"Revolutionizing Comfort: Smart Room Automation for Effortless Door Access and Temperature Control"

Abstract

The project aims to develop an IoT-based system for controlling a door and maintaining temperature using ultrasonic and DHT sensors, DC and AC motors, and relay modules. The system offers convenience and automation in door access and temperature regulation, enhancing user comfort and energy efficiency. The ultrasonic sensor is utilized to detect the presence of individuals near the door. When someone approaches, the sensor triggers the opening mechanism, activating the DC motor to open the door automatically. This feature is particularly beneficial in situations where hands-free access is desired, such as in hospitals, offices, or residential buildings. To maintain a desired temperature, a DHT sensor measures the ambient temperature, and the system compares it with the user-defined setpoint. If the temperature deviates from the setpoint, the system activates an AC unit by controlling an AC motor using a relay module. This ensures that the environment remains within the desired temperature range, improving comfort and energy efficiency. Furthermore, the project incorporates Blynk IoT integration, allowing remote control and monitoring of the system through a mobile application. The user can use the Blynk app to activate or deactivate the door opening mechanism and adjust the temperature settings as needed. Overall, this IoT-based system provides a seamless and automated solution for door access and temperature regulation, enhancing user convenience, energy efficiency, and remote-control capabilities.

Introduction: In the era of IoT (Internet of Things), automation and smart technologies have revolutionized various aspects of our lives. The project at hand aims to leverage these advancements to develop an innovative system for controlling a door and maintaining optimal temperature. With the integration of ultrasonic and DHT sensors, DC and AC motors, and relay modules, this project offers a seamless and efficient solution that enhances both convenience and energy efficiency.

Imagine a scenario where you approach a door, and it magically opens without you needing to lift a finger. This futuristic concept becomes a reality with the implementation of the ultrasonic sensor. By detecting the presence of individuals near the door, the sensor triggers the opening mechanism, activating a DC motor that smoothly opens the door. Whether it's in hospitals, offices, or even homes, this hands-free access solution offers convenience and accessibility, especially in situations where hands may be occupied, or hygiene is of utmost importance.

But the project doesn't stop there. It goes a step further by addressing the need for maintaining a comfortable and consistent indoor environment. With the integration of a DHT sensor, the system constantly monitors the ambient temperature. The user can set their desired temperature, and if there is a deviation from the setpoint, the system acts. By controlling an AC motor through a relay module, the system activates the AC unit, ensuring that the environment remains within the desired temperature range. This not only optimizes comfort but also enhances energy efficiency by regulating the AC usage based on actual requirements.

In addition to the remarkable features mentioned, the project incorporates Blynk IoT integration, making it possible to control and monitor the system remotely. Through a user-friendly mobile application, users can effortlessly activate or deactivate the door opening mechanism, adjust temperature settings, and receive real-time updates on the system's status. This remote-control capability adds a layer of convenience and flexibility, allowing users to interact with the system from anywhere at any time.

With its eye-catching blend of automation, IoT connectivity, and efficient functionality, this project showcases the transformative power of technology in simplifying our daily lives. By revolutionizing door access and temperature regulation, it offers a glimpse into a future where convenience, comfort, and energy efficiency seamlessly coexist.

Literature review:

This project introduces a comprehensive smart home system equipped with temperature monitoring, automatic door lock, security sensors, and water level control, ensuring the safety and convenience of the occupants. The system incorporates a PC as the communication medium, LabVIEW software for control, and an Arduino microcontroller integrated with sensors and voice synthesizers for real-time feedback. This invention offers a fully automated and secure environment, providing users with a safe and convenient living experience [1]. This research work presents a cost-effective smart home

automation system based on IoT and Edge-Computing. Utilizing a Raspberry Pi (RPI) as the central controlling unit, the system offers remote and automatic control of home appliances, ensuring security and privacy by storing sensitive data locally. The proposed solution efficiently processes visual and scalar sensor-generated data on the RPI, reducing bandwidth, computation, and storage costs. Compared to existing solutions, the system demonstrates a 5% faster motion detection and faster relay switching, while achieving a 6% improvement in energy efficiency. This advancement addresses the need for comprehensive smart home applications that encompass automation, security, safety, and energy conservation, making homes more convenient, efficient, and secure in the era of IoT [2]. This paper introduces qToggle, a system designed for interconnecting sensors, actuators, and other data sources to enable multiple home automation functionalities. qToggle utilizes a flexible and powerful API as the communication foundation, allowing for seamless integration of devices. The system supports devices based on ESP8266/ESP8285 chips and Raspberry Pi boards, providing a user-friendly smartphone application for controlling home appliances and sensors. With its user-friendly interface and flexibility, qToggle can be expanded with additional devices and add-ons, offering a versatile solution for home automation. The system brings simplicity and convenience to users, streamlining day-to-day tasks and enhancing the automation experience in the modern digitalized era [3]. The emergence of IoT technologies has opened up new possibilities for smart home automation, offering convenient control over home appliances remotely. However, there is a need for a reliable and user-friendly system that takes into account the devices used and network environment. This paper explores the use of NETPI and BLYNK, IoT frameworks that enable hardware-agnostic connectivity with smartphones, websites, private clouds, and advanced features like system security, data mining, and deep learning. The study demonstrates that NETPI offers flexibility for managing multiple NODEMCU controllers within a single control framework, showcasing the system's effectiveness in monitoring and controlling home appliances from a remote location. The research contributes to the advancement of smart home automation, addressing the demand for reliable and efficient systems in today's IoT-driven world [4]. This project proposes a cost-effective and hybrid IoT-based home automation system that overcomes the limitations of existing systems. The system enables easy monitoring and control of home appliances through a user-friendly interface via smartphones or laptops. The design incorporates MQTT communication and the Cayenne IoT platform to govern smart objects such as fans, lights, doors, and sensors. The NodeMCU-ESP8266 microcontroller, known for its affordability and high performance, is utilized as the hardware component. The project aims to develop a prototype that showcases the capabilities of smart home automation using IoT technology, providing users with a convenient and efficient home management solution [5]. The paper introduces a non-intrusive approach for integrating and collecting data from open standard IoT devices to enable personalized smart home automation. The focus is on leveraging big data analytics

