Shuttle Tracking Device

Submitted in partial fulfillment of the requirements for the degree of

Bachelor of Technology

in

Computer Science

By

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VIT Vellore

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I further declare that the work reported in this thesis has not been submitted and will not be submitted, either in part or in full, for the award of any other degree or diploma in this institute or any other institute or university.

Place : Vellore

Date : 11/11/2022

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CERTIFICATE

This is to certify that the thesis entitled "Shuttle Tracking System" submitted by Sanskriti Bansal - 20BCE2634, Rashi Pant - 20BCE2244, Kartik Gupta - 20BCE2308, Ishika Garg - 20BCE2793 and Harshwardhan Singh Rajawat - 20BCI0300, VIT, for the award of the degree of *Bachelor of Technology in Computer Science*, is a record of bonafide work carried out by the team under my supervision during the period, 20.07.2022 to 06.12.2022, as per the VIT code of academic and research ethics.

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Place : Vellore

Date : 10 November 2022

Signature of the Guide

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EXECUTIVE SUMMARY

A VIT student must frequently decide whether it is faster to wait for the shuttle or walk to his or her destination, especially when stuck in the rain. One may end up waiting for a long time for the shuttle, causing them to be late or, in the worst-case scenario, miss their classes. Students, on the other hand, could make a more accurate, informed decision about whether or not to wait at a stop if they had an easy way to see each bus's location in real-time.

Therefore, there is a need to develop a device which may overcome this problem by providing the actual location of the bus. As a result, the 'Shuttle Tracking System' attempts to complete this task in order to improve the existing transportation service.

In this project, we aim to accomplish the above said task by fetching the actual current coordinates of the device which are displayed on the LCD device used in the project. The device can further be used to provide location of specific shutter on google maps with a link being sent directly to the user.

The project highlights the way in which microcontrollers could be helpful in solving the real time problems and providing effective solutions by means of a functioning working model.

CONTENTS

Page No.

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

1.1 OBJECTIVE

- To create a Shuttle Tracking Device using arduino, GPS and GSM module which will be fitted in the shuttle bus.
- To make an interface using which students, staff and visitors of VIT can track the shuttle bus and make accurate and informed decisions of whether to keep walking or wait for the bus.

1.2 MOTIVATION

A VIT student must frequently decide whether it is faster to wait for the shuttle or walk to his or her destination, especially when stuck in the rain. One may end up waiting for a long time for the shuttle, causing them to be late or, in the worst-case scenario, miss their classes. Students, on the other hand, could make a more accurate, informed decision about whether or not to wait at a stop if they had an easy way to see each bus's location in real-time. As a result, the 'Shuttle Tracking System' attempts to complete this task in order to improve the existing transportation service.

1.3 BACKGROUND

S. no.	Title and author	Concept	Conclusion
1.	**GPS and GSM Based Vehicle Tracking System** by Ni Ni San Hlaing, Ma Naing, San San Naing, 2019.	An efficient vehicle tracking system is designed and implemented for tracking the movement of any equipped vehicle from any location at any time. The proposed system made good use of popular technology that combines a smartphone with an Arduino UNO.	This system is completely integrated and it becomes possible to the user to track their car very easily at any time and from anywhere. These systems keep a good control on the thefts and help avoiding them to some extent.

2.	**Smart Vehicle Tracking System using GPS and GSM Technologies** by Shraddha Shree Tummanapally and Saideep Sunkari. 2021	The significant goal is to make a security framework for every one of the vehicles. Brilliant vehicle global positioning framework is intended for following the development of the vehicle outfitted with planned framework for any area whenever. Henceforth, guaranteeing the security on the off chance that it is lost or harmed.	As the vehicle robbery is expanding step by step however because of this individual wasn't try not to utilize vehicles yet they tracked down an effective method to watch out for their vehicle without being extremely near them.

3.	**Real Time Bus Tracking System**, June 2020, International Journal of Engineering and Technical Research	Waiting time for transport in crowded cities leads to less productivity on a whole. People face this problem in their daily life where they have no idea about the current status of their transport. So the proposed solution is an android based application that will help the user to check out the current location of the bus and also will help the user to know how much time the bus will take to reach the current location of the user.	The system allows a user to track their bus from the android app. With the help of tracking user can see how far the bus is this allows user to plan their route and travel plan accordingly. App will also give the approximate time and distance of the bus.
4.	**Analysis of Bus Tracking System Using GPS on Smartphones**, June 2014	Public transport networks (PTNs) are difficult to use when the user is unfamiliar with the area they are traveling to. This is true for both infrequent users (including visitors) and regular users who need to travel to areas with which they are not acquainted. In these situations, adequate on-trip navigation information can substantially ease the use of public transportation and be the driving factor in motivating travellers to prefer it over other modes of transportation.	Sustainable urban mobility is a key factor for a citizen's quality of life, as an increasingly larger amount of the population lives in urban areas. The integration and interoperability of different transport networks are seen in that document as a key feature for the improvement of urban mobility, together with improved travel information.

