WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

IoT Based Smart Home Control System

[1.] Prof. N. B. Shirbhate [2.] ,Miss. Shreya N. Peshwe,[3.] Mr. Om N. Pawar [4.] ,Miss. Vedashri D. Sawarkar,[5]. Mr. Abhijeet H. Khade

Department of Electronic & Telecommunication Engineering, Sipna College of Engineering & Technology Amravati

ABSTRACT—

With the rapid advancements in smart home automation, the need for intelligent, energy-efficient, and secure living environments has become increasingly essential. Traditional home management systems are being enhanced with automated safety mechanisms, real-time monitoring, and remote accessibility to improve overall functionality. The proposed smart home control system integrates advanced sensing, actuation, and energy management technologies to ensure proactive hazard detection, optimized utility control, and sustainable energy utilization.

The system incorporates real-time environmental monitoring through a network of intelligent sensors, including gas/smoke detection, flame detection, and temperature sensing, ensuring early identification of potential risks. Upon detecting hazardous conditions, an automated exhaust mechanism activates to regulate indoor air quality, while an alert system featuring a siren and visual indicators immediately notifies residents, enhancing safety measures. Additionally, a dynamic actuation mechanism governs the operation of essential utilities such as lighting and ventilation, ensuring responsive environmental control.

A key feature of this system is its remote accessibility, enabling users to manage fans, lights, and other household functions via a dedicated interface. This provides seamless control and enhances convenience, allowing real-time adjustments from any location. To further improve operational efficiency, a servo-actuated regulation system is incorporated to optimize performance and adaptability.

By integrating intelligent sensing, automated safety protocols, energy-efficient mechanisms, and smart remote accessibility, this innovative home automation system ensures a safer, more efficient, and environmentally conscious living space.

KEYWORDS- Smart Home Automation, Internet of Things (IoT), Environmental Monitoring, Remote Appliance Control, Home Safety System

INTRODUCTION

The IoT-Based Smart Home Control System presents a modern solution to enhance residential living through automation, real-time monitoring, and intelligent control. Traditional home automation systems are often limited to basic functions like lighting or appliance control. However, with the advancement of Internet of Things (IoT) technologies, the potential to create smarter, safer, and more energy-efficient homes has significantly expanded. This proposed system focuses not only on convenience but also on proactive safety, environmental monitoring, and remote accessibility.

In today's increasingly connected world, smart homes are becoming a necessity rather than a luxury. IoT-enabled systems offer remote access to appliances, real-time data acquisition, and automated responses to various conditions, thus improving user comfort, reducing manual effort, and ensuring safety. This project is designed to address critical issues such as gas leaks, fire hazards, and inefficient energy use, which are common in many households.

The system integrates a network of sensors to detect gas presence, flames, temperature, and humidity. In the event of hazardous detection, it immediately shuts off the gas supply using a motorized mechanism and activates an alarm siren to notify the occupants, reducing the chances of fire or explosion. Climate data is also gathered and shared with a cloud platform, allowing users to monitor and manage indoor conditions through a mobile application from anywhere.

Additionally, relay-based automation is used to control appliances like lights and fans, promoting energy efficiency and operational flexibility. An emergency siren system provides an added layer of security during critical events. The system supports integration with alternative energy sources, contributing to sustainability.

Overall, the proposed smart home system enhances safety, convenience, and energy conservation, making it a reliable and scalable solution for modern residential environments.

PROBLEM STATEMENT

Traditional home automation systems are often limited in functionality, focusing primarily on basic control of lighting and appliances without addressing critical aspects of safety, environmental monitoring, or remote accessibility. These systems lack real-time hazard detection and do not offer automated responses to potentially life-threatening conditions such as gas leaks, fire, or fluctuating environmental parameters like temperature and humidity. Moreover, conventional setups typically require manual intervention, making them inefficient during emergencies or when the user is not present.

With the growing need for intelligent, energy-efficient, and secure residential environments, there is a pressing demand for an integrated system that can autonomously monitor environmental conditions, detect hazards in real-time, and respond instantly without user intervention. Additionally, the absence of remote control capabilities in existing systems restricts user convenience and limits the efficient management of household utilities.

This project aims to address these limitations by developing an IoT-based smart home control system that incorporates real-time sensing, automated actuation, and cloud-based remote access. The goal is to enhance home safety, improve energy efficiency, and provide users with seamless, real-time control over their home appliances and environment from anywhere in the world.

