PROJECT REPORT

ON

"GEOFENCE:AN INTELLIGENT LOCATION-BASED SAFETY FOR CHILDREN AND ELDERS"

Submitted to

VASAVI COLLEGE OF ENGINEERING

In Fulfilment of the Requirements
for BE IV sem Mini Project

BACHELOR'S DEGREE IN
ELECTRONIC ENGINEERING

BY

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CERTIFICATE

This is to certify that the project entitled

“Geofence:An intelligent location-based safety for children and elders“

submitted by

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Students of the Electronics and Communication Engineering Department, Vasavi College of Engineering in fulfillment of the requirement for the award of the degree of Bachelor of Engineering in Electronics and Communication Engineering is a record of the Bonafide work carried out by them during the academic year 2022-2023

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INTRODUCTION

we know that children are very enthusiastic in going to unknown places, and they often forget the route which traveled and in the same way many old people often forget they route Basically, our target is to help those people who don’t know how to operate phone this pocket module helps in tracking location in one click and sends it to the trusted people and in emergency situations like accidents specific module gy521 accelerometer will detect the sudden change and based on the calibration in x y z plane it will also
detect the orientation (vehicle mode) When an accident occurs this impact module in the device will automatically send the location to the nearby hospital and the buzzer will be on and alert the people around. in any dangerous situation through a single tap. it will call the nearest police station send the location.

The A9G module is a versatile and compact IoT (Internet of Things) module developed by AI-Thinker. It combines multiple functionalities into a single module, making it suitable for various applications that require GPS positioning, GSM communication, and embedded processing capabilities.

ABSTRACT

Location tracking plays a crucial role in various applications, ranging from asset tracking and fleet to personal safety and navigation systems. This abstract presents a solution for location tracking using the A9G module, a versatile IoT module integrating GPS positioning and GSM communication capabilities.The module establishes a cellular connection through GSM/GPRS networks, enabling data transmission and communication with external devices or central servers The A9G module interfaces with sensors, such as accelerometers or gyroscopes, to gather additional contextual information that enhances the accuracy and reliability of the tracking system.

The software development resources provided by AI-Thinker facilitate the development of custom applications and firmware tailored to specific tracking requirements. These resources enable the integration of the A9G module with external systems, data logging, and real-time tracking visualization.

PROBLEM STATEMENT

Ensuring the safety and well-being of children and elders is a primary concern for families and caregivers. With the advancement of technology, there is a growing need for an intelligent location-based safety system that can provide real-time monitoring and protection. Existing solutions often fall short in addressing the specific requirements and challenges associated with keeping children and elders safe.The problem lies in the lack of a comprehensive and user-friendly system that integrates GPS tracking, geofencing, and intelligent alerts to effectively monitor the whereabouts of children and elders. Current solutions either lack necessary features, are overly complex, or are prohibitively expensive, making them in accessible to many individuals and families

Literature survey

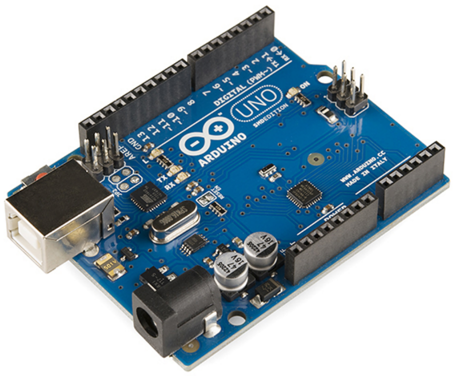
The concept of a global navigation system using satellites was first proposed by Ivan Getting in 1960. He envisioned a system that could provide accurate positioning for military purposes. ”Understanding GPS: Principles and Applications” by Elliott D. Kaplan and Christopher J. Hegarty was really helpful for understanding GPS and GSM. Later we referred to the journal ”IEEE Transactions on Vehicular Technology”, which covers essential information regarding GPS and GSM. These books and journals helped us to identify the components that are necessary for the project. Through the help of some lecturers, we got to know about A9G Module which has both GPS and GSM.

any online tutorials and guides are available that cover various aspects of working with the A9G module. Websites like GitHub, Instructables, and Hackster.io often have project tutorials and step-by-step guides that include code examples and wiring diagrams for the A9G module. AI-Thinker, the manufacturer of the A9G module, provides official documentation, including datasheets, user manuals, and technical specifications.

HARDWARE REQUIREMENTS

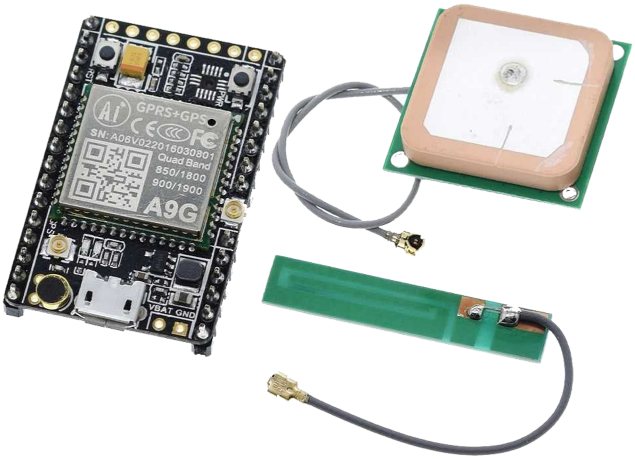
Arduino Uno (ATmega328P):

The Arduino UNO employs an ATmega328P microcontroller and is simpler to operate than comparable boards like the Arduino Mega board. It includes various features such as digital and analog Input/Output pins (I/O), shields, and other circuits. Additionally, it contains 6 analog pin inputs, 14 digital pins, a USB connector, a power jack, and an ICSP (In-Circuit Serial Programming) header. Moreover, it operates based on IDE (Integrated Development Environment) and can function on both online and offline platforms. beginfigure



A9G(combined GPS and GSM)

Using AI Thinker we checked the calibration and output of the A9G module. Using AT commands calibrated location, calling, and message sending and receiving using onboard microphones we call and communicate



with trusted persons The A9G module features a built-in Microcontroller unit (MCU) based on the ARM Cortex-M3 architecture
I/O Interfaces: The module offers multiple input/output interfaces, including UART, SPI, I2C, and GPIO.

GYROSCOPE(GY-521)

The GY-521 is a popular and widely used module that integrates a 3-axis gyroscope, a 3-axis accelerometer, and a 3-axis magnetometer into a single package. It is based on the InvenSense MPU-6050 sensor chip and is commonly referred to as the ”MPU-6050 module” or ”6DOF (Degree of Freedom) module.” Here are some key points to note about the GY-521 module 3-Axis Gyroscope
3-Axis Accelerometer
3-Axis Magnetometer

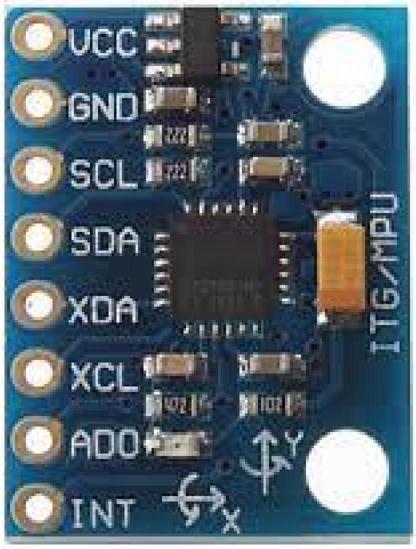


Figure 1: Gyroscope

PULSE SENSOR

Calibration of the pulse sensor is done upto 90 bpm, if it crosses the limit, danger is identified The pulse sensor works based on the principle of photoplethysmography (PPG). PPG utilizes a light source, such as an LED, and a light
detectors, such as a photodiode or a light-sensitive resistor. When the light is transmitted through the skin and blood vessels, it is partially absorbed by the blood and reflected back to the detector. The changes in blood volume with each heartbeat cause variations in the amount of light detected, creating a pulsatile waveform.

Figure 2: Pulse sensor

I2C LCD display:

The components of an I2C LCD display typically include a character LCD display based on HD44780 and an I2C LCD adapter. It is worth noting that these LCDs are best suited for displaying textual characters. For instance, a 16×2 character LCD.

IR SPEED SENSOR:

On taking the interrupts, it displays the Rpm in the serial monitor. Analog pins are used for checking the interrupts To estimate the speed of objects for location tracking purposes. accuracy and reliability of using IR speed sensors for location tracking may be limited compared to dedicated location tracking technologies like GPS. IR speed sensors are more commonly used for speed measurement in specific areas rather than providing precise location information.

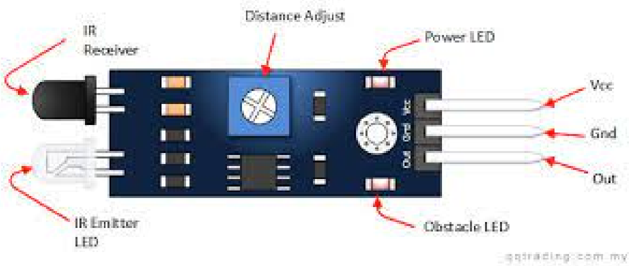


Figure 3: IR Sensor

I:

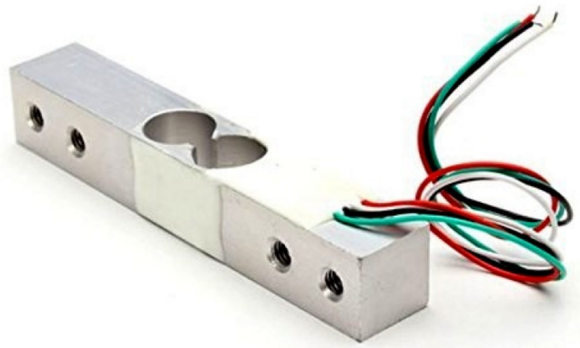


Figure 4: Load cell

LOADCELL(HX711):

On getting the calibration factor, the calibration of the load cell is done. the basic principle is the Wheatstone bridge Load cells are transducers used to measure force or weight applied to an object. While they are not directly used for location tracking, load cells can provide valuable data that can be integrated into location tracking systems.

