Computer-Assisted Safety: A Mobile Information System for Offshore Workers Using Personal Protective Equipment

by

Raihanah Binti Mohd Tahir

Dissertation submitted in partial fulfilment of
the requirements for the
Bachelor of Technology (Hons)
(Business Information System)

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CERTIFICATION OF APPROVAL

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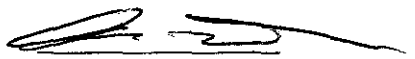
Approved by,



(Dr. Alan G. Downe)

UNIVERSITI TEKNOLOGI PETRONAS
TRONOH, PERAK
August 2011

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgement, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

RAIHANAH BINTI MOHD TAHIR

ABSTRACT

"Computer-Assisted Safety: A Mobile Information System for Offshore Workers using Personal Protective Equipment" is a project that was developed with the intention to integrate safety with the rapid development of information technology by fully utilizing Mobile Information System in the development of the system. By developing this project, it is highly hope that injuries could be reduces, rates of compliance would be increased and most importantly to save life.

The dissertation will focus on an automated approach to encouraging use of Personal Protective Equipment (PPE) and raising awareness of the importance of wearing PPE in the workplace (in this case it will focus at offshore works for the Oil and Gas Industry). An interactive system which combines knowledge management, collaborative networking and compliance reporting functionalities is intended for use by workers immediately prior to embarking on off-shore duties. The system allows workers to conduct a self-audit of their PPE availability and knowledge of use, and to submit an automated form to Health, Safety & Environment (HSE) officials in Headquarters. The system also contains background data on PPE and workplace hazards. Since worker health status is controlled in off-shore environments, the system contains a body mass index (BMI) calculator, through which weight, height and body-mass data can be transferred to HSE personnel.

The system has been resourced on an android platform for ease of worker use. Preliminary performance and usability testing results ranged from satisfactory to excellent. Prospects for further development of computer-assisted safety solutions are discussed in detail, along with implications for future research.

It is concluded that computer-assisted safety systems hold considerable promise for reducing accidents, lost-time injuries, fatalities and near-misses. The present system may be one of several that could be considered for future commercialization or in-house development.

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CHAPTER 1

INTRODUCTION

1 INTRODUCTION

1.1 BACKGROUND OF STUDY

This project has been proposed to be studied as a research topic based on the interest of Personal Protective Equipment for oil and gas industry focusing at offshore operations. Realizing the importance of the industry in generating oil and gas while at the same time providing the economical source of the country, the Health, Safety and Environment (HSE) issues are included as one of the important issues for the industry.

The non-compliance towards HSE elements might caused accident and incident and will bring to loss compared to the profit that should be gained. However, working offshore might expose workers towards various types of hazards. Virtually all the health hazards common to the industry are present offshore (Gardner, 2003). Realizing the existence of hazards at the workplace and what kind of danger it may brings to workers, the use of Personal Protective Equipment (PPE) might be one of the proposed solutions that could reduce risks of accidents. Personal Protective Equipment (PPE) is the equipment that should be worn by worker to minimize exposure to specific occupational health hazards.

It is also generally understood by Health, Safety and Environment practitioners that PPE is the last option of mitigation measures after elimination of hazard, hazard substitution, hazard isolation, engineering controls and administrative controls. Despite of the hierarchy of this mitigation measure, the use of PPE is still an aspects that should be look forward to since there are few statutory and law that enforces of PPE. Occupational Safety and Health Act 1994, Sec 24 (1) (c) had mentioned "To wear or use at all times any protection equipment or clothing provided by the employer for the purpose of preventing risks to his safety and health". Factory and Machine Act 1974, Sec 24 also mentioned "Requirement for PPE when exposed to a wet or duct process, to noise, to heat or to any poisonous, corrosive or other injuries substances which is liable to cause bodily injury". Thus, it encompasses the message that despite PPE is used as the last option of defense towards hazards; it is also plays crucial elements for offshore worker to understand and create awareness about PPE to help them reduce fatalities and injuries in the future.

1.2 PROBLEM STATEMENT

Problems occur when offshore workers do not develop a complete understanding of the usefulness of PPE. Rates of compliance with PPE usage requirements vary widely and are often insufficient to achieve desired levels of protection to the workers. Somehow, workers even misunderstand the role of PPE as the last option of defense towards hazard while at the same time incompliance of PPE or wrong type of PPE itself might bring hazard to them. Thus, there is a need to educate workers about the correct way of wearing PPE and to increase awareness of compliance towards PPE for offshore workers to reduce injuries and fatalities.

1.3 PROBLEM IDENTIFICATION

There are the occurrences of non-compliance to the regulations for wearing PPE at workplace. Basically, poor compliance towards PPE resulted from the PPE features where it is unattractive, uncomfortable or being imposed on the worker with little choice in the selection. The feeling of uneasy and uncomfortable had rise because the features of the protection equipment itself. The weight, size and even the smell of the equipments might affect the tendency of worker to wear PPE. Thus, because of feeling uncomfortable to wear the equipments, someone tend to not to wear PPE and not wearing it in a proper way and this could bring to unsafe acts. Unsafe act can be defined as not taking a safe precautions and actions towards a situation which there is the presence of hazards. For example, a worker not wearing ear protectors or hard hat in a construction area where hazards such as a noisy environment and falling objects might present in that situation.

Other than that, there are also cases in which workers wear PPE but does not wear it according to the instructions or does not know how to adjust it for maximum protection to reduce the degrees of injuries. This might occurs because of not enough training provided by the company or even the guide or manual provided from the company does not conveyed totally to reach worker to the understanding of how to optimize the equipment provided. In a simple conclusion, the PPE has not been used properly and accordingly so it is considered that they could not protect workers and in some other situations it also may case dangers towards workers.

Human factors should be considered in term of implementing a good PPE program for an organization. Human factors cover the organization factors, job factors and personal factors. Personal factors could be divided into three

elements which are the attitudes, motivation and perceptions. In case of the compliance towards wearing PPE these three elements are really crucial. A worker tendency of wearing PPE might be affected by the attitude of other worker. For example, new employee in an organization might not put emphasize on wearing PPE even though he or she is alert about the hazards that might appears and what kind of protection that should be taken just because the other senior workers do not wear proper PPE. Thus, the attitude of senior workers by not wearing PPE might influence the attitude of new worker to also not abide to the rules even though he already knew the consequences. Despite of that, motivation also could play an important role to encourage workers wear PPE to minimize injuries. Usually, motivation could come from top management of an organization by keep on promoting the cause to wear PPE and conveying a message that would best captures all workers to motivates them to wear PPE. However, another element that influence personal human factor is a man perception towards an issue or situation. In this case, worker perception towards wearing PPE must be right because if they misunderstood the concept that PPE is just a method of minimizing the exposure towards certain specific occupational hazards and PPE does not reduce the hazard itself and does not guarantee permanent of total protection.

1.4 OBJECTIVES AND SCOPE OF STUDY

The objective of proposing this interactive "Computer-Assisted Safety: A Mobile Information System for Offshore Workers using Personal Protective Equipment (PPE)" is to develop a mobile system containing information about PPE, specifically for workers in offshore platform environments focusing in Oil and Gas (O&G) industry. This project was also developed with an objective to automate existing paper-and-pencil checklists and guidelines developed by PETRONAS Carigali Sdn Bhd (PCSB) for the purpose of encouraging PPE utilization. Other than that, this project is also

conducted with the objective to increase worker compliance with PPE usage and, in so doing, reduce safety incidents in offshore works environments.

This project will specify basic requirements for PPE including head, eye, face, respiratory and body protection to protect workers from both general and specific risks available at offshore. This project also will cover the elements of providing an interactive educational and knowledge sharing of PPE for users through the use of computer, Internet and any other possible applications such as mobile applications.

The purpose of this mobile information system developed throughout this project amongst others includes:

- To educate workers about the range of PPE required for use in the offshore workspace
- To create user awareness about the importance of PPE for safe work; and,
- To enhance worker's compliance with PPE usage requirements.

