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AN IOT BASED APPROACH TO VEHICLE ACCIDENT DETECTION, REPORTING AND NAVIGATION

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ABSTRACT :

Every day around the world, a large percentage of people die from traffic accident injuries. An effective approach for reducing traffic fatalities is: first building automatic traffic accident detection system, second, reducing the time between when an accident occurs and when first emergency responders are dispatched to the scene of the accident. Recent approaches are using built-in vehicle automatic accident detection and notification system. While these approaches work fine, they are expensive, maintenance complex task, and are not available in all cars. On the other hand, the ability to detect traffic accidents using smartphones has only recently become possible because of the advances in the processing power and sensors deployed on smartphones. Most of the smartphone based accident detection systems rely on the high speed of the vehicle (extracted from the smartphone GPS receiver) and the G-Force value (extracted from smartphone accelerometer sensor) to detect an accident. As many references assure that 90% of road-traffic accidents occur at low speed of the vehicle. Hence, in addition to the high speed accident detection, this paper concentrated on low speed car accident detection. The main obstacle that encounters the low speed accident is how to differentiate whether the user is inside the vehicle or outside the vehicle, walking or slowly running. The effect of this obstacle is minimized, in this work, by a proposed mechanism that distinguishes between the speed variation of low speed vehicle and walking or slowly running person. The proposed system consists of two phases; the detection phase which is used to detect car accident in low and high speeds. The notification phase, and immediately after an accident is indicated, is used to send detailed information such as images, video, accident location, etc. to the emergency responder for fast recovery. The system was practically tested in real simulated environment and achieved quite very good performance results.

Keywords: Smartphones, Car Accident Detection, Accelerometer Sensor, GPS, Microphone

INTRODUCTION

We Traffic accidents are a major public issue worldwide. The huge number of injuries and death as a result of road traffic accident uncovers the story of global crisis of road safety. Road collisions are the second leading cause of death for people between the ages of 5 and 29 and third leading cause for people between 30 and 44. According to statistical projection of traffic fatalities, the two-year comparison of total driver participation in mortal crashes presented a three percent increase from 43,840 in 2011 to 45,337 in 2012.Additionally 184,000 young drivers (15 to 20 years old) were injured in vehicle crashes, in 2012, an increase of two percent from 180,000 in 2011 [1]. The most obvious reason for a person's death during accidents is unavailability of the first aid provision, which is due to the delay in the information of the accident being reached to the ambulance or to the hospital.

Thus, in the case of incidents involving vehicular accidents, response time is crucial for the timely delivery of emergency medical services to accident victims and is expected to have an impact on fatalities. Moreover, each minute is passed while an injured crash victims do not receive emergency medical care can make a large difference in their survival rate, for example, analysis shows that decreasing accident response time by 1 minute correlates to a six percent difference in the number of lives saved [2].

Figure 1. Smartphone Based Accident Detection

Thus, the reduction in response time would occur with widespread implementation of enhanced traffic technologies that are used to reduce the response time and thus reducing traffic fatalities. The early experiences with these technologies are concerned with development Advance traffic management system (ATMS) and development automatic car accident detection and notification system built-in vehicles in United States (U.S). The ATMS is based on traffic sensors that are used to monitor the traffic and detect the accidents. These traffic sensors are installed in main highway; some of them are installed under the surface of the road such as loop detectors [3].

However, in this system, finding the traffic sensors in every roads process is impossible, since the traffic sensors are installed in main highways only, besides, the installation cost of these sensors are high. Apart from that, these traffic sensors are affected by the environment. For example some of traffic sensors are not perform well in the snow environment. Other systems, the automatic accident detection and notification systems are equipped with the most recent manufactures vehicles, such as BMW and General Motor (GM), which depend on the vehicle on-board sensors to detect the accident and utilize the built-in radio cellular to notify the emergency responders [4].

However, the fast evolution of the technology requires the upgrading the software or even some hardware features of the vehicles in order to install the automatic accident detection and notification system, while the installation cost of these system inside the vehicles are expensive. Also, these systems are not considered as a standard option for all vehicles in U.S and other countries, these systems are just equipped with specific type of the vehicles in U.S such as BMW and GM. These facts are the ones that motivated there searchers to proof the advantages of using the smartphone in development car accident detection and notification systems.

The benefits of the smartphone that can be exploited to develop these systems are: Clearly known that the user renews the smartphone much more frequently compared with the vehicle and the smartphones are more frequently updated in software and even in hardware. Likewise, institution of smartphones gave birth to a lot of innovative technology and exchanging information globally has become more prominent. Smartphones gave a new dimension to the usage of mobile phones for the users. Regardless, the use of a smartphone gives the possibility of having additional sensors, advance power processor and communication interfaces, which permits to develop traffic accident detection and notification system that predicts when an accident has occurred based on sensor inputs to the smartphone without need to interaction with a car or changing anything in the car.

On the other hand, the low cost of the smartphones compared to the existing traffic technologies. Moreover, smartphones travel with their owners, providing accident detection regardless of whether or not the vehicle is equipped with an accident detection and notification system, and whether there is a traffic sensor installed on the road or not.

I. PROBLEM STATEMENT

We proposed a system which consist two phases; the detection phase which is used to detect car accident in low and high speeds. The notification phase used to immediately after an accident is indicated, is used to send detailed information such as accident location to the emergency responder for fast recovery.

