

Portable Security Locker Using IOT

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Abstract

Everybody possesses important possessions, such as a passport, wallet, credit card, and smartphone. Losing them as a result of theft or robbery may result in the loss of personal information, financial data, or money. When travelling abroad, losing valuables is even worse because it involves dealing with authorities that the traveler is unfamiliar with. Therefore, a Portable Security Locker using Internet of Things (IoT) is proposed to overcome the problems of misplacing important belongings or losing them due to theft or robbery. The locker is equipped with RFID module, fingerprint scanner, keypad password, alarm and GPS tracker for increased security purposes. A message that indicates whether the RFID tag is matched or not will appear on the OLED display as soon as the RFID tag is read by the RFID reader. The user must then scan their fingerprint on the fingerprint scanner if the tag matches. The user may attempt numerous times if it is not matched, though. The user must scan his fingerprint on the scanner in order to use the next level security system. The user may not attempt this level more than three times. In the event that this does not happen, countermeasures will be taken, including the activation of an alarm and GPS tracker, which will result in alert messages being sent to user's email and WhatsApp application. The user's mobile phone's ThingSpeak application makes it simple to find the location of the security locker in the event of theft or robbery. The user will be able to move on to the keypad password system at the top security level if their fingerprints match. Similar countermeasures as in the second level security system shall be used if the user attempted more than three times. The locker's location on ThingSpeak application has been compared to its location on Google Maps, and the results show a good agreement. In conclusion, the level of security offered by this Portable Security Locker is sufficient to fend off theft and robbery.

1. Introduction

Smart locker is a type of locker that connects to the Internet using Internet of Things (IoT) technology to give users a practical way to keep their possessions [1]. The fundamental benefit of a smart locker is that it enables users to keep both business and personal things safely and securely while providing the management with an easy way to regulate access. A locker is a compact, frequently narrow storage space. They can frequently be found in designated cabinets, frequently in large quantities, in a variety of public locations, including locker rooms,

workplaces, elementary, middle, and high schools, transportation hubs, and similar locations. They differ in terms of size, function, design, and security.

Everyone has important belongings in their life such as smartphone, wallet, credit card or passport. Losing them due to theft or robbery might cause loss of personal data, banking information or money. Losing important belongings is even worse when travelling abroad as it will involve various authorities that travelers are not familiar with [2]. In addition, as a human being, forgetfulness might happen [3]. This unfortunately shall lead to misplace or missing important belongings. However, with a Portable Security Locker using IoT, those unwanted circumstances could be avoided.

In this work, a Portable Security Locker is proposed to overcome the problems of misplacing important belongings or losing them due to theft or robbery. Another useful alternative would be hand luggage. However, a locker is chosen in this work due to its compact size and lightweight material. This is especially useful for those who enjoy travelling or going on a vacation as it is portable and easy to carry anywhere. The Portable Security Locker using IoT is equipped with RFID module, fingerprint scanner, password and GPS tracker with alarm, for increased security purposes. RFID is an emerging technology for data identification [4]. On the other hand, fingerprint scanner is a low-cost device which could be integrated into a growing number of devices for recognition [5]. By introducing an alarm system, this shall alert people in the surrounding in case of theft or robbery. On top of that, the Portable Security Locker using IoT can be located easily with the help of a GPS tracker on ThingSpeak application with its Maps on the user’s mobile phone. At the same time, alert messages will be sent to user’s email and WhatsApp application.

2. Methodology

This section discusses the methodology applied in completing this work.

2.1 Block Diagram

Fig. 1 shows the block diagram of Portable Security Locker. The input consists of RC522 RFID module, SFM-V1.7 UART capacitive fingerprint scanner, 4 × 4 matrix membrane keypad. As for the control unit, ESP32 Wi-Fi module with base module is used as the microcontroller. The base module is attached to the ESP32 Wi-Fi module. Lastly, for the output, there are OLED 0.96” display, Piezo buzzer and electric latch lock. The workflow of this block diagram begins when the RFID tag is scanned at the reader. If the RFID tag failed could not be read by the reader, a notification will appear on the OLED display. Then, it shall proceed to the next security level which is the fingerprint scanner where only three attempts are allowed. If the fingerprint attempts exceed three times, an alarm and GPS tracker shall be activated which resulted in a notification to be sent to user’s email and WhatsApp application. Last but not least, in the final security level, a password is entered on the keypad. Similarly, if the keypad attempts exceed three times, the same alarm and GPS tracker shall be activated with a notification to be sent to user’s email and WhatsApp application. In case of theft or robbery, the location of the security locker can be located easily on ThingSpeak application in user’s mobile phone. If the user passes all three-security level, access shall be granted and the electric latch lock will be released to unlock the locker.

