Divya H N, 2025, 13:3
ISSN (Online): 2348-4098
ISSN (Print): 2395-4752

International Journal of Science, Engineering and Technology

An Open Access Journal

Title: Gesture and Voice Controlled Home Automation

Divya H N, Ishika Keshri, Kavyashree R, Mandara R, Pushpa PB
Dayananda Sagar Academy of Technology and Management

Abstract- Home automation systems are gaining more attention due to technological advances. These smart devices and sensors help us collect or capture physical experiences and convert them into informational data. This project aims to develop a system that helps users to interact with appliances using voice and gesture commands to provide a more interactive and user friendly home experience. The Raspberry Pi takes voice commands through a microphone or gesture commands from the camera module and interprets them to manage appliances through the relay, which turns the house on and off based on the user's request. This system could also be a perfect solution for people with disabilities who want access to home devices. For example, voice commands are useful for the visually impaired, and the deaf can use hand gestures to operate the appliances.

Keywords - Gesture Control, Raspberry Pi, Microphone, Relays, Automation etc.

I. INTRODUCTION

Smart homes are efficient, cost-effective, low-power, and realize the automation of various domestic appliances. Handicapped patients, the elderly, and people with disabilities. They can operate all appliances and devices with high performance from anywhere in the house.

The objective of the proposed system is to create a system that can control home appliances using any one of the two assigned methods:

1. Gesture-based
2. Voice-based.

According to an estimate by the WHO, globally, 15 percent of the population live with some form of disability, while over 80 percent of them live in Low- and Middle-Income Countries. While India is home to over 1.36 billion residents, over 2.2 percent of this population endures some form of severe mental or physical disability. This idea integrates automation with technology.

The rest of the paper is structured as follows: Section II contains the literature review. Section III includes the methodology. The Objectives and future scope of the project are given in Section IV.

The hardware components used in the project are provided in Section V. In Section VI, the paper is concluded. Lastly, Section VII contains References.

2. Literature Review

Many home automation systems have been developed in recent years. Some of them have been specially modified to cater to the needs of the disabled and the elderly. They use hardware such as Arduino or Raspberry Pi. Implementation of home automation can be broadly classified into: Voice-controlled system and Gesture-controlled system.

Voice-controlled home automation systems switch devices on/off from spoken commands. The whole system works on an Android Application that receives voice commands from the user, and the appropriate operation is performed. The system provides control to the user and is easy to use. The sound-based systems could have some drawbacks, such as the elderly and disabled not being able to

speak loudly and clearly. Also, the elderly people are not very familiar with smartphones and hence might not be able to effectively use the system.

Gesture-controlled home automation systems switch devices on/off from gesture commands. The camera takes the input and compares it with the dataset, and the appliances are operated accordingly. The system is very accurate and provides control to the user.

Sl. No.	Title	Gap Identified
1.	Integrating Gesture Control with Biometric and RFID Authentication for Secure Home, 2024	• Reduced Model Accuracy • Increased Training Time • Complex Implementation
2.	Gesture-Controlled home automation for the differently abled: enhanced Accessibility and Independence,2023	• High Initial Setup Cost • Internet Dependency • Maintenance Issues • Data Security Risks • Technical Skills Required
3.	IoT Enabled Gesture-Controlled Home Automation for Disabled and Elderly,2020	• Limited gesture recognition • Short Bluetooth range Lack of voice integration • Battery dependence

