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Smart Solar Theft Monitoring System

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Abstract: The basic security demands of a home, whether in a metropolis or a metropolitan zone, continue to be a serious issue. In today's context, establishing a full-featured and reliable model that will accurately send alerts to the destined mode of reference in the event of an intrusion or attempted threat is essential. In this research, we offer a full simulation of an experimental prototype of a wireless sensor network based on infrared sensor technology, with individual nodes strategically and sequentially deployed. The Internet of Things underpins the operation of this system, which includes an ESP32-CAM as a functioning microcontroller. The system shall transmit the recognition to the user through the Blynk application and sound and light alert emission in the specific place where the intrusion is identified, when the suspected intrusion occurs. Because it uses solar energy as a power source, this system is cost effective and reliable, has minimal power consumption, and is environmentally friendly. The system detects human trespass using a PIR-based sensor and sends out warnings as needed.

Keywords: Solar Energy, ESP-32 CAM, PIR sensor, Blynk, Wi-Fi Module, Zigbee, Alert, Simulation.

I. INTRODUCTION

A need for a low-cost, lightweight, and effective system to monitor basic family security has become vital in this expanding age of modernization and complexity. Previous research has shown that the use of wireless GSM systems that can transmit instant notifications on the owner's designated device, which will also depend on the network coverage area of the type of network being incorporated, is beneficial. In addition, the paper presented by [1] includes an automated system that uses a smart system for security monitoring with the goal of reducing energy consumption. However, despite being an automated system, the cost of installation, as well as the technique for seamlessly attaching all of the system's components, is extremely intricate, costly, and time consuming. In [2] a Zigbee-based home configuration network, has also made a significant contribution. As a result, we've determined, based on past research that automated systems that employ Wi-Fi and other wireless networking modes are not only effective, but also very expensive and have high power consumption.

With this situation in mind, we created an integrated system that would run on solar energy while also attempting to create a low weight and readily portable model with the goal of decreasing bulk. In addition, this system includes a network of PIR sensors that will continuously detect any prospective trespass and send a notice to the Blynk app. Furthermore, this system's energy usage is reliant on solar energy, making it environmentally friendly. The system can also give a real-time solution by sending sound and light warnings to the owner as soon as the sensor is activated at the moment of detection.

II. LITERATURE SURVEY

In order to identify electrical energy theft without human contact, [3] attempts to build an implementation methodology. An easy-to-use technique for calculating the amount of energy that has been stolen from a system or a region. The cost of the system increases due to the constant use of the power source.

[4] Includes surveillance of every floor movement, and if a single step is detected, the user is notified via email. This system is simple to operate and does not need regular human activity to arm and disarm it. The system may detect a false step or sound incorrectly.

[5] includes intruder detection and email notification to the user. This system is designed for small-scale application and is also less expensive. The system's biggest flaw is that email isn't the fastest way to get alerts.

[6] incorporates a smart surveillance system that can track invasion actions, which will be monitored by the owner using a custom-designed android application. This system has a low cost and effective web-camera-based system that is utilised for remote monitoring as one of its characteristics. When motion is detected by the PIR sensor, system mentioned in

[7] is intended to save the acquired picture in raspberry pie module and transmit the outcomes through email as soon as the sensor detects motion. But it's only effective for limited regions, and the mail function can be slow at times.

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III. PROPOSED SYSTEM

We have proposed a system in which theft infiltration is monitored and an alarm is issued as soon as the PIR sensor detects an anomaly (using light and sound alert system). A photograph is recorded by the camera on the ESP-32CAM (Wi-Fi module) and sent to the owner over the internet at the same time; the user receives an alert on the Blynk application together with the image captured by the camera on the microcontroller (ESP-32 CAM). In addition, we have taken steps to make our system more energy and cost efficient by utilizing solar energy. Solar power systems harness the sun's clean, pure energy Solar panels help to reduce greenhouse gas emissions and the system may continue to operate even if there is a power outage. The base camp (House) will get an alert in conjunction with the Blynk Application in order to prevent theft; in this way, even if the Wi-Fi module is down, the system will still alert against theft.

