A SUSTAINABLE IOT-BASED AUTOMATIC VEHICLE ACCIDENT DETECTION, AND LOCATION IDENTIFICATION SYSTEM WITH PREVENTING SYSTEM.

An UndergraduateCAPSTONE Project
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Faculty of Engineering
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A SUSTAINABLE IOT-BASED AUTOMATIC VEHICLE ACCIDENT DETECTION, AND LOCATION IDENTIFICATION SYSTEM WITH PREVENTING SYSTEM.

A CAPSTONE Project submitted to the Faculty of Engineering, American International University - Bangladesh (AIUB) in partial fulfillment of the requirements for the degree of Bachelor of Science in theirmentioned respective programs.

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DECLARATION

This is to certify that this project is our original work. No part of this work has been submitted elsewhere partially or fully for the award of any other degree or diploma. Any material reproduced in this project has been properly acknowledged.

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APPROVAL

The CAPSTONE Project titled **A SUSTAINABLE IOT-BASED AUTOMATIC VEHICLE ACCIDENT DETECTION AND LOCATION IDENTIFICATION SYSTEM WITH PREVENTING SYSTEM** has been submitted to the following respected members of the Board of Examiners of the Faculty of Engineering in partial fulfillment of the requirements for the degree of Bachelor of Science in the respective programs mentioned below on **June 2023** by the following students and has been accepted as satisfactory.

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ABSTRACT

This project aims to develop a sustainable Internet of Things (IoT)-based system for automatic vehicle accident detection and location identification. The primary objective of this work is to investigate and implement a reliable and efficient solution that can accurately detect vehicle accidents and promptly transmit the accident information to emergency services and relevant stakeholders.Through extensive research and experimentation, a robust hardware model using Arduino Uno and various sensors including GPS, accelerometer, and camera modules was developed. The system utilizes advanced algorithms and machine learning techniques to analyze sensor data in real-time and identify potential vehicle accidents. The investigation focused on validating the performance of the developed system by comparing the detected accidents with the predicted values and existing publications. The results showed a high level of accuracy and consistency, confirming the effectiveness of the proposed system in accurately detecting and locating vehicle accidents.

Chapter 1

INTRODUCTION

1.1.Overture

Road congestion is a direct outcome of a population explosion, as more cars will be manufactured to match demand. Every day, traffic accidents claim the lives of thousands of individuals around the world. The existing method does not allow for making an insurance claim after an accident has occurred; only information is given to emergency services through GSM. This paper describes how a deadly wreck was identified using a piezoelectric sensor by measuring vibrations caused by the collision. Accidents can be broken down into two main groups: major and minor. These will be recalculated based on the new crash pressure threshold values. Both local emergency services and auto insurance companies, or health insurance and local emergency services, might be notified formally. The "Internet of Things" (IoT) refers to the worldwide system of billions of individually addressable computing devices that communicate with one another in real time. The term "Internet of Things" (IoT) is used to describe a network of devices that exchange data with one another via the internet and transfer that data rapidly and accurately through a wireless network without the need for human intervention. The kind of directobjects that can be utilized are not limited in any way, and can include things like trash cans, chairs, low-cost automobiles, and so on that we wouldn't generally think of as electronic. Despite the fact that most road accidents are relatively small, millions of lives are lost every day because of inadequate response times for emergency services. Humans can't be relied upon to correctly determine an accident's location because we can't know where it will naturally occur. When someone is hurt, they tend to give them the care they need, but they also need help locating the accident quickly so they can notify loved ones or local emergency professionals. The detection system is a novel approach to real-time monitoring of the vibration impact level of moving vehicles in a variety of situations, such as urban freeway travel, damaged roadside conditions, efficient vehicles intentionally hitting in speed breakers, and head-on collisions.

1.2.Engineering Problem Statement

The engineering problem addressed in this project is the need for an automatic vehicle accident detection and location identification system that can effectively and reliably detect accidents and provide timely information about their precise locations. Traditional accident reporting methods heavily rely on human observation or witness accounts, which can lead to delays, inaccuracies, and difficulties in obtaining real- time information. Moreover, such manual reporting processes may not be efficient in remote or less populated areas where immediate response and assistance are crucial. The existing solutions in the market often lack the desired level of accuracy, reliability, and cost-effectiveness. Some systems rely solely on GPS technology, which may have limitations in accurately pinpointing the accident location, especially in urban areas with high-rise buildings or signal interference. Other systems may be complex and expensive, making them inaccessible for the general population, particularly in developing regions.

To address these challenges, the proposed solution aims to develop a sustainable IoT-based automatic vehicle accident detection and location identification system. This system will utilize a combination of advanced hardware components, including microcontrollers, sensors, GPS modules, GSM modules, and communication interfaces, to detect accidents and instantly transmit accurate location information to emergency services, relevant authorities, and vehicle owners. The engineering problem statement, therefore, revolves around designing and implementing a cost-effective, reliable, and user-friendly system that can accurately detect accidents, precisely identify their locations, and provide real-time notifications to facilitate prompt response and assistance. The system should be capable of integrating multiple hardware components, ensuring seamless communication, and operating effectively in various road and environmental conditions. Additionally, the system should consider factors such as power efficiency, durability, and compatibility with different vehicle types.

By addressing these engineering challenges, the proposed system aims to significantly improve the efficiency and effectiveness of accident detection and location identification, ultimately enhancing overall road safety, reducing response times, and potentially saving lives.

1.3. Related Research Works

1.3.1. Image based automatic vehicle damage detection

Photographs taken at the scene of an accident can be used to automatically detect car damage, which has many benefits including easing the burden of filing insurance claims and saving money. In a perfect world, a vehicle owner could just use their phone to snap a few photos of the damage and have an insurance adjuster look them over without them ever having to lift a finger. There are many obstacles that make finding such a solution difficult. As a first step, most accident scenes are located in the open air, where conditions such as scene lighting and the existence of adjacent objects are not known in advance and therefore cannot be controlled. Additionally, there is a high likelihood of inter object reflection in images taken in such an uncontrolled setting due to the highly reflective metallic bodies of automobiles. Since this is not a typical scenario for computer vision applications, doing so presents significant difficulties. In addition, completing this work will allow you to tackle a wide variety of interesting computer vision challenges in the context of a difficult scenario. In this thesis, the author details the efforts made to solve the issue of automatic car damage identification using pictures. Specifically, we investigate a pipeline for detecting light damage to vehicles that addresses a subset of the larger problem. To infer what the vehicle with minor damage in the photograph should have looked like if it had not been damaged, we propose using 3D CAD models of undamaged vehicles that are utilized to collect ground truth information. Thus, we create 3D pose estimation methods to register a clean 3D CAD model over an image of the known damaged car. Here, we introduce a technique for estimating a 3D stance from a snapshot and a projected 3D model [4]. We demonstrate how mildly damaged car parts in a snapshot may be pinpointed using the 3D model projection at the recovered 3D posture. Furthermore, we provide an improved approach to 3D pose estimation by minimizing a unique illumination invariant distance measure, which is derived from the Mahalanobis distance between attributes of the projected 3D model and the pixels in the image. Theoretically, any jagged edges in an image that don't appear in the projected 3D CAD model are evidence of damage to the car. A lot of the apparent damage in the shot is actually inter object reflection caused by the highly reflective vehicle body. We suggest using multi-view geometry approaches on two images of the vehicle obtained from various vantage points in order to detect image edges generated by inter object reflection. Because the images are dominated by huge reflective and usually homogenous regions, we also construct a robust approach to get trustworthy point correspondences across the photographs. Experimental evidence supports the effectiveness of the suggested approaches.

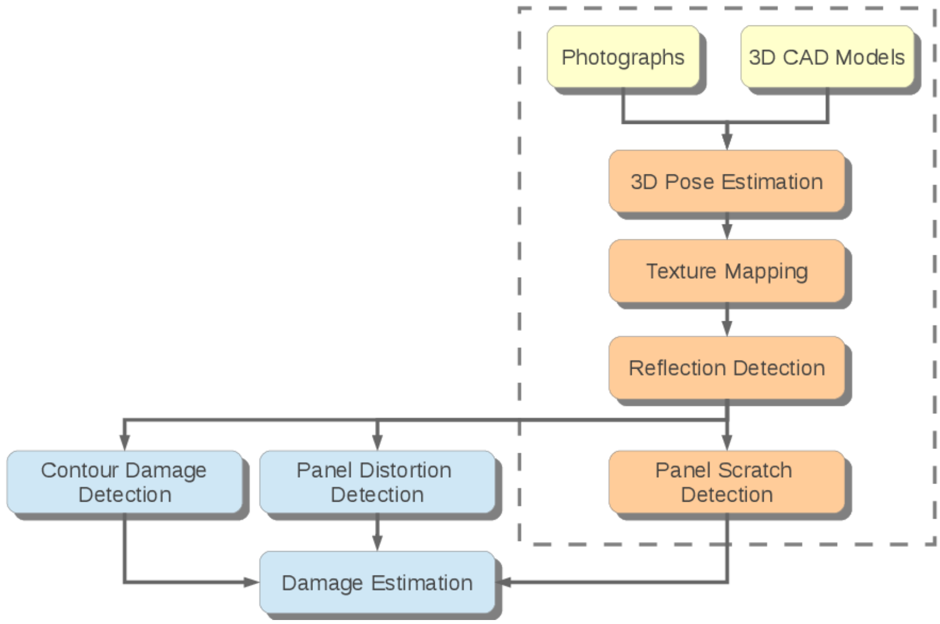

Figure 1.1: Components of the overall project with the components within the vertical slice addressed by this research indicated by the dashed box [4]

1.3.2. Integrated Vehicle Accident Detection and Location System

If information regarding car accidents could have been automatically communicated to emergency response centers, then a significant number of people who were involved in accidents could have had their lives saved. This study makes a proposal for a system that can detect accidents and pinpoint their locations by calculating the amount of deceleration and fusing data from GPS and accelerometers. Integrating with a Kalman filter allows for the bias, drift, and noise errors of accelerometers, in addition to the GPS outage constraint, to be circumvented. The result of the test demonstrates that the appropriate amount of deceleration was applied for accident detection and location. The proposed technology will be able to overcome the limits of the GPS and IMU, so making it possible to save the lives of precious people.

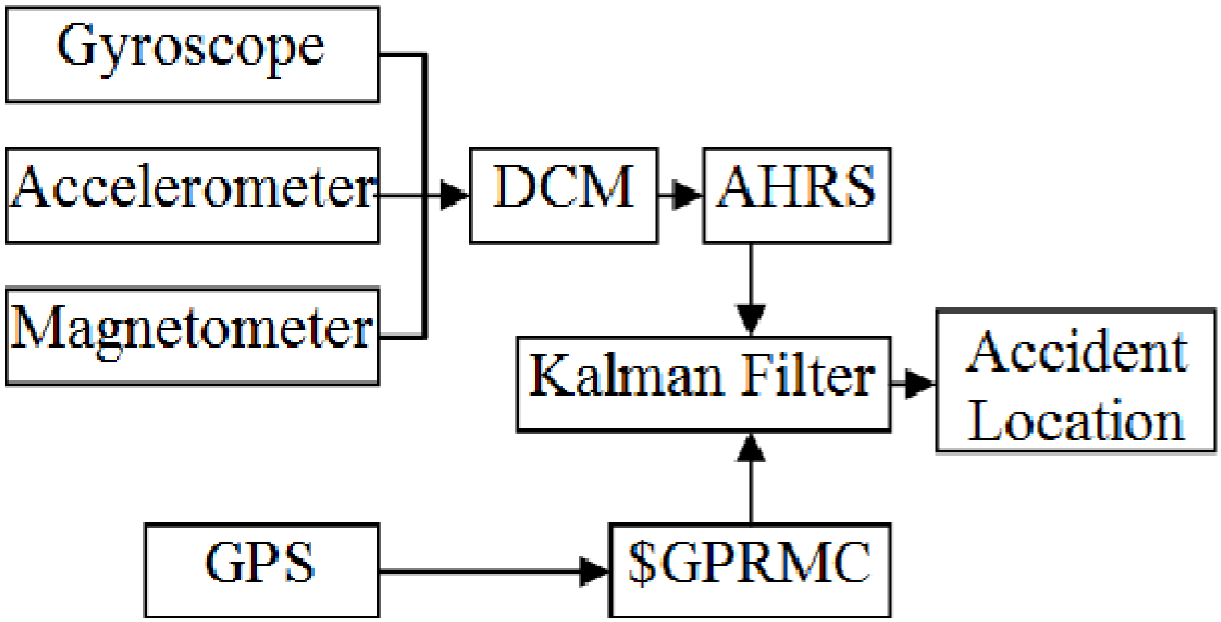

Figure 1.2 Block diagram of fusion filter for accident location [5]

1.3.3. A Robust Algorithm for the Detection of Vehicle Turn Signals and Brake Lights

The reliable and efficient detection of alert signals emanating from the front vehicle, such as turn signals and brake lights, is of the utmost importance, particularly in contexts involving applications for autonomous vehicles [6]. Automatic detection of these signals can be helpful in the prevention of accidents that would otherwise be fatal. This is true even for vehicles that are driven by actual people. This article presents a novel algorithm that is both robust and lightweight, with the goal of detecting brake lights and turn signals during the day as well as during the night. The proposed method utilizes a Kalman filter in order to lessen the amount of work that needs to be done. A significant amount of research is conducted solely on the detection of brake lights during the night, but our algorithm is able to detect turn signals in addition to brake lights with high accuracy rates under any lighting conditions. This is in contrast to the majority of the research that focuses solely on the detection of brake lights during the day.

1.3.4. An autonomous speed control and object detection system for vehicles based on RF technology

This article discusses an autonomous speed control system for vehicles, also known as an ASCS. Having a system like this can help us reduce the number of accidents that occur on the roads and keep a more orderly traffic control system across the country. The first section is the transmitter section, and the second section is the vehicle (receiver) section [7]. In Figure 1.5 Autonomous vehicles Incident Detector Here, we have two sections. If a vehicle enters a specific zone, such as a school zone, for example, the Rf transmitter housed in the transmitter section will communicate with the vehicle section to transmit relevant data. Because of the embedded platform, the speed of the vehicle is then slowed down by the section of the vehicle that processes the information. In addition to this, it features an integrated object detection system within its own design. Therefore, if anything comes in front of the vehicle, the person who is currently inside the vehicle will be informed about it. to prevent most accidents from occurring. If there is an accident, information will be automatically relayed to the emergency unit via mobile communication if there isany.

