose different learning effect from the relation of learning orders. Thus, they derived nine learning groups of social network grouping algorithms and applied to social network learning system that generated excellent analysis of learning performances.

The enumeration of binary trees [4] and t-ary trees [5] has been widely discussed in recent literature. Binary trees and t-ary trees can be called the regular trees. Therefore, these applications of binary trees and t-ary trees can generate a variety of algorithms for solving various fields of problems, efficiently. Therefore, the application of multi-tree is more complex and it is difficult to find meaningful rules. The multi-tree is often used in the inference of routing algorithms for network routers, or data transmission status in a network environment. [6] proposed binary searches or multi-way search architecture on balanced trees for rapidly efficient IP address lookup which shows very good performance in search speed. So, we apply the structure and characteristics of multi-tree to Rule-Space Mode methods, and they can fit the analysis of Rule-Space Mode.

Therefore, the section 2 introduces how to use the Rule-Space Model inferring reasonable learning effect of Blue-Red multi-trees and their definitions for a MTA course. The definitions of Blue-Red multi-trees can infer One-to-One Complementary Collaborative Learning Algorithms for MTA courses are proposed in section 3. The section 4 then describes the analysis of the MTA Course. Finally, we will have a brief conclusion and future development in section 5.

2 Blue-Red Multi-Trees of Rule-Space Model for MTA Course

We use the Rule-Space Model through analyzing learning objects for MTA courses within system, and infer all reasonable learning effect of Blue-Red multi-trees.

Definition 1: If there are number of learning objects L_i, along with i = 1, 2, 3, …, N. They create multi-tree through arrangement of learning states that satisfy the analysis of Rule-Space Model. And there is at least a degree of the node to have to be greater than 2 (not including 2) for the children nodes of multi-tree.

Definition 2: There are number of learning objects L_i, along with i = 1, 2, 3, …, N. They create multi-tree through arrangement of learning states that satisfy the analysis of Rule-Space Model. These definitions are the following:

Definition 2(a): If the Reduced Incidence Matrix $Q_{r:a}$ has M ways of N×1 matrix which are derived from reasonable learning orders, and the $Q_{r:a}$ is integrated as an N×M matrix, that the M ways of N×1 matrix in reasonable learning order is called the matrix Q_i as well, along with i=1, 2, …, M, then

$$Q_{r:a} = \begin{bmatrix} s_{11} & \cdots & s_{1j} \\ \vdots & \ddots & \vdots \\ s_{i1} & \cdots & s_{ij} \end{bmatrix} = \begin{matrix} \\ L_1 \\ \vdots \\ L_N \end{matrix} \begin{matrix} Q_1 & \cdots & Q_M \end{matrix} \begin{bmatrix} 1 & \cdots & 1 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & 1 \end{bmatrix} = Q_1 \cdot Q_2 \cdot \cdots \cdot Q_M$$

Definition 2(b): If Reduced Incidence Matrix $Q_{r:a}$ has M ways reasonable learning order based on Definition 2(a), then each of reasonable learning states of $Q_{r:a}$ is an N×1 matrix, and the multi-tree relationship is based on Definition 1. It can be expressed as Blue-Red multi-tree relationships of learning effect after testing and evaluation, showed in Fig. 1(a). We can use sign LS to express the Blue-Red multi-tree that corresponds to an N×1 matrix. Hence the values within the matrix are regarded as learning states of learning objects, showed in Fig. 1(b). Hence, we define the Blue-Red multi-tree of like the Fig. 1(a), it can be automatically transformed into the matrix of like the Fig. 1(b). It is the same, on the contrary.

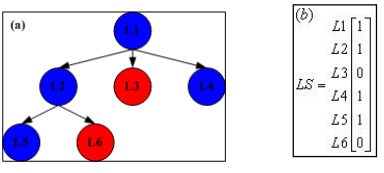

Fig. 1. An example of relationship between a Blue-Red multi-tree and their matrix by the learning conditions of MTA learning objects

Where the blue learning object shows that it passes the test and the value within matrix is regarded as 1. The red learning object shows that it does not pass the test and the value within matrix is regarded as 0.

Definition 3: If there are number of learning objects L_i, along with i = 1, 2, 3, …, N. they create multi-tree through arrangement of learning states that satisfy the analysis of Rule-Space Model, and the Reduced Incidence Matrix $Q_{r:a}$ has number M ways reasonable learning orders based on Definition 2(a), then we will obtain number (M+1) ways of Blue-Red multi-tree relationships of learning effect after testing and evaluation. If we call the matrix as $Q_{r:a+1}$, then the matrix

$$\mathbf{Q_{r:a+1} = Q_{r:a} \cdot LS_0}$$

Where LS_0 is showed as an N×1 matrix, and the values within matrix are regarded as learning states of learning objects. If these values are set as s_i, along with i = 1, 2, 3, …, N, and $s_i \in \{0\}$, and the number 0 shows that it does not pass the test. The sign · shows the connection.

3 Inference of One-to-One Complementary Collaborative Learning Algorithms

We used the Rule-Space Model to analyze all reasonable learning orders that transform various learning effects into Blue-Red multi-trees. So, for each reasonable learning effect of Blue-Red multi-tree, we can find out other Blue-Red multi-trees that can reach one-to-one complementary collaborative learning.

Definition 4: One-to-One Complementary Collaborative Learning Algorithms. If there are N ways of learning objects that create multi-tree through arrangement of learning states that satisfy the analysis of Rule-Space Model. We define the matrices of $Q_{r:a+1}$, LS_I and LS_G, where the $Q_{r:a+1}$ are the sets of all reasonable learning states, and are regarded as an N×(M+1) matrix based on Definition 3. The LS_I is a certain learning result of reasonable learning state after a testing and evaluation and is regarded as an N×1 matrix. The LS_G are the sets of being discovered to reach one-to-one collaborative learning of learning states, and are regarded as an N×K matrix. So, there are number K ways of N×1 matrix that are called the matrix LS_k, along with k=1, 2, ..., K, and K < M+1. Then matrix LS_G are the sets that LS_I finds out all learning states which satisfy one-to-one complementary collaborative learning of social network. We obtain

$$\begin{cases} \mathbf{LS_G} \subset \mathbf{Q_{r:a+1}} \\ \mathbf{LS_G} = \mathbf{LS_1} \cdot \mathbf{LS_2} \cdot \ldots \cdot \mathbf{LS_K} \\ \mathbf{LS_I} \cup \mathbf{LS_k} = \mathbf{LS_{T_0}} \end{cases}$$

Where the sign · shows the connection, the sign $\mathbf{T}_0$ shows the tautology, that is, the values within matrix LS_{T_0} must all be the values "1", and k=1, 2, ..., K.

4 Analysis of MTA Course

4.1 Analysis of Rule-Space Model for MTA Learning Objects

We overview the main chapters and re-organized the Networking Fundamentals course as following chapter dependency chart (as Fig. 2 shown). We design the most important six chapters for the Networking Fundamentals course of MTA License testing and as attributes for the integration of multi-tree and Rule-Space Model.

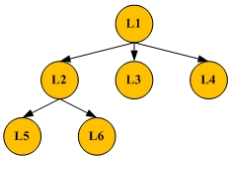

Fig. 2. The MTA course attributes relationship of learning objects

L1 is the preliminary knowledge attribute of L2, L3 and L3. L2 is the preliminary knowledge attribute of L5 and L6. Where

L1: Introduction to Computer Network
L2: OSI Reference Model
L3: Network Infrastructure
L4: Network Hardware and media types
L5: Communication protocol
L6: Technology Trend

As illustrated in Fig. 3, we use the inference method of [2] and its inference process to combine multi-trees that can be evaluated the test process and created its diagnostic evaluation for a MTA course. The Fig. 3(a) shows the relationship between learning order of objects and its hierarchical framework for a MTA course. According to Fig. 3(a), they use learning objects of a MTA course as the nodes of multi-tree diagram which can be transformed into the Adjacency Matrix of Fig. 3(b). The Fig. 3(b) can infer the Reachability Matrix of the Fig. 3(c). In the Fig. 3(c), we can know the path relationships among nodes. Therefore, we can find out all learning paths of multi-tree diagram that can be written as the Incidence Matrix of the Fig. 3(e). We observe that there are some existing unreasonable learning paths within the Fig. 3(e) and we will produce the Reduced Incidence Matrix of the Fig. 3(d) after the unreasonable learning paths are removed. Fig. 3(d) of the Reduced Incidence Matrix can be transformed into the Examinee attributes of the Fig. 3(f) that can be expressed as testers of learning objects attributes. Therefore, they will produce the Ideal Item Response Vectors.

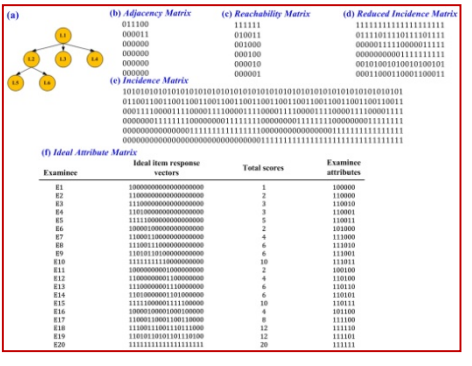

Fig. 3. Inference procedures of a MTA course with Rule-Space Model[7]

4.2 Definition and Analysis of Learning Performance for MTA Course

Table 1 expresses the definitions and analyses of performances with all learning objects of a MTA course in every Blue-Red multi-tree within social network environment. It mainly shows the multiple hierarchical relationships in six learning objects for the Networking Fundamentals course of MTA (Microsoft Technology Associate) License. They include the definition of all learning effects for every

Blue-Red multi-tree and the relationship with the total scores by learning weighting. Hence, there are twenty-one learning effect analysis of Examinee Attributes with tester's learning objects about twenty-one Blue-Red multi-trees within social network learning environment. The Examinee Attributes can transform into the Ideal Item Response Vectors distribution of learning objects with learning effects and the sum of learning Total Scores for every Blue-Red multi-tree. Therefore, we define twenty Vector Addresses (VA) to compare with position arrangements of learning objects for every Blue-Red multi-tree according to the regulations of Rule-Space Model. From left to right, these addresses are VA1(L1), VA2(L2), VA3(L5), VA4(L6), VA5(L6, L5), VA6(L3), VA7(L3, L2), VA8(L3, L5), VA9(L3, L6), VA10(L3, L6, L5), VA11(L4), VA12(L4, L2), VA13(L4, L5), …, VA18(L4, L3, L6), VA19(L4, L6, L5) and VA20(L4, L3, L6, L5), separately. It expresses that only the learning objects inside every Vector Address (VA) have passed the learning (the blue), the value of Vector Address (VA) is the number 1. If it only has a learning objects inside every Vector Address (VA) that does not pass the learning (the red), then the value of Vector Address (VA) must be the number 0.

Table 1. The definitions and analyses of performances with all learning objects of a MTA course in every Blue-Red multi-tree

Vector Addresses	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total Scores	Examinee Attributes
Learning Objects	L1	L2	L5	L6	L4, L4	L3	L3, L2	L3,L6	L3, L6, L5	L4	L4, L2	L4, L5	L4, L6	L4, L3	L3, L2	L4, L3, L2	L4, L3, L5	L4, L3, L6	L4, L6, L5	L4, L3, L6, L5		
Examinee	Ideal Item Response Vectors																					
E1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	100000
E2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	110000
E3	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	111010
E4	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	110001
E5	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	110011
E6	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	101000
E7	1	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	4	111000
E8	1	1	1	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	6	111010
E9	1	1	0	1	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	6	111001
E10	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	10	111011
E11	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	100100
E12	1	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	4	110100
E13	1	1	1	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	6	110110
E14	1	1	0	1	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	6	110101
E15	1	1	1	1	1	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	10	110111
E16	1	0	0	0	0	1	1	0	0	0	1	0	0	0	1	0	0	0	0	0	4	101100
E17	1	1	0	0	0	1	1	0	0	0	1	1	0	0	1	1	0	0	0	0	8	111100
E18	1	1	1	0	0	1	1	1	0	0	1	1	1	0	1	1	0	0	0	0	12	111110
E19	1	1	0	1	0	1	1	0	1	0	1	1	0	1	1	1	0	1	0	0	12	111101
E20	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20	111111
E21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	000000

If a learner gains a Blue-Red multi-tree that looks likes Examinee E10 when he has finished a self-learning and self-testing from the online learning system, because the nodes of L1, L2, L3, L5 and L6 pass the learning (the blue) and only the L4 node does not pass the learning (the red). Then we can infer the Examinee Attributes as the binary numbers 111011. Thus, we can derive his Ideal Item Response Vectors as the binary numbers 11111111110000000000. It shows that there are ten positions of Vector Addresses (VA) and their values as the number 1, then the sum of learning Total Scores are ten points.

4.3 Blue-Red Multi-Trees of MTA Learning Objects

Therefore, there are twenty-one relationships in Matrix $Q_{r:a+1}$ from the **Definition 3** for the learning objects of MTA. It will generate twenty-one reasonable learning states of Blue-Red multi-trees. The Matrix $Q_{r:a+1}$ is expressed as the Fig. 4.

$$Q_{r:a+1} = \begin{matrix} (E1)\ (E2)\ (E3)\ (E4)\ (E5)\ (E6)\ (E7)\ (E8)\ (E9)\ (E10)\ (E11)\ (E12)\ (E13)\ (E14)\ (E15)\ (E16)\ (E17)\ (E18)\ (E19)\ (E20)\ (E21) \end{matrix}$$
$$\begin{bmatrix} 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 \\ 0 & 1 & 1 & 1 & 1 & 0 & 1 & 1 & 1 & 1 & 0 & 1 & 1 & 1 & 1 & 0 & 1 & 1 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 1 & 1 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 1 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 \\ 0 & 0 & 1 & 0 & 1 & 0 & 0 & 1 & 0 & 1 & 0 & 0 & 1 & 0 & 1 & 0 & 0 & 1 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 & 1 & 0 & 0 & 0 & 1 & 1 & 0 & 0 & 0 & 1 & 1 & 0 & 0 & 0 & 1 & 1 & 0 \end{bmatrix}$$

Fig. 4. Matrix $Q_{r:a+1}$ for reasonable learning states of a MTA course

As shown by the Matrix $Q_{r:a+1}$ of Fig. 4, there are twenty-one reasonable learning effects of Blue-Red multi-trees that are classified for a MTA course, shown as the following Fig. 5.

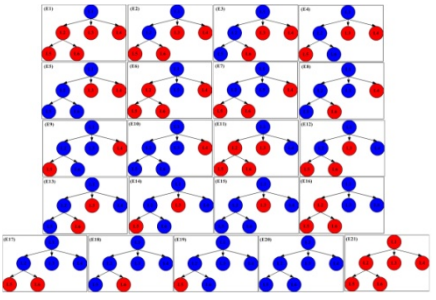

Fig. 5. Blue-Red multi-trees for reasonable learning states of a MTA course

4.4 One-to-One Complementary Collaborative Learning for Blue-Red Multi-Trees

Twenty-one learning effects of Blue-Red multi-trees from a MTA course can find out all appropriate Blue-Red multi-trees for one-to-one complementary collaborative learning according to the algorithm of **Definition 4.** Therefore, the more learners participate the learning, the more Blue-Red multi-trees will be generated. They will have more learning targets to learn and reach the growth of interactive learning. Then, it will solve issues that the social network improves the learning difficulty.

Therefore, Fig. 6 displays the distributed diagram that twenty-one learning effect of Blue-Red multi-trees finish one-to-one complementary collaborative learning with the other Blue-Red multi-trees within a MTA course. Among them, the square solid nodes represent each Examinee Attribute of Blue-Red multi-tree. For example, the E14(6) node expresses that the Blue-Red multi-tree has six points of total scores with learning effect for the Examinee E14. There will be four arrows to point to various related Blue-Red multi-tree nodes, and they include the nodes of E8(6), E10(10), E18(12) and E20(20). It expresses that the Examinee E14 of Blue-Red multi-tree can finish one-to-one complementary collaborative learning with four different Blue-Red

multi-trees. They include the Examinee E8, E10, E18 and E20 of Blue-Red multi-trees. The number fourteen on the top of arrow represents that the Excepted Learning Performances scores are fourteen points when a tester has finished one-to-one complementary collaborative learning.

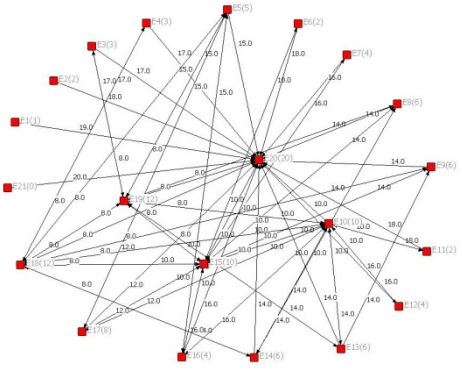

Fig. 6. The distribution of one-to-one complementary collaborative learning group for Blue-Red multi-trees of a MTA course

5 Conclusion

We used the combination of multi-tree and Rule-Space Model to infer all reasonable Blue-Red multi-trees of learning effect and definitions from a MTA course. Hence, we can derive one-to-one complementary collaborative learning algorithm from previous definitions. More importantly, we use a MTA course to illustrate our methods with analysis and verification. The Rule-Space Model analysis of learning objects within a MTA course can create twenty-one learning effects of Blue-Red multi-trees that are applied under social network environment. We will verify that how to recommend these adaptive Blue-Red multi-trees to satisfy the algorithm within one-to-one complementary collaborative learning and analyze its learning performance for certain Blue-Red multi-tree. Therefore, they can reach social learning objective by collaborative learning.

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User Adaptive Application Program Management for Personal Cloud Services

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Abstract. In this paper, we propose a User Adaptive Application Program Management (UAAM) framework in the Personal Cloud Computing Service environment. At first, we propose the architecture for the UAAM framework with its function blocks. Additionally, we describe the basic process for managing various application programs installed in multi-devices of users with its functional state flows in the UAAM framework based on the architecture. Moreover, we propose a use case scenario of the UAAM framework using Android mobile devices and Personal Cloud Computing (PCC) Server as a service framework for the Personal Cloud Computing Project [1]. Finally, we discuss the future work with the challenges to implement the UAAM framework service in more detail.

Keywords: Personal Cloud Service, Application Program Management, User Centric Management.