The system developed throughout this project will cover oil and gas industry primarily in Malaysian offshore work environment, but could be generalized to other workplace settings. Throughout this project, there are some scopes that might not be covered because the scope is too broad to be covered and might affect the focus of the project. The things that will not be examined in this project includes amongst others:

- Whether there are any gender or ethnic differences in the level of satisfaction with the application
- Whether the application actually leads to improved safety behavior

Since this project is aiming to educate workers about PPE, it will not examine whether with the implementation of the application will improve safety behavior but this project suggested on improving safety workers knowledge and attitudes towards PPE and safety itself.

1.5 SIGNIFICANCE OF THE PROJECT

Considering this issue, there is a need to create new approach to educate and share knowledge of PPE with workers to increase more understanding about the issue and in other hand could increase awareness about the important of wearing PPE at offshore. Thus, to liaise with the rapid development of information technology and Internet, there should be an approach to educate employee about PPE and any other issues on HSE via interactive applications whether through mobile applications or web based applications. In this project, the emphasize will be put into using mobile application as a mobile buddy to educate offshore workers about PPE, help them identify suitable PPE based on the hazards and task identified, and be reminded about safety at workplace and compliance towards rules encompassed by the management in order to create a safety workplace. This project is done with the intention to educate user about PPE, create awareness and enhance compliance so that as a result from this project it will help to reduce injuries and fatalities thus could be able to save lives.

Moreover, this project also will be beneficial not only to the worker at offshore but to any related parties to get the shallow knowledge of PPE without the needs to go for training. The interactive applications should be able to create awareness to all about the importance of health, safety and environment elements in an offshore workplace for oil and gas industry.

1.6 THE RELEVANCY OF THE PROJECT

"Computer-Assisted Safety: A Mobile Information System for Offshore Workers using Personal Protective Equipment (PPE)" is suggested to be built as a mean to educate people especially offshore worker considering that the use of computer and mobile applications can contribute to the Health, Safety and Environment awareness among publics and offshore worker.

By integrating all the information that need to be conveyed to worker about PPE which has been promoted to them through a classical way before which is through guide, manuals and training, the application should be interactive and can attract others to use it as a medium for education and learning about PPE.

By having the interactive application, it would best to be as the medium for worker to learn about PPE for offshore and at the same time to increase HSE awareness amongst them which could lead to reducing any injuries and fatalities.

1.7 FEASIBILITY OF THE PROJECT WITHIN THE SCOPE AND TIME FRAME

The scope of this research was focused on the policies and regulation for wearing Personal Protective Equipment (PPE) especially at offshore and basic steps and understanding about PPE among workers. Thus, the author had collected and gathered data from many parties such as Department of Occupational Health (DOSH) and National Institute of Occupational Safety

and Health (NIOSH). Then, author also had come out with a design and integrates all information into the applications that had been developed and conducted User Acceptance Test (UAT) for the applications.

Since this project had been accomplished within the timeline that had been outlined in the early stage since Final Year Project 1 (FYP/1) and Final Year Project 2 (FYP/2), it was considerable to conclude that the time frame and scope suggested was really feasible. Nine months was taken to accomplish both projects covering the analysis, design, and implementation and testing phases.

CHAPTER 2

LITERATURE REVIEW

2 LITERATURE REVIEW

2.1 INTRODUCTION

This literature review will produce an overview of offshore hazards, mitigation hierarchy for offshore, the use of Personal Protective Equipment (PPE) at offshore, the use of computer in safety management, the advantages and disadvantages of computer for wellness learning and usefulness of mobile technology as a form of learning method and Android in the market. Basically, this review integrates few journals that had been published from many trusted organizations such as the Society of Petroleum Engineers (SPE), the Petroleum Safety Authority Norway (PSA formerly known as Norwegian Petroleum Directorate) and National Institute of Occupational Safety and Health (NIOSH). This literature review aims to give overview about PPE and offshore in general and also relates the use of computer for other functions to relates to the use of computer for safety purposes.

2.1.1 OFFSHORE HAZARDS

The Society of Petroleum Engineers has defined hazard as a condition or object that has the potential to cause harm risk is the probability of an event happening times the impact of its occurrence on operations. Impact is the effect on conditions or people if the hazard is realized (occurs) in practice and potential is the likelihood that the impact will occur. In term of offshore hazards, there are few types of hazards that could be identified such as chemical, physical, biological, ergonomics and psychosocial hazard. Chemical hazard is a form of hazard from substance that can be in form of toxic, corrosive, irritant, sensitizing, and possible carcinogens. Physical hazard is the form of hazard caused from noise, vibration, various forms of radiation and thermal extremes. In the other hand, the example for biological hazard is legionella and food poisoning. Ergonomic hazards can be from the cause of manual handling and features of the workstation itself and psychosocial hazard can be associated from the work style, work hours, tour patterns and location (Gardner, 2003).

Furthermore, instead of various types of hazards presence offshore, the working features at offshore also could contribute to loss and injuries. There are several features of offshore work that have an impact on the way occupational health and hygiene has been practiced in the sector (Gardner, 2003). Other than that, there are studies being done focusing on major hazard risk components for personnel staying on the offshore installations (Vinnem J.E., 2006). The feature of working offshore usually described by the physical isolation, major hazard potential at offshore, shift and tour patterns, multiple exposures and environmental concerns. Usually, offshore installations are isolated which means workers have to travel to work by helicopter and stay there usually for two or three weeks, depending on individuals and shift patterns. The major hazard risks components for employees on offshore installations has been indicate by two major components which are major

hazards during the stay on the installations and major hazards associated with helicopter transportation of personnel (Vinnem J.E, 2006).

In the other hand, multiple exposure to various range of hazards sequentially or simultaneously such as hazardous substances, noise, vibrations, hot or cold conditions and heavy manual handling activity are all present offshore. For example, the exposure of hazardous substances is unavoidable offshore. Several hundred substances with a range of uses and toxicities are, or have, been used offshore (Hudgins, 1991)The exposure of hazardous substances offshore might happen through various situations such as the production and ancillary processes, drilling, and inhalation risks.

The effects of these hazards are different based on which types of hazards that is present in the situation. The exposure of radiation can lead to cancer and noise at workplace can contribute to deafness or noisy discotheques. The incident such as Piper Alpha disaster in 1988 could be a good example for the effects of hazards that one hazard could lead to another hazard. A study has been done to the survivor of the Piper Alpha oil platform disaster to examine the role of factors relating to the trauma, the survivors and the survivor's circumstances. The result from the study shows that the most stringent diagnostic criteria for post-traumatic stress disorder (PTSD) were met by 21% (7/33) of the survivors over 10 years after the disaster. Features such as physical injury, personal experience and survivor guilt were associated with significantly higher level of post-traumatic symptoms (Hull M.A, 2002)

2.1.2 MITIGATION PLAN

Realizing that hazards are everywhere on offshore installations where it may be in the form of chemical, physical, biological, ergonomic and psychosocial

hazard, a mitigation plan should be put into important consideration. Hazards mitigation means taking action to reduce or eliminate long-term risks from hazards and their effects. From Piper Alpha disaster 1988, many parties especially in safety industry had realized that a proper risk assessment and mitigation plan should be conducted in order to create a safe and healthy occupational environment. Usually, after disasters, repair and reconstruction are often completed in way so that the situation will be back to normal as before, without giving a proper plan to ensure that the same disaster might happens again. Thus, a proper hazards mitigation plan should be done to prevent the same disaster from striking again in the future. A proper study and plan should be done for mitigating hazards.

The mitigation hierarchy is also known as Hierarchy of Control. It is a list of control measures, in priority order that can be used to eliminate or minimize exposure to the hazard. It comes in two levels which are level 1 for elimination of hazard and level 2 for the control of hazard. Level 1 is the priority which is to eliminate hazard. The second level of the hierarchy is to control hazards which contains includes substitution of substance to a non-hazardous substance, engineering controls, administrative controls and the last option is to wear Personal Protective Equipment (PPE).

Hazards mitigation plan might be different depending on the industry that involved in. It needs the integrating understanding and co-operation from the managerial level and the operational level to properly conduct a mitigation plan. The responsibilities lie in everyone involved in the process to come out with consensus enforcement towards mitigating hazards and risks. By implementing mitigation plan might help a company to reduce loss or fatalities and at the same time could reduce short-term and long-term recovery from certain disaster. It also has to work along with the company business resumption plan. Hazard mitigation plan is important especially for oil and gas industry. If an incident occurs at certain well, for example fire explosion, the facilities need to be shut down until the recovery plan is

finished and the drilling process will be done again because the well still have its resources. However, if the recovery process has be done just to make sure that the infrastructure will look like as normal as before, there are possibilities that the same incidents might occurs again and this will cost a lot to the company instead of producing profits.

