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GPS Tracker for Supply Chain Logistics

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Chapter 1

1.1 Background

Regarding transit logistics and all the details involved in transport, there is much that can go wrong in any workday. A fleet manager is a logistics manager who may work for any company that utilises a fleet of vehicles for their business. Fleet management is essential to a smooth operating fleet of vehicles, regardless of size [1]. Any business that owns a fleet often has its vehicles spread out across a wide geographical area, state lines and sometimes even international borders. When everything is everywhere, tracking all assets, locating drivers and having effective communication can be challenging, especially for fleet managers [2].

1.2 Motivation

The project aims to help Fleet managers to monitor the activity of fleet vehicles and assets (e.g., workers and equipment) using GPS tracking, which is also termed Fleet Tracking. With our GPS Tracking, locating vehicles is made possible instantly and effectively. Live updates on all of the fleets or narrow it down to one Vehicle at any given moment. With real-time information and insights on the assets and drivers, fleet managers can also respond to any emergencies or dangers immediately. It can also avoid accidents caused by drivers being on their mobiles to communicate with their officials whilst driving.

The GPS tracking system will consist of an Arduino Uno board, Global Positioning System [GPS] receiver and Global System for Mobile Communication [GSM] module. The GPS receiver will continuously receive coordinates of the vehicle location from the GPS satellites and send this to the microcontroller, in our case, the Arduino Uno. Then the device will interact with a mobile phone wirelessly with the help of the GSM module; An SMS will be sent from the GSM module and it will send a link to the google-maps location of the Vehicle (truck, car, bus etc.).

