IMPACT: International Journal of Research in Engineering & Technology (IMPACT: IJRET)
ISSN (P): 2347-4599; ISSN (E): 2321-8843
Vol. 5, Issue 10, Oct 2017, 21-28

DATA MINING TO DEVELOP A SAFETY WORK MANAGEMENT APP BASED ON RECOMMENDER SYSTEM WITH BIM AND LBS

CHUN-LING HO[1] & HER-YUNG WANG[2]

[1]Research Scholar, Assistant Professor, Department of Information Management, Kao Yuan University, Kaohsiung, Taiwan

[2]Research Scholar, Professor, Department of Civil Engineering, National Kaohsiung University of Applied Sciences, Kaohsiung, Taiwan

ABSTRACT

Applying to business education and labors' safety training, unlike the traditional way in the past, will bring a more location-based of innovative services through mobile-oriented environment. The research considers the phenomenon and its importance on the middle-aged workforce of the construction in recent years, and provides security services- a recommended system through Building Information Model (BIM), Location-Based Services (LBS), and Mobile App. For maximum optimization of resources for system design, it integrates functional modules to construct an innovation system of safety work and management with "context-aware" and "safety training records".

In order to enhance the safety of pre-working and working safety, the study will collect the initial data of safety training history in the work cloud service, and carry out real-time data analysis and sequence mining to find out the warning mode of affecting safety behavior. Sequence mining will use the concept of the phenomenon in monitoring, and extract the events, in order to establish the relationship between the time sequences, and then establish the exact rule of sequence calculation. It is in order to adapt to the middle-aged workers in the construction warning service with the security model.

KEYWORDS: Data Mining, Recommender System, Safety Working Training in Construction, Location-Based Service, Building Information Modeling

INTRODUCTION

Instant and right information of safety education will help to improve the security on construction sites. Due to mobile service has been active and more and more completed, the cloud application and service system surround our lives. According to the long-term trends of the labors aging in Taiwan's various industrials, the research considers the phenomenon and its importance on the middle-aged workforce of the construction in recent years (Cheng, J., 2012). It will try to develop an available system to manage safety working and related facilities information from sites in the right time and correct position. To the goal of zero disaster in construction, the study will get methods-take service mold from context-aware environment, under the construction safety of "work" App Cloud Service and introduce Hybrid-based Filtering (Content-based Filtering and Collaborative Filtering) to design the recommendation with working safety training, and then continue to explore the relevance and effectiveness of their service function. That means the study focus on mobility management and via LBS objects (location-based service) and modules designed to build APP environment in construction safety management within the cloud service system.

It will integrate Building Information Modeling (BIM), mobile applications (App) and Location-Based Service (LBS) to increase construction safety as shown in Figure 1. That means to use positioning and through the App on the smartphone to understand real-time constructing information from workers. The purpose of the research is to carry out a variety of real-time and value-added services on construction sites. Managers and workers will be able to confirm the training, education compliance or not through mobile devices, and to get real-time construction information in order to reduce the incidence of construction disaster.

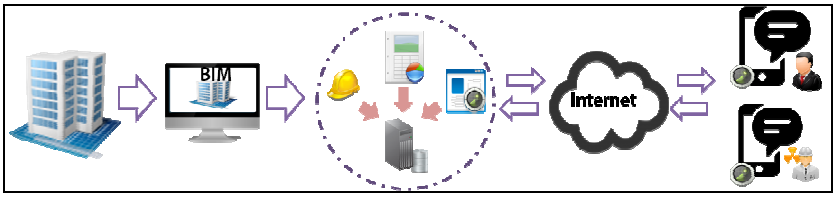

Figure 1: The Mobile Management System of Construction Safety

In order to enhance the safety of pre-working and working safety, the study will collect the initial data of safety training history in a recommended system with the functions of “context-aware” and “ safety training records”, and carry out real-time data analysis and sequence mining to find out the warning mode of affecting safety behavior. Sequence data mining will use the concept of the phenomenon in monitoring, and extract the events in order to establish the relationship between the time sequences and then establish the exact rule of sequence calculation. It is in order to adapt to the middle-aged workers in the construction work training service with the security model.