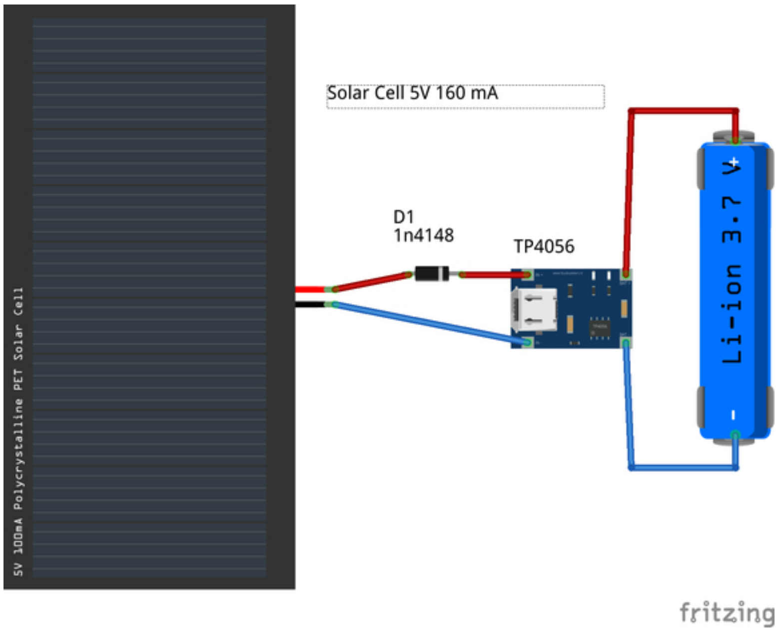


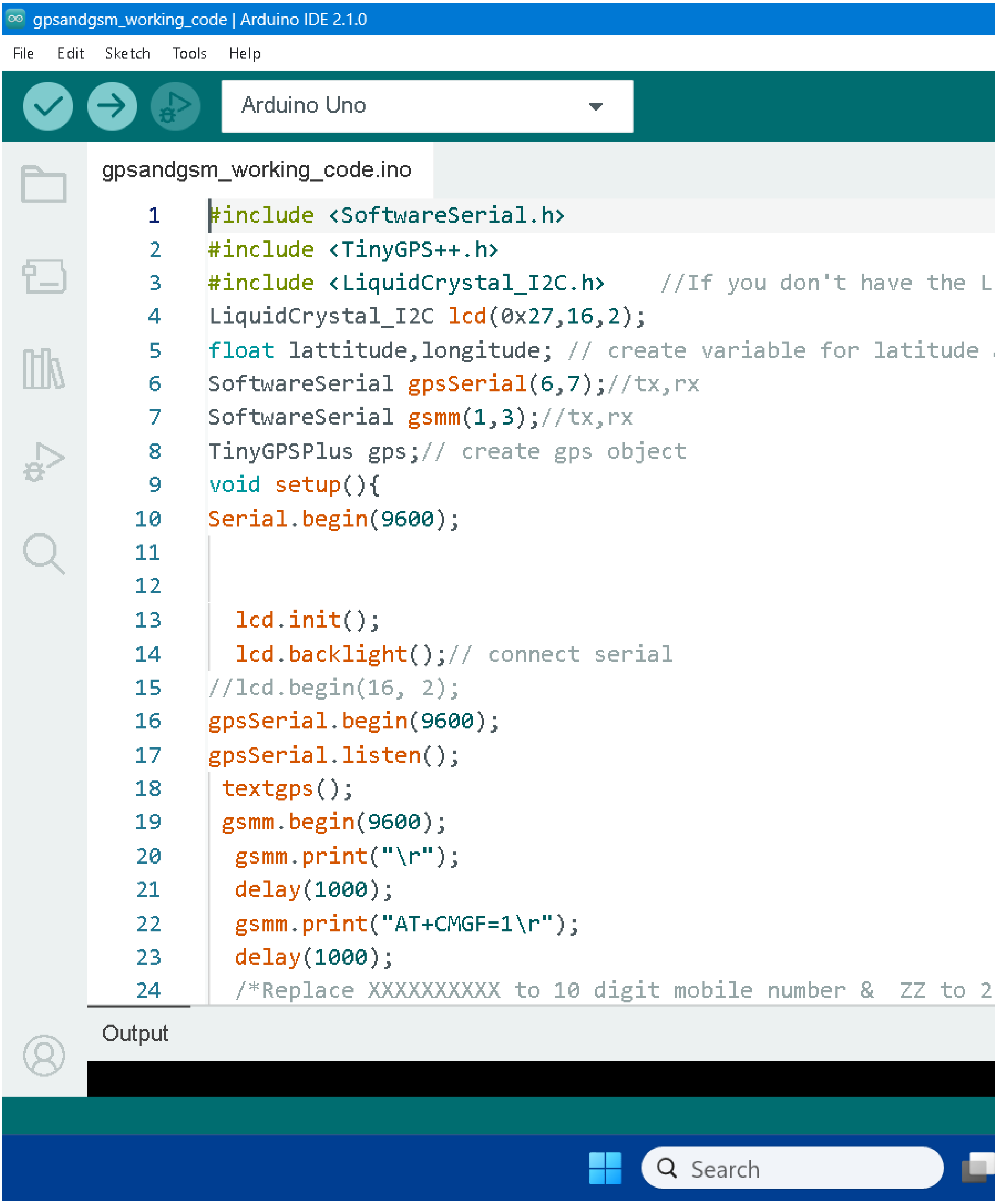
Figure 5: Solar cell

SOLAR PANEL TP4056:

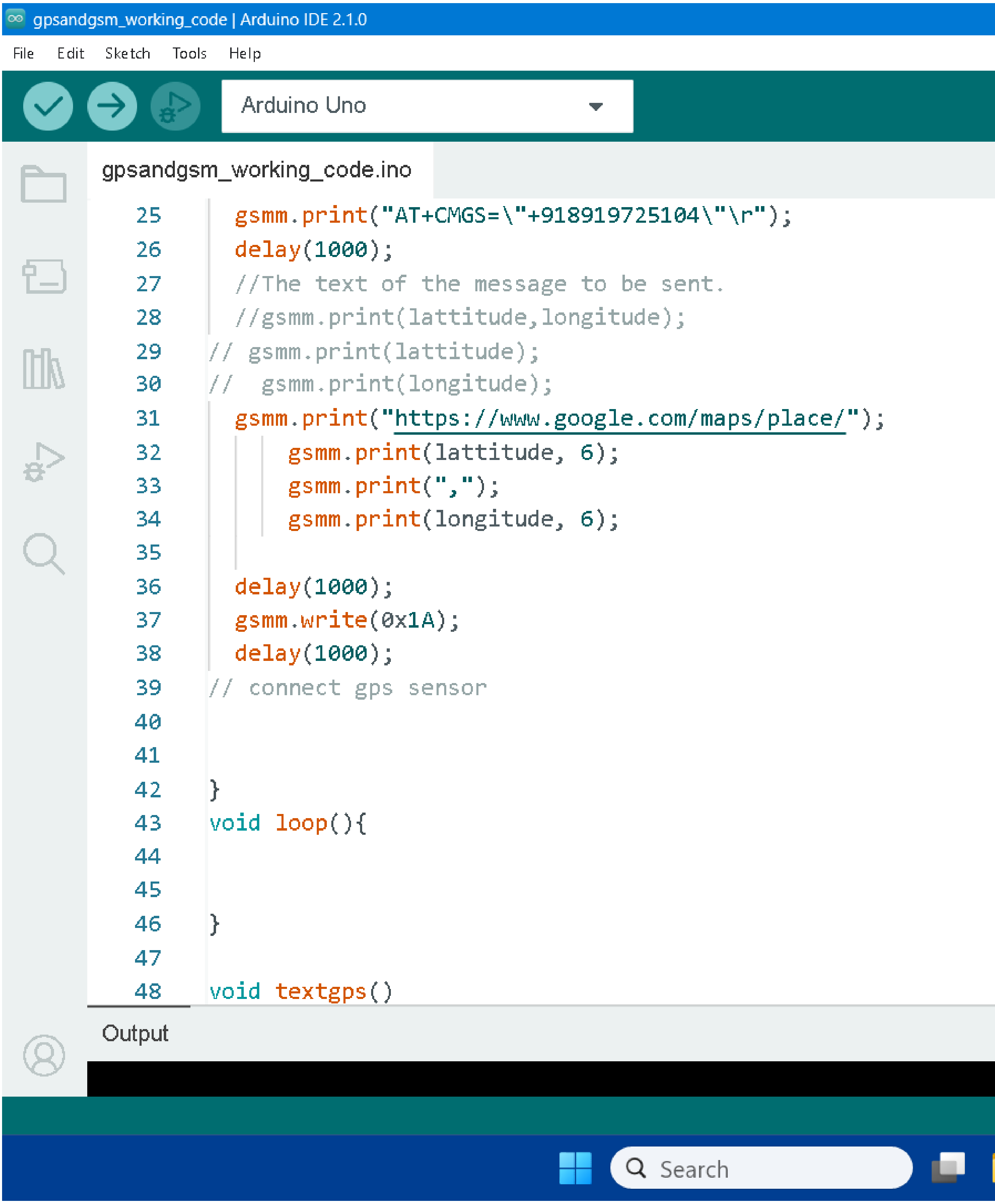
until the solar panel is active the A9G takes power from it and if the drains in it, A9G uses the battery as a source. using the TP-4056(charging module) execution of the solar cell is done.

