**VISVESVARAYA TECHNOLOGICAL UNIVERSITY**

# RESCUE BEACON

**PROJECT REPORT**


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***of***

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**DEPARTMENT OF ELECTRONICS AND COMMUNICATION**

## CERTIFICATE

Certified that the project work titled **'RESCUE BEACON'** is carried out by **P BRUNDA YADAV (1RF22EC028), PAVITHRA S (1RF22EC029), ANUSHKA N S(1RF22EC006),** who are bonfire students of RV Institute of Technology and Management, Bangalore, in partial fulfillment for the award of degree of **Bachelor of Engineering** in **ELECTRONICS AND COMMUNICATION** of the Visvesvaraya Technological University, Belgaum during the year **2010-2011**. It is certified that all corrections/suggestions indicated for the internal Assessment have been incorporated in the report deposited in the departmental library. The project report has been approved as it satisfies the academic requirements in respect of project work prescribed by the institution for the said degree.

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## DECLARATION

We , **P BRUNDA YADAV (1RF22EC028), PAVITHRA S (1RF22EC029), ANUSHKA N S(1RF22EC006),** the students of fifth semester B.E., **Electronics and communication,** hereby declare that the project titled **'RESCUE BEACON'** has been carried out by us and submitted in partial fulfillment for the award of degree of Bachelor of Engineering in **ELECTRONICS AND COMMUNICATION** We do declare that this work is not carried out by any other students for the award of degree in any other branch.

**Place: Bangalore** **Signature**

**Date:19-12-2024**

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# ABSTRACT

Rescue Beacon is an emergency rescue system designed to provide real-time GPS tracking and communication in critical situations, ensuring rapid assistance to individuals in distress. The system integrates a GPS module for accurate location tracking and a communication module (GSM, LoRa, or Wi-Fi) to transmit location data to emergency services or designated contacts.

Designed for use in high-risk or remote environments, Rescue beacon aims to enhance safety by offering a user-triggered SOS feature that instantly sends distress signals along with real-time location information.

To ensure prolonged operation in the field, the system incorporates efficient power management techniques, utilizing a low-power microcontroller and optimized battery management systems. Optional environmental sensors, such as temperature or motion detectors, provide additional context to aid rescue teams in assessing the situation. The modular architecture allows flexibility in communication options, making the system adaptable to various terrains and network availabilities.

This paper details the system's design, hardware integration, software development, and testing, with a focus on power efficiency, communication reliability, and overall system robustness. Rescue beacon is an affordable, portable solution designed to improve rescue operations and enhance personal safety in emergency situations.


Keywords:Arduino Uno ,Gsim module,Neo 6 m module,Vc 02 voice recognition module.

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# CHAPTER 1: INTRODUCTION

RescueBeacon project arises from the growing need for reliable, real-time location tracking and communication in emergency situations, particularly in remote or hazardous environments.In emergency situations, quick and efficient communication is critical to saving lives.

The RescueBeacon system is a cutting-edge solution designed to enhance rescue operations by leveraging GPS technology for precise location tracking and transmission. This project aims to provide a reliable and scalable platform that can be deployed in various scenarios, ensuring rapid response and assistance when it matters most.

Emergencies can strike unexpectedly, often in situations where immediate action can mean the difference between life and death. Whether it's a natural disaster, a personal accident, or a lost individual in a remote area, rapid response and precise communication are critical. To address this need, RescueBeacon emerges as an innovative, technology-driven solution designed to revolutionize how we approach emergency rescue and safety.

RescueBeacon is a GPS-based emergency rescue system that focuses on real-time location tracking, communication, and alerting capabilities. It is engineered to ensure that individuals in distress can be quickly located and provided with assistance, even in the most challenging scenarios. By combining Global Positioning System (GPS) technology, wireless communication**,** and intelligent sensor integration, the RescueBeacon system is a reliable companion for outdoor adventurers, vulnerable individuals, disaster response teams, and beyond.

RescueBeacon is an innovative GPS-based emergency rescue system designed to ensure quick and efficient assistance in critical situations. It leverages real-time location tracking, wireless communication, and intelligent automation to provide accurate and timely alerts during emergencies. Whether it's a natural disaster, a personal health crisis, or an accident in remote areas, RescueBeacon enables individuals to share their location and trigger alerts manually or automatically. With features like voice activation, low-power operation, and seamless portability. By minimizing response times and enhancing rescue efficiency, RescueBeacon serves as a vital tool for saving lives and improving emergency response outcomes.

RescueBeacon is a cutting-edge GPS-based emergency rescue system designed to save lives by ensuring quick and efficient responses in critical situations. This innovative solution integrates advanced technologies like real-time GPS tracking, wireless communication, and intelligent sensors to detect emergencies and transmit precise location data to rescue teams or designated contacts. Whether in natural disasters, personal health crises, or accidents in remote areas.

Voice Recognition Module There are two types of voice recognition system one is speaker-dependent and another one is speaker-independent. Speaker-dependent systems are operated only by the person whose voice is trained in the system. Whereas, speaker independent systems can be operated for any person only the words are needed to be trained in the system . In our system, we have used voice recognition module v3 which is speaker-dependent device. This module can record maximum 80 voice commands, with each 1500 MS . Before using this module, the user needs to train his/her voices so that the device can recognize the voice of the user. We have trained our commands by using Arduino IDE software. Seven commands such as Forward, Reverse, Right, Left, Stop, Low, and High have been recorded in our system to achieve our target. The training can be done in any of the language that is comfortable for the user.

A microphone is connected with the voice recognition module. Microphone is used for collecting the audio signal of the user and converting that audio signal to the electrical signal. The electrical signal is then passed to the voice module. The voice module compares the received command to the trained command. If the command doesn’t match with the trained command, the wheelchair won’t activate.[1]

According to the Federal Emergency Management Agency (FEMA) in the Emergency Management Guide for Business and Industry (1993) [17], emergencies are all unplanned events that result in death or significant injury to workers or the surrounding community. Or it can be interpreted as an event that can kill a business, stop operational activities, physical or environmental damage and anything that could potentially suffer financial loss or a company’s reputation in the eyes of the public. The purpose of an industry using the Emergency Response Preparedness (ERP) program is to prevent emergencies that occur when they occur and protect workers and the surrounding community in a hazard and secure other areas from the spread of the effects of these sources of danger. In this study, researchers observed motorized vehicles that often have problems in the middle of a trip. With this system design, it is hoped that it can provide maximum service to customers who have problems with their vehicles in any location and even outside of office hours, they can still get the appropriate service. In addition, users such as technicians, spare parts shops, motor vehicle crane services and taxis can get additional income from this application. Where the price they offer will be more expensive than the usual service because they provide services outside office hours even late at night. It is hoped that this application can be of good use to all users involved in this application [2]

The application incorporates all the unique features such as real-time location tracking and integrate all the features offered by the existing system such as GPS tracking, SOS. The application requires an initial registration along with emergency contacts and the user is asked to update the emergency contacts from time to time. When the user is travelling from one place to another, the dynamic GPS tracking offered by PubNub's channel is turned on to view the user's location on a map. Users with the same app can monitor other users with this app through the dynamic GPS Tracking system through the PubNub channel. When the SOS button is pressed then an alert message which contains the name of the user, GPS Location and a help message is sent via SMS. The user has access to first-aid information and toll free helpline phone numbers. All the information and data is integrated with Firebase.

emergency Contacts. After the Login there is a Google map with various floating buttons with navigation enabled. When navigation is started the enlisted emergency contact users with the same app can monitor/track the users who are using this app through the dynamic GPS Tracking system/PubNub DataStream Network. When in distress the user needs to press the SOS button then an alert message which contains the name of the user, GPS Location and a help message is sent to the emergency contacts. The various functionalities offered are: Spy Camera, SOS, and First-aid Information in the form of a PDF, The user has an option of calling the toll free helpline numbers with the inbuilt phone application. Has a simple user interface such that women and senior citizens of all ages can use this app. The user can also upload the profile details along with the user's picture The system is taken from the existing systems and modified to suit the needs of the proposed application.

The purpose of this paper is to provide an app to help in tackling the attacks and molestations of women. Such kind of an app is needed because of the society we live in where crime against women is getting more and more difficult to curb. The app can only help in a little way in assuring women safety by which they feel safe & secure because they know for a fact that they are being monitored by their loved ones i.e. their emergency contacts. Ultimately the safety of all the women is assured only when the society and the surrounding communities pay heed to such crimes and educate the people by spread awareness.[3]

The main focus of this article is on GPS and GSM-based vehicle tracking systems. The process is divided into two main sections. The first section involves mastering the MPLAB programming language, which is crucial for controlling GPS and GSM functionalities. The second section includes designing the circuit program and incorporating essential hardware components like GPS and GSM modules to implement the Vehicle Tracking System. The primary goal of this article is to introduce a simple technology for the tracking system using both hardware and software.The essence of data communication in this system is facilitated by wireless communication control terminals, utilizing GSM Modules for the extensive and reliable transfer of long-distance data. These modules support AT commands for instruction. The Click GSM2 module can seamlessly integrate with a diverse range of applications. As an accessory for the form factor, Click GSM2 offers a compact and straightforward solution for incorporating a GSM module into designs. It operates within the frequency range of 850MHz, 900MHz, 1800MHz, up to 1900MHz, covering Quad-band frequencies. Figure 1 shows the front and rear of GSM Modem. The GPS2 Click is an additional board designed for a specific form factor. It comes with a Quested L30 GPS module and an SMA antenna connector. The module is equipped with an advanced jamming suppression mechanism and innovative RF architecture to provide optimum GPS performance. It can be used for location, navigation, and industrial purposes, such as autonomous GPS C/A, SBAS (WAAS or EGNOS), and A-PS. The board is intended for use with active antennas, and SMD jumpers are available in three groups to select between UART and I2C communication lines. Another SMD jumper is used to choose between 3.3V or 5V power supply. GPS Modem which can be used to check the vehicle's longitude and latitude. Additionally, the module supports autonomous GPS C/A, SBAS (WAAS or EGNOS), and A-GPS for location, navigation, and industrial applications. Power Supply is the device that transfers electric power from a source to a load using electronic circuits. Some of the requirements of power supplies are small size, lightweight, low cost, and high-power conversion efficiency. It is also possible to generate multiple voltages using linear power supplies. A single voltage must be converted into the required system voltages in a multi-output power supply. For example, +12V for input power supply from the source uses voltage regulator LM7805 converts to +5V, and LM317T of voltage regulator converts to +3.3V used for GPS and GSM modem.Liquid-crystal display (LCD) as shown in use to display the command that programming sent. Programmable Interface Controllers (PIC) has been programmed; re-power up the circuit. Many words will appear on the display. [4].