and machine learning techniques to enhance the capabilities of smart home devices. The proposed approach addresses compatibility issues between devices from different manufacturers and enables seamless communication and control among them. By employing open-source frameworks like Apache Spark, Apache NiFi, and FB-Prophet, along with popular vendor tech-stacks such as Azure and DataBricks, the implementation of the proposed approach is demonstrated. The research showcases the potential of non-intrusive IoT-based big data analytics in achieving enhanced automation and optimization in smart home environments, offering a promising solution for the adoption of cost-effective and interoperable smart home technologies [6]. This paper highlights three key barriers to the broader adoption of smart home automation: different underlying technologies, security and privacy concerns, and the need for user awareness of machine intelligence. To address these challenges, the paper proposes a model that integrates IoT services and wireless technologies to develop a secure and voice-controlled artificial intelligence system for smart home automation. The model aims to achieve simplicity, security, and integration by seamlessly controlling multiple home devices through voice commands. The paper demonstrates the practical application of the model in various use cases, showcasing its potential to enhance the user experience and overcome barriers to widespread adoption of smart home technologies. By providing a secure and intelligent voice-controlled solution, this research contributes to improving living standards and enabling the seamless integration of IoT devices in residential environments [7]. The paper emphasizes the advantages of IoT-based smart homes in simplifying and enhancing daily life. It highlights potential applications such as remote control of lights, security systems, and home appliances using mobile devices. While commercial smart home automation systems can be expensive, the availability of affordable microcontrollers like Arduino has made it feasible to implement cost-effective IoT-based smart home systems. The paper introduces a user-friendly and affordable smart home model utilizing Arduino microcontrollers and various sensors. The model aims to provide a reliable and affordable solution that meets the needs of home users, allowing them effective control over home appliances. By leveraging Arduino technology and sensor integration, this research contributes to the development of affordable and user-centric smart home automation systems, making smart home technology more accessible and practical for a wider user base [8]. This study addresses the increasing demand for electric power and the challenges associated with power shortfall and emergencies. A proposed technique offers an optimal solution by automating appliances through local, web-based, and app-based automation. The system utilizes a microcontroller for local control and enables remote control via a web page or application. This approach helps conserve energy by automatically or manually switching appliances on and off based on need. Experimental results demonstrate the system's high accuracy in local, web-based, and app-based scenarios. Additionally, the system handles emergency situations by calculating the load and performing smart switching to ensure device safety during abnormal voltage conditions. By providing efficient

energy usage and addressing power shortage issues, this research contributes to improving power management and enhancing the overall efficiency and reliability of electricity consumption in residential and commercial settings [9].

Summary: This paper presents a novel approach to smart home automation that addresses key challenges in the field, including intelligent decision making, secure identification, and authentication of IoT devices, continuous connectivity, and data security. The proposed system utilizes a machine learning algorithm (Support Vector Machine) for intelligent decision making and blockchain technology for ensuring secure identification and authentication of IoT devices. The system is implemented using Raspberry Pi, a relay circuit, and various sensors, with a mobile application developed on the Android platform. Experimental results validate the effectiveness and usefulness of the proposed system, demonstrating its significance in addressing the challenges of smart home automation. The hardware and technology used are cost-effective, readily available, and replicable, making the system practical for real-life applications. By integrating machine learning and blockchain technology, this research contributes to the advancement of secure and intelligent smart home automation systems, paving the way for enhanced convenience, efficiency, and data privacy in smart home environments [10].

S.NO	Paper title	Name of the conference/ Journal	Proposed concept
1	A Low-Cost Home Automation System Using Wi-Fi Based Wireless Sensor Network Incorporating Internet of Things (2017)	IEEE	This paper presents a low-cost Home Automation System (HAS) utilizing Wi-Fi, enabling seamless control of interconnected smart devices in a home. A Wi-Fi based Wireless Sensor Network (WSN) is designed for monitoring and controlling various parameters, with an affordable implementation cost of approximately INR 6000 or USD 100.
2	Design, Implementation and Practical Evaluation of an IoT Home Automation System for Fog Computing Applications Based on MQTT and ZigBee-WiFi Sensor Nodes (2018)	MDPI journals	ZiWi is a distributed fog computing Home Automation System (HAS) that enables seamless communication between ZigBee and WiFi devices, offering faster response times and addressing cross-interference challenges. It emphasizes efficiency and security by measuring the impact of encryption mechanisms on node consumption.
3	Implementation of Realtime Database for IoT Home Automation and Energy Monitoring Apps based on Android (2019)	IEEE	This paper focuses on the implementation of a real-time database for home automation and energy monitoring in an IoT platform. It discusses the system design, data protocol, and storage mechanism, aiming for high accuracy and minimal execution time. The performance of the designed database will be showcased, emphasizing its significance in IoT applications.

4	IOT Home Automation using Bluetooth	iJRASET journals	This research paper focuses on IoT-based Home Automation, enabling convenient and efficient control of home appliances. Through the use of Bluetooth and a microcontroller, users can effortlessly manage various devices within their home, enhancing comfort and eliminating the need for manual control. Additionally, this system addresses energy wastage concerns by providing a solution that optimizes energy usage through the utilization of advanced technology.
5	IOT home automation – Smart homes and Internet of Things	3rd IAECST conference	This article explores the emerging industry of IoT furniture, where IoT chips are embedded in everyday objects such as LED lights and door locks. Due to size limitations, data collected by the furniture's sensors are uploaded to the cloud for analysis. Cloud services and protocols are essential for remote monitoring and control. However, the IoT industry is still evolving, presenting challenges in terms of suitable protocols and complex integration. This article examines the current ecosystem, industry examples, and the technical hurdles that companies must address in the IoT furniture sector.
6	Green Planning of IoT Home Automation Workflows in Smart Buildings	ACM journals	This research paper presents the IoT Meta-Control Firewall (IMCF+) framework, designed to optimize energy consumption and CO2 emissions in smart buildings. By intelligently scheduling energy consumption using the innovative Green Planner (GP) algorithm, IMCF+ balances user comfort levels with renewable energy production patterns. The framework achieves a significant CO2 reduction of 45-59% while minimizing the impact on user comfort levels by approximately 3%. The implementation and evaluation in an openHAB IoT ecosystem demonstrate the effectiveness of IMCF+ in promoting energy efficiency and environmental sustainability.

Problem statement: The problem at hand is to develop an IoT-based project that integrates various components to automate a smart home system. The project aims to address the challenges of door automation and temperature control using an ultrasonic sensor, a DC motor for the door, and a DHT sensor to monitor and maintain the desired temperature using an AC motor. Additionally, the system requires the integration of two 2-channel relays, one for controlling the motors and the other for connecting to the Blynk IoT platform for remote control. The objective is to design a reliable and user-friendly system that ensures seamless operation of the door and temperature control, while also providing remote accessibility and control through the Blynk platform.

Objective: The objective of the proposed system is to develop a comprehensive IoT-based solution for home automation that integrates various components and technologies to achieve efficient door control and temperature management. The system aims to provide seamless operation of the door using an ultrasonic sensor and a DC motor, allowing users to open and close the door remotely. Additionally, the system utilizes a DHT sensor to monitor the temperature and regulate it by controlling an AC motor. The integration of 2-channel relays enables the connection to the Blynk IoT platform, providing users with the flexibility to remotely control and monitor the system. The goal is to create a reliable and user-friendly system that enhances convenience and comfort in a smart home environment.

