Progress in Engineering Application and Technology Vol. 3 No. 1 (2022) 521-530

PEAT

Homepage: http://publisher.uthm.edu.my/periodicals/index.php/peat
e-ISSN : 2773-5303

Solar Automation Locking System

Timothy Pengiran Balang[1], Hikma Shabani[1]*

[1]Department of Electrical Engineering Technology, Engineering Technology, Faculty of Engineering Technology, Universiti Tun Hussein Onn Malaysia, 84600 Pagoh, Johor, MALAYSIA

DOI: https://doi.org/10.30880/peat.2022.03.01.052
Received 17 January 2022; Accepted 11 April 2022; Available online 25 June 2022

Abstract: Door locking mechanism is the most crucial component to keep houses and offices safe from robberies. Nowadays, door locking mechanism has been revolutionize to the modern door locking system with. This system can be found in several types to unlock and lock the mechanism by using RFID, fingerprint and password. Approaching with the latest technology which is Internet of Things (IoT), the proposed door locking system is able to monitor and control the activity of the door trough smartphones. Based on the research has been conducted, solar automation locking system able to deliver the criteria needed to solve the problem by notifying and monitor by user through Blynk application in their smartphone with the presence of magnetic sensor. Magnetic sensors are used in this system to monitor the door activity whether it is close or open and notify user through Bynk application. Hence, in this system where Node MCU is connected to Wi-Fi which powered by solar technology and interacting in the application to control the locking mechanism.

Keywords: Door Locking, Solar System, IoT, Monitoring System, Notification

1. Introduction

Automation locking system has been a very important component in the security and safety world. It is to prevent from house breaking and lock picking skills by theft. On many occasions, though, thieves have attempted to gain access to a private location by bypassing the lock [1]. Common automated door locking system can be found in several types of control such as Bluetooth, password, fingerprint, and Internet of Things (IoT).

This door locking system is suitable in home, office, and safe room. The proposed system is based on Internet of things (IoT) due to the Internet of Things (IoT) security is a technology implementation that protects a network and linked devices on the Internet [2]. Solar automation locking system is easy to be use by user. It is because this system is involving smartphone to lock and unlock the door. It could also sense the activity of the door when it is locked and unlocked or open and close.

On top of that, this system also focusing on renewable energy to be applied to supply power to the system. Therefore, solar will be able to supply sufficient power to the system and continuously keep the system running. Not only to save power consumption but this system would not be affected when

*Corresponding author: hikma@uthm.edu.my

there is blackout. As this keeps the safety of houses and offices, it needs to run 24 hours to keep user notified and able to monitor the door activity.

1.1 Literature Survey on Door Locking System

It is important that every house/office should have a locking system. Before technology began to take change of the world, locking system were still in traditional method whereby the need of unlock or lock the door using keys. Therefore, as soon as technology invade, there are many types of door lock has been invented to unlock or lock the mechanism via RFID, password, fingerprint and via Bluetooth.

RFID has become a common locking system which mostly found in office and industry. This is an identification method involving the use of a transponder to store and retrieve long-distance data. The information on an RFID label/transponder (tag) is saved electronically and can be read up to a few metres away [3]. This has been the best alternative to ensure the safety and to monitor the activity of the door. The monitoring system only can be access through computer which has been connected to the RFID mechanism.

Hence, with the new revolution which focus on IoT (Internet of Things) this would bring ease and solving daily life problems which the advancement in technology with time leading to smart access to objects through Internet [4]. This would be step up the security of the premises to new level. Smart locking has started to be the best alternative ensure the security of home/office is safe. The control of this locking systems in a way where any members allowed to control the locking systems not with keys but via their mobile [5].