Chapter 2

2.1 Hardware Components

- GSM Sim 900
- Arduino Uno
- GPS Module

2.2 Software Components

- Arduino IDE
- TinyGPS++
- PySerial
- Google Cloud
- MySQL
- phpMyAdmin

2.3 Overview structure

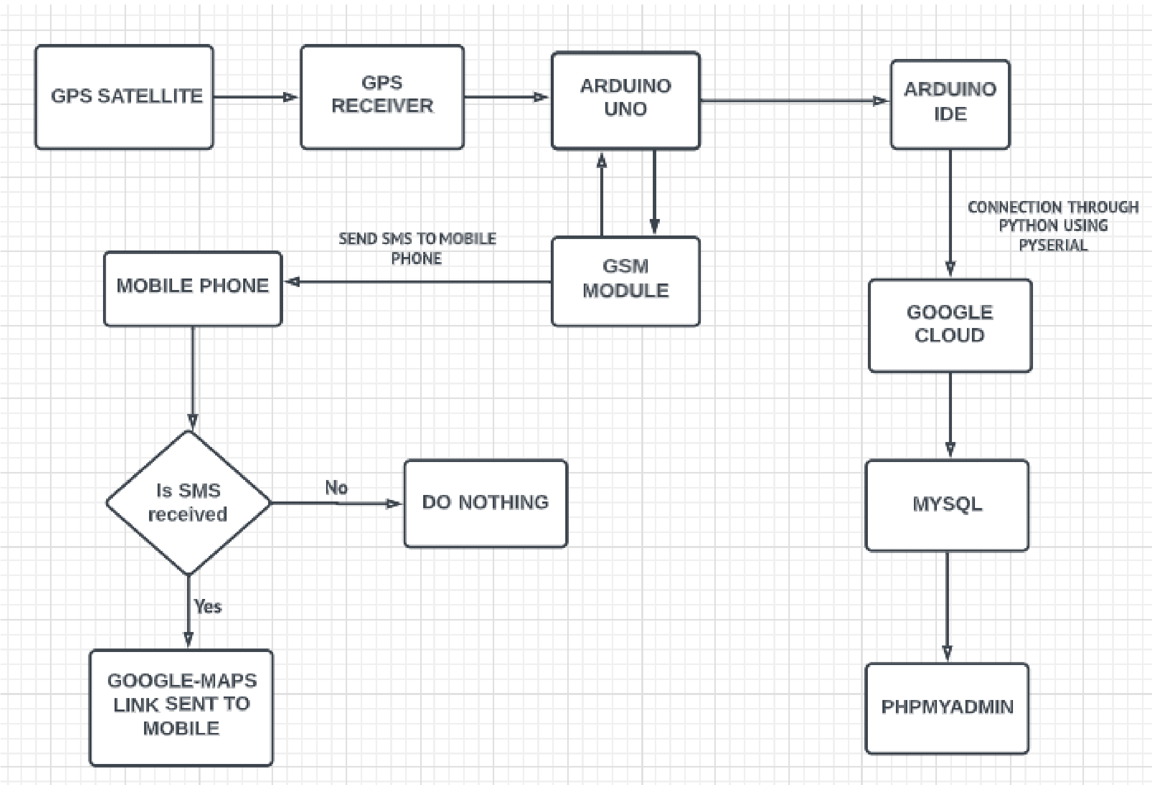

Fig 1: Overview structure of the GPS tracker

Chapter 3

3.1 Hardware Component Description

1. The Arduino Uno Microcontroller

Arduino Uno is an open-source microcontroller board based on the processor ATmega328P. There are 14 digital I/O pins, 6 analog inputs, a USB connection, a power jack, an ICSP header, and a reset button. It contains all the necessary modules needed to support the microcontroller. Just plug it into a computer with a USB cable or power it with an adapter to get started. The microcontroller can be programmed using Arduino IDE, and the language used is C/ C++.

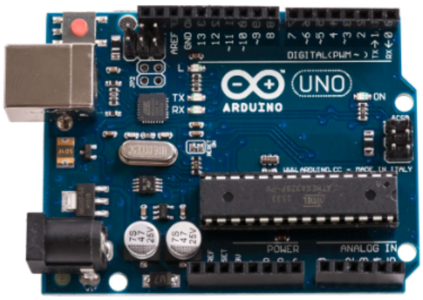

Fig 2: Arduino Uno

2. GPS MODULE - NEO 6M

The NEO-6M GPS module is a well-performing complete GPS receiver with a built-in 25 x 25 x 4mm ceramic antenna, which provides a strong satellite search capability. We can monitor the module's status with the power and signal indicators. The GPS module I used is the NE06M. This module connects to the satellites; it has to connect to at least 4 satellites to get a location. When connected, this GPS receiver continuously receives latitude and longitude values; it can give data about the speed and altitude when used with correct libraries. When connected to sufficient satellites, the GPS can be accurate to 3m of the exact location. The diagram below shows the GPS receiver board and its antenna connection.

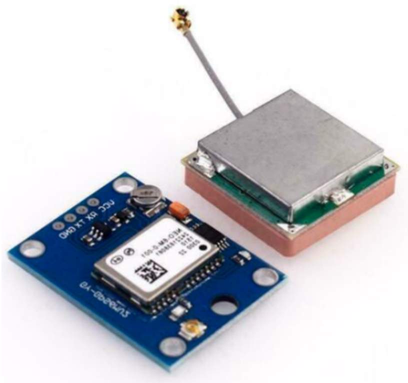

Fig 4: GPS NEO 6M module

3. GSM Module - SIM900

SIM900 GSM/GPRS shield is a GSM modem that can be integrated into many IoT projects. This shield can be used to accomplish almost anything a regular cell phone can; SMS text messages, Make or receive phone calls, connect to the internet through GPRS, TCP/IP, and more. Also, the shield supports quad-band GSM/GPRS networks, meaning it works almost anywhere in the world. GSM stands for Global System for Mobile Communications. GSM works mainly with the frequencies 850/900/1800 & 1900MHz. TDMA is a type of multiple-access communication in which every client gets a unique time slot on a specific frequency; it also partitions each cell channel into three-time partitions to increase the capacity of the information that can be transmitted. The GSM Module uses ATCOMMANDS to carry out the commands given.

