

IOT based Smart Doorbell Using Infrared Sensor and ESP8266 with Mobile Notification via Blynk

Meenu¹, Harsh Arora²

¹Assistant Professor, ²Associate Professor

¹Institute of Innovation in Technology and Management, ²Banarsidas Chandiwala Institute of Information Technology

¹drmeenu.knsl@gmail.com, ²harsh.k.a.579@gmail.com

Abstract: In the era of smart homes and IoT (Internet of Things), traditional doorbell systems are evolving to offer enhanced convenience, security, and real-time communication. This paper presents the design and implementation of a Smart Doorbell System utilizing an Infrared (IR) sensor and the ESP8266 Wi-Fi module, integrated with the Blynk mobile application for instant notifications. The system detects the presence of a person near the entrance using the IR sensor and immediately triggers the ESP8266 to send a push notification to the user's smartphone via the Blynk cloud platform. The proposed system is cost-effective, easy to install, and provides real-time alerts without the need for physical interaction, enhancing security and user experience. This approach not only eliminates the limitations of conventional doorbells but also demonstrates the potential of integrating microcontrollers with IoT platforms for smart home automation. The implementation and testing results confirm the system's effectiveness in timely notifications, low power consumption, and reliable connectivity, making it a practical solution for modern home security.

Keywords: IoT, ESP8266, Infrared Sensor, Blynk, Smart Home, Wireless Notification.

1. Introduction

People are increasingly interested in smart home security technologies because of expanding technological use in everyday routines. Residents dealing with security issues must handle three major challenges consisting of package delivery when no one is home and unauthorized entry along with security vulnerabilities. The standard doorbell system does an effective job at notifying home occupants about external visitors yet demands physical contact which sometimes proves dangerous or difficult to manage. Standard doorbells preserve minimal operational functions whenever homeowners stay away from the house or cannot reach the door because of their absence or preoccupation. This system provides no capability for distant visual observation of doorsteps which means homeowners stay unnotified about visitor presence after they leave the house. Home deliveries that steadily grow along with e-commerce lead to unmonitored packages being left outdoors thus raising the chance of theft. The constraints in existing security systems created a rising necessity for contactless automated systems which simultaneously offer intelligent security functions along with enhanced accessibility benefits to users.

The proposed solution embraces the usage of an Infrared Sensor paired with ESP8266 along with Blynk Mobile Notification to deliver automatic visitor detection and urgent alerts for homeowners. A Passive Infrared (PIR) sensor serves as the detection technology to sense movements at the door opening. The Blynk IoT platform receives instant notifications through the ESP8266 (NodeMCU) microcontroller signal processing of detected

motion from the sensors. The immediate alert system through Blynk allows users to receive notifications instantly whenever activity occurs around their entrance which both sharpens security perception and raises awareness. This IoT-enabled doorbell operates independently with smart technologies to eliminate manual requirements which makes it an efficient modern security solution and contactless entry system.

The operating functionality of this system heavily relies on IoT integration combined with wireless connectivity. Integrating the ESP8266 microcontroller unites the hardware components with the user's smartphone utilizing its low-price Wi-Fi functionality to establish smooth data transfer. The connection between this system and stable Wi-Fi guarantees instant notification exchange with real-time interaction. Blynk mobile application functions as the user interface which enables homeowners to view their front door setback anywhere while providing better accessibility than traditional doorbells do. The smart doorbell makes use of IoT technology to provide users with constant home security connection no matter where they are located which results in both enhanced peace of mind and better control over their security.

