AI Based System for Accident and Theft Detection

An Engineering Project in Community Service

Phase – I Report

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in partial fulfillment of the requirements for the degree of

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Bonafide Certificate

Certified that this project report titled **"AI Based System for Accident and Theft Detection"** is the bonafide work of "20BAC10003 Anirudh Santhosh , 20BAC10006 Yashraj Karwa, 20BAC10011 Anirudh J Babu, 20BAC10024 Nibedita Rakshit, 20BAI10193 Jessica B Johny, 20MIM10066 Keerthi S, 20MEI10073 Sivaranjani D, 20MIP10015 Sidharth E S**" who** carried out the project work under my supervision.

This project report (Phase I) is submitted for the Project Viva-Voce examination held on 26 December 2022.

Supervisor

List of Figures

List of Symbols & Abbreviations

AI	**Artificial Intelligence**
IOT	**Internet of things**
WHO	**World health organization**
SMS	**Short message service**
GPS	**Global positioning system**
GSM	**Global system for mobile communication**

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1. INTRODUCTION

Road accidents are increasing daily as the number of automobiles rises. An annual global death toll of 1.4 million and an injury toll of 50 million are reported by the WHO. Lack of access to healthcare is the main cause of death at the scene of the accident or the lengthy reaction time during the rescue effort. It has been noted that while emergency assistance will soon be available in locations with high traffic or in cities, it is more challenging to deliver it quickly on highways or in rural areas. It has been noted that delays in medical care cause serious injuries to result in mortality . To decrease the amount of fatalities from traffic accidents, an intelligent accident detection and warning system is required. Once the system identifies an accident, it will notify all emergency services like hospitals, police stations, and so on.

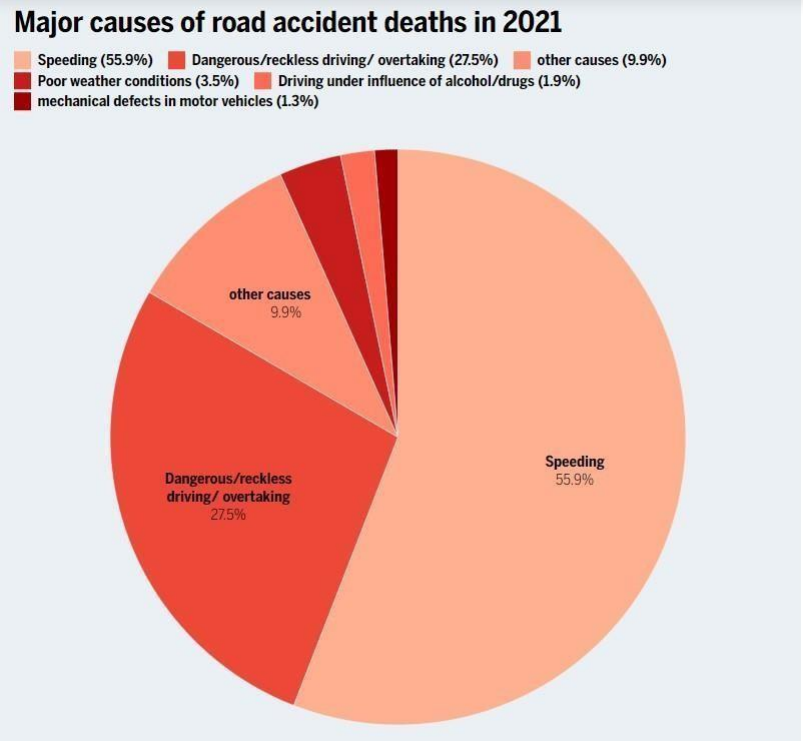

fig 1- Causes of accidents

Along with accident vehicle theft has escalated globally in recent years. To combat vehicle theft, numerous vehicle anti-theft technologies were created and put into use. However, it remains a difficult challenge to address the problem of vehicle theft. Once a car is stolen, the smart system provides a quick tracking system to locate it.

This report puts out the concept of an intelligent AI system for theft and accident detection.

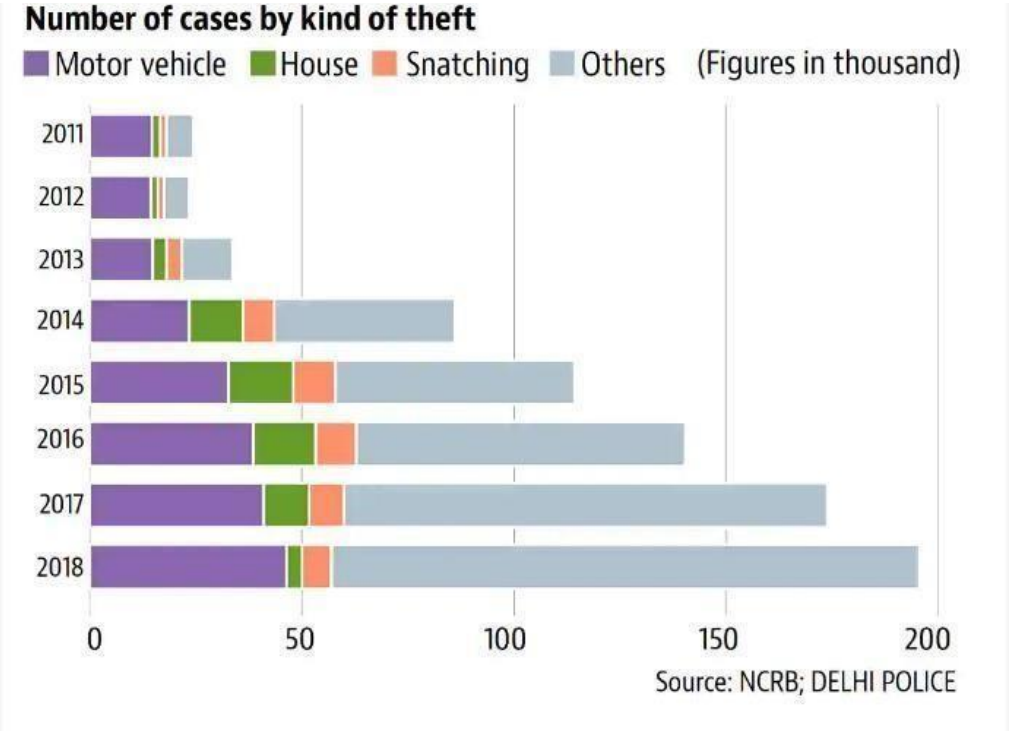

fig 2 -Number of theft cases by its kind

1.1 Motivation

- Every year, numerous people pass away in road accidents. Nothing will ever be valued more highly than a human life. Our motto is **"No one will perish in a car accident."** Technology has the potential to improve our way of life. As our nation grows every day, we will all need to embrace technology. Therefore, we need to resolve this issue. The IOT idea along with AI is being used in this project to ensure the safety of the victim whose life is in danger due to a road accident.

- Many vehicles are stolen each day around the world, and the main cause is that the owner is unaware of both the time and place of the theft. So, to **"Reduce the amount of automobiles stolen"** is our motto. Therefore, a sophisticated system will be implemented to identify the theft and notify the owner of the theft as well as the whereabouts of the car.