RELATED WORKS

“Location-Based Service” (LBS) concept combines the location and the corresponding services, and it has become an important demand for mobile users. According to the research report of Pyramid Research's market, a location-based service is expected to rise by a global market value of 280 million dollars in 2010 to 1.03 billion dollars in 2015. Looking LBS development of the past few years, it is possible to accurately grasp the location of the users. LBS are mainly a combination of two technologies of Global Position System (GPS) and Geographic Information System (GIS) two technologies. LBS will be acquired geographic coordinates by GPS services to access the real-time spatial information in GIS to various types of services and applications, such as tourism, navigation, advertising and marketing, etc. (B. Schilit, N. Adams, 1994) (Kumar, S., 2009). The technology has been adapted for many years, LBS is the highly regarded and recent emerging Internet applications during in time to the growing popularity of mobile devices. The feature is the ability to provide location-based, personal and real-time services. This study will apply LBS technology based on 3D virtual reality training of cloud platform and design the recommendation with working safety training, and then continue to explore the relevance and effectiveness of their service function. Therefore, the integration of real-time information system of this study will combine the concept of "situational" and "location-based”. In 3R (Right location, Right time, Right people) service infrastructure, it imports existing 3D virtual reality and animations materials.

A recommendation system becomes a major way to solve the problem online and can effectively analyze the characteristics of the users (G. Adomavicius, 2005). It also mentioned the recommender system using observations of user groups to assist individuals in the community to effectively identify and propose interest contents from overload and large amounts of data (J.L. Herlocker, 2004). Other scholars propose that recommender system is to solve the information

overload (Goldberg, D., 1992). A recommendation system can be divided into three modes, content-driven filtering, collaborative filtering and hybrid-based filtering (Adomavicius, 2005). The collaborative filtering is most commonly used for a recommended technique. The hybrid recommender system is to add the collaborative recommendation system in the content-driven filtering, and also to add the content-driven recommender system in the collaborative filtering. Therefore, the hybrid recommender systems contain features of both. The study gets a new hybrid recommendation architecture based on users' classification. In this architecture, it makes recommendations according to characteristics, context and operating records to classify its situation from users, and selects some appropriate recommendation algorithms according its situation.

METHODS

The recommender system can obtain real-time location to users through safety training course modules, and it operates situation (computing context) to analysis and provide appropriate training courses, with the user's current situation (context). The system can be designed a ubiquitous security education and training environment. In this study, a hybrid recommendation technique is used to classify the users to groups through the collaborative filtering technique based on three modules that are "Context-Aware of Users", "Safety Training Courses" and "Evaluation of Training Courses". It tries to find an area-optimized category of grouping users, and locating users with similar contexts. And then the content-based filtering method is used to analysis the evaluation of training courses from the users, which are supplemented by different weighted-evaluation scores, and the most suitable course content is recommended as shown in Figure 2.

