THE DEVELOPMENT OF CONSTRUCTION WORK SAFETY INTEGRATED INFORMATION ON LOCATION-BASED SERVICE

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Abstract- Due to the functions of mobile communication devices upgrade and elderly increased year by year, middle-aged and older workers play a key role in the labor market. Considering the elderly labors in construction industries have higher accident rates than other industries in Taiwan, work safety education of the elderly labors becomes important issues.For getting real-time information on 3R(Right location-Right time-Right people), the study tries to combined the concepts from situation-aware and localizationand imported and integrated 3D Building Information Modeling and Virtual Reality(VR) safety classes on cloud to develop a system called iWork based on location-based services(LBS). This study proposes a system on 3-Tire architecture with Android, XMPP, LAMP (Linux、Apache、MySQL、PHP) technologies and simulates the case of high steel building. For this reason, the functions of iWork will be developed to three modules for the users which are workers management, safe management and trace management. Thus, the purpose of this research is built an integrated information system which provides simple and friendly App to achieve work safety on real-time for workers/managers in construction site.

Keywords- Middle-Aged Labor, Location-Based Service, Mobile App, Working Safety, Construction.

I. INTRODUCTION

With the advent of an aging society, the elderly workers are an important and long-term development trend in the various industries. Particularly the labor force in the construction industry, due to working environment characteristics, middle-aged aging construction workforce becomes an important and social research issues including the body adaptability, auxiliary technological equipment, labor productivity, safety and so on for the workers. This study will investigate the middle-aged workers in construction, and according to their characteristics to develop a safety management system with real-time, location-based services (LBS) and user-friendly interface through operation technology equipment.

Although 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. 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. Through three information of building information models, facilities schedule and security training, it provides a complete information of real-time by LBS and the resume of construction safety records with App programs designed. The goal of overall research is to achieve zero grades disaster on safety construction. It is based on the core concept and tools of KikenYochiTraining(KYT) from the promotion of labor and industry purposes in Japan Disaster Prevention Association, and it predict the risk of training as a development system- iWork. With the rapid arrival of middle-aged workers, the study is focus on implemented no loading of users and immediate action of managers. The study implements on the environment of high-rise buildings, and construction worker / managers can quickly and easily obtain real-time information through touch mode system with Integration of cloud and location based information- iWork (i Work on reality kyt).

The Scope of 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. Through building information models, it develops an integration cloud service-iWork of construction safety and real-time information with situational and location service-oriented. The iWork system will integrate a virtual training, building information model and LBS technologies on construction safety, and workers/managers can easily and fast access to get information through the cloud platform services. It includes three modules that are "Real-time management on workers"," Safety training on knowledge management", and "Safety resume on construction management"

II. RELATED WORKS

2.1. Middle-Aged Labors on Construction Working

It has an increase from 2001 to 2012 on Taiwan's total working population (15+) that is an average of 9,832 thousand 11,341 thousand. During the same period, it also increases from 2,747 to 4,152 thousand in 2001 to 2012, and the labor force is the age (45 to 64 years) and the age (65 and older). It is shown that the trend is yearly increase of labor force in middle-aged and aged labors in Taiwan. It is the major employment ethnic in the middle-aged (over 45

years) , which will be accompanied by the relevant problems with elderly body from the Institute of Medicine presented the phenomenon, such as skeletal muscle force decreased, acuity decreased, cardiorespiratory function deterioration, sleep quality reduced, other negative changes and so on.

According to the Institute of Labor Safety and Health Council of Affairs, there is a result about major occupational accident in the construction from the past three years. The frequency of occurrence of the top three for the fall (20.1%), cutting thorn abrasions (17.3%) and flying objects (5.9%) in the post-disaster payment case. In structure of age, 50 to 59 years is the highest proportion of workers suffering disaster, that is accounting for 40.4% of all persons suffering disaster. If coupled with 40 to 49 years of labor, the proportion as high as 70%. It means that the elderly over 45 years of labor has standardization accidents (Accident Rate) more than 1 every year in the construction. It also displays a higher standardization accidents in middle-aged labors compared to other age groups, which highlights the safety education should be subject to attention in elderly workers of construction. Therefore, this study also further explores to raise efficiency of fitness and well safety education training mode about the aging phenomenon of construction, which could bring the benefits on overall security management.

2.2. App Mobile Service and Location-Based Service

The Internet of Things (IoT) is an environment of computing concept and popular application, such as sensor information, mobile devices, cloud services and platforms technology, are fully reacted "position (location)" information. Therefore, "Location-Based Service(LBS)" concept combines the location and the corresponding services, and it has become an important demand for mobile users. Location-based services(LBS) are mainly a combination from 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. In addition, according to research report of Pyramid Research's market, location-based services is expected to rise by a global market value of 280 million dollars in 2010 to 1.03 billion dollars in 2015.

Therefore, the integration of Global Position System and Geographic Information System on location-based services has become indispensable to critical applications and services in life with wireless network. Such as Chunghwa Telecom launched guide services early in 2007 that mobile phone base station assisted satellite positioning to find the user's location, and combines with the database platform of Chinese Yellow Pages to provide lifestyle information nearby. Further, it is actively involved in the test on location-based services, and be with the launch of Spring House Company to promote mobile ads through the Yellow Pages resources.

Looking LBS development of the past few years, it is possible to accurately grasp the location of the users. The application from the earliest safe rescue, field control, and gradually toward life, business and other aspects, and it develops rapidly and widely to be used in the positioning, navigation, entertainment, shopping, social and other fields. Its future development potential could not be underestimated.Therefore, this study will also be equipped with the application and it in guides step by step to LBS technology based on 3D virtual reality training of cloud platform tointegrate safety construction information by 3R mode.