In conclusion, one of the most important steps to create a safe and healthy working environment especially at offshore, a solid hazard mitigation plan should be conducted because realizing the facts that we may get hazards from everything around us, the best way to deal with it is to find the source of hazards, to eliminate and reduce hazards and the last resort is through wearing Personal Protective Equipment with the understanding that PPE is one element that can be used to maintain a safe and healthy occupational environment. It does not reduce the hazard itself nor does guarantee permanent and total protection.

Nevertheless, even though this project is aiming to give education and create awareness to the user, it is also should be able to educate user that the use of Personal Protective Equipment (PPE) is the last choice of defense in term of facing hazards where there are other steps that should be taken into attention first which are elimination, substitution, isolation, engineering controls and administrative controls.

2.1.3 PERSONAL PROTECTIVE EQUIPMENT FOR OFFSHORE

The requirement of wearing Personal Protective Equipment is different depending on where work may take place, when the work will be done, for what reason the equipment will be used. It is also stated in the General Industry Standard 29 CFR 1910.132, Personal Protective Equipment (PPE), Occupational Safety and Health Acts (OSHA) that requires employers to

assess workplace hazards which necessitate the use of PPE. If hazards are present, employers are required to select PPE that will protect employees. Thus, this means that it is under the responsibility of the employer to make sure PPE is provided for employee to protect them in which case there are hazard present at the workplace.

The use of PPE at offshore might be variety but the main reason why PPE is used is to be as one element to minimize exposure to specific occupational hazards. In order to promote safety program among employees there are few essential elements required such as by doing workplace survey, selection of appropriate control to hazards, selection of appropriate PPE, fitting, training, management support, maintenance and auditing the program. From these elements, there are few elements that could be done using an interactive applications whether mobile applications or web-based applications. For example, the selection of appropriate PPE can be taught to workers through interactive application. The steps to wear proper PPE, measurement of safety footwear can be done through the applications.

2.1.4 USEFULNESS OF COMPUTER IN SAFETY MANAGEMENT

In order to enhance safety program to create safe and healthy occupational environment, the use of computer can be one of the method to enhance safety management. Nowadays, there have been too many applications with the use of computer and information technology (IT) to enhance the efficiency and effectiveness of the industry. Financial and health industry has moving forward to operate as much as possible using IT to be able to compete and complete the requirements of customer and user. If medicine is to achieve major gains in quality, it must be transformed, and information technology will play a key part, especially with respect to safety (Bates D.W, 2003)

The use of computer does not only applicable for health and financial activities; there has been a lot computer usage in this era for example in term of entertainment and education. Mobile applications for entertainment and education has been around us for many years, yet the oil and gas industry altogether with the safety industry should grab this opportunity to make use of IT in order to promote safe and healthy occupational environment.

2.1.5 ADVANTAGES AND DISADVANTAGES OF USING COMPUTER

The usage of computer in whatever industry and background might bring any advantages and disadvantages. One of the advantages of using IT is because it can act as a ways to reduce errors. Information technology can reduce the rate of errors in three ways; by preventing errors and adverse events, by facilitating a more rapid response after and adverse event occurred, and by tracking and providing feedback about adverse events (Bates D.W, 2003). In term of safety, this could best be benefited by workers as a method to reduce hazards.

Other than that, IT could help people to improve communication. The communication among managerial line and operational line is very crucial in promoting healthy and safe working environment. The objectives, company mission and vision towards workplace safety should be properly communicated towards all employees. For example, in the health industry failures of communication, particularly those that result from inadequate communications between clinicians, remain amongst the factors contributing to the occurrence of adverse events (Wanlass RL, 1992)

2.1.6 UTILITY OF MOBILE TECHNOLOGY AS A FORM OF LEARNING METHOD

Besides the evolving technologies of computer and learning method through web-based, the process of learning also has been one of the alternative in line with the development of technology. Compared with traditional instruction or information from textbooks, mobile learning seems to be a more attractive way of learning that can trigger the interest and the motivation of the learners (Hwang H.-F, 2011). It has been proven that mobile learning or learning through mobile can attract and increase interest of user instead of using the traditional way of learning. A learning system need to be attractive to encourage people and gain their interest of the learning. At the same time, mobile learning could be one of the useful techniques to motivate employee continuity to learn about PPE.

Other than that, the analysis of experimental results and system logs indicate that the testing results, task-accomplished rate and learning-goal achieved rate can be improved by the support of the ubiquitous learning website (Chen G.D., Chang C.K., Wang C.Y., 2008). It is also fair to assume that the usage of mobile learning also could be used in order to learn about PPE based on the research done previously where it resulted that mobile learning could help to improve test result, task-accomplished rate and learning-goal achieved. From these three aspects, it is also considerable to say that mobile application might improve user's knowledge about PPE, increase awareness about PPE and create motivation to learn more about PPE. This statement indicates the importance of flexibility for learner to learn at their ease. Thus, with the development of mobile buddy for PPE, it is intended to give flexibility to user to know more and create awareness about PPE. They will not only get the information from the guidelines or from the supervisor.

As conclusion, realizing the job risks available for offshore workers, after few control measures and steps has been taken to avoid hazards; PPE will be the last option to defend employee or worker from hazard which it does not offer fully protection from injuries to them. Thus, with the evolving of technology whether computer based or mobile based, the learning of PPE is intended to be provided using technology. Since there are few researches done before that has shown positive impact of using mobile learning, this project will be done in a form of mobile where it will be like a mobile buddy that help user to know and understand better about PPE and at the same time increase awareness about safety habits at workplace especially offshore.

2.1.7 ANDROID IN THE MARKET

Throughout the development process of the system, developer needs to identify on which operating system to be used as a platform of developing a mobile devices. Since there are various operating systems (OS) for smart phones such as Symbian Os, iOs, Windows Mobile and Android, few papers had been revised to identify and choose which OS is most suitable for the application to be developed for this project. One of the papers that had been revised is The Android Mobile Platform by Benjamin Speckmann. The paper was submitted to the Eastern Michigan University, United States of America in partial fulfillment for Master of Science program in Computer Science at the university on April 16th, 2008.

In the paper written by Benjamin Speckmann, he compares Android with other operating systems for mobile platform; the Symbian Os and Windows Mobile. Symbian OS is the operating system majorly used for most of Nokia's mobile phones whilst Windows Mobile is the operating system developed by Microsoft. Throughout the paper, Benjamin had specifically compared Android which was developed by Google with Symbian Os and Windows Mobile based on few elements including portability, connectivity,

open platform and product diversity. Based on these four elements, Android is leading other OS for having more portability because it was built using Java language compared to Symbian Os that use C++ language. Other than that, Android is available for wider range of product not only focusing at one type of mobile phones manufacturer. Samsung, HTC and Sony Ericsson are among the manufacturers that used Android as the operating system for their smart phones. Compared to Symbian Os, it was developed specifically for Nokia smart phones. However, Windows Mobile was totally not a choice in this project because by the year 2011, it was rarely supplied on new devices.

Other than that, based on the statistics done by Nielsen on June 2011, Android operating system had been the largest share for consumers in the United States for the smart phones with 39%. It has outcompeted iOS (the operating system specifically for Apple's iPhone), RIM for Blackberry, Windows Mobile, Palm Os and Symbian Os.

