

Smart Home Security System Using IoT

Frederick Jausin¹, Lilywati Bakar^{1*}, Zurina Abdul Wahab¹

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

*Corresponding Author Designation

DOI: <https://doi.org/10.30880/peat.2022.03.01.053>

Received 17 January 2022; Accepted 11 April 2022; Available online 25 June 2022

Abstract: In this current era towards the development of technologies, a lot of electronic devices are wireless, and a lot of industry has already towards industrial 4.0. The purpose of this “Smart Home Alarm System Using IoT” is to help people live a safe environment and making sure that the home has protection against unwanted guests such as intruders and to prevent or to help people from being caught in a fire. Nevertheless, current issues suggested the need of improving the security alarm so not only it can protect people but also help people to monitor their home wireless by only using their smartphones which can be monitored from every inch of the globe. This project can identify which location of the house is being intruded or where the fire started burning by using a sensor that will be placed at different zones, such as zone 1 and zone 2. The words zone here is just an indication which can be any names regarding where the sensor is placed such as in the living room or kitchen. When the sensors of fire or intruder are triggered, the device will read and send a notification to the owner via the Blynk application that is installed in their smartphone. Besides that, a camera will also be installed which can be used to monitor from distances using the specific application or browser. For the fire alarm, a notification will be sent to the mobile phone to warn the user that there is a fire, smoke or gas leak inside the house. For the Intruder alarm, a buzzer will not be installed but it can be applied also. The reason why the intruder alarm is not installed with a buzzer is to make sure that a panic situation will not be created, to prevent other people from getting hurt by the intruders, and intruders can be cunningly detained by authorities.

Keywords: Smart Home Security System, Internet of Things, Intruder Alarm system, Fire Alarm System, Surveillance Camera, Blynk Application

1. Introduction

With the rise in global internet technology levels nowadays, a lot of people have created or modified different types of devices that are outside the box, this is called innovation and creativity. Innovation for objects or devices that were invented can have more functions and be more attractive. Today our culture has been affected to be competent. Furthermore, the world is racing to create an innovation that would change the world to be better and more futuristic. Moreover, technologies

nowadays have been towards industrial revolution 4.0 which is the internet of things (IoT) that refers to the infrastructure of connected physical devices[1] that are growing at a rapid rate as lots of devices and physical objects are connected to the Internet.

Security is one of the most serious issues when it is related to the safety of family, properties and others. The “Smart Home Security System Using IoT” is meant for the protection of people and important properties. This project is ought to be fitted inside any house which the sensors is placed on all doors and windows for protection from burglar which basically the easiest location and most often place where the burglar sneak in and sensors for sensing gas leaked is placed inside the kitchen which basically where the first place fire started to burn down a house. Intrusion and house caught on fire is an associate degree of the unfortunate reality that happening in our world these days and already causing a lot of problems and tragedies. Both of these incidents cannot be stopped but they can be prevented which is where this device will take place to protect ourselves, our family and other important properties and stuff

1.1 Introduction to Smart Security System

Smart home security system using the Internet of Things is assigned for security, comfort, convenience for homeowners by enabling them to monitor their house from far away which is by using smartphones. The system basically will notify the homeowner if any of the sensors is triggered and they can easily monitor their house by using the specific application called Blynk or the camera can also be accessed by using the provided browser.[2]

Home security has changed away from simple control panels and deadbolt locks in recent years, with locksmiths now enabling key-less entry for homes. Home security has evolved into a desirable high-tech item on many people's wish lists. While the Jetson age hasn't yet arrived, the technology underpinning today's smart homes, such as home security camera online watching features, will most likely blow our forefathers' minds [3].

The foundation for smart security systems was built generations ago, and today's security systems aren't just the result of recent technological advancements. It's necessary to look back in time to comprehend how home security has progressed into what it is now [3].