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1.2 Objective

The system primarily uses a smart system to prevent accidents and theft . The system comprises 4 features.

1) Identifying accidents and informing nearby hospitals or the family about the accident's location.

2) A voice recording device to capture the driver's voice in order to determine the cause of accident.

3) Face recognition to identify the person who stole the car and mailing the owner a photo of the thief.

2. Existing Work / Literature Review

2.1. Smartphone-Based Systems

These systems employ a smartphone's different sensors to identify and warn users of traffic accidents. An accelerometer and GPS data were employed to locate the sites of the accidents. This method does not alert any emergency agencies , it merely detects an accident .Another proposal for an accident detection technique uses a GPS module to pinpoint the accident's location and a mobile message to alert the hospitals. The primary drawback of this paper is that there is just one sensor being used. Therefore, the entire system will malfunction if the sensor is ineffective. Additionally, it can lead to more false alarms.

A smartphone-based accident detection and reporting system was suggested , For the purpose of identifying car accidents, the G-force value, noise, and speed are used. Noise and gravitational force are extracted using the mobile sensor and accelerometer (microphone). An alert is sent to the emergency number as soon as the accident is discovered. This gadget may overreact when an accident occurs at a low speed because speed is an important component for accident detection. An Android app for accident notification and identification has been made in another proposal .To find an accident, they have merely utilized a GPS module and an accelerometer mobile sensor. When the accident is located, it calls the emergency number with a pre-recorded audio message.

2.2. Deep Learning-Based Systems

The proposed system is an intelligent accident detection and rescue system which mimics the cognitive functions of the human mind using the Internet of Things (IoTs) and the Artificial Intelligence system (AI). An IoT kit is developed that detects the accident and collects all accident-related information, such as position, pressure, gravitational force, speed, etc., and sends it to the cloud. In the cloud, once the accident is detected, a deep learning (DL) model is used to validate the output of the IoT module and activate the rescue module. Once the accident is detected by the DL module, all the closest emergency services such as the hospital, police station, mechanics, etc., are notified. Ensemble transfer learning with dynamic weights is used to minimize the false detection rate. Due to the dataset's unavailability, a personalized dataset is generated from the various videos available on the Internet. The proposed method is validated by a comparative analysis of ResNet and InceptionResnetV2.

2.3. 8051-Based Theft Detection

The main purpose of this project is to prevent vehicle theft. This functionality is achieved by detecting vehicle status in theft mode and by sending an SMS which is generated automatically. This SMS is then sent to the owner of the vehicle. The owner can then send back the SMS in order to disable the ignition of the vehicle. Thus in this way crimes can be reduced to a great extent as vehicles today are being stolen in large number. How the system works is when a person tries to steal the vehicle, the microcontroller is interrupted and the command is sent to the GSM modem to send SMS. On the receipt of the message, the owner sends back the SMS to the GSM modem. This is done in order to stop the engine. This GSM modem is interfaced to the microcontroller. This microcontroller on the receipt of the message uses a mechanism that helps to stop the engine. Motor is being used in this project in order to indicate vehicle ON/OFF state. This project was done using a 8051 controller which has a less compatibility and feasibility compared to RassberryPi.

3. Topic of the work

- **System Design / Architecture**

Accident and Alert System

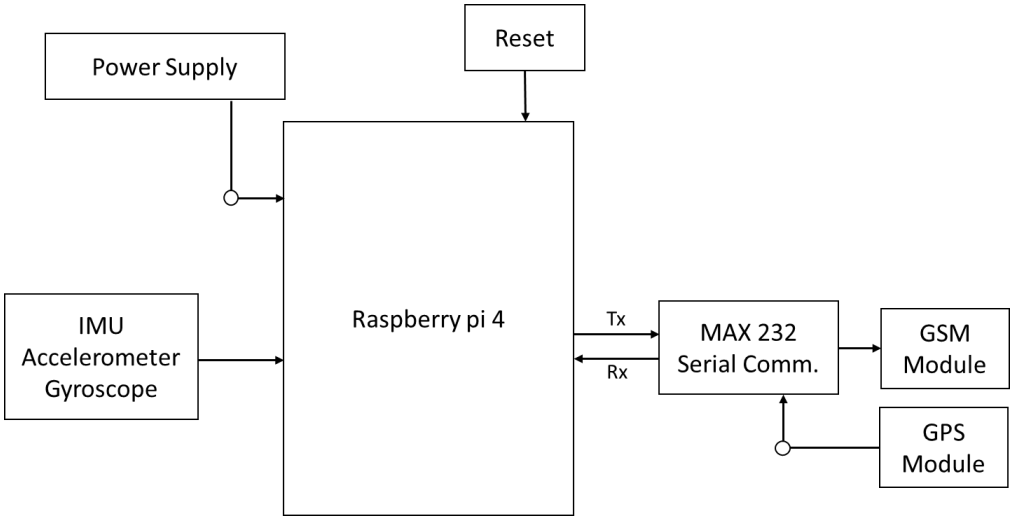


fig 3 – Block diagram for accident and alert System

Theft Detection

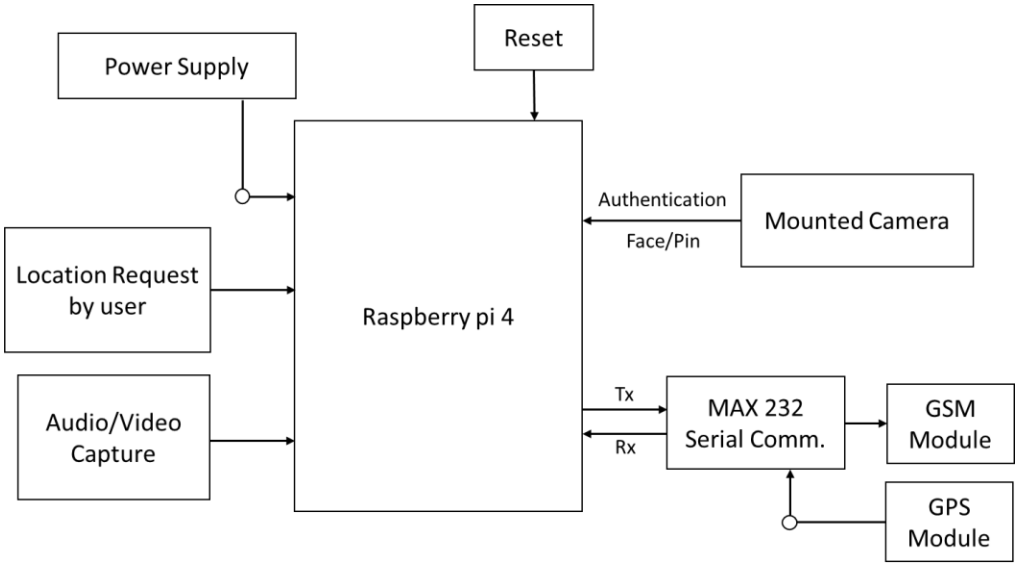
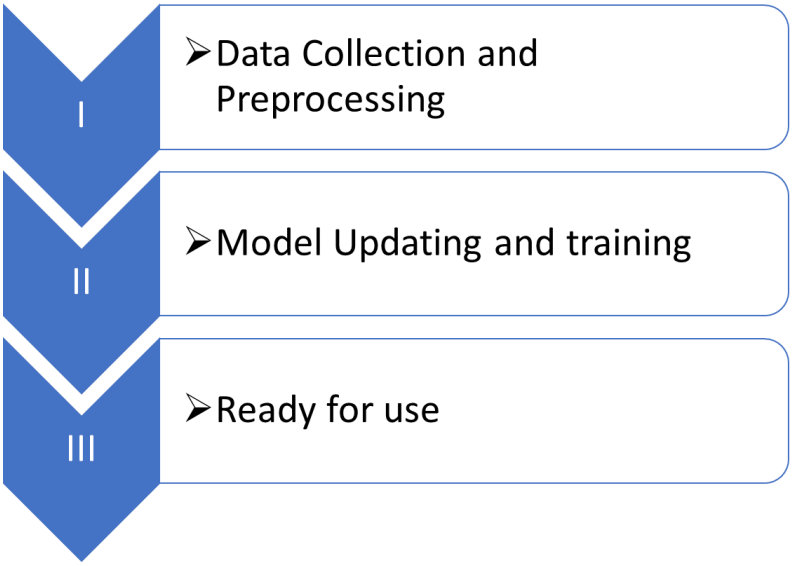


