

A Survey on Vehicle Safety and Alert System

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Abstract

Road accidents are the significant issue for everyone. Every day, a considerable amount of valuable lives are lost as a result of collisions. Before accident occurs, we are using preventive measures. If accident occurs, device that communicates information about crash site to local emergency responders, to respond quickly is critical. Numerous scholars have suggested a variety of automatic accident warning systems in the research literature. Among them are smart phone-based accident detection, Global System for Mobile Communications (GSM) and Global Positioning System (GPS) technology. The location of accident that we get from the GPS is sent to the user defined mobile numbers, ambulance service and police station by the help of GSM. Alcohol sensor is used to detect whether the driver is drunk or not, temperature sensor is used to detect whether the engine is overheated or not, eye blink sensor is used to detect whether the driver is asleep/drowsy or not. A study on different proposed methodologies involving various techniques for the stages involved along with their advantages and disadvantages is done which can help in the determination and appropriation of an efficient, accurate accident alert and detection system.

Key words: Accident, Sensors, GPS, GSM

I. INTRODUCTION

The roads are pretty much everyone's preferred mode of transport. As population and technology grows, people are likely to better their quality of life. And for that, they buy new and better vehicles. Before the discovery of the wheel, primitive man would remain secluded from other groups and communities. They could commute only within walking distance. The discovery of the wheel entirely evolved the early man life. His social boundary also grew with time. With passing time, primitive man evolved to a mannered, civilized individual and refined the design of the wheel. With the advent of technology, transportation has become an indispensable part of our lives. Though it has countless advantages and uses, we have to deal with the major problem it brings with it that costs human life.

With the increase of population, the number of the vehicle also increases that leads to road accident. In the entire world, the number of accidents increases daily and around 80% of accidents contribute to losing lives. In 2018 alone, India reported approximately 151,417 fatalities due to road accidents. As per the government of India's National Crime Records Bureau (NCRB) data, in 2019, there were a total of 437,396 road accidents all over India and a death of 154,732 people. Also, government sources, since 2000, the total road length all over India has increased by 39%, but the number of motor vehicles has increased by 158%. This is a clear indication of the uneven development for roads and number of motor vehicles which inevitably results in more accidents and proves to us how every step that can be taken in this direction can save hundreds of lives and make roads safer. These accidents are the deficiency of substructure, deficiency of traffic control, and the absence of scientific accident management. The most significant crucial cause behind the harm of survives in an accident is the absence of instant service (first aid). In most cases, people lose their lives in a few seconds. We cannot prevent accidents from happening but what we can is to give the victim a fighting chance at survival by ensuring quicker emergency medical backup.

Road accidents come with a high chance of fatality. This is because, our country lacks the best emergency health care facilities. With the help of an accelerometer, the accident can be precisely detected. This can be then used to send emergency alert message to the nearest police station and health care center.

Injuries and crashes are caused mainly by human error. Some of the most common human behaviors that lead to mishaps are:

1. Over Speeding
2. Drunken Driving
3. Distractions to Driver
4. Red Light Jumping
5. Avoiding Safety Gears like Seat belts and Helmets

IOT is a technology transition in which the devices will allow us to sense and control the physical world by making objects smarter and connecting them through an intelligent network. IOT started in 2008 and 2009. In these years, more “things” connected to the internet than people in the world. In the year 2003, world population was 6.3 billion and 500 million devices were connected. In the year 2020, world population was 7.6 billion and the connected devices were 50 billion. This shows how IOT is spreading worldwide. IOT focuses on connecting “things” such as machines, to a computer network such as internet. Nowadays IOT related wireless technologies are developed in terms of protocols performance reliability, latency, cost effectiveness and coverage and also the IOT technologies are designed for short-range radio communication like Bluetooth, ZigBee etc. IOT networks have many topologies but the general one is star or tree-based. The data collected by group of sensors will be sent to central controller in order to guarantee centralized processing. Mesh topology is another topology which is generally used in the development of hardware devices. Network nodes in the mesh topology are directly and dynamically connected, therefore they allow many-to-many communications. Wearable devices which are made up of IOT technology will generate large amount of data. This should be stored for future analyses.