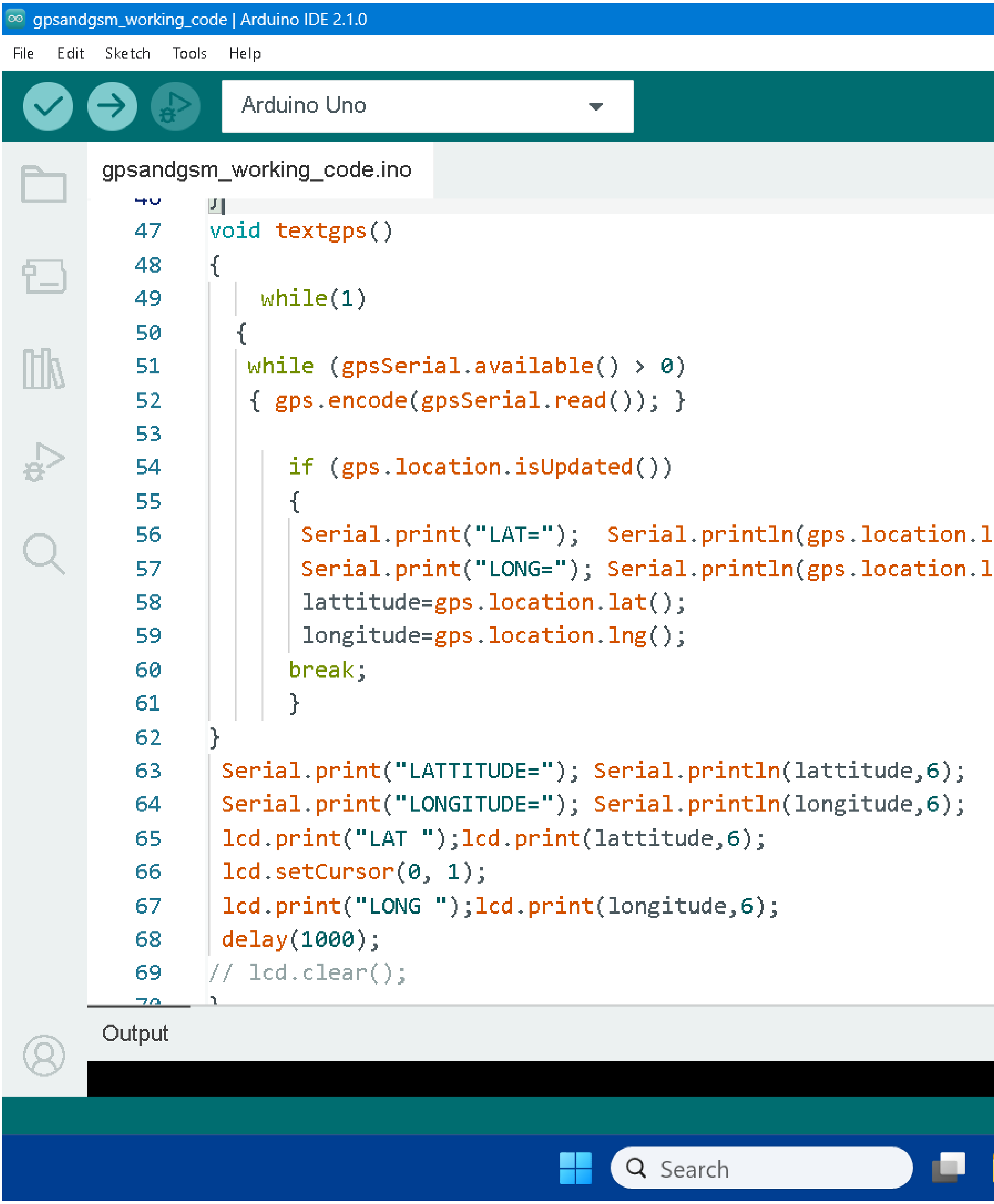
Solar cells can be utilized in location tracking devices to provide a sustainable and renewable power source. Location tracking devices typically rely on batteries for their power supply, but solar cells can help extend the battery life and reduce the need for frequent replacements or recharging.

DESIGN CODE



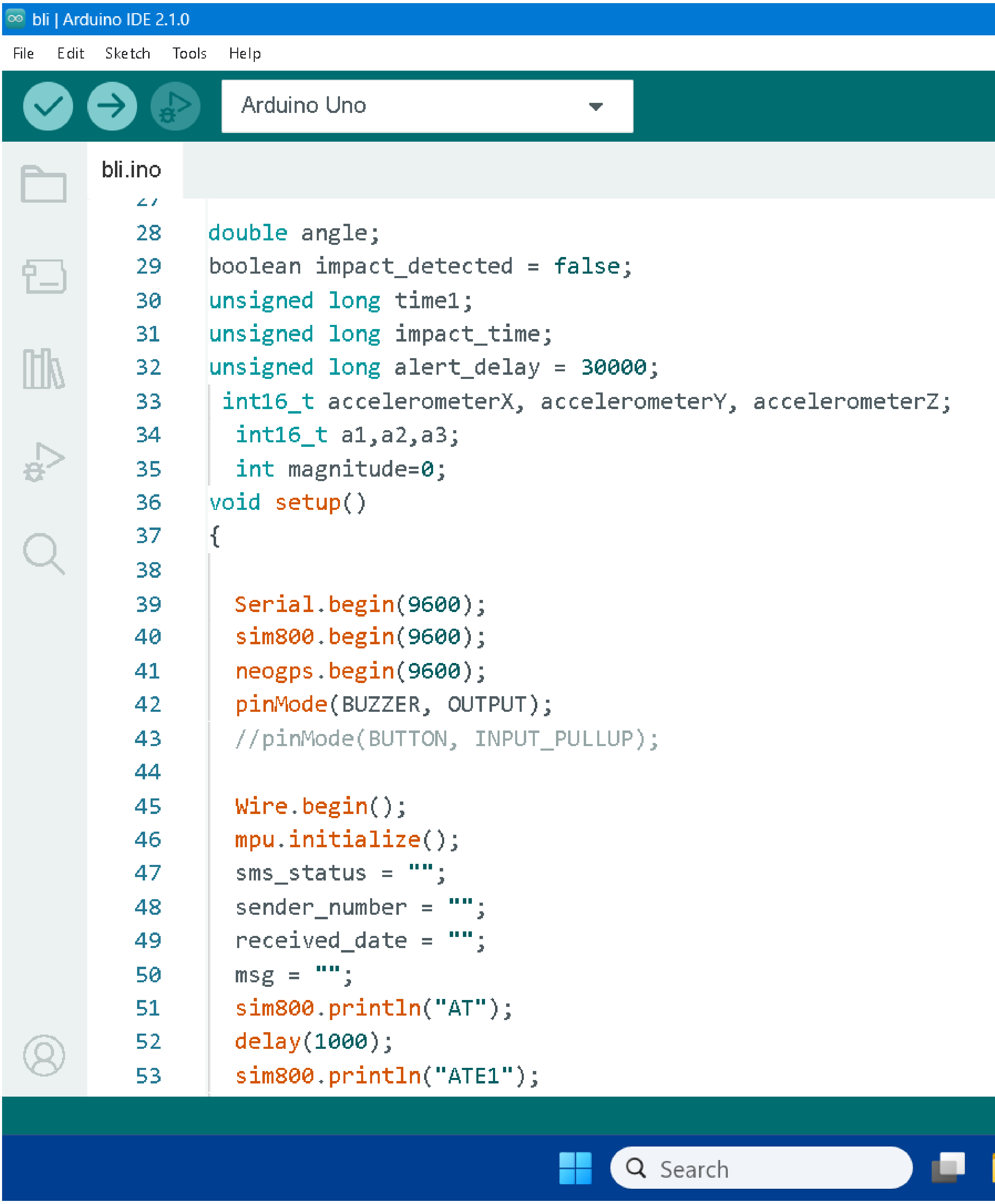
gpsandgsm_working_code | Arduino IDE 2.1.0
File Edit Sketch Tools Help
Arduino Uno
gpsandgsm_working_code.ino
#include <SoftwareSerial.h>
#include <TinyGPS++.h>
#include <LiquidCrystal_I2C.h> //If you don't have the L
LiquidCrystal_I2C lcd(0x27,16,2);
float lattitude,longitude; // create variable for latitude
SoftwareSerial gpsSerial(6,7);//tx,rx
SoftwareSerial gsmm(1,3);//tx,rx
TinyGPSPlus gps;// create gps object
void setup(){
Serial.begin(9600);
lcd.init();
lcd.backlight();// connect serial
//lcd.begin(16, 2);
gpsSerial.begin(9600);
gpsSerial.listen();
textgps();
gsmm.begin(9600);
gsmm.print("\r");
delay(1000);
gsmm.print("AT+CMGF=1\r");
delay(1000);
/*Replace XXXXXXXXXX to 10 digit mobile number & ZZ to 2
Output
Search