Table-1: Literature Survey

III. METHODOLOGY

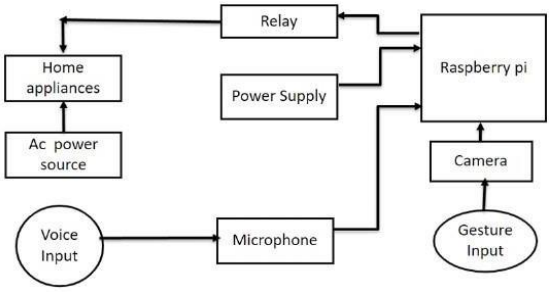
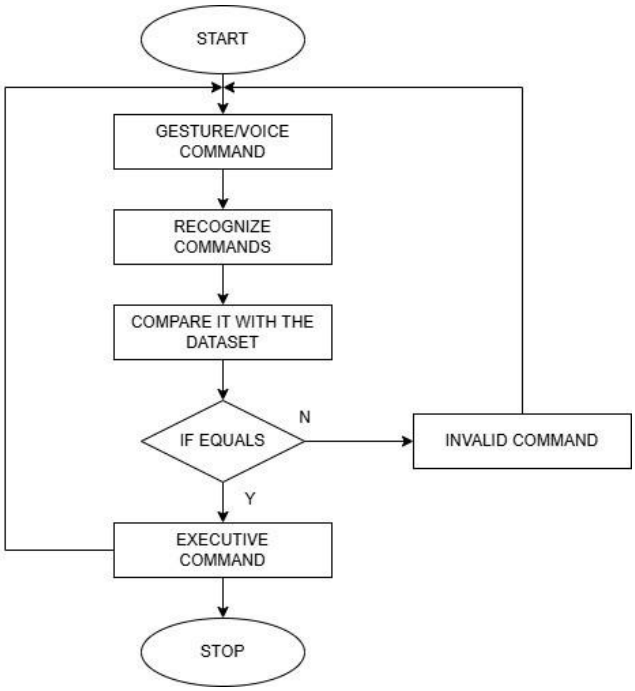


Chart-1: Block diagram of the system.

If the user chooses to give voice commands, the user will say the desired commands. The device now detects it through a microphone that is connected to the Raspberry Pi, which converts the voice command to text. It will compare with the dataset. If a match is found, the appliances are operated accordingly. If the command is invalid, the user needs to give valid commands again.

If the user chooses to give gesture commands, the user needs to give the commands in front of the camera module. The camera takes the input and compares it with the dataset. If a match is found, the appliances are operated accordingly. If the



command is invalid, the user needs to give valid commands again.

2: Flowchart for system operation.

1: Start
2: Give the Voice or Gesture Commands
3: Commands are recognized by comparing them with the dataset
4: If invalid, retry the commands
5: If valid, Appliances are controlled
6: Repeat the process to control the other devices 7: Stop

IV. OBJECTIVES AND FUTURE SCOPE

Dual Control – Voice and Gesture:
The system allows users to control devices using either their voice or hand gestures. This gives users more flexibility. For example, someone who cannot speak can use gestures, and someone who cannot move their hands easily can use voice.

Hands-Free Operation:
This feature lets people control appliances without touching anything. It is helpful for people with limited mobility, during COVID-like situations, or in places where cleanliness and hygiene are important.

Cost-Effective Design:
The system uses low-cost components like Raspberry Pi, a simple camera, and microphone. These are easily available and reduce the total cost, making it affordable for home and educational use.

Quick Response:
When a command is given (voice or gesture), the system responds quickly. This gives a smooth experience to the user without delays, which is important for comfort and safety.

Easy to Expand in Other Fields:
The same system can be modified to work in hospitals (for patients to call for help), schools (for smart classrooms), or vehicles (for touch less controls). It has great potential for future improvements and uses in many real-life applications.

The aim of this project is to build such a system using Raspberry Pi as the main controller, along with a microphone for voice input, a camera for gesture input, and relay modules to control electrical devices. This solution will be cost-effective, user-friendly, and designed to help a wide range of users, especially those with special needs. It will not only improve comfort and independence at home but also has the potential to be used in other fields like healthcare, education, and public services, where contactless operation is highly valuable.

V . HARDWARE COMPONENTS

Raspberry Pi:
The Raspberry Pi acts as the central processing unit, receiving voice commands through a microphone or gesture commands from the camera module, and interprets them to manage appliances through the relay, which turns the appliances on and off based on the user's request

Figure 1: Raspberry Pi

Relay module:
A relay acts as an electric switch, translating signals from a microcontroller (like a Raspberry Pi or Arduino) into commands to turn on or off various home appliances.

Figure 2: Relay module

Camera module:
The camera module is directly or indirectly connected to the computer network or system. Its primary role is to capture and analyze images of hand movements, allowing the system to recognize and interpret gestures as commands.

Microphone:
If a user prefers to use voice commands, the microphone provides an alternative input method. A microphone is a gadget that catches audio, allowing the system to recognize and interpret voice as commands.