II. SURVEY CARRIED OUT

In survey paper [1], we observe the drivers exhaust driving and vehicle theft activity which causes real time problems such as accident causing many hazards. This system continuously monitors and tracks the vehicle at real time environment using web page in smart phone. If the driver chooses the wrong path the system gives alert message to the owner smart phone as well as Raspberry Pi audio system. This system also provides the children safety environment by using sensors and updating the alerts such as speed, time, location and date to vehicle owner with help of data base. These module gets interfaced with Raspberry Pi gives the information of longitude, latitude, speed, time of the vehicle by using real time tracking and stores the information in database server for further updating.

Super Login: In this provision, the vehicle’s owner can track the vehicle in this smartphone using super login on the web page. Here only owner can access this login.

Secondary Login: In this provision, the student’s parents can track the school vehicle in the smart login on the web page. Hence only registered student’s parents can access this login.

This system (Figure 1) provides safety and secure solution for wrong path alert using smart phone android application for the selection of particular selection of particular path from A to B through which the vehicle supposed to travel.

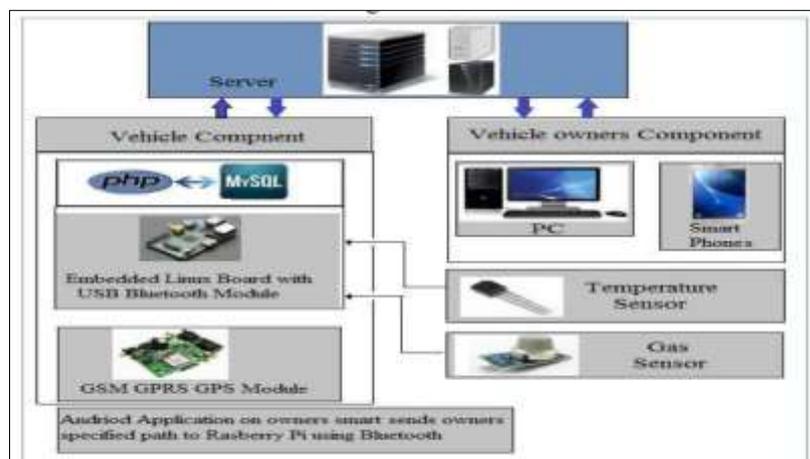


Figure 1 System Design

The system is only for the restricted application like only for school vehicle from any location A to location B. This system only sends the alert message to the vehicle owner mobile and Driver’s vehicle. On the wrong path, the system provides the vehicle current location. It does not consider the immediate response after the accident has been occurred, instead it just informs the driver regarding the alert message for wrong path or in case accident situation occurs.

In paper [2], we observe some criteria. Majority of accidents occur due to drunken driving. In this case, it is necessary to develop an appropriate in-vehicle system with warning modules that can directly improve driving safety. The Drunken Driving Law in India states that if person while driving a motor vehicle has Blood Alcohol Level exceeding 30mg of intake per 100ml of blood which is detected with the help of Breathalyzer.

These are some steps how the system works (Figure 2)

- A smart apparatus for ensuring seat belt usage will be designed.
- Alcoholic sensor will check blood alcohol concentration.
- Bumper sensor will help in saving driver life during vehicle collision along with designed system by sending SMS to ambulance, police station and relative.

- This system will control vehicle accident and make driving more safe which helps in saving the life.

Here they are using Bumper sensor impact then fuel supply will block. SMS is sent to relative, police station and ambulance along with the location of vehicle.

It deals with only alcohol sensor and Bumper sensor it does not control the overheating of engine, sometimes it leads to the collision.