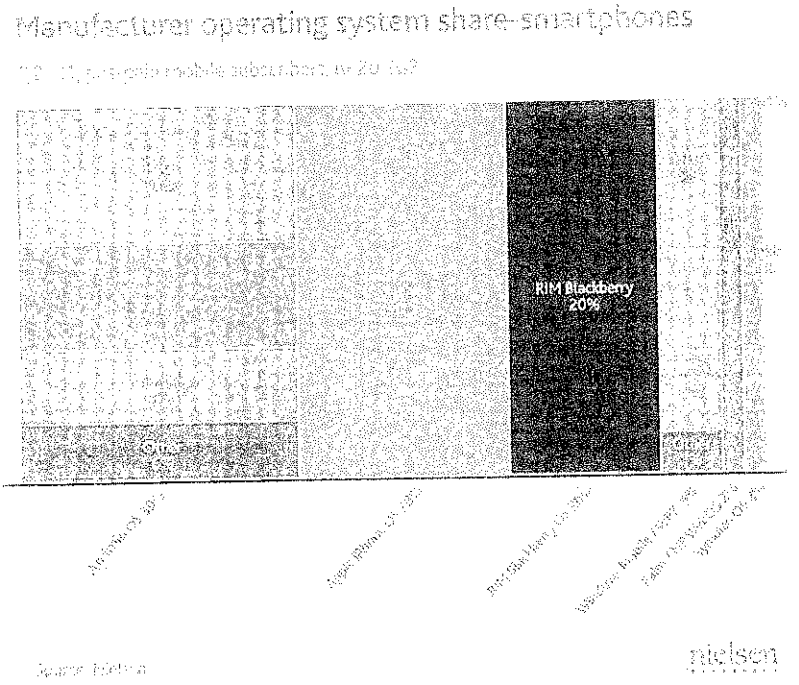

Figure 1: Manufacturer Operating System Share Smart Phones in the US

CHAPTER 3

METHODOLOGY

3 METHODOLOGY

3.1 RESEARCH METHODOLOGY

For this project, the methodology that had been used was Rapid Application Development Process (RAD). It is a type of software development methodology widely use all over the world which it uses minimal planning flavor or rapid prototyping. It involves methods like iterative development and software prototyping. It is a merger of various structured techniques, especially data-driven Information Engineering, with prototyping techniques to accelerate software system development (Whitten, 2004).

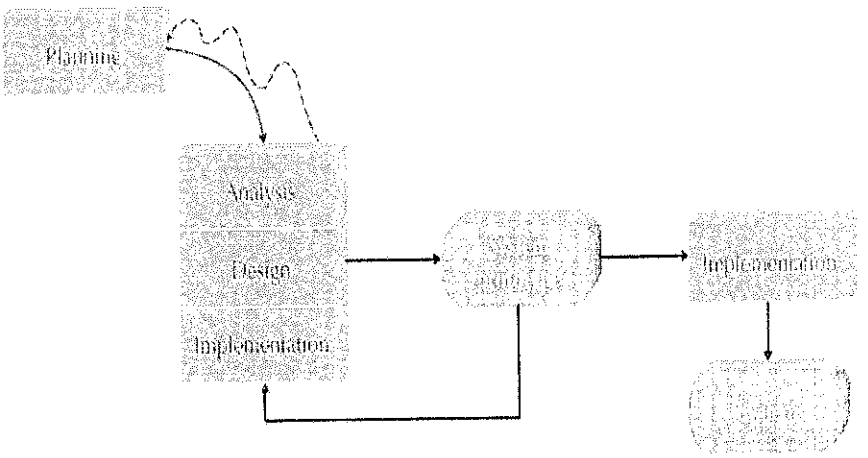

Figure 2: Rapid Application Development Methodologies

The reason why this method was chosen was because the approaches of RAD include developing and refining the data models, process models, and prototype in parallel using an iterative process. Iterative process is a repeated process of prototyping, testing, analyzing and refining the product or process. The advantages of using this methodology was developer would be able to plan and later do the analysis, design and implementation process in parallel which reduces the time consuming. Other than that, it will better identify the user requirement through analysis and design phase until the development of the prototype itself. Only if the system prototype is able to meet specific stages of user requirement, it will then be implemented.

3.1.1 PLANNING

The planning phase involved the project initiation. The deliverables required for this project were feasibility studies and system request. For this Interactive Application for Personal Protective Equipment (PPE) at Offshore Project, the planning phase had been done during the submission of title of the proposal and preliminary report submission which was the extended proposal. The key element that had been done during this phase was identifying business values of the project, feasibility analysis, developing work plan, work staffing and control the project. Basically, this phase could be done through wide study to the specific areas that related to the project. For example, to study about the behavior or offshore worker towards PPE, and at the same time to study about the acceptance and applicability of interactive application for the educational use and means. It needs detail study about these issues to better help in planning the development of this project. For this project, it can be said that the planning phase had been done during FYP/1.

3.1.2 ANALYSIS

The analysis part of this project had been done thoroughly few weeks after the project initiated which were few weeks after the submission of project title proposal itself. According to Rapid Application Development methodology, there were four important elements needed to support the analysis part of this project. The elements were project methodology, people, management and tools. Project methodology had been identified where author used Rapid Application Development which in detail also used iterative process.

In term of people, the focus was the analysis towards the end user and also the developer. Issues covered in this element were about the user requirements, users want and user needs. This analysis involved sponsor, user coordinator, user requirement planning team, user design team, and user review board. To be specific to this project, the targeted end users were the management and employee of oil and gas companies that has offshore operations. Thus, author had conducted an interview session with executive from HSE Knowledge Management Section, HSE Department, PETRONAS Carigali Sdn Bhd to collect information and user requirements suitable for this project. Thus, from the interview session, author had come out with some functionality that after that was included in the system. The functionalities amongst others include:

- The application should be able to identify task that will be done by the user
- The ability to list down possible hazard identified that will be encountered during the task
- To be able to list down the PPE needs by the user according to the task and hazards identified

- The ability to provide simple guidance on how to use PPE e.g. goggles, safety boot
- To create reminder for user to wear PPE and safety awareness at workplace
- To have interactive knowledge learning for about PPE i.e. games, quizzes

Other than that, after few considerations the system was also suggested to be done in Android platform because the number of devices running in Android is increasing and becoming wider day by day. Android is a software stack for mobile devices that includes an operating system, middleware and key applications. In order to develop an Android application, developer needs to have Android Software Development Kit (SDK) that provides the tools and Application Programming Interfaces (APIs) necessary to begin developing applications on the Android platform using the Java programming language.

To make the system compatible and acceptable by all and could be access widely, it was better to develop the system in an Android platform. The following pie chart and table is based on the number of Android devices that have accessed Android Market within a 14-day period ending on the data collection date noted below

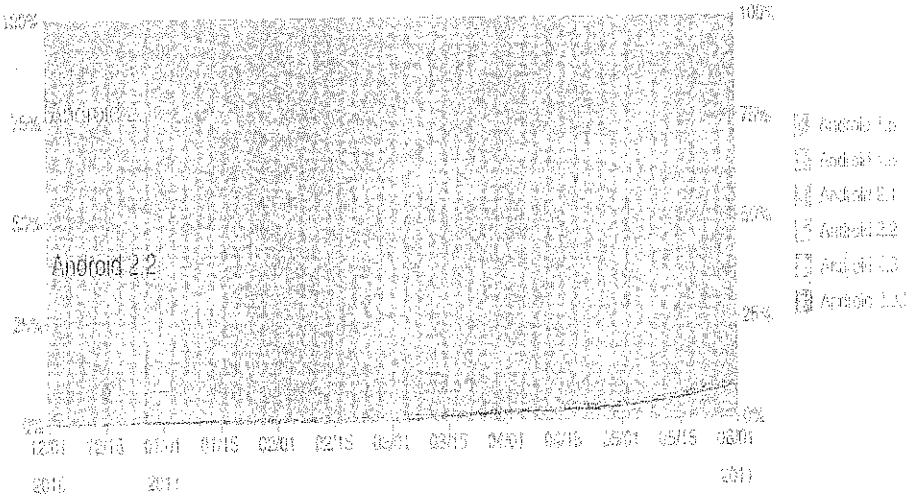

Figure 3: Data collected during a 14-day period ending on June 1, 2011

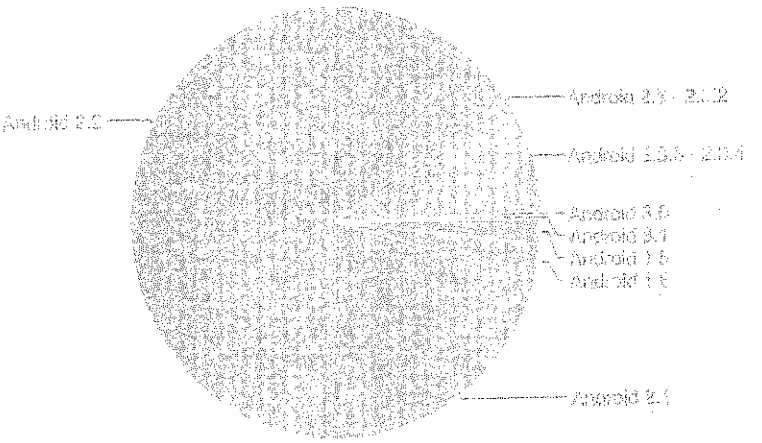

Figure 4: Data collected during a 14-day period ending on June 1, 2011

3.1.3 DESIGN

The design phase was the main focused in this Final Year Project 2 (FYP/2) where author will basically focus on the system design, functionalities, interfaces and the software programming suitable for the system. In order to decide the best design for the system, author had met with few parties to capture their suggestions and opinion about this project. Among the parties that had been interviewed for this project include:

- Mr. Wan Tarmizi Wan Ismail (Manager, HSE Department, Universiti Teknologi PETRONAS)
- Ms. Masfarita Mustaffa (Senior Executives, HSE Knowledge Management, Corporate HSE, PETRONAS Carigali Sdn Bhd)
- Mr. Faris (Plant Supervisor, PETRONAS Carigali Sdn Bhd)
- Ms. Mareena Mohd Amin (Telecommunication Engineer, Technip Geoproduction (M) Sdn Bhd)

All the information gathered from these people were gathered and analyzed to come out with the best design for this system considering the needs of user and industry. The draft of the designed interfaces is shown in the next section which shows roughly how the system is planned to look like.

3.1.4 IMPLEMENTATION

The implementation phase amongst others focus on the programming and coding part of the system as well as the system testing after the prototype was developed. The implementation phase started with designing the main page of the system and later on designing the other sub-pages for the system consists

of the interfaces of the other functionalities for the system. After designing the interfaces for each of the functionality, the next stage was to write a code for each of the functionalities accordingly. The functionalities of the system amongst others include:

- The application should be able to identify task that will be done by the user
- The ability to list down possible hazard identified that will be encountered during the task
- To be able to list down the PPE needs by the user according to the task and hazards identified
- The ability to provide simple guidance on how to use PPE e.g. goggles, safety boot
- To create reminder for user to wear PPE and safety awareness at workplace

3.2 PROJECT ACTIVITIES

The activities that had been done for this project included meeting prospective user to get their comment and ideas about this project and the early designing of this project involving the system flow, system functionalities and interfaces.

Since FYP/1, author had dealt with Ms. Masfarita Mustaffa, Senior Executive of HSE Knowledge Management from Corporate HSE Division, PETRONAS Carigali Sdn Bhd to get her feedback and suggestions regarding this project. She was very optimist about the project and very helpful along the way in completing this project by helping in providing some references that can help in term of preparing what are the functions needed to be put inside the system. She had provided two important documents to be used as reference in

this project which are PETRONAS Carigali Behavioral Safety Programme (CBS): Pre-Task Risk Assessment Tool (P.A.U.S.E) and PETRONAS TECHNICAL STANDARD (PTS 60.2114) PERSONAL PROTECTIVE EQUIPMENT. From this document, one of the main functionalities of the system had been determined which were the flow of hazards and PPE self-checking for user.

Other than that, the other activities that had been done throughout this project were writing of the code for the system. It was the most crucial part of the project because if the prototype was not being able to be done, this project could not be considered as successful. To provide author with the skills in writing the code to develop the prototype, a special class had been conducted on 23rd – 24th July 2011 specifically to equip student with basic knowledge on developing an Android application. The class was conducted by Mr. Helmi Baraja from TeratoTech Sdn Bhd. He is one of the Android developers for TeratoTech Sdn Bhd which has profiles on developing mobile applications for government and many other clients. The company had collaborated with government to develop e-voting applications for mobile. From the class, author had been equipped with basic knowledge to develop Android applications starting from installing Android SDK, Eclipse, Java Development Kit (JDK) and Java Runtime Environment (JRE).

Besides that, the other activities were the presentation of the project with the prototype and poster to Mr. Sabri, a post-graduate student under supervision of Ms. Nazleeni Samiha Haron, the co-supervisor for this project. Since Mr. Sabri is a post-graduate student specializing on the mobile application development, his suggestions and opinions about this project was really helpful for author before preparing for Pre-EDX (Engineering Design Exhibition).

Furthermore, the system also had been developed based on the flow chart prepared during the design phase. The system flow-chart had been the major guidance for the developer during the development period especially the coding part. It showed how the system works from one stages to another based on the activities. Basically, the flow-chart focus on the main functionality which is the Pre-Tasks Risks Assessment Tools (P.A.U.S.E)

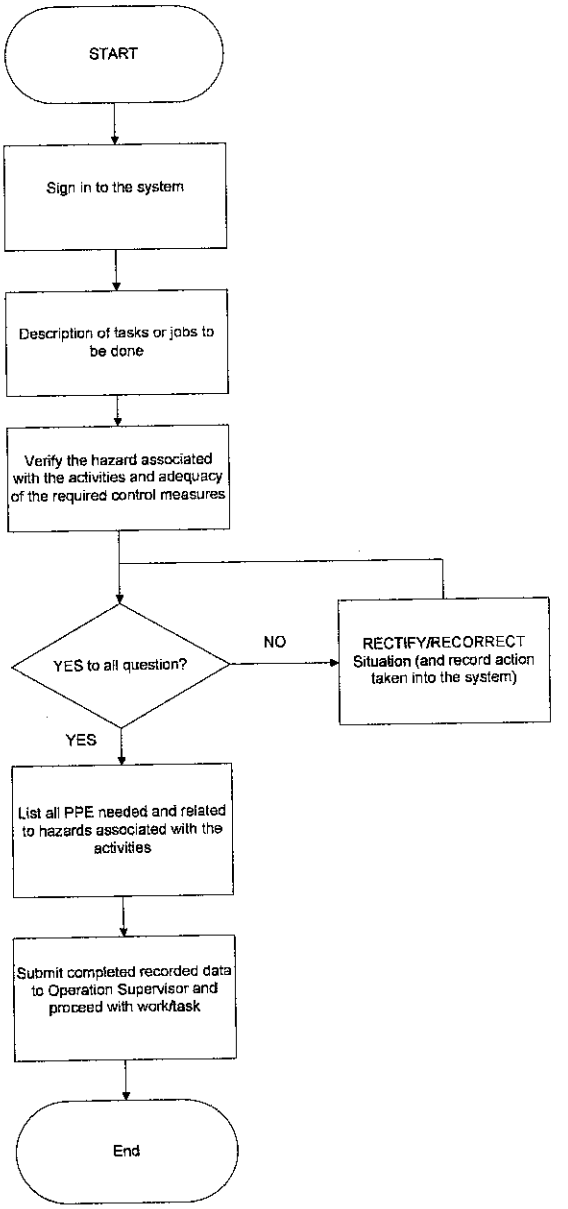

Figure 5: System Flowchart

Other than that, the use case diagram of the system can be shown in Figure 7.

