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CHAPTER 1: INTRODUCTION

1.1 Introduction

In contemporary society, road traffic accidents stand as a pervasive and pressing issue, causing significant loss of life, injury, and economic damage worldwide. Despite ongoing efforts to improve road safety through advancements in vehicle technology and infrastructure, the frequency and severity of accidents remain a formidable challenge. According to statistics from the World Health

Organization (WHO), road traffic injuries are a leading cause of death and disability globally, with millions of lives lost and countless individuals sustaining life-altering injuries each year. The repercussions of road accidents extend beyond immediate casualties, impacting families, communities, and economies on a profound level. Beyond the loss of human life, accidents result in substantial financial burdens, strain healthcare systems, and disrupt social and economic activities. Moreover, the emotional toll on survivors and their loved ones is immeasurable, with long-lasting psychological trauma often accompanying physical injuries.

In response to the ongoing threat posed by road accidents, researchers and engineers have turned to technology-driven solutions to enhance road safety and minimize the impact of accidents. Intelligent accident detection and alert systems represent a promising avenue for addressing the challenges associated with road safety. These systems leverage a combination of sensors, microcontrollers, and wireless communication technologies to detect accidents in real-time and facilitate prompt response and assistance. The proposed accident detection and alert system integrates various components, including the Arduino UNO microcontroller, GPS Module, GSM Module, ADXL335 sensor, and Power Supply, to create a comprehensive monitoring and notification system. The Arduino UNO serves as the central processing unit, coordinating the operation of the system and interfacing with the various sensors and communication modules.

The GPS Module provides precise location data, allowing the system to pinpoint the exact location of an accident and transmit this information to emergency responders and relevant authorities. the GSM Module enables communication by sending automated alerts and notifications to predefined contacts, including emergency services, law enforcement agencies, and designated family members or caregivers. By leveraging GSM technology, the system ensures that critical information reaches the appropriate parties in a timely manner, facilitating rapid intervention and assistance in the event of an accident. Through the integration of advanced technology and innovative design, intelligent accident detection and alert systems offer a proactive approach to road safety, empowering individuals, communities, and governments to mitigate the impact of accidents and save lives. By harnessing the potential of technology-driven solutions, we can work towards a safer and more secure transportation environment for all road users.

1.2 Objectives

The objective of an accident detection and alert system is to enhance road safety by promptly detecting accidents and alerting relevant parties. By facilitating rapid emergency response, the system aims to minimize injuries and property damage, potentially saving lives. Key objectives include preventing false alarms, increasing user awareness, and integrating with existing infrastructure for efficient communication and coordination during emergencies. Additionally, the system should be adaptable, scalable, and accessible to maximize its effectiveness across different vehicle types, communication networks, and geographical regions. Continuous data collection and analysis help identify trends and inform improvements, ensuring the system evolves to meet evolving road safety needs effectively.

1.3 Problem Statement

The primary goal of the project is to detect accidents promptly and notify the rescue team in a timely manner. The existing gap lies in the reliance on manual intervention post-accident occurrence, which may result in delays in alerting emergency services. An automated system is required to swiftly provide the latitude and longitude coordinates of the accident location without any delay, thereby maximizing the potential to save human lives. Therefore, the challenge is to develop a robust accident detection and alert system that seamlessly integrates with existing infrastructure to ensure rapid response and efficient deployment of rescue resources, ultimately minimizing the impact of accidents on human life

1.4 Existing System

Numerous researchers have explored accident detection systems, with traditional approaches relying on long-term traffic data for accident prediction, including factors like annual average daily traffic and hourly volume. However, real-time traffic accident prediction has gained traction, correlating accidents with real-time traffic data obtained from various detectors such as induction loops, infrared detectors, and cameras. While real-time prediction focuses on pre-accident traffic conditions, incident detection studies concentrate on post-incident traffic changes. Nevertheless, the efficacy of these systems is limited by factors like sensor availability, funding constraints, algorithm effectiveness, weather, and traffic flow variability. In addition to automatic detection, manual incident detection methods rely on motorist reports, transportation department inputs, aerial or closed-circuit camera surveillance, but suffer from delays and inaccuracies. Conversely, driver-initiated incident detection systems offer advantages in quick reaction and more detailed incident information, but are subject to limitations such as driver incapacitation in severe accidents. Conventional built-in automatic accident detection systems typically use impact sensors or car airbag sensors for accident detection, coupled with GPS for location tracking.