As urban congestion and emergency response demands escalate, the rapid transit of emergency vehicle (EV) becomes a focal point of research. In recent years, the advancement of Vehicle-to-Everything (V2X) technology introduces innovative solutions for prioritizing EV. V2X technology enables the realtime exchange of information among vehicles, including their location, speed, and other vital parameters, allowing social vehicles (SVs) to anticipate the arrival of EV and thereby efficiently clear the way. Strategies for electric vehicle (EV) passing has been investigated using the Cellular Automata (CA) model, which can simulate the intricate dynamics of road traffic.In light of this, the present study leverages the capability of vehicles in a V2X environment to access a broad range of real-time information, designing an innovative strategy for SVs to yield. This strategy enables SVs to change lanes immediately once conditions are met, thereby substantially enhancing the traffic efficiency of EV on the roads. This paper proposes an EV prioritization strategy based on V2X technology, which allows SVs to yield without stopping or waiting. Simulation results demonstrate that V2X technology enables SVs to respond swiftly and effectively to EV, significantly reducing their transit times. Additionally, the transit time for EV correlates with lane density. This study presents innovative approaches to accelerate urban emergency response and enhance cooperative driving among vehicles. In further research, we'll explore a wider range of metropolitan areas and challenging environmental circumstances.[5]

The quarantine wristband is a wearable device that monitors the location of the patient and alerts when the person moves out of the quarantined area. It also measures the heart rate, blood oxygen level, and temperature of the patient wearing the band. It alerts when the patient needs an emergency on pressing the emergency button or SOS button. Also detects any tamper in the wearable device. All these data are then displayed and can be accessed in the cloud using the open-source IoT platform. The health department can access it and take the necessary action for those in need. This device may help the government better monitor and manage the quarantine of people during the pandemic. Wearable devices assist the subject in quarantine to comply with medical regimens and limitations; hence, a wearable band would be a good solution in this situation. A quarantine wristband using IoT (internet of things), that would detect and track the quarantine subjects in real-time was thus developed. This allows a patient in isolation to monitor his or her own health while simultaneously being accessible to health authorities. OLEDs are used to create digital displays in devices. It was used to display the experiment's outcomes. OLED Display is an OLED monochrome 128x64 dot matrix display module with I2C Interface. OLED screens has an advantage of low power consumption. It is compatible with any kind of microcontroller having an operating voltage of around 5V. The Quarantine Wristband has a simple design that considers cost, global supply chain disruption, and other factors. The quarantine wristband with cloud-based monitoring system provides a scalable, low-cost solution for detecting and tracking absconding COVID-19 quarantine subjects in real-time. The various health monitoring features also helps us prioritize a safe and less risky quarantine period with constant help to the quarantined person from the authority. This kind of wristband can help the subject under quarantine monitor his/her health during the quarantine period. This method of analysis differs from the others in that it incorporates a self-monitoring mechanism. This wristband may be utilized by enclosing the component in a case which is water resistant and lightweight, so that it is simpler to wear as a wristband. Depending on the duration of the quarantine, as set by the concerned authority, the battery capacity could be chosen. The device can be powered by using a lithium-ion battery in case for a fixed period of use. We have used a USB battery or power bank to power up the quarantine wristband. The advantages of employing lithium-ion batteries to power the gadget are long shelf life, quick charging, and little maintenance. And also, it is non-hazardous. Last but not least, the casing covering the component should be lightweight, water resistant, and non-allergic in order to make the wearable comfortable enough to be worn over the wrist. This allows a patient in isolation to monitor his or her own health while simultaneously being accessible to health authorities. This Quarantine Wristband having a simple design was developed considering the cost, global supply chain disruption, and other factors. [6]

Empowering Women's Safety with a Raspberry Pi-based Device" is an innovative project aimed at combating violence against women by providing a wearable, multi-functional safety device. The device utilizes a Raspberry Pi Camera Rev 1.3 , GPS , push button, buzzer, and camera module to capture multiple images and send emails to the nearest police station in case of an emergency. The device is designed to be embedded in women's clothing, making it easy to carry and use in case of danger. The software code is specifically designed to provide a one-click protocol, enabling quick and efficient activation of the device. The project's main objective is to provide women with an effective tool to enhance their safety, especially in situations where they might feel threatened or unsafe. The implementation leverages email as the primary means of communication, enabling the transmission of captured images and location data. The use of photos serves to provide visual evidence for authorities, aiding in the response to the emergency. The Raspberry Pi's compact nature allows for easy embedding within clothing, while the push button ensures straightforward activation when needed. This implementation underscores the device's efficiency and user-friendliness in enhancing personal safety and security. The results of this safety device project are indeed very promising. By utilizing the Raspberry Pi Camera module Ver 1.3 as the core component, the device gains access to robust processing capabilities, all within a compact form factor and at a low cost. This affordability ensures that the device is accessible to a wide range of users, including hobbyists, students, and professionals, who can benefit from the extensive support provided by the large and active Raspberry Pi community. The device's versatility extends its application potential, encompassing fields such as robotics, IoT, and media centers. The integration of the Raspberry Pi Camera module Ver 1.3 into the safety device significantly enhances its capabilities, offering highquality images and a video feed that can be employed for surveillance and monitoring purposes. Furthermore, the inclusion of SMTP and MIME protocols in the device's design facilitates secure and efficient communication of images and alerts to the nearest police station. With further refinement and development, this safety device has the potential to play a crucial role in preventing and addressing incidents of harassment and violence, ultimately contributing to a safer society.[7]

Internet of Things points to expanding network of physical objects. Here, the data accumulation is done by the usage of sophisticated sensors, which communicates with each other and stores the data in cloud. IoT is transforming the way people communicate, work and live. It has been integrated in our everyday life starting from smart home devices to medical industries. In this paper, we have aimed to provide a review of different types of IoT based health monitoring devices proposed by researchers and how they are monitoring specific diseases. Such devices are categorized based on their types and comparison has been made based on available features. The following paper will focus on different wearable health devices; their operations, limitations and challenges. Moreover, an application on how these devices could be used for emergency situations has also been discussed. It will help future researchers to have an overview on the recent advancements in health care monitoring system. The number of nodes connected to the internet are increasing day by day and this burst amount of connections give rise to an emerging technology named as Internet of Things (IoT). It is consisting of smart devices connected to internet and embedded with processors and sensors. These sensors collect the data and send to the remote server or cloud where collected data will be analyzed. Some of the applications of this technology includes: smart transportation system, smart home, smart city, medical services etc. We have seen significant amount of changes in medical sector around the last decade. Such smart devices can be used for medical diagnosis purposes like cardiac arrhythmia, coronary heart diseases and many more. Patients can continuously monitor electrocardiogram (ECG) reading through these wireless devices. Further research on this technology will give us an idea of several wearable devices such as wearable patch, wristband, Smart clothe etc. These devices can monitor heart rate, electrical pulse condition, diagnosis of different physical illness like CVD and other chronic diseases. For monitoring purposes, the extracted data needs to be stored in the server. Wearable electrodes are being embedded in textile fabric. Here the fibers must be electrically conductive. Also, they are capable of storing data in cloud storage. The device is work worthy when we attach this anywhere with our wearing clothe. This paper aimed to provide a review on different types of IoT based health monitoring devices proposed by researchers and how they are monitoring specific diseases. Such devices are categorized based on their types and comparison has been made based on available features. Furthermore, an overview of the use of pulse rate sensor and Lm35 has also been included in this paper. Time and resources are being invested to bring effective devices which will reshape the medical healthcare industry. It has been integrated in our everyday life starting from smart home devices to medical industries. In this paper, we have aimed to provide a review of different types of IoT based health monitoring devices proposed by researchers and how they are monitoring specific diseases. Such devices are categorized based on their types and comparison has been made based on available features. The following paper will focus on different wearable health devices; their operations, limitations and challenges. Moreover, an application on how these devices could be used for emergency situations has also been discussed. It will help future researchers to have an overview on the recent advancements in health care monitoring system.[8]

To address the issue of emergency vehicle delays in congested urban areas, this paper proposes a novel priority strategy for emergency vehicles based on the V2X environment. Implemented within a newly developed dual-lane cellular automaton model featuring emergency vehicles, this strategy leverages real-time information acquisition to allow civilian vehicles to change lanes immediately when conditions permit, significantly reducing travel time for emergency vehicles and minimizing the impact on social vehicles traffic speed. Simulation results confirm that this strategy substantially enhances the efficiency of emergency vehicle operations in urban areas, paving the way for future advancements in urban traffic management and emergency response optimization. In summary, current research on priority strategies for EV lanes requires that SVs wait until all conditions for yielding are met before they can change lanes or stop. These strategies often involve lengthy implementation periods and significantly impact the driving speed of SVs. In light of this, the present study leverages the capability of vehicles in a V2X environment to access a broad range of real-time information, designing an innovative strategy for SVs to yield. This strategy enables SVs to change lanes immediately once conditions are met, thereby substantially enhancing the traffic efficiency of EV on the roads. Based on their proximity to EV, SVs are classified into three types: those outside the influence zone, those within the same lane's influence zone, and those within a different lane's influence zone. Vehicles outside the influence zone, including those far ahead or behind the EV, move independently of the EV and update their speed and position according to the fundamental update mechanism. EV also adheres to the fundamental update mechanism, with the exception of the random deceleration mechanism. The driving rules for the remaining vehicles are as follows. This paper proposes an EV prioritization strategy based on V2X technology, which allows SVs to yield without stopping or waiting. Simulation results demonstrate that V2X technology enables SVs to respond swiftly and effectively to EV, significantly reducing their transit times. Additionally, the transit time for EV correlates with lane density. This study presents innovative approaches to accelerate urban emergency response and enhance cooperative driving among vehicles. In further research, we'll explore a wider range of metropolitan areas and challenging environmental circumstances.[9]

# CHAPTER 2: THEORY AND FUNDAMENTALS OF AREA RELATED TO PROBLEM STATEMENT

There have been significant previous works closely related to GPS-only localization and its improvements for better accuracy and resilience. In this section, we review the previous works and highlight our approach compared to them.

