iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 14 **Issue:** II **Month of publication:** February 2026

DOI: https://doi.org/10.22214/ijraset.2026.77318

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 14 Issue II Feb 2026- Available at www.ijraset.com

Review on AI Based Gesture Home Automation

Mariya Sheikh[1], Trupti Gahane[2], Harshada Dewalkar[3], Sahil Nakkawar[4], Kahekasha Sheikh[5]
Department of Electronics & Tele-Communication, Polytechnic, Ballarpur Institute of Technology, India

Abstract: ***In today's fast-growing technological world, automation has become an essential part of modern living. Home automation systems are designed to make daily life easier, safer, and more comfortable. This project presents an AI based gesture home automation system with voice control that allows users to control home appliances such as lights and fans without physically touching any switches. The system uses Artificial Intelligence and computer vision techniques to recognize hand gestures through a camera, while voice commands are identified using speech recognition technology. The recognized gesture or voice command is processed and sent to a microcontroller, which controls the appliances using relay modules. This system is especially helpful for elderly and physically challenged people, as it provides a touchless and easy-to-use interface. Experimental results show that the system works accurately and efficiently in real-time conditions, making it suitable for smart home applications.***

Keywords: Artificial Intelligence, Home Automation, Gesture Recognition, Voice Control, Smart Home, IoT

I. INTRODUCTION

With the rapid advancement of technology, the concept of smart homes has gained great importance in recent years. Home automation refers to the automatic control of household appliances using modern technologies such as Artificial Intelligence (AI), Internet of Things (IoT), and embedded systems. Traditional home automation systems mainly depend on manual switches or mobile applications, which may not always be convenient for all users. To overcome these limitations, gesture-based and voice-based control systems have emerged as effective solutions.

This project focuses on designing an AI based gesture home automation system integrated with voice control. Gesture control allows users to interact with appliances using simple hand movements, while voice control enables hands-free operation. By combining both methods, the system provides flexibility, convenience, and improved user experience. The project aims to demonstrate how AI can be applied practically to make everyday life smarter and more comfortable.

II. BASIC CONCEPTS OF AI BASED GESTURE HOME AUTOMATION

The basic concept of AI based gesture home automation is to allow machines to understand and respond to natural human actions. In this system, hand gestures act as an input method for controlling electrical appliances. A camera captures real-time images of the user's hand movements, which are then processed using computer vision and AI algorithms. These algorithms analyze hand landmarks, finger positions, and motion patterns to identify specific gestures.

Each gesture is predefined and mapped to a particular appliance operation, such as turning a light ON or OFF. Along with gesture control, voice control is added to make the system more user-friendly. Voice commands are captured through a microphone and converted into text using speech recognition techniques. By combining gesture recognition and voice control, the system offers a smart, touchless, and natural way to control home appliances..

III. WORKING PRINCIPLE OF THE SYSTEM

The working principle of the AI based gesture home automation system is based on understanding human actions and converting them into machine commands. The system mainly works by using two natural input methods: hand gestures and voice commands. These inputs are processed using Artificial Intelligence techniques and then used to control home appliances. At the beginning, a camera is placed in front of the user to continuously capture real-time video of hand movements. The camera sends live video frames to the AI processing unit, such as a laptop or Raspberry Pi. Using computer vision and AI-based hand tracking algorithms, the system detects the position of the hand and identifies specific finger movements. Each hand gesture is already predefined and linked to a particular action, such as switching a light ON or OFF.

Along with gesture control, a microphone is used to capture voice commands spoken by the user. The spoken words are converted into digital text using speech recognition technology. The system compares the recognized words with predefined commands like "light on," "fan off," or "all off." This allows the user to control appliances even without using hand gestures.

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Once the system successfully recognizes either a gesture or a voice command, it generates a control signal. This signal is transmitted wirelessly through Bluetooth or Wi-Fi to the microcontroller. The microcontroller processes the received command and activates the corresponding relay module. The relay acts as an electronic switch that controls the electrical appliance.

The entire process occurs in real time, providing quick and smooth operation. The system continues to monitor gestures and voice commands, allowing continuous control of appliances. This working principle makes the system touchless, efficient, and easy to use, especially for elderly and physically challenged individuals.

IV. SYSTEM DESIGN AND COMPONENT DESCRIPTION

A. Hardware Components

The hardware design focuses on capturing user gestures, processing the data, and controlling electrical appliances. A camera module is used to capture real-time hand gestures. This camera continuously monitors the gesture area and sends image frames to the processing unit.

B. Software Design

Once the gesture is recognized, the software maps it to a predefined command. The command is then transmitted to the automation controller using communication protocols such as MQTT, HTTP, or serial communication. Error handling and feedback mechanisms are also included to improve system reliability.

C. System Integration

Hardware and software components are integrated to work as a complete system. The entire circuit is designed to minimize power loss and improve system stability. This integrated circuit approach ensures accurate command execution and long-term reliability of the system.