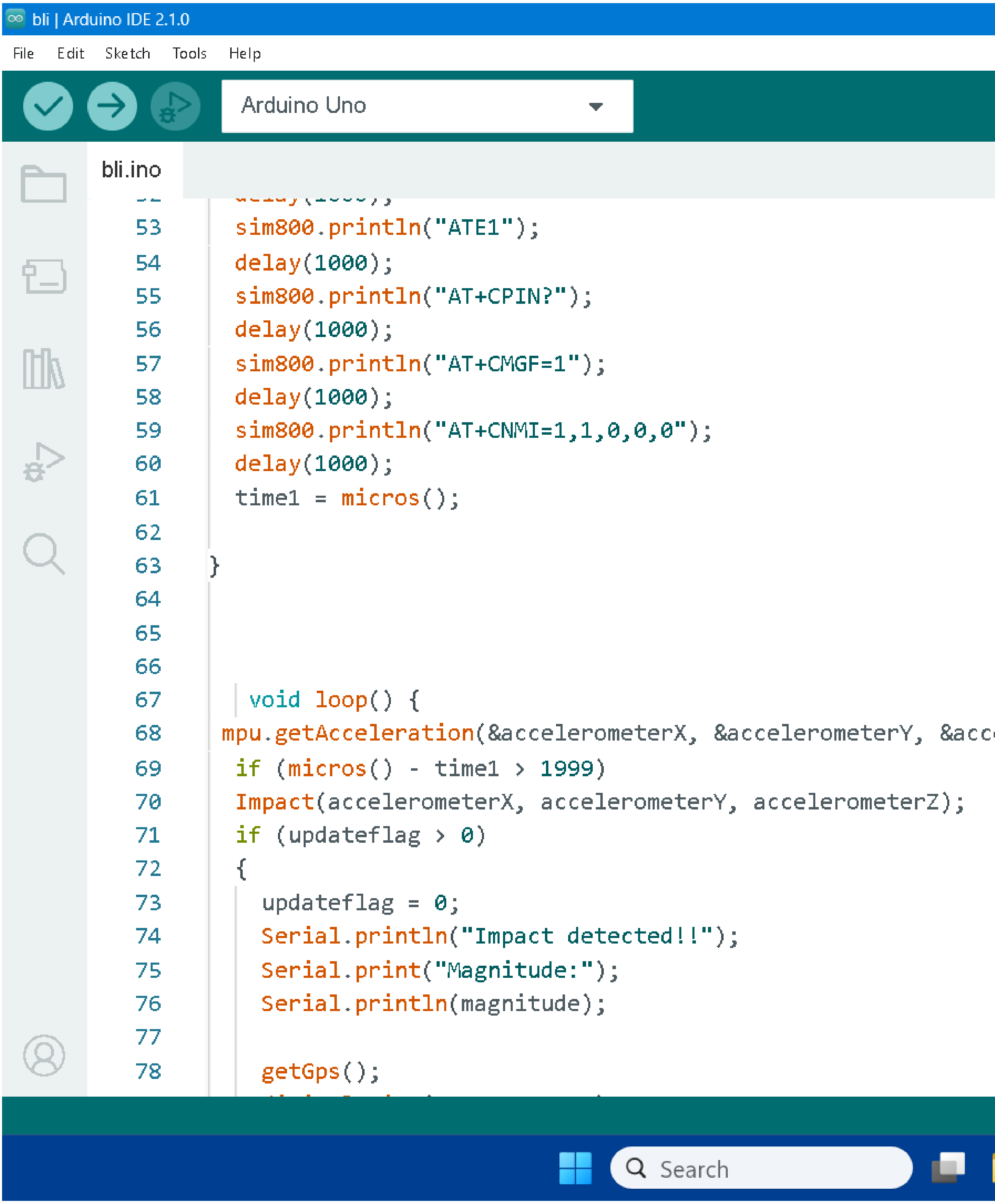

gpsandgsm_working_code | Arduino IDE 2.1.0
File Edit Sketch Tools Help
Arduino Uno
gpsandgsm_working_code.ino
gsmm.print("AT+CMGS=\"+918919725104\"\r");
delay(1000);
//The text of the message to be sent.
//gsmm.print(lattitude,longitude);
// gsmm.print(lattitude);
// gsmm.print(longitude);
gsmm.print("https://www.google.com/maps/place/");
gsmm.print(lattitude, 6);
gsmm.print(",");
gsmm.print(longitude, 6);
delay(1000);
gsmm.write(0x1A);
delay(1000);
// connect gps sensor
}
void loop(){
}
void textgps()
Output
Search

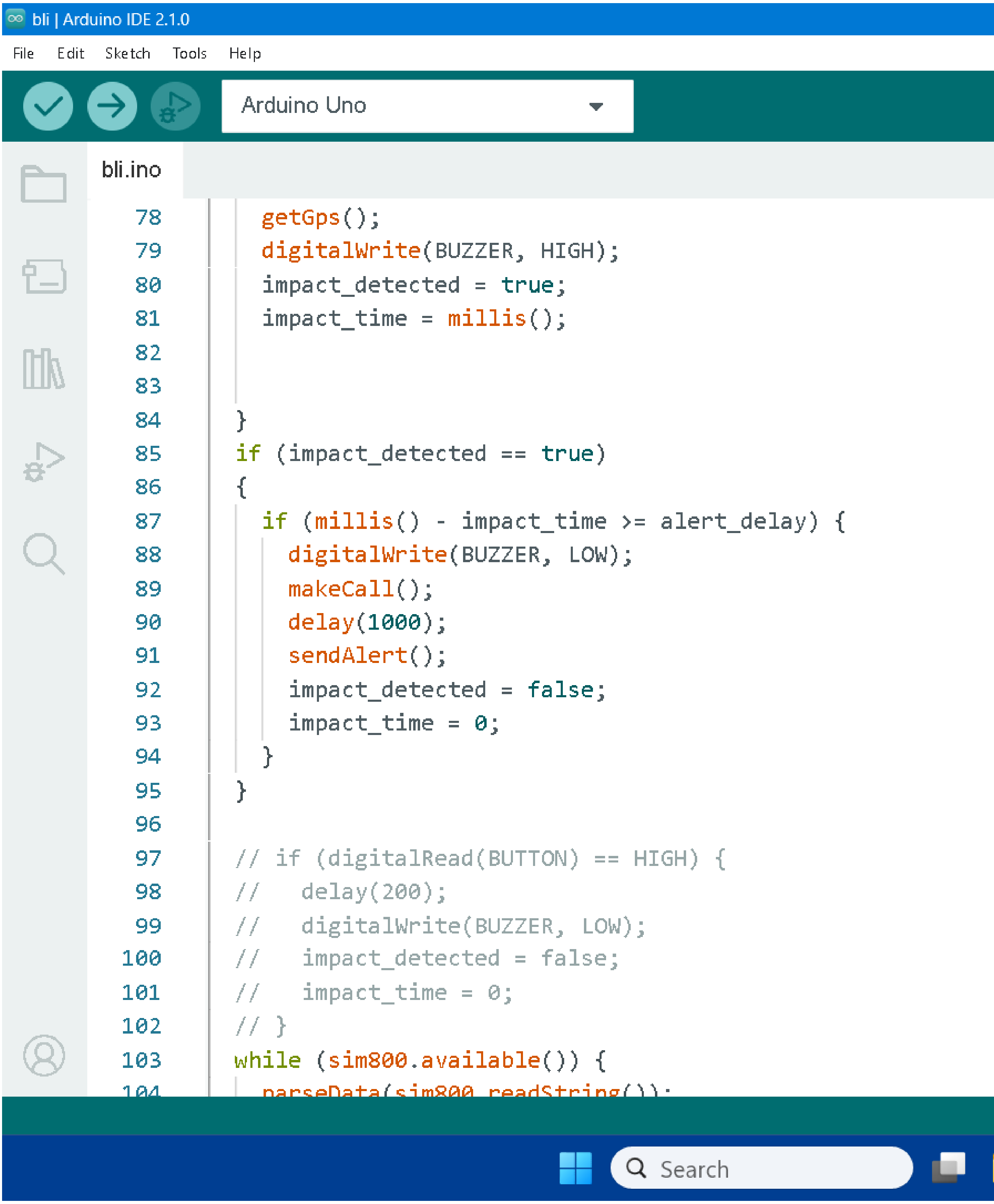

gpsandgsm_working_code | Arduino IDE 2.1.0
File Edit Sketch Tools Help
Arduino Uno
gpsandgsm_working_code.ino
void textgps()
{
while(1)
{
while (gpsSerial.available() > 0)
{ gps.encode(gpsSerial.read()); }
if (gps.location.isUpdated())
{
Serial.print("LAT="); Serial.println(gps.location.
Serial.print("LONG="); Serial.println(gps.location.
lattitude=gps.location.lat();
longitude=gps.location.lng();
break;
}
}
Serial.print("LATTITUDE="); Serial.println(lattitude,6);
Serial.print("LONGITUDE="); Serial.println(longitude,6);
lcd.print("LAT ");lcd.print(lattitude,6);
lcd.setCursor(0, 1);
lcd.print("LONG ");lcd.print(longitude,6);
delay(1000);
// lcd.clear();
Output
Search

