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Development and Implementation of RFID Car Tracking System Using Arduino Uno

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ABSTRACT: There has been recent and trending needs for Radio frequency identification (RFID) technology due to its cost effectiveness, high security, high memory capacity and high speed of reading as compared to other Auto-ID Systems such as CCTV, Smart Cards, Biometric systems, and burglary/intruder alarm systems. The project highlighted a car tracking system using RFID technologies incorporated with Arduino Uno based on ATmega328. The system integrated SIM 808 GSM Module and GPS in the design for high efficiency, low power consumption and effective data transfer utilizing TCP/IP Protocols for user's easy access to the internet.

KEYWORDS: Arduino Uno, SIM 808, RFID, GPS, GSM, Car Tracking System

I. INTRODUCTION

Past years, there was increasing rate of car theft especially in remote areas without the thieves been located in their hidden places. Other Auto-IDs such as CCTV, Smart Card, Biometric system, and burglary/intruder alarm system are no more promising. This has resulted in projecting the technology called RFID integrated with Microcontroller, employing SIM 808 GSM module interface to handle such menace autonomously. In the project prototype, Arduino Uno based on *ATmega328* was integrated to fathom a designed Car Tracking system installed in the Car which propagates a radio wave through the GPS antenna and the user sends the stored tag messages to the RFID reader for interpretation which thereafter communicates serially detecting the Latitudinal and Longitudinal location of the Car been tracked as well as the Manufacturers information and the date of dispatch through Web applications on the Google Map.

1.1 Radio Frequency Identification (RFID) System

RFID is an auto-ID that employs devices called tags to save and remotely recover data. RFID propagates radio waves to capture data from tags. The tracking technology of RFID utilized three essential components: tag (passive, semi passive and active), reader (antenna or integrator) and software (middleware). RFID tag has microelectronic circuits which transmits the car data to a remote RFID reader which is then tracked through the software. This system provides the position of the car with the accuracy of 4m to 6m. Information such as position of the car, mileage and speed are delivered by the tracking system to the Centre. The information is repeated by one minute interval. The information is sent to and received from RFID tags by a reader using radio waves. RFID reader, basically a radio frequency (RF) transmitter and receiver, is controlled by a microprocessor or digital signal processor (DSP). RFID reader with an attached antenna reads data from RFID tags [1].

The tag is composed of a microchip connected to an antenna; microchip can store a maximum of 2 kilobyte of data, which can include information about the product, the manufacturing date, the destination among other information. In order to retrieve the data stored in the tag we need a reader, which is a device that emits radio waves, these radio waves are received by the tag which activates the microchip and then the data get transmitted [2].

RFID makes it possible to give each product in a consumer store its own distinguished identifying number, to provide assets, people, work in process, medical devices etc. all with individual separate identifiers - like the license plate on a car but for every item in the world. This has made greater headways in pencil tracking or bar code tracking that has

been in existence since the 1970s[10]. Interestingly, passive RFID tags (those without a battery) can be read if passed with nearness to an RFID reader. It is regardless to "show" the tag to the reader device, as with a bar code; which implies that does not require line of sight to "see" an RFID tag, the tag can be read inside a case, carton, box or other container, and unlike barcodes RFID tags can be read hundreds at a time. Bar codes can only read one at a time. Some RFID tags can be read from several meters away and beyond the line of sight of the reader. The application of bulk reading enables an almost-parallel reading of tags [4].

When a tagged object passes the read region, the reader signals the tag to send its saved data. Tags can hold many kinds of information about the objects they are attached to, including serial numbers, time stamps, configuration instructions, and much more. Once the reader has received the tag's data, that information is relayed back to the controller through a standard network interface, such as an Ethernet LAN or even the internet. The controller can then use that information for a variety of purposes. For instance, the controller could use the data to simply inventory the object in a database, or it could use the information to redirect the object on a conveyor belt system.