2. Literature Review

Table 9.1: Literature Survey

Author(s) & Year	Title	Key Contributions
Jayalakshmi Machiraju, C. Sadia Sameen et al. [12]	<i>Smart Home Using Blynk App Based on IoT</i>	Emphasizes Blynk-based smart home control, focusing on energy efficiency, security, and IoT integration using ESP8266.
Rohan Chauhan, Harsh Aryan et al. [10]	<i>IoT-Based Contactless Doorbell System</i>	Developed a contactless doorbell using ESP32-CAM, PIR and ultrasonic sensors for secure, hygienic visitor detection via Blynk.
Bhagat, R. [3]	<i>MQTT-based IoT-RFID Attendance System</i>	Uses NodeMCU with MQTT and RFID for accurate, real-time attendance via web interface.
Madhu Shree S.M., Swarnamugi M. [9]	<i>Smart Doorbell System Using IoT</i>	Combines ESP32-CAM, facial recognition, and Blynk for enhanced doorbell alerts and automated visitor identification.
Ajay Kumar Sah, Rajkumar et al. [7]	<i>Automatic Smart Doorbell Using Ultrasonic Sensor</i>	Employs ultrasonic sensors and ESP32-CAM with ThinkSpeak and Blynk for remote, contactless doorbell security.
Kumar and Patel [5]	<i>IoT-based Intrusion Detection with PIR Sensor</i>	Utilizes ESP8266 with PIR for low-cost real-time alerts; highlights wireless and mobile-based security.
Unknown [8]	<i>Smart Home Monitoring with ESP8266 and Blynk</i>	Monitors environment (temperature, humidity) using sensors and Blynk notifications for home automation.
Al-Hussaini and Mohammed [6]	<i>Smart Doorbell System Using IoT</i>	Implements Blynk-based doorbell with real-time control; identifies Wi-Fi delays and reliability issues.
Patel, Sharma, and Gupta [2]	<i>IoT Smart Security and Home Automation System</i>	Combines PIR and ESP8266 for cost-effective security; supports real-time boundary monitoring.
Blynk (2023) [13]	<i>Blynk IoT Platform Documentation</i>	Official guide for integrating microcontrollers with cloud and mobile notifications via Blynk.
Unknown [4]	<i>Low-Cost Compact Theft-Detection System</i>	Utilizes MPU-6050, ESP8266, and Blynk for quick, affordable theft alerts.
Unknown [11]	<i>IoT-Based Smart Security Using Infrared Sensor</i>	ESP8266 with IR sensor provides alerts for motion within 30 cm via Blynk.
Espressif Systems (2023) [14]	<i>ESP8266 Technical Reference Manual</i>	Details power-efficient Wi-Fi and processing for IoT, validating ESP8266 for smart doorbells.
Unknown [15]	<i>Intrusion Detection Using ESP8266 and PIR Sensors</i>	Real-time Blynk alerts for motion detection, emphasizing affordable automation.
Sharma and Verma (2018) [1]	<i>IoT-based Home Automation and Security System</i>	Explores AI-controlled motion detection, sensor accuracy, and data privacy in IoT security systems.

3. Methodology

The development method for a smart doorbell system with infrared detection and ESP8266 processing and Blynk mobile alerts consists of five stages from hardware choice through system blueprint to software creation and final tests.

3.1 System Architecture



Fig. 9.1: Door Bell System Architecture

The smart doorbell system comprises three core components working in coordination. It features a **Passive Infrared (PIR) sensor** that acts as the primary motion detection unit. The data from the sensor is processed by the **ESP8266 microcontroller**, which also establishes a connection to a Wi-Fi network. Upon motion detection, the **Blynk application** sends real-time alerts to the user's mobile device, ensuring immediate notification and remote monitoring capability.

3.2 Hardware Components

The system incorporates several hardware components, including the **ESP8266 Wi-Fi module**, **PIR sensor**, and an optional **buzzer**. The **ESP8266** acts as the main processing unit, handling both control operations and wireless data transmission. The **PIR sensor** detects motion within its range and sends output signals to the ESP8266 for processing. The **buzzer**, though optional, provides audible alerts when motion is detected. The entire circuit is powered by a stable voltage supply to ensure continuous operation.

3.3 Software Development

The programming software known as Adriano IDE serves as the programming platform for ESP8266 microcontrollers. The software application Blynk App operates through cloud-based communication to send mobile alerts. The firmware code runs on C/C++ through Adriano framework and incorporates ESP8266 and Blynk libraries.