1 Introduction

As a user has one and more mobile devices such as smartphones and tablet PCs, they need to use and manage their devices more easily. To address the requirements, some researchers focus on a cloud computing service technology personally provided by various methods. As one of methods, the Personal Cloud Computing Service treats a personalized service based on diverse mobile devices to facilitate user's ubiquitous life. [1][2][3] It enables a user with multi-devices, e.g. smart phones, tablet PCs, smart TVs, and so on, to share the data stored in the devices including personal information such as contact information, scheduling information in a Calendar application, e-mail data, files like a picture, video and document, and others. In this paper, we focus on maintaining a consistent user experience (UX), which enables a user to facilitate accessing to a same application and data among his or her multi-devices, in the Personal Cloud Computing Service environment.

In order to support to make the data sharing available among multi-devices belonging to the user, there are various researches to study the data sharing using synchronization method. [4]-[7] In [4], the authors represent a middleware for synchronization, Syxaw (Synchronizer with XML-awareness), in a mobile and a resource-constrained environment. The Syxaw interoperates transparently with resources on the World Wide Web, and provides a model of synchronization

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including a synchronization protocol and a XML based reconciliation model. Similarly, [6] focuses on the data synchronization using a middleware for synchronization, Polyjuz. The Polyjuz enables sharing and the synchronization of data across a collection of personal devices that use formats of different fidelity in [6]. In addition, Wukong in [5] is a file service supporting heterogeneous backend services, allows ubiquitous and safe data access. However, they do not consider an application program installed in user's devices. Besides data consistency, it is needed to provide a consistent environment for executing application in devices. In this aspect, iCloud [7] proposes the proper service for consistency of user's experience. iCloud [7] is a syncing model where large content is synced between devices, smaller meta-data type content is stored in the cloud, and shared changeable data like mail is stored in the cloud. However, it considers only iOS based contents and devices.

In addition, some of them focus on the context-aware methods for supporting the data sharing, which is adaptive to diverse personal preference and status information of service users, among multi-devices over wireless and mobile networks. [8][9] The WhereStore [8] is a location-based data store for smart-phones interacting with the cloud. It uses the phone user's location history to determine his future location, and pre-fetches and caches cloud data for the predicted future locations of the user. Thereby it decreases the overall data access latency and reduces the probability of data becoming unavailable in periods of no connectivity. Nevertheless, they still do not consider the application program itself as target data in their mechanism. In [9], the authors focus on adaptive behavior of cloud computing applications. They implement context-awareness in a mobile environment, and take advantage of remote configuration of in application settings, making the local application adept to changes saved in the cloud and pushed to individual attached devices. Although they describe the similar framework to our work, they also do not consider dynamicity of user's experience.

In this paper, we propose a User Adaptive Application Program Management (UAAM) framework. The UAAM framework makes it possible to adaptively manage application programs according to user's state information such as usability of applications or devices. In addition, the UAAM framework facilitates to provide the personal cloud service among multi-devices. First of all, we explain the architecture for the UAAM framework with its function blocks. Additionally, we describe the basic process for managing various application programs installed in multi-devices of users in the UAAM framework based on the architecture using its functional state flows. Moreover, we propose a use case scenario of the UAAM framework using Android mobile devices, for example smartphones and tablet PCs, and Personal Cloud Computing (PCC) Server developed in the Personal Cloud Computing Project [1]. Finally, we discuss the future work with the challenges to implement the UAAM framework service in more detail.

2 User Adaptive Application Program Management Framework

As mentioned in a previous section, the UAAM framework is an application program management framework in multi-devices environments for Personal Cloud

Computing. In addition, the UAAM framework is a user-convenient and device-adaptive framework for executing and managing application in diverse devices as well as accessing data given by various contents of devices. It provides 1) application program management among devices belonging to a specific user using web based synchronization and a push process with a web server and cloud storage, and 2) user and device adaptive application program management based on diverse information of users and their devices besides application programs.

2.1 Architecture for User Adaptive Application Program Management

The UAAM framework is consists of 2 basic components: a UAAM Server using PCC resources – PCC server and PCC storages – and a UAAM agent installed in user's devices. The UAAM agent collects information of the device and application usability per a user, and communicates with a UAAM server to send local processed information for device and application usability as well as changed application status such as a newly installed application and application local data updated during execution of applications. The UAAM server is a web server, which uses PCC resources to provide a computing and storage service, and it supports to manage information related to applications installed in various devices per a user, and to maintain a consistent and device adaptive execution environment of applications across multi-devices belonging to a specific user. Fig. 1 shows the basic architecture for proposed user adaptive application program management framework with function block in Personal Cloud Environments.

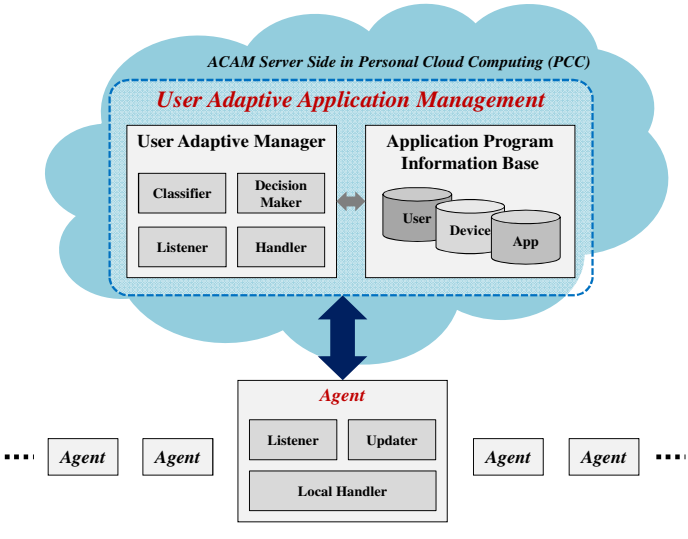

Fig. 1. Architecture for User Adaptive Application Management Framework

As shown in Fig. 1, the UAAM server is divided by 2 parts: User Adaptive Manager and Application Program Information Base. The User Adaptive Manager is

a key part to process user adaptive application program management according to management rules selected by a Decision Maker based on user's and device's properties and state information. In detailed, it basically processes application synchronization among devices when the state of applications in the devices is changed. In addition, throughout tracing and analyzing diverse information collected by devices, it manages the applications per a device and a user with a user adaptive method. For example, it controls the synchronization process according to the application usability in a target device. The Application Program Information Base stores diverse information including processed information such as the usability of applications and devices per a user as well as collected information of user, device, and application, and provides a data service for the User Adaptive Manager.

The UAAM agent is installed in devices, and it consists of Listener, Updater, and Local Handler. The Listener detects state changes of applications in a device or receives a notification from the UAAM server because an application is updated by another device. Also, the Updater reflects changed information in an inner side of a device, and communicates with the UAAM server when the agent sends the changed information in a device. The Local Handler is a main module to control functional processes for managing applications in a device. It provides to handle events catching from the Listener in practice, to locally process simple analytic information from collected information of applications, and to reflect the updated information to a device in practice.

2.2 UAAM with Adaptive Selection of Application Management Rule

As mentioned above, the key functions of the UAAM framework is to provide application synchronization processes for maintaining consistency of application execution among multi-devices, and to manage applications with an adaptive method based on various information, especially usability of device and application, from a user and his or her devices. Fig. 2 shows process flows in the UAAM framework with functional states in which the UAAM server and agent are.

In the agent side, there are 2 kinds of closed flows: 1) updating an application status when it is changed, and 2) collecting and sending information, which is either raw data or processed data from the device. The update process is consists of Listening and Updating, and the basic flow is similar to an application sync process in [10]. The Listening is a waiting state, and it goes to Updating if it catches the change such as installing a new application, uninstalling an existing application, and changing the local data resulted by execution of an application. When an application in the device is changed, the agent goes from Listening to Updating. The Updating is an actuation state, and the agent communicates with the UAAM Server in order to send the change of an application to the server or to receive the change of an application from server. The collecting process is consists of Collecting, Flushing, and Local Processing. When the agent collects application information, the agent is in the Collecting. Using the collected information, the agent calculates the usability of applications installed in a device under the Local Processing. In the Flushing, the processed information is sent to the UAAM Server as a key factor to make a decision for managing applications among devices per a user.

The UAAM server processes main functions to support efficiently and automatically managing applications among devices per a user. The basic flow in the server is also similar to an application management process in [10], however, the UAAM server has a function to select a management rule adaptively. For supporting this adaptive function, we propose a simple decision algorithm using the usability of applications.

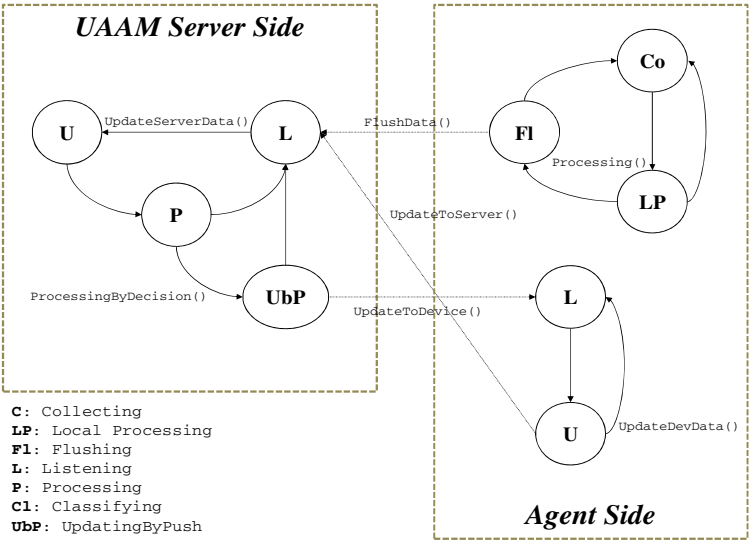

Fig. 2. Functional State Flows in User Adaptive Application Management Framework

The usability of applications is defined as a rate value to represent how often an application is executed during a time interval. When the time interval for a device i is T_i, the usability of an application j installed in the device i is defined as follows:

$$u_{j_i} = \frac{h_{j_i} - h_{max}}{h_{j_i}} \tag{1}$$

where h_{j_i} is the rate to execute the application j in the device i during T_i, and h_{max} is the maximum of h_{j_i}, $j_i = 1, 2, 3, \ldots, N$. In addition, using this parameter, we derive the usability of the device i, u_i, as follows:

$$u_i = \frac{\sum_{j_i=1,2,\ldots,N} u_{j_i}}{N} \tag{2}$$

where N is the total number of applications installed in the device i.

The u_{j_i} is calculated for Local Processing state, and this calculation is repeated by T_i. Also, this calculated u_{j_i} is sent to the UAAM server as essential information for

determining a management rule in the server, and then, it is stored in the Application Program Information Base. Additionally, the u_i is a reference value for determining a management rule in the UAAM server. The example of the decision rule is as follows:

Adaptive Scheduling Interval for Management. When the $u_i(t)$ is a current value and $s_i(t)$ is a current duration of management scheduling for the device i, if $u_i(t) < u_i(t-1)$, $s_i(t) = s_i(t-1) + \alpha \cdot s_i(t-1)$ where $0 < \alpha < 1$. Otherwise, $s_i(t) = s_i(t-1) - \alpha \cdot s_i(t-1)$ where $0 < \alpha < 1$.

Adaptive Synchronization of Application Programs. When the ε is a threshold value, if $u_{j_i} < \varepsilon$, the application j_i is eliminated from a synchronization list.

In a case of ε, it should represent the enough value to remove an application which is seldom selected for execution by a user. Also, if the application deleted from a list is chosen by a user again, it can be added in the list.

3 Use Case with a Scenario

For developing the UAAM framework, we use not only some devices with Android platform such as smartphones (e.g. Galaxy S) and tablet PCs (e.g. Galaxy Tab) but also a web server connected with the PCC server and PCC storage service, which has already implemented as a result from PCC project [1]. Also, the scenario for a use case, which we design as a reference model of the proposed framework, is shown in Fig. 3.

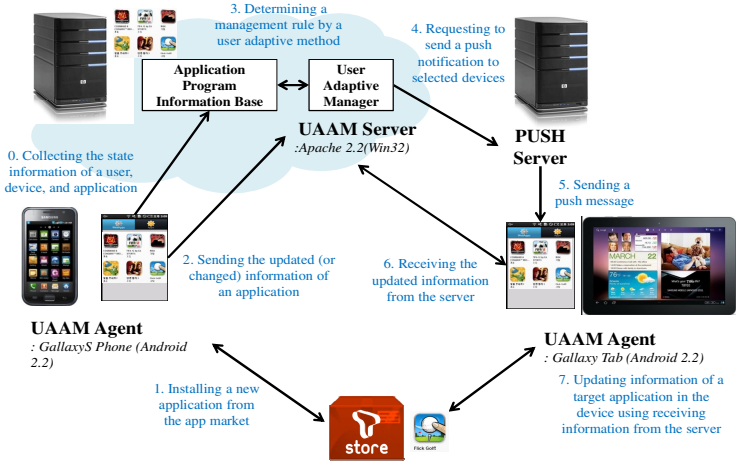

Fig. 3. Reference Scenario for UAAM Framework

4 Conclusion and Future Work

In this paper, we propose application program management framework with a user adaptive method, the UAAM framework. This concept is based on a management method proposed in [10], however, the UAAM framework provides automatic adaptive control for application program management among devices, so that, it adaptively reflects properties of a user which possesses multi-devices like a smartphone, and tablet PC. Namely, the UAAM framework facilitates to adaptively manage application programs over multi-devices throughout the management rule controlled by the usability of applications and devices. Also, we propose the use case scenario as a Personal Cloud Computing (PCC) Service framework. As a future work, we implement the UAAM framework in a large scaled environment with the more detailed functions. Also, we improve the performance with recursive measurement and feedback, for example, the fine tuning mechanism for the proposed management rule control algorithm.

Acknowledgments. This work was supported by the IT R&D program of MKE/KEIT. [K10035321, Terminal Independent Personal Cloud System].

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Guidelines of Data Delivery Scheme for Healthcare Applications on Android Platform

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Abstract. This paper addresses guidelines of data delivery scheme on Android platform, allowing for security and transmission speed of data. Conventionally, smartphone-based healthcare application deals with individual private data such as lifelog. These need to be transmitted securely and processed through several 3rd party applications. Therefore, we analyze the Android platform from the perspectives of secure data transmission and fast data transmission. Firstly, we perform experimental test with practical lifelog data to evaluate proper data delivery scheme. Secondly, we analyze the each delivery methodologies and suggest guidelines for proper data delivery scheme enabling secure and fast data transmission.

Keywords: Healthcare, data delivery, lifelog, guideline.

1 Introduction

Major challenges to modern healthcare is to find solutions to cope with aging population, rising of inpatient and ambulatory costs, lack access to facilities and personal of rural residents. Due to the aging population, chronic disease began to emerge as the central healthcare issue. Chronic disease is the major cause of disability, the principle reason why patients visit hospitals [1]. Especially, South Korea is expected to become the most aged country in the world in 2050, raising worries it could erode the economy's growth potential.

However, the development of technologies to overcome these problems is going very quickly. Specifically, Mobile devices can bring healthcare to the patient through the connected devices reaching the rural patient. Aggregated data also improves triage and diagnosis. And standardized and commonditized devices can reduce costs.

On the other hand, todays, the number of smartphone users is growing rapidly, including among healthcare professionals and the general public. Smartphone-based applications are getting more attention in healthcare day by day. The wide adoption of smartphones by the general public emphasizes the opportunity of better healthcare and mobile telecare services through patient oriented applications, for example, patient education, disease self-management, and remote monitoring of patients.

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From the perspective of medical field, smartphones allows personal health devices to be connected with short range wireless communication such as Bluetooth. Also, smartphones connects to the internet. Therefore, smartphones can transmit accurate patient's data to healthcare professional in real time.

From chronic disease perspective, this disease is closely related to lifestyle of the patient. In general, the patient in the presence of chronic disease has responsibilities to use medications properly, to change behaviors to improves symptoms or slow disease progression. Therefore, we need to monitor daily condition of body and lifestyle and provide consulting for chronic disease people.

Currently, we are developing lifelog-based healthcare support system for chronic disease people. As an initial phase of this work, we are making a digital health screening form [2-3]. Current version of the form focuses on lifestyle information and vital index of a user and provides a link of medical treatment information to a health portal. In implementation of the digital health screening form, we allow for two primary consideration points. Firstly, we are trying to gather a variety of information as possible from the user. Secondly, we are attempting to deliver gathered data effectively.

This paper is associated with the second consideration. Prior to discussing effective data delivery mechanism, we evaluate the data delivery methodologies used in implementation of the screening form. After evaluation, we analyze the security point of each delivery methodology. Finally, we propose guidelines of data delivery scheme.

The remainder of this paper is organized as follows. In section 2, we present background of this work. The section 3 describes evaluation result for each data delivery scheme and discusses the security points for each method. In section 4, we propose the guidelines while we implement data delivery scheme. Finally, we summarize this work and discuss the future works in section 5.

2 Background

In Korea, SBI (Systems Biomedical Informatics) research center aims to create personalized 'health avatar', representing individuals genomic through phenomic reality (or 'digital self') using multi-scale modeling and data driven semantics for the purpose of personalizing healthcare [4].

'The health avatar platform' will be created as an agent space and health data integration pipeline. 'Health avatar platform' will create a space for interacting plug-in intelligent health agents and data analysis toolkits and provide a data and access grid for heterogeneous clinical and genomic data. The health avatar platform will function as an infra-structure for the development and evaluation of intelligent health applications for personalized medicine. This work is conjunction with the 'Connected Self' of health avatar project supporting lifelogs and stream-type data mining for health protection and developing 'Mobile Health Screening Form (HSF)' where reflects personal information, lifestyle patterns, illness history.

3 Android Platform and Data Delivery Evaluation

Android is a software stack for mobile devices that includes an operating system, middleware, and key applications. Android developers can leverage existing data and services provided by other applications. This communication model reduces developer burden and promotes functionality reuse. Android achieves this by dividing applications into components and providing a message passing system so that components can communication within and across application boundaries. However, Android's message passing mechanism can become an attack point if it used incorrectly.

Intents, an abstract description of an operation to be performed, are delivered to application components, which are logical application building blocks. Android defines four types of components

- Activities: an application component that provides a screen with which users can interact in order to do something. Activities are started with Intents, and thy can return data to their invoking components upon completion. All visible portions of applications are Activities.
- Services: an application component that can perform long-running operations in the background and does not provide a user interface. Another application component can start a service and it will continue to run in the background even if the user switches to another application. Additionally, a component can bind to a service to interact with it and even perform inter-process communication. Intents are used to start and bind to Services.
- Broadcast Receivers: an application component that responds to system-wide broadcast announcements. Many broadcasts originate from the system. Applications can also initiate broadcasts – for example, to let other applications know that some data has been downloaded to the device and is available for them to use. More commonly, though, a broadcast receiver is just a 'gateway' to other components and is intended to do a very minimal amount of work. For instance, it might initiate a service to perform some work based on the event.
- Content Providers: an application component that manages access to a structured data. It encapsulates the data and provides mechanisms for defining data security. Content providers are the standard interface that connects data in one process with code running in another process.