5	**Microcontroller-Based Automobile Tracking System with Audio Surveillance using GPS and GSM Module** By -Nureni A. Yekini., Adetokunbo O. Oloyede, Akinwole K. Agnes and Folasade M. Okikiola, 2016	Automobile tracking system with audio surveillance using GPS and GSM Module to provide an alternative solution to security challenges experienced by car owner, and to develop a system that can track the location of vehicles. To make use of Microcontroller Unit, GPS, and GSM unit. The design is an embedded application, which will continuously monitor a moving Vehicle and report the status of the Vehicle on demand	Vehicle Tracking System with audio surveillance using GPS and GSM presents efficient location of the vehicle on the map by integrating the several communication technologies and display setups. The locations of the vehicle are displayed on Google map, GPS and GSM modems are used to track the location of the information and to send the information to tracking server.
6	**Vehicle tracker system design based on GSM and GPS interface using arduino as platform**. Narcisa T. Morallo. 2021	A vehicle tracker based on global system for mobile communication (GSM) and GPS Interface using Arduino as platform designed to track vehicles remotely using GSM network. While previous works uses internet to track vehicles. This is a low-cost design with materials readily available. The importance of this project is for cost-savings and security.	A design of vehicle tracker system using GSM, GPS, and Arduino is successfully developed. A working design for the system provides an accurate and timely data. Throughout the test, location tracking was accurate. A tolerable average time delay of less than a minute was computed during the test. GPS and GSM modules are proved to be very efficient in designing a vehicle tracker with this platform.

Table 1.1: Literature Review

2. PROJECT DESCRIPTION AND GOALS

In this project, we will learn about how to make a GPS & GSM Based Vehicle Tracking System using Arduino. Most of the vehicle tracking systems available in the market are too costly. So, we decided to make our own Tracking System. The vehicle tracking system will send you the location to your mobile phone along with the Google map coordinate. You can request the location at any time & view the location on Google Maps installed on your mobile phone.This is a cheaper solution than a two-way GPS communication system where the communication is done in both ways with GPS satellites. This project uses only one GPS device and two-way communication is achieved using a GSM modem. The GSM modem with a 2G SIM card is used for communication between the device and mobile phone.

We have to select a proper low power GSM & GPS Module.The Board has a 32-bit ATSAMD21 controller from Atmel which can be programmed using Arduino IDE. You can also make this project using Neo-6M GPS Module & SIM 800/900 GSM Module with Arduino UNO Board. But this will make the device size large. We will discuss in detail about this Arduino GPS & GSM Based Vehicle Tracking System.

3. TECHNICAL SPECIFICATION

Arduino has an 8-bit controller but it has a 32 bit Atmel ATSAMD21G18 controller, which makes the device super fast. It has a voltage regulator IC to control the excess voltage. Similarly, there are two antennas, one is the GSM Antenna & another one the GPS Antenna. The signal problem is not seen in this module because of its best design. You can insert a micro sim here. Remember this is a 2G Modem only, so only 2G Sim can be used according to the frequency band. It also has a Micro-SD Port. You can also use an SD Card to save the data in text format.The board doesn't need any external DC Jack or higher power supply. It can be powered using a 3.7V, 100mah Lithium-Ion Battery. There are two battery ports in the module, one port is for the Battery charging and the other for the Battery power supply. Once the battery is connected, you can slide the switch to turn on the device. Two LEDs are there which indicate the status of the power.

3.1 GPS+GSM Based Vehicle Tracking System using Arduino

The Arduino IDE doesn't have any pre-installed support for the SAMD Board. So you need to add the Board first to the Arduino IDE. So, go to the board manager and search for Arduino Zero.On the hardware part, connect the micro USB cable to the Maduino Zero Board. And also connect the other end to the computer USB port.
Now go to the tools, here you will find the Arduino SAMD Board. So from the list select the Arduino Zero Native USB Port. Also from the list select the com port.

3.2 Working of the Arduino GPS+GSM Vehicle Tracking

After uploading the code, open the Serial Monitor. The Serial Monitor will display the initialization message. If the location is fixed, Serial Monitor will display the Latitude and Longitude. If the location is still not retrieved, the Serial Monitor will still display the Checking Module.

