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Emergency Accident Alert Mobile Application

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Abstract

Background/Objectives: This paper aims to report on the development of an Emergency Accident Alert mobile application to send an accurate alert and notification of accident to the emergency call center. **Methods/Statistical Analysis**: Rapid Application Development strategy is adopted to develop the mobile apps using Phone gap, HTML, CSS, JavaScript and JQuery. Usability testing using questionnaire survey method was conducted with 35 respondents to investigate user acceptance of the apps in accordance to ten heuristic principles. **Findings:** Emergency Accident Alert mobile application has been successfully developed and integrating the 10 heuristic principles to send an alert and notification of accident to the emergency call center accurately. As precise information during accident reporting to the emergency call center is very crucial in order to minimize the negative impact of an accident, the developed apps is found to be able to assist bystander and eyewitness of road accident to send an accurate alert and notification of any specific accident including some details of victim's condition to the emergency call center accurately. Prototype usability testing result shows positive users feedback on the mobile application usability. Specifically, results found that the apps are to be useful, easy to be used and conformed to the usability principles. Ensuring application adherence to usability principles resulted in wide and positive acceptance of the application by public users. **Application/Improvements:** Future enhancement for the application to include automated and intelligent redundant emergency report screening verify that the report is genuine.

Keywords: Alert, Emergency, Mobile Application, Road Accident, Usability

1. Introduction

Today, road accidents happen almost everywhere and the world is in a state where the number of road accidents had reach an alarming level. The rapid development of the road network and the escalating number of vehicles on Malaysian roads caused increasing number of road accidents involving fatal and serious injuries[1]. Association for Safety International Road Travel states that there are approximately 1.3 million people met with fatal accident in road accidents every year[2]. Average number of deaths per day reaches 3,287 people. Adding to the figure, 20-50 million people are injured or became disabled due to road accidents. Emergency response of various Emergency Response Team (ERT) are the most critical bases when accident happened[3]. Therefore, fast and efficient emergency response is demanded to minimize numbers of casualties and injuries caused by road accidents[3]. However, their responses heavily rely on an accurate information reported by public during emergency reporting. Call center is the most critical part of the Emergency Response Systems in order to gain accurate and useful information of the reported accident as to ensure prompt and effective rescue mission[4].

There are many difficulties faced by the emergency operator when it comes to the situation of handling emergency calls for instance miscommunications[5]. Stated "misalignment refers to mismatching between structural properties of different conversational contributions, so that the projected sequence of activity is in some way hampered". Misalignment of communications between call-taker and caller might end up in risking someone else's life. The dissatisfaction expressed by the callers regarding the call-takers inability to entertain their

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request at crucial moment might lead to complaints by the caller[5]. Thus, this may prolong the time taken for the ERT to save the victim. Various factors that influence human decision making in managing emergency such as time pressure, stressful situations where the operator is afraid of the failure to manage emergency and high workload of managing multiple task[6]. This may lead to wrong information being transferred at wrong time that may affect rescue process and save victims life. The highlighted problem that may cause disruption to the process of communicating accident information is the communication barriers experienced of the callers. The delay that occurs when the caller fails to communicate about the victim's condition and also the location of the accident, thus making it difficult for the operator to respond to the situation immediately. Also, in[7] stated that the current method that is being applied by the Emergency Response Team is the "scoop-and-run" method where the patient or the victim will be transported immediately to the hospital. Upon the arrival of the patient at the hospital is the only time when the decision for further treatment is made and the Emergency Response Teams are the people in-charged to fill in the personal details and medical condition of the patients[7].

Therefore, two main objectives of this project are to develop a mobile application for public people or eye-witness to be able to send accurate information to the emergency response call center and to conduct usability assessment of the developed mobile application. Usability assessment is deemed to be crucial as the apps is aim at public as the users. The importance of this research is mainly to study about how revolving technology in current era will be able to become medium for life saving. Through the development of mobile application, bystanders are able to lend a helping hand by sending fast information to the ERT for immediate response. Important critical information also is conveyed faster and clearer through texting rather than verbal communication which may be interrupted by noise and language accent.