LITERATURE REVIEW

1. Patel, A., Sharma, M., and Joshi, R. In their study, the authors proposed an IoT-based home automation system that enabled users to control appliances such as lights and fans through a mobile application. The system utilized microcontrollers and Wi-Fi communication for automation. Although the project offered improved convenience and user interaction, it lacked safety mechanisms such as gas or fire detection, limiting its effectiveness in emergency scenarios.
2. Kumar, S., and Mallick, R., This paper focused on environmental monitoring using IoT-enabled temperature and humidity sensors. The system collected real-time data, which could be viewed remotely by users. However, the project did not implement any form of automation or safety response mechanisms such as automated alarms, gas shutoff, or smart regulation of electrical devices, making it inadequate for hazard management in homes.
3. Rani, P., and Singh, A., The authors introduced an MQTT-based smart home system capable of real-time communication and remote appliance control. The project was notable for its cloud integration and mobile interface, allowing users to monitor home conditions. Nevertheless, the system lacked critical safety features like flame detection, emergency sirens, or gas shutoff systems that would be essential during hazardous events.
4. Sharma, D., and Mehta, V. In their research, a fire and gas detection system was implemented using basic sensors. The study successfully detected anomalies in the environment and alerted users via an LED and buzzer system. However, it operated as a standalone unit and did not integrate with any cloud system or actuator-based safety mechanism such as a motorized gas regulator.
5. Nath, R., Yadav, T., and Choudhary, K. The paper emphasized automated energy conservation using motion sensors and timers. Their system aimed to reduce unnecessary energy consumption by detecting room occupancy and controlling lights accordingly. While energy efficiency was achieved, the system lacked real-time hazard detection or appliance-level control through mobile applications.
6. Rao, M. S., and Iyer, P., This study presented an IoT-based security system using PIR sensors and GSM modules to detect intrusions and notify homeowners. Though it enhanced household security, it did not integrate environmental sensors for gas or temperature monitoring, nor did it provide mobile control over appliances.
7. Jadhav, N., and Kulkarni, B., The authors developed a home automation model using Arduino and Bluetooth technology. The project allowed users to manually control lights and fans via a mobile interface. However, the absence of remote cloud access and automated safety responses limited its scalability and practicality for real-world applications.
8. Stolojescu-Crisan, C., Crisan, C., and Butunoi, B.-P In their research, the authors proposed an IoT-based smart home automation system focusing on energy efficiency and user comfort. The system utilizes various sensors and actuators to monitor and control home environments. It offers functionalities like temperature and humidity monitoring, and appliance control through a mobile application. While the system enhances energy management and user convenience, it does not incorporate safety mechanisms such as gas or fire detection.

From the existing body of work, it is clear that while individual projects focus on automation, monitoring, or energy efficiency, very few provide a holistic system that combines all these aspects with robust safety measures. The proposed project addresses this gap by integrating real-time hazard detection, cloud-based control, automated gas regulation, relay-based appliance control, and environmental monitoring in a single scalable smart home framework.

METHODOLOGY

The proposed system is designed to detect hazardous gas leaks and respond to fire emergencies using an embedded automation framework. The core of the system is powered by an ESP32 microcontroller, which integrates data acquisition, processing, and wireless communication. A regulated power supply module converts AC voltage to the required DC levels to power all components. The MQ-2 gas sensor continuously monitors the environment for the presence of flammable gases. When gas levels exceed a predefined threshold, the ESP32 triggers a set of responses: activating a buzzer to alert nearby individuals, turning on an indicator light via a relay, and sending real-time alerts to a remote user through a cloud server.