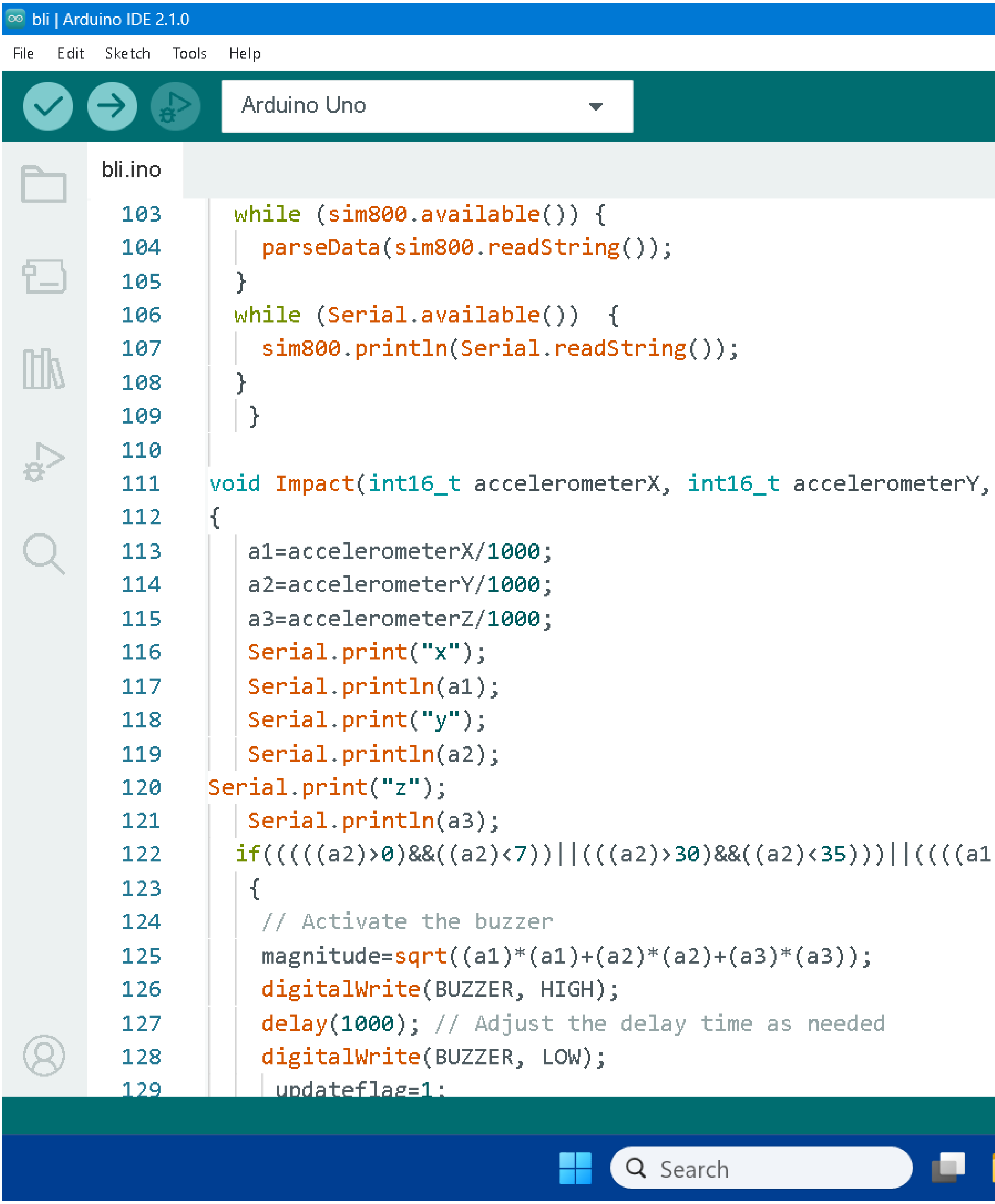
MAIN CODE:

```
#include <Wire.h>
#include <MPU6050.h>

#include <AltSoftSerial.h>
#include <TinyGPS++.h>

#include <math.h>
#include <SoftwareSerial.h>

const String EMERGENCY_PHONE = "+918919725104";
#define rxPin 6
#define txPin 7

SoftwareSerial sim800(rxPin, txPin);
AltSoftSerial neogps(1,3);
TinyGPSPlus gps;
MPU6050 mpu;

String sms_status, sender_number, received_date, msg;
String latitude, longitude;
#define BUZZER 9
//#define BUTTON 11


byte updateflag;

```


bli | Arduino IDE 2.1.0
File
Edit
Sketch
Tools
Help
Arduino Uno
bli.ino
double angle;
boolean impact_detected = false;
unsigned long time1;
unsigned long impact_time;
unsigned long alert_delay = 30000;
int16_t accelerometerX, accelerometerY, accelerometerZ;
int16_t a1,a2,a3;
int magnitude=0;
void setup()
{
Serial.begin(9600);
sim800.begin(9600);
neogps.begin(9600);
pinMode(BUZZER, OUTPUT);
//pinMode(BUTTON, INPUT_PULLUP);
Wire.begin();
mpu.initialize();
sms_status = "";
sender_number = "";
received_date = "";
msg = "";
sim800.println("AT");
delay(1000);
sim800.println("ATE1");
Search


bli | Arduino IDE 2.1.0
File Edit Sketch Tools Help
Arduino Uno
bli.ino
sim800.println("ATE1");
delay(1000);
sim800.println("AT+CPIN?");
delay(1000);
sim800.println("AT+CMGF=1");
delay(1000);
sim800.println("AT+CNMI=1,1,0,0,0");
delay(1000);
time1 = micros();
}
void loop() {
mpu.getAcceleration(&accelerometerX, &accelerometerY, &acc
if (micros() - time1 > 1999)
Impact(accelerometerX, accelerometerY, accelerometerZ);
if (updateflag > 0)
{
updateflag = 0;
Serial.println("Impact detected!!");
Serial.print("Magnitude:");
Serial.println(magnitude);
getGps();
Search


bli | Arduino IDE 2.1.0
File Edit Sketch Tools Help
Arduino Uno
bli.ino
getGps();
digitalWrite(BUZZER, HIGH);
impact_detected = true;
impact_time = millis();
}
if (impact_detected == true)
{
if (millis() - impact_time >= alert_delay) {
digitalWrite(BUZZER, LOW);
makeCall();
delay(1000);
sendAlert();
impact_detected = false;
impact_time = 0;
}
}
// if (digitalRead(BUTTON) == HIGH) {
//   delay(200);
//   digitalWrite(BUZZER, LOW);
//   impact_detected = false;
//   impact_time = 0;
// }
while (sim800.available()) {
Search



```
  while (sim800.available()) {
    parseData(sim800.readString());
  }
  while (Serial.available())  {
    sim800.println(Serial.readString());
  }
   }

void Impact(int16_t accelerometerX, int16_t accelerometerY,
{
   a1=accelerometerX/1000;
   a2=accelerometerY/1000;
   a3=accelerometerZ/1000;
   Serial.print("x");
   Serial.println(a1);
   Serial.print("y");
   Serial.println(a2);
Serial.print("z");
   Serial.println(a3);
  if(((((a2)>0)&&((a2)<7))||(((a2)>30)&&((a2)<35)))||((((a1
   {
    // Activate the buzzer
    magnitude=sqrt((a1)*(a1)+(a2)*(a2)+(a3)*(a3));
    digitalWrite(BUZZER, HIGH);
    delay(1000); // Adjust the delay time as needed
    digitalWrite(BUZZER, LOW);
     updateflag=1;
```