2.1 GPS-ONLY LOCALIZATION:

Location estimation using only GPS data is often the first and initial setting adopted by many products and solutions due to its simplicity. As mentioned in Section I, there have been numerous works incorporating additional sensors and prior information to improve GPS-based localization. However, in the absence of additional sensors and prior information, GPS-only localization has been investigated to compensate for its shortcomings. The first approach pursues improvements in GPS hardware and signal processing. COIN-GPS adopted a directional antenna for indoor coverage and availability. The nonline-of-sight (shortly NLOS) effect was modelled to reduce pseudo-range error in urban canyons. The multipath effect, a well-known challenge in GPS signal processing, has been extensively studied. Recently, random forest regression was utilized to mitigate the multipath effect by filtering out reflected signal components. The second approach aims to enhance localization algorithms using raw GPS data. The factor graph optimization with GPS pseudo-ranges and RTK data (carrier phase and Doppler velocity measurements) was also proposed to improve positioning accuracy. Similarly, relative GPS positions were estimated by the graph optimization additionally with Time-Relative RTK-GNSS factors for loop closure. Learning-based methods have been employed to improve GPS-only localization. Kanhere et al. used the set transformer encoder-decoder architecture with LOS vectors and pseudo-range residual as features. Mohanty and Gao integrated a graph neural network and a learnable Kalman filter with various features such as LOS vectors, pseudo range residual/uncertainty, and C/N0 values. PR Net proposed a satellite-wise multilayer perceptron to regress pseudo range error using Android raw GNSS measurements. Position Net trained neural residual maps to cope with urban canyons. The third approach utilizes only GPS position data (in the form of longitude, latitude, and altitude) available in any GPS system. This approach is considered as position-only localization, distinguishing it from range-only and bearing only localization. Position data can be obtained not only from GPS systems but also from other sensors such as radio beacons, RADAR, and LiDAR. Position-only localization has been extensively studied as a part of (multiple) target tracking. Bayesian filtering has been widely employed in position-only localization. As examples of position-only localization with GPS, Aloi and Korniyenko compared the position accuracy of two different filters: a double exponential filter and a Kalman filter. In their evaluation, the two methods demonstrated similar accuracy with their synthetic data, but their modified double exponential filter had significantly better accuracy with their real dataset. In the framework of EKF localization, Choi and Kim revealed that position data from an off-centred GPS could improve position and orientation accuracy mathematically and experimentally.Further investigated an interacting multiple model (shortly IMM) filter, which incorporates multiple motion models and state representations. Our Approach: In this paper, we focus on the third approach because raw GPS data are sometimes not available in low-cost GPS systems (e.g. Ascen Korea GPS620 used in the ETRI Deep Guider dataset). We aim for position-only localization applicable to all GPS systems from consumer-grade GPS to more advanced GPS. Specifically, we improve the accuracy of position-only localization with Bayesian filtering and two velocity constraints.

## 2.2 HANDLING GPS OUTLIERS:

Sometimes, GPS data can be substantially corrupted due to its inherent limitation as a radio-based localization system. When the multipath phenomenon is severe (e.g. in urban canyons), its GPS position becomes highly inaccurate, exhibiting large bias errors. Such inaccurate GPS data can be considered as outliers, which may cause degeneration in localization algorithms. There have been many works related to outlier detection and rejection. In conjunction with Bayesian filtering, the Mahala Nobis distance has been commonly utilized as a probabilistic distance measure considering the state covariance. For example, Chae et al. rejected highly inaccurate GPS observation using the Mahala Nobis distance and predefined thresholds. In nonlinear optimization, robust kernels (also known as robust loss functions) can be employed to mitigate the influence of outliers by assigning lower weights to them. For example, Ch'ng et at. utilized the M-estimator with the Cauchy kernel for their GPS/INS fusion. Fake GPS data generated by GPS spoofing attacks can be considered similar to outliers. To detect the fake GPS data, Zhou et al exploited the velocity consistency from two different sources: Doppler measurements and pseudo-ranges. Our Approach: In this paper, we point out that GPS-only localization can fall into degeneracy (or ambiguity) not only due to outliers but also due to normal data as demonstrated in Section IV. We do not tackle outlier detection and rejection as explored in the above previous works. Instead, we aim to enhance the resilience of GPS-only localization with two velocity constraints by recovering from degenerated (or ambiguous) states.

A constraint can be useful in solving a problem because it restricts the solution space. That’s why a constraint is sometimes referred to as prior knowledge. A motion model describes how a target object is expected to move over time and may contain specific kinematic or dynamic constraints that are beneficial for target tracking and localization. Explored four combinations of different motion constraints (constant speed and constant turn rate) and their representations in two coordinate systems (polar and Cartesian coordinates) for target tracking. They showed that their four combinations exhibited varying performances in different trajectories according to their constraints. They incorporated the four combinations into an IMM filter and demonstrated the best accuracy in various synthetic and real datasets. Westny .examined a range of motion models (from pure integrators to kinematic models and neural ODEs) for trajectory prediction using their graph neural networks. They found that a simple constant velocity model (denoted as 1XI in their notation) yielded the best result in the public highway and roundabout datasets. Choi, improved heading estimation using the average of two velocities derived by GPS and INS, respectively. Bayesian filtering can be incorporated with a constraint. The smooth variable structure filter (shortly SVSF). is a novel filtering technique based on the Kalman filter and sliding mode concept. The SVSF can yield smoother estimates within its smoothing boundary layer by applying a saturation function to innovation residuals of observations. The SVSF has been applied to numerous applications and enhanced through various variants proposed Tanh-SVSF, utilizing the hyperbolic tangent function as a new saturation function for better chattering suppression. They applied their Tanh-SVSF to the target tracking under model uncertainty and presented better accuracy than the original SVSF. Akhtar combined multiple filters (EKF, unscented Kalman filter (UKF), cubature Kalman filters (CKF), and SVSFs) and achieved better accuracy in target tracking .

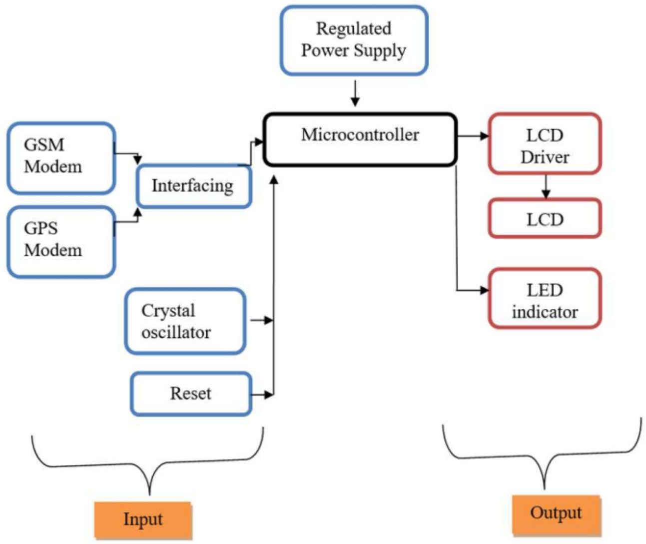

Figure 2.1 Overview of a system

GPS-only localization can utilize only position measurements, so it inherently suffers from ambiguities in its state variables. These ambiguities arise from unobserved state variables and their mutual entanglements. Even though GPS-only localization initializes with the good state variables, it frequently becomes trapped in these ambiguities and is not recovered. Highly noisy GPS measurements (so-called as outliers) are a representative example of contaminating the state variables. The degenerated state variables are not recovered even though GPS measurements return to normal with small noise. From our observation, the state variables can fall into the ambiguities without outliers when a vehicle undergoes abrupt movements (e.g. urgent heading change and sudden stop). This is because such abrupt movements result in significant changes in linear and angular velocity, thereby violating the above assumption of the CV model (zero acceleration).

The Arduino Nano is a compact, feature-rich, and breadboard-friendly board based on the ATmega328 microcontroller [5]. It has a similar set of features as the Arduino Demaline, but in a different packaging. It only has a DC power jack and uses a Mini-B USB cord rather than a conventional USB cable. This microcontroller has an operating voltage of 5V. That means the input voltage can be between 7V and 12V.The input voltage shouldn't exceed 20V as it may damage the device. The microcontroller has 14 I/O digital pins and 8 analog input pins. A current of 40mA flows per I/O pin. And has a flash memory of 32KB to store data even when the power is off. The microcontroller operates with a clock speed of 16MHz. NEO-6M GPS Module can track up to 22 satellites on 50 channels. This gps module achieves the industry's highest level of sensitivity i.e., -161 dB tracking, while consuming only 45mA supply current. A u-blox NEO-6M

GPS chip is present at the core of the module. The chip size is compact and functions well. The chip's Power Save Mode is one of its greatest features (PSM). The systems power usage can be reduced by selectively switching sections of the receiver ON and OFF. This feature utilised in power-constrained applications such as GPS wristwatches with decreased power consumption. The module has a default baud rate of 9600.