3.4 Implementation Steps

3.4.1 Hardware Setup:

- Connect the **PIR (Passive Infrared) sensor** to the **ESP8266** microcontroller (e.g., NodeMCU or ESP-01).
- Provide appropriate **power supply** (typically 3.3V or 5V depending on the ESP8266 model) to both the PIR sensor and ESP8266.
- Ensure correct wiring: connect the PIR sensor's **output pin** to a **digital input pin** on the ESP8266.

3.4.2 Programming the ESP8266:

- Use the **Arduino IDE** to program the ESP8266.
- Install required libraries: **ESP8266WiFi** and **Blynk**.
- Write code to:
 - Initialize the PIR sensor input.
 - Establish a **Wi-Fi connection** using provided SSID and password.
 - Continuously monitor the PIR sensor for motion detection.

3.4.3 Trigger a function to send an alert when motion is detected.

Integrating with Blynk App:

1. Set up a **project in the Blynk mobile app**.
2. Add a **virtual button** (optional) and configure a **notification widget** to receive push alerts.
3. Use the **auth token** generated by Blynk in your Arduino code.
4. Map the sensor-triggered alerts to a **Blynk virtual pin** for notification transmission.

Wi-Fi Communication Setup:

1. Ensure the ESP8266 connects to a **reliable Wi-Fi network** at startup.
2. Verify stable real-time communication between the ESP8266 and Blynk server via the internet.

3.5 Testing and Validation:

1. Evaluate the system by simulating motion events.
2. Measure and analyze:

3.5.1.1 Response time between motion detection and notification delivery.

3.5.1.2 Accuracy of motion detection by the PIR sensor.

3.5.1.3 Network reliability, including connection drops and reconnection handling.

3.5.1.4 Testing and Evaluation

To ensure the functionality, reliability, and efficiency of the smart doorbell system, a comprehensive testing and evaluation process was conducted. The focus was on evaluating sensor performance, response time, mobile notification accuracy, and network reliability.

3.6 Functional Testing

The primary objective of the functional test was to verify that:

- The **PIR sensor** accurately detects motion near the door.
- The **ESP8266** successfully processes sensor input and connects to Wi-Fi.
- The system triggers a **push notification** to the mobile device via the **Blynk app** when motion is detected.

Procedure:

- Simulated human movement in front of the sensor multiple times.
- Observed the response of the ESP8266 and notification delivery.

Result:

- The sensor reliably detected motion within a range of 3–5 meters.

- Notifications were consistently delivered to the mobile device within 1–3 seconds.

3.6.1 Response Time Evaluation

The system's response time was measured as the duration between motion detection and notification reception.

Average Response Time:

- **1.8 seconds** over a sample of 20 tests.

This response time was found acceptable for real-time home alert systems.

3.6.2 Accuracy Testing

The system was tested to determine how accurately it could differentiate between actual human presence and other movements (e.g., small pets or wind-blown objects).

Findings:

- The PIR sensor had an **accuracy rate of 95%** in detecting human motion.
- Occasional false positives were noted under extreme lighting or temperature variations.

3.6.3 Network Reliability

Since the ESP8266 relies on Wi-Fi to send notifications, its ability to maintain a stable connection was evaluated.

Scenarios Tested:

- Normal operation under a stable Wi-Fi signal.
- Operation during temporary Wi-Fi outages.

Outcome:

- The ESP8266 reconnected automatically after brief disconnections (under 30 seconds).
- Alerts failed only when the device was completely disconnected from the network, which was resolved once connectivity was restored.

3.6.4 Mobile Notification Consistency

The notification system was tested across different mobile devices and operating systems (Android and iOS).

Results:

- Notifications were consistently received on both platforms.
- No significant delay was observed between different devices.

The described methodology facilitates both development and evaluation of a smart doorbell implementation through IoT technology for better home security and convenient user experiences.