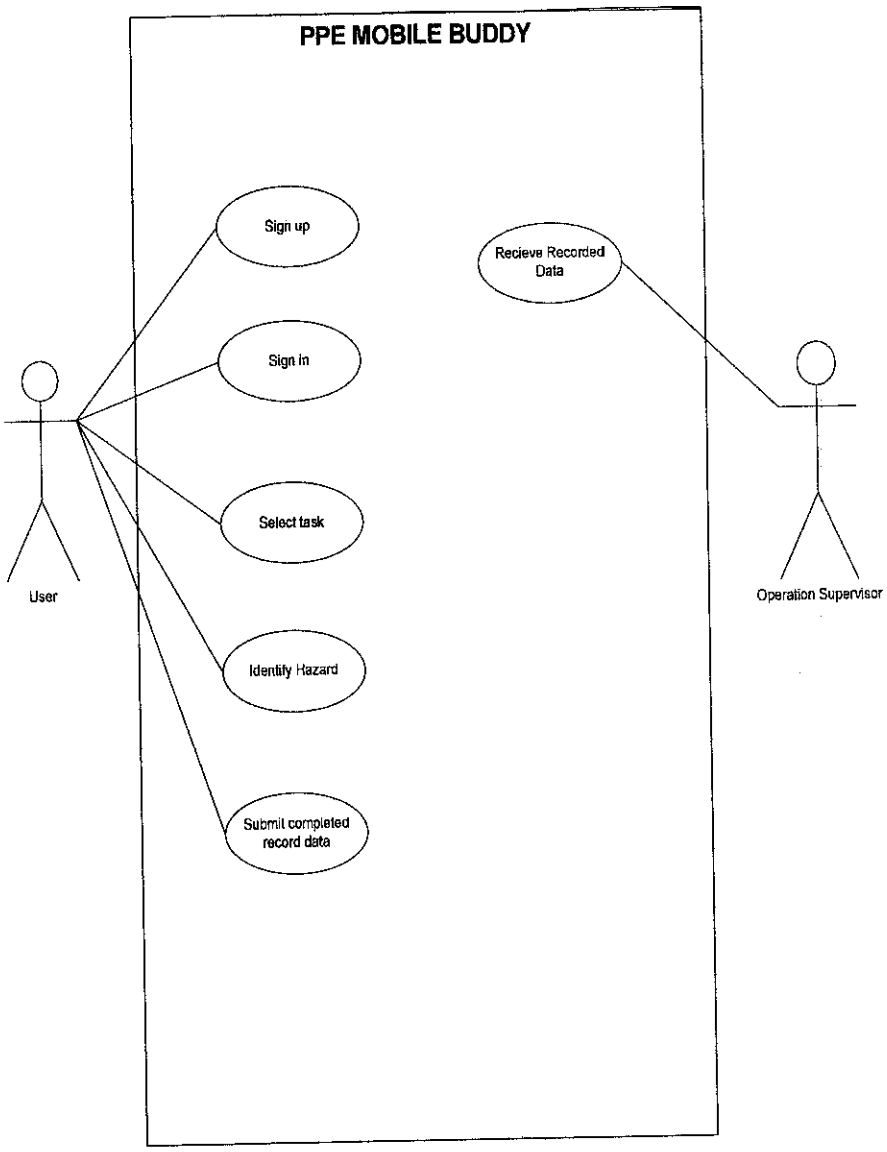

Figure 6: Use Case Diagram

3.3 KEY MILESTONES

There are few important dates that were taken into high attention. The important dates are amongst other:

- Submission of Progress Report – Week 7 (July 4, 2011)
- Pre- Engineering Design Exhibition (EDX) – Week 11 (August 3, 2011)
- Dissertation – Week 12 (August 19, 2011)
- Viva Presentation – Week 13 (August 19, 2011)
- Final Dissertation and Technical Report Submission – Week 14 (August 24-26, 2011)

The project submission and project milestone was based according to FYP/2 Timeline provided by the course coordinator. Provided below is the Gantt chart for the project

3.4 GANTT CHART

No	Activities	May		June				July				August			
		W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14
1	Presentation and Interview with selected parties														
2	Progress Report														
3	Programming and Prototyping														
4	Pre-EDX														
5	Dissertation														
6	Viva Presentation														
7	Final Dissertation														
8	Submit Technical Report														

Done Progressing To be done

3.5 TOOLS REQUIRED

Hardware:

- Computer
- Mobile phone (specifically smart phone with an Android operating system)
- Printer
- Scanner

Software:

- Android SDK
- Eclipse (eclipse-SDK-3.6.2-win32-x86_64)
- ADT Plugins (ADT-10.0.1)
- JDK (Java Development Kit)
- JRE (Java Runtime Environment)

CHAPTER 4

RESULTS AND DISCUSSION

4 RESULTS AND DISCUSSION

4.1 USER NEEDS ASSESSMENT AND ANALYSIS

The user needs assessment process was carried out through interviews with the parties which involved highly in oil and gas industry and related to Health, Safety and Environment department. Among the parties that had been interviewed are:

- Mr. Wan Tarmizi Wan Ismail (Manager, HSE Department, Universiti Teknologi PETRONAS)
- Ms. Masfarita Mustaffa (Senior Executives, HSE Knowledge Management, Corporate HSE, PETRONAS Carigali Sdn Bhd)
- Mr. Faris (Plant Supervisor, PETRONAS Carigali Sdn Bhd)
- Ms. Mareena Mohd Amin (Telecommunication Engineer, Technip Geoproduction (M) Sdn Bhd)

The reason why these people were interviewed was because they have high knowledge on the issues and topics covered in this project such as about HSE at Offshore platform, telecommunication at offshore and knowledge management related to HSE.

The first person that author had interviewed and discussed about this project was Ms. Masfarita Binti Mustaffa, Senior Executive, HSE Knowledge Management, Corporate HSE, PETRONAS Carigali Sdn Bhd. The reason why she had been interviewed by the author was because she located in the Knowledge Management department for HSE. Thus, her knowledge and information about the system that had already been done related to HSE is highly beneficial for this project. Throughout the interview, Ms. Masfarita was very positive that interactive mobile system focused on PPE at offshore is needed and could bring large benefit in term of HSE. She stated that there's no system already built especially on mobile focusing on PPE at PETRONAS Carigali. From the interview itself, author was provided with two documents to help understand better about PPE and to plan for the system flow charts and design. The flow chart shown at Figure 6 is the outcome from the discussion with Ms. Masfarita Mustaffa and Dr. Alan G Downe considering what benefits the system could bring based on the designed flowchart.

The other party that had been interviewed by the author was Mr. Wan Tarmizi B. Wan Ismail, Manager of HSE Department at Universiti Teknologi PETRONAS. The reason why Mr. Wan Tarmizi was interviewed was to get his suggestions and opinion about the usual practice of giving user's alert about PPE. From the interview, the author was told by Mr. Wan Tarmizi that in UTP there was no other approach used to increase awareness and alert about PPE, except just with the assumption that everyone understand about PPE from the guidelines provided to them. Thus, he made a conclusion with a mobile buddy inside everyone's phone, it might be one of the best approaches to remind and increase awareness about PPE. Besides that, the system also could be done not only focusing on PPE at offshore but also to other industry and other workplace.

Other than that, author had presented about this project to Mr. Faris, Plant Supervisor from PETRONAS Carigali Sdn Bhd. Basically, Mr. Faris was interviewed because he has high experienced working and staying offshore,

thus he can cover on the issues of the user needs and requirements especially at offshore. Since the system is intended to be developed for PPE at offshore, his involvement to understand and give feedback about this system was highly needed and important. From the presentation that I had given to him about this project, Mr. Faris was quite satisfied with the flow that I had already designed shown in Figure 6. It was according to him, best portraying the flow of what usually an offshore worker do; describing task, hazard identification and author had added the PPE's list according to the hazards identified. He also suggested that maybe this system can be liaises with Permit to Work (PTW) because there is no automated electronic system for PTW currently used at offshore. However, Mr. Faris also raised the concern of the use of mobile phone at offshore because mobile phone is prohibited at offshore especially at the work area. He suggested that the system to be done in a web basis as a replace to mobile phone.

To get a better overview about the use of mobile phone at offshore, the author attended a seminar entitled Telecommunication at Offshore with Co-supervisor, Ms. Nazleeni Samiha Harun. The talk was given by Ms. Mareena Mohd Amin, Telecommunication Engineer from Technip Geoproduction (M) Sdn Bhd. She confirmed that mobile phone is not allowed offshore because it could lead to sparks and ignite fire. However, she really attracted with the project of designing a mobile system especially for PPE at offshore. Her recommendation was to use another type of mobile device that is certified as safe to be used offshore. The devices must be declared and certified with IS (Intensively Safe) to be used offshore.

After considering all the issues raised regarding the design of this project such as user need, the use of mobile devices at offshore and user demand of mobile devices, with few discussions with supervisor, Dr. Alan G. Downe, author had decided to still continue this interactive application for PPE for Offshore basically to be used as a mobile buddy. However, this mobile buddy not to be used when a worker enter offshore platform but to be used as a

preparation before they depart to offshore. It also can act as a soft reminder to worker to always planted the awareness about safety inside their mind even though not at the workplace and not during working time.

