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IOT BASED VEHICLE TRACKER

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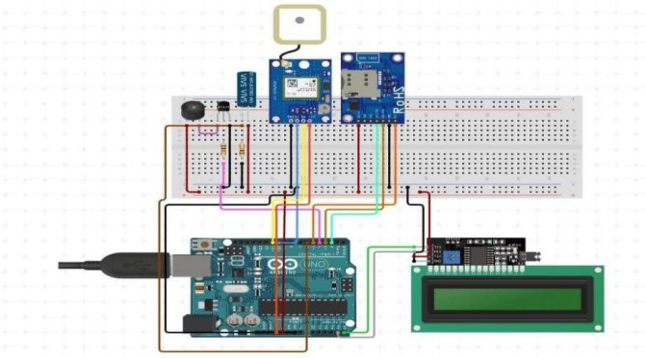
ABSTRACT

This project aims to address the critical issue of individuals being left without assistance in the event of an accident while riding their vehicle. With the implementation of an accident detection and alert system, this project seeks to provide a solution to this problem. The system utilizes an Arduino, GPS Receiver, and GSM module to control the entire process. The GPS Receiver identifies the vehicle's direction, while the GSM module sends an SMS containing the directions and a link to Google Maps to the assigned contact. The system can detect severe accidents using a Vibration sensor and can also identify rollovers. The microcontroller sends this information to the GSM module, which transmits the data, including the victim's precise location, to the assigned contact. The contact can then use the GPS MODEM to locate the victim and provide immediate assistance. This project offers a professional and innovative solution to a significant problem, ensuring the safety of individuals riding their vehicles. The implementation of the Accident Detection and Alert System using Arduino is a highly effective solution, particularly in developing nations such as Nepal, India, and Bangladesh where the number of vehicles on the road is rapidly increasing. With the rise in vehicular accidents, fatalities have also been on the rise. However, the Accident Detection and Alert System using Arduino can prevent uncertain deaths by sending a message alert to a registered mobile number, providing the precise location of the accident through a Google map link. This system is a valuable investment in ensuring the safety of drivers and passengers alike.

Keywords: GSM Module, GPS Modem, Ardunio Uno, Google Map Link.

I. INTRODUCTION

In the twentieth century, the automobile industry experienced exponential growth, leading to a significant increase in the number of vehicles on the road. Unfortunately, this also resulted in a rise in the number of accidents, primarily caused by heterogeneous traffic and a lack of traffic separation. Shockingly, India has the highest number of road accident deaths globally, with 13 million fatalities reported in 2014-15 alone. These statistics only account for recorded accidents, and the actual number is likely much higher. Fortunately, modern navigation technology, such as GPS, has become an integral part of vehicle systems. By utilizing various sensors, GPS can accurately locate a vehicle's position on the road network. Map Matching algorithms integrate GPS data with spatial road network data to identify the correct link on which a vehicle is traveling and determine its physical location. This technology can be utilized to detect accidents and alert Rescue Service Centers, providing immediate assistance to accident victims.



While existing accident detection and prediction systems have limitations, our system aims to automatically detect accidents and alert the nearest hospital or medical services of the exact location. Our device can detect accidents and send alert messages to rescue teams in significantly less time, potentially saving lives. The alert message includes geographical coordinates, time, and angle of the accident. The device is activated by a sensor,

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which sends its output to the microcontroller, triggering the alert. Our project utilizes a GPS and GSM module for optimal performance. As road safety continues to be a major social concern globally, our system offers a professional and effective solution for detecting and responding to accidents.