fig 4 - Block diagram for Theft detection

Face Recognition



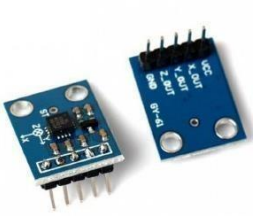
▲ Face Recognition through a few shot learning model

fig 5- Methodology for Face Recognition

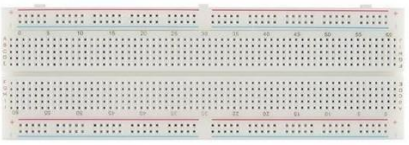
Components required:

- Components needed:
  - Hardware requirement:

Raspberry Pi 4



ADXL335



Breadboard board

Male-to-female

Male to male wires

GPS module

4wheeled chassis

Web camera or Pi camera

MCP 3208

- Software requirement:

Open cv

Python

Proteus(For simulation)

- **Working Principle**

Accident Detection and Alert System

- When the system gets started GPS gets initialized which receives the signal from the satellite and transfer the latitude and longitude value to the receiver.
- GSM receives the message and then it gets started through which the message is been send to emergency server numbers.

- While travelling if the accident occurs then it is been sensed by the vibration sensor, which gives indication to the system to send the alert message to the nearby ambulance, police station and insurance office numbers given in the program.
- A threshold value is been set to which if the value goes beyond the threshold value then the alert message is been send.
- The System will even have a voice recording system to record the voice which gets initialized when the vehicle starts. The recording system record the sound to know the mode of accident

Theft Detection and Alert System

- When the system gets started GPS gets initialized which receives the signal from the satellite and transfer the latitude and longitude value to the receiver.
- GSM(Twilio Api) receives the message and then it gets started through which the message is been sendto the owner.
- The camera module in the system identifies the owner , if the recognized person is not the owner or friends/family members then the face is captured and mailed or messaged to the owner.
- If the automobile is stolen then the current location of the vehicle is sent to the owner.

- **Expected Results**

  - The system will identify the accident and provide neighbouring hospitals or family members the accident's location on Google Maps through SMS so that the injured person can receive care as soon as possible.
  - The system contains a voice recorder which will capture audio in order to determine the cause of accident.
  - The system will even be able to tell if the car is stolen or not, and if it is, it will notify the owner the car's current location on Google Maps through SMS so that they can monitor it.
  - The system features a camera module that can recognize faces and determine whether they belong to the owner or not. If the automobile is taken, the owner will receive a mail or SMS message with the image of the criminal.

- **Results**

- **Simulations :**

  - In order to preview the outcomes prior to implementing the circuit in real life, a simulation was carried out using Proteus software. This approach allowed for an evaluation of the results in a virtual environment before proceeding with the actual circuit integration. By utilizing Proteus software, the necessary assessments and adjustments could be made effectively, ensuring a smoother and more efficient implementation process.

- **Simulations results:**

  - In the simulation, we utilized a Raspberry Pi and an MCP3208, which functions as an Analog-to-Digital Converter (ADC). This ADC was connected to a potentiometer, enabling the instant modification of voltage values. This setup played a crucial role in the crash detection process. By incorporating three potentiometers, we simulated the behavior of an ADXL335 accelerometer within the simulation software. This configuration allowed us to mimic the response of a physical accelerometer and analyze its performance in detecting crashes effectively.

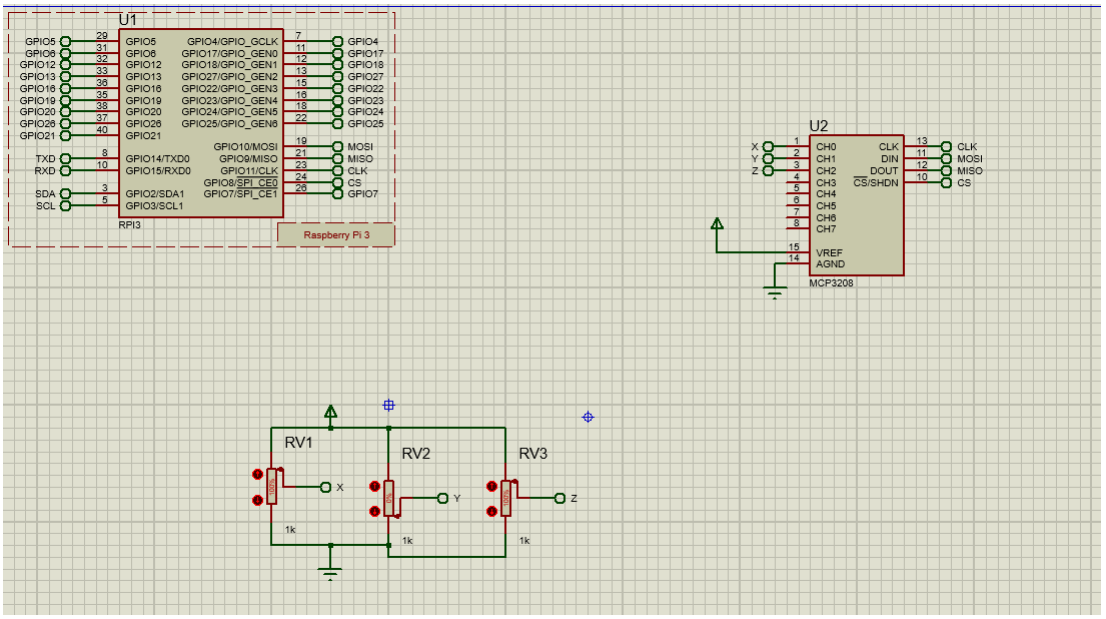


fig 6- Simulation for Accident Detection

- **Hardware Implementation:**

1) ADXL 335

- The ADXL335 is a low-cost, three-axis accelerometer sensor. It is designed to measure acceleration in three dimensions. The sensor outputs an analog voltage proportional to the acceleration along each of the X, Y, and Z axes.
- The basic working principle of the ADXL335 is based on the deflection of the cantilever beams in response to acceleration. When the sensor is subjected to acceleration in a particular direction, the proof mass moves in that direction, causing the cantilever beams to deflect. The deflection of the beams changes the distance between the sensing electrodes, which changes the capacitance between them.
- The change in capacitance is proportional to the acceleration.
- The analog output signals from the sensor are amplified and filtered by the signal conditioning circuitry and then converted to digital signals using an analog-to-digital converter (ADC). The digital signals can then be processed by a microcontroller.

