Accident Detection and Emergency Alerting System for Road Safety

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ABSTRACT

On road accidents is a key issue for road safety and is a major source of loss of lives both of the drivers and commuters. Even with all modern developments in the field of vehicle design, road lane design and management, accidents are still more common. Timely accident detection and the concurrent action in providing emergency health care to the victims are necessary to ensure road safety. This may be ensured by informing an emergency healthcare and administration units like hospitals and police stations about the accident on priority. Road traffic accidents contribute to large number of deaths world-wide every year. In these cases it is necessary to inform the family members in time and seek healthcare assistance at the earliest. Unfortunately, in many cases either the family members are communicated very late or the emergency services reach the spot at a delayed time. The delay in attending the accident victims, informing the concerned authorities and family and in mobilization of ambulance services for relocating the victims for immediate healthcare lead to casualty and many a times to fatal injuries. This paper proposes real-time accident detection and alerting system that uses smartphones. Every smartphone has number of sensors embedded in its design. Our system makes use of few of these commonly available sensors across all smartphones to build a web application for remote monitoring. The system will provide faster response time in locating and mobilizing the emergency services for the victims. When the system detects an accident it alerts the nearest emergency station like police administration, healthcare service and ambulance operators of the same. It also provides real time tracking for these emergency service providers.

KEY WORDS: ROAD SAFETY, ACCIDENT DETECTION, EMERGENCY ALERTING SYSTEM, HEALTHCARE, G-FORCE.

INTRODUCTION

Now-a-days, due to increased traffic and human recklessness, there has been a huge rise in road accidents. Many-a-times, these accidents either remain unnoticed or are addressed late as they occur in isolated locations. The local public and health administration that include nearby police station, hospitals and ambulance service

NGOs, are not informed in time and it results in delayed assistance to the victim. This demand for immediate and timely identification and localization of such events and providing necessary assistance in saving lives of victims.

In the existing systems the external hardware intervention has been the major source of difficulties. These systems are costly and are high on maintenance that is attributed to the hardware centric solution. Accident detection and emergency alerting system is an application that can be remotely accessed for alerting the public and official authorities such as police, healthcare services and paramedical services such as ambulance when an accident occurs.

The proposed system focuses on reducing the time of accident detection and increasing the chances of

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emergency services assistance for the victim. On detecting an accident the system will alert the nearest emergency service provider and public administration about the location of the accident seeking immediate help. The servicing party on receiving exact details of accident may track the accident spot using Google map through this system and provide timely assistance to the accident victim.

According to the World Health Organization, 1.35 million deaths were estimated per year (approximately 4 casualties every minute). The major reason is not the criticality of an accident; rather it is the delay in emergency assistance.

The proposed system aims

- To identify the accident and its severity and to make the nearby authorities aware of the case.
- To alert the public authorities nearest to the site of accident so that the accident gets noticed as soon as possible.
- To detect the accident accurately and send alerts.
- To record driving habits of vehicle owner and driver and to assess the driver while the vehicle is on the road.

MATERIAL AND METHODS

Smartphones are being used extensively in applications that identify road traffic accidents. A variety of algorithms and techniques use accelerometer and GPS to detect vehicle accidents. Zaldivar, et, al., has demonstrated a system incorporating smartphone as prime device coupled with ODB-II connections in the vehicles. Their system sends SMS containing particulars of accident to emergency contacts specified by the user when an accident has been detected [Jorge Zaldivar, 2011]. Simultaneously, a call to the emergency services is made automatically. ODB-II connections is common among all most every modern vehicle that can transfer vehicle parameters such as acceleration, oil pressure, speed, etc., in real-time.

Alwan and Ali have proposed an accident detection and notification system for cars that uses smartphones. Their systems consider the high speed of the moving vehicle as the most important parameter in confirming the possibility of an accident. This is due to the fact that major accidents are caused due to over speeding. The have used GPS in smartphone to track the speed of vehicle and the G-force value obtained through accelerometer of the smartphone. This system has been reported to provide encouraging results [Zainab S. Alwan, 2015].

White, Thompson and others have demonstrated a system using smartphones for automatic detection and notification of traffic accidents in US [Jules White, 2011]. Their system uses accelerometer and acoustic data collected from smartphones to alert the emergency services by sending accident data records via VOIP communication channels. They have dealt with combining sensors and context data, communication

channels and web services to effectively detect a traffic accident and spreading awareness of the situation to emergency respondents.