Architecture: The proposed system architecture for the IoT-based home automation project is designed to provide efficient control over the door and temperature regulation in a smart home environment. The architecture consists of several components and technologies working together seamlessly.

1. NodeMCU (Node Microcontroller Unit): The NodeMCU serves as the central controller in the system. It is an open-source IoT platform based on the ESP8266 Wi-Fi module, providing connectivity and processing capabilities.

2. Ultrasonic Sensor: An ultrasonic sensor is connected to the NodeMCU to detect the presence of objects in front of the door. It emits ultrasonic waves and measures the time taken for the waves to bounce back, enabling the system to determine if there is an obstruction in front of the door.

3. DC Motor and Relay: The DC motor is used to control the door's opening and closing mechanism. It is connected to a 2-channel relay, which acts as a switch to control the motor's operation. The relay is connected to the NodeMCU, allowing it to send signals to activate or deactivate the motor based on the inputs received from the ultrasonic sensor.

4. DHT Sensor: The DHT sensor is used to measure the temperature and humidity in the environment. It provides real-time temperature readings, which are used to regulate the AC motor for maintaining the desired temperature. The DHT sensor is connected to the NodeMCU, allowing it to gather temperature data and send it for processing.

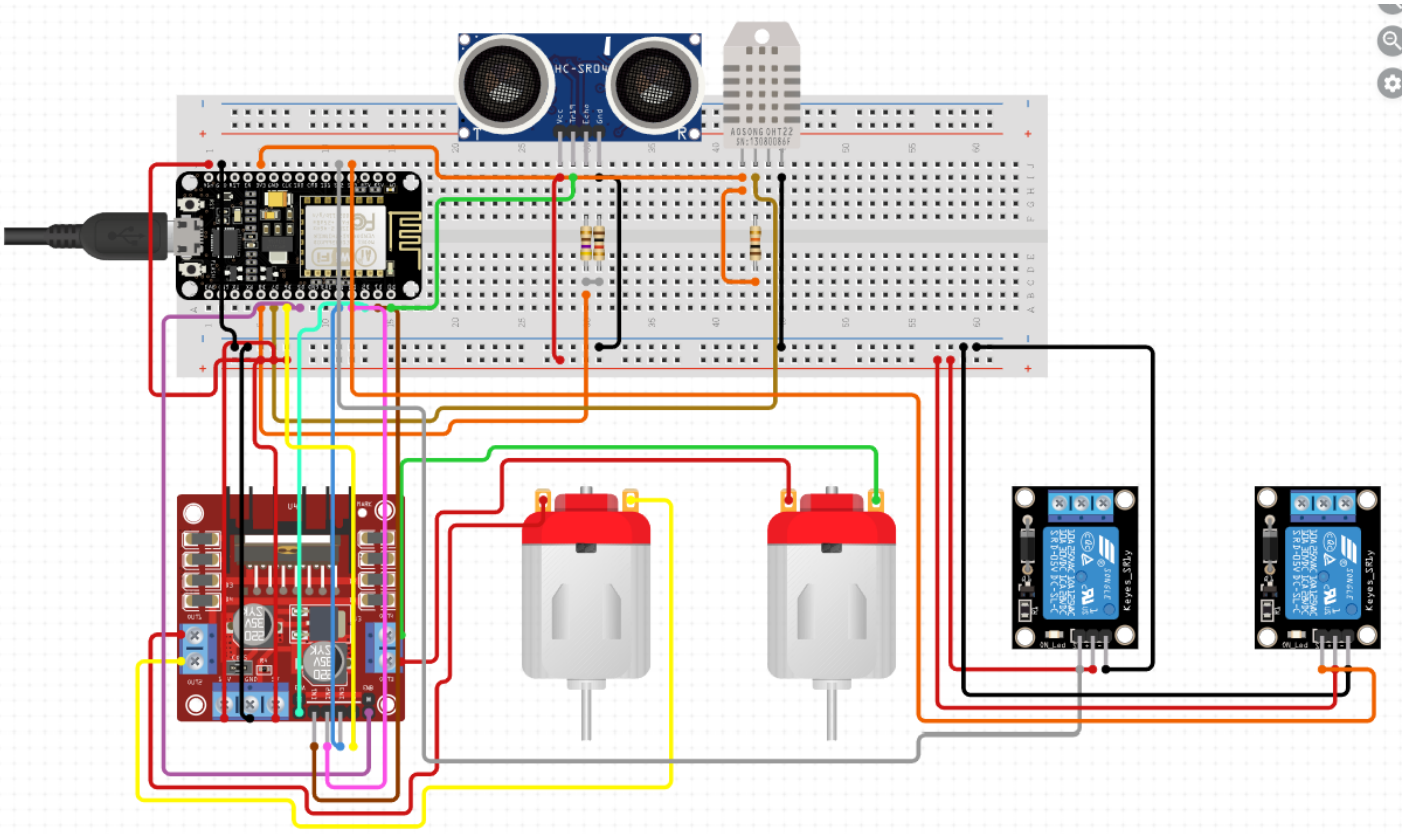
5. AC Motor and Relay: The AC motor is connected to another 2-channel relay, enabling control over the air conditioning

system. The relay is connected to the NodeMCU and receives signals based on the temperature readings from the DHT sensor. When the temperature exceeds the set threshold, the relay triggers the AC motor to turn on and regulate the temperature.

6. Blynk IoT Platform: The Blynk platform is utilized for remote control and monitoring of the system. It provides a mobile application and web interface through which users can access and control the door and air conditioning system. The 2-channel relay connected to the Blynk platform enables users to remotely activate or deactivate the motors as desired.

The proposed system architecture leverages the capabilities of the NodeMCU as the central controller, integrating the ultrasonic sensor, DHT sensor, DC motor, AC motor, and relays. The system is designed to provide seamless communication and control, allowing users to remotely open and close the door, regulate the temperature, and monitor the system through the Blynk platform.

Overall, the proposed system architecture offers an efficient and convenient solution for home automation, enhancing comfort, security, and energy efficiency in a smart home environment.



Implementation method: The implementation of the proposed IoT-based home automation system involves several steps:

1. Hardware Setup: Connect the NodeMCU board to the necessary components, including the ultrasonic sensor, DHT sensor, DC motor, AC motor, and relays. Ensure proper wiring and connections between the components and the NodeMCU board.

2. Software Development: Develop the firmware or software code for the NodeMCU board using the Arduino IDE or any suitable programming environment. Write code to interface with the sensors, read data, control the motors, and communicate with the Blynk IoT platform.

3. Blynk Integration: Set up an account on the Blynk platform and create a project. Obtain the authentication token required to establish communication between the NodeMCU board and the Blynk platform. Integrate the Blynk library and incorporate the necessary code in the firmware to establish a connection with the Blynk server.