Working

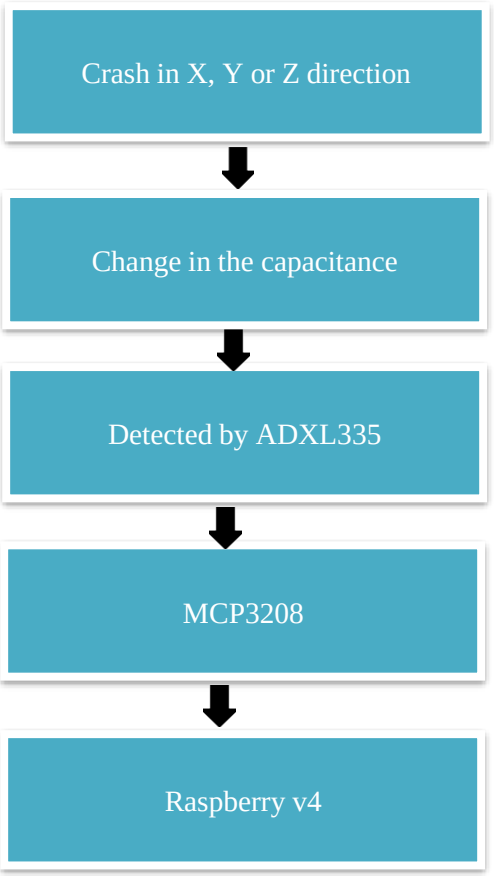


fig 7- Working of ADXL335

Mcp3208(ADC)

- The MCP3208 is an 8-channel, 12-bit analog-to-digital converter (ADC). It is designed to convert analog signals into digital signals for use in digital devices, such as microcontrollers and computers.

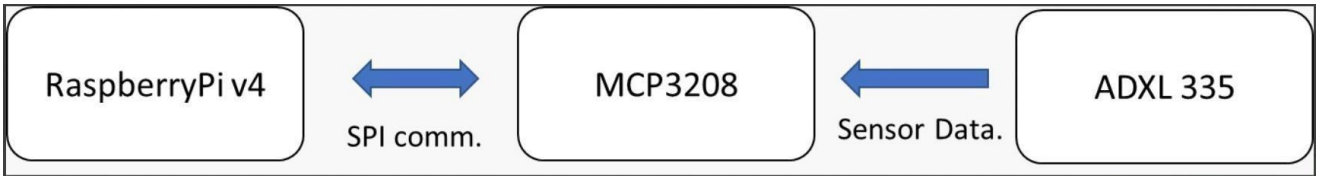


fig 8- Communication flow

2) GPS module

- The GPS module is a device that receives signals from multiple satellites to determine its precise location on Earth.
- It consists of a GPS receiver, an antenna to capture satellite signals, and associated circuitry to process the received data.

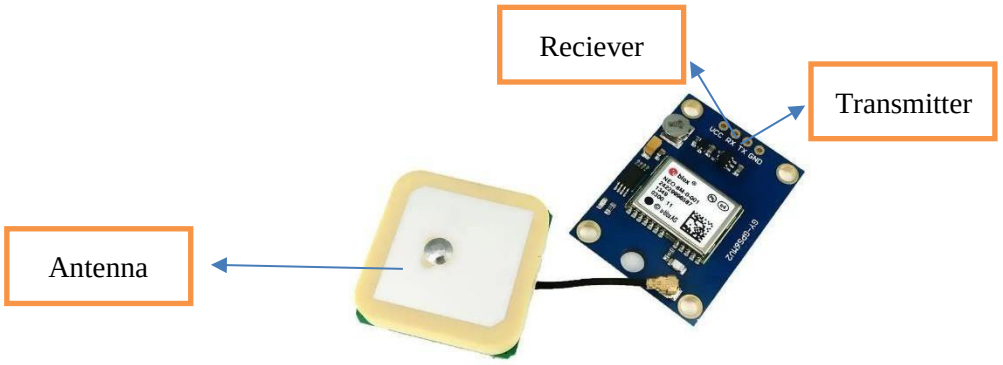


fig 9- GPS module and its parts

- The module's UART (Universal Asynchronous Receiver-Transmitter) pins, such as TX (transmit) and RX (receive), are connected to the Raspberry Pi's UART pins, allowing data transmission between the raspberry pi and GPS module.
- The transmitter of the raspberry pi is connected to receiver of GPS module and vice versa.

Circuit Connection

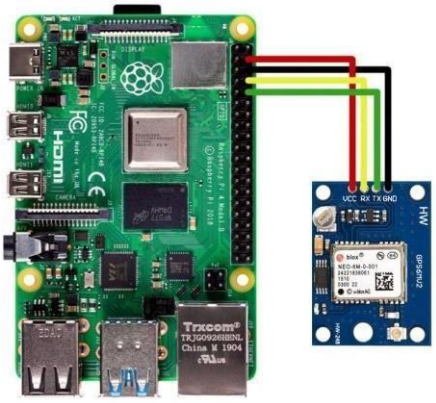


fig 10- GPS module connection with Raspberry Pi V4

Block diagram of connection:

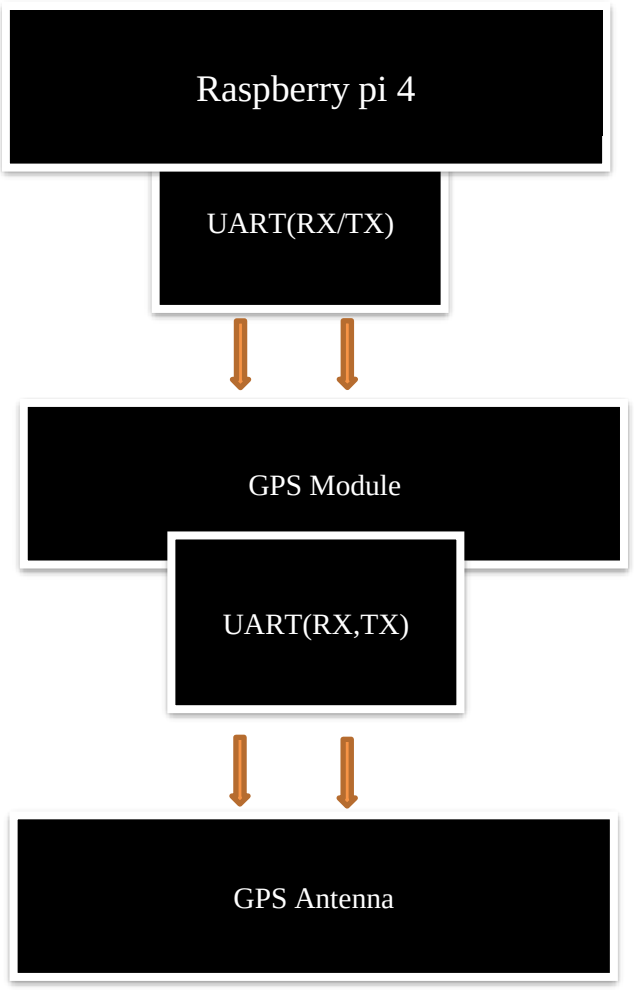


fig 11- GPS module block diagram

fig 12-Integrating GPS module

3) SMS

- For sending SMS we are using an API called **Twilio API.**
- It is a is a cloud communications platform that provides APIs (Application Programming Interfaces) for developers to build communication solutions using text messages, voice calls, video calls, and other communication channels.
- With Twilio's APIs, developers can add communication capabilities to their applications without needing to build the infrastructure to support them. Twilio handles everything from routing messages to managing the infrastructure.

Why Twilio is better than GSM?

- Customizability: Twilio allows developers to customize their messages with specific branding and formatting, including the ability to send MMS messages with images and videos.
- Programmability: Twilio allows developers to integrate SMS messaging into their applications using API, giving them more control over how the SMS messages is sent and received, as well as the ability to easily automate messaging tasks.
- Scalability: Twilio is built to handle large-scale messaging, enabling developers to send messages to millions of recipients at once with ease.

Working of Twilio API:

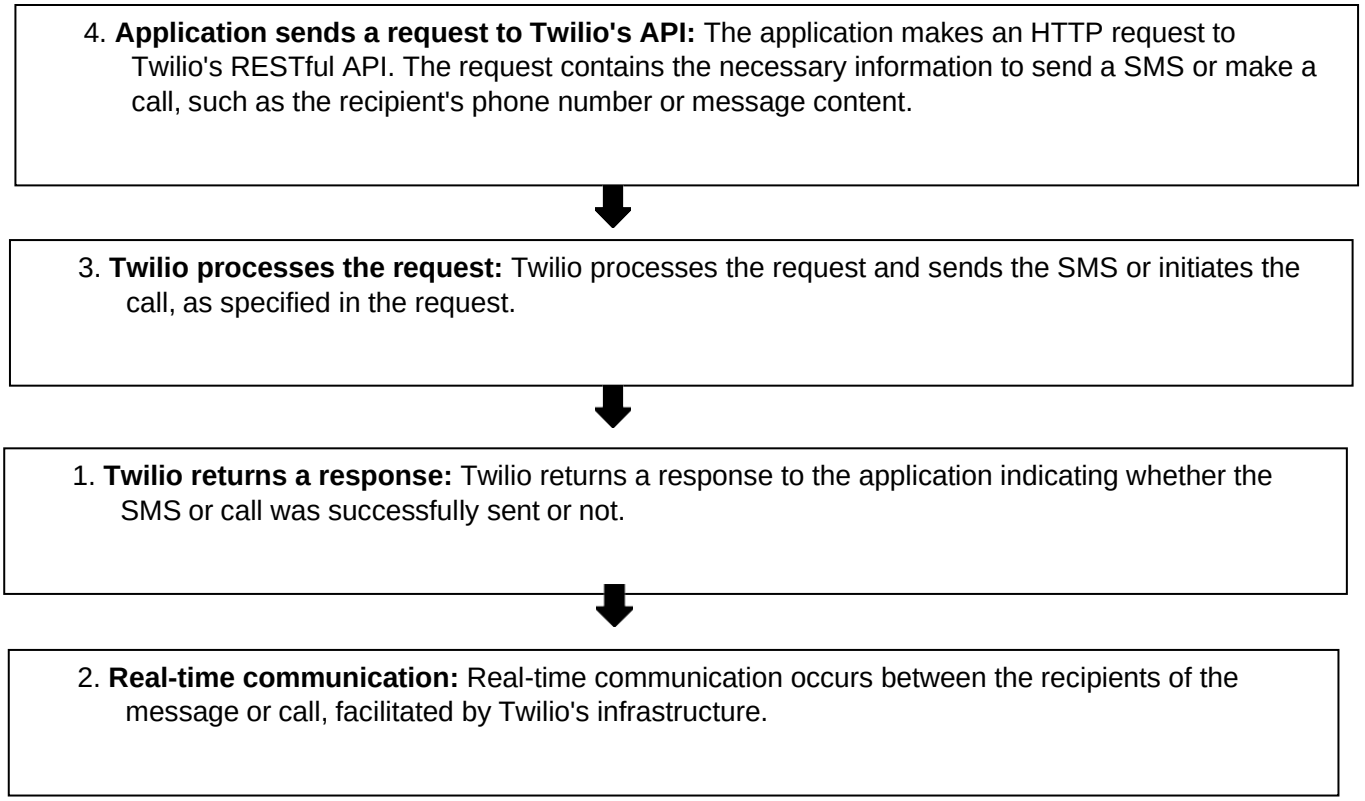


fig 13-GSM module working

How Twilio helped in this project?

- At the time of occurrence of an accident our ADXL Module will send a distress signal towards the GPS module.
- The GPS module further takes up this signal to find the present location and calculates the latitude and longitude of the crash site.
- This data is then sent into the Twilio API using internet that is provided by the GSM module.
- The Twilio API acts as a SMS service that collects the data send by GPS and send the crash site location with the necessary details to the nearby hospital.

