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# Voice Assistant Home Automation using Arduino Along with Biometric Door Lock System

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**ABSTRACT:** his paper presents a smart home automation system that integrates biometric authentication, voice control, and cloud-based monitoring using IoT technology. The system is developed using an Arduino microcontroller, a fingerprint sensor for secure access control, and a voice assistant for hands-free operation of home appliances. The implementation includes interfacing the fingerprint sensor with Arduino to authenticate users, utilizing the ThingSpeak platform for cloud-based data storage and remote access, and integrating Google Assistant for voice commands. Real-time data logging and monitoring through ThingSpeak enable user activity tracking, secure access management, and seamless control of household devices. Performance evaluation demonstrated high authentication accuracy, efficient voice recognition, and reliable data synchronization, ensuring enhanced security, convenience, and scalability for modern smart homes.

**KEYWORDS:** Voice Assistant, Arduino, Biometric Door Lock, Home Automation, IoT, Security, ThingSpeak

## I. INTRODUCTION

With the rapid advancement of technology, security and automation have become integral components of modern living. Traditional security measures, such as mechanical locks and physical keys, are increasingly insufficient in preventing unauthorized access and ensuring safety. As security threats evolve, a more intelligent, automated, and remotely accessible solution is required to enhance home security and convenience. Recent research highlights the growing adoption of smart home automation systems that integrate biometric authentication, voice control, and IoT-based monitoring to address these challenges effectively [1][2]. This paper presents a Voice Assistant Home Automation System with a Biometric Fingerprint Door Lock, designed to provide an advanced, hands-free, and secure solution for home security. The system leverages biometric fingerprint recognition to ensure that only authorized users can access the home, significantly reducing the risks associated with lost keys or unauthorized duplication [3]. Additionally, the integration of voice assistant technology allows users to control appliances such as lights, fans, and door locks without physical interaction, improving accessibility and user experience [4].

To further enhance the system's capabilities, IoT (Internet of Things) technology is employed for remote monitoring and control. Cloud platforms like ThingSpeak enable real-time data logging, analytics, and remote access, allowing users to monitor and control home appliances from anywhere in the world [5][6]. This feature improves security by maintaining access logs and providing alerts in case of unauthorized attempts. The system's integration with IoT and biometric authentication makes it a cost-effective, scalable, and user-friendly solution compared to traditional security mechanisms [7][8].

Several studies have explored the combination of home automation and biometric security. For instance, prior work on voice-controlled home automation systems using Google Assistant has demonstrated the efficiency of voice-based smart control [9]. Additionally, the use of Arduino-based automation has been explored in smart building management, showing potential for further optimization and integration with cloud-based security frameworks [10]. Furthermore, the base paper on Voice Assistant Home Automation Using Arduino [11] provides foundational insights into integrating Arduino and voice assistants for home automation, which this research extends by incorporating biometric security and IoT cloud integration. This paper is structured as follows: Section II discusses related works in smart home automation and biometric security. Section III presents the system design and methodology, including hardware and software components. Section IV provides implementation details, followed by Section V, which discusses performance evaluation and results.



## II. RELATED WORKS

Smart home automation has advanced with IoT, voice control, and biometric security. Norris et al. [1] and IJISSET [2] proposed IoT-based systems for remote appliance control, while Dhanapal and Balasubramanian [3] integrated fingerprint authentication for enhanced security. Thakur et al. [4] developed a voice-controlled system, and Kumar & Sharma [6] implemented cloud-based monitoring for improved accessibility.

Cloud integration further strengthens automation by enabling remote access and data analytics. Akhtar et al. [9] and Kumar & Raj [10] utilized ThingSpeak for cloud-based monitoring, while Jose & Raj [7] and Kumar et al. [8] leveraged Blynk for smart home control. Patil et al. [11] introduced a voice-controlled Arduino-based system, which lacked biometric security and cloud integration. This paper enhances prior works by combining biometric authentication, voice control, and IoT-based cloud monitoring for improved security and convenience.

