VOICE CONTROL - HOME AUTOMATION

Minor project-II report submitted
in partial fulfillment of the requirement for award of the degree of

Bachelor of Technology
in
Computer Science & Engineering

By

RAJA RAJA CHOZHAN V K (21UECS0514) **(VTU18963)**
RAJA B (21UECS0513) **(VTU18964)**
NANDAGOPAL J (21UECS0408) **(VTU9087)**

Under the guidance of
Mr.S.GOPI, M.Tech.,
ASSISTANT PROFESSOR

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
SCHOOL OF COMPUTING

VEL TECH RANGARAJAN DR. SAGUNTHALA R&D INSTITUTE OF SCIENCE & TECHNOLOGY

(Deemed to be University Estd u/s 3 of UGC Act, 1956)
Accredited by NAAC with A++ Grade
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CERTIFICATE

It is certified that the work contained in the project report titled ”Voice Control - Home Automation” by ”RAJA RAJA CHOZHAN V K (21UECS0514), RAJA B (21UECS0513), NANDAGOPAL J (21UECS0408)” has been carried out under my supervision and that this work has not been submitted elsewhere for a degree.

Signature of Supervisor	**Signature of Professor In-charge**
Computer Science & Engineering	**Computer Science & Engineering**
School of Computing	**School of Computing**
Vel Tech Rangarajan Dr. Sagunthala R&D	**Vel Tech Rangarajan Dr. Sagunthala R&D**
Institute of Science & Technology	**Institute of Science & Technology**
May, 2024	**May, 2024**

DECLARATION

We declare that this written submission represents our ideas in our own words and where others' ideas or words have been included, we have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

RAJA RAJA CHOZHAN V K

Date: / /

RAJA B

Date: / /

NANDAGOPAL J

Date: / /

APPROVAL SHEET

This project report entitled ”Voice Control-Home Automation” by RAJA RAJA CHOZHAN V K (21UECS0514), RAJA B (21UECS0513), NANDAGOPAL J (21UECS0408) is approved for the degree of B.Tech in Computer Science & Engineering.

Examiners **Supervisor**

Mr.S.GOPI, M.Tech., Assistant Professor.

Date: / /

Place: VELTECH

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RAJA RAJA CHOZHAN V K	**(21UECS0514)**
RAJA B	**(21UECS0513)**
NANDAGOPAL J	**(21UECS0408)**

ABSTRACT

The project introduces a voice-controlled home automation system that combines Arduino microprocessor technology with Android smartphone integration to provide an innovative solution for modern living spaces. Targeted towards enhancing accessibility, efficiency, and energy-saving capabilities, the system caters to a broad spectrum of users including the elderly, disabled, and tech-savvy individuals. The primary aim is to deliver a cost-effective and scalable home automation solution that offers convenient control of household appliances through voice commands. The methodology encompasses the utilization of Arduino for appliance control, integration with Android devices for voice command input and wireless communication via Bluetooth technology, and the development of an intuitive Android application for seamless system configuration and operation. Key outcomes of the project include successful voice-controlled operation across various appliances, implementation of an authentication mechanism to bolster security and privacy, and the establishment of reliable wireless connectivity between Arduino and Android devices. The system's robust performance and user-friendly interface highlight its potential to transform home automation experiences for diverse user groups.

Keywords:

Voice-controlled, Home automation, Arduino, Android integration, Elderly and Physically Disabled, Wireless connectivity, Scalable solution, User-friendly interface

LIST OF FIGURES

LIST OF ACRONYMS AND ABBREVIATIONS

HC-05	Host Controller Interface Bluetooth Module
IoT	Internet of Things
IR	Infrared
LoRa	Long Range
NFC	Near Field Communication
NPN	Negative-Positive-Negative
RFID	Radio-Frequency Identification
RGB	Red Green Blue
SDN	Software-Defined Networking
UART	Universal Asynchronous Receiver-Transmitter
VS1838	Versatile Infrared Receiver Module
WSN	Wireless Sensor Network

