IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 5, Issue 3, March 2016

Immediate Accident Precision over Medical Application for Android Technology

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Abstract: With the rapid development of society, there are some side-effects including the increasing number of car accidents. On average one out of every three motor vehicle accidents results in some type of injury. There are many solutions proposed to avoid the problem. Many lives are lost due to improper post-accident signaling and tracing out the exact location. Our project provides solution for the above stated problem which involves intimating the nearby hospitals and relatives by giving the accident location of vehicle using GSM and GPS technologies. Heart of our project is the android app where we can use the existing internal hardware modules like GPS, GSM etc. to get/send the required information to the concerned persons. Our system as stated above consist of two units namely Crash Detector and Android Control Unit. Crash Detector is responsible for detecting the accident condition using three-axis accelerometer sensor and one false alarm switch details of which is mentioned in system architecture. Android Control Unit send the accident notification to the victim's android phone where an android app will get the GPS location of accident spot and get nearby hospital's location around 5KM and send the notification in the form of SMS. We also send the intimation to their relatives as well hence avoiding any chance of mislead and/or no communication after the accident.

Index Terms: Global Positioning System (GPS) System, Global System for Mobile Communication (GSM), Smart Phone, Crash Detector, Android Control Unit, False Alarm.

I. INTRODUCTION

FALL accident has been the major cause of injury to the elderly in recent years. To protect the elderly from the injury of fall accident events or to give an immediate assistance to the elderly after the occurrence of a fall accident event, many researchers have been devoted to the design of a fall detection algorithm and system .Among all the currently proposed algorithms, the fall detection system can be roughly divided into two categories namely, environmental monitoring-based and wearable sensor-based systems.

Real-time traffic information is essential for supporting the development of many Early Crash Notification Service for Portable Device applications: accident detection, vehicle navigation etc. It is widely accepted that providing rapid assistance to victims of road accidents is of utmost importance, especially in severe accidents, in which the victims are not able to call for help. Thanks to advances in wireless technologies, intelligent systems are arising to help develop safety and efficiency services for road transportation. For these reasons, an intelligent emergency call system or data message (eg: sms) system utilizing sensors to automatically detect a crash, and uses a wireless network to send critical information (e.g., location of the accident, vehicle identification and number of passengers) to emergency services in a rapid manner would save lives. Our system as stated above consist of two units namely Crash Detector and Android Control Unit. Crash Detector is responsible for detecting the accident condition using three-axis accelerometer sensor and one false alarm switch details of which is mentioned in system architecture. Android Control Unit send the accident notification to the victim's android phone where an android app will get the GPS location of accident spot and get nearby hospital's location around 5KM and send the notification in the form of SMS. We also send the intimation to their relatives as well hence avoiding any chance of mislead and/or no communication after the accident.

II. SYSTEM OVERVIEW

The architecture of the proposed fall accident detection and rescue system is shown in Fig.1.

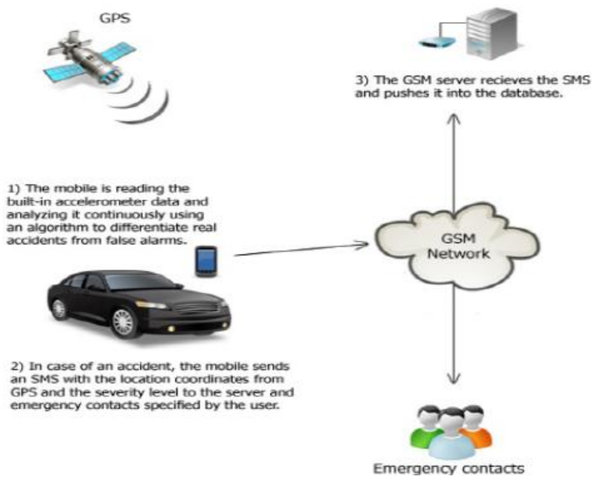

Fig.1: The architecture of the proposed fall accident detection and rescue system.