Block Diagram

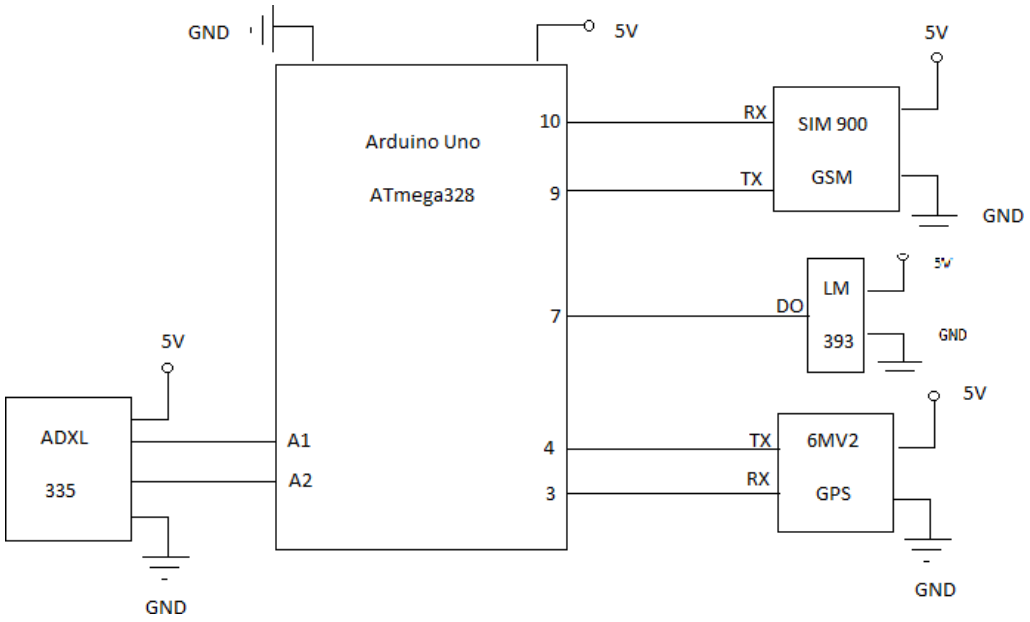

Fig 1: Block diagram of the circuit

II. BASIC THEORY

A. Arduino Uno

Arduino is an open-source electronics platform that has gained immense popularity for its user-friendly approach to hardware development. It was created to make electronics more accessible to both beginners and experienced developers. At its core, Arduino consists of a microcontroller, often an ATMega series chip, and a simplified programming environment that allows users to write and upload code to control various electronic components.

Arduino boards are available in a variety of form factors and can be easily connected to a wide range of sensors, actuators, and other hardware components, enabling users to create interactive and innovative projects. The Arduino IDE (Integrated Development Environment) provides a simple, C/C++-based programming environment, making it easy for individuals with little to no coding experience to get started.

Arduino has found applications in diverse fields, from hobbyist projects and educational initiatives to industrial automation and IoT (Internet of Things) applications. Its open-source nature encourages a collaborative and vibrant community, resulting in a wealth of online resources, libraries, and shields (expansion boards) that extend its capabilities. Whether you're a student, maker, or professional, Arduino offers an accessible platform for turning creative ideas into functional electronic prototypes.

Figure 2: Overview of Arduino Uno board

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GSM SIM900

The GSM SIM900 module is a compact and versatile communication device that plays a crucial role in enabling mobile communication for various applications. Developed by SIMCom, the SIM900 module is designed to facilitate Global System for Mobile Communications (GSM) connectivity in an efficient and reliable manner.

With a small form factor, the SIM900 module is well-suited for integration into a wide range of electronic devices, making it a popular choice for projects that require cellular communication capabilities. It supports quad-band GSM operation, allowing it to work on various frequencies and be compatible with GSM networks worldwide.

