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Vehicle Tracking System by GPS & GSM

A Graduation Project Submitted to the Department of Communication and Computer Engineering in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Communication and Computer Engineering

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صَدَقَ الله العَظيم

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Chapter One

1.1 Introduction

The Global Positioning System (GPS) is a globally available satellite navigation system that offers precise location and time information in any weather condition, at any location on or near the Earth where there's an unobstructed line of sight to four or more GPS satellites. Operated by the US government, GPS is freely accessible to anyone with a GPS receiver.

GPS functions by utilizing a network of satellites orbiting the Earth that transmit meticulously timed signals. These signals are received by a GPS receiver, which utilizes them to determine the receiver's position, speed, and direction. GPS has become an integral part of contemporary life, finding applications in navigation, geolocation, and tracking. It has revolutionized the way we navigate, enabling effortless and accurate journey planning..

1.2 Aim of the project

The primary objective of the Global Positioning System (GPS) is to provide location and time information to users worldwide. Originally developed by the United States Department of Defense for military purposes, GPS has since evolved into a widely utilized civilian technology.

GPS operates by utilizing a network of satellites orbiting the Earth that transmit precisely timed signals. These signals are received by a GPS receiver, which employs them to calculate the receiver's position, speed, and direction. GPS serves a diverse range of applications, including navigation, geolocation, and tracking.

Beyond providing location and time information, GPS holds several other significant objectives:

1. To offer a reliable, all-weather navigation system that can be utilized anywhere on or near the Earth.

2. To support the development of novel technologies and applications that rely on accurate location and time information.

3. To provide an independent and reliable source of location and time information, usable for scientific and research purposes.

The objective of GPS is to offer users precise and trustworthy location and time data for a diverse range of applications.

1.3 Proposed Method

The Global Positioning System (GPS) employs a combination of satellite signals and ground-based control stations to provide users with accurate and reliable location and time information. Here's an overview of the fundamental operation of GPS:

1. A network of satellites orbits the Earth and transmits precise timing signals.

2. A GPS receiver receives these signals and utilizes them to calculate its location, speed, and direction.

3. The GPS receiver compares the time a signal was transmitted by a satellite with the time it was received, enabling it to determine the distance from the satellite.

4. By comparing the distance from four or more satellites, the GPS receiver can calculate its location in three dimensions (latitude, longitude, and altitude) as well as its speed and direction.

5. The GPS receiver can also utilize signals from ground-based control stations to enhance the accuracy of its calculations.

6. Subsequently, the GPS receiver displays the location information to the user or employs it for various functions, such as navigation or tracking.

The proposed method of GPS involves the utilization of satellite signals and ground-based control stations to calculate the location, speed, and direction of a GPS receiver. This information is then applied to a variety of applications, including navigation, geolocation, and tracking.

1.4 Problem Statement

Several potential issues can impact the accuracy and reliability of the Global Positioning System (GPS). Some of the most prevalent challenges include:

1. Satellite Satellite signal interference: GPS signals can be disrupted by various factors, including atmospheric conditions, solar flares, and man-made interference from sources such as radio waves. television broadcasts. This can result in errors in the location information provided by GPS.

2. Obstructed line of sight: In order to receive GPS signals, a receiver must have an unobstructed line of sight to at least four satellites. If the receiver is located in a location with poor satellite visibility, such as inside a building or in a heavily forested area, it may not be able to receive sufficient signals to determine its location accurately.

3. Receiver error: GPS receivers can also be a source of error. Factors such as manufacturing defects hardware malfunctions, and software bugs can all contribute to errors in the location information provided by GPS.

Chapter Two

2.1 History of the GPS Program

The Global Positioning System (GPS) has evolved over many years, with several key milestones marking its development. Below is an overview of the significant events in the history of GPS:

1. 1957: The Soviet Union launches Sputnik, the first artificial satellite, initiating the space race between the Soviet Union and the United States.

2. 1960: The U.S. Navy creates Project NOAH, which demonstrates that satellite signals can be used for navigation.

3. 1964: The U.S. Department of Defense (DoD) establishes the Advanced Research Projects Agency (ARPA) to manage the development of new military technologies.

4. 1973: ARPA launches NAVSTAR-1, the first GPS satellite, as part of the NAVSTAR (Navigation System Using Timing and Ranging) program.

5. 1978: The second generation of GPS satellites, known as Block II, is launched. These satellites can transmit signals that are accessible to civilian users, though their accuracy is intentionally reduced by the U.S. government through selective availability.

6. 1993: The U.S. government announces that GPS will be available for continuous civilian use once the system reaches full operational status.

7. 1996: The U.S. government decides to discontinue selective availability, thus enhancing the accuracy of GPS signals for civilian users.

8. 2005: The U.S. Air Force launches the third generation of GPS satellites, Block III. These satellites feature improved accuracy and a new military signal designed to enhance security.

9. 2011: The U.S. Air Force introduces the first GPS Block IIF satellite, which includes a new civilian signal, L5, to improve GPS accuracy and reliability for civilian users.

10. 2020: The U.S. Air Force launches the first GPS Block III satellite, which includes the M-Code military signal, aimed at increasing security and reliability for military users.

2.2 GPS for Fleet Vehicles

The Global Positioning System (GPS) can be utilized to track and manage fleet vehicles, such as delivery trucks, buses, and taxis. Below are some of the key advantages of using GPS for fleet management:

1. Increased efficiency: GPS helps fleet managers optimize vehicle routes and schedules, which reduces fuel consumption and boosts the overall efficiency of the fleet.

2. Improved safety: GPS allows fleet managers to monitor the speed and location of vehicles, thereby enhancing safety and lowering the likelihood of accidents.

3. Real-time tracking: GPS enables real-time vehicle tracking, allowing fleet managers to quickly locate and dispatch vehicles when necessary.

4. Better customer service: GPS allows fleet managers to provide more accurate estimated arrival times to customers and offer faster, more reliable services. GPS Vehicle Tracking Now and, in The Future

2.2.1 GPS Vehicle Tracking Now

GPS vehicle tracking is a technology that enables fleet managers to monitor and track the location, speed, and movement of their vehicles in real time. This is achieved through GPS receivers installed in the vehicles, which send location data and other information to a central server or dashboard for access and analysis.

GPS vehicle tracking is extensively used by businesses, governments, and various organizations to enhance fleet efficiency, safety, and asset management. The key advantages of GPS vehicle tracking include:

1. Real-time tracking: GPS vehicle tracking provides fleet managers with real-time updates on the location and movement of their vehicles, ensuring they have the latest information on their fleet's whereabouts.

2. Increased efficiency: By using GPS vehicle tracking, fleet managers can optimize vehicle routes and schedules, helping to reduce fuel costs and enhance the overall operational efficiency of the fleet.

3. Improved safety: GPS vehicle tracking allows fleet managers to monitor the speed and location of vehicles, which helps to improve safety and minimize the risk of accidents.

2.2.2 GPS Vehicle Tracking in the Future

It GPS vehicle tracking is expected to evolve and advance over time, with new technologies and features being developed to enhance its functionality. Some potential advancements in GPS vehicle tracking that we might see in the future include:

1. Improved accuracy: As GPS technology continues to advance, we can expect further improvements in the precision of GPS vehicle tracking.
2. Better integration with other systems: GPS vehicle tracking is likely to become more seamlessly integrated with other systems, such as telematics and IoT (Internet of Things) platforms, offering a more complete view of vehicle performance and operational data.
3. Predictive analytics: Future GPS vehicle tracking systems may incorporate machine learning and other advanced techniques to predict and prevent problems, such as vehicle breakdowns or accidents, before they occur.
4. Autonomous vehicles: The rise of autonomous vehicles will likely have a major impact on GPS vehicle tracking, as the technology will play a key role in helping these vehicles navigate and operate safely.

As technology continues to develop, GPS vehicle tracking will likely see significant improvements, driving better fleet efficiency, safety, and asset management.

