Person Location Tracking Using Global Positioning System and ESP8266 with Internet of Things

N. Umapathi, Saiteja Sabbani, and S. Poovarasan

Abstract This paper explores the idea of locating the student's location within the organization/institute. This is done by using a GPS-based receiver modem attached to ID card of student and using a SQL coded database. Initially, the system is provided with all the coordinates of the places within organization/institute, and these coordinates (latitude, longitude and altitude) are stored in a lookup table (LUT) in the database. When the student with the GPS receiver roams inside the campus, his coordinates are recorded by the GPS modem and sent to the database via Internet (cellular/Wi-Fi network). This coordinates are then compared with the coordinates in the LUT; if the coordinates are matched with any of the contents in LUT, then the system identifies this and knows the location of student; otherwise, the student is considered as out of campus. Any authorized person can access this data, i.e., students' location at any time by either Web site or the application provided to the person by entering the unique ID number of the person who is to be tracked. Programming the NodeMCU has been developed in C environment with a self-made SQL database and person location data transfer to Internet of things using ThingSpeak software. This ThingSpeak software is used for the development of application.

Keywords GPS · SQL · NodeMCU ESP8266 · IoT · ThingSpeak

1 Introduction

The main aim of the project is to track a student position who is roaming inside the school or institute campus by using Global Positioning System (GPS) technology. Nowadays, parents face lot of problems while sending their children to the school and returning to home as they can get lost in the way. The idea is to overcome this problem by placing a GPS module in the identity card of the student.

N. Umapathi (✉) · S. Sabbani
Department of ECE, Jyothismathi Institute of Technology & Science, Karimnagar, Telangana, India

S. Poovarasan
R&D Engineer, Error Free Solutions, Erode, Tamil Nadu, India

GPS module is used to track the student's current location, and later, this data is sent to the database. The NodeMCU ESP8266 is interfaced between the GPS module and database. The authorized user can access the data from database with valid unique login ID and can also do same thing using mobile application. Using Internet of things (IOT) technology with GPS module-based system helps access to database remotely and provides additional flexibility to the system. Programming has been developed in C environment with a self-made SQL database.

2 Related Works and Studies

System referenced in [1] has a tracking system based of GPS, GSM and RFID tags. The location of the buses is found by using a GPS module which is placed along with the RFID tags inside the buses, and this live location is monitored by authorized person using their mobile through IoT. Work referenced in [2] is a real-time attendance monitoring system based on GPS and fingerprint scanner. GPS is used to get the live location of the student and send this information to the smartphone. Work in [3] is developed based on widespread usage of Wi-Fi-enabled mobile devices. The system utilizes Wi-Fi-based MD and classifies these MD into static device SD and mobile phone MP using the nonintrusive method. Later, their location variations mapping between SD and its use are achieved. Work in [4] is an indoor positioning technology based on WSN research. Improvement in indoor positioning of user is done using Wi-Fi location of fingerprint. The system applies Gauss filter on the RSSI in fingerprint to remove unwanted multipath and noises. System with reference to [5] tracks the location of people within a bounded environment using RFID transponders and WPS. This location acquisition is achieved by data collection by RFID transponders and next position identification by using Wi-Fi positioning system. Reference [6] is a system based on IoT for monitoring school bus using RFID and GPS using the ESP8266 microcontroller's Wi-Fi server. This location of bus can be accessible by parents using a mobile application. Reference [7] is a system for child safety and security. The system has a combination of various sensors like MQ-3, IR proximity GPS and RFID to ensure the safety and get the live location of the children. Work referenced in [8] is built on ARM7 LPC2148 microcontroller. It uses GPS to get location of the child and GSM to send this information as an SMS of Google Maps link to parents. Work in [9] uses RFID satellite tag to detect the latitude and longitude of the user entity. This is achieved by generating a pseudocode and establishes connection to obtain the reference points on earth. LabVIEW is used for simulation and development of software. Reference [10] is location identification of Indian Railway using a GPS receiver and to alert the passengers about the arrival of trains.