2.3 GPS NOISE AND FREQUENCY:

We examined the effect of GPS noise and acquisition frequency on two velocity constraints. We performed experiments in all combinations of GPS noises (0.1, 0.2, 0.5, 1, 2, and 5 meters) and acquisition frequencies (1, 2, 5, and 10 Hz). These configurations spanned from highly accurate and responsive RTK-GPS systems to inaccurate and slow consumer-grade GPS systems. Each combination included 400 trials in total (100 times trials for each of the four trajectories). Present four error criteria without and with outliers, respectively. It was natural that higher GPS noise and less frequent GPS data (at the top-right) derived larger errors. Table 2 and 3 are located at the top-middle ($\sigma G$ = 0.5 meters and 1 Hz). Firstly, we could find an important characteristic of the proposed method: its effectiveness was more relevant in more challenging situations (higher noise and less frequent data). The accuracy differences shown in the last row of Figure 13 indicate blue-coloured improvements at the top-right. Such more difficult situations correspond to consumer-grade GPS systems. A system is a collection of people who cooperate with each other by means of systematic and structured rules to create a single unit that performs a function to achieve goals. Information Whereas information is data that is processed to be more useful and meaningful for the recipient, as well as to reduce uncertainty in the decision-making process regarding a situation. Mobile Applications are software applications made specifically to run on tablets as well as smartphones. At this time, on smartphones and tablets, there is one application that is useful for providing several kinds of applications that run on these devices. This application is often called a store. Examples of stores are the apple apps store and google play store. Service is something that is intangible, which involves action or performance through processes and performance, which is offered by one party to another. In its production, services can and may not be tied to a physical product.

This ADPLL consists of a reference phase accumulator (RPA), a proportional-integral (PI) filter, a digital controlled oscillator (DCO), and a variable phase accumulator (VPA). The RPA is used to accumulate the reference phase ' relatively, the VPA accumulates the phase of DCO output. The

DCO is controlled by the digital signals to generate output with different frequencies. Besides, a PI filter is adopted to ensure the loop stability, and improve the output phase noise of ADPLL. The VPA is composed of two parts, one is a counter to accumulate the positive edge of the DCO output, and the other is a time to digital converter (TDC), which is used to calculate the time difference between the positive edges of the DCO output and reference. The Arduino Nano is a compact, feature-rich, and breadboard-friendly board based on the ATmega328 microcontroller. It has a similar set of features as the Arduino Demilune, but in a different packaging. It only has a DC power jack and uses a Mini-B USB cord rather than a conventional USB cable. This microcontroller has an operating voltage of 5V. That means the input voltage can be between 7V and 12V.The input voltage shouldn't exceed 20V as it may damage the device. The microcontroller has 14 I/O digital pins and 8 analog input pins. A current of 40mA flows per I/O pin. And has a flash memory of 32KB to store data even when the power is off. The microcontroller operates with a clock speed of 16MHz. NEO-6M GPS Module can track up to 22 satellites on 50 channels. This gps module achieves the industry's highest level of sensitivity i.e., -161 dB tracking, while consuming only 45mA supply current. A u-box NEO-6M GPS chip is present at the core of the module. The chip size is compact and functions well. The chip's Power Save Mode is one of its greatest features (PSM). The systems power usage can be reduced by selectively switching sections of the receiver ON and OFF. This feature utilised in power-constrained applications such as GPS wristwatches with decreased power consumption. The module has a default baud rate of 9600. It has an operating voltage from 2.7v to 3.6v.

GPS transfer plays a critical role in solving various real-world problems that require accurate positioning and location data. In navigation and route planning, GPS helps drivers, pilots, and sailors determine the most efficient routes by providing real-time location and transferring route information through applications like Google Maps. In vehicle and fleet tracking, GPS devices installed in vehicles transmit location data to managers, enabling efficient logistics, route optimization, and theft prevention. GPS is also vital in emergency response and search and rescue operations, where location data from GPS-enabled devices helps emergency services quickly locate individuals during accidents, natural disasters, or in remote areas. In precision agriculture, GPS is used to optimize land usage by guiding machinery for planting, irrigation, and harvesting, thereby improving crop yields. Similarly, GPS transfer is used in wildlife tracking to monitor animal movements for conservation purposes and in sports and fitness applications where athletes track their routes and performance. By transferring accurate location data, GPS technology provides practical solutions to navigation, tracking, safety, and resource management challenges across various industries.

The theory and fundamentals of area are crucial concepts in mathematics and its applications, involving the quantification of the space enclosed within two-dimensional boundaries. Area is defined as the measure of the extent of a flat surface, expressed in square units such as square meters ($m^2$), square centimetres ($cm^2$), or square feet ($ft^2$). The calculation of area depends on the shape and dimensions of the object. For basic geometric shapes, specific formulas are applied: for rectangles and squares, the area is calculated by multiplying length and width, while for triangles, while irregular shapes may require the use of calculus or approximation methods, like dividing them into smaller known shapes. The importance of understanding area extends to various fields, including construction, architecture, agriculture, and engineering, where precise measurements are critical for planning and resource allocation. For example, in construction, calculating the area of floors, walls, and ceilings helps determine the materials needed, such as tiles or paint. In agriculture, farmers calculate the area of land to estimate crop yields or irrigation requirements. Moreover, in real-world problem-solving, area calculations are integrated into optimization problems, such as minimizing material usage while maximizing usable space.Beyond geometry, area is fundamental in higher-level mathematics, particularly in calculus, where it is used to find the area under curves using integral techniques. Additionally, modern applications, such as computer graphics, machine learning, and geographic mapping, rely heavily on area-related computations. Thus, understanding the theory of area equips individuals with the tools to approach problem statements analytically, enabling accurate decision-making and efficient solutions across various domains.

Starting from motorized vehicle users who experience problems with their vehicles in the middle of the road and outside office hours, where it is not easy to find the closest technician and repair shop and provide services outside working hours, especially on holidays and holidays. It may happen that a technician may come but the damage causes the vehicle to be towed where it requires a car crane service, besides that there can also be damage to a motorized vehicle that requires replacement of spare parts and also while the vehicle must be towed to the workshop, vehicle users can be escorted by two-wheeled or four-wheeled transportation to go home or to the nearest hotel so as to provide a solution and start to finish. What is meant by an integrated system here is that motor vehicle technicians, workshop owners, spare part owners, motorized vehicle crane services and taxis participate in an integrated system, and they register in this system including providing their availability data to provide services outside working hours including holidays and holidays. In addition to providing time availability, they also have to provide their stand-by position at that time so that the system will be able to seek assistance from the closest location to problematic vehicle users. In conventional RF transmitter, the reference clock is generated by an off-chip crystal. Despite of its good performance; the off-chip crystal is too expensive for consumer electronics. Besides, its large size is not acceptable in compact systems, especially portable devices. In our SOS system, an on-chip oscillator is adopted to reduce device area and cost. Shows the simplified schematic of the on-chip RC oscillator, consisting of a charge pump (CP) and a voltage hysteresis comparator. The comparator is used to compare the voltage difference between reference and the output voltage of CP. The result of this comparison controls the CP to charge or discharge the capacitor periodically; hence an output with an accurate frequency is produced. GPS is the most popular sensor for outdoor localization. GPS-only localization is the simplest and initial setting; thus, it has been employed in many applications. This paper presents more accurate GPS-only localization with two velocity constraints based on Bayesian filtering. GPS-only localization inherently suffers from ambiguity problems in its state variables due to the limitation of position-only observations. These ambiguities lead to incorrect or diverged state estimates, which are commonly observed in cases of violating assumptions in motion and observation models. Since two proposed velocity constraints can resolve the ambiguity problems, EKF localization with two additional constraints can achieve more accurate localization and demonstrate better recovery from broken state estimates. We quantitatively validated such improvements in localization accuracy and recovery using synthetic data with various GPS trajectories and configurations. Experimentally, the constant velocity model with two velocity constraints exhibited around 25% less position error and 70% less orientation error on average compared to the original constant velocity model. We also qualitatively observed similar results with two real-world datasets. In our experiments with real-world datasets, two velocity constraints successfully resolved state ambiguities after abrupt motion and severely incorrect GPS measurements.

GPS transfer plays a critical role in solving various real-world problems that require accurate positioning and location data. In navigation and route planning, GPS helps drivers, pilots, and sailors determine the most efficient routes by providing real-time location and transferring route information through applications like Google Maps. In vehicle and fleet tracking, GPS devices installed in vehicles transmit location data to managers, enabling efficient logistics, route optimization, and theft prevention. GPS is also vital in emergency response and search and rescue operations, where location data from GPS-enabled devices helps emergency services quickly locate individuals during accidents, natural disasters, or in remote areas. In precision agriculture, GPS is used to optimize land usage by guiding machinery for planting, irrigation, and harvesting, thereby improving crop yields. Similarly, GPS transfer is used in wildlife tracking to monitor animal movements for conservation purposes and in sports and fitness applications where athletes track their routes and performance. By transferring accurate location data, GPS technology provides practical solutions to navigation, tracking, safety, and resource management challenges across various industries. GPS transfer is a powerful technology used to solve a wide range of problems that require precise positioning, navigation, and real-time location sharing across multiple industries. In navigation and route planning, GPS allows users to determine their current location and plan optimal routes for travel. Applications like Google Maps, Waze, and car navigation systems rely on GPS signals to transfer real-time traffic data, suggest alternative routes, and estimate arrival times, benefiting drivers, pilots, and sailors. In vehicle and fleet tracking, GPS devices installed in vehicles send continuous location data through cellular networks or satellites to centralized systems, helping companies monitor logistics, improve delivery efficiency, reduce fuel costs, and prevent theft.

In emergency response and search-and-rescue operations, GPS-enabled devices play a crucial role in saving lives by transmitting precise location data to emergency services, enabling quick assistance during accidents, natural disasters, or for individuals stranded in remote or hazardous areas. GPS is widely applied in precision agriculture, where farmers use GPS-guided equipment to optimize crop planting, irrigation, and harvesting. Transferring GPS data to software systems helps reduce waste, increase productivity, and monitor large fields efficiently.