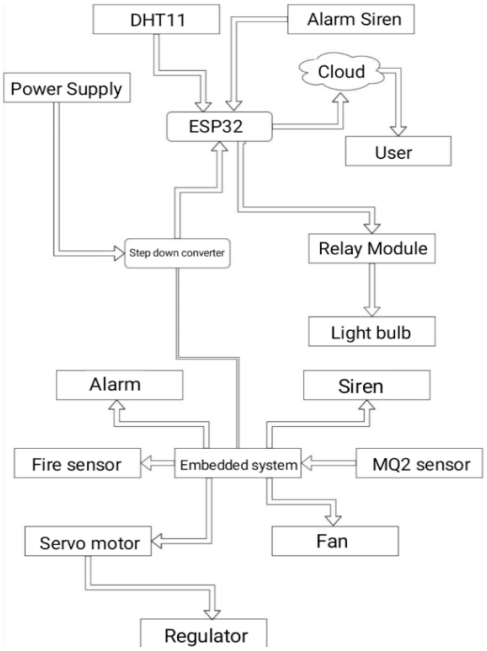

Fig (1) Block diagram of the project

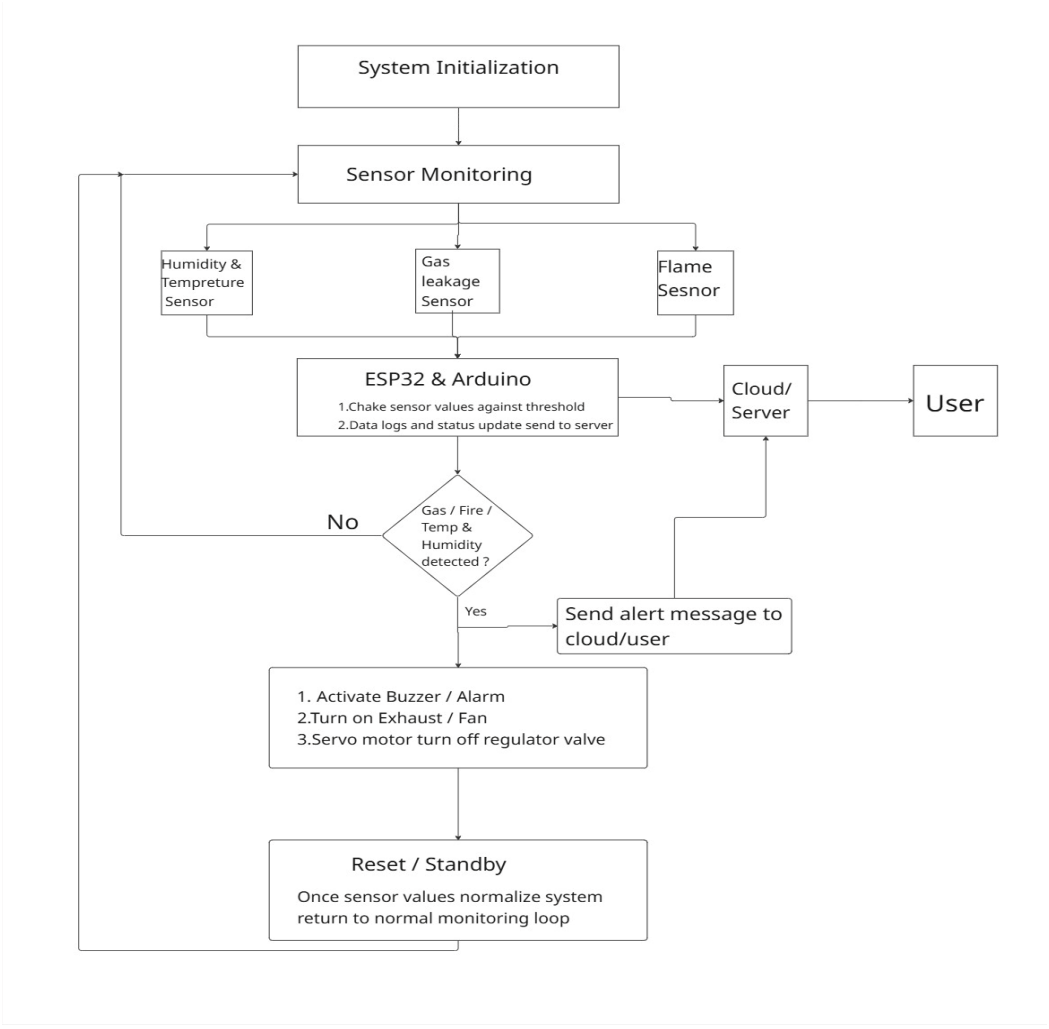

Fig (2) Flowchart of the project

A DHT11 sensor is employed to monitor temperature and humidity, providing additional environmental context. In case of fire detection, as determined through sensor data analysis, the system activates an exhaust fan to ventilate the area and sounds an alarm to warn occupants. Simultaneously, a servo

motor controlled by the embedded system is used to actuate a gas valve for automatic shutoff, thereby preventing further escalation. A secondary embedded controller (Arduino Uno) may be employed to handle parallel processes, such as relay operations and fan control, thereby offloading tasks from the ESP32. Data is logged and transmitted wirelessly, enabling remote monitoring and real-time response. All components are integrated on a custom PCB and mounted on a modular board for demonstration and testing purposes.

