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Accident Detection and Response System with Error Avoidance

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Abstract

Accidents have been a major issue faced worldwide creating a huge social and economic loss. Accident Detection and Response System(ADRS) is an auto-detection system inside a Vehicle, based on a microcontroller platform, that detects the type of accident, performs error check and notifies a central control system, based on Matlab, which intimates nearest Health Care worker, Ambulance, Hospital, Police and Vehicle Owner Contact through a text message in case of an accident. This System proposed aims at reducing delays in accident response, brings in accountability to the system as well as avoid delays caused by ignorance of accident situation by public resulting in delayed reporting of accident to authorities, which is a persistent problem in developing and under developed nations.

Keywords: Accident detection, Automated Accident response, Vehicle SoS, Road Safety Automation

INTRODUCTION

In India, Central Government's report indicated a figure of 1,46,000 deaths due to road accidents in the year 2015.[6] Government report agrees that there are huge time delays between the occurrence of accident till the arrival of any first – aid service. Another major issue, also studies and reported by BBC suggests that people in India are afraid to report an accident considering intimidation from police and long-hurl judicial procedures. Accountability in Hit and Run cases which, according to central government's report touch the figure of 55,000 every year is still very weak.

In Developing and Under developed nations we lack a basic accident response infrastructure especially in tough terrains and solitary areas. Many cases have been observed in Himalayan states of India like Himachal, Uttarakhand where for more than 24 hours, it was not even known that a vehicle fell of into a gorge. In other cases, authorities were notified about the accident beyond 3 to 4 hours when the debris was seen by a local resident. These 3 – 4 hours may be the deciding factor between life and death of the victim. Due to lack of first aid itself, many fatalities occur which could have otherwise been avoided.

Using this ADRS System, we can inform control centres about any major road accident immediately. We can perform simultaneous checks over the data collected through the sensors to predict the type of accident, transmit vehicle's id which enables authorities to know probable number of victims, details of probable victims like Medical History/Blood Groups etc.

These inputs could help authorities device a plan of action for efficient relief as well as keep the medical services prepared. Nearest available ambulance and health centre workers can be rushed to site for the first aid within minutes of accident saving numerous life. The data generated would also be used to identify accident prone locations to suggest safety measures for the same to authorities responsible and for ambulance positioning.

Since most of the developing and under developed nations aren't equipped with cameras on highway, vehicle tracking systems and other electronic instruments to be used for accident detection, this system also aims at bringing accountability in case of delayed response by emergency services. It can help in bringing accountability to hit and run cases by recording even the minor incidents which can help immensely in investigations.

RELATED WORK

This section describes the related work done in the field of accident detection and response. Researchers have been exploring similar fields of research as to ADRS system. The idea has been discussed on many occasions but lack of implementation as well as design according to geographic and demographic requirements has not been seen.

