# Smart Road Accident Detection and communication System

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***Abstract*— The number of fatal and disabling road accident are increasing day by day and is a real public health challenge. Many times, in the road accidents, human lives will be lost due to delayed medical assistance. Hence road accident deaths are more prominent. There exist many accident prevention systems which can prevent the accidents to certain extent, but they do not have any facility to communicate to the relatives in case accident happens. In this paper, the authors made an attempt to develop a car accident detection and communication system which will inform the relatives, nearest hospitals and police along with the location of the accident.**

***Index Terms*—Accident, Accident Detection, communication, GPS, GSM.**

## I. INTRODUCTION

The number of fatal road accidents are increasing day by day and has been a great challenge put in front of public health and concerned agencies. Every day in newspapers the main news in the front page is a road accident. The most prominent deaths of today's population are because of road accidents [1]. Over 1,37,000 people were killed in road accidents in 2013 alone. This count is more than the number of soldiers who sacrificed their lives on battlefields. There are many reasons for road accident happenings like improper construction and maintenance of the roads, overcrowding and increasing count of vehicles. Apart from this, the lack of road sense by the drivers and other users of the road have further complicated the matters. Mostly the youngsters are losing their lives on roads because of rash driving, drunken driving and other reasons, which is a great loss for our nation [2]. According to the World Health Organization, road traffic injuries caused an estimated 1.25 million deaths worldwide in the year 2010 i.e. one person is killed every 25 seconds [3]. There were 464,000 road accidents in 2015 in India. The states Tamil Nadu and Maharashtra reported (3,668) and (3,146) i.e. the largest number of people killed in two-wheeler accidents, while Uttar Pradesh reported largest number of lives lost due to (5,720) truck accidents and (2,135) car accidents [4]. A Report on Road Accidents in India 2016, published by Transport Research wing under Ministry of Road Transport & Highways, Government of India, has revealed that the country recorded at least 4,80,652 accidents in 2016, leading to 1,50,785 deaths. The number suggests that at least 413 people died every day in 1,317 road accidents [5]. At present India accounts for 10 percent of global road accidents with more than 1.46 lakh fatalities annually.

Increased number of transportation has given rise to more number of road accidents. However, we cannot limit the increasing number of transportation but of course, we can limit the fatal road accident deaths with timely and effective communication of the accidents to hospitals and police. Nowadays technology has become the driving force of our modern world. Hence using micro-controller technology, we developed smart road accident detection and communication system. There exist many types of accident prevention systems installed in cars. The most common conventional accident prevention systems are bags, ABS etc.

Air bag: An airbag is a type of vehicle safety device and is an occupant restraint system. The airbag module is designed in such a way that during a collision or sudden deceleration the air bags inflates rapidly and deflates quickly to provide a safe landing to the driver's head. It consists of the airbag cushion, a flexible fabric bag, inflation module and impact sensor or accelerometer. The airbag provides an energy absorbing surface between the vehicle's occupant and a steering wheel. Car air bags are effective safety features to prevent serious injuries at the time accident but have caused some fatalities [6]. Previous research has shown that the installation of air bags in vehicles significantly reduces crash related deaths, but these analyses have used statistical techniques which were not capable of controlling for other major determinants of crash survival [7].

(ABS): The most effective chassis control system for improving vehicle safety during severe braking is anti-lock braking system (ABS). Anti-lock braking mechanism prevents the locking of wheels at the time of panic braking to maintain a tractive contact with the road and thereby decreasing the braking distance of the vehicle. Anti-lock Braking can prevent accident, but it will not communicate. The automatic Accident prevention systems have recently been a part of many modern cars to reduce injuries and casualties on the road. However, these systems are limited to high-end luxury vehicle only, due to high cost of components and equipment [8]. In this paper we have developed an affordable and reliable system using Arduino UNO R3.

The rest of the paper is organized as follows. The work done by various researches in this domain has been presented in section II. The system block diagram and description has been discussed in section III. Experimentation and the performance of the system is presented in section IV. Results of the experiments were discussed in section V and the paper is concluded in section VI.

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## II. Related Work

The rapid technological growth is now providing global opportunities to enable intelligent transportation system (ITS) to tackle road accidents which is considered one of the world's largest public injury prevention problem. In research literature, a number of automatic accident detection systems are proposed by numerous researchers. These include accident detection using smartphones, GSM and GPS technologies, vehicular ad-hoc networks and mobile applications [9].