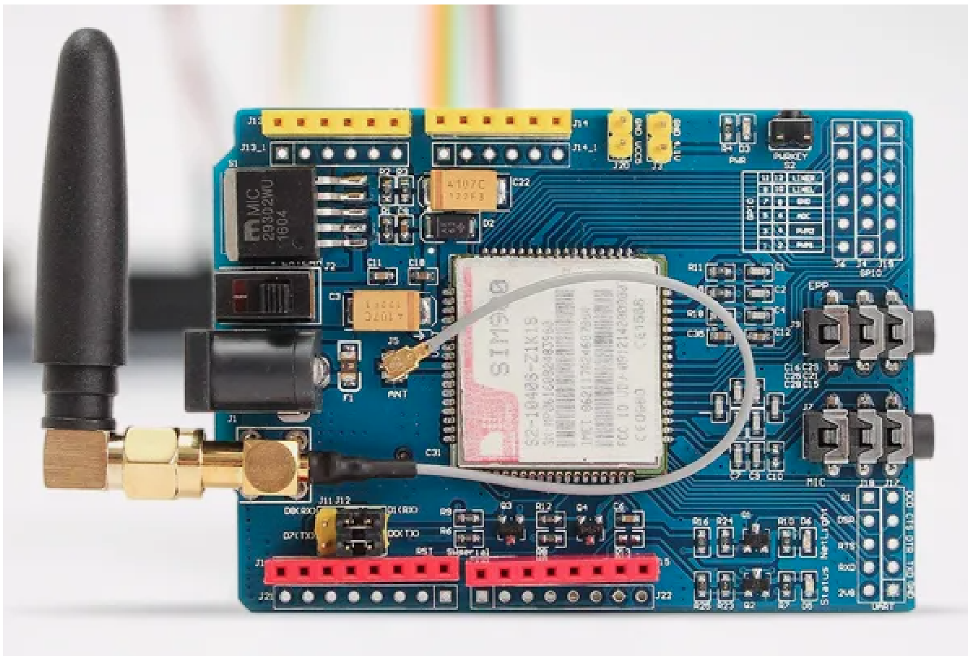

Fig 5: GSM SIM900 module

3.2 Software Component Description

1. Arduino IDE

The Arduino Software (IDE) makes writing and uploading code to the board offline easy. This software can be used with any Arduino board. It connects to the Arduino boards to upload programs and communicate with them. Programs written using Arduino Software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension .ino.

2. PySerial

PySerial is a Python API module which is used to read and write serial data to Arduino or any other Microcontroller.

3. TinyGPS++

TinyGPS++ is a new Arduino library for parsing NMEA data streams provided by GPS modules. Like its predecessor, TinyGPS, this library provides compact and easy-to-use methods for extracting position, date, time, altitude, speed, and course from consumer GPS devices.

4. Google Cloud

Google Cloud offers computing, storage, networking, big data, machine learning and IoT services, as well as cloud management, security and developer tools. We connected to Google cloud for the accumulating real time data.

4. MySQL

MySQL is an open-source relational database management system. We stored all the accumulated real time data in MySQL.

5. phpMyAdmin

PhpMyAdmin is a free tool written in PHP that provides us with an interface to work with MySQL databases. Through this application, we can create, modify, and delete records and import and export tables from the MySQL database. We can also run MySQL queries, optimise and repair the database, and perform many more tasks. Through this platform we could see all the real time data that the tracking system was collecting.

Chapter 4

4.1 Discussion

The circuit for the tracking unit consists of an Arduino Uno, which processes all the functions needed. The SIM900 GSM module is connected to the Arduino Uno through UART Communication. A software serial was used to help connect the GSM module to pins 7 & 8. The SIM900 needs a current of 2A, and a voltage of 5V, to connect to a network and initialise GSM communication. However, the Arduino 5V port only outputs a 500mA current, so an external power source is needed to power the GSM module. We used an adapter rated 5V,2A, with a USB cable (shown in the setup below) to power the SIM900 module. The other component of the setup is the GPS module/receiver. The Gps module is connected to the Microcontroller, with its Rx & Tx connected to the software serial 10 & 11, respectively. The GPS module can be powered from the 5V output of the Arduino Uno as a specific high Current is needed for the GPS receiver. The Microcontroller and the GPS receiver are also through UART communication. The GPS receiver and the SIM900 GSM module will share the same ground with the Micro-Controller.The external power source used to power the GSM module, which provides sufficient Current to the sim, for it to be able to connect to the GSM network.