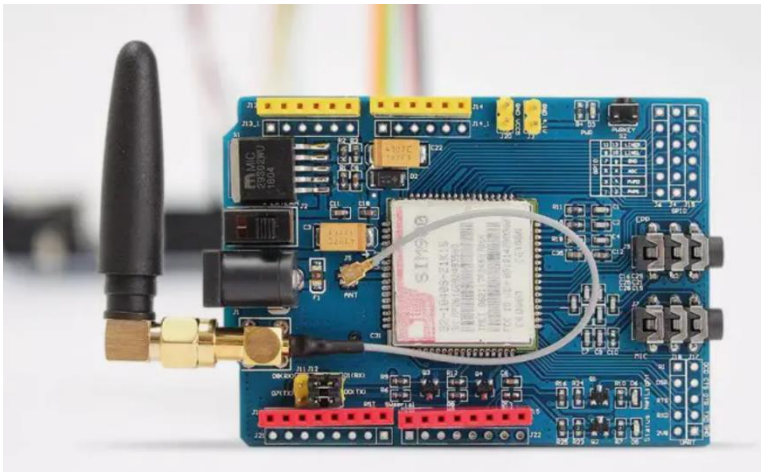
The module is equipped with multiple communication interfaces, including UART, making it easy to interface with microcontrollers and embedded systems. It can handle various data transmission tasks, including sending and receiving SMS messages, making voice calls, and establishing GPRS data connections for Internet access.

The GSM SIM900 module has found applications in fields such as IoT, remote monitoring, vehicle tracking, and more, where reliable mobile communication is essential. Its flexibility and robust performance have made it a valuable tool for connecting devices to the GSM network and enabling seamless data exchange.

Figure 3: Overview of GSM module

B. LCD (Liquid Crystal Display)

Liquid Crystal Display (LCD) is a prevalent and versatile technology used in a wide range of electronic devices, such as televisions, computer monitors, smartphones, digital clocks, and more. It functions as a flat-panel display that utilizes the unique properties of liquid crystals to control the passage of light, resulting in the creation of images and text on a screen.



LCDs consist of several essential components, including two glass plates with electrodes, a layer of liquid crystals, and polarizing filters. The liquid crystals are the central element, capable of changing their orientation when an electric current is applied. This property enables them to act as valves for controlling the passage of light.

The operation of an LCD involves manipulating the liquid crystal molecules to control the alignment of polarized light, which, in turn, produces the desired images and colors on the screen. By adjusting the voltage across specific pixels, various colors and shades can be displayed, offering a wide range of visual possibilities.

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LCD technology has several advantages, such as energy efficiency, slim form factor, and excellent image quality. It has largely replaced older cathode ray tube (CRT) displays due to its compactness and versatility, making it the go-to choice for most modern consumer electronics and industrial applications. However, it has faced competition from newer display technologies like OLED and LED displays, which offer their own unique advantages. Nevertheless, LCDs continue to play a significant role in the world of displays and are continually evolving to meet the demands of today's technology-driven world.

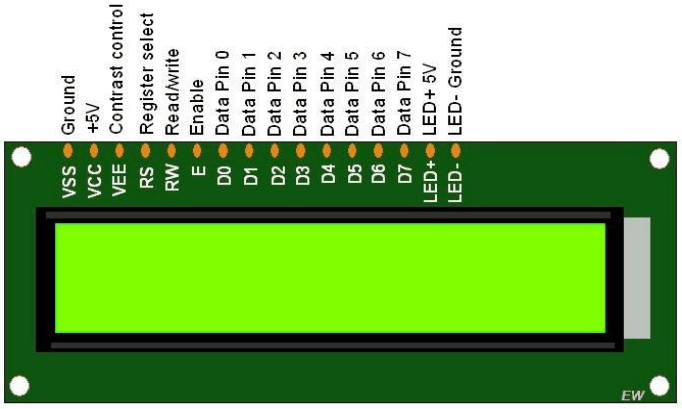

Figure 4: External View of LCD

C. GPS NEO 6M

The GPS NEO-6M is a compact and versatile Global Positioning System (GPS) module that offers precise location tracking and positioning capabilities. Developed by u-blox, a leading provider of positioning and wireless communication technologies, this module is designed for a wide range of applications that require accurate geographic data.

The NEO-6M module features a high-performance u-blox 6 GPS chipset, known for its exceptional sensitivity and accuracy. It can receive signals from multiple satellites simultaneously, enabling reliable and rapid positioning even in challenging environments, such as urban canyons or dense foliage.

