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Automatic Vehicle Accident Detection and Messaging System Using GSM and GPS Module

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Abstract: ***As more and more people migrate from village to urban area; the urban lifestyle is becoming more complex. The condition of the road is also become worse due to heavy traffic and high ratio of vehicles on roads. Road collisions, which incur significant destruction of life and assets, are on the rise daily as the number of vehicles grows. The World Health Organization's (WHO) study estimates that fifty million individuals are harmed and a total of 1.35 million individuals die each year in the world. The absence of medical help at the scene of an incident or the long response time during the rescue effort is the main causes of mortality. The majority of fatal accidents result from the lack of an appropriate medical facility at the scene. In order to monitor the mechanical condition of their vehicles and to give their valued customers personalized services, the majority of enterprises today employ a variety of previously established smart sensing systems. These systems also give clients access to vital smart recommendations enabling them to safely operate their cars them to operate their cars safely. We increase the security of the person by assessing their position while they are moving and keeping track of the cars by sending SMS by utilizing all of this preloaded smart monitoring equipment. With the help of the GSM module, our system would transmit the accident's precise location to the registered mobile numbers as well as the ambulance, the passengers' families, and the closest police station. The system that we propose in the automobile would first detect the accident using vibration detectors, and then detect the axial and latitudinal location of the site of the collision using GPS. Finally, it would determine the precise position of the car. In this study, an acceleration sensor can be employed as a vehicle rollover or crash detector both during and after a collision. A serious accident can be identified by keeping an eye on data collected by the accelerometer and vibration sensor. The major goal of this initiative is to reduce the amount of time it takes to get to the accident scene and deliver emergency medical care that can save lives. When an accident occurs in a remote place and no one is available to report it, this technique may prove to have been a lifeline. By responding quickly, emergency services can prevent an accident from happening and save a life. In this study, we looked at a number of articles about accidents detection devices and the effects of their use.***

Keywords: Accelerometer, Vibration sensor, Arduino Uno, GSM Module, GPS Module, Buzzers, Microcontroller.

I. INTRODUCTION

Every person, whether they reside in cities or countryside, has a basic desire for travel. You can get from one location to another in a variety of ways, including via air, sea, train, and road in automobiles, motorcycles, buses, and trucks. The main means of connecting cities and villages are roads. Due to how convenient driving is, cars are now the primary mode of transportation. With more automobiles on the road, there is a higher likelihood of crashes involving vehicles (Vas). When traveling, especially in terrible weather (BWC), one never knows what will happen on the next route. Vehicles can be split into two primary categories: equipped (EVs) and non-equipped (EVs). Evs are equipped with sensors to help them prevent or spot accidents. Evs include automobiles with a microcontroller with various sensors or a smartphone-based application [1].

Each year, there are more fatalities and cases of permanent impairment due to daily traffic accidents. According to a study in the New Age every day, 6,749 traffic accidents in the country resulted in at least 9,951 fatalities and 12,356 injuries in 2022. The primary causes of crashes are speeding, careless driving, driver exhaustion, the presence of stray animals on the roadways, and inadequate infrastructure. Due to the emergency medical services' slow reaction, the majority of deaths and impairments in these incidents occur. The period immediately following a traumatic injury is referred to as the "golden hour," during which time the likelihood of preserving a person's life rises, on average, by one-third. As a result, enormous resources have recently been devoted to supporting effective and timely rescue attempts [2].

Today, vehicles play a significant role in our daily lives. They help us get to work, communicate with friends and family, and transport our goods. But it can also result in catastrophe for us or even result in our deaths due to mishaps. One of the most

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significant and fundamental danger factors when driving is speed. It not only influences the severity of a crash but also raises the likelihood of getting into one.

Accidents still happen occasionally despite the numerous efforts made by numerous public and nonprofit organizations throughout worldwide through various initiatives to raise awareness against irresponsible driving. If emergency personnel had been able to get the accident data in time, many lives might have been saved. This will help with accident detection and notification, potentially preserving the lives of the wounded. When an accident occurs in a remote location with no one nearby to report it, this technique could be utilized to handle it. Vehicle use has risen linearly over the previous generation, raising the risk to human life. This is because there aren't enough places for emergencies. As a result, we are implementing a warning system to help with the emergency system and accident system improvements in order to get around this dilemma. The technology alerts the rescue team to the accident's occurrence and sends them the accident's coordinates, or the location's longitude and latitude. The system will classify it as an accident if there is an unanticipated acceleration measured by the accelerometer and a significant change reported by the vibration sensor. From that point on, it will notify the GSM and GPS modules, which will then detect the location and send a message stating what happened with the place where it happened. This research assists in offering a workable remedy for the dire situation it makes possible. The current approach primarily prioritizes passenger safety rather than providing emergency assistance in the event of a collision. Our system is designed to automatically identify accidents and notify the closest hospital or emergency services of their exact position. This device delivers essential information to an emergency rescue team seconds after an accident. This technology will aid in the saving of lives by detecting accidents and alerting rescue crews in a much shorter amount of time. The location of the mishap, its timing, and its angle are all listed in the alert message. With the aid of a sensor, the apparatus is activated when an accident is detected. The sensor sends the microcontroller its result [3].

