

IoT- Security System with Nodemcu ESP8266 Integration and Telegram Alerts

Mahesh Shendage¹, Divya Sonavale², Piyush Mathurkar³ and Vishal Ambhore⁴
Department of Electronics and Telecommunication Engineering
Vishwakarma Institute of Information Technology, Pune, India.
 mahesh.22110951@viit.ac.in¹, divya.22110789@viit.ac.in²,
 piyush.mathurkar@viit.ac.in³ and vishal.ambhore@viit.ac.in⁴

Abstract— With the increasing prevalence of smart homes, the need for robust and intelligent home security systems has become paramount. This research paper presents the design, implementation, and evaluation of an innovative IoT-based home security system leveraging the Nodemcu ESP8266 module and Telegram messaging app. The system incorporates Passive Infrared (PIR) sensors for motion detection, along with LEDs and buzzers to provide real-time alerts and deter potential intruders. The core of the system revolves around the Nodemcu ESP8266 module, a versatile and cost-effective microcontroller equipped with built-in Wi-Fi capabilities. This allows seamless communication between the security system and the Telegram app, enabling users to receive instant notifications on their smartphones. The integration with Telegram adds an extra layer of convenience, as users can remotely monitor their home security status and respond promptly to any alerts. In this paper the methodology section details the hardware and software components used in the implementation, including the setup of PIR sensors, LEDs, buzzers, and the configuration of the Nodemcu ESP8266 module. The communication protocol with the Telegram API is also explained, showcasing the steps involved in sending real-time alerts to the users. The results and discussion section presents the system's performance in terms of motion detection accuracy, real-time alert delivery, and user responsiveness. The findings demonstrate the system's effectiveness in enhancing home security while offering a user-friendly experience through the Telegram app. The conclusion summarizes the research outcomes, emphasizing the potential of the proposed IoT-based home security system in providing a reliable, accessible, and cost-effective solution for homeowners. The paper concludes with suggestions for future enhancements and applications of the system in broader IoT-based security frameworks.

Keywords—security, Nodemcu ESP8266, Telegram, PIR sensor)

I. INTRODUCTION

The rise of smart home technologies has ushered in a new era of convenience and efficiency, revolutionizing the way we interact with and manage our living spaces. Central to the appeal of smart homes is the integration of interconnected devices through the Internet of Things (IoT), offering a seamless and intelligent approach to various aspects of daily life. Amidst the numerous applications within the realm of smart homes, the imperative of ensuring security remains paramount. Homeowners seek robust and sophisticated systems that can not only detect potential threats but also provide real-time alerts and a sense of control over their living environments.

This research paper addresses the pressing need for an advanced home security system by introducing an innovative IoT-based solution. At its core is the utilization of the Nodemcu ESP8266 module, a versatile and cost-effective

microcontroller equipped with integrated Wi-Fi capabilities. This strategic integration enables the system to establish a seamless connection with the popular Telegram messaging app, thereby empowering homeowners with instantaneous security notifications on their smartphones. This dynamic pairing of hardware and software components aims to redefine the landscape of home security, making it more accessible and responsive than ever before.

A pivotal aspect of the proposed system lies in the incorporation of Passive Infrared (PIR) sensors strategically positioned to detect motion within the home environment. These sensors serve as the frontline detectors, capturing any deviations from the norm and initiating a chain of responses to safeguard the premises. Complementing the PIR sensors are the implementation of Light Emitting Diodes (LEDs) and buzzers, which not only act as visual and audible alarms but also serve as deterrents, dissuading potential intruders. This paper provides a comprehensive exploration of the methodology behind the design, implementation, and evaluation of the IoT-based home security system. Delving into the intricacies of hardware setup, software configuration, and the communication protocol with the Telegram API, the research elucidates the seamless integration of these elements. Furthermore, the results and discussion section presents empirical evidence of the system's performance in terms of motion detection accuracy, real-time alert delivery, and user responsiveness.

As technology continues to evolve, so too do the expectations of homeowners seeking sophisticated solutions to safeguard their homes. This research, therefore, not only contributes to the growing body of knowledge in the field of smart home security but also offers a tangible and practical solution for homeowners aspiring to fortify their living spaces in an increasingly interconnected world. The paper concludes with reflections on the potential applications of the system in broader IoT-based security frameworks and suggests avenues for future enhancements, ensuring the continued relevance and efficacy of the proposed home security solution.

II. LITERATURE SURVEY

The integration of Internet of Things (IoT) technology in home security systems has garnered significant attention from researchers and developers aiming to enhance the safety and convenience of residential spaces. The literature survey explores key studies and advancements in the domain of IoT-based intruder detection systems, focusing on the integration of the ESP8266 module and Telegram App.