Fig. 1 Block diagram of proposed method of person location tracking using GPS and ESP8266 with IOT
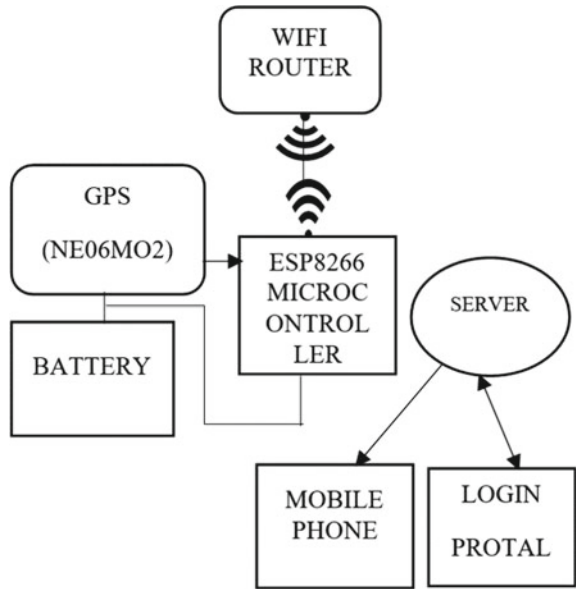
3 Implementation Details

The students will have to wear the identity card which has NodeMCU and GPS module on it. As soon as the supply is turned on, the NodeMCU is automatically connected with the specified hotspot defined in the program. When student moves from one place to another inside the college campus, the GPS present in the ID card will track the latitude and longitude position of the student and sends the data to the database.

In database, we have lookup table (LUT) and tracking table. When the data arises from the GPS is stored in tracking table for few seconds and it is compared with the LUT for finding the location of the student. If the data is matched with the LUT, the current location of the student is identified and is displayed in the application provided (Fig. 1).

4 Components Used for System Design

In this project, system design and architecture comprise two parts:
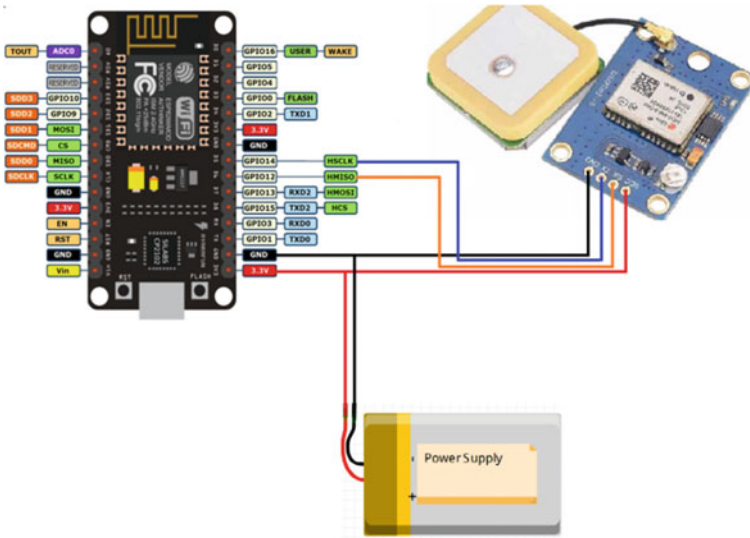
- Hardware and Internet of things (IoT).

Fig. 2 Circuit diagram of proposed method

4.1 Hardware Architecture

NodeMCU ESP8266

NodeMCU ESP8266 is a microcontroller with a built-in Wi-Fi capability. It is a 32-bit MCU with 16 digital I/O's and 1 analog I/O (with 10-bit resolution). It has a whooping 4 Mb of flash memory for storing programs and 64 Kb of SRAM. It can communicate with sensors/other devices using serial, SPI and I2C protocols at 80 MHz clock speed. To program this microcontroller, we can use Arduino IDE by including required libraries and installing the drivers. One feature which separates this MCU from other is the Wi-Fi function it offers with a 2.4 GHz PCB antenna.