The nodes will be placed along the perimeter of a house, building, or other monitored location. To communicate between the nodes and the base camp, the ZigBee/XBEE module will be utilized. When a warm body enters the range of the lined-up sensors, an alert is created utilizing the light and sound system, which is then communicated to the base camp through sensor networking. Simultaneously, an alert notice will be sent to the owner over the internet, and photographs of the incident will be available on the owner's android Smartphone, which he or she can save to their device's internal memory. The Wi-Fi Module is used to establish Internet communication. The photos sent to the owner can be utilized to prevent theft as well as aid in the investigation of a heist. With an alarm system at each node, the owner will be able to pinpoint the region where the thief is attempting to infiltrate and take prompt action.

A. *Block Diagram:*

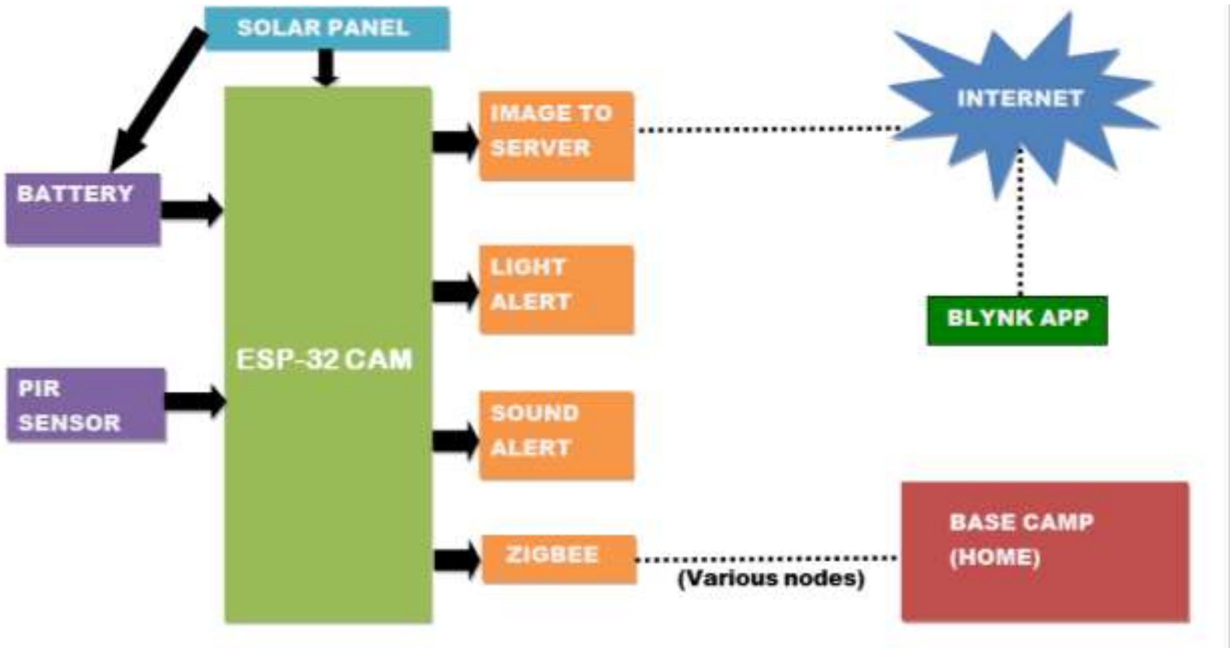

Fig. 1 Block Diagram of the system

B. Components of a node:

1. Solar Panels: A photovoltaic module, often known as a solar panel, is a collection of photovoltaic cells placed in a framework for installation. Solar panels create direct current electricity using sunlight as a source of energy. These were utilised to make our system more energy efficient. The solar panels are linked to the TP4056, which is then connected to the Lithium Battery and MCP1700-3320E, which is connected to GND and voltage supply;

2. ESP-32 CAM: The ESP32-CAM is a tiny, low-power camera module based on the ESP32 microcontroller. It features an OV2640 camera and a TF card slot onboard. The ESP32-CAM may be utilised in a variety of smart IoT applications, including wireless video surveillance, Wi-Fi picture upload, and QR recognition. It serves as both a microcontroller and a camera for our system, as well as a Wi-Fi module. It is attached to a PIR sensor, which detects warm bodies and sends the information to the owner over the internet;

