



PASSIVE INFRARED SECURITY SYSTEM

AP Amrit Pradhan, GIET University, 22ece120.apamritpradhan@giet.edu

Jyotirmayee Panigrahi, GIET University, 22ece030.jyotirmayeepanigrahi@giet.edu

Abstract: Unwanted security attacks on homes, businesses, banks, workplaces, etc. are becoming more common in most cities these days. The security system is a crucial component for these regions. An electronic sensor called a passive infrared (PIR) sensor measures objects that generate infrared light within its field of vision and is used in motion detectors like automatically activated lighting and security systems. Heat energy is released as radiation by anybody that has a temperature higher than zero. Rather than measuring or perceiving heat, PIR sensors pick up infrared radiation that is reflected or released by the target. The temperature at that location in the sensor's range of view rises to the intruder's body temperature if the sensor identifies an animal, bug, or human. The sensor converts the consequent change in the infrared light it receives into a change in the output voltage, which initiates detection. The PIR sensors typically pick up on broad movement. They just describe the movements of humans, animals, or other objects; they don't provide details about what or who moved. Any object with a temperature higher than absolute zero emits radiation. Heat energy is one way to express this energy. A large portion of heat radiation is invisible to the human eye due to its infrared wavelengths, but it can be picked up by electronic devices designed especially for this use. An alarm is set off by a circuit component that crosses two contacts. The relay is triggered when the PIR sensor detects movement, breaking the circuit and setting off the alarm. In both residential and business settings, PIR motion sensors can offer numerous advantages. Although PIR cameras and motion sensor cameras are frequently contrasted, PIR offers a significant advantage over conventional motion detection. For instance, because motion detection cameras only pick up on all forms of movement, they are unable to differentiate between the movement of leaves and a human invader. Because PIR only detects changes in temperature, it produces more accurate triggers; frequent false triggers like insects, wind, leaves, etc., are not detected. saving you money and time on expense monitoring. The creation of a security system using a motion detector PIR sensor is the main topic of this study.

Keywords: - IoT, Node MCU, Wireless Alerts, Fire detection

1. Introduction:

The Passive Infrared (PIR) Security System is an innovative IoT-based security solution designed to enhance safety and surveillance in residential, commercial, and industrial environments. At the core of this system is the Passive Infrared (PIR) sensor, which detects



the infrared radiation emitted by objects, particularly focusing on human presence and motion within a specific range. Unlike traditional security systems that constantly consume power, PIR sensors work passively, activating only when they detect movement, thus offering a highly energy-efficient solution.

This security system integrates seamlessly with IoT technology, enabling real-time monitoring, data analysis, and remote control through connected devices such as smartphones, tablets, or centralized control panels. When unauthorized movement is detected, the system can trigger a series of security protocols, including setting off alarms, activating surveillance cameras, turning on lights, or sending instant notifications to the user or security personnel. This automation adds an extra layer of security and responsiveness, allowing users to take immediate action, regardless of their physical location.

In addition to providing robust security, the PIR Security System is cost-effective, easy to install, and highly scalable, making it suitable for both small-scale home setups and larger commercial operations. The system's ability to conserve energy while remaining alert and functional 24/7 makes it an attractive option for those looking to improve security without inflating energy costs. As IoT continues to evolve, this solution exemplifies the practical application of connected technology in everyday life, revolutionizing how we approach safety and security.

2. Literature Review:

Wilson's research provides a comprehensive overview of PIR sensor technology, focusing on its underlying principles, functionality, and broad applications in security systems. The paper discusses how PIR sensors detect infrared radiation, highlighting their effectiveness in motion detection for security purposes. It also addresses various PIR sensor configurations and their sensitivity to environmental changes, offering foundational insights into the role of PIR in motion-based security systems. This study is essential in understanding the basics of PIR sensor operations and their advantages in energy-efficient security solutions. Researcher explored various architectures that allow IoT-enabled devices to enhance traditional security systems by enabling remote monitoring, data analytics, and real-time alerting through smart devices [1]. The book emphasizes the importance of low-cost, scalable solutions that can be deployed in smart homes and industrial security. It also highlights various case studies that showcase how PIR sensors combined with IoT platforms can significantly improve the reliability and flexibility of security systems. This text provides valuable insights into the application of IoT in security and showcases practical implementations of PIR sensors. Kumar and Singh focus on the integration of IoT and PIR sensors in security systems [2]. Study research delves into the