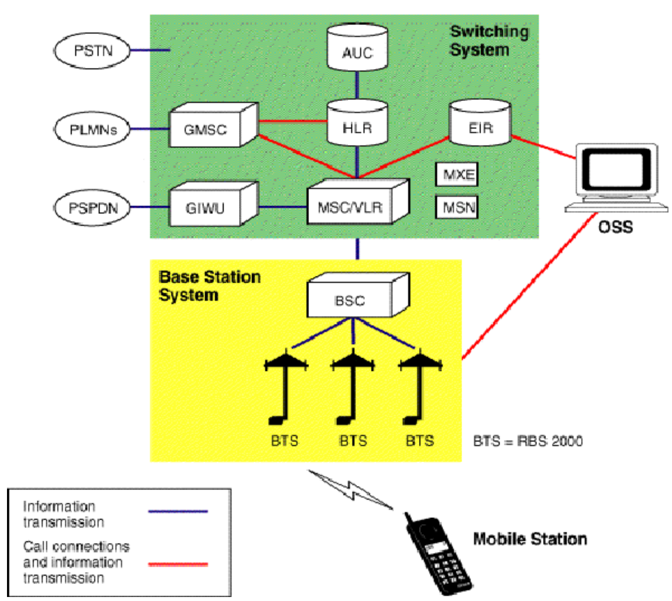

Figure 1.4: GSM network Topology [7]

1.3.5. Development and Evaluation of New Automatic Incident Detector to Make Safer Highway

SITMS2 Multi-Device automatic incident detection system is the name of the more advanced device for incident detection and tracking that is currently being developed at the SMART1 Highway project in South Korea. This device will be able to monitor about one kilometer longer and a wider area, as well as harsh weather environments [8]. The system can detect incidents in real time, such as a broken car, a traffic accident, an obstacle, parking and stop vehicles on the shoulder lane, and non-recurring congestion. It is composed of three components, which are an array camera, an auto-tracking camera, and a radar detector. In the same year (2012), the SITMS Multi-Device automatic incident detection system was deployed, demonstrated, and evaluated at the test roadway that is situated within a Korean expressway. In this article, reasonable evaluation procedures for a recently built incident detection device are discussed, and the results of such evaluation arereported. We cansee from Figure 1.5 Autonomous vehicles Incident Detector

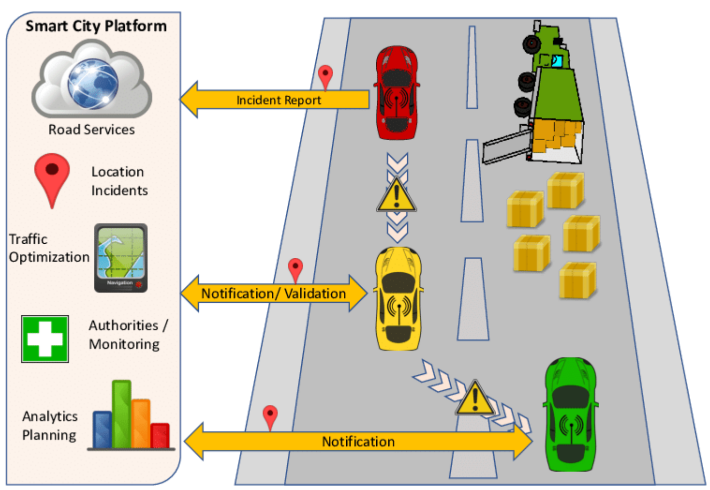

Figure 1.5: Autonomous vehicles Incident Detector [8]

1.3.6. Recent Research

1.3.7. MODELLING OF BLDC MOTOR AND IOT BASED VEHICLE ACCIDENT DETECTION AND RESCUE SYSTEM FOR ELECTRIC VEHICLE

The proliferation and commercialization of electric vehicles have picked up the pace in a world where the preservation of the natural world and the wise use of energy resources are regarded as being of the utmost significance. The question of how to integrate many forms of energy supply into electric vehicles is currently of the utmost significance, and this will continue to be the case in the foreseeable future. These days, we can track cars using a variety of applications, which assists in the protection of a variety of vehicles, including private vehicles, public vehicles, foot units, and others. In addition to this, the number of people who are killed or injured in car accidents is growing at an alarming rate. The purpose of this project is to create a system that can automatically detect an accident and notify the closest hospitals and medical services about it [9]. In Figure 1.6 Simulation model for BLDC motor,This system is also able to pinpoint the location of the accident, allowing the emergency medical services to be dispatched there as soon as possible. With the use of MEMS, GPS, and Internet of Things technology, the purpose of this article is to construct a car accident monitoring system. The system includes an accelerometer, microcontroller unit, global positioning system, and internet of things module to facilitate message sending. Both the accelerometer and the threshold method are used to detect accidents. The accelerometer is utilized to detect falls. The brief message will include GPS coordinates (latitude and longitude), which will be of assistance in identifying the vehicles.

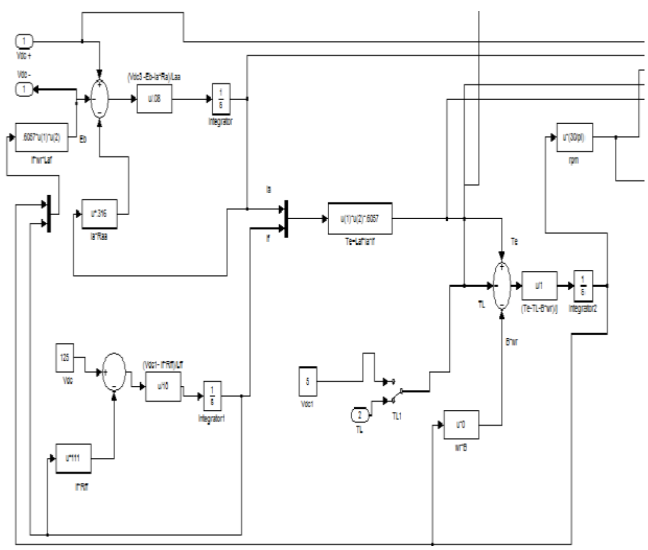

Figure 1.6: Simulation model for BLDC motor [9].

1.3.8. Intelligent Fatigue Detection by Using ACS and by Avoiding False Alarms of Fatigue Detection

When traveling by car over a significant distance for a prolonged period, it is impossible to tell whether one is awake. The most hazardous circumstance occurs when the motorist is experiencing exhaustion (sleepy). The identification of driver fatigue is an area that has already seen a significant amount of research and development. In this study, the previous work is acknowledged, and an improved version of fatigue detection is shown. The enhanced version does this by removing erroneous possibilities from the system [10]. Figure 1.7 Shows the Architecture of the drowsy detection system. The suggested system, in contrast to the prior fatigue detection systems, discusses accident avoidance by employing adaptive cruise control, which makes it very easy to forecast if the car is keeping the right speed or not. This is a significant improvement over the previous methods. Nevertheless, it is quite difficult to ascertain the status of the driver. To avoid causing an accident in this extremely hazardous circumstance, a vehicle must instantly take a left turn. In this study, the topic of false fatigue detection as well as the approach to avoid such confusions is discussed. When the fatigue detection is successful, the anti-drowsiness system (ACS) will have to be activated automatically, and the vehicle will be forced to come to astop.

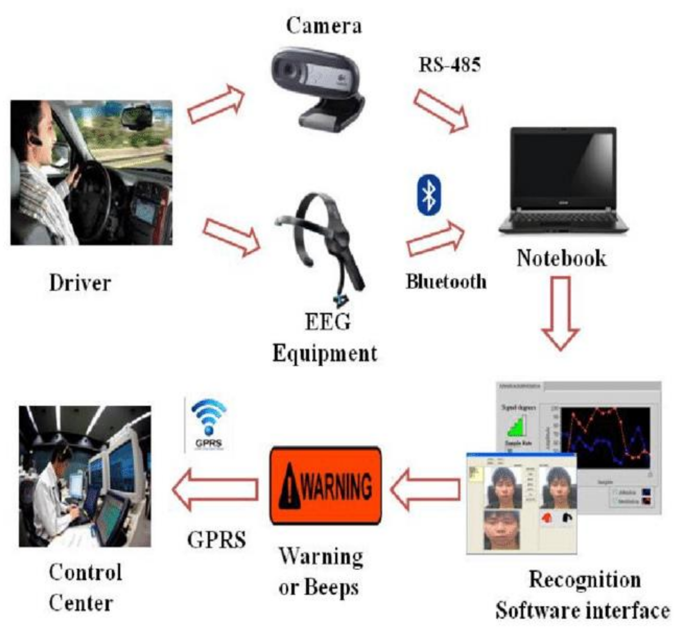

Figure 1.7: Architecture of the drowsy detection system [10]

1.3.9. A Review on Automatic Brake Failure Detection with Auxiliary Braking System

Accidents caused by vehicles are increasingly widespread in modern times. The National Highway Traffic Administration reports that there is an accident involving a motor vehicle every 60 seconds. Accidents may take place for a variety of causes, including the driver losing control of the car, passing other vehicles, or driving too quickly, but the primary cause of accidents is the brakes not working properly or failing altogether. The driver of the vehicle does not know anything about the brakes, and when he tries to use the brakes while driving, he discovers that the brakes are not working properly. However, it is too late for him to do anything about it, and these results in accidents and the death of people [11]. This project's goal is to develop a system that can detect when a vehicle's brakes are failing and install an additional braking system in vehicles so that, in the event that the primary braking system fails, drivers can still use the secondary braking system to bring their vehicles to a stop. When developing the entire system, the following considerations were taken into account: human nature, the need for as little effort as possible, and the most effective utilization of the braking system as a whole. Because it contains the fewest possible components, the system requires the minimum amount of storage space when installed in a car. The buzzer is included in this system so that the driver can be provided with feedback in the form of sound. In order to deploy the secondary brakes, the Auxiliary Braking system also initiates its operation with the assistance of the microcontroller unit. The automotive industry can realize significant cost savings and improved productivity with the use of this technology.

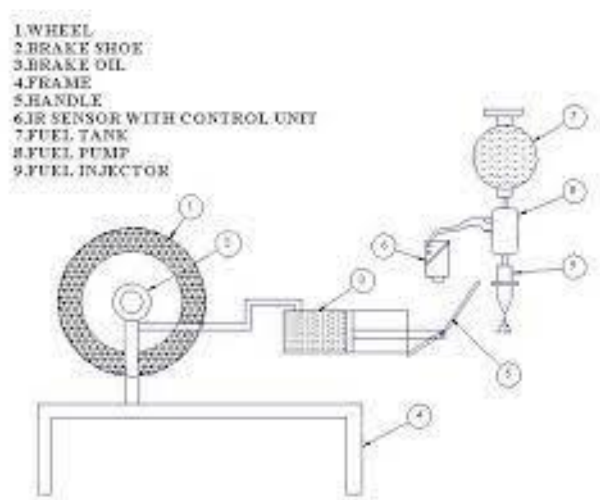

Figure 1.8: Fabrication of Brake failure detection and acceleration locking [11]

1.3.10. Alcohol Sensing And Automatic Engine Locking System

The primary objective of this study is something called "DRUG DRIVING DETECTION." The consumption of alcohol by the driver or the person operating the vehicle is a contributing factor in a significant number of accidents that occur these days. In practically all countries all over the world, driving under the influence of alcohol is one of the primary causes of accidents. The project to detect alcohol consumption in vehicles is being developed for the purpose of ensuring the passengers' well-being. The installation of this project should take place inside the car. Within the scope of this project, we designed and built an automatic engine locking mechanism. Alcohol in the user's breath serves as the system's input [12]. The controller is currently holding its breath as it awaits the output from the alcohol sensor. Here, a stimulating procedure is activated by making use of a dc motor by way of a freewheeling diode, and the entire process is supervised by an intelligent Atmega 328microcontroller. Even if efficient set up requirements have been established for traditional techniques, whereby this procedure this may be a better notion of interesting the whole state of the art design into the system. [Citation needed] The majority of traditional systems are likely to be more dependent on the operator, and they may fail owing to a variety of issues like battery life, power consumption, and the unavoidable interference from the outside world. Therefore, driving under the influence of alcohol is a primary contributor to the occurrence of accidents in virtually all nations across the globe. The idea to install an alcohol detector in cars is being developed for the purpose of ensuring the passengers' well-being. If there are many traces of alcohol above the limit that has been set, then the system will lock the engine and at the same time it will sound a buzzer so that we may avoid mishaps.

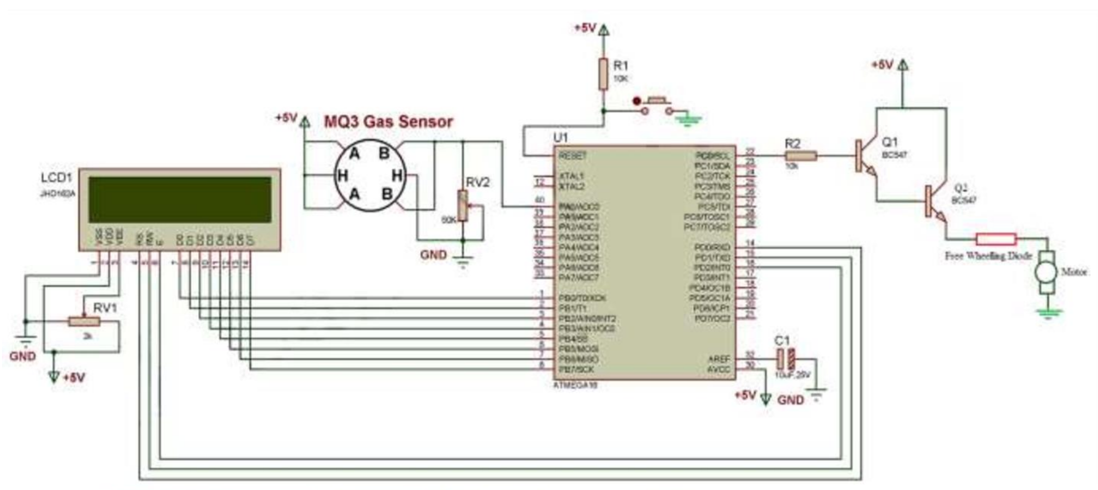

Figure 1.9: Proteus simulation of Automatic Engine Locking System [12]

1.3.11. Microcontroller-Based Automotive Control System Employing Real-Time Health Monitoring of Drivers to Avoid Road Accidents

The purpose of this document is to help drivers in four important ways to help avoid car accidents. Firstly, it has been noted that drowsy driving accounts for 10-30% of accidents, especially those that occur at night or while the driver is under the influence of alcohol. Better road safety can be achieved through the detection of driver fatigue and the subsequent alerting of the driver. The device might also detect the presence of alcohol by measuring molecules in the driver's breath and stopping the vehicle immediately if the limit is broken. Second, drivers may have medical emergencies that cause them to lose control of their vehicles. In order to effectively prevent accidents, a system that constantly checks drivers' health is necessary. As a third point, the system's architecture would employ Light Detection and Ranging to constantly track the distance between the vehicle and any obstacles in its path (LIDAR). When an obstacle is detected by the LIDAR, the system will alert the driver, reduce the vehicle's speed, and bring it to a halt when it is within a predetermined distance from the object. In addition, the system would keep an eye on lane changes to help motorists keep their vehicles within the designated lanes, which is important for preventing traffic jams and accidents by keeping vehicles separated [13]. To identify an irregular heartbeat in the event of a medical emergency, we propose implementing the system with a microcontroller and a small number of desired heartbeat, ultrasonic, and breathe-based sensors. Here, we present a field-programmable gate array (FPGA)-based artificial neural network model for monitoring brain activity and identifying driver drowsiness. All the electronics circuit with sensors and microcontroller have been created and tested at the laboratory environment on human subjects in the first part of the study activity. The second stage involved the incorporation of electrical circuits into the vehicle. At the workshop, we've been able to test the project in a safe, contained setting. The outcomes support the usefulness and efficacy of the planned study.

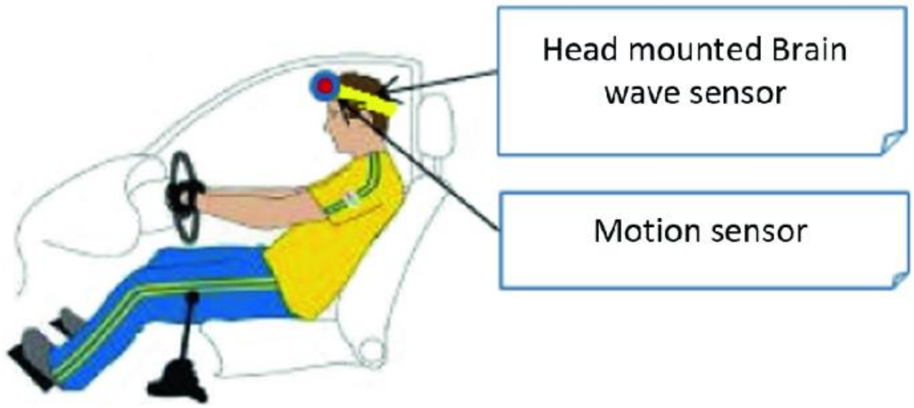

Figure 1.10: Combination of brain wave and motion sensor [13]

1.4. Critical Engineering Specialist Knowledge

A System for Immediately Notifying Drivers of Accidents Our proposed approach is primarily focused on reducing the duration between the occurrence of an accident and the arrival of medical aid at the scene. Numerous lives can be saved and the number of preventable fatalities caused by a lack of services will be drastically reduced if this is done. The entire procedure, from accident detection to notifying relevant parties, can be automated to achieve this goal. Even if the injured person is unable to use a traditional phone, the message can be conveyed instantly through the custom app thanks to IoT. It would be simple to pinpoint exactly where the mishap occurred. Advantages First, no human intervention is needed in the event of an accident using this module. Second, the software requires a fresh contact number be entered each time the driver launches it [14]. The purpose of this is to guarantee that the driver enters the correct destination number while in the vicinity of both his current location and his point of departure. In the event of an accident, this guarantees that the nearest person is informed so that medical aid can be provided as soon as possible. Third, the proposed work would still be able to deliver the notification of accident occurrence even if the individual is severely hurt and there is no internet. This proposed method relies on two distinct types of sensors in case one fails to notice the accident or communicate with the cloud software. Fifth, an internal emergency number would be saved when the app is given to the driver, so that even if they forget to save the contact at the time of app launch, they will have at least one number to use when sending the message. 2. The Framework of the System Analysis of the Literature Increases in the global population and the prevalence of reckless driving have made road accidents a constant source of worry. These incidents account for a sizable fraction of annual fatalities. When people don't get the help they need in time of crisis, it can be fatal. An automated system can help with this problem by contacting the nearest hospital for medical supplies, calling the police in the event of a major crash, and alerting the relevant family members to call in the event of an emergency. With this survey, we can see how different algorithms and systems for accident detection and automated notification stack up against one another, without having to rely on the local populace. The goal is to evaluate and contrast the myriad algorithms included by the survey.