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3. PIR Sensor: The PIR sensor itself contains two slots, each of which is composed of a specific IR-sensitive substance. We can see that the two slots can'look' out over a certain distance because the lens used here isn't doing anything (basically the sensitivity of the sensor). When the sensor is turned off, both slots detect the same quantity of IR, which is the ambient amount emitted by the room, walls, or outside. One half of the PIR sensor is intercepted when a warm body comes in the vicinity of the sensor it gives rise to a positive potential difference between the two poles. These bursts of change are what are observed;

***4. ZigBee/XBee*:** Zigbee has created a global open-ended wireless technology designed to meet the particular requirements of low-cost, low-power IoT networking. The IEEE 802.15. 4 physical radio specification underpins the Zigbee standard, which works in unlicensed bands such as 2.4 GHz, 900 MHz, and 868 MHz. Zigbee is the only loT solution that includes everything from a mesh network to a common language that lets smart devices to communicate with one another. Through standardisation and testing of all tiers of the stack, Zigbee gives users and developers more options and freedom, as well as the assurance that goods and services will operate together. Zigbee is utilised for the creation of personal area networks using tiny and low power digital radios in our sytem of high-level communication protocols, Zigbee is hence a wireless ad hoc network with low, low data rates and near proximity (i.e. personal area);

5. Alert System: This is a light warning and a sound warning for our whole system. The alarm system will be used to detect the anomaly. Light is initiated by buzzing sound and lighting. We utilise a buzzer and a light attached to our system to do this. At every node, this system is present. A relay module and voltage link the bulb. The ESP-32 output serves as an input into the relay module and the owner receives additional output from the relay module. In the same way, an ESP-32 CAM output pin is attached to the sound alarm buzzer.