V. APPLICATIONS OF AI BASED GESTURE HOME AUTOMATION

Smart home automation for controlling lights, fans, air conditioners, and other household appliances
Assistive technology for elderly people and individuals with physical disabilities
Touchless control systems in hospitals, laboratories, and healthcare environments
Smart offices and conference rooms for managing electrical equipment
Home energy management systems to reduce power wastage

VI. ADVANTAGES AND LIMITATIONS

A. Advantages

Enables touchless operation, improving hygiene and safety
Provides a natural and intuitive user interface using hand gestures
Reduces dependency on physical switches and remote controls
Highly beneficial for elderly and physically challenged users

B. Limitations

System performance depends on proper lighting condition
Accuracy may decrease when gestures are similar in appearance

C. Possible Improvements

Use of advanced sensors and AI-based analysis

VII. FUTURE SCOPE

The future scope of the AI-based gesture-controlled home automation system is promising. The system can be enhanced by integrating voice recognition and facial recognition to provide multimodal interaction. Edge AI implementation can further improve response time and data privacy by processing information locally.

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VIII. CONCLUSION

The AI-based gesture-controlled home automation system presents an innovative and practical approach to modern home automation. By combining artificial intelligence, computer vision, and IoT technologies, the system provides a seamless, contactless, and user-friendly method for controlling household appliances. While certain challenges such as lighting dependency and privacy concerns exist, continuous advancements in AI and sensor technologies are expected to overcome these limitations. Overall, the proposed system demonstrates significant potential to enhance smart living environments and improve the quality of life.

IX. ACKNOWLEDGEMENT

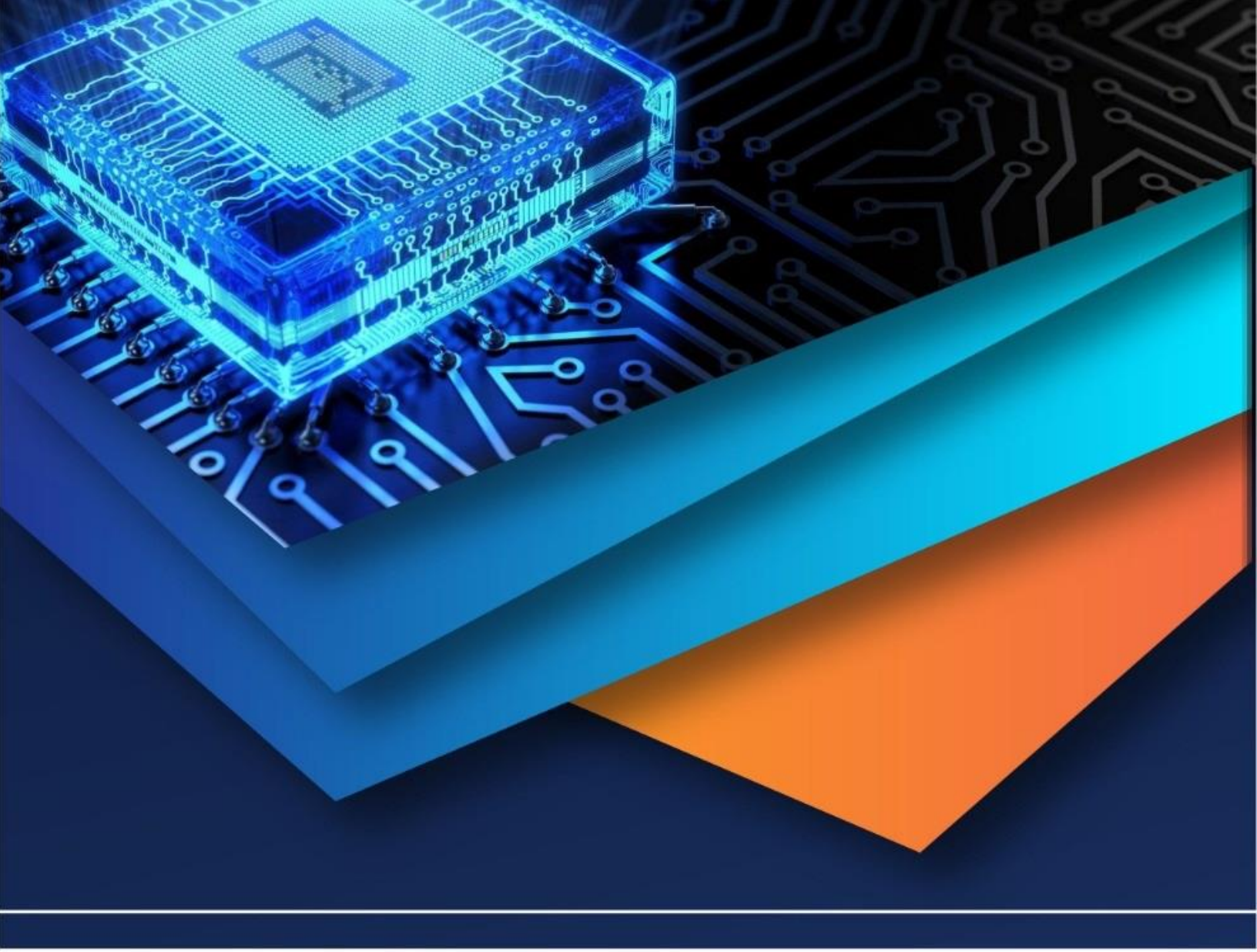
I would like to express my sincere gratitude to my project guide Ms. Kahekasha Sheikh and faculty members for their guidance and support throughout the completion of this project. I am also thankful to my team members and family for their encouragement and cooperation.

Their technical knowledge and support helped me understand the concepts clearly and complete the work successfully. I am also thankful to the Head of the Department Mr. Balvir Chand and all the faculty members for providing the necessary facilities, academic support, and a positive learning environment.

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10.22214/IJRASET

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