International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 9 Issue 11, November-2020

Accident Alert and Vehicle Tracking System

Dr. Avinash Chandra, Rishab Kaul, Shaanvi Mehta, Subharthi Saha
Vellore Institute of Technology

Abstract: **The number of vehicle collisions in India is among the highest in the world. One major factor that leads to these accidents becoming fatal is the response of the emergency services which in most cases are not notified sufficiently within time as the passengers of the vehicle may not be in a state to make calls or raise alarms. Our systems will detect the occurrence of an accident, notify the emergency services with the exact location of this collision and also inform a select number of emergency contacts that have been set by the user. The proposed system will detect the occurrence of the accident using various sensors present in the system, detect the location of the vehicle using the GPS module along with the use of Google Maps data and send the emergency messages and distress signals automatically in case of an accident where the passengers are not in a state to respond/raise an alarm. The messages will be sent using a GSM module present in our system. The system will always provide a small window of time for the user to cancel the distress call in case of a rare occurrence of a false detection by our system so as to not disturb the emergency services and also to not cause panic amongst the family and friends of the user. If the user does not respond within the time delay, the system is activated and the necessary processes are carried out. This time window is to stop the system from activating, and can only be done manually by the user with the help of a button.**

Keywords**:** ***Accident Alert, Disaster Management, Road Safety, GSM, GPS***

1. INTRODUCTION

In a 2013 survey, the SaveLIFE Foundation found that 74% of Indians were unlikely to help an accident victim, whether alone or with other bystanders. Apart from the fear of being falsely implicated, people also worried about becoming trapped as a witness in a court case - legal proceedings can be notoriously protracted in India. And if they helped the victim get to the hospital, they feared coming under pressure to stump up fees for medical treatment. A member of the SaveLIFE foundation highlighted the contrast in the reluctance of passers-by to help victims of road accidents with their response to train crashes or bomb blasts. In these cases, he said, "before the police or media arrives everybody's been moved to the hospital". The big difference between road accidents is that there are usually just one or two victims. "The chances of getting blamed are much higher," he said.

The main objectives of our project are:

1. Automate the alert system concept providing additional features not present in pre-existing systems.
2. Successfully detecting the occurrence of an accident without the need for user input using various sensors for detecting the accident.
3. Decreasing the time between the occurrence of the accident and notification of the emergency services using the GSM module.
4. Informing the emergency contacts set by the user that an accident has occurred so that their immediate family or friends are aware of the situation using the GSM module.

5. Providing the exact location of the vehicle in the form of latitude and longitude coordinates in order to decrease the response time of the emergency services using the GPS module.
6. Providing a small timeframe for the user to manually cancel system activation using a button on the system in case of a rare occurrence of false detection.
7. The device shall also consist of an LCD screen which may be used to interact with the system and view the state of the system.

2. LITERATURE REVIEW

J. White, C. Thompson, H. Turner, B. Dougherty, and D. C. Schmidt quote that traffic accidents are one of the leading causes of death in the United States. The time between the accident and the dispatch of emergency medical personnel to the scene is an important indicator of survival after the accident. Eliminating the time between the occurrence of an accident and the dispatch of the first responders to the scene reduces the mortality rate by 6%. One approach to eliminating the delay between the occurrence of an accident and the dispatch of the first responder is the use of in-vehicle automatic accident detection and notification systems that detect when a traffic accident occurs and immediately notify emergency personnel. However, these in-vehicle systems are not available in all cars and are expensive to retrofit for older vehicles.

C. Thompson, J. White, B. Dougherty, A. Albright, D. C. Schmidt state that accident detection systems help reduce car accident fatalities by reducing the response time of emergency responders. Smartphones and their on-board sensors (such as GPS receivers and accelerometers) are promising platforms for the construction of such systems. This paper makes three contributions to the study of the use of smartphone-based accident detection systems. First, we describe solutions to key issues related to the detection of traffic accidents, such as the prevention of false positives by using mobile context information and on-board polling

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sensors to detect large accelerations. Second, we present the architecture of our smartphone prototype accident detection system and empirically analyze its ability to withstand false positives as well as its ability to rebuild accidents. Thirdly, we discuss how smartphone-based accident detection can reduce overall traffic congestion and increase the preparedness of emergency responders.

