

## Homemade Realtime GPS Tracker (SIM800L, Ublox NEO-6M, Arduino)

By [buliko \(/member/buliko/\)](#) in [Circuits \(/circuits/\)](#) > [Microcontrollers \(/circuits/microcontrollers/projects/\)](#)

49,213

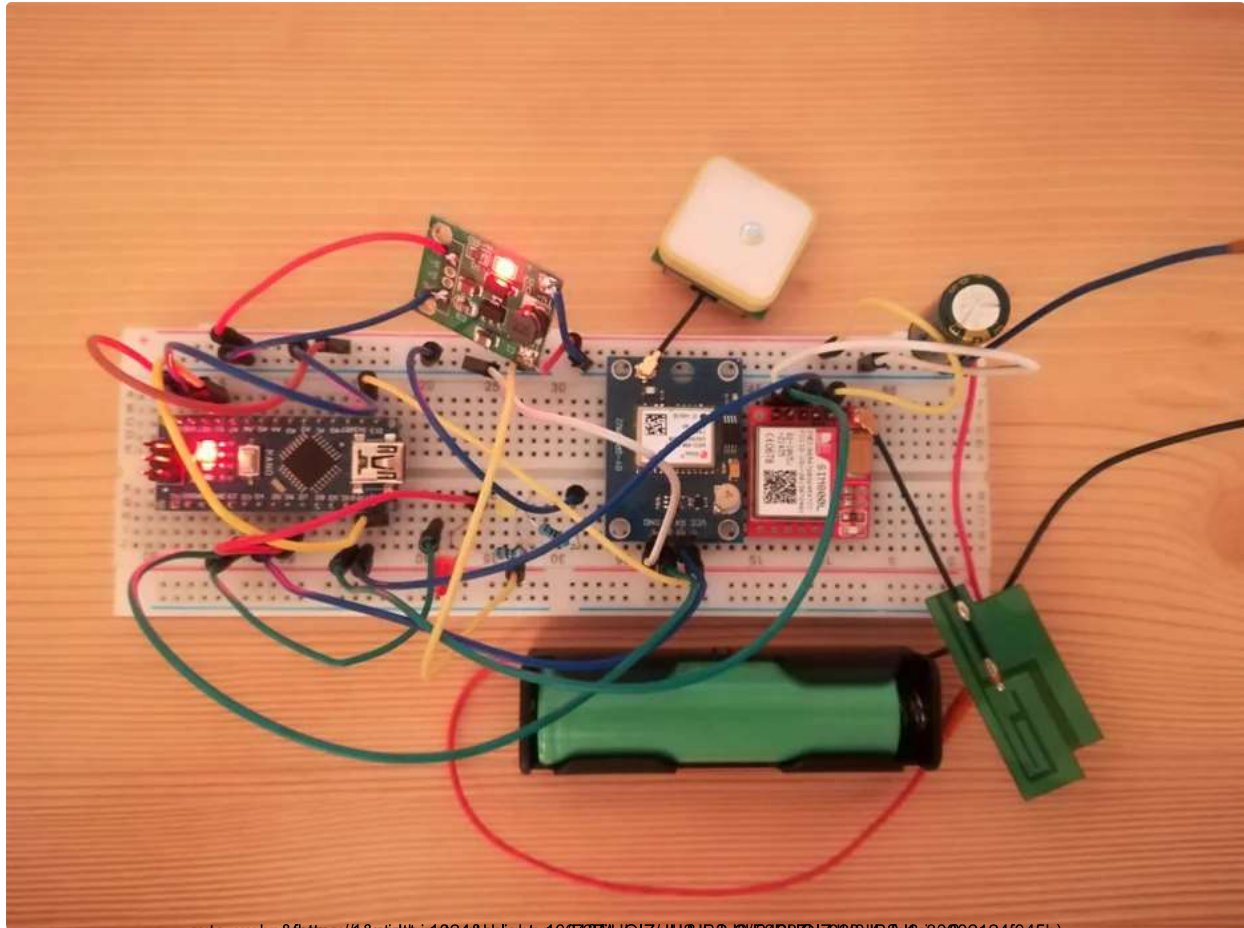
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So you have got a GSM module lying around like me? Also a GPS-tracker?

We think the same!

In this instructables, I will try to guide you how to accomplish your goal from a newbie's perspective.

As I had no previous electrical engineering knowledge (to be honest, the project doesn't need that much, but nah), and had no clue how to make a device which pumps data real-time to a webserver, I encountered numerous problems. Still, I eventually managed to get things to work.

So, in this tutorial, I want to emphasise the mistakes a starter can make, and build-up the project accordingly.

Remember: Always be careful while you work with electricity!