When an accident occurs, the values of the speedometer or vibrator are modified, and the system then checks to see if there are any differences between the two values. If the parameters are altered, the GPS module captures the precise location, and the communication of the location is delivered through SMS via the GSM module, which is sent to the registered cell phones and the ambulance. As a result, the rescue crew can arrive at the accident site without delay by clicking the address hyperlink in the received message, which will direct them to Google Maps. Additionally, the system will send a message to the registered mobile phones informing friends and family about the accident [4].

Accidents still happen occasionally despite the numerous efforts made by various governmental and non-governmental groups throughout the world through various programs to raise awareness against irresponsible driving. If the emergency services had been able to get the crash information in time, many lives might have been saved. According to a study by Virtanen et al., 4.6% of accident fatalities may have been avoided in Finland alone if emergency services had been available at the scene of the accident at the appropriate time [5]. Therefore, saving the priceless human life depends on effective automatic accident detection and automatic notification of the emergency services with the accident location. Today, GPS is a crucial component of every automotive system. The American Department of Defense (DoD) created the well-known technology of GPS for use by the military. It was later made available for civilian use. It can deliver precise time, coordinates, and speed. GlobalSystem for Mobile Communications (GSM), on the other hand, is a popular digital mobile telephone system. GSM services are offered by more than 690 cell phones in 213 nations, and 82.4% of all mobile connections worldwide use GSM. In addition to voice communication, it provides data transfer via Short Message Service (SMS) and General Packet Radio Service (GPRS). Since the early 1960s, modern navigation has used a variety of sensors to gather data and determine a vehicle's location. In recent days, GPS has become a dominant source for position information in a vehicle.

Additionally, it suggested sending a location through SMS when providing emergency services. The J2ME platform, which is expensive and exclusive to certain phones, was the system's suggested usage [6]. Amin et al. suggest using the GPS speed data to create an accident detection system. However, the MM was not used by the authors [7]. In light of the fact that a vehicle is constrained by the road network, this study suggests using the MM capacity to monitor the position of a vehicle and detect an accident based on the monitored position and the vehicle's speed. When an accident is discovered, the Rescue Service Center will be notified of its location via the GSM network.

II. RELATED WORK

In paper [5], a framework is presented by the researchers proposed system which will sense it and inform passenger's relatives, nearest Police Station and Medical Facility for performing requiredemergency action but it is time consuming system. In paper [8], the researchers presented an accident management system to find out dangerous driving can be detected. It can be used as a crash or rollover detector of the vehicle during and after a crash. With signals from an accelerometer, a severe accident can be recognized.

The proposed scheme is not suitable to limit due resources. The technique used a severity scale to measure the impact of an accident.

In paper [9], the authors presented a system to detect an accident at GPS & GSM Based Accident Detection And Auto Intimation that alert message is sent to the rescue team which is uncertain for accident happened area. In paper [4], [10], [11] the researchers proposed a notification system based on a call by utilizing different components, such as sensors, Wi-Fi module etc. for detecting accident of vehicle but it time consuming. In paper [3], [12], [6], [13], the researchers provided a strategy for detecting using different sensors which are study based system and others are used mobile application which is not available all time to monitor for detect location. In paper [7], [14], [15], the researchers presents automatic vehicle accident detection and reporting System using black box. This framework is placed in moving vehicle to detect accident using alcoholic sensor, crush detect sensor, arduino uno and relay module which is cost consuming system. In paper [[3], [16], [17], [18], [6], the authors discussed a technique for accident detection by using hardware with different sensors and Automatic Accident Detection and Reporting Framework for Two Wheelers. In paper [19], [20], [21], the researchers detect an accident with the use automatic vehicle detection using GPS and challenging an image processing which complex process is for detects location where an accident occurred. In paper [22], [23], [10], [24], the researchers presented a system that detects an accident by observing the condition of a car accident alert system using pressure sensing devices and vibration sensor to determine the collision impact of an accident and a gyro sensor to determine the x-y displacement of the vehicle. In paper [[25], [26], [2], [27], the researcher presented an accident detection system and notifies the concerned number in case of an accident A Novel Internet of Things-Enabled Accident Detection and Reporting System for Smart City Environments which is complex structure and costly. In paper [10], the researchers provided a strategy for detecting finding the occurrence of any accident and reporting the location of accident to the previously coded numbers so that immediate help can be provided by ambulance or the relatives concerned. GSM technology is used to intimate the vehicle position in the form of latitude and longitude coordinates through sms. According to the author, different sensors sense the situation of occurrence of accident occurred to place then inform medical ambulance for save people which is costly time wastage system.