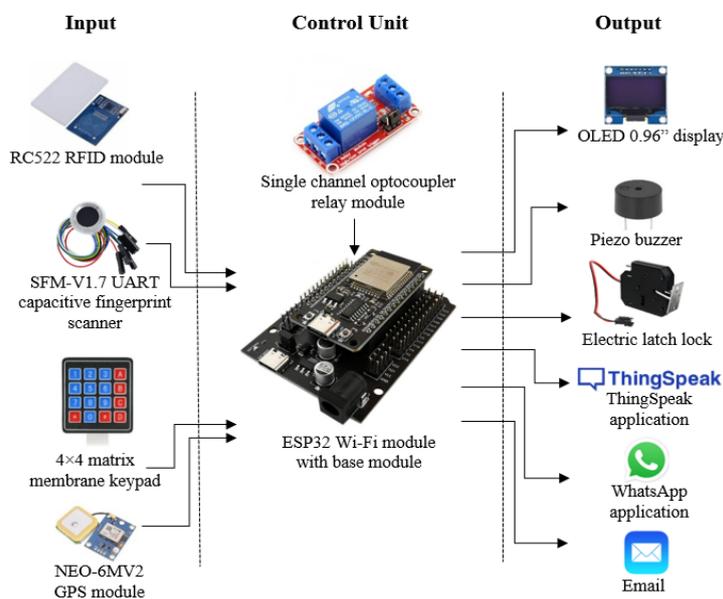


Fig. 1 Block diagram of Portable Security Locker

3. Results and Discussion

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 ThingSpeak application.

3.1 Final Product

The final product of the Portable Security Locker using IoT can be seen in Fig. 2. It consists of a three-level security system equipped with GPS tracking system linked to the ThingSpeak application installed in the user's mobile phone, in case of theft attempt. The RFID module, fingerprint scanner, and keypad password make up the three-level security system. Fig. 2(a) shows the Portable Security Locker using IoT before assembly. Meanwhile, Fig. 2(b) and (c) show the internal and external view of the locker after assembly. Last but not least, the final product can be viewed in Fig. 2(d).