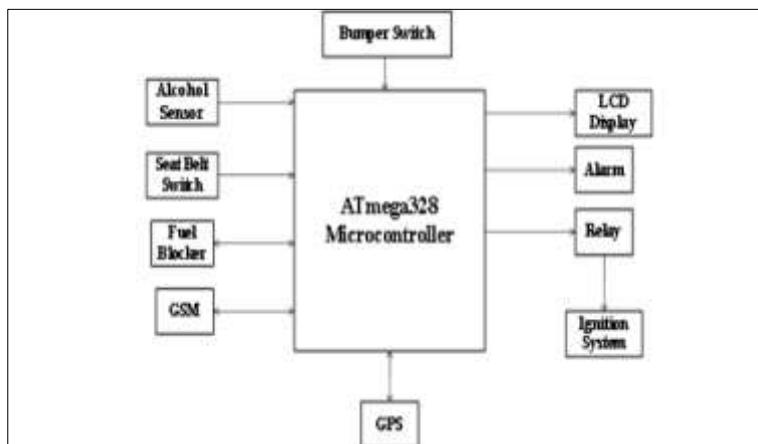


Figure 2 Block diagram

In survey paper [3], we observe that due to reduce in moral values once cannot get proper help when they need. This can be solved by this technology itself. Due to time laps many lives are in risk. To reduce this risk factor automatic accident detection and victim analysis play an important role. Reducing the time laps will reduce the death rate. Nowadays mobile is a common electronic gadget that is present with everyone and this problem can be solved by it only. By using technologies GPS and GPRS one can easily help the victim. Preventing overloading of vehicles and making sure that highways have a divider separating the two carriageways would also make a huge difference.

This is automatic system which will provide the solution for identifying the accident location and also the status of the victims in the accident. The physiological parameters such as heart rate, body temperature and coma stage status of the victims are the vital information transmitted to the nearest emergency care centres spontaneously when the accident occurred.

In order to do this system, we should have alcohol detector and by using alcohol sensors sensing of drunk state of the driver if it is in proper way next seat belt sensing module will come into appearance then it will sense that weather the seat belt is used or not. If all these conditions are OK then vehicle gets start. Once vehicle get started GPS system will continuously monitor for the accident prone area.

The complete integration with automobile, the accident identification module will be fastened with the standard Airbag ECU (Electronic Control Unit). This will optimize the proposed technology to the maximum extent and deliver the best accident identification system. The collision detection algorithm for the ECU of single point sensing airbag system has enhanced accident detection system to release the airbag provision in the present vehicles. So, the present work will be fastened with this existing system to provide the enhanced and instant result.

In [4] it describes how an accident is quickly sensed using 4 of its efficient and dynamic sensors (Figure 3). If it's a car-car or car-object collision, accelerometer aids in detection of accident. If it's a flip over accident, then there is a tilt sensor. If the accident is caused by leakage of inflammable gases or even if excess smoke, then there is a smoke detector sensor. Finally, if the engine overheats or the vehicle catches fire, then there is a heat sensor to detect it. Once, the accident and type are confirmed, that data along with the location (with the help of GPS module) is sent to the microcontroller which process it further before sending it to the server. The server further delineates the data to storage in the dedicated website for the perusal of police, hospitals and other EMS peripherals. This data is also simultaneously sent to the mobile app which is paired, which then sends it to the nearest hospital, nearest police station, hometown police station, 3 pre-set emergency contacts, pre-set Insurance company. The system guarantees maximum chance of emergency rescue officials arriving on the scene and thus minimizing the chance of the accident being fatal.

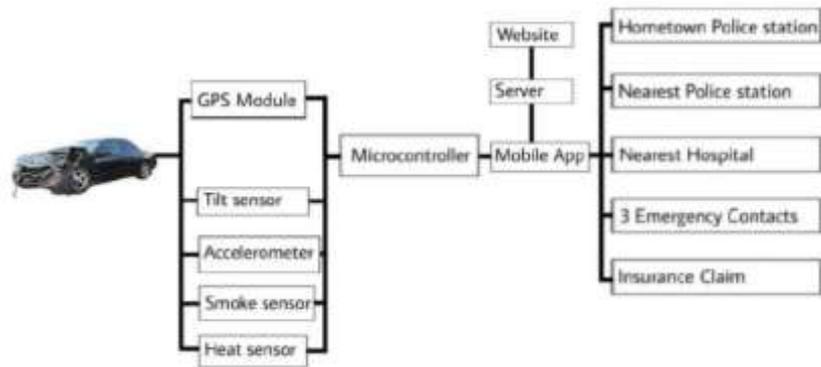


Figure 3 Pictorial representation of proposed system

In [5] the aims stated as follows:

- Switch on the ignition only if the seat belts are locked in.
- Deploy a gas sensor to make sure that driver is not drunk. If the driver is not drunk, then only the engine will ignite.
- To ensure the driver is not drowsy, eye-blink sensors are deployed in the automobile.
- To circumvent a crash, a proximity sensor is deployed to discover the interruption in front of the automobile on the path.
- To ensure post-crash safety, an alert system is deployed which makes use of a GPS system to attain the geographical location of the crashed vehicle and it is sent to a responsible and authorized individual. The accident is detected with the use of a vibration sensor.

The system sends location of the accident to an ambulance as well for quick medical response and attention. The system doesn't send location to the police station and emergency contacts. If the family is not notified, then the necessary help may not be received, because who else can we trust than one's own family.

In [6], when a vehicle meets with an accident, the piezo sensor and Micro electro mechanical system (MEMS) sensor will detect the signal and convert it into digital. This sign will be analyzed through Arduino. The Arduino sends the alert message through the GSM Module and the location will be detected through GPS module. And live location can be streamed and stored with the help of ESP-32 camera. Furthermore, the gathered data and will be converted to text message which will be sent to control station (Figure 4).

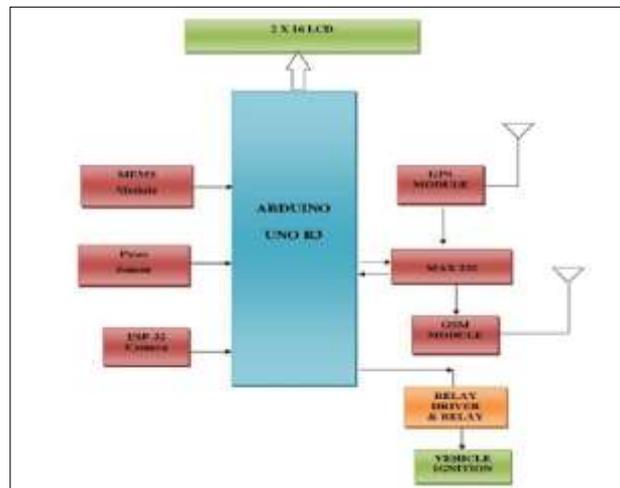


Figure 4 Methodology

Advantages:

- Sim card can be changed at any time.
- Anybody and straight forward to operate.
- Inform to the control station or rescue team immediately.
- Enlightened protection and Simple in Design.
- In case of theft car ignition can switch off with the useful resource of the usage of GSM.
- Live video streaming helps to identify the accident place.

Disadvantages:

- The mobile network may not be available and the notification to user may not be delivered in a timely manner.

- The GPS receiver's connections to the satellites may be hindered or time delay and the location information may not be accurate.

In [7], Theft of vehicle is a major misfortune for the proprietor of vehicle. As the quantity of vehicle expands, the quantity of issues related with them likewise increments, for example, road turned parking lot, vandalism and robbery. Every day around seventy vehicles are stolen with numerous cases stay unsolved expanding each passing year. This paper describes the design of a system that can give information of vehicle position every time there's a request for it.

It is the controllable system that combines GPS receiver module with GSM communication network. GPS (to point the location) and that data can be transmitted using GSM modem (as a means for communicating with the vehicle) through SMS (Short Message Service). The information accessed by the website and the position of the vehicle will be displayed through the Google Map. The system can be installed in vehicle at hidden place, the action starts by activating the engine without a key this will cause a signal to be sent to the microcontroller. The microcontroller will detect the signal and send a message to the owner via mobile phone and can stop the engine immediately by disconnecting the power supply.