The NEO-6M module is known for its low power consumption, making it suitable for battery-operated devices. It supports multiple communication protocols, including UART and I2C, making it compatible with a variety of microcontrollers and systems.

With its compact size and straightforward interface, the GPS NEO-6M is commonly used in applications like asset tracking, vehicle navigation, drones, outdoor sports, and more. It provides precise latitude, longitude, and altitude data, along with time information, enabling accurate location-based services and applications. Its reliability, accuracy, and ease of integration make it a popular choice for GPS-enabled projects and products.

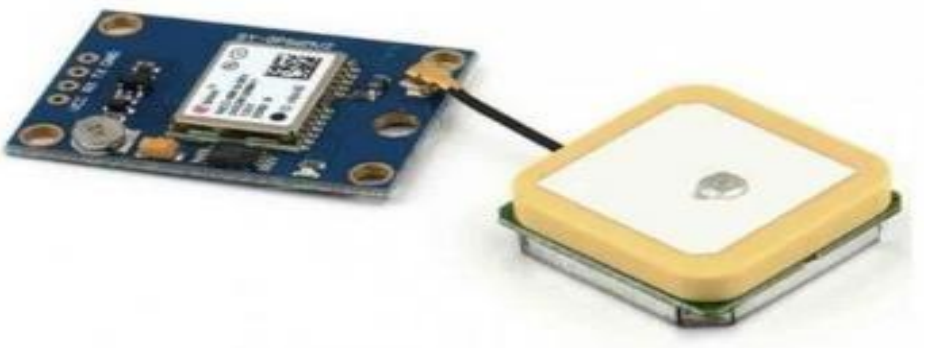

Figure 5: GPS NEO 6M

D. Vibration Sensor

A vibrating sensor, often referred to as a vibration sensor or accelerometer, is a critical component in various industries and applications, serving as a fundamental tool for measuring and monitoring mechanical vibrations and movements. These sensors are designed to detect and quantify oscillations, shocks, and accelerations in objects, structures, or machinery, providing valuable data for analysis and control.

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Vibrating sensors typically work on the principle of piezoelectricity or microelectromechanical systems (MEMS) technology. Piezoelectric sensors generate an electrical charge in response to mechanical stress, while MEMS-based sensors utilize tiny structures and integrated circuits to measure acceleration and motion accurately.

The applications of vibrating sensors are diverse, spanning fields like automotive, aerospace, manufacturing, and structural health monitoring. They are integral to vehicle stability control systems, seismic activity monitoring, predictive maintenance of machinery, and even in consumer devices like smartphones for screen orientation and gaming.

Figure 6: Vibration Sensor

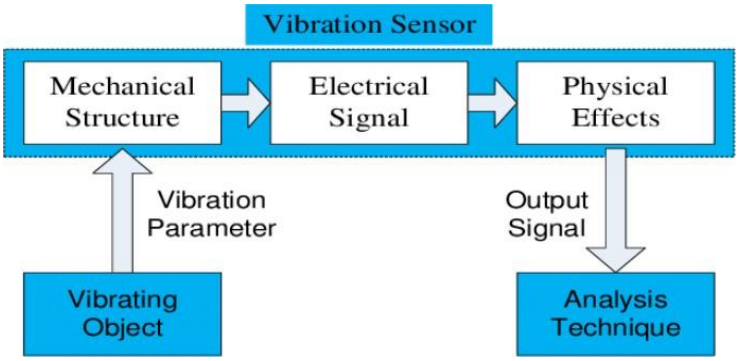
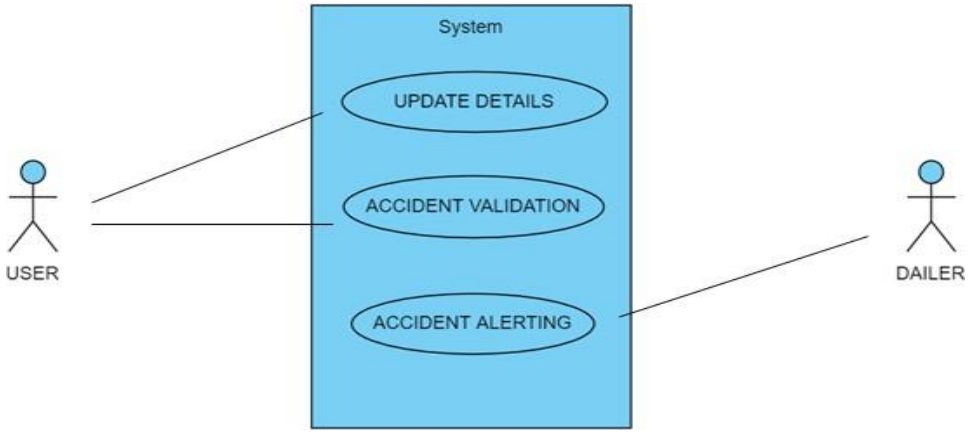