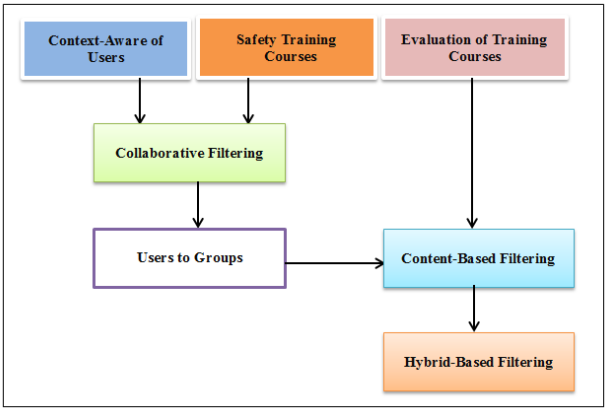

Figure 2: The Hybrid-Based Filtering of Recommended System

The part of context-aware includes (1) identifying the user's identity, (2) the user's training history, and (3) perceiving the user's time-location-security conditions. The recommendation system can obtain the real-time and right location information from users. Through the safety training course module and the user's context, the system can provide suitable training courses by computing context. It adopts rating and social filtering as the recommendation algorithm to filter the content, and then generates the contextual reasoning module, which is mainly deduced and proposed the situation to the user. Safety training courses are provided by the work system. In addition, the study presents the courses into four feature values, including the average difficulty, the total time, the average learning power and the relevance. The recommendation engine calculates the Recommended Score (RS) for each course, according to the three modules, and then finds the courses with the highest RS to give the users a safety training course as shown in Figure 3.

Data mining has been successfully applied in the wide fields, such as production, manufacture, health care, finance and marketing (Brachman, R. J., 1996) (Daskalaki, S., 2003) (Agrawal, R., 1993). As techniques of data mining have been successfully applied in various fields, this study applied association rules of data mining, which can extract hidden and useful information from the recommend system. And the other to obtain prediction functions, it is established warning service of security model by decision tree with classification.

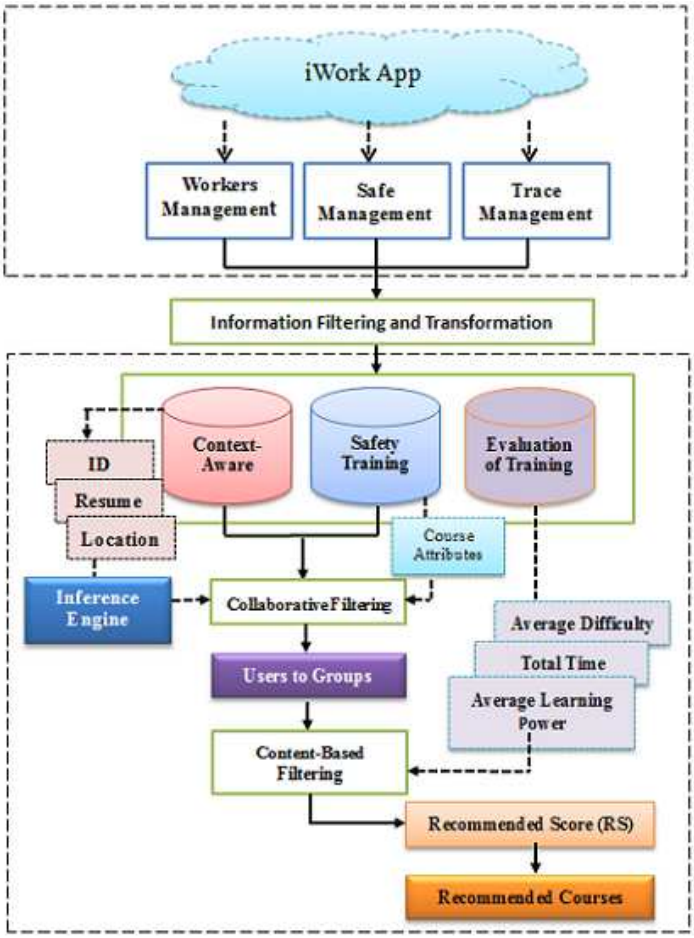

Figure 3: Service Experience Engineering to a Recommender System with Context-Aware

Before data mining, it must first be pre-treated data from raw data with missing. Namely clearing data, it includes discards unwanted data of field. And the data pre-processing and conversion including collecting relevant information to calculate the noise and then determined of the missing data and the correct data type. In mining phase, this study used Microsoft SQL Server 2010 as the tool for data mining. It also applied SQL Server Business Intelligence Development Studio which has developed an integrated business intelligence environment, including Cube, data sources, reports, dimensions, analysis services database. The main stages of the entire mining process include data collection, data preprocessing, data mining, modelling, evaluation and final knowledge representation. An important step in the pre-operation is data pre-processing, including data integration, data clearing, data conversion. And through the phpMyAdmin functionality of Database Management, it transposed the original data into SQL syntax. All mining history of the system, it clustered data to identify key factors in all affect performance and in order to provide effective decisions in safety system.