A. Advantages of RFID System

1. Cost effective
2. High memory capacity
3. It replaces the barcode in ATM card or credit card
4. No line of sight between the tag and reader.
5. Capable of far-fetched read interval
6. reduction of labor costs
7. The reduction of inventory inaccuracies
8. Automatic scanning and data logging.
9. high degree of security and product authentication

B. Shortcomings of RFID System

1. Has to be scanned to get information.
2. Reader collision or overlap.
3. Tag collision or tag clustering

C. Trending Applications of RFID System

1. Data surveillance
2. Identification of product and price at shopping stores
3. Tracks money laundering
4. Monitors speed of cars, road-tax evasion, illegal parking of cars, combats traffic congestion and vehicles theft.
5. Mobile Payment
6. Real-time asset management and retail sales
7. Ultrahigh-frequency identification (UHFID) tags help to monitor agricultural equipment
8. Improves patients' safety in the hospital.
9. Deployed in libraries for identifying information such as book's title or material type.
10. Employed in RFID biometric passport which authenticates the identity of travellers.
11. RFID card system tracks students and staff attendance in colleges and tertiary institutions, thereby preventing unauthorized entry and exit.
12. Helps in human microchip implant to assign a unique ID number of persons linked with the database.
13. Research impact created by RFID in museum enables visitors to retrieve information stored in the tag during exhibition
14. Counterfeit prevention (e.g. in the pharmaceutical industry)
15. Supply chain management

An RFID system could comprise of several readers that spread across a warehouse facility or along an assembly line. In actual sense, all of these readers could be channelled to one controller. Obviously, a single reader can interact several tags at the same time[3].

The technology of RFID[5] is applied in various disciplines such as asset tracking, inventory management, controlling access to confined areas, personnel tracking, supply management, ID badging, as key to unlocking car door, automatic

payment deduction while using toll booths, building access systems, payment cards[10], student ID cards, and wireless sensor and mesh networks.

II. RELATED WORK

In the paper [6] GPS and RFID Based Intelligent Bus Tracking and Management System was deployed, GPS was used for obtaining the position of the bus using Google web page and RFID tracks the bus. RFID card was also deployed for transactions relating to fuel filling and RFID module (receiver) which is used to receive data from ZigBee RFID transmitter at bus to receiver at server side.

As indicated in the paper project, when a vehicle is impounded, the location data from the tracking system can be used to find the location and so alert the police for future surveillance. When users make a request, the GPS coordinates of the vehicle are sent to a specified mobile. The user will be provided with the position of the vehicle in terms of latitude and longitude which can be viewed using Google Maps [7].

Owing to the difficulty in checking traffic manually and trouble in finding theft vehicles, the author[8] targeted at providing vehicle access control and tracking in the combination of RFID system with instinctive license plate identification and Internet of Things (IoT) at crowd areas, and stopping the theft vehicle.

The content of the paper stipulates that as the vehicle moves through the RF Detector area, the RF Reader module will read the vehicle ID [9] by scanning the RF chip and the associated computing module will validate the vehicle ID with pre-stored records and automatically checking for all certificates validity. If any invalid details found, the system will take action to the department through email.

The research focused on the design of a security system for motorcycle consisting of a SIM808 GSM Module to transmit warning messages, and a GPS tracker to provide information in latitude and longitude coordinates to track the stolen motorcycle using Google Maps [11].

Arduino Uno board, Mobile connectivity GSM/GPS for vehicle tracking and various sensors are used for Fuel level, Temperature, Humidity, Obstacle and also inform the driver for dangers of accident and measures are attached in the car. The sensors attached in the Cars are connected to the Arduino AT Mega Microcontroller [12]. The information is stored in the server which informs these based on the current position of the Car when viewed by the webpage and the variation in the sensor are transmitted by SMS to the Customers' Mobile Phones. This informs the service centre on request about the breakdown or accident in the Car, until a certain threshold in the Temperature is ascertained

III. METHODOLOGY

This project proposes a car tracking system for tracking Car theft by employing RFID-GSM technology and GPS enabled. The GPS receiver and SIM 808 GSM module employ Arduino UNO based on *ATmega328*. The system is installed in the Car. A GSM mobile phone can be used to transmit and receive the information. Therefore, the GPS system will transmit the location, longitudinal and latitudinal extents with regards to the actual location of Car to the SIM 808 GSM Modem. In case, someone loses or gets confused amidst numerous identical Cars parked outside, an SMS can be sent to the Car GPS.