Asmitha H et al proposed an IEEE paper titled as Accident Avoidance and Detection but it has a limitation that if power supply fails, the circuit won't work. The author R.Saranya published a paper titled as Vehicle Accident Prevention using Sensors but the system is not portable. Pranali Revankar has published a paper titled as Vehicle to Vehicle Communication using Zigbee and it has disadvantages such as jamming, bogus traffic information. The author Shwetha Patil published a paper named as Accident prevention and detection of collision using RFID tags but here the face detection is not accurate. The author Kumar proposed a paper titled as Accident detection and alerting system using GPS & GSM and it has a disadvantages of having several number of hardware devices and difficult to operate [1], [25]. A Study" where only show the study bases GSM technology for accident detection [3] . In paper [28], Monagi H. Alkinani et al. 5G and IoT Based Reporting and Accident Detection (RAD) System to Deliver First Aid Box Using Unmanned Aerial Vehicle which is costly with drone type accident system.

In this paper the section II deals with the proposed system model and its implementation and section III deals with the results and discussion and section IV deals the output obtained from this project and discussed the future enhancement and the last section listed the numerous references related to this project

III. HARDWARE DESCRIPTION

A. Arduino Leonardo

The ATmega328P serves as the basis for the Arduino Uno microcontroller board (datasheet). It contains 6 analog inputs, a quartz crystal with a frequency of 16 MHz, a USB connection, a power connector, an ICSP header, and a reset button. It also has 14 pins for digital input and output, 6 of which may be used as PWM outputs. It comes with everything required to support the microcontroller; to get started, just use a USB cable for linking it to a computer, or an AC-to-DC converter or battery to supply electricity to it.

You can experiment with your UNO without worrying too much about making a mistake; in the worst situation, you can start over by replacing the chip for a few bucks. The word "Uno"—which translates to "one" in Italian—was selected to signify the launch of the Arduino Software (IDE) 1.0. Version 1.0 of the Arduino Software (IDE) and the Uno board served as the foundation for further editions of Arduino.

The open-source Arduino platform is used to create electrical projects. With Arduino, you can write and upload code for computers to a physical programmable circuit board (commonly called a microcontroller) using a piece of software called the IDE (Integrated Development Environment), which runs on your computer. Because the Arduino IDE employs a condensed form of C++, learning

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to program is made simpler. Finally, Arduino offers a standard form factor that separates the microcontroller's functionality into a more usable packaging.

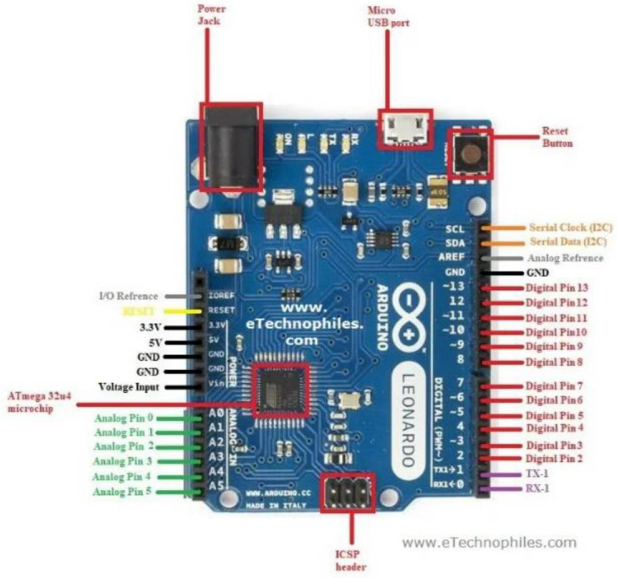


Figure-1: Arduino Leonardo Circuit

1) Accelerometer sensor- Accelerometers detect acceleration and vibration. It describes a way to gauge how quickly speed varies. An accelerometer sensor is used to detect both static (earth gravity) and dynamic acceleration. All three axes of acceleration are measured. These three axes are up/down, left/right, and forward/backward.
2) Accident Detection Phase- Accident prevention strives to reduce the number of fatalities in road accidents other unpleasant incidents that occur while driving. The accident incidence is determined at this phase using a variety of components, including a microphone, pressure sensor, accelerometer, and GPS. These components' further information are as follows.
3) LCD- The operation instructions and output location are shown on the LCD panel.



Figure-2: LCD Display Panel

4) RESET- At any time during operation, the microcontroller can be reset using the reset button. It can be applied to complete message transmission. The microcontroller resets and the function start over if the reset button is pushed.