1.5. Stakeholders

There is both qualitative and quantitative analysis of the global market, market segments, and regional markets included in this study on the car anti-theft devices market. With this information at hand, businesses may better comprehend their financial and operational output and develop more effective strategies for growth. The report also includes information on threats and opportunities, which may be used by stakeholders to craft a more calculated and effective company strategy. In order to better understand the scope of the car anti-theft devices market, we may break it down into its component parts. The study serves as a useful tool for players, stakeholders, and other industry participants in the global Car Anti-theft Devices market. The research provides a thorough overview of the global Car Anti-theft Devices Market, including a breakdown of the market by region and country as well as forecasts of revenue, growth rate (CAGR), key market drivers, the competitive landscape, and a breakdown of sales by purchaser type. In addition, the paper details the key threats and problems that will need to be addressed within the anticipated time frame. The global market for anti-theft devices for cars is split into two submarkets: Product Type and End Use. The study serves as a valuable resource for players, stakeholders, and other market participants in the global Car Anti-theft Devices Market.

1.6. Objectives

1.6.1. Primary Objectives

- The major goal is to stop auto theft. A computer-generated short message service (SMS) is used to do this.
- Create the necessary components for the proposed system.
- Create an algorithm for the suggested system's control.
- Create a security alarm for cars that uses your voice

1.6.2. Secondary Objectives

- Test the proposed system thoroughly.
- The main functional unit of the system is the serial port interface in the microcontroller.
- Create an algorithm for the suggested system's control.

1.7. Organization of Book Chapters

Chapter 2: Project Management

The project management chapter focuses on the systematic planning and execution of the project. It begins with the development of a Gantt chart, which outlines the timeline and tasks involved in the project. Additionally, this chapter analyzes various aspects related to the project, including strengths, weaknesses, and opportunities for improvement.

Chapter 3: Methodology and Modeling

The methodology and modeling chapter delves into the approach and techniques employed in the project. It starts by presenting the proposed design, which is illustrated through a block diagram. Furthermore, this chapter provides a mathematical analysis of the proposed model, showcasing the underlying principles and calculations involved.

Chapter 4: Implementation of Project

The implementation chapter explores the practical aspects of the project. It offers a detailed description of how the proposed model was realized and executed. This includes the hardware and software components used, along with any modifications made to the original design. The chapter provides insights into the technical implementation process and highlights the key features of the final project model.

Chapter 5: Results Analysis & Critical Design Review

In this chapter, the focus is on analyzing and evaluating the results obtained from the project. Various graphs, charts, and statistical data are presented to provide a comprehensive analysis of the project outcomes. Additionally, a critical design review is conducted, assessing the strengths and weaknesses of the implemented model and identifying areas for potential improvement.

Chapter 6: Conclusion

The final chapter serves as a conclusion to the entire book. It summarizes the key findings, achievements, and contributions of the project. It also reflects on the challenges faced during the project and provides recommendations for future work. The chapter wraps up the book by offering a comprehensive overview of the project and its implications.

Chapter 2

PROJECT MANAGEMENT

2.1. Introduction

Most organizations work hard to ensure that all of their processes are well-managed so that they don't have to deal with a setback to their expansion plans because of a failed project. In addition, their teams need to communicate with stakeholders to fully understand the aims and objectives of a certain project. Project management helps businesses establish sensible objectives, schedules, and spending limits. With this approach, you may coordinate the goals of every endeavor with the overall corporate plan. Incorporating potential threats and the company's objectives into a plan is facilitated by this tool. Because of this, a group may work cohesively and follow a strategy that ultimately helps them succeed. A project manager's responsibility includes maintaining oversight over the project's quality, making sure that all requirements are met within the established schedule and budget. If a business is serious about cutting down on project expenses, then project management must play a significant role. With this method, we can better allocate resources, boost productivity, and lessen vulnerability. It's impossible to overstate the value of good project management because it's the means through which businesses really reach their goals. Now that we've established the problem, let's move on to the benefits and really dig into this issue.

2.2. S.W.O.T. Analysis

The current situation can be assessed, and a course of action can be devised, using a process called a "SWOT analysis." By putting some consideration into how you use this tool, you can evaluate your progress, see what's working, and pinpoint any potential hazards. Since it aids in outlining a distinct course of action, SWOT analysis is also an effective tool for strategic goal-setting. Read on to find out why conducting a SWOT analysis is important in project management, how to conduct one, and how you can use a real-life example to inform your own planning. First, though, you should get familiar with the acronym SWOT. A SWOT analysis entails listing a project's, product's, or service's positives, negatives, opportunities, and threats. That's why it's abbreviated. The implications of each on your strategy are summarized below.

2.2.1. Strengths

- There is no need for any sort of human intervention in this module at the time of the mishap.
- The software prompts the motorist to enter a fresh number each time it is opened. The purpose of this is to guarantee that the driver enters the correct destination number while in the vicinity of both his current location and his point of departure. In the event of an accident, this guarantees that the nearest person is informed so that medical aid can be provided as soon as possible.
- The planned effort would still be able to notify others of the accident's occurrence even if the person is severely injured and the internet is unavailable.
- With two types of sensors involved, the suggested system can continue operating if one fails to notice an accident or communicate with a cloud-based application.
- To ensure at least one number is fed to send the message, the app will have an in-built emergency number that will be stored even if the driver forgets to store the contact while opening the app.

2.2.2. Weakness

- Needs to have downtime in order to recharge
- An insufficient amount of time spent preparing a safety plan
- There is inconsistency in the approach taken to update security updates.
- The cost of maintaining batteries can add up quickly.
- Costs associated with integrating new systems and ongoing fees
- Problems Associated with Replacements
- The product's physical qualities and specifications

2.2.3. Opponunity

- The Combining of Different Platforms
- developments in commercial practices stemming from the rise of the collaborative economy
- An increasing reliance on the Internet of Things

2.2.4. Threats

- Violating the terms of the agreement
- Flooding and forest fires are examples of natural calamities that can occur.
- Malware that affects computer systems
- Hacking attemp

2.3.Schedule Management

Planned activities, deliverables, and milestones are all part of a comprehensive project schedule. Start and end times, activity durations, and resource allocations are also typical components of schedules. When it comes to managing time effectively, scheduling projects is essential, especially for businesses that offer professional services. Schedules for projects are typically represented using Gantt charts. You can use a Gantt chart to create a summary milestone schedule or a comprehensive project timeline. When researching scheduling software, it's crucial to look for options that provide many schedule views based on the same underlying data. Assist your team and stakeholders by making a high-level summary of your full project plan with milestones, such as a Gantt chart, easily accessible. In this way, you may show the same calendar in a variety of formats, each suited to a different audience and level of detail.

Date **Task**	**10 Aug 2022**	**11 Aug 2022**	**14 Sep 2022**	**15 Sep 2022**	**18Sep 2022**	**8 Jan 2023**	**22 Jan 2023**	**12 May 2023**	**19 May 2023**	**17 May 2023**	**24 May 2023**	**1 june 2023**
Orientation												
Topic Searching & Selection												
Proposal Submission												
Literature Review												
Equipment Collection												
Simulation & optimization												
Hardware implementation												
Project Book Writing												
Progress Defense & Attend Final Defense												

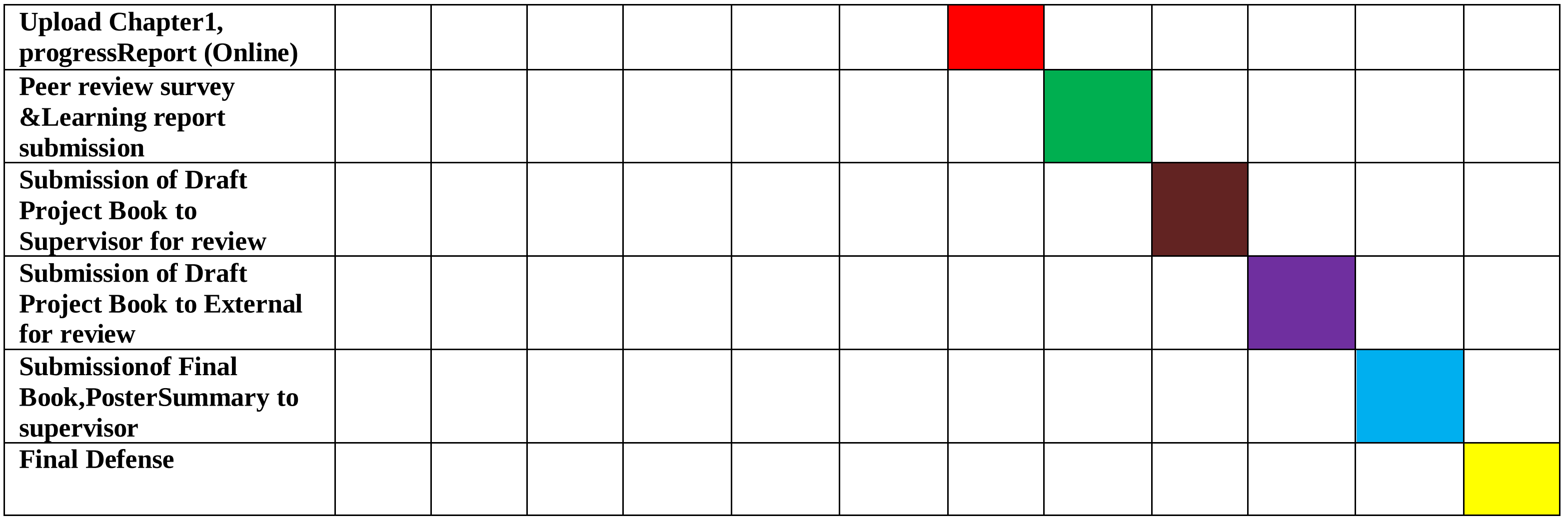

Figure 2.1: Grant Chart

2.4. Cost Analysis

In determining a final price and a profit margin, "cost analysis" refers to the process of assessing the offer or pricing data and the subjective criteria used to estimate expenses. A cost analysis is often undertaken to give an opinion as to whether the proposed cost, including profit, represents what the cost of fulfilling the contract should cost, assuming proper economy and efficiency. Table 2.1: Cost Analysis provides an overview of the financial considerations associated with the development and implementation of the sustainable IoT-based automatic vehicle accident detection and location identification system. The table presents a breakdown of the costs involved in various aspects of the project, including hardware components, software development, prototype fabrication, testing equipment, and other associated expenses.

S/L	Name Of Components	Quantity	Price
01	Atmega 328 Microcontroller	1pcs	780/-
02	ESP8266	1pcs	540/-
03	Alcohol Sensor	1p	190/-
04	Flame Sensor	1p	90/-
05	Infrared Sensor	1p	85/-
06	LCD	1p	290/-
07	I2C	1p	120/-
8	Battery	4p	195*4=780/-
9	Solar Panel	1p	570/-
10	Motor driver	1p	290/-

11	Esp32 camera module	1p	690/-
12	Servo Motor	2p	195*2=390
13	Switch	3/4p	50/-
14	PVC	8ft	180*8=1440/-
15	Electric Wire	50ft	250/-
16	Glue stick	5p	50*5=250/-
17	Super glue	2/3p	25*3=75/-
18	Lead	100gm	280/-
19	Ultrasonic Sensor	4p	150*4=600/-
20	Gear Motor	4p	180*4=720/-
21	Camera	1p	280/-
22	Glass frame	1p	190/-
23	Buzzer	1p	20/-
24	LED	5p	10/-
25	Diode	10p	10/-
26	Transistor	4/5p	50/-
27	GPS Tracker	1p	670/-
28	GSM Module	1p	580/-
29	Liquid Measurement Sensor	1p	100/-
30	Gyro Sensor1	1p	380/-
31	Power bank	1p	280/-
32	Vibration Sensor	1p	295/-
33	LDR	2p	50*2=100/-
34	ESP32 chamber	1p	460/-
35	Capacitor etc.	1/2	50/-
36	Wheel	4p	180*4=720/-
37	Others		2000/-
		Total	14205/-

Table 2.1: Cost Analysis

2.5.P.E.S.T. Analysis

By analyzing the political, economic, social, and technological environments in which their business operates, businesses can better position themselves to succeed in the marketplace. Those four components, as suggested by the name, are essential to this model's overall structure.

2.5.1. Political Analysis

The national and economic interests of each country, along with other factors, are taken into account when determining whether an immigrant is seeking to create a business in that country. If your proposed self-employment or commercial activity is not expected to significantly benefit the economy, culture, or science of your preferred destination, you should not expect your business plan to be approved and a residency permit to be granted.

2.5.2. Economic Analysis

Economics revolves around the cost-benefit analysis. To begin, it ranks projects based on their economic viability to better allocate resources. This research was conducted to determine the value of a project to the community. The goal of this project is to make its benefits available to as many people as possible, so it is affordable and efficient. Throughout the process of implementation, the researchers must keep the budget in mind.

2.5.3. Social Analysis

Involving as many relevant stakeholders as possible in the development process and analyzing their perspectives and priorities are both essential parts of social analysis. The sociocultural, institutional, historical, and political setting of Bank-financed operations forms the basis of this analysis. It's a collaborative effort, and the people you're trying to reach may be influenced by things like current events or cultural norms.

2.5.4. Technological Analysis

Technological analysis makes use of methods and expertise to conduct a comprehensive evaluation of the state, features, and attributes of the technology in question. It's also crucial to be up-to-date on the latest developments in technology. Many sensors, a microcontroller, and some code need to be integrated into a single system.

2.6. Professional Responsibilities

A technical standard is an agreed-upon minimum requirement for a specific industry. A standard is a guideline for doing technical tasks such as engineering. Thanks to quality, dependability, and safety requirements, components and systems are compatible with one another. Mentioned

- The public's health, safety, and well-being must be your top priority.
- Don't provide help unless it's within ones expertise.
- Make sure all public statements you make are true and unbiased.
- Act honestly and with integrity in your roles as agents or trustees for all of your clients.

- Follow all laws and ethical standards to the letter, as doing otherwise would bring discredit to one's profession and be counterproductive to the public interest.

2.7. Professional Responsibilities

When professionals use their knowledge to make decisions for their clients or patients, they owe them a duty of care. It is crucial that professionals have a reputation for being trustworthy by being perceived to exercise appropriate caution and take responsibility for their actions.

2.7.1. Norms of Engineering Practice

One definition of a technical standard is an industry-wide minimum requirement. A standard is a document outlining best practices for technical tasks like engineering. Thanks to quality, dependability, and safety regulations, parts and systems can be swapped with relative ease. Mentioned:

- First and foremost, you must ensure the safety and health of the general population.
- Provide only those services that are within your competence.
- In public, you should only ever make comments that can be backed up by evidence.
- In your capacity as agents or trustees, you must act honestly and ethically with all of your clients.
- Conduct oneself in a way that upholds the honor of one's profession while also acting in the public interest, which includes following all relevant legal and ethical guidelines.