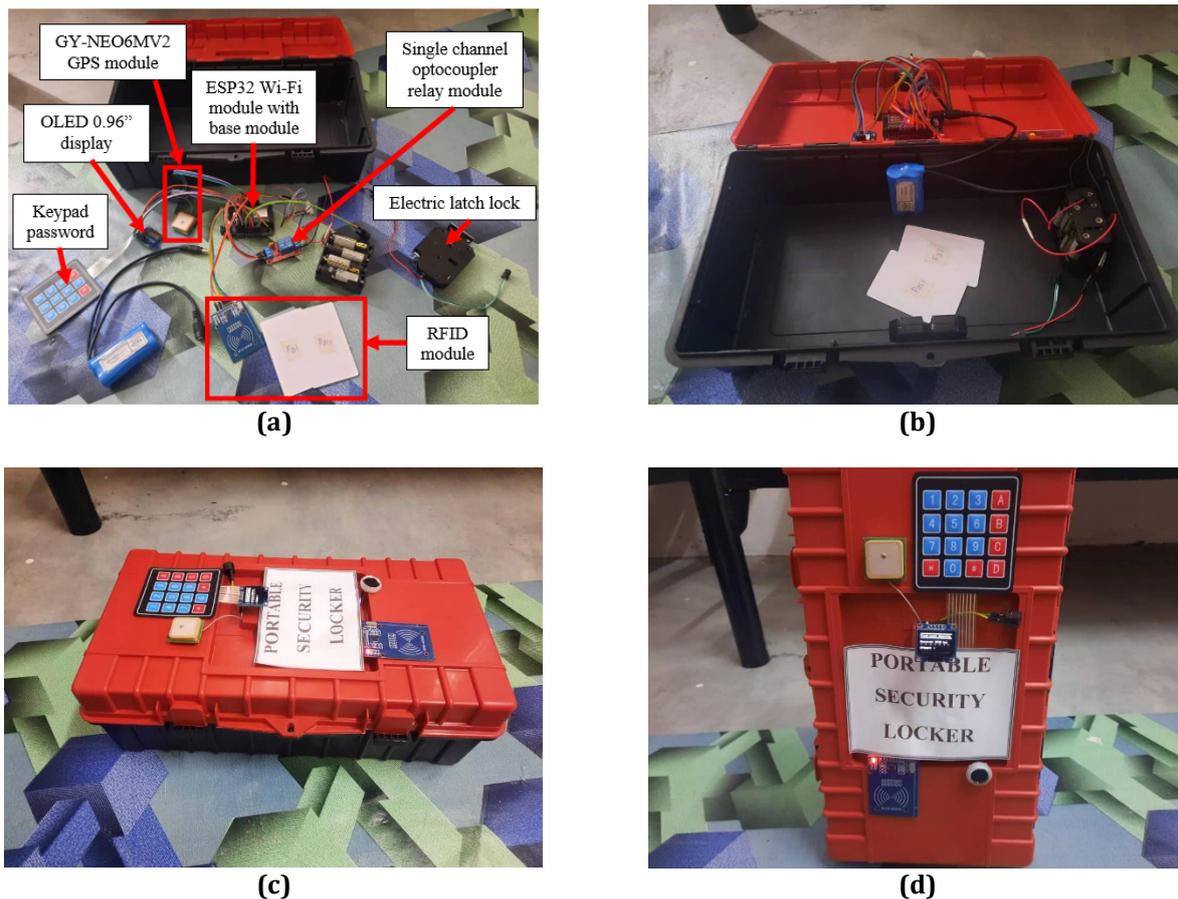


Fig. 2 The Portable Security Locker using IoT: (a) Before assembly; (b) After assembly (internal view); (c) After assembly (external view); (d) The final product

3.2 First Level Security System – RFID Module

RFID module is the first level security system which consists of RFID tag and reader. The tag as a transmitter is kept by the user while the RFID reader is connected to the ESP32 Wi-Fi module as a receiver. This level of security system is indefinite which means that the user can scan the RFID tag on the reader countless times. The RFID tag must be matched with the reader in order for the user to pass through the first level of security system.

(i) Unsuccessful case – RFID tag is invalid

Fig. 3 shows the unsuccessful case which implies the RFID tag is invalid. The notification is displayed on the serial monitor in Arduino IDE software.

