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The Vandestopper: An Anti-Vandalism Detection System for Fire Extinguisher

Nor Faezah Adan*, Muhammad Idzhan Marjohan, Muhammad Azim Sanep, Muhammad Yudiazwie Muhammad Zaidi

Department of Electrical Enginering, Centre for Diploma Studies,
Universiti Tun Hussein Onn Malaysia, Pagoh Higher Education Hub,
84600 Pagoh, Johor, MALAYSIA.

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Abstract : Vandalism is one of the factor to missing and damaged fire extinguishers in schools. Financial implication drives the need to resolve this issue hence this project is proposed. Each fire estinguisher will be equipped with systems that are capable to detect its location, capture an image of anyone standing in front of it and generate notifications to user's smartphone. There are two separate systems required. System 1 uses ESP32-CAM and IR sensor while system 2 uses the NodeMCU ESP8266 and GPS Module. Both systems are connected to blynk on the user's smartphone via WiFi. System 1 is activated when IR sensor is triggered which will notify users the presence of vandals, capture their image and display the image in the Blynk app. System 2 will continuously update location of the fire extinguisher in the Blynk app. The system can be implemented anywhere with a Wi-Fi access.

Keywords: IoT, NodeMCU, ESP32-CAM, GPS

1. Introduction

Fire extinguisher is an essential fire prevention tool in any building. It acts as a first-line defense to extinguish fire at the early stages. The fire extinguisher should be placed in a suitable place and must always be in good condition as prescribed. However, mistreatment of fire extinguishers and other fire prevention tools such as firehydrants has been reported. This issue was also prevalent in location such as schools where vandalism is one of the common problem among students. It is difficult to identify the offenders without a proper CCTV in place. Plus it is also difficult to find the missing fire extinguishers once it is removed from its location. Some fire extinguishers are not placed in locked cases hence they are prone to vandalism. Therefore, in order to identify the vandals for further action and locate the missing fire extinguishers, a security system with Internet of Things (IoT) capability is proposed. As we know, internet of Thinking (IoT) is an important tool for the development of Industrial Revolution 4.0 (IR4.0). The Internet of Things (IoT) describes the network of physical objects that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with

**Corresponding author: norfaezah@uthm.edu.my*

other devices and systems over the internet. It is growing rapidly nowadays because it helps to improve productivity. For example, you can control a device from a distance or remotely.

Thus, IoT will be able to help improve the productivity of teachers and guards by reducing the unnecessary investigation required to identify the vandals and to locate the missing fire extinguishers in school. Eventually, vandalism towards fire extinguisher may also be reduced or prevented in the future when the system is in place.

1.1 Literature Review

Automatic car washing system with IR module using conveyor belt [1], this project may be detected via sensors. The sensor delivers input to the microcontroller, which then causes the microcontroller to issue commands to other devices. The requirements of our project are similar to the project that is Infrared (IR) sensor. Our project requires an Active Infrared sensor or better known as a regular IR sensor to detect the motion of the object and it does not require contact with the object. Active IR sensors are not very sensitive compared to passive IR sensors. This is because passive IR sensors are used to detect things further and are mostly used in the military. However, active IR sensors can detect close objects as efficiently as in our project, we installed the sensor is on the wall to detect the movement of the fire extinguisher. When the sensor detects the movement, it will give input to the microcontroller.

The Global Positioning System (GPS) is a navigation system or location determination. The GPS is certainly very helpful in terms of navigation or in determining location [2]. The type of component used in this project is the Neo-6m GPS module. The functionality of the Neo-6m GPS in our project isto track the availability of fire extinguishers at the designated location and to track the actual location of fire extinguishers that have been removed from the designated location. Therefore, it can give an advantage to our project because it can detect the fire extinguisher being moved in detail along with the coordinates. The GPS location is expressed as a coordinate point, which can then be used to display the location where the GPS is located.

We know that the anticipation for home security has turned out essential and this can be easily controlled with the ESP32-CAM and it is achieved with motion sensors such as PIR module which captures the image whenever a motion is detected [3]. So, we will install the ESP32-CAM as a microcontroller for our project as well as improving the security of the fire extinguisher from intruders. We will connect this ESP32-CAM with the Blynk app to display who diverted or vandalized the fire extinguisher and made it easier for users to track the location of the fire extinguisher from the Neo-6m GPS. If any motion is detected, the image will be recorded immediately with the ESP32-CAM and it will be updated in the Blynk app. One of the best advantages is it has an OV2640 sensor from Omni Vision and the image captured is of good quality and sufficient enough for finding the theft [4].