EXPERIMENTAL SETUP & RESULT

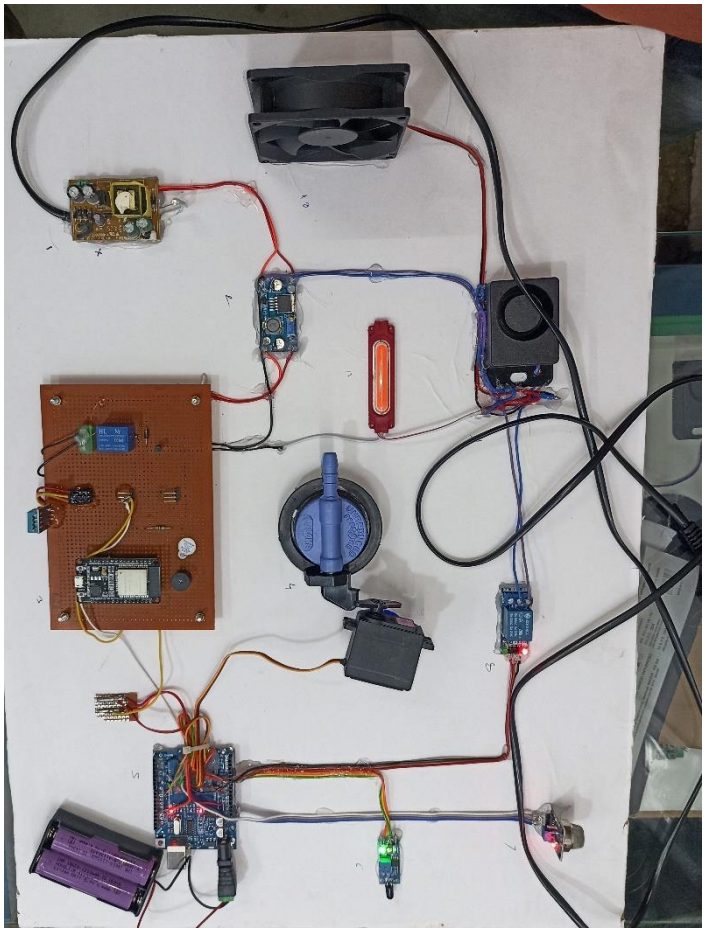

Fig (3) Top View of Project

RESULT

The implementation of the IoT-based home automation system yielded promising results, demonstrating its effectiveness in enhancing residential convenience, safety, and energy efficiency. The system successfully enabled remote control of household appliances such as lights and fans through a user-friendly mobile application, providing users with real-time monitoring and management capabilities. Sensor integration proved to be reliable, with the DHT11 sensor accurately monitoring temperature and humidity levels and the MQ-2 sensor promptly identified gas leaks, triggering immediate alerts to the user's mobile device. These features collectively contributed to a responsive and secure home environment.

The system's performance was consistent, with rapid response times observed between user commands and actuator actions. The relay modules and servo motors operated seamlessly, executing tasks such as switching appliances on/off and controlling mechanical operations with precision. The integration of the ESP32 Wi-Fi module ensured stable and continuous connectivity between the microcontroller and the mobile application, facilitating uninterrupted communication. Overall, the project achieved its objectives by delivering a cost-effective and scalable solution for smart home automation. The successful deployment and testing of the system underscore its potential for real-world applications, offering a foundation for future enhancements and integration of additional smart features.

.

