

Voice-Controlled Home Automation System Using Arduino and Bluetooth

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Abstract: This paper presents the design and implementation of a cost-effective voice-controlled home automation system using Arduino Uno and Bluetooth technology. The proposed system allows wireless control of household electrical appliances through voice commands from a smartphone. Bluetooth communication enables seamless connectivity, and Arduino handles the control logic and switching operation via relays. The system is designed to aid physically challenged and elderly individuals by providing an easy and hands-free method of controlling home devices. This project demonstrates an integration of embedded systems and IoT principles to create an intelligent and accessible home automation solution.

Keywords: Home Automation, Arduino Uno, Bluetooth, Voice Control, Embedded Systems, IoT.

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I. INTRODUCTION

In today's digital world, automation has become an essential part of modern living. Home automation systems allow users to control electrical devices remotely or automatically. The voice-controlled home automation system eliminates the need for manual switches by enabling control through simple voice commands. This system leverages Arduino Uno as the microcontroller and an HC-05 Bluetooth module to receive commands from a smartphone. It offers enhanced comfort, accessibility, and energy efficiency, especially benefiting elderly and differently-abled individuals.

II. SYSTEM DESIGN AND METHODOLOGY

The system consists of a smartphone, Bluetooth module (HC-05), Arduino Uno microcontroller, and the relay modules connected to the electrical appliances. Voice commands are converted to text on the smartphone and sent via Bluetooth. The Arduino interprets the received command and activates or deactivates the respective relays to control appliances such as lights and fans. In the overall process includes voice acquisition, Bluetooth communication, command processing, and device control.

III. HARDWARE AND SOFTWARE IMPLEMENTATION

The Arduino Uno (ATmega328P) serves as the processing unit. The HC-05 Bluetooth module provides wireless communication, while a 4-channel relay module isolates low and high voltage circuits for safety. Software

implementation involves coding in the Arduino IDE using C/C++ language. The Software Serial library is used for Bluetooth communication. The prototype was tested with LEDs simulating home appliances and later with real devices such as fans and bulbs.

IV. RESULTS AND DISCUSSION

The system successfully executed commands such as "light on", "fan off", and "all on", providing immediate response with minimal latency. It operated effectively within a Bluetooth range of approximately 10 meters. The project proved reliable, low-cost, and user-friendly. Challenges observed included occasional speech recognition errors due to the background noise and limited Bluetooth range, which can be addressed by future upgrades.

V. APPLICATIONS AND FUTURE SCOPE

Applications include in this smart home automation, elderly assistance, and energy-efficient control systems. Future enhancements may include Wi-Fi integration using ESP32, IoT connectivity for remote monitoring, and AI-based predictive control for user convenience. The system can also be expanded to support smart assistants like Google Assistant or Alexa for complete smart home integration.

VI. CONCLUSION

The voice-controlled home automation system using Arduino and Bluetooth demonstrates the feasibility of low-cost, user-friendly smart home solutions. It provides a practical example of embedded systems integration for real-

world accessibility and convenience. This project highlights the potential of an open-source hardware to make smart technology affordable and scalable for every household.

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