NOTE: I am not professional. The code may be not sophisticated enough for all of your need. The project is intended to be a "hobby project", but! it worked for me. And if it worked for me, it would work for you too!



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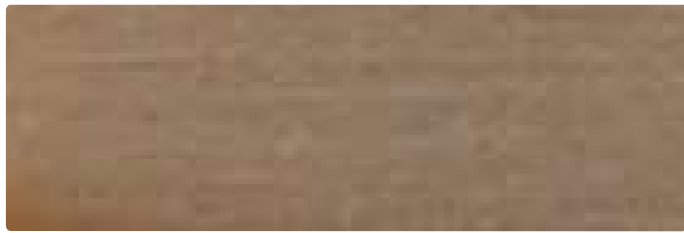


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## Step 1: Prerequisites





### **GSM MODULE - SIM800L**

- Pretty tiny, easy-to-use
- Capable of using mobile internet (GPRS)
- Cheap

### **GPS MODULE - Ublox NEO6M**

- Also small
- Handles its job very well

A microcontroller - can be anything - you could use the famous Arduino Uno or the Nano to free up some space

Battery - I used a 18650 cell as the main, and only power source (Nominal 3.7V)

Battery holder - why? - because soldering an 18650 battery is pretty dangerous because of the heat.

DC-DC Boost Converter Step Up Module 5V - Must have, since the Arduino I used needs 5V

Tools, basic stuff which can come in handy:

Wires, soldering iron, breadboard for testing



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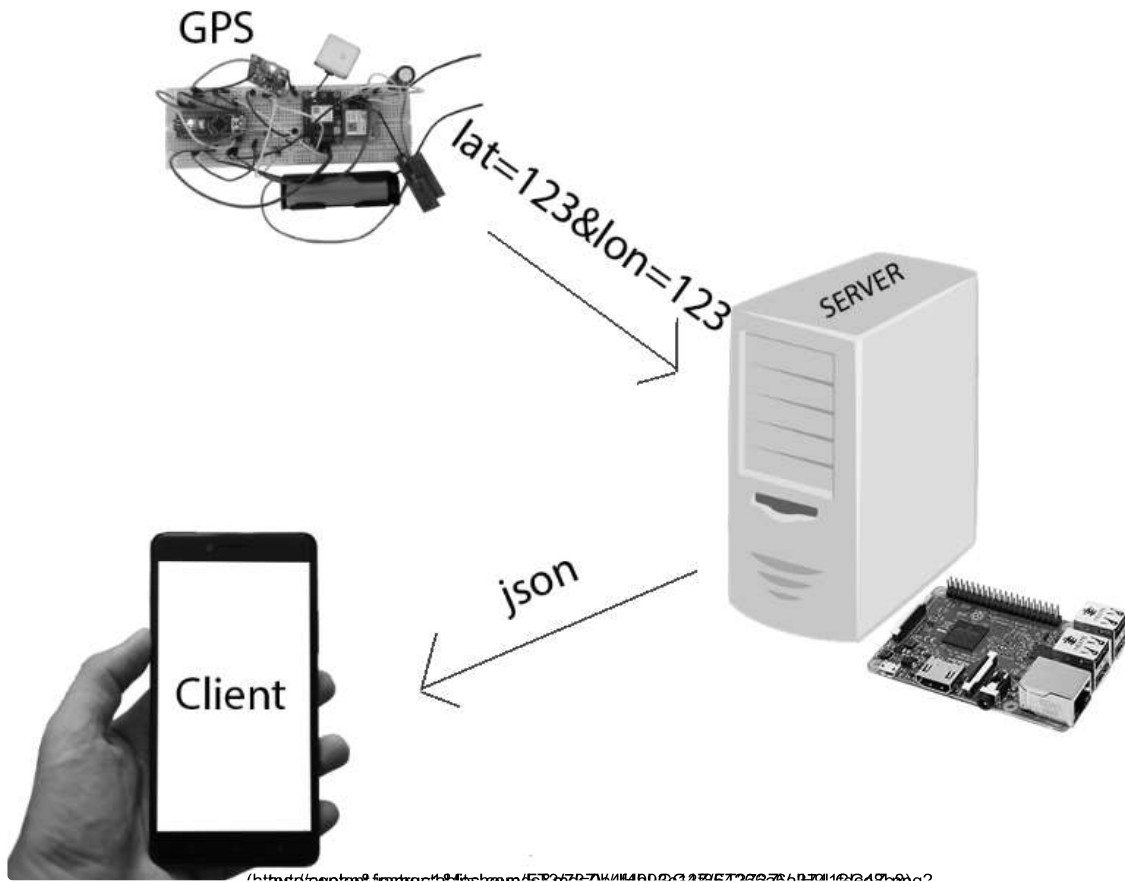


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## **Step 2: Main Concept**



The main concept of the system is the following:

It consists of 3 parts:

1. **A device** - which have the proper GPS-Coordinates and can connect to a server remotely and send data to it
2. **A webserver** - which can receive incoming data - store it - and serve other clients
3. **The platform** - where we can view the coordinates - Ideally it should be now a mobile application, or a website



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### Step 3: The SIM800L Module



I had hard times with the module.