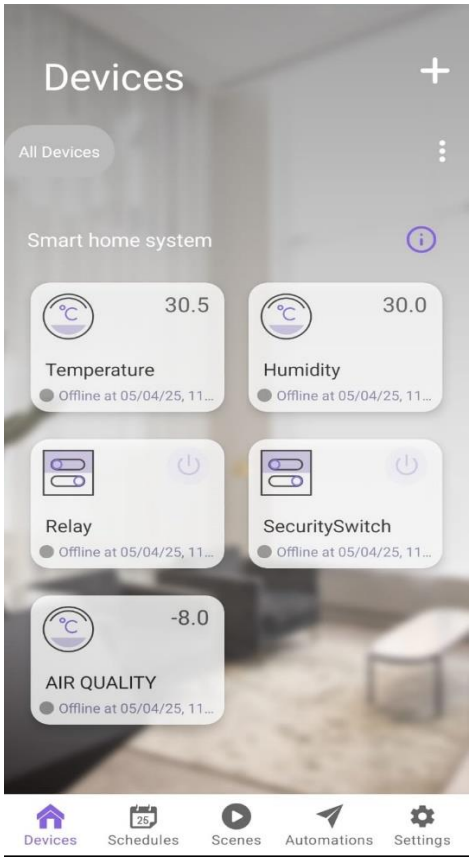

Fig (4) Status Overview of Smart Home System Devices via Mobile Application User Interface

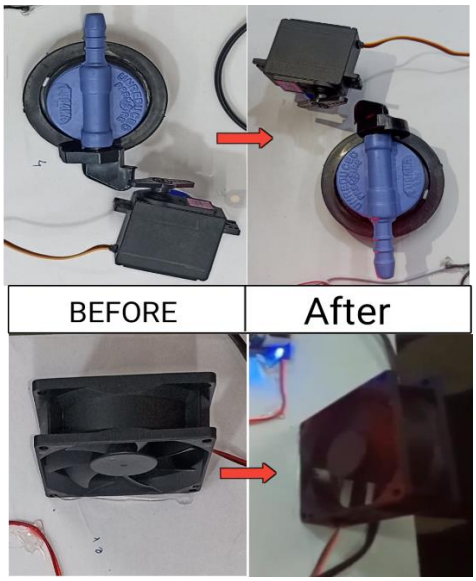

Fig (5) Output of the project

CONCLUSION

In conclusion, the development and implementation of the IoT-based home automation system have demonstrated significant potential in enhancing residential living through increased convenience, energy efficiency, and security. The integration of various sensors and actuators enabled real-time monitoring and control of household appliances, providing users with the ability to manage their homes remotely via a user-friendly mobile application. The system's responsiveness and reliability were evident in its performance, with accurate sensor readings and prompt execution of user commands. Moreover, the use of cost-effective components and open-source platforms underscores the system's scalability and adaptability for broader applications.

This project lays a robust foundation for future advancements in smart home technologies, paving the way for more sophisticated and integrated home automation solutions.

REFERENCES

1. Patel, A., Sharma, M., and Joshi, R. "IoT-Based Home Automation System for Appliance Control via Mobile Application." International Journal of Scientific Research in Engineering and Management (IJSREM), vol. 6, no. 4, 2022.

2. Kumar, S., and Mallick, R. "Environmental Monitoring Using IoT-enabled Temperature and Humidity Sensors." International Journal of Innovative Research in Science, Engineering and Technology (IJIRSET), vol. 10, no. 3, 2022.

3. Rani, P., and Singh, A. "MQTT-Based Smart Home System with Cloud Integration and Remote Appliance Control." International Journal of Computer Applications (IJCA), vol. 175, no. 12, 2020.

4. Sharma, D., and Mehta, V. "Implementation of Fire and Gas Detection System Using Basic Sensors." International Journal of Recent Technology and Engineering (IJRTE), vol. 9, no. 5, 2021.

5. Nath, R., Yadav, T., and Choudhary, K. "Automated Energy Conservation System Using Motion Sensors and Timers." International Journal of Engineering Research & Technology (IJERT), vol. 11, no. 1, 2022.

6. Rao, M. S., and Iyer, P. "IoT-Based Home Security System Using PIR Sensors and GSM Modules." International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering (IJAREEIE), vol. 9, no. 6, 2021.

7. Jadhav, N., and Kulkarni, B. "Bluetooth-Controlled Home Automation System Using Arduino." International Research Journal of Engineering and Technology (IRJET), vol. 7, no. 11, 2020.

8. Stolojescu-Crisan, C., Crisan, C., and Butunoi, B.-P. "IoT-Based Smart Home Automation System for Energy Efficiency and Comfort." Sensors, vol. 21, no. 15, 2021.