Activity Tracker For Vehicles

A Project Report Submitted to

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Bachelor of Technology
in
Computer Engineering

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DEPARTMENT OF COMPUTER ENGINEERING

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<u>RECOMMENDATION</u>

The project report of Phase-1 entitled *"Activity Tracker"* submitted by: **0801CS201014 - Animesh Pathak, 0801CS201020 - Aryan Jain, 0801CS201043 - Isha Sawasiya, 0801CS201070 - Pranjal Jhawar, 0801CS201071 - Pulkit Paramhans**, students of B.E. IV year in the session 2023-24, towards partial fulfillment of the degree of **Bachelor of Engineering in Computer Engineering** of Rajiv Gandhi Proudyogiki VishwaVidhyalaya, Bhopal is a satisfactory account of their work.

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<u>CERTIFICATE</u>

The project report of Phase-1 entitled ***"Activity Tracker"*** submitted by: **0801CS201014 - Animesh Pathak, 0801CS201020 - Aryan Jain, 0801CS201043 - Isha Sawasiya, 0801CS201070 - Pranjal Jhawar, 0801CS201071 - Pulkit Paramhans**, students of B.E. IV year in the session 2023-24, towards partial fulfillment of the degree of **Bachelor of Engineering in Computer Engineering** of Rajiv Gandhi Proudyogiki VishwaVidhyalaya, Bhopal is a satisfactory account of their work.

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DECLARATION

We, **0801CS201014 - Animesh Pathak, 0801CS201020 - Aryan Jain, 0801CS201043 -Isha Sawasiya, 0801CS201070 - Pranjal Jhawar, 0801CS201071 - Pulkit Paramhans**, hereby declare that the work presented in the B.Tech project report has been carried out by us and under the supervision of **Prof. DA Mehta, Professor, Computer Engineering Department,** and co-supervision of **Mrs. Nikita Tiwari, Assistant Professor, Computer Engineering Department, S.G.S.I.T.S Indore(M.P.).**We further declare that the work submitted for the award of the degree doesn't contain any part of the work which has been submitted for the award of any degree either in this university or any other University without proper citation.

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ABSTRACT

The Activity Tracker project stands at the forefront of a transformative journey aimed at redefining vehicular safety through technological innovation and proactive measures. In response to the escalating challenges within the domain of road safety, this initiative integrates cutting-edge technologies, notably GPS tracking, collision detection, and fire/smoke sensing. These components collectively form a comprehensive Advanced Driver Assistance System (ADAS), synergizing to preemptively address and mitigate risks associated with vehicular incidents.

The project's primary objectives revolve around the timely provision of real-time alerts to both vehicle owners and designated emergency contacts. By harnessing the power of GPS tracking, the system ensures precise location data, enabling swift responses to potential threats and accidents. The integration of collision detection technology enhances the project's capacity to identify and alert users to imminent collisions, while fire/smoke sensing adds an additional layer of safety by detecting potential hazards within the vehicle environment.

An integral feature of the Activity Tracker is the incorporation of black box functionality, enabling the comprehensive recording and storage of critical incident data. This facilitates in-depth post-incident analysis, offering valuable insights into the sequence of events leading up to an accident. Through continuous learning from these analyses, the project aims to drive iterative improvements in vehicle safety, contributing to an evolving paradigm of proactive and data-driven safety measures.

In essence, the Activity Tracker project embodies a groundbreaking endeavor dedicated to fostering a safer road environment. By leveraging technological prowess, the initiative not only aims to prevent accidents but also endeavors to shape a future where road safety is a dynamic and evolving discipline. The commitment to innovation, technology, and proactive safety measures underpins the essence of this project, offering a promising vision for a safer and more secure transportation ecosystem.

CONTENTS

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

In this chapter, there is a brief introduction about the project giving the need for the project, the problem being solved, objectives, and also the approach to be used.

1.1 Preamble

In a world marked by ever-increasing vehicular complexities and safety challenges, the need for proactive measures to mitigate risks and enhance road safety has become paramount. Recognizing this imperative, the Activity Tracker project emerges as a pioneering initiative, amalgamating cutting-edge technologies such as GPS tracking, collision detection, and fire/smoke sensing. This endeavor seeks to redefine vehicular safety standards by not only alerting vehicle owners and emergency contacts in real-time but also by incorporating black box functionality for detailed incident analysis. As we embark on this journey, our commitment is resolute—to usher in a new era where accidents are preempted, emergency responses are swift, and each journey on the road is underpinned by an unwavering commitment to safety and well-being.

1.2 Need of the Project

The Activity Tracker project addresses the critical need for advanced vehicular safety by combining GPS tracking, collision detection, and fire/smoke sensing. In a landscape where road accidents remain a significant concern, this system provides real-time alerts to vehicle owners and emergency contacts, enhancing response times and mitigating potential risks. The integration of black box functionality ensures comprehensive incident data recording for post-accident analysis, fostering continuous improvements in vehicle safety. With a focus on preemptive measures and rapid emergency response, the Activity Tracker stands as a vital solution in promoting overall road safety and reducing the severity of incidents

1.3 Problem Statement

The current state of road safety demands urgent attention to address three critical facets: proactive vehicular safety measures, real-time threat mitigation strategies, and universal access to black box data. The traditional reactive approach to safety falls short in the face of increasing road complexities and the growing number of vehicles. A shift towards proactive measures involving advanced technologies like predictive analytics and artificial intelligence is imperative. Real-time threat mitigation, facilitated by interconnected systems such as connected vehicles, is essential to promptly identify and address emerging risks on the road.

1.4 Objectives

The main objective of this project is to make available following services :

- Prevention of overspeeding
- Accidental Failure Detection.
- Commercial Renting Services Integration.

1.5 Proposed Approach

The proposed Activity Tracker model integrates essential components, including a GPS sensor, ESP-32 microcontroller, collision sensor for collision detection, and a fire/smoke sensor. This comprehensive system aims to prevent accidents by providing real-time alerts to the car owner and emergency contacts. In the event of a collision or fire/smoke detection, the system activates a GSM module to send SMS notifications to the owner and designated contacts, ensuring immediate awareness and swift response

CHAPTER 2

BACKGROUND STUDY

In this chapter, the background of the project is presented. The first section contains the brief description of the Tools and Technologies to be used in the development process and the next sections contain information about the Existing Solutions.

2.1 Area of Concern

The primary area of concern that the Activity Tracker project seeks to address revolves around the persistent challenges and inherent risks prevalent in contemporary vehicular safety. With the escalating complexity of road networks and the growing number of vehicles, the potential for accidents and their associated consequences has intensified. The project identifies this critical area of concern as an urgent call to action, aiming to proactively mitigate risks through advanced technologies. By focusing on GPS tracking, collision detection, and fire/smoke sensing, the project targets key vulnerabilities in vehicular safety. The overarching goal is to transform this area of concern into a sphere of tangible solutions, ensuring that each vehicle equipped with the Activity Tracker contributes to a safer and more secure road environment, ultimately alleviating the burdens associated with accidents and fostering a culture of preventative measures.

2.2 Tools and Technology

The Activity Tracker project employs a range of tools and technologies to integrate IoT capabilities and Adafruit components, ensuring a robust and comprehensive solution. The key tools and technologies utilized in this project include:

2.2.1 ESP-32 Microcontroller:

The ESP-32 microcontroller stands at the core of the Activity Tracker system, assuming a pivotal role as the central processing unit (CPU). This component is specifically chosen for its exceptional computational capabilities and versatility, enabling it to orchestrate the seamless functioning of the entire activity monitoring system.

Computational Power:

At the heart of its functionality lies the ESP-32's robust computational power. As the primary processor, it executes intricate algorithms and computations essential for managing, processing, and interpreting data generated by an array of sensors integrated into the Activity Tracker. This computational prowess ensures that the system can handle complex tasks efficiently, providing accurate insights into users' physical activities.

Sensor Integration:

A key feature of the ESP-32 is its ability to seamlessly integrate with a diverse range of sensors. These sensors may include accelerometers, gyroscopes, and heart rate monitors, each contributing specific data points relevant to monitoring different aspects of physical activity. The microcontroller acts as a hub, collecting, and coordinating information from these sensors in real-time.

Communication Module Control:

In addition to sensor management, the ESP-32 is responsible for controlling the communication modules within the Activity Tracker system. This involves overseeing the transmission and reception of data between the device and external entities, such as smartphones, computers, or other compatible devices. The microcontroller ensures efficient communication, enabling the Activity Tracker to relay valuable information to users or store data for later analysis.

Real-time Processing:

Ensuring real-time monitoring of physical activities is a critical function of the. ESP-32. Its ability to swiftly process incoming data from sensors allows the Activity Tracker to provide instantaneous feedback to users, enhancing the overall user experience and responsiveness of the system.