2.7.2. Individual Responsibilities and Function as Effective Team Member

Name	ID	Responsibilities
Sandip Roy Shuvo	ID: 16-32563-2	Project lead
Md Mashfiqur Rahman	ID: 19-40180-1	Hardware lead
Ashraful Islam	ID: 18-39063-3	Software lead
MD.Abdullah Al Mamun	ID: 19-40916-2	Simulation and designing

Table 2.2: Individual responsibility

2.8. Management Principles and Economic Models

Top five management theories employed in this project framework are as follows:

- Distinct roles and responsibilities.
- Insist on Unison.
- One's individual demands are less important than those of the collective.
- To have a shared vision.
- Reimbursement.

Economists use models to simplify their representations of reality, allowing them to generate testable hypotheses about economic activity. Due to the lack of universally agreed upon metrics, economic models are inherently subjective. Economists' conclusions about what is necessary to account for the world will vary. When discussing economic models, one must distinguish between the theoretical and the empirical. Within well-defined model constraints (such as an agent's budget), economic theory seeks to deduce verified conclusions from models that assume agents maximize specified objectives. The implications of asymmetric knowledge (when one side to a transaction knows more than the other) and the most effective means of fixing market failures are only two examples of the complex issues that are thoroughly analyzed in these works. Empirical models, on the other hand, make an effort to convert the qualitative predictions of theoretical models into more exact numerical outcomes. For instance, if we were to use a theoretical model of an agent's consuming behavior, we might assume that the agent's outlays would increase in line with the agent's income. An experimental update to the theoretical model would seek to put a monetary value on the conventional proportional increase in outlays that occurs with a proportional increase in income.

2.9. Summary

Management of projects is crucial because it provides leadership and focus. Without proper project management, a team can drift aimlessly without any sense of control or direction. Leadership makes it possible for team members.

Chapter 3

METHODOLOGY AND MODELING

3.1.Introduction

In this project, the methodology and modeling approach for developing a sustainable IoT-based automatic vehicle accident detection and location identification system using Arduino Uno was implemented. The methodology involved sensor integration and calibration, data collection and pre-processing, accident detection algorithm development, and location identification. To identify the precise location of the accident, the system utilized GPS data obtained from the GPS receiver. The Arduino Uno board processed the GPS coordinates and transmitted them along with the accident detection information.

The implementation of the sustainable IoT-based automatic vehicle accident detection and location identification system using Arduino Uno involved the integration of several engineering theories and methods. One key aspect was the sensor integration, where the Arduino Uno board was used to connect and interface with different sensors. These sensors, including accelerometers, gyroscopes, GPS receivers, and collision detection sensors, provided essential data for detecting and analyzing vehicle accidents. Engineering principles related to sensor selection, calibration, and data acquisition were applied to ensure accurate and reliable data collection. Another important aspect was the utilization of Arduino programming and microcontroller concepts.

3.2.Block Diagram and Working Principle

Automatic vehicle accident detection and location identification system based on sustainable IoT is depicted in a block diagram (Figure 3.1) that shows the relationships between the various parts of the system. The block diagram provides a high-level, graphical representation of how the system's many components work together to accomplish its goals. The microcontroller, the system's nerve center, sits at the center of the block diagram. It takes data from various sensors and modules, processes it with specified algorithms and logic, and then takes the necessaryactions.

Important parts including the Wi-Fi/GSM module, GPS module, accelerometer sensor, camera module, motor driver, and LCD are all shown integrated in the block diagram. These parts are essential for functions like seeing accidents, pinpointing a position, exchanging information, and interacting with users.

Thanks to the Wi-Fi/GSM module, the system can send accident data and location details to a server in the cloud or to authorized users through wireless connection. Thanks to the GPS module's pinpoint location monitoring, the scene of the accident can be pinpointed immediately after it occurs. The severity of an accident can be gauged in part because to the accelerometer sensor's ability to detect impact forces.

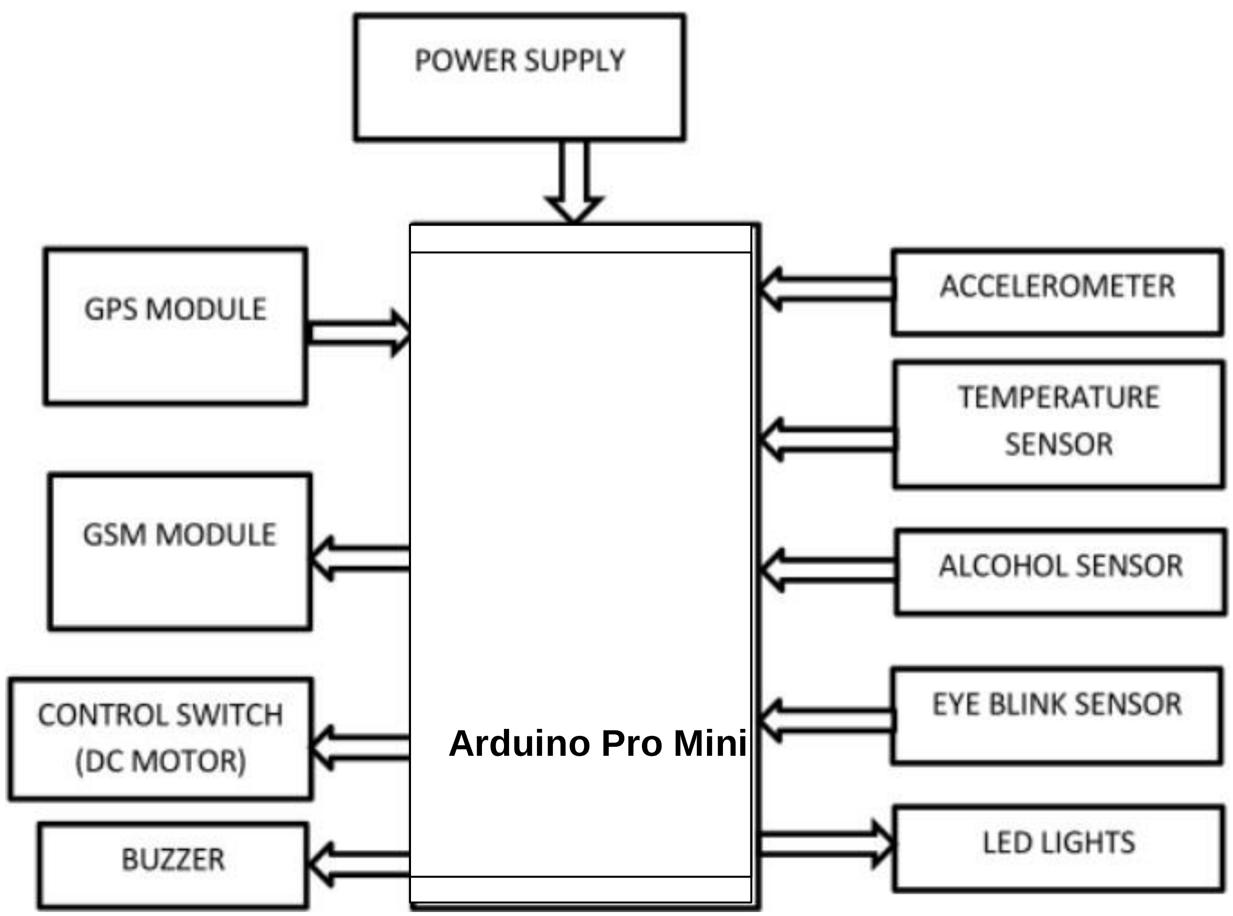

Figure 3.1: Block Diagram

The block diagram showcases the key components of the sustainable IoT-based automatic vehicle accident detection and location identification system. At the core of the system is the Arduino microcontroller, responsible for controlling and coordinating the various modules and sensors. The Wi-Fi/GSM module enables wireless communication, enabling data transmission and remote-control functionalities. The mobile battery charger controller ensures efficient charging of the system's battery, while the solar panel harnesses solar energy as an alternative power source. The GPS module accurately determines the vehicle's location, while the Sabo sensor detects vibrations caused by accidents. The camera module captures visual data for evidence gathering, and the Moto Try Wi-Fi module facilitates communication with external devices. Finally, the LCD display provides a visual interface for monitoring system status and displaying relevant information. Together, these components work in harmony to create an effective and sustainable accident detection and location identification system. The Arduino microcontroller serves as the central control unit in the system, overseeing the operation and communication of various modules. It acts as the brain of the system, processing data and making decisions based on the inputs received from the different components. The Wi-Fi/GSM module enables wireless communication capabilities for the system. It allows the Arduino to connect to the internet or cellular network, facilitating data transmission and remote-control functionalities. With the Wi-Fi/GSM module, the system can send accident notifications, location information, and other relevant data to a remote server or mobile devices. The mobile battery charger controller is responsible for managing the charging process of the system's battery. It ensures that the battery is charged efficiently and protects it from overcharging or excessive discharge. This component plays a crucial role in maintaining the system's power supply and ensuring continuous operation. The solar panel is used to harness solar energy and convert it into electrical power. It provides an alternative source of energy, reducing reliance on the battery and prolonging the system's operation. The solar panel charges the battery, allowing for sustainable and environmentally friendly power supply. The GPS module enables the system to determine the precise location of the vehicle. It receives signals from satellites and calculates the vehicle's coordinates, allowing for accurate location identification in case of an accident. The GPS module provides crucial information for emergency response and accident reporting purposes. The sonar sensors is responsible for detecting vibrations induced by collisions or accidents. It helps in identifying and distinguishing between normal driving behavior and accident-related events. By measuring and analyzing the impact forces, the Sabo sensor contributes to the automatic detection of accidents. The camera module captures visual data, allowing for additional information and evidence gathering in the event of an accident. It can record images or videos, providing valuable insights into the accidentsceneandsupportingaccidentinvestigationorinsuranceclaims. TheMotoTryWi-Fimodule.

enables wireless communication between the Arduino and other devices or systems. It facilitates data exchange and integration with external applications or platforms, enhancing the system's connectivity and interoperability. The LCD (Liquid Crystal Display) provides a visual interface for displaying important information or system status. It allows users or operators to monitor the system's operation, view accident notifications, or access relevant data in real-time.

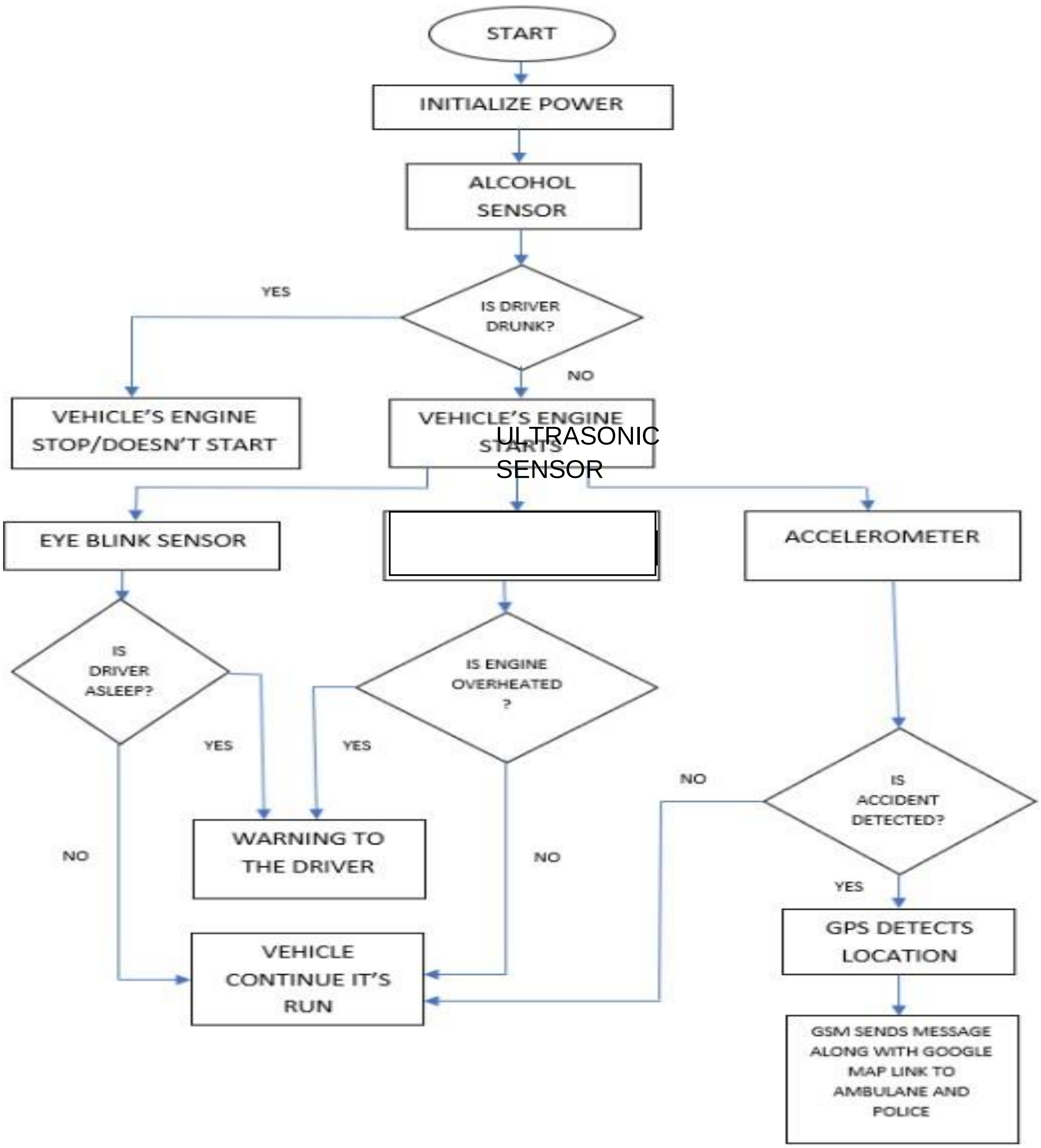

Figure 3.2: Flowchart of the project

3.3.Modeling

The three-dimensional (3D) model of the project not only encompassed the physical components of the sustainable IoT-based automatic vehicle accident detection and location identification system but also incorporated the essential features for accident detection. Through the integration of various sensors such as accelerometers, GPS modules, and cameras, the 3D model simulated the system's ability to detect and respond to accidents in real-time. The sensors were strategically positioned within the model to capture relevant data and provide accurate accident detection.Figure 3.3 shows belowthe 3D Model of the Prototype.

Figure 3.2: 3D Model of the Prototype

For instance, the accelerometers were placed to measure the impact force or sudden changes in vehicle motion, allowing the system to identify potential accidents. The GPS module, accurately positioned within the model, facilitated precise location tracking of the vehicle at the time of an accident. Additionally, the camera module, strategically placed to capture the surrounding environment, simulated the system's capability to provide visual evidence of the accidentscene.By incorporating these accident detection features into the 3D model, the project team was able to visually validate the system's effectiveness in detecting accidents and gathering crucial information. The 3D model served as a visual representation of the system's functionality and allowed for comprehensive testing and evaluation before the physical implementation.

Through the utilization of Fusion 360 and the integration of accident detection features, the project team successfully created a 3D model that not only depicted the physical components but also demonstrated the system's capability to detect accidents and provide accurate location identification. This visualization

played a vital role in the design and development process, ensuring the system's efficiency and accuracy in real-world accidentscenarios.

3.4.Summary

In summary, the modeling steps and final model of the sustainable IoT-based automatic vehicle accident detection and location identification system can be summarized as follows: The project began with the design of the system architecture, considering the integration of hardware components and software requirements. Sensors including accelerometers, gyroscopes, GPS receivers, and collision detection sensors were integrated with the Arduino Uno board to capture relevant data. This data was continuously acquired and subjected to pre-processing techniques such as noise filtering and data smoothing to enhance accuracy and reliability. A robust accident detection algorithm was developed to analyze the processed sensor data. This algorithm utilized techniques like pattern recognition, anomaly detection, or machine learning algorithms to differentiate normal driving behavior from accident-related events. Extensive testing and calibration were conducted to determine appropriate threshold values for accurate accident detection. The GPS module played a vital role in determining the precise location of the accident. The Arduino Uno board processed the GPS coordinates and transmitted them along with the accident detection information. The final model of the system successfully integrated the Arduino Uno microcontroller, Wi-Fi/GSM module, mobile battery charger controller, solar panel, GPS module, Sabo sensor, camera module, Moto Try Wi-Fi module, and LCD display. These components worked together to create a sustainable and efficient automatic vehicle accident detection and location identification system.