## III. SYSTEM DESIGN AND METHODOLOGY

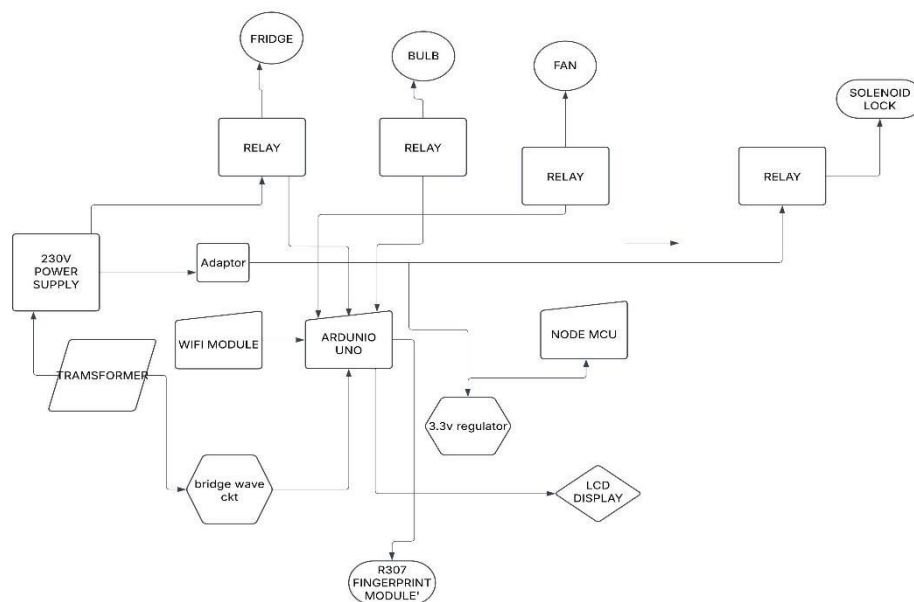


Figure 1:Block Diagram of the proposed system

The proposed system integrates biometric authentication, voice assistant control, and IoT-based remote monitoring to enhance home automation security. The core components include an Arduino microcontroller, a fingerprint sensor for secure access control, Google Assistant for voice commands, and ThingSpeak for real-time data storage and monitoring. These components work together to provide a seamless, hands-free, and highly secure home automation experience. A block diagram of the system is presented in Figure 1, illustrating the interaction between biometric authentication, voice-based control, and cloud monitoring. The hardware components of the system include the Arduino microcontroller, which serves as the central processing unit, handling inputs from various sensors and controlling output devices. A fingerprint sensor is used for biometric authentication, ensuring that only registered individuals can unlock the door [5]. The ESP8266 Wi-Fi module enables cloud connectivity, allowing real-time monitoring and control of devices through ThingSpeak [9]. For voice control, Google Assistant is integrated via IFTTT, allowing users to operate appliances hands-free [4]. Additionally, a solenoid door lock is employed for secure biometric-based access [5], while a relay module is used to switch electrical appliances on and off [1].

The software implementation involves several platforms. The Arduino IDE is used for programming the microcontroller and managing hardware interactions. ThingSpeak is utilized for storing and analyzing real-time sensor data, allowing users to access historical logs and monitor device activity [9]. Furthermore, IFTTT acts as a bridge between Google Assistant and ThingSpeak, ensuring smooth execution of voice commands [4].





The system follows a structured workflow, beginning with user registration and authentication. New users register their fingerprints, which are stored in the Arduino's memory. When a registered user places their finger on the scanner, the system verifies access and triggers the solenoid door lock [5]. For voice-controlled automation, users give voice commands through Google Assistant, which are processed via IFTTT and sent to ThingSpeak, ultimately activating the respective appliance [4]. Additionally, the ESP8266 module continuously sends sensor data to ThingSpeak, allowing users to monitor access records and control appliances remotely [9].

By integrating biometric security with IoT-based automation, the proposed system ensures a highly secure, efficient, and scalable home automation solution. The combination of fingerprint authentication, voice commands, and cloud monitoring provides enhanced convenience and protection, addressing the limitations of traditional security systems.