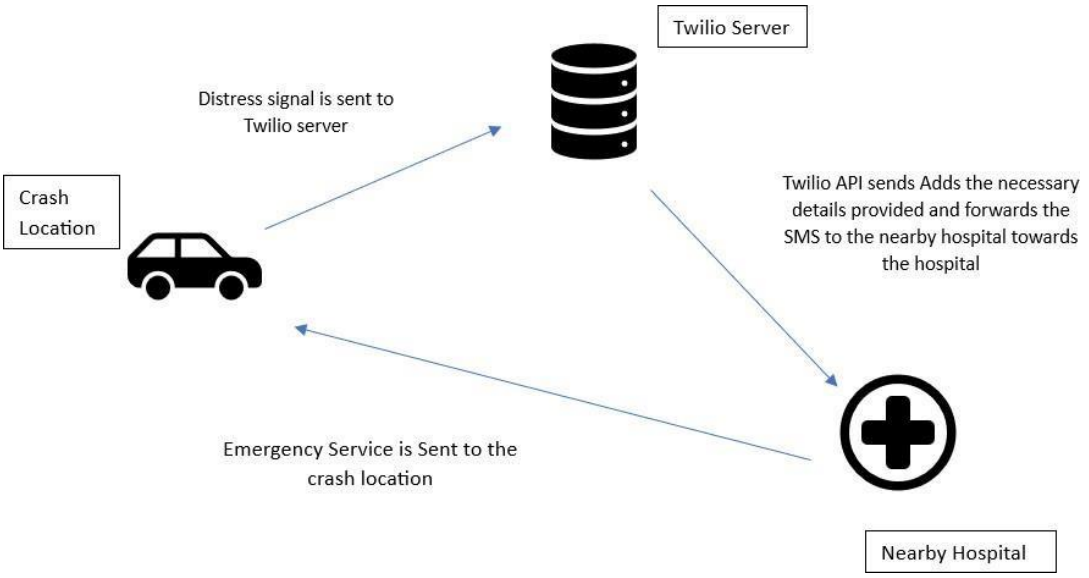


fig 14- Communication flow

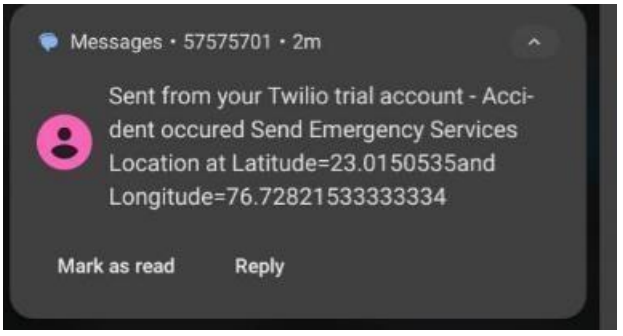


fig 15- Message sent to one of the members phone

4) Face recognition

- We have implemented the Face recognition by making use of the face recognition library in python as it is more efficient and fast.
- We tried to implement the face recognition using our own model as well as using VGG16 but the accuracy was little less.
- In this scenario's being fast and more accurate s more important as if not then may lead to a theft of car.

Working:

- The system captures or receives an **input image** or video frame containing one or more faces. Here we are capturing the input image using a Web camera.
- The input image is processed to detect the presence and location of faces within the image and this process is called **Face Detection.**
- The faces are processed to extract facial features that can uniquely represent each face. Deep learning-based models, such as convolutional neural networks (CNNs), are often used for this purpose. In our own model creation we have used **HaarCascade Classifier.**
- The face recognition library provides pre-trained models that can extract discriminative features from faces this process is called **Feature extraction.**
- A dataset is collected and stored in the local file system.
- Once the faces are stored in the local file system **Face matching** is done in order to match the faces.
- The faces are correctly detected and recognized.

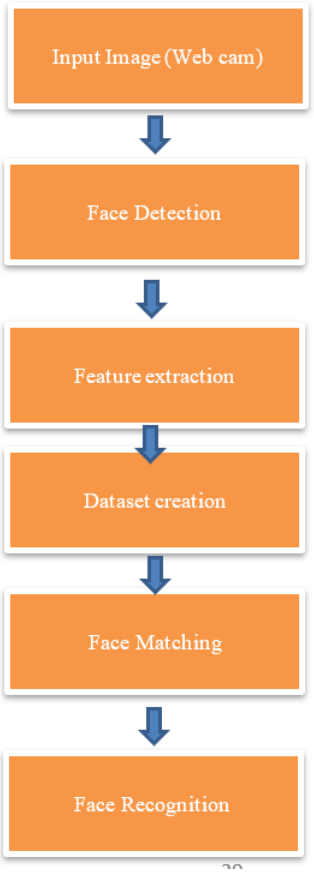


fig 16- Face recognition block diagram

Dataset:

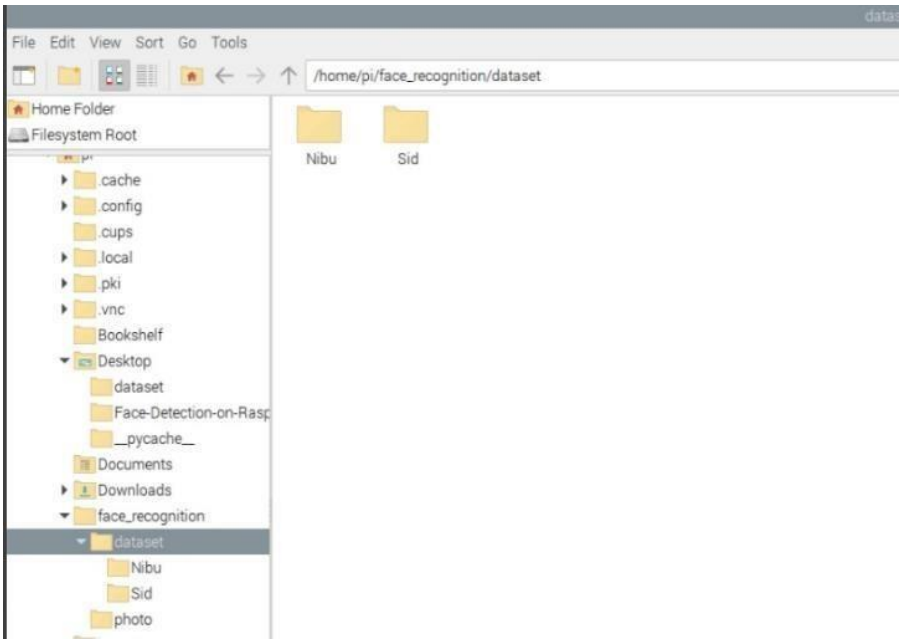


fig 18- Directories' inside the face recognition folder

fig 19- Images inside the folder

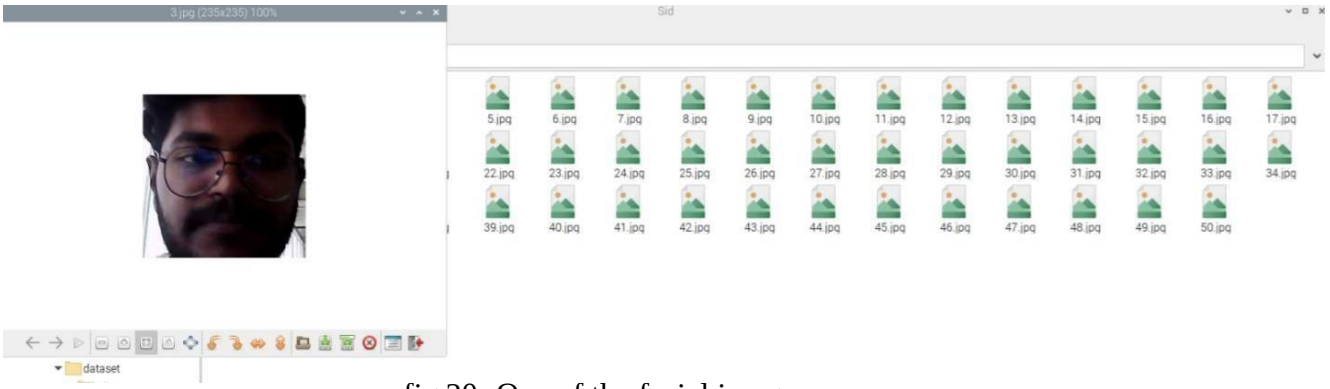


fig 20- One of the facial images

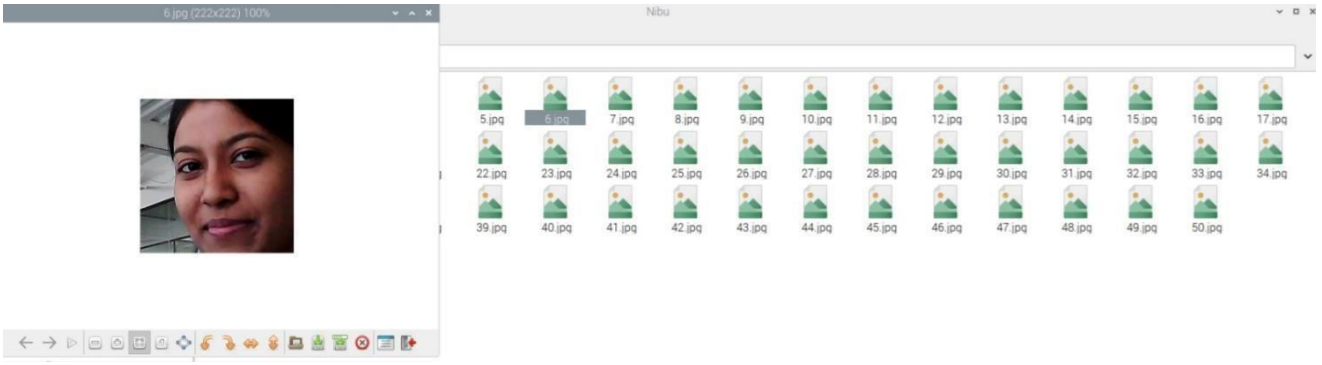


fig 21- One of the facial images

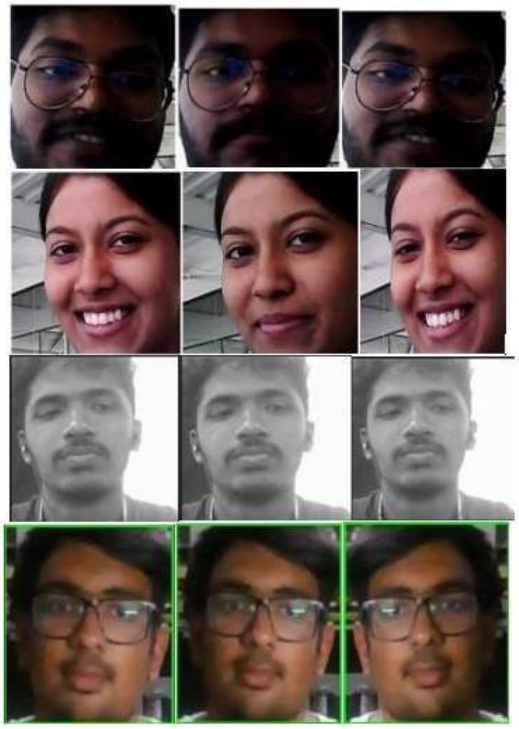


fig 21- Face dataset of different students

5) **Hardware Integration:**
   - The hardware was integrated and this are some of the clicks which we took while integrating the circuit.

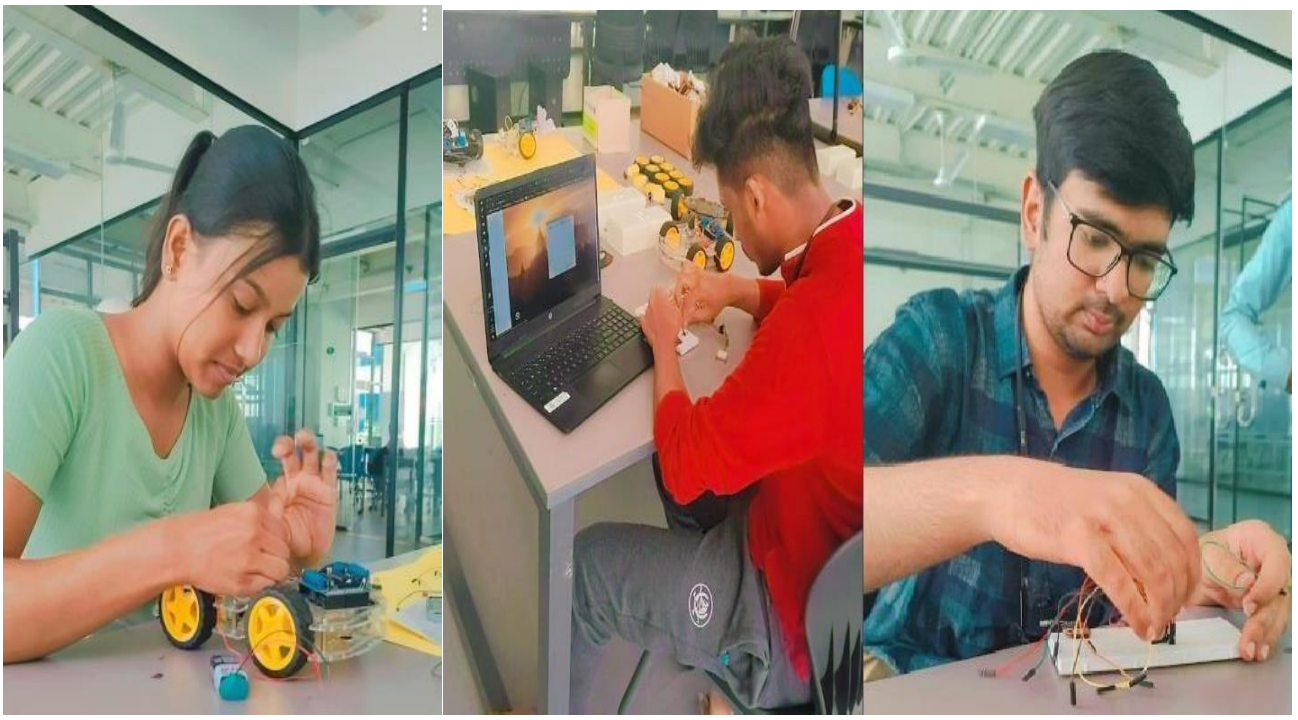


fig 22- Us working in the Lab

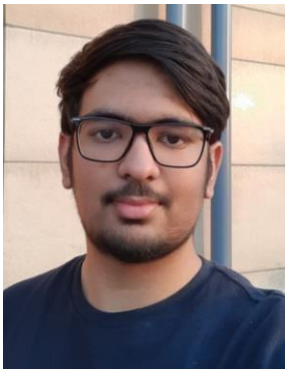
Individual Contribution

1) Anirudh Santhosh (20BAC10003)