..........Code Continuous

WORKING AND DESIGN

WE COMPLETED THE WHOLE PROCESS IN 4 PHASE

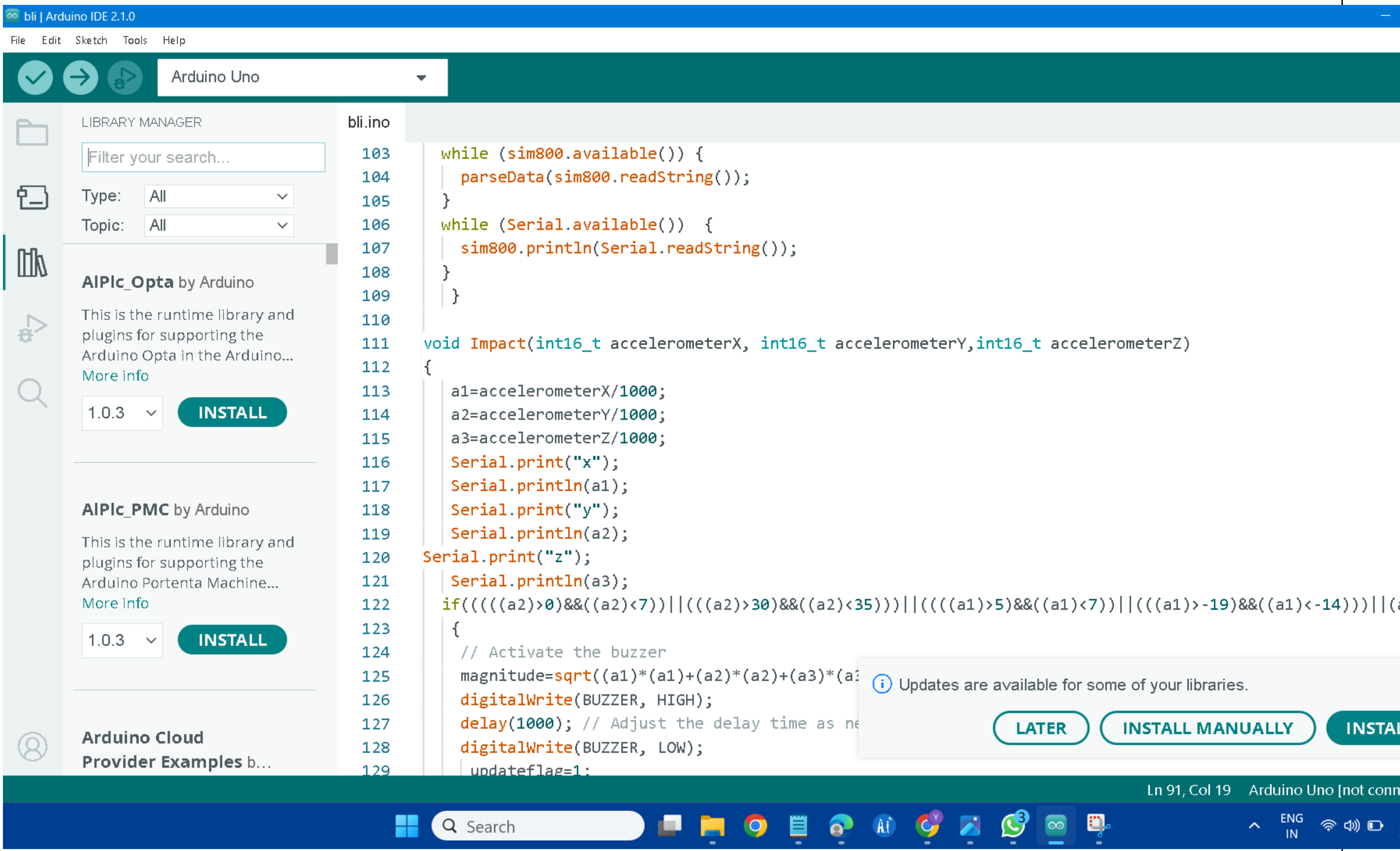
Working

In this project we are working on v02.02.20190915r firmware which is on A9G. The gyroscope(GY-521) identifies the danger if orientation crosses the threshold which in return triggers the loadcell(HX711). When it identifies the response from loadcell(if average human weight reduces from 80 to suddenly drop almost to 0) then it triggers the GSM and it immediately sends the location coordinates and danger message to the trusted person.

Software Used

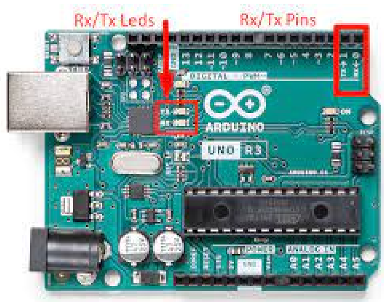
Arduino IDE

At the beginning we simulated the whole circuit using the proteus 8 software. Later we installed the software serial and neo gps library files on the Arduino uno board using the Arduino IDE, this is a very user-friendly IDE, and the GPS and GSM testing was done using the same IDE as well



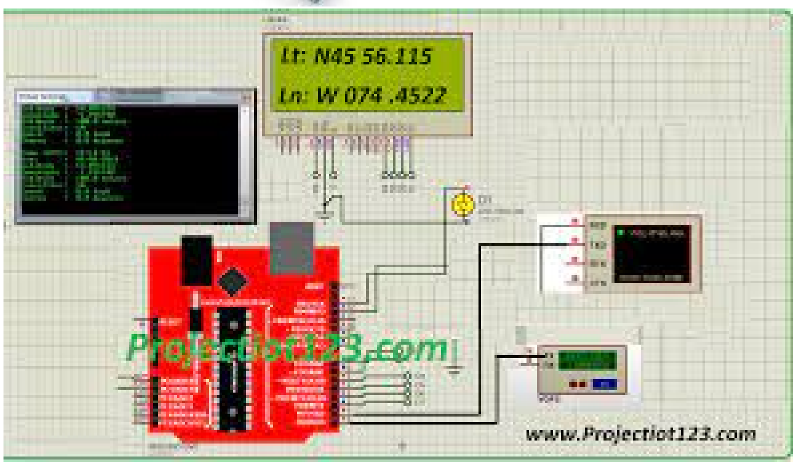
Software serial

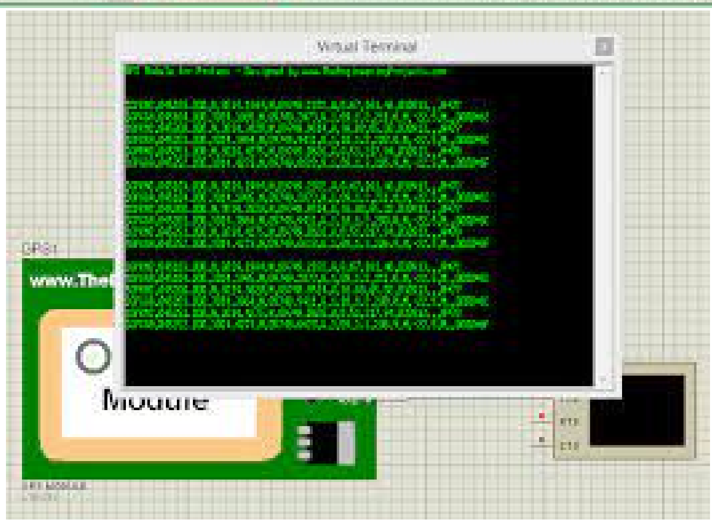
we used this software to execute the GSM to check its proper UART Serial communication. The Tx and Rx are heart of this serial communication. So, selection needs to be done carefully.



Neo GPS

We used this software to execute the GPS. It actually gives the location in NMEA format, using this library it converts into human-readable format.





Flow Of Solution

This project was executed in four phases phase 1 dealt with the software simulation oriented and phase 2 was calibration oriented, phase 3 was GPS and GSM oriented and phase 4 is the assembling and conclusion.

In this process we selected the proteus software then we imported all the GPS and GSM, the Gyroscope(MPU-6050), loadcell(HX711) and Arduino. Using .hex files generated by Arduino IDE, we simulated the circuit on proteus.