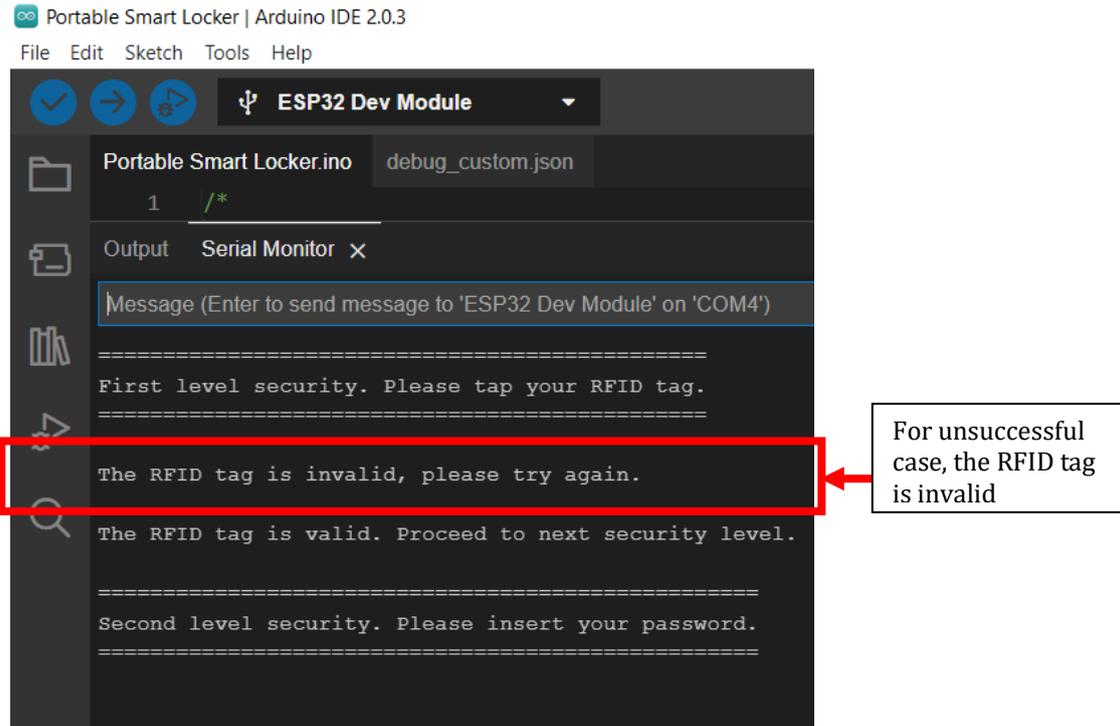


Fig. 3 The unsuccessful case which implies the RFID tag is invalid

(ii) Successful case – RFID tag is valid

The successful case which implies the RFID tag is valid can be viewed in Fig. 4 and the notification is displayed on the serial monitor in Arduino IDE software.

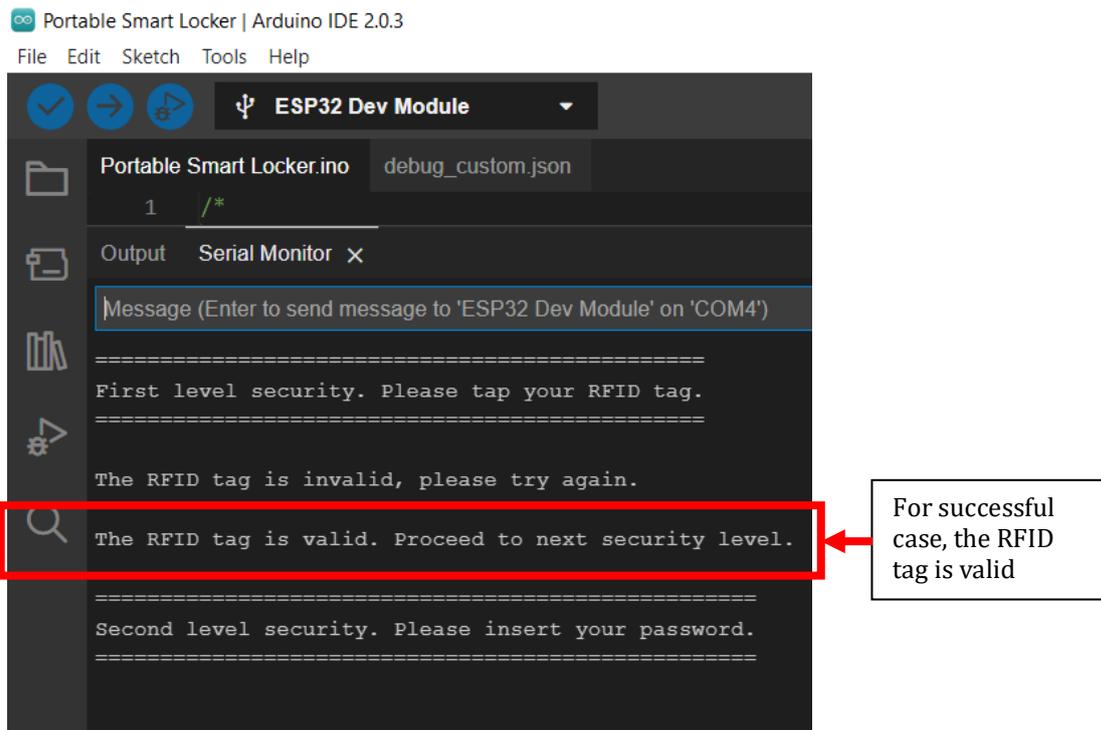


Fig. 4 The successful case which implies the RFID tag is valid

3.3 Second Level Security System – Fingerprint Scanner

For the second level security system, the user's fingerprint needs to be scanned on the fingerprint scanner and must be matched with the fingerprint that is stored in the database of the scanner in order to proceed to the next security level which is keypad password. If the fingerprint attempts exceed three times, an alarm and GPS tracker shall be activated which resulted in a notification to be sent to user's email and WhatsApp application.