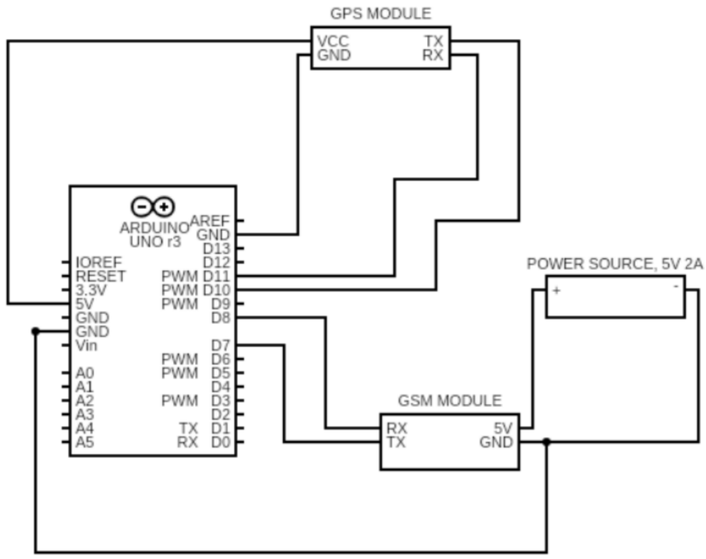

Fig 6: Circuit diagram of the GPS Tracker

The final physical setup of the tracking unit is shown below.

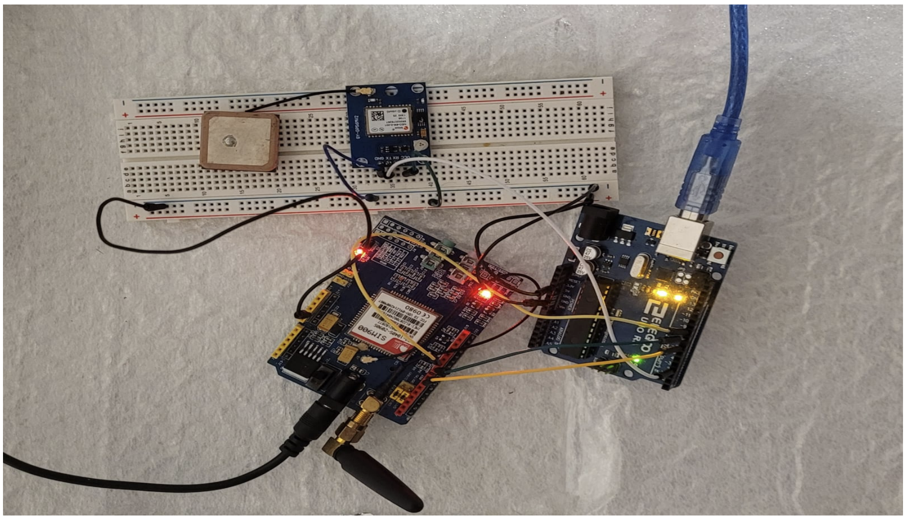

Fig 7: Physical Setup of the GPS Tracker

The programming of the Microcontoller was done using C through Arduino IDE. TinyGPS++ Library was added to assist in acquiring the Latitude and Longitude using the GPS receiver.

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

Fig 8: Library used in Arduino IDE for acquiring Latitude and Longitude values

The figure below shows the working flow of the GPS tracker.