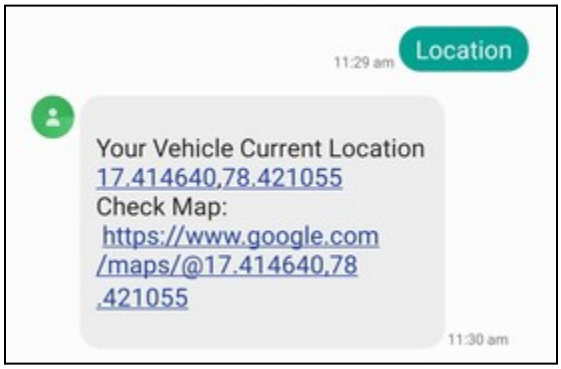

Fig 3.1

Now you can send the SMS to get the Location. So, on your mobile phone open the messaging app and then enter the phone number of the SIM used in the Arduino Zero board. After that, type the word "Location", and then simply send it.

Within a while, the Serial Monitor will display the message received status and also tells about the date ,time, and mobile number. Similarly, you will receive an SMS on your mobile phone with the Latitude Longitude coordinate. Along with the coordinate, you will receive a link to google maps. You can click the link and open it either using google maps or using a Chrome browser.

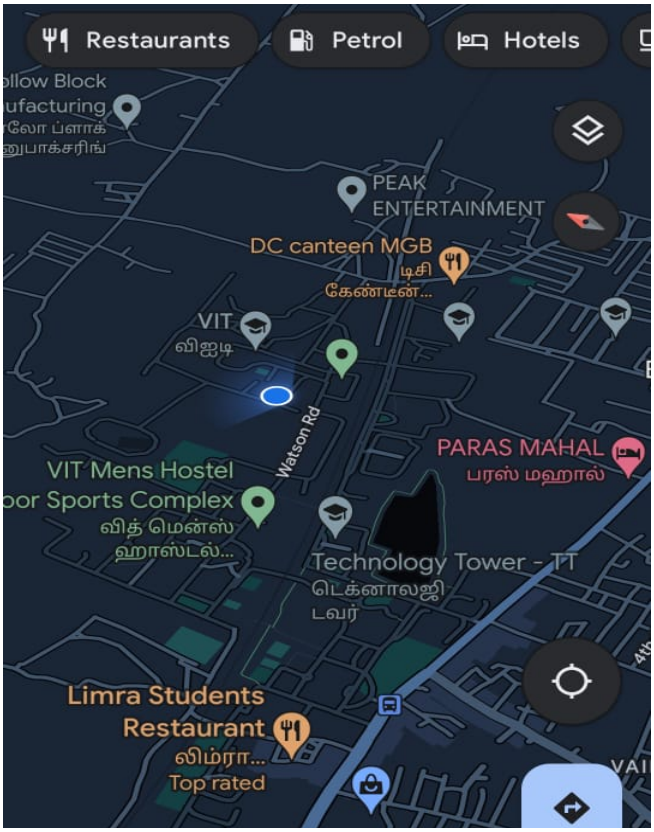

Fig 3.2

This can be implemented in shuttle buses for tracking or It can be used for controlling the theft of the vehicle. Or it can be used in finding the location of someone who is using your vehicle.

4. DESIGN APPROACH AND DETAILS

4.1 DESIGN APPROACH MATERIALS AND METHODS

Sample circuit diagram of our project:

