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Three-Level Car Security System with GPS Tracker Using IoT

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Abstract: Nowadays, car theft is common and because of that, there is a need to invest on a car security system. Hence, this work focusses on developing a Three-level car security system with GPS Tracker using IoT. Arduino Mega 2560 module act as a microcontroller for RC522 RFID module and R307 fingerprint scanner module which is for the first and second level security. A 4×3 matrix keypad and NEO-6M GPS are integrated with the NodeMCU ESP8266 Wi-Fi module for the security and GPS tracking system. The car security system consists of three level security which are RFID tag, fingerprint scanner and keypad password. Upon entering the car, the owner has to tag the RFID before scanning the fingerprint and entering the password. The owner is given three chances to enter the password or else, the GPS tracking is activated. In worst case scenario, the thief might enter the car by force and steal the car. In this case, the owner shall receive a notification via text message on Blynk application and email for second notification. Furthermore, the location of the car can also be obtained from the NEO-6M GPS tracking system which is linked to the Blynk application on the owner's mobile phone. The Blynk application shall display the location of the car on Google maps together with its latitude and longitude. It is shown from this work that the car security system provides a sufficient level of security to avoid car theft. In addition, the GPS tracking system is able to detect the location of the car which is displayed on the Blynk application installed in car owner's mobile phone.

Keywords: Car security system, RFID, keypad password, fingerprint scanner, GPS tracking system

1. Introduction

Nowadays everyone has a car and they will enjoy being able to go to a convenience store, travels anywhere they want, and many else. However, there is a situation when people forgot to lock the car which opens up to loss or theft of the belongings in the car and even the car itself. If the car is mission due to car theft, the owner may lodge a report at the police station. The task is now for the police to trace the car and unfortunately, in most cases, it is most unlikely that the user will get the car back [1]. In the old car, the security system that is installed is just basic and does not include a GPS tracker. Therefore, the car is untraceable upon theft. In addition, even if the car is equipped with a GPS tracker, the chances that someone could hack into the system is average but in reality, there are a lot of stolen cars reported [2].

Radio-frequency identification (RFID) is commonly used as it is the most modern and effective device that uses electromagnetic fields to automatically identify and track RFID tag that is attached to an object. In the RFID system, there is an RFID receiver that receives radio signal from RFID tag and it requires a reader to store the data. Each RFID

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tag has its own unique identifying number. One of the applications of RFID is its utilization as an anti-theft and monitoring system [3]- [5].

In this work, an IoT-based RFID keypad & fingerprint car security system with GPS tracking is proposed in this work. The system shall have the capability to prevent car theft. The system combines the Arduino Mega 2560 module and RFID technologies. A serial communication link exists between the RFID and the Arduino. The keyboard and fingerprint port device are used to make it a protection system in the car as it has the owner's password to turn on the car engine [6]. For the Global Positioning System (GPS), it will detect the location of the car when the RFID integrated with the keypad or fingerprints fails after attempting more than three times. The tracking system produces the coordinates (latitude and longitude) of the car via the Blynk application [7]. In addition, the alarm shall sound and the owner will get a notification through the Blynk application informing that someone attempted to enter the keypad or fingerprints more than three times and may have the intention to steal the car.

2. Methodology

This section discusses the methodology applied in completing this work.

2.1 Block Diagram

Fig. 1 shows the block diagram of the input and output components that are connected to two microcontrollers which are Arduino Mega 2560 and NodeMCU ESP8266 Wi-Fi module. The RFID module and R307 fingerprint scanner are connected to Arduino Mega 2560 as input component while the output components are LCD display with I2C module, Piezo buzzer and LEDs. On the other hand, the input components to NodeMCU ESP8266 Wi-Fi module are 4 × 3 matrix keypad and NEO-6MV2 GPS module whereas the output components are the Blynk application. As soon as the car owner's RFID tag is scanned on the RFID reader, "pass accepted" will appear on the LCD display if the tag is matched. At the same time, the green LED will light on and Piezo buzzer will sound. If the tag is not matched, a "wrong password" shall appear on the LCD display and the red LED will light on accompanied with a sound from the buzzer. Next, the car owner shall proceed to the second level of security system by scanning his fingerprint on the scanner. Upon authorization, a correct password must be entered on the keypad password as the final security level. Any attempts must be less than three times. In the case of incorrect password entered more than three times, NEO-6MV2 GPS module shall be activated.