I would like to start with some characteristics and references.

According to the datasheet:

- It operates between 3.4V - 4.4V
- It can send SMS, make voice calls to other phones, and even connect to the Internet!
- We can communicate with it via AT-commands!
- **It can use up to 2A at peak times!** Note: you probably won't be able to measure it with a multimeter - because of its low sampling rates

My experience is that the SIM800L below 3.8V doesn't really work.

For further information visit: [datasheet](#)

([http://img.filipeflop.com/files/download/Datasheet\\_SIM800L.pdf](http://img.filipeflop.com/files/download/Datasheet_SIM800L.pdf)).

So your job is to **provide at least 3.8V** to the module (ideally 4V), a power supply which outputs **at least 2A**.

Before using the module in the final device, I suggest you establish communication with your SIM800L and your computer to make sure your device is working properly.

First things first, **plug in the SIM Card** like in the picture above.

To connect it with your PC, you can use an USB to TTL converter or an Arduino.

Now, I go with the Arduino.

Connect the SIM800L VCC and GND to your power source terminals.

Connect TX to Arduino 10th digital pin, RX to arduino 11th digital pin.

**Download the code**, I linked in this step.

With the code, you can send commands, and get them back, on your Serial Monitor.

Some simple commands:

AT --> Returns OK, if connection is OK.

ATD+123456789; --> Call a given phone number. Note: Don't forget to end it with a semicolon.

AT+CPIN? --> Returns SIM Card status (locked or not)

If you want to send an SMS, you need to end your input with a special character, it can be done with the '\$' symbol.

For further interesting commands I suggest you read [this](http://www.electrodragon.com/w/Category:SIMCOM) (<http://www.electrodragon.com/w/Category:SIMCOM>).

There are various commands, get familiar with them, they are really useful.

There is a red status LED which tells you what operation the SIM800L is in.

64 MS ON - 800MS OFF - SIM800L is not registered to the network.

64 MS ON - 3000MS OFF - SIM800L is registered to the network.

64 MS ON - 300MS OFF - SIM800L is in GPRS mode

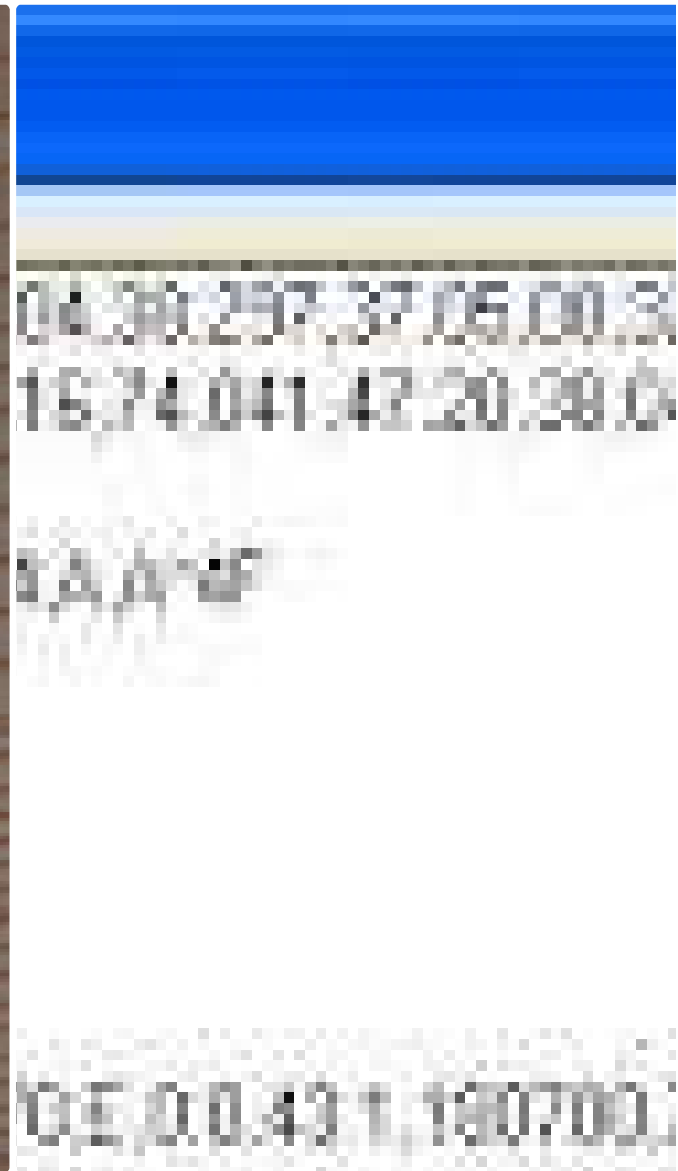
If the SIM800L keeps restarting after about 8-10 blinks, it may be due to lack of efficient power supply.