In the Blynk three most important components are App, Server and Libraries [5]. App helps to develop stunning interfaces for your projects by utilising the many widgets that we supply. Server isin charge of all communications between the smartphone and the hardware. You can use our Blynk Cloud or set up your own private Blynk server. While, Libraries allows hardware to communicate with the server via commands. Blynk is an internet-of-things platform that allows users to remotely operate electronic devices using iOS or Android apps. It provides the necessary information and graphics. Blynk has the ability to store and display sensor data. Microcontroller in our project which are NodeMCU ESP8266 and ESP32-CAM will notify the Blynk app that a fire extinguisher has been removed.

2. Materials and Methods

The proposed model has two separate systems as shown in **Figure 1**. A free IoT platform called Blynk is used to create the interface of the systems on user's smartphone. In terms of functionality, System 1 is used to detect movement of the fire extinguisher (if it is moved from its location) which activates the camera on ESP32-CAM and notification and System 2 is used to continuously update the location of the fire extinguisher. Blynk will prompt notification to user, display the captured image and location map. **Figure 2** shows the complete flowchart of the systems.

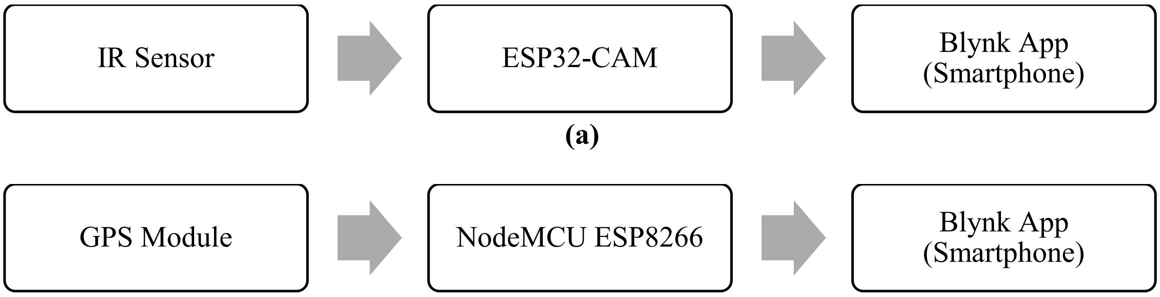
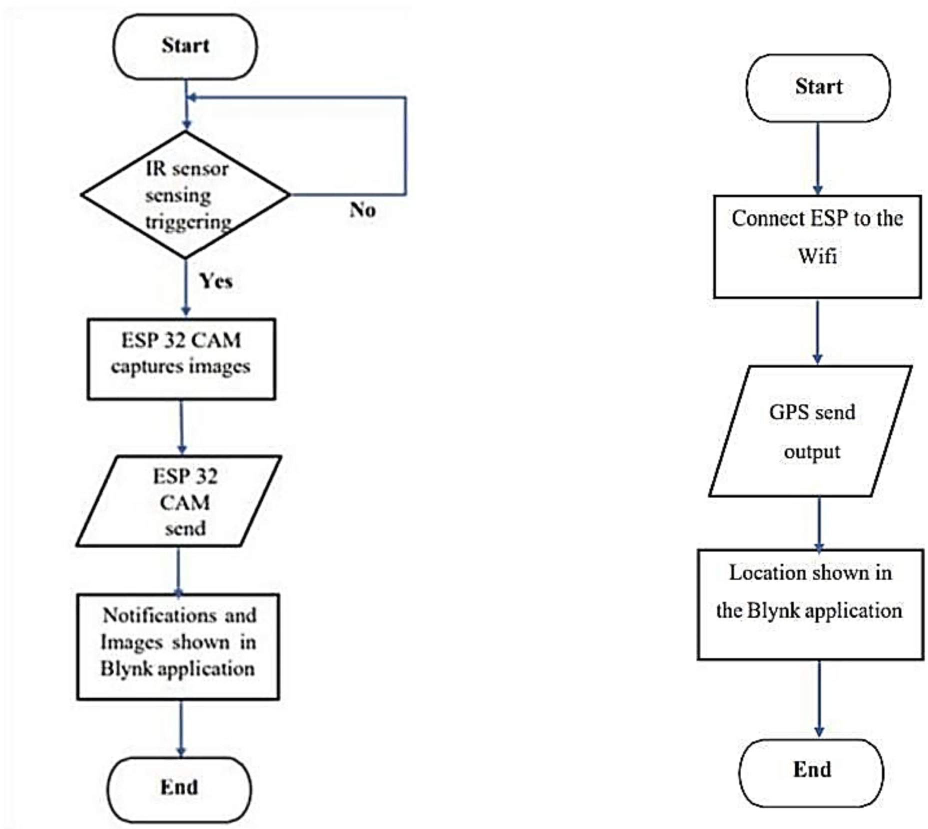