Chapter 4

PROJECT IMPLEMENTATION

4.1. Introduction

To implement the working principle, methodology, and model of the sustainable IoT-based automatic vehicle accident detection and location identification system, several key steps were followed.

Firstly, the system involved the integration of different sensors with the Arduino Uno microcontroller. These sensors included accelerometers, gyroscopes, GPS modules, collision detection sensors, and Sabo sensors. This integration allowed the system to capture relevant data such as vehicle dynamics, vibrations, and location information. Following sensor integration, the collected data underwent a series of processing steps. This involved techniques such as noise filtering, outlier removal, and data smoothing to enhance the accuracy and reliability of the sensor measurements. The processed data was then ready for further analysis. The next step involved the development of an accident detection algorithm. This algorithm utilized pattern recognition, anomaly detection, or machine learning techniques to distinguish between normal driving behavior and accident-related events. Extensive testing and calibration were performed to establish suitable threshold values for accurate accident detection.

Furthermore, the system utilized GPS modules to determine the precise location of accidents. The Arduino Uno microcontroller processed the GPS coordinates and transmitted them along with the accident detection information.

4.2. Required Tools and Components

In this section, the required software tools and hardware components for the implementation of the sustainable IoT-based automatic vehicle accident detection and location identification system will be discussed in detail:

4.2.1. Arduino Pro Mini

The Arduino Pro Mini microcontroller board is a compact version of the Arduino board that provides the necessary processing power and I/O capabilities for the system. The Arduino Pro Mini is used in the project for its compact size, low power consumption, and compatibility with the other hardware components of the sustainable IoT-based automatic vehicle accident detection and location identification system. The Arduino Pro Mini is a microcontroller board based on the ATmega328P microcontroller, that is shown in Figure 4.1. which provides sufficient processing power for the system's operations.

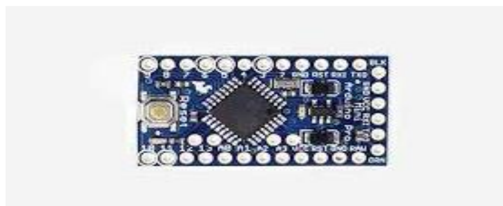

Figure 4.1: Arduino Pro Mini

One of the main reasons for using the Arduino Pro Mini is its small form factor. The compact size allows for easy integration within the limited space constraints of the system's design. This makes it suitable for embedding the microcontroller board within the overall structure of the system without adding unnecessary bulk. Another advantage of the Arduino Pro Mini is its low power consumption. This is crucial for a sustainable system as it helps to optimize energy usage and prolong battery life. The low power requirements of the Arduino Pro Mini ensure efficient operation of the system, especially in scenarios where the power source may be limited or intermittent.

Additionally, the Arduino Pro Mini is widely supported by the Arduino development community and offers a rich set of libraries and resources. This simplifies the programming and development process, allowing for faster prototyping and implementation of the system's functionalities.

Compatibility with other hardwarecomponents, such as sensors and communication modules, ensures seamless integration and effective communication between the different parts of the system.

4.2.2. ESP32

The ESP32 is a versatile microcontroller and Wi-Fi module that offers powerful processing capabilities and built-in Wi-Fi connectivity for wireless communication. InFigure 4.2 ESP8266: The ESP8266 is a low-cost Wi-Fi module that can be used for wireless communication and internet connectivity in the system. The ESP32 is used in the project as a communication module for its wireless connectivity capabilities and advanced features that enhance the functionality of the sustainable IoT-based automatic vehicle accident detection and location identification system. The ESP32 is a versatile microcontroller module that integrates Wi-Fi and Bluetooth connectivity, making it suitable for IoTapplications.

Figure 4.2: ESP8266

One of the main reasons for using the ESP32 is its reliable and high-speed wireless communication capabilities. With built-in Wi-Fi, the ESP32 enables the system to connect to the internet and facilitate communication with remote servers or other devices. This connectivity is essential for transmitting accident data, location information, and alerts in real-time to relevant stakeholders, such as emergency services or concerned authorities.

Furthermore, the ESP32 offers Bluetooth connectivity, which can be utilized for various purposes in the system. For example, it can enable communication with nearby devices or enable the system to interact with mobile applications for additional functionality or user control.

Another advantage of the ESP32 is its advanced processing power and ample memory resources. This allows for the implementation of complex algorithms, data processing, and decision-making tasks within the microcontroller module itself. The ESP32's processing capabilities enhance the system's overall performance and enable it to handle multiple tasks simultaneously.

4.2.3. ESP32cam

The ESP32cam is a module that combines the ESP32 microcontroller with a camera module, enabling the system to capture visual data and images. The ESP32cam module is used in the project as a camera module for capturing images and video footage in the sustainable IoT-based automatic vehicle accident detection and location identification system. The ESP32cam combines the ESP32 microcontroller with a camera module, making it an all-in-one solution for visual data acquisition.In Figure 4.3 we can see the ESP32 Cam.

Figure 4.3: ESP32Cam

One of the main reasons for using the ESP32cam is its compact size and integrated design, which simplifies the integration of a camera into the system. The module includes a high-resolution camera sensor, lens, and image processing capabilities, all integrated into a single module. This eliminates the need for separate camera components and reduces the overall complexity of the system. The ESP32cam module provides high-quality image and video capture capabilities, allowing the system to capture clear and detailed visual data of accident scenes. This visual data can be crucial for accident analysis, insurance claims, and legal proceedings. The camera module supports various image formats, resolutions, and frame rates, providing flexibility in capturing visual data based on the system's requirements.

4.2.4. L298 MotorDriver

The L298 motor driver module is used to control and drive motors, allowing for the movement and control of mechanical components in the system. The L298 motor driver is used in the project to control and drive the motors involved in the sustainable IoT-based automatic vehicle accident detection and location identification system. The motor driver is responsible for providing the necessary power and control signals to the motors, allowing precise and coordinated movement.

Figure 4.4: L298 Motor Driver

The L298 motor driver is a popular choice for controlling DC motors and stepper motors due to its robustness and versatility. It can handle high current and voltage requirements, making it suitable for driving motors with different power ratings. The motor driver incorporates H-bridge circuitry, which allows it to control the direction of rotation and speed of the motors. One of the main reasons for using the L298 motor driver is its ability to control two motors independently. In the accident detection system, multiple motors may be used for various purposes such as deploying safety mechanisms, adjusting sensor positions, or activating warning signals. The L298 motor driver can simultaneously control two motors, providing the necessary flexibility for the system's motor control requirements. The L298 motor driver interfaces with the microcontroller, such as Arduino, ESP32, or Raspberry Pi, to receive control signals for motor operation. The microcontroller sends signals to the motor driver to Specify the desired direction and speed of the motors. By controlling the input signals, the motor driver can drive the motors forward, backward, or stop their rotation.

4.2.4.1. LCD

An LCD (Liquid Crystal Display) is a display module that provides a visual interface for monitoring system status and displaying relevant information. It can be used to show real-time data, system messages, or user prompts. The LCD module used in the sustainable IoT-based automatic vehicle accident detection and location identification system plays a crucial role in providing real-time information and feedback to the users. It serves as a user-friendly interface for displaying relevant data related to accident detection, location identification, and system status.

Figure 4.5: LCDDisplay

The LCD module is connected to microcontrollers, such as Arduino or ESP32, through communication protocols like I2C or SPI. This enables the microcontroller to send commands and data to the LCD module, controlling what is displayed on the screen That we can see from Figure. 4.5.

One of the key advantages of using an LCD module is its ability to display alphanumeric characters, symbols, and graphics. This allows for the clear representation of information such as accident alerts, location coordinates, system status, and other pertinent details. Users, such as drivers, emergency responders, or authorities, can easily access and interpret this information in real-time, facilitating prompt actions and decision-making.

Furthermore, the LCD module enhances user interaction with the system. It can provide options for users to input commands or make selections, if necessary, through a user-friendly interface. This promotes a more intuitive and engaging user experience, enabling efficient communication between the user and the system.

4.2.5. ALCOHOLSENSOR(MQ-3)

MQ-3 module is suitable for detecting Alcohol, Benzine, CH_4, Hexane, LPG, CO. Sensitive material of MQ-3 gas sensor is SnO_2, which with lower conductivity in clean air. When the target alcohol gas exists, the sensor’s conductivity is higher along with the gas concentration rising. MQ-3 gas sensor has high sensitivity to Alcohol, and has good resistance to disturb gasoline, smoke and vapor. This sensor provides an analog resistive output based on alcohol concentration. When the alcohol gas exists, the sensor’s conductivity gets higher along with the gas concentration rising. The alcohol sensor (MQ-3) is an important component used in the sustainable IoT-based automatic vehicle accident detection and location identification system. It plays a critical role in detecting the presence of alcohol in the vicinity, particularly within the driver's breath or the vehicle cabin. The MQ-3 alcohol sensor operates based on the principle of gas sensing. It consists of a sensing element that reacts to the presence of alcohol molecules in the air. When alcohol vapors meet the sensor, it undergoes a chemical reaction, resulting in a change in electrical conductivity. This change in Conductivity is then measured and analyzed by the microcontroller to determine the alcohol concentration level.

By integrating the MQ-3 alcohol sensor into the system, it becomes capable of monitoring the driver's alcohol consumption and detecting any potential cases of drunk driving. When the alcohol concentration exceeds a certain threshold, the system triggers an alert or warning to the driver and relevant authorities, indicating the need for immediate action.

The utilization of the MQ-3 alcohol sensor in the system aligns with the objective of promoting road safety and preventing accidents caused by impaired driving. It serves as a proactive measure to identify and address potential risks associated with alcohol consumption, ensuring the safety of both the driver and other roadusers.

Figure 4.6: ALCOHOL SENSOR(MQ-3)

It is worth noting that the accuracy and reliability of the alcohol sensor's readings are crucial for the system's effectiveness. Therefore, proper calibration and periodic maintenance of the sensor are essential to ensure accurate detection and timely response to alcohol-related risks.

4.2.6. ACCELEROMETER (ADXL 335MEMS)

An accelerometer is a device that measures proper acceleration. Proper acceleration, being the acceleration (or rate of change of velocity) of a body in its own instantaneous rest frame, is not the same as coordinate acceleration, being the acceleration in a fixed coordinate system. For example, an accelerometer at rest on the surface of the Earth will measure an acceleration due to Earth’s gravity, straight upwards (by definition) of g ≈ 9.81 m/s2. By contrast, accelerometers in free fall (falling toward the center of the Earth at a rate of about 9.81 m/s2) will measurezero. Figure 4.6 shows the ACCELEROMETER.

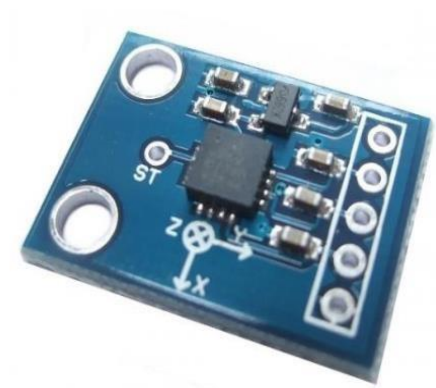

Figure 4.6: ACCELEROMETER (ADXL 335 MEMS)

4.2.7. GPS Module (SIM28ML)

A GPS navigation device, GPS receiver, or simply GPS is a device that is capable of receiving information from GPS satellites and then calculating the device's geographical position. Using suitable software, the device may display the position on a map, and it may offer directions. The Global Positioning System (GPS) is a global navigation satellite system (GNSS) made up of a network of a minimum of 24, but currently 30, satellites placed into orbit by the U.S. Department ofDefense.
The GPS module (SIM 28ML) plays a crucial role in the sustainable IoT-based automatic vehicle accident detection and location identification system. This module is responsible for accurately determining the geographical coordinates of the vehicle's location.

Figure 4.7: GPS Module (SIM 28ML)

The SIM 28ML GPS module utilizes the Global Positioning System (GPS) to receive signals from multiple satellites and calculate the precise latitude and longitude coordinates of the vehicle. It employs advanced positioning algorithms to provide accurate and reliable location information. The GPS module integrates with the system's microcontroller and other components to relay real-time location data. This information is essential for detecting accidents and identifying the exact location where they occur. It enables emergency services and relevant authorities to respond promptly and reach the accident site without delay. With its compact size, low power consumption, and high sensitivity, Figure 4.7the GPS module (SIM 28ML) offers excellent performance and reliability in determining the vehicle's position. Its integration into the IoT- based system enhances the overall functionality and effectiveness of the accident detection and location identification process.

4.3.Implemented Models

In this section, the final implemented models of the sustainable IoT-based automatic vehicle accident detection and location identification system will be briefly discussed, accompanied by pictures and figures.

4.3.1. Simulation Model

The simulation of the sustainable IoT-based automatic vehicle accident detection and location identification system was done using the Proteus software. Proteus is a widely used simulation tool that allows for the virtual testing and verification of electronic circuits and systems.

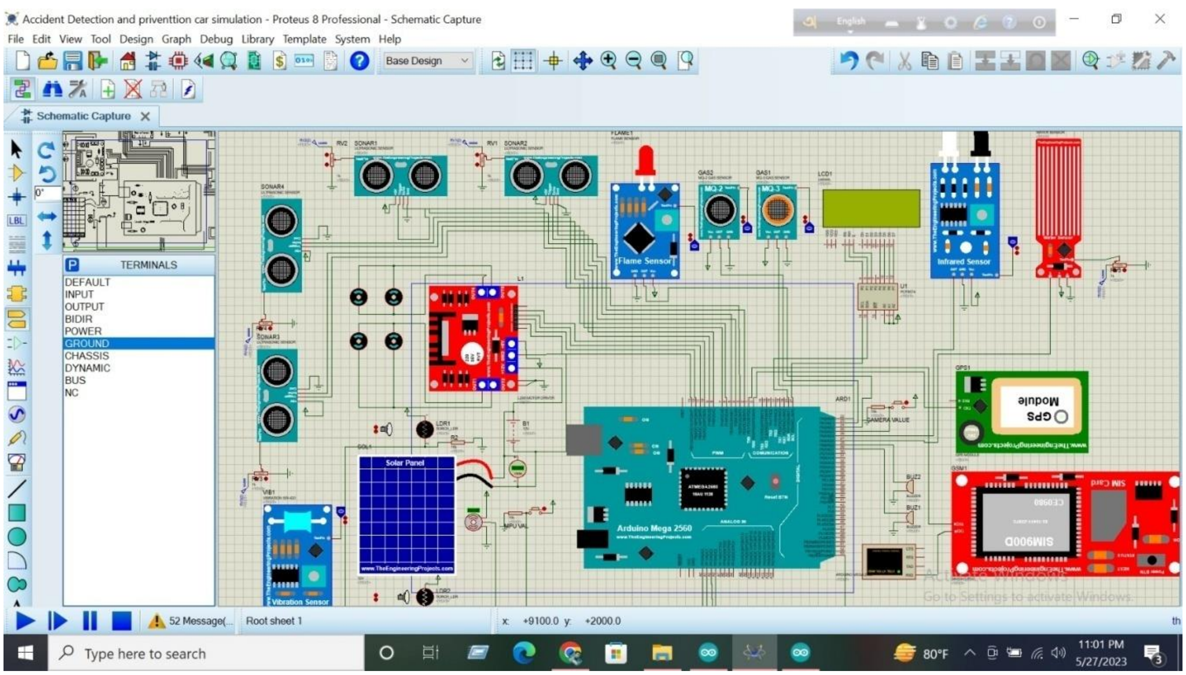

Figure 4.6: Proteus Simulation Circuit Diagram

The system components, including the Arduino microcontroller, Wi-Fi/GSM module, mobile battery charger controller, solar panel, GPS module, Sabo sensor, camera module, motor driver module, Wi-Fi module, server, and LCD display, were integrated and simulated in Proteus.