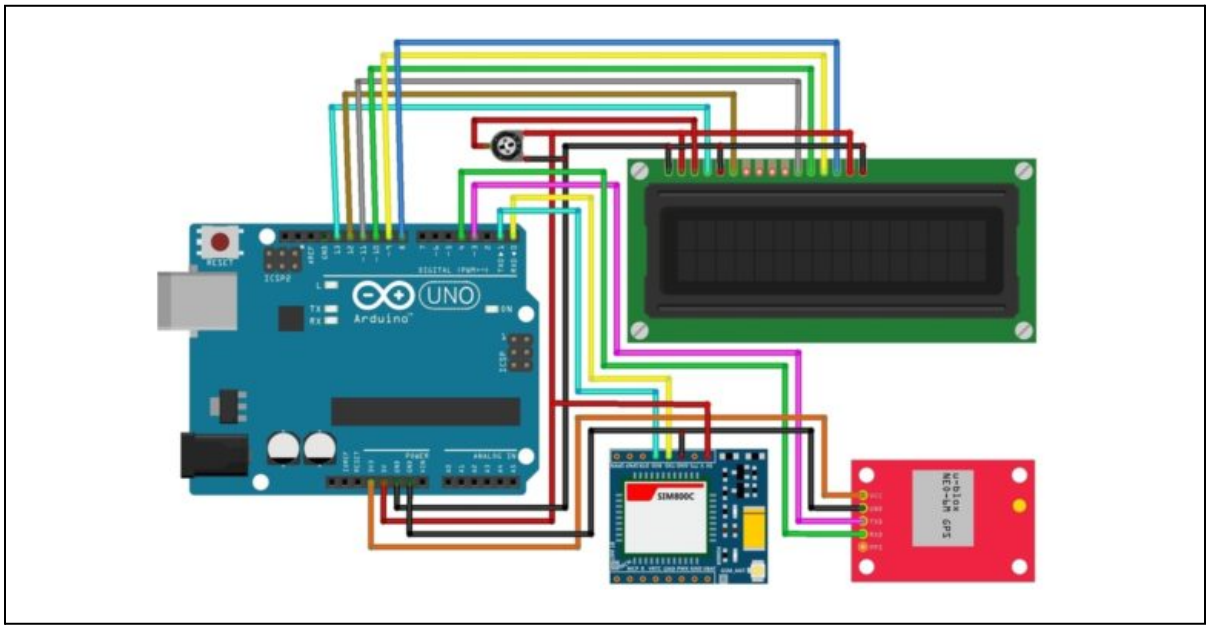

Fig 4.1

Components used in our project:

Arduino UNO R3

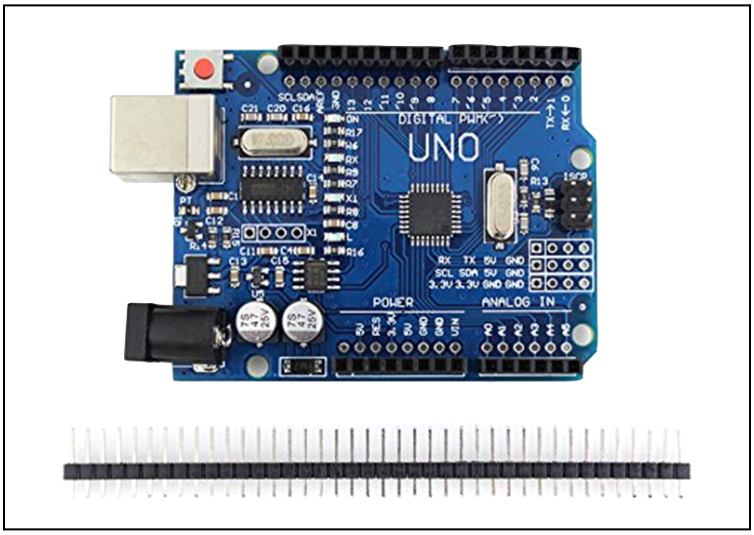

Fig 4.2

Arduino Uno R3 is one kind of ATmega328P based microcontroller board. It includes the whole thing required to hold up the microcontroller; just attach it to a PC with the help of a USB cable, and give the supply using AC-DC adapter or a battery to get started.
The R3 Arduino Uno is the 3rd as well as most recent modification of the Arduino Uno. Arduino board and IDE software are the reference versions of Arduino and currently progressed to new releases. The Uno-board is the primary in a sequence of USB-Arduino boards, & the reference model designed for the Arduino platform.

GSM SIM 800L

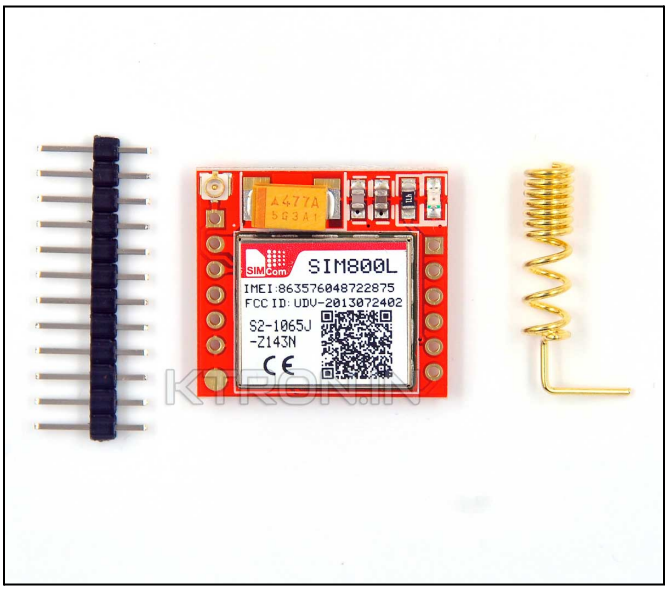

Fig 4.3

The SIM800L GSM/GPRS module is a miniature GSM modem that can be integrated into a large number of IoT projects. You can use this module to accomplish almost anything that a normal cell phone can do such as sending SMS messages, making phone calls, connecting to the Internet via GPRS.
At the heart of the module is a SIM800L GSM cellular chip from Simcom.
The chip's operating voltage ranges from 3.4V to 4.4V, making it an ideal candidate for direct LiPo battery supply. This makes it a good option for embedding in projects that are short of space and much more.

