Geolocation using NodeMCU

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ABSTRACT

PROBLEM STATEMENT:

The major and common problem is that in the evolution of new technologies for the future world GPS module is expensive to use.Our device is very cheap and it can be installed in any device with a little space occupied.It detects the coordinates of the particular location and returns them.

HOW THE STUDY ADDRESSES

THE PROBLEM:

The device created detects the current coordinates of the device from Google API using the Wi-Fi MAC addresses and return its coordinates with accuracy and using blynk app we can get to know the location on map and results will be displayed on OLED screen.

KEY RESULTS:

- ***NODEMCU ESP2866 module working(since it is a Wi-Fi module).***
- ***DESIGNING A USER-FRIENDLY DEVICE.***

INTRODUCTION

Geolocation is defined as the process of finding, determining and providing the exact location of a computer, networking device or equipment. It enables us to view the device location based on geographical coordinates and measurements. Geolocation commonly uses Global Positioning System (GPS) and other related technologies to assess and specify geographical locations. It provides the location of a device but is generally used in a variety of applications to help locate human users. Geolocation is a technology that works through a pre-built GPS in a device that propagates the device's longitudinal and latitudinal coordinates. The coordinates are identified on a map to provide a complete address that usually includes a country, city, town/colony, building name and street address.

Ability to geolocate a device is indispensable for B2B and end-user applications. Accurate localization can help optimize processes in manufacturing and logistics, and also can improve user experience in many ways either known or yet to be discovered. The most popular geolocation methods are as follows:

• Using a GPS module: A rather conventional and reliable approach, providing the best available accuracy for outdoor applications.

• Positioning based on cellular networks (GSM, LTE, etc): A reliable method for both indoor and outdoor use. However, a device needs to support cellular connectivity.

• Wi-Fi positioning: An efficient approach for environments where a device is located within the range of numerous Wi-Fi access points (AP). ESP8266 can be a very good solution for Wi-Fi positioning, the location can further be refined if a host system supports cellular connectivity. This application note assumes that a host system connects to a Wi-Fi network using an ESP8266 module, such as ESP-WROOM-02 manufactured by Espressif. Another assumption is that this module uses Espressif's AT firmware. An ESP8266 module needs to be connected to a host system via UART. The device acting as a host system is responsible for configuring, managing, and controlling the module. An ESP8266 scans for nearby Wi-Fi access points and obtains their SSID, RSSI, and MAC address characteristics. Then the ESP8266 module is connected to Google's Geolocation API to determine a location based on the obtained AP characteristics.

However, the accuracy of results may vary depending on how many access points are available and how many of them are connected to the internet. Availability of cellular network information is not necessary for geolocating with ESP8266. However, if the host system supports cellular connectivity, this information can be used to further improve the localization accuracy.

As stated previously, geolocation of a device with an integrated ESP8266 module involves the following actions:

1. A device obtains SSID, RSSI, and MAC address characteristics of the nearby Wi-Fi access points and cellular sub-systems.

2. The obtained information is then consolidated into a data block.

3. The data block is transmitted to Google's geolocation service with the help of Geolocation API.

4. The geolocation service estimates the latitude and longitude in degrees as well as the accuracy of the estimated location in meters.

5. The service returns the JSON-formatted response back to the device.

6.The same details are printed on the OLED screen using BLYNK.

LITERATURE REVIEW

The ESP8266 is a low-cost Wi-Fi microchip with full TCP/IP stack and microcontroller capability produced by manufacturer Espressif Systems in Shanghai, China. The chip first came to the attention of Western makers in August 2014 with the ESP01 module, made by a third-party manufacturer Ai-Thinker.
This small module allows microcontrollers to connect to a Wi-Fi network and make simple TCP/IP connections using Hayesstyle commands.
However, at first there was almost no English-language documentation on the chip and the commands it accepted. The very low price and the fact that there were very few external components on the module, which suggested that it could eventually be very inexpensive in volume, attracted many hackers to explore the module, chip, and the software on it, as well as to translate the Chinese documentation.

Google APIs is a set of application programming interfaces (APIs) developed by Google which allow communication with Google Services and their integration to other services. Examples of these include Search, Gmail, Translate or Google Maps. Third-party apps can use these APIs to take advantage of or extend the functionality of the existing services.

The APIs provide functionality like analytics, machine learning as a service (the Prediction API) or access to user data (when permission to read the data is given).
Another important example is an embedded Google map on a website, which can be achieved using the Static maps API, Places API or Google Earth API.