Figure 1: Block diagram for (a) System 1, (b) System 2



(a) **(b)**

Figure 2 : Flow chart of (a) System 1, (b) System 2

2.1 Electrical Design

Figure 3 (a) and **Figure 3 (b)** shows the circuit diagrams for System 1 and System 2 respectively. Both diagrams were drawn using Proteus software. Simulation is not possible due to lack of working library for ESP32-CAM and NodeMCU ESP8266 in Proteus and other existing Computer Aided Design (CAD) software. The circuit diagrams were used as reference for actual wiring of the components.

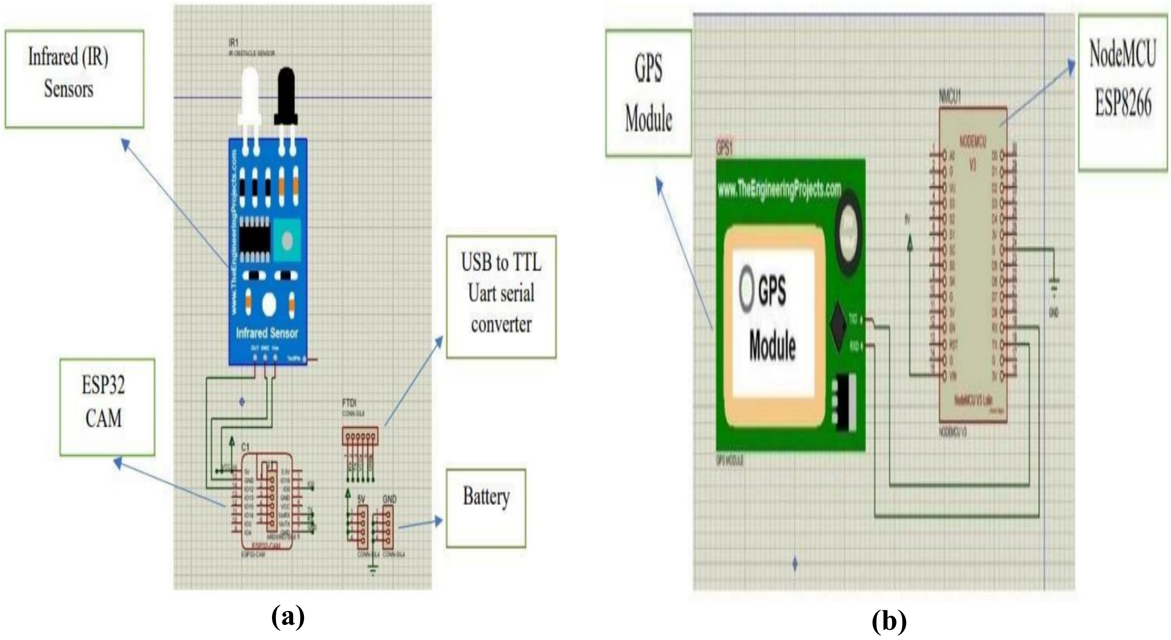


Figure 3: circuit diagram (a) System 1, (b) System 2

2.2 Circuit Testing

Figure 4 showed System 1 connection for function test. ESP32-CAM uses the Arduino IDE software to program it. However, in order to connect a laptop to upload the program to ESP32-CAM, a USB to TTL converter is required. Once the program has been uploaded, the USB to TTL converter will be disconnected from the laptop and connected to a 5V DC power bank to provide power supply to ESP32-CAM during the test. An object is moved to and fro the IR sensor to determine the maximum sensing distance. The maximum sensing distance of the IR sensor is 3 cm. System 1 is located 6 cm above the fire extinguisher, so when the fire extinguisher is lifted from its hook for removal, the object will enter the IR sensing area. The IR sensor was also triggered in the test to initiate notification and display the captured image via Blynk app.