1.1.1 Integrated Smart Door System

In 2019, Muchammad Husni et. al [6] paper reported that for the integrated smart door system is being control from an Android smartphone to unlock and lock the door. Microcontroller that is being used in this system Arduino GSM. To access the system, the user will require an Android smartphone. The webservice validates usernames and passwords. If the validation is successful, the webservice will send a success code to the Raspberry Pi via Bluetooth. If the code is correct, the Raspberry Pi will tell Arduino GSM to move the Microswitch. The door will be locked or unlocked by Microswitch.

1.1.2 Smart Door Lock System on Smartphone

In 2019, Sagar Suryawanshi et.al [7] paper has been reported that a locking system is using android phone to control the door automation. The microcontroller involve in this paper is Arduino Uno Rev 3. The microcontroller basically will receive data from the user through the cloud system to activate and deactivate the locking system. Hence, this smart door lock only applicable to android phone user. It incorporates multi-layered security systems such as user registration, authentication, and authorization via One Time Password (OTP) or real-time random PIN generation. It enables for remote control and has a high level of security. Besides, other ways to control the automation of the locking system is through speech command. It will transition from voice to text. The detected word will appear in the form of text on the Android screen, allowing the user to determine whether or not the command is correct.

2. Materials and Methods

The methodology of this proposed system is basically focusing on the materials, instruments, procedures and data collection method in detail. It is important to identify the suitable materials and instrument to be used in completing the project. Hence, this will determine the prototype of the project is suitable to be applied and can work well when it is completed. Besides, procedures and data collection method have to be the best that suits during the execution of this project. This enables the system could

provide the exact functionality and assure users to able to use the system as per specification. This process will determine the efficiency of the project to be completed.

2.1 Block diagram of the system

Shown in Figure 1 is the design of the Solar Automation Locking System. This is to get a clear view on the element connected and could operate the system. The solar panel will go through the solar charge controller to regulate the voltage that will charge the deep cycle battery. The solar charge controller will power up the NodeMCU simultaneously connected to the deep cycle battery. Then the deep cycle battery will be connected to the relay and solenoid lock to power the solenoid lock and energize the relay. Next, the Node MCU will be connected to the solenoid lock, magnetic door sensor and relay. This would enable Node MCU to send notification for the door sensor and control the solenoid lock to be switch through Blynk application. That would complete the process of the system.

