ABSTRACT

The aim of this project is to create a wearable device to allow the monitoring of the location of patients in quarantine, to make sure that they do not leave. The device created can be strapped onto the patients and will be able to track their location. The concept used to track is geo fencing.

- The hardware part of the project includes Node MCU to which a GPS module is connected and the values of latitude, longitude and altitude are getting printed in the serial monitor.
- Now the values of the latitude, longitude are used to calculate the distance from a pre declared latitude and longitude called the home latitude and home longitude.
- The variable called “Distance_from_home” is calculated and published in the ADAFRUIT IO server as feeds. These feeds are shown in a dashboard.
- Now deciding on the radius of fencing, a trigger can be set in the servers to give us notification.
- But since we all use mobile phones, it is practical to have a notification on our phone.
- That is achieved using IFTTT applets that can be used to monitor a feed from ADAFRUIT IO and give an alert on a pre declared condition.

INTRODUCTION

Coronavirus becomes officially a global pandemic due to the speed spreading off in various countries. An increasing number of infected with this disease causes the Inability problem to fully care in hospitals and afflict many doctors and nurses inside the hospitals. This project proposes a smart system that monitors the patients holding the Coronavirus remotely, in order to protect the lives of the health services members (like physicians and nurses, police,) from infection.

There are a lot of cases of people not following the quarantine protocols and are still leaving the hospitals and their homes. We are trying to do this project to try and create a viable solution to this problem by making a GPS tracking device which will enable hospital authorities to ensure that patients are not following protocols for any reason whatsoever. With this project we hope to give relief to public, hospital authorities and the unaffected population all over the world and some confidence of being safe.

We aim to achieve this by implementing the concept of geo fencing. A geofence is a virtual perimeter for a real-world geographic area. A geo-fence could be dynamically generated—as in a radius around a point location, or a geo-fence can be a predefined set of boundaries. The use of a geofence is called geofencing.

The person under quarantine is required to wear a wearable device or install an app on their phone which relays the location of the person at specific time intervals to the monitoring station.

The monitoring station sets up a virtual geofence around the home of the person under quarantine and if the person under quarantine moves out of the area of the geofencing then an alert is sent out to the monitoring station which can then track and return the violator to quarantine immediately thus preventing the further transmission and spread of the virus.

COMPONENTS USED

NODEMCU:

NodeMCU is an open-source Lua based firmware and development board specially targeted for IoT based Applications. It includes firmware that runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module.

The NodeMCU ESP8266 development board comes with the ESP-12E module containing ESP8266 chip having Tensilica Xtensa 32-bit LX106 RISC microprocessor. This microprocessor supports RTOS and operates at 80MHz to 160 MHz adjustable clock frequency. NodeMCU has 128 KB RAM and 4MB of Flash memory to store data and programs. Its high processing power with in-built Wi-Fi / Bluetooth and Deep Sleep Operating features make it ideal for IoT projects. NodeMCU can be powered using Micro USB jack and VIN pin (External Supply Pin). It supports UART, SPI, and I2C interface.

GPS MODULE:

The GPS QUESTAR TTL is a compact all-in-one GPS module solution intended for a broad range of Original Equipment Manufacturer (OEM) products, where fast and easy system integration and minimal development risk is required. The receiver continuously tracks all satellites in view and provides accurate satellite positioning data. The GPS QUESTAR TTL is optimized for applications requiring good performance, low cost, and maximum flexibility; suitable for a wide range of OEM configurations including handhelds, sensors, asset tracking, PDA-centric personal navigation system, and vehicle navigation products. Its 56 parallel channels and 4100 search bins provide fast satellite signal acquisition and short start-up time. Acquisition sensitivity of -140dBm and tracking sensitivity of -162dBm offers good navigation performance even in urban canyons having limited sky view. Satellite-based augmentation systems, such as WAAS and EGNOS, are supported to yield improved accuracy. USB-level serial interface is provided on the interface connector. Supply voltage of 3.8V~5.0V is supported.

