FM Signal Detection and Data Logging System

Problem statement

To develop a field strength information collecting system. This system makes use of Commercial FM receiver or car receiver for knowing whether there is signal reception in a particular area or not. The system gives a feedback on a mobile application which displays data on Google maps and excel sheet. The feedback includes location of a place where there is improper reception of signal. We make use of GPS module to collect the latitude and longitude data and a GSM module to communicate this information at the front –end at Akashwani as and when dictated by the Arduino controller which receives information from the AGC input in the FM receiver which is used to monitor the signal strength**.**

Working and block diagram of the system

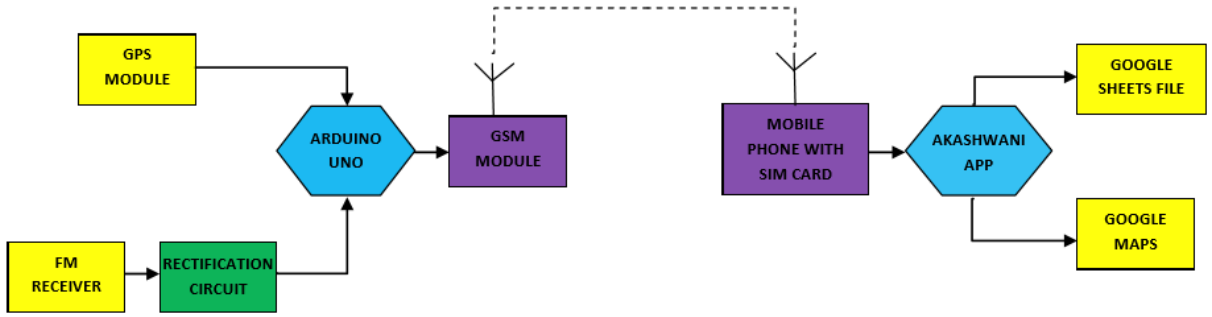

Figure 1. Block Diagram

The above block diagram covers the essential hardware components that will form an integral functional part of the setup. At the heart of the client side circuitry, is the Arduino Uno, an open-source microcontroller board based on the Microchip ATmega328P microcontroller. It is responsible for processing input given to it and accordingly giving some output. The input signal comes from the rectification circuitry (analog) as well as the GPS module (digital).

The GPS module used is the SIM28ML. It sends the current latitude and longitude coordinates to the Arduino Uno.

The rectification circuit rectifies the signal coming from the FM receiver. It is a variable DC voltage signal that corresponds to the strength of the FM signal available. This voltage signal is then given to an analog pin of the Arduino Uno. The Arduino Uno performs an ADC conversion to get values ranging 0-1023. When the FM signal was present and strong, it was found that values from the ADC were lying in a certain range, whereas when it was absent, the values were outside this range. Thus, based on these observations, it can be determined whether signal is present or not.

The GSM module used is the GSM SIM900A. It is a breakout board and minimum system of SIM900 Quad-band/SIM900A Dual-band GSM/GPRS module. It can communicate with controllers via AT commands (GSM 07.07 ,07.05 and SIMCOM enhanced AT Commands). The Arduino Uno gives it instructions to send an SMS to the server when the FM signal is absent, through the Arduino sketch uploaded.

Once the SMS is sent, the server receives it on their phone. Upon opening the custom app, the server can view the location marker via Google Maps. As multiple SMS are received with different location coordinates, all the links and coordinates are stored in a csv file. This provides the server with a systematic log of all the coordinates for future reference.

Code and Explanation

```
#include <TinyGPS.h>

#include <SoftwareSerial.h>

SoftwareSerial Gsm(7, 8);

int signal=A1;    //from receiver antenna



char phone_no[] = "+918552046121"; //replace with phone no. to get sms
```

```
TinyGPS gps;      //Creates a new instance of the TinyGPS object

void setup()
{
   Serial.begin(9600);
   Gsm.begin(9600);
         pinMode(signal,INPUT);
}
void loop()
{
  bool newData = false;
  unsigned long chars;
  unsigned short sentences, failed;
  int strength=analogRead(signal);
  char sig_resp;


   // For one second we parse GPS data and report some key values
  for (unsigned long start = millis(); millis() - start < 1000;)
  {
     while (Serial.available())
           {
              char c = Serial.read();
                        Serial.print(c);
```

```
                        if (gps.encode(c))
                         newData = true;
                }
        }
Serial.println(strength); /*
if(strength>70&&strength<150)
{
   sig_resp='Y';
        delay(300);
        Serial.println(sig_resp);
 }
else
{
   sig_resp='N';
        delay(300);
        Serial.println(sig_resp);//380=95 lower threshold
}  */
if (newData)      //If newData is true
{
        float flat, flon;
        unsigned long age;
        gps.f_get_position(&flat, &flon, &age);
        Gsm.print("AT+CMGF=1\r");
        delay(400);
```

```
        Gsm.print("AT+CMGS=\"");
        Gsm.print(phone_no);
        Gsm.println("\"");

        if(strength>70&&strength<150)
        {
                sig_resp='Y';
                delay(300);
                Serial.println(sig_resp);
                Gsm.print("Y");
                delay(200);
}


else
        {
                sig_resp='N';
                delay(300);
                Serial.println(sig_resp);
                Gsm.print("N");
                delay(200);
                Gsm.print("http://maps.google.com/maps?q=");
        }
        // Gsm.print("Latitude = ");
```

```
        Gsm.print(flat == TinyGPS::GPS_INVALID_F_ANGLE ? 0.0 : flat, 6);
        //Gsm.print(" Longitude = ");
        Gsm.print(",");
        Gsm.print(flon == TinyGPS::GPS_INVALID_F_ANGLE ? 0.0 : flon, 6);
        delay(200);
        Gsm.print(",");
         Gsm.println(sig_resp);
         Gsm.print(",");// End AT command with a ^Z, ASCII code 26
         delay(200);
         Gsm.println((char)26); // End AT command with a ^Z, ASCII code 26
          delay(200);
          Gsm.println();
          delay(2000);
   }
   Serial.println(failed);
        if (chars == 0)
                Serial.println("** No characters received from GPS: check wiring **");
}
```

Hardware

Arduino Uno

Features:

1. The Arduino Uno can be programmed with the (Arduino Software (IDE))
2. communicates using the original STK500 protocol
3. hardware based on Atmega328 ic.