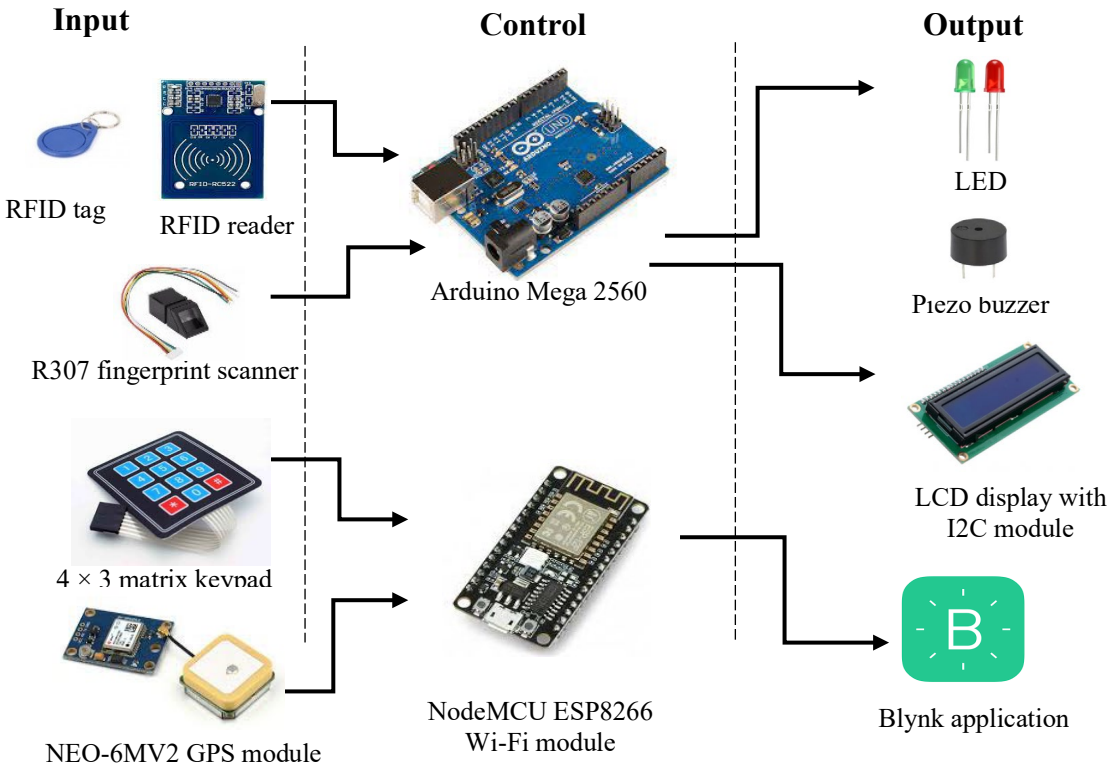


Fig. 1 – Overall block diagram of Three-Level Car Security System with GPS Tracking System using IoT

2.2 Blynk Application

Blynk application is an IoT software that offers a platform for developing mobile (IOS and Android) applications that may connect electronic equipment to the Internet and remotely monitor and control them. With white-label smartphone applications, private clouds, system management, data mining, and deep learning, Blynk is a hardware-agnostic IoT platform. Enter the most common IoT network to connect the devices to the cloud, design control applications, evaluate telemetry information, and manage the product deployed on a scale. In this work, the coordinates in terms of latitude and longitude shall be displayed on the Blynk application. The car owner can also view the location of his car on Google maps in the same application.

3. Results and Analysis

This section discusses the results obtained and analysis about developing and designing first level security system which is the RFID module, second level security system which is the fingerprint scanner, third level security system which is the keypad password, and GPS tracking system which is linked to the Blynk application.

3.1 First Level Security System – RFID Module

RFID module is the first level security system which consists of RFID reader and tag. The tag as a transmitter is kept by the car owner while the RFID reader is connected to the Arduino Mega 2560 as a receiver. As soon as the RFID tag is read by the RFID reader, a buzzer sounded for 3 seconds which indicates that the RFID tag is matched. At the same time, the LED light also turned green for 2 seconds. If the RFID tag is not matched with the RFID reader, the buzzer switched on for 1.5 seconds and LED light turned red for 2 seconds. Fig. 2 shows the RFID module as the first level security system.