The SMS sent would be transmitted through the GSM service provider, thereby reaching the Car. The Car will have a GSM device installed, which includes an MTN μ SIM card of 4G. Through the SIM 808, the SMS will be received and sent to the Arduino Uno in the Car. When the message is received, the Arduino Uno verifies the password and the request. If everything matches then it will perform the request required by the owner by sending a link that has longitude & latitude through Google Maps, showing the location of the Car.

SIM808 module is a GSM and GPS two-in-one function module. It is based on the latest GSM/GPS module SIM808 from SIMCOM, supports GSM/GPRS Quad-Band network and combines GPS technology for satellite navigation. The latest firmware support Bluetooth function. You can use all AT commands for BT functions right now.

It features ultra-low power consumption in sleep mode and integrated with charging circuit for Li-Ion batteries, that make it get a super long standby time and convenient for projects that use rechargeable Li-Ion battery. It has high GPS



receive sensitivity with 22 tracking and 66 acquisition receiver channels. Besides, it also supports A-GPS that available for indoor localization. The module is controlled by AT command via UART and supports 3.3V and 5V logical level.

3.1 Hardware and Software Requirements for the Project:

A. Hardware Requirements:

- SIM 808 Module
- Arduino UNO
- Arduino cable
- 9V supply
- GPS antenna and GSM antenna
- Arduino sketch

B. Software Requirements:

- Arduino IDE
- SIM808 library

After connecting the power source, you press the vertical key on the board for at least 1 second. For this project, you can use the DFRobot_SIM808 library to communicate between Arduino and SIM808.

By sending the number 1 to the SMS system, the link of Google Map will be sent to you for your car.

The Google link is as follows:

<https://maps.google.com?q=lat,long>.

Lat., long. in the above link will be replaced with the cars position latitude and longitude. The latitude and longitude are also displayed on the screen.