RESULTS AND DISCUSSIONS

This study adopted Case Method of Non-Experimental method, and used In-depth-Interview of Qualitative Technique through small-scale exploratory study. It interviewed face to face with workers to collect data, and summarized and analyzed, including the characteristics explained, data collected, the phenomenon of knowledge analysis and the system design and introduction. In order to understand the acceptability of the service system, this study tries to use structural equation modelling (SEM) to measure the behavior intention of users. The measurement structure on questionnaire is divided into 6 phases and they are "System Quality", "Self-Efficacy", "Computer Anxiety", "Perceived Usefulness", Perceived Ease of Use" and "Behavior Intention". The questionnaire is based on Technical Acceptance Model (TAM) to analyze its significance on "Behavior Intention" between "Perceived Usefulness" and "Perceived Ease of Use". The framework of SEM is such as Figure 4 and given for 9 hypotheses (H1, H2, H3, H9).

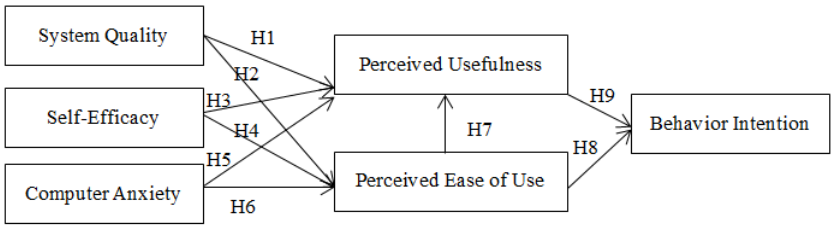

Figure 4: The Framework of Measuring the Behavior Intention with SEM

To test the model, the study used AMOS to analysis the Goodness-of-fit Index including Chi-Square test, GFI, NFI, and CFI exceed the recommended 0.90 threshold levels. In addition, RMSEA is lower than 0.80 as recommended by Hair et al (1998). RMR is lower than 0.05 as recommended by Bagozzi and Yi (1988). The fitness values satisfied the recommended standard. The overall fit is shown as Table 1, and the test of the hypotheses is shown as Table 2.

Table 1: Goodness-so-Fit of Measurement Model

Fit Indices	The Value	Specification	Goodness-of-Fit
χ2/df	2.023	< 3	Good
GFI	0.857	> 0.8	Good
AGFI	0.781	> 0.8	Normal
RMR	0.032	< 0.05	Good
RMSEA	0.085	< 0.08	Normal
NFI	0.927	> 0.9	Good
CFI	0.913	> 0.9	Good
RFI	0.915	> 0.9	Good
IFI	0.906	> 0.9	Good
PNFI	0.632	> 0.5	Good
PGFI	0.672	> 0.5	Good

Table 2: The Test of The Hypotheses

			Hypothesis	Coefficient	t-Value	Assessment
Perceived Usefulness	< -	System Quality	H1	0.53***	2.856	Significant
Perceived Usefulness	< -	Self-Efficacy	H3	0.26***	3.219	Significant
Perceived Usefulness	< -	Computer Anxiety	H5	0.107	3.378	Nonsignificant
Perceived Ease of Use	< -	System Quality	H2	0.02**	5.021	Significant
Perceived Ease of Use	< -	Self-Efficacy	H4	0.016***	4.026	Significant
Perceived Ease of Use	< -	Computer Anxiety	H6	0.072	2.117	Nonsignificant
Perceived Usefulness	< -	Perceived Ease of Use	H7	0.316***	6.529	Significant
Behavior Intention	< -	Perceived Ease of Use	H8	0.271***	5.926	Significant
Behavior Intention	< -	Perceived Usefulness	H9	0.169***	8.226	Significant