4.2 EXPERIMENTATION AND MODELLING

After developing the system, tests were carried out. The reason why the system needed to be tested was to gather as much data as possible regarding few important elements. The test elements amongst others include:

- System's problems and defects
- The efficiency and effectiveness of the system
- User satisfaction
- Time needed by the system to run
- Rating about system interface
- System performances

The first test done was to test whether the system works well in different type of phone that is using Android operating system. This test was basically focusing on the performances of the system.

Phone Model	Android Platform	Remarks
HTC Incredible S	Android 2.3	Installation successful and application is similar to emulator.
Samsung Galaxy S	Android 2.2	Installation successful and application is similar to emulator.
Samsung Galaxy SII	Android 2.3.3	Installation successful and application is similar to emulator.

Table 1: Performance Testing for Different Android Platforms

Basically, the prototype has been developed in the Android SDK as a default for Android 2.2 Platform and API Level 8. Thus, this test was done to check performance of the application at different Android Platform which was Android 2.2, Android 2.3 and Android 2.3.3. It was to test whether the application developed was able to be used in other platforms not only on Android 2.2 as per the platform it used on the development phase.

The second test that had been conducted was the user satisfaction test that includes system interfaces, systems problems and defects.

Elements	Rating	Remarks
Application installation	5	The installation to the devices is easy.
Interfaces	4	The interfaces can be improved in future works.
Functionality	4	Other new functionalities could be added to the system in the future.
Time to run	5	The application does not take long time to run.
Choices of color	4	The color could be varied and more attractive in the future.
Icons used	4	There should be more icons with pictures used in future.

Table 2: Usability Testing

1 = Very dissatisfied

2 = Somewhat dissatisfied

3 = Neither satisfied nor dissatisfied

4 = Somewhat satisfied

5 = Very satisfied

Application Installation:

The element covers the aspects on how easy the application was installed into the hardware devices which is to the mobile phones with the Android operating system.

Interfaces:

The elements of interfaces cover User Interfaces (UI) aspects of the application such as the attractiveness of the system interfaces.

Functionality:

This aspect test on all of the functionalities provided in the application whether it meets the user satisfaction or not.

Time to run:

This aspect of testing focuses on the time taken for the application to run on the real devices and how long does it takes to launch the application.

Choices of color:

This is one of the aspect under User Interfaces (UI) element which it test whether the choices of color for this application meets the user satisfactory level.

Icon used:

This element gathers the date from user whether the icon used (e.g. button, drop down, list, checkbox etc.) meet the satisfaction of user.

4.3 PROTOTYPE

4.3.1 INTERFACES

The interfaces of the prototype developed are based on the emulator for Android SDK not based on the screen of the mobile phones. The reason why the interfaces are shown based on the emulator is to show the interfaces of the system via the developer's view during the development of the system. The first page of the emulator is the home page. It is shown the home page of an Android phone. Then, from the home page, user needs to select the menu button to choose for the icon of the application.

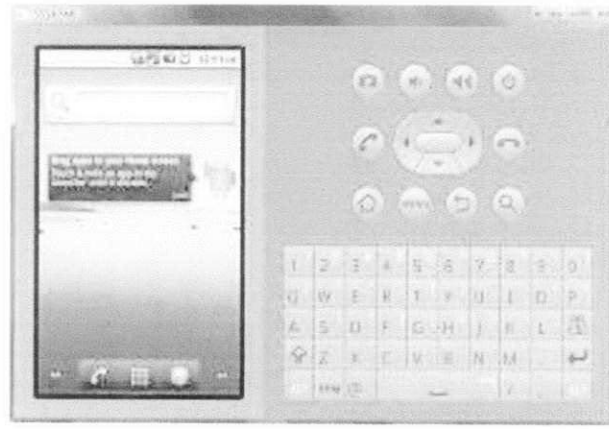

Figure 7: Homepage of the Emulator

Figure 8: Menu Page to Choose Application

From the menu page, user needs to choose for PPE icon to launch the application. Then, the main page of the application will appear.

Figure 9: Main Page of the Application

From the main menu, user can see six main functionalities of the application which are:

- Introduction page
- Know Your PPE
- Guideline
- P.A.U.S.E
- BMI Calculator
- Reminder

By selecting "Introduction" button, user will be directed to the Introduction page which contains text of introductory of the system.

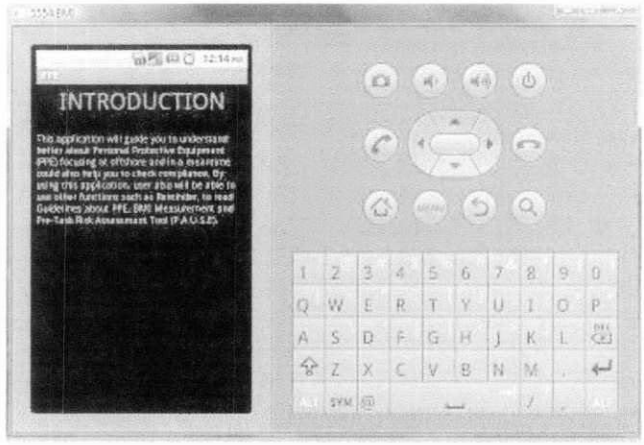

Figure 10: Introduction Page

By selecting "Know Your PPE" button, user will be directed to the main page of the functionality listing all types of PPE.

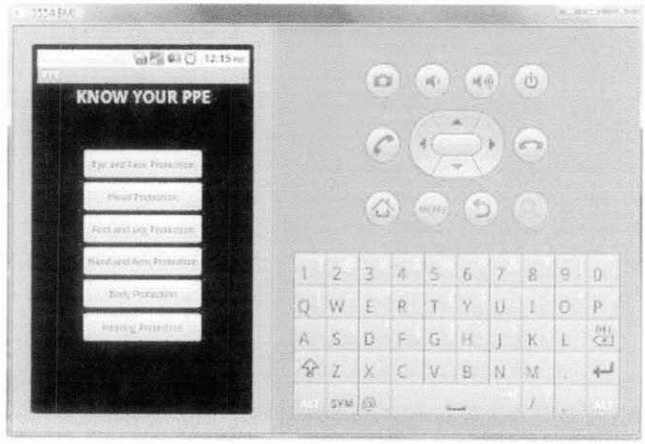

Figure 11: Types of PPE

For example, if user chooses the Eye and Face Protection, user will be directed to the page that list out the PPEs suitable for Eye and Face Protection.

By selecting the "Guideline" button, user will be directed to the page that will allow user to read the Guideline related to PPE.

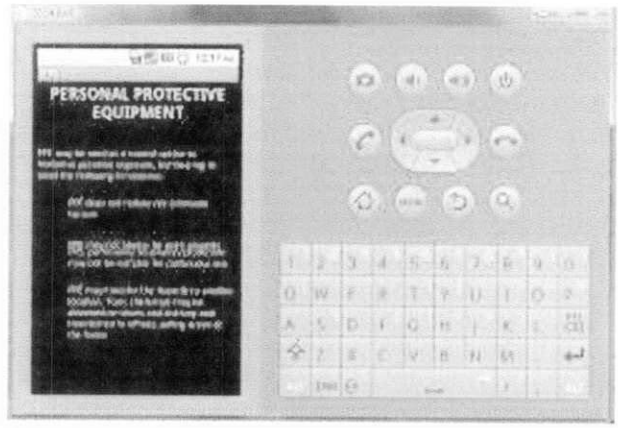

Figure 13: Guideline

By selecting "P.A.U.S.E" button, user will be directed to the PAUSE functionalities that needs user to choose types of jobs and tasks and the system will show the hazards and PPE related to the job done.