design and development of a smart security system using IoT and PIR sensors. The paper presents a detailed methodology on how PIR sensors can be integrated with IoT-enabled microcontrollers (such as NodeMCU) to create a real-time monitoring system. The research highlights the benefits of this setup, including the system's low power consumption, easy scalability, and ability to send immediate alerts to users' mobile devices when motion is detected. This study offers practical design frameworks for building IoT-based security systems and serves as a guideline for creating such systems using PIR sensors [3]. The article explores various IoT-enabled security solutions that utilize PIR sensors. The paper provides a thorough analysis of the different types of PIR-based security systems, comparing them in terms of efficiency, power consumption, and real-time monitoring capabilities. Sharma discusses how PIR sensors enhance security systems by detecting intrusions based on human motion and evaluates the role of IoT in enabling remote access, scalability, and automation. This comprehensive review highlights the growing importance of IoT and PIR sensor integration in modern security solutions [4]. They focus on implementing IoT-based home security systems using PIR sensors and the NodeMCU microcontroller. Their study outlines how this combination provides real-time alerts through Wi-Fi, enabling users to monitor home security remotely via mobile devices. The research also demonstrates how the PIR sensor's motion detection capability is enhanced when integrated with the NodeMCU's Wi-Fi capabilities, allowing instant notifications of intrusions. This paper provides an in-depth view of low-cost home security solutions using readily available hardware and open-source software, making it accessible for a wide range of users [5]. A smart home security system that combines PIR sensors with IoT technology. The paper details how PIR sensors, when integrated with IoT platforms, can provide automated responses such as triggering alarms, activating cameras, and sending notifications to users in real-time. The research also discusses the use of cloud storage to record and analyse motion detection data, offering users a more comprehensive and data-driven approach to home security. Their study emphasizes the advantages of smart home security systems in terms of flexibility, cost-effectiveness, and ease of installation [6]. This book, show detailed examination of embedded security systems, with specific chapters dedicated to motion detection technologies such as PIR sensors. The authors explore how embedded systems can be programmed to interface with sensors and actuators, including PIR-based systems for security purposes. They also discuss different design architectures and real-world applications in both residential and commercial settings. This book serves as a critical resource for understanding the integration of PIR sensors in embedded security systems and highlights design considerations for effective implementation. [7]. The book provides a detailed review of various motion detection systems that rely on PIR sensors. Their study compares different PIR-based systems, focusing on their applications in residential and commercial security. The review also



explores the advantages and limitations of PIR technology in terms of accuracy, energy efficiency, and ease of deployment. Patel and Singh emphasize how PIR sensors can be enhanced through integration with other IoT devices, increasing the overall effectiveness of security systems [8]. This paper presents an IoT-based security surveillance system that uses PIR sensors in combination with the NodeMCU platform. The research outlines the step-by-step design process of the system, demonstrating how PIR sensors detect motion and trigger alarms, while the NodeMCU enables remote access and notifications via Wi-Fi. The paper emphasizes the practicality of this low-cost solution, showing how it can be easily implemented in homes or small businesses to provide effective security monitoring. The integration of cloud-based alerting systems is also discussed, enhancing the system's utility [9]. This focus on the design and implementation of an IoT-based intruder detection system that utilizes PIR sensors for motion detection. The system is aimed at providing real-time surveillance and alerting users through mobile devices. Johnson discusses the advantages of combining PIR sensors with IoT for remote monitoring, as well as the challenges involved in optimizing the sensitivity and range of PIR sensors in various environments. This study contributes practical insights for designing responsive and user-friendly security systems [10].

3. Working Principle:

The IoT-based Intrusion Detection and Alert System uses sensors, a microcontroller, and a mobile app to detect movement or obstacles and alert users right away. It is composed of the NodeMCU ESP8266, PIR sensor, buzzer, LED, and the Blynk app.

1. **System Initialization:** Upon startup, the NodeMCU is connected to Wi-Fi and will connect to the Blynk server. The connectivity will allow the system to forward notifications to the user's phone.
2. **Intrusion Detection:** The PIR sensor detects motion by sensing changes in temperature from objects or people.
3. **How Alerts Work:** A buzzer sounds to alert people nearby. The LED lights up to indicate something has been detected. NodeMCU sends a signal to the Blynk server, which will then send a notification to the user's phone, alerting him even from afar.
4. **Continual Monitoring:** The system then resets itself and continues its monitoring for new movements or obstacles after it sends an alert.

5. User Interaction: The Blynk app allows users to see alerts and event logs on their phones. This helps them monitor the system and stay informed about any activity.