Versatility and Adaptability:

The ESP-32's versatility is a noteworthy aspect, allowing for the integration of various sensors catering to different tracking requirements. This adaptability ensures that the Activity Tracker can effectively monitor a broad spectrum of physical activities, making it suitable for diverse user needs.

Wireless Connectivity:

Equipped with built-in support for wireless communication protocols like Wi-Fi and Bluetooth, the ESP-32 facilitates seamless connectivity. This feature enables the Activity Tracker to communicate with other devices, networks, or mobile applications, enhancing its utility and extending its capabilities beyond standalone operation.

Energy Efficiency:

Considering the constraints of wearable devices, the ESP-32 is designed with energy efficiency in mind. This optimization ensures that the microcontroller efficiently utilizes power resources, prolonging the battery life of the Activity Tracker, a critical aspect for a device intended for continuous and prolonged use.

The ESP-32 microcontroller's role within the Activity Tracker system extends far beyond being a mere processing unit. Its computational strength,sensor integration capabilities, communication module control, real-time processing abilities, versatility, wireless connectivity support, and energy efficiency collectively contribute to the effectiveness and reliability of the overall activity monitoring.

2.2.2 GPS Sensor:

The inclusion of a GPS sensor within the vehicle tracking system plays a vital role in delivering accurate and real-time geolocation information. Positioned as a crucial component, the GPS sensor serves as a sophisticated navigational tool, enhancing the overall functionality and safety features of the system.

Real-time Location Tracking:

The primary function of the GPS sensor is to provide real-time tracking of the vehicle's precise location. Leveraging signals from global positioning satellites, the sensor continuously determines the vehicle's coordinates with remarkable accuracy. This real-time tracking capability is paramount for various applications within the system.

Geolocation Data Precision:

The GPS sensor ensures the acquisition of precise geolocation data. This information goes beyond basic coordinates, including details such as latitude, longitude, altitude, and sometimes speed and heading. The high precision of the data enables the system to offer comprehensive insights into the vehicle's current position and movement.

Event-triggered Alerts:

The real-time geolocation data acquired by the GPS sensor becomes instrumental in triggering event-specific alerts. In the unfortunate event of an accident or potential threat, the system utilizes the GPS data to promptly alert the car owner and designated emergency contacts. This proactive alert mechanism enhances the safety and security features of the vehicle tracking system.

Anti-theft Measures:

Beyond safety applications, the GPS sensor contributes to anti-theft measures within the vehicle tracking system. In case of unauthorized vehicle usage or theft, the real-time tracking feature enables law enforcement authorities to track and recover the stolen vehicle quickly

2.2.3 Collision Sensor:

The integration of a collision sensor within the Activity Tracker system serves as a crucial layer of safety and accident prevention. This sophisticated sensor is meticulously designed to detect sudden and impactful changes in the vehicle's acceleration or orientation, providing a preemptive indication of a potential collision. The detailed functionalities of the collision sensor are instrumental in fortifying the overall safety features of the Activity Tracker system.

Detection of Abrupt Changes:

At the core of the collision sensor's functionality is its ability to keenly monitor the vehicle's dynamics. By continuously assessing changes in acceleration and orientation, the sensor can swiftly identify abrupt alterations indicative of a potential collision. This real-time monitoring forms the foundation for proactive accident prevention.

Preemptive Signaling:

Upon detecting a significant deviation from the normal acceleration or orientation patterns, the collision sensor promptly initiates signaling mechanisms within the system. These signals serve as an early warning, alerting both the vehicle's occupants and external entities, such as emergency contacts or the Activity Tracker's central processing unit, about the potential collision scenario.

Accident Prevention Features:

The collision sensor plays a pivotal role in the accident prevention features integrated into the Activity Tracker system. By providing timely alerts, it allows for swift responses and interventions, contributing to the overall goal of mitigating the impact of a collision or even preventing it altogether.

Sensitivity Adjustment:

To cater to diverse driving conditions and vehicle types, the collision sensor often features adjustable sensitivity settings. This customization allows for fine-tuning the sensor's responsiveness, optimizing its performance based on factors such as vehicle model, driving terrain, and user preferences.

In summary, the collision sensor within the Activity Tracker system goes beyond simple detection, offering a comprehensive suite of features aimed at accident prevention. Its ability to detect abrupt changes, preemptively signal potential collisions, integrate with emergency response mechanisms, provide sensitivity adjustments, contribute to data logging, and even interact with airbag systems collectively enhances the system's capacity to ensure the safety and well-being of vehicle occupants.

2.2.4 Fire and Smoke Sensor:

The incorporation of a fire and smoke sensor within the Activity Tracker system represents a critical safety measure designed to identify and respond to instances of fire or smoke within the vehicle environment. This sensor is meticulously engineered to detect the presence of these hazards, and its multifaceted functionalities contribute to the system's ability to swiftly respond to potential risks and enhance overall safety.

Fire and Smoke Detection Mechanism:

At the core of the fire and smoke sensor's functionality is its advanced detection mechanism. The sensor employs specialized technology to identify the presence of fire or smoke particles within the vehicle's interior. This meticulous detection process forms the foundation for timely and accurate alerts.

Real-time Monitoring:

The sensor continuously monitors the vehicle environment in real-time. This continuous surveillance ensures that any emergence of fire or smoke is promptly identified, allowing the system to initiate immediate response protocols.

Alert Triggering:

Upon detecting the presence of fire or smoke, the sensor triggers a series of alerts within the Activity Tracker system. These alerts are designed to notify both the vehicle owner and designated emergency contacts, ensuring that appropriate actions can be taken swiftly to mitigate potential risks and hazards.

Mitigation of Potential Risks:

The primary goal of the fire and smoke sensor is to mitigate potential risks associated with fire incidents within the vehicle. By providing early detection and immediate alerts, the sensor empowers vehicle owners and emergency contacts to take swift actions, potentially minimizing the impact of the incident and enhancing overall safety.

Sensitivity Adjustment:

To accommodate varying conditions and potential sources of false alarms, the fire and smoke sensor often features sensitivity adjustment settings. This customization allows users to fine-tune the sensor's responsiveness, optimizing its performance based on factors such as the vehicle's interior environment and potential interference.

Data Logging for Analysis:

providing a valuable resource for post-incident analysis, system improvements, and understanding patterns associated with fire or smoke incidents.

In conclusion, the fire and smoke sensor within the Activity Tracker system stands as a proactive safety feature, offering a comprehensive suite of functionalities. Its advanced detection mechanisms, real-time monitoring, alert triggering, emergency response coordination, risk mitigation capabilities, sensitivity adjustments, integration with safety systems, and data logging collectively ensure a robust and effective response to fire or smoke incidents, reinforcing the system's commitment to enhancing vehicle safety.

2.2.5 GSM Module:

The integration of the GSM module within the Activity Tracker system represents a strategic augmentation aimed at establishing a robust wireless communication framework. The GSM module, operating on the widely adopted Global System for Mobile Communications (GSM) standard, serves as a pivotal component, enabling the system to engage in wireless communication and dispatch SMS notifications. This detailed functional overview delves into the intricacies of the GSM module's features and its role in ensuring timely and reliable communication, particularly in critical situations.

Wireless Communication Hub:

At its core, the GSM module assumes the role of a central wireless communication hub. It leverages GSM technology to establish and maintain a stable communication link between the Activity Tracker system and external entities, ensuring a continuous and reliable channel for information exchange.

SMS Notification Transmission:

A primary function of the GSM module lies in its capability to transmit Short

Message Service (SMS) notifications. In scenarios necessitating urgent communication, such as the detection of emergencies like fire, smoke, or collisions, the module orchestrates the transmission of SMS alerts. This functionality is instrumental in promptly disseminating critical information to both the car owner and designated emergency contacts.

Real-time Communication Dynamics:

The integration of the GSM module is strategically designed to facilitate real-time communication, especially during critical situations. By relying on SMS notifications, the system mitigates potential delays associated with data connectivity or internet access. This real-time communication capacity is fundamental for delivering immediate and actionable information, enhancing the system's responsiveness in emergencies.

Advantage of Network Independence:

The GSM module's reliance on mobile network infrastructure provides a notable advantage—network independence. This feature empowers the system to maintain communication even in areas with limited or no internet connectivity, expanding the operational reach of the Activity Tracker system.

User-Centric Integration:

In advanced implementations, the GSM module seamlessly integrates with the user interface of the Activity Tracker system. This integration empowers users to configure communication preferences, manage emergency contact lists, and customize the content of SMS notifications, providing a user-centric approach to communication control.

Remote Control and Configuration Capabilities:

Beyond its communication capabilities, the GSM module facilitates remote control and configuration of the Activity Tracker system. Users can remotely manage settings, update software, or perform diagnostics, enhancing the system's flexibility and ease of use.

2.2.6 Adafruit Components:

Adafruit components, likely including sensors, displays, and communication modules, are utilized to enhance the project's capabilities. Adafruit's products often provide user-friendly interfaces and reliable performance, contributing to the overall success of the Activity Tracker.