2. Road Traffic Accident Emergency Response in Malaysia

The three main providers of emergency response in Malaysia are 1. The fire and rescue service, 2. The police services and 3. The ambulance services. Each of the earlier mention emergency providers is responsible in providing services and responses to different types of rescues. The fire and rescue service deals with potentially harmful fires, rescue operations and the road traffic collisions. The police services concern security of persons and properties covering all categories of emergencies. The ambulance service aims to reduce loss of life and damage by reducing response time. Also, other providers Civil Defense Department and volunteer organizations are there to assist the three main providers[8]. Malaysian Emergency Rescue Services (MERS 999) is the single call centre service for emergency with a single number i.e. 999. When Road Traffic Accident (RTA) occur, public should call the MERS 999 call centre or the specific emergency services provider to report it. Then, the information of the RTA will be sent to the respective emergency services provider for immediate rescue. Figure 1 shows the current process of RTA emergency handling.

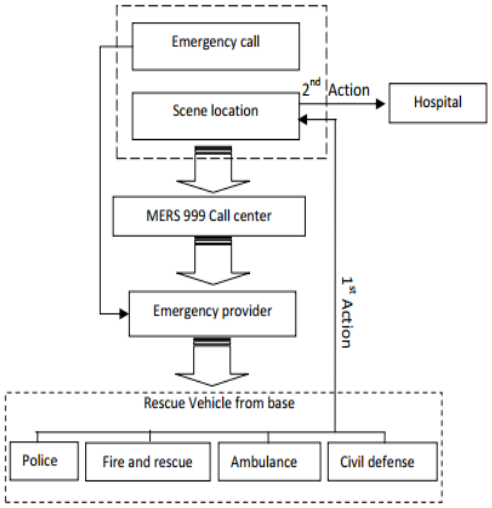

Figure 1. Flowchart of handling a road accident emergency.

3. Technology in Emergency Responders

As year progress ahead, advancement in technology has made the world a better place to live in. Technology has taken a space in every earthling that lives on this planet and has been embedded in many appliances to enhance human way of living.

3.1 Wreck Watch vs. On Star

Applications related to medical fields are in the state of growing. A suggestion of creating a mobile application

in order to lessen the time for the emergency responder to attend to the accident, traffic accident detection and notification apps using a smartphone[9]. The apps works through the functions of accelerometers and acoustic data that are able to detect when an accident occur that involves the owner and a central emergency dispatch server will be notify after that accident[9]. A mobile application called Wreck Watch is developed as being suggested.

Previously, before the idea of having a mobile application that can detect an accident, there is a system embedded in a car called OnStar Automatic Crash Response that works with similar concept as the mobile application. Whenever a crash occurs, the built-in sensors inside the owner's car will alert a system called the OnStar Advisor and the vehicle will be automatically connected to the Advisor to check the condition of the car without the owner moving a single part of his body[10,11]. In the circumstances that a crash occurs that causes the airbag of the car to be forced open, the General Motor's (GM) OnStar system will be triggered and called for assistance[12]. Comparison of the two magnificent ideas is done in Table 1 in order to see the pros and cons in a clearer view.

Table 1. Comparison between wreck watch and On Star

Characteristics	WreckWatch	OnStar
Affordability	Implemented using smartphone. Any user (with smartphone) can have it for free	Implemented in GM cars only-Not all user can afford.
Information access	Accident information sent to Emergency Response Team (ERT) and to all user having the application (enable them to reroute to avoid accident)	Automatically connect to OnStar Advisor (OnStar Operator) that checks on victims' condition and assist in sending assistance upon crash.