Fig 7: Block diagram of Vibration sensor

Use case Diagram:



- The user has the facility to update details of him and emergency contacts.
- The user has the facility to abort the emergency dial to responder by usingcontrol switch.
- The dialler/responder is the one who awaits for the accident alert designedfrom the system.

Software Requirements

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output

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- activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.

Over the years Arduino has been the brain of thousands of projects, from everyday objects to complex scientific instruments. A worldwide community of makers - students, hobbyists, artists, programmers, and professionals - has gathered around this open-source platform, their contributions have added up to an incredible amountof accessible knowledge that can be of great help to novices and experts alike.

Arduino was born at the Ivrea Interaction Design Institute as an easy tool for fast prototyping, aimed at students without a background in electronics and programming.As soon as it reached a wider community, the Arduino board started changing to adapt to new needs and challenges, differentiating its offer from simple 8-bit boards to products for IoT applications, wearable, 3D printing, and embedded environments. All Arduino boards are completely open-source, empowering users to build them independently and eventually adapt them to their particular needs. The software, too, is open-source, and it is growing through the contributions of users worldwide.

III. WORKING PRINCIPLE

The entire setup will be meticulously mapped out in the form of a comprehensive block diagram. An accident sensor will be the first to detect any untoward incident and relay the information to the microcontroller. The GPS system will then pinpoint the exact latitude and longitude of the vehicle, which will be transmitted via GSM to a pre-saved phone number stored in the EEPROM. A button sensor will be utilized for accident detection, and a buzzer will activate to signal system activation. Locating the exact position of the accident is crucial for timely medical assistance. The phone numbers can be easily modified by the user as needed. The microcontroller will send an alert message to the pre-saved numbers via the GSM module, and the user can pre-enter any message into the system. A clear status display will be provided on an LCD screen. In the event of no casualties, the message transmission can be terminated with a switch, which will restart the microcontroller and initiate the process anew.

The Accident Detection and Alert System using Arduino is a sophisticated and innovative solution designed to enhance road safety by promptly identifying and responding to vehicular accidents. This system integrates various sensors, microcontrollers, and communication modules to create a comprehensive network capable of detecting and reporting accidents in real-time.

At the core of the system is the Arduino microcontroller, a versatile open-source platform known for its ease of use and flexibility. The Arduino board serves as the central processing unit, managing and coordinating the inputs from different sensors. These sensors are strategically placed in vehicles and on roads to capture relevant data associated with accidents.

One crucial component of the system is the accelerometer. The accelerometer measures the acceleration of the vehicle and, in the event of a sudden deceleration or impact, triggers the accident detection mechanism. Accelerometers can detect abrupt changes in velocity, enabling the system to distinguish between normal driving conditions and potential accidents.