DOI 10.17148/IJARCCE.2016.5322

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ISSN (Print) 2319 5940

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The proposed system is mainly composed of three blocks: the smart phone-based pocket fall accident detector, the coordination center, and the rescue center which is composed of the hospitals nearby or the first-aid stations.

As can be seen in the part of smart phone-based pocket fall accident detector (see Fig.1), the triaxial accelerometer and the ecompass will be used to acquire the posture of motion activities for the elderly. In the proposed system, the inclusion of the ecompass is to acquire the tilt angle, i.e., pitch, of the smart phone also a false alarm is included in smart phone. This is because when the elderly is suffering a fall accident event, the smart phone in the user's pocket also tends to lie down, and the pitch angle is usually small. Actually, the work of acquiring the pitch angle of the smart phone can also be accomplished by using a gyroscope that provides the angular acceleration information of the smart phone. However, the gyroscope is only available in higher grade smart phones. On the contrary, the ecompass is available in most of the smart phones. Furthermore, the tilt angle (pitch angle) of the smart phone can be estimated by using the ecompass in conjunction with the triaxial accelerometer. We, therefore, decide to use the ecompass for the estimation of pitch angle so that the proposed algorithm can be applied for most of the smart phone systems.

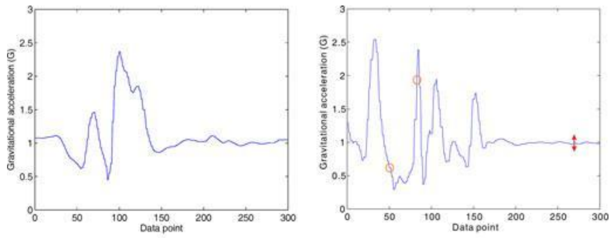

Fig.2: S [n] sequence with 300 data samples under a fall event. (a) Sequence obtained with the detector fastened on the chest. (b) Sequence obtained by placing the detector in the pocket.

Fig. 2 shows a scenario of placing the smart phone-based fall accident detector in the pocket of the elderly A loud sound as a warning signal will be sent out once a fall accident event is detected, and then the longitude and latitude, i.e., the current position, of the elderly will be transmitted to the coordination center via the 3G network. The coordination center is composed of an emergency signal handling program module, which is used to receive the current position and important personal information of the elderly. The received longitude and latitude can then be integrated and displayed with an electronic map, e.g., Google map.

III. REVIEW OF RELATED WORKS

More complex emergency call systems have been proposed in the literature. In **US Patent 7133661, ―Emergency information notifying system, and apparatus, method and moving object utilizing the emergency information notifying system‖, 2006.**, the authors describe a system that gathers vehicle data and sends it to a centralized database in case of an accident. Upon a trigger signal – the accident is detected though one or several sensors located in the vehicle. Similarly, **European Committee for Standardization TC 278 WG, ―Road transport and traffic telematics ESafety -ECall minimum set of data‖, 2008**,describes a system that notifies the status of a moving object – in terms of images of the object and its surroundings, data of collisions and temperature of the object, and its positioning to third parties over a radio link. This status is notified to insurance and roadside assistance companies whenever a collision is detected**. Pothole Patrol, Thomas, Metal. (2011). Global Navigation Space Systems: reliance and vulnerabilities. The Royal Academy of Engineering. London, UK.** Is another system that monitors road conditions using GPS and an external accelerometer for detection. **C. Thompson, J. White, B. Dougherty, A. Albright, and D. C. Schmidt, ―Using smartphones to detect car accidents and provide situational awareness to emergency responders**. Developed a prototype of an on-board unit that allows the driver to communicate with his vehicle, as well as with other available devices (PDAs, cellular, sensor networks, and so on) and with the road infrastructure in order to consume intelligent transport services.