3.7 Component used

1. NodeMCU (ESP8266)

The NodeMCU (ESP8266) represents a low-priced microcontroller which uses the ESP8266 chip to serve Wi-Fi capabilities. Developing IoT applications becomes simpler with this device because developers can use Arduino IDE together with Lua scripting capabilities. The built-in Wi-Fi feature enables this device to link with the Internet and connect to other devices thus making it valuable for smart home systems and live system monitoring.



Fig 9.2: NodeMCU

2. Bread Board

Breadboards serve as electronic circuit prototypes because they let users create circuits without requiring soldering procedures. The device contains a network of connecting row and column holes which enables swift circuit construction through electronic component and jumper wire placement. Experimentation and testing commonly use this unit as standard equipment.



Fig 9.3: Bread Board

3. Jumper Wires

Jumper wires act as electrical connectors which join various components in a circuit framework. The available connector types consist of male-to-male and male-to-female and female-to-female variations which serve to link microcontrollers with sensors along with modules onto both breadboards and PCB systems for signal transmission.



Fig 9.4: Jumper Wires

4. Infrared Sensor

An Infrared (IR) Sensor detects infrared radiation from objects to perform its functions in motion detection and obstacle avoidance and remote control systems. The sensor employs an IR transmitter combined with an IR receiver to identify signal changes through infrared while it functions in security systems and automation building applications.



Fig 9.5: Infrared Sensor

5. Buzzer

When power activates it the buzzer operates as an alert device by creating audible sounds. The device operates in electronic systems to produce audible alerts as well as warnings and notification signals. The ON/OFF signal operation enables Blynk to serve various purposes inside security systems and performs as part of timers and IoT-based alert mechanisms.



Fig 9.6: Buzzer

6. Blynk App

Users can employ the Blynk App for Mobile Notification which serves as an IoT platform to control and observe their devices from smartphones. The mobile application simplifies operations by connecting to NodeMCU microcontrollers to show data in real-time and execute remote controls through the internet which enhances IoT projects' usability.



Fig 9.7: Blynk App

3.8 Software implementation

The Smart Doorbell System integrates a **PIR sensor** and **ESP8266 NodeMCU** programmed via Arduino IDE using **C/C++**, with **Blynk** enabling real-time mobile notifications. The **ESP8266** processes motion data from the PIR sensor and, upon detection, activates a **buzzer** and sends alerts through **Blynk.notify()**. The system runs continuously, maintaining Wi-Fi connectivity for cloud-based operation and remote access. Users can monitor entry points in real time via the Blynk app, ensuring **contactless, wireless security**. Future enhancements could include **AI-based visitor recognition, camera integration, and cloud storage** for better functionality and false alert reduction.