ADAFRUIT:

Adafruit.io is a cloud service - that means it does not need to be managed by the user. We can connect to it over the Internet. It's meant primarily for storing and then retrieving data but it can do a lot more than just that.

- It displays your data in real-time, online
- The projects can be connected to the internet through adafruit. Control your project remotely and save all the data for analysis.
- Connect your project to other internet-enabled devices
- Another important aspect of Adafruit is it is available for free.

Adafruit IO's MQTT API exposes feed data using special topics. You can publish a new value for a feed to its topic, or you can subscribe to a feed's topic to be notified when the feed has a new value. Any one of the following topic forms is valid for a feed:

- (username)/feeds/ (feed name or key)
- (username)/f/ (feed name or key)

Where (username) is your Adafruit IO username (the same as specified when connecting to the MQTT server) and (feed name or key) is the feed's name or key. The smaller '/f/' path is provided as a convenience for small embedded clients that need to save memory.

IFTTT:

IFTTT derives its name from the programming conditional statement “if this, then that.” What the company provides is a software platform that connects apps, devices and services from different developers in order to trigger one or more automations involving those apps, devices and services.

The automations are accomplished via applets — which are sort of like macros that connect multiple apps to run automated tasks. You can turn on or off an applet using IFTTT’s website or mobile apps (and/or the mobile apps’ IFTTT widgets). You can also create your own applets or make variations of existing ones via IFTTT’s user-friendly, straightforward interface.

ARDUINO IDE:

The Arduino Integrated Development Environment (IDE) is a cross-platform application (for Windows, macOS, Linux) that is written in functions from C and C++. It is used to write and upload programs to Arduino compatible boards, but also, with the help of third-party cores, other vendor development boards.

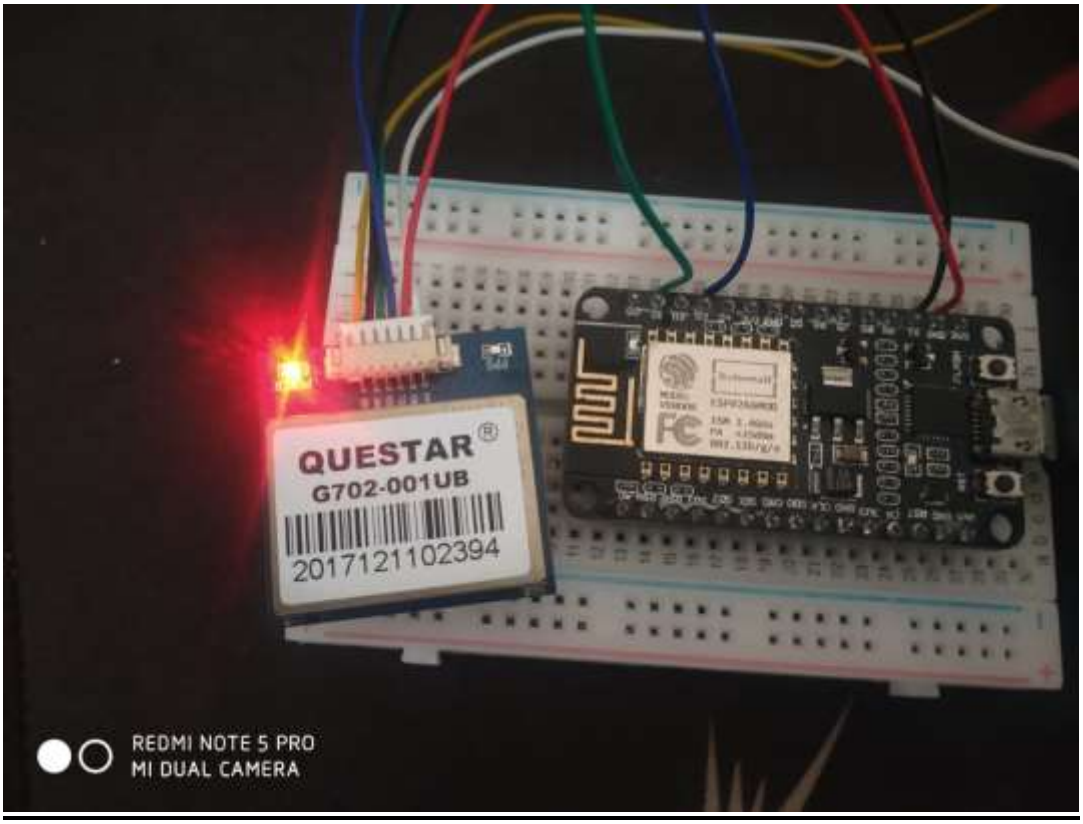
The source code for the IDE is released under the GNU General Public License, version 2. The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub main() into an executable cyclic executive program with the GNU toolchain, also included with the IDE distribution. The Arduino IDE employs the program avrdude to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware.