4. Technology in Medical World

4.1 MUA Health

The increase in awareness about the importance of health had induced to the creation of MUA Health systems where it is actually a mobile application integrated with health monitoring system to monitor the wellbeing of human physical activities, heart conditions and also the weight[13]. MUA Health is designed to work in both online and offline connection as user does not typically perform exercise near an active Internet connectivity. MUA Health has its own local and remote database to know when to submit health related information to medical server when there is Internet connectivity.

4.2 Personal Heart Monitoring and Rehabilitation System

A personal heart monitoring system using smartphones has been developed to detect heart threatening disease[14]. To aid this system, patient details had been taken by cardiologist and cardiac conditions of the patient is taken as an input into the system. The patient is needed to wear an ECG sensor everywhere to measure the patient's blood pressure and weight few times a day. When there is a chest pain attack, the smartphone will notify the patient. For false alarm situation, the patient is capable of switching the smartphone. However, under the circumstances that there is heart attack and the patient passed out, the smartphone will automatically dials emergency number and plays a recorded message stating the patients name, the emergency and the current location. After that, first aid instructions will be played to allow any bystanders to help the patient while the ambulance is on the way.

5. Methodology

Rapid Application Development (RAD) approach is used in developing the application. An early prototype development which resembles the actual product helps to portray the functions of the application. Application development phases that involves are as follows:

- Requirements Planning Phase involves gathering information and requirements through interviewing process with Head Nurse of Accident and Emergency Department of Hospital in Penang.
- User Design Phase describes the designing process of the mobile application interfaces.
- Construction Phase is the full development of the mobile application that involves fully-running code.
- Cutover Phase requires the involvement of user in using the application to test its usability for further improvement.

5.1 System Architecture

The system architecture of Emergency Accident Alert is shown in Figure 2. The system incorporates the role of user until the emergency operator. Anyone who has the application will send the details of victim and the accident to where the information will be stored in the Emergency Call Operator Database. The Emergency Call Operator will be able to retrieve the information and view it in the desktop where it will then be the operator's responsibility to send further assistance to the victim accordingly.

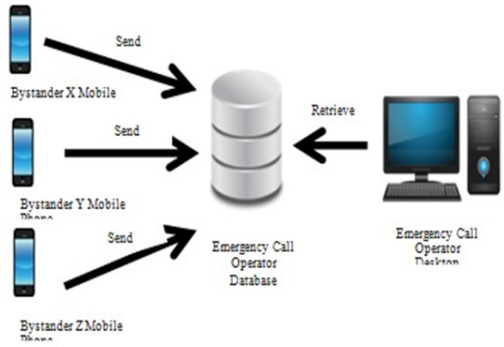

Figure 2. System architecture of emergency accident alert.

To develop the application, a scripting languages consisting of Hypertext Markup Language (HTML), Cascading Style Sheet (CSS), JavaScript and JQuery are blend together and compiled using an online compiler, Phone Gap, to produce. apk file suitable to be downloaded into smartphone. The database will be using JavaScript and the interface at the desktop is using all the four scripting languages.

6. Discussions

This results and discussions section will focus intensively on the prototype including the system flow, interfaces and results from usability testing.

6.1 System Flow

Figure 3 shows the process flow of Emergency Accident Alert. At the beginning, bystanders are bounded to enter their identification number or passport number to allow the system to store their details for security purposes. After successfully entering all the necessary details, the bystander needs to submit the information, however should they need to make any amendments to the details; they may do so through an edit button.

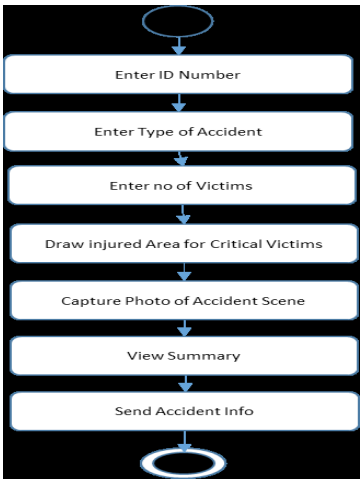

Figure 3. System flow of emergency accident alert system.