IV. PROPOSED SYSTEM ARCHITECTURE

This section logically illustrates the mechanism of the proposed system structure together with each module that constructs the overall system architecture. The proposed system, called car accident detection and notification system consists of two phases; the detection phase, is used to identify the occurrence of an accident, and notification phase, is used to inform an emergency center for fast response and recovery.

A. Detection Phase

This phase constitutes the main objective of this work which is responsible for discovering the existence of car accident. The detection phase relies on the information extracted from smartphone accelerometer sensor, GPS receiver and built-in microphone to determine the occurrence of car accident. The following steps illustrate the operation of different interoperated components.

Smartphone Accelerometer sensor: The detection phase continuously extracts accelerometer sensor information to record the G-force (acceleration force) experienced by the occupant.

Smartphone GPS receiver: The detection phase continuously extracts GPS data for the purpose of determining vehicle speed. Vehicle speed is used to increase the probability of detecting an accident based on accelerometer sensor information.

Detection Phase Specification: The most important factor that is used, by car accident detection systems, to detect car accident is the G-Force value, of above 4G [4], experienced by smartphone accelerometer sensor. Also, [9] mentioned that, several studies have been performed rear-ended impacts with volunteers; the data used in these

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studies mean a unique opportunity to analyze how acceleration influences the risk of injury. The results are shown that most occupants suffer from neurological signs, had a mean acceleration above 4G. The proposed detection phase, running inside the smartphone, continuously sampling and reading the smartphone accelerometer sensor to detect the collision. In the case of an accident, the smartphone experiences the same acceleration force experienced by the occupants of the vehicle, because smartphones are frequently carried in a pocket attached to the occupants.

B. Notification Phase

Car accident detection phase without notification phase is like doing nothing. Logically the most important task of the detection phase is the accuracy of the detection process, while the most important task of the notification phase is the speed and the type of information that are supplied to the emergency responders to respond for an accident. Fig.6 shows the architecture of the proposed notification phase.

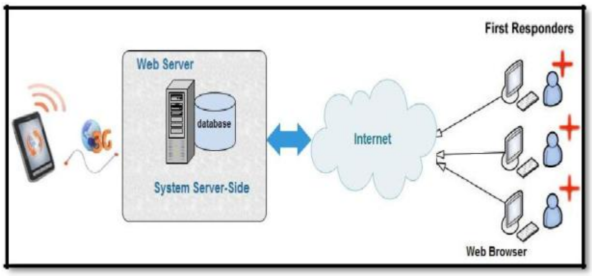


Fig 3 Notification Phase Components

Actually there are two types of notification that can be sent by the smartphone:

Driver and /or Passenger Notification

When detection phase confirms that an accident has taken place then a smartphone GPS receiver is required to find the geographical location of the accident and then utilizes the built-in 3G data connection to send accident information such as: G-force (acceleration force) experienced by the occupants during an accident, speed of the vehicle, the GPS location, time of the accident, and a false alarm (showing what happened immediately after the accident is detected) are sent to emergency responders for fast recovery as shown in Fig. 4.

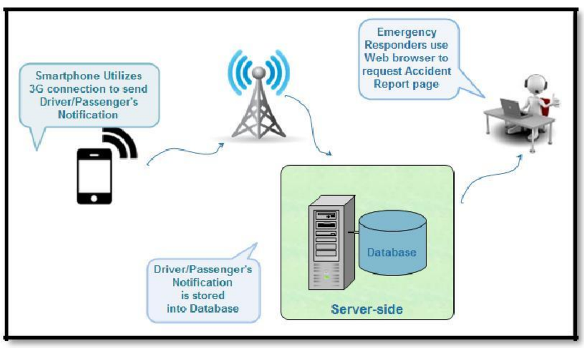


Fig 4Notification to the Emergency Responders

SMS Notification

To strengthen the notification phase, it is found a good idea to notify the contacts of the driver/passenger, such as family member, about the accident through sending SMS message that comprises the location where the accident is happened**.**

V. IMPLEMENTATION

As previously mentioned the system consists of detection phase and notification phase. The detection phase is fully implemented as an application running on smartphone while notification phases Is Smartphone Side Implementation and the system server side respectively.