(a) **(b)**

Fig. 2 - RFID module as the first level security system (a) scanning the RFID tag; (b) RFID tag is matched based on the LCD display

3.2 Second Level Security System – Fingerprint Scanner

Next, the car owner needs to scan his fingerprint on the fingerprint scanner as the second level security system. If the fingerprint is matched with the fingerprint stored in the database of the scanner, the owner has passed the second level security system. In order to confirm to that, *Found ID* is shown on the LCD display. Fig. 3 shows the fingerprint scanner as the second level security system.

(a) (b)

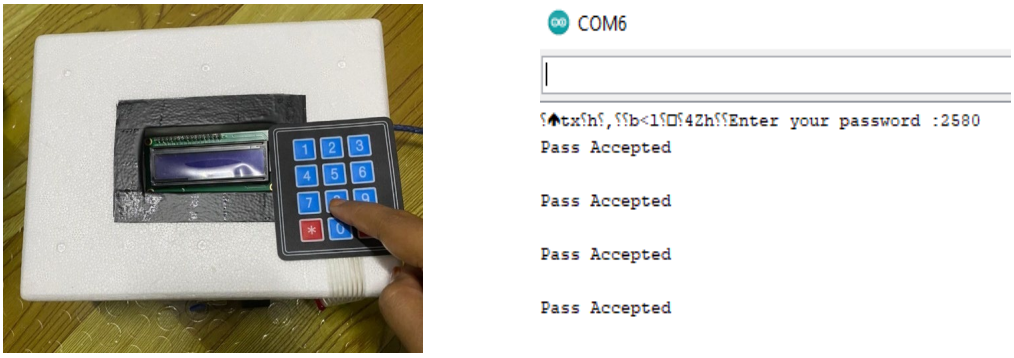
Fig. 3 - Fingerprint scanner as the second level security system (a) fingerprint scanning; (b) fingerprint is matched

3.3 Third Level Security System – Keypad Password

After the fingerprint has been detected, the car owner needs to enter the password on keypad to pass the third level security system. If the password is entered correctly, the GPS tracking system will not be activated (Successful case). On the other hand, if the password is wrongly entered more than three times, the GPS tracking system will be activated which is linked to the Blynk application in car owner's mobile phone (Unsuccessful case).

(i) Successful Case - Password is Correctly Entered

Fig. 4 shows the successful case which implies the password is entered correctly.



(a) (b)

Fig. 4 - Successful case which implies the password is entered correctly

(ii) Unsuccessful case – Password is wrongly entered

Fig. 5 shows the unsuccessful case which implies the password is entered wrongly.