CHAPTER 2: LITERATURE SURVEY

This paper proposes to utilize the capability of a GPS receiver to monitor the speed of a vehicle and detect an accident basing on the monitored speed and send the location and time of the accident from GPS data processed by a micro-Controller by using the GSM network to the Alert Service Centre. Accident detection and alert systems have garnered significant attention from researchers and practitioners aiming to enhance road safety and minimize the severity of accidents. Various approaches have been proposed to detect accidents promptly and notify relevant stakeholders for timely response and assistance.

One prevalent method involves utilizing GPS receivers to monitor vehicle speed continuously and detect anomalies indicative of accidents. By analyzing changes in speed data, these systems can identify sudden decelerations characteristic of collision events. Upon detecting an accident, the system utilizes the GPS coordinates to pinpoint the accident location and sends alerts via GSM networks to designated emergency response centers or contacts. This approach leverages the ubiquity of GPS technology and the reliability of GSM communication to ensure swift and effective accident detection and response.

The Latitude and Longitude are detected using GPS and it is sent as message to rescue team through GSM module. The message is received by another GSM module. Google Map Module: It displays Google map shows you exact location of accident and its details. It gets detail SMS from accident location. Hence there is small variation in co-ordinates .An OFF switch is also provided at times of need to avoid false message.

Another emerging trend in accident detection systems involves the integration of accelerometers and gyroscopes to capture vehicle dynamics and orientation changes during accidents. Accelerometers detect abrupt changes in vehicle acceleration, while gyroscopes measure angular velocity and orientation. By analyzing data from these sensors, the system can infer the occurrence and severity of accidents, enabling timely alerts to emergency services and concerned individuals. Additionally, the integration of GPS technology facilitates accurate location tracking, further enhancing the effectiveness of accident response efforts

advancements in vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication technologies have opened up new possibilities for accident detection and prevention. V2V communication enables vehicles to exchange real-time information about their speed, position, and trajectory, facilitating collision avoidance and cooperative maneuvering to prevent accidents. Similarly, V2I communication allows vehicles to interact with roadside infrastructure, such as traffic lights and road signs, to receive timely alerts and warnings about hazardous conditions or obstacles ahead.

Moreover, the emergence of autonomous and semi-autonomous vehicles presents opportunities for integrating accident detection and response capabilities directly into vehicle control systems. These systems leverage onboard sensors, such as lidar, radar, and cameras, to continuously monitor the vehicle's surroundings and detect potential collision risks. In the event of an imminent collision, the vehicle's autonomous control system can take evasive action, such as braking or steering, to mitigate the impact or avoid the accident altogether.

Furthermore, piezoelectric sensors have been proposed as a viable option for accident detection systems. These sensors generate voltage proportional to impact forces experienced during collisions. By monitoring voltage changes exceeding predefined thresholds, the system can trigger alerts and transmit accident details, including location and time, via GPS and GSM networks. Additionally, integration with Google Maps enables visualization of accident locations, facilitating rapid response and coordination among emergency responders.

Overall, the literature survey highlights the diverse approaches and technologies employed in accident detection and alert systems, each offering unique advantages in terms of accuracy, responsiveness, and ease of implementation. Continued research and development in this field hold the promise of further improving road safety and reducing the impact of accidents on human lives.

CHAPTER 3: MATERIALS AND METHODS

3.1 Hardware Requirements:

In the proposed system, various components including the Arduino NANO, GPS Module, GSM Module, and ADXL335 Accelerometer are utilized to create a comprehensive solution for location tracking and monitoring. The Arduino platform serves as the central controller for integrating these components and executing the necessary functions, leveraging its versatility and open-source nature.