1.2 Theory

The emergence of the Internet of Things technology, as well as the widespread adoption of big data, cloud computing, and other concepts, such as wireless communication-based automatic fire alarm and intrusion alarm systems, has drawn a lot of attention both at home and abroad in recent years [4]. Some alarm systems serve a single purpose which is only served as either burglary alarm or fire alarm. A combination of systems that provides both the fire alarm and intrusion alarm protection can make it more convenient. The intrusion alarm may also be combined with closed-circuit television surveillance (CCTV) system [5] that can automatically record or take a picture of the activities of the intruders, and it may interface to access control systems for electrically locked doors.

2. Materials and Methods

The material and methods will explain about the concept of using several sensors and using NodeMCU ESP8266 for the Smart Home Security System. Furthermore, it will cover the list of materials that will be used in completion of this project.

- a) NodeMCU ESP8266[6]
 - Acts as a brain of the system to control the behavior of the system
 - Operating Voltage 3.3 V

- Comes with 17 GPIO Pins
- b) MQ2 Gas Sensor [7]
- Typically, the operating voltage is +5.0 V
 - 4 Pins which is Vcc, Ground, Digital Out, and Analog Out.
 - Digital Out: Can be used to get digital output from this pin, by setting a threshold value using the potentiometer
 - Analog Out: This pin outputs 0.0-5.0 V analog voltage based on the intensity of the gas
- c) Digital Humidity and Temperature Sensor (DHT-11)[8]
- Power supply 3.5 V to 5.5 V
 - Data: Outputs both Temperature and Humidity through serial Data
 - NC: No Connection and hence not used
- d) Passive Infrared (PIR) Motion Sensor[9]
- Input voltage is +5.0 V for typical applications. Can range from 4.5 V- 12.0 V
 - Digital pulse high (3.3 V) when triggered (motion detected) digital low (0V) when idle (no motion detected)
- e) Magnetic Door Switch [10]
- Reed Switch triggered when contacting with magnet
- f) Raspberry Pi Wemos 18650 Battery Shield V3 ESP32[11]
- Acts as a power supply for the system
 - Over charge and over discharge protection
 - Output: 3.0 V 1A and 5.0 V 2 A
 - Input: 5.0 V to 8.0 V
- g) ESP32-Cam Video Streaming and Face Recognition [12]
- Wireless camera can be connected with either bluetooth or Wi-Fi
 - Typically, the operating voltage is +5.0 V

2.1 Flowchart of the system

Figure 1 shows the flow chart for the intruder alarm system where the system will check if there are intruders that trigger the sensors. PIR motion sensor will be used to detect if intrusion happens either at zone 1 or zone 2. If the sensors are triggered, the system will send the data to the Blynk application and will send a notification to the user or homeowner. To detect an event that happens to the door, a magnetic door switch will be used. When either the front door or back door was to be open, the switch will be triggered and the system will send the data to the Blynk application then a notification will be sent to the user or owner of the house.