B. GSM- Global System for Mobile Communication

For the transmission of mobile communication and information services, GSM is an open, digital cellular technology. The most prevalent cellular technology in use today is the GSM system. A number of factors have contributed to its popularity as a mobile phone technology, including the ability to roam internationally and the assurance of being able to use GSM networks. Additionally, it is quite affordable and less pricey.



Figure-3: GSM Module

C. GPS- Global Positioning System

A satellite navigational system called GPS (Global Positioning System) is used to locate an item on the ground. A GPS receiver may receive geolocation and time data from this global navigation satellite system anywhere on or near the planet. Here, GPS is employed for both navigation and tracking. As a result, a base station can track the cars, and a navigation system may assist the driver in getting to their destination.

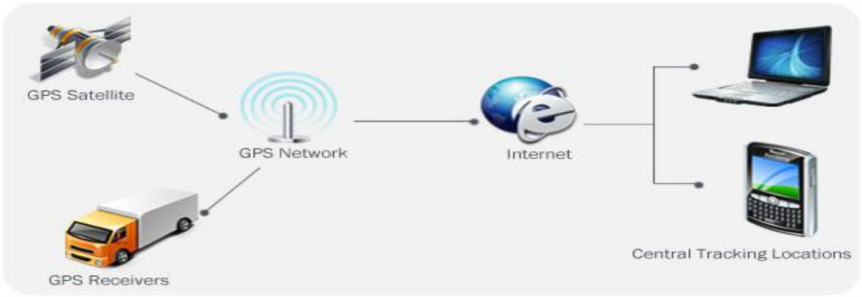


Figure-4: GPS Tracking System

D. Frequency Response Of Vibration Sensor (Adxl335)

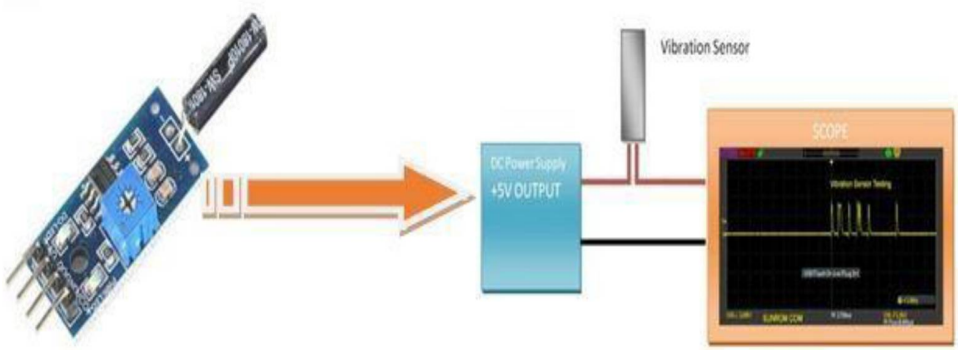


Figure-5: Frequency Response of Vibration Sensor (ADXL335)

A little spring mechanism serves as the sensor's main component. When the applied vibration force rises over a particular threshold, the spring turns on the contact. From it protrude two legs. A resistance value greater than 10 MOhm often separates the two terminals. A brief short circuit forms between the two terminals when a vibratory force is applied to the switch, which causes the spring within to vibrate. System to detect vibration installed on an internal spring. The movement of the spring system causes it to make contact with the exterior wall and produce output voltage.

E. L293D Driver

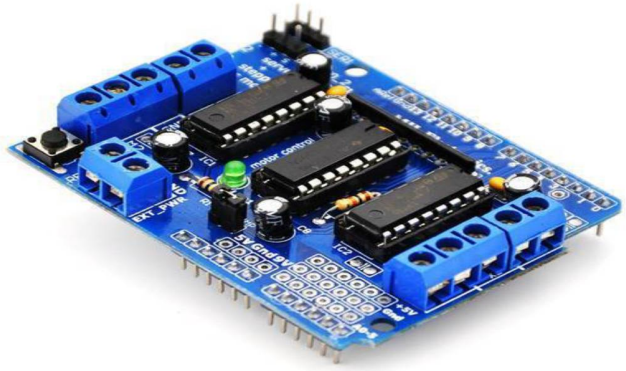


Figure-6: L293D Driver

It operates on the H-bridge theory. A circuit called an H-bridge enables voltage to flow in either direction. H-bridge IC are perfect for operating a DC motor because, as you are aware, voltage has to alter its direction in order to allow the motor to revolve in either a clockwise or an anticlockwise manner.

F. Buzzer

A buzzer is a signaling tool that uses electricity to produce a buzzing sound. When an accident happens, the gadget is engaged and the buzzer beeps to let you know.



