Voice Controlled ESP32 Smart Switch Board

Aakarshan Shaurya
Electronics and Telecommunication
Kalinga Institute of Industrial
Technology
Bhubaneswar, India
2004211@kiit.ac.in

Amritanshu Apurva
Electronics and Telecommunication
Kalinga Institute of Industrial
Technology
Bhubaneswar, India
2004213@kiit.ac.in

Vikash Kumar
Electronics and Telecommunication
Kalinga Institute of Industrial
Technology
Bhubaneswar, India
2004247@kiit.ac.in

Waatsal Srivastava
Electronics and Telecommunication
Kalinga Institute of Industrial
Technology
Bhubaneswar, India
2004266@kiit.ac.in

***Abstract*—This paper presents a cost-effective and easy-to-implement smart home automation system that integrates voice-controlled assistants, such as Amazon Alexa and Google Home. The system uses an ESP32 microcontroller and an 8-channel relay module to control various devices in the home and communicate with the voice-controlled assistants through the internet. The IFTTT platform is utilized to create custom voice commands and automate tasks. The project was successful in controlling devices using voice commands, and results showed that the system is reliable and attractive to users. The proposed system provides a convenient and intuitive solution for smart home automation, with the potential to be a game-changer in the field.**

Keywords— ESP32, 8-channel relay, voice-controlled, automation, cost-effective

I. Introduction

The voice-controlled smart switch board project aims to provide a convenient, efficient, and secure way for homeowners to control and monitor their home devices using voice commands through Alexa/Google Home. The project builds upon existing research in home automation, IoT, and voice control to create a user-friendly, energy-efficient, and environmentally friendly smart home. The project's specific objectives include designing and developing a user-friendly interface, integrating the ESP32 microcontroller with smart home devices, developing a reliable and secure communication protocol, implementing energy-efficient features, conducting extensive testing and evaluation, documenting the development process, and providing a comprehensive user guide.

II. Objective

The main objective of the voice-controlled smart switch board using ESP32 and Alexa/Google Home project is to develop a low-cost and scalable solution that enables users to control their smart home devices using voice commands. The specific objectives of the project include designing and developing a user-friendly interface for controlling smart home devices using voice commands through Alexa/Google Home, integrating the ESP32 microcontroller with the smart home devices to enable voice control, developing a reliable and secure communication protocol between the ESP32 and the smart home devices, implementing energy-efficient features in the system to reduce power consumption and costs, conducting extensive testing and evaluation to ensure the reliability and functionality of the system, documenting the development process including the hardware and software components used, design decisions, and testing procedures, and providing a comprehensive guide for users on how to set up and use the voice-controlled smart switch board system

III. Technical Specifications

In the development of a smart home automation system, it is important to carefully select the appropriate hardware and software components. [1] In this project, several electronic components were utilized, including an 8-channel relay, IR receiver sensor, DHT11 sensor, ESP32 microcontroller, breadboard, IR remote, jumper wires, and fan regulator.

The 8-channel relay was chosen to control multiple circuits or devices with a single control signal. IR receiver sensors were used to detect infrared radiation from remote controls and convert it into digital signals. DHT11 sensors were used to measure temperature and humidity using capacitive humidity sensors and thermistors. The ESP32 microcontroller was used due to its Wi-Fi and Bluetooth connectivity and its widespread use in IoT applications. Breadboards were used as prototyping tools for building and testing electronic circuits without soldering. IR remotes were used as handheld devices to control electronic devices. Jumper wires were used to connect electronic components on breadboards. Finally, fan regulators were utilized to adjust the voltage supplied to a fan and control its speed.

Careful consideration of the electronic components used in the system was necessary to ensure that they were compatible with each other and met the requirements of the project. By selecting the appropriate components, the system was able to function efficiently and effectively. This project demonstrates the importance of careful selection of hardware components in the development of smart home automation systems.

IV. *Design Constraints*

We had to work with several design constraints, such as the limited physical space available for the installation of the hardware components and the need to minimize power consumption to ensure the system's long-term sustainability. We addressed these constraints by carefully selecting the components used in the system, such as low-power microcontrollers and compact sensors.