Furthermore, wildlife tracking uses GPS to monitor animal movements for conservation purposes, helping researchers study migration patterns and protect endangered species. In construction and surveying, GPS allows engineers to measure and transfer location data to ensure accurate site planning, equipment placement, and mapping of infrastructure projects. Fitness and sports applications also rely on GPS technology for tracking routes, speed, and performance during activities like running, cycling, and hiking.

In marine and aviation industries, GPS transfer provides critical data for navigation, collision avoidance, and safe travel through air and sea routes, even in adverse weather conditions. Additionally, GPS is integral to geolocation services in IoT devices, enabling real-time tracking for applications such as smart wearables, pet tracking, and asset monitoring. Disaster management also benefits from GPS technology by enabling authorities to map affected areas, coordinate relief efforts, and transfer location data for search missions. Overall, GPS transfer has become a cornerstone for solving complex problems related to navigation, safety, resource optimization, and environmental monitoring, offering immense value in industries such as transportation, agriculture, construction, healthcare, and beyond.

GPS operates by transferring satellite data to a GPS receiver, which calculates the user's position through trilateration and transmits that information for analysis or display. This capability addresses numerous problems across industries and applications.

One major problem solved by GPS transfer is accurate navigation and positioning. Before GPS, navigating unfamiliar territories or vast oceans relied on imprecise maps or manual calculations. GPS systems solve this by providing accurate, real-time location data to users, enabling them to find optimal routes, avoid traffic congestion, and predict travel times. This is widely used in personal devices, vehicle navigation systems, aviation, and maritime operations.Another key problem addressed is asset tracking and management. GPS transfer allows businesses to monitor vehicles, machinery, or goods in transit by continuously sending location data to central servers. This has revolutionized logistics and supply chain management, ensuring timely deliveries, optimizing routes, and reducing operational costs. For example, fleet managers use GPS trackers to oversee delivery trucks and avoid delays, while shipping companies use GPS to track cargo vessels.

In emergency response and public safety, GPS transfer is used to quickly locate individuals in need of assistance. For instance, during natural disasters, GPS-enabled devices help emergency services identify the precise locations of victims or stranded individuals. In law enforcement, GPS tracking is used to monitor suspects, trace stolen vehicles, or coordinate rescue missions in hazardous environments like forests, mountains, or oceans.

Environmental monitoring and wildlife conservation also heavily rely on GPS transfer. Researchers attach GPS-enabled collars to animals to monitor migration patterns, study behavior, and protect endangered species. GPS data is also used to map deforestation, track wildfires, and study climate change impacts by transferring geospatial information to central systems.

In agriculture, GPS transfer solves problems related to resource optimization and large-scale land management. Precision agriculture uses GPS to guide tractors and irrigation systems, ensuring accurate planting, fertilization, and harvesting. This minimizes resource wastage and increases crop yields.

In the construction and surveying industry, GPS transfer plays a crucial role in mapping and measuring land, ensuring accurate placement of structures, and enabling automated machinery to operate within defined boundaries. Surveyors use GPS to transfer location data to computer systems for site planning and infrastructure development.

GPS transfer also addresses problems in disaster management and recovery. In scenarios like earthquakes, hurricanes, or floods, GPS-enabled systems provide real-time mapping of affected areas, allowing authorities to plan and coordinate relief operations efficiently. Similarly, GPS transfer aids in time synchronization, where precise timing data is critical for applications like power grid operations, telecommunications, and financial systems.

In summary, the theory of GPS transfer enables solutions to problems in navigation, tracking, resource management, safety, and environmental conservation by accurately transmitting location data across systems. This ability to share real-time geospatial and temporal information has transformed industries, improving efficiency, safety, and decision-making processes worldwide.

In emergency response and search-and-rescue operations, GPS-enabled devices play a crucial role in saving lives by transmitting precise location data to emergency services, enabling quick assistance during accidents, natural disasters, or for individuals stranded in remote or hazardous areas. GPS is widely applied in precision agriculture, where farmers use GPS-guided equipment to optimize crop planting, irrigation, and harvesting. Transferring GPS data to software systems helps reduce waste, increase productivity, and monitor large fields efficiently.

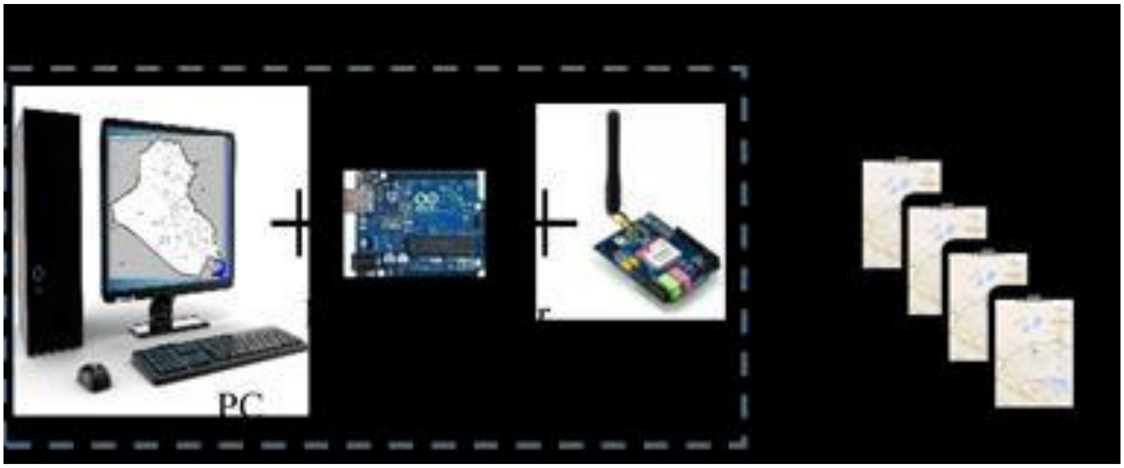

Figure 2.2 Implemented tracking system

Furthermore, wildlife tracking uses GPS to monitor animal movements for conservation purposes, helping researchers study migration patterns and protect endangered species. In construction and surveying, GPS allows engineers to measure and transfer location data to ensure accurate site planning, equipment placement, and mapping of infrastructure projects. Fitness and sports applications also rely on GPS technology for tracking routes, speed, and performance during activities like running, cycling, and hiking.

In marine and aviation industries, GPS transfer provides critical data for navigation, collision avoidance, and safe travel through air and sea routes, even in adverse weather conditions. Additionally, GPS is integral to geolocation services in IoT devices, enabling real-time tracking for applications such as smart wearables, pet tracking, and asset monitoring. Disaster management also benefits from GPS technology by enabling authorities to map affected areas, coordinate relief efforts, and transfer location data for search missions. Overall, GPS transfer has become a cornerstone for solving complex problems related to navigation, safety, resource optimization, and environmental monitoring, offering immense value in industries such as transportation, agriculture, construction, healthcare, and beyond.

# CHAPTER 3:DESIGN

## 3.1 HARDWARE SPECIFICATION:

3.1.1 **Microcontroller (Arduino)**

Central unit that processes data from sensors and manages communication.

Voice recognition Module (VC-02)

Interface with microcontroller to trigger GPS location transfer.

**3.1.2 GPS Module (neo 6m)**

Provides real-time location data.

Connects via serial communication to the microcontroller.

**Communication Module (sim 900A)**

Connects to the microcontroller for data transfer.

**3.1.3 Power Supply**

The project focuses on transferring GPS location data using an Arduino Uno and a VC-02 voice playback module. The system acquires GPS coordinates through a GPS module, processes the data, and vocalizes it using pre-recorded audio files stored on the VC-02 module. The hardware setup involves connecting the GPS module and VC-02 to the Arduino via serial communication using the SoftwareSerial library. The GPS module's TX pin is connected to the Arduino's RX pin, and its RX pin is connected to the Arduino's TX pin. Similarly, the VC-02 module's TX and RX pins are connected to the Arduino. A speaker is connected to the VC-02 for audio output, and a regulated power supply ensures stable operation, particularly for the power-hungry GPS module.

The software implementation uses the TinyGPS++ library to parse latitude and longitude data from the GPS module in real-time. The extracted data is split into digits and direction indicators, such as “N” for North or “E” for East. Each component is mapped to corresponding pre-recorded audio files stored on the VC-02’s SD card. For instance, numbers like “12.9716” are broken down into individual digits, while directional indicators are mapped to files such as “north.mp3.” The Arduino sends commands to the VC-02 module to play these audio files in sequence, creating a coherent spoken output. For example, if the location is latitude 12.9716 N and longitude 77.5946 E, the playback would say: “Latitude one two point nine seven one six North. Longitude seven seven point five nine four six East.” Timing is carefully managed in the code to ensure proper playback without overlapping audio files.

Testing involves validating the system in both stationary and moving scenarios, ensuring accurate GPS data acquisition and correct audio playback. Challenges like power stability, GPS signal reliability, and audio synchronization are addressed by using a stable power source, testing in open areas, and implementing delays between audio commands. The project successfully converts GPS data into audible format, enabling real-time spoken location updates. This system has potential applications in navigation, tracking systems, and assistive technologies for the visually impaired.

## 3.2 SOFTWARE SPECIFICATION

**3.2.1 Programming Language**:

C++ (Arduino IDE ).

The Arduino IDE (Integrated Development Environment) is the primary software used to program and upload code to Arduino boards, such as the Arduino Uno. It provides a user-friendly interface that allows users to write, compile, and debug their code, known as sketches. The IDE includes a code editor with features like syntax highlighting and error detection, making it easier to write and edit Arduino programs. It also supports adding libraries, such as TinyGPS++ for GPS data parsing and Software Serial for managing multiple serial devices, which are essential for projects like GPS location transfer using the VC-02 module.