C. Circuit Diagram:

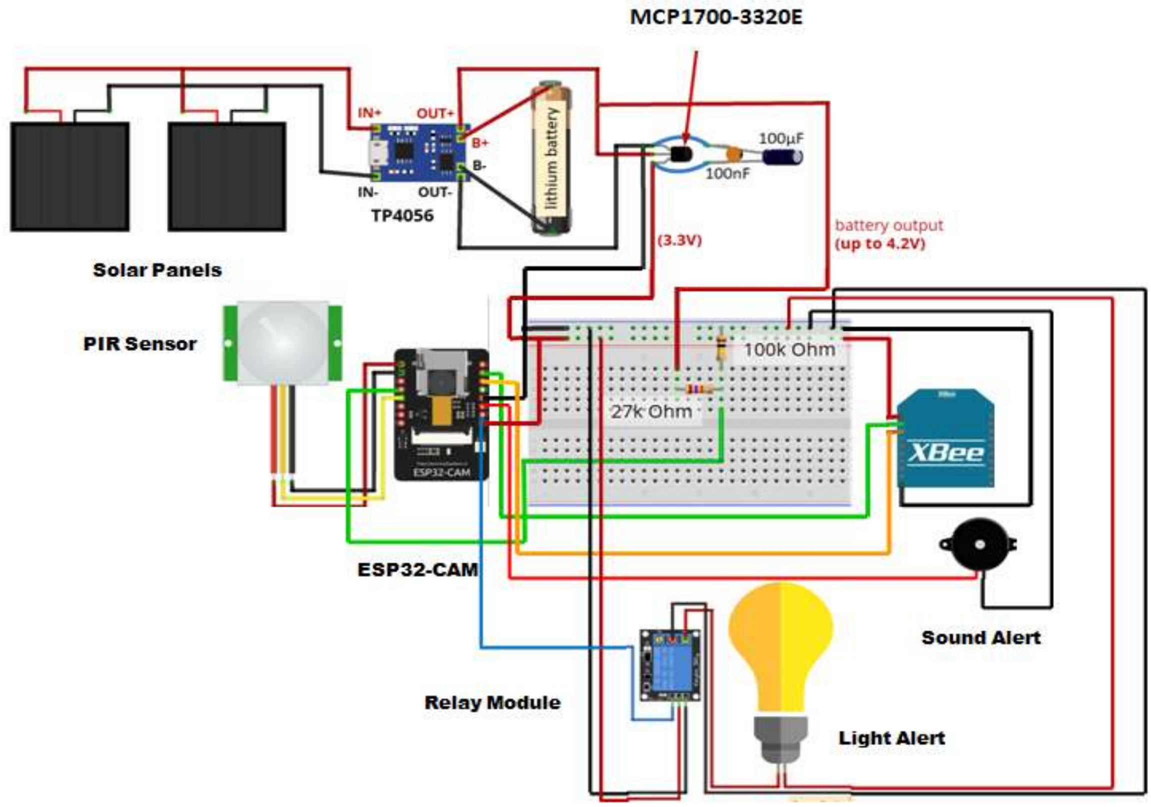

Fig. 2 Circuit Diagram

In Fig. 2, the PIR sensor is connected to the ESP-32 CAM through the input/output pin (GPIO 12). For the power supply solar panels are used such that solar panels are connected to the Lithium Battery through TP4056 which is connected to the MCP1700-3320E and further to the 3.3V of the microcontroller. The Battery output of 4.2V is from the lithium battery is connected to the Microcontroller (ESP-32 Cam) along with a resistor to avoid short circuit. The GPIO 16 and GPIO 0 are connected to the XBEE module and other I/O pins are used to transfer the output to the relay module which initiates the light alert and the buzzer which gives a sound Alert as soon as a warm blooded body cones in the vicinity of the PIR sensor. The camera on the Micro-controller (ESP-32 Cam) Clicks the pictures and transfers it

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through the server to the owner, which are displayed on the blynk application along with the notification "Intrusion Detected".

D. Flow chart:

The flow chart in Fig. 3 shows the flow of the system. Firstly, the system is in rest state unless and until a warm object comes in its area of surveillance of the PIR sensor. If the PIR sensor detects something the light and buzzer alerts are initiated and an immediate notification along with photographs clicked by camera on microcontroller will be transmitted through server. All the Base Camps will also be warned.