#### IV. IMPLEMENTATION

The proposed voice assistant-based home automation system with a biometric door lock is implemented using an Arduino microcontroller, ESP8266 Wi-Fi module, fingerprint sensor (R307), solenoid door lock, and ThingSpeak cloud integration. The system is designed to enhance home security and automation by incorporating biometric authentication for controlled access and voice commands for appliance control, ensuring a seamless and efficient user experience. The integration of IoT technologies enables real-time monitoring and remote access, making the system highly reliable and scalable. The fingerprint authentication module is a crucial component of the system, responsible for verifying user identity before granting access. When a user places their finger on the R305 fingerprint sensor, the sensor captures and processes the biometric data, comparing it against stored templates in the EEPROM of the Arduino. Upon successful authentication, the Arduino triggers the solenoid door lock via a relay module, allowing the authorized user to enter. In case of an unauthorized fingerprint attempt, the system logs the entry and notifies the user through an alert mechanism, thereby enhancing security. The authentication records, including the timestamp and user ID, are transmitted to the ThingSpeak cloud, allowing homeowners to remotely monitor access logs in real time. This cloud integration ensures data persistence and provides analytical insights into entry patterns, strengthening home security measures.

The voice-controlled home automation functionality is achieved through the integration of Google Assistant, IFTTT (If This Then That), and the Blynk platform. When a user issues a voice command, such as turning on or off a light, the command is processed through the ESP8266 Wi-Fi module, which relays the signal to the Arduino microcontroller. The microcontroller interprets the command and controls the corresponding home appliances via relay switches. This enables users to manage household devices effortlessly through voice interaction. The system also includes a manual override function, ensuring that appliances can still be controlled in the absence of an internet connection, thereby increasing reliability and practicality.

To facilitate remote monitoring and data storage, the system employs ThingSpeak, an IoT analytics cloud platform, for real-time data logging and visualization. The cloud interface stores and displays user access logs, appliance status, and unauthorized entry attempts, providing homeowners with comprehensive control and oversight. Secure communication between the microcontroller and the cloud is achieved using the MQTT (Message Queuing Telemetry Transport) protocol, ensuring low-latency, efficient data transmission. Furthermore, to enhance data security, AES encryption is implemented to protect sensitive information from unauthorized access. The system is optimized for power efficiency by implementing sleep modes on the ESP8266 module, reducing energy consumption during idle states. The combination of biometric authentication, voice-controlled automation, and IoT-based remote monitoring creates an intelligent and highly functional smart home solution. By integrating real-time access control with cloud-based monitoring, this system provides enhanced security, convenience, and energy efficiency, making it a robust implementation for modern home automation.

#### V. RESULT AND DISCUSSION

The proposed voice assistant-based home automation system with a biometric door lock has been successfully implemented and tested. The system effectively integrates biometric authentication, voice control, and IoT-based remote monitoring, demonstrating its reliability and efficiency in enhancing home security and automation.

The circuit setup, as shown in Figure 2, comprises an Arduino microcontroller, an ESP8266 Wi-Fi module, an R305 fingerprint sensor, a solenoid door lock, a relay module, and an LCD display. Each component is interconnected to ensure smooth operation, with the microcontroller serving as the central processing unit. The ESP8266 module enables cloud



connectivity via ThingSpeak, while the relay module facilitates the control of home appliances. During testing, the hardware components functioned as expected, responding accurately to user inputs and commands.