Figure 5 Displaying the command



Figure 6 IoT Devices receiver side

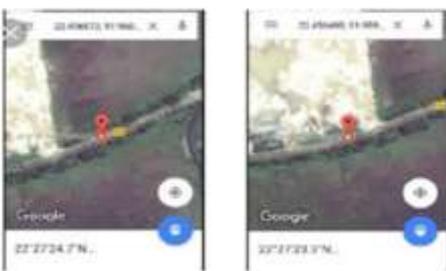


Figure 7 Location tracking using GPS



Figure 8 Getting outputs for the actions

Advantages:

1. It consists of an option to send police complaint. When the complaint is sent to that police station the information of the vehicle will also be sent including the vehicles location.
2. It can store owner's close friends details in the program and that will be considered during friend's alert system. When the owner is very far away from his vehicle he can activate friend's alert system so that the vehicle's location can be tracked by those friends.

Limitations:

1. It consists of two power supplies of the framework. So it consumes lot of power and it may be costlier for the consumer.
2. It has a feature called voice announcement system. When the owner activates it then the voice announcement like "Driver is thief" will start shouting. But owner has to continuously keep on tracking the vehicle to know that if the vehicle is in a crowded area then he can activate this. It wastes the time of the owner.

In [8] presentation of a literature survey on Automobile safety, practice of design and regulation. Automobile safety is the study and practice of design, construction, equipment and regulation to minimize the occurrence and consequences of traffic collisions.

Deaths and injuries from these roadway crashes result in increased costs to employers and lost productivity in addition to their toll in human suffering.

OCCUPATIONAL DRIVING: Truck drivers tend to endure higher fatality rates than workers in other occupations, but concerns about motor vehicle safety in the workplace are not limited to those surrounding the operation of large trucks.

CRASH AVOIDANCE: Crash avoidance systems and devices help the driver and, increasingly, help the vehicle itself to avoid a collision.

DRIVER ASSISTANCE: It helps the driver to detect obstacles and to control the vehicle.

CASHWORTHINESS: Crashworthy systems and devices prevent or reduce the severity of injuries when a crash is imminent or actually happening.

POST-CRASH SURVIVABILITY: Post-crash survivability is the chance that drivers and passengers survive a crash after it occurs. Technology such as Advanced Automatic Collision Notification can automatically place calls to emergency services and send information about a vehicle collision.

PEDESTRIAN SAFETY: The attention has also been given to vehicle design regarding the safety of pedestrians in car-pedestrian collisions.

LIGHTS AND REFLECTORS: Vehicles are equipped with a variety of lights and reflectors to mark their presence, position, width, length, and direction of travel as well as to convey the driver's intent and actions to other drivers.



Figure 9 Working of proposed system

Advantages:

1. Automatic Braking systems to prevent or reduce the severity of collision.
2. Infrared night vision systems to increase seeing distance beyond headlamp range.
3. Adaptive cruise control which maintains a safe distance from the vehicle in front.

Disadvantages:

1. Infants left in cars: Very young children can perish from heat or cold if left unattended in a parked car.
2. Infants and children: Vehicle restraint systems such as airbags and seat belts, far from being effective, are hazardous if used to restrain young children.
3. Pregnant women: Unrestrained or improperly restrained pregnant women are 5.7 times more likely to have an adverse fetal outcome than properly restrained pregnant women. If seatbelts are not long enough.

In [9], the wired connections to the vehicle will give appropriate analog signals to the device. The controller will convert these analog signals into digital signals and with the help of GSM and GPS, the digital data will be transferred to the web server. The web server has the business logic written. It will process the digital data to give desired results. We are taking only three parameters-speed, longitude, and latitude. We have used Google maps integration services to convert the longitude and latitude into the proper address and display it on the map to the users. The device will be connected to the GSM service provider through the GSM network. Using it, the data is sent over to the tracking server. Our tracking server, i.e. the business logic consists of a socket listener application running in the background, which keeps listening on a predefined port. The GPS parameters are received by the socket on that particular port and stored in the database after proper conversion. Finally, we have hosted our web app using AWS server and through this interface, all the functionalities can be seen and used by the user.

Advantages:

1. It is used for accident detection, finding lost vehicles, identifying fuel theft and towing, and taking corrective decisions based on the meaningful insights generated by the system.
2. It is effectively used in tracking purpose of cabs/taxis, stolen vehicles, school/college buses etc.
3. The system is cost effective by minimizing the hardware cost and software requirement.