(i) Successful case – Fingerprint is matched

Fig. 5 shows the fingerprint is matched with the notification displayed on the serial monitor in Arduino IDE software.

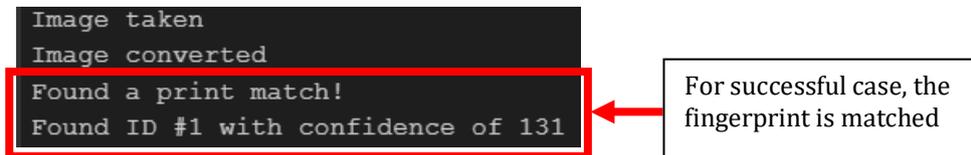


Fig. 5 The successful case which implies the fingerprint is matched

(ii) Unsuccessful case – Fingerprint is unmatched

In the case of incorrect password entered more than three times, an alarm shall be activated. Fig. 6 shows the notification on serial monitor in Arduino IDE software upon password failure which resulted in the alarm being activated.



Fig. 6 The unsuccessful case which implies the fingerprint is unmatched

3.4 Third Level Security System – Keypad Password

Finally, the user has to enter the password on keypad to pass the final level security system. If the keypad password attempts exceed three times, an alarm and GPS tracker shall be activated which resulted in a notification to be sent to user's email and WhatsApp application. On the other hand, if the user passes all three-security level, access shall be granted and the electric latch lock will be released to unlock the locker. The keypad password must be entered correctly in order to grant the user access to the locker.

(i) Successful case – Password is correctly entered

Fig. 7 shows the password is correctly entered with the notification displayed on the serial monitor in Arduino IDE software.

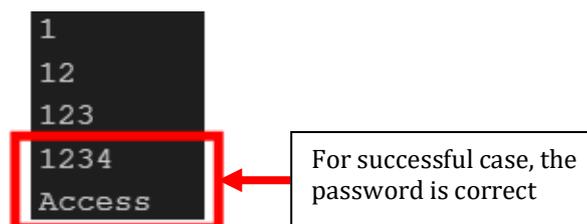


Fig. 7 The successful case which implies the password is entered correctly

(ii) Unsuccessful case – Password is incorrectly entered

Fig. 8 shows the password is incorrectly entered with the notification displayed on the serial monitor in Arduino IDE software.

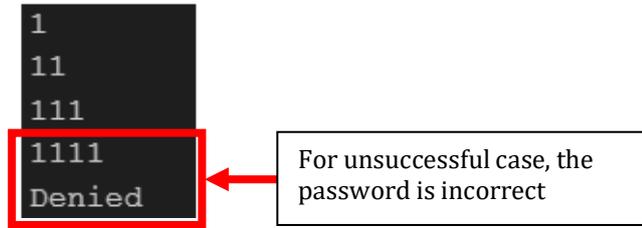


Fig. 8 The unsuccessful case which implies the password is entered incorrectly

3.5 Message Alerts System on Email and WhatsApp Application

The ESP32 Wi-Fi module shall connect to Wi-Fi after three unsuccessful attempts in order to alert the user via mobile phone. Fig. 9 shows the message alerts which is displayed on user’s email and WhatsApp application, both of which are sent to the mobile phone.