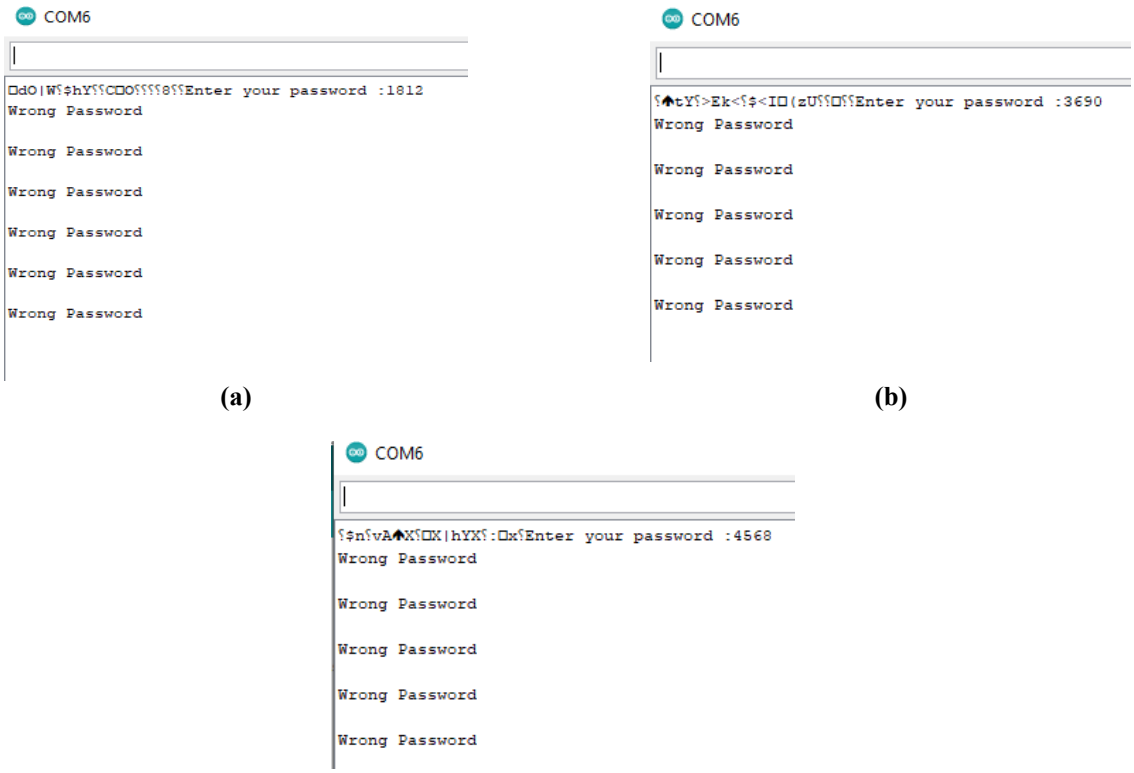
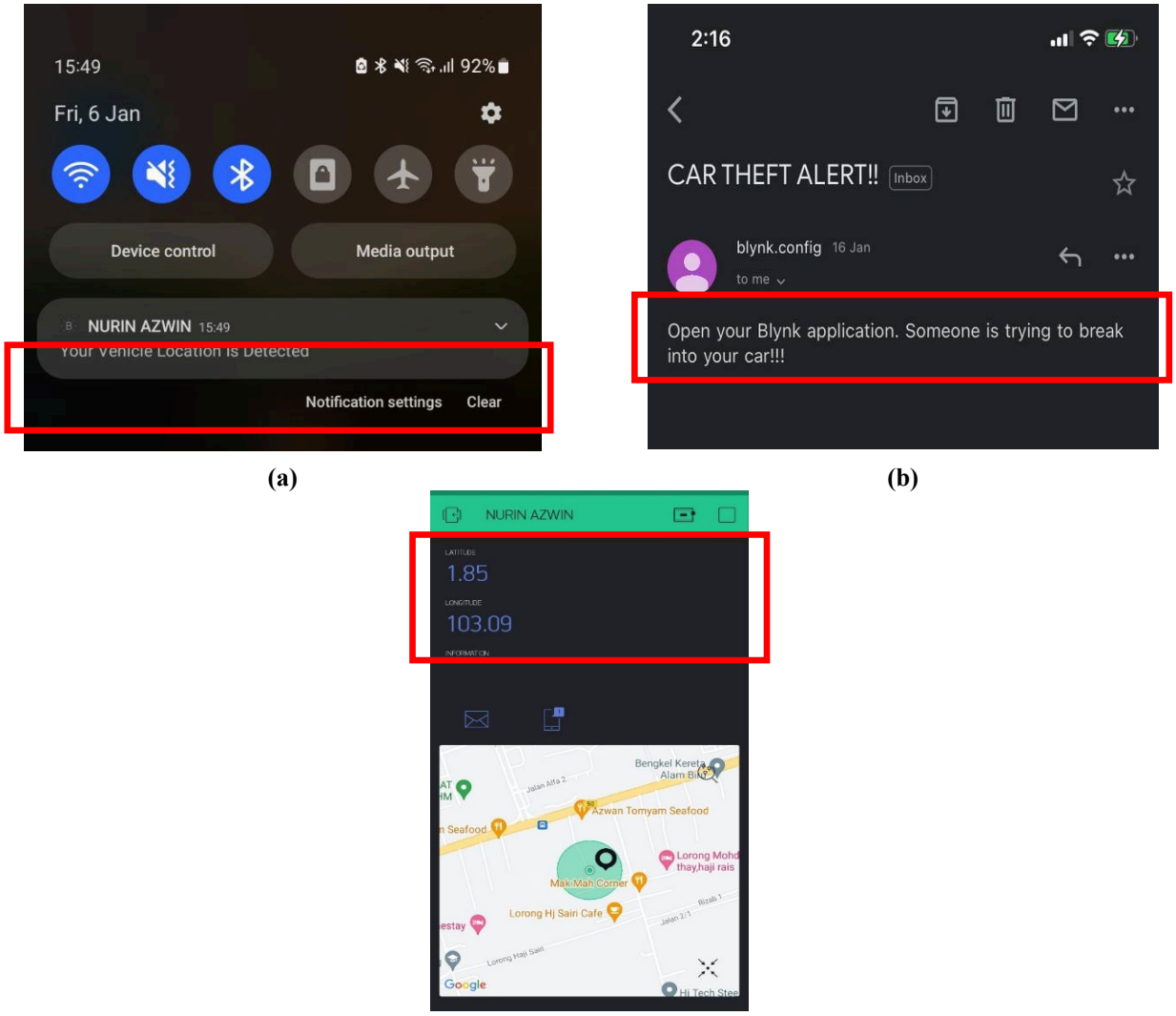