In Android security model, all applications are treated as potentially malicious. Each applications runs in its own process and applications can only access their own files by default. These isolation mechanisms aim to protect applications with sensitive information from malware. Despite their default isolation, applications can optionally communicate via message passing.

Android provides a sophisticated messaging passing system, in which 'Intent' is used to link applications. Intent is a message that declares a recipient and optionally includes data. Intents can be sent between three of the four components: Activities, Services, and Broadcast Receivers. All of these forms of communication can be used with either explicit or implicit Intents.

In simple cases for own components such as explicit routing using explicit Intent, Intent carries explicit class specifier and Android platform can directly locate component and start it. This is a typical way for an application to launch various internal Activities that it has as the user interacts with the application.

For all 3rd party components such as implicit routing using implicit Intent, Intent carries action specification and Android platform applies a resolution mechanism to identify a suitable component to start. Implicit Intents do not specified a particular component. However, they include enough information for the systems to determine which of the available components are in the best category to run for that Intent.

When Intents are issued, Android platform looks for the most appropriate way of responding to the request. The intent resolution mechanism basically revolved around matching an Intent against all of the <intent-filter> descriptions in the installed application packages.

We need to be careful while we use Intents, especially 'implicit intent', in Activities, Services, and Broadcast Receivers because inappropriate implicit intent causes Activity hijacking, Service hijacking, and Broadcast theft [5].

Apart from Content Providers, Intents can be used to deliver data among Activities, Services and Broadcast Receivers.

Content Providers is only mean to share data and give access to a specific set of data across applications. In Content Providers, data are stored in files or SQLite database. Content Providers implement a standard set of methods to load/store data of the type it controls.

We evaluate the performance of data delivery between application components of Android including conventional Socket. In this performance test, we use practical lifelog data such as user's movement information (accelerometer sensor) and location changing information (GPS) as a source data. In test, we differentiate length of data and measure the delivery times. And all experiments are maintained in the same environment. Fig. 1 shows the evaluation result for each data delivery scheme such as Intent, Broadcast Receiver, Content Provider and Socket.

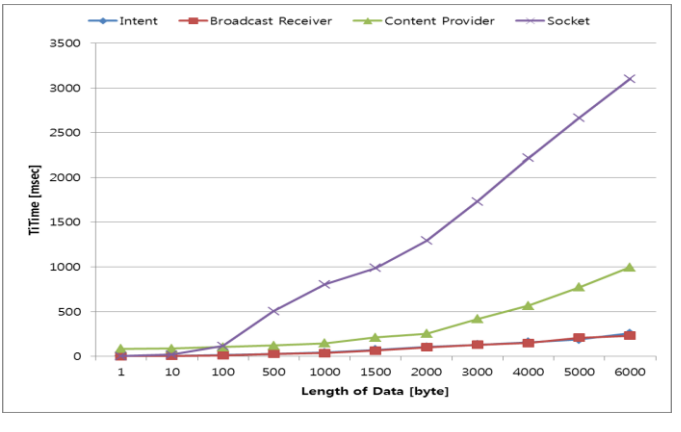

Fig. 1. Evaluation result for each data delivery scheme on Android platform

4 Guidelines for Data Delivery Scheme

Table 1 shows the several methodologies of data delivery and its limitation.

Table 1. Data delivery methodologies and its limitation

Type		Transmission Speed	Security	Intra-application	Inter-application	Other platform
Intent	to Activity	Fast	E*: good I*: bad	O	X	X
	to Service	Fast	E*: good I*: bad	O	O	X
	to Broadcast Receiver	Fast	E*: good I*: bad	O	O	X
Content Provider		Marginal	Good	O	O	X
Socket		Slow	-	O	O	O

E*: explicit intent, I*: implicit intent.

We can use Intent to deliver messages including data to another Activities, Services and Broadcast Receivers in intra-application with explicit intents. And we can also deliver messages through implicit intents to another Services and Broadcast Receivers in inter-application.

Using an explicit Intent guarantees that the Intent is delivered to the intended recipient, whereas implicit Intents allow for late runtime binding between different applications. However, the usage of implicit intents can be dangerous because multiple applications can register components that handle the same type of Intent. This means that the operating system needs to decide which component should receive the Intent.

Therefore, we recommend the explicit Intent while we want to transfer messages including data in intra-application. For the case of inter-application delivery, we recommend the Content Provider to transfer data.

As aforementioned section shows the result of data delivery speed, the usage of Socket is not recommended because of slow transmission speed. However, while we need to transfer data between different platforms, the Socket is only solution inter-platform delivery.

In summary, we recommend the proper data delivery scheme in Android platform as follows.

- Data delivery in intra-application: using explicit Intent is the best solution according to the point of speed and secure transmission
- Data delivery in inter-application: using Content Provider is proper solution from speed and secure perspectives
- Data delivery between heterogeneous platforms: Intent and Content Provider are not applicable. The Socket solution is recommended

5 Conclusion

This paper describes the data delivery scheme of Android platform and its evaluation from the perspective of data transmission speed and security consideration.

In general, smartphone-based healthcare applications deal with individual private data such as lifelogs so that secure and fast data transmission are important point.

From the result of this work, the Intent-based messaging between Android components is the fastest method. However, the using improper implicit Intent casues hijacking of Activities, Services and Broadcast Receiver. On the other hand, Content Providers provides a marginal speed and well-structured data architecture. Therefore, Content Providers is good selection in inter-application. In this experiment, the Socket method is seen as the most inefficient. As a communication standard, however, Socket method can exchange data with heterogeneous platform, for example, between Android and iOS platform.

In conclusion, according to the purpose of data transmission, we need to switch the methodologies.

We believe that this work provides a better understanding and greater insight into the effectiveness of the smartphone-based healthcare applications in implementing secure and fast data transmission.

We need to allow for inter-platform data delivery scheme as the future work to collaborate with heterogeneous smartphones seamlessly. Because Android and iOS platform have different operating architecture, we are considering of structured XML format to comply with standardized communication protocol.

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Personalized Application Recommendations Based on Application Usage and Location

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Abstract. The purpose of this study is to recommend proper applications to users when they need them based on personal situations and common application usages. We propose application recommendation based on the frequency of an application usage and a location. Application usages and locations are gathered from users' devices and analyzed them at a personal cloud server. Personalized applications can be recommended based on a user's context. In addition, generalized applications can be recommended based on other people' experiences. The application usages should be calculated by the number of application execution by some period. It is important to decide the period. Also, more effective algorithms should be developed.

Keywords: Personal Cloud Service, Application Recommendation, Application Usage, Location.

1 Introduction

So many applications are being developed and introduced at application markets. Even users install lots of applications on their devices. However, they use only a few applications they are needed.

Researches on adaptive user interfaces have been widely studied. Adaptive user interfaces on mobile devices have been shown to be studied.[1,2,3,4] Applications are recommended based on the user's context; time, location, weather, emotion, and activities [1]. The historical context information was considered and probabilistic learning algorithm was developed [1].

Commercial mobile application markets have recommended mobile applications [5]. T-Store serves several methods to recommend applications; categories, up-to-date items, hits, downloads, ratings, propensities to purchase. Especially, they analyze users' propensities to purchase mobile applications and recommend applications which other users with similar propensities to purchase have purchased at the market.

The study of adaptive user interfaces does not seem to consider others. It shows just top three applications to match their context on home screen of the mobile devices and the recommended applications are that the user own on the mobile device. They just reconstruct application lists on home screen based on the user's

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context. In addition, commercial mobile application markets do not seem to consider personalized context.

The purpose of this study is to recommend proper applications to users when they need them based on personal situations and common application usages. We propose application recommendation based on the frequency of an application usage and a location.

2 Experimental

Requirements for application recommendation are collected and defined. Scenarios will be described as the result. The scenarios should be developed based on the conceptual diagram for personal cloud computing shown in the following Fig.1. Fig. 1 shows the conceptual diagram for personal cloud computing retrieved from demonstration sites [6].

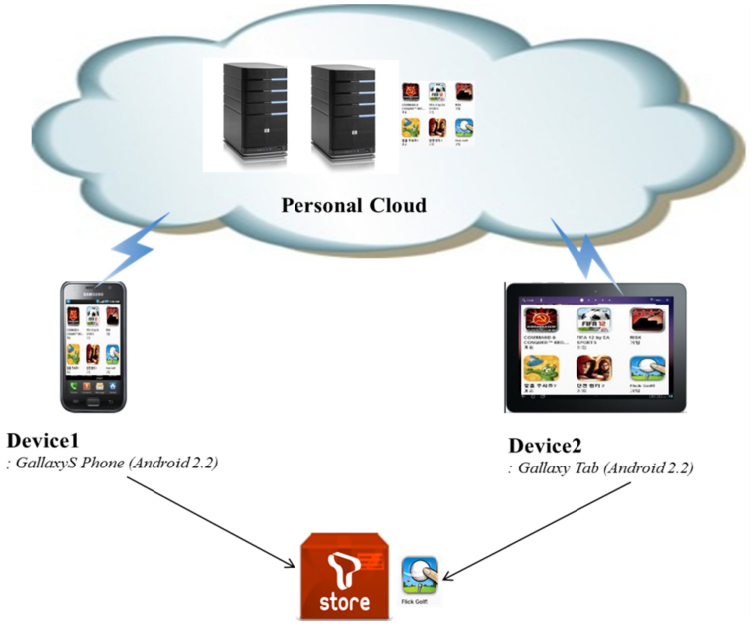

Fig. 1. Testbed for Personal Cloud Computing [6]

Users own several devices; smartphones, tablet PCs, IPTVs. Users expect to experience with similar user interfaces. Also, users should be served proper applications in their situations.

An agent on their devices should send real-time data for application usages and their location. Requirements for devices count the frequency of application usage and send the frequency to a personal cloud server once a day. The locations of the device are detected by GPS and it should be sent to a server. The period may be proper once 3 or 5 minutes.

Personal cloud servers should store users' context-information; application usages, locations. The servers should analyze GPS and then figure out some location based on GPS data. And then some relations with application usages for that location should be made. The applications should be recommended based on the location. If there are applications used at the location, the server recommends the application to a user device.

Databases are needed to store huge users' logging data. Algorithms for application selection should be developed.

3 Result

Modules for application selection algorithms based on location are shown in the Fig.2. Devices count application execution and send GPS data periodically to a server. The server analyzes GPS data and figure out a location. Data from devices are piled up in the server's databases. Applications are recommended by application selection algorithms. Personal user interface manager shows application lists to a user's device. A user can decide applications to use at the situation.

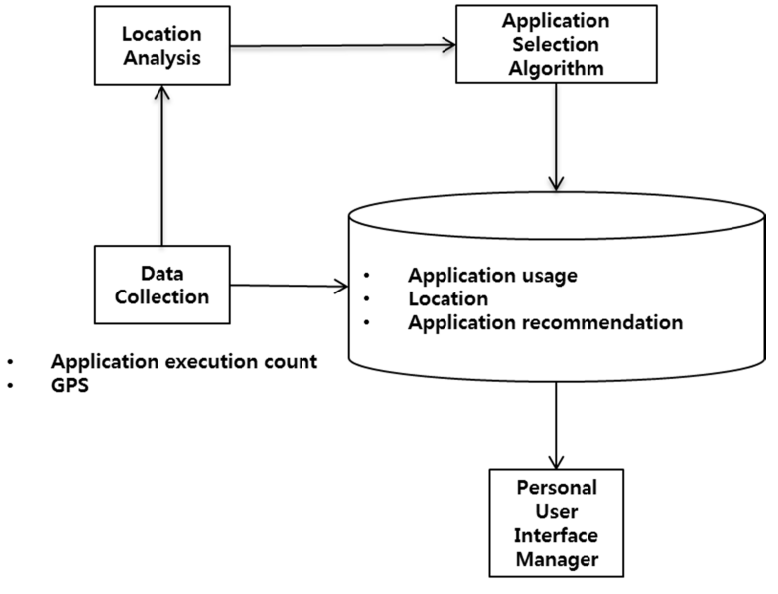

Fig. 2. Modules for Application Selection Algorithm based on Location

A detailed flow chart for application selections based on device locations is shown in the Fig.3. The number of application executions should be counted by devices to analyze application usages. GPS data should be detected whenever an application is executed. It should be updated periodically to a personal cloud server. A personal cloud server analyzes device locations in relation to an application execution. Applications to recommend should be constructed. The lists for recommended applications are pushed to devices to be being used by a user.

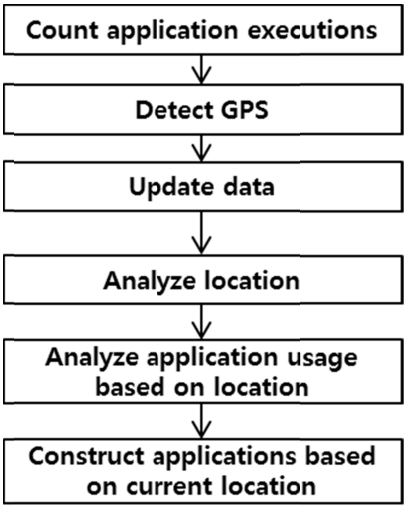

Fig. 3. Application Selection Flow Chart based on Device Location

Databases of application recommendations are comprised of locations and applications shown in the Fig.4. Locations should be categorized several area; home, buildings, streets, and so on. Applications executed at the location are connected with the location. The applications related to a location should be rated by application usages.

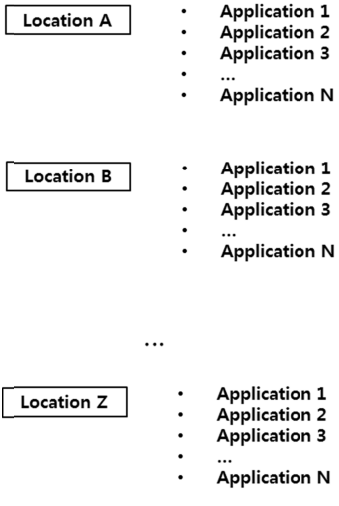

Fig. 4. Recommended Applications based on Locations as a result of the above Application Selection Algorithm

Application recommendations can be selected by a user's historical information for application usages. On the other hand, other people' application usages at the same location can be used to recommend applications to a user. The Fig.5 shows the recommended applications based on locations and application usages by other people.

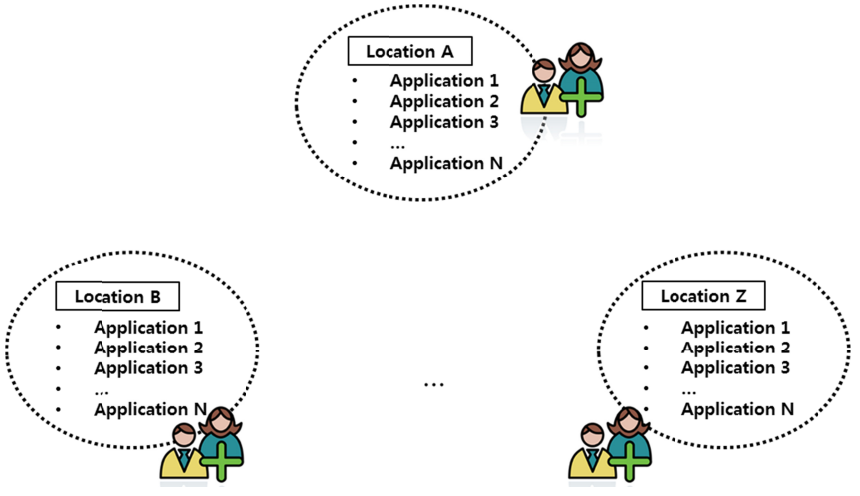

Fig. 5. Recommended Applications based on Locations and Application Usages by Other People

4 Discussions

Application usages and locations are gathered from users' devices and analyzed them at a personal cloud server. Personalized applications can be recommended based on a user's context. In addition, generalized applications can be recommended based on other people' experiences. The application usages should be calculated by the number of application execution by some period. It is important to decide the period. Also, more effective algorithms should be developed.

Users' log data such as application usages and locations is constantly piled up to personal cloud servers. Those data should be distributed to several servers for big data. The processing for big data is needed to our project.

5 Future Works

For big data, MapReduce mechanism should be added to this work. And then performance tests should be performed and the result should be reported.

Acknowledgments. This work was supported by the IT R&D program of MKE/KEIT. [K10035321, Terminal Independent Personal Cloud System].

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Knowledge Digest Engine for Personal Bigdata Analysis

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Abstract. The bigdata analysis has an issue of high knowledge creation. In this paper first, we define personal big data, and using personal bigdata created by user activity we try to create high knowledge about the user. We have created personal bigdata analytic engine and knowledge digest engine for high knowledge creation and personalized service. The engine is used to collect, process and analyize personal big data. And In the process we refine, associate, and fuse data for analysis. In this paper, we show the process of analyzing personal big data, and detailed structure of analyzing engine for persoanl big data. High knowledge about the user will lead to better personalized services, and better adaptive services.

Keywords: User Activity Analysis, Personal Bigdata, personalized services, adaptive services.

1 Introduction

Personal bigdata are created every day. From GPS, acceleration sensors, to electroencephalography sensors are easily reachable to users who are interested in their personal bigdata [1, 2]. Currently these data are used as it is or used with basic pattern recognition or basic statistical analysis. Such data as GPS are used in navigation system as GPS sensor value [3], and in some application, GPS data are used to find a favorite places that user likes to go using statistical approach [4]. These data are collected using multiple devices and sources shown on Table 1.

These collected data are unstructured and they cannot be made to knowledge without data processing. The purpose of personal bigdata analysis is to inference the specific user characteristics that are not normally shown with basic statistical approach. In this paper, we show the steps of data processing for personal bigdata analysis and the steps of analysis engine we have structured to fit the personal big data analysis.