4. Sensor Calibration: Calibrate the ultrasonic sensor and DHT sensor to ensure accurate readings. Adjust the thresholds for the ultrasonic sensor to detect obstructions in front of the door. Set the desired temperature range for the DHT sensor to regulate the AC motor.

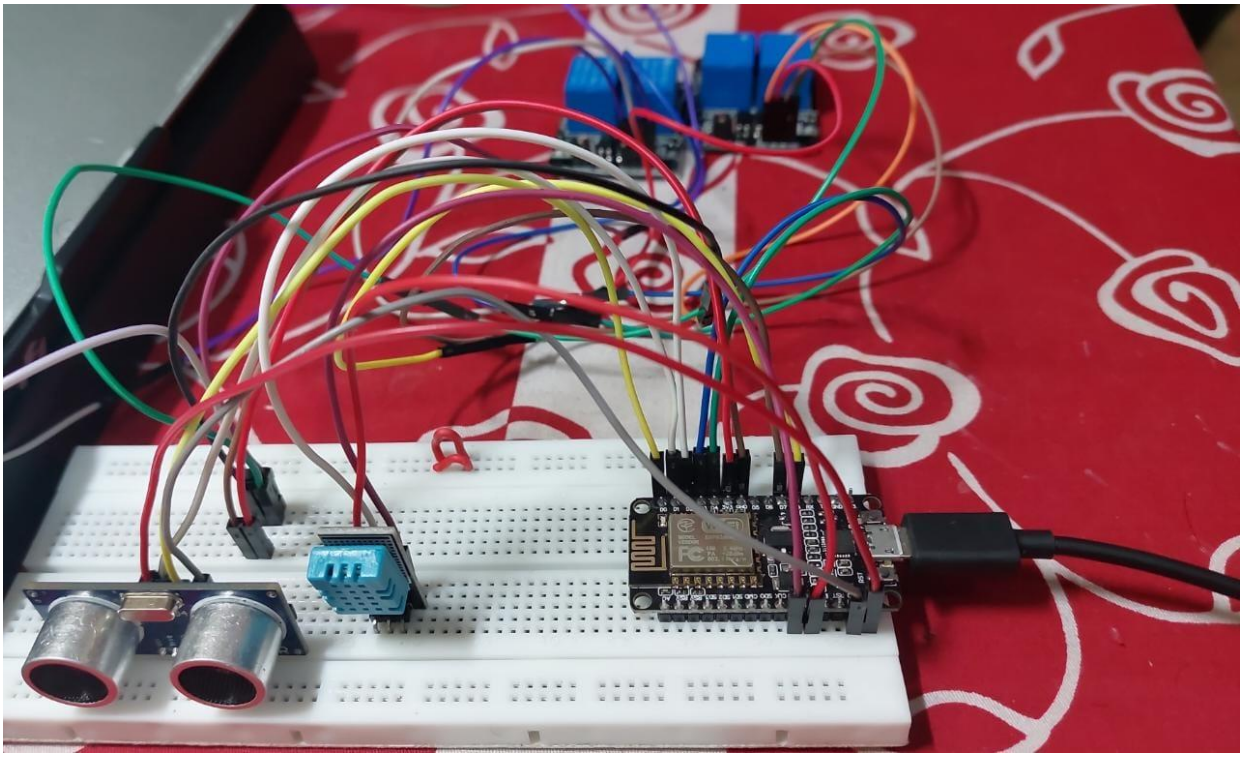
5. Mobile App Configuration: Customize the Blynk mobile application interface to include controls for the door and air conditioning system. Configure the app to display real-time sensor data such as temperature and humidity readings.

6. Testing and Deployment: Upload the firmware to the NodeMCU board and power up the system. Test the functionality by opening and closing the door based on the ultrasonic sensor readings. Monitor the temperature readings and observe the control of the AC motor based on the DHT sensor data. Ensure that the Blynk app successfully communicates with the NodeMCU board for remote control.

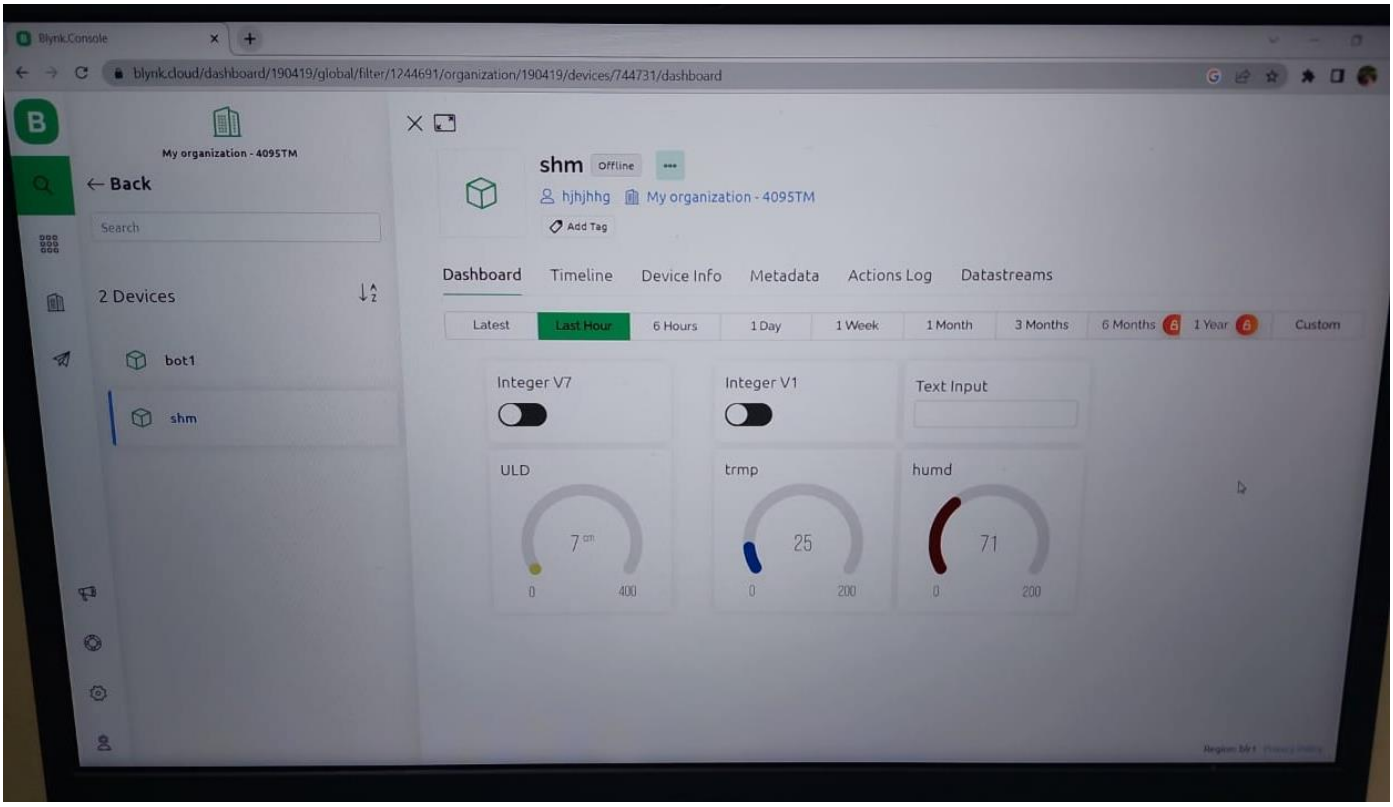
7. Refinement and Optimization: Fine-tune the system as necessary to optimize performance and ensure smooth operation. Adjust sensor thresholds, motor control logic, and app interface based on user requirements and feedback.