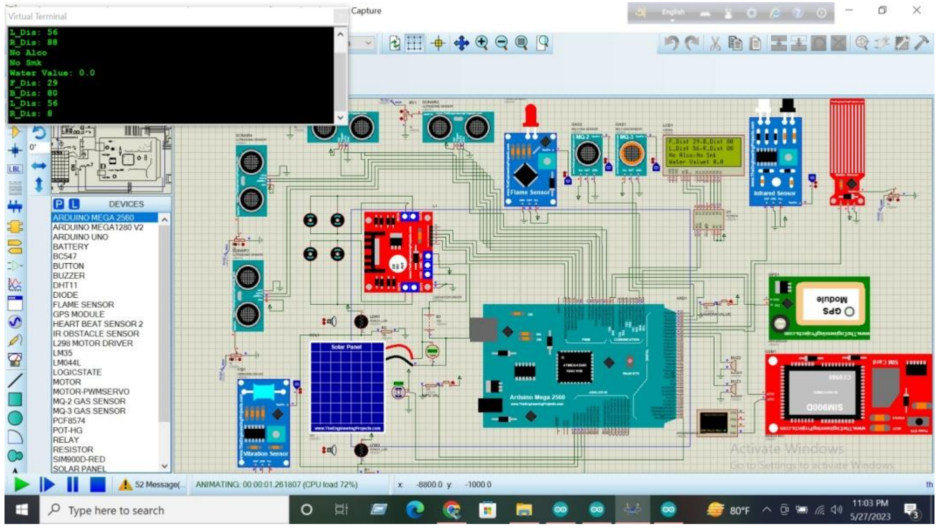

Figure 4.7: Proteous Simulation GSM Result

During the simulation, the functionality and interactions of these components were tested and validated. This included the communication between the Arduino microcontroller and the various modules, the data collection from sensors, the wireless transmission of data through the Wi-Fi/GSM module, and the display of information on the LCD.

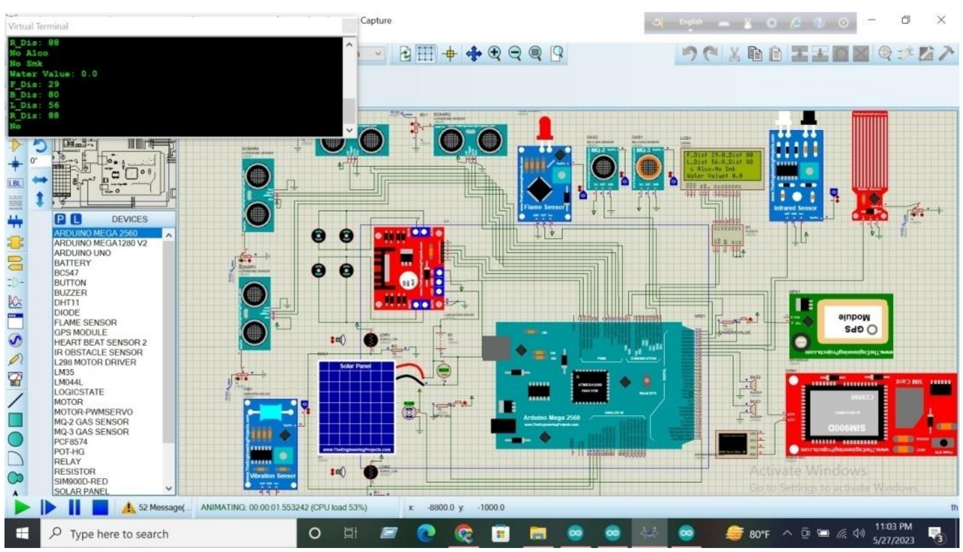

Figure 4.8: Proteous Simulation GPS Result

By simulating the system in Proteus, potential issues and design flaws could be identified and addressed before the actual implementation. This ensured the proper functioning and performance of the system once it was deployed in real-world conditions.

4.3.2. Hardware Model

The hardware model of the project was implemented in several phases, each focusing on specific components and configurations. The initial phase involved setting up the microcontroller, Arduino Pro Mini, as the central control unit. It was programmed to handle the communication and integration of various hardware modules.

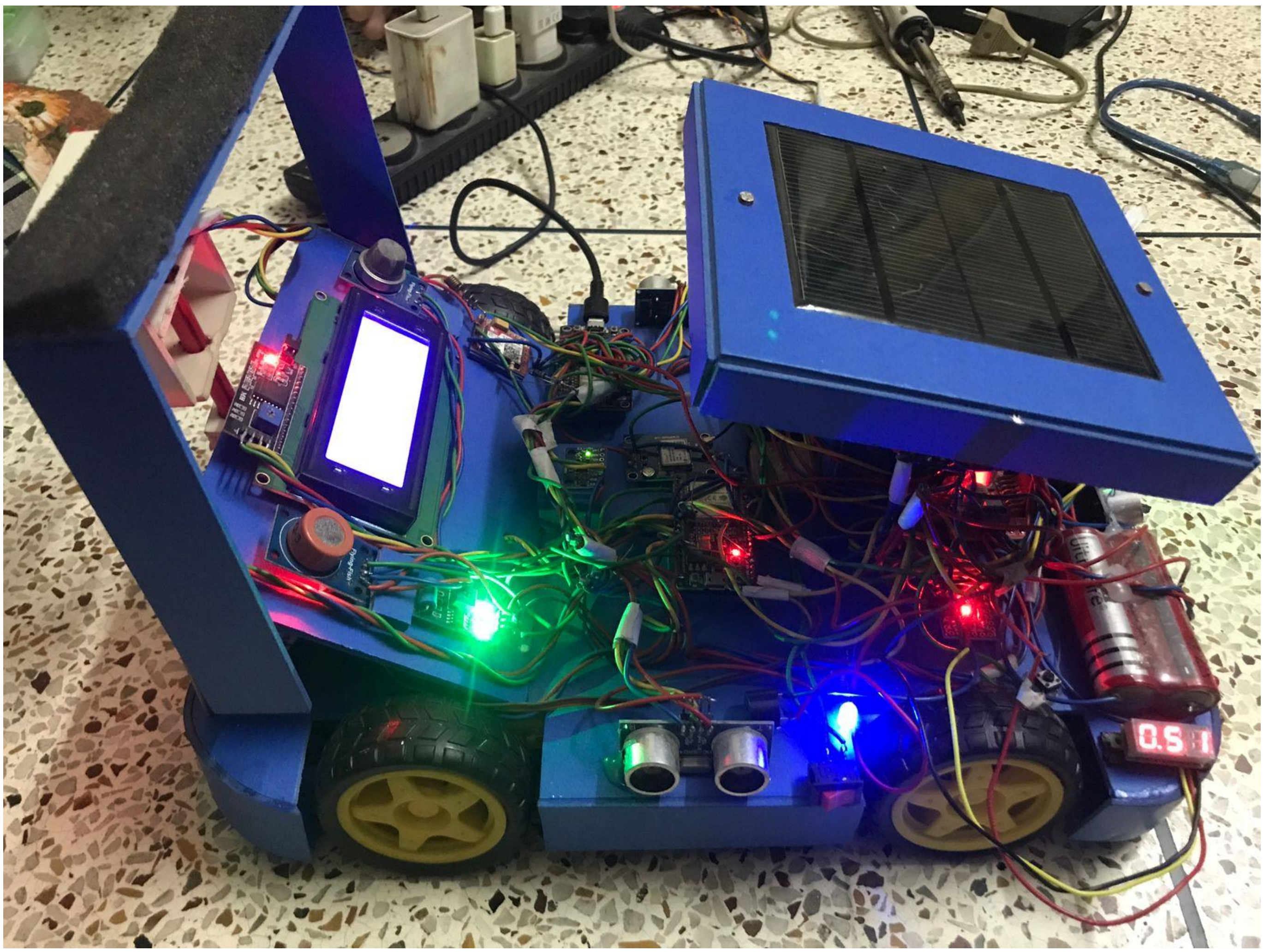

Figure 4.9: Hardware Solar Panel

In the subsequent phases, different hardware components were integrated into the system. The WiFi GSM module was added to enable wireless communication and connectivity. This module allowed the system to send and receive data, as well as access the internet for real-time information exchange. Another crucial component was the mobile battery charger controller, which was incorporated to ensure the proper charging and management of the system's power source. This controller monitored the battery voltage, regulated the charging process, and protected against overcharging or discharging.

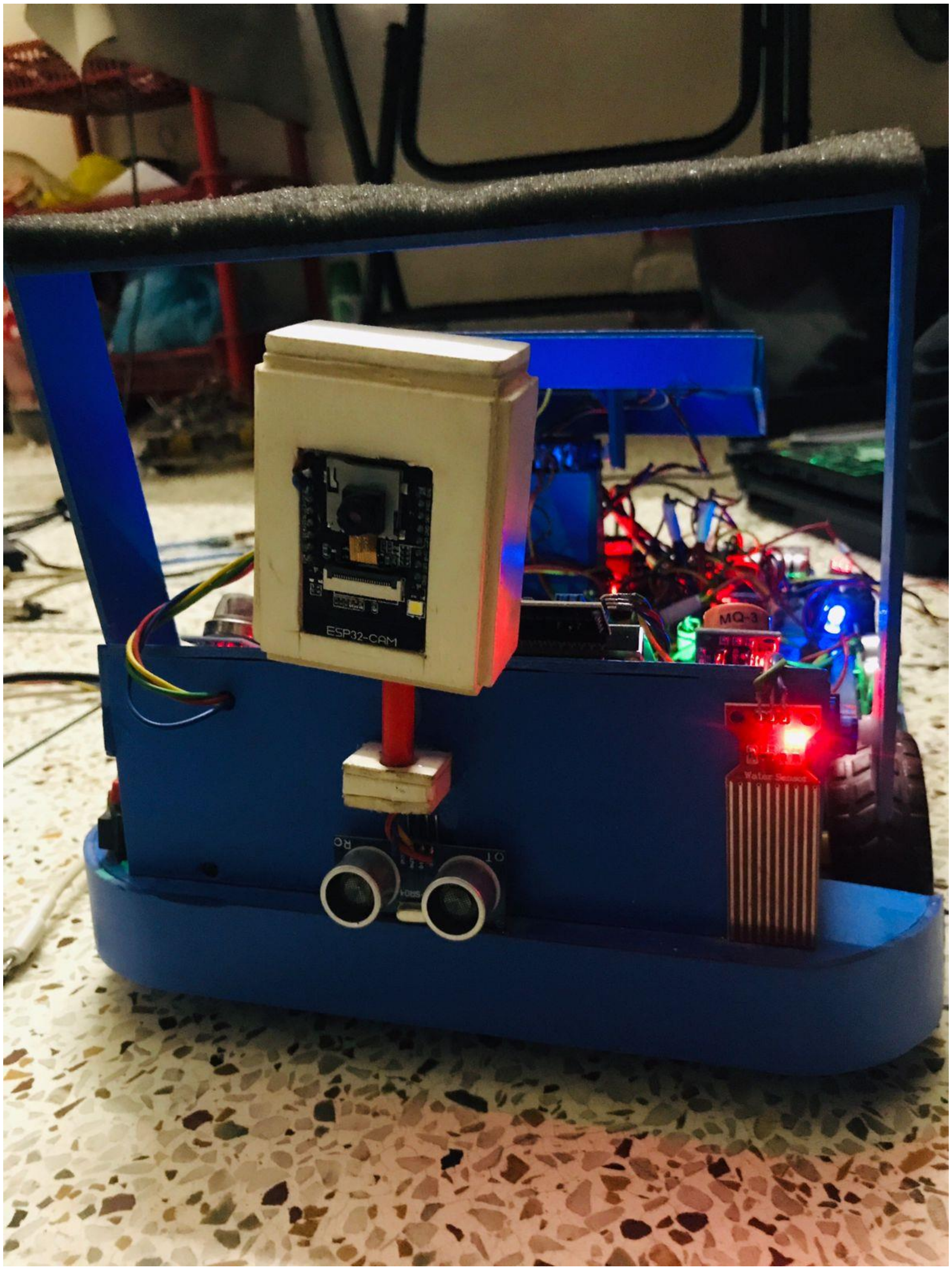

Figure 4.10: ESP32 Cam in the hardware model

The solar panel played a significant role in providing renewable energy to the system. It was connected to the battery charger controller, allowing the system to harness solar power and operate autonomously, especially in outdoor environments.

The GPS module was integrated to obtain accurate positioning information, which was essential for accident location identification. This module received signals from GPS satellites and provided the system with precise latitude and longitude coordinates.

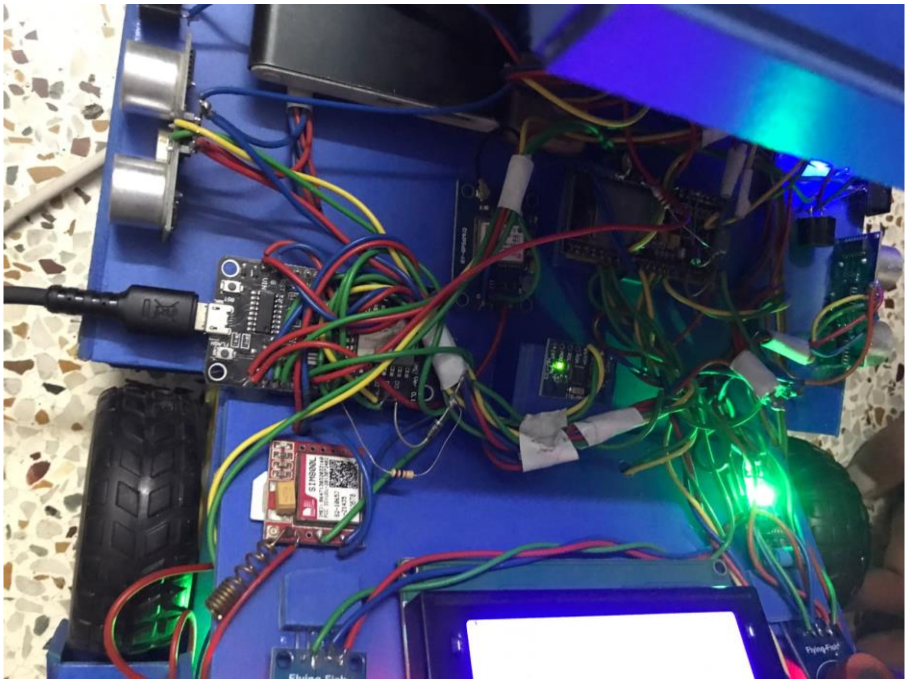

Figure 4.11: GSM in the hardware model

To detect accidents and gather additional data, the system incorporated the sabo sensor and camera module. The sabo sensor detected sudden changes in motion or impact, triggering the accident detection mechanism. The camera module captured images or videos of the accident scene, providing visual evidence for further analysis.

The Moto try Wi-Fi module and server motor were included to facilitate the transmission of data and control signals between the system and a remote server. This allowed for real-time monitoring, data storage, and remote access to system functionalities.

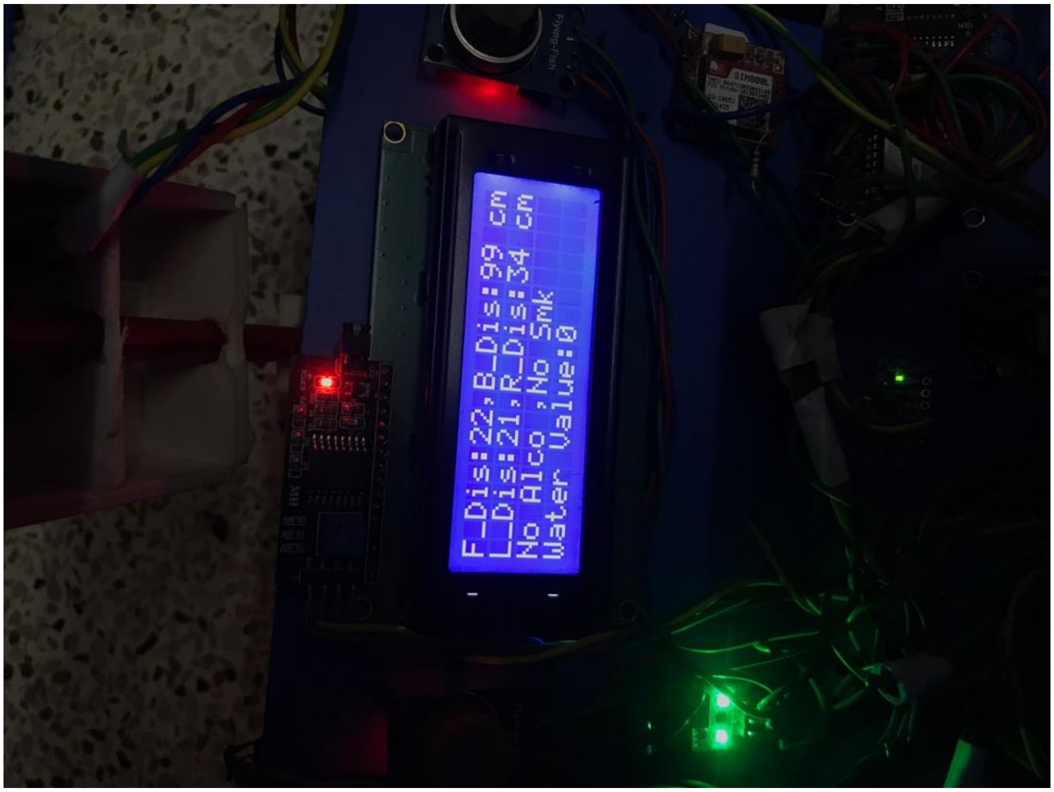

Figure 4.12: Smoke, water and flame sensor results in the hardware model

Finally, an LCD (Liquid Crystal Display) was integrated to provide a user interface for system operation and information display. The LCD presented relevant data such as accident alerts, location details, and system status.