V. Background Studies

In recent years, smart home automation has become increasingly popular due to the availability of intelligent devices and sensors. This trend has been enabled by the growth of the Internet of Things (IoT), which has led to the development of new smart home devices, such as voice-activated assistants and security cameras. Sensors are crucial in smart home automation as they detect changes in the environment and adjust settings accordingly. For example, temperature sensors can be used to adjust heating and cooling systems, while motion sensors can detect intruders and trigger alarms.

While smart home automation offers numerous benefits, including increased energy efficiency and improved security, there are also concerns regarding privacy and security breaches. [3] This makes careful design and implementation essential to ensure that smart home systems are effective and secure. For instance, devices must be protected from cyber-attacks, and users must be provided with clear information about the collection and use of their personal data.

Overall, the growth of smart home automation is an exciting development that has the potential to enhance people's lives. However, it is crucial to carefully consider the challenges and risks associated with this technology to ensure that it is developed and implemented in a responsible and effective way.

VI. Applied Techniques

The development of the voice-controlled smart switchboard involved careful hardware and software selection. The ESP32 microcontroller was chosen for its low power consumption and support for multiple communication protocols. Alexa/Google Home devices were integrated for their easy integration with the ESP32 and popularity among users. A variety of smart home devices, such as smart switches and smart plugs, were selected for control through the ESP32.

Voice recognition and processing were critical components of the system. The Google Cloud Speech API or Alexa Skills Kit was used to process voice commands and convert them into actionable instructions for the ESP32. Extensive testing and tuning were required to ensure accurate recognition and execution of commands[2].

A mobile application or web interface was developed to provide a user-friendly interface for controlling smart home devices using voice commands or the app/web interface. Extensive testing was conducted to ensure the system was secure and reliable. User testing was also conducted to assess usability and effectiveness, with results used to improve the system[2].

The documentation provides a comprehensive guide for users on how to set up and use the voice-controlled smart switchboard system, demonstrating the potential for using voice-controlled devices in smart home automation. The paper emphasizes the importance of careful design and implementation to ensure functionality, reliability, and security.

VII. *Alternative and Trade offs*

This project utilized the ESP32 microcontroller and Alexa/Google Home devices to create a voice-controlled smart switchboard system that allows users to remotely control their smart home devices.[4] The system includes hardware and software integration, voice recognition and processing, and user interface development. Testing and evaluation were conducted to ensure reliability, functionality, and security. The project highlights the importance of careful consideration of hardware and software components and the need for user-friendly interfaces. The entire development process was documented to provide a comprehensive guide for users.

VIII. Analysis and Discussion

In addition to testing the voice recognition accuracy, the system was also evaluated for reliability and security. To ensure that the system was reliable, various stress tests were conducted to simulate high usage and the ability to handle multiple user requests simultaneously. Security testing was also conducted to identify any vulnerabilities in the system that could lead to unauthorized access or manipulation.