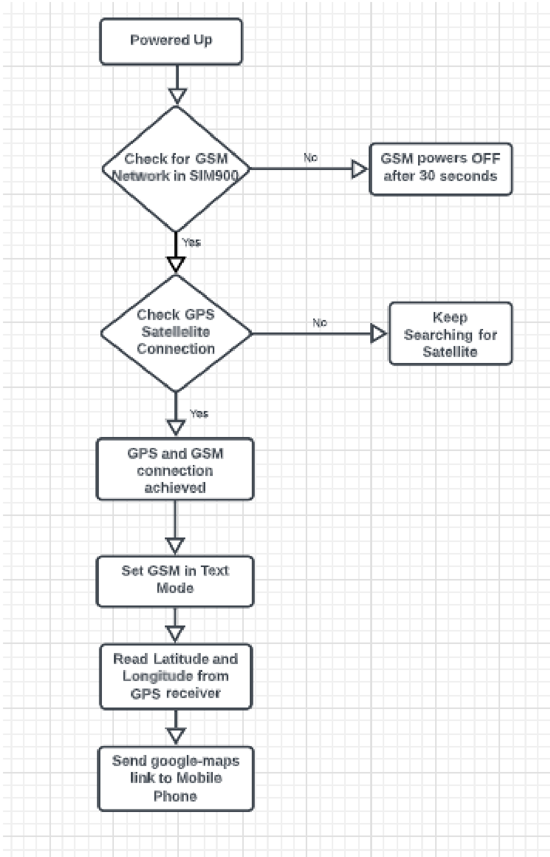

Fig 9: Working flow chart of the GPS Tracker

PySerial was used to connect Arduino to Python. Then through Python, data from the tracking system was sent to Google cloud for accumulation and then stored in MySQL Database.

The whole data flow starting from the GPS tracker to the database is shown in Fig 1 (Overview structure of the GPS Tracker).

4.2 Result

Below snapshot shows the messages sent by the GSM module.

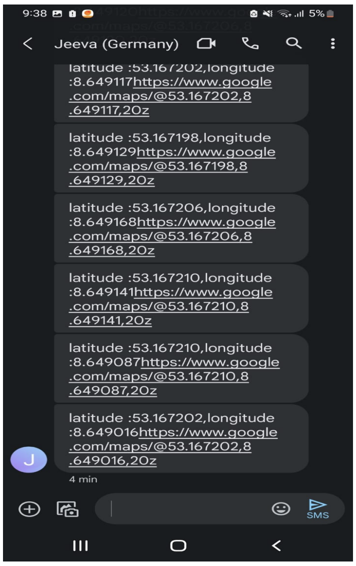

Fig 10: Snapshot of the SMS sent by the GSM module

When we click on the link, it gives the exact location on Google Maps, like the snapshot shown below.

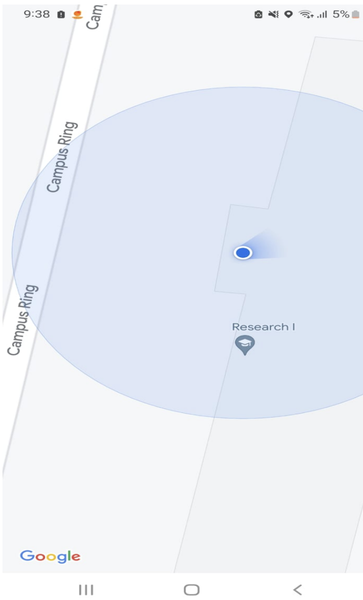

Fig 11: Snapshot of the Google-map location

All the data that the tracking system was collecting can be seen through phpMyAdmin as shown below.