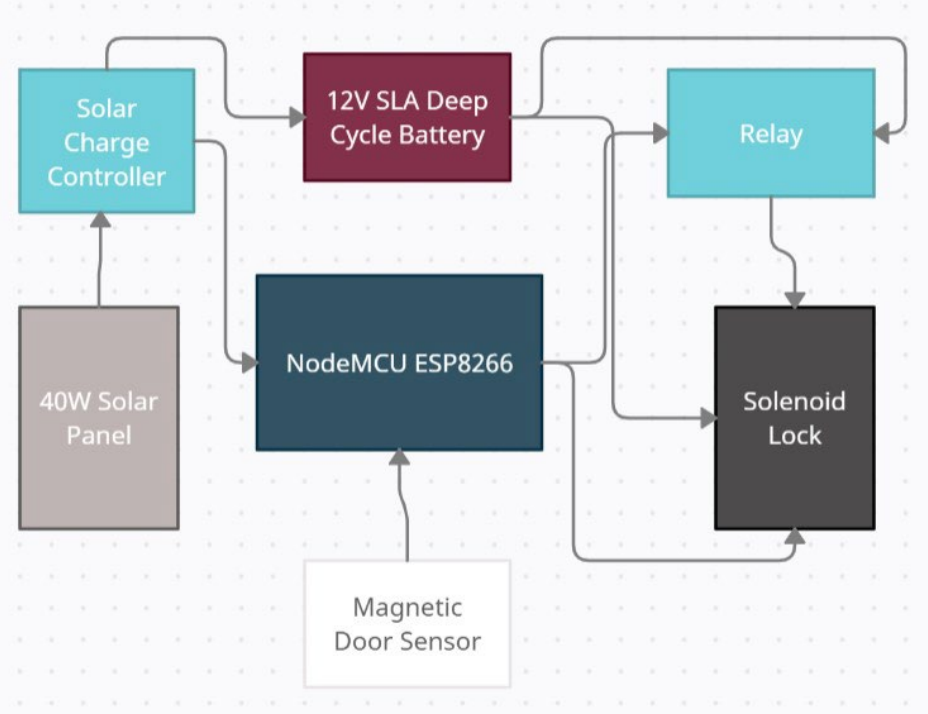

Figure 1: Block diagram of the system

2.2 Flowchart of proposed system

Before constructing this locking system, a flow chart of system needs to be constructed as an overview of the working principle. It is crucial to have a flow chart to ensure that the system will provide a performance that meet the requirement in order to achieve the objectives of the project. On top of that, this ensure the procedure of making this project is being built accordingly which would save time and cost that will be managed precisely. The flow chart summarizes the whole process of the system to enable user to understand working principle of the system. This process will determine the efficiency of the project to be completed.

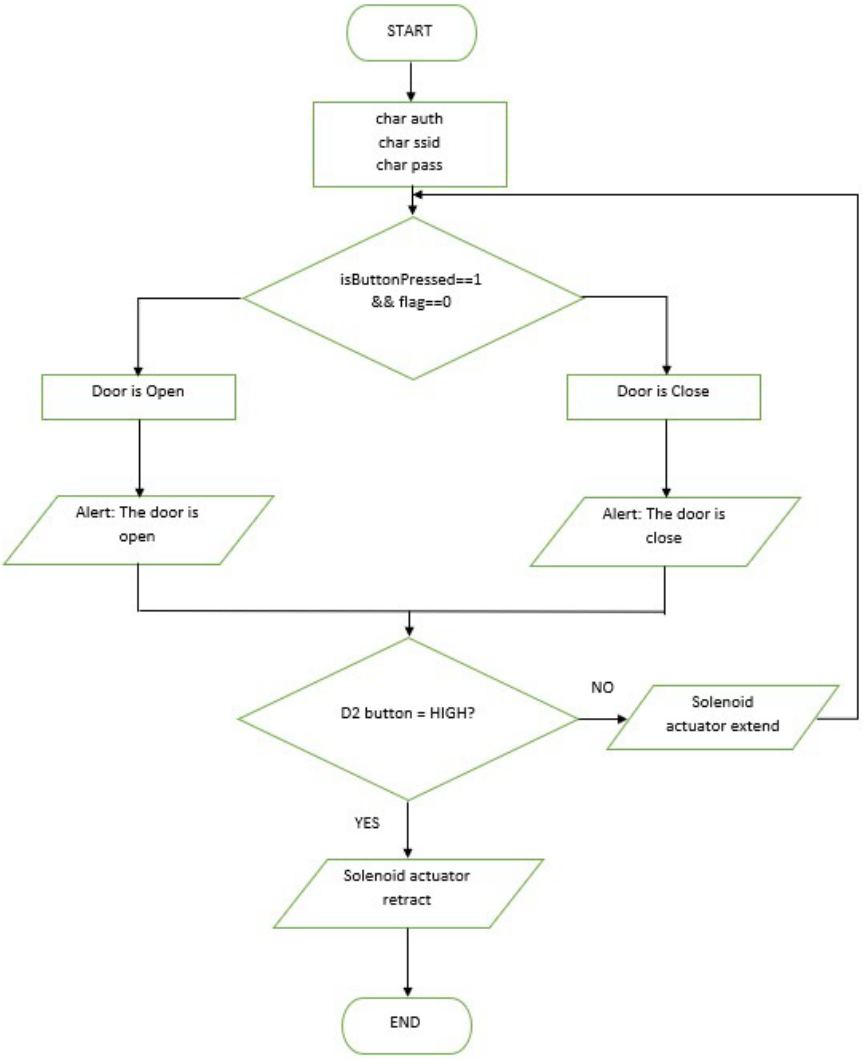

Figure 2: Flowchart of proposed system

2.3 Schematic circuit & 3D design board layout

Figure 2 shows the schematic circuit for the proposed system designed by using circuit design software that is Proteus Pro 8. The circuit of the system consists of NodeMCU ESP8266 and terminal block. Terminal block is used in this system is to connect easily wires to the and conduct maintenance to the system.