NEO 6M GPS MODULE

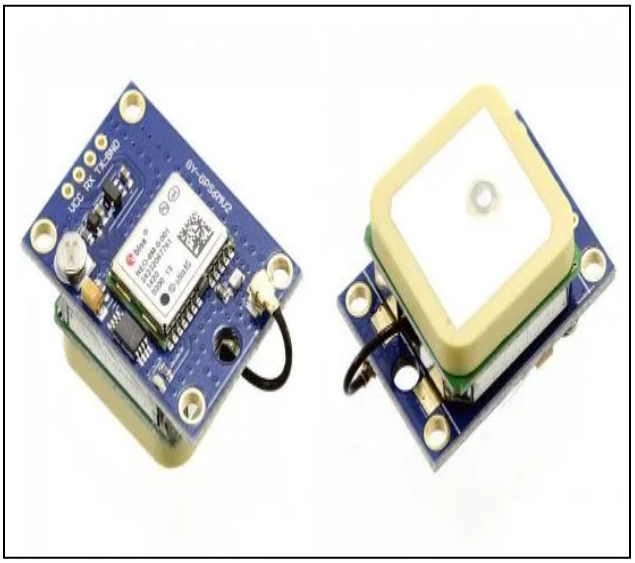

Fig 4.4

The u-blox NEO-6M GPS engine on these modules is quite a good one, and it also has high sensitivity for indoor applications. Furthermore, there's one MS621FE-compatible rechargeable battery for backup and EEPROM for storing configuration settings. The module works well with a DC input in the 3.3- to 5-V range (thanks to its built-in voltage regulator).

BREADBOARD

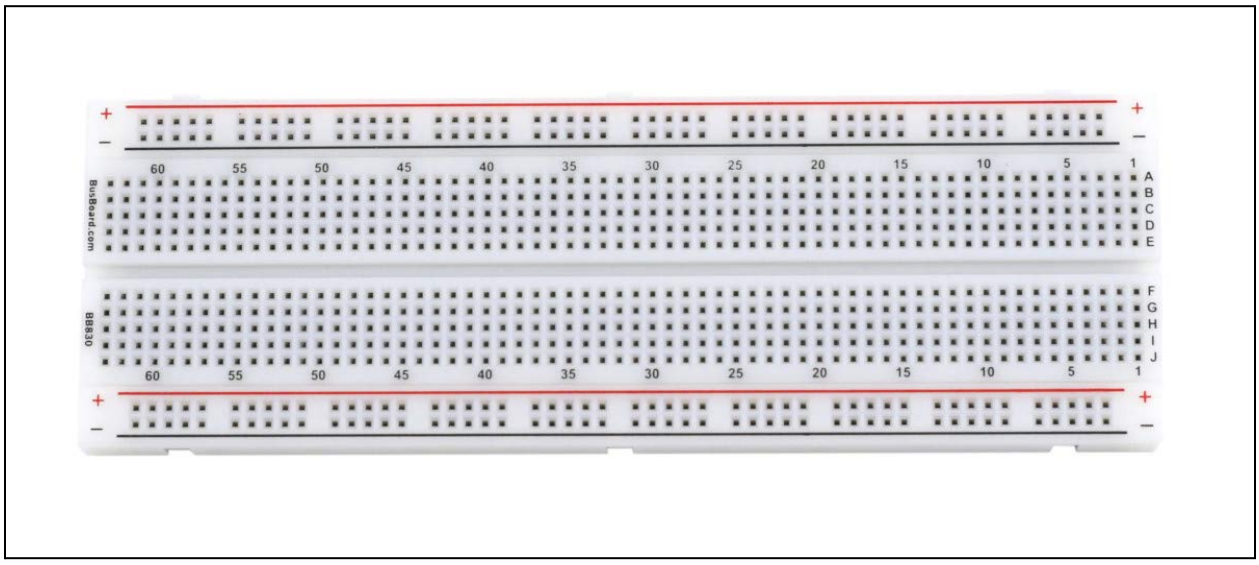

Fig 4.5

A breadboard, solderless breadboard, or protoboard is a construction base used to build semi-permanent prototypes of electronic circuits. Unlike a perfboard or stripboard, breadboards do not require soldering or destruction of tracks and are hence reusable. For this reason, breadboards are also popular with students and in technological education.

A variety of electronic systems may be prototyped by using breadboards, from small analog and digital circuits to complete central processing units (CPUs).