2.3 Related Technology

2.3.1 GPS module

A AGPS (Global Positioning System) module is a device designed to determine the location of a device or vehicle by receiving satellite signals. It typically includes a GPS receiver and an antenna, and is usually compact and portable. The GPS receiver captures signals from a constellation of satellites orbiting the Earth, using these signals to calculate the device's latitude, longitude, and altitude. This information is then transmitted to other devices or systems, such as a computer or navigation system, via various interfaces, including USB, serial, or Bluetooth. GPS modules are widely used in numerous applications, such as navigation, asset tracking, and mapping.

2.3.2 NEO-6 GPS MODULE FEATURES

The The NEO-6 GPS module is a compact, high-performance GPS unit manufactured by u-blox, a leading GPS technology provider. Key features of this module include:

1. High sensitivity: The NEO-6 module features a highly sensitive receiver that can track GPS signals in challenging environments, such as dense urban areas or thick forests.
2. Low power consumption: The module is designed for power efficiency, consuming only 25 mA of current.
3. Multiple connectivity options: It supports various connectivity interfaces, including UART, I2C, and USB, enabling easy integration with different systems.
4. Compact size: The module is small and lightweight, making it ideal for portable applications or environments with limited space.
5. Wide operating temperature range: It can operate in a broad temperature range from -40°C to +85°C, making it suitable for diverse environmental conditions.
6. Support for multiple GNSS systems: The module is compatible with several Global Navigation Satellite Systems (GNSS), including GPS, GLONASS, Galileo, and QZSS, providing wide coverage.
7. High accuracy: The NEO-6 module offers precise location information with an accuracy of 2.5 meters (CEP50) under optimal conditions.

2.3.3 GSM TECHNOLOGY

GSM (Global System for Mobile Communications) is a digital mobile phone technology that is widely adopted worldwide. It is the most prevalent mobile phone standard, with over 5 billion users across the globe.

GSM operates primarily in the 900 MHz and 1800 MHz frequency bands in most countries, while in the United States, it operates in the 850 MHz and 1900 MHz bands. The technology uses time division multiple access (TDMA) to divide each 200 kHz frequency band into time slots, allowing multiple users to share the same frequency channel. Each user is assigned a specific time slot, and the system cycles between these slots to send and receive data.

GSM supports a range of services, including voice calls, text messaging, and data services such as internet browsing and email. It also utilizes SIM (Subscriber Identity Module) cards, which contain a unique identification number and store essential user information, such as the phone number and contacts.

Over time, GSM technology has evolved, incorporating newer standards such as GPRS (General Packet Radio Service) and EDGE (Enhanced Data rates for GSM Evolution), which offer faster data speeds and greater capacity. More recently, the development of 3G (Third Generation) and 4G (Fourth Generation) technologies has further expanded the capabilities of mobile networks.

2.3.3.1 GSM MODULE

A GSM (Global System for Mobile Communications) module is a device that enables a system or device to connect to a GSM mobile network. It typically includes a GSM modem and an antenna and is usually compact and portable. The GSM modem is capable of transmitting and receiving data via the GSM network. It communicates with the network using radio frequency (RF) signals and can be connected to other devices or systems through various interfaces, such as USB, serial, or Bluetooth.

GSM modules are commonly used in many applications, including wireless communication, remote monitoring, and asset tracking. They allow for sending and receiving text messages, making and receiving calls, and accessing the internet or other data services. GSM modules are also widely used in machine-to-machine (M2M) communication, where they connect devices or systems to each other or to a central server or network.

GSM modules are available in a variety of sizes and configurations and are compatible with different types of GSM networks, such as 2G, 3G, and 4G. They are generally easy to integrate into different systems and applications and are utilized in various industries, including transportation, energy, and healthcare.

Figure 1 GSM Module

2.3.3.2 FEATURES OF GSM MODULE

GSM (Global System for Mobile Communications) modules are devices that enable a system or device to connect to a GSM mobile network. Some key features of GSM modules include:

1. Network Connectivity: GSM modules are designed to connect to a GSM mobile network, enabling them to send and receive data, make and receive voice calls, and access the internet or other data services.
2. Multiple Connectivity Options: GSM modules generally support various connectivity interfaces, such as USB, serial, and Bluetooth, which simplifies their integration into different systems and applications.
3. Compact Size: These modules are typically small and lightweight, making them ideal for use in portable applications or environments with limited space.
4. Low Power Consumption: GSM modules are built for power efficiency, consuming minimal current to support long battery life in portable or battery-operated devices.
5. Support for Multiple Frequency Bands: GSM modules can operate across several frequency bands, such as 900 MHz and 1800 MHz, making them compatible with networks in different regions and countries.

2.3.4 Difference between GSM mobile and GSM/GPRS module

GSM/GPRS (General Packet Radio Service) modules and GSM mobile phones are both devices that connect to a GSM mobile network. However, they differ in several important ways:

GSM mobile	GSM/GPRS module
1. Purpose: GSM mobile phones are primarily used for making and receiving calls, as well as sending and receiving text messages. They also offer various additional features like internet access, email, and app support.	1. Purpose: GSM/GPRS modules are mainly used to provide wireless communication and data connectivity to other devices or systems. They are often utilized in applications like machine-to-machine (M2M) communication, remote monitoring, and asset tracking.
2. Form factor: GSM mobile phones are generally larger and more feature-rich, designed as standalone devices with a user interface and display.	2. Form factor: GSM/GPRS modules are smaller, more compact, and focused on providing wireless connectivity to other devices. They lack a user interface or display and are meant to be integrated into other systems or applications.
3. Connectivity options: GSM mobile phones offer a wide range of connectivity options, including Bluetooth, Wi-Fi, and NFC, enabling them to connect to various devices and networks.	3. Connectivity options: GSM/GPRS modules usually offer fewer connectivity options, such as USB, serial, and Bluetooth, which are specifically aimed at enabling connectivity with other devices or systems.
4. Power consumption: GSM mobile phones generally consume more power due to their multiple features and functionalities.	4. Power consumption: GSM/GPRS modules are designed to be power-efficient, consuming less current to ensure long battery life, particularly in portable applications.

Figure 2 Difference between GSM mobile and GSM/GPRS module

2.4 Arduino

Arduino is an open-source platform used for creating electronic devices and systems. It consists of both hardware (microcontroller boards) and software (the Arduino Integrated Development Environment, or IDE). The platform is built around the Atmel AVR microcontroller and provides a variety of tools that simplify the development and prototyping of electronic projects. Arduino boards are available in several form factors, including the widely used Arduino Uno, which is ideal for beginners, and the more advanced Arduino Mega, which offers additional inputs and outputs for larger projects. Additionally, the Arduino platform offers a variety of add-on boards to extend functionality.

called "shields," which can be plugged into the main board to add additional functionality, such as Wi-Fi, Bluetooth, or GPS.

