

# IOT-ENHANCED LIVING: ELEVATING COMFORT AND SECURITY THROUGH SMART HOME AUTOMATION

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**Abstract** — The "Internet of Things" is quickly emerging as a disruptive business opportunity in technology, with standards primarily developing for wireless communication between devices and gadgets in everyday human life, commonly referred to as Things. The objective of this project is to manage home appliances and construct an intelligent wireless home security system utilizing Wi-Fi as the communication protocol. Various types of wireless communication techniques, including ZigBee, Wi-Fi, Bluetooth, GSM, etc., can be employed for implementing Home Automation. However, these existing methods have limitations due to their short-range functionality. To overcome these drawbacks, we plan to execute the project titled "IoT-based Smart Security and Smart Home Automation." The project concentrates on regulating lights and fans, termed as Home Automation, and ensuring smart security by transmitting a captured image via email to the owner through the internet when an object is detected. The implementation of this project will involve the utilization of the "Node MCU" Module, offering significant assistance to handicapped and elderly individuals.

**Keyword-** *Ariduino,IOT,MCU,Smart Phone,WI-FI*

## 1. INTRODUCTION

Home automation involves the management and regulation of household appliances through micro- controller or computer technology. The prevalence of automation is on the rise due to its ability to offer convenience, security, and efficiency. In this system, sensors detect the status of appliances and transmit updates to a web server. When users are away from home, they can remotely access and modify the status of appliances, such as turning them on or off, using a local PC. This paper will outline the methodology for controlling home appliances through a web server. The essence of this

IoT-based smart security and smart home automation system lies in its pursuit of combining comfort with simplicity. The project seamlessly integrates wireless home security and home automation, offering a comprehensive solution. The current prototype of the system excels in sending timely alerts to the owner via email over the Internet, triggered by the detection of human movement near the entrance of their house.

The system's functionality extends beyond mere security alerts. When the owner discerns that the person entering their house is not an intruder but an unexpected guest, they have the flexibility to take various actions. The user can remotely make arrangements, such as opening the door and activating specific appliances inside the house, all controlled by the embedded micro-controller. This enables the owner to warmly welcome their guest without being physically present. Similarly, the system caters to the user's convenience as they enter their home. By leveraging the same set of sensors, the user can pre-set conditions, ensuring a seamless transition to comfort upon entering. This includes automating the activation of electrical appliances or tuning into their favorite TV channel, all accomplished without manual intervention.

One noteworthy advantage of this IoT system is its adaptability to connectivity challenges. Even in the absence of Wi-Fi, the system seamlessly switches to 3G or 4G services, ensuring continuous functionality. This capability sets it apart from existing methods where such flexibility might be limited. In essence, the IoT-based smart security and smart home automation project not only addresses security concerns but also enhances the overall living experience. By overcoming various drawbacks present in traditional approaches this project brings forth a harmonious blend of comfort.

And simplicity, paving the way for a more sophisticated and user-friendly home environment.

**2. METHODS**

Bluetooth-based home automation systems, employing smartphones, Arduino boards, and Bluetooth technology, offer a secure and cost-effective solution for controlling various devices. The system proposed by R. Piyare and M. Tazil [2] utilizes a Bluetooth connection with a PC or smartphone serving as the receiver device. With high communication rates, robust security features, and low costs, this Bluetooth-based home automation system is suitable for real-time applications.

Despite its advantages, one notable limitation is the Bluetooth network's restricted range, reaching up to 10 meters. If a smartphone goes beyond this range, it loses the ability to control home appliances, representing a significant drawback for users.

On the other hand, voice recognition-based home automation systems present an innovative solution [1,3] for individuals with disabilities or elderly individuals who may find it challenging to operate devices manually. In this setup, wireless communication between the smartphone and Arduino UNO is facilitated through Bluetooth technology. The system enables users to control appliances by issuing voice commands, enhancing accessibility.

However, the voice recognition system is not without its challenges. The effectiveness of communication between the user and the voice recognition tool depends on the signal-to-noise ratio (SNR). In instances where the voice signal is noisy, the communication may be significantly affected, leading to inaccuracies in command recognition. This limitation highlights the importance of a stable and clear audio input for optimal functionality.