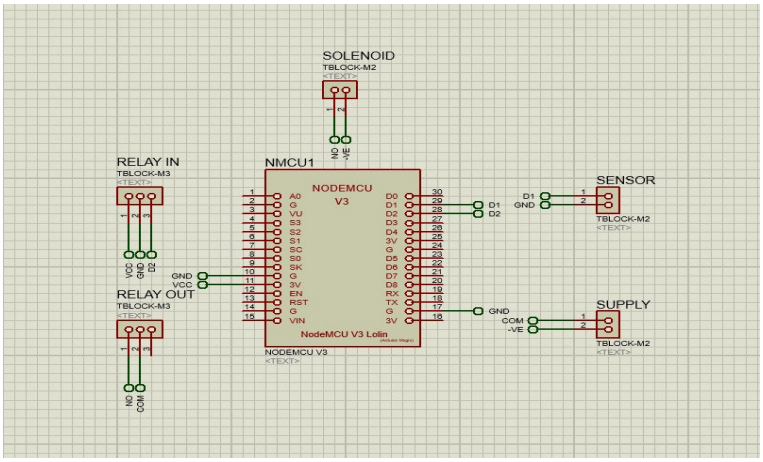

Figure 3: Schematic circuit of proposed system

While Figure 4 shows the 3D board layout of the proposed system. The board display the layout realistic view of the component which also done by using Proteus 8 software. This helps to visualize the layout of the board to ensure the size of PCB board and casing needed for the proposed system.

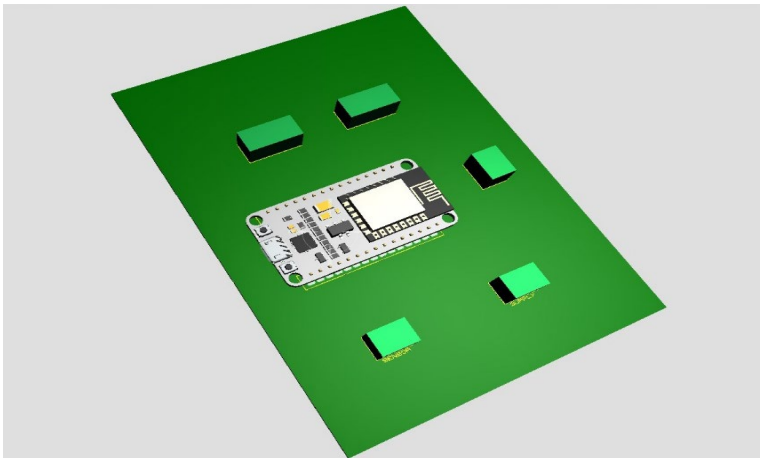

Figure 4: 3D board layout design of the proposed system

3. Results and Discussion

This section shows the result after completing the proposed system prototype. The project has been developed and completed, has been evaluated to measure the effectiveness and to ensure that it has successfully met the outlined goals and objectives.

3.1 Results

This subtopic explains the calculation of the specification, voltage supply by solar panel and charging state of the battery of the solar system needed to supply and execute the whole system. It is important that the solar panel wattage is suitable to supply to charge the battery. Hence, this would enable the battery to be charge sufficiently and able to supply to the whole system.

Based on Table 1, the calculation is to provide details of the specification requirement of the components that suits to operates the whole system. Explaining on the solar panel, it is assumed that a solar panel will receive sunlight at least 80.00 % based on the weather condition in Malaysia. Therefore, at least the solar panel is able to supply 32.0 W to the battery to charge. With the supply, the current supply to the battery is around 2.7 Ah with the assumption of the system will work at least 12 hours per day. This would enable the current is safe to supply through the solar charge controller with maximum rating 10 A. Besides, the solenoid uses 7.2 W per hour when multiply with 12 hours in total 86.4 Wh.