By following these implementation steps, the IoT-based home automation system can be successfully deployed, allowing users to remotely control the door and regulate the temperature in a convenient and efficient manner.

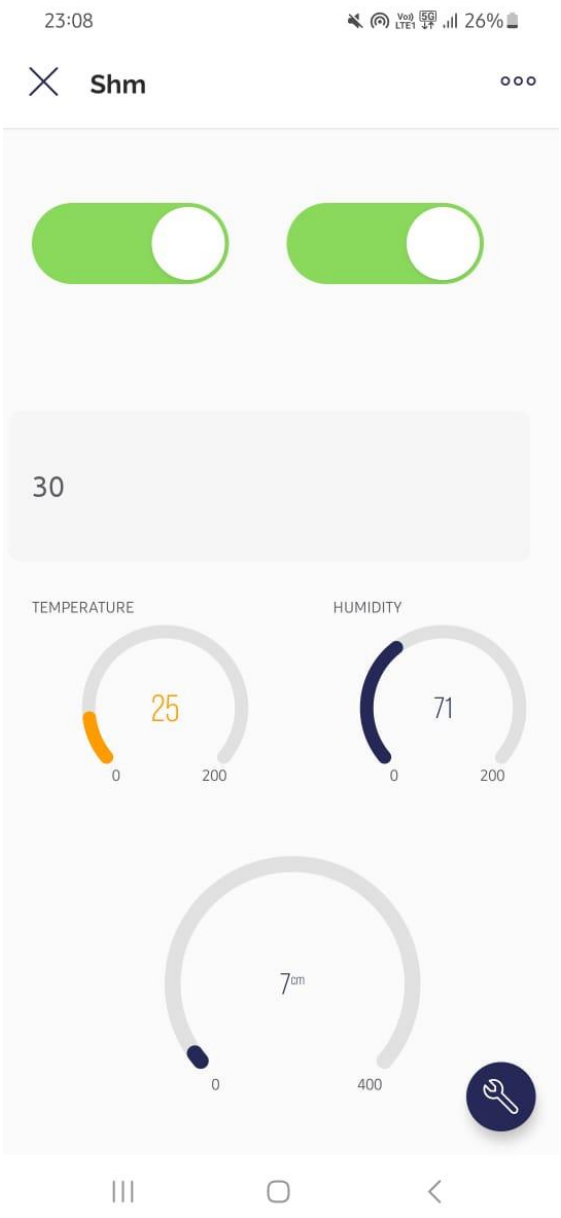
Circuit:



Web view:

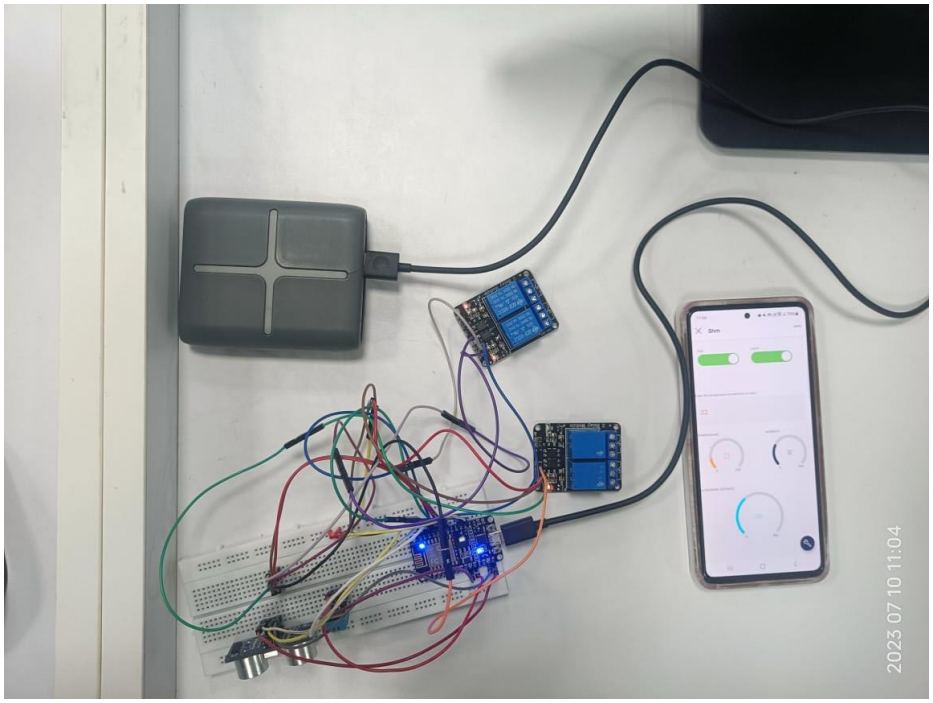


App view:

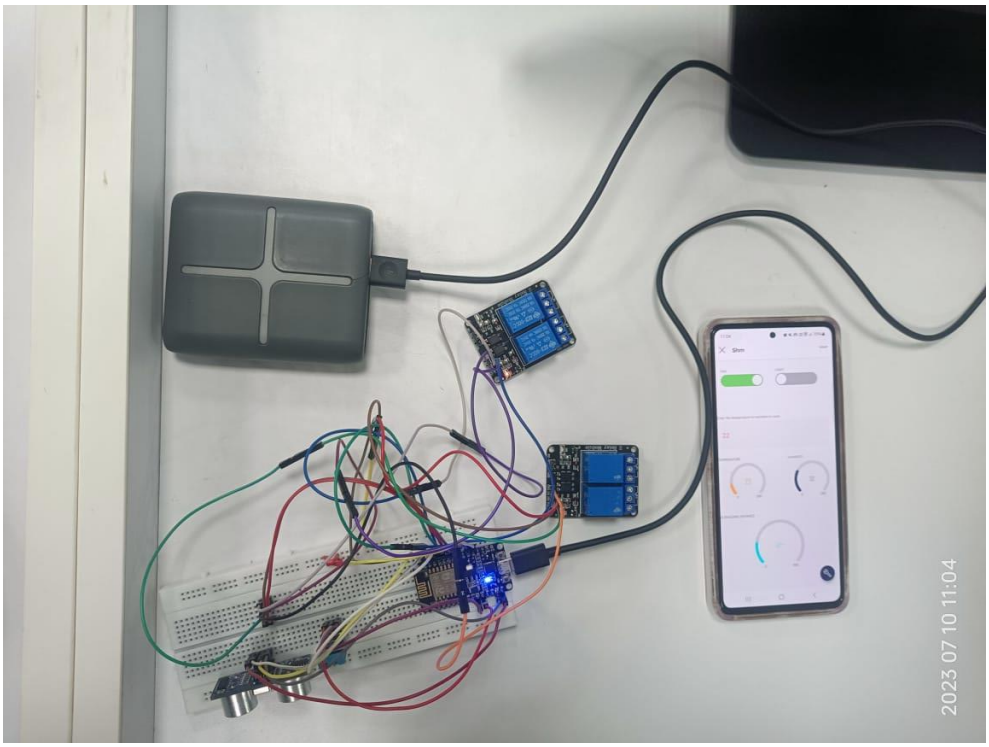


Implementation images:

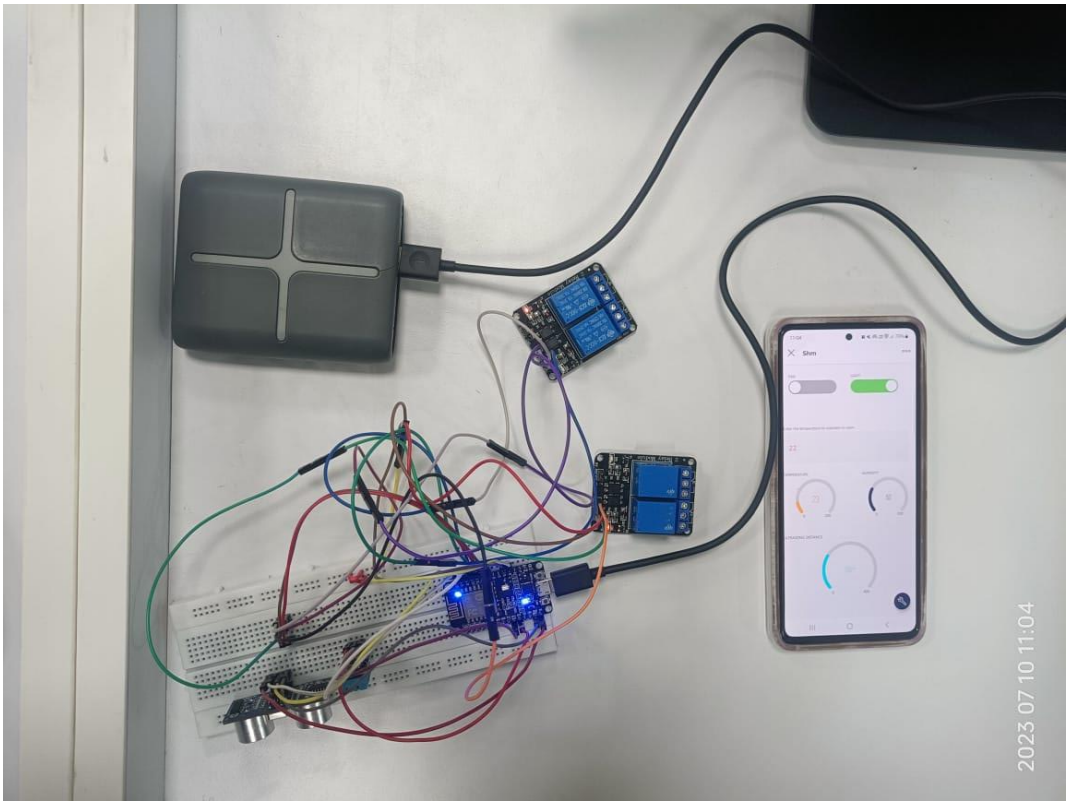
1) **Case where the digital switch of fan and light is on and the ac switch is turned on:**



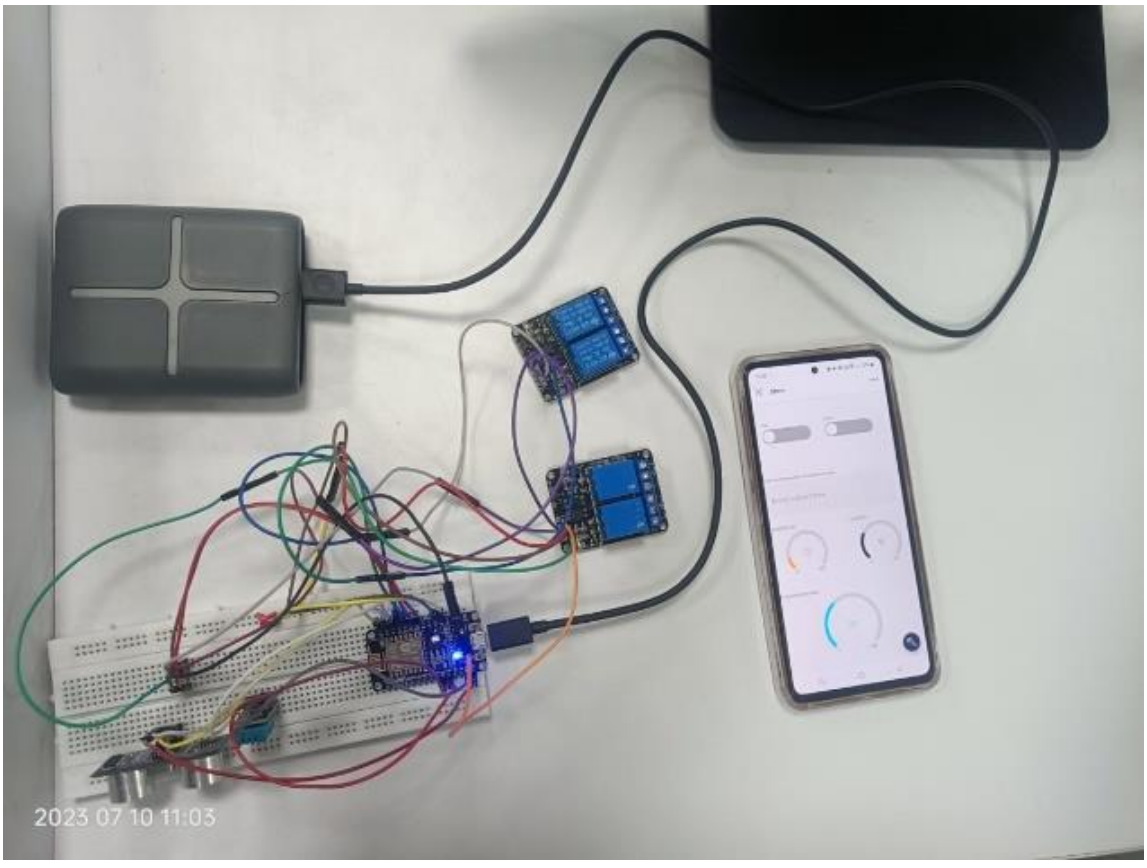
2) **Only fan of the relay is turned on:**