Fig. 5 - The display on serial monitor of Arduino IDE (a) first failure; (b) second failure; (c) third failure

3.4 GPS Tracker Linked to the Blynk Application

The GPS tracking system in this work can read location data (coordinates of latitude and longitude) of the car from the NEO-6M GPS module as soon as it is activated upon failure of wrongly entered password more than three times. The data received shall be displayed on the serial monitor of Arduino IDE and Blynk application. The received coordinates on the Blynk application will appear on Google maps. The Blynk application is connected to the NodeMCU ESP8266 Wi-Fi module which obtained the data from the GPS tracker. The GPS module runs on 3-V supply voltage and communicates via 9600 baud rate serial connection. The Tx and Rx pins are linked to digital GPIO which are pin D1 and D2 on the NodeMCU ESP8266 Wi-Fi module. As soon as the location data is obtained by the GPS tracker, a notification will be sent to the car owner's mobile phone informing that the location of the car which implies that someone is trying to break into the car. At the same time, an email shall also be sent to alert the car owner for second notification. The location of the car shall be displayed on the Google maps on Blynk application. Fig. 6 shows the operation of GPS tracking system in this work.



(a) **(b)**

(c)

Fig. 6 - Operation of GPS tracking system as soon as it is activated upon the failure in entering the correct password more than three times (a) a notification is sent to the car owner's mobile phone; (b) an email is also sent to alert the car owner for second notification; (c) the coordinates and location of the car on Google maps are displayed on Blynk application

3.5 Procedures to Locate the Coordinates of GPS Tracking System on Blynk Application in UTHM Campus

The procedures are listed below and the location of the car based on the coordinates on Blynk application are shown in Table 1.

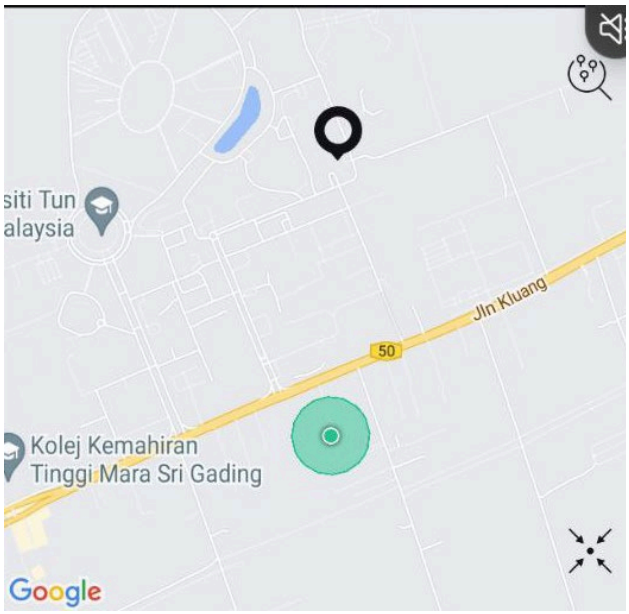
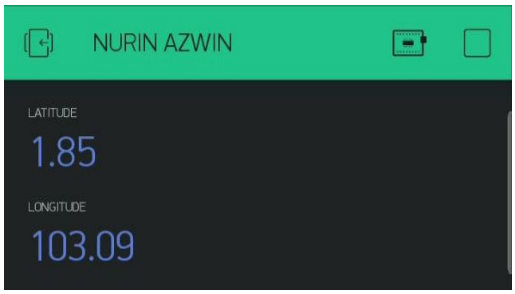
(i) The reference location point is chosen. In this case, the reference location point is at the foyer of Block G1, FKEE UTHM.
Note that: The car owner stays at the foyer of Block G1, FKEE UTHM and holds the mobile phone with Blynk application. On the other hand, the GPS Tracking system is located inside the owner's car which shall move from one point to another based on the chosen location points.