Note: * p<0.05 ** p<0.01 *** p<0.001

The testing result suggests “Computer Anxiety” has no direct effect to behavioral intention. It means that H5 (Computer Anxiety to Perceived Usefulness) and H6 (Perceived Ease of Use) are not supported in the test. For safety training course, the location-based service by technology and mobile-services will not lead to the user's willingness to reduce and exclude the use. Therefore, the recommendation system may provide a personalized training course based on the user’s experience and preference. In this study, it uses data mining and SEM to validate the feasibility of the service model. Therefore, the service design can apply Hybrid-Based Filtering to achieve individual recommended training course, and then enhance the quality and efficiency of safety training.

CONCLUSIONS

This study will be as an object on construction safety and education, training of the middle-aged workers, and assumed in research are the conditions for popularity of smart phones, wireless network and the workers of science with and technology. How to apply technological innovation and service experience model to achieve zero disaster in construction working will be the most important core purpose of this research. It takes working environment, safety and education, training as the theme and import the architecture of service experience engineering to build the recommender system by using hybrid recommendation technique. It collects user experience data from work and investigates the status of middle-aged workers. Through user experience and service model, it will serve as the basis for the recommender system for safety training.

REFERENCES

1. Adomavicius, G., Tuzhilin, A. (2005). *Toward the Next Generation of Recommender Systems: A Survey of the State-of-the-Art and Possible Extensions. IEEE Transactions on Knowledge and Data Engineering*. 17, pp. 734-749.
2. Agrawal, R., Imielinski T.,And A. Swami (1993). *Mining Association Rules Between Sets of Items in Large Databases. Proceedings of the ACM SIGMOD Conference on Management of Data*. Washington, DC, USA.
3. Brachman, R. J., T. Khabaza, W. Kloesgen, G. Piatetsky-Shapiro and E. Simoudis (1996). *Mining Business Databases, Communication of the ACM*, 39-11, pp. 42-48.
4. B. Schilit, N. Adams, and R. Want (1994). *Context-aware computing applications, In Proceedings of the 1st International Workshop on Mobile Computing Systems and Applications*.

5. Cheng, J., Chiang, C.H. (2012). *Phased Retirement for Older Workers in Taiwan. Journal of Family Economics*. 13, pp. 328–3.

6. Daskalaki, S., Kopanas, I., Goudara, M. and Avouris, N.(2003). *Data mining for decision support on customer insolvency in telecommunications business. European Journal of Operational Research*. 145-2, pp.239-255.

7. G. Adomavicius, and A. Tuzhilin(2005). *Towards the Next Generation of Recommender Systems: A Survey of the State-of-the-Art and Possible Extensions. IEEE Transactions on Knowledge and Data Engineering*, 17, pp. 734-749.

8. Soundarya R & Uma R.N, Building Information Modelling of a Two Storey Building using Autodesk Revit and Autodesk Naviswork Manage, International Journal of Civil Engineering (IJCV), Volume 6, Issue 4, June-July 2017, pp. 33-46

9. Goldberg, D., Nichols, D., Oki, B. M., & Terry, D.(1992). *Using Collaborative Filtering to Weave an Information Tapestry, Communications of the ACM*, 35(12), pp. 61-70.

10. J.L. Herlocker, J.A. Konstan and L.G. Terveen(2004). *Evaluating collaborative filtering recommender system. ACM Transactions on Information Systems,* 22(1), pp.5-53.

11. Kumar, S., Qadeer, M. A., Gupta, A.(2009). *Location Based Services using Android. The 3rd IEEE international conference on Internet multimedia services architecture and applications*.