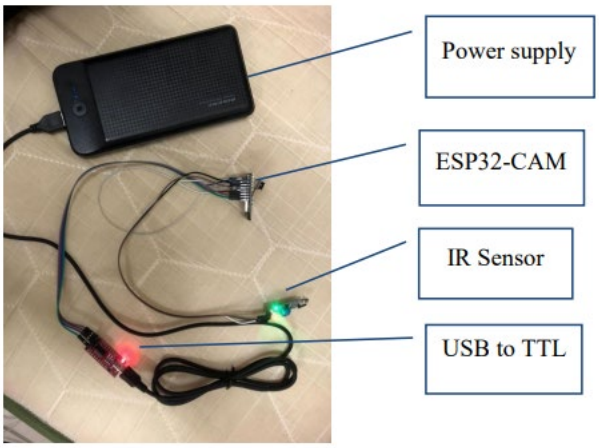


Figure 4: System 1 circuit assembly for testing

Figure 5 showed System 2 connection for function test. NodeMCU ESP8266 also uses the Arduino IDE software to program it. NodeMCU ESP8266 can be connected directly to the laptop using micro-usb cable. Once the program has been uploaded, the cable is disconnected from the laptop and connected to a 5V DC power bank to provide power supply to NodeMCU ESP8266 during the test. The system is moved around the campus to test the accuracy of the GPS module via map display in Blynk app.

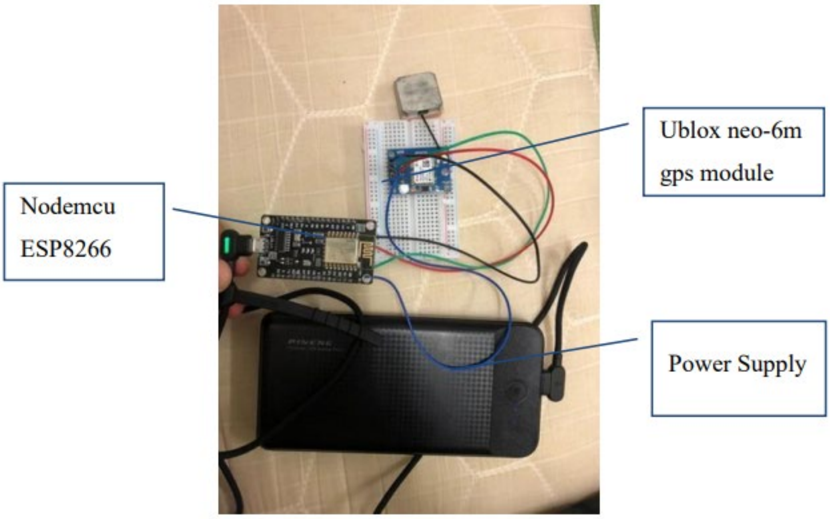
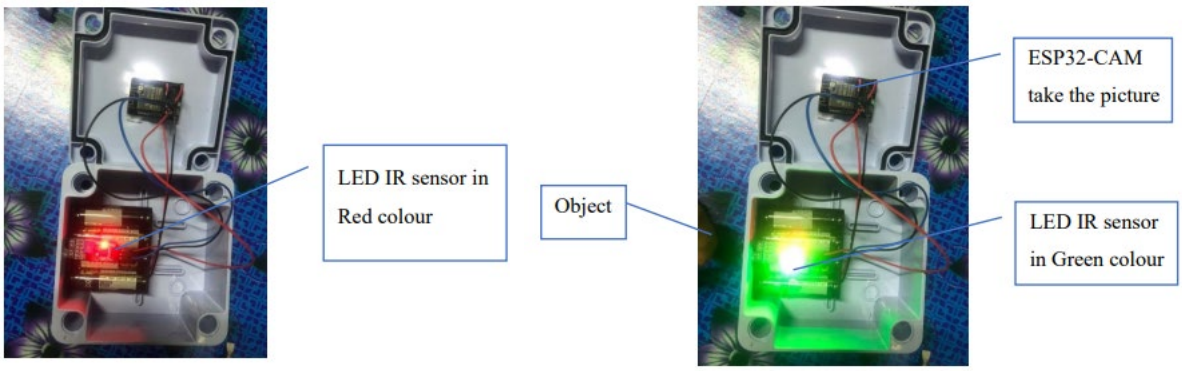