Home appliances:
Basic home appliances like light bulbs and a fan are used. Lights use AC Voltage, and the fan uses a DC voltage. Various other household appliances like an AC, freezers, and ovens can also be controlled using this system.

VI. CONCLUSION

A Smart home system is successfully developed using the Raspberry Pi, relay module, camera module, and microphone. This paper provides an accessible, reliable, and flexible way to control home appliances. It can be easily implemented in any house and can also be extended depending on the number of appliances.

The feature that makes our system special is that the user can choose either voice commands or gesture commands. In case there's any disturbance in the surroundings that's causing hassle to receive the voice commands, we can give a hand gesture command.

The concept in this paper can be applicable in many automation programs within the regions of transportation, healthcare, education, commercial automation, military, etc. Also, an addition could be the incorporation of facial and fingerprint recognition, which enables security.

REFERENCES

1. A. K. Thomas et al., "Integrating Gesture Control with Biometric and RFID Authentication for Secure Home Automation," 2024 1st International Conference on Advances in Computing, Communication and Networking (ICAC2N), Greater Noida, India, pp. 1842-1845, doi: 10.1109/ICAC2N63387.2024.10895479, 2024.
2. D. Tomar, D. Nauni, A. M. Zaidi and M. Kaur, "Gesture- Controlled Home Automation for the Differently Abled: Enhanced Accessibility and Independence," 2023 3rd International Conference on Technological Advancements in Computational Sciences (ICTACS), Tashkent, Uzbekistan, pp. 1560-1564, doi: 10.1109/ICTACS59847.2023.10389929, 2023.
3. P. M. Sathya, P. Velrajkumar, P. Lavanya, L. Ramesh and C. Senthilpari, "Raspberry Pi Processor-based iGloves for Mute Community and Home Automation System," 2022 8th International Conference on Smart Structures and Systems (ICSSS), Chennai, India, pp. 01-05, doi: 10.1109/ICSSS54381.2022.9782194, 2022.
4. N. Ganji, S. Gandreti and T. R. Krishnaiah, "Home Automation Using Voice and Gesture Control," 2022 7th International Conference on Communication and Electronics Systems (ICCES), Coimbatore, India, pp. 394- 400, doi: 10.1109/ICCES54183.2022.9835832, 2022.
5. S. Kshirsagar, S. Sachdev, N. Singh, A. Tiwari and S. Sahu, "IoT Enabled Gesture-

Controlled Home Automation for Disabled and Elderly," 2020 Fourth International Conference on Computing Methodologies and Communication (ICCMC), Erode, India, pp. 821-826, doi: 10.1109/ICCMC48092.2020.ICCMC-000152, 2020.

6. N. Kheratkar, S. Bhavani, A. Jarali, A. Pathak and S. Kumbhar, "Gesture Controlled Home Automation using CNN," 2020 4th International Conference on Intelligent Computing and Control Systems (ICICCS), Madurai, India, pp. 620-626, doi: 10.1109/ICICCS48265.2020.9121058, 2020.

7. N. Jayaweera, B. Gamage, M. Samaraweera, S. Liyanage, S. Lokuliyana and T. Kuruppu, "Gesture Driven Smart Home Solution for Bedridden People," 2020 35th IEEE/ACM International Conference on Automated Software Engineering Workshops (ASEW), Melbourne, VIC, Australia, pp. 152-158, doi: 10.1145/3417113.3422998, 2020.

8. K. N. Trong, H. Bui and C. Pham, "Recognizing hand gestures for controlling home appliances with mobile sensors," 2019 11th International Conference on Knowledge and Systems Engineering (KSE), Da Nang, Vietnam, pp. 1- 7, doi: 10.1109/KSE.2019.8919419, 2019.

9. S. Kumar and S. S. Solanki, "Voice and touch control home automation," 2016 3rd International Conference on Recent Advances in Information Technology (RAIT), Dhanbad, India, pp. 495-498, doi: 10.1109/RAIT.2016.7507951, 2016.
10. Y. Mittal, P. Toshniwal, S. Sharma, D. Singhal, R. Gupta and V. K. Mittal, "A voice-controlled multifunctional Smart Home Automation System," 2015 Annual IEEE India Conference (INDICON), New Delhi, India, pp. 1-6, doi: 10.1109/INDICON.2015.7443538, 2015.