4. Design and Simulation:

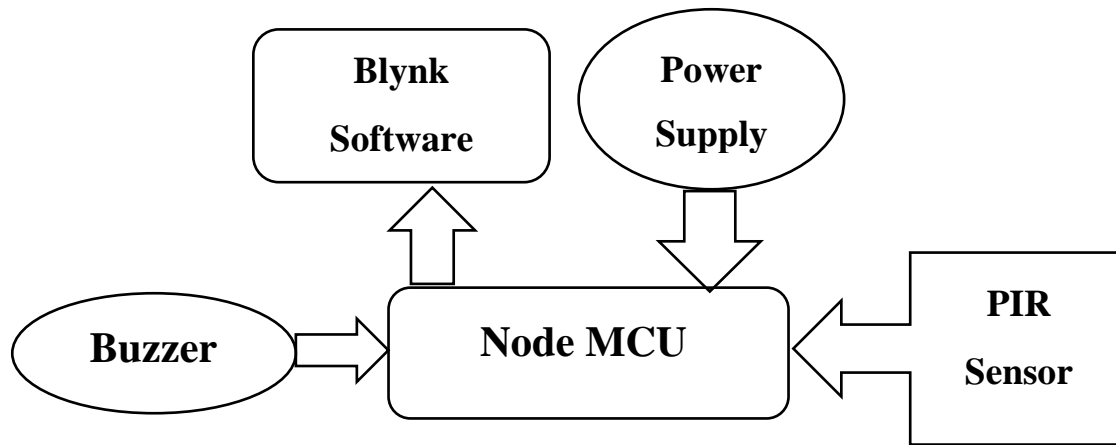


Figure 1: Block Diagram of Parking assistance system using Node MCU

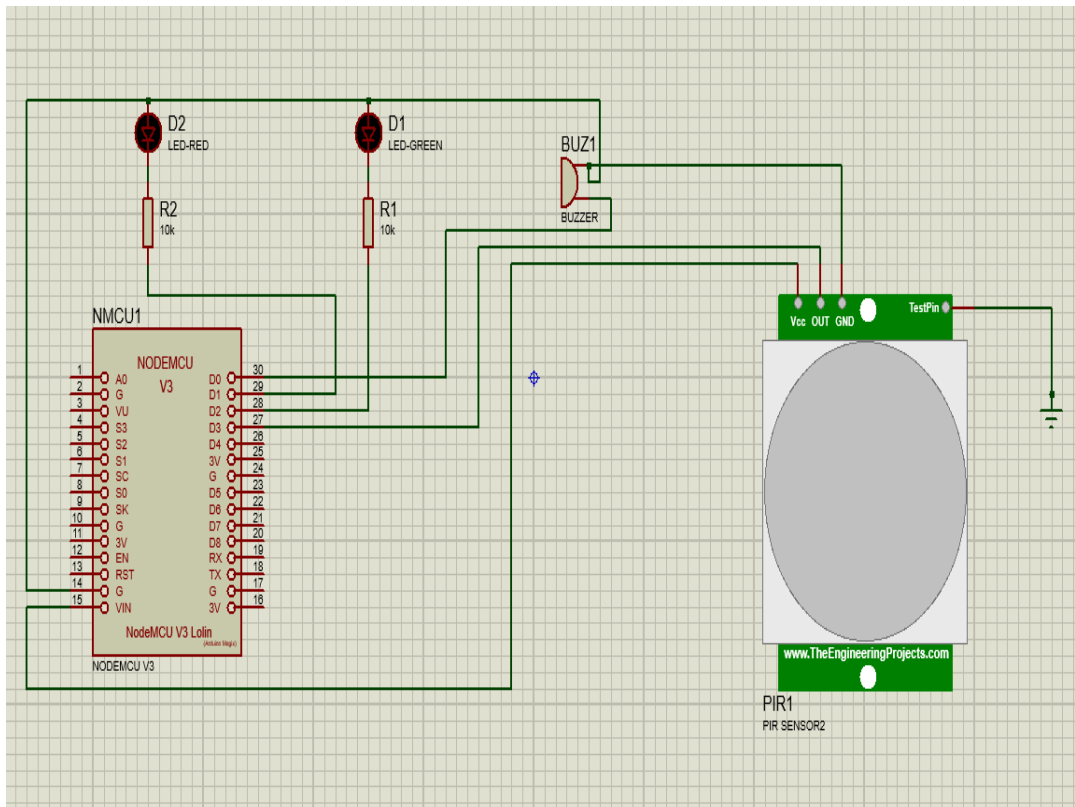


Figure 2: Circuit Design on Proteus software

4.1 Simulation Parameter:

Table: - Components

COMPONENTS	QUANTITY	SPECIFICATION
Node MCU	1	ESP8266
Infrared Sensor	1	
Buzzer	1	



PIR Module	1	
LED	2	
Diode	2	

5. Working Procedure:

The IoT-based Intrusion Detection and Alert System is implemented by using sensors, a microcontroller, and a mobile application to detect intrusion and alert the users on the spot. This begins when the system is switched on. The NodeMCU ESP8266 links up with a Wi-Fi network and creates a link with the Blynk server for remote notifications. The PIR sensor detects motion through a change in infrared radiation, which is usually caused by moving people or objects. In the meantime, the IR sensor constantly scans for nearby obstacles by emitting infrared signals and then detecting their reflection. Whenever the sensors detect any activity, they send signals to the Node MCU to process them.