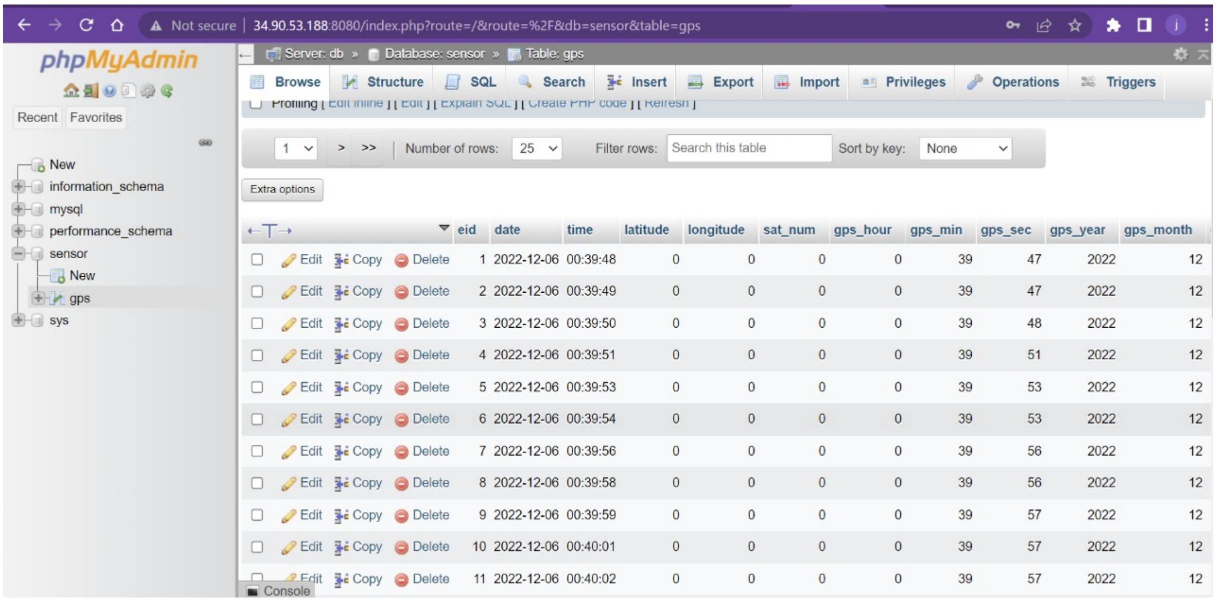

Fig 12: Snapshot of phyMyAdmin where the real time data is stored

Chapter 5

5.1 Conclusion

Implementing a fleet tracking program will resolve most of the problems faced by the fleet managers, like route optimisation, manage communication, time management, and risk management related to issues at one time. A fleet manager can regularly monitor the logistics on the route. A Tracking unit was designed in interaction with a Mobile phone, and the system's working was tested. The Tracking unit was designed using a NEO-6M GPS Module, SIM900 GSM module and an Arduino Uno Microcontroller. The Tracking Unit worked sufficiently, but a few improvements could be made.

5.2 Future Work

Instead of the GSM module sending messages, we would like to improve the system so the fleet manager can send a message to receive the google link. Once they receive this message it can be clicked to view the location of the fleet truck, thereby the fleet manager need not sit in front of any monitor to know where the fleet truck is.

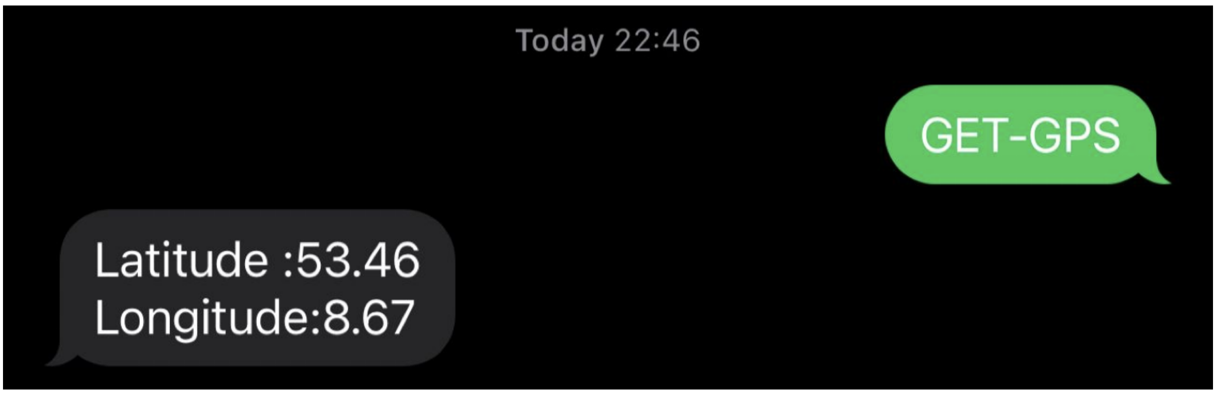

Fig 12: Snapshot how it looks after implementing the future scope

5.3 Challenges Faced

- The GPS module was not actively synchronised with satellites, so improvising the connection took time.

- We went through a short circuit due to an external adapter source given to the GSM module.

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Appendix

Group members responsibilities for completion of the Project:

Jeeva Sam: Implementing the GPS tracking system and testing the system

Harshitha Konduru: Report

Ozogu Tolumoyi: Presentation

Github link: **https://github.com/jeevasam30/Sensor_network**