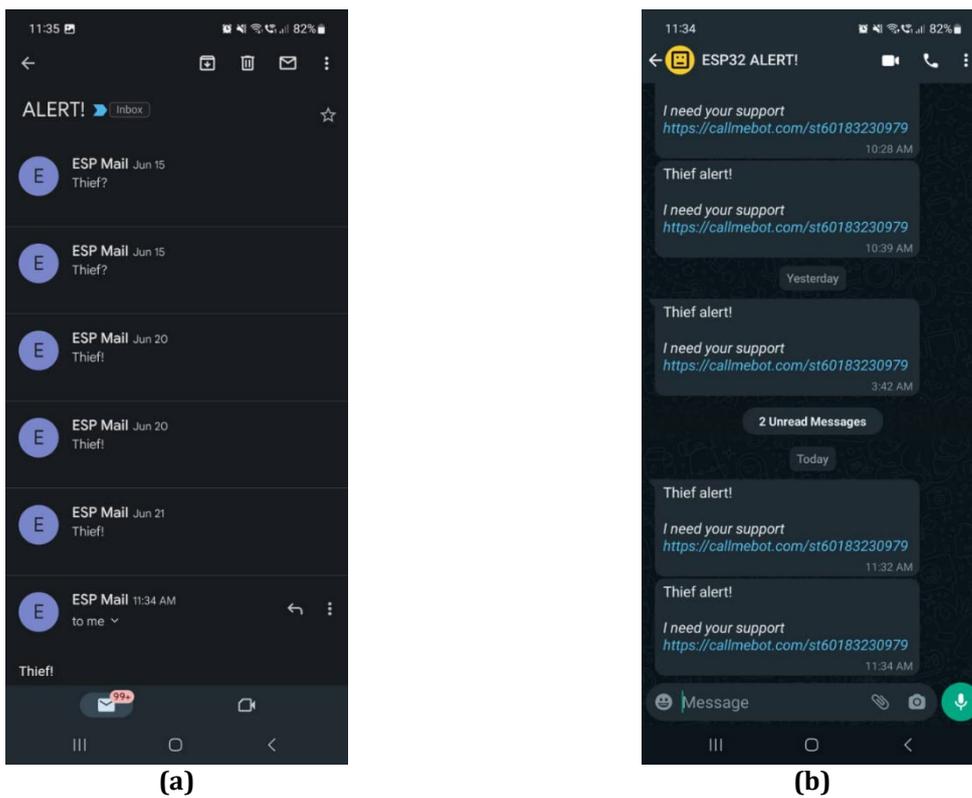


Fig. 9 The message alerts received by the user on mobile phone which are sent to: (a) Email; (b) WhatsApp application

3.6 GPS Tracking System Linked to ThingSpeak Application

This section discusses the performance of GPS tracking system in locating the locker on ThingSpeak application which is further validated by comparing its location on Google Maps on user’s mobile phone. The experiments are conducted on various locations in UTHM which can be viewed in Fig. 10 to Fig. 13. Based on the results, both locations on ThingSpeak and Google Maps are almost similar. The slight discrepancies might be attributed to the accuracy of GY-NEOM6V2 GPS module which is only 2.5 m.

Fig. 10 shows the location of the Portable Security Locker located at Dewan Sultan Ibrahim UTHM. Fig. 10(a) shows the location on ThingSpeak application. For verification purpose, the locker is also located on Google Maps by using another mobile phone and the display is shown in Fig. 10(b).

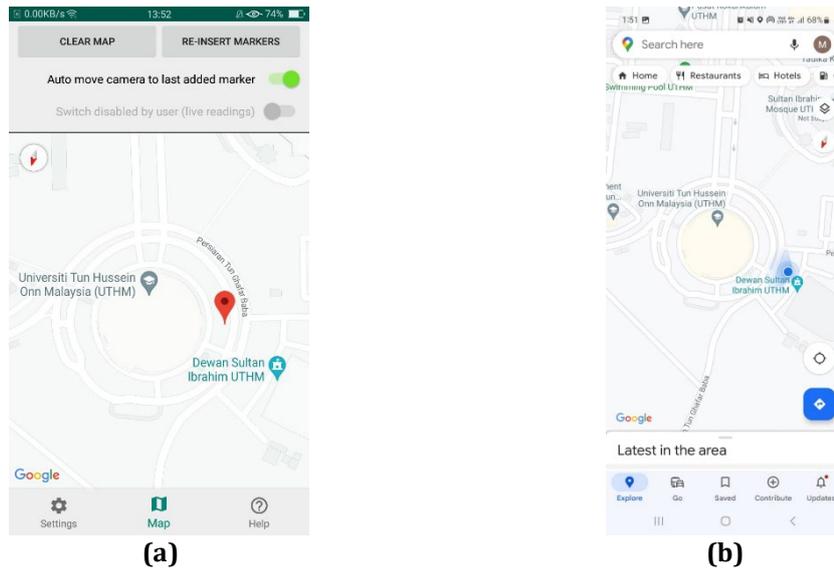


Fig. 10 The location of the Portable Security Locker at Dewan Sultan Ibrahim UTHM on:
 (a) ThingSpeak application; (b) Google Maps on another mobile phone