Figure-7: BUZZER Module

G. EEPROM

The user can keep and update at any moment the phone numbers of the police and family members in EEPROM. Even if the power is out for a long period, the saved data will remain intact.

H. Battery

An apparatus that stores chemical energy and transforms it into electrical energy is a battery. Electrons move from one substance (electrode) to another through an external circuit during chemical reactions in batteries. An electric current can be created by the passage of electrons and employed to perform tasks.



Figure-8: Rechargeable Battery

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IV. DESIGN METHODOLOGY

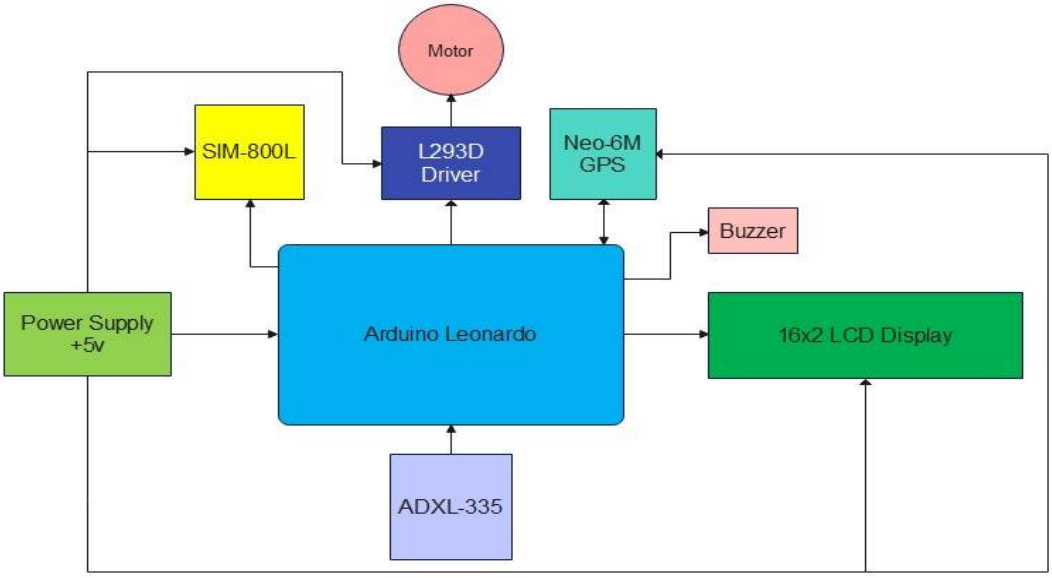


Figure-9: Methodological Diagram

A sensor ADXL-335 will sense the occurrence of an accident and give its output to the microcontroller. Here a button sensor is used for detection which will get pressed when the vehicle meets with an accident. A buzzer is present in this system with starts beeping indicating that the system is now activated. The GPS detects the latitude and longitudinal position of the vehicle. It is essential to locate the position to provide medical assistance. The phone numbers are pre saved in the EEPROM by the user. These numbers can be changed at any point of time. The microcontroller sends an alert message to these pre saved numbers using the GSM module. Any message can be pre entered in the system by the user. A LCD screen displays the status of the output. In case there is no casualty, the sending of the message can be terminated with the help of a switch. The switch will restart the microcontroller and its function will start from the beginning.

V. CIRCUIT DIAGRAM

To begin with implementation, Arduino is connected to GPS and GSM module also LCD display. Sensor, Buzzer is connected to driving motors and finally power supply is connected to arduino and different devices. Once the connection is set up, configured to the Arduino esp software following the pin configuration for the implementation.