Since the battery is able to store 108 Wh capacity, it can supply enough power to solenoid. NodeMCU ESP8266 will get the supply from the USB port on the solar charge controller as it suits the requirement of the operating voltage needed for NodeMCU.

Table 1: Operating specification for proposed system

Component	Specification	Calculation
Solar panel	40 W	40 W × 0.8 = 32 W (Assuming 80.00 % of sunlight absorb by solar panel) P = IV, I = $\frac{32}{12}$ = 2.667 Ah
Battery	12.0 V, 9 Ah	P = 12 × 9 = 108 Wh
Solenoid	12.0 V, 0.6 A	P = 12 × 0.6 = 7.2 W 7.2 W × 12 h = 86.4 Wh
Solar charge controller	12.0 V, 10.0 A USB = 5.0 V	12.0 V, 10.0 A
NodeMCU ESP 8266	5.0 V – 9.0 V	5.0 V – 9.0 V

Table 2 shows the voltage generated by the solar panel when exposed to direct sunlight The solar panel is exposed to the sun between the hours of 9 a.m. and 7 p.m. This is to see how successful the solar panel is in absorbing sunlight over a period of time.

Table 2: Voltage produce by solar panel

Volt	Time
19.5	9.00pm
19.3	10.00pm
19.1	11.00pm
18.7	12.00pm
18.6	1.00pm
18.4	2.00pm
18.3	3.00pm
17.5	4.00pm
17.5	5.00pm
15.6	6.00pm
12.3	7.00pm

Figure 5 shows the vivid depiction of the solar panel's efficiency in collecting sunlight According to the graph, it is clearly more effective in the morning with a reading range of 19.5 V to 19.3 V. As a result, from midday until in the afternoon, it drops to 18.3 V. While the lowest measurement observed in the evening was 12.3 V, which is due to the sunset and the sun absorbing less light. The reading was taken using a multimeter, and the voltages were then managed by a 12.0 V solar charge controller, which distributed the voltages in a safe amount to the battery to prevent it from being overcharged.

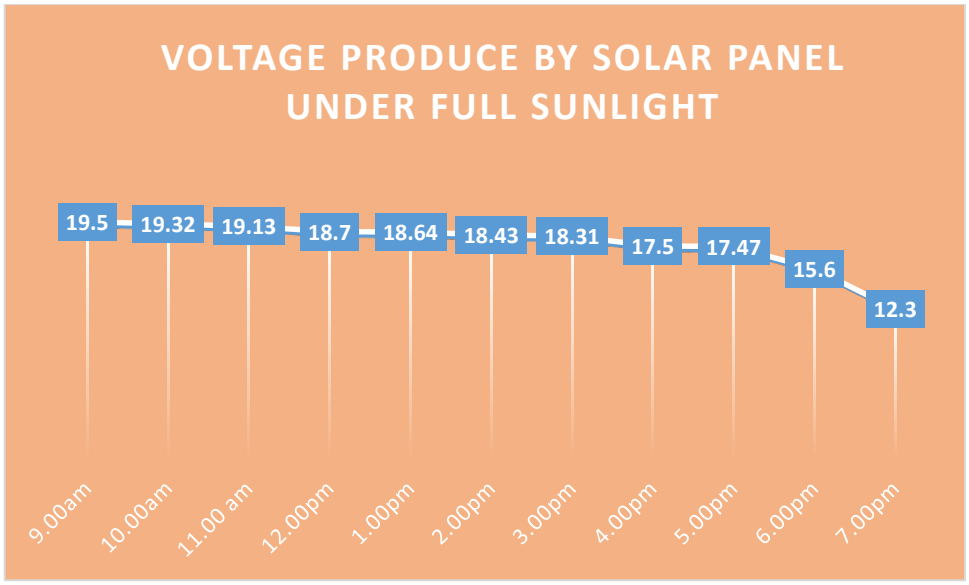

Figure 5: Voltage produce by solar panel

Table 3 shows the measured voltage for the battery to reach full capacity. It is separated into phases to ascertain the voltages that the battery accumulates at each stage. This would aid in determining when the battery would be fully charged and keeping the system running continually.