Sensor Integration:

Adafruit is recognized for its diverse range of high-quality sensors, and their integration within the Activity Tracker project serves to enhance the system's sensing capabilities. These sensors could include accelerometers, gyroscopes, temperature sensors, or any other relevant components. The precise choice of sensors depends on the specific monitoring requirements of the Activity Tracker, allowing for accurate and comprehensive data collection related to physical activities or environmental conditions.

Display Modules:

Adafruit's display modules are likely integrated into the Activity Tracker to provide an intuitive and user-friendly interface. These displays may present real-time information about the user's physical activities, system status, or emergency alerts. The user-centric design philosophy of Adafruit's display products contributes to an enhanced user experience, ensuring that information is presented in a clear and accessible manner.

Communication Modules:

Adafruit's communication modules play a vital role in facilitating seamless data exchange within the Activity Tracker system. These modules could include Bluetooth or Wi-Fi transceivers, enabling connectivity with external devices or networks. The reliable performance of Adafruit's communication components ensures efficient communication between the Activity Tracker, smartphones, and other compatible devices.

User-Friendly Interfaces:

One of the distinguishing features of Adafruit's products is their emphasis on user-friendly interfaces. The integration of Adafruit components ensures that the Activity Tracker project offers an intuitive and accessible interface for users. This aspect is crucial for enhancing user engagement, allowing individuals to easily interact with the system and interpret the information presented.

Reliable Performance:

Adafruit's commitment to producing reliable and high-performance electronic components contributes to the overall dependability of the Activity Tracker. The sensors, displays, and communication modules from Adafruit are designed to operate consistently under varying conditions, ensuring the system's reliability in monitoring, alerting, and communication functionalities.

Customization and Flexibility:

Adafruit components often provide a degree of customization and flexibility in their functionalities. This feature allows developers working on the Activity Tracker project to tailor the system to specific requirements, ensuring that the integration of Adafruit components aligns seamlessly with the project's objectives and use cases.

CHAPTER 3

LITERATURE REVIEW

This chapter describes the literature survey done to study the concepts of existing systems.

3.1 Inception

The inception phase of the Activity Tracker project delves into an exploration of existing literature, laying the groundwork for the integration of state-of-the-art technologies in the realm of vehicular safety. The review encompasses a comprehensive survey of scholarly articles, research papers, and industry reports, focusing on the challenges and advancements within the field of Advanced Driver Assistance Systems (ADAS). Key themes include the evolution of GPS tracking, the efficacy of collision detection technologies, and the incorporation of fire/smoke sensing mechanisms in modern vehicle safety. By synthesizing knowledge from diverse sources, the literature review sets the stage for informed decision-making and innovative implementation, ensuring the Activity Tracker project is not only aligned with contemporary safety standards but also at the forefront of pioneering advancements in ADAS.

3.2 Tools Required for Implementation

In the intricate process of implementing the Activity Tracker project, the chosen hardware components serve as the building blocks, each contributing a unique capability to the system. The GPS module stands as the sentinel, responsible for real-time location tracking and the provision of essential geospatial data. Acting as the brain of the operation, the microcontroller, whether Arduino or Raspberry Pi, orchestrates the harmonious interplay between various sensors and controls the overarching functionality of the Activity Tracker.

The collision sensor, with its array of accelerometers and gyroscopes, becomes the vigilant guardian, detecting abrupt changes in acceleration or orientation that could signify a collision. Simultaneously, the fire/smoke sensor acts as a watchful sentinel within the vehicle, promptly detecting the presence of smoke or fire, thereby ensuring swift responses to potential hazards.

The GSM module emerges as the lifeline, facilitating seamless wireless communication to dispatch SMS alerts promptly to both the vehicle owner and designated emergency contacts. This interconnected network of hardware components operates seamlessly under the umbrella of a reliable power supply, be it a rechargeable battery or the vehicle's electrical system, ensuring uninterrupted functionality.

To augment the system's capabilities further, the implementation incorporates a storage module, typically an SD card, to record and store critical incident data. This feature transforms the Activity Tracker into a black box, preserving a detailed record of events for post-incident analysis and continuous improvement.

In the digital realm, software tools, namely Adafruit and ArduinoIDE, play a pivotal role in configuring components and programming the microcontroller. These tools provide the necessary interface for seamless communication between hardware and software, ensuring a cohesive implementation that aligns with the project's overarching goals of advancing vehicular safety through innovative and interconnected technologies. This integrated approach underscores the project's commitment to creating a robust, intelligent, and proactive system that enhances overall road safety.

3.3 A Study of Available Approaches

A study of available approaches for the Activity Tracker project involves exploring existing methods, technologies, and solutions related to vehicular safety, GPS tracking, collision detection, and fire/smoke sensing. Here, we delve into some key aspects of these available approaches:

Vehicular Safety Systems:

Numerous vehicular safety systems exist, ranging from basic safety features in vehicles to advanced Advanced Driver Assistance Systems (ADAS). These systems often incorporate technologies such as lane departure warning, automatic emergency braking, and adaptive cruise control. Studying these approaches provides insights into industry standards and existing safety measures.

GPS Tracking Solutions:

There is a plethora of GPS tracking solutions available for vehicles, both commercial and consumer-oriented. These solutions vary in terms of accuracy, real-time tracking capabilities, and additional features. Examining these approaches helps in understanding the diversity of GPS tracking technologies and identifying best practices.

Collision Detection Technologies:

Collision detection technologies are integral components of ADAS. These technologies can use a combination of sensors, including radar, lidar, and cameras, to detect and respond to potential collisions. Studying these approaches offers insights into the effectiveness of different sensor combinations and algorithms for collision detection.

3.4 Summary of reviewed Literature

The reviewed literature for the Activity Tracker project encompasses a comprehensive exploration of IoT applications in vehicular safety, focusing on the integration of advanced sensors and communication modules. The research highlights the significance of microcontrollers, such as the ESP-32, in enabling real-time monitoring and control. Studies on GPS sensors underscore the critical role of precise geolocation data for accident prevention and emergency response. Additionally, the literature emphasizes the importance of collision sensors and fire/smoke sensors in enhancing vehicle safety measures. The incorporation of GSM modules for wireless communication aligns with existing research on efficient alert systems in vehicular IoT applications. Adafruit components, as reviewed, have demonstrated reliability and user-friendly interfaces in similar projects. Overall, the synthesis of literature provides a strong foundation for the proposed Activity Tracker, emphasizing the need for an integrated approach leveraging IoT technologies and advanced sensors to address key challenges in vehicular safety and emergency response systems.

Summarizing all the information gathered from research papers are:

GPS-Based Location Tracking and Navigation: Exploring studies focusing on advancements in GPS-based location tracking, navigation algorithms, and applications in the automotive sector.

Sensor Technologies for Collision Detection: Investigating research papers on sensor technologies beyond ADAS, specifically examining accelerometers, gyroscopes, and other sensors for collision detection in vehicles.

Black Box Functionality in Automotive Applications: Explore research on black box functionalities in automotive applications, specifically focusing on data recording, storage, and analysis for post-incident investigations.

CHAPTER 4

ANALYSIS

In this chapter, a detailed analysis of the project has been discussed. It includes requirement analysis. i.e. functional requirements and non-functional requirements of the proposed system, various hardware and software requirements.

4.1 Detailed Problem Statement

The contemporary landscape of road safety presents a pressing need for comprehensive solutions that encompass three pivotal dimensions: proactive vehicular safety measures, real-time threat mitigation strategies, and universal access to black box data. The existing paradigm of safety on the roads primarily relies on reactive approaches, which are proving inadequate in light of the escalating complexities of modern road systems and the burgeoning number of vehicles in circulation. To effectively address the multifaceted challenges posed by the current state of road safety, a paradigm shift towards proactive measures is not only beneficial but imperative.

Proactive vehicular safety measures entail the incorporation of advanced technologies, with a particular focus on predictive analytics and artificial intelligence. The conventional methods of ensuring safety have been predominantly reactive, relying on measures such as speed limits, traffic signals, and law enforcement to respond to incidents after they occur. This reactive approach is proving insufficient in dealing with the dynamic and intricate nature of contemporary road networks. By adopting proactive measures, powered by cutting-edge technologies, it becomes possible to anticipate potential hazards and mitigate risks before they escalate into accidents.

Real-time threat mitigation stands as another critical facet of the road safety conundrum. With the advent of interconnected systems, such as those manifested in connected vehicles, there exists an unprecedented opportunity to promptly identify and address emerging risks on the road. These interconnected systems can facilitate the exchange of real-time data between vehicles, infrastructure, and other relevant stakeholders. Such a networked approach allows for the instantaneous detection of anomalies, hazardous conditions, or erratic behavior among vehicles, enabling swift responses to prevent accidents and enhance overall road safety.