4. Digital I/O Pins 14 (of which 6 provide PWM output) PWM Digital I/O Pins 6 Analog Input Pins 6 Flash Memory 32 KB (ATmega328P) of which 0.5 KB used by bootloader

GPS module

Features:

1. based on SIMCOMs SIM28M GPS module
2. used to get the precise location (of the receivers) and display it on the map
3. low power consumption
4. can track signals with small intensity

GSM module

The GPRS/GSM Shield provides a way to use the GSM cell phone network to receive data from a remote location. The shield achieves this via any of the three methods:

- Short Message
- Service Audio

GPRS Service

The GPRS Shield is compatible with all boards which have the same form factor (and pinout) as a standard Arduino Board. The GPRS Shield is con-gured and controlled via its UART using simple AT commands. Besides the communications features, the GPRS Shield has 12 GPIOs, 2 PWMs and an ADC.

SPECIFICATIONS:

1. Quad-Band 850 / 900/ 1800 / 1900 MHz - works on GSM networks in all countries across the world.
2. GPRS multi-slot class 10/8 GPRS mobile station classB
3. Compliant to GSM phase 2/2+ Class 4 (2W@850/900MHz) Class 1 (1W@1800/1900MHz)

4. Control via commands (GSM 07.07, 07.05 and SIMCOM enhanced AT Commands)
5. Short message service Free serial port selection RTC supported with Super Cap
6. Power on/o and reset function supported by Arduino interface

FM Receiver

FM Receiver receive the radio waves in the frequency range of 88-108 Mhz. and convert the information into useable format. For the project purpose Receiver was tuned to 101 MHz (Akashwani Pune). IC CD1619CP Based FM Receiver AGC (Automatic Gain Control) o/p pin- for exacting information.

Rectification Circuit

Converts AC Signals into corresponding DC signal. The output of the circuit is I/p to Arduino for detecting purpose.

components required:

Diodes-Purpose Rectification

RC (Resistor capacitor) Low pass Filter-Purpose Produce corresponding DC signal.

Software

Arduino

Arduino is a platform which has ready to plug USB compatible development boards for common microcontrollers and has a software counterpart in the form of Integrated Development Environment (IDE). Here Arduino IDE is used to program Arduino Uno, GSP module, GSM module as it is open source.

MIT App inventor

App Inventor develops applications for Android phones using a web browser and either a connected phone or emulator. The App Inventor servers store your work and help you keep track of your projects.

The App Inventor development environment is supported for Mac OS X, GNU/Linux, and Windows operating systems, and several popular Android phone models. Applications created with App Inventor can be installed on any Android phone

Scratch

1. Scratch is a visual programming language and online community targeted primarily at children, by coding with 'blocks' in the editor. Users of the site. can create online projects using a block-like interface.
2. Implementation language: Squeak (Scratch 0.x, 1.x); ActionScript (Scratch 2.0)

Google Maps

Google Maps is a mapping Service Developed by google, it is used to mark the location (Latitude and Longitude) given by the GPS module.

Results

1. Arduino Uno was powered with 5V DC power supply. The code was burnt on Arduino Uno.

2. Automated gain control(AGC) pin 21 of IC CD1619CB on the FM radio receiver was connected to a rectifier circuit which was then connected to analog pin A1 of Arduino Uno and was monitored serially.

3. GSM module SIM900A was powered with 12V DC power supply. Receiver(RX) pin of GSM module was monitored serially for characters from GPS module. For weak signal strength, the GPS module sent the latitude, longitude and Google maps link of current location to the GSM module.

4. In Arduino Uno, for the digital range of 80-130 a good signal strength for FM band 101Mhz (Vividhbharati) was obtained. For this range no message was sent. While for the remaining range the signal strength was weak and a message containing Google maps link of current location was sent from the sim card

present on the GSM module SIM900A to the registered mobile number given in the code.

5. The mobile application (named Aakashwani) was kept open. As soon as the message arrived, the google link sent in the message opened on the mobile app. Current location was showed on the google map. Simultaneously a csv file was created in the background which was stored in the internal mobile storage. A list of all google links where the signal strength is weak is stored in the csv file.

User Interface (Mobile application Akashwani)

The application also creates the .csv file contains Google map URL's and its signal strength.

Conclusion

We have built a system which can detect the presence of radio signal (FM signal) in car and provides whether it is weak or strong. So the system consists of arduino, GPS, GSM and FM receiver. The GPS is used to track the location of a car on a google map. FM receiver demodulates the FM signal. For FM receiver we have use a FM detector IC. At the output of automatic gain control pin of a IC we get output depends on strength of input FM signal. So the threshold is set. If the signal at car's antenna is greater than threshold, then no message is send otherwise SMS is send via GSM on mobile phone. The SMS provides the link for a google map which gives the location of the car where signal is weak. Also an excel sheet is created in the Phone Memory which keeps on storing the location's co-

ordinates for further reference. The app is created to read the location and open it. Thus we have developed a field strength information collecting system. By using this type of system it is easy to know the about places where reception is poor and for further improvement of signal. It will be helpful for AKASHVANI PUNE.