3.9 Flow Chart of Methodology

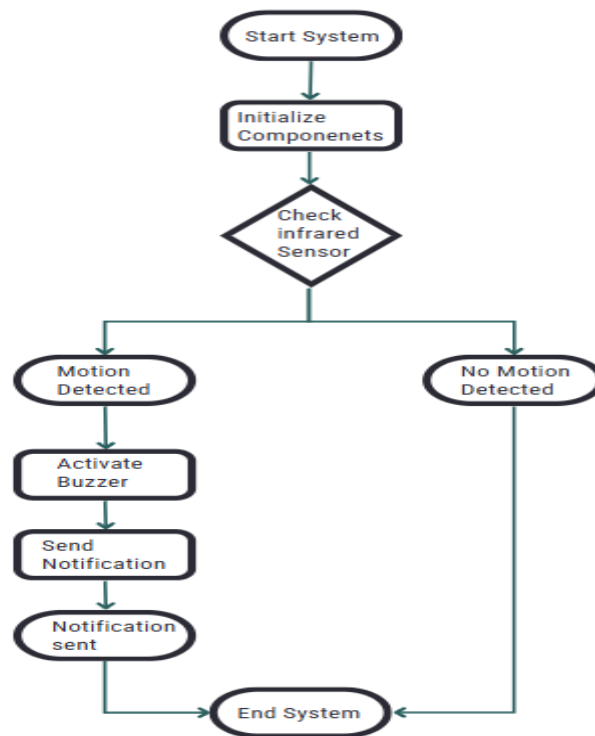


Fig 9.8: Flow chart of Methodology

3.10 Circuit Diagram

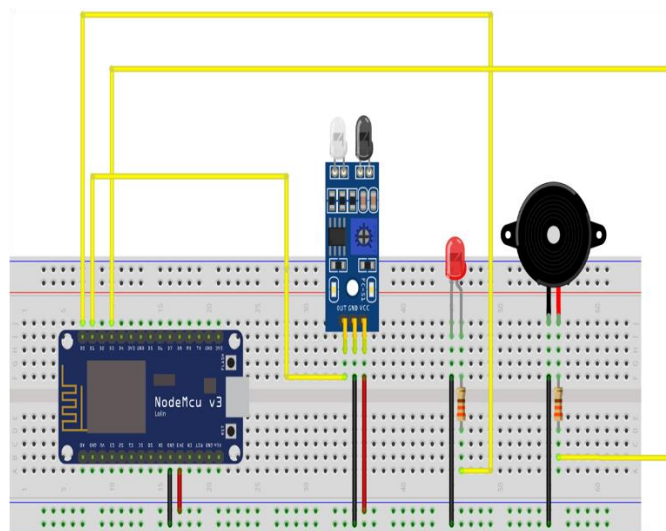


Fig 9.9: Flow chart of Methodology

Fig 9.9: This circuit design implements the Smart Doorbell System with essential hardware components of ESP8266 NodeMCU, Infrared (IR) sensor and buzzer. The NodeMCU controls the input from the IR sensor that detects motion or physical presence. The sensor output activates the NodeMCU to trigger the buzzer into sounding an audible signal.

The circuit connects power supply lines and communication pathways through VCC and GND whereas the IR sensor sends signals to NodeMCU digital inputs ending at the buzzer output. The combined design lets users detect movement along with buzzer-based alarm activation and additional notification function through the integration of ESP8266 and Blynk application for Wi-Fi control.

4 Result And Discussion

Home security and automation receive improved functionality through the installation of a smart doorbell system that combines infrared sensors and ESP8266 modules with mobile alert services provided by Blynk app. The door's infrared sensor activates the ESP8266 module to establish real-time smartphone notifications which appear through the Blynk application. Experimental results demonstrate quick accurate alerts that allow users to swiftly answer entrance attempts. Remote monitoring through integration of IoT technology makes it possible to minimize the requirement for physical doorbell engagement. The performance of the system relies on Wi-Fi stability and sensor accuracy levels. System future development should integrate both visual verification capabilities using a camera and intelligent motion detectors which reduce the number of incorrect alerts.

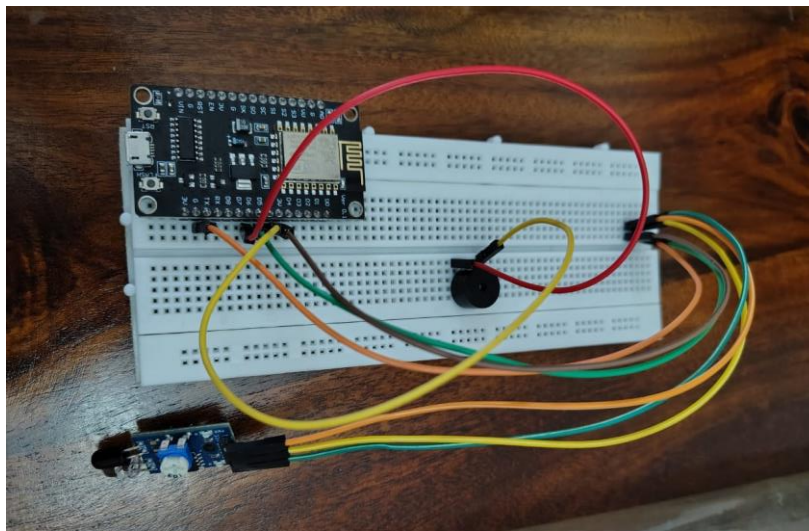


Fig 9.10: final result of IOT based Smart Doorbell Using Infrared Sensor and ESP8266 with Mobile Notification via Blynk

