AUTOMATIC CRASH NOTIFICATION VIA SMARTPHONE

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Dedicated to my father, Lim Sow Jiun and my mother, Wong York Moi.

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ABSTRACT

Accident is very common nowadays, especially in big cities. It significantly results in the loss of lives and materials as well as contributes a high death rate as a result, globally. However, there is yet an effective solution to acknowledge the emergency departments or family members soon after the accident has taken place. Hence, Automatic Crash Notification Via Smartphone system is designed to help in reducing the number of deaths by saving lives in the shortest time after an accident has occurred. When accident is detected, signal will be sent to Android smartphone via Bluetooth technology as to trigger the smartphone to automatically send SMS with the details of the driver's as well as the precise GPS location to any predefined number such as the emergency medical services or family members for an instant help. The driver's name, GPS location, number of passenger onboard, vehicle model and registration number will be included in the emergency help SMS to ease the job of emergency medical services to spot the accident as soon as possible. With this intelligent life saving system, victims will no longer feel helpless and insecure.

ABSTRAK

Kejadian kemalangan jalan raya merupakan fenomena yang biasa pada zaman ini, terutamanya di kawasan bandar. Kemalangan jalan raya bukan sahaja mengakibatkan kerugian dari segi kewangan, tetapi juga nyawa yang berharga. Namun, hingga hari ini, tiada satu cara yang efektif di mana laporan kejadian kemalangan dapat dibuat dengan secepat mungkin. Justeru itu, Automatic Crash Notification Via Smartphone diperkemukakan dengan tujuan utamanya melaporkan kejadian kemalangan dalam masa yang tersingkat kepada pihak penyelamatan kecemasan dan juga ahli keluarga yang tersayang. Sebaik sahaja kemalangan berlaku, gegaran akan dirangsang dan mengaktifkan Android smartphone untuk menghantar SMS kepada nombor-nombor yang telah ditetapkan sebelum itu melalui teknologi Bluetooth. Maklumat seperti nama drebar, lokasi GPS, bilangan penumpang dalam kereta, jenis model kereta dan nombor plat kereta akan dimasukkan dalam SMS bagi memudahkan kerja pasukan penyelamat untuk mengesan kejadian kemalangan tersebut dengan cepat, tepat dan cekap. Dengan adanya sistem ini, kejadian kemalangan jalan raya dapat dilaporkan dengan cepat dan bantuan kecemasan dapat dihulurkan kepada mangsa-mangsa dengan pantas.

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LIST OF ABBREVIATIONS

ACN	-	Automatic Crash Notification
AMPS	-	Advanced Mobile Phone System
ANSI	-	American National Standards Institute
API	-	Android Platform Identifier
Apps	-	Application
BlueBee	-	Bluetooth module
CDMA	-	Code Division Multiple Access
COM	-	Communication
CPU	-	Central Processing Unit
GPS	-	Global Positioning System
GSM	-	Global System for Mobile Communication
GUI	-	Graphical User Interface
IC	-	Integrated Circuit
IDE	-	Integrated Development Environment
iOS	-	iPhone Operating System
KLCC	-	Kuala Lumpur Convention Centre
OS	-	Operating System
PDA	-	Personal Digital Assistant
PIC	-	Peripheral Interface Controller
SDK	-	Software Development Kits
SMS	-	Short Message Service
SPP	-	Serial Port Profile
USART	-	Universal Asynchronous Receiver Transmitter
Wi-Fi	-	Wireless Fidelity
ZigBee	-	Zonal Intercommunication Global wireless technology

APPENDIX

CHAPTER 1

INTRODUCTION

This chapter explains on introduction, objectives, problem statements, scope of work, methodology and structure of the project.

1.1 Introduction

In this cutting edge technology era, the developments of transportation system have been very vibrant. The demand for automobile has increased dramatically and has been playing an important role in our daily life. It also enhances the standard of living. But increasing number of transports on land had lead to an increase in number of accidents and most of them are lethal.