Circuit Designed on proteus

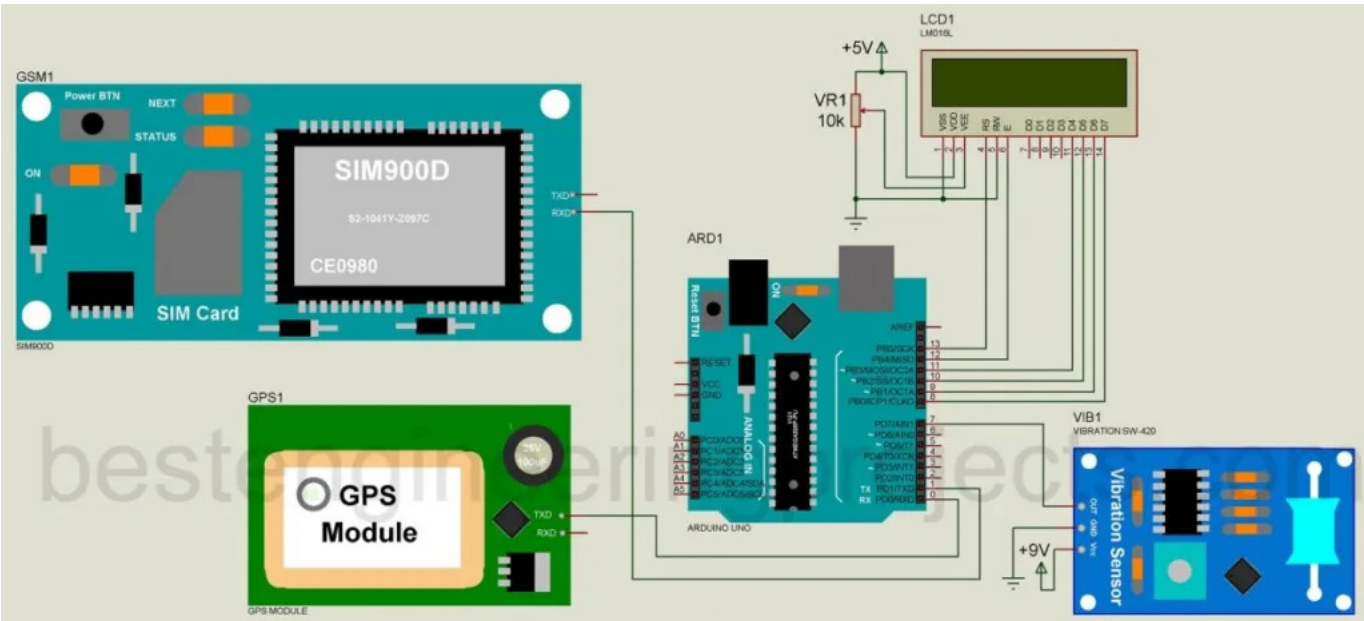


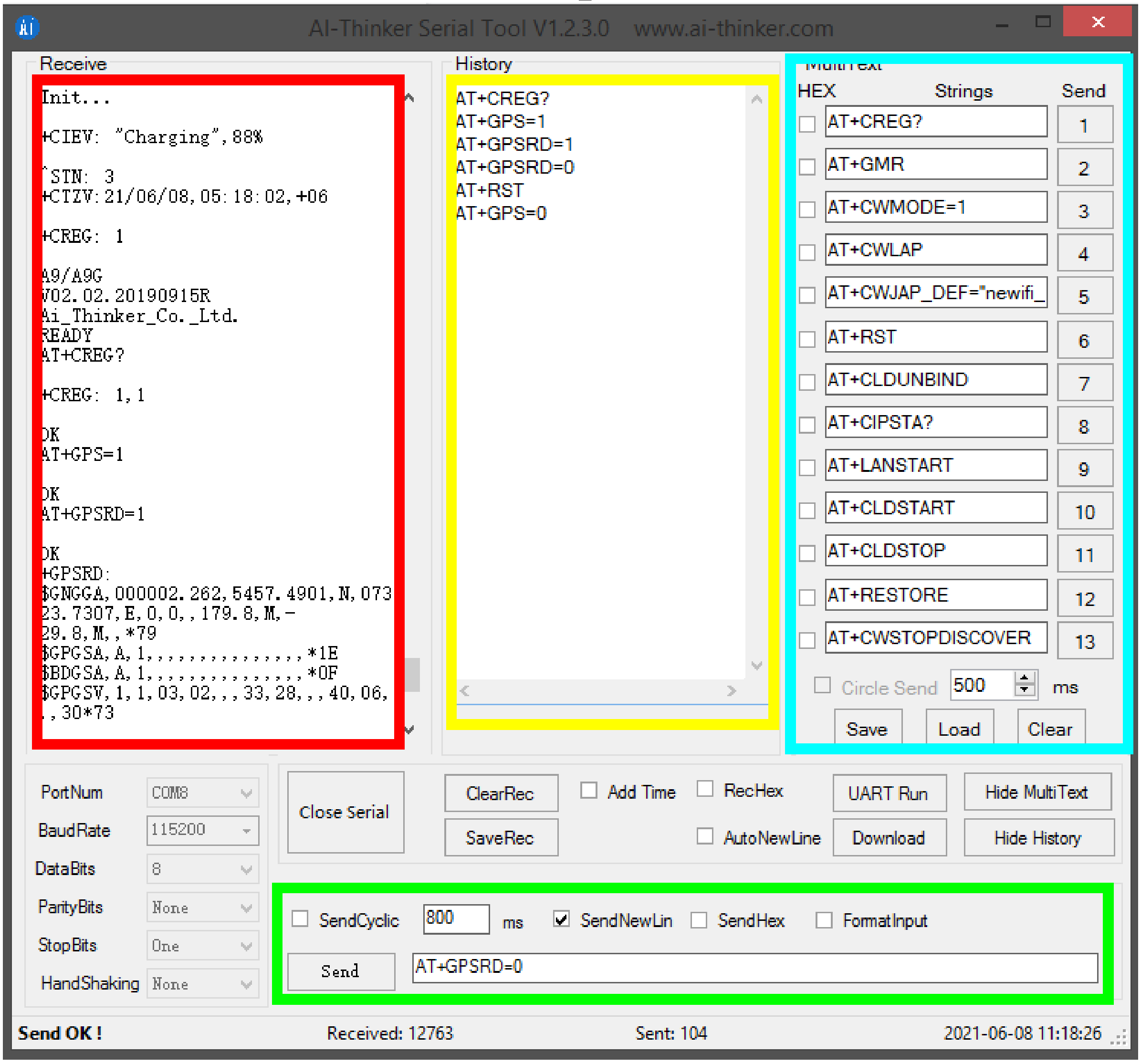
Figure 1: Arduino, GPS and GSM Based Accident Detection System

Phase 2:

Calibrated was done and checked if any error occurred and if the module is capable of getting the desired output.

A9G:

Using AI Thinker we checked the calibration and output of the A9G module. Using AT commands calibrated location, calling and message sending and receiving using onboard microphone we call and communicate with a trusted person



Type	Description	Example
GPGGA	GPS fix data	$GPGGA, 123519, 4807.038,N, 01131.000,E, 1,08,0.9, 545.4,M,46.9,M,,*47
GPGLL	Geographic position, Latitude / Longitude	$GPGLL,4916.45,N,12311.12,W,225444,A, *1D
GPGSA	GPS DOP and active satellite	$GPGSA ,A,3,03,04,,09,12,,,24,,,,,2.5,1.3,2.1*39
GPGSV	GPS Satellites in view	$GPG SV,3,1,11,03,03,111,00,04,15,270,00,06,01,010, 00,13,06,292,00*74

Figure 6: Phase 3

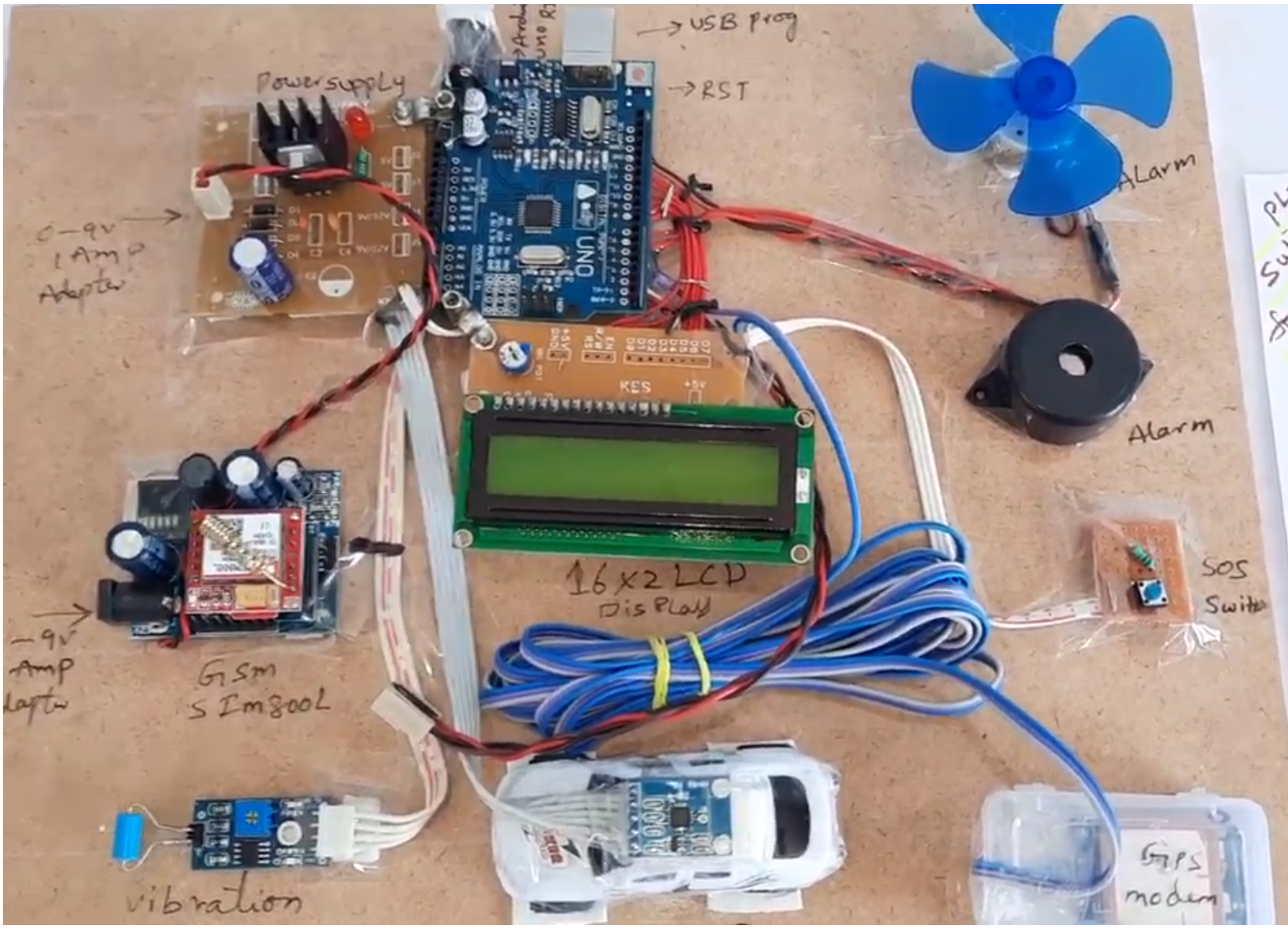
Phase 3

conversion of NMEA format human understandable format of Neo GPS and checking the accuracy of location. Using SIM900A, checking whether the GSM sends the message properly and without any large delay time. 12 voltage supply is needed to work this GSM module.

Phase 4

After checking all the components working, Assembling the components into a single circuit is done. Also checking if the Arduino Uno is capable of handling the load. Hence after the whole assembly of the circuit, check the desired output of the complete module in real time.

Circuit Diagram



Observations

- All the AT commands in the GSM(SIM900A) are giving the desired outputs which are

  1.ATD+91xxxxxxxxxx - CALL CIEV "1" CALL SOUNDER "1" This Command calls the trusted person

  2.AT+CMGF=1
  AT+CMGW="+91xxxxxxxxxx"
  DANGER MESSAGE This command sends the messages

- NEOGPS format on Serial monitor
  1. $GPGGAGlobalPositioningSystemFixData.Itprovides$ $3Dlocationandaccuracydata$
  2.GPGSA It provides GPS DOP and active satellites
  3.$GPGSVItprovidesthedetailedinformationofthe$ $GPSsatellite$
  4.GPGLL It provides the geographic Latitude and Longitude
  5.$GPRMCItprovidestheposition, velocity, andtime$
  6.GPVTG It provides the dual ground/water speed "$GPGGA, 103005, 3807.038, N, 07128.99030, E, 1, 07, 1.43, 134.5, M, 42.9, M, , *78$"

NEOGPS NMEA IS CONVERTED INTO A ”HUMAN UNDERSTANDABLE FORMAT”

AT COMMANDS FOR CALLING FEATURE

ATD: This command is used to dial a phone number ,Ex: ”ATD+1234567890;” will dial the number +1234567890.