Fig. 11 shows the location of the Portable Security Locker at Sultan Ibrahim Mosque UTHM. The location is displayed on ThingSpeak application in Fig. 11(a). A second mobile phone is used to locate the locker on Google Maps for verification purposes, the result is displayed in Fig. 11(b).

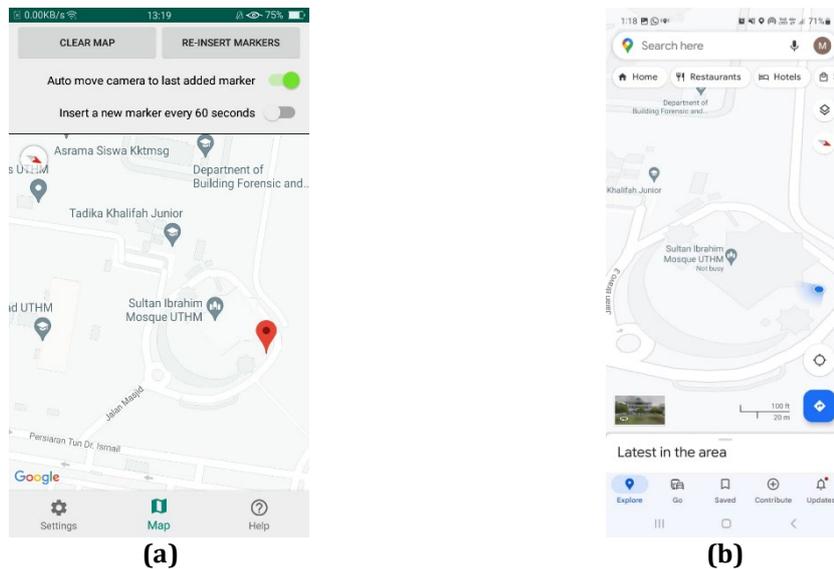


Fig. 11 The location of the Portable Security Locker at Sultan Ibrahim Mosque UTHM on:
 (a) ThingSpeak application; (b) Google Maps on another mobile phone

Fig. 12 shows the location of the Portable Security Locker at FKEE Block QB. The location on ThingSpeak application is shown in Fig. 12(a). Fig. 12(b) depicts the display from another mobile phone used to locate the locker on Google Maps for verification purposes.

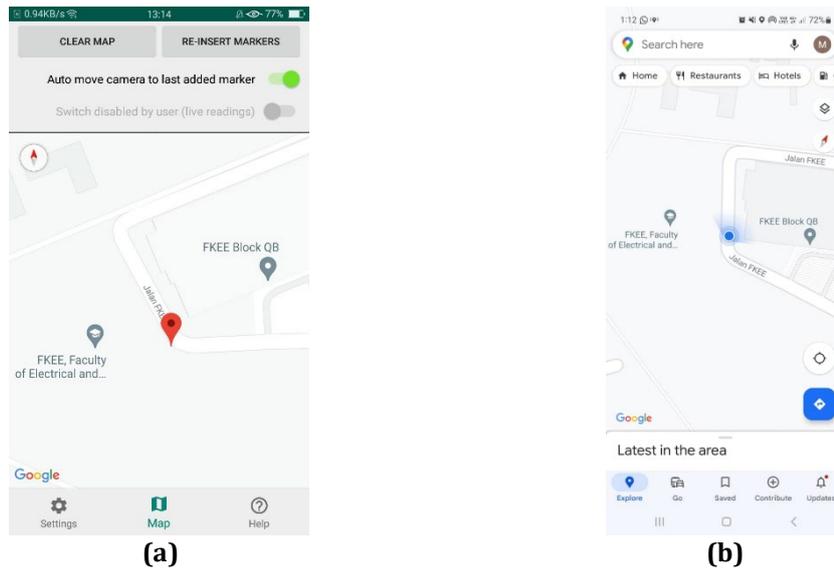


Fig. 12 The location of the Portable Security Locker at FKEE Block QB on: (a) ThingSpeak application; (b) Google Maps on another mobile phone

Fig. 13 shows the location of the Portable Security Locker is tested at G1 FKEE. The location on ThingSpeak application is depicted in Fig. 13(a). The display is shown in Fig. 13(b) and the locker can also be found on Google Maps using a different mobile device for verification purposes.