If you don't get OK after AT, check wiring! If you have a multimeter, check continuity of the wires.

Check the connections of the wires and solder joints! The module will only work when blinking.



## Step 4: Ublox Neo 6m



Some characteristics

- Maximum voltage: 3.6V - I powered it with Arduino's 3.3V pin
- Max current draw is 67mA - so you can power it from arduino
- Temperature range: : -40-85 Celsius (I guess it will fit you)

The unit I ordered came with an antenna seen on the picture, I just plug that in the corresponding slot.

The device when has signals, blinks with blue LED.

First, check how a GPS works [here](http://www.physics.org/article-questions.asp?id=55) (<http://www.physics.org/article-questions.asp?id=55>), if you don't know.

When the device is on, and finds 3 satellites, it sends a lot of comma separated values to the Arduino like above.

To help our job, we can use some external libraries to parse this data to be more human readable.



You can use TinyGps (<https://github.com/mikalhart/TinyGPSPlus>), library or NeoGPS (<https://github.com/SlashDevin/NeoGPS>), library. I used the 2nd one because that is more lightweight.

For testing, you have to connect the power pins to arduino 3.3V and GND.

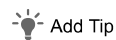
Download this **code**

([https://github.com/LessonStudio/Arduino\\_GPS/blob/master/Arduino\\_GPS.ino](https://github.com/LessonStudio/Arduino_GPS/blob/master/Arduino_GPS.ino)), and use it with your GPS. RX --> Digital pin 10, TX --> Digital pin 11

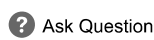
**Note:** Don't forget to use the module outdoors, preferably when there is no cloud.

After half a minute, the device should blink and output your GPS coordinates! :)

Once, you know that your SIM800L and GPS module are working adequately, you can go onto the next step.



Add Tip



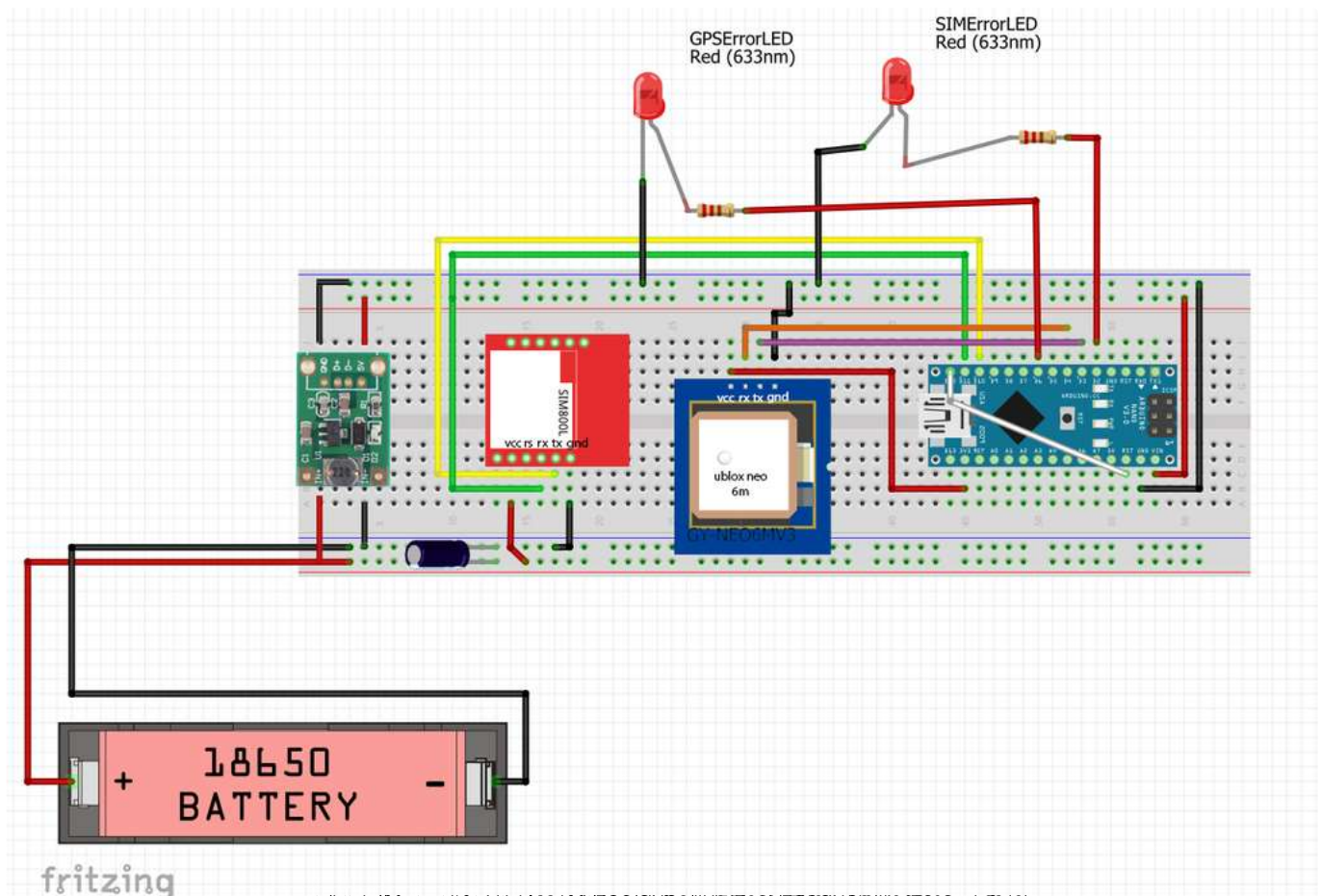
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## Step 5: Circuitry