(ii) The second point is chosen to confirm the coordinates of the car on the Blynk application. In this case, the second point is chosen to be at the Tunku Tun Aminah library. Upon reaching the second point, the coordinate of the car is read on the Blynk application.

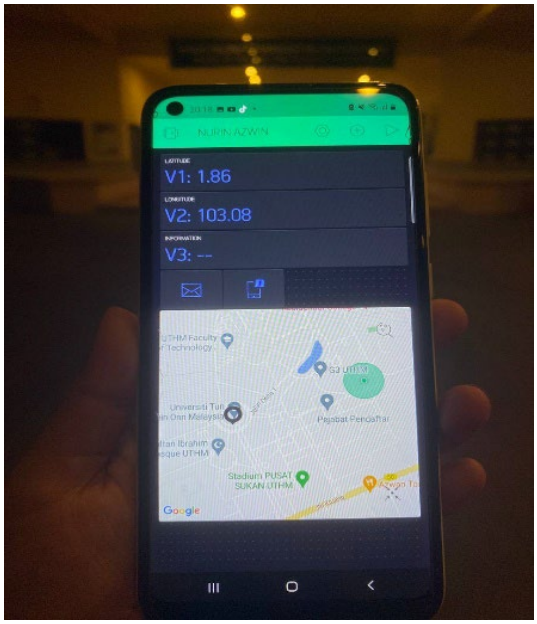
(iii) The third point is chosen to confirm the coordinates of the car on the Blynk application. In this case, the third point is chosen to be at the F2 Examination Hall. Upon reaching the third point, the coordinate of the car is read on the Blynk application.

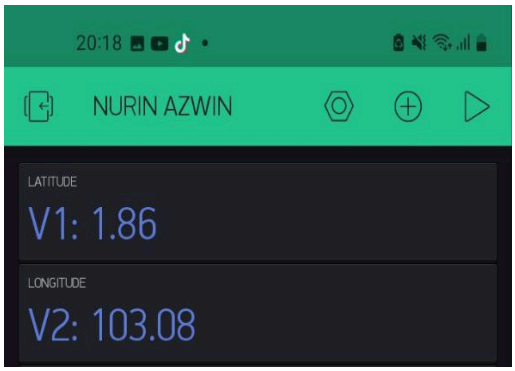
(iv) The fourth point is chosen to confirm the coordinates of the car on the Blynk application. In this case, the fourth point is chosen to be at the Bus Stop near Dataran Anggerik UTHM. Upon reaching the last point, the coordinate of the car is read on the Blynk application.

Table 1 - Coordinates obtained from the GPS tracking system which is displayed on Blynk application