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LNEE 182, pp. 261–267, DOI: 10.1007/978-94-007-5085-2_34,

Table 1. Devices/Source for collection of personal bigdata

Devices / Source	Collected Data
Zephyr HxM BT	Heart rate (HR), Speed, Distance
Withings Weight	Weight, BMI, Fat
Withings BP	Blood pressure, HR
Nonin SpO2	Oxygen level, HR
Jawbone UP	Movement, Sleep Pattern
Fitbit ultra	Walking, Distance, Calorie, Time
Motoactv	Walking, Distance, Calorie, Time
Nike+	Walking, Distance, Calorie, Time
Bodymedia FIT	HR, Temperature
Smartphone	GPS, Time, 3-axis Accelerometer, etc
Social network	Written contents, associated friends, time, location, etc.
Purchase	Purchase, price, amount, place
Web logs	Keywords, Time, Platform
Schedule	Associated Friends, time, location
NeuroSky	EEG
Emotiv EPOC	EEG

2 Background

2.1 Personal Bigdata

Bigdata is known for three Vs; Volume, Variety and Velocity [5]. Currently these bigdata analyses are mostly done in the fields of social network analysis [6, 7] as a analysis of many people. We define personal bigdata as a data created by the user's activity that has the attribute of bigdata. The personal big data records have volume, in sense that these data are recorded over a lifetime. Also even though we will not be written in this paper, the video and audio also can be used as a personal data, which is known to be huge in volume. The devices give variety of personal data, which are structured, unstructured, semi structured data. These data are used to service personalized services in real time, and these data are created in streams, which gives velocity attribute of bigdata.

2.2 Personalized Services

Current commercial personalized services use stereotypes [8, 9]. Such internet services group people into gender, ethnic, age, and interest groups to provide different services for different people. In research papers, for personalized services, used real "personal" data for analysis to provide real personalized services [1]. But, these services are domain-specific, and use limited information of user.

In this paper, we show how to analyze personal bigdata user for personalized services.

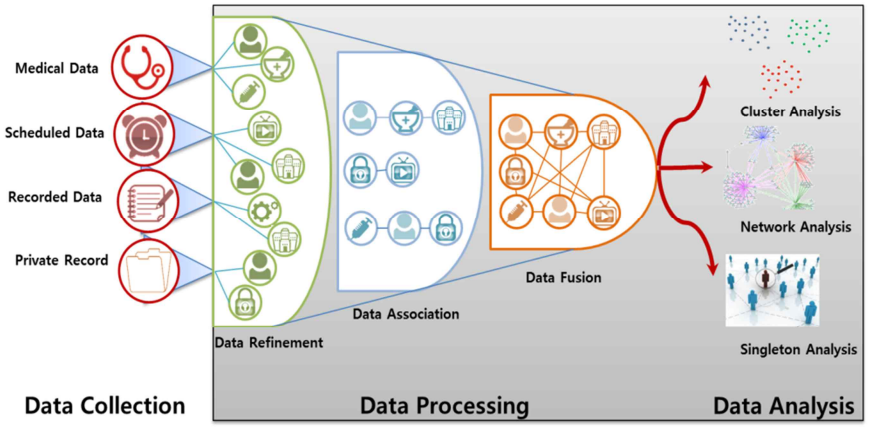

Fig. 1. The process of personal big data analysis

3 Data Processing of Personal Bigdata

Figure 1 shows the data processing of personal big data. The process consists of three part data collection, data processing, and data analysis.

3.1 Data Collection

The data are collected using the sensors introduced in the Table 1, or data created by the user. Such data as email, schedules, and personal notes also can be used as a personal bigdata as well as a private record and medical data can be used. Due to the lifetime difference of data, some data such as profile is collected only once, while some data such as social data are collected in batch, or once a week, and some data such as EEG is collected every millisecond.

3.2 Data Processing

3.2.1 Data Refinement

Personal bigdata are sometimes unstructured, and not complete. And since these data came from different source of origin the value it represents may need normalization. Therefore in the data refinement process, natural language processing or database mapping is used to create values that can be used in analysis from the personal bigdata. Missing value imputation is used to fill in the missing values using regression or mean value. Sometimes missing value imputation is not used depending on the data type, such data as heartbeat is has a lifetime of 2~3 seconds while heartbeat pattern of daily life can be found using logs of heart beats, the missing value does not need to be imputed every time for a personalized services. Noise filtering algorithms are used to remove the background noise. Lastly, for data refinement the selection of useful and

meaningful data is needed. These data are used as it is for a personalized service, and are used in the association.

3.2.2 Data Association

Using the refined data, we associate different kinds of data. We check for correlation, association using statistical and data mining approach. These links represent knowledge of a user. For example, using GPS data and medical data, we may find the favorite hospital the user goes for a specific disease. Using purchase data and time data, we may find the frequency of buying specific goods. Linking separate data allow us to find more specific user activity and allow us to represent more accurate data. The linked data itself also can be used in personalized services.

3.2.3 Data Fusion

For data fusion, we use the associated data and link them together to form a new network. We used network construction algorithm to form different kind of networks for analysis. Different scenarios are created according to the network.

3.3 Data Analysis

We use clustering analysis, network analysis and singleton analysis for data analysis. For clustering analysis, we separate each entity to the specific time frame then select the attributes for clustering. The timeframe that has similar values are clustered. These clusters are used to provide personalized services.

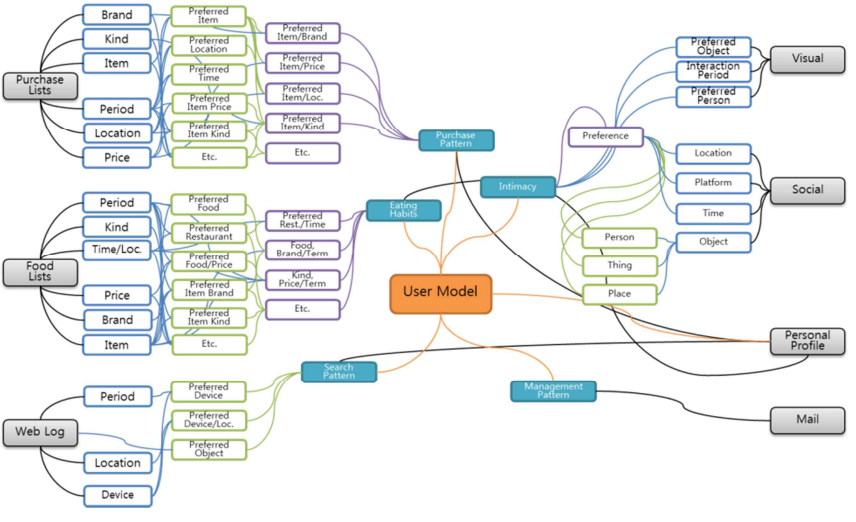

Fig. 2. Creation of user model using analysis of personal big data

The networks that are constructed in the data fusion level, the network are used to recognize specific status of the user. Also data itself can be a network, such as social network data; therefore the network analysis is applied to the specific data.

On the singleton analysis, we try to see the changes in the single value depending on other value changes to gather information of the single value. Such analysis as change in weight depending on different variables can be analyzed using singleton analysis.

These analyses are used to create user model, shown on Figure 2. Seven basic logs are used for analysis, and user model, which represents the characteristics of user, is then used for personalized service

4 Personal Bigdata Analytic and Knowledge Digest Engine

4.1 Personal Bigdata Analytic Engine

Personal bigdata analytic engine consist of four modules shown on Figure 3; preprocessing module, feature extraction module, analysis module, and low level knowledge information handle module.

Preprocessing module is module for the refinement process explained on 3.2.1. The data are preprocessed to fit the machine learning. Natural languages are transformed into weights or fuzzy logics, and different words are mapped to standard words. The missing values are imputed, and values are normalized.

Feature extraction module uses feature selection algorithms to select most useful and meaningful features from the data. These selected features are then analyzed using mining library, and statistic library. The analyzed knowledge is called low level knowledge information, and it is stored into the database.

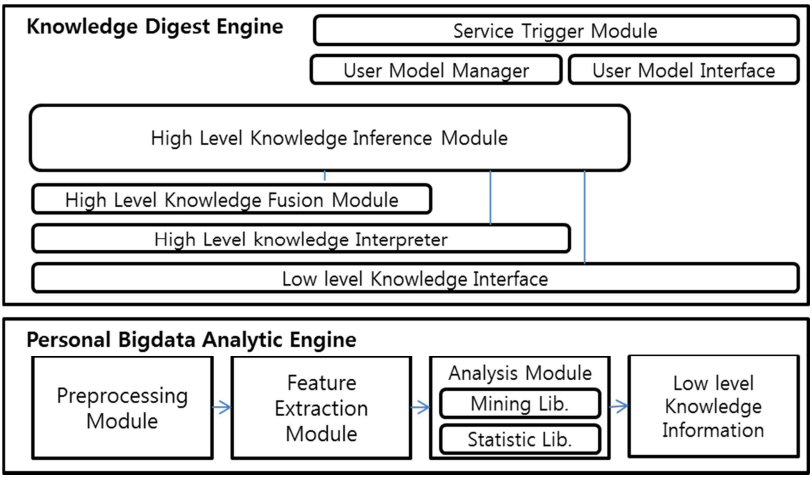

Fig. 3. Structure of Personal Bigdata Analytic Engine and Knowledge Digest Engine

4.2 Knowledge Digest Engine

Knowledge digest engine is also shown on Figure 3. As explained on 3.2.2 and 3.2.3 the data gathered from low level knowledge information and processed by the interpreter, or linking the low level knowledge information data, and then links are fused with other links to construct a network. This network is then used to create high level knowledge, which is the characteristics of the user, which will update the user model. After the user model update, the service is triggered through service trigger module.

5 Future Work

For future work, we plan to automatize the analysis and provide service accordingly. The recognition of user activity and data gathering itself needs improvements. The image analysis, natural language analysis, and auditory analysis must be improved for better real-time personalized service. The data analysis from variety of data from single source can be biased, so we plan to gather from different sources for the analysis. More data collection is needed for further verification of our engine.

6 Conclusion

In this paper, we have shown how to analyze personal bigdata and structure of personal bigdata analysis engine and knowledge digest engine. The challenge of the personal bigdata is the finding the best analysis algorithm for variety of data, and interpreting the meaning of the results. Also, the devices for gathering personal bigdata should be developed for ease of gathering information.

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Activity Classification Using a Single Tri-axial Accelerometer of Smartphone*

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Abstract. Activity recognition and classification is very useful filed. In this paper, we present the activity classification using a single tri-axial accelerometer of smartphone. Smartphones have a lot of sensors and a powerful performance, and many researchers study using smartphone sensors. Especially, utilization with the accelerometer is very large. The topic of the activity classification can be used as many parts, such as health-care part, medical part, and emergency part. We want to make the activity predictive model in everyday life using the activity classification. To make this model, user's activity should be classified and recorded. In order to classify the daily activity, some elements should be considered. In this paper, we analyze to find the optimized environments for activity classification.

Keywords: Activity classification, Accelerometer, Smartphone, Daily activity.

1 Introduction

Today, smartphone is the most popular devices that many people have. These smartphones have a lot of sensors and a powerful performance. The development of smartphones was able to provide users with a variety of useful services. In addition, researchers have investigated sing a smartphone sensors and a powerful performance. Smartphones are closely connected with everyday life. Therefore, most research topics are related to the user's lifestyle.

Among the many sensors of smartphone, accelerometer sensor is used in many filed. Originally, accelerometer sensor is used to switch the screen according to the direction of the smartphone. To do this, smartphone has a single tri-axial accelerometer sensor. This sensor is able to receive about x-location, y-location, and z-location information. Using this sensor, there are some studies related to situation awareness

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or health care system. These studies are classify the situation using a variety of algorithms (e.g. Decision Tree, Clustering, …). This is analyzed in a short period of time.

We try to analyze user activity for a long period. Based on this analysis, we will make the predict user activity model. Using this model, a more user-friendly lifelog services are able to provide customized services. So, we need a continuous analysis and recording to do this. In order to do this from a smartphone, many things should be considered, such as battery, memory, data length, and like that. In this paper, we conducted a experiments to find the optimized smartphone environments for activity classification for a long period.

The remainder of this paper is organized as follows. In section 2, we explain related work and background of this paper. Section 3 describes the contribution. In section 4, we show the result of the experiments. Finally, we summarize this paper and conclude the result in section 5.

2 Related Works

Many researches using acceleration sensor have been carried out. The final goal of these studies is that accurate analysis of user activity. For this purpose, the accurate of classification is important. So, the new algorithm or new classification method is presented. In one study, Neuro-fuzzy classifier algorithm is used for activity classification [1]. In this paper, Neuro-fuzzy algorithm is transformed to clarify a particular activity. Activity also can be classified by using Decision tree [2]. In order to accurately classification, Nishkam Ravi's paper was used the statistical data of the acceleration sensor [3]. Using this statistical data, the accuracy of different algorithms is compared. Uwe Maurer's paper, the accuracy of classification is studied according to the location of the acceleration sensor [4]. In a recent study, smartphone has been used in order to analysis the user activity [5-6]. One paper analyzes several algorithms using smartphone [5], and other paper is used the Hierachical Hidden Markov Models [6].

Unlike previous papers, there are various studies using activity classification. These papers are focused that classification algorithm is used to treat a particular event. In this area of research, most papers are related to health-care topic [7-10]. Unlike these papers, Myong-Woo Lee's paper presents human activity classification and generation of the exercise information [11].

3 Contribution

In session 2, we reviewed many kinds of studies. To classify the patterns of activity, many kinds of experiments were performed. Acceleration sensors used in most experiments has the range of 10 ~ 30 Hz sampling rate. The sampling rate of acceleration sensor is able to accurately classify the user activity. If frequency rate is increase, the number of data obtained in time is increased. This causes a more accurate analysis is possible. However, if a data is classified and recorded for a long time, long frequency rate cause the following problems.

- The length and size of the recorded data
- Limited battery of smartphone
- Accuracy of the activity classification

These problems are very important issues in the smartphone environment because smartphones have limited resources. In particular, if user are using for a long period of time, these issues are very important.

3.1 The Length and Size of the Recorded Data

If frequency rate is increased, the number of data obtained in time is also increased. If the data record 12 hours, the length of the data are as follows:

- Based on 10 Hz: 12 hours * 3600 second * 10 Hz = 432000
- Based on 30 Hz: 12 hours * 3600 second * 30 Hz = 1296000

As the frequency rate is doubled, the data recorded is also doubled. If such as acceleration sensor data to be stored, the data record in terms of efficiency is very inefficient. Acceleration sensor data has three-axis data information. So, the length and size of the data can be greatly increased.

3.2 Limited Battery of Smartphone

Acceleration sensor operates continuously, it is caused battery life problem. In order to record continuously, the battery maintained for as long as possible is important. This problem, the use of sensor can be solved by a long period.

The Best way to solve the two problems, the acceleration sensor sampling frequency is to reduce. In doing so, the length of the data is reduced, and the battery maintenance is increased. However, this case, the accuracy of the activity classification is dropped. So, we conduct experiments to find the optimized smartphone environments.

4 Experiments

We conduct experiments to find the optimized smartphone environments. To find such an environment, we record the acceleration sensor data by changing the sampling rate, and analyze the accuracy of activity classification. In addition, we compare the resulting graph and the data length to find the difference for each rate.

In our experiments, we classify the basic activity, such as sitting, standing, and walking. These tree activities are the most common behavior. The sampling rate of acceleration sensor mounted on smartphone that is used in this experiment has 16 Hz.

For this experiment, we use 1 second, 5 second, 15 second, and 30 second of data collection rate. The results of each experiment are compared. The order of activity is sitting, standing, and walking in the experiments.

4.1 16 Hz Sampling Rate Result

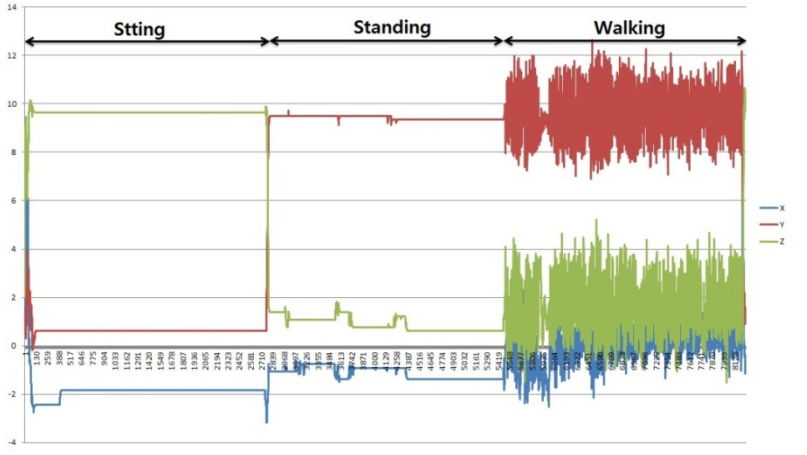

Fig. 1. The acceleration sensor data graph of 16 Hz sampling

This result is a rate of 16 Hz. The number of acquired data is approximately 8000. This result can be used as the basis graph to compare with other results. As can be confirmed by the graph, the characteristics of each activity are clearly distinct. Sitting and Standing is a static activity, walking is the dynamic activity.

4.2 1 Second Sampling Rate Result

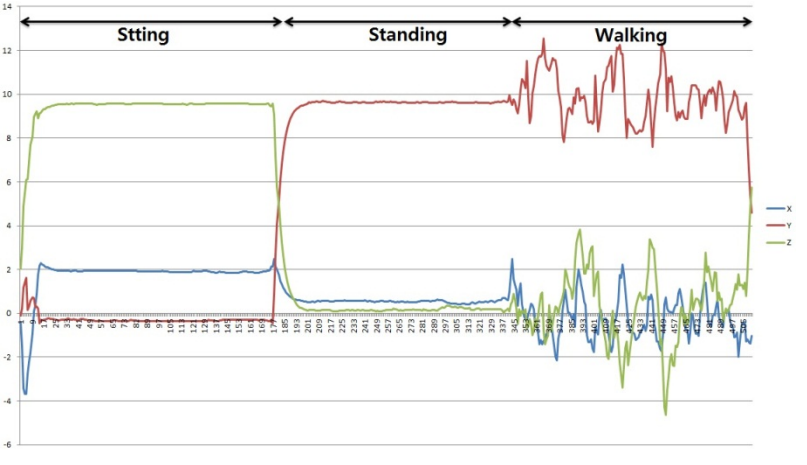

Fig. 2. The acceleration sensor data graph of 1 second sampling rate

This is result of a 1 second sampling rate. The number of acquired data is approximately 500. As can be confirmed by the graph, the characteristics of each activity are

distinct. When compared with the results of 16 Hz rate, static activity result has not changed significantly. But, the dynamic activity (walking) of the cycle was lengthened. In addition, the activity changing can be observed.