METHODS AND MATERIALS

Android OS for smartphones is powered by Google. Generally, most of the phones have GPS and Wi-Fi enabled all time so Google not only tracks the location but it also tracks the nearby Wi-Fi networks. For example, if a person is walking through a street with Wi-Fi and GPS enabled, his phone is constantly scanning the nearby Wi-Fi networks. Parallely what Google does is, it saves the MAC addresses and the name of the Wi-Fi networks along with the location of the phone. So based on the signal strengths received by phone, Google estimates the location of that particular Wi-Fi network and it saves that data into the database. Therefore, next time if anybody will pass through that same Wi-Fi networks and does not have GPS enabled in his phone he can still get the location of the phone based on the location of that particular Wi-Fi network.Briefly it can be described as:

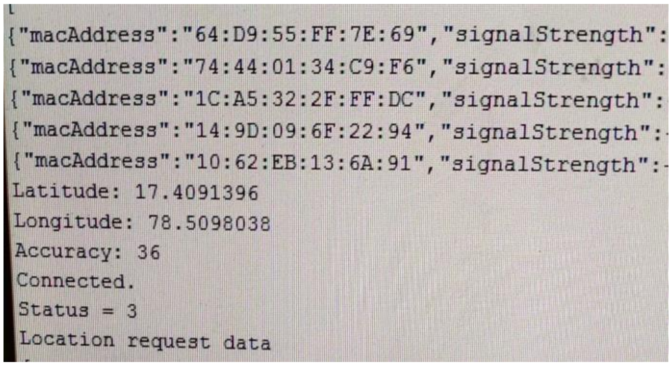
1. A device obtains SSID, RSSI, and MAC address characteristics of the nearby Wi-Fi access points and cellular sub-systems.
2. The obtained information is then consolidated into a data block.
3. The data block is transmitted to Google's geolocation service with the help of Geolocation API.
4. The geolocation service estimates the latitude and longitude in degrees as well as the accuracy of the estimated location in meters.
5. The service returns the JSON-formatted response back to the device.
6. The same details are printed on the OLED screen using BLYNK.

DATA AND RESULTS

GPS is notoriously hungry for the battery it does not work indoors, and it requires an expensive chip to calculate your position as well as a data link to send the information to the Internet. There have been alternative solutions for communication standards such as Bluetooth or Wi-Fi which have proven to be quite challenging due to short-range limits of these networks and devices as well as relatively short battery life. So the ideal solution to track anything should:

- work indoors and outdoors
- offer a long battery life

Fig.1 and Fig.2 show how this device runs and send us the location.



```
[
{"macAddress":"64:D9:55:FF:7E:69","signalStrength":
{"macAddress":"74:44:01:34:C9:F6","signalStrength":
{"macAddress":"1C:A5:32:2F:FF:DC","signalStrength":
{"macAddress":"14:9D:09:6F:22:94","signalStrength":-
{"macAddress":"10:62:EB:13:6A:91","signalStrength":-
Latitude: 17.4091396
Longitude: 78.5098038
Accuracy: 36
Connected.
Status = 3
Location request data
```

Fig.1 Location of College found using made device.

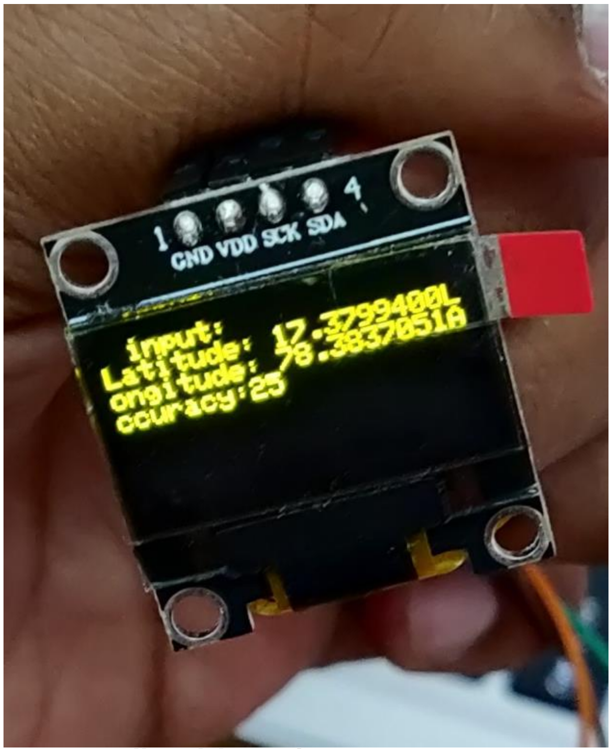


Fig.2 Collected data is shown on a OLED screen.

DISCUSSION AND CONCLUSION

In the end, we have created a system that locates the objects exact geographical location irrespective of the type of object. This system does not require expensive materials and can be implemented in all possible fields be it from industries to defense to navy to agriculture and so on. It is extremely user-friendly and doesn't comprise complex procedures. The process to set this system up takes very less time. This system provides us with a location based on the coordinates generated.

Limitations:

- Requires WiFi connectivity and internet connectivity

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