Universal access to black box data further underscores the need for transparency and accountability in road safety. The black box, or event data recorder, installed in vehicles, captures crucial information about the vehicle's performance and the events leading up to an incident. Ensuring universal access to this data can significantly enhance post-incident analysis, investigations, and the overall understanding of the factors contributing to road accidents. This transparency not only aids law enforcement and regulatory bodies but also serves as a valuable resource for researchers, policymakers, and the general public. In conclusion, the evolving landscape of road safety necessitates a departure from traditional reactive approaches towards a holistic strategy that integrates proactive vehicular safety measures, real-time threat mitigation strategies, and universal access to black box data. Embracing advanced technologies such as predictive analytics and artificial intelligence, coupled with the seamless connectivity of vehicles, represents a crucial step towards fostering a safer and more resilient road environment. This shift is vital in addressing the challenges posed by the increasing intricacies of road systems and the growing volume of vehicles on the roads.

4.2 Existing System

This section enlists the various online platforms which are providing helpers for a particular task.

Advanced Driver Assistance Systems (ADAS)

Advanced Driver Assistance Systems (ADAS) encompass a variety of technologies designed to assist drivers and improve overall road safety. These systems often include features such as adaptive cruise control, lane departure warning, automatic emergency braking, and more.

ADAS has the potential to enhance driver safety by providing assistance and alerts in various driving situations. However, it is essential to acknowledge certain limitations. For instance, ADAS systems may not perform optimally in adverse weather conditions, and their effectiveness can be influenced by factors like sensor quality and accuracy. Additionally, the reliance on these systems might lead to complacency among drivers, emphasizing the importance of maintaining driver attentiveness and intervention readiness.

4.3 Requirement Analysis

In this section the requirements of the system are specified, Functional and Non-Functional requirements.

4.3.1 Functional Requirements

A functional requirement specifies the functionality of a system or one of its subsystems. It also depends upon the type of software, expected users, and the type of system where the software is used. Functional user requirements may be high-level statements of what the system should do but functional system requirements should also describe clearly the system services in detail.

Collision Detection:

- The activity tracker should include collision detection capabilities using sensors.
- In the event of a collision, the system must trigger immediate alerts to the owner and emergency contacts.

Fire and Smoke Detection:

- The system should integrate fire/smoke sensors for early detection of potential hazards.
- Instant notifications must be sent to the owner and emergency contacts if smoke or fire is detected.

SMS Alerts via GSM Module:

- Utilize a GSM module for sending SMS alerts to the owner designated.

- Messages should include details about the type of incident (collision, fire/smoke) and the vehicle's location.

Black Box Functionality:

- Incorporate black box features to record and store critical data related to vehicle status and incidents.
- Ensure data integrity and accessibility for post-incident analysis.

4.3.2 Non Functional Requirements

Requirements, which are not related to the functional aspect of the software, fall into this category. They are implicit or expected characteristics of software.

- Reliability: The system must be highly reliable in accurately detecting collisions, fire/smoke, and providing real-time GPS tracking.
- Accuracy: Collision and fire/smoke detection mechanisms should have a high level of accuracy to minimize false positives or negatives.
- Responsiveness: SMS alerts must be sent promptly upon the detection of a collision or fire/smoke, ensuring a quick response.
- Usability: The user interface for accessing GPS tracking and incident data should be intuitive and user-friendly. Alerts should be clear and easily understandable by the owner and emergency contacts.
- Scalability: The activity tracker should be designed to scale, accommodating additional features or updates in the future.

4.4 Use Case Analysis

A use case diagram is a dynamic or behavior diagram in UML. Use case diagrams to model the functionality of a system using actors and use cases. Use cases are a set of actions, services, and functions that the system needs to perform. In this context, a "system" is something being developed or operated, such as a website. The "actors" are people or entities operating under defined roles within the system.

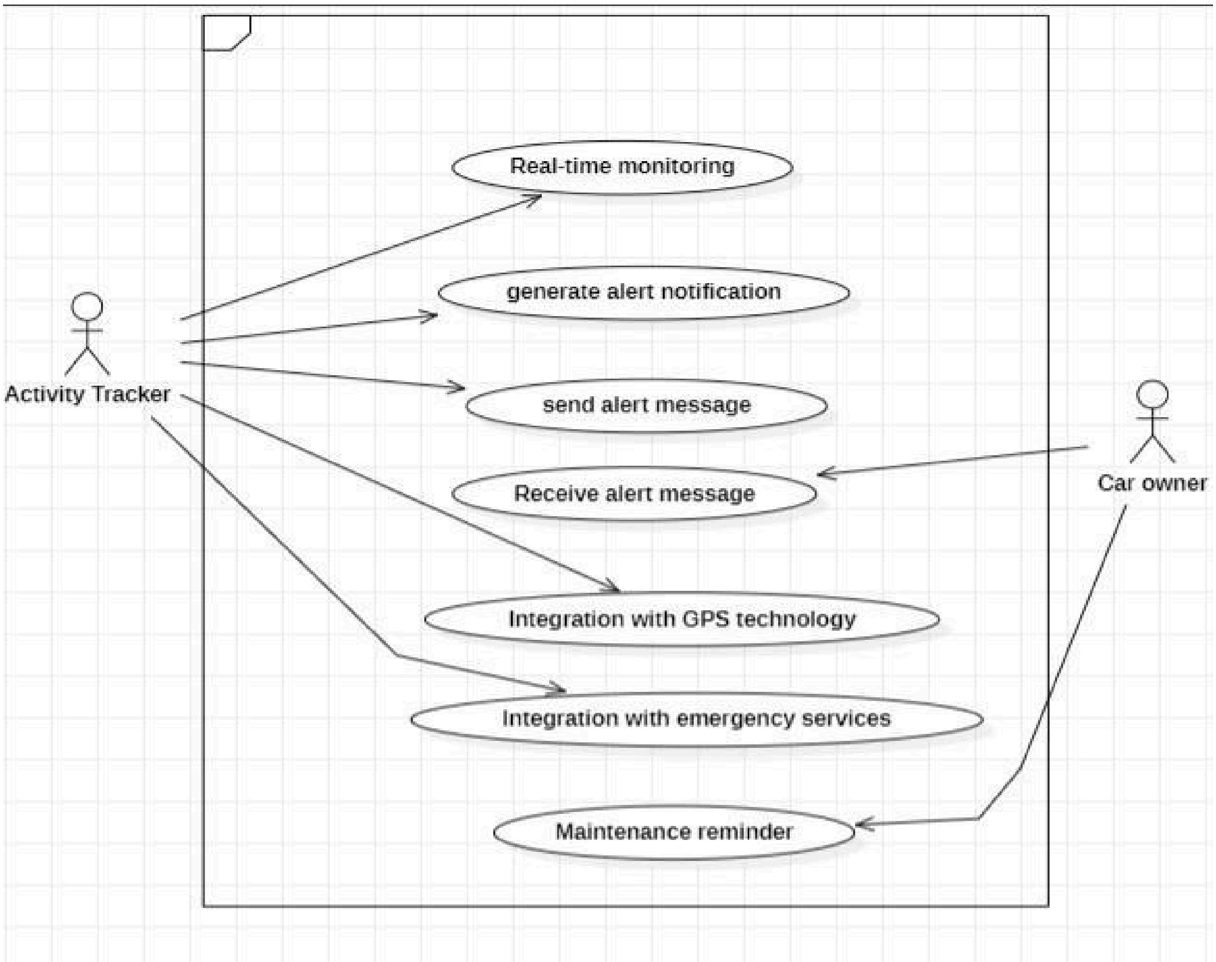


Figure 4.1: Use Case Diagram

4.5 System Requirements

System requirements form the foundation for the successful implementation of a comprehensive road safety initiative. Ensuring the integration of predictive analytics, real-time communication infrastructure, and universal access to Activity tracker data demands careful consideration of hardware, software, connectivity, and security aspects to create a robust and effective system.

4.5.1 Software Used

Arduino IDE - The Arduino Integrated Development Environment (IDE) is a software application used to program and upload code to Arduino boards. It provides a user-friendly interface for writing, compiling, and uploading code to Arduino

Adafruit - Adafruit offers a range of software tools and libraries to support their hardware products, particularly those designed for DIY electronics and microcontroller projects.

4.5.2 Hardware Used

Sensors used -

- piezo sensor
- GSM module
- GPS sensor
- ESP-32 MCU
- MQ-6 smoke sensor
- Photodiode fire sensor

4.6 Feasibility Study

4.6.1 Technical Feasibility:

1. Integration of Predictive Analytics and AI:

- Assess the readiness of existing vehicle systems for the incorporation of predictive analytics and AI algorithms.
- Ensure compatibility with a wide range of vehicle makes and models to facilitate widespread adoption.
- Evaluate the computational requirements and processing capabilities needed to execute real-time analysis of vehicular data.

2. Real-Time Communication Infrastructure:

- Investigate the feasibility of establishing a robust communication network among vehicles, road infrastructure, and central monitoring systems.
- Examine the reliability and latency of communication protocols to support

- Ensure scalability to accommodate the increasing number of connected vehicles without compromising system performance.