4.3 5 Second Sampling Rate Result

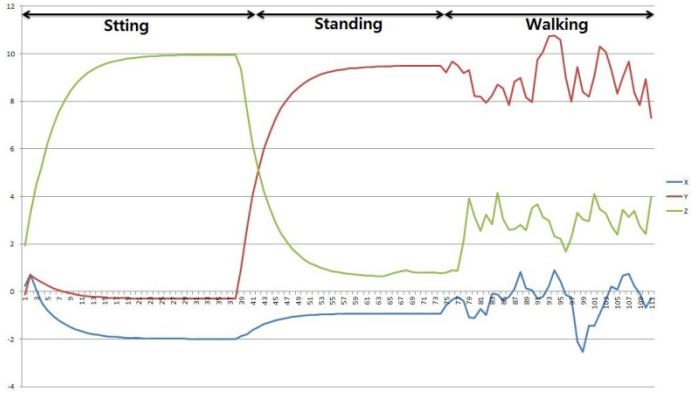

Fig. 3. The acceleration sensor data graph of 5 second sampling rate

This is result of a 5 second sampling rate. As can be confirmed by the graph, the graph is shaped like a curve. The characteristics of the dynamic activity are still appeared.

4.4 15 Second Sampling Rate Result

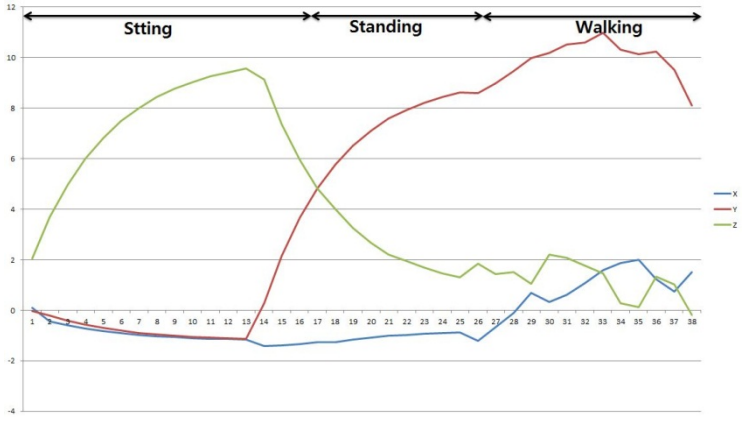

Fig. 4. The acceleration sensor data graph of 15 second sampling rate

This is result of a 5 second sampling rate. As can be confirmed by the graph, characteristics of each activity have almost disappeared. Unlike previous results, the static

activity characteristic is changed to a curve in a straight line. In addition, the comparing standing with walking is almost impossible.

4.5 30 Second Sampling Rate Result

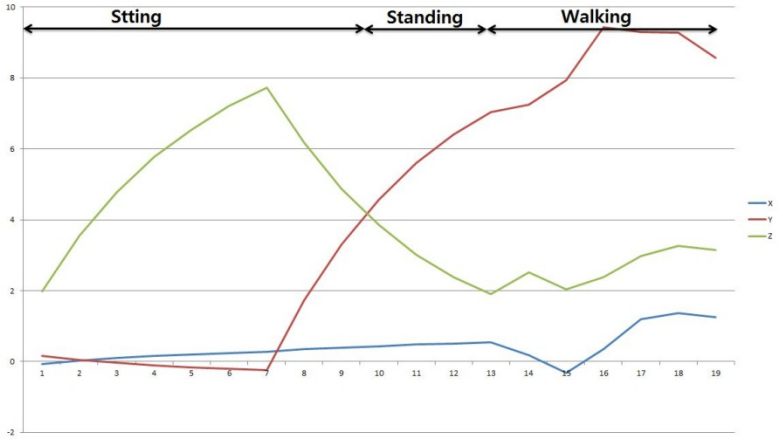

Fig. 5. The acceleration sensor data graph of 30 second sampling rate

This is result of a 5 second sampling rate. As can be confirmed by the graph, , the comparing standing with walking is impossible.

5 Conclusion

We conduct experiments to find the optimized smartphone environments. As can be seen through the experiments, as the data collection period is long, the activity characteristics are disappeared. It is fatal to the accuracy of the activity classification. We classify the activity data using the classification tool. The results are as follows.

Table 1. Activity classification accuracy result for each rate

Algorithm	**Time rate**				
	0 Sec (16Hz)	1Sec	5 Sec	15 Sec	30 Sec
Naïve Bayes	97.60%	95.11 %	93.69 %	91.11 %	84.21 %
J48	98.86%	97.65 %	95.50 %	93.74 %	89.47 %
Bayes Net	98.74%	94.52 %	92.68 %	90.11 %	89.47 %

15 seconds and 30 seconds training data are very small. So, it is shown higher accuracy than we think. But, as data increases, the accuracy is drop.

Considering the accuracy and experiment results, we conclude that the range of 5 seconds is most appropriate sampling rate. In the range of 5 seconds, the

characteristics of each activity are distinct and accuracy of classification is also higher. In the next studies, we collect actual life activity data using this sampling rate, and classify the activity.

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An Analysis on Personalization Technologies of Policy Based Dynamic Power Management of a Server System

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Abstract. This paper presents an analysis about personalization technologies of policy based dynamic power management of a server system by using the result of the survey. First, we surveyed about the technologies of policy based dynamic power management of a server system, which are adopted into IT infrastructure via boom of green technology. In addition, we analyze the requirements of the personalization technologies of the policy of the dynamic power management. We suggest the required functions of the policy based power management in terms of personalization.

Keywords: Personalization, Policy based, Dynamic power management, Server system.

1 Introduction

Due to increased demand for solution to global energy and environmental problems, green technologies are attracting attention recently. In the area of server computing, the power management of server systems is the one of green technologies, which reduces the power consumption of computing. Especially, the fast growth of usage of internet and server based computing, the necessity of reduction of power consumption of server systems become required. Generally, the power management of a server system is very complicated because it is the multiple-input-multiple-output control problem to have many things to consider. Therefore, for the effectiveness of the power management of a server system, the policy is used to abstract a simple human-understandable rule from the complicated control functions.

There were some researches about how to formulate the policy of the power management of a server system [1-4]. Generally, the researches focused on how to optimize power reduction by using control or optimization theories. There are few researches about human factors of the policy formulation, e.g., personalization of a policy of power management. An administrator of a server system should make the policy to control the server system and reduce the overall power consumption of the system. The administrator can control the server system more effectively if the policy making is personalized to his or her preference. Therefore, the purpose of this study is to analyze and propose required functions of personalization of policy making of

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dynamic power management of a server system through the survey of current technologies.

The outline of the paper is as follows: Section 2 provides the background for dynamic power management of a server system. Section 3 describes the concept of the policy for the dynamic power management, and the state of the art of the policy based power management. In Section 4, we give the analysis of the requirement of personalization of the policy based power management. Finally, we conclude this paper and provide the discussion about the further studies in Section 5.

2 Dynamic Power Management of a Server System

Some previous papers defined the concept of the dynamic power management (DPM). Dynamic power management is a design methodology for dynamically reconfiguring systems to provide the requested services and performance levels with a minimum number of active components or a minimum load on such components [5]. Dynamic power management refers to the use of runtime strategies in order to achieve a tradeoff between the performance and power consumption of a system and its components [6]. A typical 3 level dynamic power management system is depicted in Fig. 1. The DPM master server monitors and controls the DPM managed nodes through network. DPM proxy servers may be used because of limit of network capability of the DPM master server.

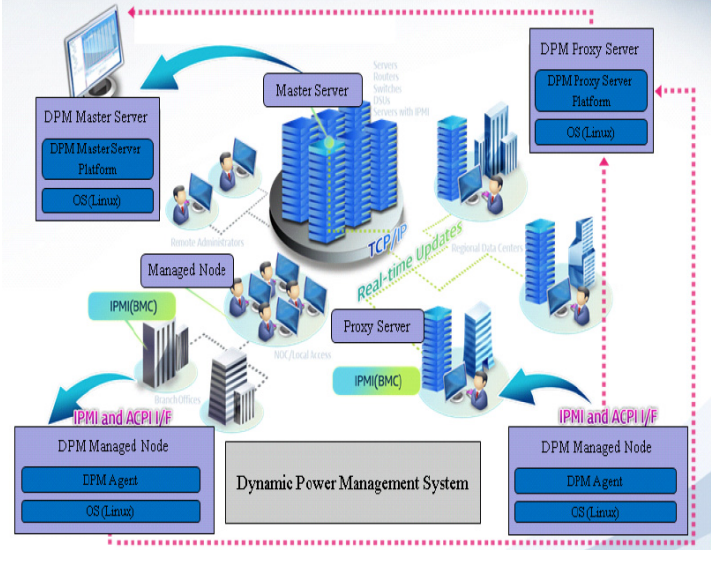

Fig. 1. An example of the 3 level dynamic power management system

The problem of the dynamic power management can be formulated as a MIMO (multiple-input-multiple-output) control problem as in Fig. 2.

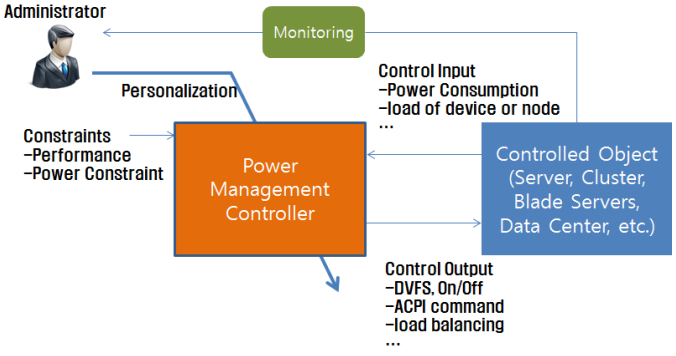

Fig. 2. The problem formulation of the dynamic power management

The controlled object can be a server cluster, blade servers, and a data center. The controller has the policy of power management. The controller issues its control output based on control input from the controlled object. The constraints of the control problem are about the performance and the power consumption. The constraints are usually in an inverse relationship. The typical inputs and outputs of the dynamic power management are summarized in Table 1. Therefore, the problem of the dynamic power management is considered as the optimization problem of the design of the controller that controls the controlled object and satisfies the constraints of the performance and the power consumption.

Table 1. Typical Inputs and outputs of the dynamic power management

	type	Methods
Input	Power consumption sensing values	Power consumption, ambient temperature, chassis temperature, fan speed, CPU temperature, CPU frequency, CPU voltage, etc.
	Load	Page requests, etc.
	Resource utilization	CPU usage, memory usage, network usage, etc.
	performance	Response time, length of queue, etc.
Output	Processor	DVFS (Dynamic Voltage and Frequency Scaling), power gating, etc.
	RAM	ZettaRAM control, multi-voltage setting
	HDD	Idle State control, multi spin-speed control, spin down control
	Power supply	Remote power-off control
	Load distribution	Load balancing, power-shifting, virtual machine migration

3 Policy Based Power Management of a Server System

Some previous papers defined the concept of the policy of the power management as follows: The management system ties into all elements of the system and makes global decisions called "policy" on the basis of inputs from all parts of the systems [7]. The main function of a power management policy is to decide when to perform component state transitions and which transition should be performed, depending on system history, workload, and performance constraints [1].

The policy of the power management is classified as in Table 2 in terms of range of inputs of the controller that are covered by the control logic.

Table 2. Classification of the policy of the power management [8]

Level Based Power Policy	A Controller is assigned to each physical level of the system. Control outputs of the controllers are controlled in consideration of some aspects of the physical levels. The physical levels of the controlled objects can be a single node level, a rack level or a cluster level.
Application Based Power Policy	A Controller is assigned to each application on the system. Control outputs of the controllers are controlled in consideration of some aspects of the applications.
Service Based Power Policy	A Controller is assigned to each service on the system. Control outputs of the controllers are controlled in consideration of some aspects of the service. It is the one of variations of the application based power policy.
Time Based Power Policy	Control outputs are varying via a function of time like the day, the month, and the year. It is most popular.

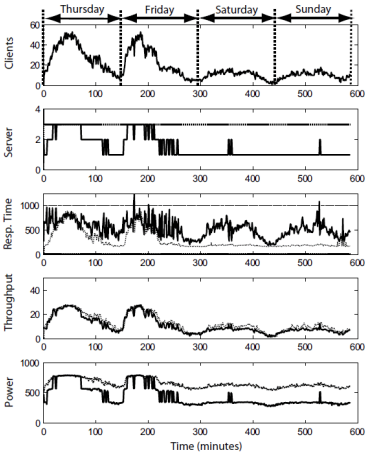

Fig. 3. An example of system behavior in terms of time period [9]

4 Analysis of Requirements of Personalization Technique

In order to make a policy by an administrator, the power management software should have some functions as in Table 3.

Table 3. Required functions of the power management software for policy personalization

function	Description
Information monitoring	The function of storing the information from the DPM managed nodes into database.
History function	The function of presentation of the historical trends of the inputs/outputs of power and control of a DPM Master Server.
Statistics	The function of calculating the statistics of the power and control input/output of DPM Master Server
Reporting	The function of giving personalized reports for easy understanding of an administrator.
Policy configuration (Policy editor)	The function of giving personalized policy scheduling and configuration for easy setting of the policy by an administrator.

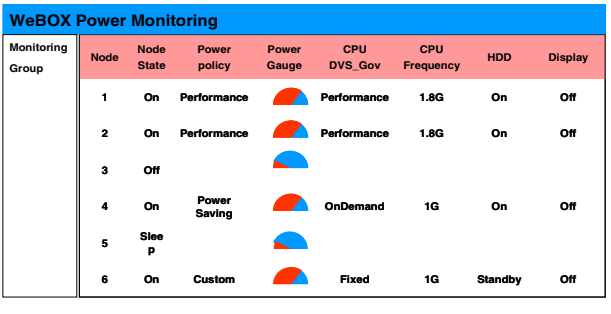

Fig. 4. An example of the dashboard to monitor information from DPM managed nodes

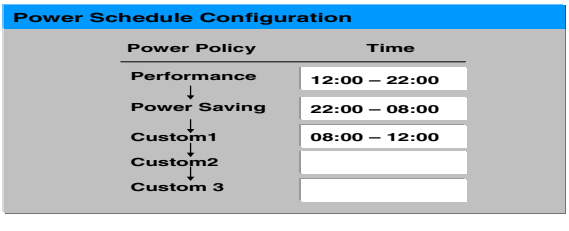

Fig. 5. An example of the dashboard for policy scheduling

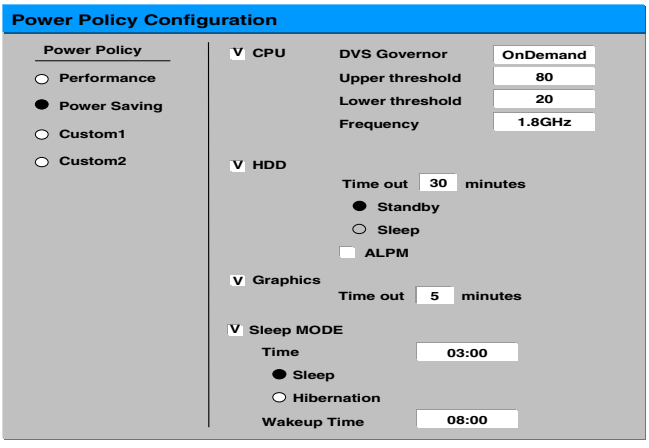

Fig. 6. An example of the dashboard for policy configuration

The overall functionality for personalization of the policy of the dynamic power management is depicted in Fig. 7.

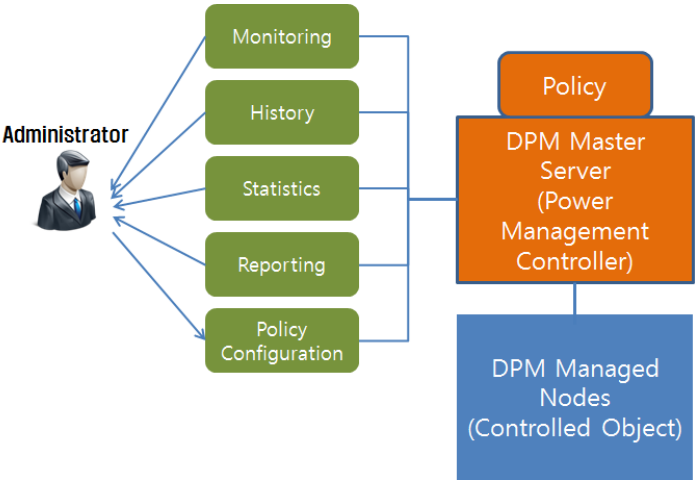

Fig. 7. The concept of the personalization of the policy of the dynamic power management

5 Concluding Remark

In this paper, we analyzed the required functions of the personalization of the policy making for the dynamic power management by surveying some previous researches. We will implement the required functions and investigate which required function is most important in terms of the satisfaction of personalization of the policy making.

Acknowledgments. This work was supported by the IT R&D program of MKE/KEIT, [10040696, Development of energy saving green server under 1mW/MIPS for cloud service].

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Distributed Media Conversion System over Cloud Environment

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Abstract. Due to the technological advances and innovation, Cloud Computing has become the future Internet trend. Users can use Internet services anytime and anywhere through the Cloud virtualization framework and the rapid development of mobile devices. Especially in 3G even 4G-related technologies evolution, the increasing bandwidth makes the media service becomes a popular service. However, due to the heterogeneity of mobile devices, supporting all kinds of media transmission format for a single device is impractical. Even we can install file conversion program in a device to solve this problem, but it would cause additional power consumption and time wasting. In order to solve this problem smoothly, we propose a Distributed Media Conversion System (DMCS) over Cloud Environment. DMCS is based on MapReduce frameworks to conduct distributed media Conversion. With the help of DMCS, we can adjust the multimedia transmission format based on user terminal devices for decreasing energy consumption and assuring media service quality.

Keywords: Cloud Computing, MapReduce, Hadoop, Media Conversion.

1 Introduction

Cloud Computing [1-4] is regarded as the backend solution for processing huge data streams and computations while facing the challenges of everything will be connected with seamless networks in the future. Cloud technologies can provide a virtual, scalable, efficient, and flexible data center for context-aware computing and online service. Cloud technology combined with media services is one of the future Internet trends [5-8]. Users are not only acquiring media content at home but also accomplishing ubiquitous media services through the mobile devices.

However, the media services are supported with variety of formats, such as avi, mpeg, etc. It is hard for a client to support all of these audio and video formats. Even though user can rely on installing file conversion program in mobile device to transcode, it would cause more energy consumption and time wasting for conversion. For the real time media content, time wasting is directly affecting the service quality. In this paper, we propose a Distributed Media Conversion System (DMCS) over Cloud

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Environment. DMCS is based on MapReduce framework to conduct distributed media conversion. According to user's device supported formats, accelerate conversion time through DMCS and cloud architecture.

This paper is organized as follows: In Section 2, we review the Hadoop framework and MapReduce operation model. In Section 3, we describe the proposed DCMS architecture. We describe how to implement DCMS in Section 4. The final section presents our conclusions and future works.