The ZigBee-based wireless home automation system, as explored in previous studies [4], shares similarities with Bluetooth technology[4]. ZigBee is a widely adopted transceiver standard known for its low data rate and power consumption. With a physical range of 10 to 20 meters, extendable up to 150 meters using direct sequence spread spectrum (DSSS), ZigBee is well-suited for prototyping and research activities. This technology provides an efficient solution for wireless communication within smart home setups. In contrast, the GSM-based home automation system relies on the Global System for Mobile communication [5, 6]. This system facilitates communication between the main module and appliances through text messages. However, a

notable drawback of the GSM-based system is its reliance on text messages, which lacks the guarantee of consistent message delivery. Consequently, the system's reliability is compromised, introducing a limitation that may affect the consistent and seamless operation of the home automation functions.

To overcome existing drawbacks, we are implementing "IoT-Based Smart Security and Smart Home Automation." This advanced solution utilizes Internet of Things (IoT) technology, eliminating limitations like short ranges and unreliable messaging systems. The project aims to provide a more robust and versatile smart home experience, enhancing security measures and automation capabilities

**3. HARDWARE**

Arduino UNO: Arduino UNO is a microcontroller board that serves as the brain of the system. It is responsible for controlling and coordinating the various components in the project, executing programmed instructions, and facilitating communication.



**Fig 1.Arduino UNO**

Node MCU: Node MCU is another microcontroller board that often integrates Wi-Fi capabilities. It enables wireless communication and connectivity, making it suitable for IoT applications.



**Fig 2. Node MCU**

Relays for connecting home appliances: Relays act as switches for home appliances, allowing the microcontrollers to control the power supply to these devices. They facilitate automation by enabling or disabling appliances based on programmed conditions.

Air purity Sensor (MQ135): This sensor measures air quality by detecting the presence of various gases.

In this context, it can provide information about the purity of the air within the environment. Humidity and Temperature Sensor (DHT11): The DHT11 sensor measures the humidity and temperature of the surrounding environment. This data is valuable for maintaining a comfortable and controlled atmosphere in the home.

IR Sensor: Infrared (IR) sensors are used to detect infrared radiation. In the project, they may be employed for applications such as motion detection or as part of a security system.

Camera module (OV7670): The OV7670 camera module captures images. It can be utilized for surveillance or monitoring purposes, enhancing the security features of the system.

Mobile phone for operating home appliances: A mobile phone serves as a remote control interface, allowing users to operate and monitor home appliances from a distance. This enhances user convenience and accessibility.

Blink app installed on the mobile phone: The Blink app is likely used for monitoring and controlling the system remotely through the mobile phone. It provides a user-friendly interface for interacting with the smart home features.

Arduino IDE (Software): The Arduino Integrated Development Environment (IDE) is a software platform used for programming and uploading code to the Arduino and Node MCU boards. It facilitates the development and implementation of the system's logic and functionality.

Together, these hardware components form a comprehensive system for smart home automation and security, integrating sensors, controllers, and communication devices to create an intelligent and responsive environment.

#### 4. PROPOSED METHOD

The proposed system is successfully implemented using Node MCU, effectively addressing the limitations of previous methods. All sensors are seamlessly integrated into the Node MCU board, and real-time results are accessible on a smartphone, updating every second. The system offers proactive monitoring, detecting gas leakages through the air purity sensor. In such instances, a high sensor value prompts the activation of a fan to expel the gas.

To accommodate the camera module's requirements, it is connected to the Arduino UNO board. Unlike Node MCU, which has limited analog pins, Arduino UNO provides multiple analog pins necessary for the camera module's operation. The system employs an IR sensor to

detect motion, triggering the camera module to capture images. These images are not only stored locally on a PC but are also sent to the user's email, enhancing the security features of the project. This comprehensive approach ensures effective monitoring, timely responses to environmental changes, and secure image capture for further analysis.