4.6.2 Financial Feasibility:

- Initial Investment: The financial feasibility of the initiative involves an initial investment in integrating predictive analytics, artificial intelligence, and real-time communication systems. This encompasses costs related to technology acquisition, software development, and infrastructure upgrades. The initial investment will be offset by the potential long-term benefits of reduced accidents, improved traffic flow, and enhanced post-incident analysis.
- Return on Investment (ROI): The financial viability of the initiative lies in its ability to generate a positive return on investment over a specified time frame. The reduction in accident-related costs, emergency response expenses, and the potential for increased public safety contribute to the overall ROI. Additionally, potential partnerships with technology providers and government incentives may positively impact the financial feasibility of the initiative.

While the upfront costs associated with integrating advanced technologies may be substantial, the financial feasibility of the initiative is supported by the prospect of long-term cost savings, increased operational efficiency, and the potential for positive economic and societal impacts. A detailed financial analysis, including a comprehensive cost-benefit analysis and consideration of funding sources, will be crucial for substantiating the financial viability of this road safety enhancement initiative.

CHAPTER 5

DESIGN

This chapter specifies the working of the system and various UML diagrams.

5.1 Introduction

In the evolution of vehicular safety, the design of the Activity Tracker system stands as a pivotal milestone. As we embark on the design phase, our objective is clear: to craft a sophisticated and comprehensive system that seamlessly integrates cutting-edge technologies to enhance road safety. This phase is more than the amalgamation of hardware and software; it's the orchestration of an intelligent ecosystem that encompasses GPS tracking, collision detection, fire/smoke sensing, and real-time communication. The design of the Activity Tracker aims to transcend traditional safety paradigms by not only reacting to incidents but proactively mitigating risks through a holistic and interconnected approach. As we delve into the intricacies of system design, our focus is on precision, reliability, and the creation of an intelligent safeguard that ensures each journey is a testament to the future of vehicular safety.

5.2 System Architecture

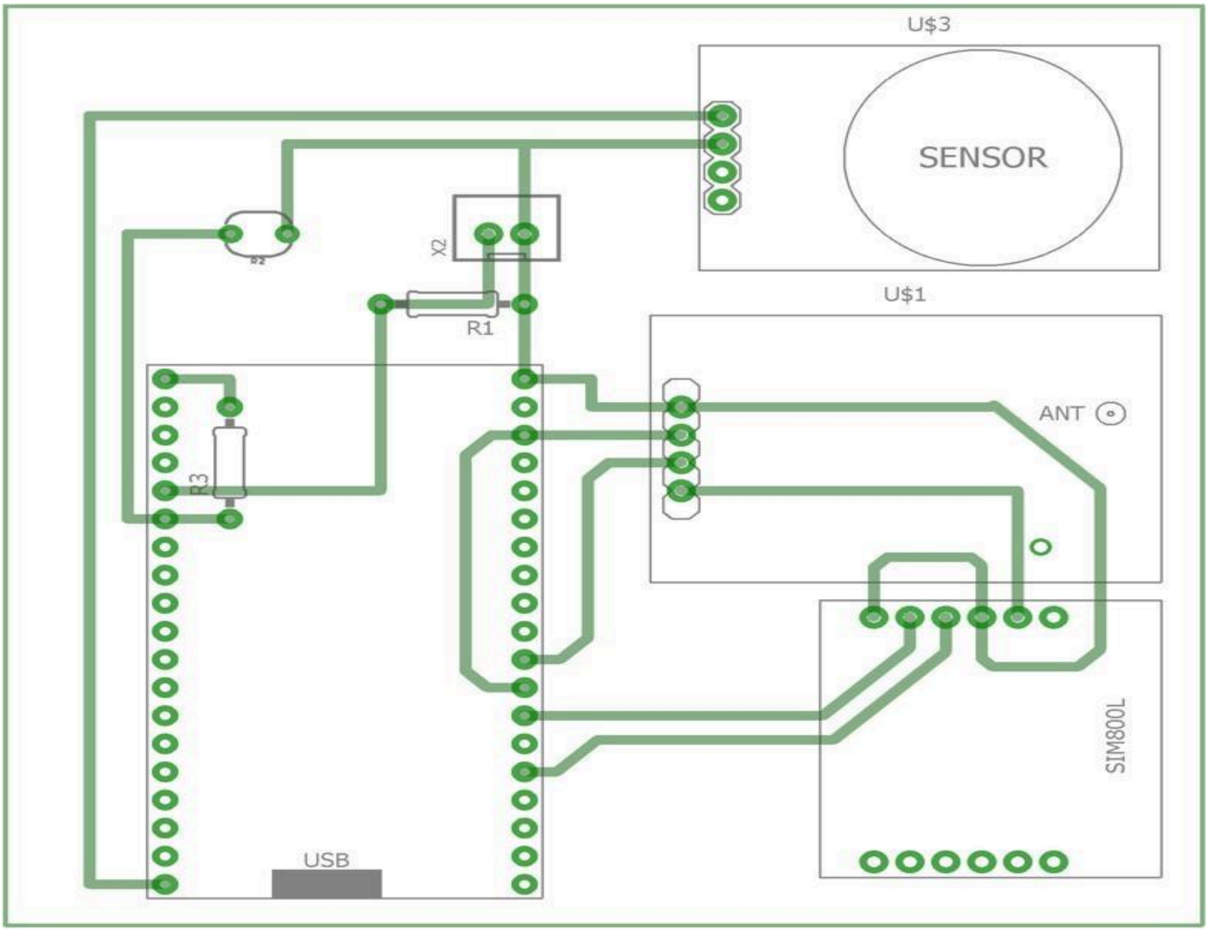


Figure 5.1: PCB Diagram

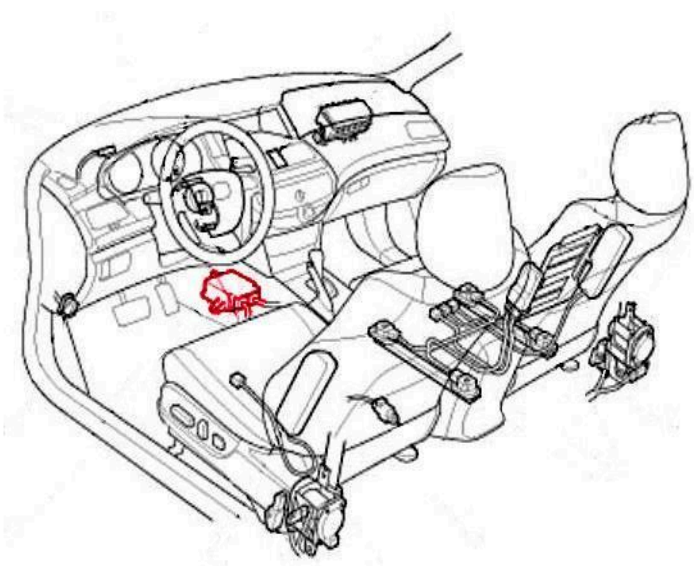


Figure 5.2: Safest place where Activity tracker is placed

5.3 System Block Diagram

This section shows the block diagram of the interaction between a user and a helper with the system.