GPS 6MV2 Module

The NEO-6MV2 is a GPS module used for keeping track of location of students in campus. The functionality of the module is to provide the latitude and longitude data. It offers the data update rate of 5 Hz and works with 3.3 V. The module has 4 pins Vcc, GND, Tx and Rx that means it uses UART interface to communicate with the microcontroller. This module is suitable for this project as it has small size with dimensions $16 \times 12.2 \times 1.4$ mm and has a microstrip antenna (Figs. 2 and 3).

5 Results and Experimental Analysis

The NodeMCU when provided with the power supply is connected to the Wi-Fi network which is given in programming. Next GPS data/coordinates from the GPS
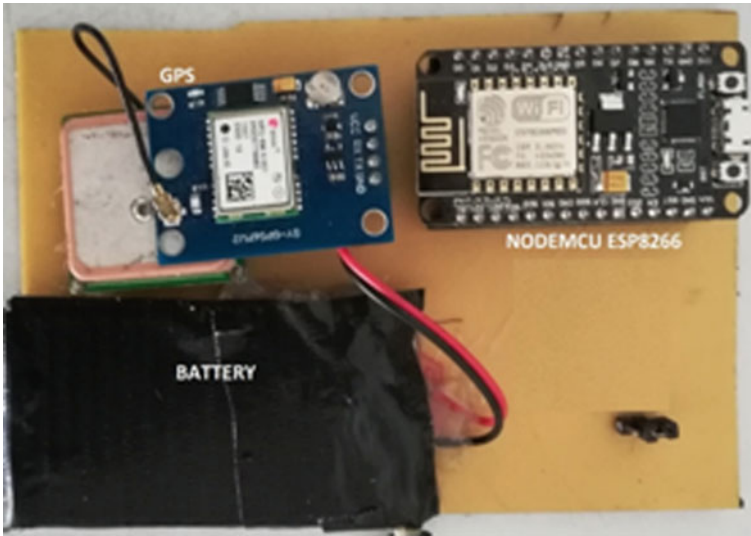
Fig. 3 Person location tracking using GPS and ESP8266

module is automatically updated into database, and location of the student status inside the campus is recorded. Student location is then compared with lookup table, exact location is shown to the authorized user by their login, and it is also shown in mobile application and Internet of things.

At first, all the location coordinates of places within the campus (where a student can present) are entered into the LUT in the database. Data entry into LUT is done by giving the latitude and longitude values of particular place and saving them subsequently. Figure 4 shows the model LUT with coordinates of the places within the campus. To search for a student position within campus, user must enter the ID

ID	LAT1	LAN1	LAT2	LAN2	LOCATION		
1	12.894594	80.121660	12.895092	80.122366	MAIN BLOCK	Edit	Delete
2	12.89522	80.12166	12.895885	80.1220066	HI-TECH BLOCK	Edit	Delete
3	12.8933	80.1232	12.8944	80.1245	GP-BLOCK	Edit	Delete
4	12.8933	80.1228	12.8945	80.1231	CIVIL BLOCK	Edit	Delete
5	12.894212	80.122604	12.894851	80.122842	MECH SCI LAB	Edit	Delete
6	12.895545	80.1214	12.8958	80.1255	LIBRARY	Edit	Delete
7	12.8953	80.1208	12.8954	80.1210	ADMISSION CELL	Edit	Delete
8	12.895981	80.121147	12.896104	80121162	MAIN GATE	Edit	Delete
9	12.9555	80.1208	12.8956	80.1210	POWER ROOM	Edit	Delete
10	12.895808	80.122950	12.895867	80.122862	MARINE CANTEEN	Edit	Delete
11	12.895181	80.122100	12.895534	80.122423	EEE LAB	Edit	Delete
12	12.8948	80.1226	12.8953	80.1228	IMST	Edit	Delete
13	12.89436	80.12328	12.89418	80.12319	FIRST YEAR STAFF ROOM	Edit	Delete
14	12.8953	80.1210	12.8955	80.1208	GATE 2	Edit	Delete
15	12.8944	80.1231	12.8949	80.1225	ARROW SH	Edit	Delete