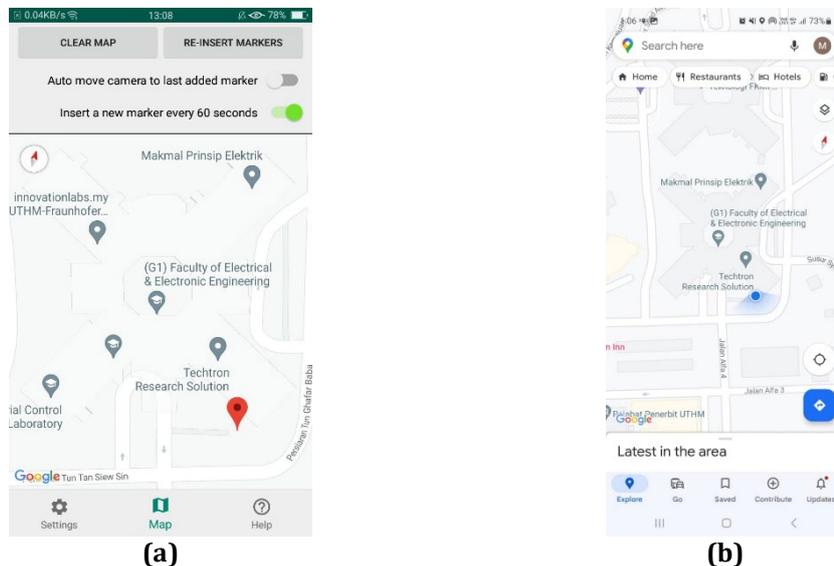


Fig. 13 The location of the Portable Security Locker at G1 FKEE on: (a) ThingSpeak application; (b) Google Maps on another mobile phone

4. Conclusion

A Portable Security Locker using IoT is designed and developed in this work which consists of a RFID module, fingerprint scanner and keypad password. As soon as the RFID tag is read by the RFID reader, a message shall appear on the OLED display which tells the user whether the tag is matched or not. If the tag is matched, the user shall then scan their fingerprint on the fingerprint scanner. On the other hand, if it is unmatched, the user may try again countless times. The next level security system requires the user to scan his fingerprint on the scanner. In this level, the user may not attempt more than three times. Otherwise, countermeasures shall take place where an alarm and GPS tracker shall be activated which resulted in a notification to be sent to user’s email and WhatsApp application. In case of theft or robbery, the location of the security locker can be located easily on ThingSpeak application in user’s mobile phone. The matched fingerprint shall lead the user to proceed to the final level security

system which is keypad password. If the user attempted more than three times, similar countermeasures shall occur as in the second level security system. The location of the locker on ThingSpeak application has been verified with its location on Google Maps which shows a good agreement. In conclusion, this Portable Security Locker provides a sufficient level of security to avoid theft or robbery. On top of that, the GPS tracking system is able to detect the location of the locker which is displayed on the ThingSpeak application installed in user's mobile phone.

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Conflict of Interest

The author declares that there are no conflicts of interest associated with this paper's publication. There are no any personal, business or professional ties that might influence this work. The research's neutrality and integrity are guaranteed by this transparency. The author promises to immediately disclose any future possible conflicts of interest that might surface.

Author Contribution

The authors confirm contribution to the paper as follows: **study conception and design:** Muhammad Nur Hakim Nordin; **data collection:** Muhammad Nur Hakim Nordin; **analysis and interpretation of results:** Muhammad Nur Hakim Nordin; **draft manuscript preparation:** Muhammad Nur Hakim Nordin, Shaharil Mohd Shah. All authors reviewed the results and approved the final version of the manuscript.

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