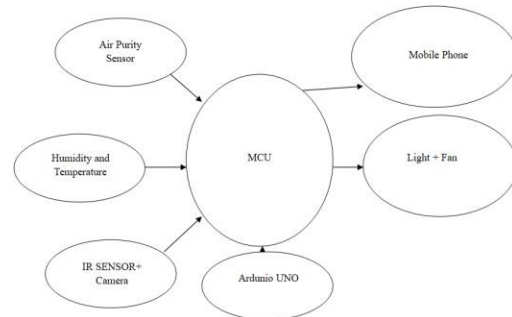


Fig 3. Proposed System

The versatile prototype can be utilized in the following ways:

**a. Smart Security System:**

The system operates as a smart security solution by integrating sensors such as the air purity sensor, IR sensor, and camera module. It detects gas leakages, monitors motion through the IR sensor, and captures images using the camera module. In case of unusual events, the system can alert the user in real-time, providing enhanced security for the monitored environment.

**b. Smart Home Automation System:**

The prototype functions as a smart home automation system by connecting various sensors to the Node MCU board. Users can remotely control home appliances through their smartphones, with real-time updates on sensor readings. This offers convenience and customization, allowing users to manage their home environment efficiently.

**c. Environment Monitoring:**

The system is also capable of environmental monitoring through sensors like the air purity sensor and humidity/temperature sensor. It continuously assesses air quality and environmental conditions, providing valuable data for analysis. This feature contributes to creating a healthier and more comfortable living space.

The proposed system boasts several advantages:

**Comprehensive Solution at Low Cost:**

This system offers a cost-effective solution that caters to both home security and home automation needs. Despite its affordability, it provides a wide range of functionalities, making it an accessible option for various users.

Enhanced Accessibility for Handicapped and Aged Individuals:

Particularly beneficial for handicapped and elderly individuals, the system's remote control capabilities simplify daily tasks. Users can operate devices and ensure home security with ease, enhancing their overall quality of life.

Long-Distance Device Control:

The system enables remote control of devices from a considerable distance. This feature adds a layer of convenience, allowing users to manage their home environment even when they are far away.

High Security and Time Efficiency:

The system prioritizes security, ensuring that both home automation and security measures are highly secure. Additionally, the system is designed for optimal time efficiency, streamlining tasks and minimizing manual interventions.

## 5. RESULTS

The outcomes of the implemented setup are visualized through the Blink app, providing users with real-time data and updates. The captured images from the OV7670 camera are not only stored in a designated folder on the PC but are also sent directly to the user's email. This dual functionality ensures that users have convenient access to visual data through the Blink app while also having a secure and retrievable archive of captured images for further reference. The combination of these features enhances the monitoring and security aspects of the system, providing a comprehensive solution for users.

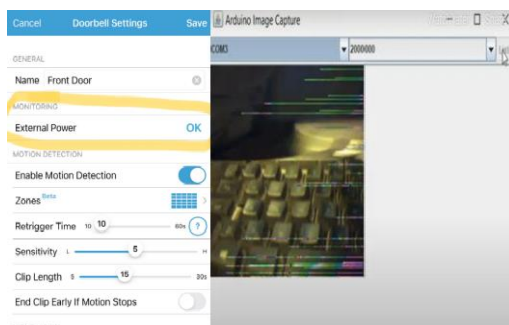


Fig 4. Output Images

## 6. CONCLUSION

The Internet of Things (IoT)-based home automation system relies on internet connectivity for operation. The proliferation of IoT devices presents both challenges and advantages. Notably, the system can seamlessly switch to 3G or 4G services when Wi-Fi is unavailable, highlighting the adaptability of IoT technology.

- One noteworthy feature of this project is the integration of a camera with the

microcontroller. This addition allows users to make informed decisions, such as determining whether to welcome a guest based on the captured picture received. In cases of uncertainty or potential security threats, users can take proactive measures by forwarding the image to the police station, providing an added layer of security and responsiveness.

- It's worth mentioning that this project is not limited to a specific microcontroller, as indicated by the mention of Raspberry. This flexibility allows users to choose hardware that best suits their requirements, enhancing the project's versatility and adaptability to various setups and preferences.

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