2 Relate Work

Due to the wireless technologies grow rapidly in recent years, growing number of users use wireless terminal or mobile equipment for access media services. Terminal devices are affect by computation and power limitations, transcoding in terminal devices is not apply for media transmission, especially in media streaming service. It might not satisfy the user quality of service due to power consumption and large data processing. The concept of distributed computing can be used to solve transcoding problems.

From the concept of google cloud architecture [9], the Apache Software Foundation develops Hadoop project for a reliable, scalable, efficient distributed computing architecture [10]. The core framework of Hadoop is MapReduce and the Hadoop Distributed File System (HDFS) as illustrated in Fig 1. The HDFS operations can be divided into create, delete, move or rename files, etc. It is similar to the traditional hierarchical file system, storing the Hadoop cluster node's files.

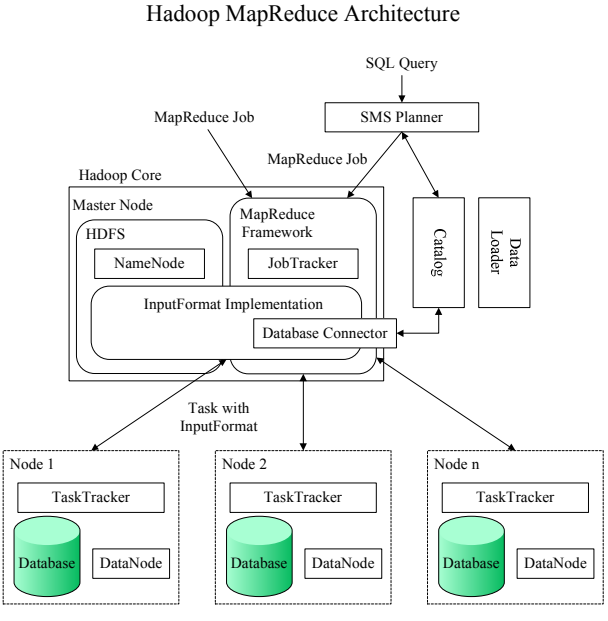

Fig. 1. Hadoop Framework

The MapReduce computation engine is used for running processes which composed by JobTrackers and TaskTrackers. Job Tracker is responsible for managing the scheduling of all jobs; it is the core of tasks allocation in Hadoop framework. The clients in Hadoop need to define the required content of the job and its configuration, submitting to the JobTracker. TaskTracker is responsible for implementing user-defined operation. Each job is divided into sets of tasks, including the Map and Reduce as follow:

- Map: When the Master node accepts a task, it will divide the task into a number of subtasks and assigned to the Worker nodes. Each Worker node send the results back to the Master node when they finfish the subtasks.
- Reduce: Master node receives the results of the Worker nodes subtasks, according to specific algorithm to remove duplicate information and merge into one.

3 Distributed Media Conversion System

In this section, we introduce Distributed Media Conversion System (DMCS) over Cloud Environment. DMCS uses the Hadoop platform to construct the distributed computing architecture. It has following features:

- Without installing other file conversion program
- Decrease power consumption and time wasting
- Assure the quality of multimedia services, especially for real time services

Through DMCS split media file into multiple frames and assign to the host cluster servers for transcoding, media conversion can be more efficient and faster. The DMCS framework is shown as Fig 2. It consists of a Head-End server and several Cloud node servers. Head-End server operates as Master node in original Hadoop framework. When Head-End server receives the media file or streaming conversion

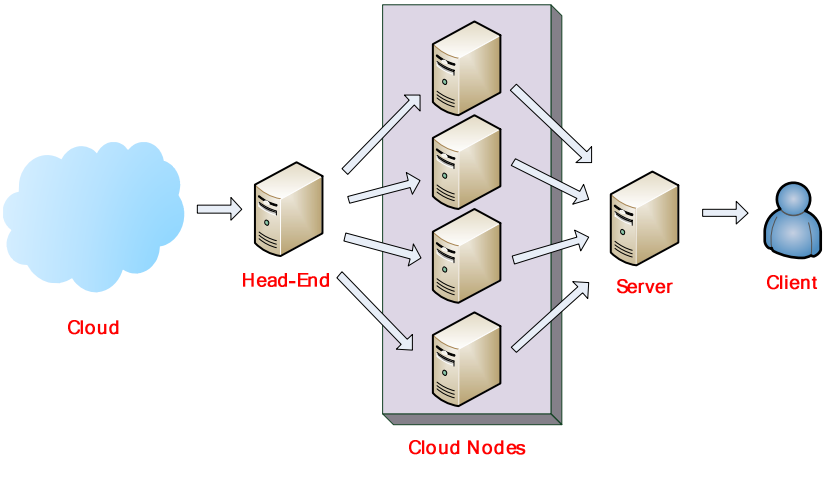

Fig. 2. DMCS Framework

request from client, it assigns the request to Cloud node servers according to the requested file and specification of mobile device. Then the requested media file would be downloaded from cloud, and divided into Group of pictures (GOP). The Cloud node servers individually receive partial file and conduct media conversion. After conversion, each partial file merges into original media content in another format, through server sends to client.

4 DCMS Implementation

In this section, we will discuss how we implement DCMS based on MapReduce framework. A Head-End server task assignment program includes assignment information and Cloud node control. Assignment information records each partial file converting location, when part of the servers in DCMS occur exception, we can manual close server for repairing, meanwhile we can use the backup information restore convert functions quickly.

In each Cloud node, we use processing program records conversion status include file transported situation and server connected state. When an exception occurs in DCMS Cloud node server, it would initiatively send error information to Head-End server. Fig 3 shows a conversion form H.264 to Scalable Video Coding (SVC) in Cloud node server. It conducts conversion according to the order of GOP.

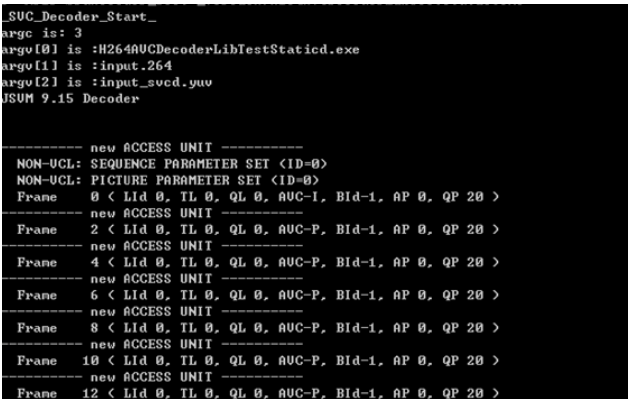

Fig. 3. H.264 Convert to SVC

We compare the conversion performance with 1, 2 and 9 Cloud node servers as shown in Fig 4. Streaming and media file conversion are evaluated respectively. We conduct different format conversion such as H.264 convert to SVC, MPEG convert to avi. The implementation shows almost 10 times faster than use single Cloud node server in converting. With different encoder and decoder, media conversion can be more efficient and faster under demanding service quality.

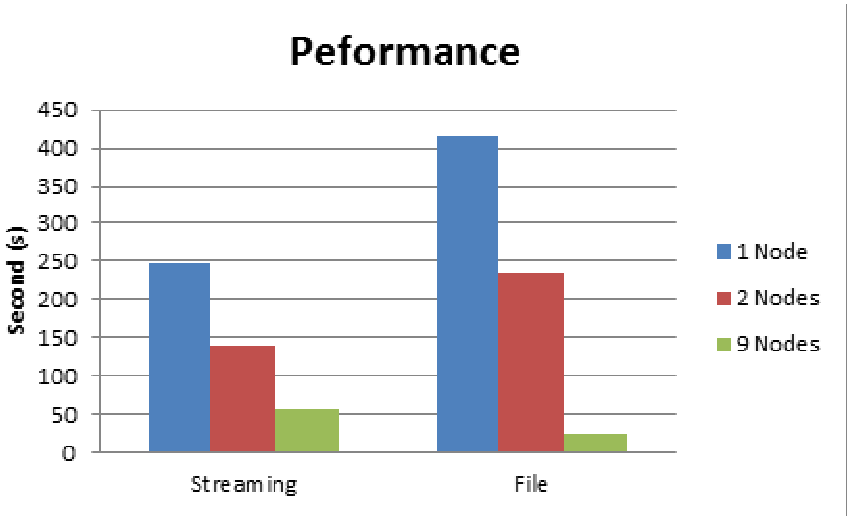

Fig. 4. Conversion Performance (1 Minute File and Streaming)

5 Conclusion

In this paper, we propose a Distributed Media Conversion System (DMCS) which based on MapReduce framework to conduct distributed media conversion. With the help of DMCS and cloud architecture, we can adjust media transmission format based on user terminal device for decreasing energy and time consumption. Meanwhile, we can assure the media service quality.

In the future, we will further analyze the GOP, dividing the fixed background pictures and dynamic media information. The fixed background pictures simply conduct a one-time processing for decreasing loading of DMCS. Dynamically management for DCMS is also our goal.

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A Novel Service Oriented Architecture Combined with Cloud Computing Based on R-OSGi

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Abstract. Service-Oriented Architecture (SOA) is a hot topic of software development and systems integration industry because the concept of reuse and flexibility. OSGi(Open Service Gateway Initiative) is a great framework to implement SOA, and the advanced OSGi-"R-OSGi" can declare its service as the remote type, and then other R-OSGi can share service between different machines. Although R-OSGi can share its service to other machine, there is no centralized architecture to play the role as Service Registry. In this paper, we propose a novel architecture to solve this problem based on R-OSGi, which we combined the cloud computing to our architecture to help the low-end computer to compute large amount of data.

Keywords: Distribution Systems, R-OSGi, Service Oriented Architecture, Embedded System, Cloud.

1 Introduction

Service-Oriented [1] is like ubiquitous service industry. The spirit of the service industry is use the fastest speed to meet customer needs, and the most important part is its efficiency and quality. Service-Oriented is applying the spirit of the pursuit of efficiency and quality to the IT industry. Most of service industries are doing product integration. Like convenient stores, there are lots of operations like offer, bargain, purchase, shipment, etc. However, in the consumer's point of view, we can get what we want (get the service) in the convenient store.

Service-Oriented is emphasizing the concept of integration. If you want to have efficient solution, not every system must grow out of nothing. To meet the demand, we can use existing systems to improve efficiency, save development costs. If there is no similar system, we must think about how to achieve the concept of reuse. The OSGi (Open Service Gateway Initiative)[2] Alliance was founded by Ericsson, IBM, Motorola, Sun Microsystems and enterprises in March 1999. The OSGi is a module system and service platform for the Java programming language that implements a complete and dynamic component model. The characteristics of the platform contains

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platform independent, application independent, secure, multiple services, multiple local network technologies, multiple device access technologies, co-existence with other standards, etc. The most important feature of the platform is its characteristics of the SOA. Service-Oriented Architecture diagram is as figure 1.

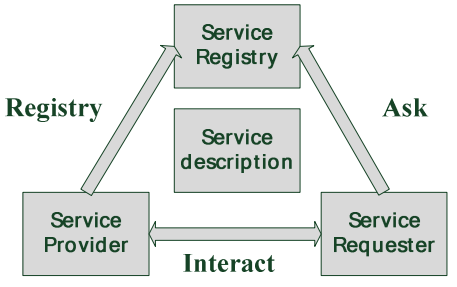

Fig. 1. Service-Oriented Architecture diagram

There are three main components in the Service-Oriented Architecture: Service Provider, Service Registry and Service Requester. All the Service Providers in the SOA registered the service on the Service Registry. The Service Requester asks the Service Registry for the service, and the Service Registry will tell the Service Requester who has the service it requested. After Service Requester get the Service Provider's location, the Service Requester sends the requirement to the Service Provider, waiting for the response. In the traditional OSGi, it contains Servicer Registry functions, we can add a new service anytime, and then we can go to OSGi's Service Registry building a new bundle with service we added to save the development time.

An important problem of OSGi that is not easy to share service between the Service Registry of different machine. The emergence of the R-OSGi(Remote OSGi)[3][4] is to solve this problem. All we need to do is add an R-OSGi bundle in the traditional OSGi platform, then registry your bundle as the remote type, then this service can share it to other R-OSGi platform. We can put the service on the high-speed computing computer, and set the service as remote type to share the loading. Until today, there is no centralized management structure. If we need to use the remote service, we need to know the Service Provider's IP, then download and install the service bundle (service bundle is providing the function interface, the programmer can import the service bundle to call function while programming). Eventually, we can use the remote service.

This paper proposed a novel architecture to implement the SOA based on remote characteristics of R-OSGi, makes all Service Provider registry its service to a centralized server. The Service Requester asks this Server to get the Service IP location and its service, makes an auto connection. And in this paper, we combined the Cloud into our architecture; we build the Service Provider on the Cloud. The Client can use the Service Provider on the Cloud to enhance the development. We refer the paper [5] - [9] to design our system. The rest of the paper is organized as follow. Section 2 introduces the system framework and role of each server. Section 3 evaluates the system performance and compares the different service level; finally, gives conclusions.

2 System Architecture

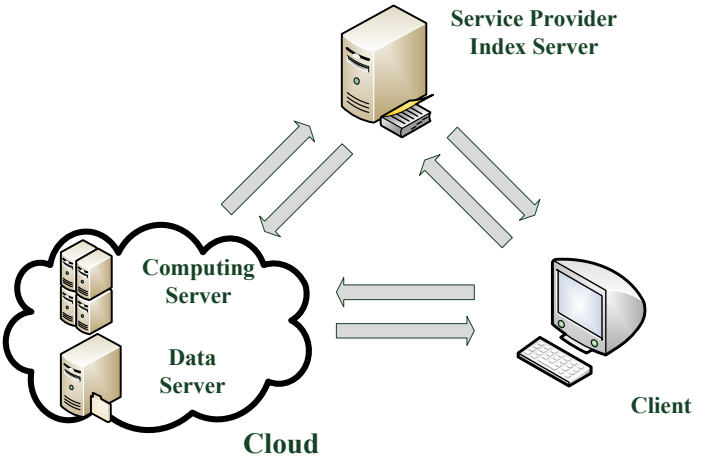

Fig. 2. System Architecture

The system architecture is consisted of three main components: (1) Cloud (2) Service Provider Index Server (SPIS); (3) Client, as shown in figure 2. Details of system framework components will be introduced as following sections.

(1) Cloud: The Cloud plays the role as Service Provider in the Service-Oriented Architecture. It provides three different levels depend on the service content: (A) Provide bundle download only; (B) Provide High Speed Computing (HSC) ability; (C) Provide HSC and bundle download. Details of three levels are introduced in table 1.

Table 1. The different Service Level of SPS

Level	Function	Statement
A	Provide bundle Download only	Providing traditional OSGi function, provide function bundle download to the Client. The bundles stores in the Cloud's Data Server.
B	Provide High Speed Computing(HSC)	Provide service bundle to the Client and provide the Cloud's high speed computing ability.
C	Provide HSC & Bundle download	Provide judge bundle, function bundle, and service bundle. Judge bundle can switch to the best mode between the function bundle and service bundle according to the Internet's condition. The Judge bundle will record the linking speed, if the computing time is slower than linking speed, it will change to the client to operate itself.

(2) Service Provider Index Server (SPIS): SPS is the core component of our architecture; it is responsible for recording the description and its function of the Service. It plays the role as Service Registry in the Service-Oriented Architecture. Cloud will

provide the service information to the Cloud. Cloud arranges the information it provided and stores all of them in the Information Service Bundle. The Client first link to the SPIS, it will download the Information Service Bundles to the machine. The Client can use the Information Service Bundle to check the Service in the Cloud.

(3) Client: Client is the normal service user. It plays the role as Service Requester in the Service-Oriented Architecture. It means that the Client will ask the SPIS for the service, and get the location of the Cloud, then get the service from the Cloud. If Client wants to realize what service other OSGi provide in the Internet, Client need to link to the SPIS to get the Service Information Bundle. The Client can get the newest information of the service by using the local function of OSGi to renew the Service Information Bundle. The services are described according to the level of service in table 2.

Table 2. The different Service Level of Cloud(Client side)

Level	Function	Statement
A	Provide the bundle download	Client downloads function bundles into the Client's machine from the Cloud. The Client can use the service locally.
B	Provide High Speed Computing(HSC)	The Client downloads the service bundle from Cloud and install to the OSGi. The Client uses the functions in the service bundle to program. When the program start running, it will link to the SPS and use the service by R-OSGi.
C	Provide HSC & Bundle Download	The client will download service bundles, function bundles, and judge bundle. The Client uses the functions in the Judge Bundle. When the program start working, the Judge Bundle will record the linking speed. The program will use the highest speed according the local machine and Internet's condition.

3 Performance Evaluation

This paper proposed a novel architecture to improve the system efficiency based on the distributed ability by R-OSGi. In order to verify the best performance of our architecture, the Service Provider offer the service level C, it means the system will change the service between local machine and Cloud according to the Internet's condition. The Client we use the embedded system "Mini6410" developed by Friendly Arm. The CPU is Samsung S3C6410A, ARM1176JZF-S, main frequency is 533MHz, memory size is 256M DDR RAM. The SPS specifications: CPU is DualCore Intel Core i3 540,3066MHz; the memory size is 4096MB DDR3 RAM.

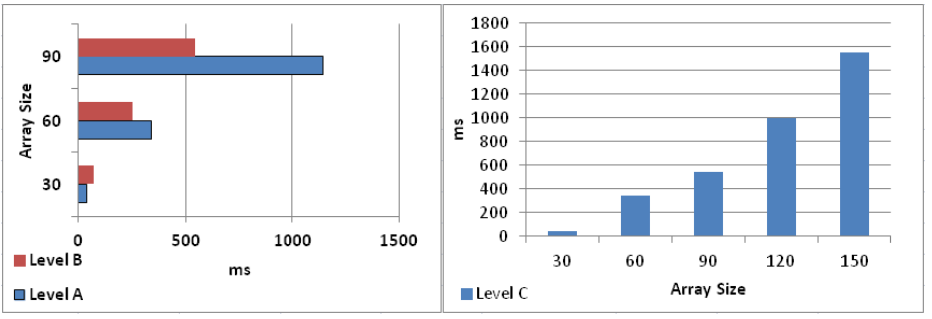

Fig. 3. The operation time of different service levels (a) level A, B (b) level C

We design a application to analysis our architecture with level C service. The application is providing the matrix multiplication.

The operation time of different service levels is as the figure 3. Level A is running the program in local machine; level B is running with SPIS; level C will change the service between function bundle and service bundle according to the efficency. For the stable of the the system, we set the operation time 1.5 times greater than the other one, then we change the service.