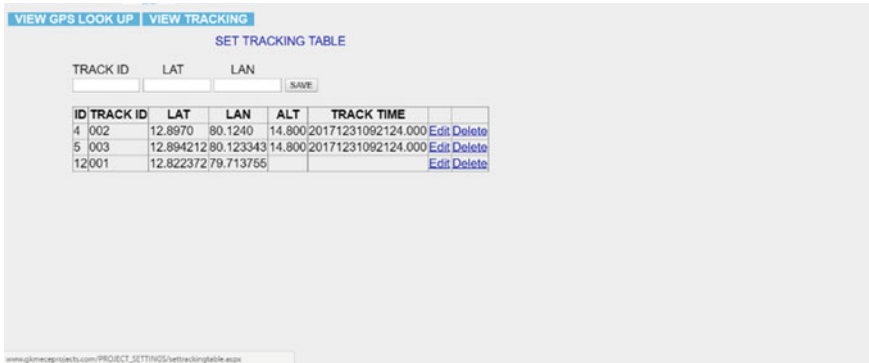**Fig. 4** LUT with latitude and longitude values of places within campus

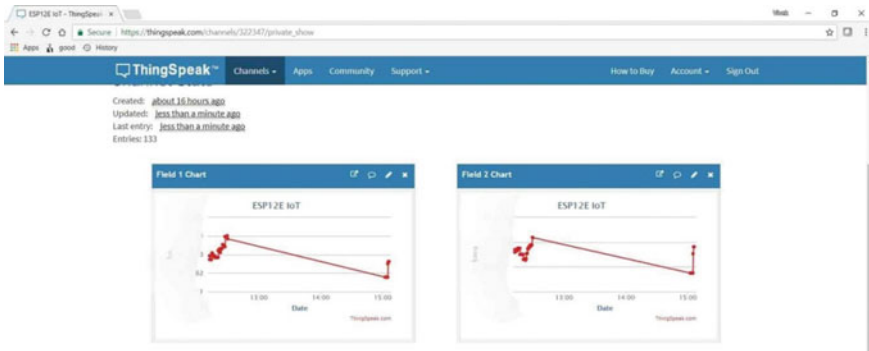**Fig. 5** Tracking of person with ID within campus

Fig. 6 Graphical representation of person's location

number in the respective column. The NodeMCU then compares these values with the values in the LUT, and if the values are matched, it provides a tracking table as in Fig. 5 with tracking time and latitude and longitude values. Later, the ThingSpeak Web site using these values within tracking table plots a graph with time vs latitude and time vs longitude as shown in Fig. 6.

6 Conclusion

The paper describes an identity card which operates based on ESP8266 and GPS module. It is controlled with the help of an html webpage created, and live latitude and longitude data of students are obtained with the help of GPS module placed in the identity card. The GPS data is received over a wireless technology Wi-Fi by using a particular Internet protocol. It is advantageous as it offers reliability and privacy on both sides and the data is transferred to Internet of things using ThingSpeak. It is

authenticated only by the authorized user. Hence, it offers only the person concerned to view the details.

7 Future Work

Necessary action can be taken in short span in case of class bunking and roaming in and around the campus. In the future, latitude and longitude value of student is compared with attendance sheet whether the student is present or not inside the campus. Further, the identity card is implemented as a chip and the chip is placed inside the body to monitor continuously and to save the person in and anywhere in the world. This system is further implemented in areas like a hospital, industry, schools and colleges, and so far, it is used to find the soldiers in the military areas and festival occasions.

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