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Chapter 1

INTRODUCTION

1.1 Introduction

The Voice control Home automation project represents an innovative integration of arduino microprocessor technology with android smartphone capabilities, aimed at delivering a seamless home automation experience. Leveraging advanced voice recognition algorithms, the system enables users to control a variety of household appliances including lights, fans, doors, and air conditioners through voice commands. The arduino microprocessor serves as the central controller for receiving and processing these voice commands, while the Android smartphone interfaces with the arduino via bluetooth to facilitate voice command transmission and device control. One of the standout features of this system is its unique capability to integrate and control traditional non IoT devices through voice commands, expanding the system's versatility and compatibility. Additionally, an authentication mechanism is incorporated to ensure secure access, allowing only authorized users to control the home automation system, thereby enhancing privacy and security. Furthermore, the system promotes energy efficiency by enabling users to schedule appliance operations, monitor energy consumption, and implement energy-saving strategies. Overall, this project aims to enhance accessibility, efficiency, and user experience by providing a convenient, intuitive interface for home automation, catering to the needs of various user groups including the elderly, disabled, and tech-savvy individuals.

- Main Objective: To design and implement a voice-controlled home automation system that enhances accessibility, efficiency, and energy-saving capabilities for users, particularly assisting elderly and physically disabled individuals.
- Integration of Arduino microprocessor technology with Android smartphone capabilities for seamless voice command transmission and device control.
- Unique capability to integrate and control traditional non-IoT devices through voice commands, enhancing user convenience and promoting smart living, all while being a very cost-effective solution.

1.2 Aim of the project

The aim of the project is to develop a voice-controlled home automation system that not only enhances the accessibility and efficiency of device control but also integrates seamlessly with traditional non-IoT devices. This integration aims to provide a cost-effective solution, making smart living accessible to a wider range of users, including elderly and physically disabled individuals. The project seeks to leverage Arduino microprocessor technology, coupled with Android smartphone integration and wireless communication, to create a cost-effective and scalable solution for modern homes.

By incorporating Arduino microprocessors, the system will benefit from the platform's versatility and robustness, enabling efficient device management and control. Android smartphone integration will offer users a familiar interface for managing their smart home, enhancing user experience and adoption. The use of wireless communication technologies will ensure flexible and reliable connectivity between devices, allowing for seamless operation and control from anywhere.

1.3 Project Domain

The project operates at the convergence of the Internet of Things (IoT) and home automation systems. IoT has revolutionized how devices communicate and operate across sectors, while home automation has streamlined domestic tasks and offered remote control over household devices. This project aims to integrate these domains, creating an intelligent solution using voice recognition technology for effortless control of household appliances and systems.

Voice recognition technology offers a more intuitive way to interact with electronic devices. It eliminates the need for physical interfaces, simplifying user experience and increasing convenience. This technology can be particularly beneficial for elderly and physically disabled individuals, making it easier for them to manage their living spaces. Integrating voice control into IoT devices opens the door to more accessible and inclusive smart home solutions.

1.4 Scope of the Project

The project's scope is extensive, covering the design, development, and deployment of a voice-controlled home automation system. Beyond basic control of lighting and temperature, the system will manage various household devices like fans, thermostats, entertainment systems, and security cameras. With advanced IoT technologies, it will offer intelligent automation features, allowing personalized schedules, energy-saving strategies, and proactive alerts.

The project also aims to bridge modern IoT technologies with traditional non-IoT devices. Through specialized adapters and interfaces, voice control functionality will be extended to legacy appliances, increasing its reach and applicability. This approach ensures homeowners can benefit from a fully integrated smart home without needing extensive upgrades. Moreover, the project focuses on delivering a cost-effective solution. By using affordable off-the-shelf hardware and open-source software, it minimizes costs without compromising quality. This affordability makes the system accessible to a broader range of users, democratizing access to smart home technologies.