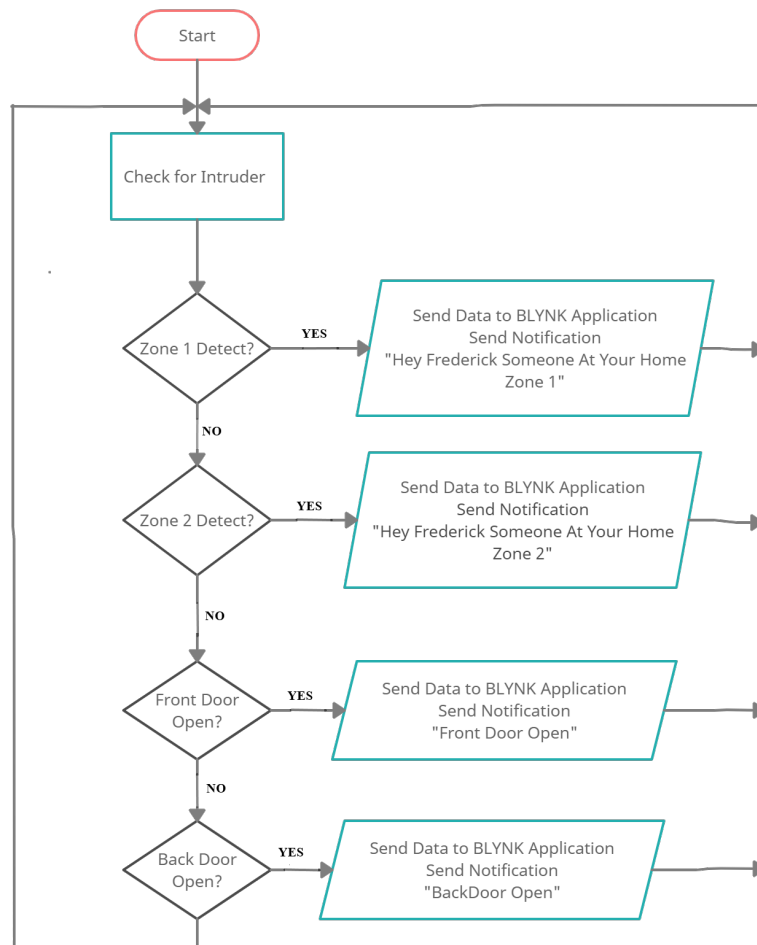


Figure 1: Intruder alarm system flow chart

Figure 2 shows the flow chart for the fire alarm system. The system firstly will identify the temperature and humidity level inside a certain area and the data will be sent to the Blynk application then it will be displayed inside the application. This will help users to monitor the temperature and humidity level inside their house. Next, the system will use MQ2 gas sensors to check if there is a gas leak inside the house. The MQ2 gas sensor will be triggered if the volume of gas exceeded the limit and the data will be sent to the BLYNK application then it will send a notification to the user to notify there is a gas leaked.

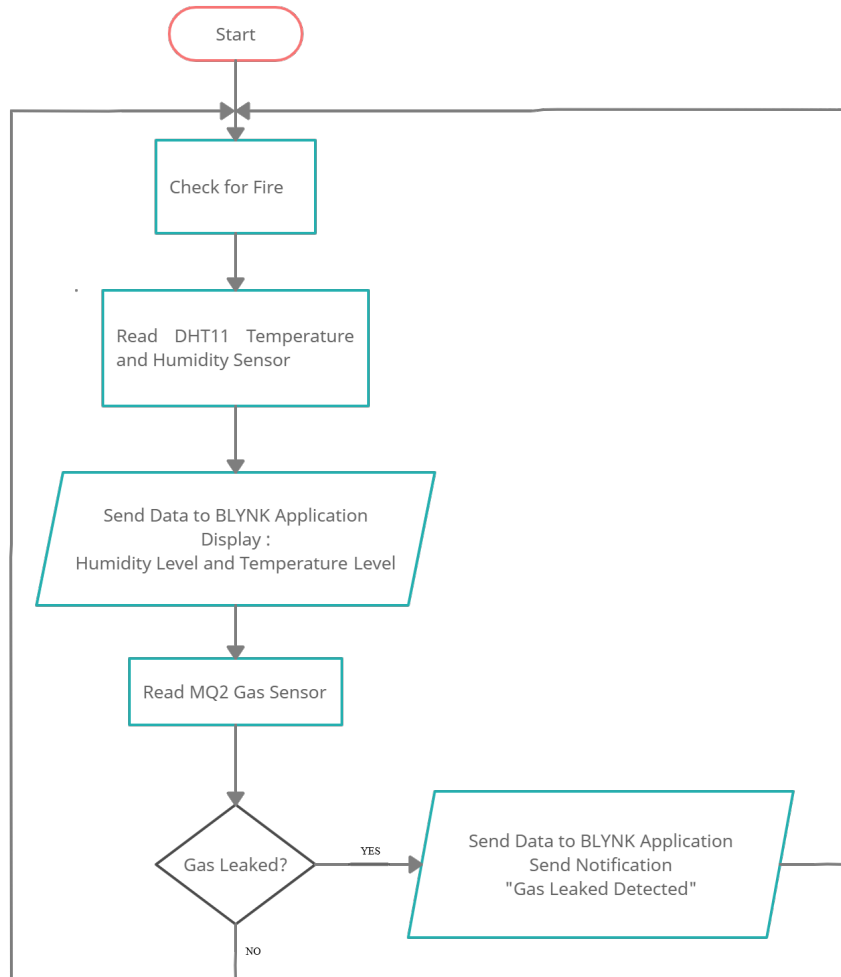


Figure 2: Fire alarm system flow chart

Figure 3 shows the block diagram of the surveillance camera. The function of the surveillance camera is to monitor the live event of what happened around the house and if any of the sensors were to be triggered, not only the user gets the notification, but the user also can monitor the live event occurring around the user’s house.