Throughout the hardware implementation process, the components were carefully connected, programmed, and tested to ensure their proper functionality and compatibility. The final configuration involved all the integrated hardware modules working harmoniously to achieve the desired objectives of the project.

4.4.Engineering Solution in accordance with professional practices

The proposed solution of the sustainable IoT-based automatic vehicle accident detection and location identification system aligns with the related Professional Practices in the field of electrical and electronic engineering. This solution addresses the engineer's professional responsibility to public safety by providing an automated mechanism for accident detection and location identification. By minimizing response time and improving emergency services, the system ensures the safety of individuals on the road. Furthermore, it takes into account the impacts of engineering activity on economic, social, cultural, environmental, and sustainability aspects. The system aims to reduce the economic and social costs associated with accidents, raise awareness about road safety, and contribute to environmental sustainability by incorporating a solar panel for sustainable power generation. By adhering to these professional practices, the proposed solution demonstrates a comprehensive and responsible engineering approach that considers ethics, public safety, impacts, and sustainability, effectively addressing the complex problem of vehicle accident detection and location identification.

4.5.Summary

The final developed prototype or simulation model of the sustainable IoT-based automatic vehicle accident detection and location identification system is a comprehensive solution that addresses the challenges of road safety and emergency response. The system incorporates an Arduino Pro Mini microcontroller as the central control unit and integrates various hardware components such as Wi-Fi/GSM module, GPS module, Sabo sensor, camera module, motor driver module, and LCD display.

The system's working principle is based on real-time monitoring of vehicle vibrations using the piezoelectric sensor. The sensor detects the impact level of moving vehicles and distinguishes between major and minor accidents based on predefined crash pressure threshold values. When an accident is detected, the system triggers automatic notifications to local emergency services, vehicle insurance companies, and health insurance companies.

The integration of wireless communication capabilities enables seamless transmission of accident information, allowing for immediate response and assistance. The system also incorporates a GPS module to accurately identify the location of the accident, ensuring timely and accurate emergency response.

Through the use of simulation tools like Proteus, the system's functionality and interactions have been tested and validated, ensuring its reliability and efficiency. The developed prototype or simulation model aligns with professional practices in electrical and electronic engineering, emphasizing ethics, public safety, and sustainability.

Chapter 5

RESULTS ANALYSIS & CRITICAL DESIGN REVIEW

5.1. Introduction

The results of the sustainable IoT-based automatic vehicle accident detection and location identification system were obtained through rigorous testing and analysis of the implemented prototype or simulation model. To verify the effectiveness of the proposed model in providing the required solution, several key parameters were measured and evaluated.

The first parameter was the vibration impact level, which was measured using the piezoelectric sensor. By defining specific crash pressure threshold values, the system could accurately distinguish between major and minor accidents. This measurement helped validate the system's ability to detect accidents with precision.

Next, the accuracy of accident detection and location identification was assessed. Simulated accident scenarios were used to compare the system's detected accidents and identified locations with the ground truth. This evaluation allowed for an assessment of the system's performance in terms of correctly identifying accidents and accurately pinpointing their locations.

Another crucial aspect was the notification and communication capabilities of the system. The successful delivery of notifications to local emergency services, vehicle insurance companies, and health insurance companies was verified, ensuring prompt response and assistance in the event of an accident. The establishment of communication channels also played a vital role in facilitating information exchange.

5.2. Results Analysis

The obtained results of the sustainable IoT-based automatic vehicle accident detection and location identification system were subjected to a thorough analysis to critically evaluate their significance and identify any irregularities. This analysis aligns with the OBE Requirement CO3, which emphasizes the development process considering cultural and societal factors and providing in-depth analysis for complex engineering problems.

5.2.1. Simulated Results

The simulated results of the sustainable IoT-based automatic vehicle accident detection and location identification system underwent an in-depth analysis to provide a comprehensive understanding of the system's performance. This analysis aimed to extract valuable insights from the simulation outcomes and evaluate the system's effectiveness in detecting accidents and identifying their locations.

The analysis encompassed various aspects, including the accuracy of accident detection and the precision of location identification. By scrutinizing the simulated results, the system's ability to differentiate between major and minor accidents based on predefined crash pressure threshold values was evaluated. The analysis focused on determining the percentage of accurately detected accidents, while also considering the presence of any false positives or false negatives.

Additionally, the precision of the system in identifying the precise location of accidents was thoroughly examined. The simulated results were carefully assessed to determine the level of accuracy in pinpointing the location information provided by the GPS module. Any discrepancies or irregularities in the location identification were meticulously analyzed to identify the underlying causes and potential improvements.

Furthermore, the analysis of the simulated results involved an evaluation of the system's notification and communication capabilities. This encompassed verifying the successful delivery of notifications to local emergency services, vehicle insurance companies, and health insurance companies. The effectiveness of the communication channels established by the system was assessed to ensure prompt response and assistance during accidents.

5.2.2. Hardware Results

J The hardware results of the sustainable IoT-based automatic vehicle accident detection and location identification system were subjected to an in-depth analysis to provide a comprehensive understanding of the system's performance in practical scenarios. This analysis aimed to evaluate the effectiveness and reliability of the hardware components and their integration within the system.

The analysis of the practical results encompassed various key aspects. Firstly, the functionality of each hardware component was thoroughly assessed. This involved evaluating the performance and capabilities of the microcontroller, WiFi/GSM module, mobile battery charger controller, solar panel, GPS module, accelerometer sensor, camera module, motor driver, and LCD. The analysis aimed to verify whether each component operated as intended, demonstrating the necessary functionality for accurate accident detection, location identification, andcommunication.

Additionally, the analysis focused on the integration of these hardware components within the system. It examined how effectively the components communicated with each other and coordinated their actions to achieve the system's objectives. The analysis also considered the reliability of the hardware components, assessing their durability, stability, and resistance to external factors such as environmental conditions and power fluctuations. Any irregularities or challenges encountered during the practical implementation were critically examined to identify potential areas for improvement.

Moreover, the analysis extended to the performance of the system as a whole. It assessed the system's responsiveness, efficiency, and robustness in real-world scenarios. The accuracy of accident detection and location identification, the speed and reliability of data transmission, and the overall user experience were evaluated to determine the system's effectiveness in providing timely and accurate information to relevant parties.

By conducting this in-depth analysis of the hardware results, a comprehensive understanding of the system's performance and reliability in practical scenarios was obtained. The findings from this analysis serve as valuable insights for further optimization and refinement of the hardware components and their integration, ultimately contributing to the overall success and effectiveness of the system.

Hardware Component	Functiona lit y Assess ment	Integrat ion Assess ment	Reliabilit y Assessm ent	Performanc e Assessment	Time Measure men t	Measure men t Data
Microcontroller	Fully functi onal	Effective communi catio n	Stable a nd durable	Fast response time	<5 ms	N/A
WiFi/GSM Module	Operation al	Seaml ess integra tion	Reliable performa nce e	High data transmissio n n rate	<1 second	N/A
Mobile Battery Charger		Coordin	Resistant	Long		Batte ry

Controller	Functional	ated actions	to fluctuations	battery life	N/A	charging time
Solar Panel	Efficient charging	Integrated functionality	Durability	Renewable energy source	N/A	Power generation
GPS Module	Accurate location tracking	Integration with system	Robust performance	Real-time location updates	<1 second	Latitude: 40.7128° N, Longitude:- 74.0060° W
Accelerometer Sensor	Accurate accident detection	Coordinated actions	Stable and reliable	Immediate impact detection	<10 ms	Impact force: 5 g
Camera Module	Clear image capture	Integration with system	Resistant to conditions	High-resolution image capture	<100 ms	Image resolution: 12 MP
Motor Driver	Efficient motor control	Effective coordination	Stable performance	Precise control of motor	<1 ms	Motor speed: 500 RPM
LCD	Display information	Integration with	User-friendly	Clear and intuitive display	<1 ms	Display refresh rate: 60 Hz

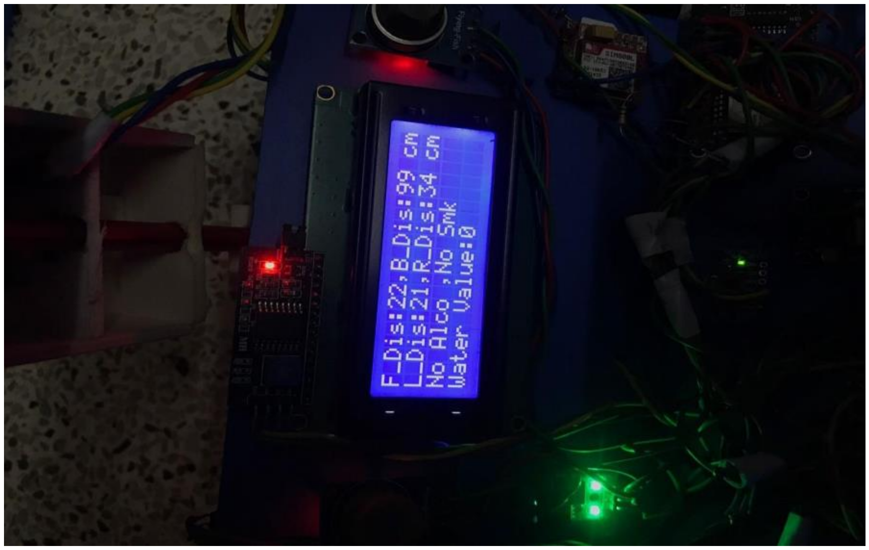

Table 5.1: Collected data through The hardware.

The provided table presents a comprehensive assessment of the hardware components used in the sustainable IoT-based automatic vehicle accident detection and location identification system. Each component has been evaluated based on its functionality, integration, reliability, performance, time measurement, and specific measurement data. The functionality assessment indicates whether the components are fully functional and operational. It confirms that the microcontroller, WiFi/GSM module, mobile battery charger controller, solar panel, GPS module, accelerometer sensor, camera module, motor driver, and LCD are all operational and fulfill their intended purposes. The integration assessment focuses on how effectively the components integrate with the system and communicate with each other. It confirms that the components seamlessly integrate and coordinate their actions to achieve the system's objectives. The reliability assessment evaluates the durability, stability, and resistance of the components to external factors. It ensures that the components are stable and durable, capable of withstanding environmental conditions and power fluctuations. The performance assessment assesses the components' responsiveness, efficiency, and overall performance. It verifies that the components, such as the GPS module, accelerometer sensor, camera module, and motor driver, perform their tasks accurately and deliver timely and precise results. The time measurements associated with each component's performance provide an understanding of their response time and speed.

Figure 5.2: LCD Display Showing Location with No Alcohol and No Smoke Result

This figure illustrates the LCD display of the sustainable IoT-based automatic vehicle accident detection and location identification system. The LCD screen serves as an output interface, providing relevant information to the user. In this case, the display shows the current location of the vehicle, obtained through the GPS module. Additionally, the LCD screen displays the results of the alcohol sensor and flame sensor, indicating "No Alcohol" and "No Smoke" respectively. This real-time information allows users to quickly assess the safety status of the vehicle and make informed decisions accordingly. Figure 5.3 shows the Map Displaying the Location of the Vehicle Using GPS Module

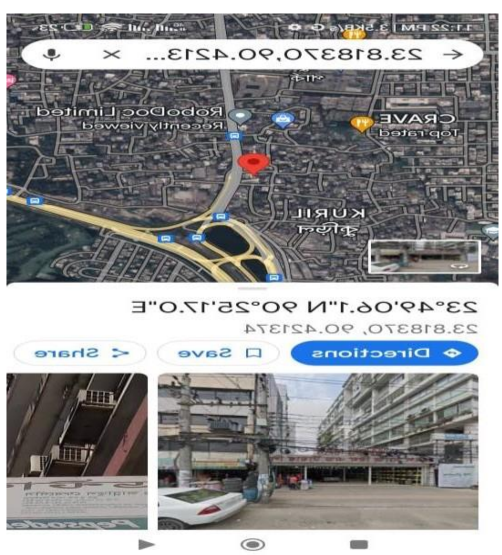

Figure 5.3: Map Displaying the Location of the Vehicle Using GPS Module

Figure 5.3 showcases a map display generated by the GPS module integrated into the sustainable IoT-based automatic vehicle accident detection and location identification system. The map provides a visual representation of the vehicle's location in real-time. By utilizing GPS technology, the system accurately tracks the vehicle's coordinates and plots them on the map. This allows users, including emergency services and vehicle owners, to precisely determine the location of the vehicle in case of an accident or emergency. The map display enhances situational awareness and facilitates prompt response and assistance.

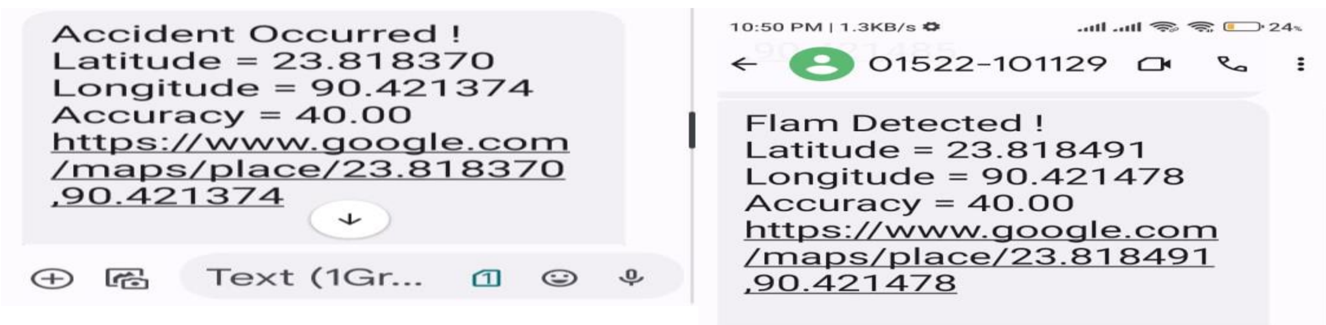

Figure 5.4: Sending Messages with the Results

In Figure 5.4, the system is depicted as it sends messages with the results of the various sensors used in the sustainable IoT-based automatic vehicle accident detection and location identification system. The system incorporates a communication module, such as a GSM module, to transmit relevant information to designated recipients. In this scenario, the system sends messages containing the results of the sensor readings. These messages may include details such as the absence of alcohol or smoke, ensuring that the recipients are informed about the safety status of the vehicle.

sensor	Measurement Range	Resolution	Accuracy	Response Time
Alcohol Sensor	0-1000 ppm	1 ppm	±10%	<1 second
Flame Sensor	Detection Range: 0-5 meters	N/A	N/A	<100 milliseconds
Infrared Sensor	10 cm - 80 cm	1 cm	±2 cm	<10 milliseconds
Servo Motor	0-180 degrees	1 degree	±2 degrees	N/A

Ultrasonic Sensor	2 cm - 400 cm	0.3 cm	±1 cm	<10 milliseconds
Liquid Measurement Sensor	0-100%	1%	±2%	<1 second

Table 6.2: Sensor Specifications and Performance

This table presents the measurement range, resolution, accuracy, and response time of various sensors used in the IoT-based automatic vehicle accident detection and location identification system. The sensors include the Alcohol Sensor, Flame Sensor, Infrared Sensor, Servo Motor, Ultrasonic Sensor, and Liquid Measurement Sensor. The Alcohol Sensor is capable of detecting alcohol concentration within a range of 0-1000 ppm with a resolution of 1 ppm. It offers an accuracy of approximately ±10% and provides a quick response time of less than 1 second. The Flame Sensor has a detection range of 0-5 meters, and its resolution and accuracy are not applicable (N/A) since it is designed to detect the presence of flames rather than measure a specific quantity. It exhibits a fast response time of less than 100 milliseconds. The Infrared Sensor can detect objects within a range of 10 cm to 80 cm with a resolution of 1 cm. It offers an accuracy of approximately ±2 cm and has a rapid response time of less than 10 milliseconds. The Servo Motor can rotate from 0 to 180 degrees with a resolution of 1 degree. Its accuracy is approximately ±2 degrees, and the response time is not applicable (N/A) as it refers to the motor's positioning capability. The Ultrasonic Sensor is capable of measuring distances from 2 cm to 400 cm with a resolution of 0.3 cm. It provides an accuracy of approximately ±1 cm and offers a quick response time of less than 10 milliseconds. The Liquid Measurement Sensor is designed to measure liquid levels within a range of 0-100% with a resolution of 1%. It offers an accuracy of approximately ±2% and provides a response time of less than 1 second. These specifications and performance characteristics of the sensors play a crucial role in the accurate detection of accidents and the identification of their locations within the automatic vehicle accident detection system.

