Intelligent System for Accident Detection

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Abstract— **A significant number of fatalities resulting from road accidents occur every day throughout the world. The two effective ways to lower fatalities due to road accident are building intelligent systems to identify accidents and secondly the deployment of first responders on the scene. In recent times we have seen the deployment of such systems in cars. Although being efficient these methods turn out to be costly, require constant servicing and do not serve people other than the one driving the car. On the other hand, the development in smartphones has made them an easy and handy tools to detect accident using sensors already present in them. The majority of accident detection solutions for smartphones rely on the high speed of the vehicle (extracted from the smartphone's GPS receiver) and the G-Force value recorded via the accelerometer and the gyroscope sensor. According to numerous sources, 90% of car accidents on the road take place while the speed is low. Therefore, this work focused on low speed car accident detection in addition to high speed accident detection. It can be difficult to tell if a user is inside or outside of a vehicle, walking or slowly jogging, which is the main challenge in low-speed accidents. In this work, a proposed method that distinguishes between the speed fluctuation of a low speed vehicle and a walking or slowly moving person is used to reduce the impact of this obstacle.**

Impact Statement **— The proposed system consists of two phases; the detection phase which is used to detect car accident in low and high speeds. Second one being the notification phase which immediately after an accident sends a detailed notification containing location information to the close relative/friend of the person.**

Index Terms— **AI; intelligent transportation systems (ITS); cognitive science; deep learning; IoT; ResNet; InceptionResnetV2; accident detection; sensors**

I. INTRODUCTION

As the demand for vehicles increases so will the accidents increase along with it. Life of the people is at high risk. This being due to lack of emergency facilities present in our country. Lack of first aid resources, which results from a delay in the report of the accident being sent to the hospital or an ambulance, is the most obvious cause of a person dying in an accident. Response time is therefore essential for the prompt provision of emergency medical treatment to accident victims in cases involving vehicular accidents and is anticipated 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, an analysis stated that for every 1 minute saved in a road accident 6% of lives are saved of people involved in a road accident. Therefore, the decrease in response time would happen as better traffic technology are widely employed to decrease response times, which in turn reduces traffic fatalities. The creation of the Advanced Traffic Management System

(ATMS) and the automatic car accident detection and warning system incorporated into vehicles in the United States represent the earliest experiences with these technologies (U.S). The ATMS is built around traffic sensors, which track traffic and look for accidents. Some of these traffic sensors, like loop detectors, are installed underneath the surface of the road on the major roadway. 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 they are expensive, these traffic sensors are affected by the environment. For example some of traffic sensors are not perform well in the cold environment. The most modern vehicles from manufacturers like BMW and General Motor (GM) have automatic accident detection and notification systems installed. These systems rely on the vehicle's on-board sensors to identify accidents and use the vehicle's integrated radio cellular to alert the emergency services. The installation of an automatic accident detection and warning system within a vehicle, however, necessitates replacing some hardware or software features due to the rapid advancement of technology, and the cost of doing so is high. In addition, not all automobiles come equipped with these technologies. 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 inspired the researchers to demonstrate the benefits of utilising smartphones in the creation of car accident detection and notification systems. The advantages of the smartphone that can be used to create these systems are as follows:

• 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 opened a new dimension to the usage of mobile phones for every user.

• However, using a smartphone offers the chance to have more sensors, a powerful processor, and communication interfaces, allowing the development of traffic accident detection and notification systems.. It operates without requiring interaction with a car or making any changes to the car and anticipates when an accident has occurred using sensor inputs to the smartphone.

• 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.

II. LITERATURE REVIEW

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 created an Android application that, upon accident detection, sends an SMS to a pre-specified address containing pertinent accident and emergency information, a call is automatically made to the emergency services. The car must comply with the OBD-II standard in order for this system to function. 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 unavailable 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 based on a smartphone client/server application was developed called WreckWatch. that uses the communication interfaces and embedded sensors in smartphones to construct an accident detection and notification method. As a result, this filtering will turn off the detection process in case of low speed conditions and cannot detect the accident in low speed, as the WreckWatch detection process only starts recording the accelerometer information and looking for potential accidents if the speed of the vehicle (as well as the smartphone) is greater than speed threshold. Nevertheless it's crucial to note that the vehicle is also susceptible to collisions if it consistently travels at low speeds, as mentioned in [6].

- In [7], The E-call system examines the deployment of a service that is able to detect and notify portable device crashes (smartphone). The portable device and the server centre are connected via the cellular network in this arrangement. The E-call system's primary flaw is that it uses the smartphone's built-in accelerometer sensor as a crash sensor. In this situation, this causes a high rate of false positives to appear while the user is outside the car.