Table 3: Voltage measured every charging stage

Charging State (%)	Voltage
100	12.7
90	12.5
80	12.4
70	12.3
60	12.2
50	12.0
40	11.9
30	11.8
20	11.6
10	11.3
0	10.5

Figure 6 shows the charging state of the 12.0 V deep cycle battery to a full capacity that is charge by the solar panel. Analyzing the data, the battery which the condition is low 0.00 % will accumulate at least 10.5 V of voltage when being charge. Hence, at the mark of 40.00 % the battery could already have 11.9 V which is enough to operate the whole system. Reaching 80.00 % the battery obtain 12.5 V and almost reaching its maximum storage capacity.

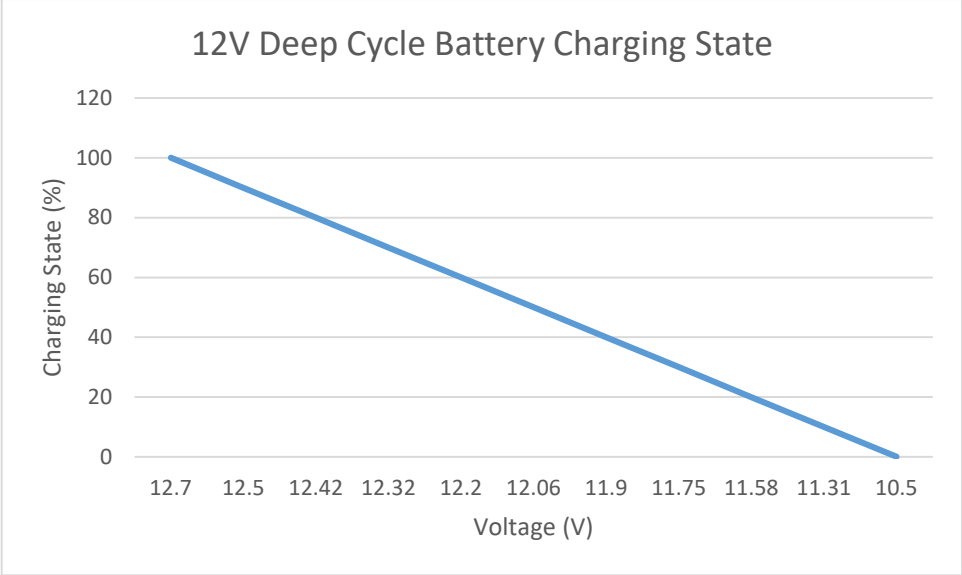

Figure 6: Battery charging state to full capacity

After all the research has been done and planning of the design system, this section shows the effectiveness of the proposed system which have been tested and gone through troubleshooting period. The system is fully equipped and as shown in the figures below are the results of the system operated fully.