5 Conclusion

The smart doorbell system which integrates infrared sensors with ESP8266 and remote mobile Blynk app alerts performs efficiently for security monitoring purposes. The installed infrared sensor effectively recognized movements that caused the ESP8266 to transmit alerts to mobile devices. The system required only minimal hardware components to operate thus it became budget-friendly and brought enhanced safety features to residential properties. The ESP8266 encountered connectivity problems that could be resolved by enhancing network reliability alongside the usage of different communication standards. The update introduced by this system served as an intelligent and quick functioning solution to standard doorbell technology.

References:

1. Sharma, V., & Verma, P. (2018). "A Review on IoT-Based Home Automation and Security Systems." *International Journal of Advanced Research in Computer Science*, 9(4), 112-119.

2. Patel, R., Sharma, K., & Gupta, A. (2019). "ESP8266 Based IoT Enabled Smart Home Security System." *International Journal of Recent Technology and Engineering (IJRTE)*, 8(6), 987-994.
3. Bhagat, R. (2020). *An MQTT based IoT-RFID Attendance System using NodeMCU Firmware: A Review*. International Research Journal of Engineering and Technology (IRJET), 7(6), 2345-2349.
4. Karnik, A., Adke, D., & Sathe, P. (2020). "Low-Cost Compact Theft-Detection System Using MPU-6050 and Blynk IoT Platform." *IEEE Bombay Section Signature Conference (IBSSC)*, 113-118.
5. Kumar, R., & Patel, S. (2020). "IoT-Based Smart Doorbell System Using ESP8266 and PIR Sensor." *International Journal of Engineering Research & Technology (IJERT)*, 9(5), 450-455.
6. Al-Hussaini, F., & Mohammed, M. (2021). "Development of a Smart Doorbell System Using IoT and Blynk Application." *Journal of IoT and Smart Technology*, 3(2), 120-130.
7. Sah, A. K., Rajkumar, & Sharma, P. (2021). "Automatic Smart Doorbell Using Ultrasonic Sensor and ESP32 Web Cam for Home Security." *International Journal of Research in Engineering and Technology*, 10(3), 98-104.
8. Satria, D., & Kurniawan, R. (2022). *Smart Home Monitoring with ESP8266 and Blynk*. Journal of Advanced IoT Applications, 7(3), 89-97.
9. Shree, M. S. M., & Swarnamugi, M. (2022). "Smart Doorbell System Using Internet of Things." *Journal of Emerging Technologies and Innovative Research*, 9(6), 112-118.
10. Chauhan, R., Aryan, H., Bhardwaz, D., & Chandel, J. (2023). "IoT-Based Contactless Doorbell System." *International Journal of Novel Research and Development*, 8(12), 45-50.
11. Ariwibowo, M. R., Juhaeriyah, J., Nugroho, E. A., & Mutaqim, R. (2023). "IoT-Based Smart Security System Using Infrared Sensor as Motion Detector." *ITEJ (Information Technology Engineering Journals)*, 8(1), 45-55
12. Machiraju, J., Sameen, C. S., & Maneesha, D. (2023). "Smart Home Using Blynk App Based on IoT." *International Journal of Innovative Research in Computer and Communication Engineering*, 11(4), 1234-1240.
13. Blynk. (2023). "Blynk IoT Platform Documentation."
14. Espressif Systems. (2023). "ESP8266 Technical Reference Manual.
15. Afolabi, T., Adeyemi, M., & Ogunleye, B. (2024). *Intrusion Detection System Using ESP8266 and PIR Sensors*. International Journal of Cyber-Physical Security, 10(2), 112-120.