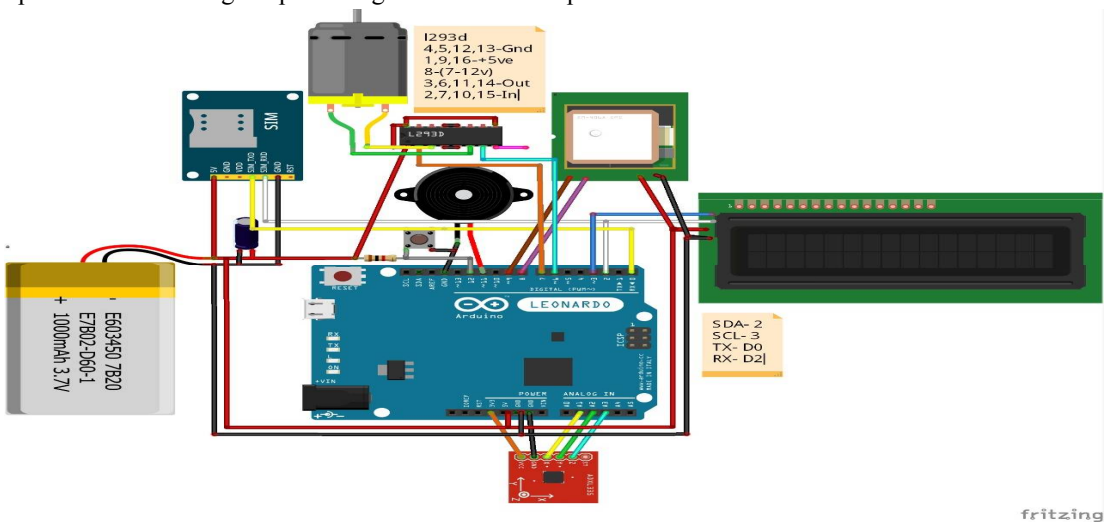


Figure-10: Circuit Diagram

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VI. IMPLEMENTATION

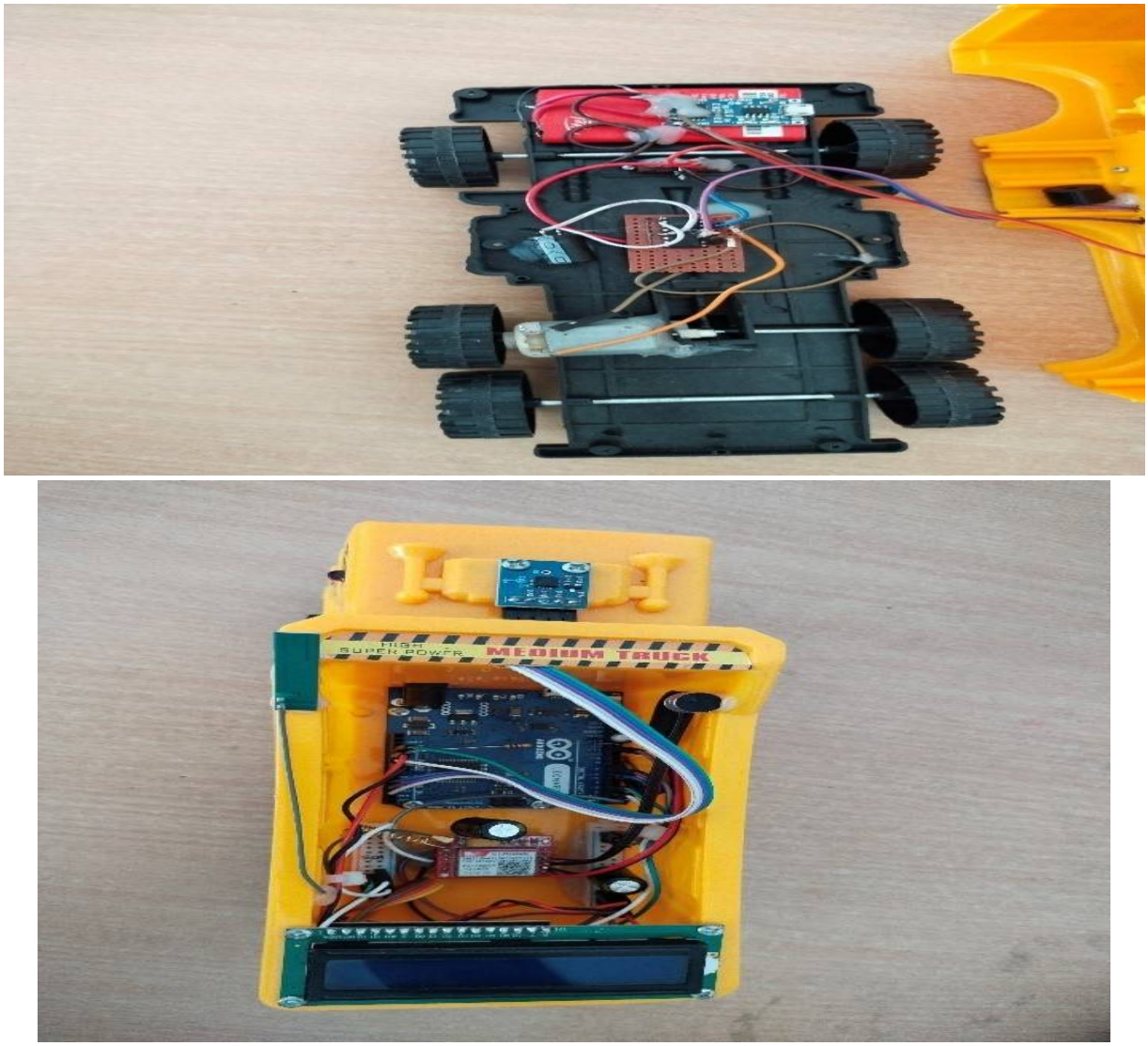


Figure-11: Implemented View of Complete System

The Arduino Uno is employed in this system as a microcontroller that oversees the whole detecting system. Additionally, it has parts like LEDs and infrared sensors. On the side of the road, two IR sensors are used. These sensors are mutually exclusive and are wired to ATmega328P microcontrollers. The position of the vehicle is determined based on the output from the sensors, and this information is supplied to the microcontroller. The drivers are then cautioned by LEDs installed on either side, which regulates traffic at the turn. In this study, an Arduino serves as the microcontroller and a vibration sensor to detect an accident. Additionally, it has elements like the GPS and GSM modules. In order to provide information to the Arduino, which then sends it to the GSM module, the GPS module and vibration sensor must operate together. The GPS module works in conjunction with the vibration sensor to deliver the latitude and longitude information of the accident region when it detects an accident. Other motor drivers receive this information after it has been transmitted to the GSM module. The Arduino Uno, which helps move the message to other gadgets in the system, serves as the system's brain in this study. When an accident happens, the vibration sensor will be triggered, and the GSM module will then transmit the data to the registered number. The physical coordinates of the region can be covered by the location being transmitted through a tracking system using GPS. A vibration sensor, which serves as a key component of the system, is capable of spotting an accident. By giving patients medicine on the scene of the accident, it might be prolonged. A message is sent to the associated mobile phone in the interim so that assistance may be sent as quickly as feasible.