- In [8], The authors have created an Android application that uses the smartphone's accelerometer sensors on its own to detect accidents. When an accident is detected, a programme generates geographic data using GPS and delivers location information via pre-recorded voice message to India's 108 ambulance emergency response service. The main premise of this programme is that the mobile phone shouldn't be carried by the driver of the car; instead, it should be docked within the car, and the accelerometer sensor's validity is checked by tilting the phone left or right or by letting it fall freely. The system's primary flaw is that the smartphone could accidently tilt or fall inside the car at any time.

III. METHODOLOGY

This section logically demonstrates the suggested system structure's mechanism as well as each module's role in creating the overall system architecture. The suggested system, known as the car accident detection and notification system (CADANS), has two phases: the detection phase, which is covered in section III-A after that, is used to find an accident, and the notification phase, which is covered in section III-B after that, is used to notify an emergency center for prompt action and recovery.
Figure shows the main components used in the detection phase. The primary goal of this activity, which is to identify any car accidents, is represented by this phase. In order to detect the occurrence of a car accident, the detection phase uses data gathered from the smartphone's accelerometer sensor, GPS receiver, and built-in microphone. The following steps illustrate the operation of different interoperated components shown in Figure:

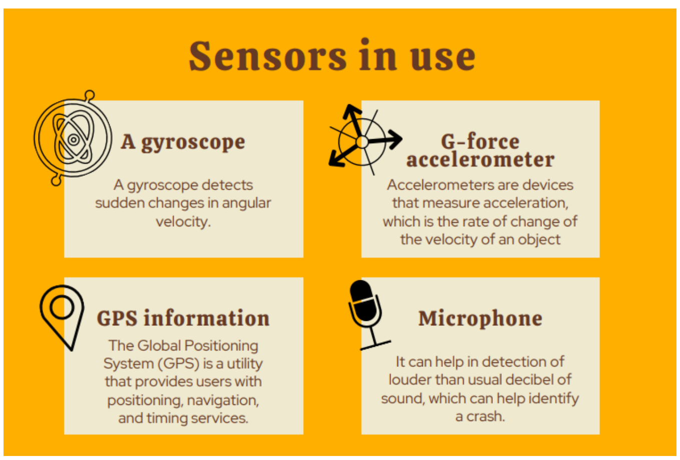

Fig. 1. Sensors in use

• Smartphone Accelerometer and Gyroscope sensor: The detection phase continuously extracts accelerometer and Gyroscope 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. Accelerometer sensor data is utilized to increase the probability that an accident will be detected.

• Smartphone microphone: The microphone is used to detect high-decibel acoustic events such as sound of an airbag deploying. Based on information from the accelerometer sensor and GPS data, the likelihood of detecting an accident is increased by using the microphone.

Detection Phase Specification: The maximum crucial issue this is used, through vehicle 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 those research suggest a very precise possibility to analyze how acceleration affects the risk of injury. The effects are proven that maximum occupants be afflicted by neurological signs, had a median acceleration above 4G. Actually, the G-Force number is insufficient evidence to identify an automobile crash and would produce a false positive result. The suggested detection phase continually samples and reads data from the smartphone's accelerometer sensor while running inside the device to find collisions. The smartphone feels the same acceleration force as the car's occupants in the event of an accident, because smartphones are frequently carried in a pocket attached to the occupants [4]. In actuality, there are a number of things that need to be taken into account during the accident detection phase.

The following issues are listed and examined:

• The empirical results mentioned in [4] showed that when the smartphone is dropped inside the vehicle, it experiences approximately 2G's on the y-axis and z-axis with nearly 3G's on the x-axis before it is reset. This allowed researchers to filter out acceleration values caused by dropping the phone inside the vehicle or sudden stopping, whose acceleration values could be interpreted as car accidents. The smartphone experiences an acceleration of about 1G in each direction, which is less than that experienced during the fall, in the event of a rapid halt (emergency braking) that does not result in an accident. To prevent any false positives from occurring within the car, 4G was selected as the acceleration threshold value.

• The most important system done in this field is activated when the vehicle is at high speed of above 24 km/h [4] and the smartphone acceleration experiences greater than 4G. This system didn't take into account accident detection when the vehicle is travelling at a low speed, below 24 km/h, which is also subject to an accident. The detection of car accidents at low speeds, below 24 km/h, and smartphone acceleration experiences greater than 4G, is thus one of the paper's primary achievements.

• Additionally, it is important to consider some situations that result in false positives, such as dropping a smartphone by accident when the user is outside of a vehicle and other false positives whose acceleration values are unknown. Therefore, different characteristics are looked at and implemented to determine whether the phone is within the vehicle or outside the vehicle in order to address these concerns and to decrease the false positives reported from these cases.