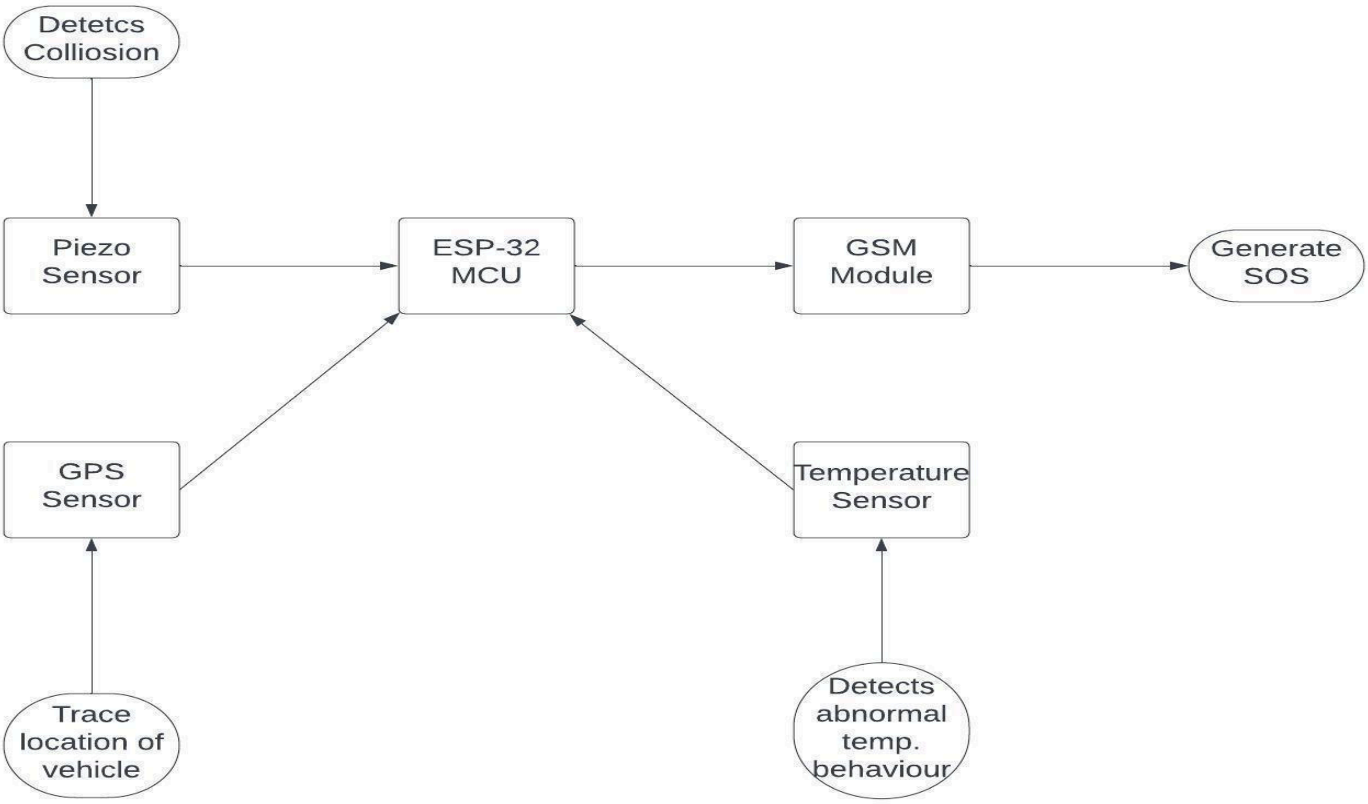


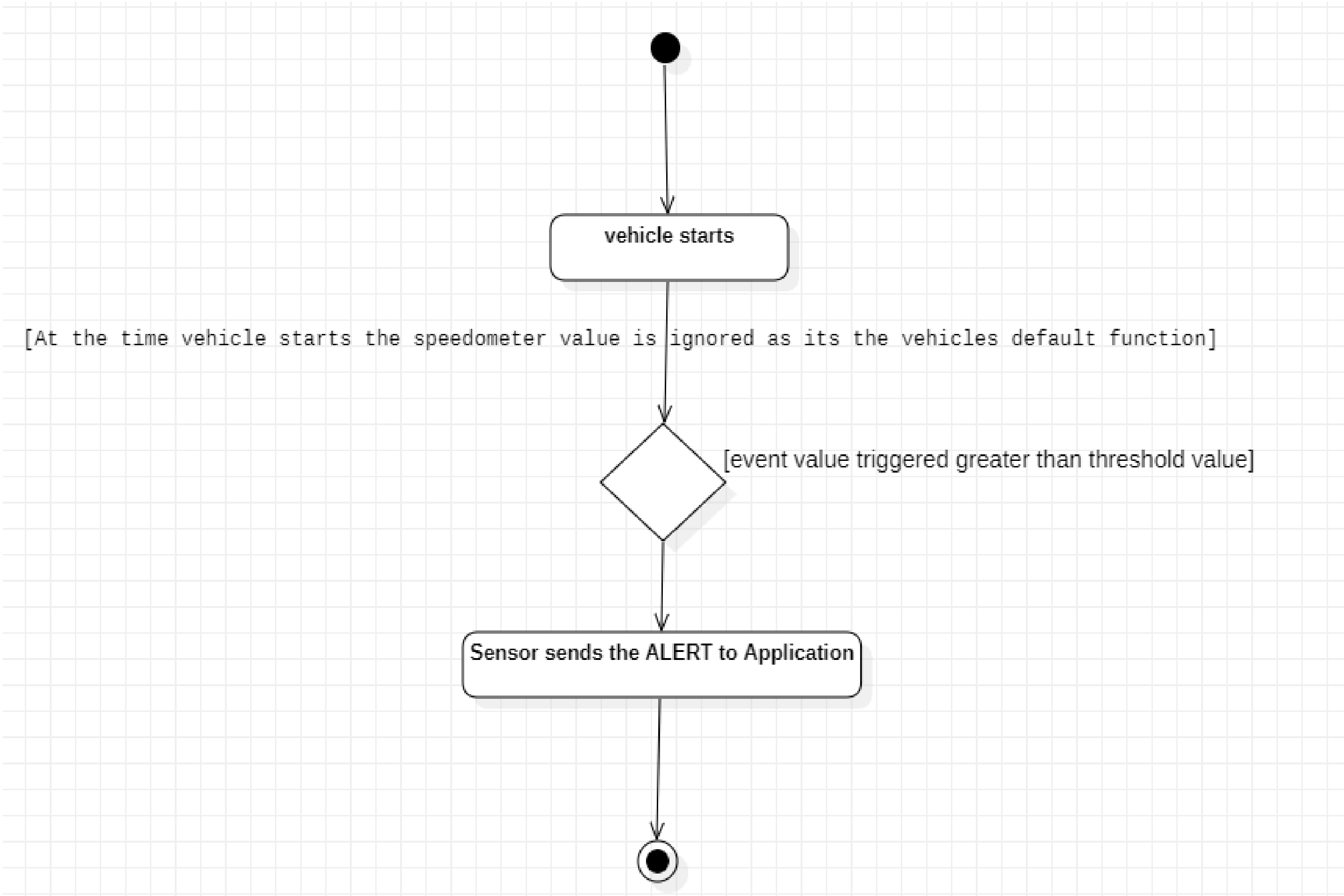
Figure 5.3: Block Diagram

5.4 Activity Diagram:

An activity diagram is a behavioral diagram i.e. it depicts the behavior of a system. An activity diagram portrays the control flow from a start point to a finish point showing the various decision paths that exist while the activity is being executed. It depicts both sequential processing and concurrent processing of activities. They are used in business and process modeling where their primary use is to depict the dynamic aspects of a system. Activity is a particular operation of the system. Activity diagrams are not only used for visualizing the dynamic nature of a system but are also used to construct the executable system by using forward and reverse engineering techniques. The purpose of an activity diagram can be described as

- Modeling workflow by using activities.
- Draw the activity flow of a system.
- Describe the sequence from one activity to another.
- Describe the parallel, branched, and concurrent flow of the system.
- High-level understanding of the system's functionalities.