### 3.2.2 Code:

```
#include <SoftwareSerial.h>
```

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


// Pin Definitions

SoftwareSerial gps(8, 9);      // NEO-6M GPS Module (RX, TX)

SoftwareSerial gsm(6, 7);      // SIM900 GSM Module (RX, TX)


// TinyGPS++ instance

TinyGPSPlus gpsParser;


// Variables

String latitude = "";

String longitude = "";


void setup() {

  // Begin Serial Communications

  Serial.begin(9600);        // Debugging

  gps.begin(9600);           // NEO-6M GPS Module

  gsm.begin(9600);           // SIM900 GSM Module
```

```
  // Initialize GSM Module
  initializeGSM();

  Serial.println("System Ready. Fetching GPS data...");
}

void loop() {
  // Process incoming GPS data
  while (gps.available() > 0) {
    char c = gps.read();
    gpsParser.encode(c); // Feed data into TinyGPS++

    // Check if GPS has a valid fix
    if (gpsParser.location.isUpdated()) {
      // Get the latest latitude and longitude
      latitude = String(gpsParser.location.lat(), 6);  // 6 decimal places
      longitude = String(gpsParser.location.lng(), 6);

      // Print to Serial Monitor
```

```
      Serial.println("Latitude: " + latitude);

      Serial.println("Longitude: " + longitude);



      // Send the location via SMS

      String message = "Current Location: Latitude " + latitude + ", Longitude " + longitude;

      sendSMS("+1234567890", message); // Replace with the recipient's number

      Serial.println("Message Sent: " + message)

     / / Wait before sending the next message (e.g., every 1 minute)

      delay(60000);

    }

  }

}

void initializeGSM() {

  delay(1000);

  gsm.println("AT"); // Check communication

  delay(1000);

  gsm.println("AT+CMGF=1"); // Set SMS mode

  delay(1000);

  Serial.println("SIM900 initialized.");
```

```
}

void sendSMS(String number, String message) {

  gsm.println("AT+CMGS=\"" + number + "\"");

  delay(1000);

  gsm.println(message);

  delay(100);

  gsm.write(26); // Send Ctrl+Z to send SMS

  delay(1000);