The computing array size is from 30 to 150, the increase array size is 30 per time. As the fig.3.(a), when the array size is 30, the operation time of level B is greater than level A because it waste some time on the communication. Although when the array size is 60, the operation time of level B is greater than level A, the Level A is not 1.5 times slower than Level B. Level C choose using function bundle. In other words, it uses the local machine to calculate the matrix multiplication when the array size is 60. The fig.3.(b) shows the Level C changes its bundle at array size 90 to achieve the best quality of computing.

4 Conclusion and Future Work

This paper proposed a novel architecture based on R-OSGi to implement Service-Oriented Architecture. If the Service Provider on the Internet provides our architecture level C services, the machine can change its operation bundle according to the Internets condition. It means that the local machine will choose the best quality of efficiency. We can use our system to let an embedded system with network and panel to computing amounts of data and achieve the quality of display.

In future work we will strengthen the Judge Bundle's judgment ability. In the Client side, the Judge Bundle will take the delays problem in to our consideration to make the architecture more completely.

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A Personalized Tour Recommendation System over Cloud

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Abstract. This paper introduces a cloud-based personalized tour recommendation system that automatically generates a trip based on the user's choice. Specifically, we utilize the *Point of Interest* (POI) and *Line of Interest* (LOI) to construct the scenic spots and trips on the cloud server. The cloud system provides POIs to the user by using the *k-nearest neighbor* algorithm. The user selects the POIs that the user wants to visit, and the cloud system integrates the selected POIs into a personalized LOI for the user.

Keywords: Cloud, Line of Interest (LOI), Point of Interest (POI).

1 Introduction

Smartphones and cloud computing become two important technologies for user's modern life. Smartphones provide interfaces for users to access information anytime and anywhere. The servers on the cloud provide massive storage as well as huge computing power. This paper utilizes the storage and computing power of the cloud server and the convenience of the smartphone to provide a personalized tour recommendation system to users. We use the Cyuantoumu Trail as an example.

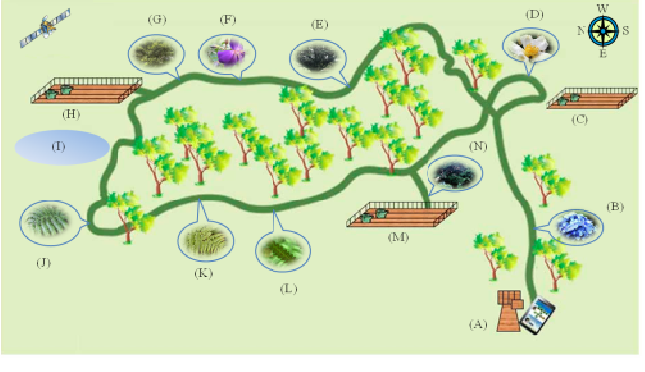

Fig. 1. The Cyuantoumu Trail

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Figure 1 shows an example of the Cyuantoumu Trail in the I-Lan County that is located at North East of Taiwan. The Cyuantoumu Trail includes (A) Entrance Image; (B) Hydrangea; (C) Scenery Platform; (D) Taiwan Gordonia; (E) Calocedrus formosana; (F) Asian Melastome; (G) Taiwan Acacia; (H) Scenery Platform; (I) Ecological Pond; (J) Taiwan Sago Frens; (K) Microlepia speluncae; (L) Cyclosorus taiwanensis Holtt; (M) Large-Leaf Banyan Platform; (N) Ficus caulocarpa.

A user can browse the Cyuantoumt Trail's information through the smartphone before the user visits the trail. Moreover, through GPS in the smartphone, the user can obtain the location information and the distance to next scenic spot. When the user stands at the Scenery Platform [see Fig. 1(C)], the user can see Luo-Dong Town, Turtle Island and the Lanyang Plain. The user can take pictures at Scenery Platform, upload these pictures to the cloud server and share the pictures with the user's travel note on the cloud server. When the user arrives at the Taiwan Acacia [i.e., a flower; see Fig. 1(G)], the cloud server provides information of plants and ferns to the user around the scenic spot (i.e., the flower) through the smartphone. In addition, when the user attempts to find the correct position of a plant [e.g., Microlepia speluncae; Fig. 1(K)], the user can search the plant on the cloud server and identify the plant through the GPS and the compass in the smartphone.

We utilize *points of interests* (POIs) and *lines of interests* (LOIs) to construct the scenic spots and trips on the cloud server. A *point of interest* (POI) [1] is a specific location that the user is interested in. A *Line of Interest* (LOI) is a tour line composed of several POIs. In Fig. 1, the scenic spots (a)~(N) are POIs and the Cyuantoumu Trail is the LOI. The design of POI and LOI are elaborated in the following section.

2 The Proposed POI

The POI metadata elements are utilized to create the POI database. We define the metadata elements of the POI based on [2] and [3]. The POI metadata elements and an example are illustrated in table 1. The POI metadata elements include *Title*, *Type*, *Coordinate*, *Address*, *Description*, *Publisher*, *Contributor*, *Source*, *Language*, *Creator*, *Distance*, *Transportation Type*, *Cardinal directions*, and *Gyroscope*.

"Title" is the naming of the POI. "Type" is defined in three aspects including *plants*, *ecological* and *landscape*. "Coordinate" indicates the latitudes and longitudes of the POI and "Address" indicates the location area of the POI. "Distance" is the distance between the POI and its entrance. "Transportation Type" identifies the transportation type to the POI. "Description" represents the description of the POI. "Cardinal directions" and "Gyroscope" identify the POI (e.g. a plant) and help the user to find the POI. "Publisher" indicates the publisher of the reference source. "Contributor" is the contributor of the reference source. "Source" is the content reference source. "Language" is the description's language (e.g., English). "Creator" is the POI's creator.

Table 1. POI metadata elements and an example

Elements	Example
Title	Scenery Platform
Creator	Chih-Hsin Tsai
Language	English
Description	In Scenery Platform, the user can see Luodong Town, Turtle Island and the Lanyang Plain.
Publisher	Nature Trails of the Loudong Forest District
Contributor	Nature Trails of the Loudong Forest District
Source	Book: The Enchanting Lanyang Trails
Coordinate	24.650294, 121.610155
Address	Sanxing Town
Transportation Type	Walk
Distance	0.8 km
Gyroscope	Heading, Pitch, Roll
Cardinal directions	38 Degrees
Type	Landscape

3 LOI Recommendation

An LOI contains six elements including *Title*, *Description*, *Transportation Type*, *Distance*, and *Visiting Sequence*. The elements are listed in Table 2. "Title" refers to the theme of a trip. "Description" introduces the features of the LOI. "Transportation Type" identifies the recommended transportation type to the LOI.. "Distance" is the total length of the LOI. "Visiting Sequence" lists the POIs of the LOI in sequence. "Date" is the date when the LOI is created.

Table 2. LOI metadata element

LOI elements	Example
Title	Cyuantoumu Trail
Description	Despite its small size the Cyuantoumu enjoys breathtaking views over the whole of Lan-yang.
Transportation Type	Walk
Distance	1.3 km
Visiting Sequence	1
Date	2012/04/16

In [2], the LOI should be created by the user. In our system, the LOI is automatically generated by the cloud server. In the biginning, the cloud system randomly shows *n* POIs to the user based on the county selected by the user. After the

user selects a POI, the cloud system then provides another *n* POIs by using *k-nearest neighbor* algorithm. Based on the above mechanism, the user can choose the POIs that the user attempts to visit. After the user finishs picking up the POIs, the cloud system automatically integrates the selected POIs into an LOI. Assume that the user selects Scenery Platform [Fig. 1(C)], Ecological Pond [Fig. 1(I)] and Large-Leaf Banyan Platform [Fig. 1(M)] three POIs. The cloud system creates an LOI that includes the selected POIs and calculates the distances automatically.

4 The Smartphone System Development

The system on the smartphone includes the GPS [4], Compass [5], Gyroscope [6], Webview, and Camera functions. The GPS function determines user's location, the Compass function helps user to confirm heading direction, the Gyroscope function detects the angle of the smartphone's rotating, the Webview function provides information of plants and ferns, and the user takes pictures by using the Camera function.

Figure 3 demonstrates the results of smartphone system development. Figure 3(A) is the demonstration of the Graphical User Interface (GUI) that explores the POI information (i.e., GPS, Webview and Compass) to the user. Figure 3(B) shows the Camera, Compass and Gyroscope functions. In Figure 3(A), (1) activates the Camera function, (2) uploads the photograph, (3) displays the POI's information and (4) guides the user to find out the POI. After the user push (1) in Figure 3(A), the smartphone shows Figure 3(B). In Figure 3 (B), Compass (1) detects the direction of the user taking pictures and Gyroscope (2) detects device's orientation.

(A) The GUI for exploring a POI.

(B) Compass and gyroscope view while taking a picture

Fig. 3. Smartphone System Feature Overview

To take high-definition photographs, our system combines the professional digital camera and the smartphone. Figure 4 illustrates the upload scenario where the smartphone (a) provides the GPS trace, the time and the direction information. The digital camera (b) provides photographs and time. The time of the smartphone is synchronized with that of the digital camera. The smartphone and the digital camera connect to the computer (d) through USB (c). The photographs and information are integrated by the computer and uploaded to the cloud system (f) through Internet (e).

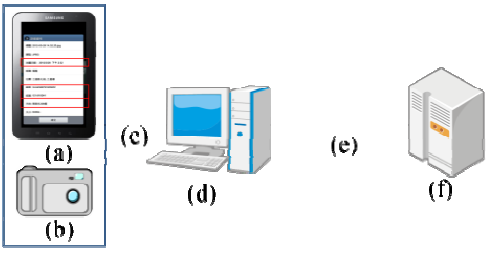

Fig. 4. Uploading structure

5 GPS Measurement

The cloud system automatically recommends the POIs and composes the LOI based on the user's selection (i.e., the selected POIs). Since the LOI is automatically generated, the distance of the LOI should be calculated based on the information (e.g., POI's latitude and longitude) retrieved from the database. In our design, the distance is not simply calculated based on the latitudes and longitudes of two POIs. Since the trail is usually not a straight line, this system calculates the distance between two POIs based on the GPS trace. The user visited the POIs uploads the POIs' information with the GPS traces. To reduce the upload data and improve the accuracy, we design an experiment to evaluate the accuracy of GPS. In this experiment, we capture the latitude and longitude of a point and measure each point for 120 times (1 measure per second). The distance of each point is 5 meters, and we evaluate 7 points (i.e., 0, 5, 10, 15, 20, 25 and 30 meters). Then we use Great-circle distance to calculate the distance.

$$\text{distance} = \text{r} * \text{radians} \tag{1}$$

In (1), r is the radius of earth (i.e., 6,371,000 meters) and

$$\text{radians} = arccos(sinx_1 \text{sin}x_2 + cosx_1 \text{cos}x_2 \cos(y_1 - y_2)) \tag{2}$$

where x1 and y1 are the current latitude and longitude, and x2 and y2 are the target latitude and longitude.

Based on (1) and (2), we obtain the average value, the error range and the standard deviation. The results are listed in Table 3.

Table 3. Measurement result

	Average value	Error Range	Standard deviation
5-meter	5.62121338	0.62121338	1.13509358
10-meter	10.73193760	0.7319376	0.57179983
15-meter	14.96755105	0.03244895	0.33221218
20-meter	19.35946632	0.64053368	0.39698181
25-meter	24.31126964	0.68873036	0.33168697
30-meter	27.82924227	2.17075773	0.55371809

Based on Table 3, the measurement of 15-meter has the lowest error range and lower standard deviation. On the other hand, a normal walking speed for human is 1.25 meter/sec. In other words, we can capture the latitude and longitude from GPS each 12 seconds.

Moreover, based on (1) and (2), if the distance is 15 meters, then the variance of the the latitude or the longitude is 0.00013489824. Therefore, when the variance of the latitude or the longitude is less than 0.00013489824, the smartphone system will not record the latitude or the longitude. In this way, the system can reduce the stored data of the GPS trace, save the upload bandwidth, and reduce the computing power of the cloud servers.

6 Conclusions

The paper introduces a cloud-based personalized tour recommendation system that automatically generates a trip based on the user's choice. Specifically, the paper elaborates the metadata elements of the POI and the LOI. Then the paper takes the Cyuantoumu Trail as an example to illustrate the cloud system. The smartphone system is also demonstrated. Based on the GPS measurement results, this paper suggests that the GPS trace can be recorded every 12 seconds. The GPS trace can be recorded and transmitted effectively.

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Android Mobile Position and Care App Utilizing Smartphone Short Message Service

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Abstract. Due to the coming of an aged society, homecare service becomes more and more important. For providing the elderly better living quality and peaceful living space, this study utilizes Android smartphone platform to develop a mobile position and care app combining with function of SMS and GPS. This application switches the mobile to the silent mode and sends the preset message to the caller when the elderly do not want to be disturbed or unavailable. Meanwhile, the application can utilize SMS to trigger GPS positioning function, notifying the families the location of the user, effectively preventing the elderly from getting lost.

Keywords: Android, Homecare, SMS, GPS.

1 Introduction

Along with the recent development of orange technology, there is a growing concern in homecare issue for the elderly. According to official statistics, by the end of 2010, there have been 2,487,893 elderly people over 65 years old in Taiwan, occupying 10.74% of total population, and the number is growing continuously. According to the latest population projection conducted by Council for Economic Planning and Development (CEPD), it is estimated that in 2017, Taiwan will become an aged society, while in 2025 become a super aged society. In comparison with some European countries, such as Germany, France and United Kingdom, it demonstrates rapid population aging in Taiwan.

Owing to the strength declining and exiting from the labor market of the elderly, the way they live their life differs from the young people. For example, the elderly go to bed at a regular time and need more time to rest. Therefore, when calling the elderly, it is necessary to understand their habits, avoiding to disturb them.

Due to the coming of an aged society, homecare service for the elderly becomes more and more important. [1] [2]. To prevent the elderly from being disturbed when

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they are taking rest or unavailable, this study utilizes Android to develop an application which automatically switches the mobile to vibration or silent mode and send present message to the caller.

On the other hand, according to the survey of Federation for the Welfare of the Elderly in 2008, the missing elderly occupied about 50% of the missing persons. Due to the regulations in Taiwan, the police only handle people who have been lost for more than 24 hours, failing to offer timely assistance. To prevent the elderly from getting lost and increase the chance to find them back, this study develops an application combining SMS with GPS. Users can send SMS with identification code to trigger the GPS in the mobile of the elderly to get their location information [3] [4] [5].

The remainder of this paper is organized as follows. Section 2 introduces the Android system architecture and its basic components; Section 3 introduces the implementation method for various functions of the application; Section 4 introduces the implementation layout of applications; Section 5 is conclusion of this study.

2 Android System Architecture and Its Basic Components

According to the research reports, handset mobile phone has become one of the most commonly seen personal items of modern people. Meanwhile, built-in CPU of handset mobile phone is able to process great amount of computing data and support a variety of wireless access technology. Considering future development of mobile communication, in 2007, Google initially established Open Handset Alliance (OHA) [6], developing an open platform for mobile devices named Android.

To enable application designers developing applications more easily, Google provides full-function API, e.g. layout arrangement, layout conversion, data exchange between applications, etc. in Android SDK [7]. It allows application designers to utilize services such as Google Map or Gmail to develop applications on open mobile development platform. For making application development of handheld device easier, Android also provides abundant support for mobile communication and various sensors, e.g. GPS, Video-Camera, compass, 3D Accelerometer and map/location function.

As shown in Figure 1, execution environment of Android contains the built-in core Libraries, thus, it can support most functions of core Libraries of Java language. When executing program, every Android application would run the routine provided by the operation system separately and have individual Dalvik virtual machine (DVM). To make Android more applicable in mobile phones, Linux kernel of Android also enhances Interprocess Communication (IPC) and Power Management. Meanwhile, Linux Kernel (Version 2.6) also plays the role of abstract interface among all hardwares and applications, providing basic functions such as thread and memory management.

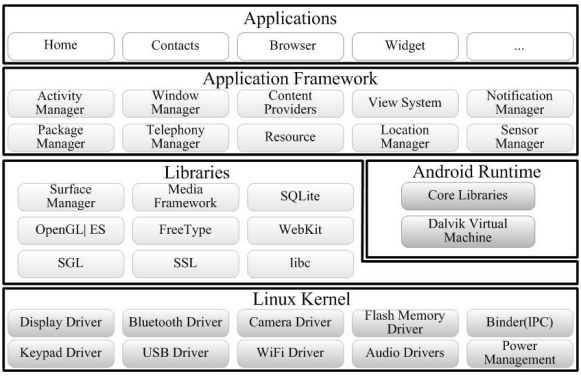


Fig. 1. Android system architecture

Generally, Android applications are consisted of four components including: Activity, Service, Broadcast Receiver and Content Provider. Application developers can decide the components of the application by adding the script to AndroidManifest.xml. Users can conduct interaction through Activity. Activity displays View which is consisted of user interface and responds to events. When implementing in context for long time without interacting with users, it can utilizes Service component to provide service.

Android is an open mobile platform which also supports call, SMS, data connection, SIM card and other phone services. Because the 2G/3G module in mobile phones has been mature, there are a variety of consistent and simple software interface available for the hardware. Therefore, users only need to insert SIM card into the module, turning on the power to initiate the service. Phone modules can automatically finish the initialization such as searching the network and network registration. After initialization is done, users can use phones to make calls and send text messages.

For e-map and positioning service, positioning system plays a crucial role. Among the widely applied positioning systems, the most commonly seen are GPS (Global Position System) and AGPS system which utilize Cell signal to assist positioning. Android phone can be used as GPS. Once the GPS function is initiated, the location of the mobile can be viewed in Google map.

3 System Implementation

3.1 Implementation of Auto SMS Responder

In the busy society, there are some situations we are unable to answer calls, such as during driving, meeting, working or taking rest. This application can be used to notify the caller when we are under these situations.

The flowchart of this application is shown in Figure 2:

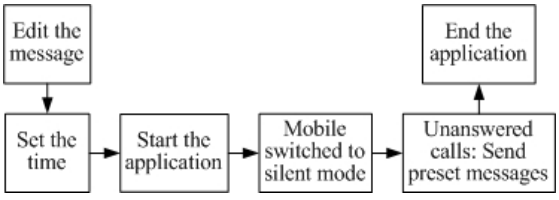


Fig. 2. Auto SMS responder flowchart

When the application starts, users can edit the messages to reply. Part of the source code is as below:

```
button_input.setOnClickListener(new
Button.OnClickListener(){
public void onClick(View arg0){
message =
editText_message.getText().toString();
editText_viewmessage.setText(message);
editText_message.setText(""); }});
```

After setting the message to reply, we have to set the execution time of the application and then identify whether the application is executed. If it is, the call state of the phone would be changed. Part of the source code is as below:

```
toggleButton.setOnClickListener(new
Button.OnClickListener(){
public void onClick(View arg0){
if(cycle == 0){
if(toggleButton.isChecked()){
switches = 1;
// Set as silent mode
ChangeToSilentMode();}
else{ switches = 0;
// Set as normal mode
ChangeToNormalMode();
}}}});
```

Finally, the using state of the phone can be obtained by *TelephonyManager*. If the state is *CALL_STATE_RINGING*, it automatically captures the phone number and sends the preset message.