In addition to accelerometers, the system may also incorporate gyroscopes and GPS modules. Gyroscopes provide information about the vehicle's orientation, helping to determine the angle and direction of impact during an accident. GPS modules offer location data, allowing authorities to precisely identify the accident's location. This combination of sensors ensures a comprehensive understanding of the accident's dynamics.

Upon detecting a potential accident, the Arduino microcontroller activates the alert mechanism. This can involve various actions, such as sending an alert to emergency services, notifying nearby vehicles, or triggering an alarm within the vehicle itself. Communication modules, such as GSM (Global System for Mobile Communications) or IoT (Internet of Things) modules, play a vital role in transmitting these alerts.

The GSM module enables the system to send SMS notifications to predefined emergency contacts, providing them with essential details about the accident, including location, time, and severity. I more advanced implementations, the system might leverage IoT technology to transmit real-time data to a cloud server, enabling a more extensive and dynamic network for accident reporting and analysis.

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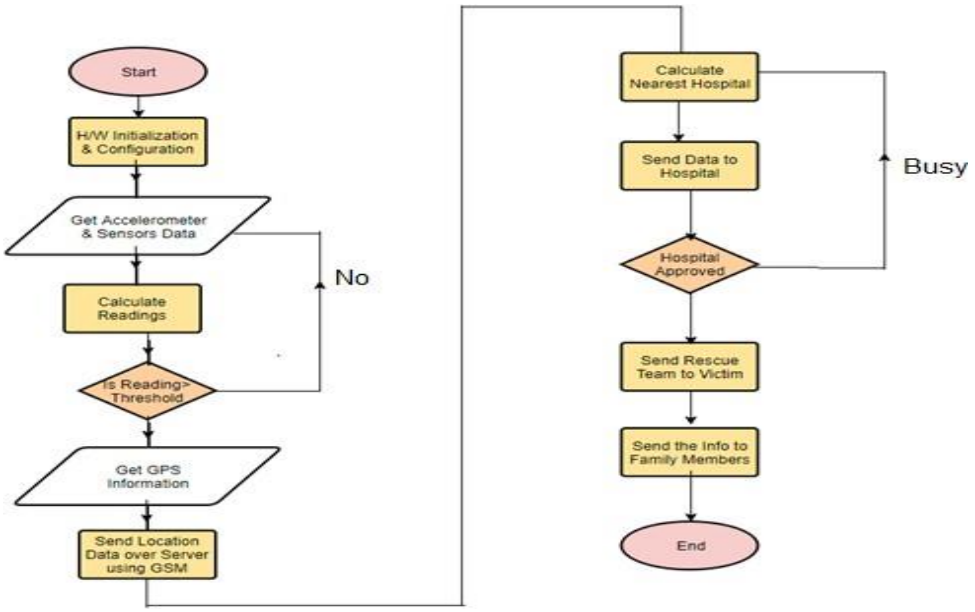
To enhance the system's reliability, power-efficient designs and backup power sources are often integrated. This ensures that the Accident Detection and Alert System remains operational even in the event of a vehicle's power failure after an accident.

User interfaces can also be part of the system, allowing drivers to receive immediate feedback and take appropriate actions. LED displays or sound alarms within the vehicle can notify the driver if an accident is detected, prompting them to confirm their well-being or take necessary actions.

In conclusion, the Accident Detection and Alert System using Arduino is a cutting-edge application of technology aimed at improving road safety. By combining sensor data, microcontroller processing, and communication modules, this system provides a rapid and reliable means of identifying accidents and promptly alerting emergency services, contributing to faster response times and potentially saving lives on the road. The versatility of Arduino and the integration of advanced sensors make this system a scalable and adaptable solution for addressing the critical issue of road safety.