• Smartphone Side Implementation

The all about smartphone side is developing Android application, using Eclipse IDE, which runs on the smartphone. The highest version of Android system with which the application has been tested is Kit Kat with API level is 19. UI screen that represents the home screen for the proposed application is shown in Fig.5.

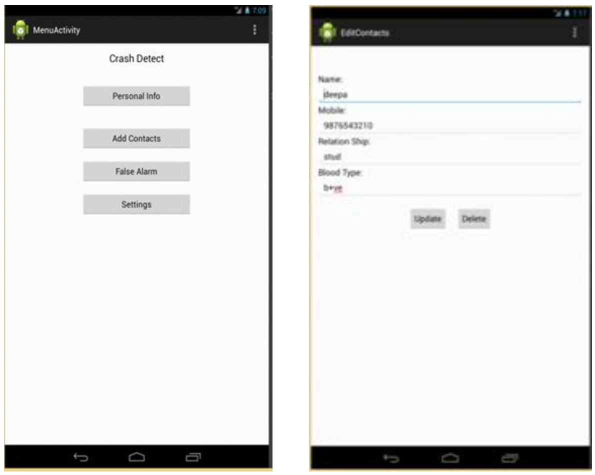
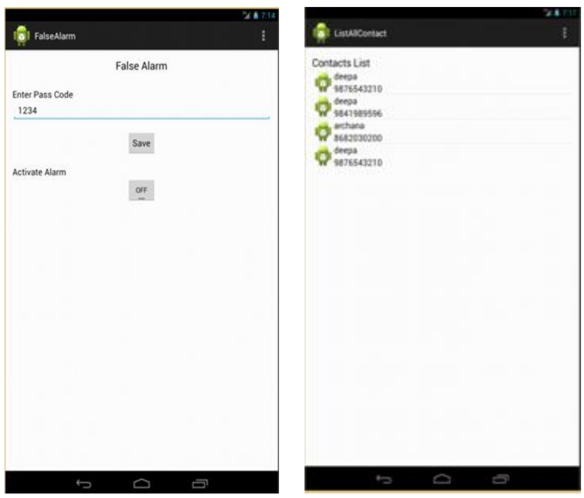


Fig 5, 6 UI Screen for car accident detection Application



The application consists of the following Activities which are listed as follows:

• Add personal information about user.

IJARCCE
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- Add contacts.
- Activate False alarm.
- Settings for editing and updating contacts.

- **System Server Side Implementation**

According to the proposed notification phase, the system allows to send two types of notifications to report the accident, which are Driver, and/or Passenger notification and Bystander's notification. These notifications are sent, via utilizing smartphone built-in 3G connection, to the notifications that are resided into the database. Therefore, according to notification phase architecture, the emergency responders should contact the web server, through the internet, for display the accident notifications, as shown in Fig.8 responders use web browser to retrieve and requesting the notification web page. The emergency system server-side and finally resided into the database. Thus, to find out about an accident, the authorized emergency responders in the emergency center needs to access to the whole accident notifications that are resided into the database.

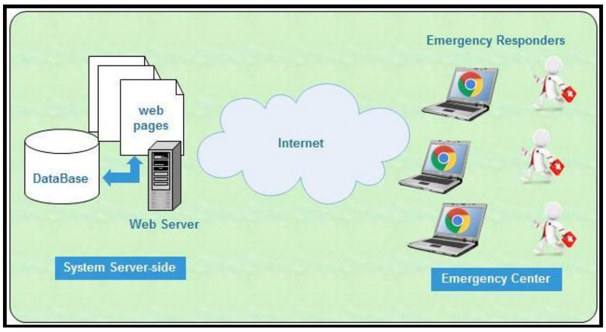


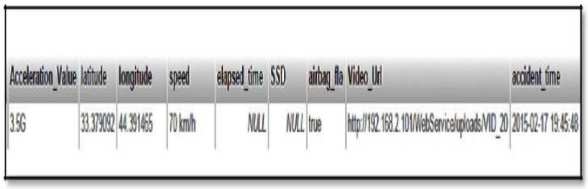
Fig 7 Communication between System Server-Side and Emergency Responders