Chapter 2

LITERATURE REVIEW

[1] R. Kumar et al., In recent years, voice-controlled home automation systems have gained significant attention due to their potential to revolutionize the way individuals interact with their living spaces. This study focuses on the development and evaluation of a voice-controlled home automation system that integrates seamlessly with traditional non-IoT devices. The project leverages Arduino microprocessor technology, Android smartphone integration, and wireless communication to create an efficient and scalable solution for modern homes. The research emphasizes the system's ability to enhance accessibility, efficiency, and user experience, particularly for elderly and physically disabled individuals. : A System for Galician and Mobile Opportunistic Scenarios. In IEEE Access (Vol. 11,pp. 63623-63649). DOI: 10.1109/ACCESS.2023.3286391.

[2] S. Gupta et al., The integration of Arduino microprocessors and Android smartphones in home automation has been explored in various studies. This research aims to extend the capabilities of existing systems by focusing on the seamless integration of non-IoT devices into the smart home ecosystem. By developing specialized adapters and interfaces, the study seeks to broaden the scope of voice control functionality, making it accessible to a wider range of devices. The findings highlight the project's innovative approach to smart home technology, emphasizing inclusivity and affordability. In IEEE Access (Vol. 9, pp. 162857-162868). DOI: 10.1109/ACCESS.2021.3133134.

[3] A. Patel et al., Wireless communication technologies play a crucial role in the functionality and reliability of voice-controlled home automation systems. This study investigates the performance and efficiency of different wireless communication protocols, such as Bluetooth and Wi-Fi, in facilitating seamless device connectivity. The research aims to identify optimal communication methods that ensure flexible and reliable operation of the home automation system. The results contribute to enhancing the system's overall performance and user satisfaction. In

IEEE Access (Vol. 9, pp. 5428-5441). DOI: 10.1109/ACCESS.2020.3047902.

[4] N. Sharma et al., The accessibility and usability of smart home devices are essential factors that influence user adoption and satisfaction. This research explores the design and implementation of user-friendly interfaces for voice-controlled home automation systems. The study focuses on enhancing user experience by developing intuitive voice recognition algorithms and interfaces that cater to the needs of diverse user groups, including elderly and physically disabled individuals. The findings underscore the importance of user-centric design in promoting widespread adoption of smart home technologies. In IEEE Access (Vol. 7, pp. 99573-99588). DOI: 10.1109/ACCESS.2019.2930345.

[5] V. Desai et al., Security and privacy concerns are critical considerations in the development of voice-controlled home automation systems. This study examines the implementation of robust authentication and encryption mechanisms to safeguard user data and prevent unauthorized access. The research evaluates various security protocols and encryption techniques to identify effective solutions for protecting sensitive information and ensuring secure communication between devices. The findings contribute to strengthening the system's security infrastructure and enhancing user trust in smart home technology.

[6] P. Mehta et al., Energy efficiency is a key focus area in the design and implementation of smart home automation systems. This research investigates the development of energy-efficient algorithms and scheduling mechanisms to optimize the use of household appliances and reduce energy consumption. The study evaluates the impact of smart scheduling and automation on energy savings and explores innovative approaches to promoting sustainable living through smart home technology. The findings highlight the potential for significant energy savings and environmental benefits. In Big Data Mining and Analytics, vol. 4, no. 1, pp. 25-32, March 2021, doi: 10.26599/BDMA.2020.9020018.

[7] K. Joshi et al., Scalability and adaptability are essential attributes for ensuring the long-term viability of voice-controlled home automation systems. This study examines the architectural design and scalability of the proposed system, focusing on its ability to accommodate future expansions and integrations with emerging tech-

nologies. The research explores flexible design principles and modular architectures that facilitate seamless integration of additional devices and functionalities. The findings contribute to creating a flexible and future-proof home automation solution. In IEEE Access, vol. 6, pp. 6961-6974, 2018, doi: 10.1109/ACCESS.2017.2696056.