M. S. Amin, J. Jalil, M. Reaz, discuss that speed is one of the basic causes of vehicle accidents. A lot of lives could have been saved if the emergency service could get information about the accident and reach it in time. GPS has now become an integral part of the vehicle system. This paper proposes to use the capability of the GPS receiver to monitor the speed of the vehicle and detect accidents on the basis of monitored speed and to send the accident site to the Alert Service Center. The GPS monitors the speed of the vehicle and compares it with the previous speed every second through the Microcontroller Unit. Whenever the speed is below the specified speed, an accident is assumed to have occurred. The system will then send the accident location acquired from the GPS along with time and speed by using the GSM network. This will help you reach the rescue service in time and save valuable human life.

According to **Iman M. Almomani, Nour Y. Alkhalil, Enas M. Ahmad, and Rania M. Jodeh,** The Global Positioning System (GPS) is becoming widely used for tracking and monitoring of vehicles. Many systems have been set up to provide services that make them more popular and needed than ever before. A "GPS vehicle tracking system" is proposed in this paper. This system is useful for fleet operators to monitor the driving behavior of employees or parents monitoring their teen drivers. In addition to working as a safety system combined with car alarms, this system can also be used in the prevention of theft as a retrieval device. The main contribution of this paper is the provision of two types of end-user applications, a web application, and a mobile application. This way, the proposed system provides a ubiquitous vehicle tracking system with maximum accessibility for the user at any time and anywhere. The tracking services of the system shall include the acquisition of the location and ground speed of the vehicle at the present time or at any previous date. It also monitors the vehicle by setting speed and geographical limits and therefore receives SMS alerts when the vehicle exceeds these pre-defined limits. In addition, all movements and stops of the vehicle can also be monitored. Tracking vehicles in our system uses a wide range of new technologies and communication networks, including General Packet Radio Service (GPRS), the Global Mobile Communication System (GSM), the Internet, and the World Wide Web and Global Positioning System (GPS).