The circuit is as on the picture.

So, the 3.4V - 4.2V 18650 battery is the main power source. Sim800L gets the energy directly from it. There is a capacitor between them in parallel in order to improve the stability of the circuit.



When you choose a capacitor, you should choose a low ESR capacitor.

One 5V step-up converter boosts the battery's voltage to 5V (it is needed because Arduino works with 5V).

The 5V power rail is connected to the Nano here. The SIM800L and Neo6m are connected with Nano as on the picture. (Sim Tx-D10, SimRx-D11; NeoTX-D3, NeoRX-D4)

D12 is connected to RST, so we are able to programmatically reboot the system (except the SIM800L). NOTE: This reboot method may not be the best practice)

And lastly, two LEDs are connected to the NANO, so we can tell the user, if any error is happening.



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## Step 6: Code

The code is attached to the Instructables or take a look at [github](https://github.com/buliko/SIM800L-NEO6M-homemade-tracker) (<https://github.com/buliko/SIM800L-NEO6M-homemade-tracker>).

You may modify it to work properly for your needs, or you can use other's code if you want.

waitUntilResponse(); helper function was taken from [his code](https://github.com/CheapskateProjects/SimGpsTransmitter) (<https://github.com/CheapskateProjects/SimGpsTransmitter>). Check his work, and code too!

Briefly, in the setup function, we need to enable the GPRS connection of our SIM800L module. We know if it is successful if the LED blinks rapidly. (setupGPRSConnection())

In the loop function - every 15 secs the sendData() function is called - which has the HTTP request

I used query strings to push data to the webserver in this format:

ip address/file.php?key=value&key=value e.g. <http://xxx.xxx.xxx.xxx/log.php?lat=xy&lon=xy>.  
(<http://xxx.xxx.xxx.xxx/log.php?lat=xy&lon=xy>).

If any error happens, the corresponding LED will light up. (SIM, GPS)



neogps.ino

(<https://www.instructables.com/SHU4833W/JHATN8X8>)



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## Step 7: Webserver



For our use, a simple lightweight webserver is enough.

There are some options you can choose from:

1. You could use a remote server of a company, which you probably need to pay for regularly.
2. You could use your own computer. I only suggest it for testing, it is not really efficient to run it 24/7, because of energy wasting, safety issues.
3. You could use a tiny computer, like Raspberry Pi. Lightweight, cheap, doesn't consume much power.

I tried the 2nd, and 3rd option, they worked well. Well, the main aim is not servers of this instructables, but I hint you some advices.

**If you use a PC**, you use probably Windows. If I were you, I would install an Apache (<https://httpd.apache.org/>) or XAMPP (<https://www.apachefriends.org/index.html>) server onto it.

XAMPP already has PHP in it, besides that it also comes with HTML, Perl, and a Database Managing System. With PHP, you can make a dynamic server. If you want to use the local server you have just made from anywhere in the world, you need to assign static IP to your PC and do some portforwarding. A helpful tutorial for static IP ([https://hotcomm.com/FAQ/FAQ\\_staticIP.asp](https://hotcomm.com/FAQ/FAQ_staticIP.asp)):

And the whole portforwarding thing (<https://stackoverflow.com/questions/822902/access-xampp-localhost-from-internet>):

**If you have a Raspberry**, it is a good a practice to use it. You can get familiar with the Linux commands, and run your own server 24/7.