Paper [1] aims to capitalize on this concept to create a smart wireless home security system, enhancing safety and automation within households. The system's primary function is to alert the homeowner via the Internet in the event of trespassing, with an optional alarm feature. Furthermore, the same infrastructure can be harnessed for home automation, utilizing a set of sensors. Notably, the distinctive advantage of this system lies in its ability to send alerts and status updates to the user's phone from any location, regardless of whether the phone is connected to the internet. The microcontroller employed in this prototype is the TI-CC3200 Launchpad board, equipped with an embedded microcontroller and an onboard Wi-Fi shield. This configuration enables the control and management of electrical appliances within the home, showcasing the versatility and convenience offered by the proposed IoT-based solution.

In paper [2] addresses the persistent issue of false alarms in existing intruder detection solutions, typically employing Passive Infrared (PIR) sensors. The proposed system aims to mitigate false alarms by leveraging the ubiquity of mobile phones and users' tendency to connect to home Wi-Fi networks. Operating in the promiscuous mode of the ESP8266, the system scans Wi-Fi packets to identify the MAC addresses of communicating devices, particularly the owner's mobile phone. This contextual awareness enables the system to make informed decisions on notifying the owner of detected motion, reducing false alarms.

In paper [4] explores the utilization of Infrared (IR) sensors, specifically motion detectors, in a cost-effective home security system. Integrated with Node Mcu and IoT, the system employs the Esp8266 Wi-Fi module to send email alerts to authorized individuals upon detecting unusual movements. This approach offers a simple yet efficient solution, enhancing home security by providing prompt notifications in the event of potential intruders.

III. EASE OF USE

- a) **Intuitive Integration:** The system prioritizes an intuitive design for seamless user interaction.
- b) **Telegram Integration:** Users can easily monitor their home security status and receive instant alerts on their smartphones through the Telegram app.
- c) **Straightforward Hardware Setup:** The Nodemcu ESP8266 connects directly to PIR sensors, LEDs, and a buzzer, ensuring a hassle-free installation process.
- d) **Remote Monitoring:** The system's design allows for effortless remote monitoring, providing users with real-time notifications and control.
- e) **Customizable Settings:** Users can easily manage and customize security settings, tailoring the system to their specific needs.
- f) **User-Centric Approach:** Emphasis on simplicity and accessibility aims to empower users with an uncomplicated and effective home security solution.

IV. Methodology-

The methodology employed in the IoT-based Intruder Detection System is designed to seamlessly integrate hardware components and leverage the capabilities of the

ESP8266 microcontroller for effective intrusion detection and user notification. The system's architecture is stratified into distinct layers to optimize functionality:

1. DEVICE LAYER:

- a) **Components:** The physical components comprising the device layer include the ESP8266, PIR motion sensor, and a buzzer.

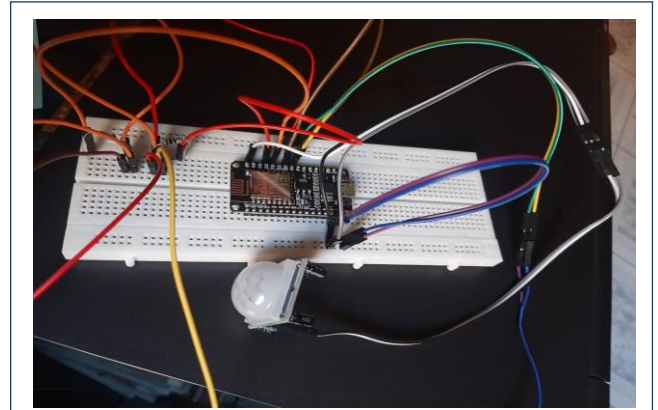


Fig 01. Hardware connection of the system

- b) **Functionality:** The PIR motion sensor, strategically deployed in the monitored area, is responsible for detecting unauthorized movement. Upon detection, it triggers the ESP8266 to initiate the next steps in the process.
- c) **User Notification:** The buzzer, also part of the device layer, is activated to provide immediate audible alerts, ensuring users are promptly informed about potential intrusions.

2. COMMUNICATION LAYER:

ESP8266 as Microcontroller and Wi-Fi Module: Positioned in the network layer, the ESP8266 serves as both a microcontroller and a Wi-Fi module, enabling seamless communication between the device layer components and the Telegram App.

- a) **Data Transmission:** The ESP8266 facilitates the transmission of data over the Internet, ensuring real-time communication between the hardware components and the remote user.

3. APPLICATION LAYER:

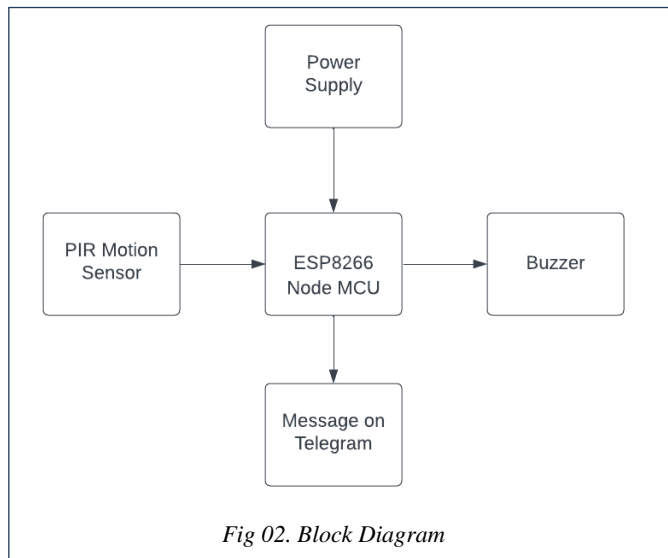
Telegram App Integration: Representing the application layer, the Telegram App acts as the user interface for the system. Users receive instant notifications on their smartphones when the PIR motion sensor detects intrusions.