Figure 5.4: Activity Diagram Of Sensor Detection



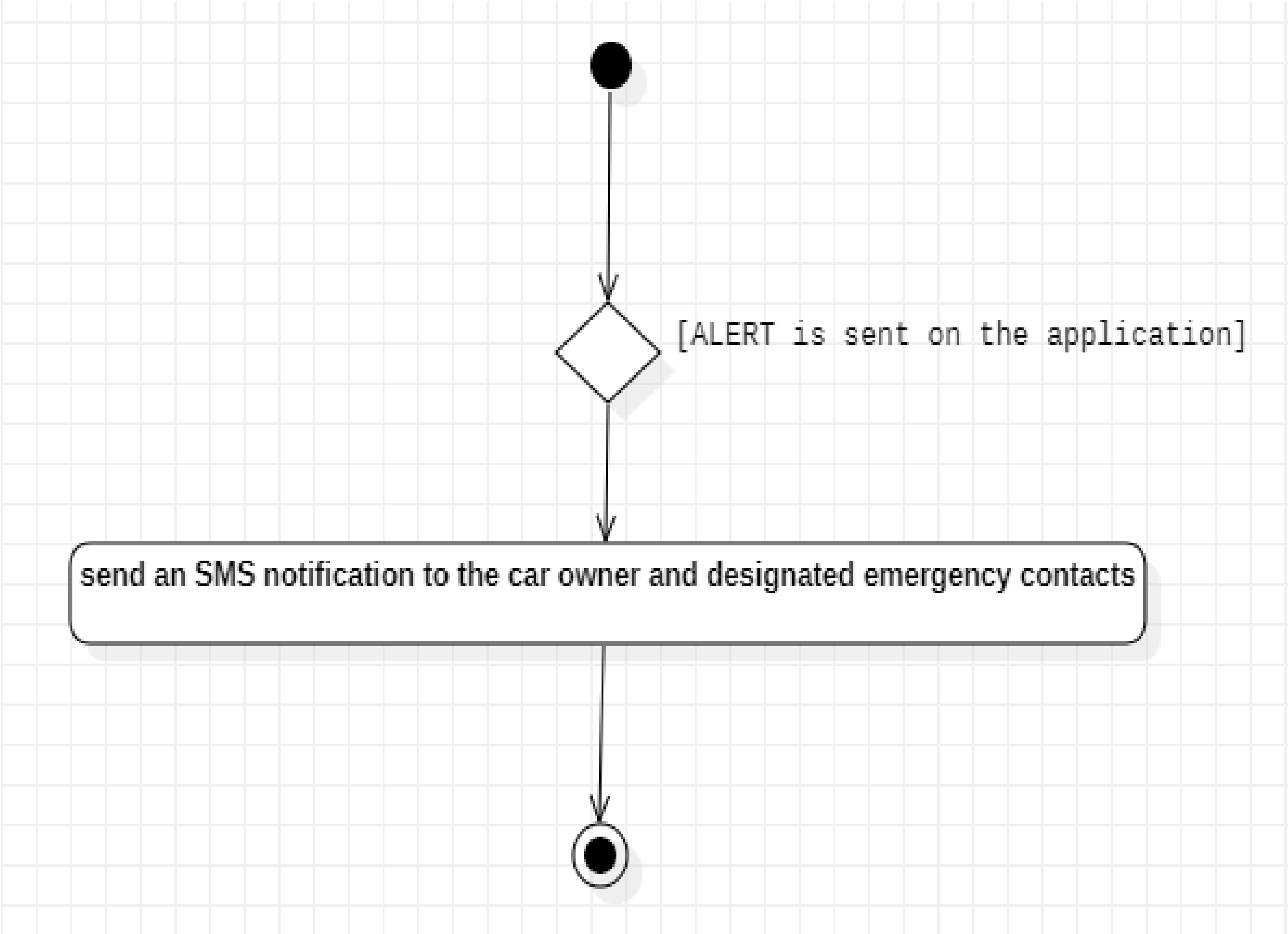


Figure 5.5: Activity Diagram Of SMS Notification

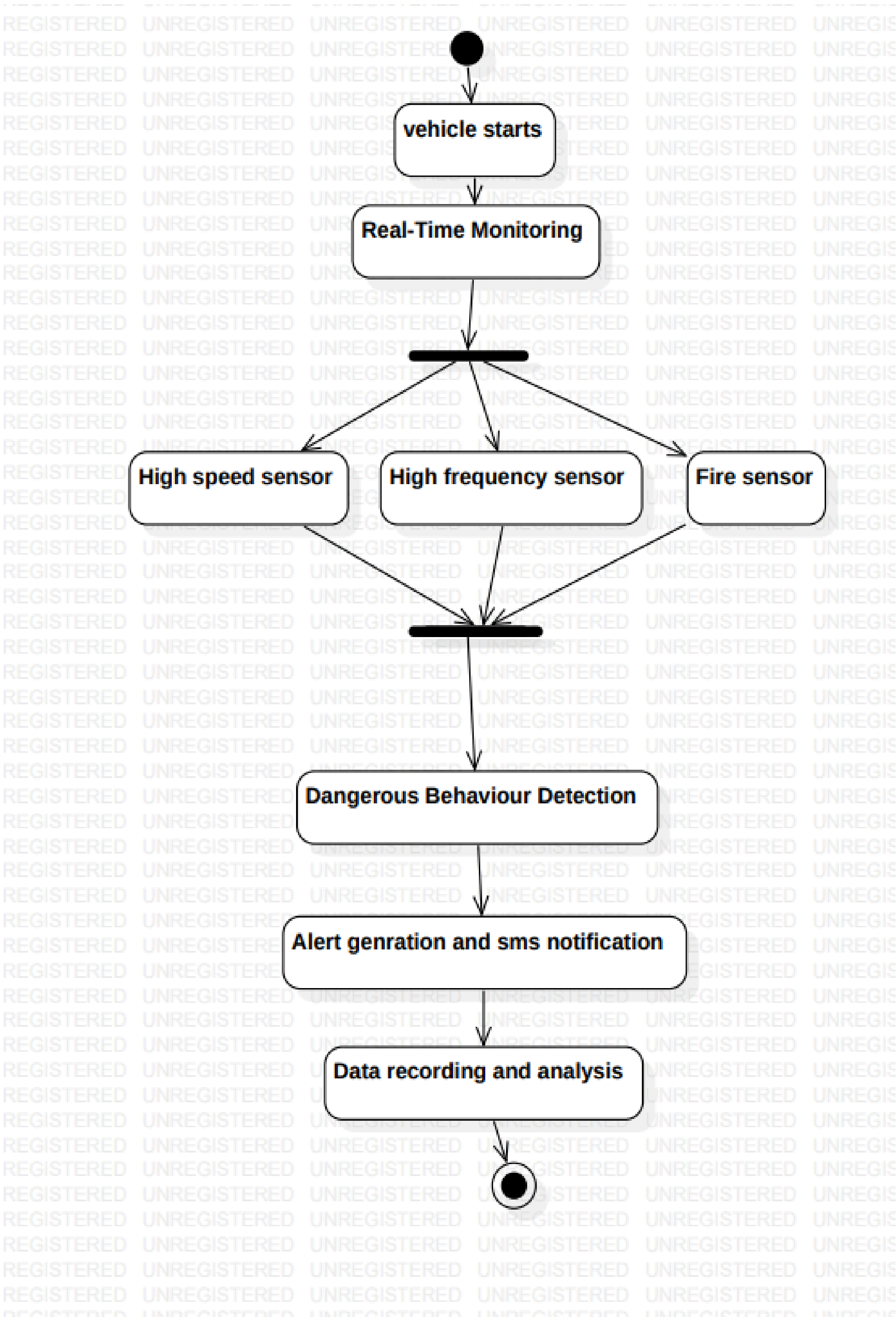


Figure 5.6: Overall Activity Diagram

CHAPTER 6

IMPLEMENTATION

The implementation phase revolves around the development of the system modules and providing their description. The implementation also deals with providing the full logical view of the modules. The chapter involves the modules and package descriptions that are used for implementation.

6.1 Hardware & Software used

Hardware Components for the Activity Tracker:

GPS Module:
- Responsible for providing real-time location tracking and geospatial data.

Microcontroller (e.g., Arduino, Raspberry Pi):
- Serves as the central processing unit, managing data from various sensors and controlling the overall functionality of the Activity Tracker.

Collision Sensor:
- Utilises accelerometers, gyroscopes, or other relevant sensors to detect abrupt changes in acceleration or orientation indicative of a collision.

Fire/Smoke Sensor:
- Includes sensors designed to detect the presence of smoke or fire within the vehicle.

GSM Module:
- Facilitates wireless communication to send SMS alerts to the owner and emergency contacts.

Power Supply:
- A reliable power source, such as a rechargeable battery or the vehicle's electrical system, to ensure continuous operation.

Storage Module:

- For the implementation of black box functionality, a storage module (e.g.,SD card) to record and store critical data related to incidents.

Softwares:

- Adafruit
- ArduinoIDE

6.2 Code Description

All the IOT sensors are being coded through Arduino IDE, using various libraries. Following is the base code for working of the system that includes integration of all hardware

Major_Project.ino

```
#include <TinyGPS++.h>

//sender phone number with country code.
//not gsm module phone number
const String PHONE = "+919131708395";

//GSM Module RX pin to ESP32 2
//GSM Module TX pin to ESP32 4
#define rxPin 4
#define txPin 2
HardwareSerial sim800(1);

#define RXD2 16
#define TXD2 17
HardwareSerial neogps(2);

TinyGPSPlus gps;

String smsStatus,senderNumber,receivedDate,msg;
boolean isReply = false;

const int piezoPin = 34;
const int threshold = 1023;

void setup() {
  //delay(7000);

  Serial.begin(115200);
  Serial.println("esp32 serial initialize");

  sim800.begin(9600, SERIAL_8N1, rxPin, txPin);
  Serial.println("SIM800L serial initialize");
```

Major_Project.ino

```
  neogps.begin(9600, SERIAL_8N1, RXD2, TXD2);
  Serial.println("neogps serial initialize");

  smsStatus = "";
  senderNumber="";
  receivedDate="";
  msg="";

  sim800.println("AT+CMGF=1"); //SMS text mode
  delay(1000);
  sim800.println("AT+CMGD=1,4"); //delete all saved SMS
  delay(1000);
} //setup function ends

void loop() {
//**************************************************
  while(sim800.available()){
    parseData(sim800.readString());
  }
//**************************************************
  while(Serial.available())  {
    sim800.println(Serial.readString());
  }
//**************************************************
  int sensorValue = analogRead(piezoPin);
  int digitalValue = map(sensorValue, 0, 1023, 0, 1023);

  if (digitalValue > threshold) {
    sendLocation();
  }
//**************************************************
} //main loop ends
```

Major_Project.ino

```
      else if(cmd == "+CMGR"){
        extractSms(buff);
        Serial.println("Sender Number: "+senderNumber);
        Serial.println("PHONE: "+PHONE);
        if(senderNumber == PHONE){
          if(msg == "get location"){
            sendLocation();
          }
          else if(msg == "get speed"){
            sendSpeed();
          }
        }
        sim800.println("AT+CMGD=1,4"); //delete all saved SMS
        delay(1000);
        smsStatus = "";
        senderNumber="";
        receivedDate="";
        msg="";
      }
    //////////////////////////////////////////////////
    }
    else{
    //The result of AT Command is "OK"
    }
}
//MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM

//MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM
void extractSms(String buff){
   unsigned int index;
   Serial.println(buff);