Supporting features:

The following elements are chosen to enhance the detection process and decrease the likelihood of false positives that arise from any circumstances in which their acceleration values are unknown:

• The built-in microphone is used to listen for the high decibel acoustics event to detect an accident such as airbag deployment, impact noise and car horns. However, the driver and passengers can make loud noises that the device may mistake for the sound of an airbag deploying. These benign noises include phone drops, shouting, laughing, loud music, and driving with the windows down.. None of these noise-making activities would produce noise levels more than the 160 dB range required for airbag deployment, according to empirical findings in [4]. However, some smartphone microphone infrastructure suffers from signal clipping at 140 dB, making it difficult to distinguish between sounds, such as listening to the radio at full power versus an airbag deployment. Because of this, it is difficult to utilize the sound alone to detect an accident, but it can be used in conjunction with an acceleration threshold value as a secondary filter to enhance detection and decrease false positives. Additionally, the sound threshold value in the CADANS was chosen to be 140 dB because to the signal clipping process.

• To increase the likelihood of an accident, increase the accuracy of detection and reduce the false positives, the suggested detection system instructs the smartphone camera to record a video of what is happening at the time of an accident as soon as the detection procedure detects an indication of accident. The emergency responder will then review the video to confirm whether an accident actually occurred. The device is also made to enable witnesses to record videos and email them to emergency personnel for additional investigation.

Notification Phase:

Detecting a car accident without notifying anyone is the same as doing nothing. The accuracy of the detection process makes sense as the most important work of the detection phase, whilst the speed and type of information sent to the emergency responders to enable them to respond to an accident makes sense as the most important task of the notification phase. The given figure shows the architecture of the proposed notification phase.

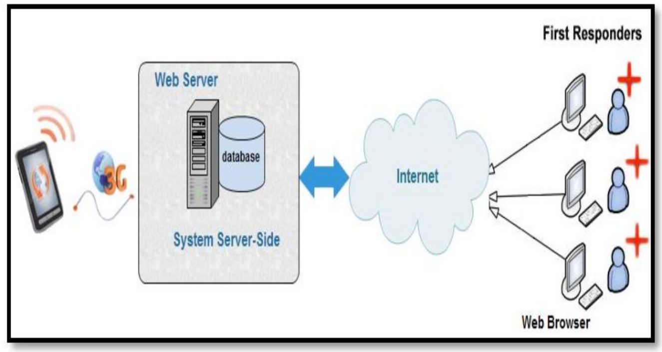

Fig. 2. Notification Phase

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

1. **Driver and /or Passenger Notification**

When the detection phase determines that an accident has occurred, a smartphone GPS receiver is needed to determine the exact location of the collision. It then uses the smartphone's built-in data connection to send accident information, including the G-force (acceleration force) felt by the occupants during the collision, the vehicle's speed, the GPS location, the airbag's deployment status, the time of the collision, and a recording video (showing what happened immediately after the collision).

2. **SMS Notification**

It is thought to be a good idea to send an SMS message with the location of the accident to the driver's or passenger's contacts, such as a family member, in order to reinforce the notification phase.

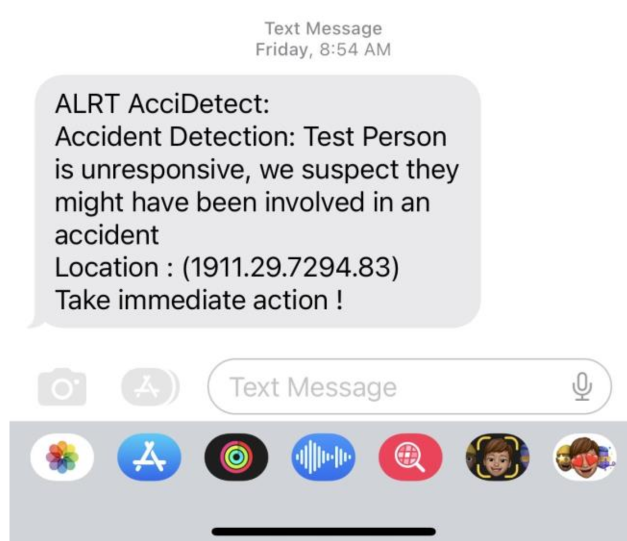

Fig. 3. SMS Notification

IV. FUTURE SCOPE

Bystander's Notifications

The given figure shows how the app allows for uninjured people and bystanders to send multiple streams of videos and images from an accident location. Additionally, a GPS receiver on a smartphone is needed to pinpoint the accident's exact location before notifying emergency personnel.