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VII. DETECTION ACCURACY MEASUREMENT

Attempt of Occurrence	Detect of Clash?	Detection Number of Clash	Number of Clash not Detect	Accuracy of Detection (%)
1	Yes	14	1	$=\frac{14}{15}*100\%$ $= 93\%$
2	Yes			
3	Yes			
4	Yes			
5	Yes			
6	Yes			
7	Yes			
8	Yes			
9	No			
10	Yes			
11	Yes			
12	Yes			
13	Yes			
14	Yes			
15	Yes			

Table-1: Accuracy Measurement

VIII. RESULT AND DISCUSSION

The use of the implemented method for detecting automobile accidents demonstrates that it has produced notable outcomes for pinpointing the site of accidents using GSM and GPS systems. When an accident occurs, this technology communicates the position to Google Maps so that connected users may quickly locate the scene and call for police or emergency medical assistance. With regards to accident detection, this technology has a 93% accuracy rating. All classes of users may use this technology, which is affordable and effective for saving lives, and it is excellent for tracking faraway locations in unintentional cases.

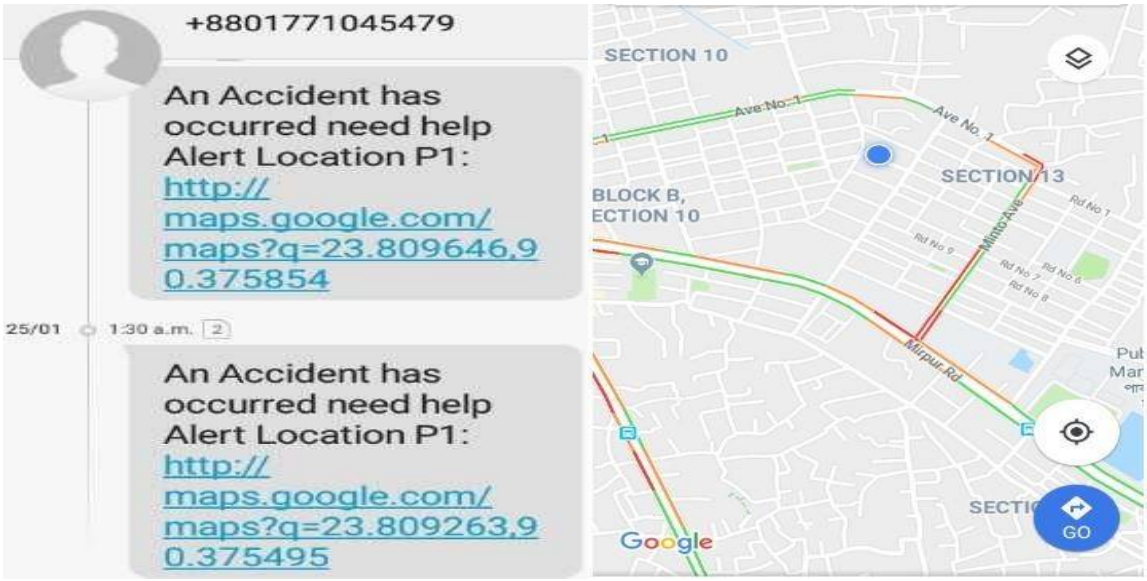


Figure-12: Accident Detected Location in Google Map and Sending Location Message in Remote Mobile

IX. CONCLUSION

With the help of an SMS message sent to the registered mobile numbers, the suggested system is designed to convey the victim's accident location to the responsible parties. In order to locate the car and communicate accident information, this system employs a GPS module and a GSM module.