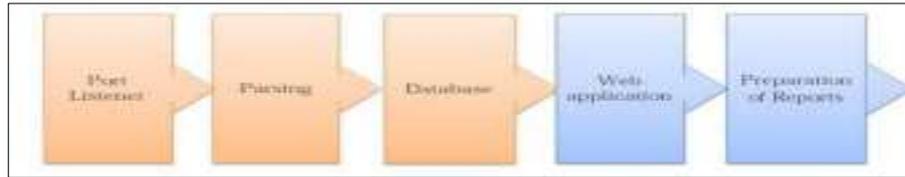


Figure 10 Working of web app using AWS server.

In [10], android application detects an accident using an accelerometer which is built in the smart phone. The phone must be docked inside the vehicle and not held by any person. The working of this application is as follows: When the device is tilted above a certain threshold and is detected by the accelerometer, the application waits for 15 seconds. Here, three kinds of input can be received. If the user is active, he can press “cancel” if the device was tilted by mistake. If the user is active, he can press “send” if an accident has occurred. If the user is inactive and no button is pressed after 15 seconds, an accident is assumed to have occurred. The current location is fetched by GPS and a pre-recorded voice message along with the location is sent to the 108 ambulance emergency response service. A study on GPS services provided by Android has been thoroughly conducted. Thus, through the use of just a smart phone without any extra hardware components, efficient accident detection and notification has been achieved.

Advantages:

1. The system uses a GPS module which is now present in almost all vehicles and is also cheap.
2. The system also allows the emergency center to gauge the severity of the accident by sending the previous speeds of the vehicle and moreover allows the vehicle occupant to manually turn off the alarm and hence reduce false alarms.
3. There is also a method to stop sending the alert message and hence save time of the rescue time.
4. Both the accident and the accident location can be detected as opposed to only one in the other approaches.

Limitation: The live system can't work if any of the following occur at the time of the crash: Automatic or phone is disconnected or damaged. No GPS signal at the time of the crash.

In [11], the author proposed an intelligent system (Figure 11) that composed of a GPS receiver, Vibration sensor, GSM Modem and integrated with Vehicular AD-Hoc Network (VANET). The employee of VANET by enhanced Ad hoc On-Demand Distance Vector protocol (AODV) helps these services in finding the optimum route to the emergency message. The use of GSM, GPS, and VANET technologies allows the system to track vehicle and provides the most instant and accurate information about the vehicle accident spot. Vehicle Ad hoc Network is a Network which contains mobile nodes that topology constantly changing. The mobile nodes can move quickly from one place to another place. Most current VANET routing protocols select paths according to minimum hop count. Minimum hop paths have poor performance because they tend to contain wireless links between far nodes. These long wireless links can be slow or lossy, leading to poor throughput. Cause to mobility the link between far nodes is broken speedily.