3.2 Application of Global Positioning System

Under an aged society with low fertility, every child and elder is our apple of the eye. When they go out without coming home on time and answering the phone, the families must be worried. In consideration of this situation, this application is designed to

verify the identification code in SMS to trigger GPS and notify the location information of phone holder automatically. The flowchart of the application execution is as shown in Figure 3:

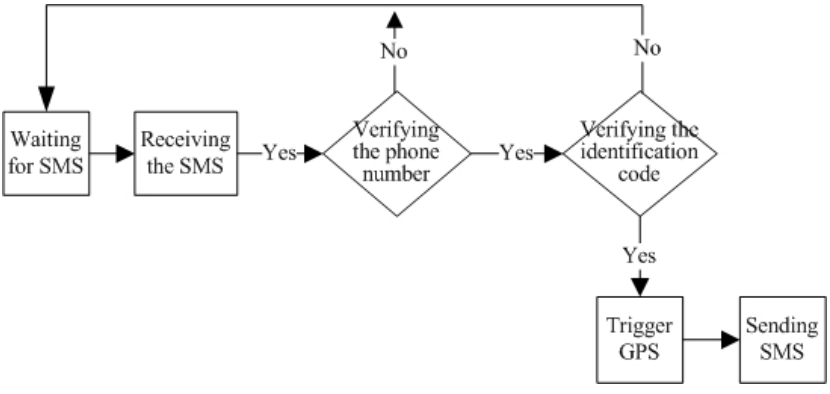


Fig. 3. The flowchart of SMS Triggering GPS Function

After receiving the SMS, the application would verify the phone number and identification code. Part of the source code is as below. When both the identification code and phone number are verified, the application would trigger GPS function and notify the present location of phone holder via SMS.

```
private boolean matchesnum(Context
context, String message) { // Capture
the setting phone number
SharedPreferences preferences =
context.getSharedPreferences(
  GPSCareActivity.PREFERENCES,
Context.MODE_PRIVATE);
// Capture the phone number
String code1 = preferences.getString(
 GPSCareActivity.PREFERENCES1_CODE,
GPSCareActivity.PREFERENCES1_CODE_DEFA
ULT);
code1="+8869"+code1;
// Check if the phone number is approved
return
code1.equalsIgnoreCase(message); }
```

4 Application Interface

The following will demonstrate the interface of the application and its functions.

4.1 SMS Responder

When the application is executed, it would ask the users to edit the message to reply as shown in Figure 4. After editing the message, click Enter button to store or Clear button to delete the previous content.

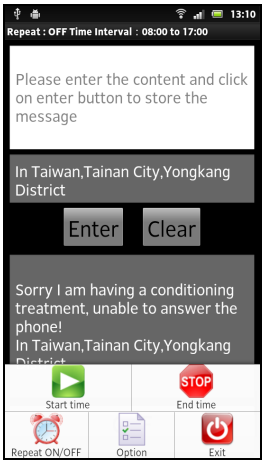


Fig. 4. Edit the message to reply

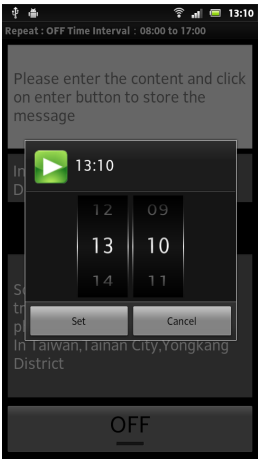


Fig. 5. Set the cycle time for sending preset message automatically

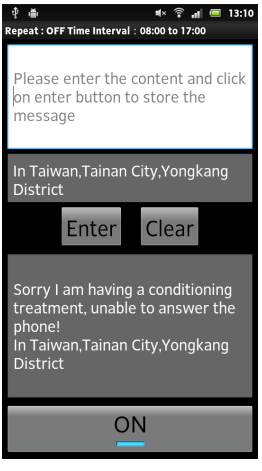


Fig. 6. Start /End the application

For further setting, users can click the Setting button. At this time, users can click "Start time" button and "End time" button to set the start and end time for executing the application as shown in Figure 5.

As shown in Figure 6, after setting the time, there will appear a silent icon on the top of the screen. Users can click "On" or "Off" to start or end the application. During the application is executed, if someone calls, and the phone holder does not answer, the application automatically sends the preset messages to the caller as shown in Figure 7.

4.2 SMS Triggering GPS

The application can not only automatically send the preset messages, but also trigger GPS positioning function via SMS. As shown in Figure 8, users can click on "Option" button to conduct setting. Then enter the identification code and phone numbers approved to obtain GPS location information of the phone as shown in Figure 9:

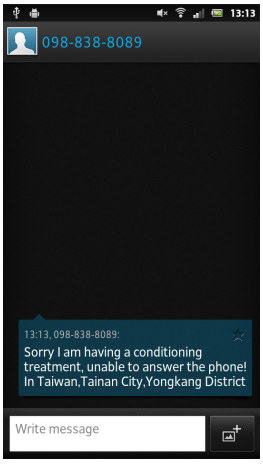


Fig. 7. The caller get the preset message

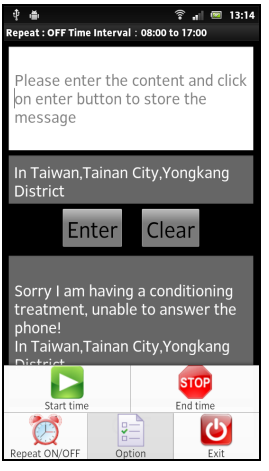
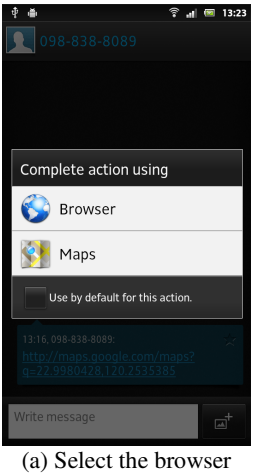


Fig. 8. Open GPS Options

Fig. 9. Enter identification code and the approved phone numbers

The design of SMS triggering GPS allows only specific phone numbers to obtain GPS location information of this phone holder. Owing to this information has privacy concern, it is better be approved by the phone holder before setting the phone numbers.

Fig. 10. After verifying the identification code, triggering GPS to notify the present location of the phone holder



(a) Select the browser

(b) Display the location by Google map

Fig. 11. Notify the Present Location

After setting GPS Options, when someone sends SMS to this phone, the application will verify if it is on the approved list. After verifying the identification code, GPS function will be triggered and notify the sender the present location of phone holder via SMS as shown in Figure 10.

As shown in Figure 10, when the sender receives the SMS, they can click on the link in the SMS and obtain the present location of the phone holder through the Google map service as shown in Figure 11.

5 Conclusion

Recently, Taiwan has become an aged society, making the orange technology highly developed. Smartphone has the characteristics of personalization, multi-function and portability, therefore, it is suitable to develop a mobile care system with high portability on the platform. This study utilizes Android open platform to develop a homecare application which automatically sends the preset message to the caller when they do not want to be disturbed or unavailable. Users can use SMS to trigger GPS by sending SMS with identification code to obtain the location information of the elderly.

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Interactive e-Learning with Cloud Computing Framework

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Abstract. Cloud computing has been regarded as the most potential technology to realize innovative educational services, because it intrinsically provides massive computing and storage capacities. Accordingly, many researchers have noticed that the potential of cloud computing in driving the educational innovative applications. Despite much research on cloud to education, little effort has been devoted to explore the impacts of cloud computing on educational services. To this end, we intend to unveil those potential impacts and see to how the educational services can be benefited by cloud. Overall, we conclude that with the assistance of cloud computing, the educational services can be identified by five intrinsic major characteristics: *instant*, *intelligent*, *multi-sensory*, *seamless* and *social*.

Keywords: Cloud computing, Education.

1 Introduction

Cloud computing has been regarded as the most potential technology to realize different kinds of innovative application. It is a computing mode of networks in providing software and hardware resources, placed in a data center, to provide services [2]. If the cloud is accessible to the public, it is called public cloud, while it is private one if for an internal organization [2]. By taking advantages of dynamic massive storage and massive calculation [7], users can flexibly enjoy the convenience of cloud computing.

Of late, many researchers have noticed that the potential of cloud computing in driving the educational innovative applications. They have unfolded some of its applications to education. Sultan argued that the cash-strapped educational institutions can use it to deliver a variety of information technology services due to its pay-as-you-go mode [14]. They indicated that in the educational institutions of some areas, such as Middle East and North Africa, cloud computing is viewed as an empowering tool used to advance the development of the educational technology, since cloud computing can save much time to build and maintain their own information technology infrastructure. Similarly, Wheeler and Waggener also indicated that cloud computing provides much richer

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services over the Internet than before, useful for delivering the information technology services of educational institutions [17]. For example, Google Apps for Education and Google Docs services are tailored to fit the needs of educational institutions. Those services may provide a platform for those institutions to develop their own ones, facilitating teaching and learning purposes. For example, Al-Zoube applied Google Docs service to develop a cloud-based learning system and indicated that many applications such as word processing, spreadsheets, or presentations can be used through web browsers due to cloud computing [1]. Such web-based applications can provide students and teachers with free or low-cost schemes to supersede expensive proprietary productivity tools. More importantly, such web-based applications are innately useful for achieving collaborative learning activities such as collaborative writing [13]. Later, Calvo et al. also applied Google Docs service to develop a cloud-based learning tool to support the collaborative writing, capable of managing collaborative and individual writing assignments in large cohorts [3]. Moreover, Calvo et al. conducted an empirical analysis in order to realize the perspectives of lecturers and students on the tool. Their results revealed that the lecturers considered the tool quite time-saving for distributing assignments, but students took confusing view of it. On the other hand, some educational applications are found by using the private cloud. Dong et al. proposed a framework of private cloud to embrace the benefits of cloud computing [6]. It literally improves the performance, availability and scalability of traditional learning systems and further offers better services for educational purposes. Afterward, Ouf et al. extended the work of Dong et al. to integrate Web 2.0 technologies into a cloud-based learning system for promoting the social interaction among students [11]. Later, Doelitzscher et al. presented a systematic study about how to use private cloud to develop a cloud-based educational system, which involves information technology infrastructure, software development platform, and educational software applications [5]. Recently, Vaquero developed a private cloud called EduCloud to support an advanced computer science course and conducted an empirical analysis to explore whether cloud computing is useful in educational scenarios for computer science students [5]. His results revealed that cloud computing did not help motivate students in terms of performance, but it comes with the advantage of avoiding much effort of setting up the software necessary for course activities.

Despite much research on cloud to education, little effort has been devoted to explore the impacts of cloud computing on educational services. To this end, we intend to unveil those potential impacts and see to how e-learning can be benefited by cloud.

2 Characteristics of Cloud Computing

Cloud computing intrinsically provides massive computing and storage capacities, enabling the delivery of a variety of service [14]. By its intrinsic features, although some researchers have interpreted it in different perspectives [7, 15], most of them state four basic characteristics of it: 1) it is applicable to massive storage and massive calculation; 2) its payment mode is pay-as-you-go, the users only need to pay for actually used resources; 3) it is a computing mode providing services according to requirements, the required resources may not be allocated beforehand; 4) it is a service-oriented architecture, the service scale can be set and provided dynamically

according to requirements [7, 15]. Fundamentally, cloud computing provides three levels of service: infrastructure as a service (IaaS), platform as a service (PaaS), and software as a service (SaaS), as summarized in the following.

IaaS offers hardware infrastructure such as computing power and storage space as services. It enables users to directly rent the hardware infrastructure rather than spending time and budget to build their own [4, 7, 15], with the advantage of the infrastructure being scaled easily to accommodate the future demand [4, 16]. Two well-known examples in this service are Amazon EC2 (Elastic Cloud Computing) for supplying computing power service and Amazon S3 (Simple Storage Service) for supplying storage space service.

PaaS offers software development platform as services. This service enables users to directly design, implement, debug, test, deploy and operate their software in cloud [16]. Unlike IaaS, the users of PaaS do not need to address hardware configurations or software installations, instead, they can utilize PaaS to directly create their own software in cloud. Two well-known examples in this service are Google App Engine and Microsoft Azure that allow users to develop software in cloud without dealing with hardware and software configurations.

SaaS mainly offers software on the Internet as services. This service enables users to directly access software by using the Internet instead of installing special software on their computer [15]. Unlike PaaS, SaaS only hosts completed software whereas PaaS offers a development platform that hosts both completed and in-progress software [4]. Examples of Google Apps for Education and Google Docs belong to this category, which provide we-based educational and office software applications.

3 Impact of Cloud Computing on Educational Services

Defined as various software applications for education, educational services can be application programs of open source, proprietary or others. Distinguished from traditional e-learning environment, in cloud computing contexts, the educational services intend to provide learners various services with five major characteristics: *instant*, *intelligent*, *multi-sensory*, *seamless* and *social*, as shown in Fig. 1.

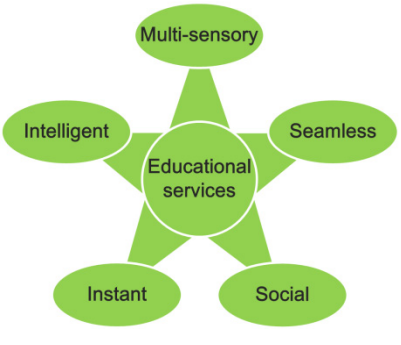

Fig. 1. The impact of c-learning

Instant: it refers to instant services, such as Google Instant [8] and Google Scribe [9]. Google Instant provides an instant searching engine, while Google Scribe provides a just-in-time aid for writing, as shown in Fig. 2. The common characteristic of them is to use cloud computing to anticipate the text being entered every moment, so as to provide the search result or suggested words to reduce the user's input burden and even facilitate alternative options. Accordingly, it can be foreseen that cloud computing is useful to realize instant services so as to promote the learning efficiency.

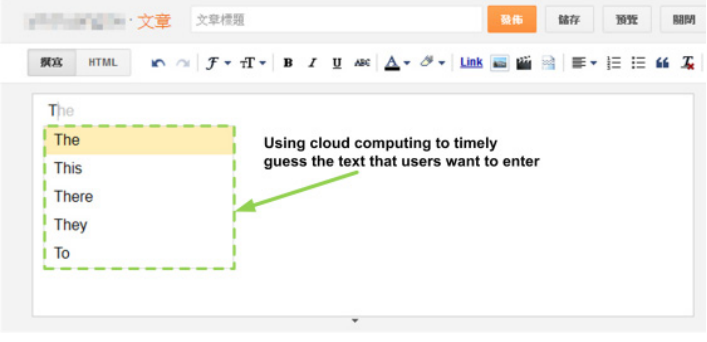

Fig. 2. The Google Scribe

Intelligent: it refers to intelligent services. For example, Google Goggles [10] is an intelligent image searching engine, running in mobile devices to search the photos taken by users. Up to now, it can identify letters, landmarks, books and signs automatically. Specifically, Google Goggles employs artificial intelligence (AI) technology for image recognition, realized by cloud computing to instantly respond the request. Consequently, it can be foreseen that cloud computing is able to fast execute complex AI applications to provide intelligent services.

Multi-sensory: it refers to the service that provides users with multi-sensory experience, such as Qwiki [12]. Qwiki is a search engine that provides narrated slideshows instead of links to give users a multi-sensory experience. Specifically, Qwiki automatically collects associated texts, images, videos, and voices on a subject from cloud and then reorganizes them as a sort of narrated slide show. As a result, users can easily obtain a short and interactive story about the subject from Qwiki. In a sense, cloud computing enables services into multi-sensory experience so as to help learners acquire information in multiple angles.

Seamless: it refers to seamless use of service, such as Google Docs. Google Docs is a word processing service, in which users can directly create and edit documents, spreadsheets or presentations on cloud, so that users can seamlessly access their files. Based on the paradigm, users can have services anywhere through different kind of terminal, such as the browsers of general computers or the apps of mobile devices [18]. Consequently, those services are accessible ubiquitously regardless of end devices.

Social: it refers to the service for social interaction, such as Facebook and Google Docs. Facebook is the most famous social networking site at present, providing users with many functions for social interaction, such as message boards, chat rooms, blogging and games. Thus, users can use Facebook to find their friends, and even know their friends' friends, so as to expand their circles. Even more, Google Docs not only provides users with a word processing service, but also facilitates them with social interaction, such as collaborative editing. During collaborative editing, users and peers can use instant messaging to discuss how to edit a document concurrently, as shown in Fig. 3. Accordingly, cloud computing enables services possess more social interaction elements, bringing learners together.

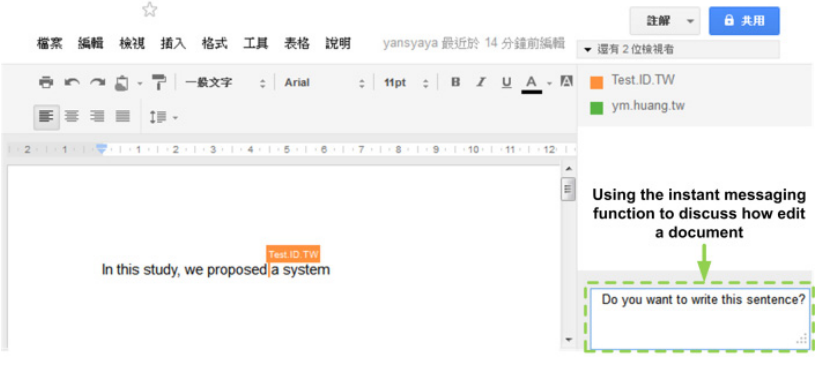

Fig. 3. The Google Docs

4 Conclusions

Cloud computing has a considerable potential for realizing different kinds of innovative application. This paper describes how we explored the impacts of cloud computing on educational services. Overall, with the assistance of cloud computing, the services of e-learning can be identified by five intrinsic major characteristics: *instant*, *intelligent*, *multi-sensory*, *seamless* and *social*. As the major characteristics are involved in educational services, the learners' learning will become more autonomous, convenient and meaningful.

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