The OS was Raspbian Jessie with a headless setup(no keyboard, monitor) - I controlled it with my computer with SSH connection.




I used Putty(<https://www.putty.org/>) to log into my Raspberry. Don't forget to change your account's password, so that others can't log into you Pi. Default is: pi, passw: raspberry.

I installed a lighttpd webserver with sqlite3. Good tutorial found here (<https://www.gaggl.com/2013/01/webserver-and-database-combination-on-raspberry-pi/>):

I used mainly PHP in the server code. With PHP you can receive data, read/write databases - encode a query into a json format, etc. ...This tutorial ([https://www.tutorialspoint.com/sqlite/sqlite\\_php.htm](https://www.tutorialspoint.com/sqlite/sqlite_php.htm)), will help you a lot, how to manage your database with PHP.

You can view my code on github (<https://github.com/buliko/SIM800L-NEO6M-homemade-tracker>) also, in the server\_files folder.

And of course, you have to enable portforwarding to your Pi on your router, if you want to access that remotely.

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## Step 8: Ending/Experience

An enclosure is yet to be made.

My experince is that, the system works not too bad. But there are stability improvements awaiting.

If the tracker didn't work with the code I attached, don't worry. Try to make sure the SIM800L and NEO 6M are working as they should. You can modify freely my code, or look for better one. I just hope, that I could show you an example, how you can complete this project.

I accept any advice, correction from comments. Feel free to ask.

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[Microcontroller Contest \(/contest/microcontroller2018/\)](/contest/microcontroller2018/)

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## Recommendations



[\(/Modular-Display-Clock/\)](/Modular-Display-Clock/)

**Modular Display Clock** [\(/Modular-Display-Clock/\)](/Modular-Display-Clock/) by Gammawave  
[\(/member/Gammawave/\)](/member/Gammawave/) in Clocks

7 1.5K



[\(/Interactive-Electronic-Toy-of-Jack-O-lantern-Horse/\)](/Interactive-Electronic-Toy-of-Jack-O-lantern-Horse/)

**Interactive Electronic Toy of Jack-O-lantern & Horse** [\(/Interactive-Electronic-Toy-of-Jack-O-lantern-Horse/\)](/Interactive-Electronic-Toy-of-Jack-O-lantern-Horse/) by

511



[\(/contest/puzzles22/\)](/contest/puzzles22/)



[\(/contest/moveit22/\)](/contest/moveit22/)



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Please be positive and constructive.

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## 12 Comments



(/member/setiawanandry58/) setiawanandry58 (/member/setiawanandry58/) Question 4 months ago

Answer

▲ Upvote

Great...but if want to use telegram bot and telegram as interface.? Can it does?



(/member/entongjina002/) entongjina002 (/member/entongjina002/) 1 year ago

Reply

▲ Upvote

Hi sir..... can you help me to my thesis project... I want to send the GPS location data to firebase using GSM sim800l and Arduino..

This is my code that I use :

```
#define TINY_GSM_MODEM_SIM800
#define TINY_GSM_RX_BUFFER 256
#include //https://github.com/vshymanskyy/TinyGSM (https://github.com/vshymanskyy/TinyGSM)
#include //https://github.com/arduino-libraries/ArduinoHttpClient (https://github.com/arduino-libraries/ArduinoHttpClient)
#include
#include
#include
#define rxPin 7
#define txPin 8
SoftwareSerial sim800(txPin, rxPin);
AltSoftSerial neogps(0,1);
TinyGPSPlus gps;
const char FIREBASE_HOST[] = "https://famous-segment-319603-default-rtdb.firebaseio.com/"
(https://famous-segment-319603-default-rtdb.firebaseio.com/);
const String FIREBASE_AUTH = "yzZb6JRN6pHMoDxdtUPHhyhrCL0R1WtP9TPBWKM3n ";
const String FIREBASE_PATH = "/";
const int SSL_PORT = 443;
char apn[] = "internet.globe.com.ph (http://internet.globe.com.ph)";
char user[] = "";
char pass[] = "";
TinyGsm modem(sim800);
TinyGsmClientSecure gsm_client_secure_modem(modem, 0);
HttpClient http_client = HttpClient(gsm_client_secure_modem, FIREBASE_HOST, SSL_PORT);
unsigned long previousMillis = 0;
void setup()
{
  Serial.begin(115200);
  neogps.begin(9600);
  Serial.println(F("device serial initialize"));
  sim800.begin(9600);
  Serial.println(F("SIM800L serial initialize"));
  Serial.println(F("Initializing modem..."));
  modem.restart();
  String modemInfo = modem.getModemInfo();
  Serial.print(F("Modem: "));
  Serial.println(modemInfo);
  http_client.setHttpResponseTimeout(10 * 1000); //^0 secs timeout
}
```

```

void loop()
{
  Serial.print(F("Connecting to "));
  Serial.print(apn);
  if (!modem.gprsConnect(apn, user, pass))
  {
    Serial.println(F(" fail"));
    delay(1000);
    return;
  }
  Serial.println(F(" OK"));
  http_client.connect(FIREBASE_HOST, SSL_PORT);
  while (true) {
    if (!http_client.connected())
    {
      Serial.println();
      http_client.stop();// Shutdown
      Serial.println(F("HTTP not connected"));
      break;
    }
    else
    {
      gps_loop();
    }
  }
}

void PostToFirebase(const char* method, const String & path , const String & data, HttpClient* http)
{
  String response;
  int statusCode = 0;
  http->connectionKeepAlive();
  String url;
  if (path[0] != '/')
  {
    url = "/";
  }
  url += path + ".json";
  url += "?auth=" + FIREBASE_AUTH;
  Serial.print("POST:");
  Serial.println(url);
  Serial.print("Data:");
  Serial.println(data);
  String contentType = "application/json";
  http->put(url, contentType, data);
  statusCode = http->responseStatusCode();
  Serial.print(F("Status code: "));
  Serial.println(statusCode);
  response = http->responseBody();
  Serial.print(F("Response: "));
  Serial.println(response);
  if (!http->connected())
  {
    Serial.println();
    http->stop();// Shutdown
    Serial.println(F("HTTP POST disconnected"));
  }
}

void gps_loop()
{
  String latitude = String(gps.location.lat (http://gps.location.lat()), 6);
  String longitude = String(gps.location.lng(), 6);
  delay(100);
  // Serial.print("Latitude= ");