IMPLEMENTATION PROCEDURE:

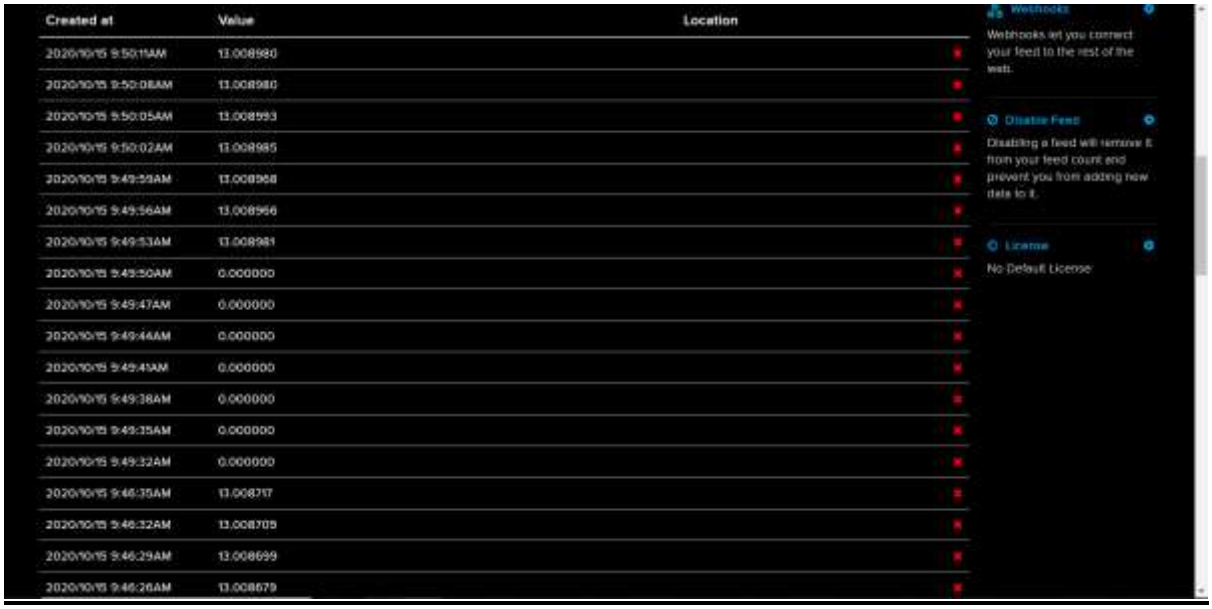
1. The circuit consists of a NodeMCU, GPS module and a buzzer.
2. The GPS module is connected serially to the NodeMCU. We use a NodeMCU here because of its wifi module.
3. Once the circuit is done, upload the code using Arduino IDE.
4. Once the code start running, we will be able to receive live data from the GPS module in the adafruit server.
5. There are three feeds in the server, one gpslat, which records the latitude of the patient, gpslng, which records the longitude of the patient and gpslatlng, which records the distance from the home centre initialized in the code.
6. We also have a dashboard on the server to display the data recorded from the gpslatlng feed.
7. The dashboard records and displays the location of the patient on a world map in satellite view.
8. It also records the time interval between the recorded location in a graph, so we know the latest location immediately.
9. We use IFTTT platform to make an applet that is used to send notification to the concerned authority.
10. The IFTTT platform checks for the distance recorded in the feed and sends a notification when it exceeds a set distance, which can be changed according to the administrator.
11. Alternatively, we could also set a trigger on Adafruit server, which will send an email to a concerned authority.