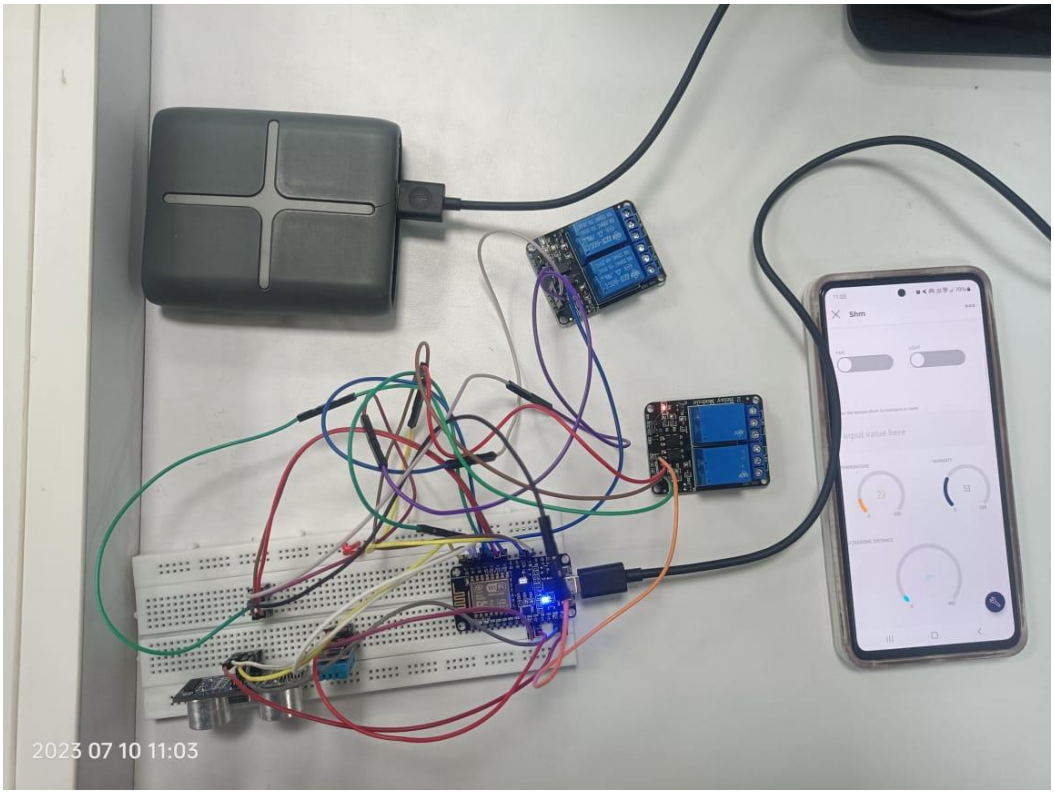
3) **Only the light of the relay is turned is on:**