3. METHODOLOGY

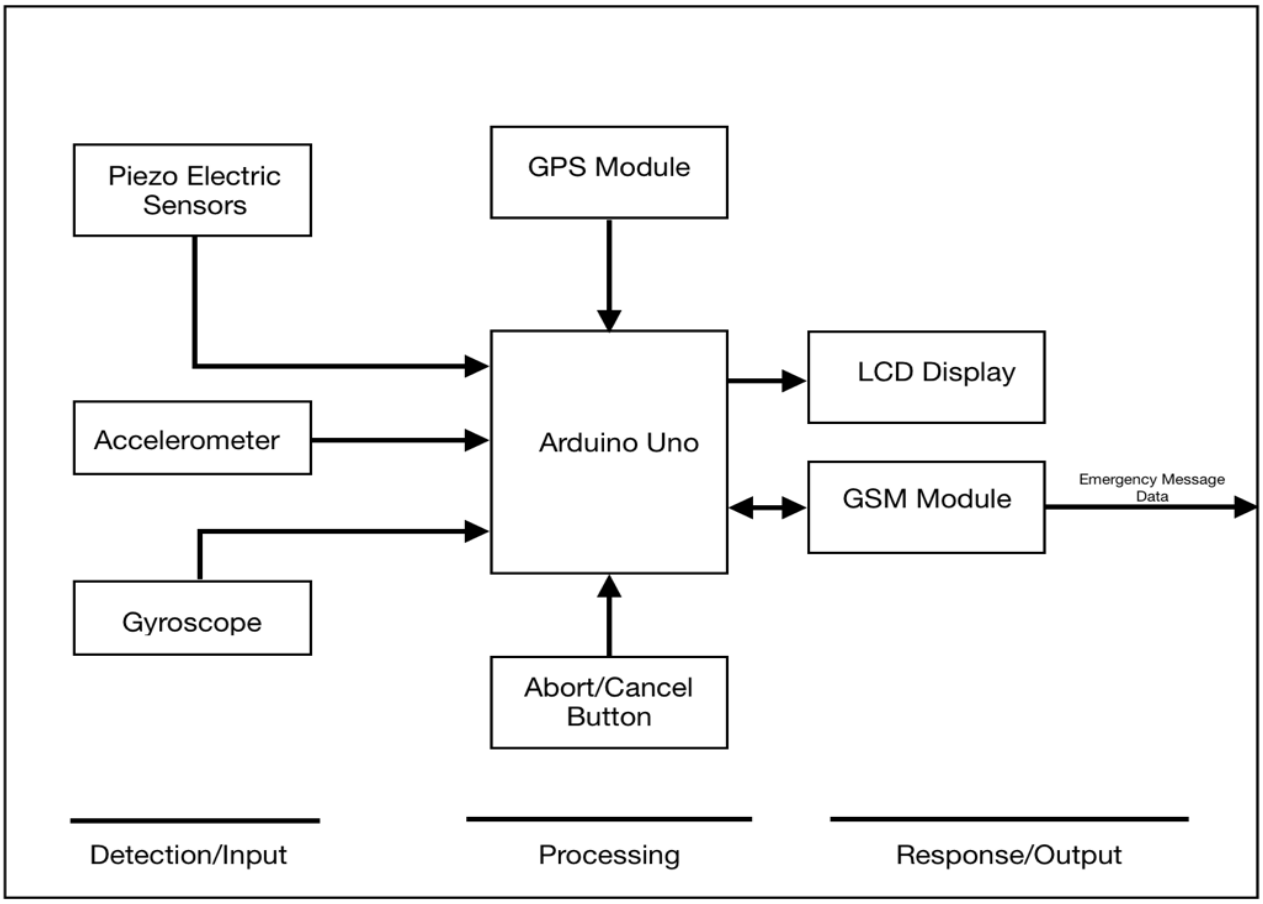

Fig. Block Diagram of the proposed system

The system execution will take place with the following steps:

1. Detection of a collision
2. Piezoelectric sensors - Detect physical impact on the vehicle beyond a threshold value.
3. Gyroscope - Detect the orientation change of a car from its normal orientation, if the vehicle flips upside down, side-ways, etc. a collision is detected.
4. Accelerometer - detects a sudden change in the movement of a car. If the car rapidly decelerated, piezoelectric sensor data is verified to accurately detect the occurrence of a collision.
5. Processing of the sensor data- The precedence is first given to the piezoelectric sensors which detect an impact beyond a set threshold value. If the threshold value is crossed, the system checks accelerometer data for the sudden deceleration input. The gyroscope only activates the system in case the orientation of the car is changed which occurs in a relatively smaller number of cases and hence if the gyroscope detects an orientation change, a collision is detected and the system is activated. The data from other sensors is also verified, but a gyroscope detection alone is also considered as an accurate detection. The piezoelectric sensors and accelerometer data both are cross-checked with one another for accurate detection. Two types of collisions mainly differ in this case. The first being, an impact of the vehicle (with the system onboard) originally in motion with another object or vehicle which may be stationary or in motion. In this case, piezoelectric sensors followed by the accelerometer both detect an impact due to the physical impact as well as the rapid change in the acceleration of the vehicle and hence the detection is accurate. In the second case, a vehicle that is in motion may collide with a stationary vehicle (with the system onboard). In this case, there is a physical impact which is also followed by a change in the acceleration of the car from stationary to some particular value, and hence both the piezoelectric sensors and the accelerometer detect the occurrence of a collision and the detection is accurate. In the first case mentioned, there may be a chance that the driver of the vehicle (with the system onboard) attempted to rapidly decelerate to prevent a collision and successfully did so. As the piezoelectric sensors, in this case, do not detect any impact, the situation is considered as a collision avoided, and hence the system is not activated. If the driver failed to avoid the collision, the rapid deceleration will be followed by an impact. As both rapid deceleration and physical impact are detected, the system is activated with accurate detection.
6. Collection of GPS data - The longitude and latitude coordinates of the vehicle are collected using the GPS module with the help of Google Maps at the time of detection of a collision.
7. Time delay for the user to manually abort/cancel system activation - Done with the help of an abort/cancel button present on the system in the rare case of false detection of a collision by the system. Once the time delay is over, and no input from the abort button is detected, the system is activated.
8. Sending of Emergency Distress Message - Once the system is activated, a distress message pre-defined by the user is sent both to the emergency services as well as the emergency contacts that have been selected by the user. The distress message also contains the exact location of the vehicle in the form of latitude and longitude coordinates. These messages are sent using the GSM module present in the system.
9. LCD display functionality - The LCD display present on the system reflects the state of the system and helps the user view information regarding the system.