RESULTS AND CONCLUSIONS

Circuit:



Latitude values:



Created at	Value	Location
2020/10/15 9:50:11AM	13.008980	
2020/10/15 9:50:08AM	13.008980	
2020/10/15 9:50:05AM	13.008993	
2020/10/15 9:50:02AM	13.008985	
2020/10/15 9:49:59AM	13.008968	
2020/10/15 9:49:56AM	13.008966	
2020/10/15 9:49:53AM	13.008981	
2020/10/15 9:49:50AM	0.000000	
2020/10/15 9:49:47AM	0.000000	
2020/10/15 9:49:44AM	0.000000	
2020/10/15 9:49:41AM	0.000000	
2020/10/15 9:49:38AM	0.000000	
2020/10/15 9:49:35AM	0.000000	
2020/10/15 9:49:32AM	0.000000	
2020/10/15 9:46:35AM	13.008717	
2020/10/15 9:46:32AM	13.008709	
2020/10/15 9:46:29AM	13.008699	
2020/10/15 9:46:26AM	13.008679	

Webhooks

Webhooks let you connect your feed to the rest of the web.

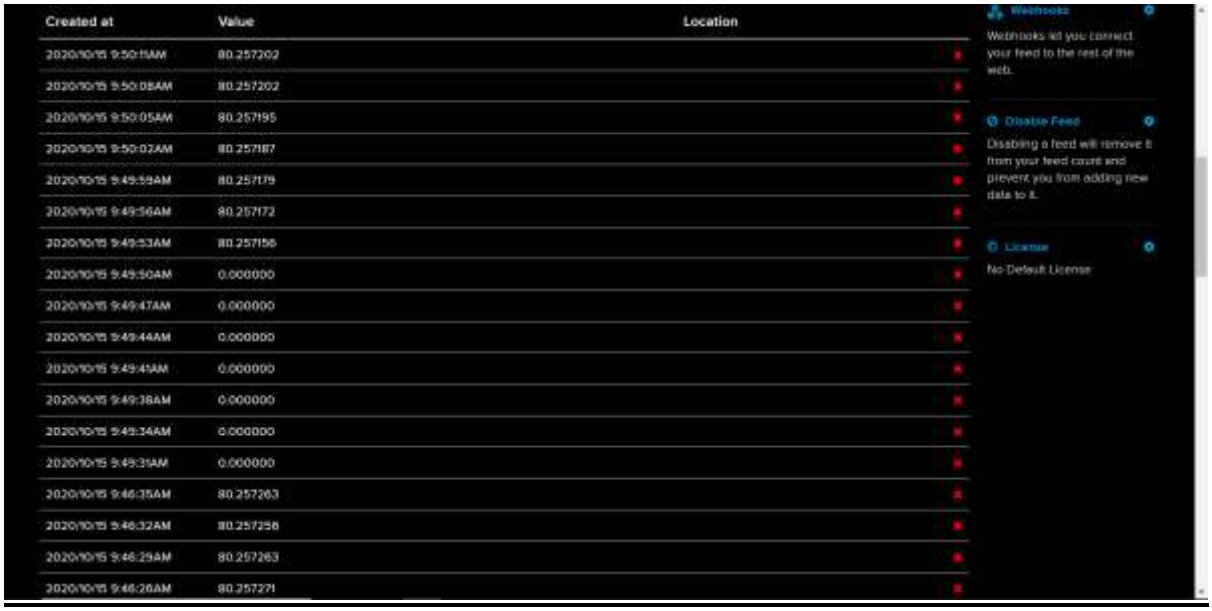
Disable Feed

Disabling a feed will remove it from your feed count and prevent you from adding new data to it.