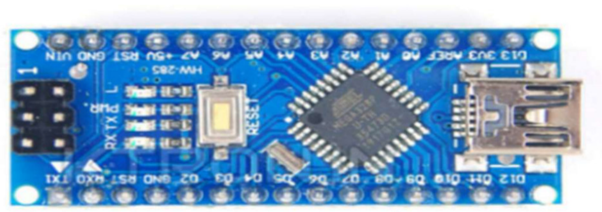

Figure 1: **Aurdino NANO**

The GPS Module is essential for determining the precise location of the tracked object or device. By receiving signals from satellites orbiting the Earth, the GPS receiver calculates latitude, longitude, and altitude, enabling applications like navigation, asset tracking, and geofencing. Additionally, supplementary data such as speed, distance travelled, and time of sunrise and sunset enhances its utility in various scenarios.

Figure 2: GPS (NEO-6m) Receiver Module

Similarly, the GSM Module facilitates communication with external devices and networks using cellular technology. By interfacing with mobile networks, the system can transmit data, receive commands, and send alerts or notifications to designated recipients. This capability is particularly useful for remote monitoring and control applications, allowing users to stay informed and take timely actions based on real-time information.

Figure 3: GSM (sim900A) Module

The ADXL335 Accelerometer complements the GPS and GSM modules by providing orientation and motion sensing capabilities. By detecting acceleration along three axes, the accelerometer enables the system to monitor movement and detect sudden changes or impacts. This information can be utilized in applications such as motion tracking, gesture recognition, and vehicle stabilization, enhancing the overall functionality of the system.

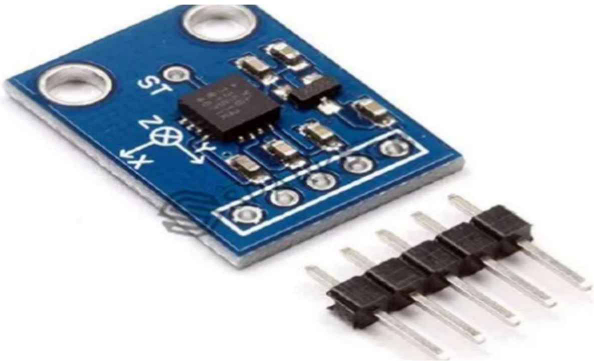

Figure 4: ADXL335 Sensor

the buzzer and push button plays a crucial role in alerting nearby individuals or authorities when an accident occurs. Once the system detects a significant event, such as a sudden impact or change in vehicle speed, it triggers the buzzer to emit a loud sound till the 20 second after that the system will send the message to the verified phone number if it is a false detection then user can press the push button and stop the buzzer.

Figure 5: Buzzer &   Push Button

Overall, the integration of these components creates a versatile and powerful system for location tracking, monitoring, and communication. Whether deployed for asset tracking, vehicle navigation, or personal safety applications, the proposed system offers a reliable and efficient solution for various real-world scenarios. Moreover, the modular design of the system allows for scalability and customization to meet specific requirements and preferences'

3.2 Software Requirement:

Arduino is an open-source electronics platform renowned for its user-friendly hardware and software. Its boards can interpret various inputs, from sensor data to social media messages, and translate them into outputs like motor activation or LED illumination. This functionality is enabled by sending instructions to the microcontroller using the Arduino programming language, which is based on Wiring, and the Arduino Software (IDE), built on Processing.

Since its inception, Arduino has been the cornerstone of countless projects, ranging from mundane gadgets to sophisticated scientific tools. A diverse community of makers, encompassing students, hobbyists, artists, programmers, and professionals, has coalesced around this open-source platform. Their collective efforts have generated a wealth of accessible knowledge, beneficial to beginners and experts alike.

Initially developed at the Ivrea Interaction Design Institute to facilitate rapid prototyping for students lacking electronics and programming backgrounds, Arduino quickly gained traction beyond academia. It evolved to meet evolving demands, expanding its range from simple 8-bit boards to encompass products tailored for IoT applications, wearables, 3D printing, and embedded systems.