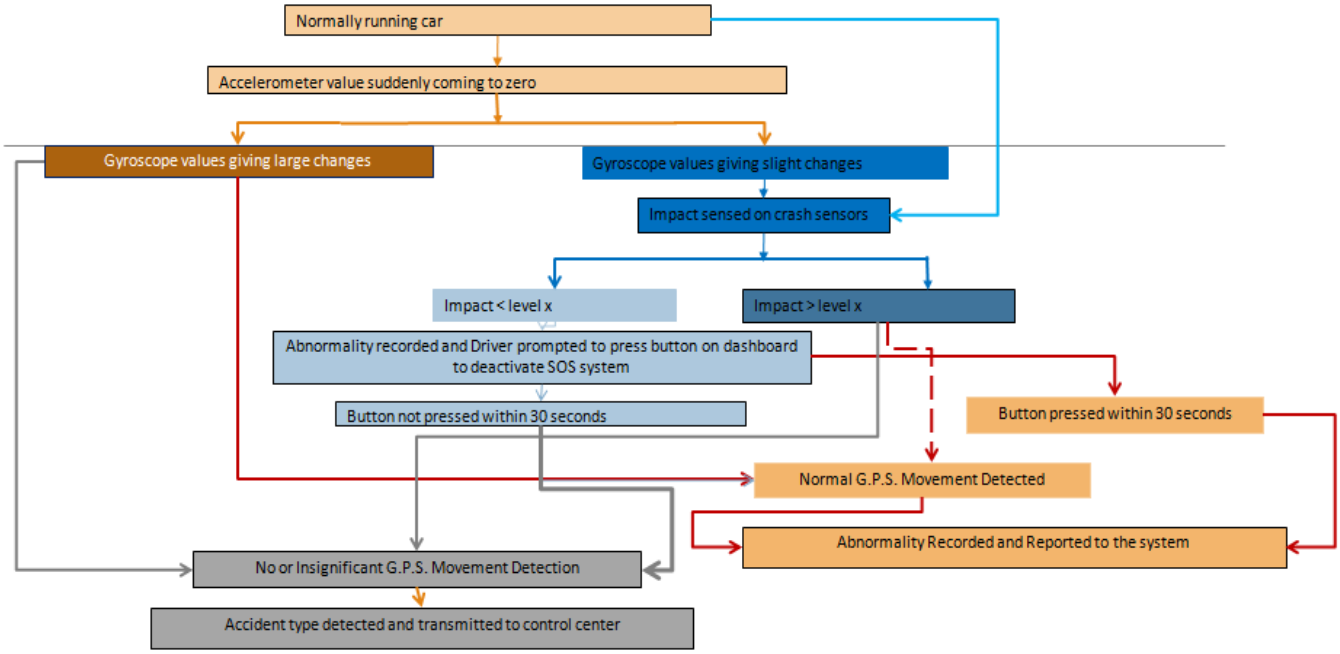
The Lexus 2014 models are equipped with a new feature called the Lexus Enform [3]. A feature called the Safety Connect detects an accident through a force sensor at the rear end of the and sends an automatic notification to the response service center through the

smartphone. The biggest disadvantage with the system is service change to use the system as well as requirement of a smartphone.

OnStar Corporation, a subsidiary of General Motors Company, introduce accident notification service in the United States, Ecuador and Venezuela by the name of Chevystar [4]. It provided options of Automatic Crash Response and Roadside Assistance [4]. Online reviews about the system were unsatisfactory over pricing, poor service and lack of assistance, showing the inefficiency of the system. In contrast, ADRS provides dedicated accident detection and response notification. The requirement of a smartphone is also eliminated.

Auto Accident App, launched by PlatinumPeak LLC [5], is a smartphone application providing free accident assistance victims. It gives one-button access to emergency service. The main is that it is a form of manual reporting about the accident after it is has taken place. Hence, it doesn't really provide any form of rescue for the passengers.

SYSTEM DESIGN



A. In-Vehicle System

The In-Vehicle System comprises

1. Microcontroller
2. Sensors
3. GSM module,
4. GPS module
5. Power Source.

The Controller is placed under the rear seat of the vehicle enclosed in a hard case made of Honeycomb maze aluminum at the inner surface and glass fiber on the outer surface to prevent or minimize the damage during an accident.

It uses three major sensors

1. Vibration Sensors for Impact Detection.
2. Gyroscope
3. Infrared speed sensors.

The system instigates if the speed suddenly comes to near zero mark or the impact is high. A huge impact is accredited to multiple extreme vibrations bringing the current transmitted to the microcontroller from the sensor to absolute 0 at-least 20 times in a span of 5 seconds.

If the huge vibrations are recorded less than 10 times in a span of 5 seconds, the impact is considered small. The vibration sensitivity is accredited differently to different vehicle models and is pre-programmed for every model the sensor is fixed in.

For a case when speed comes to zero, gyroscope reading is checked as well. A sudden change in the gyroscope reading for a span of up to 5 seconds is related with toppling of the vehicle on the road but for greater than 5 seconds, it is related with falling off a cliff.

If the gyroscope readings are normal, the next check point is level of impact. If the level of impact is small, the driver is

intimated to respond through a button press.

If he presses the button within 30 seconds, the driver is considered to be safe. In this case, a communication about an abnormal activity with the G.P.S. location is sent to the central control system.