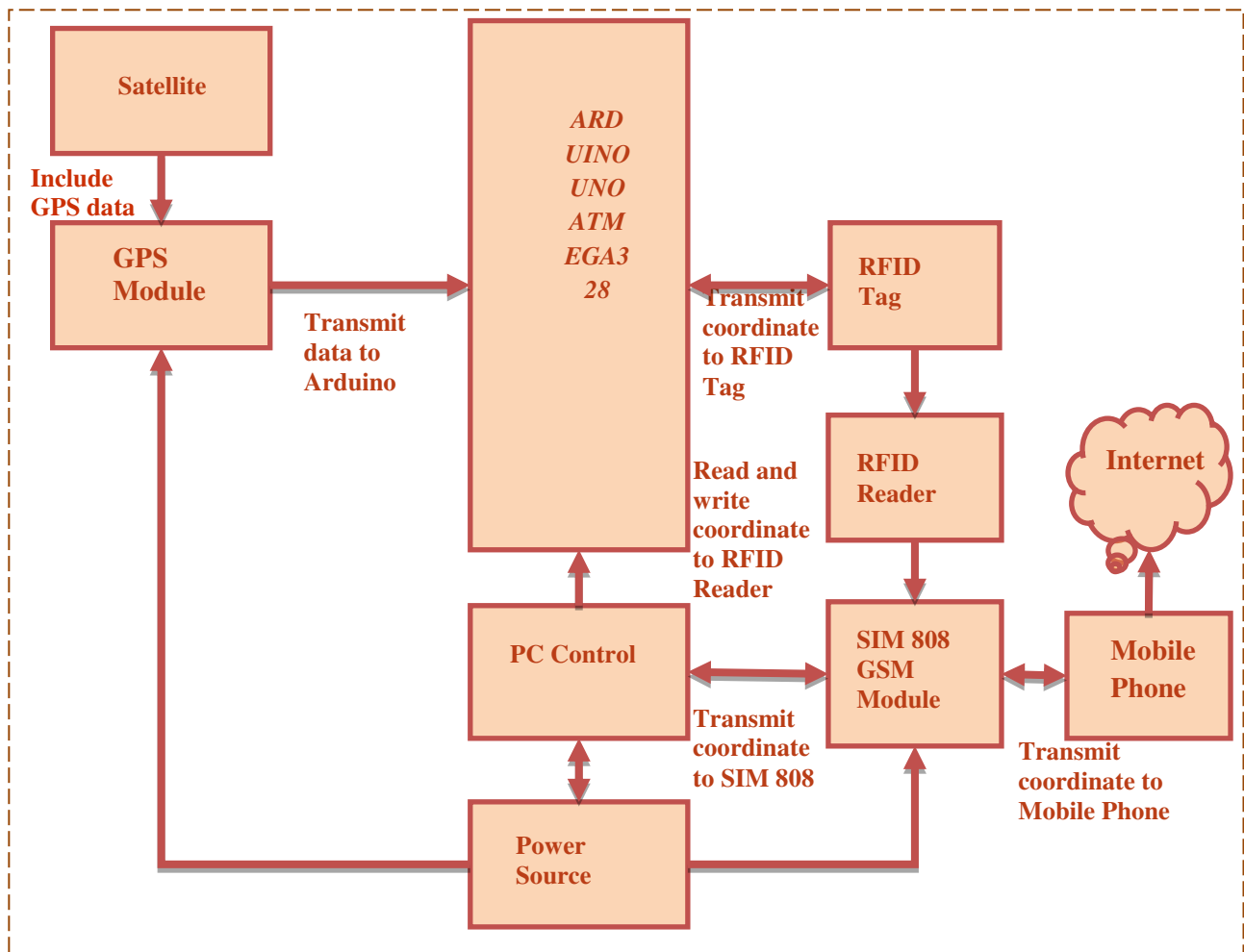


Fig1: Block diagram of the Proposed RFID Car Tracking System

The block diagram of the proposed Car tracking system in Fig.1 shows how our system actually works. The Car tracking unit is installed inside the car that is to be tracked. The GPS receiver receives the coordinate from the satellite which is then send to the GSM tower by the GSM modem. The coordinate is then sent to a computer via internet where it is stored in the database for displaying the location on Google map. The user can also see the location of the vehicle in a mobile phone, when the user sends an SMS to the GSM modem in the vehicle, the GSM modem send another SMS back to the user with the coordinates of the location of the vehicle along with a Google map link. GPS satellites continuously transmit their current time and position [6]. A GPS receiver monitors multiple satellites and solves equations to determine the exact position of the receiver and its deviation from true time.

3.2 Implemented Algorithm

The implemented algorithm of the proposed RFID Project is depicted in Fig.2 below, the GPS module which is connected to the Arduino Uno microcontroller to locate the latitude and longitude of the Car. For doing that, we had used Arduino IDE software to program the code. In the coding we had included two libraries softwareSerial.h and DFRobot_sim808.h. After initialization those libraries, we had created a serial sim808 Module and integrated GPS Connected and disconnected after successful reception of message in the SIM 808 GSM Module. If the receiver received a data, that data will be fetched into the “.serial print ()” method. Then, if “char()” method return to true, longitude, latitude data will be printed into serial monitor.

Then we have used SIM808 module with Arduino Uno microcontroller for sending location data of the Car to the user via GSM network. For communication with mobile device and SIM808 module, AT command has been used in programming.