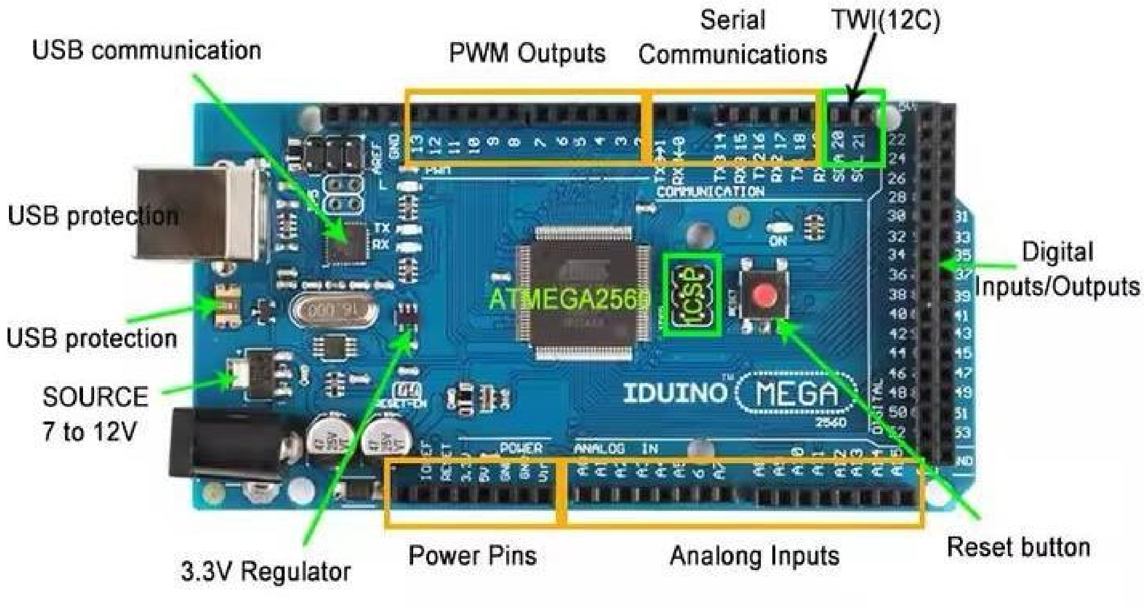


Figure 3 Arduino Mega kit

2.4.1 ARDUINO FEATURES

Arduino is an open-source platform used for developing electronic devices and systems. Here are some key features of the Arduino platform:

1. Open-source: Arduino is open-source, meaning its hardware and software designs are publicly available, allowing users to modify and share them. This openness makes it easy for users to customize the platform to suit their specific needs.

2. User-friendly: Designed with simplicity in mind, Arduino is accessible even to beginners in electronics and programming. It includes a user-friendly Integrated Development Environment (IDE) that facilitates writing and uploading code to the board.

3. Extensive libraries and examples: Arduino offers a wide selection of libraries and example projects, making it easy to perform common tasks like reading sensors, controlling motors, and enabling communication via WiFi or Bluetooth.

4. Community support: Arduino benefits from a large, active community of users who contribute knowledge, code, and ideas. This community makes it easy for users to find assistance and resources when working on their projects.

5. Versatility: Arduino is used in a wide array of applications, ranging from home automation to robotics to artistic installations. Its simplicity and flexibility make it a favored choice for many different types of users.

2.4.2 Performance

- Digital I/O: Pins 0 to 13.
- Analog I/O: Pins 0 to 5 (R3 supports pins 0 to 7).
- ISP Download Function: Supports In-System Programming for downloading.
- Input Voltage: Can be powered via USB, without the need for an external power supply, or by using an external 5V to 9V DC input.
- Voltage Input: Accepts external voltage input.
- Output Voltage: Provides 5V DC output and 3.3V DC output.
- External Power Input: Allows connection for external power.
- Microcontroller: Powered by an Atmel Atmega328 microprocessor. Due to strong community support, it benefits from extensive Arduino platform development and utilizes a 32-bit MCU.
- Arduino Dimensions: 70 mm wide by 54 mm high.

2.4.3 Arduino components

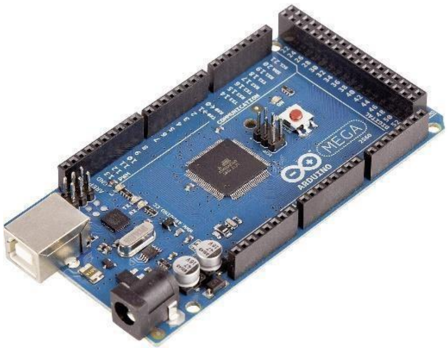
The Arduino Mega is a microcontroller board that uses the ATmega2560 chip. It features several components that allow it to interface with various electronic components and devices. Key components on the Arduino Mega board include:

1. Microcontroller: The primary microcontroller chip on the Arduino Mega is the ATmega2560.
2. USB Port: The board includes a USB port for powering the board and enabling communication with a computer.
3. Power Jack: In addition to the USB connection, the board can also be powered via a DC power jack.
4. Digital I/O Pins: The Arduino Mega has 54 digital input/output pins that allow it to connect with a variety of electronic components such as sensors, LEDs, and motors.
5. Analog Input Pins: The board features 16 analog input pins for reading analog signals from sensors.
6. PWM Pins: It includes 14 Pulse-Width Modulation (PWM) pins, which are used to control the brightness of LEDs or the speed of motors.
7. Reset Button: The board has a reset button that can be used to restart the microcontroller.
8. Crystal Oscillator: A crystal oscillator is present on the board to generate the clock signal required for the microcontroller's operation.
9. Serial Communication: The board has a serial communication interface, enabling communication with external devices like GPS modules and Bluetooth modules.
10. I2C Interface: The Arduino Mega includes an I2C interface for connecting to I2C-compatible devices, such as sensors and LCD displays.
11. SPI Interface: It also features an SPI interface for connecting to SPI devices, including SD cards and RFID readers.
12. Ethernet Port: Some versions of the Arduino Mega include an Ethernet port, allowing the board to connect to a network.
13. SD Card Slot: Certain versions of the Arduino Mega are equipped with an SD card slot for storing data.

Chapter Three

3.1 Project Requirements:

Table 3. 1 Table of Project Requirements

1. **Arduino Mega 2560 Board:** Serves as the microcontroller responsible for managing and coordinating the entire system's operations. 	2. GSM **Module (SIM800L GPS/GPRS):** Functions as the communication unit for sending and receiving text messages. 
3. GPS **Module (Ublox NEO-6M):** Determines the geographic location of the device. Keep ’em coming! . 	4. **16x2 LCD Display:** Provides system feedback and shows the vehicle’s latitude and longitude coordinates. 

5. **12V, 2A AC/DC Adapter:** Delivers electrical power to the entire system. Shoot over the next one when you're ready! 	6. **Breadboard:** Utilized for distributing electrical power across different components. 
7. **Jumper Wires:** Serve as connectors to link various modules and circuit boards together. 	

3.2 System block diagram

Figure 3. 1 System Block Diagram

3.3 Procedures of the system

In this project, the Arduino acts as the central controller, managing the entire operation alongside a GPS receiver and GSM module. The GPS receiver identifies the vehicle's coordinates, while the GSM module is responsible for transmitting those coordinates to the user via SMS. Additionally, a 16x2 LCD display is optionally included to show system status or the current coordinates. The hardware setup includes the Ublox NEO-6M GPS module and the SIM800L GSM module. Once the components are assembled and the Arduino is programmed, the system can be installed in a vehicle and powered on. To locate the vehicle, the user simply sends an SMS with the word "car" to the system. This message is received by the GSM module, which forwards the content to the Arduino. The Arduino then checks if the message matches the predefined keyword. If it does, the Arduino retrieves the vehicle's coordinates by parsing the $GPGGA string from the GPS data and sends a response to the user via the GSM module. This response includes both the latitude and longitude, along with a Google Maps link showing the vehicle'sexactlocation.

3.4 Concept and Overview

This vehicle tracking system obtains location data from a GPS module and transmits it via a GSM module to a specific mobile phone using mobile network communication. **Figure 3.3 – Concept and Overview of the Vehicle Tracking System** Vehicle tracking is a significant technological innovation that enables real-time monitoring of vehicle movements. The system relies on the Global Positioning System (GPS) to determine the precise location of the vehicle being tracked. Once the coordinates are obtained, they are sent to the user's mobile device using satellite or radio communication networks. Thanks to this advanced technology, vehicle tracking systems have gained widespread popularity, especially among owners of high-value vehicles seeking enhanced security.