In the project, I made significant contributions to both the software and hardware aspects, showcasing my versatile skills and expertise. On the hardware front, I played a crucial role in integrating the ADXL335 sensor, which facilitated accident detection by monitoring and analysing physical movements. Additionally, I successfully integrated and implemented the GPS module, enabling precise location tracking and data acquisition. Another noteworthy contribution of mine was in the domain of theft detection, particularly in the area of face recognition. By leveraging my knowledge and understanding of facial recognition algorithms, I contributed to the development and implementation of this security feature, enhancing the system's capability to identify unauthorized individuals. Throughout the project, my involvement spanned across various fields, demonstrating my holistic approach. I actively participated in debugging and troubleshooting diverse sets of code, ensuring smooth software operation. Moreover, I played a crucial role in the overall hardware integration, ensuring seamless coordination and functionality among different

components. Furthermore, I made valuable contributions to the research aspect of the project by actively engaging in the process of writing a report paper. Through meticulous analysis, critical thinking, and clear articulation, I provided valuable insights and information, enriching the scholarly output of the project. Overall, my contributions encompassed a wide range of responsibilities, including software development, hardware integration, debugging, report writing, and collaborative problem-solving. By actively participating in multiple aspects of the project, I significantly contributed to its success and accomplishment.

2) Yashraj Karwa (20BAC10006)



In the project, I played a crucial role in the integration of the ADXL335 sensor, which serves as a vital component in the implementation of accident detection. Through my expertise and efforts, I successfully integrated the ADXL335 sensor into the system, enabling the accurate monitoring and analysis of physical movements for detecting accidents. Moreover, I demonstrated my proficiency in circuit design and hardware integration. Through careful consideration of system requirements and functionality, I actively participated in designing the circuitry necessary for the project. Additionally, I made significant contributions to the creation of the project report. By actively participating in the report writing process, I ensured the documentation of project goals, methodologies, and outcomes in a comprehensive and organized manner. I contributed to both the software and hardware aspects of the project. On the software side, I actively collaborated in developing and optimizing software modules, ensuring their compatibility with the hardware components and overall system architecture. Simultaneously, I applied my technical expertise to assist in the hardware integration process, ensuring the seamless operation and synchronization of various hardware elements.

3) Nibedita Rakshit (20BAC10024)

In the project, I collaborated with a fellow team member and took a lead role in developing the face recognition component. Through our combined efforts and expertise, we successfully implemented the face recognition module, which played a critical role in the overall functionality of the project. This involved leveraging advanced algorithms and techniques to detect and identify individuals based on their facial features, enhancing the system's security and user identification capabilities.

Furthermore, I actively contributed to the creation of the project report. By working closely with the team, I participated in documenting the project's recognition component, I also played a key role in the simulation aspect of the GSM module. By utilizing simulation tools and techniques, I collaborated with the team to validate the functionality and performance of the GSM module within the project context. Moreover, I actively contributed to the simulation of the face recognition module. Overall, my contributions encompassed the development and implementation of the face recognition module, collaboration in report creation, and active participation in the simulation aspects of both the GSM module and face recognition component. By leveraging my technical skills and collaborative mindset, I played a significant role in the successful execution and documentation of these key project elements.

4) Anirudh J babu(20BAC10011)

In the project, I initially focused on integrating the GSM module into the system, recognizing its potential for fulfilling the project's communication requirements. However, as the project progressed and after careful evaluation, I discovered that the Twilio API offered greater accuracy and faster performance compared to the GSM module. Recognizing the importance of optimizing the system's functionality, I actively contributed to the transition from the GSM module to the Twilio API, ensuring seamless integration and improved communication capabilities. In addition to my involvement in the integration process, I played a vital role in the creation of the project report. Collaborating closely with the team, I actively participated in documenting and organizing project objectives, methodologies, results, and conclusions. Furthermore, I actively contributed to the hardware aspect of the project by assisting in circuit connections.

5) Jessica B Johny (20BAI10193)

In the project, I made valuable contributions to the simulation phase, focusing specifically on simulating the GSM module. Through my expertise and understanding of simulation techniques, I actively participated in creating a simulated environment to assess the performance and functionality of the GSM module within the project context.

Additionally, I played a collaborative role in assisting my colleagues with the face recognition component of the project. Furthermore, I played a vital role in the report writing process. Leveraging my communication skills and attention to detail, I actively contributed to the creation of a comprehensive and cohesive project report. Working closely with the team, I participated in documenting the project's objectives, methodologies, results, and conclusions in a clear and organized manner.

6) Sidharth ES (20MIP10015)

In the project, I made significant contributions to the software aspect, taking a crucial role in the integration of the GSM module. With my expertise in software development, I successfully led the integration process, ensuring the seamless incorporation of the GSM module into the system. This involved coordinating with team members, managing dependencies, and ensuring proper functionality and communication between the software and the GSM module. Furthermore, I played a crucial role in debugging the codebase. By carefully analysing and identifying issues, I actively contributed to the resolution of errors that arose during the development and testing phases. Through my systematic approach and attention to detail, I effectively pinpointed and addressed software-related issues, ensuring the smooth operation of the system.

Additionally, I collaborated closely with my colleague to integrate the GPS module into the project. By leveraging my software expertise, I actively participated in the integration process, working together to establish reliable GPS functionality within the system. This involved

implementing appropriate software interfaces, data parsing, and synchronization techniques to ensure accurate positioning and data acquisition.

7) **Sivaranjani D (20MEI10073)**

In the project, I collaborated closely with a team member to work on the GSM module integration and debugging tasks. Together, we tackled the challenges associated with integrating the GSM module into the system, ensuring its smooth operation and seamless communication with other components. By actively participating in the integration process, we effectively resolved any encountered errors, utilizing our combined expertise to debug and optimize the codebase. Through our collaborative efforts, we successfully addressed issues, ensuring the reliable functionality of the GSM module within the project.

Furthermore, I made valuable contributions to the creation of the project report. By actively participating in the report-making process. Additionally, I took the initiative in the initial installation of libraries on the Raspberry Pi. Recognizing the importance of a solid foundation, I proactively installed the required libraries and dependencies to support the project's software development. This involved conducting research, following installation procedures, and ensuring the compatibility and functionality of the libraries on the Raspberry Pi platform.

8) **Keerthi S (20MIM10066)**

In the project, I made significant contributions to the report-making process, ensuring the accurate documentation of project details, methodologies, and outcomes. By actively participating in the report creation, I collaborated with team members to organize and present the project's progress and findings in a clear and concise manner. Additionally, I played a key role in the initial installation of libraries on the Raspberry Pi. Understanding the importance of a solid software foundation, I actively contributed to setting up the necessary libraries and dependencies to support the project's development. Furthermore, I actively supported my team members in the initial setup of the project.

CONCLUSION

The project is done in order to reduce the number vehicle accidents, providing appropriate healthcare facilities as fast as possible. This project also focusses on detecting theft and providing the location of the vehicle so that the owner can track the vehicle easily. The overall project is focused on helping the community by saving there life and money. The community focused in this project are the common people owning automobile used for travelling. By the end of phase 2 we have successfully completed our project which is implemented in a miniaturized chassis.

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