If movement or an obstruction is found:

1. The system has the ability to activate a buzzer to produce an audible alarm and turn on an LED as a visual alert to whoever is nearby.
2. The NodeMCU sends a notification to the user's smartphone through the Blynk app, showing the intrusion.

After a triggering alert, the system resets and starts monitoring for further activity. The Blynk app enables viewing alerts and logs, hence keeping the user continuously updated on the status of their property. This system ensures a reliable real-time solution for home and property security.

6. Result Analysis:

The IoT-based Intrusion Detection and Alert System successfully detects motion and obstacles, providing immediate local alerts through a buzzer and LED while sending real-time notifications to the user's smartphone via the Blynk app. It demonstrates quick

response times, reliable performance, and accuracy in detecting intrusions under proper sensor placement and environmental conditions.

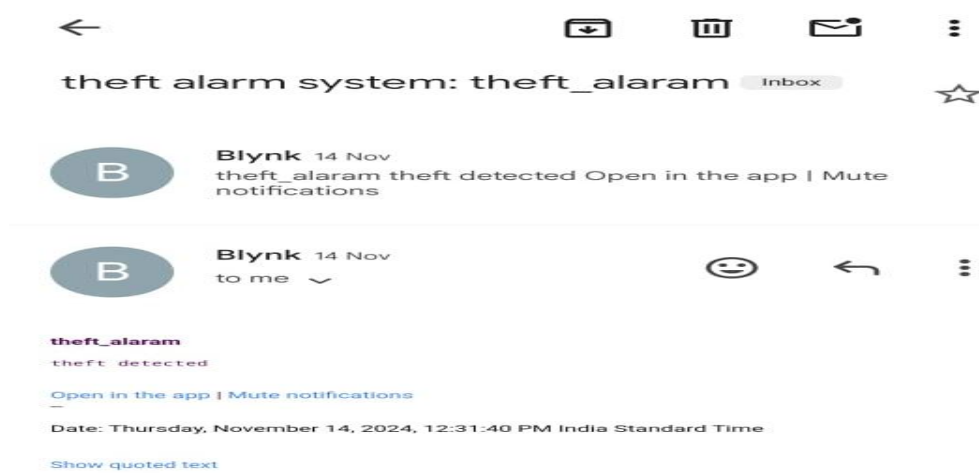


Figure 3: Result Analysis

7. Conclusion:

The Passive Infrared (PIR) Security System presents a reliable, efficient, and cost-effective solution for enhancing security in homes, offices, and other environments. By utilizing PIR sensors, this system offers real-time motion detection and immediate response through visual and audible alerts, effectively deterring unauthorized access. The integration of IoT technology with the NodeMCU board enables remote monitoring and control, allowing users to stay informed of potential security breaches from anywhere. Its energy-efficient design, ease of assembly, and scalability make it a versatile option that can be customized to meet various security needs. Overall, the PIR Security System showcases the practical application of IoT in modern security, providing both convenience and peace of mind to users.

8. References:

1. J. Wilson, "Passive Infrared (PIR) Sensors: Fundamentals and Applications," *Journal of Sensor Technology*, vol. 12, no. 3, pp. 145-157, 2020.



2. A. Kumar and S. Singh, IoT-Based Security Systems Using PIR Sensors, Springer, 2021.
3. M. Elshenawy, "Design and Implementation of a Smart Security System Using IoT and PIR Sensors," International Journal of Electronics and Communication Engineering, vol. 15, no. 2, pp. 80-88, 2022.
4. K. Sharma, "IoT Security Solutions: A Review of Passive Infrared Systems," IEEE Access, vol. 8, pp. 19413-19427, 2020.
5. M. Hasan, A. Alam, "IoT-Based Home Security System Using PIR Sensor and NodeMCU," International Journal of Advanced Research in Computer Science and Software Engineering, vol. 9, no. 6, pp. 12-18, 2021.
6. S. P. Harish, R. K. Gupta, "Smart Home Security System Using PIR and IoT," International Journal of Internet of Things and Cyber-Assurance, vol. 5, no. 3, pp. 130-139, 2021.
7. B. K. Mishra, A. S. Mohapatra, Embedded Security Systems: Design and Applications, 1st ed., McGraw Hill, 2019.
8. D. Patel, J. Singh, "A Review of PIR-Based Motion Detection Systems for Security," Journal of Security and Applications, vol. 22, no. 2, pp. 50-62, 2023.
9. P. K. Mishra, "IoT-Based Security Surveillance Using PIR and NodeMCU," International Journal of Computer Applications, vol. 183, no. 13, pp. 35-40, 2021.
10. L. Johnson, "Design and Implementation of IoT-Based Intruder Detection System Using PIR Sensor," International Journal of Engineering Research and Technology (IJERT), vol. 10, no. 8, pp. 250-255, 2022.