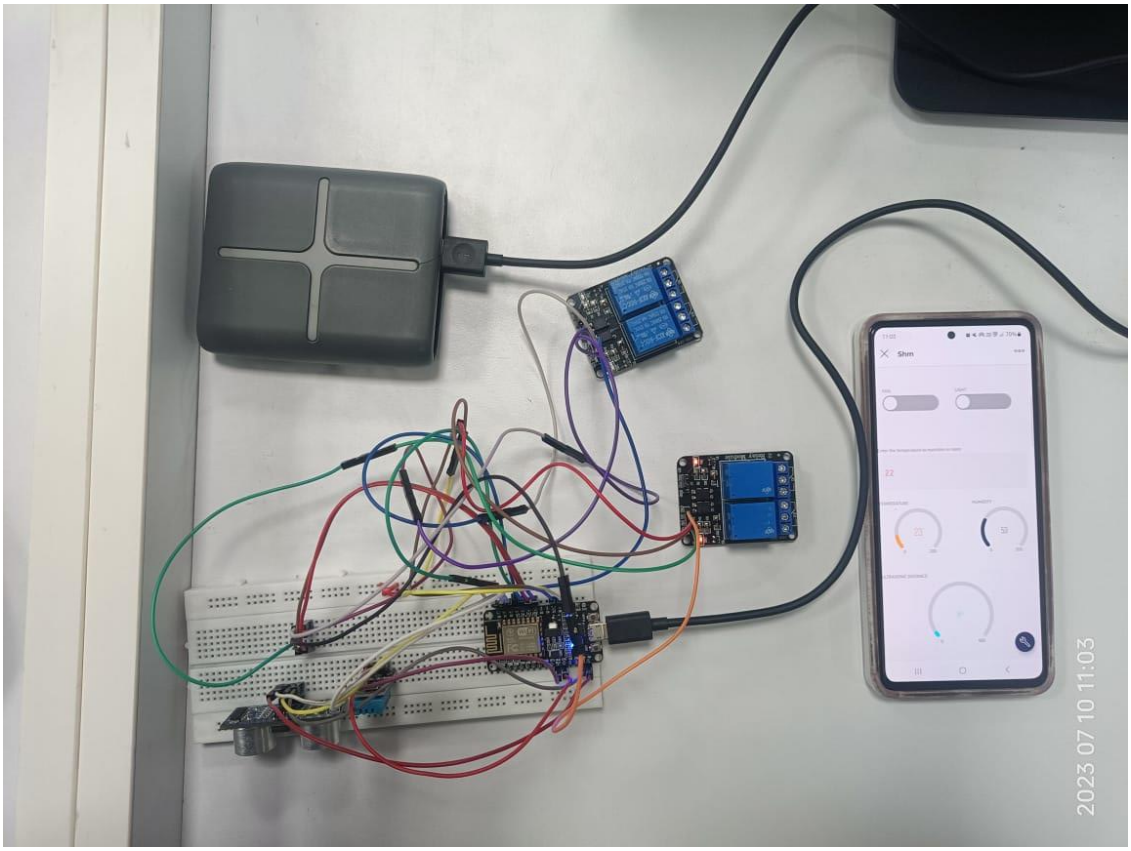
4) **Everything is turned off:**



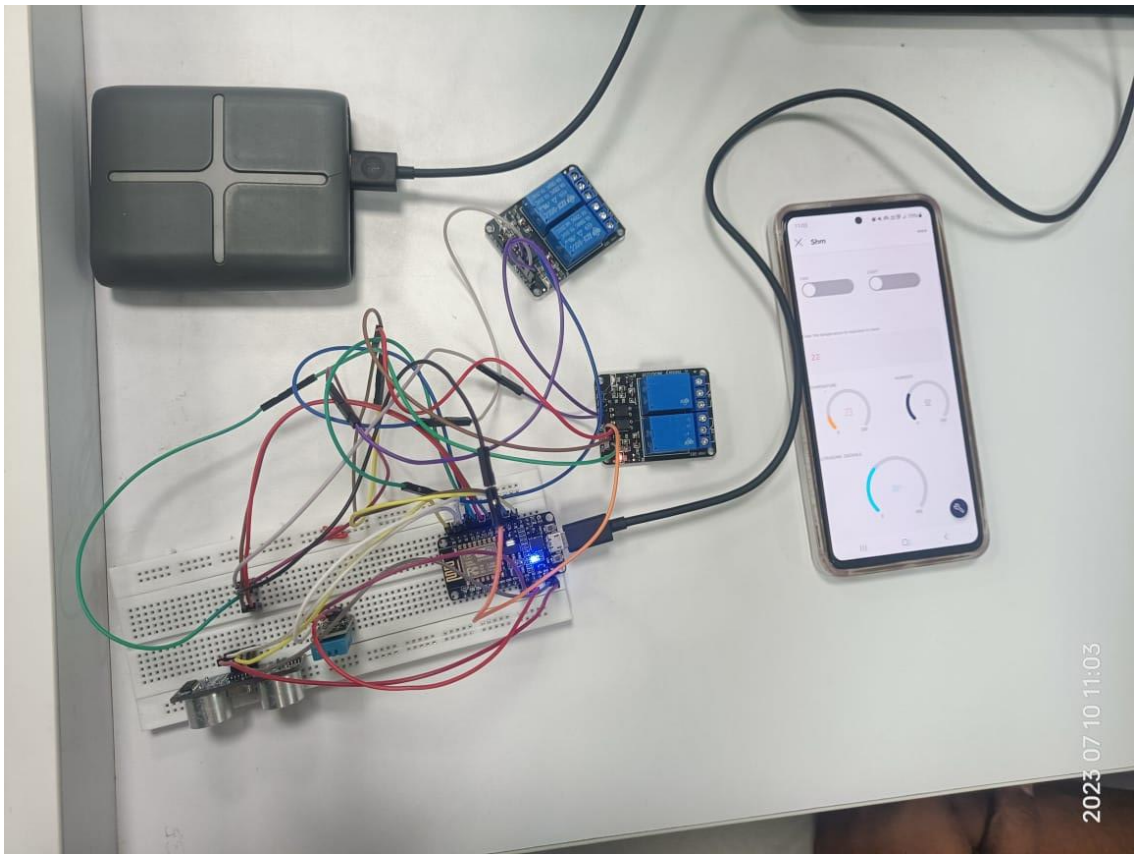
5) **Only the door is open as the ultrasonic is detecting object:**



6) **The door as well the AC is turned on:**



7) **Only the AC is turned on to maintain temperature:**



Results:

The implementation of the IoT-based home automation system yielded successful outcomes. The system demonstrated efficient control over the door and temperature regulation, providing convenience and comfort to the users. The results obtained from various tests and evaluations are as follows:

1. Door Control: The ultrasonic sensor accurately detected the presence of objects in front of the door, allowing for reliable door opening and closing operations. The DC motor responded promptly to the sensor inputs, ensuring smooth and precise door movement.

2. Temperature Regulation: The DHT sensor provided accurate temperature readings, enabling effective regulation of the AC motor. The system maintained the desired temperature within the specified threshold, ensuring optimal comfort in the environment.

3. Remote Control: The integration of the Blynk IoT platform enabled remote control of the system. Users were able to conveniently access the mobile application or web interface to open and close the door, as well as control the AC motor from anywhere.

4. Real-time Monitoring: The Blynk platform facilitated real-time monitoring of

the system's status, including the door position and temperature readings. Users could easily monitor and track the operation of the system through the intuitive interface.

Discussion:

The results of the IoT-based home automation system indicate its successful implementation and functionality. The system effectively addressed the objective of providing efficient control over the door and temperature regulation in a smart home environment. By leveraging the capabilities of the NodeMCU board, the system demonstrated reliable and responsive operation.

The integration of the ultrasonic sensor and DC motor for door control ensured safe and efficient access to the premises. Users could easily open and close the door remotely, eliminating the need for manual operation.

The temperature regulation feature, enabled by the DHT sensor and AC motor, provided a comfortable living environment. The system effectively maintained the desired temperature range, enhancing energy efficiency and user convenience.

The integration with the Blynk IoT platform offered seamless remote control and monitoring capabilities. Users could access the system from anywhere, allowing for easy management of the door and temperature settings. The real-time monitoring feature provided users with valuable insights into the system's operation and environment conditions.

Overall, the implemented IoT-based home automation system successfully achieved its objectives, providing efficient control over the door and temperature regulation. The system demonstrated reliability, convenience, and user-friendly operation. Future enhancements may include additional features such as energy monitoring, integration with voice assistants, and enhanced security measures to further enhance the smart home experience.

Conclusion:

In conclusion, the implementation of the IoT-based home automation system proved to be successful in achieving efficient control over the door and temperature regulation in a smart home environment. The integration of the ultrasonic sensor, DHT sensor, DC motor, AC motor, and relays with the NodeMCU board provided reliable and responsive operation. The Blynk IoT platform enabled convenient remote control and monitoring capabilities, enhancing user convenience and comfort. The system demonstrated effective performance in maintaining desired temperature levels and ensuring secure access to the premises. Overall, the implemented system showcased the potential of IoT technology in creating smart and automated home environments.

Future Scope:

The IoT-based home automation system has immense potential for further enhancements and expansions. Some areas for future development include:

1. Integration of Additional Sensors: Incorporating additional sensors such as

motion sensors, light sensors, or gas sensors can enhance the system's functionality and enable more comprehensive monitoring and control.

2. Energy Efficiency Optimization: Implementing energy monitoring and management features can help users track and optimize energy consumption, leading to greater energy efficiency and cost savings.

3. Voice Control Integration: Integrating voice assistants or voice control technologies can provide a hands-free and intuitive user experience, allowing users to control the system using voice commands.

4. Enhanced Security Measures: Implementing advanced security measures such as biometric authentication or encrypted communication protocols can enhance the security and privacy of the smart home system.

5. Integration with Smart Appliances: Integrating the system with other smart appliances and devices in the home ecosystem can create a more interconnected and cohesive smart home environment.

By exploring these future avenues, the IoT-based home automation system can be further enhanced, offering advanced features and functionalities that cater to evolving user needs and preferences in the realm of smart home technology.

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