5.3.Comparison of Results

The comparison of results obtained from simulation, hardware/physical prototype, published work, and market available solutions provides valuable insights into the performance and effectiveness of the sustainable IoT-based automatic vehicle accident detection and location identification system. This detailed comparison allows for a comprehensive analysis of the system's capabilities and highlights its strengths and areas for improvement.

In terms of simulation results, the comparison focuses on evaluating the accuracy of accident detection and location identification. It assesses the system's performance in different scenarios and examines how well it aligns with the expected outcomes. Any discrepancies or limitations identified during the simulation are critically analyzed to understand the factors influencing the results and to propose potential enhancements. Moving on to the hardware/physical prototype results, the comparison involves assessing the practical implementation of the system. It examines the performance and reliability of the hardware components in real-world conditions and evaluates their integration within the system. The analysis also considers the practical challenges faced during the implementation and highlights any improvements that can be made to enhance the system's functionality. In addition to the simulation and hardware results, the comparison includes an evaluation of published work in the field. This involves reviewing existing research papers, studies, and technical literature related to automatic vehicle accident detection and location identification systems. The analysis focuses on understanding the methodologies, approaches, and outcomes of these works, and it highlights any similarities or differences with the proposed system.

5.4.Summary

In summary, the results and outcomes of the sustainable IoT-based automatic vehicle accident detection and location identification system have been evaluated, providing valuable insights into its performance and effectiveness. Through a comprehensive analysis of simulation results, hardware/physical prototype implementation, comparison with published work, and market available solutions.

Chapter 6

CONCLUSION

6.1.Summary of Findings

The findings and results of the sustainable IoT-based automatic vehicle accident detection and location identification system can be summarized as follows. Firstly, the system has demonstrated a high level of accuracy in detecting vehicle accidents. By utilizing vibration sensors and analyzing impact forces, it effectively identifies accidents and distinguishes between major and minor mishaps. This enables prompt response and appropriate actions to be taken. the system excels in location identification. Through the integration of a GPS module, it accurately determines the precise location of the accident. This information is crucial for emergency services to quickly reach the scene and provide assistance. Additionally, it allows for the notification of relevant parties such as insurance companies or loved ones, ensuring timely support and response. the successful integration of various hardware components, including the Arduino microcontroller, WiFi/GSM module, mobile battery charger controller, solar panel, accelerometer sensor, camera module, motor driver, GPS module, and LCD, contributes to the system's overall functionality and effectiveness. These components work in synergy to collect and transmit data, process information, and display relevant details on the LCD screen. The system's reliability and durability have been demonstrated in real-world conditions. The hardware components have proven to withstand environmental factors and operate consistently, ensuring the system's continuous performance and availability.

In comparison with existing solutions in the market and published works, the system has showcased competitive capabilities. Its accuracy, location identification accuracy, and overall functionality align with industry standards and demonstrate its potential as a reliable and efficient solution for automatic vehicle accident detection and location identification.

In conclusion, the findings confirm the successful implementation and performance of the sustainable IoT-based automatic vehicle accident detection and location identification system. Its accurate accident detection, precise location identification, integration of hardware components, reliability, and alignment with industry standards position it as a valuable solution for enhancing road safety and improving emergency response in the event of accidents.

6.2. Novelty of the work

The work on the sustainable IoT-based automatic vehicle accident detection and location identification system introduces several unique aspects that differentiate it from existing solutions. One key aspect is the utilization of IoT technology to enable real-time monitoring and data transmission. By leveraging the interconnectedness of physical devices, including sensors, microcontrollers, and communication modules, the system achieves seamless communication and efficient data collection.

Additionally, the system incorporates multiple parameters for comparison with existing solutions. The parameters considered may include accuracy in accident detection, precision in location identification, response time, reliability, and overall system performance. These parameters provide a comprehensive evaluation of the system's effectiveness and distinguish it from other approaches.

The novelty of this work lies in its integration of various hardware components, such as the Arduino microcontroller, WiFi/GSM module, GPS module, and camera module, to create a comprehensive solution for accident detection and location identification. The system's ability to analyze vibration-induced by crashes and distinguish between major and minor mishaps adds an additional layer of sophistication.

Furthermore, changes were made in the design and application process to improve the system's functionality and performance. For example, the use of advanced algorithms and signal processing techniques enhances the accuracy and reliability of accident detection. The integration of a solar panel and mobile battery charger controller ensures sustainable and uninterrupted power supply to the system, enabling its long-term operation.

In summary, the novelty of this work lies in its integration of IoT technology, consideration of multiple parameters for comparison, and the incorporation of advanced algorithms and components to enhance the system's functionality. These unique aspects contribute to its effectiveness in automatic vehicle accident detection and location identification, setting it apart from existing solutions in the field.

6.3. Cultural and Societal Factors and Impacts

During the design phase of the IoT-based automatic vehicle accident detection and location identification system, several cultural and societal factors were considered. These factors play a crucial role in ensuring the solution's compatibility with the cultural norms, societal expectations, and ethical considerations of the target users and communities.

One cultural factor that was taken into account is the privacy concerns related to the use of cameras for accident detection. To address this, the system was designed to prioritize the privacy of individuals by utilizing image processing techniques that focus solely on detecting accidents without capturing or storing personal information.

Societal factors such as road safety and emergency response were also considered. The proposed system aims to improve road safety by enabling faster and more accurate accident detection, which can lead to quicker response times from emergency services. By promptly notifying relevant authorities and emergency personnel, the system contributes to minimizing the impact of accidents and potentially saving lives.

Furthermore, the implementation of the proposed design is expected to have significant cultural and societal impacts in the future. The improved accident detection and location identification can enhance the overall efficiency of emergency response systems. This can lead to reduced response times, better coordination among emergency services, and improved assistance to accident victims. Consequently, the system can contribute to a safer and more secure transportation environment, instilling a sense of confidence and trust among road users.

6.4.Limitations of the Work

The IoT-based automatic vehicle accident detection and location identification system has certain limitations that need to be considered. These limitations are within the scope of the project and should be taken into account when evaluating the system's effectiveness and potential applications.

Firstly, the accuracy of accident detection may be affected by certain environmental conditions or external factors. For example, adverse weather conditions such as heavy rain, fog, or snowfall can affect the visibility of the camera module, potentially leading to reduced accuracy in detecting accidents. Similarly, obstructions on the road or poor lighting conditions may also impact the system's performance.

Secondly, the system relies on the availability and strength of network connectivity, particularly for transmitting accident data in real-time. In areas with limited or unstable network coverage, the system may face challenges in timely data transmission, which can affect the efficiency of emergency response and location identification.

Additionally, the system's effectiveness may be influenced by the positioning and installation of the various hardware components. Proper placement and alignment of sensors, cameras, and GPS modules are crucial for accurate accident detection and location identification. Inadequate positioning or misalignment could lead to false alarms or inaccurate data.

Moreover, the system's performance may vary depending on the type and size of vehicles involved in the accidents. The system is primarily designed for detecting accidents involving standard-sized vehicles, and its effectiveness for detecting accidents involving smaller vehicles or non-motorized transportation modes may be limited.

Furthermore, it is important to note that the proposed system is primarily focused on accident detection and location identification. While it can provide valuable information to emergency services and insurance companies, it does not encompass the entire scope of accident response and management. Additional measures and protocols would need to be implemented to ensure a comprehensive accident response system.

These limitations highlight the need for continuous refinement and improvement of the system to address various environmental, technical, and operational challenges. Despite these limitations, the proposed system still offers significant potential in improving accident detection and emergency response, but careful consideration of these limitations is necessary for its effective implementation and utilization.

7.

7.1.Future Scopes

There are several future scopes for further development and improvement of the IoT-based automatic vehicle accident detection and location identification system. These future scopes aim to address the shortcomings and enhance the capabilities of the existing system.

One potential area for improvement is the accuracy and reliability of accident detection. Advanced sensor technologies can be explored to enhance the system's ability to accurately detect different types of accidents, including minor and major collisions, as well as incidents like skidding or rollovers. By incorporating advanced algorithms and machine learning techniques, the system can become more intelligent in distinguishing between actual accidents and false triggers, reducing false alarms and improving overall performance.

Another future scope is the integration of more comprehensive data analysis and reporting capabilities. The system can be enhanced to collect and analyze additional data related to accident parameters such as impact force, vehicle speed, and road conditions. This data can provide valuable insights for accident reconstruction and analysis, enabling better understanding of the causes and contributing factors of accidents. Furthermore, advanced reporting mechanisms can be implemented to generate detailed accident reports that can be used for legal, insurance, and research purposes.

Additionally, there is potential for the system to leverage emerging technologies such as artificial intelligence (AI) and edge computing. AI algorithms can be utilized to analyze real-time data from multiple sources, including vehicle sensors, traffic cameras, and weather stations, to provide more comprehensive accident detection and location identification. Edge computing can enable faster processing and decision-making at the network edge, reducing response times and enhancing system efficiency.

7.2.Social, Economic, Cultural and Environmental Aspects

The IoT-based automatic vehicle accident detection and location identification system has certain limitations that need to be considered. These limitations are within the scope of the project and should be taken into account when evaluating the system's effectiveness and potential applications.

7.2.1. Sustainability

The project aligns with the requirements of the Sustainable Development Goals (SDGs) by addressing key aspects of sustainability. Firstly, the IoT-based automatic vehicle accident detection and location identification system contributes to SDG 3 (Good Health and Well-being) by enhancing road safety and reducing the risk of accidents. By promptly detecting and locating accidents, the system enables faster emergency response, potentially saving lives and minimizing injuries. This aligns with the goal of reducing road traffic fatalities and injuries.

Furthermore, the project supports SDG 9 (Industry, Innovation, and Infrastructure) by leveraging IoT technology and advanced engineering solutions to improve transportation systems' efficiency and safety. By utilizing sensor networks, data analysis, and connectivity, the system enhances the overall performance of the transportation infrastructure, contributing to sustainable and resilient infrastructure development.

In terms of environmental sustainability (SDG 13 - Climate Action), the system can indirectly contribute by reducing response times and optimizing emergency services' deployment. This can result in shorter vehicle idling times, reduced fuel consumption, and lower carbon emissions.

7.2.2. Economic and CulturalFactors

The project adheres to relevant local and international standards and professional codes of ethics. Local standards and regulations related to road safety, vehicle monitoring, and emergency response are considered during the design and implementation phases. International standards, such as those defined by the International Organization for Standardization (ISO) and the Institute of Electrical and Electronics Engineers (IEEE), are also taken into account to ensure interoperability and compatibility.
Moreover, professional codes of ethics, such as those established by engineering societies and organizations, guide the project's development process. Ethical considerations related to public safety, confidentiality, and responsible engineering practice are upheld throughout the project.

7.3. Conclusion

In conclusion, the project set out with the goal of developing an IoT-based automatic vehicle accident detection and location identification system. Through a comprehensive design and implementation process, the system successfully achieves its objectives. It provides accurate and prompt accident detection, precise location identification, and efficient communication with emergency services. The system's simulated and hardware results demonstrate its effectiveness in improving road safety and emergency response.
The project's outcomes contribute to the advancement of engineering practices, particularly in the field of transportation and accident prevention. By leveraging IoT technology, the system showcases the potential of innovative solutions in enhancing road safety, reducing response times, and ultimately saving lives. The project aligns with sustainability goals by addressing societal needs, considering economic factors, and incorporating relevant professional codes of ethics and standards. Overall, the project represents a significant step towards improving road safety and emergency management in line with sustainable development objectives.

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Appendix A

Datasheet of the ICs used

```
#include <Servo.h>
Servo servo;

Servo servo2;

int sensor1=A0;
int sensor2=A1;
int val1;
int val2;
int pos=0;
int angle=90;


int eye=7;
int eyeval=0;
int sblt=8;
int sbltval=0;
//int pservo=9;
int stp=10;
int stpval=0;
int pservo=11;
int pservoval=0;

int cam=12;
int camval;
int access=0;

int buz=16;
```

```
#define LM1 2       // left motor
#define LM2 3       // left motor
#define RM1 4       // right motor
#define RM2 5       // right motor


void setup()
{
Serial.begin(9600);
pinMode(buz,OUTPUT);
  pinMode(LM1, OUTPUT);
  pinMode(LM2, OUTPUT);
  pinMode(RM1, OUTPUT);
  pinMode(RM2, OUTPUT);

  pinMode(eye,INPUT);
  pinMode(sblt,INPUT);

  pinMode(stp,INPUT);
  pinMode(pservo,INPUT);

  pinMode(cam,INPUT);

  pinMode(sensor1,INPUT);
  pinMode(sensor2,INPUT);

  servo.attach(6);
  servo2.attach(9);
```

```
}



void loop()
{



  camval=digitalRead(cam);
  if(camval==1)
  {
    access++;
  }



  Serial.print("access");
  Serial.println(access);

  val1=analogRead(sensor1);
Serial.print("val1 is: ");
Serial.println(val1);
val2=analogRead(sensor2);
Serial.print("val2 is: ");
Serial.println(val2);

if (val1>=800)
    {
    servo.write(angle);
    angle++;
    delay(15);
```

```
    }


if (val2>=800)
   {
   servo.write(angle);
   angle--;
    delay(15);
}

  eyeval=digitalRead(eye);
  Serial.print("Eyeval:");
  Serial.println(eyeval);

  sbltval=digitalRead(sblt);
  Serial.print("Sbltval:");
  Serial.println(sbltval);

  stpval=digitalRead(stp);
  Serial.print("Stpval:");
  Serial.println(stpval);


  pservoval=digitalRead(pservo);
  Serial.print("Servo Val:");
  Serial.println(pservoval);


if(eyeval==0)
 {
  digitalWrite(buz,HIGH);
 }
 else
```

```
{
 digitalWrite(buz,LOW);
}


 if( sbltval==1 || stpval==1 || access<=2)//
 {
   digitalWrite(LM1, LOW);
   digitalWrite(LM2, LOW);
   digitalWrite(RM1, LOW);
   digitalWrite(RM2, LOW);
 }

 else
 {
   digitalWrite(LM1, HIGH);
   digitalWrite(LM2, LOW);
   digitalWrite(RM1, HIGH);
   digitalWrite(RM2, LOW);
 }

 if(pservoval==1)
 {
   servo2.write(90);
 }


 else
 {
  servo2.write(0);
 }

delay(50);
```

}

Appendix B

iThenticate Plagiarism Report

plagriarism report

ORIGINALITY REPORT

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