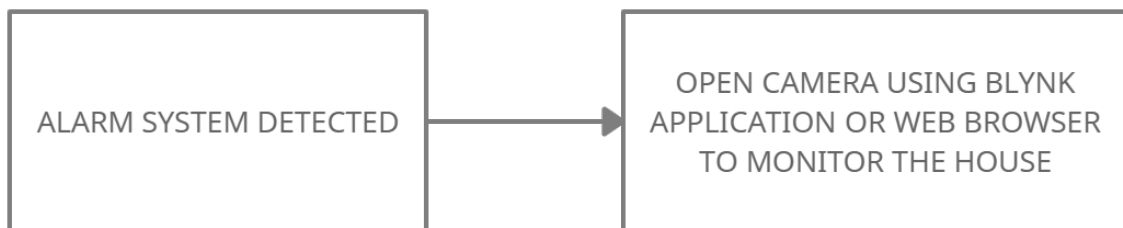


Figure 3: Surveillance camera system block diagram

2.2 Schematic diagrams

Figure 4 shows the schematic circuit diagram of the alarm system that was constructed using Proteus software. The purpose of constructing this circuit diagram was to design a PCB layout for the system then converts it to the actual circuit using PCB board.

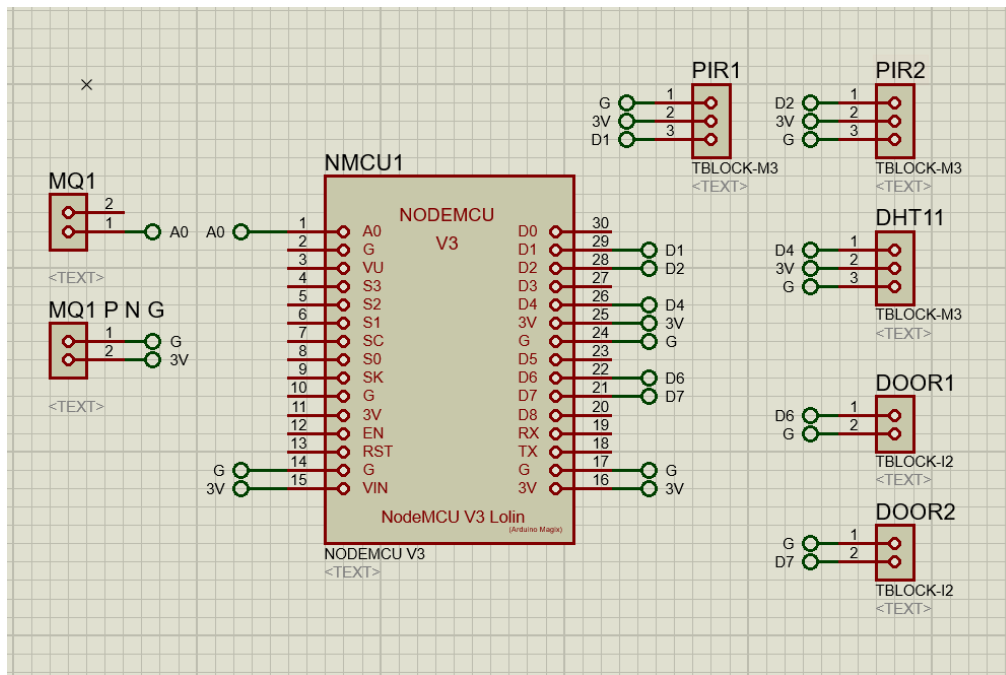


Figure 4: Schematic circuit diagram of the alarm system

2.3 Prototype diagram

Figure 5 shows the house plan and the design. The house plan was printed from the internet and the house design was constructed using DIY material as a prototype of the house to indicate each zone and where are the convenient places to apply the sensors.