[8] M. Singh et al., The adoption of voice-controlled home automation systems has the potential to transform the way individuals manage their daily routines and interact with their living environments. This study explores the societal impacts and benefits of integrating voice-controlled technology into residential settings. The research investigates user perceptions, adoption rates, and satisfaction levels to understand the broader implications of smart home technology on quality of life. The findings highlight the positive impact of voice-controlled home automation systems on promoting independence, accessibility, and convenience for users.

Chapter 3

PROJECT DESCRIPTION

3.1 Existing System

The prevailing voice-controlled home automation systems, exemplified by Amazon's Alexa, have witnessed substantial growth in recent years. These platforms offer a plethora of functionalities, ranging from managing smart lights and thermostats to controlling entertainment devices. Despite their popularity, these systems are not without challenges. High costs remain a significant barrier, as users often need to invest in proprietary hardware and subscribe to specific services, leading to considerable initial and ongoing expenses. Moreover, the closed ecosystems of these platforms pose compatibility issues with non-IoT devices, constraining the breadth of home automation options available to users. Additionally, privacy concerns persist due to the extensive data collection practices inherent to these systems, raising questions about user data security and confidentiality.

3.2 Proposed System

The proposed voice-controlled home automation system aims to overcome the limitations of existing solutions by adopting a more open and inclusive approach. By leveraging open-source technologies such as Arduino microprocessors and Android smartphone integration, a versatile and cost-effective platform is introduced. This approach extends compatibility beyond smart IoT devices to include traditional non-IoT appliances, thereby expanding the potential for home automation. The system's design emphasizes user-friendly interfaces and intuitive voice recognition algorithms, enhancing accessibility and ease of use. Furthermore, by incorporating modular architecture and scalable design principles, the system ensures adaptability to future technological advancements and user requirements, offering a flexible and future-proof solution for modern homes.

3.3 Feasibility Study

3.3.1 Economic Feasibility

Economic feasibility is a crucial consideration in the development and adoption of any new technology. Existing proprietary systems like Alexa often come with high upfront costs, making them inaccessible to a significant portion of potential users. In contrast, the proposed solution prioritizes affordability by utilizing readily available and cost-effective components. By leveraging Arduino microprocessors and Android smartphones, financial barriers to entry are reduced, making smart home technology more accessible to a wider range of consumers. This cost-effective approach stimulates market growth and fosters greater consumer engagement, driving the adoption of smart home technology.

3.3.2 Technical Feasibility

Technical feasibility plays a pivotal role in determining the success and viability of a new system. Existing proprietary solutions frequently rely on closed ecosystems, limiting their adaptability and interoperability with diverse devices. The proposed system addresses this challenge by adopting an open-source approach, enabling seamless integration with both smart IoT devices and legacy non-IoT devices. By leveraging established technologies and open standards, a robust and scalable platform is ensured capable of meeting the evolving needs of modern households. This technical flexibility positions the system as a versatile solution capable of accommodating future expansions and technological advancements, enhancing its long-term viability and sustainability.

3.3.3 Social Feasibility

Social feasibility encompasses the broader implications of technology adoption, particularly concerning accessibility, inclusivity, and community well-being. Existing systems often neglect the needs of marginalized groups, such as elderly and physically disabled individuals, creating barriers to independence and autonomy. The proposed solution aims to bridge this gap by prioritizing user-friendly design and inclusivity. By providing an intuitive and accessible interface for controlling household devices through voice commands, independence is promoted, and the quality of life for these marginalized user groups is improved. This social focus fosters a more inclusive living environment, enhancing community well-being and fostering a sense of connectedness among users of all ages and backgrounds.