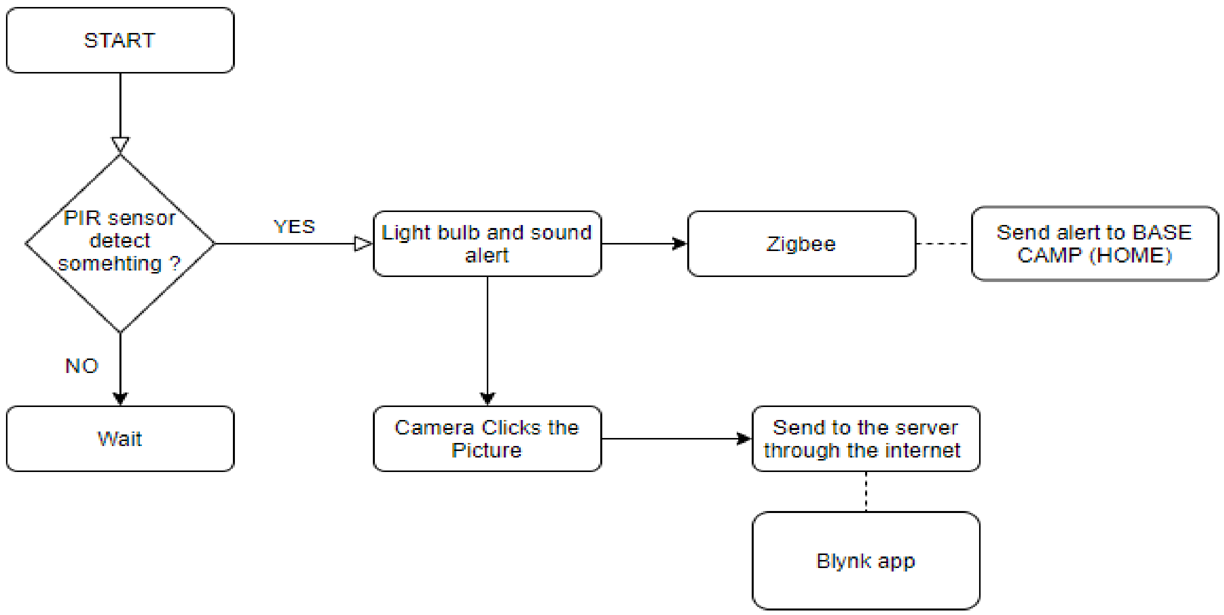

Fig. 3 Flow chart

IV. RESULT

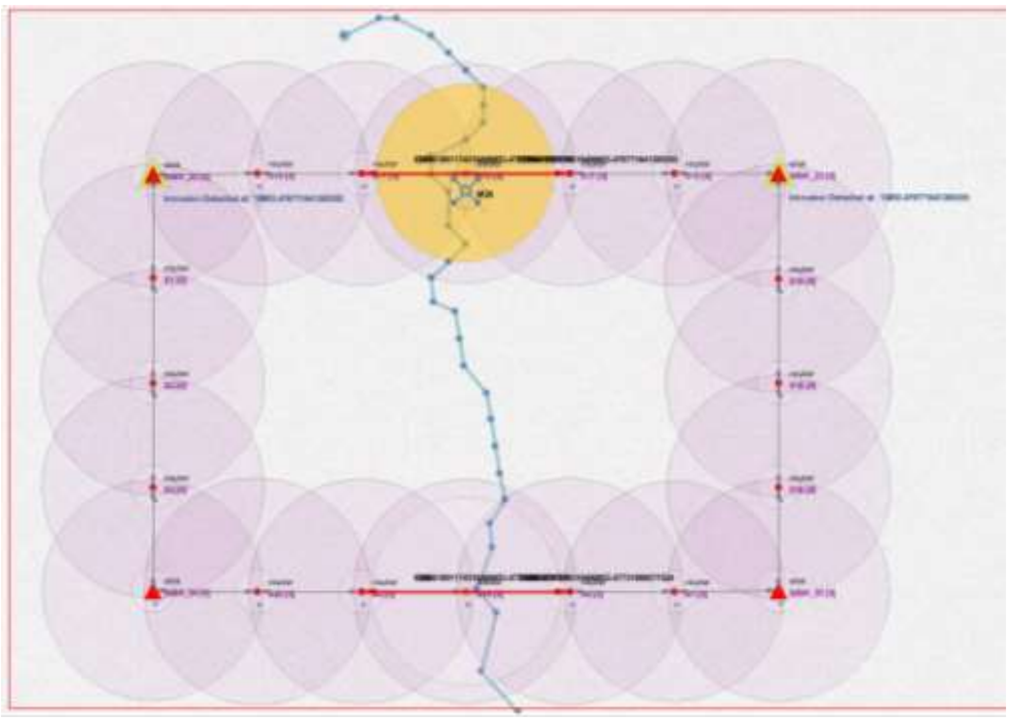

Fig. 4

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Fig. 5

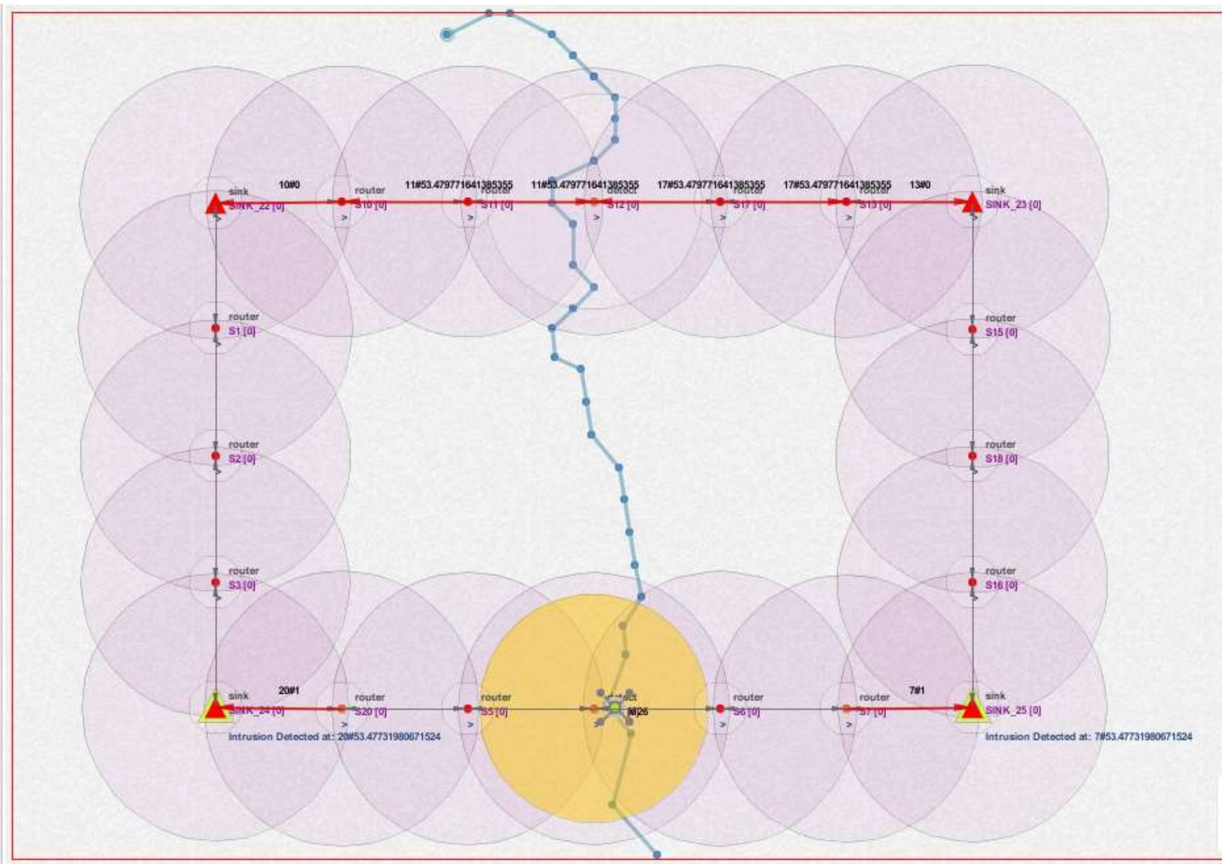

Fig. 6

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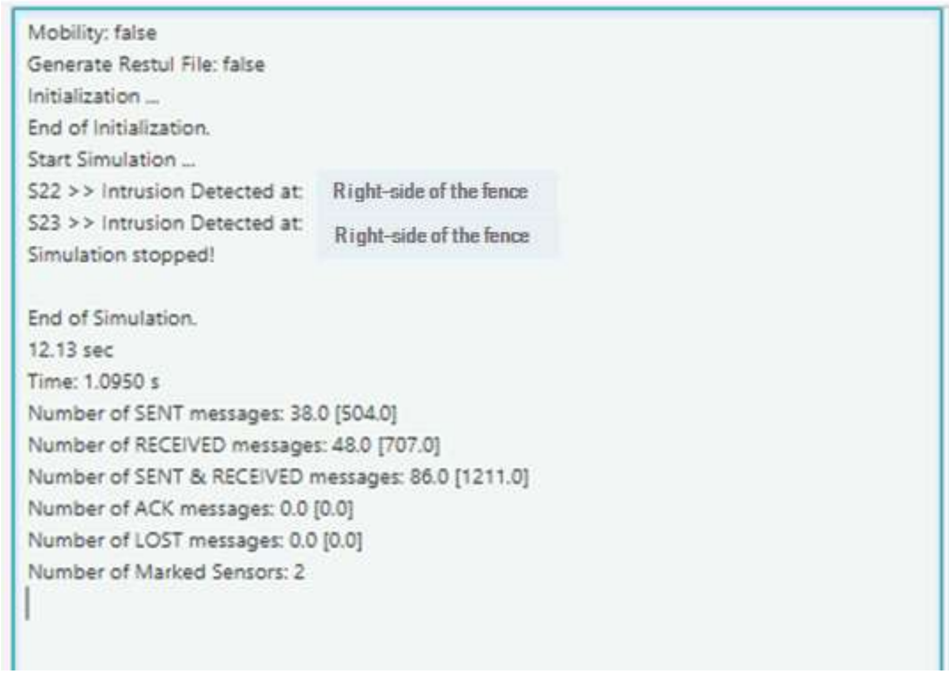

Fig. 7

The result displays the simulation result of our system. As we can see in Figure (1) that the system gives a alert when a warm body comes in its vicinity and simultaneously the console will display that intrusion is detected along with it also displays the side of the fence where intrusion is detected. Similarly Figure (2) & (4) also shows the simulation and console result when the intrusion is detected on the right side of the fence. As shown in the console, in the similar way an alert will be send to Blynk application along with the photograph of captured by camera on ESP-32 Cam .

V. CONCLUSION

With the knowledge that theft is prevalent in our nation, in particular in bungalows and row-houses, in such scenarios this sort of system can be employed. The system is efficient and precise in energy. The live steaming function of the ESP-32 CAM may also be used for future progress. Furthermore, by sending a direct alarm and photos to emergency authorities, like the police or any general emergency department in the region, we may add a future scope to this project, so that urgent action can be done accordingly.

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