Figure 5: Prototype and house design plan

3. Results and Discussion

The results and discussion section presents data and analysis of the study. This section can be organized based on the stated objectives, the chronological timeline, different case groupings, different experimental configurations, or any logical order as deemed appropriate.

3.1 Intruder alarm system

a) Notification on Blynk application

i. Zone 1 PIR Motion Sensor

As shown In Figure 6 is the notification alert for an intruder in zone 1. Basically, when the PIR motion sensor in zone 1 is triggered, the data that was obtained by the sensor will be sent to the Blynk application through the microcontroller NodeMCU ESP8266 then the Blynk application will generate a notification that will be sent to the user.

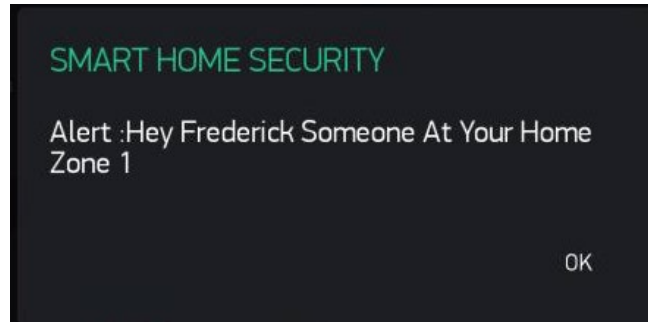


Figure 6: Notification on blynk application for zone 1

ii. Zone 2 PIR Motion Sensor

Figure 7 shows the notification that was sent to the Blynk Application on a mobile phone when the PIR motion sensor in zone 2 was triggered. The process was the same as shown in Figure 6 but the sensor was located at a different location. This shows that the sensor detects someone that might be an intruder.

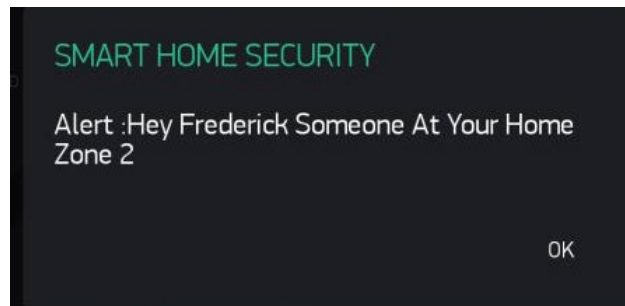


Figure 7: Notification on blynk application for zone 2

iii. Front Door

Referring to Figure 8, the notification for the magnetic door switch was obtained. When the magnetic door switch that was placed on the door was triggered, the data will be sent directly to the microcontroller then the Blynk application will generate the notification that notify the user that the door was opened.

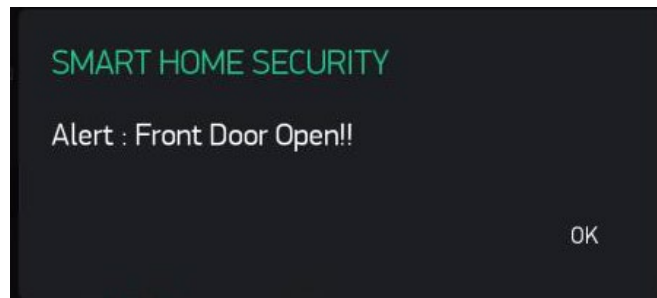


Figure 8: Notification on blynk application for front door

iv. Back Door

Figure 9 shows the notification when the magnetic door switch at back door was triggered. When the switch was triggered the NodeMCU will send the data to the Blynk Application through Wi-Fi then the Application will generate notification to inform the user that someone open the back door.