All Arduino boards are entirely open-source, empowering users to construct and customize them to suit their specific requirements. Similarly, the software remains open-source, continually evolving thanks to global user contributions.

3.3 Methods:

The block diagram and pin diagram given below demonstrates a simple overview of the system's process flow.

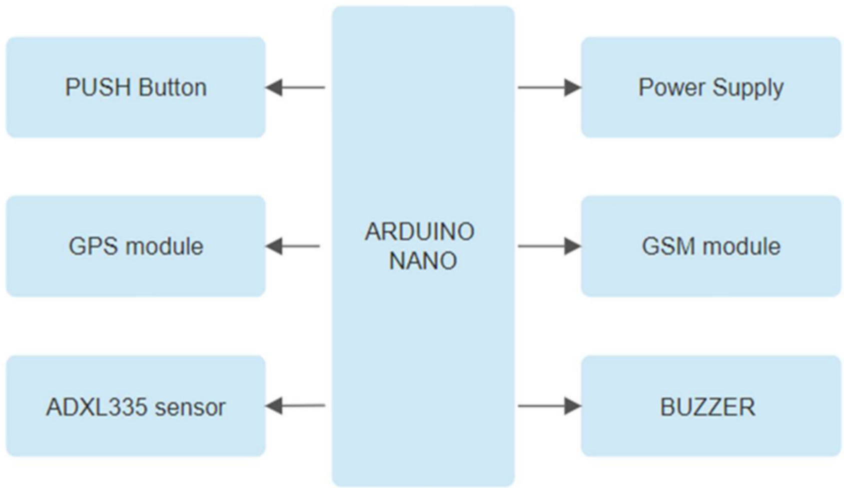

Figure 6: Block Diagram

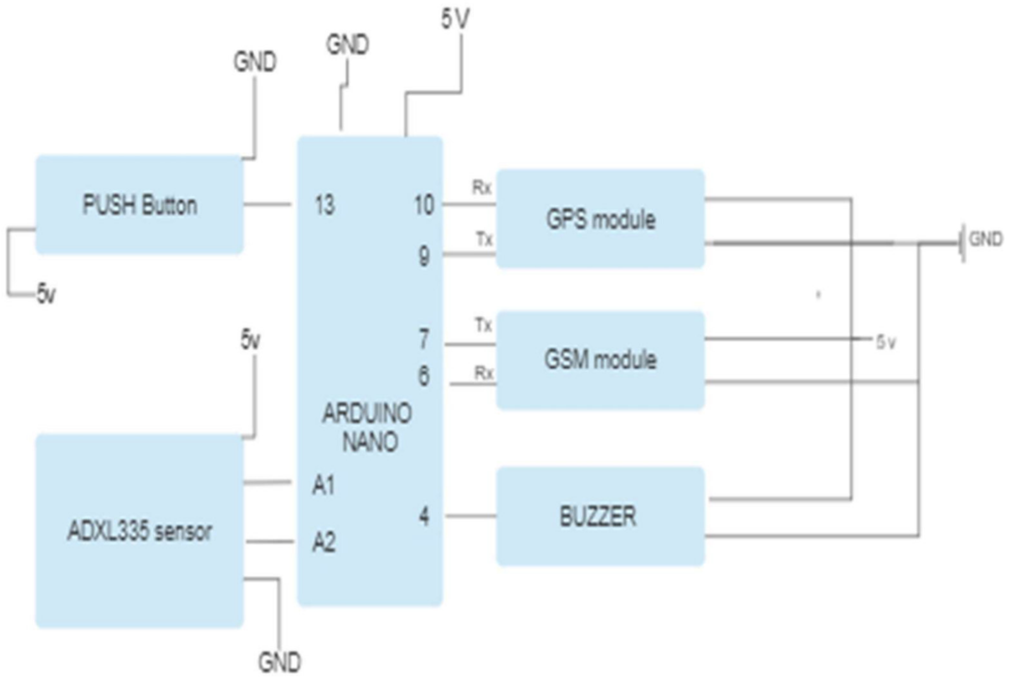

Figure 7: PIN Diagram

CHAPTER 4: WORKING METHODOLOGY

The accident detection and alert system utilizes an Arduino UNO as the controlling unit, interfacing with various sensors and modules to ensure passenger safety. The system employs an accelerometer to detect any sudden falls or changes in vehicle speed. Upon detecting a significant change, the Arduino reads the current GPS location and utilizes a GSM module to send an SMS alert to a designated mobile number, providing the precise location details. Additionally, the system activates a buzzer to audibly signal the alert. To prevent false alarms, passengers have the option to press an "IAM OKAY" button. This action signals to the Arduino that there is no immediate danger, thereby preventing unnecessary alerts. In case of an actual emergency, after thirty seconds of the buzzer sounding, it automatically stops, and the SMS alert is sent out. This ensures that genuine emergencies are promptly addressed while minimizing the likelihood of false alarms. Overall, the system offers a comprehensive approach to accident detection and alerting, combining sensor data, communication modules, and user input to enhance passenger safety during travel.

Chapter 5: WORKFLOW

The accelerometer sensor will activate after the accident has occurred. The accelerometer operates on the principle of measuring changes in acceleration. Once activated, the accelerometer triggers the GPS sensor to determine the current location. GPS receivers are widely used in various applications such as cell phones, fleet management systems, and military applications

For accurate location tracking, a GPS receiver must receive data from at least four satellites. These satellites transmit signals in the radio frequency range of 1.1 to 1.5 GHz, and the GPS receiver calculates the travel time difference between the signals to determine the location. The GPS receiver module generates output signals in NMEA string format, providing longitude, latitude, altitude, time, and other parameters.