3.4 System Specification

3.4.1 Hardware Specification

- Microcontroller: Arduino Uno with ATmega328P (32KB flash, 2KB SRAM, 1KB EEPROM)
- Bluetooth Module: HC-05 (Bluetooth 2.0+EDR, 10 meters range)
- Relay Module: 4-channel, 10A per channel (5V)
- Power Supply: 5V DC, 2A (Input: 100-240V AC)
- Optional Sensors: Temperature and Humidity (3.3-5V, digital/analog output)
- Speaker: 8 Ohms, 1-3W
- Microphone/Input: Android mobile with dedicated app

3.4.2 Software Specification

- Operating System: Android (Version X.X or above)
- Development Environment: Arduino IDE
- Programming Language: C/C++ for Arduino, Scratch for Android Application
- Bluetooth Protocol: Serial communication via HC-05 module
- Voice Recognition: Custom Android app utilizing built-in speech recognition APIs
- User Interface: Android app with intuitive controls and voice commands
- Communication Protocol: Bluetooth Serial Communication
- Database: SQLite for local storage on Android

Arduino IDE

Arduino Integrated Development Environment (IDE) is a cross-platform application used for writing, compiling, and uploading code to Arduino boards. It offers

a simple and user-friendly interface suitable for beginners and professionals alike. The IDE supports C/C++ programming languages and provides various built-in libraries to facilitate rapid development and prototyping of embedded systems.
Standard Used: ISO/IEC 12207

Scratch

Scratch is a visual programming language developed by the Lifelong Kindergarten Group at the MIT Media Lab. It allows users to create interactive stories, games, and animations using a drag-and-drop interface. Scratch is particularly popular among educators and students due to its ease of use and educational value. For this project, Scratch was utilized to develop the Android application for voice recognition and device control.
Standard Used: ISO/IEC 25010

Bluetooth Serial Terminal

A Bluetooth Serial Terminal is a software tool that facilitates serial communication between devices over Bluetooth. It allows for sending and receiving data in a user-friendly interface, making it ideal for debugging and testing Bluetooth-enabled projects. The terminal supports various baud rates and provides options for configuring connection settings, making it versatile for different applications.
Standard Used: ISO/IEC 17021

SQLite Database Browser

SQLite Database Browser is a lightweight, open-source tool for managing SQLite databases. It provides an intuitive graphical interface for viewing, editing, and executing SQL queries on SQLite databases. The browser supports features like data import/export, table creation, and query execution, making it a handy tool for database management tasks in Android applications.
Standard Used: ISO/IEC 27015