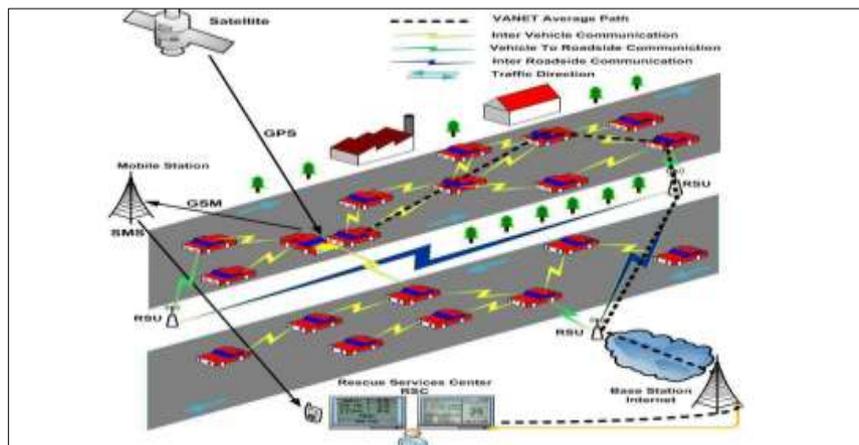


Figure 11 Accident detection system and VANET

In [12], proposed system presents the development and implementation of a digital driving system for a semi-autonomous vehicle to improve the driver-vehicle interface. The system is able to monitor Road lane violation, Drowsiness and Alcohol with the help of camera and sensors. The main objective of the system is to provide safety and to avoid road accidents. The system uses two ARM controllers i.e. Master for detection and Slave for controlling the parameters. The use of CAN protocol is used for communication between ARM controllers. A model is developed on which camera is mounted for lane detection, Sensor for alcohol and drowsiness detection and a GSM and GPS modules are mounted for tracking purpose. Whenever the lane is departed a warning is displayed to driver. A tracking system is also used to keep the track, which uses a GPS module. These detected data by controllers is displayed on the PC.

Master section: The Master block is responsible for controlling unauthorized Lane shifting and monitoring alcohol and drowsiness. From the Figure 12, the master section is ARM controller 2. Whenever alcohol or drowsiness of a driver and lane shifting is detected

the controller monitors and provides control action like interlocking the vehicles ignition system, alerting the driver and controlling unauthorized Lane shifting. The Master is connected with GPS and GSM module which are interfaced to the controller to keep the track of the vehicle and it sends the latitude and longitude information to the tracking section.

Slave section: Slave section in Figure 12 is ARM controller 1. The Slave block is responsible for detecting the Alcohol content and Drowsiness of the driver. The alcohol detection is carried out with the help of MQ303 alcohol sensor and drowsiness is carried out with eye-blink sensor. It is also interfaced with camera which is facing down the road, as it is monitoring the Lane detection for accident avoidance. Mobile camera is connected to Personal Computer wirelessly which is responsible for detecting and controlling of unauthorized Lane shifting. PC is connected to ARM controller via. RS232.

Tracking section: Tracking section consists of a Personal Computer and a GSM module. Personal Computer is installed with maps connected to internet. GSM module is responsible to get the SMS from the slave block's GSM module. The SMS contains the information of present latitude and longitude (location of vehicle) which is helpful to keep the track of vehicle.

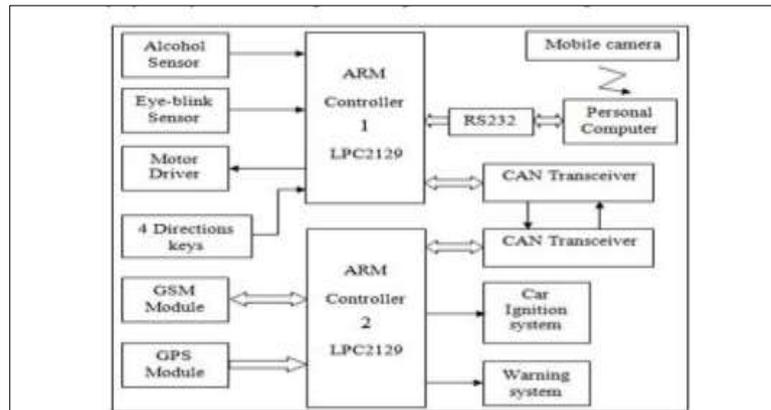


Figure 12 Proposed block diagram

CONCLUSION

The brief framework by this literature review we are going to conclude that with the continuous advancement in science and technology, more emphasis is given for vehicle safety. With the increase in number of vehicle, the number of road accident is also increasing day by day, so it is our duty to control it. Mostly the accident takes place because of drunk drivers, drowsiness while driving and overheating of engine causing fire. Implementation of this project will help to decrease the accident caused because of above reason. Our system integrated with a Temperature sensor, eye blink sensor, alcohol sensor, accelerometer using the concept of GPS and GSM has been implemented. Alcohol sensor detects if the driver is drunk or not, Eye blink sensors detects whether the driver is drowsy, temperature sensor helps us in detecting the heat of the engine, accelerometer detects the occurrence of accident. Unfortunately, if accident happens to take place, the system detects it and with the help of GPS exact location can be pointed and informed to emergency unit using GSM module. This helps to save many lives by informing rescuing agent in time. Over all, this system is very affordable, targets common people and easily implemented in all types of vehicles and will control vehicle accident and make driving more safe which helps in saving the life.

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