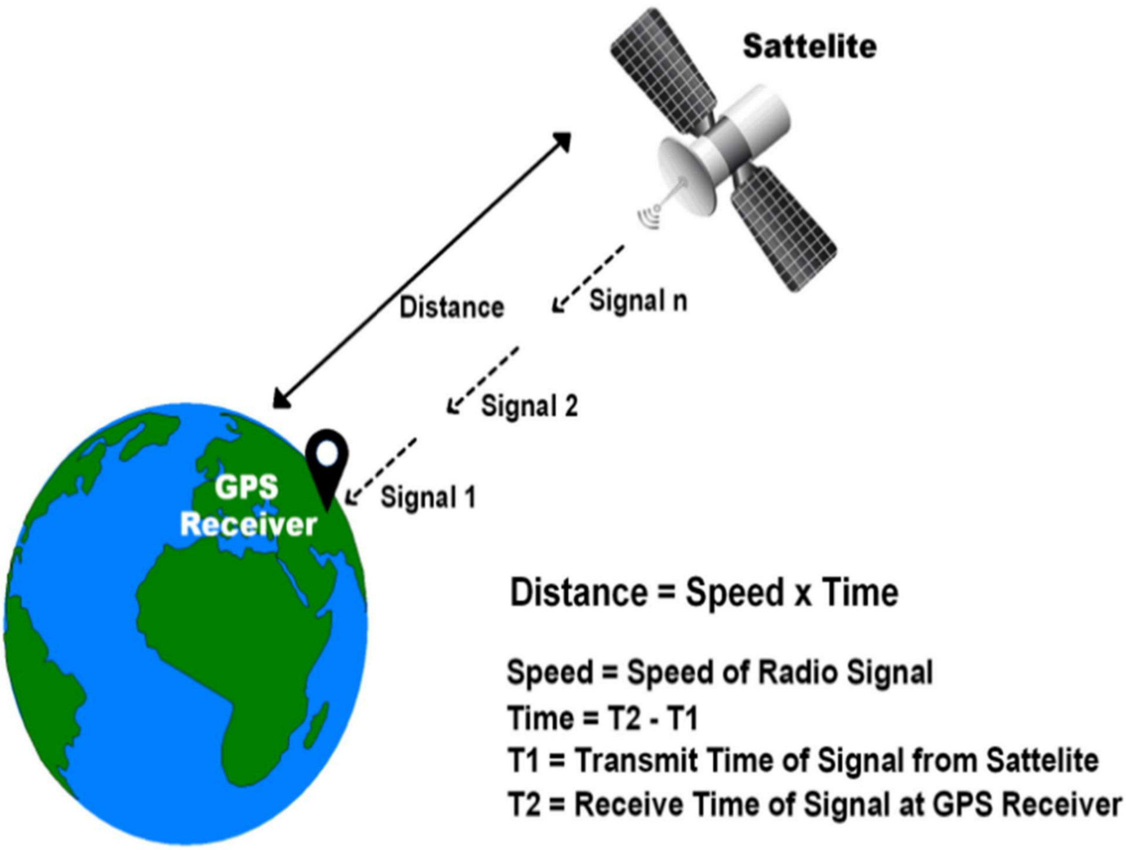

Figure 8: GPS Distance Calculation

Once the victim's exact geographical coordinates are obtained, the GSM module is activated. GSM technology is widely used, with around 800 million users across 190 countries, covering over 70% of the global digital wireless communication market. GSM divides geographical areas into hexagonal cells, with transmitter power and load determining each cell's coverage and capacity.

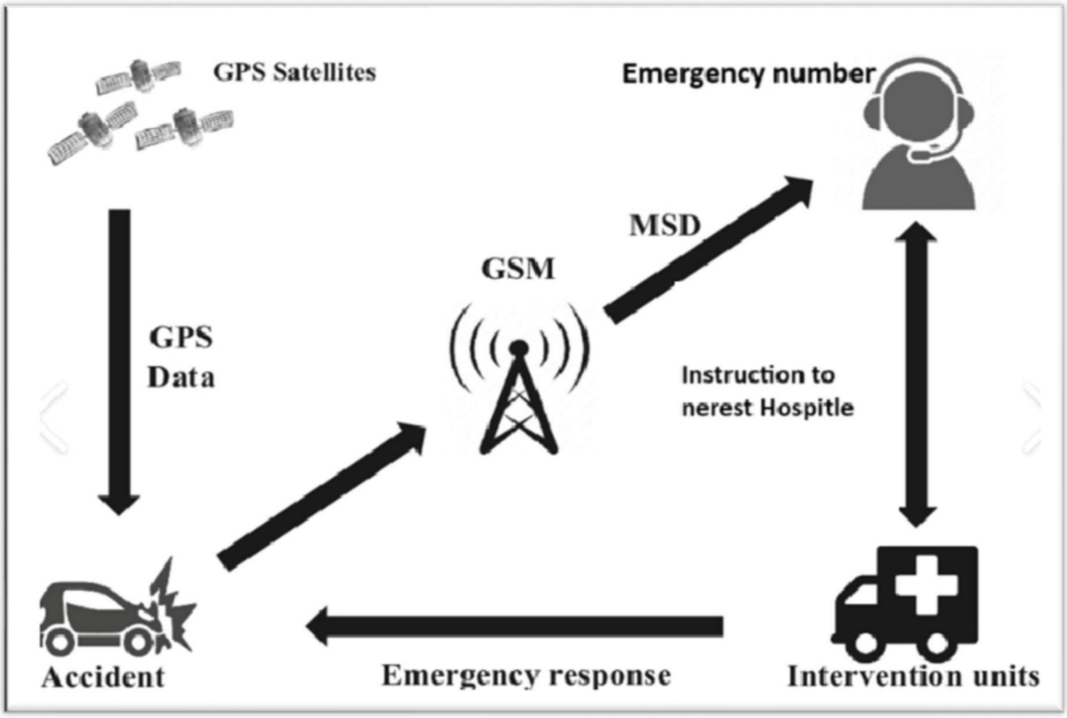

Figure 9: Workflow Diagram

GSM operates using frequency bands such as uplink 890 to 915 MHz and downlink 935 to 960 MHz, with additional bands added later. During program execution, the GSM modem receives the instruction 'STOP', causing the microcontroller to generate an output to disable the ignition switch. Warnings can be sent via telephone servers, enabling alerts to be sent via voice calls or text messages regardless of the recipient's carrier or service provider.