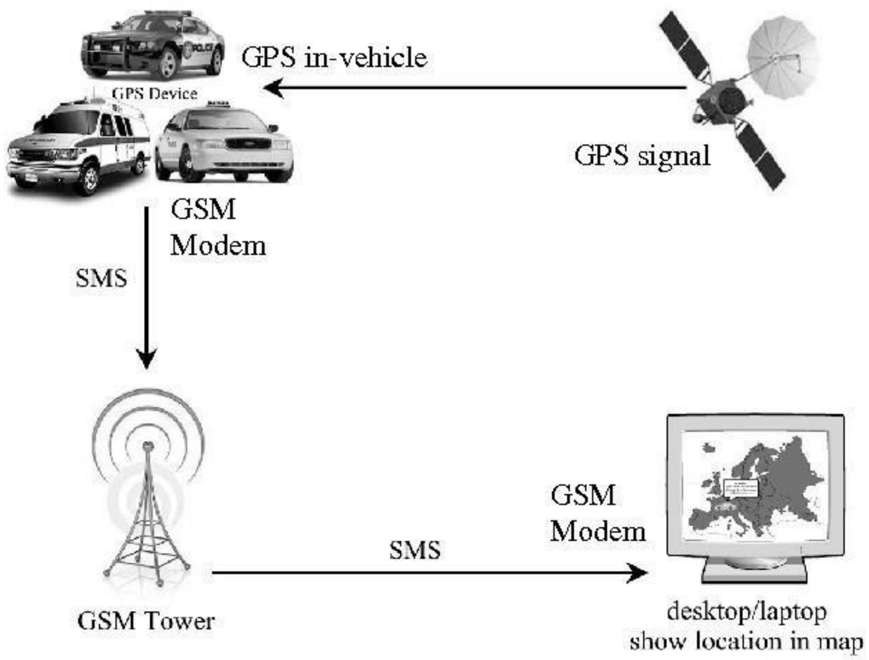


Figure 3. 2 Vehicle Tracking System Concept and Overview

The GPS system is made up of a constellation of 24 satellites orbiting the Earth, supported by ground control stations and user receivers. These satellites continuously send signals that are captured by GPS receivers on the ground. The receivers use these signals to determine their exact location, speed, and direction. GPS technology has transformed the way we travel and explore the world, enabling anyone with a GPS receiver to pinpoint their position and navigate to any location, no matter where they are on Earth.

3.4.1 Circuit Diagram

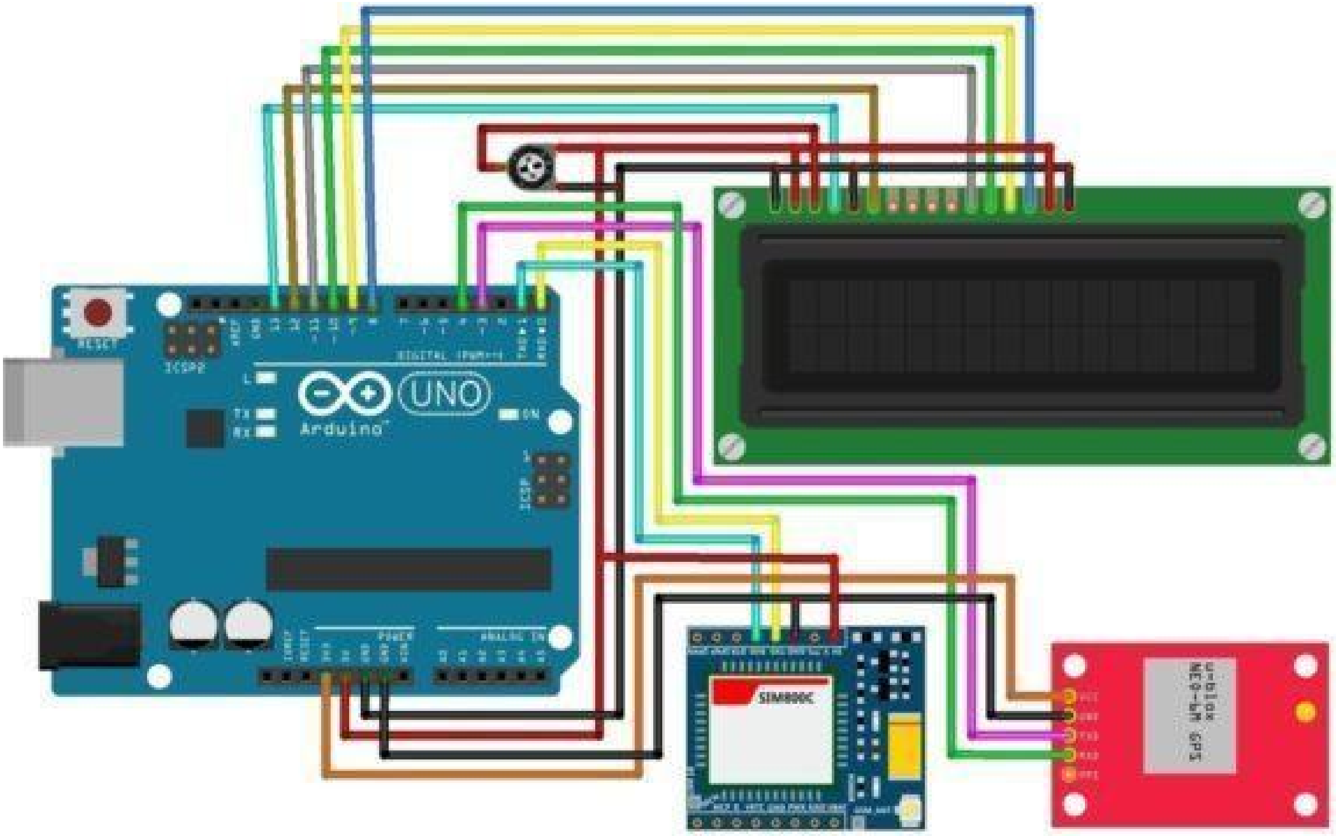


Figure 3. 3 System Circuit Diagram

3.5 Working of the system

The circuit connections for the Vehicle Tracking System are straightforward. The TX pin of the GPS module is connected directly to Arduino's digital pin 9, while its RX pin is linked to digital pin 10. Using the SoftwareSerial library, serial communication is enabled on pins 9 and 10, designating them as RX and TX, respectively. By default, pins 0 and 1 on the Arduino are used for serial communication, but the SoftwareSerial library allows for serial communication on other digital pins. The GPS module is powered by a 3.3V supply from the Arduino board. The TX and RX pins of the GSM module are connected to the Arduino's TX1 and RX1 pins. Similarly, serial communication is set up on these pins using the SoftwareSerial library, making TX1 and RX1 the designated TX and RX pins. The GSM module is powered through an external 12V supply. Additionally, the optional LCD's data pins (SDA and SCL) are connected to the Arduino for communication.

3.6 Wiring the connection

3.6.1 CONNECTING GSM MODULE TO ARDUINO

There are two methods for connecting the GSM module to the Arduino. In both cases, the communication between the Arduino and GSM module is serial. The first method involves using the serial pins (RX and TX) of the Arduino. In this case, the TX pin of the GSM module is connected to the RX pin of the Arduino, and the RX pin of the GSM module is connected to the TX pin of the Arduino (GSM TX -> Arduino RX and GSM RX -> Arduino TX). The ground pin of the Arduino should also be connected to the ground pin of the GSM module, completing the three necessary connections. At this point, the wiring is complete, and you can load the necessary programs to enable communication with the GSM module and make it functional. Note: The issue with this method is that Arduino uses the serial ports for programming via the Arduino IDE. If the RX and TX pins are being used for wiring, the program won't be successfully uploaded to the Arduino. To resolve this, you must disconnect the RX and TX connections each time you upload a new program to the Arduino. After the program has been uploaded, the connections can be re-established to get the system running. To avoid this hassle, we can use an alternate method where two digital pins of the Arduino are used for serial communication. These digital pins must be PWM-enabled. For this, we can use the TX1 and RX1 p
ins, which are PWM-enabled pins on the Arduino. This method works thanks to the SoftwareSerial library of Arduino, which allows serial communication through other digital pins by simulating hardware functions. The library takes care of the serial data communication tasks. Below is the circuit diagram that shows how to connect the GSM module to the Arduino, enabling you to send and receive SMS using the Arduino and GSM module.There are two methods for connecting the GSM module to the Arduino. In both cases, the communication between the Arduino and GSM module is serial. The first method involves using the serial pins (RX and TX) of the Arduino. In this case, the TX pin of the GSM module is connected to the RX pin of the Arduino, and the RX pin of the GSM module is connected to the TX pin of the Arduino (GSM TX -> Arduino RX and GSM RX -> Arduino TX). The ground pin of the Arduino should also be connected to the ground pin of the GSM module, completing the three necessary connections. At this point, the wiring is complete, and you can load the necessary programs to enable communication with the GSM module and make it functional. Note: The issue with this method is that Arduino uses the serial ports for programming via the Arduino IDE. If the RX and TX pins are being used for wiring, the program won't be successfully uploaded to the Arduino. To resolve this, you must disconnect the RX and TX connections each time you upload a new program to the Arduino. After the program has been uploaded, the connections can be re-established to get the system running. To avoid this hassle, we can use an alternate method where two digital pins of the Arduino are used for serial communication. These digital pins must be PWM-enabled. For this, we can use the TX1 and RX1