ATA: answer an incoming call.
ATH: hang up or end an ongoing call.
AT+CLCC: get the current call status and information,
AT+CCWA: This command enables or disables the call waiting notification.
AT+CLIP: This command enables or disables the Caller ID feature.

AT COMMANMDS FOR MESSAGE FEATURE

AT+CMGS - Send SMS message
AT+CMGF - Set SMS message format
AT+CMGR - Read SMS message
AT+CMGL - List SMS messages
AT+CMGD - Delete SMS message
AT+CMGW - Write SMS message to memory
AT+CMSS - Send SMS message from memory storage

This A9G takes place in 2 major steps

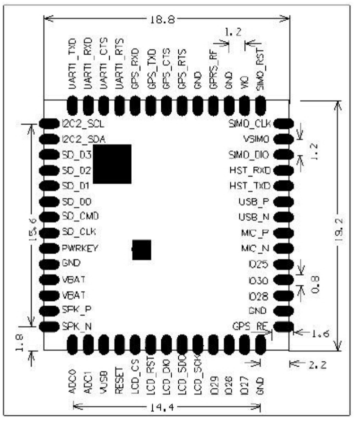
1.Calibration of A9G

2. Real-Time location tracing

安信可科技 Ai-Thinker

A9G GPRS/GSM+GPS/BDS MODULE V1.2

A9G GPRS/GSM+GPS/BDS Module



Features

- Complete quad-band GSM / GPRS module, 800/900 / 1800 / 1900MHz
- SMD package for easy MP & testing
- Low power mode, average current 2mA or less
- support GPS, BD.
- Supports digital audio and analog audio, supports HR, FR, EFR, AMR voice coding
- Support voice calls and SMS messages
- Embedded network service protocol stack
- Support standard GSM07.07,07.05AT command and Anxin expandable command set
- Support PBCCH
- Supports firmware upgrade via serial port

Overview

The A9G is a complete quad-band GSM / GPRS module that combines GPRS and GPS / BDS technologies and integrates it in a compact SMD package, saving customers time and money in developing GNSS applications.

The A9G can be used in a wide range of IoT applications and is ideal for IoT applications for home automation, industrial wireless control, wearable electronics, wireless location sensing devices, wireless location system signals and other IoT applications.

A9G SMD package, through the standard SMT equipment to achieve rapid production of products, especially for automation, large-scale, low-cost modern production methods for the convenience of a variety of Internet of Things hardware terminal applications.

Product specifications

Model Name	A9G
Package	SMD54
Size	19.2*18.8*2.5(±0.2)mm
Frenquency	850/900/1800/1900MHz
GPRS Multi-slot	Class 12
GPRS Mobile Station	Class B
Compatible with GSM Phase 2/2+	Class 4 (2W@850/ 900MHz) Class 1 (1W@1800/1900MHz)
Power supply	3.5~4.2V typical value 4.0V
Current	1.14mA@DRX=5 1.03mA@DRX=9
AT command	3GPP TS 27.007, 27.005
GPRS Class 12	Max 85.6kbps (up & down)
Coding scheme	CS 1,2, 3, 4
PBCCH	Support
Text	Point to point sms send and receive Cellular broadcast message, Text / PDU mode
Voice coding mode	Half Rate (HR)、Full Rate (FR)、 Enhanced Full Rate (EFR)、 Adaptive Multi-Rate (AMR)
Audio processing mechanism	Echo Cancellation, Echo suppression, Noise suppression
SIM Card	1.8V/3V
UART	3 pcs (including firmware upgrade serial port), baud rate support 2400~1843200bps , default 115200bps
Antenna	Pad（include GSM、GPS）
Communication Interface	I2C、USB、UART、SDMMC、GPIO、ADC
GPS Sensitivity	Cold start: -148 dBm Hot start: -162 dBm Recapture: -164dBm Tracking: -166 dBm
GPS boot time	Cold start ＜27.5s Hot start < 1s Recapture < 1s
GPS accuracy	Horizontal positioning accuracy：2.5m High positioning accuracy：3.5m
Working temperature	-20°C～+75°C
Weight	About 3.0g

Contact US

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PROBLEM'S FACED

At first Calibration of A9G takes more time than we expected. after getting desired output our GPS antenna has broken due to its weight upon soldering GPS for A9G heats up it is difficult to send messages from A9G but receiving them is easy so we shifted to NEO-GPS 7M but connecting to the satellite is a tedious task

We choose SIM900A for GSM It works good overall BUT cost of the components has been increased due to multiple defective components

CONCLUSION

location tracking is a complex and controversial issue that involves the collection and monitoring of an individual's geographic location. use cases in various fields such as navigation, emergency services Moreover, location tracking has facilitated the development of numerous applications and services that enhance our daily lives, such as ride-hailing services, food delivery apps, and social networking platforms. In conclusion, the project focused on implementing location tracking for children and elderly people using the NeoGPS 7M and SIM900A modules. These modules, when combined, provide a reliable and accurate means of tracking individual locations, offering several benefits and potential use cases. The NeoGPS 7M and SIM900A modules provide a reliable solution for tracking the location of elderly family members or patients who may have mobility issues or cognitive impairments. This enables caregivers or family members to keep an eye on their loved ones and provide timely assistance if needed.

FUTURE SCOPE

1. We want we make it more power efficient
2. Compact form
3. More accurate
4. Reduce all types of real-time errors in the module
5. COST efficiency

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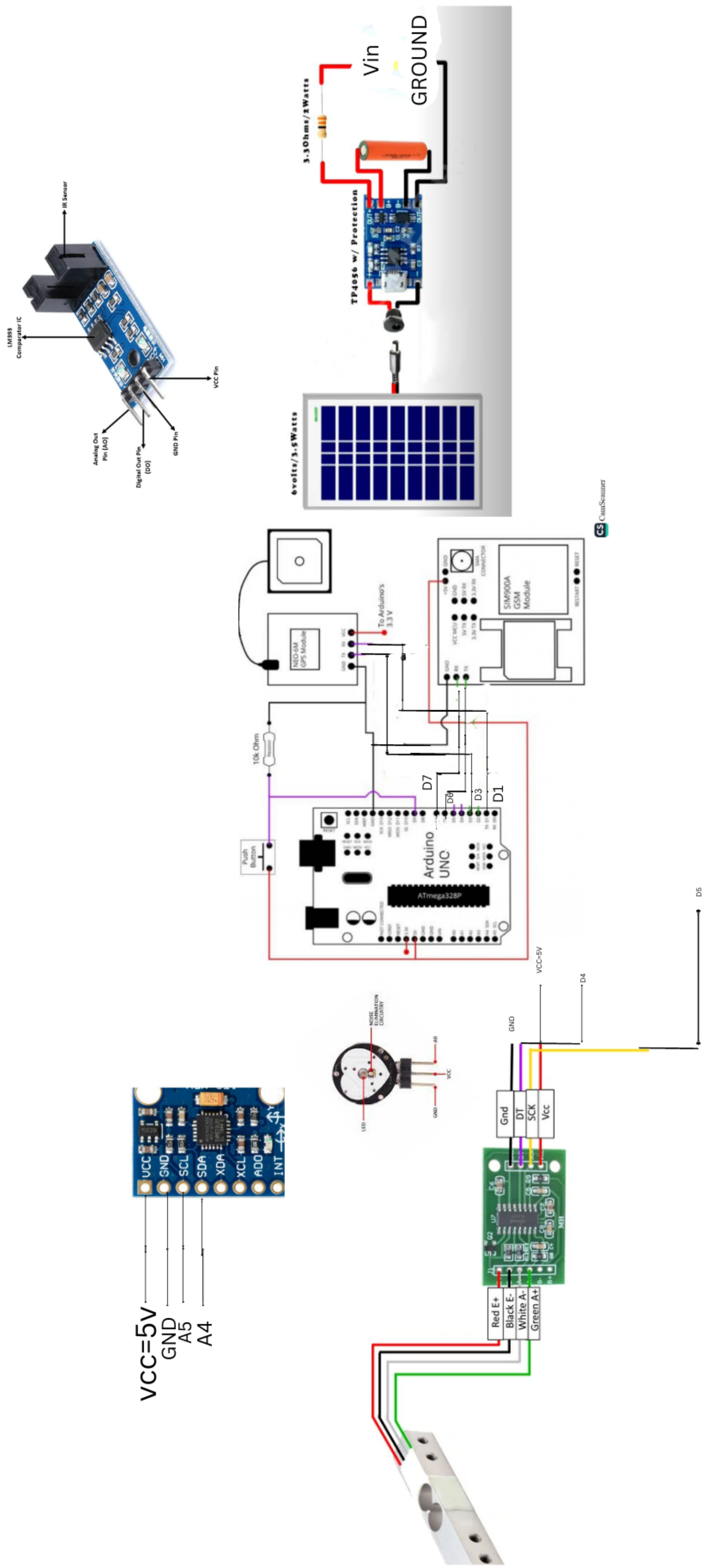

Figure 7: Caption