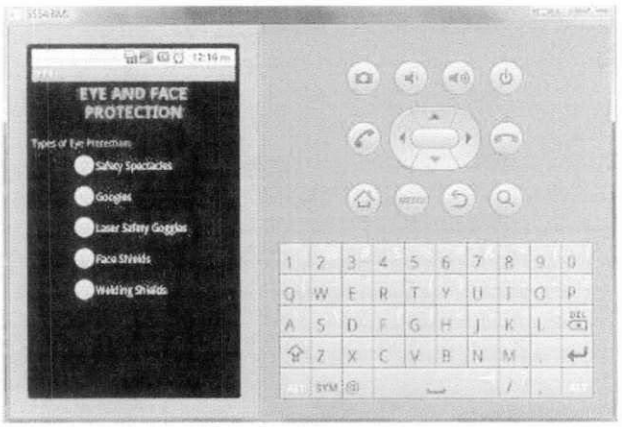

Figure 12: PPE Suitable for Eye and Face Protection

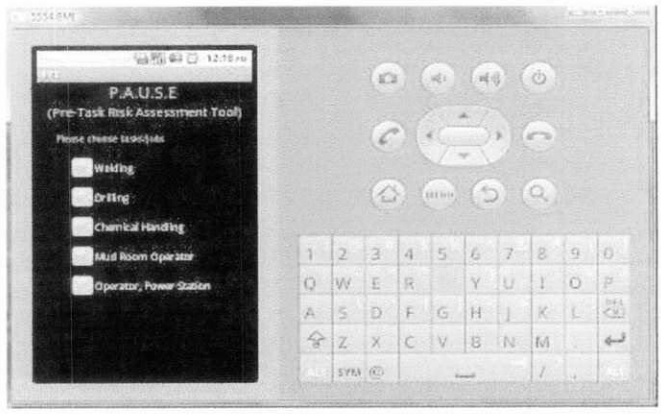

Figure 14: Choose Jobs/Tasks Page

Figure 15: Hazards Related to Jobs Chosen

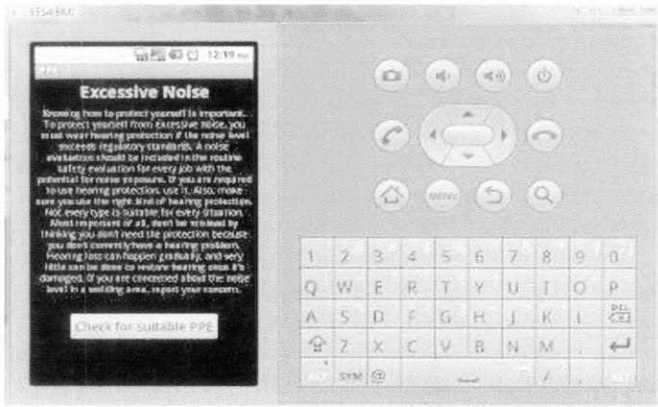

Figure 16: Explanation about Hazards Identified

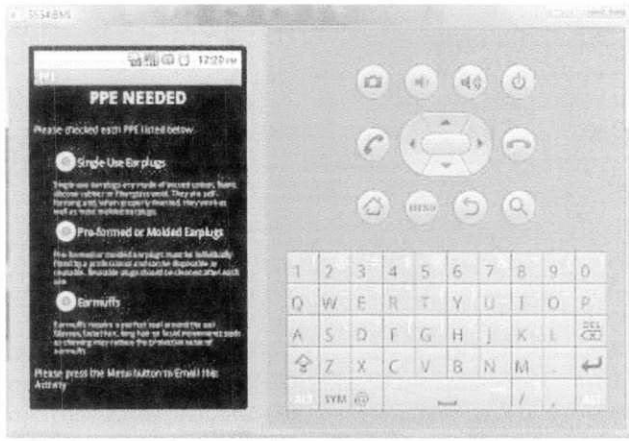

Figure 17: PPE Needed for the Hazards Identified.

From this page, user needs to choose the Menu button and then select the Email icon to send the report to HSE Supervisor.

Figure 18: Email Received

The email will be received from the applications with the title "Pre-Tasks Risks Assessment Tools (P.A.U.S.E). User can insert some comments in the email, just like usual email send by any mobile phones.

By selecting "BMI Calculator" button, user will be directed to the BMI Calculator that can calculate BMI for user.

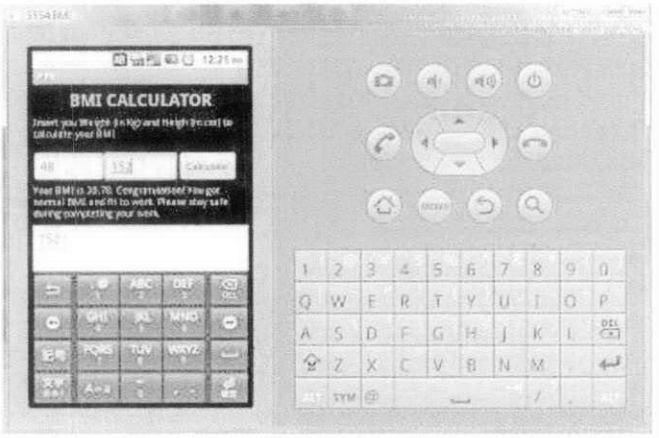

Figure 19: BMI Calculator

The last functionality is the Personal Reminder. By selecting "Personal Reminder" button from the main page of the application, user will be able to set date time and time before going back to offshore and the system will pop out the reminder that will remind user to wear proper PPE and stay safe at offshore.

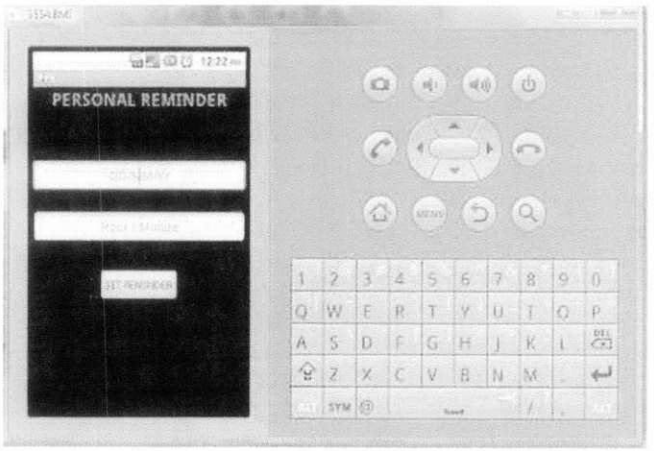

Figure 20: Personal Reminder

4.4 PROJECT DELIVERABLES

The deliverables of this project includes the submission of few reports from the beginning of the project in Final Year Project 1 (FYP/1) that were submitted in January Semester 2011 and the other remaining reports submitted in Final year Project 2 (FYP/2) in May Semester 2011. The reports among others include:

- FYP/1 Extended Proposal (submitted in January Semester)
- FYP/1 Proposal Defense (presented to Supervisor and External Examiner in January Semester)
- FYP/1 Interim Report (submitted to Supervisor and External Examiner)
- FYP/2 Progress Report (submitted to Supervisor)
- FYP/2 Pre-EDX (presented with prototype and posters to External Examiners)
- FYP/2 Dissertation (to be submitted to External Examiner and Supervisor)
- FYP/2 Viva (to be presented to Supervisor and External Examiner)

This project delivered all of the required deliverables including the posters and the prototype for the project.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5 CONCLUSION AND RECOMMENDATION

As a conclusion, this system could be considered as 100% completed because it had successfully produced the prototype as per being planned and according to the schedule of the project timeline. This system had been able to produce almost all the functionalities that had been designed in the Design phase of the project where inside all the functionalities; they integrate the core objective of this project which is:

- To develop a mobile system containing information about PPE, specifically for workers in offshore platforms environments
- To automate existing paper-and-pencil checklists and guidelines developed by PETRONAS Carigali Sdn Bhd (PCSB) for the purpose of encouraging PPE utilization
- To increase worker compliance with PPE usage and, in so doing, reduce safety incident in offshore works environments.

5.1 RELEVANCY OF THE OBJECTIVES

This project is relevance to its objectives since all the functionalities designed in the design phase which has been designed specifically according to the objectives has been able to be developed. Thus, with all the main functionalities included in the system to be added with some improvisation in

interfaces and usability in the future, it is highly suggested that this application if it is used in the future could reduce injuries at offshore and most importantly could save life. There are strong potential that may exist for further development and pre-commercialization of the system. Future works also should include usability testing and expansion to include other functionalities. Generalizations of PPE information systems to other work environments may offer promising future research and development also. Last but not least, the effective use of computer-based system such as mobile applications seem to enhance behavioral safety programs can result in reduced workplace injuries and will save lives.

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