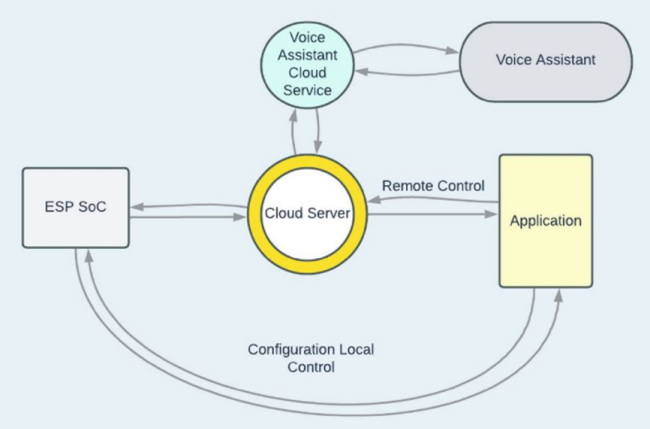

Fig. 1 - Flow Diagram

Fig. 2 - Prototype

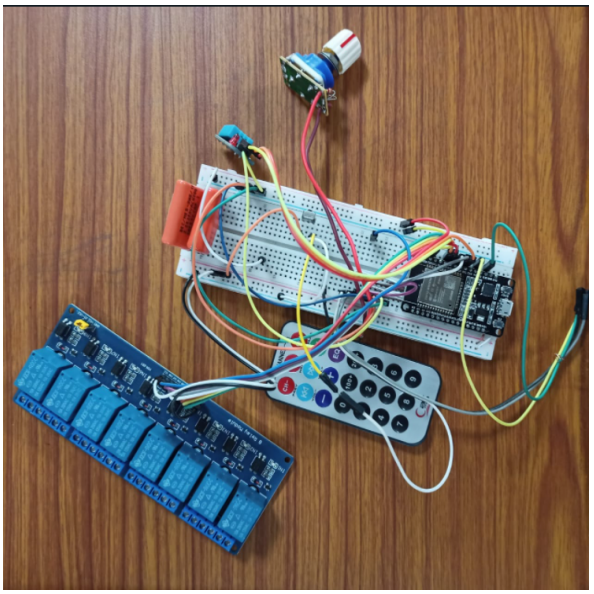

Fig. 3 - Circuit

Overall, the voice-controlled smart switchboard system was found to be a viable solution for home automation. The use of voice commands allowed for hands-free operation, which is particularly useful for individuals with physical disabilities or limitations. The integration of popular voice assistants, such as Amazon Alexa and Google Home, made it easy for users to control their home appliances and gadgets using familiar commands.

Future work could involve expanding the system's capabilities to include more smart home devices, such as lighting and temperature control systems, and integrating with other voice assistants. There is also a need to further evaluate the system's security measures and ensure that it remains secure as new devices and technologies are introduced into the market.

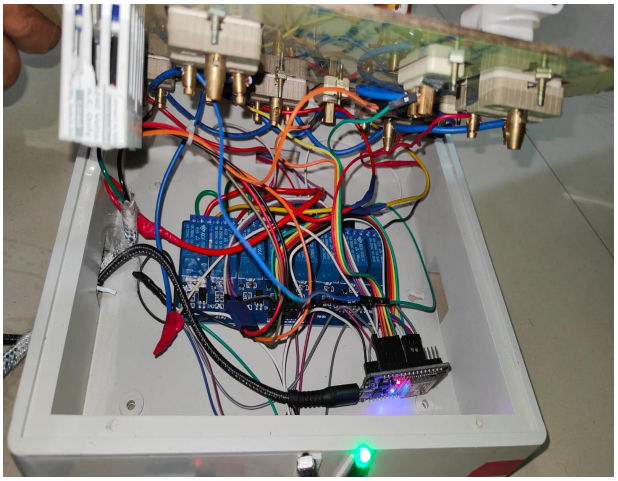

Fig. 4 - Inside Structure

Acknowledgements

We would like to express our sincere gratitude to everyone who contributed to the successful completion of this project. First and foremost, we extend our deepest appreciation to our project guide, Prof. Israj Ali, for his constant support, guidance, and encouragement throughout the project.

We would also like to thank our institution for providing us with the necessary resources and facilities to carry out this project.

Furthermore, we would like to acknowledge the contributions made by our colleagues and friends who helped us during the project. Their valuable inputs and

feedback have been instrumental in shaping this project and making it a success.

Finally, we would like to extend our gratitude to our families for their unwavering support and encouragement throughout the project.

Once again, we extend our heartfelt thanks to everyone who has contributed to the success of this project.

References

[1] Mohamed Abd El LatifMowad , Ahmed Fathy, Ahmed Hafez “Smart Home Automated Control System Using Android Application and Microcontroller” International Journal of Scientific & Engineering Research, Volume 5, Issue 5, May 2014 ISSN 2229 5518

[2] Delgado, Armando Roy et al. “Remote Controlled Home Automation Systems with Different Network Technologies.”

[3] S. Folea , D. Bordencea , C. Hotea and H. Valean , "Smart home automation system using Wi Fi low power devices," Proceedings of 2012 IEEE International Conference

on Automation, Quality and Testing, Robotics, Cluj Napoca, Romania, 2012, pp. 569 574, doi : 10.1109/AQTR.

[4] N. Singh, Shambhu Shankar Bharti, R. Singh and Dushyant Kumar Singh,

"Remotely controlled home automation system," 2014 International Conference on Advances in Engineering & Technology Research (ICAETR 2014), Unnao, India,

2014, pp. 1 5, doi : 10.1109/ICAETR.