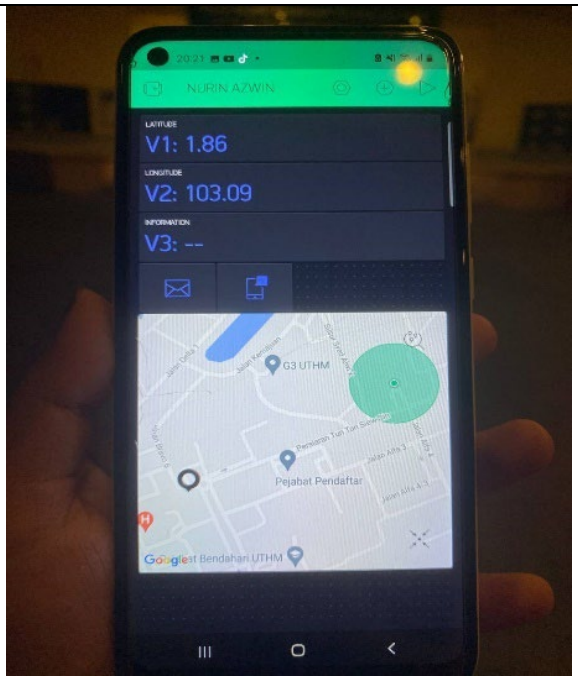
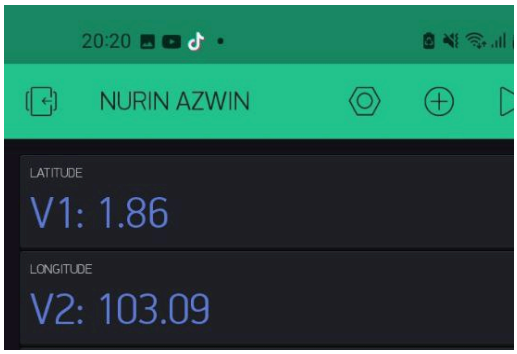
Chosen location from reference point	Coordinate of chosen location	Coordinate display on Blynk application
Reference point: Foyer of Block G1, FKEE UTHM	 	 Latitude: 1.85 Longitude: 103.09

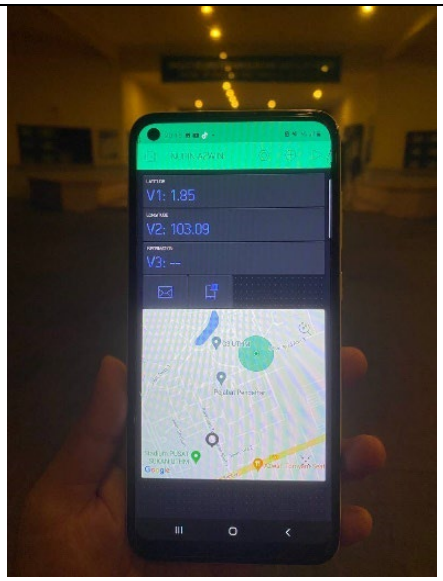
Second point: Tunku Tun Aminah Library

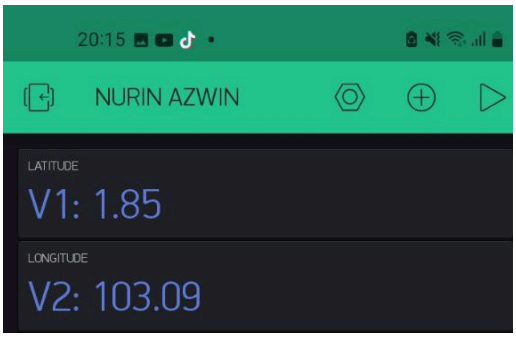




Latitude: 1.86
Longitude: 103.08

Third point: F2 Examination Hall	 	 Latitude: 1.86 Longitude: 103.09





Latitude: 1.85
Longitude: 103.09

Fourth point: Bus Stop near Dataran Anggerik UTHM

4. Conclusion

In conclusion, a Three-level Car Security System with GPS Tracker using IoT is designed and developed in this work. The three-level car security system consists of RFID module, fingerprint scanner and keypad password. Once the RFID tag is read by the RFID reader, a message shall appear on the LCD display which tells the owner whether the tag is matched or not. If the tag is matched, the car owner shall then scan his fingerprint on the fingerprint scanner. If his fingerprint is matched with the fingerprint stored in the database of the scanner, he shall proceed to the third level security system which is entering a keypad password. For the successful case, the GPS tracking system will not be activated as the password is entered correctly and for unsuccessful case, the GPS tracking system will be activated which is linked to the Blynk application in car owner's mobile phone, if the password is wrongly entered more than three times. Upon failure in entering the correct password more than three times, a notification is sent to the car owner's mobile phone. An email is also sent to alert the car owner for a second notification. The coordinates and location of the car on Google maps are displayed on Blynk application. It is shown from this work that the car security system provides a sufficient level of security to avoid car theft. In addition, the GPS tracking system is able to detect the location of the car which is displayed on Blynk application installed in car owner's mobile phone.

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