}
```

## 3.3 Design Issues:

Designing a real-time GPS tracking system using GSM involves addressing several critical challenges to ensure functionality, reliability, and efficiency. One major issue is power management, as the GPS, and GSM modules are all power-intensive, which can quickly deplete the battery in portable systems. To overcome this, low-power microcontrollers, periodic GPS updates, and efficient power regulators need to be implemented. Another concern **is** signal interference, especially when operating GSM modules in close proximity. Proper grounding, shielding, and frequency optimization are essential to minimize interference.

The communication range is another design issue, range, obstacles, and regulatory frequency limitations. Maximizing range requires clear line-of-sight deployment, high-gain antennas, and careful adjustment of parameters such as spreading factor and bandwidth. Additionally, network dependence is a challenge for GSM-based systems in remote areas where cellular coverage is unreliable

Ensuring data accuracy is critical, as GPS modules are prone to signal drift or temporary loss of satellite connection, leading to inaccuracies. Advanced data processing techniques like Kalman filtering and timeout mechanisms can help mitigate this. The system's scalability also poses a challenge when handling multiple devices, as it can lead to congestion in communication. This requires efficient time-slot allocation and unique device IDs to avoid packet collisions.

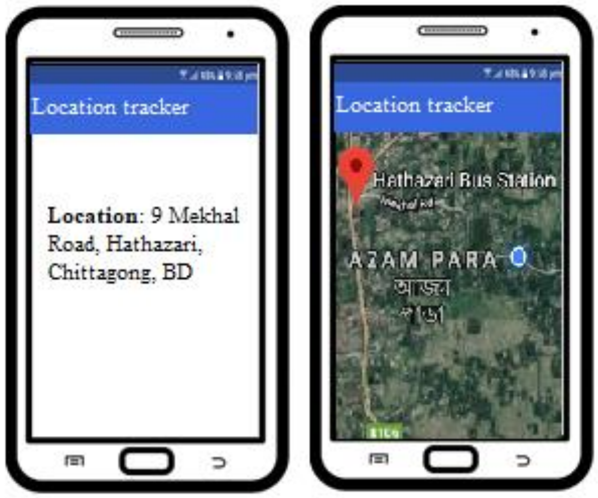


Figure 3.1 Interfaces of location tracker

Finally, cost constraints and environmental factors like harsh weather or extreme temperatures may affect the durability and affordability of the system. To address these, selecting low-cost but reliable modules and using rugged enclosures with industrial-grade components can enhance system performance without significantly increasing costs. By carefully addressing these design issues, the system can achieve reliable and efficient real-time GPS tracking in a variety of scenarios.

Testing involves validating the system in both stationary and moving scenarios, ensuring accurate GPS data acquisition and correct audio playback. Challenges like power stability, GPS signal reliability, and audio synchronization are addressed by using a stable power source, testing in open areas, and implementing delays between audio commands. The project successfully converts GPS data into audible format, enabling real-time spoken location updates. This system has potential applications in navigation, tracking systems, and assistive technologies for the visually impaired.

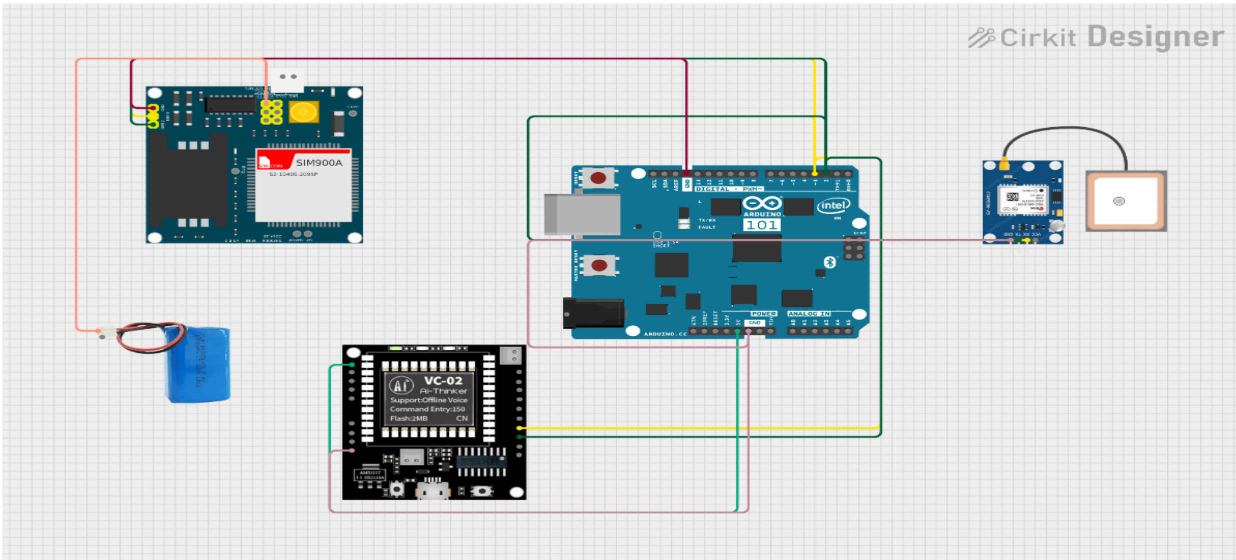


Figure 3.2 Hardware design

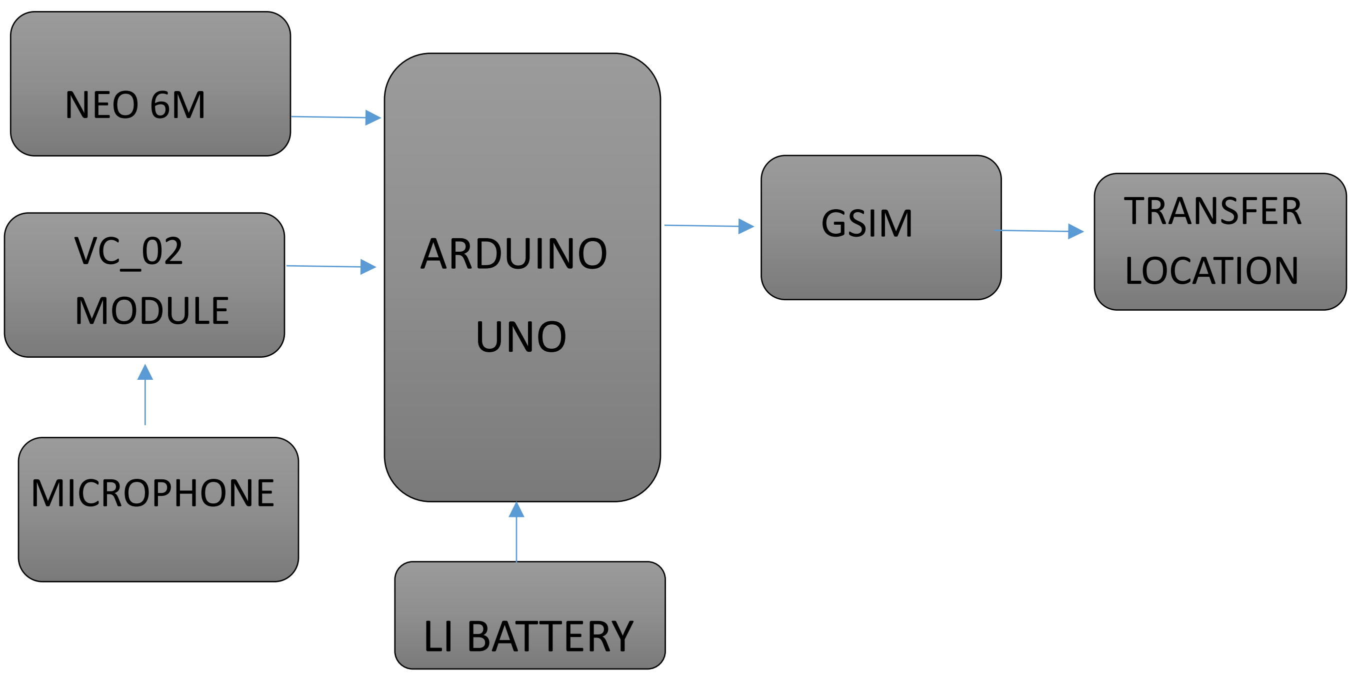


FIGURE 3.3 Block representation

# CHAPTER 4: IMPLEMENTATION

## 4.1 EXPERIMENTAL METHODOLOGY

The experimental methodology for transferring GPS location data using a GPS module and the VC-02 voice recording and playback module involves multiple stages, including hardware setup, data acquisition, and processing, followed by transmitting the location in voice format. The primary components include an Arduino uno , a GPS module (neo 6m),the vc-02 voice recognition module , and essential connections like jumper wire ,power supply , bread board .

All these above mentioned components are interfaced which is given in figure 3.1.

- **Activation**: The user activates the system with a voice command like "start tracking" or "where am I?". The voice module recognizes the command and sends it to the microcontroller.
- **GPS Location Processing**:
  - When the command for location tracking is given, the GPS module retrieves the current coordinates (latitude, longitude) and sends them to the microcontroller.
  - The microcontroller can then process these coordinates to determine the exact location and, if needed, provide navigation instructions.
- **Voice Feedback**
  - For a fully voice-enabled experience, a text-to-speech module could read the coordinates or navigation instructions aloud, making it easier for users to understand their location without needing to view a screen.
- **Tracking and Alerts**:
  - When requested, the system can keep tracking continuously and log locations at regular intervals.
  - The user can ask for their current location at any time, or specific keywords (like "emergency" or "help") can trigger location sharing with pre-specified contacts.

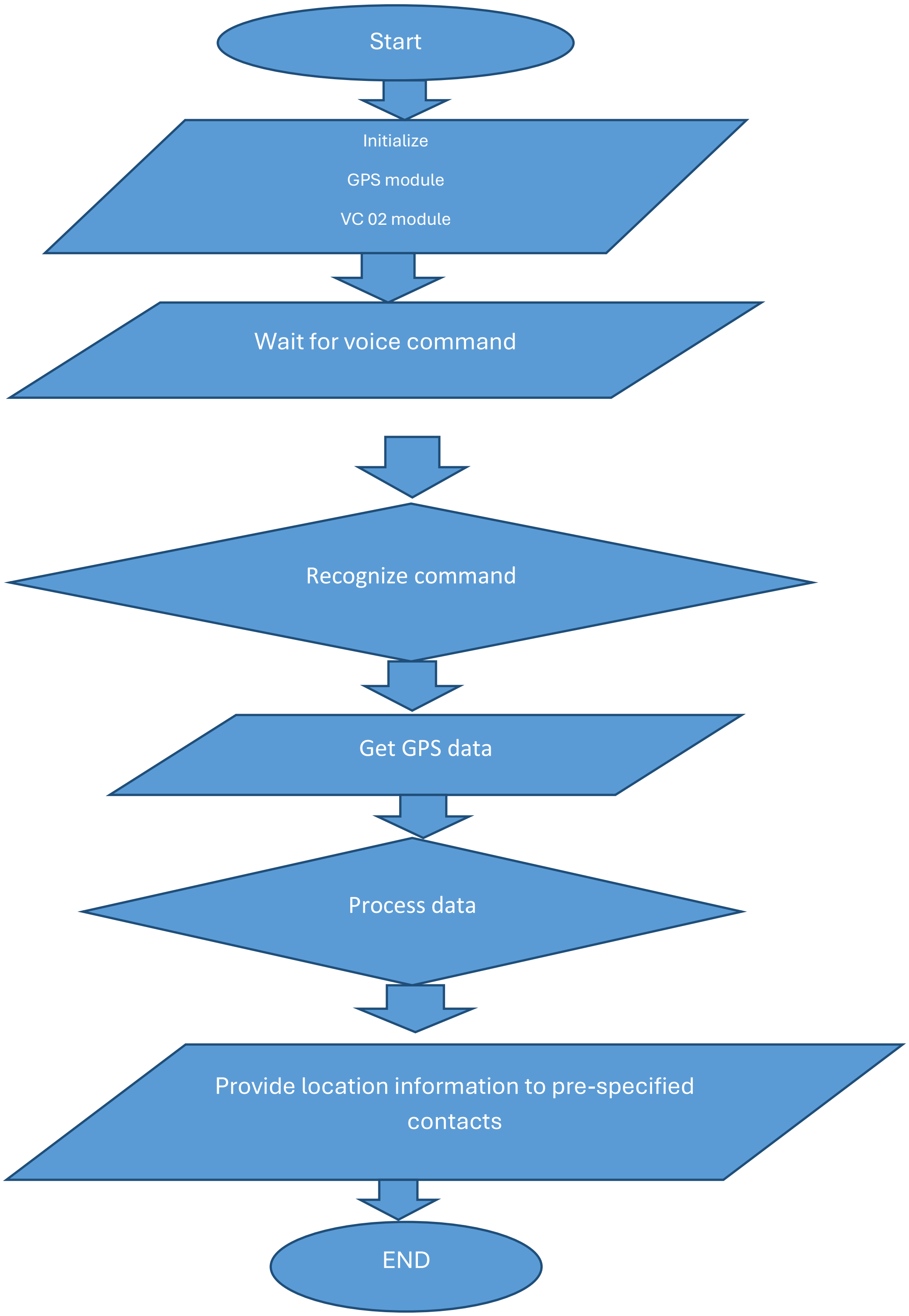


FIGURE 4.1 Data flow of the system

# CHAPTER 5: RESULT, DISCUSSION AND INTERFERENCE

## 5.1 RESULT:

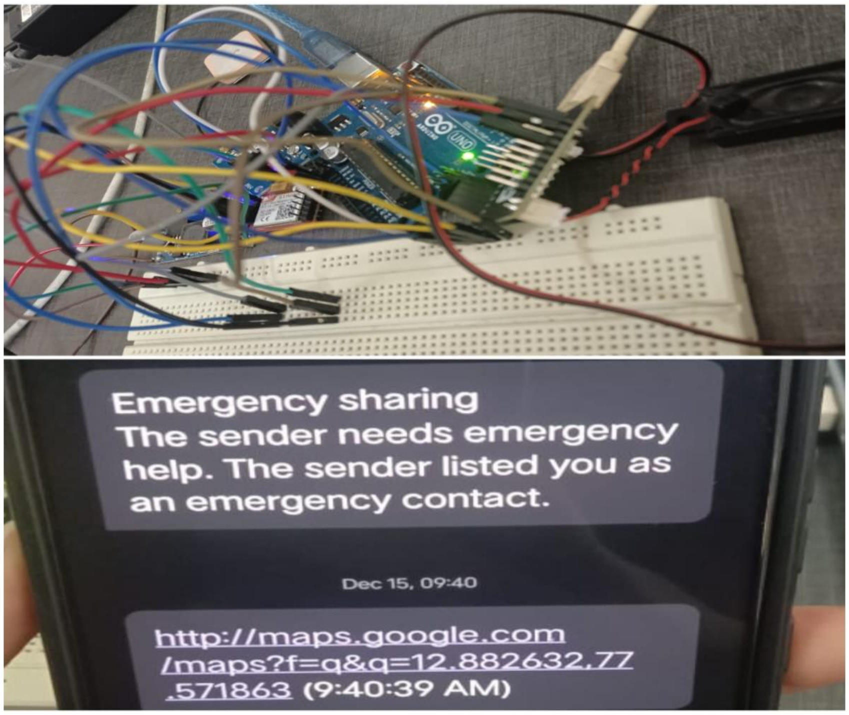


**Figure 5.1 Final Outcome**

Integrating the VC-02 voice recognition module, NEO-6M GPS module, and GSIM GSM module enables GPS data transfer based on voice commands. The VC-02 processes specific voice inputs, such as "Send Location," which triggers the microcontroller to query the NEO-6M GPS module for real-time location data. This data, including latitude, longitude, and altitude, is then transmitted via the GSIM module through SMS or uploaded to a server over the GSM network. The system's performance depends on several factors: the VC-02's accuracy in recognizing commands, which may be influenced by ambient noise; the NEO-6M's ability to lock onto satellites for precise GPS data, which can be affected by environmental conditions; and the GSIM's ability to send data, which relies on GSM signal strength and proper configuration. With efficient integration, the system provides accurate and timely GPS data transfer, but challenges such as voice recognition errors, weak GPS signals, or GSM network issues may require troubleshooting to ensure reliable operation. Integrating the VC-02 voice recognition module, NEO-6M GPS module, and GSIM GSM module creates a system capable of voice-activated GPS data retrieval and transmission. The VC-02 module recognizes pre-programmed voice commands such as "Send Location" or "Help," which are processed by a microcontroller. Upon recognizing a command, the microcontroller communicates with the NEO-6M GPS module to retrieve location data, including latitude, longitude, altitude, and other parameters like speed and time if configured. This GPS data is then formatted and transmitted using the GSIM GSM module, either as an SMS to a designated phone number or as data sent to an online server via HTTP or MQTT protocols.

The system offers flexibility and automation, with the voice command interface making it user-friendly for real-time applications such as vehicle tracking, personal safety, or remote monitoring. The VC-02 can store up to 150 voice commands and has onboard noise cancellation to improve recognition in moderately noisy environments, though performance may degrade in high-noise areas or with unclear speech. The NEO-6M GPS module provides an accuracy of approximately 2.5 meters under ideal conditions, with a cold start time of around 27 seconds and a hot start time of 1 second. However, GPS performance can be affected by obstructions such as buildings, trees, or indoor environments, resulting in delayed or inaccurate data.

The GSIM GSM module handles data transmission, allowing the system to operate over a wide area, provided there is GSM network coverage. For SMS, the module formats the GPS coordinates into a readable text message, while for internet-based data transfer, it requires proper APN settings and network credentials. Challenges include ensuring synchronized communication between modules, managing latency from GPS data retrieval and GSM transmission, and handling errors such as GPS signal loss or GSM network interruptions. Despite these potential issues, this integrated system is highly versatile and can be adapted for a variety of real-world applications with appropriate programming and error-handling mechanisms. The NEO-6M, VC-02, and GSIM modules each offer distinct advantages that, when combined, create a powerful and versatile system for GPS-based applications.

## 5.2 DISCUSSIOIN

The NEO-6M GPS module stands out for its reliability and precision, offering an accuracy of approximately 2.5 meters under optimal conditions. It supports multiple satellite constellations and has robust features like cold start and hot start capabilities, ensuring quick satellite acquisition. Its low power consumption makes it suitable for battery-powered systems, while its compact design allows easy integration into portable devices. Additionally, it outputs NMEA standard data, which is widely compatible with microcontrollers and software tools. The VC-02 voice recognition module enhances the system with its user-friendly voice interface. Capable of recognizing up to 150 pre-programmed commands, it simplifies operation by allowing hands-free control. Its built-in noise reduction improves command accuracy in moderately noisy environments, making it ideal for automotive or outdoor use. Unlike some advanced AI-based voice systems, the VC-02 operates offline, ensuring privacy, low latency, and consistent performance without requiring an internet connection. The GSIM GSM module further extends the system's capabilities by enabling remote communication over the GSM network. It supports both SMS and GPRS for data transfer, allowing GPS information to be sent directly to mobile phones or uploaded to cloud servers. This makes it suitable for applications like vehicle tracking, remote monitoring, and personal safety devices. The GSIM module is widely compatible with 2G networks, making it a cost-effective option for long-range communication in areas with basic cellular infrastructure. When used together, these modules create a robust system that is accurate, easy to use, and capable of transmitting data over long distances. The NEO-6M ensures precise location data, the VC-02 offers a seamless user experience with voice commands, and the GSIM module ensures reliable data transfer, even in remote locations. This combination is particularly advantageous for applications where ease of use, low power consumption, and wide-area communication are critical