Figure 5: System 2 circuit assembly for testing

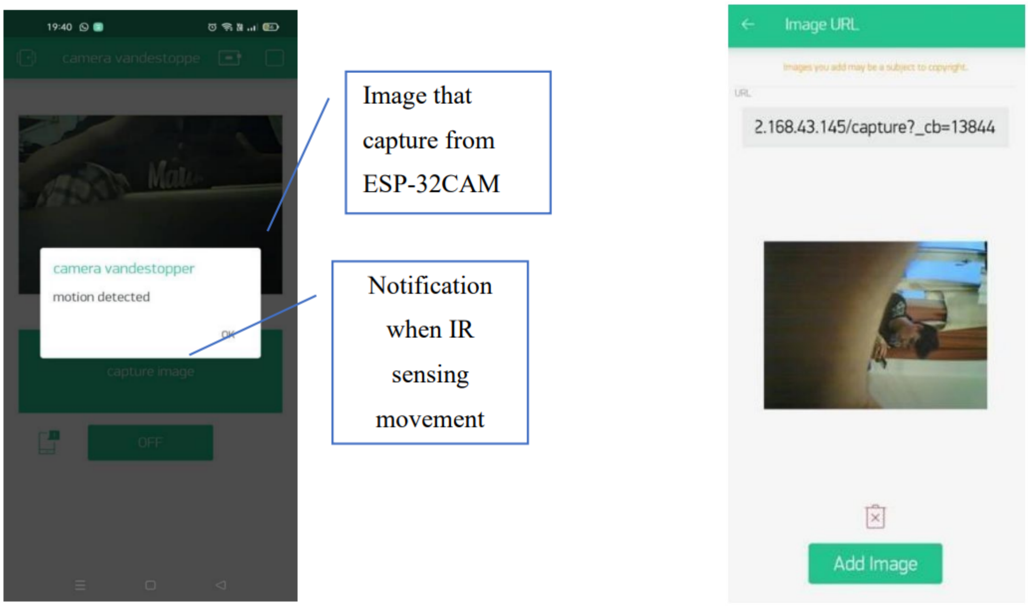
3. Results and Discussion

Figure 6 shows the LED status before and after IR sensor sensing movement for System 1. The LED changed colour from red to green when an object is detected meanwhile the ESP32-CAM automatically captures image of the object and send it to Blynk app for display and also generate notification to user in Blynk app as shown in **Figure 7**.



(a) **(b)**

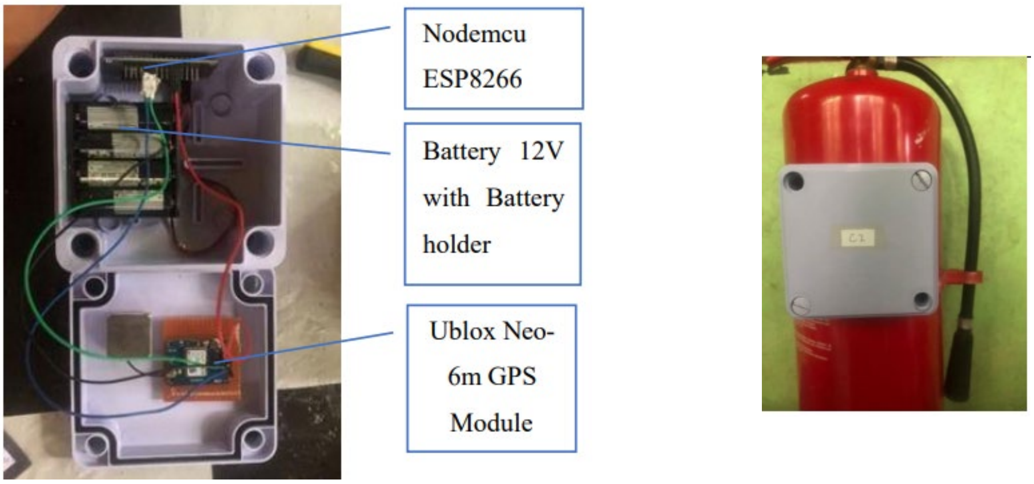
Figure 6: System 1 when (a) no object detected, (b) object detected by IR sensor



(a) **(b)**

Figure 7: Blynk app displayed (a) notification and, (b) captured image when IR sensor triggered

Figure 8 showed the complete assembly for System 2. **Figure 9** shows the location map of fire extinguisher is displayed in Blynk app complete with the information of latitude, longitude, number of satellite connected to GPS module and direction of System 2 from user's smartphone. System 2 is able to update the location of the fire extinguisher but it takes quite some time to update the new location when the fire extinguisher is moved around.