From the Transport Statistic Malaysia by Ministry of Transport Malaysia in year 2011, the number of accidents in 2010 is 414421, an increment of 26.21 % compared to year 2005 which is 328364 accidents[1]. Some of these accidents resulted in death and a portion of it is due to failure of emergency rescue team to reach the victim on time[2]. Despite a growing wireless communication network and availability of medical transport, the time to notify emergency personnel of a crash and respond the crash victims can be quite lengthy [3][4][5].

An automatic crash notification via smartphone application system is crucial to reduce the respond time[6]. Understanding the necessity, an automated crash notification via smartphone application system has been developed in this project. An automated crash notification via smartphone application system consists of impact sensor which can detect the crash and trigger the smartphone through Bluetooth technology[7][8]. The smartphone, once triggered, will send a SMS notification to preset numbers together with the GPS location (longitude and latitude) to inform the respective party about the accident. Immediate actions can be taken to help victims without any unnecessary prolong time-wasting which plays vital role in saving one's life[9].

The need for an automated crash notification via smartphone application system is very important. Thus, the understanding on the construction of the automatic crash notification via smartphone application system, its operating principles and its requirements are very important. In this project, an automatic crash notification via smartphone application system is designed[10][11].

The prototype of an automatic crash notification via smartphone application system is designed based on the studies on equipments, components and applications with a thorough understanding of its operating principles. The construction and operating principles of an automatic crash notification via smartphone application system are to be identified together with the appropriate hardware such as shock sensor, PIC controller, BlueBee module and Android smartphone application.

1.2 Objective

The objectives of this project are:

I. To develop an automatic crash notification via smartphone application system.

II. To study the functionality of shock sensor, Bluetooth technology, smartphone application, GPS and SMS functionality.

III. To enable the SMS deliverance to preset responders.

IV. To enable GPS functionality in smartphone application.

V. To develop the automatic crash notification system compatible to Android smartphone only.

1.3 Problem statements

The aim of this project is to design an automatic crash notification via smartphone application system. The Auto Channel, the Largest Independent Automotive Information Resource reviews that in the United States, 5 million people are injured and 40 000 lives are lost annually in traffic accidents. It reports that 30 percent of deaths occur within minutes of the crash. Fifty percent occur before the patient arrives at a hospital. Fully 70 percent of deaths occur within two hours of a crash [12]. Delay in providing immediate aid has been one of the main factors that leads to fatality. When severe accidents happen, the injured and unconscious victims will not able to call and seek immediate help by themselves. Worse still, if accident takes place at a deserted location, no one will even notice and provide necessary immediate actions.

"Delays in medical treatment are directly associated with higher fatality rates and worse outcomes from serious injuries in crashes," said Dr. Stewart Wang, associate

professor of Surgery and director of Research at the Trauma Center at the University of Michigan[12]. "This post-crash technology can be especially effective in two cases – rural areas, where a crash is not always quickly seen by passersby and response times are often greater than 1 hour, and urban areas during off-peak driving times." It may take a long time or even up to days in some situations for people to discover a crash which already happened hours or days ago.

Even if accident happens at a crowded venue, it does not guarantee that victims can get instant help as although many witnesses around, there is still possibility that none of them would have called for emergency aid as they misunderstand each other that others might have done it and they do not need to make the call anymore. Besides, in most cases, no precise location of the accident spots will be provided by witnesses whom call for help. Good Samaritans usually only provide a rough picture about the location of accidents such as in Kuala Lumpur Convention Centre (KLCC), without mentioning which part of KLCC. KLCC has a huge area of 1,300,000 square-foot which is equivalent to 120,000m^2. So, in that case, emergency medical services would have to go round in order to find the spot of accident. This could result the delay in providing help to the victim which reduces the chances of surviving of the victims.

1.4 Scope of project

This project covers the analysis, design and development of an automatic crash notification via smartphone application system. It consists of a system that is able to notify the responders through the SMS deliverance and GPS location with the study of the functionality of impact sensor, Bluetooth technology, GPS navigation, and SMS functionality. This project also includes the study about the method to prevent false positives if false signal if detected. However, this system is only for Android based smartphone. It does not include iOS, Window operating smartphone.