III. RESEARCH METHODS

In the core concept of the system development, it is based on KYT model from Japanese workplace safety hazard of predictable which contents are the production process, and be focused on risk factors for the development of safety education target and training activities. Through "self-management" to control the hazard of the process that may occur, it is in order to predict and prevent possible occurrence of the accident and can improve security awareness of all participants by peer forces in a team. Therefore, the system is designed for the three elements, and they are o workers, construction and safety. The concept at KYT through iWork (i Work on kyt) with real-time information systems could achieve the goal of zero occupational accidents by integration services. The System is developed friendly front-end interface of iWork by user experience. That spatial information shows that the human-computer interaction and real-time information presenting, so interaction with the series of the location (Location), and time (Time), the event (Event) in construction environment become an important foundation for system design and service context.

The mobile application of front-end user is the App form. It provides three functions through smart phones: "My work", "My security," "My resume", and iWork App to use interface design is shown in Fig.1. And the system combines application modules of three databases (3D virtual training, building information model, construction history record) from cloud platform on backend to calculate, integrate and deliver location-based information. For the effective development the system, this study analyzed the literature review, observation interviews, member-based system to design and development the concept. And it imports the scientific research into the design methods and human-computer interface design processes to develop interactive systems and technological architecture, performance analysis and verification of the subsequent experiments.



Fig.1. User interface of iWork App

IV. THE SYSTEM OF 3R: IWORK

4.1. The system of 3R: iWork

The service-oriented architecture of this system - iWork is designed for Construction safety management model by user experience. With a simple interface - "My work", "My security" and "My resume" to induce inertia and dependent on the user's application, it is in order to achieve future goals on construction safety history and zero disaster. So the concept of system-iWork development is designed as shown in Fig.2.

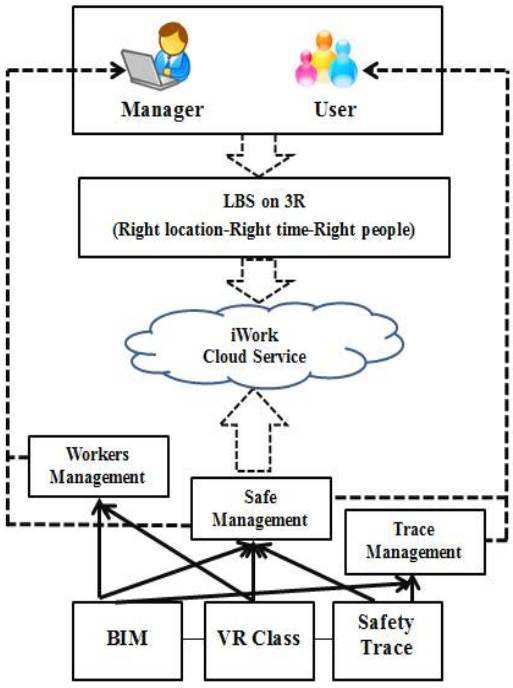


Fig.2. The concept of system design–iWork

4.2. The design of service system

System architecture of this research is mainly based on location service, and provides information to front-end user with the correct position, the right time and the right people parameters through integrated mechanism designed. And then it develops a set belonging management system to construction safety resume.

According to the International Data Corporation (IDC) in 2012 for the use of smart phone operating system to investigate, Android market share has reached 75 percent. Therefore, this study will use the popular Google Android as a development platform, which includes the development-related applications and executable software on standard platform. While it provide users with information by push and pull methods of location-based services.

In addition, the front-end users will be able to use smart phones with Android system to automated capture the needs of IT through location-based services. It also reduces troubled degree that users are not easy to operate a computer and mobile device, as well as reduces the time required for information search. And at the rear of mobile devices and mobile web development program, it helps improve complexity and resource costs on the traditional cross-platform development. The system for the three-Tier architecture, it has main three parts including Presentation Tier, Logic Tier and Data Tier. Then Presentation Tier is App program, Logic Tier is a location-based services and web server, and Data Tier is a collaborative computing on cloud and application database. It is shown as Fig.3. The part in Presentation Tire, whose main job is to pass the message to the back-end users and information results of back-end processing are presented to the users. Therefore, this research considers the issues of cross-browser and then uses the jQuery Mobile to develop interface on mobile web interface.

In Logic Tier, location-based services will be made through mobile devices to get position information. Via XML-based XMPP(Extensible Messaging and Presence Protocol) which includes information sharing and communications protocol for message-oriented middleware, it will pass information to the back-end to operate. Also in the web server, it places LAMP (Linux, Apache, MySQL, PHP) operating environment to develop web. Finally, in part of Data Tire, the database applies low-cost, full-featured and open source-MySQL, and through web Service of .Net technology to reduce the computational burden of front-end on mobile devices.

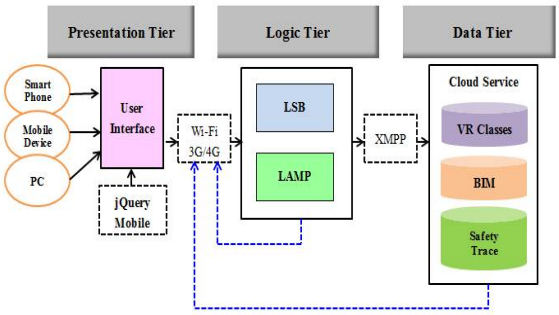


Fig.3. The architecture of service system design

CONCLUSIONS

In this study, the goal-oriented is in order to enhance middle-aged labors whose working safety in construction, and to solve construction manager

common needs on safety training, safety records and to get information immediately. It uses the existing 3D virtual reality construction safety education and training courses on the cloud platform, and through full-grown of LBS technology to combine the elements attributes with location and time parameters that are widely applied for building information model. It can useful for construction safety management by integrating information on space automation.

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