```

```
// Serial.print(latitude);
// Serial.print(" Longitude= ");
// Serial.println(longitude);
String Data = "{}";
Data += "\"latitude\":" + latitude + ",";
Data += "\"longitude\":" + longitude + """;
Data += "}";
PostToFirebase("PATCH", FIREBASE_PATH, Data, &http_client);
}
```

-----

This is the result I got.. What possible solution I need to do.... Please help me...

(<https://content.instructables.com/FPW/JXET/KVL85OH4/FPWJXETKVL85OH4.png?auto=webp&fit=bounds&frame=1>)

▲  
1

(/member/ssalhi863/) ssalhi863 (/member/ssalhi863/) 3 years ago

Reply

▲ Upvote

Why we use webserver ?

There is another way

Send coordination with SMS message than past it in Google maps

It's very easy and simple please give us a tutorial about it sir

(/member/AdietaN/) AdietaN (/member/AdietaN/) 3 years ago on Step 6

Reply

▲ Upvote

Excuse me, Sir..  
I want to ask...  
I have an error with your code  
#include <stdlib.h>  
#include <NeoSWSerial.h>  
can you tell where the library is from  
  
and before that I say thank you. because this article is very useful and high class

▲  
1

(/member/AndreasS82/) AndreasS82 (/member/AndreasS82/) 3 years ago

Reply

▲ Upvote

Glad to hear, it works well on your side.

I am from Germany and tried hard to run the Sim800L well.

Just because, when I tried it at home with power adapter, sometimes it works. When it gets connection, then it can run many hours. With 3,7V.

But sometimes it could not connect although there was a good gsm 3G Connection.

When I tried it outside, it never works.

I tried to use StepDown Converter. All of them have a various voltage.

In the end I am searching for an alternative for the Sim800L.



In the near future, the 2G/3G stops working.

The 4G Modules are very expensive. About 80\$ from china.

So I hope one day for a cheap 4G Module which works well with 5V/3,3V and does not need 2A!

Rather can use 0,5A from Arduino itself.

Please tell us if your project still works well and where you use it.

By the way the NEO-6M Module works like a charm from the first minute on. Also the 7M Module sends some more informations.