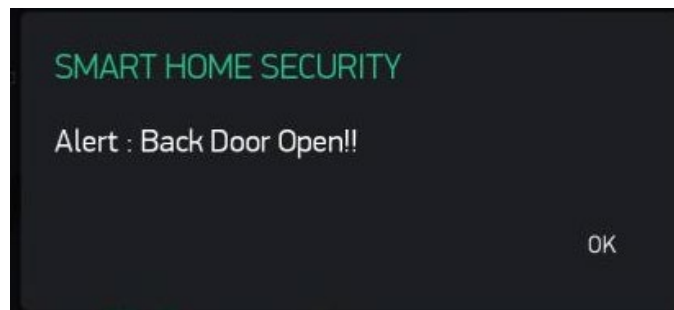


Figure 9: Notification on blynk application for back door

3.2 Fire Alarm System

a) Notification and display on Blynk application

i. Gas detection

Figure 10 shows the notification alert when the MQ2 gas sensor detects gas leaked inside a room such as in the kitchen. The sensor will send the signal to the NodeMCU then the data will be sent to the Blynk Application and generates the notification alert to notify the user that there was gas leaked. The sensor is tested using gas from lighter. Other than that, the Blynk application also provided a gas level indicator that will be used to monitor the gas level in the area as shown in Figure 11.

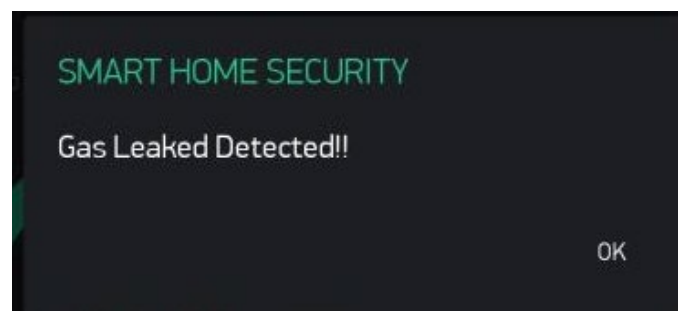


Figure 10: Notification on blynk application for gas leaked detection

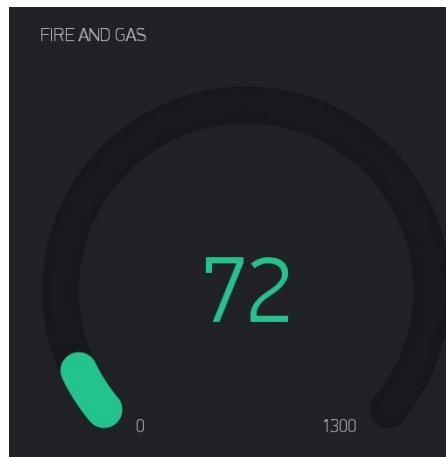


Figure 11: Gas level indicator

ii. Temperature and Humidity Reading

Figure 12 shows the interface of the Blynk Application for the Alarm system. The figure also shows the meter for the humidity, temperature, and gas level in certain area where the result was based on inside a room where the result was obtained. The humidity level inside a room shows 71g.m^{-3} , the temperature level inside the room was $28.4\text{ }^{\circ}\text{C}$ which it shows that the temperature is in normal state, and the gas meter shows the level was 72 g/mol .

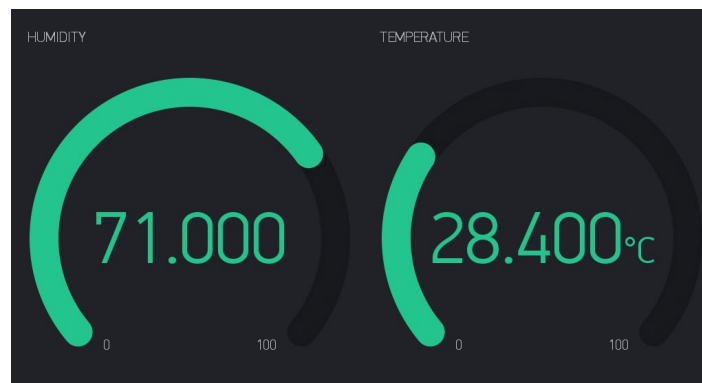


Figure 12: Temperature and humidity indicator

3.3 Surveillance camera

i. Monitor on Blynk Application

The camera surveillance as shown in Figure 13 is used to monitor the house when the sensor is triggered. It allows user to monitor their house to see if there are unusual event occur around the house when the owner is not around and also during the owner inside the house.