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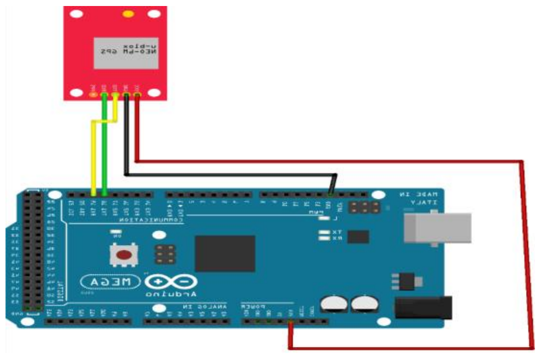


Figure 3. 4 Connection of GSM Module with Arduino.

3.6.1.1 Automatically turn on GSM shield

To enable the shield to turn on automatically instead of manually pressing the "Power" button, the following steps should be followed:

1. First, solder the R1 and R3 connections on the shield, as indicated in the figure below—highlighted in red.

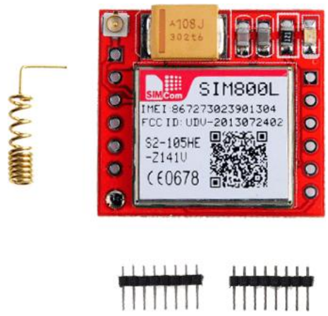


Figure 3. 5 Soldering R1&R3 Connections on GSM Module

1) • Connect the TX pin on the shield to the TX pin on the Arduino, as depicted in the schematic.
2) • Connect the TR pin on the shield to the TR pin on the Arduino, as shown in the schematic.

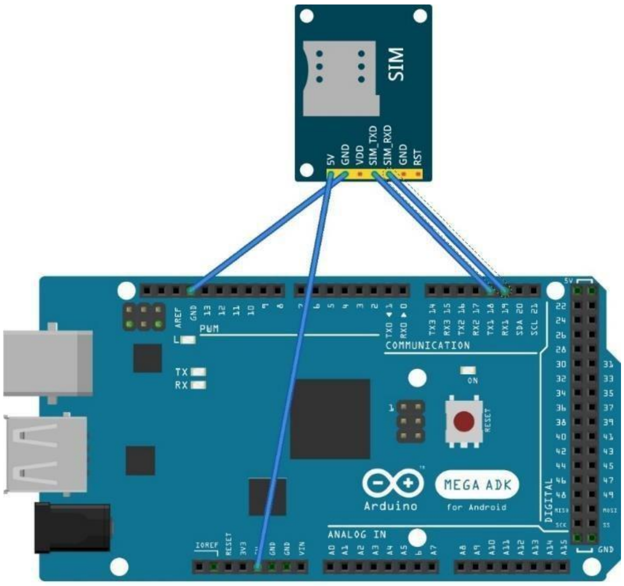


Figure 3. 6 Connection GSM with Arduino

3.6.1.2 Booting the GSM Module

4 • Insert the SIM card into the GSM module and secure it (ensure that the SIM card is not protected by a PIN lock).

5 • Connect the adapter to the GSM module and power it on (it should start automatically—refer to section 3.6.1.1 for details).

6 • Wait for a minute or so and observe the blinking pattern of the "status LED" or "network LED" (the GSM module may take a little time to establish a connection with the mobile network).

7 • Once the connection is successfully established, the status/network LED will blink continuously every 3 seconds. The module may then attempt to place a call to the mobile number associated with the SIM card, or send and receive SMS messages.

7.1.1.1 GSM Module AT Commands

The GSM module can be interfaced using AT commands. Below are some examples of GSM AT commands..

Table 3. 1 SIM800 GSM/GPRS Some AT Commands

AT Command	Description
AT	Handshaking with SIM800
AT+CMGS=PHONE_NUMBER (in international format)	Send SMS to the number
AT+CMGF=1\r	Set the SIM800 to text mode
ATDP+ PHONE_NUMBER (in international format)	Call the number
AT+CMGR=1\r	Read the second SMS from the inbox
AT+CMGR=2\r	Read the second SMS from the inbox
ATA	Receive an incoming call
ATH	Hang up a call
AT+CREG?	Check SIM registration in the network
AT+CCID	Read SIM information to confirm plugging
AT+CSQ	Signal quality test

7.1.1.2 Testing AT Command of GSM

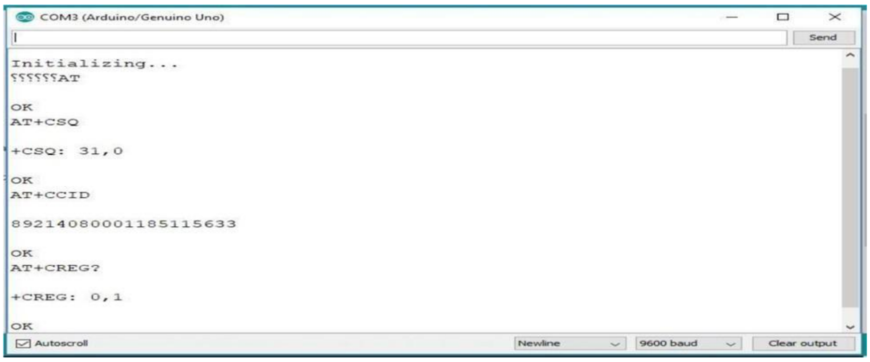


Figure 3. 7 GSM AT Command Test

7.1.2 Connecting GPS Module with Arduino

The NEO-6M GPS module has four pins: VCC, RX, TX, and GND. It communicates with the Arduino through serial communication using the TX and RX pins, making the wiring process very straightforward:*Table 3. 2 GSM Pinout with Arduino*

NEO-6M GPS Module	Wiring to Arduino UNO
VCC	5V
RX	TX pin defined in the software serial
TX	RX pin defined in the software serial
GND	GND