License

No Default License

Longitude values:



Created at	Value	Location
2020/10/15 9:50:11AM	80.257202	
2020/10/15 9:50:08AM	80.257202	
2020/10/15 9:50:05AM	80.257195	
2020/10/15 9:50:02AM	80.257187	
2020/10/15 9:49:59AM	80.257179	
2020/10/15 9:49:56AM	80.257172	
2020/10/15 9:49:53AM	80.257156	
2020/10/15 9:49:50AM	0.000000	
2020/10/15 9:49:47AM	0.000000	
2020/10/15 9:49:44AM	0.000000	
2020/10/15 9:49:41AM	0.000000	
2020/10/15 9:49:38AM	0.000000	
2020/10/15 9:49:34AM	0.000000	
2020/10/15 9:49:31AM	0.000000	
2020/10/15 9:46:35AM	80.257263	
2020/10/15 9:46:32AM	80.257256	
2020/10/15 9:46:29AM	80.257263	
2020/10/15 9:46:26AM	80.257271	

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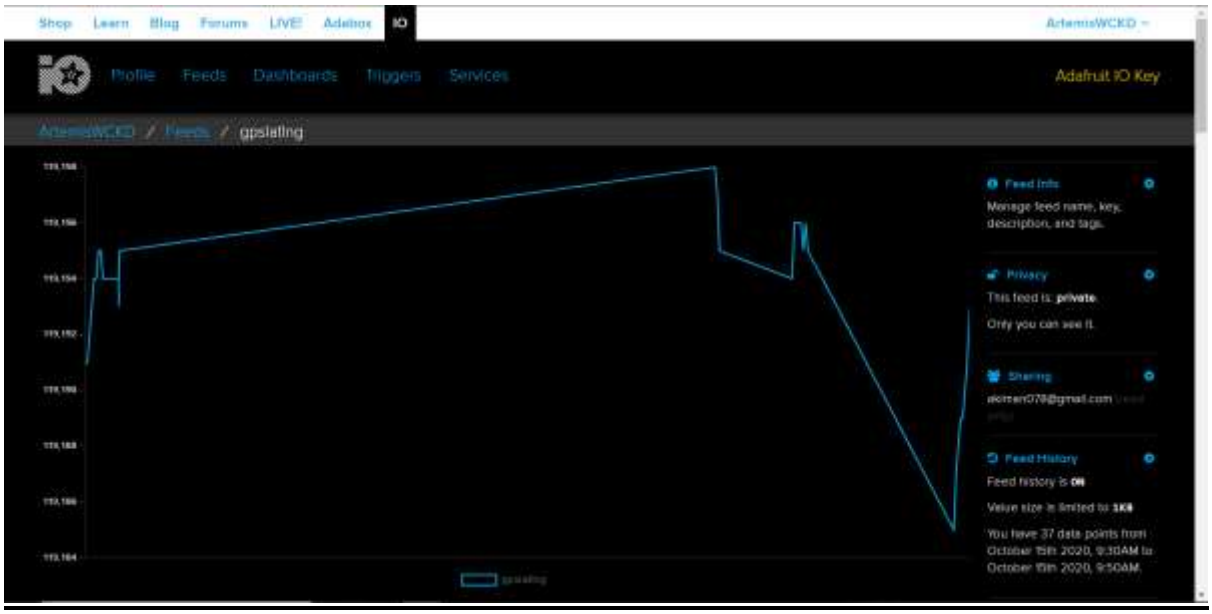
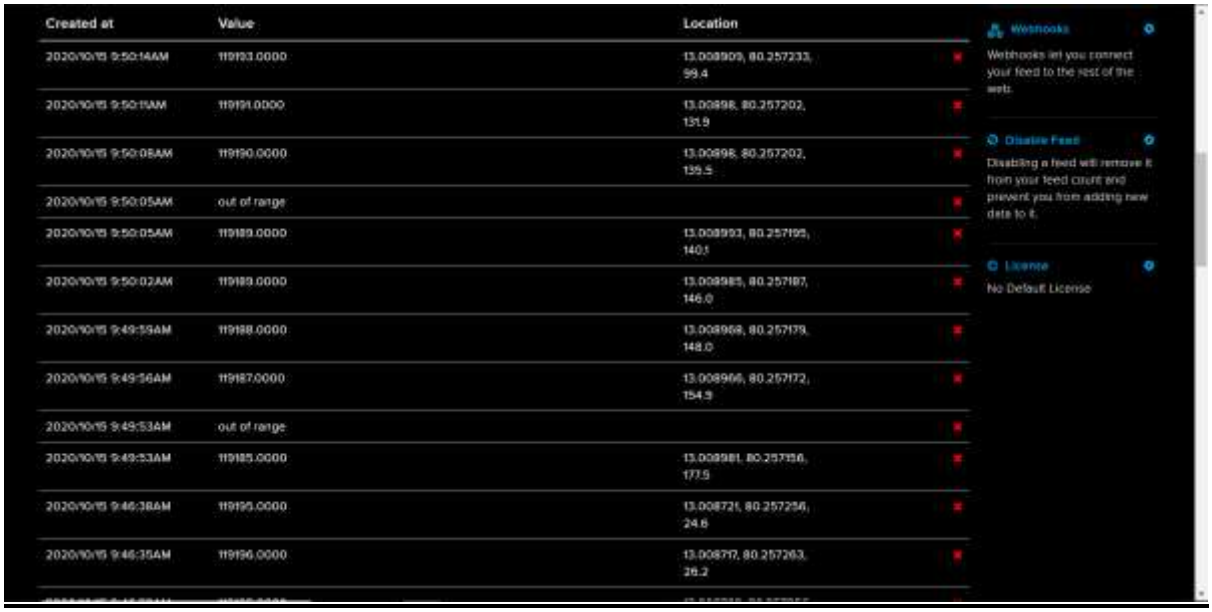
The distance from the centre is graphed:



The distance is recorded in the feeds:



Created at	Value	Location
2020/10/15 9:50:14AM	119193.0000	13.008909, 80.257233, 99.4
2020/10/15 9:50:11AM	119191.0000	13.00898, 80.257202, 131.9
2020/10/15 9:50:08AM	119190.0000	13.00898, 80.257202, 139.5
2020/10/15 9:50:05AM	out of range	
2020/10/15 9:50:05AM	119189.0000	13.008993, 80.257195, 140.1
2020/10/15 9:50:02AM	119189.0000	13.008985, 80.257187, 146.0
2020/10/15 9:49:59AM	119188.0000	13.008968, 80.257179, 148.0
2020/10/15 9:49:56AM	119187.0000	13.008966, 80.257172, 154.9
2020/10/15 9:49:53AM	out of range	
2020/10/15 9:49:53AM	119185.0000	13.008981, 80.257156, 177.5
2020/10/15 9:46:38AM	119195.0000	13.008721, 80.257256, 24.6
2020/10/15 9:46:35AM	119196.0000	13.008717, 80.257263, 26.2