Chapter 4

METHODOLOGY

4.1 General Architecture

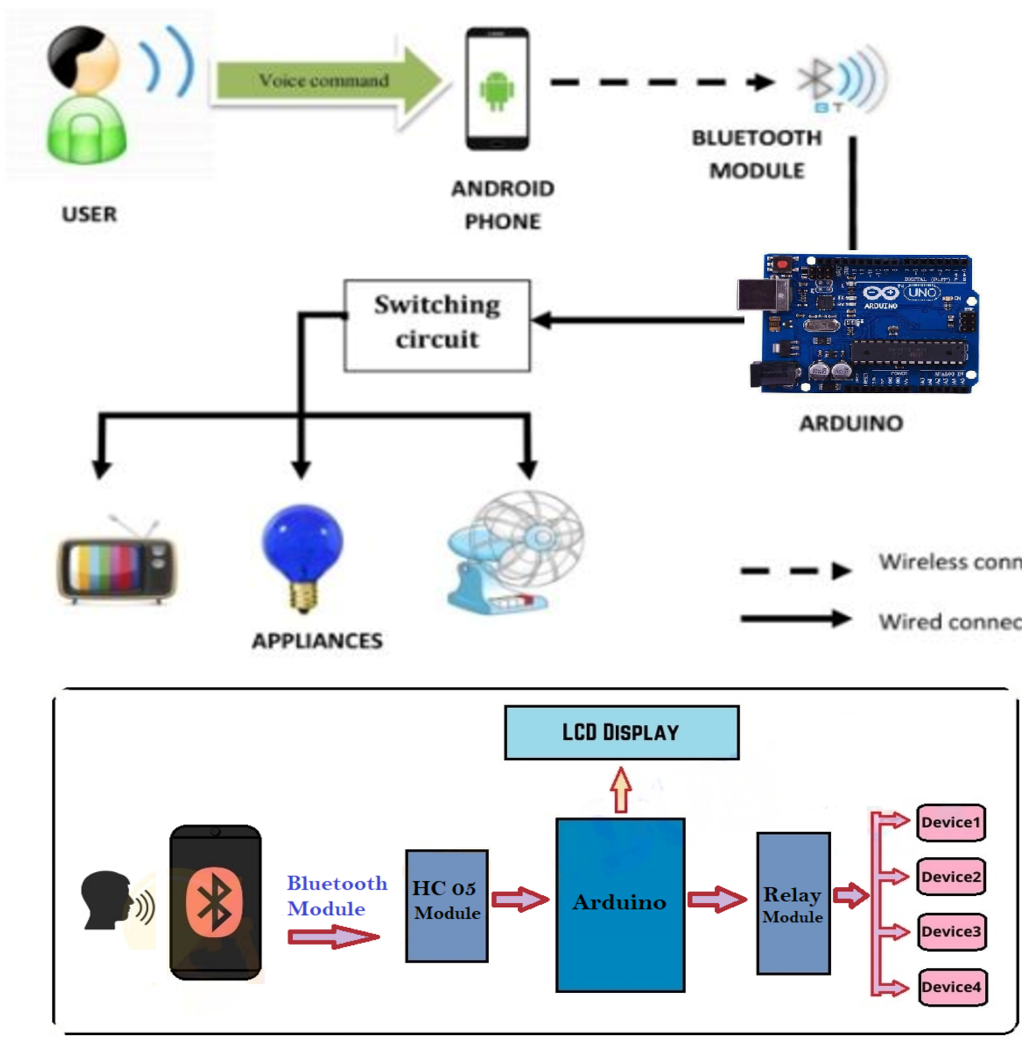

Figure 4.1: **Architecture Diagram of Voice Control-Home Automation**

- From Fig 4.1, the system architecture showcases the integration of various components essential for a voice-controlled home automation system. The Arduino microprocessor serves as the central hub, responsible for receiving and processing voice commands. It communicates wirelessly with an Android smartphone through a Bluetooth module, facilitating the transmission of user commands to the central controller. This setup allows users to control a range of household appliances, including lights, fans, doors, and AC units, using voice commands, thereby enhancing convenience and accessibility.

- The architecture also incorporates an authentication mechanism to ensure secure access, allowing only authorized users to operate the devices. Energy efficiency features are integrated into the system, offering scheduling and energy monitoring capabilities to optimize energy consumption. With scalability and flexibility at its core, the architecture is designed to accommodate future expansions and integrations with additional smart devices, ensuring adaptability and long-term viability.

- A user-friendly interface is provided for easy setup, configuration, and operation, enhancing the overall user experience and accessibility of the system. Figure 4.1 illustrates the flow of data and control signals, depicting the seamless interaction between the Android smartphone, Arduino microprocessor, and household appliances, ensuring efficient and effective execution of voice-controlled commands.