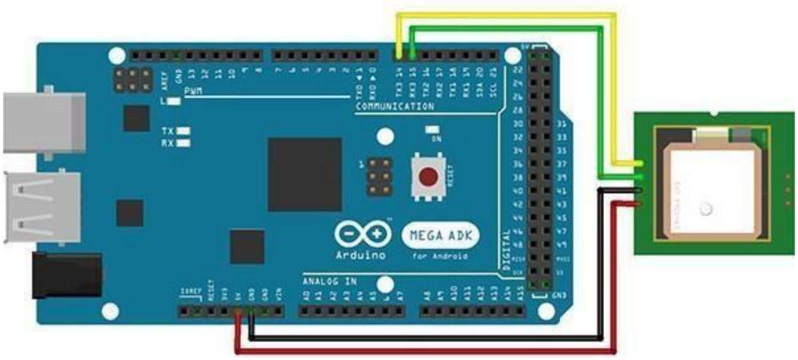
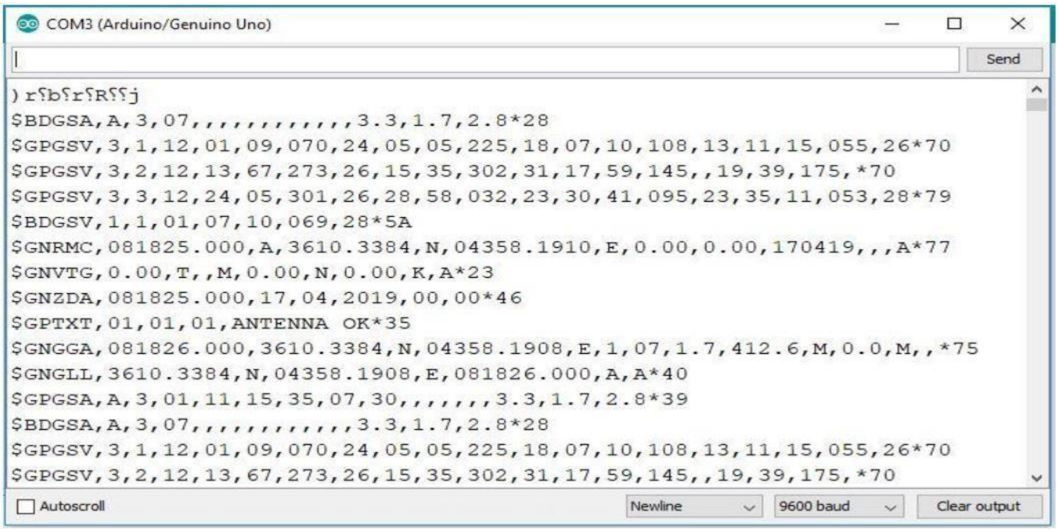


Figure 3. 8 Connection of GPS Module with Arduino

7.1.2.1 Output of GPS in the Format (Raw data)



```
$BDGSA,A,3,07,,,,,,,,,,,,3.3,1.7,2.8*28
$GPGSV,3,1,12,01,09,070,24,05,05,225,18,07,10,108,13,11,15,055,26*70
$GPGSV,3,2,12,13,67,273,26,15,35,302,31,17,59,145,,19,39,175,*70
$GPGSV,3,3,12,24,05,301,26,28,58,032,23,30,41,095,23,35,11,053,28*79
$BDGSV,1,1,01,07,10,069,28*5A
$GNRMC,081825.000,A,3610.3384,N,04358.1910,E,0.00,0.00,170419,,,A*77
$GNVTG,0.00,T,,M,0.00,N,0.00,K,A*23
$GNZDA,081825.000,17,04,2019,00,00*46
$GPTXT,01,01,01,ANTENNA OK*35
$GNGGA,081826.000,3610.3384,N,04358.1908,E,1,07,1.7,412.6,M,0.0,M,,*75
$GNGLL,3610.3384,N,04358.1908,E,081826.000,A,A*40
$GPGSA,A,3,01,11,15,35,07,30,,,,,,,3.3,1.7,2.8*39
$BDGSA,A,3,07,,,,,,,,,,,,3.3,1.7,2.8*28
$GPGSV,3,1,12,01,09,070,24,05,05,225,18,07,10,108,13,11,15,055,26*70
$GPGSV,3,2,12,13,67,273,26,15,35,302,31,17,59,145,,19,39,175,*70
```


Figure 3. 9 GPS Raw Data Output

7.1.3 Connecting LCD Module to Arduino

To connect the LCD to the Arduino board, the following pins should be connected:

- LCD Ground pin to Ground
- LCD VCC pin to +5V power
- LCD SDA pin to SDA
- LCD SCL pin to SCL