```

Major_Project.ino

```
    delay(1000);
    Serial.println("GPS Location SMS Sent Successfully.");
    //*/
  }
}
//MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM

//MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM
void sendSpeed()
{
  // Can take up to 60 seconds
  boolean newData = false;
  for (unsigned long start = millis(); millis() - start < 2000;)
  {
    while (neogps.available())
    {
      if (gps.encode(neogps.read()))
      {
        newData = true;
      }
    }
  }
  if (newData)      //If newData is true
  {
    newData = false;
    Serial.print("Speed km/h= ");
    Serial.println(gps.speed.kmph());
    delay(300);
    ///*
    sim800.print("AT+CMGF=1\r");
    delay(1000);
    sim800.print("AT+CMGS=\""+PHONE+"\"\r");
```

Major_Project.ino

```
    index =buff.indexOf(",");
    smsStatus = buff.substring(1, index-1);
    buff.remove(0, index+2);

    senderNumber = buff.substring(0, 13);
    buff.remove(0,19);

    receivedDate = buff.substring(0, 20);
    buff.remove(0,buff.indexOf("\r"));
    buff.trim();

    index =buff.indexOf("\n\r");
    buff = buff.substring(0, index);
    buff.trim();
    msg = buff;
    buff = "";
    msg.toLowerCase();

    //Serial.println("---------------------------------");
    //Serial.println(smsStatus);
    //Serial.println(senderNumber);
    //Serial.println(receivedDate);
    //Serial.println(msg);
    //Serial.println("---------------------------------");
}
//MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM

//MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM
void sendLocation()
{
  // Can take up to 60 seconds
  boolean newData = false;
```

Major_Project.ino

```
  boolean newData = false;
  for (unsigned long start = millis(); millis() - start < 2000;)
  {
    while (neogps.available())
    {
      if (gps.encode(neogps.read()))
      {
        newData = true;
      }
    }
  }
  if (newData)      //If newData is true
  {
    newData = false;
    Serial.print("Speed km/h= ");
    Serial.println(gps.speed.kmph());
    delay(300);
    ///*
    sim800.print("AT+CMGF=1\r");
    delay(1000);
    sim800.print("AT+CMGS=\""+PHONE+"\"\r");
    delay(1000);
    sim800.print("Speed km/h: ");
    sim800.print(gps.speed.kmph());
    delay(100);
    sim800.write(0x1A); //ascii code for ctrl-26 //sim800.println((char)26); //ascii code for ctrl-26
    delay(1000);
    Serial.println("GPS Speed SMS Sent Successfully.");
    //*/
  }
}
//MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM
```

CHAPTER 7

TESTING

This chapter includes testing which refers to the process of evaluating the quality, functionality, and performance of a system. It helps to identify and rectify any defects or issues that could impact the overall success of the project

7.1 Test Cases

Test Case – 1

GPS Sensor Testing:

Objective: Validate the accuracy of vehicle location detection and data transmission to the microcontroller.

Test Steps:

Activate GPS sensor and monitor vehicle location updates on the map.

Drive the vehicle along predefined routes to simulate different scenarios.

Ensure that the microcontroller receives accurate and timely location data.

Expected Result: Accurate vehicle location updates displayed on the map, Microcontroller receives and processes GPS data correctly.

Actual Result: Accurate vehicle location updates displayed on the map, Microcontroller receives and processes GPS data correctly.

Pass/Fail: Pass

Test Case – 2

Microcontroller Testing:

Objective: Verify sensor data reception, data processing, and control logic.

Test Steps:

Simulate sensor data inputs (e.g., GPS, collision, smoke) to the microcontroller.

Monitor the microcontroller's response to sensor inputs.

Check if the microcontroller processes data accurately and triggers appropriate actions.

Expected Result: Microcontroller successfully receives, processes, and responds to sensor inputs according to predefined logic.

Actual Result: Microcontroller successfully receives, processes, and responds to sensor

inputs according to predefined logic.

Pass/Fail: Pass

Test Case - 3

Collision Sensor Testing:

Objective: Test the detection of collision impacts and promptness of SMS alerts.

Test Steps:

Simulate collision impacts of varying intensity (minor/major).

Verify if the collision sensor detects impacts and triggers alerts accordingly.

Expected Result: Collision impacts detected accurately; SMS alerts sent promptly after collision detection.

Actual Result: Collision impacts detected accurately; SMS alerts sent promptly after collision detection.

Pass/Fail: Pass

Test Case - 4

Smoke Sensor Testing:

Objective: Validate the detection of smoke and promptness of alerts.

Test Steps:

Introduce smoke near the smoke sensor to simulate fire/smoke events.

Confirm if the smoke sensor detects the presence of smoke.

Verify if alerts are generated promptly upon smoke detection.

Expected Result: Smoke detection by the sensor; Alerts generated promptly upon smoke detection.

Actual Result: Smoke detection by the sensor; Alerts generated promptly upon smoke detection.

Pass/Fail: Pass

Test Case - 5

GSM Module Testing:

Objective: Ensure successful sending of SMS notifications with relevant information.

Test Steps:

Trigger various events (e.g., collision, smoke detection) to generate SMS alerts.

Verify if SMS notifications are sent successfully using the GSM module.

Confirm that SMS alerts contain relevant information (e.g., type of event, vehicle location).

Expected Result: SMS notifications sent successfully with relevant information included.

Actual Result: SMS notifications sent successfully with relevant information included.

Pass/Fail: Pass

Test Case – 6

Integration Testing

Objective: Test the seamless operation of all components and triggering of appropriate responses.

Test Steps:

Execute test scenarios that involve multiple components (e.g., GPS tracking, collision detection, SMS alerts).

Confirm that all components work together seamlessly to detect and respond to sensor inputs.

Validate if the system triggers appropriate responses (e.g., alerts, data recording) based on sensor inputs.

Expected Result: All components operate seamlessly together, triggering appropriate responses to sensor inputs.

Actual Result: All components operate seamlessly together, triggering appropriate responses to sensor inputs.

Pass/Fail: Pass

CHAPTER 8

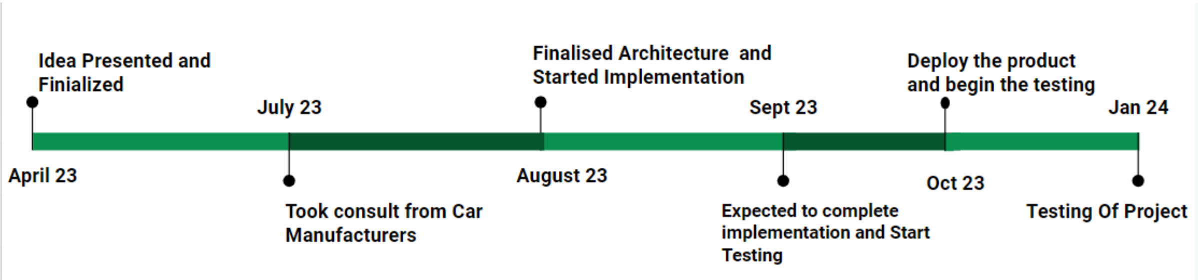
CONCLUSION

8.1 Conclusion

In conclusion, the development of the Activity Tracker represents a significant stride towards enhancing vehicular safety through the integration of advanced technologies and innovative features. By combining GPS tracking, collision detection, fire/smoke sensing, and real-time communication via a GSM module, this system offers a comprehensive solution for both preemptive accident prevention and rapid response in emergency situations. The utilisation of a microcontroller, coupled with sophisticated algorithms, ensures efficient data processing and decision-making. The inclusion of black box functionality further adds a layer of depth to post-incident analysis, enabling continuous improvements in vehicle safety. The hardware components, ranging from GPS modules to collision and fire/smoke sensors, work in tandem to create a robust and reliable system. On the software side, custom firmware, algorithms, and user interfaces contribute to a seamless and user-friendly experience. This project, with its multifaceted approach to safety, not only aligns with the evolving landscape of Advanced Driver Assistance Systems (ADAS) but also signifies a commitment to proactive measures that extend beyond the traditional scope of vehicular safety. As the Activity Tracker moves towards implementation, it holds the promise of significantly reducing the frequency and severity of accidents, thereby making a substantial contribution to overall road safety.

Timeline of Project:

The timeline of project is shown below-



REFERENCES

1. Intelligent vehicle black box using IoT - Research Paperfrom https://www.researchgate.net/publication/324052304_Intelligent_vehicle_black_box_using_IoT

2. International Research Journal of Engineering and Technology (IRJET) - Research Paper from https://www.irjet.net/

3. Accident Detection System using Black Box System - Research Paper from http://ijesc.org