6.2 Use-Case

Figure 4 illustrates how the application works in real situation.

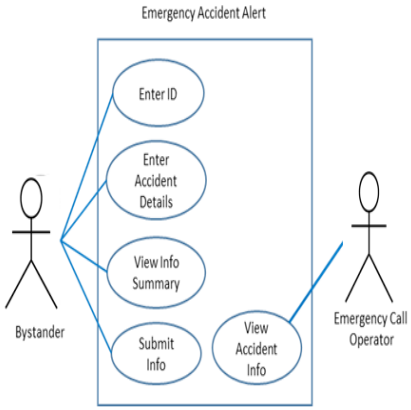

Figure 4. Use-case of emergency accident alert.

On user part, they are required to enter their identification details; be national Identity Card (IC) number for Malaysian or passport number for non-Malaysian. Reason wise, is to avoid the user to misuse the application to send false alarm to the 999 emergency operator. Successfully entering the identification details will only allow user to proceed. After that, user will be directed to the next few pages that require the details of the accident including the number of victims, areas of injury, photo of the scene etc. User will be able to view the summary of input details before submitting the report. The information submitted by the smartphone owners will be stored in the emergency call operator database where it will be retrieved by the emergency call operator at the operator's desktop (desktop view).

6.3 Interfaces

Figure 5 is the summary page of the Emergency Accident Alert mobile application handled by user and Figure 6 is the desktop view of Emergency Call Operator.

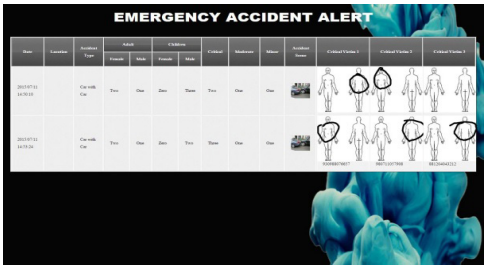

Figure 5. Summary details of accident in emergency accident alert.

Figure 6. Desktop view of emergency call.

7. Usability Assessments

According to the ISO/IEC 9241, usability is referred as: "The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use"[15]. As to ensure ease of use of the applications, 10 specific usability heuristics for touch screen-based mobile devices as outlined by[16] have been integrated in the development of application as depicted in Table 2.

Table 2. Usability heuristic

Usability Heuristic Principles
1. Visibility of System Status
2. Match between System and Real World
3. User Control and Freedom
4. Consistency and Standards
5. Error Prevention
6. Recognition rather than Recall
7. Flexibility and Efficiency of Use
8. Aesthetic and Minimalist Design
9. Help Users Recognize, Diagnose and Recover from Errors
10. Help Documentation

8. Usability Testing Results

In view to achieve the second objective, a set of 16 questions have been distributed to 35 respondents or users who involved in user acceptance testing. Preliminary usability testing have been conducted using a questionnaire survey targeting public as the respondents. Table 3 presents the demographics of respondents who are of public respondents using a simple random sampling technique. The age of the respondents was summarized as follows: 28.6% (10) of respondents were aged below 21; 42.9% (15) of respondents were between the age of 21 and 30 years old; 20% (7) respondents were between 31 to 40 year old and only 8.6% (3) respondents were over 41 years of age.

The questions asked are based on the 10 usability principles which are visibility of system status, match between system and the real world, user control and freedom, consistency and standards, error prevention, recognition rather than recall, flexibility and efficiency of use, aesthetic and minimalist design, help users recognize, diagnose and recover from errors and lastly help and documentation. For the first and second questions, user's response seems to be positive when being asked about the changes visibility and reasonable time taken for page to transit from one to another. On the third and four questions, 10% of user selected neither agree nor disagree for statement that asks user state whether the system dis-