The application for detection of accidents and alerting to concern parties incorporates following tasks and services:

1. **Localization:** Accident alerts are sent to the nearest control station such as police station on the very first moment of collision. This results in reduction of late emergency services. Use of GPS helps in giving the precise location results so that the rescue team can be reached to the site of accident easily.
2. **Rescue notifications:** Alerting system notifies the contacts and also the nearest population to the victim so that supervision or aid can be received immediately.
3. **Consideration of multiple factors:** To achieve accuracy for accident detection and to reduce the false positive scenarios, the system takes various environmental cases and parameters as input. These environmental factors are calculated with the help of android device based sensors.

The Proposed System: The system accounts for improvisation of the accident alerting and benefits the user in many different ways. Different functionalities of the systems are depicted in Fig. 1. The activity diagram detailing the sequencing of actions is shown in Fig. 2.

Figure 1: Accident Detection & Alerting System Use Case

Moreover, the current system improvises on the existing systems on following parameters:

- **Hardware independent:** The current system is based on mobile based sensors and requires less or no dependency on external hardware, thus free from wear and tear.
- **Cost effective:** The existing systems are costly and require quite maintenance as they are hardware based. Due to no such dependency in this system, accessibility to the application is quite cheap and easier.
- **Localized real time notifications:** Accident alerts are given to the nearest control station such as police station on the very first moment of collision. This results in reduction of late emergency services.

Cellular network usage is the key to notification and thus, is faster unlike system.

- Multiple factor consideration: The system takes various environmental cases and parameters as input. These environmental factors are calculated with the help of android device based sensors instead of IoT based sensors. These parameters altogether make the detection and alerting mechanism effective which results in lesser false positives.

Figure 2: Activity diagram for Accident Detection & Alerting System

RESULTS AND DISCUSSION

In the road traffic accident when an impact is severe, the system based on collected parameters from the smartphone sensors detects the accident. At the accident victim's end, the victim is usually not in a position to contact the public administrative service or healthcare service due to lack of information. From the victim's perspective the system on detecting the accident sends emergency alert to nearest emergency service provider and the family members listed in the emergency contacts.

Table 1. G-Force finding

Height (in centimeters)	G-Force value		
	Maximum	Minimum	Average
10	2.4846214	1.1262852	1.8054533
15	2.5383567	1.2018174	1.8850871
30	2.9815913	1.7661392	2.3738652
40	3.3154914	2.0415938	2.6285426

At the service provider end, the details about the time of accident, the location parameters (using GPS) such as longitudes and latitudes of the accident spot are received

when the system detect an accident. This real time alert to service provider helps them to mobilize the resources including ambulance services in time. They may track the mobilization of assistance to the accident spot in real-time. Tests were conducted where the smartphone was subjected to undergo abrupt situation like hard shake, or motion to notice the G-force value changes. Few tests involved dropping of smartphone from height of 10, 15, 30 and 40 centimetres to record the variation in g-force values. The results are shown in Table-1.

The maximum G-force value was recorded when the smartphone was dropped from a height of 40 centimetres. The proposed system generates an alert if the G-force value exceeds 4g. It was observed in fatal accident the vehicle subjected to it had recorded the G-force value in excess of 4g. Therefore, 4g was considered as threshold value in generating emergency alerts. This value serves to detect occurrence of an accident. It may be used to differentiate the false positives that may be reported when the smartphone is dropped from a certain height and/or the vehicle stops when the brakes are applied suddenly. The system snapshots depicting the activities on the user end on smartphone are shown in Fig. 3.

Figure 3: Working of the system

CONCLUSION

The proposed system aims to reduce the fatality in road traffic accidents. It incorporates the use of smartphone sensors such as accelerometer to decide whether or not the emergent situation is an accident. If the system detects the situation as accident, it alerts the nearby service provider that includes public administration such as police station and healthcare services like hospitals and ambulance services. This system bridges the requirements of the accident victims in localizing and alerting the public authority and for servicing agencies to track the emergent situation by mobilizing assistance. The system serves to better the survival rate of the victims in road traffic accidents. The proposed improvements to this system include – employing an acceleration filter that ignores G-force values below 4g, and maintaining a count-down time alert which will allow the victim to

cancel the alert within 15 seconds when a false alert is generated in exceptional cases. The system may provide better and more accurate assistance for road safety if additional sensors like gyroscope, microphone, camera and a voice recognition module can be integrated into it.

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