CHAPTER 6: FLOWCHART

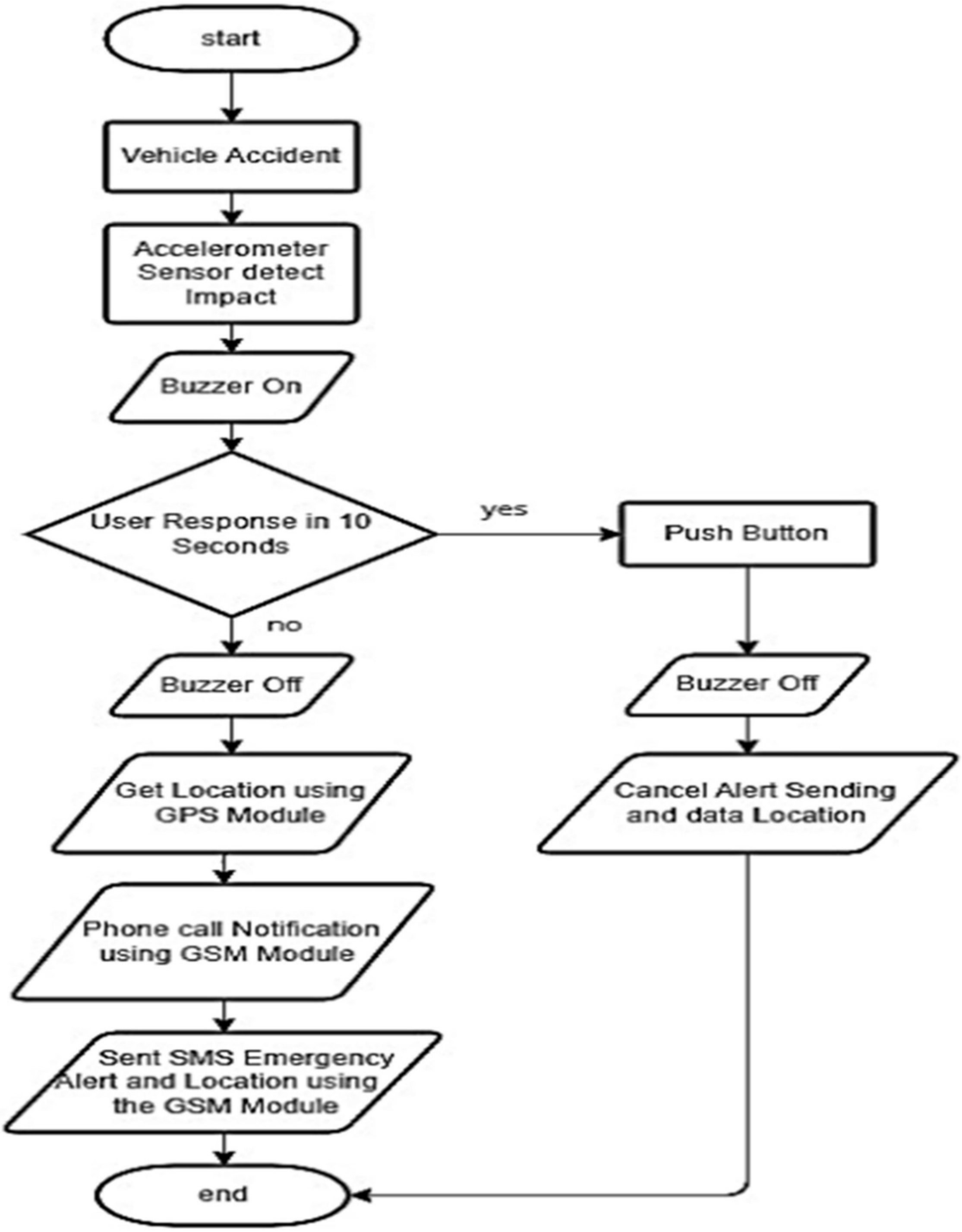

Figure 10: Flowchart

CHAPTER 7: RESULTS AND DISCUSSION

CHAPTER 8: TESTING

There are four individual tests that have to be performed before setting up the proposed system.