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Accelerometer and vibrator technology are used in this system to improve the efficiency and accuracy of accident detection. In the way we live our daily lives, it will be quite important. This project's primary goal is to reduce the likelihood that someone may perish in an accident that we cannot prevent. For incidents that happened at odd hours, in remote locations, or when it was dark, this gadget creation is much more helpful. Future days will see a considerably more significant impact on daily life from this car monitoring and accident alarm capability.

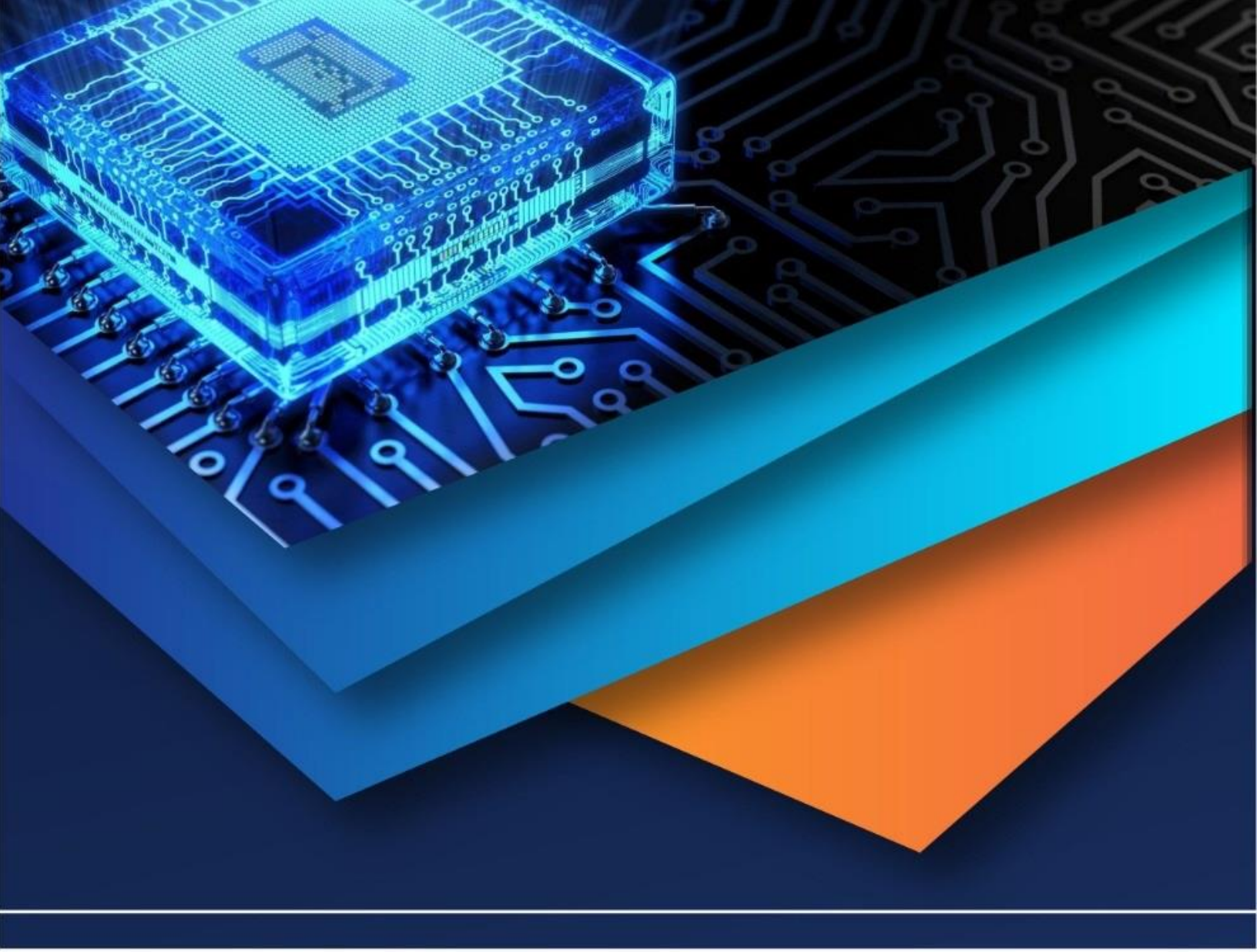
X. FUTURE SCOPE

The system may be made better by adding a face recognition algorithm that focuses on the driver's eyes and continually checks their level of alertness. A modeled car uses the developed system, which may also be interfaced to a real-world vehicle to collect data in real time. By giving the sensors a casing, the system may be made crash-proof and the effect of an accident will be lessened.

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