4. RESULTS

When an accident (simulation) occurred, the device successfully transmitted the distress messages to the given mobile numbers. The sensors and modules used in the device functioned properly and the desired output was obtained. The GPS Module tracked the location with reliable accuracy levels, providing the latitude and longitude coordinates of the device. The GSM module was individually tested as well, to verify proper delivery of multiple messages to multiple numbers and the results were satisfactory. We had planned to test the system vigorously to fine-tune the various threshold values but had to halt the process. This testing would involve multiple test cases. We had also planned to make the casing for the system in order to protect the system from dust and debris. For partial simulation purposes, Proteus Software has been used and the results obtained from successful execution have been given below.

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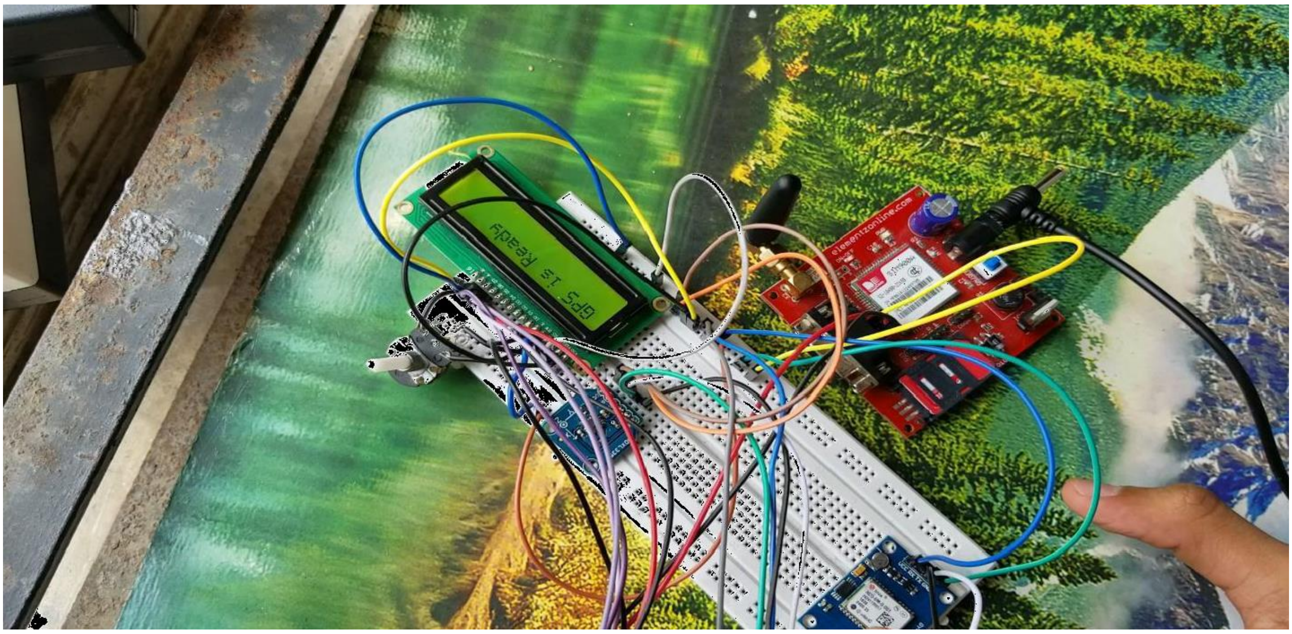