LCD DISPLAY

Fig 4.6

LCD (Liquid Crystal Display) is a type of flat panel display which uses liquid crystals in its primary form of operation. LEDs have a large and varying set of use cases for consumers and businesses, as they can be commonly found in smartphones, televisions, computer monitors and instrument panels.

4.2 CODES AND STANDARDS

CODE:

```
#include <TinyGPS++.h>
#include <SoftwareSerial.h>
#include<LiquidCrystal.h>
LiquidCrystal lcd(13, 12, 11, 10, 9, 8);
```

```
static const int RXPin = 4, TXPin = 3;
static const uint32_t GPSBaud = 9600;
const byte interruptPin = 2;
volatile byte state = LOW;
// The TinyGPS++ object
TinyGPSPlus gps;
int temp=0,i;
// The serial connection to the GPS device
SoftwareSerial ss(RXPin, TXPin);
String stringVal = "";
void setup(){
  Serial.begin(9600);
  pinMode(interruptPin, INPUT_PULLUP);
  attachInterrupt(digitalPinToInterrupt(interruptPin), blink,
FALLING);
  ss.begin(GPSBaud);
  lcd.begin(16,2);
  pinMode(13,OUTPUT);
  digitalWrite(13,LOW);
  lcd.print("Vehicle Tracking");
  lcd.setCursor(0,1);
  lcd.print("    System      ");
  delay(2000);
  gsm_init();
  lcd.clear();
  Serial.println("AT+CNMI=2,2,0,0,0");
  lcd.print("GPS Initializing");
  lcd.setCursor(0,1);
  lcd.print("  No GPS Range  ");
  delay(2000);
  lcd.clear();
  lcd.print("GPS Range Found");
```

```
  lcd.setCursor(0,1);
  lcd.print("GPS is Ready");
  delay(2000);
  lcd.clear();
  lcd.print("System Ready");
  temp=0;
}

void loop()
{
  if(state){
    lcd.clear();
    lcd.setCursor(0,1);
    lcd.print("Loc. Request");
    delay(1000);
    lcd.clear();
    lcd.setCursor(0,1);
    lcd.print(lat);
    lcd.print(",");
    lcd.print(longi);
    delay(2000);
    lcd.clear();
    lcd.setCursor(0,1);
    lcd.print("System Ready");
  }
serialEvent();

      while(temp)
      {
        while (ss.available() > 0)
        {
          gps.encode(ss.read());
```

```
                if (gps.location.isUpdated())
                {
                 temp=0;
                 digitalWrite(13,HIGH);
                 tracking();
                }
          if(!temp)
          break;
        }
      }
      digitalWrite(13,LOW);
}
void serialEvent()
{
  while(Serial.available()>0)
  {
    if(Serial.find("Track Vehicle"))
    {
      Serial.println("Loop Entered");
      temp=1;
      break;
    }
    else
    {
    temp=0;
    }
  }
}
void gsm_init()
{
  lcd.clear();
  lcd.print("Finding Module..");
```

```
boolean at_flag=1;
while(at_flag)
{
  Serial.println("AT");
  delay(1);
  while(Serial.available()>0)
  {
    if(Serial.find("OK"))
    at_flag=0;
  }

  delay(1000);
}
lcd.clear();
lcd.print("Module Connected..");
delay(1000);
lcd.clear();
lcd.print("Disabling ECHO");
boolean echo_flag=1;
while(echo_flag)
{
  Serial.println("ATE0");
  while(Serial.available()>0)
  {
    if(Serial.find("OK"))
    echo_flag=0;
  }
  delay(1000);
}
lcd.clear();
lcd.print("Echo OFF");
delay(1000);
```

```
  lcd.clear();
  lcd.print("Finding Network..");
  boolean net_flag=1;
  while(net_flag)
  {
    Serial.println("AT+CPIN?");
    while(Serial.available()>0)
    {
      if(Serial.find("+CPIN: READY"))
      net_flag=0;
    }
    delay(1000);
  }
  lcd.clear();
  lcd.print("Network Found..");

  delay(1000);
  lcd.clear();
}
void init_sms()
{
  Serial.println("AT+CMGF=1");
  delay(400);
  Serial.println("AT+CMGS=\"+918850015326\"");   // use your 10
digit cell no. here
  delay(400);
}
void send_data(String message)
{
  Serial.print(message);
 delay(200);
}
```

```
void send_sms()
{
  Serial.write(26);
}
void lcd_status()
{
  lcd.clear();
  lcd.print("Message Sent");
  delay(2000);
  lcd.clear();
  lcd.print("System Ready");
  return;
}
void tracking()
{
    init_sms();
    send_data("Vehicle Tracking Alert:");
    Serial.println(" ");
    send_data("Your Vehicle Current Location is:");
    Serial.println(" ");
    Serial.print("Latitude: ");
    Serial.print(gps.location.lat(), 6);
    Serial.print("\n Longitude: ");
    Serial.println(gps.location.lng(), 6);

   // https://www.google.com/maps/@8.2630696,77.3022699,14z
   Serial.print("https://www.google.com/maps/@");
   Serial.print(gps.location.lat(), 6);
   Serial.print(',');
   Serial.print(gps.location.lng(), 6);
   Serial.print(",14z");
    send_sms();
```

```
    delay(2000);
    lcd_status();
}
void blink() {
  state = !state;
}
```