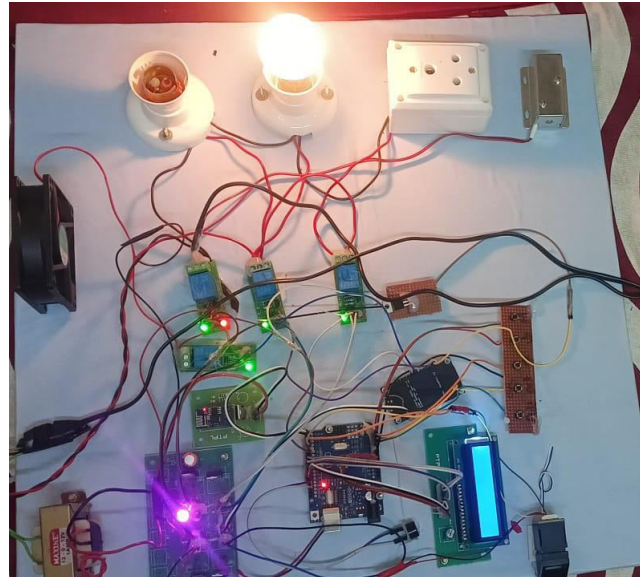


Fig. 2 circuit setup

When an authorized user places their finger on the fingerprint sensor, the system successfully verifies the biometric data and displays a confirmation message on the LCD screen, as illustrated in Figure 3. The message "Authorized Person - Door Open" is shown, and the solenoid door lock is triggered, granting access. This process is executed within seconds, ensuring quick and seamless authentication. Additionally, the entry event is recorded and transmitted to the ThingSpeak cloud, where the homeowner can monitor access logs in real time.

Conversely, when an unauthorized person attempts to gain access, the system denies entry and displays an alert message on the LCD, as depicted in Figure 4.



Fig 3 Access approval to open door

The message "Unauthorized Person - Access Denied" is shown, and the solenoid door lock remains locked. Simultaneously, an alert is logged on the ThingSpeak dashboard, notifying the homeowner of the unauthorized attempt. This feature enhances security by providing real-time intrusion detection and logging.

The ThingSpeak dashboard, as shown in Figure 5, effectively visualizes the system's real-time data, including user authentication logs, appliance control status, and unauthorized access attempts. The dashboard provides graphical representations of recorded data, enabling users to analyze entry trends and appliance usage patterns over time. The cloud-based monitoring system ensures that homeowners have remote access to security and automation controls, adding an extra layer of convenience.

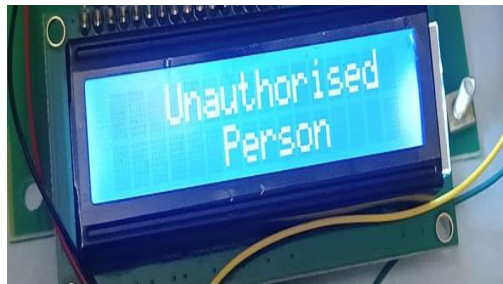


Fig 4. Access Denial

Through extensive testing, the system has demonstrated high accuracy in fingerprint recognition, efficient real-time data transmission via the ESP8266 module, and seamless integration with cloud-based monitoring. The voice control feature, implemented using Google Assistant and IFTTT, has been tested for various appliance control commands, with a high response rate and minimal latency. The inclusion of manual override functionality ensures that the system remains operational even in the absence of an internet connection, increasing its reliability.

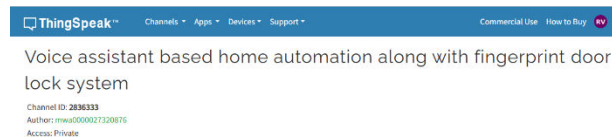


Fig 5 ThingSpeak Dashboard

Overall, the experimental results validate the effectiveness of the proposed system in providing a secure and smart home automation solution. The integration of biometric authentication, voice control, and IoT-based cloud monitoring significantly enhances home security and convenience. Future improvements may include expanding the system with facial recognition, AI-based anomaly detection, and enhanced encryption techniques to further strengthen data security.

## VI. CONCLUSION

The proposed voice assistant-based home automation system with a biometric door lock successfully integrates IoT and smart security solutions to enhance both convenience and safety. By utilizing fingerprint authentication and voice control via Google Assistant, the system ensures seamless access management while preventing unauthorized entry. The implementation of a solenoid door lock, controlled through Arduino and ESP modules, guarantees secure and efficient operation. Real-time monitoring through the ThingSpeak cloud platform enables users to track entry logs and control home appliances remotely, improving overall home security and automation.

The system's effectiveness has been validated through rigorous testing, demonstrating reliable authentication and appliance control. The LCD module accurately displays user authorization status, ensuring immediate feedback to residents. Unauthorized access attempts are logged in the cloud, providing an additional layer of security. This project highlights the potential of integrating AI-driven automation and IoT in modern homes, paving the way for future enhancements such as multi-factor authentication, AI-based intrusion detection, and encrypted data transmission to further strengthen security and usability.