In [10], Aciek IdaWuryandari et al, have presented a head up display on smart car. This system is integrated with obstacle avoidance computer via ethernet network, which continuously alerts the driver and gives warning messages to prevent the accident. All of information, warning, and guidance will be shown on Head Up Display. The data which is retrieved from sensors installed in the car will be sent to the driver main computer and will be displayed on the head up display. In [11] the authors have created an application HDy Copilot using multimodal alert dissemination for accident detection. This system uses both, eCall and IEEE 802.11p (ITS-G5). The proposed accident detection algorithm receives inputs from the vehicle, via ODB-II. The algorithm also retrieves the inputs from inbuilt smartphone sensors namely the accelerometer, the magnetometer and the gyroscope. In [12], authors proposed a novel vision-based road accident detection algorithm on highways and expressways. This algorithm is based on an adaptive traffic motion flow modeling technique. The authors have used Farneback Optical Flow for motions detection and a statistic heuristic method for accident detection.

In [13] authors have developed time synchronized hybrid (TSH) vehicle control systems to avoid accidents. Drowsy driving is the primary cause of motor vehicle accidents and is a risk factor that leads to the loss of human life [14]. As a solution for drowsy driving, in [15] the authors have proposed a system that will be mounted on a car, in front of the driver's seat, which will continuously focus on the person driving the vehicle thereby monitoring the person's actions and give voice messages to the driver, instructing him about the safety procedures every time he comes inside the car. If he found to be drowsy, a warning message is given to the driver telling him that he is drowsy and he should stop the car.

All the above systems are either preventing the accident by alerting the driver or detecting the accident. However, there is no communication facility in the systems when accident happens. There are some systems which have facility to communicate. In [16] the authors have developed e-NOTIFY system which allows fast detection of traffic accidents, improving the assistance to injured passengers. It also reduces the response time of emergency services through the efficient communication of relevant information about the accident using a combination of V2V and V2I communications. But in this system OBUs are supposed to be installed in cars which limits this facility only for higher end luxury cars. In this paper, authors have proposed the mechanism that has the facility to detect the accident and communicate the same to the relatives along with the accident location. It also capable to send the message to nearby hospitals and police along with the vehicle information and the drivers condition.

## III. System Design

A: Principle: The accident is detected by the vibration and gyroscope sensors and immediately a message is sent to the emergency contact numbers using GSM module along with the location identified by the GPS module.

B: System Description

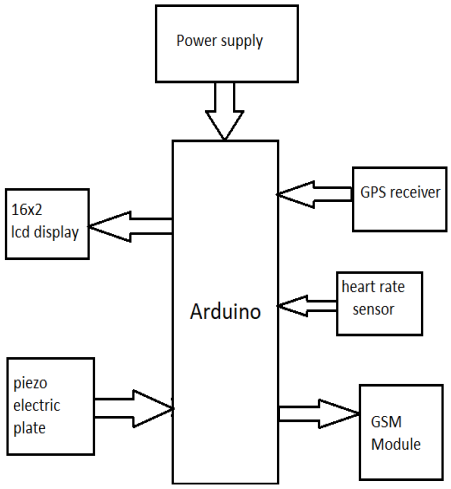


Fig1.System block diagram

Accident detection mechanism:
If the vehicle gets any head-on collision the vibrations are produced. If the vibrations exceed a threshold value they are detected. The central processing unit in the system will sense that accident has occurred. Similarly, if the vehicle doesn't collide but topples or tilts by any large angle the system will detect the accident from the gyro sensor. The system will wait for 10 seconds. If reset button is pressed by the driver within 10 seconds the system considers that accident is not serious and it resets back to normal operation.

In both the cases if the reset button is not pressed it will be treated as serious accident. The heart rate sensor will detect the heart rate of the driver, the current location will be collected from the GPS module and SMS will be sent to emergency contacts. The system also locates nearby hospital and police station and message will be sent along with the vehicle information.

The heart rate sensor will detect the heart rate of the driver only when the accident has occurred. By sending the heart rate information, the hospitals will get to know about the condition of the driver and accordingly they can react to help the driver. The system also makes the headlights and tail lights of the vehicle blink so that passerby people and vehicles can see the accident vehicle even in the night, so that they can also come to rescue.

C: Algorithm.

1. Is the vibration level /angle > threshold
2. If yes wait for 10 seconds and check for reset status
3. If reset button is pressed go to 1 else go to step 4
4. Collect the heart rate information.
5. Collect current location from GPS module
6. Send SMS to emergency contacts using GSM module
7. Get nearby police station and hospital number.
8. Send SMS using GSM module along with vehicle information

## IV. Performance and Experiments

The prototype of the system has been developed and installed in a remote-controlled toy car. Extensive experimentation has been done to assess the performance of the system under controlled environment. The car was made to collide with the wall to detect the collision. The performance of gyro sensor was studied by tilting the car at large angles. The values of vibration sensor and gyro sensor have been monitored on serial monitor.