4.3 CONSTRAINTS, ALTERNATIVES AND TRADEOFFS

Constraints: The gsm module is old and it only supports 2g sim support which is very hard to find these days. The gsm module with a higher model is hard to find in the market and really expensive.

Alternatives And Tradeoffs: Instead of GPS module and GSM module, we could have used wifi module and GPS coordinates collected through phone using peer to peer sharing but we avoided that due to unstable wifi connection in the campus.

5. SCHEDULE TASKS AND MILESTONES

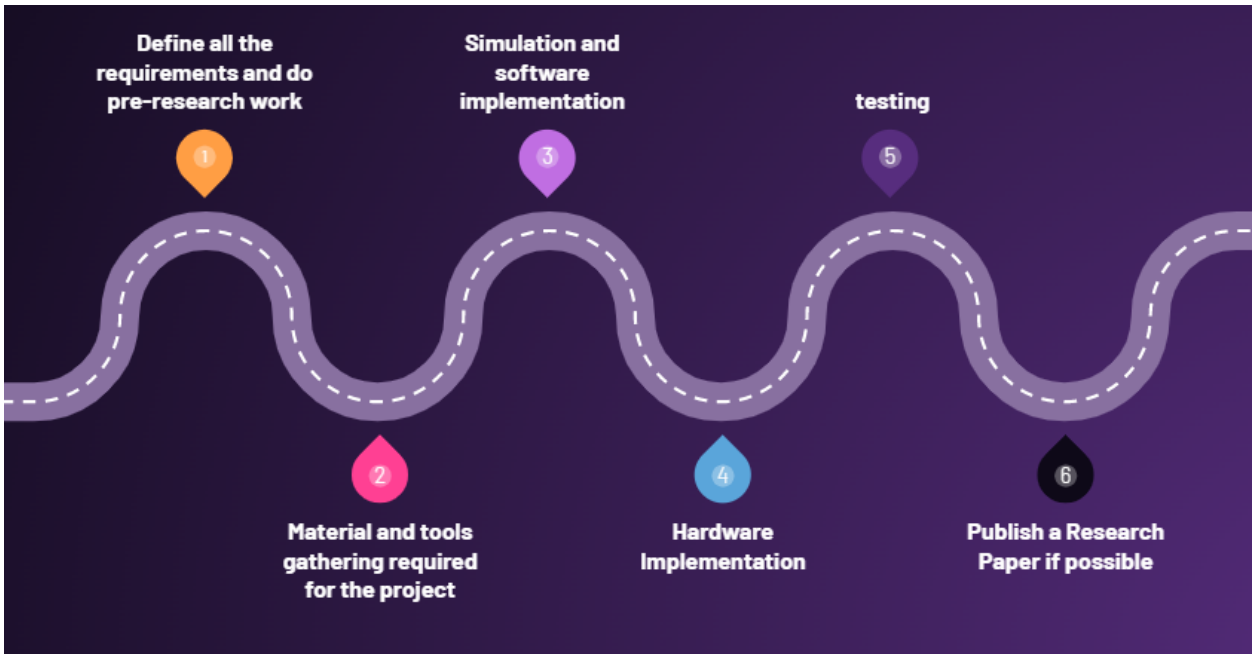

Fig 5.1

6. PROJECT DEMONSTRATION

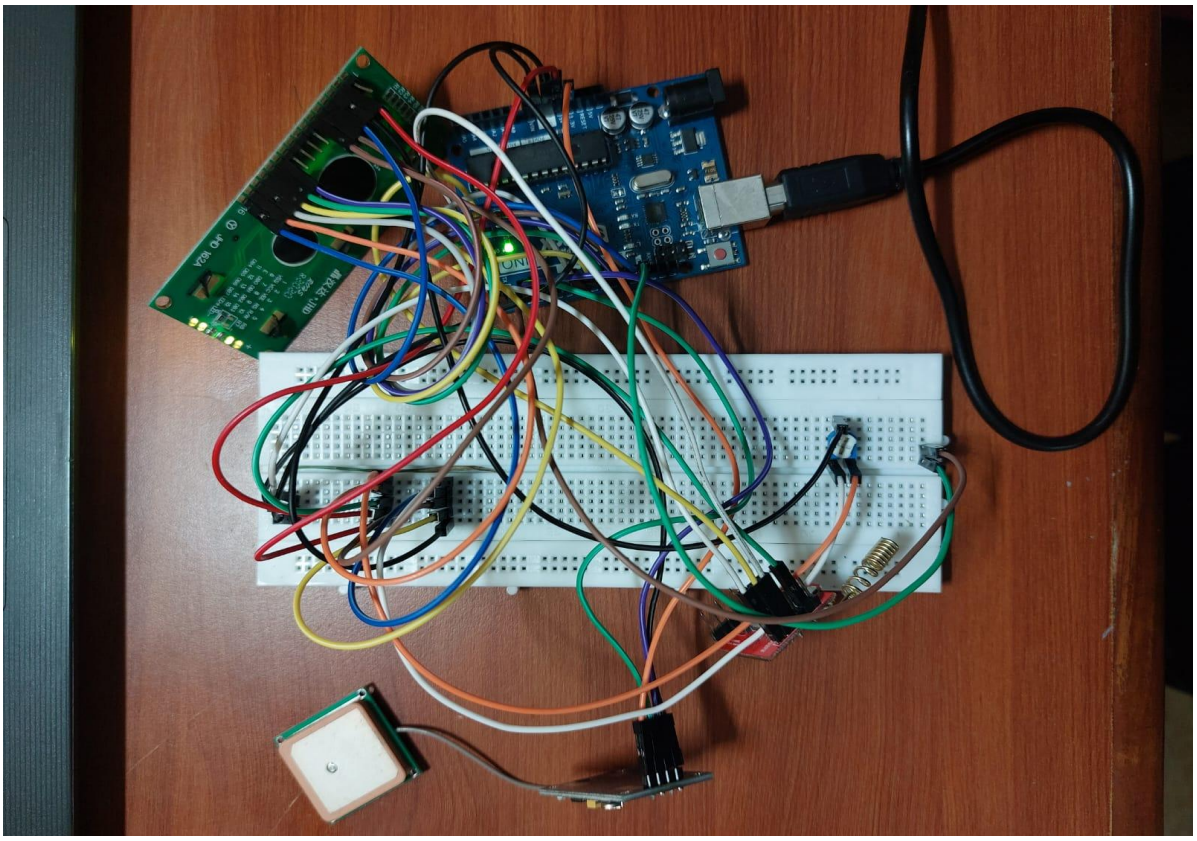

Fig 6.1

Fig 6.2

Fig 6.3

WORKING:

https://drive.google.com/file/d/1lMifq6H-hpuJg7iTSMfThpCfhZOEjHdv/view?usp=share_link

EFFICIENCY:

The efficiency of our proposed model is found to be 75% which can be improved further in the future.

7. COST ANALYSIS AND DISCUSSION

The total cost of this project was around Rs. 2700, comprising of:

Component	Price (Rs.)
SIM800L GPRS GSM Module	330
Breadboard 840 point with jumper wires	219
Digital Potentiometer	229
LCD 16*2 DISPLAY	230
NEO-6M GPS	800
Arduino UNO	800

Table 2.1: Cost Breakdown

8. FUTURE WORK

An appropriate front end or user-based API can be linked to the shuttle tracking system in order to get more accurate results. Newer models of GSM and GPS might prove more efficient and can give the exact position of the shuttle/vehicle.

9. SUMMARY

An efficient vehicle tracking system is designed and implemented for tracking the movement of any equipped vehicle from any location at any time. The proposed system made good use of popular technology that combines a smartphone with an Arduino UNO. This is easy to make and inexpensive compared to others. The designed in vehicle device works using Global Positioning System (GPS) and Global System for Mobile Communication (GSM) technology that is one of the most common ways for vehicle tracking. The device is embedded inside a vehicle/shuttle for those positions to be determined and tracked in real time. An Arduino UNO is used to control the GPS receiver and GSM module.

The shuttle tracking system uses the GPS module to get geographic coordinates at regular time intervals. The GSM module is used to transmit and update the shuttle location to a database. This project gives minute by minute updates about shuttle location by sending SMS through GSM modem. This SMS contains the latitude and longitude of the location of the shuttle. Arduino UNO gets the coordinates from GPS modem and then it sends this information to user in text SMS. GSM modem is used to send this information via SMS sent to the owner of the vehicle. Location is displayed on LCD. And then Google map displays location and name of the place on the cell phone. Thus, users are able to continuously monitor a moving vehicle on demand using a smartphone and determine the estimated distance and time for the vehicle to arrive at a given destination.

10. REFERENCES

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