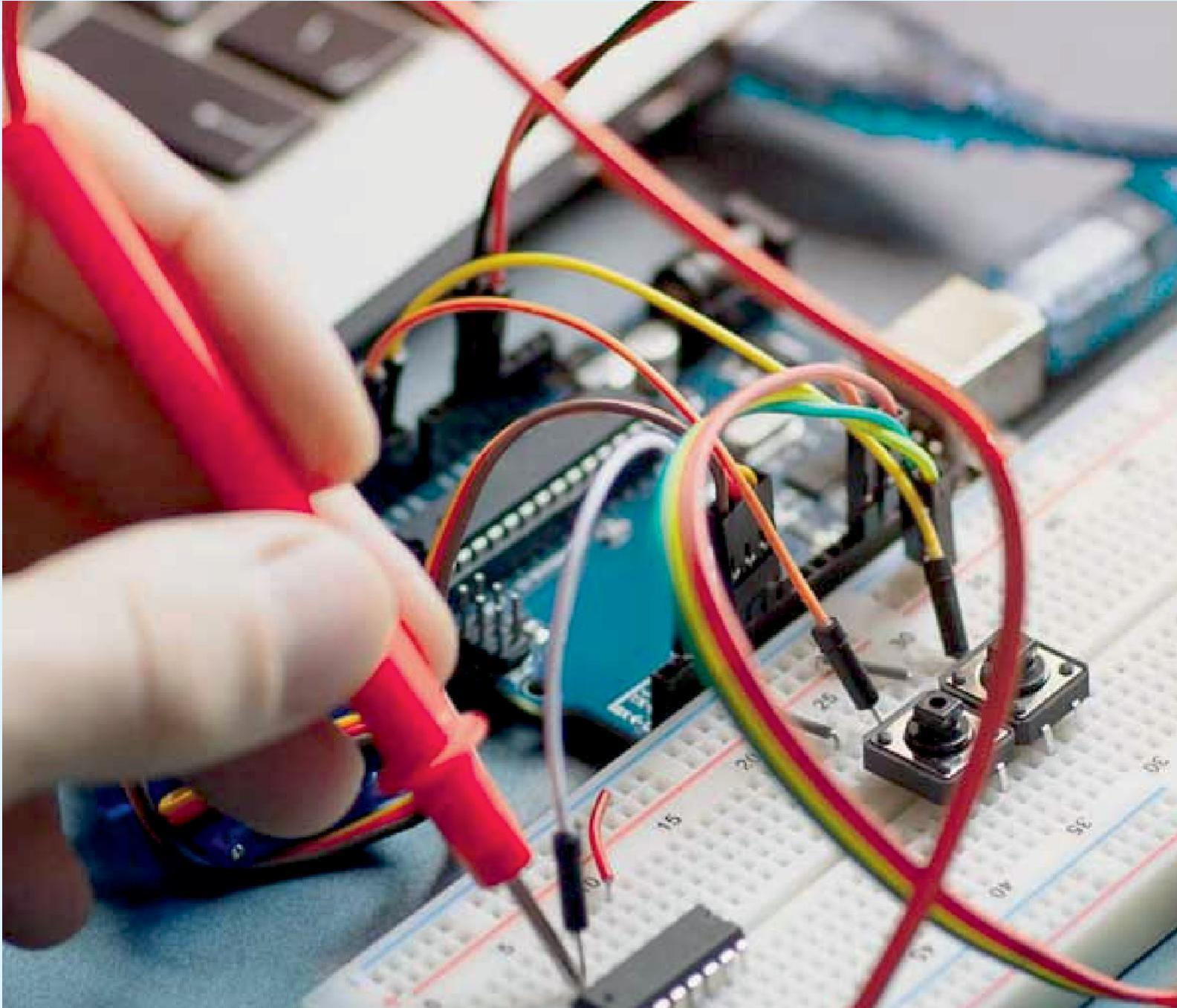
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