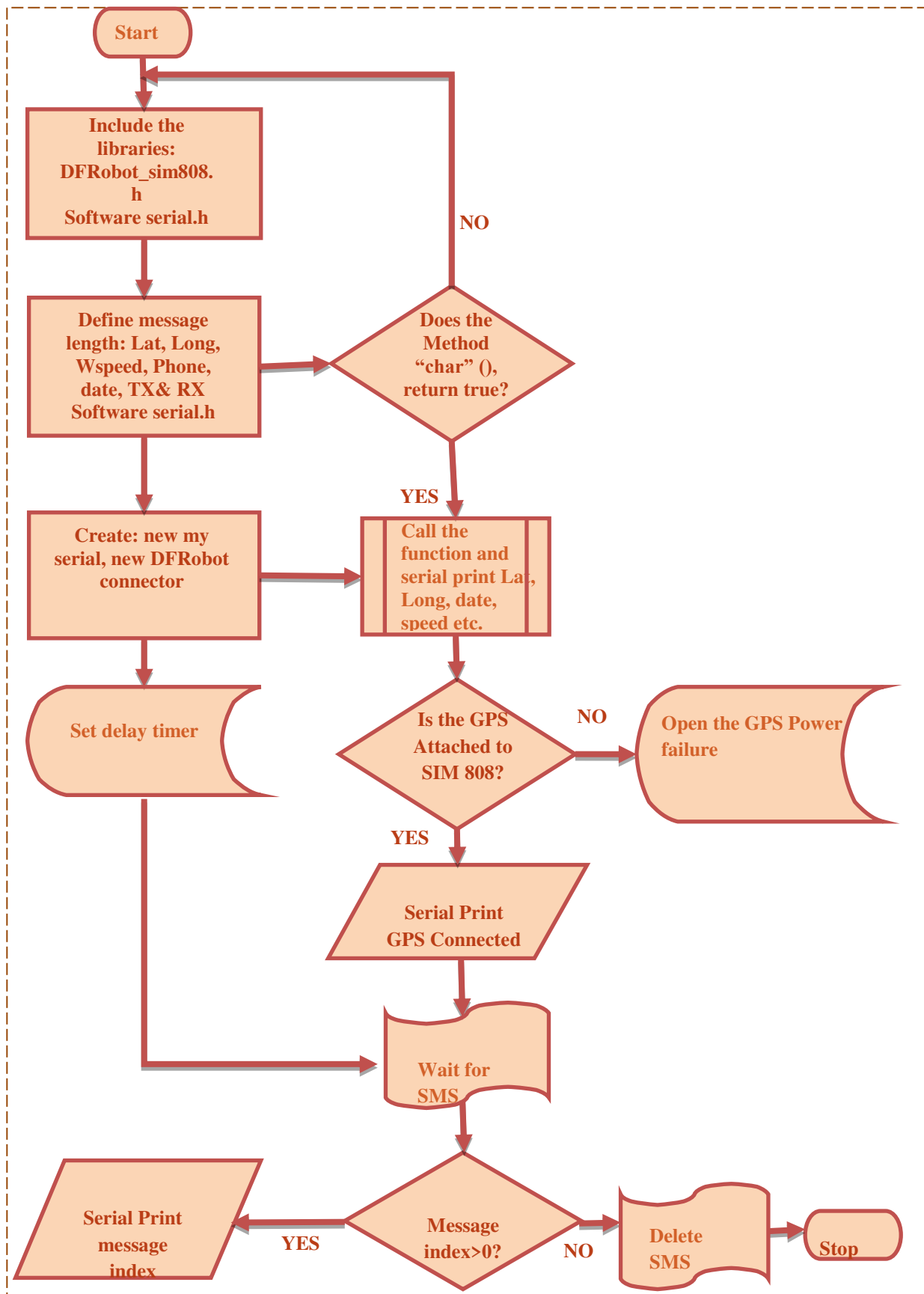


Fig.2: Flowchart for the Implemented Project Algorithm

IV. SYSTEMS DESIGNS AND ANALYSIS

The system design is composed of ArduinoUno, SIM808 module including GPS and GSM antenna as shown in Fig.3below. The essential part of the design is microcontroller Arduino Uno. The geo location of a Car can be captured through GPS receiver and that data will be transmitted to the web server by using GSM technology. That data will be stored in a database. For monitoring the location of the Car on the map, we had developed a web application.

For storing the location data, a text file had been used. We had also developed a mobile application to view the location of Car in a mobile device by using Android Studio.

The SIM808 module is initialized to start gathering geo location data from the satellite; device initialization is done using AT commands and includes GPS and GSM module; to turn on the GPS, first it is powered on and put in reset mode. Then the module become ready for receiving coordinates from satellite. The GPRS is next turned on; the process includes GPRS power on, setting APN of service provider, initiating HTTP protocol, and setting protocol method (Get method). Device initialization process may take up to 1 minute to worm up and calculate the accurate position. In case of network un-availability, the acquisitioned GPS coordinates and other data such as time and speed are stored temporarily until the network returns back to service then the stored coordinates are sent with their time stamp and speed. SIM808 requires nearly2A peak current. So, external power supply like 12V-2A battery is used to provide the power.