A vehicle accident prevention and reporting system using GSM and Arduino involves a combination of hardware and software components to monitor vehicle conditions, detect accidents, and report them to a predefined contact. Here's a simplified explanation of how it works:

Flow Chart:



IV. SIMULATION RESULTS

When an accident occurs the vibration sensor detects collisions and passes that signal to the microcontroller , by using GSM and GPS a SMS is sent to the registered mobile number mentioned in the code and the latitude and longitude is also sent in the form of Google maps. The message is received by the registered mobile number along with the specific location.

Figure 7: When mobile number is stored successfully

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Figure 8: Latitude and longitude values where the accident was detected

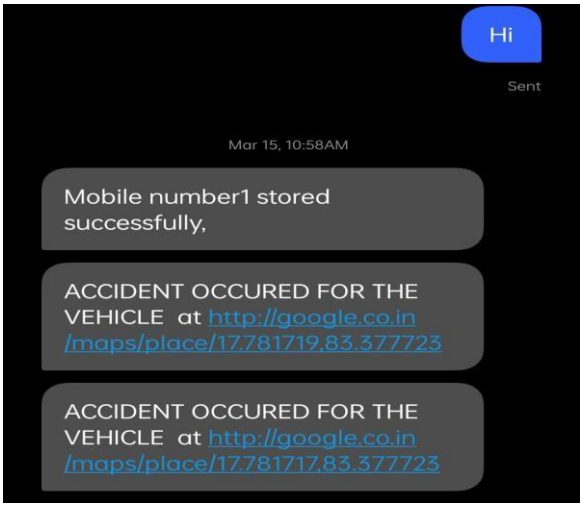

Figure 9: Message received by the specified phone number

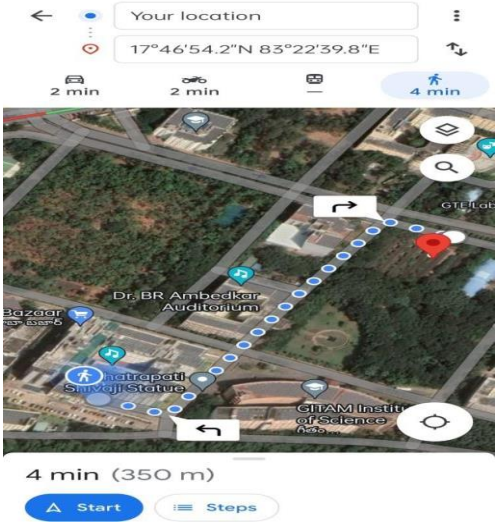

Figure 10: Location of the accident sent via Google Map

V. CONCLUSION

This innovative system offers an optimal solution to the inadequate emergency facilities provided to victims of road accidents. By utilizing advanced technology, immediate action can be taken to alert the relevant parties through messaging. It is important to note that this system is network-dependent and may not function in areas with poor network coverage. The proposed method is highly advantageous to the automotive industry, enabling medical teams to respond promptly and save precious human lives. Vehicle tracking systems are also essential for efficient fleet management, leading to increased profits through better scheduling and route

planning. Both for personal and business use, vehicle tracking enhances safety and security, communication, performance monitoring, and productivity. It is evident that this technology will play a significant role in our daily lives in the years to come.

The primary objective of the accident alert and detection project is to reduce fatalities resulting from unavoidable accidents. By alerting paramedics promptly, the chances of saving lives are significantly increased. This vehicle tracking and accident alert feature is expected to become even more critical in our day-to-day lives in the future. However, communication may be challenging in areas with no GSM network provision.

VI. FUTURE SCOPE

The future scope of this system can have some improvisation using a wireless webcam can be added in this for capturing the images which will help in providing driver`s assistance. This can also be bettered by locking all the brakes automatically in case of accident. Mostly in accidents, it becomes serious as the drivers lose control and fails to stop the vehicle. In such cases, the vibration sensor will be triggered because of the vibrations received and also processed by the processor. The processor has to be linked to the devices which can lock the brakes when triggered. With this improvement, we can stop the vehicle and can weaken the impact of the accident. This system can also be utilized in fleet management, food services, traffic violation cases, rental vehicle services etc.

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