Figure 13: Camera surveillance on blynk application

4. Conclusion

As for the conclusion, the alarm system is very important when it comes to the safety of people. Based on the research studied, most alarm system only provides either one of the alarms which is a fire alarm or intruder alarm. This alarm system was done and presented with both fire and intruder alarm systems to save cost and to be more flexible to detect all unwanted events to happen. Other than that, this alarm system provides a surveillance camera as the feature that will be used to monitor the activities outside and inside the house. In a nutshell, the objective of the alarm system was able to be achieved where the notification was able to produce and the meter of temperature, humidity, and gas was able to display.

Several issues and problems were encountered in completing this project. Internet connectivity must be in a stable state to experience all the features of the alarm system or else the notification and the camera system will not be in a good performance. The other issue was the tunneling process of the internet protocol (IP) address was complicated where all the available tunneling software were paid to use which become an issue in the budget. The tunneling software that was used is called Ngrok which needs to always run-in order to activate the tunneling process so that the system can be connected with different Internet protocols in different internet connectivity. Hence, different tunneling software that is reliable needs to be used which need to be paid.

Acknowledgement

The author would like to thank Faculty of Engineering Technology, Universiti Tun Hussein Onn Malaysia, for its support.

References

- [1] S. Soumya, M. Chavali, S. Gupta & N. Rao, Internet of Things based Home Automation System. IEEE, 848-850 (2016)
- [2] M. Mohd Nor Azmi, L. Vellasami, A., Zainal, Mohammed, F., N. Mohd Daud, Vejasegaran, R., . . . Ku Azir, K. P. (2016). Home Automation System with Android Application. 299-302.
- [3] S.-h. H. K. H. e. a. Byoung-kug Kim, "Journal of Energy," efficient and rapid time synchronization for wireless sensor networks IEEE Transactions on Consumer Electronics, vol. 56, no. 2010, p. 2258, 2010.
- [4] N. Sharma, and T. Indra Home Security System Based on Sensors and IoT. doi:15680/IJRSET.2015.0506155 (2016)

- [5] G. Kesavan, P. Sanjeevi & P. Viswanathan, A 24 hour IoT framework for monitoring and managing home automation. 2016 International Conference on Inventive Computation Technologies (ICICT). doi:10.1109/inventive.2016.7823205 (2016)
- [6] A. Al Dahoud & M. Fezari, NodeMCU V3 For Fast IoT Application Development. Notes, 5. (2018)
- [7] B. B. L. Heyasa & R. G. Van Ryan Kristopher, Initial Development and Testing of Microcontroller-MQ2 Gas Sensor for University Air Quality Monitoring. IOSR Journal of Electrical and Electronics Engineering (IOSR-JEEE), 12(3), 47-53 (2017)
- [8] H. A. N. Dan-ao & W. A. N. G. Fei, Research application of the digital temperature and humidity sensor DHT11 [J]. Electronic Design Engineering, 13, 027 (2013)
- [9] A. Setiawan, A. I. Purnamasari, N. D. Nuris, I. Ali & R. Narasati, IoT: Theft detection of the mosque charity box through Arduino R3 with HC-SR501 sensor and MC-38 sensor. In IOP Conference Series: Materials Science and Engineering (Vol. 1088, No. 1, p. 012085). IOP Publishing (2021)
- [10] S. A. Mahdi, Development of Anti-Theft Door System for Security Room. Academic Research International, 4(3), 237 (2013)
- [11] “DIY Fun DIY Your Dream,” DIY MORE, [Online]. Available: <https://www.diy-more.cc/products/micro-usb-wemos-esp32-plug-18650-battery-shield-v3-esp-32-for-arduino-raspberry-pi>. [Accessed 18 December 2021].
- [12] R. B. Salikhov, V. K. Abdrakhmanov, & I. N. Safargalin, Internet of Things (IoT) Security Alarms on ESP32-CAM. In Journal of Physics: Conference Series (Vol. 2096, No. 1, p. 012109). IOP Publishing (2021)