Table 3. Usability testing results

Usability Principle		Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)	N
Principle #1:	Q1: The changes that occur in the app are visible to me	-	-	-	40%	60%	35
	Q2: The changes that occur in the app is within reasonable time	-	-	-	50%	50%	35
Principle #2:	Q1: The app displays information in logical order	-	-	10%	20%	70%	35
	Q2: The logical order eases me in understanding the app	-	-	10%	30%	60%	35
	Q3: The language used in the app is understandable	-	-	-	20%	80%	35
Principle #3:	Q1: The 'edit' buttons at the summary page eases me to return back to specific page to change the information that have been entered earlier	-	-	10%	30%	60%	35
	Q2: The app needs to have emergency exit button to allow me to terminate the app immediately when required.	-	-	10%	30%	60%	35
Principle #4:	Q1: The interfaces of the app are consistent.	-	-	-	60%	40%	35
	Q2: The app consistency eases me in using the app.	-	-	-	60%	40%	35
Principle #5:	Q: The app provides error messages or warning whenever crucial information needed are not entered.	-	-	20%	30%	50%	35
Principle #6:	The app provides sufficient visual aids.	-	-	30%	30%	40%	35

Principle #7:	Q1: The steps required to complete the form in the app is reasonable and not too long	-	-	10%	40%	50%	35
	Q2: The animation transitions between one page to another is displayed in smooth manner	-	-		40%	60%	35
Principle #8:	Q: All the information asked in the app is reasonable to me.	-	-	-	20%	80%	35
Principle #9:	Q: The error message display eases me in following the correct step.	-	-	-	40%	60%	35
Principle #10:	Q: Help button provided in the app assist me in using the app when needed.	-	10%	-	40%	50%	35

plays information in logical order and whether the logical order eases the user. Meanwhile, the remaining percentage seems to agree with the statement.

For the first and second questions, user's response seems to be positive when being asked about the changes visibility and reasonable time taken for page to transit from one to another. On the third and four questions, 10% of user selected neither agree nor disagree for statement that asks user state whether the system displays information in logical order and whether the logical order eases the user. Meanwhile, the remaining percentage seems to agree with the statement. The possibility that the 10% user selected the option might be due to the confusion during the handling of the mobile application.

The possibility that the 10% user selected the option might be due to the confusion during the handling of the mobile application. Since Emergency Accident Alert uses English as a medium, all user found that the language used is understandable. The next 2 questions prompt user's view on the importance of Edit and Exit button to user. 90% of user agrees that the Edit and Exit button will be helpful for user to return to specific pages or leave the application whenever appropriate. The remaining 10% stated neither agree nor disagree for both questions.

On the question "The app provides sufficient visual aids", the user's respond seems to be uncertain where 30% gave an average answer, neither strongly agree or strongly disagree, another 30% stated agree while 40% stated strongly agree. This indicates that the possibility of giving the average answer signifies that the user does not really mind to have more visual aid in the mobile app, while the remaining 70% are more incline towards agreeing of sufficient visual aids in the app.

For the final question in the questionnaire, "The app should have a Help button", 10% of the respondent disagree that there is a need to have a Help button. On the other hand, 90% voted for agree and strongly agree. This indicates that the respondent requires a Help button to guide them in filling the mock accident details.

Other than the stated questions, feedbacks given on the remaining questions are mostly similar to one another between the respondents in which the respondents had given a positive view on the mobile application ease of use. Improvement such as having an edit button and exit button should be made to the mobile application to ease user in entering required details of the accident swiftly.

9. Conclusions

Emergency Accident Alert involves a medical and emergency domain in which the information about it needs a lot of detailed research. Through the research, core prob-

lem identified that may obstruct and delay the life saving process are the communication barriers. In order to curb the problem, the author had come up with an idea to utilize the technology available in the current trend which is smartphone. Before any application is developed, information is required to be elicited to know the correct flow during the emergency call handled by the ERT. Through findings, a prototype of the application had successfully been built to show the available functionality of the system that will further be used by user upon completion. Also, usability testing conducted found that the application developed is easy to be used and conformed to the usability principles.

10. Acknowledgements

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