In case the driver doesn't respond after a minor impact, impact is a major impact or gyroscopic variation exists, we send the data to control room and check for G.P.S. location in a space of 20 seconds 3 times. If the G.P.S. value change significantly, describing movement of more than 500 meters, it signifies an error in detection.

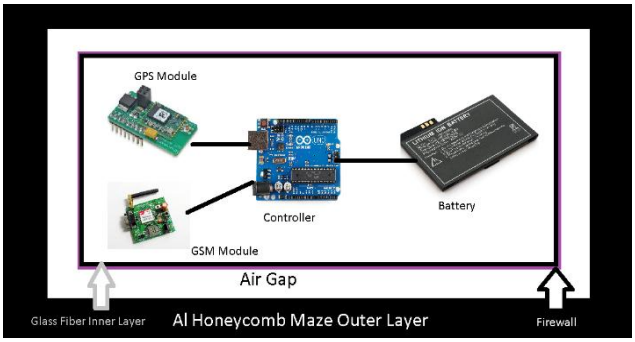
In this case, the central control system is notified to record it as an abnormality. System in this case wouldn't proceed for response. In the case when G.P.S. value change is insignificant; the central system is sent an accident conformation and response is requested.

The system is attached to a Li-Po/Li-ion battery which operates the microcontroller. The battery gets charged from the main vehicle battery constantly enabling the system to work even after the accident.

The system uses GSM Cellular Services to communicate with the central control system and sends binary data depicting type of accident, vehicle identification number and G.P.S. location. Flags are used to confirm about the accident or report the case as an abnormality.

Using GSM Technology Eliminates the dependency over a Smartphone and Near Field Communication System. Also, range of GSM services is widespread with extensive network coverage, especially in scarcely populated regions. GSM module can also be programmed to work over multiple bandwidths of multiple telecom service providers in case of an emergency. This is similar to using emergency calling service present on mobile phones.

B. Control Room System



The Control room system would comprise of

1. MATLAB based desktop application.
2. Text message sending API
3. SQL database.

All the details about A vehicle, like model, capacity, registration number, owner details, emergency contact are associated with a unique identification number on a database. Relevant data is retrieved whenever accident is reported.

The second database has G.P.S. Coordinates of Hospitals and health care centers, police station with their contact numbers and address stored. G.P.S. Coordinates of Ambulance are constantly updated to this database. This database is used to retrieve communication numbers according to G.P.S. location of an accident.

The third database is created to update records of accidents and abnormal activities with G.P.S. location and Vehicle I.D. involved. This database is designed to be used for accident analysis and investigations.

The System receives a confirmation on the accident online and it detects the GPS location from the GPS Coordinates received. It retrieves information from the database about nearest health care worker, ambulance, hospitals and police stations. It then retrieves information about vehicle and owner using the vehicle ID received.

It sends the message about accident with details of vehicle number, maximum capacity of passengers, GPS coordinates, type of accident and driver details to nearest heath center workers, ambulance and hospitals. Vehicle number and GPS location is transmitted to Police and information about accident involvement and GPS location is sent to the emergency contact registered.

CONCLUSION

The system is an application of Internet of Things 2.0 where devices interact without major human involvement. The system provides a solution for efficient accident detection and response to nations lacking emergency response infrastructure.

Real time implementation of this idea would result in saving of many lives lost due to inefficient accident response as well as eliminate the need of physically reporting the accident. This system also brings in reliability and accountability to the existing emergency service infrastructure, thus helping in improving the efficiency of emergency services.

This system can be linked to drones in future for surveillance of area by the time medical help arrives and give real time inputs to medicos for efficient response. The drones can even detect fatalities occurred using heat sensors and digital image processing.

Drones can be manipulated to detect heart rate of victim and even administer first aid medicines through in built I.V. syringes. The drones can also be helpful in predicting if air ambulance is required and nearest possible area for air ambulance to land of have access to.

We are moving towards faster freeways in developing countries. In case of accident, it would become necessary to divert or stop traffic near the crash site. The System, when implemented extensively can also be used by authorities to conceal accident area and well as divert traffic, thus reducing incidents of traffic congestion due to an accident as well as restoring normalcy.

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