The all useful, new web technologies, are used to develop the system server side, are listed as follows:

1. Apache is chosen as a web server.
2. MYSQL is chosen to be the main database.
3. HTML5, PHP, JavaScript and CSS to develop the web pages.
4. Google Map JavaScript API v3 is used to bring the power and convenience of Google Maps to the Web Pages.
5. Server Sent Event API[10], which is new web technology that is used to push fresh data from server to client (web browser) instantly, without needing to wait for them to request that data.

VI. PRACTICAL TEST

This practical test is performed while the smartphone inside the vehicle, which is running at speed of approximately (70 km/h), to test the CADANS in high speed condition. Besides that, to achieve all conditions that trigger the first scenario of detection phase mechanism the smartphone is forcefully dropped into the vehicle and the radio is played with all windows are closed to accomplish the high decibel level of sound event. After the Accident is confirmed, the CADANS immediately began recoding the video, for 10 seconds, and uploaded to the web server. Then the CADANS began executing two operations asynchronously which are: sending driver/passenger's notification to the web server via built-in 3G connection, and sending SMS notification to emergency contacts. The database at the server is examined and it is found filled with a new record related to this practical test as shown in Fig. 9.



Acceleration_Value	latitude	longitude	speed	elapsed_time	SSD	airbag_fla	Video_Url	accident_time
3.5G	33.379092	44.391465	70 km/h	NULL	NULL	true	http://192.168.2.101/WebService/uploads/VID_20	2015-02-17 19:45:48

Fig 9 database record shows the accident information that was inserted during first practical test.

Also, the smartphone of emergency contact (whose number is chosen before the test is performed) received a new SMS message as shown Fig. 22.

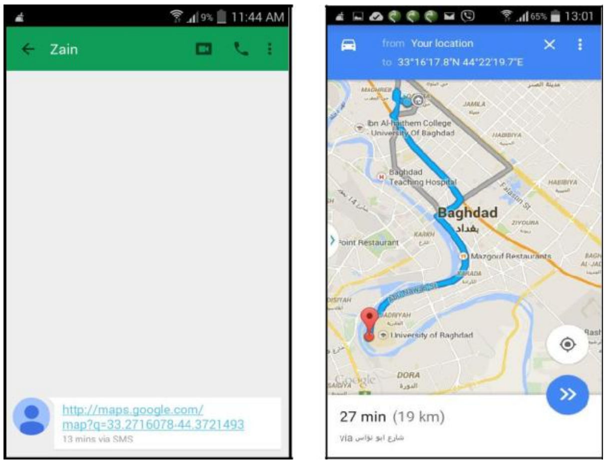


Fig 8 (a): UI Screen for Message Application (b): Map shows the Red Marker on the Accident Location

VII. CONCLUSION AND FUTURE WORK

It has been realized that the smartphone based car accident detection system is not an easy task to handle. It is really surrounded with many obstacles that prevent the researchers from achieving 100% accurate detection system. One of the main obstacles; is determining that the occupant is inside or outside the vehicle while the vehicle is travelling at a low speed. The proposed system minimizes the impact of this obstacle which is proved in the practical results conducted in this work. As a future work, a further analysis can be tried to improve the accuracy of detection phase and reduces the probability of false positive signs that are generated from being the user is inside or outside the car when the vehicle is travelling at a low speed. Therefore, it is suggested that the researchers investigate in the field of "Activity Recognition" based on smartphone sensors, which is used to detect the current activity of the user whether he is driving, walking, running. Also, a voice recognition module can be constructed and added to the proposed system to differentiate between airbag deployment and benign noise. Achieving this enhancement would increase the proposed system reliability and decrease false positive signs

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