GPS antenna and GSM antenna are connected to the port of SIM808 module. The module and Arduino have a common ground. We had uploaded the program into the Arduino microcontroller which program is written in C programming language. Uploading program into Arduino is done by using Arduino IDE software.

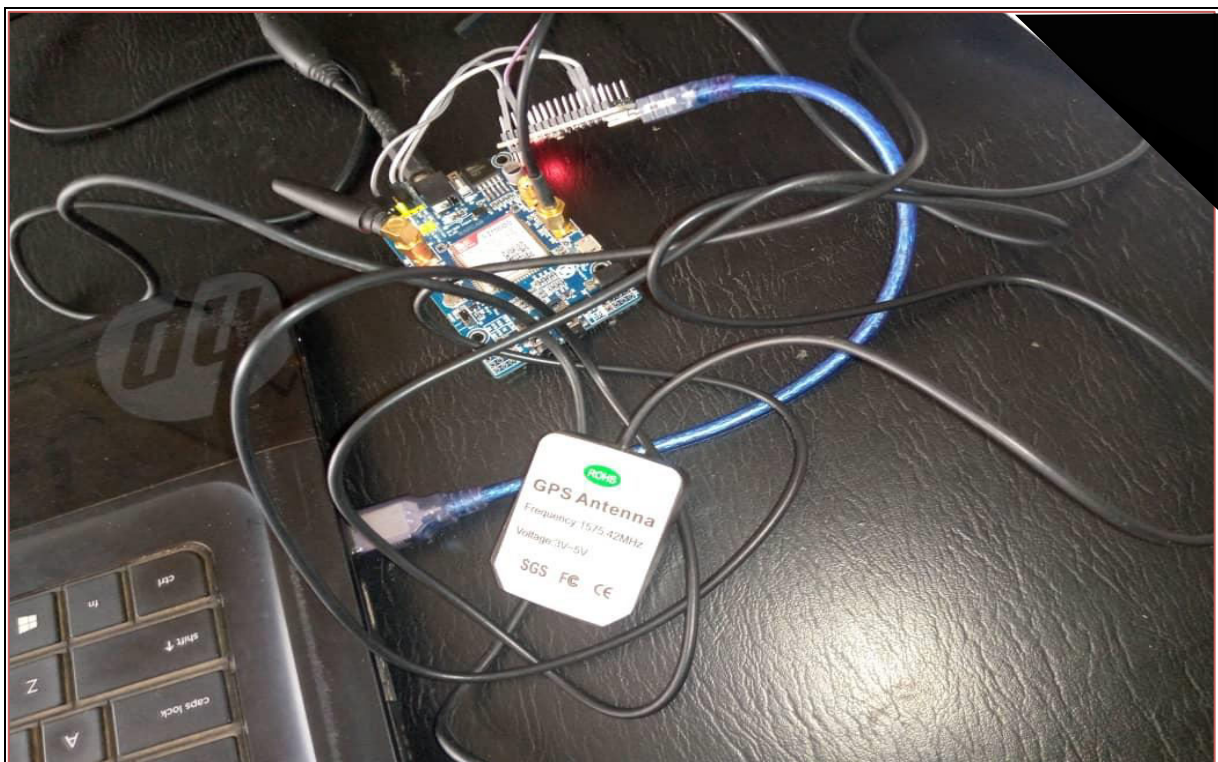


Fig 3: The Proposed RFIDCar Tracking System



V. CONCLUSION

In this Project we used **Arduino UNO** based on ATmega328 which interfaces different hardware peripherals. The system designs an embedded application, which will frequently track a moving car and produce the condition of the car on demand using **RFID and GSM Technology**. By so doing, the Arduino is interfaced serially to a GSM Modem, SIM808 and GPS Receiver. The GPS receiver will periodically display the latitude and longitude which indicates the position of the Car. A GSM modem is used to send the position (Latitude and Longitude) of the Car from a remote area. The GPS modem gives many parameters as the output. The data is sent to the user's mobile phone who has demanded for the position of the Car; it also saves the data in the database for future use.

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