---

(/member/pulugujjua/) pulugujjua (/member/pulugujjua/) Question 3 years ago

Answer

▲ Upvote

Hello @buliko

I am using only Sim 800L module. I want to get location using AT commands. Give me some tips and please make some corrections in code below or else please share code if you have. Thankyou

```
#include "Arduino.h"
#include "Sim800L.h"
#include<SoftwareSerial.h>
char My_Array[20];
int count = 0;
#define TIME_OUT_READ_SERIAL 5000
String _buffer;
String number = "+123456789";
String text;
SoftwareSerial sim(10,11);
void setup()
{
  delay(5000);
  Serial.begin(9600);
  _buffer.reserve(255);
  delay(1000);
  sim.begin(9600);
  delay(1000);
  Serial.println("Setup Complete");
  Serial.println("Type s to send sms, c to calculate location");
}
void loop() {
  if(Serial.available()>0)
  {
    switch(Serial.read (http://serial.read()))
    {
      case 's':
        sendsms("message");
        break;
      case 'c':
        calculateLocation();
        break;
    }
  }
  if(sim.available()>0)
  {
    Serial.println(sim.read (http://sim.read()));
  }
}
String _readSerial()
{
  uint64_t timeOld = millis();
  while(!Serial.available() && !(millis()> timeOld + TIME_OUT_READ_SERIAL))
```

```

{
delay(13);
}
String str;
while(Serial.available())
{
if(Serial.available() > 0) //something (//something) is there to be read
{
char C = Serial.read (http://serial.read());
if(C == '.')
{
int i = 0;
while (i != count)
{
Serial.print(My_Array[i++]);
}
}
else My_Array[count++] = C;
}
if(Serial.available()>0)
{
str += (char) Serial.read (http://serial.read());
}
}
return str;
}
String _readSerial(uint32_t timeout)
{
uint64_t timeOld = millis();
String str;
while(!Serial.available() && !(millis()> timeOld + timeout))
{
if(Serial.available()>0)
{
str += (char) Serial.read (http://serial.read());
}
}
return str;
}
void sendsms(String text)
{
Serial.println ("Sending Message");
sim.write("AT+CMGF=1\r");//Sets (//sets) the GSM Module in Text Mode
delay(1000);
sim.println("AT+CMGF=1");
delay(1000);
sim.write("AT+CMGS=\"+123456789\"");//Mobile (//mobile) phone number to send message
sim.write("\r");
delay(1000);
sim.println(text);
delay(1000);
sim.write(0x1A);
delay(1000);
sim.println((char)26);// ASCII code of CTRL+Z
delay(1000);
_buffer = _readSerial();
}
bool calculateLocation()
{
activateBearerProfile();
Serial.println("activated");
uint8_t type=1;
uint8_t cid=1;

```

```

String tmp = "AT+CIPGSMLOC=" + String(type) + "," + String(cid) + "\r\n";
sim.print(tmp);
/*sim.write("AT+CIPGSMLOC=");
sim.write(type);
sim.write(",");
sim.write(cid);
sim.write("\r\n");*/
String data = _readSerial();
Serial.println(data);
if(data.indexOf("ER")!=(-1)) return false;
uint8_t indexOne;
uint8_t indexTwo;
indexOne = data.indexOf(".") + 1;
indexTwo = data.indexOf(",");
String _locationCode = data.substring(indexOne,indexTwo);
Serial.println(_locationCode);
// sendsms(_locationCode);
indexOne = data.indexOf(",")+1;
indexTwo = data.indexOf(",", indexOne);
_longitude = data.substring(indexOne,indexTwo);
sim.print(_longitude);
indexOne = data.indexOf(",", indexTwo) + 1;
indexTwo = data.indexOf(",", indexOne);
_latitude = data.substring(indexOne,indexTwo);
sim.print(_latitude);
return true;
}
String getLocationCode()
{
return _locationCode;
}
String getLongitude()
{
return _longitude;
}
String getLatitude()
{
return _latitude;
}
void activateBearerProfile()
{
sim.print(F("AT+SAPBR=3,1,\"CTYPE\","GPRS" "\r\n"));
_buffer = _readSerial();
Serial.println(_buffer);
sim.print(F("AT+SAPBR=3,1,\"APN\","bsnlnet" "\r\n"));
_buffer = _readSerial();
Serial.println(_buffer);
sim.print(F("AT+SAPBR=1,1 "\r\n"));
delay(1200);
_buffer = _readSerial();
Serial.println(_buffer);
sim.print(F("AT+SAPBR=2,1 "\r\n"));
delay(3000);
_buffer = _readSerial();
Serial.println(_buffer);
}

```

---

(/member/camicami123/) camicami123 (/member/camicami123/) Question 3 years ago

Answer

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Hello. Why my database is not updating or receiving any data?

(/member/ZoheirB/) ZoheirB (/member/ZoheirB/) 3 years ago

Reply

▲ Upvote

Hello @buliko

Can you add the platform part where we can view the coordinates on pc or mobile app

Thank you

(/member/langtupt/) langtupt (/member/langtupt/) 3 years ago

Reply

▲ Upvote

Hello Khun @buliko,

I have a hosting can you help me guide setup in my hosting?

Thank you very much

1 reply ▼

(/member/DIY+Hacks+and+How+Tos/) DIY Hacks and How Tos  
(/member/DIY+Hacks+and+How+Tos/) 4 years ago

Reply


▲ Upvote

Cool project. You should enter this into the Microcontroller contest.

1 reply ▼

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-  Living  
(/living/)
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