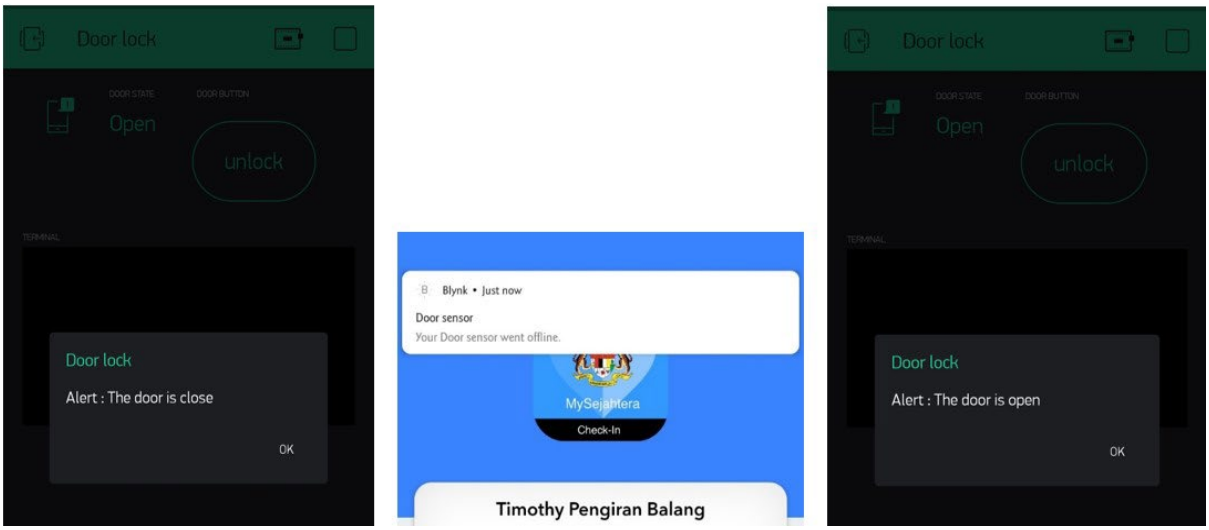

Figure 7: Notification pop-up through smartphones

Shown in Figure 7, the Blynk application was able to receive notification after the system is being run for a period of time. The NodeMCU was able to send data through a connection of hotspot Wi-Fi from a phone which is registered in the program coding. The magnetic sensors work well to detect the position of the door. The proposed system was successful to deliver the objectives of the whole research.