8.1 Reading data from Adxl335 module

The Arduino reads data from accelerometer module; it is based on MEM technology. accelerometer is embedded into single chip. This chip uses I2C bus interface which is used for communicating with host interface. It has 8 pins in the chip, In order to check I2C connection between the Arduino and MPU 6050, code should be generated. Wire library's header is included, we define and some variables after this, convert function has to be defined, Setup function which usually checks for serial connection which has to be established.

8.2 Location data Reading from GPS module

U-blox Neo-6M GPS module has to be tested to check if it is able to point the location. GPS receivers actually work by figuring out how far they are from a number of satellites. They are pre-programmed to know where the GPS satellites are at any given time. The satellites transmit information about their position and he current time in the form of radio signals towards the Earth. These signals identify the satellites and tell the receiver where they are located. It indicates the position fix, it will blink at various rates depending on what state it is in. No Blinking indicates that it is searching for the satellites. If it blinks every second which indicates that the position is found.

8.3 Sending Alert message by GSM SIM900A module

We have to make sure that the connection is established between Arduino and GSM. Thereare two ways of doing it, One is to connect TX pin of GSM to RX pin of Arduino and RX pin of GSM module to TX pin of Arduino. Two is by selecting two PWM enabled pins of Arduino (Pin 9, 10). It uses software serial library of Arduino, when the connection is established the data can be fed directly to GSM.

CHAPTER 9: CONCLUSION AND FUTURE SCOPE

9.1 Conclusion

In this article, the prototype of an automatic accident detection system is proposed. This device could be used to prevent vehicle thefts in the future. Because of the high accuracy tracking technology, this prototype might be used to trace down those responsible for the horrible crimes. This prototype can also be integrated with emergency services in collaboration with local governments to quickly dispatch a rescue team to the accident location. The system must be implemented and put into practice shortly. The predominant purpose of this suggested accident detection and alert system is to reduce the number of individuals who die in various road accidents in unavoidable circumstances. Paramedics are called to the scene of any accident to increase the chances of survival. For accidents that occur in deserted locations or at night, this gadget is significantly more effective. This low-cost effective car tracking and accident alert technology will play a far larger role in daily life in the future. To further improve the system, efforts could be directed towards enhancing object detection accuracy, possibly through the implementation of techniques like Non-Maximum Suppression, leading to more precise region identification. Additionally, expanding the repertoire of pre-trained models could enhance performance.

9.2 Contribution

The proposed system significantly contributes to reducing the death rate caused by accidents through its effective accident detection and alert mechanism. By utilizing the proposed methodology, the system swiftly detects accidents and retrieves the accident location using a GPS module. Subsequently, it sends alert messages via a GSM module to medical emergency services, enabling timely arrival at the accident site and potentially saving lives. This integrated approach can substantially decrease the fatalities resulting from accidents by ensuring prompt emergency response and medical assistance.

9.3 Future Scope

The future scope of this system entails several potential enhancements to further improve road safety. One such enhancement involves integrating a wireless webcam to capture images, aiding in providing driver assistance and facilitating post-accident analysis. Additionally, the system can be upgraded to automatically lock all brakes in the event of an accident, mitigating the severity of collisions by halting the vehicle's movement. This improvement leverages a vibration sensor to detect accidents and triggers brake locking mechanisms via the processor. Furthermore, the system's versatility enables its utilization in various domains such as fleet management, food services, traffic violation detection, and rental vehicle services, indicating its potential for broader applications beyond accident detection and response

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