(a) **(b)**

Figure 8: System 2 circuit (a) inside the casing and (b) placement at fire extinguisher

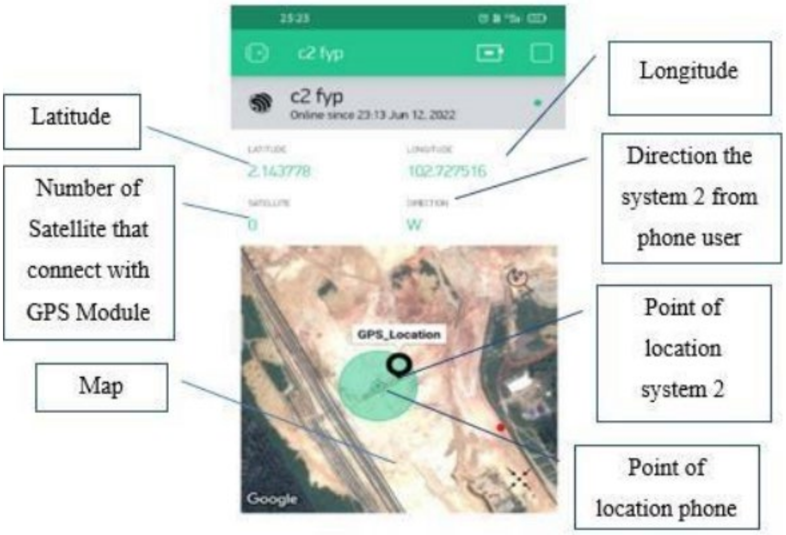


Figure 9: Location of fire extinguisher is displayed in Blynk app

4. Conclusion

In conclusion, both systems worked according to the designed flowchart. In System 1, the IR Sensor can detect the holder of the fire extinguisher when lifted within 3 cm and the green LED indicator will turned on. As the IR sensor triggered, ESP32-CAM will then captures an image of the offender and displays it in the Blynk app and generates a notification to alert user when the fire extinguisher is moved. In System 2, the GPS Module detects the location of the fire extinguisher carried by the offender and that info is displayed in the Blynk app.

For future improvement, the security system can be improved with face detection feature to make it easier for teachers or guards to immediately identify the offender.

Acknowledgement

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References

[1] Reddy, M, et al. “Automatic Car Washing System with IR Module Using Conveyor Belt.” International Journal of Scientific Development and Research, vol. 2, no. 5, 2017, ISSN: 2455-2631

[2] A. M. Luthfi, N. Karna and R. Mayasari, "Google Maps API Implementation On IOT Platform For Tracking an Object Using GPS," 2019 IEEE Asia Pacific Conference on Wireless and Mobile (APWiMob), 2019, pp. 126-131, doi:10.1109/APWiMob48441.2019.8964139.

[3] S. Somani, P. Solunke, S. Oke, P. Medhi and P. P. Laturkar, "IoT Based Smart Security and Home Automation," 2018 Fourth International Conference on Computing Communication Control and Automation (ICCUBEA), 2018, pp. 1-4, doi: 10.1109/ICCUBEA.2018.8697610

[4] B. Siddineni, R. Nanditha, T. J. Satyanarayana and V. S. Rama Krishna Sighakolli, "Design ofan IoT based Surveillance System using Blynk, IFTTT, and Telegram," 2021 12th International Conference on Computing Communication and Networking Technologies (ICCCNT), 2021, pp. 01-06, doi: 10.1109/ICCCNT51525.2021.9579790.

[5] Srivastava, P., Bajaj, M., & Rana, A. S. (2018). IOT based controlling of hybrid energy system using ESP8266. 2018 IEEMA Engineer Infinite Conference (ETechNxT). doi: 10.1109/ETECHNXT.2018.8385294