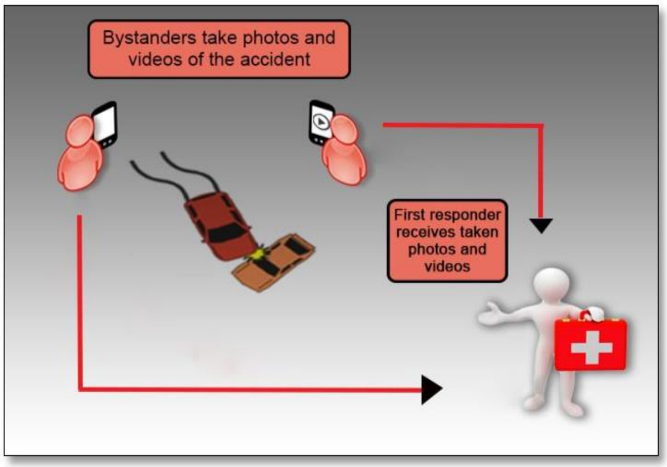

Fig. 4. Bystander's Notification

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.

V. CONCLUSION

. In the current situation we can't use driver less cars, it is being implemented but it will take some time. But we can't wait until it is implemented in our country. So, instead of the driver less cars we are taking some preventive measures and immediate response after the occurrence of the accident. This system provides the optimum solution to poor emergency facilities provided to victims in road accidents in the most feasible way. With the help of this technology immediate action can be taken when an accident occurs by alerting the respective people by sending a message, so that many lives can be saved by this project. The drawback with this technique is that it doesn't work without a network. So in areas where there is no network it will not be able to send the alerts. The proposed method is very helpful for the automotive business industry. This can be used by medical teams/police to reach the accident spot in time and save the precious human lives.

Due to safety matter and the significant damage concerned, crash testing of the app in real environments (real car accident) is not realistic and practical. However, constructing some cases that simulate the scenarios of the proposed detection phase mechanism and testing the app against these cases would yield a high confidence that supports the reliability and certainty. It is also difficult to test the app in real accident to achieve a high decibel level of sound event (greater than 140db) without existence of airbag deployment.

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 and reduce the probability of false positives. The app notifies the family or friends quickly about the accident, the proposed system sends SMS message which contains accident location coordinates to predefined emergency contacts.

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VII. REFERENCES

[1] National Highway Traffic Safety Administration (NHTSA), Dept. of Transportation (U.S),"Traffic safety facts 2012: Young Drivers", Washington (DC), April 2014.

[2] Evanco and William M., "The Impact of Rapid Incident Detection on Freeway Accident Fatalities", technical report available from Mitretek (center for information system), McLean, Virginia, USA, report No .WN 96W0000071, June 1996.

[3] Peter T. Martin, Joseph P. and Hansen B.," Incident Detection Algorithm Evaluation ", final report available from Utah Department of Transportation, USA, Vol. 1, Issue 1, Part 122 of MPC report, March 2001.

[4] Chris T., White J., Dougherty B. , Albright A. and Schmidt DC.," WreckWatch: Automatic Traffic Accident Detection and Notification with Smartphones ", International Journal of mobile network and application, Springer, Hingham, MA, USA., Vol. 16, Issue 3, PP. 285-303, March 2011.

[5] Jorge Z., Carlos T. , Juan C. and Pietro M., "Providing Accident Detection in Vehicular Networks through OBD-II Devices and Android-based Smartphones", Proceedings of the IEEE 36th Conference on Local Computer Networks, Washington, DC, USA, PP. 813-819,October 2011.

[6] Bannister G., Amirfeyz R., Kelley S., Gargan M., " Whiplash injury ", International journal of British Editorial Society of Bone and Joint Surgery, Vol.91 , No. 7, PP. 845-850, July 2009.

[7] Sneha R.S. and Gawande A. D., "Crash Notification System for Portable Devices", International Journal of Advanced Computer Technology (IJACT), Vol.2, No-3, PP.33-38, June 2013.

[8] Patel K.H., "Utilizing the Emergence of Android Smartphones for Public Welfare by Providing Advance Accident Detection and Remedy by 108 Ambulances", International Journal of Engineering Research & Technology (IJERT), Vol.2, Issue 9, PP 1340-1342, September – 2013.

[9] Krafft M., Kullgren A., Malm S. and Ydenius A.," Influence Of Crash Severity On Various Whiplash Symptoms: A Study Based On Real-Life Rear-End Crashes With Recorded Crash Pulses", Proceedings of the 19th International Technical Conference on the Enhanced Safety of Vehicles (ESV), Washington DC, United States, June 2005.

[10] Cook D., "Data Push Apps with HTML5 SSE", First Edition, O'Reilly Media, Inc, March 2014.