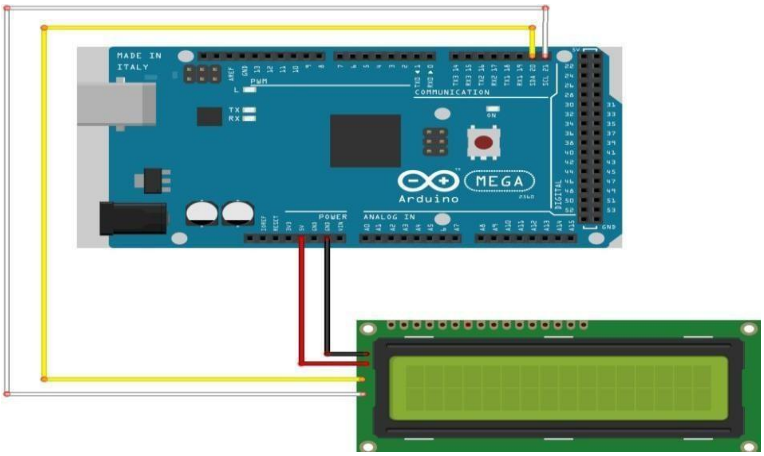


Figure 3. 10 LCD with Arduino

7.1.4 Final Wiring:

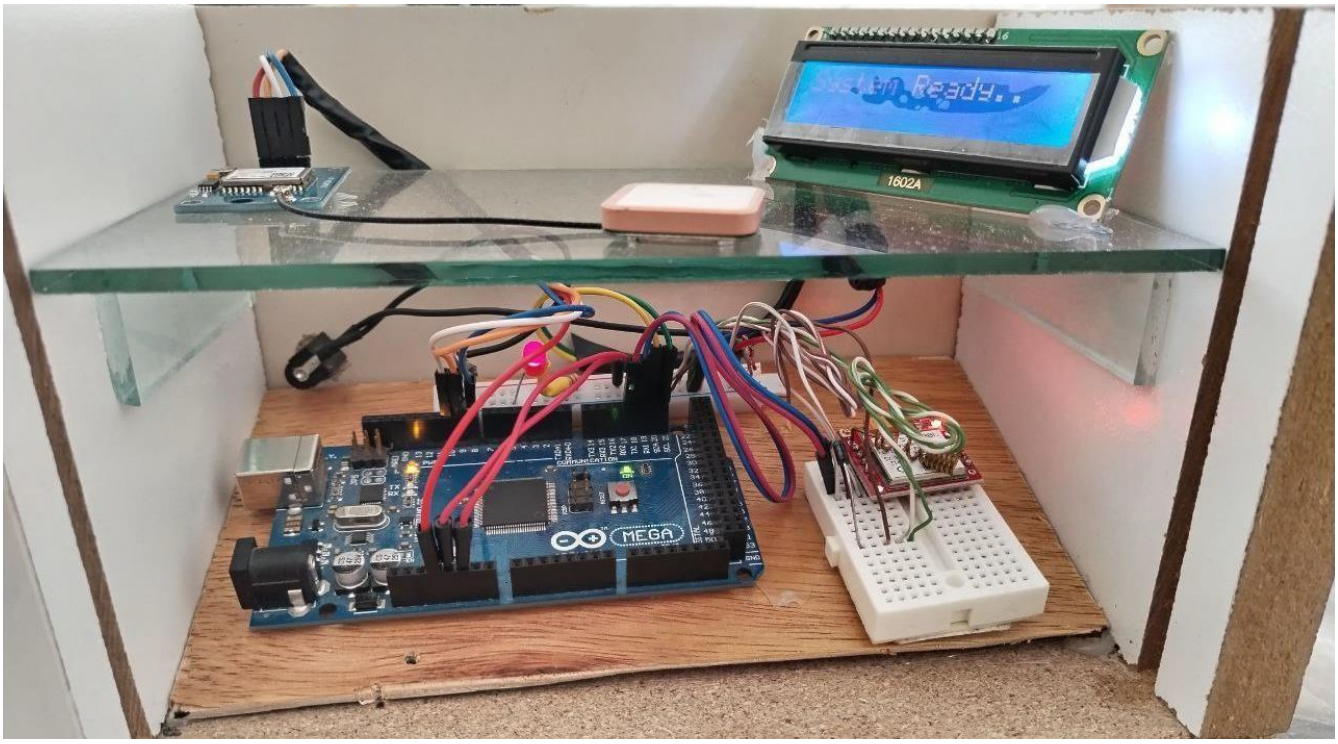


Figure 3. 11 Final Connection of Overall System

Chapter Four

4.1 Project Implementation

Figure 4. 1 Project Design

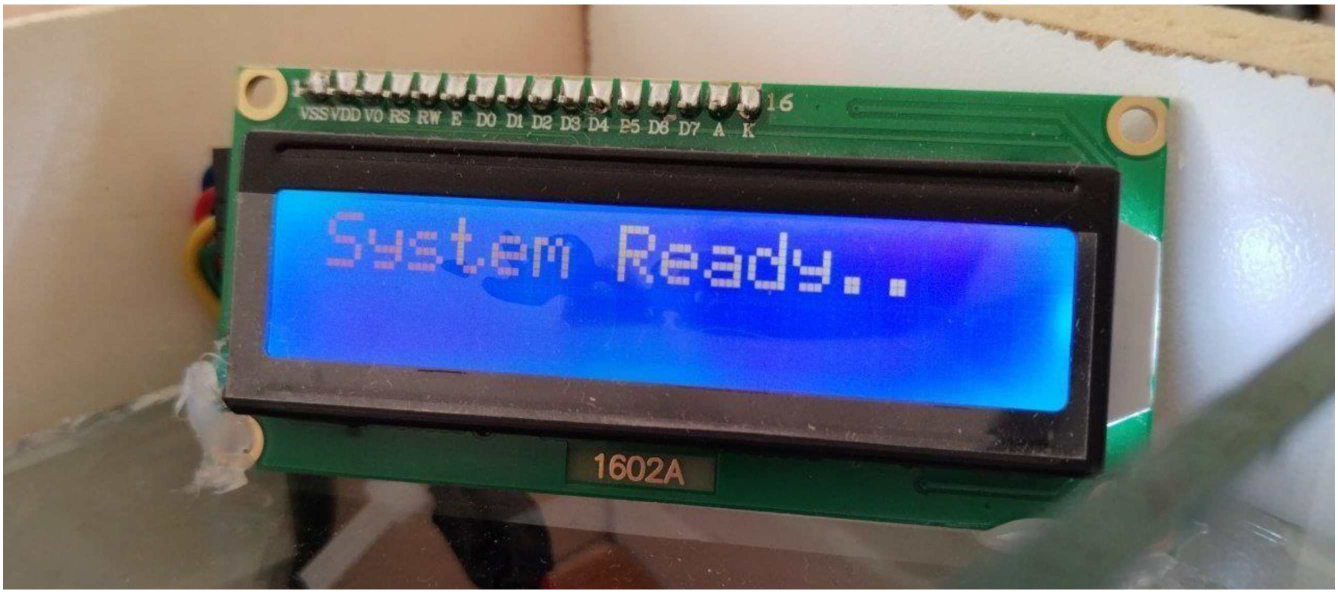


Figure 4. 2 Project ready to work

Figure 4. 3 Project find the location

4.2 System place in Vehicle

The hardware components of the project should be concealed and can be placed under the hood, such as next to the car engine. There are two ways to power the hardware components: either by using an external battery or by connecting them directly to the car's battery.

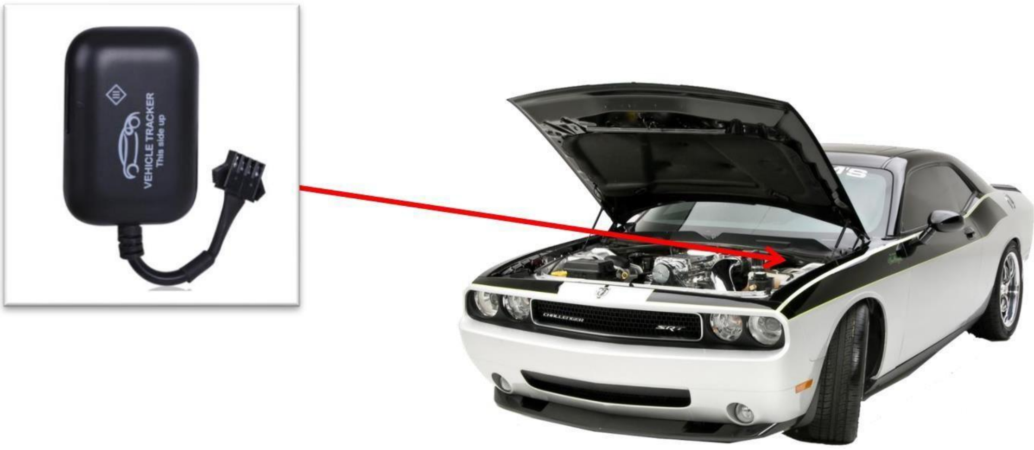


Figure 4. 4 The place of the system in the Vehicle

4.3 System flowchart

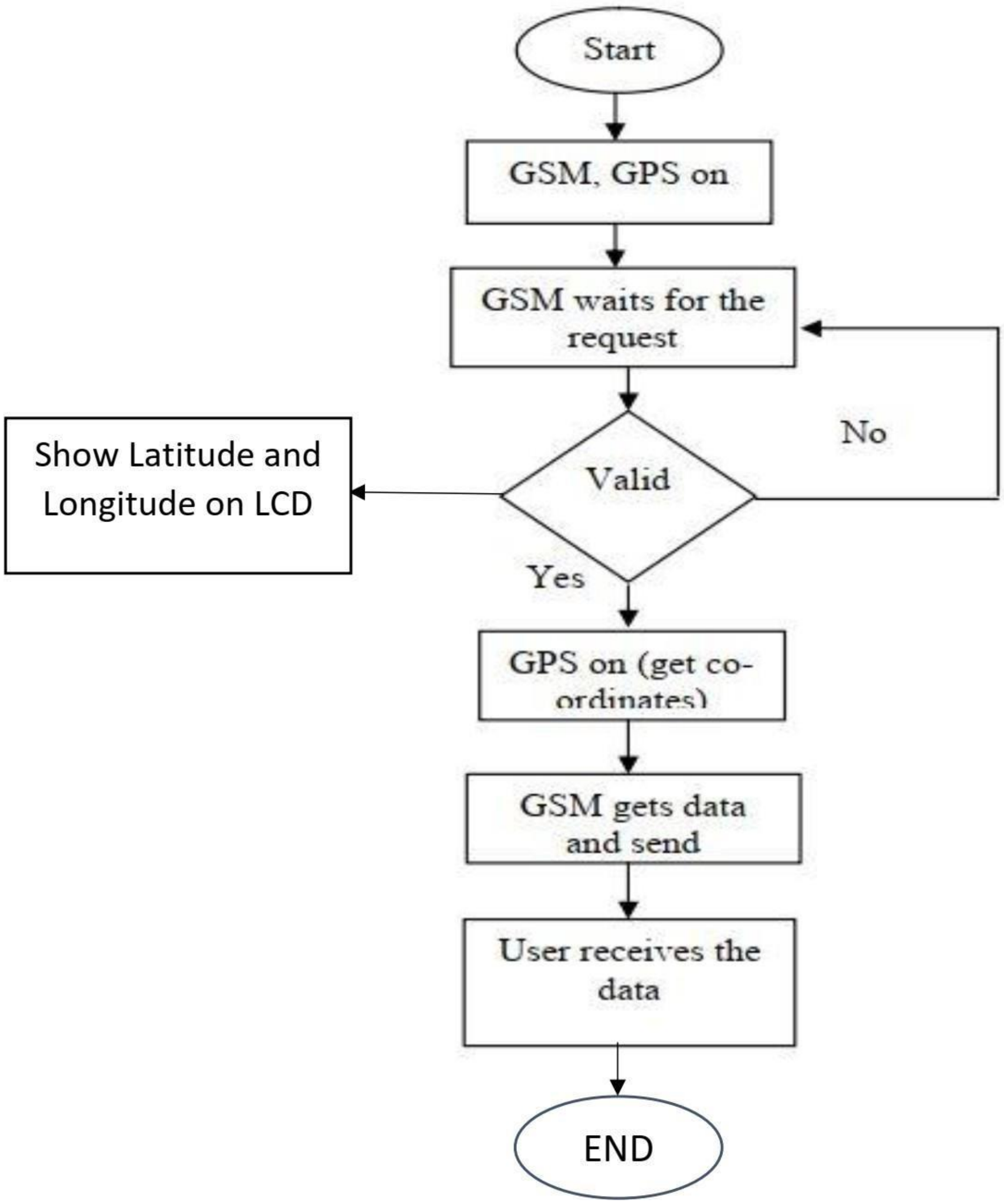


Figure 4. 5 System Flowchart

Chapter Five

5.1 Results

▪ The Tracking process allows you to instantly locate your vehicle's current position by sending a specific SMS (not all SMS messages, only the designated ones).