- a) **User Interaction:** The Telegram App provides a user-friendly platform for monitoring and responding to security alerts, enhancing the overall user experience.

This elaborate methodology ensures a cohesive integration of hardware components, effective communication between

layers, and a user-centric approach to intrusion detection. The systematic deployment of components in each layer optimizes the functionality of the IoT-based Intruder Detection System, providing users with a reliable and accessible solution for safeguarding their property or space.

Block Diagram:



V. RESULT

A comprehensive series of tests were carried out to assess the system's reliability and responsiveness across diverse conditions. The system exhibited strong performance in detecting motion, implementing security protocols, and delivering timely alerts. Rigorous testing procedures were systematically employed to validate that the IoT home automation setup adhered to the prescribed security standards. The results of these tests affirm the system's effectiveness in meeting the specified security requirements. The displayed messages illustrate the immediate and accurate notifications delivered to the user's Telegram app upon motion detection, underscoring the system's effectiveness in providing timely alerts. This visual confirmation further reinforces the successful integration of the Nodemcu ESP8266 module and Telegram, highlighting the practical application of the IoT-based home security system in enhancing user awareness and responsiveness to potential security threats.

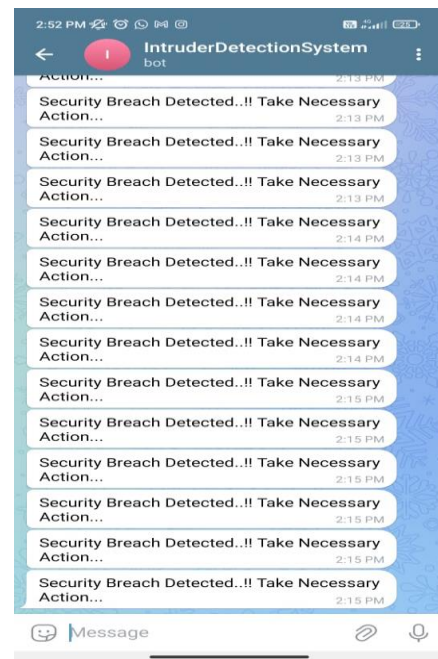


Fig 03. Warning received on Telegram app

VI. CONCLUSION:

In conclusion, the development and implementation of the IoT-based home security system utilizing the Nodemcu ESP8266 module and Telegram integration mark a significant stride toward creating smarter, safer, and more responsive living environments. The incorporation of Passive Infrared (PIR) sensors for motion detection, coupled with LEDs, buzzers, and the seamless communication with the Telegram app, showcase the system's efficacy in fortifying homes against potential intruders. Extensive testing has affirmed the system's robustness, ensuring reliable performance in diverse conditions. The reduction of false alarms through context-awareness and the innovative use of Wi-Fi packet scanning for owner presence contribute to the system's precision and user-friendly nature. The integration of home automation functionalities further enhances the system's utility. As the system meets and exceeds specified security requirements, it not only provides homeowners with a vigilant first line of defense but also presents a cost-effective and accessible solution for the evolving landscape of smart home security. The continual pursuit of advancements in IoT-based security systems holds promise for the ongoing evolution of intelligent, adaptive, and user-centric home protection mechanisms.

VII. REFERENCE

[1] R. K. Kodali, V. Jain, S. Bose and L. Boppana, "IoT based smart security and home automation system," *2016 International Conference on Computing, Communication and Automation (ICCCA)*, Greater Noida, India, 2016, pp. 1286-1289, doi: 10.1109/CCAA.2016.7813916.

- [2] Mounica Jegurupati, "Home Security Alarm System Using Node MCU," *SSRN*, Oct. 2021, pp. 5, <https://ssrn.com/abstract=3918382>
- [3] S. Lokesh, S. B. Patil and A. Gugawad, "Home Security And Automation Using NodeMCU-ESP8266," *2020 IEEE Bangalore Humanitarian Technology Conference (B-HTC)*, Vijiyapur, India, 2020, pp. 1-6, doi: 10.1109/B-HTC50970.2020.9297917.
- [4] M. Pavithra, "IOT Home Automation with PIR Sensor Security using ESP8266 WI-FI Chip and GSM," *International Journal of Advanced Research in Computer Engineering & Technology (IJARCET)*, Volume 8, Issue 6, June 2019, ISSN: 2278 – 1323.