The voltage developed by the vibration sensor (piezo electric plate) was determined using a multimeter. The formula for determining the potential developed by piezo electric effect is governed by the equation

$$V = [(d_{mn}T) / (\varepsilon\varepsilon_0 A)] \times F$$

V=voltage produced
$d_{mn}$= piezoelectric crystal coefficient
ε= crystal dielectric coefficient
$\varepsilon_0$= 8.854 x $10^{-12}$
T=thickness of crystal
A=Area of surface

Keeping T and A of the piezo electric plate constant we get the expression as voltage developed is directly proportional to the mechanical stress or force applied on the plate.

The heart rate values were determined by using pulse rate sensor. The basic heartbeat sensor consists of a LED and a detector like a light detecting resistor or a photodiode. The heart beat pulses cause a variation in the flow of blood to different regions of the body. When a tissue is illuminated with the light source, i.e. light emitted by the led, it either reflects (a finger tissue) or transmits the light. Some of the light is absorbed by the blood and the transmitted or the reflected light is received by the light detector. The amount of light absorbed depends on the blood volume in that tissue. The detector output is in form of electrical signal and is proportional to the heart beat rate. The heart rate or pulse rate of a person may vary according to the situations. The normal estimated heart rate is 70-80bpm. If the person is in resting condition the heart rate will be dropped to 40-60bpm. In case of fright or hypertension it may exceed 100bpm.

We developed the system in such a way that when the accident occurs, the heart rate sensor will determine the heart rate of the driver and along with the current location the heart rate information is also sent.

## V. Results

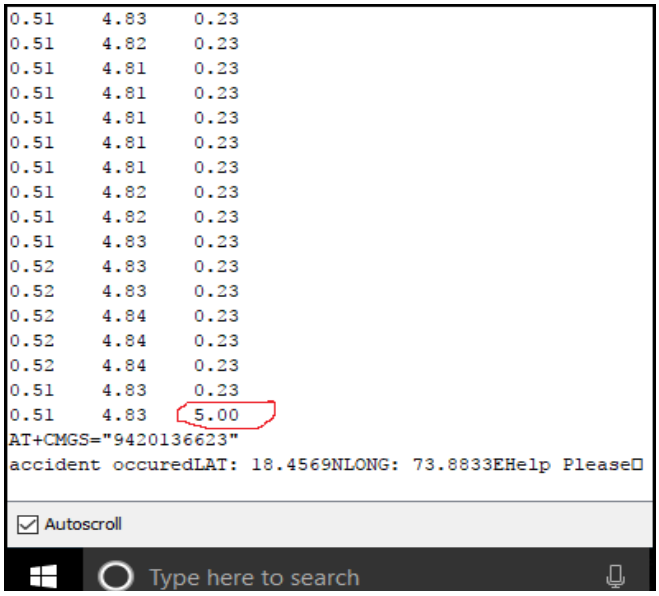


Fig.2 Screenshot showing values of vibration sensor (piezo electric plate)

Fig.2 shows the values of vibration sensor. Whenever the car collides with an object, vibration sensor gives the high output which is shown by the red the circle in the fig.2. If the vibrations exceed this threshold value and the reset button is not pressed in 10 seconds GSM module sends the SMS to stored number using AT commands.

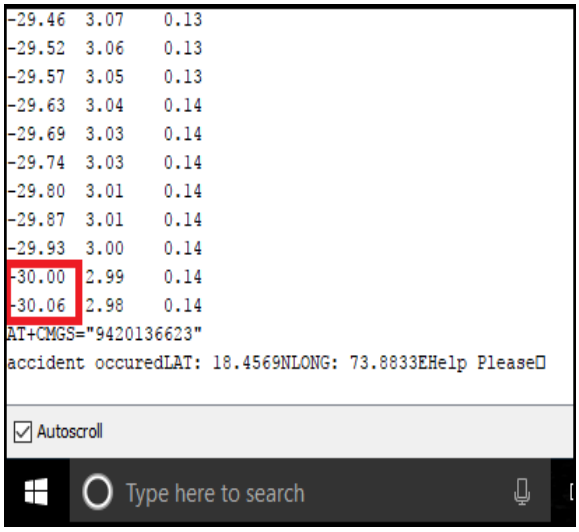


Fig.3 screenshot showing values of gyro sensor

Fig.3 shows the values of gyro sensor. Whenever the car topples or tilts by more than 30 degrees towards left, right, front or back the GSM module sends the message to the stored number using AT commands.

## VI. CONCLUSION

Smart road accident and communication system has been developed. Experiments have been conducted by implementing the system in a toy car.It is observed that the system is working properly. The system sends the message to the stored emergency numbers successfully when the car is collided and toppled or tilted by more than 30 degrees and if the reset button is not pressed in the stipulated time interval.

Future scope: An android app can be developed for this in which instead of just receiving the co-ordinates of the location, it can be exactly pin pointed on the map. The heart rate can also be continuously monitored by the app to determine the driver's condition till the medical help arrives.

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