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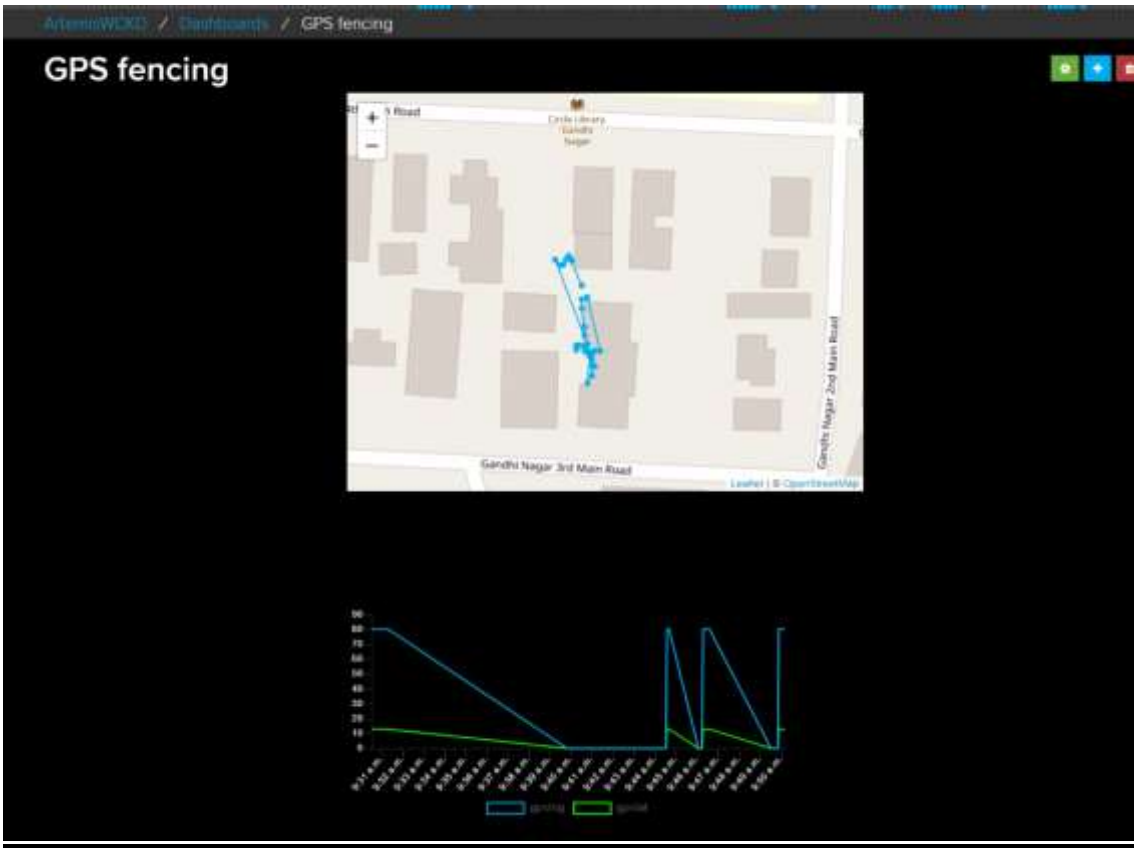
The location is marked on the map:



IFTTT activity log:

Notification on phone:

In this project we have successfully designed and implemented a quarantine monitoring system using node mcu and adafruit server based on the principle of Geo Fencing.

We have built this project in order to successfully impose the quarantine system in order to curb the spread of the virus and this can also be implemented in other useful sectors.

RECOMMENDATIONS:

This project can be improved by incorporating purpose built Printed Circuit Boards (PCBs) which will make it truly wearable.

Also the usage of highly powerful GPS modules can make the tracking very accurate and can also be used to increase the range of the tracker. So even if the patients manage to circumvent the hospital security and leave, they can still be tracked down.

The concept and implementation used here can be utilized in areas such as, correctional facilities, mental wards, hospitals, rehabilitation centres.

The data can be furthered secured by using private servers, to keep the data safe.

The Speed of the notification system can be brought down by using LTE or 5G technologies for lower latency and faster transmission of data.

The cost of production of each individual unit can be brought down by the Economies of Scale.