II. RELATED WORK

The early experiments with smartphone based accident detection systems are discussed as follows: - In [5], the authors develop car accident detection and notification system that combines smartphones with vehicles through a second generation of On-Board- Unit (OBD-II) interface to achieve smart vehicle modeling, offering the user new emergency services. The authors have developed an Android application that in case of accident detection sends an SMS to a pre-specified address with relevant data about the accident and an emergency call is automatically made to the emergency services. The only requirement to achieve the goal of this system is that the vehicle supports the OBD-II standard. The OBD- II standard is mandatory since 2001 in U.S and there is also a European version of this standard, thus this solution is applicable to all vehicles in U.S and European countries and is not available in all vehicles in other countries. Besides that, the maintenance or upgrading process of this system is expensive operation.

In [4], the authors have developed a smartphone based accident detection and notification system. In this system, a prototype smartphone based client/server application was developed and called Wreck Watch that implements a mechanism to provide accident detection and notification by using the embedded smartphone sensors and communication interfaces. The main issue related with Wreck Watch system is the deactivation of the system when the speed is below speed threshold since the detection process of Wreck Watch begins to recording the accelerometer information and looking for potential accidents only if the speed of the vehicle (as well as the smartphone) is greater than speed threshold and thus, this filtering will shut off the detection process in case of low speed condition and cannot detect the accident in low speed. But it is important to mention that the vehicle is also subject to an accident in case it is continuously travelling at low speed as mention in [6]. - In [7], the E-call system explores the possibility of implementing an automatic crash detection and notification service for portable devices (smartphone).

This system uses the cellular network to communicate between the portable device and the Server Center. The main issue with this system is the E-call system uses smartphone built-in accelerometer sensor as a crash sensor, and in this case the E-call system subjects to high rates of false positives emerging while the user is outside the vehicle. - In [8], the authors have developed an android application that is used to sense the accident using only the accelerometer sensors in the Android Smartphone. After sensing the accident, application automatically generates the geographical information by GPS and sends location information via pre-recorder voice message to 108 ambulance emergency response service that is running in India.

The key assumption of this application is that the mobile phone should not be kept along with the person who is driving the vehicle; it must be docked inside the vehicle and the validation of the accelerometer sensor is performed by tilting the mobile left or right or free fall motion. The main issue with system is the smartphone may tilt or fall in any time inside the vehicle accidentally without having a real accident and thus, the probability of false positive will be increased and false alarm will be reported.

A. Existing System:

An enhanced accident detection and victim status indication system:

This system is used to identify the accident occurrence and to detect the victim's status. The microcontroller based system hardware has been developed to acquire the various parameters such as accident location, heart rate and beat and body temperature at accident occurrence spot and the same data have been transmitted to the Lab VIEW software to analyze and indicate the physiological status of the victims. The same data and analysis report will be transmitted to the mobile phones which are in emergency care center and phone numbers for which the users would like to send the intimation.

B. Drawbacks of Existing System:

The system should be improved in such a way that all the modules are incorporated within the vehicles Integration with in an automobile is demand in this Accident detection system The conditions of false positive are maximized here.

III. PROPOSED WORK

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 is used to identify the occurrence of an accident, and notification phase.

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.

When vehicle accident is happen at that moment immediately report is send to server in that information like exact location of accident, people information who are suffered from accident. Then server sends these information to emergency responders like police station, ambulance ,hospitals and relatives etc.,

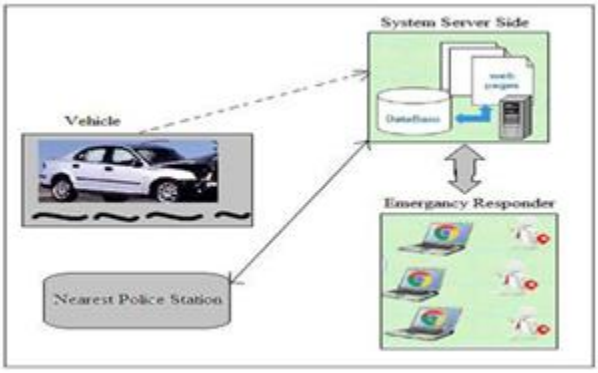

Figure 2. System Design

A. Detection Phase:

The main components used in the 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.

- **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.

- **Smartphone microphone:** The microphone is used to detect high-decibel acoustic events such as sound of an airbag deploying. The microphone is used to increase the probability of detecting an accident based on accelerometer sensor information together with GPS data.

VI. FUTURE SCOPE

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

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.

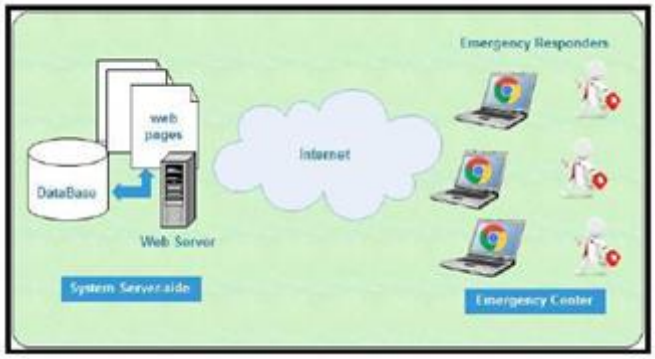

Fig.4. Notification Phase

IV. APPLICATIONS

i) Stolen Vehicle Recovery
ii) Fleet Management
iii) Asset Tracking
iv) Transit Tracking

V. CONCLUSION

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. Every smartphone based accident detection and notification system is exposed to false positives. In the proposed system, helpful supporting features were added to the system to increase the accuracy of detection process.

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