1.5 Methodology

Project will start with literature review related to the project such as the shock sensor, PIC controller 16f877a, BlueBee module, smartphone, SMS and GPS function. Project will then proceed with both software and hardware development such as PIC coding, Bluetooth connection, SMS and GPS functions in smartphone. Software and hardware will then be integrated as one system. If there is any error, testing and troubleshooting are required to obtain the desired results before the verification.

1.6 Structure of the project

Chapter 1 describes the background, current problem statements, objectives and scopes covered in order to complete this project.

Chapter 2 describes about the literature review based on the project; statistic of the accidents in Malaysia, smartphone, Short Message Service, Global Positioning System, Bluetooth, PIC controller 16f877a, BlueBee wireless module and shock sensor.

Chapter 3 consists of logical approach and organized methods to develop an automatic crash notification via smartphone application system. Then, detailed descriptions on the automatic crash notification via smartphone application system are given. Clear and concise works performed to develop the automatic crash notification via smartphone application system are outlined. Also, assumptions, justified approach and logically organized procedures conducted to achieve the objectives of this project are elaborated in order to achieve the optimum results eventually.

Chapter 4 consists of integration of the automatic crash notification via smartphone application system. Possible outcomes of the research related to the results are discussed and analyzed.

Chapter 5 summarizes the design, modeling and development of the automatic crash notification via smartphone application system. Finally, brief statements on the successful states and future research in this field are recommended.

CHAPTER 2

BACKGROUND

This chapter will discuss about the literature review and studies on statistic in Malaysia, Smartphone, Short Message Service (SMS), Global Positioning Service (GPS) and Bluetooth technology.

2.1 Statistic of Motor Vehicles Involved in Road Accidents in Malaysia.

Traffic accidents are a major cause of death and injuries worldwide, but while they are declining in many parts of the developed world, fatalities are still on the rise in many developing countries including Malaysia. From the Transport Statistic Malaysia from Ministry of Transport Malaysia, it shows the increment of 60.79% of number of accidents in Malaysia from the year 2002 (507846) till 2011 (817151), which indirectly shows that the accident rate in Malaysia in at the alarming stage[1]. Report also reveals that instant help can increase the chances of surviving and save lives[13][14].

2.2 Existing Technology/System

BMW Assist, Ford's 911 Assist, Toyota's safety Connect and OnStar develop a technology, "Calling for Help when You Can't", an advanced automatic collision notification technology (ACN), which enables the call for help when an accident is detected [15]. This great invention has the capability to inform and dispatch the EMS to victims, automatically. Generally, when accident occurs, ACN will be activated and thus automatically connect the victim to an assigned operator for verification. Operator will contact and send help even if communication between unconscious victim and operator has failed. However, the intelligent system is only available for certain models of vehicles and implemented in few places only like Houston, Texas and Boston, Massachusetts

In 2002, Ford Motor Company has implemented a public safety technology, Automatic Crash Notification (ACN) technology to assist emergency medical personnel to respond to an accident in minimum time in Houston. Tri-axial accelerometer is used as a sensor to measure the acceleration and deceleration forces and directions from frontal, rear or side, to determine the impact. Besides, it is deployed together with air bags, seat occupant sensors and safety belts to determine the status of all the passengers onboard. When accident occurs, cellular phone automatically calls to 9-1-1 Emergency Network. Even if victim may not be able to respond due to severe injury, responsible operator will still respond to accident by sending EMS personnel with the provided location data which will be automatically transmitted by installed GPS receiver in vehicle. Not only so, as it is integrated together with the seat occupant sensors and safety belts sensors, number of passengers onboard can also be determined. This is useful for EMS personnel to give the best preparation to take action based on the specific accident. ACN technology is an effective system especially in two cases; rural area where no many passersby and during off-peak hour in urban area. The ACN by Ford Motor Company requires an operator to respond to the accident for help. However, the proposed Automatic Crash Notification via Smartphone system tends to inform the EMS personnel, police department, fire and rescue department and love ones directly, soon once accident is detected.