▪ Then The device inside the vehicle sends an SMS containing the vehicle's latitude and longitude, along with a map URL for quick navigation.

▪ Message from vehicle:

http://maps.google.com/maps/@36.172500,43.9671046

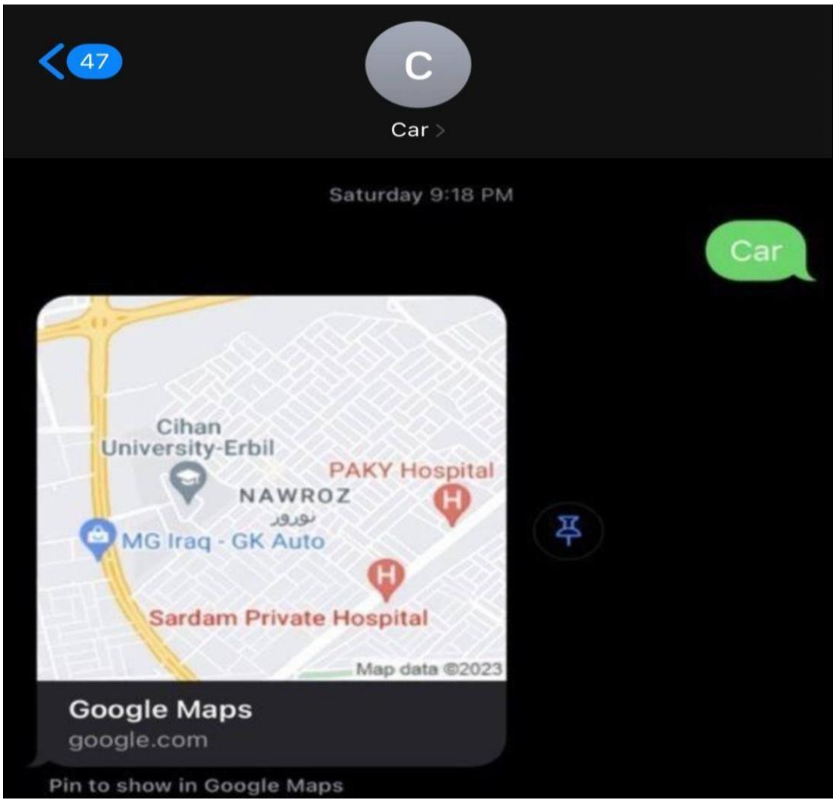


Figure 5. 1 Show the car location in Google Map

▪Additionally, the system displays the vehicle's location on the LCD connected to it to ensure the microcontroller's functionality.

Figure 5. 2 Vehicle Latitude and Longitude on LCD

5.2 Advantages

▪ Commercial fleet operators are the most common consumers of car monitoring devices. These systems are used for practical tasks such as routing, protection, dispatch, and data collection.

▪Vehicle tracking systems ensure the safety of cars.

▪ The processing is both precise and quick.

▪ The device is one-of-a-kind because we use a fingerprint reader.

▪ This project can be used to identify cabs, school buses, and institution vehicles.

▪ Applications for this project include the military, telecommunications, navigation, cars, planes, fleet management, remote monitoring, and remote control.

5.3 Conclusion

The use of vehicle tracking systems leads to improved fleet management, resulting in significant profits. This technology enables better scheduling and route planning, allowing for efficient handling of larger workloads within specific timeframes. Vehicle tracking systems offer benefits such as enhanced safety and security, improved communication, performance monitoring, and increased productivity for both personal and business use. As a result, this technology will continue to play a major role in our daily lives in the years to come.

This research paper presents an effective real-time vehicle tracking system that utilizes GPS and GPRS of a GSM network, making it flexible, customizable, and precise, suitable for various global applications. The combination of GPS and GPRS provides uninterrupted and real-time tracking of vehicles. The system employs Google Maps API to display vehicle locations on maps.

Arduino, the central processor, and the GSM module that enables data transmission over the GSM network power the system. The GPS module provides location data, which is automatically updated in the database whenever new data is received. The system provides accurate location information for vehicles, including latitude, longitude, altitude, date, satellites, speed, and course.

The outcomes of the system are comparable to industrial devices. For future work, additional services can be added to the system using sensors or actuators. One such improvement could be incorporating various types of sensors to prevent vehicle theft, which is a persistent issue that cannot be entirely eliminated.

5.4 Future Work

▪ By increasing its memory, we can navigate up to 256 locations and up to N locations. The EEPROM can be used to save past navigational positions.

▪ By integrating GPS and GSM on the same module, we may make the kit smaller.

▪ By raising the price of the GPS receivers, we can boost accuracy by up to 3m.

▪ High sensitivity vibration sensors allow us to detect accidents. With the use of a vibration sensor, we can recognize when a car has an accident on the road and relay the location to the owner, the hospital, and the police.

▪ We can help the traffic by using our gear. by maintaining the kits in every vehicle and being aware of where every vehicle is.

▪ We can quickly locate our car anywhere in the world if it is stolen.

Through maintaining vehicle location on the vehicle.

Appendix

The codes

```
#include <Wire.h>

#include <LiquidCrystal_I2C.h>

LiquidCrystal_I2C lcd(0x27,16,2);


#include <TinyGPS++.h>

#include <SoftwareSerial.h>


static const int RXPin = 10, TXPin = 9;

static const uint32_t GPSBaud = 9600; // The TinyGPS++ object

TinyGPSPlus gps;


SoftwareSerial ss(RXPin, TXPin); //SoftwareSerial sim(2,3);

String sms = "";

int a,b;

void

setup(){ delay(100

00);

Serial.begin(9600);

Serial1.begin(9600); // gsm sim800

ss.begin(GPSBaud);

Wire.begin();

 lcd.begin(16,2);

 lcd.backlight();

    lcd.clear();
```

```
  lcd.print("In the name of");
  lcd.setCursor(5,1);
  lcd.print("GOD");
  delay(2000);
  lcd.clear();
  lcd.print("System Ready..");
  delay(2000);
Serial1.println("AT+CMGF=1"); // text mode
Serial1.println("AT+CNMI=1,2,0,0,0");
Serial.println("ok");
}
float Latitude;
float Longitude;

void loop(){

while (ss.available() > 0)
{

gps.encode(ss.read());
if (gps.location.isUpdated()){

  Latitude=   (gps.location.lat());
```

```
  Longitude = (gps.location.lng());


lcd.clear();
lcd.print("lat:  ");
lcd.print(Latitude,6);
lcd.setCursor(0,1);
lcd.print("long: ");
lcd.print(Longitude,6);
delay(1000); } }
if(Serial1.available()>7){ sm
  s= Serial1.readString();
  if(sms.indexOf("car") >0){
   Serial.print("sms=");
  Serial.println(sms);
    a=1;
    sms="";
    delay(2000); } }
if(a==1){ del
  ay(1000);
Serial1.println("AT+CMGF=1");
  delay(400);
 Serial1.println("AT+CMGS=\"+9647514451216\"");
```

```
delay(400);
Serial1.print("https://www.google.com/maps/@" );
Serial1.print(Latitude,6);
Serial1.print(',');
Serial1.print(Longitude,6);
Serial1.print(",14z");
delay(400);
Serial1.write(26);
a=0;
delay(6000);
}
}
```

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