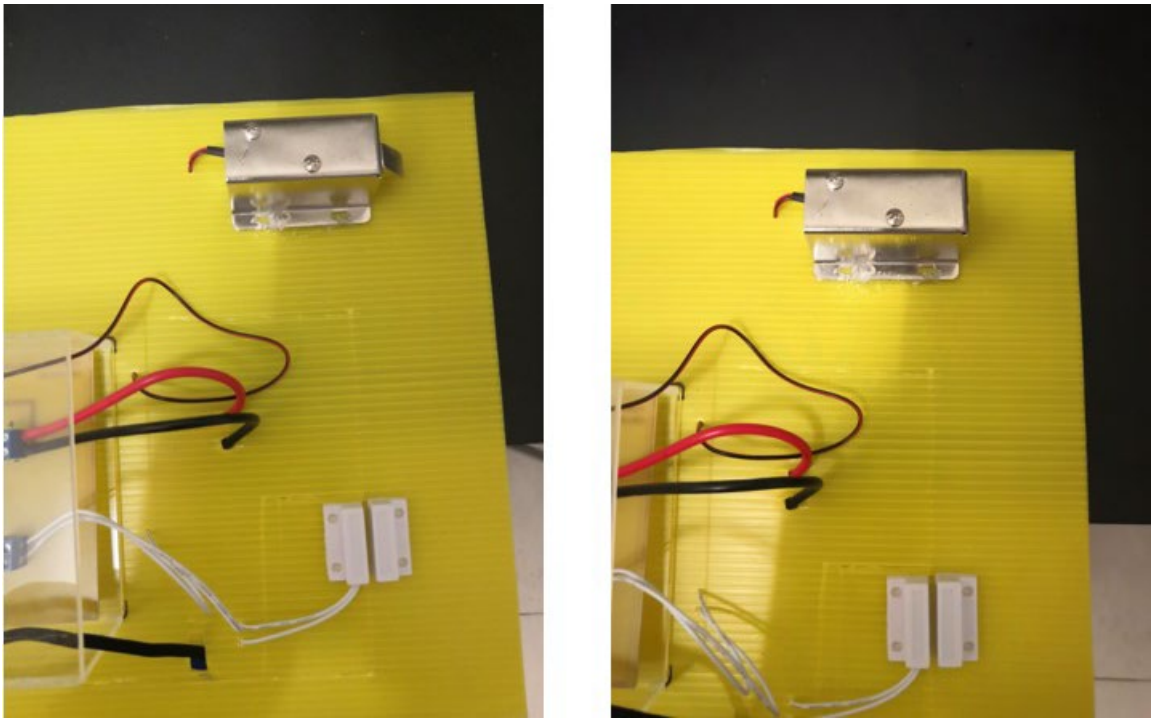

Figure 8: Solenoid lock condition controlling through Blynk application

Figure 8 shows the solenoid able to react to the command from the Blynk application. A relay is connected to the solenoid whereby the Node MCU interact with smartphone to control the operation of the solenoid. Lock and unlock method only can be use through the Blynk application whereby the authentication code in the program coding is similar with the application.

3.2 Discussions

This system would be able to serve user best on the operation of the control system. This will ensure the safety of their home or office from unwanted event such as house break-in. They will always be notified through the Blynk application if they are equipped with good internet connection. Hence, for the next step of this project all the components will be connected and could operate perfectly to achieve the main objectives. Internet of Things (IoT) is really a helpful technology which could ease human and to control everything at the tip of our finger. Besides, as this project leading towards renewable energy, this would encourage more people to start implementing this system to their house or office. This would help to stop any dam being constructed that would destruct the river and the habitat living around it.

4. Conclusion

Summing up the process, the solar automation locking system has been developed successfully. This system which consists of a microcontroller NodeMCU ESP8266 that is compatible to C language and Arduino IDE. Besides, the load for this system is solenoid lock and magnetic sensor. The solenoid lock is control through the Blynk application in order to lock and unlock. While the door sensor will send notification whenever the magnetic sensor senses the changes of the door condition. In addition, the calculation of the solar system has provided more details to ensure that the system operates withing the required specification. The result was successfully obtained and meet the requirement of the proposed system. With that being said, the objective of solar automation locking system was achieved.

Acknowledgement

The authors would like to thank the Faculty of Engineering Technology and Universiti Tun Hussein Onn Malaysia for its support throughout the progress of completing prototype of the proposed system.

References

[1] I. Ha "Security and Usability Improvement on a Digital Lock System based on Internet of Things". International Journal of Security and Its Application. Vol 9(8), pp 45-54, (2015). DOI: //dx.doi.org/10.14257/ijsia.2015.9.8.05.

[2] P, I., A. (2020). "A Survey on Smart Door Lock Security Methodologies Implemented using Various Wireless Access Technologies". International Research Journal of Modernization in Engineering Technology and Science. Vol 2(9), September 2020.

[3] (Hassan et al, 2020). 'The Automatic Door Lock to Enhance Security in RFID System'. Journal of Physics. Conf. Ser.1500. htpps://doi.org/10.1088/1742-6596/1500/1/012132

[4] (Isrhat et al, 2017). 'Smart Door Lock System with Automation and Security'. Department of Computer an Information System Engineering, NEDUET, Karachi, Pakistan., 29(1), pp 73-76, 2017.

[5] A. Agarwal, N. Hada, D. Virmani, Gupta. (2017). 'A Novel Design Approach for Smart Door Locking and Home Security using IoT'. International Journal of Innovative Research in Science, Engineering and Technology. Vol. 6(8).

[6] (Husni et al, 2019). "Integrated smart door system in apartment room based on internet." Universitas Ahmad Dahlan, Surabaya, Indonesia., 17(6), pp. 2747-2754, 2019. DOI: 10.12928/TELKOMNIKA.v17i6.12322

[7] (Surywanshi et al, 2019). "Smart Door Lock System on Smartphone." Vidyawarta Research Journal. pp. 13-16. Retrieved from https://www.vidyawarta.com/02/wp-content/uploads/2019/03/special_issue_Advanced_Computing_and_Data_Processing.pdf#page=13