## 5.3 INTERFERENCE

Interfacing the NEO-6M GPS module, VC-02 voice recognition module, and GSIM GSM module involves integrating these components with a microcontroller to create a functional system for voice-controlled GPS data transmission. The microcontroller acts as the central hub, coordinating communication between the modules. The VC-02 connects via UART or serial communication, allowing the microcontroller to receive voice commands. These commands trigger specific actions, such as retrieving GPS data or sending it via GSM. The NEO-6M GPS module also uses UART for communication, providing real-time NMEA data (e.g., latitude, longitude, and altitude) to the microcontroller. The microcontroller processes this data, formats it as needed, and prepares it for transmission.

The GSIM GSM module interfaces similarly via UART, enabling the microcontroller to send SMS messages or establish a GPRS connection for data transfer. Proper AT commands are used to configure the GSM module, set APNs, and initiate data transmission. Careful timing and error handling are necessary to ensure smooth operation, as all three modules rely on serial communication, which may require software-based UART (Software Serial) or multiplexing if the microcontroller has limited hardware UART ports. Power requirements must also be managed carefully. The NEO-6M GPS module typically operates at 3.3V to 5V, while the VC-02 and GSIM modules have specific voltage requirements, often requiring 5V for stable operation. Voltage regulators or level shifters might be necessary to ensure compatibility and prevent damage to the modules.

The microcontroller's firmware is programmed to interpret voice commands from the VC-02, request and parse GPS data from the NEO-6M, and send it via the GSIM module. This integration requires attention to synchronization, error handling (e.g., GPS signal loss or GSM network failure), and optimal resource allocation to prevent conflicts in data transmission. Once interfaced correctly, this system offers robust, voice-controlled functionality for a range of applications such as vehicle tracking, personal safety devices, or remote asset monitoring. GPS detection technology is utilized across a wide range of fields due to its ability to provide accurate location and timing data. In transportation and navigation, it is essential for vehicle tracking, route optimization, aviation, and maritime operations. In agriculture, GPS enables precision farming, crop monitoring, and livestock tracking, significantly improving efficiency. Emergency services rely on GPS for search and rescue operations, disaster management, and enhancing emergency response systems . Personal and asset tracking is another critical application, with GPS embedded in wearable devices, child safety gadgets, and vehicle recovery systems. In military and defense, it is used for navigation, troop tracking, and precision-guided weaponry. Surveying and construction benefit from GPS in land mapping, site planning, and equipment guidance.

# CHAPTER 6: CONCLUSION

The integration of the SIM900 GSM module, GPS module, and VC-02 voice recognition module in the proposed Voice-Controlled Vehicle Tracking and SOS System showcases the practical application of advanced electronics and communication technologies in real-world scenarios. This project bridges the gap between convenience, safety, and innovation, addressing critical needs such as vehicle tracking and emergency alert systems with voice command integration. By leveraging these technologies, the system provides an intuitive, efficient, and user-friendly solution for vehicle owners, enhancing safety and accessibility even in challenging situations.

The voice recognition feature, powered by the VC-02 module, demonstrates how modern systems can be made hands-free and interactive. With predefined voice commands like “Location” and “Emergency,” users can perform critical actions without relying on manual interfaces. This feature is especially useful in emergency scenarios where quick access to functionality is crucial. The use of a voice-controlled mechanism ensures accessibility for individuals with physical disabilities, making it an inclusive system. By training the VC-02 module with specific commands, the system is both customizable and reliable in recognizing user input.

The GPS module plays a vital role in the project by providing real-time location data. Its ability to deliver accurate latitude and longitude coordinates ensures precise tracking of vehicles. This feature not only helps users locate their vehicles when requested but also adds a layer of security by enabling the system to share the location during emergencies. Such capabilities are invaluable for personal safety, theft prevention, and fleet management in commercial applications. Furthermore, the project showcases how GPS technology can be seamlessly integrated into a multi-functional system for enhanced utility.

The GSM module, SIM900, further enhances the system's functionality by enabling communication via SMS. This ensures that critical messages, such as the vehicle's location or an SOS alert, can be sent instantly to predefined contacts. The use of SMS as a communication medium ensures reliability, as SMS services are widely available and function even in areas with weak internet connectivity. The combination of GSM and GPS technologies allows for an effective and versatile solution for real-time tracking and emergency communication.

The project also highlights the role of the Arduino Uno microcontroller in integrating and managing multiple modules. Acting as the brain of the system, the Arduino processes voice commands, retrieves GPS data, and sends SMS messages, ensuring seamless operation. Its flexibility and compatibility with various sensors and modules make it an ideal choice for prototyping and implementing this system. The project effectively demonstrates the Arduino's capability to handle diverse tasks, making it an essential component of the overall design.

In addition to its technological achievements, this project emphasizes the importance of user safety and convenience. The incorporation of an SOS feature ensures that users can alert their loved ones or authorities in times of distress, providing peace of mind. Moreover, the voice-controlled interface reduces distractions and promotes hands-free usage, making it particularly suitable for drivers. The system's design reflects a commitment to enhancing user experience while prioritizing safety and security.

Despite its success, the project does face some challenges. One of the key challenges is ensuring accurate voice recognition in noisy environments. Environmental factors such as background noise or speech variations can affect the performance of the VC-02 module. Additionally, the GPS module's accuracy may be influenced by factors like weather conditions, tall buildings, or remote locations. Similarly, ensuring that the SIM900 module functions reliably across different cellular networks and regions may require additional configuration and testing.

Future enhancements to this project could include integrating additional features such as real-time tracking via a mobile application, enhancing voice recognition accuracy with machine learning algorithms, or incorporating additional sensors for monitoring vehicle conditions. These improvements would further increase the system's functionality and adaptability, making it even more valuable for users.

In conclusion, this project successfully combines the functionalities of the SIM900 GSM module, GPS module, and VC-02 voice recognition module to deliver a practical and innovative solution. By addressing key concerns such as vehicle safety, accessibility, and emergency communication, the system exemplifies how modern technology can be applied to solve real-world problems. The project not only demonstrates technical competence but also emphasizes the importance of safety, user experience, and adaptability, making it a valuable contribution to the field of embedded systems and IoT solutions.

## FUTURE SCOPE:

The Voice-Controlled Vehicle Tracking and SOS System holds immense potential for future development, driven by the rapid advancements in technology and the increasing demand for smarter and more efficient safety solutions. One key area of growth lies in integrating the system with Internet of Things (IoT) platforms, enabling real-time vehicle tracking and voice commands accessible via a mobile app or web interface. A dedicated mobile application could enhance user interaction by providing live GPS location mapping, push notifications, and remote control functionalities. To improve voice recognition accuracy, the system can incorporate machine learning algorithms, making it adaptable to various accents, languages, and noisy environments. Additional sensors, such as accelerometers and motion detectors, could enhance security features by detecting unauthorized vehicle movement, accidents, or theft. These sensors could also be used to trigger automatic SOS alerts in critical situations.

Furthermore, the system can evolve to include advanced security features like geo-fencing, remote engine lock/unlock, and driver authentication using biometric technologies such as voice, fingerprint, or facial recognition. Upgrading the GSM module to 4G/5G compatibility would ensure faster communication and better reliability, even in areas with poor 2G/3G coverage. For commercial use, the system could be scaled to support fleet management, enabling businesses to monitor multiple vehicles in real time, optimize routes, and analyze driver behavior. Additionally, integrating artificial intelligence could provide predictive maintenance alerts, ensuring timely servicing and reducing downtime. The device's hardware design could also be made modular, allowing users to attach new components like cameras for video surveillance or RFID readers for secure vehicle access.

Incorporating solar-powered systems or optimizing power consumption would make the system more sustainable and portable. Moreover, by adhering to legal requirements, such as compliance with government regulations on emergency systems or toll payment integration, this project could serve as a versatile and comprehensive solution for both personal and commercial vehicles. With these enhancements, the system has the potential to evolve into a highly intelligent vehicle safety and management platform, addressing the needs of modern transportation and ensuring its relevance for years to come.

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