Fig. Device functioning, LCD showing GPS is ready to transmit

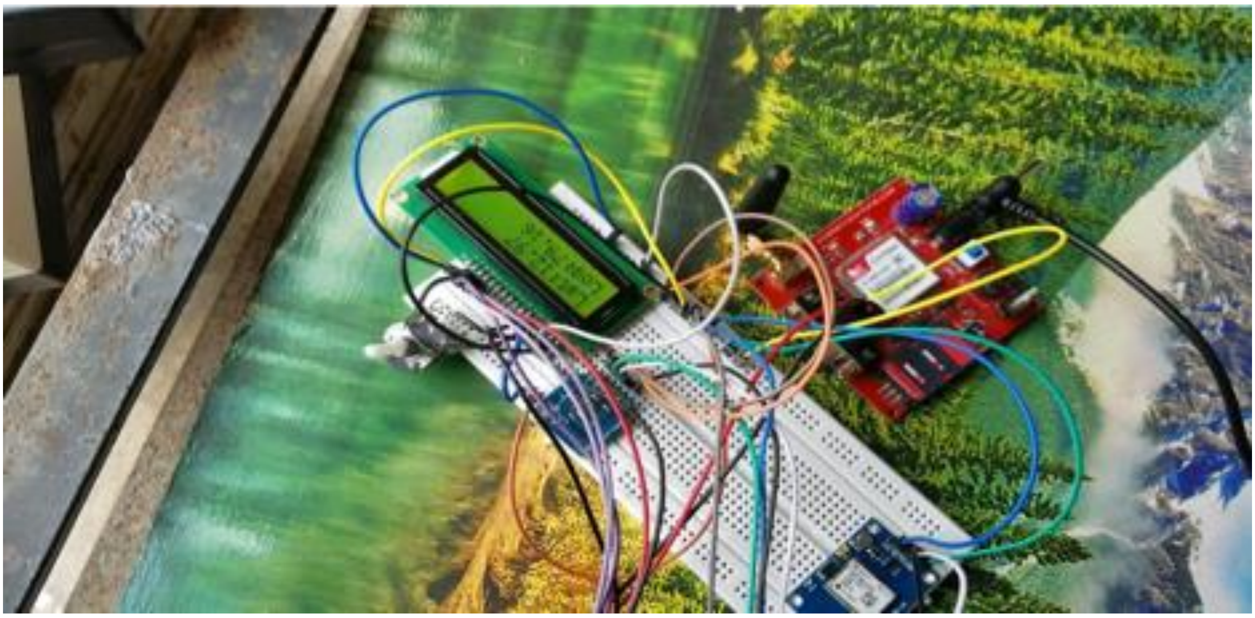

Fig. Accurate location data detected by the device

<u>Our proposed system comes with the following improvements/advantages:</u>

- The system is relatively cost-effective for its application.
- Automates the emergency alert system which is currently present in a few vehicles and no longer requires user input.
- It can include a larger number of emergency contacts as compared to existing manual alert systems which offer only around 2-3 contacts.
- Eliminates the need for the victim of a collision to rely on passer-by or other vehicles to contact the emergency services for them.
- Provides location of the vehicle collision making it easier for the emergency services to locate the premises.
- Provides a time delay to cancel the system activation ensuring no false detections go through and causes panic within family members or leads to the wasteful deployment of emergency services.
- Can be installed in various types of vehicles as the system requirements are minimal.

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5. FUTURE SCOPE

The system can be further worked on and improved by adding camera functionality. This will help provide a real-time video stream to emergency services, record the accident occurrence, and help in legal and insurance proceedings with the police, court, and insurance companies. The system can be incorporated with both 4G/5G functionality and 2G functionality and depending on the network strength actively operate on the stronger network. The 4G/5G network will allow the live transmission of video and large data transmission while the 2G network will ensure basic features always work even in poor networks. The system can include driver monitoring features in the future to alert the driver in case the driver is drowsy or sleepy while driving the vehicle. A number plate monitoring system software along with cameras can be implemented as well to log the number plates of the vehicles that were around the vehicle (with a system onboard) to identify the culprit vehicles in situations such as a hit --and- run.

6. CONCLUSION

The existing systems just provide an SOS button that you may press in case of an accident but sometimes the accident can be severe enough that the victim is not able to reach for the panic button. Hence, the automation of this concept provides a more effective solution to the problem at hand. It will greatly aid the emergency services as the vehicles can be tracked and the location of the collision site can be searched using navigation software readily available such as google maps. Our system has a false detection prevention button as well so this would help provide efficient and accurate data and not waste the precious time of the emergency services. IT eliminates the need to depend on passers-by for the survival of the victims of the crash. It is Cost-effective and can be easily installed.

However, with such advantages come some disadvantages too. Natural Disaster scenarios may burden the network with more data than the network can handle and hence crash the network.
In rare cases, if the navigation services are down, the system will not be able to detect the location. Furthermore, in extremely deserted areas, lack of network connectivity may hamper the device operation

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