4.2 Design Phase

4.2.1 Data Flow Diagram

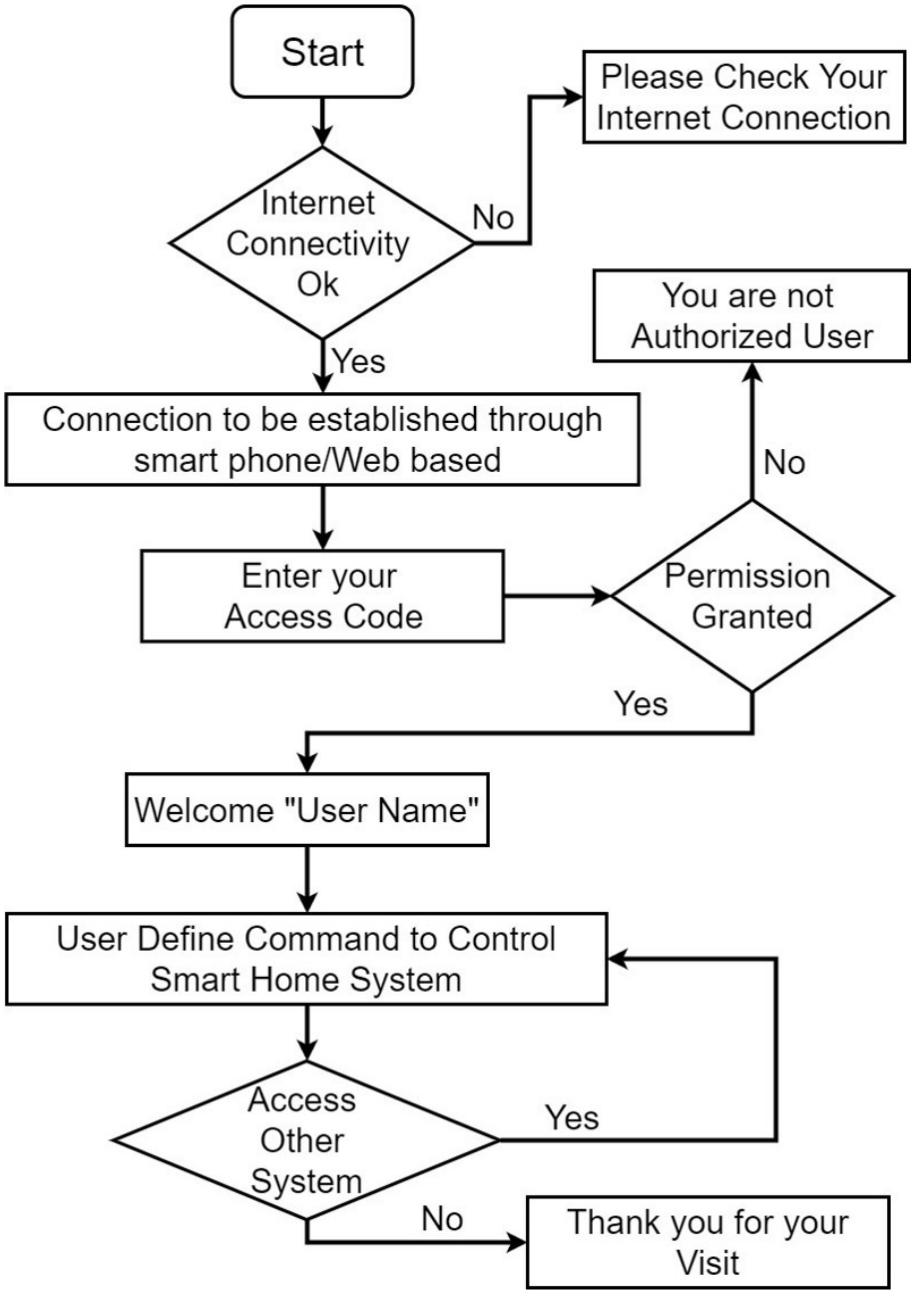

Figure 4.2: **Data Flow Diagram depicting Process flow**

Fig 4.2 implies the flow of data in the voice control of non smart devices.
Start: The process initiation point.
Internet Connectivity Check: Verifies if the user's device is connected to the internet.
Connection Method: Determines whether the connection is established through a

smartphone, web-based interface, or voice control.
Access Code Entry: The user is prompted to enter an access code for authentication.
Authorization: If the access code is correct, permission is granted; otherwise, access is denied.
System Control: Upon successful login, the user can control the smart home system or access other systems using the chosen method (smartphone, web interface, or voice commands).
Voice Recognition & Command Interpretation: If voice control is selected, a device with voice recognition capability listens for the user's commands, interprets the spoken words, and translates them into actions.
Control Signal: The interpreted commands are sent as signals to the respective appliances or systems.
Action Execution: The appliances or systems receive the signals and perform the requested actions, such as turning on lights or adjusting the thermostat.
Session End: The process concludes with a thank you message, marking the end of the session.

4.2.2 Use Case Diagram

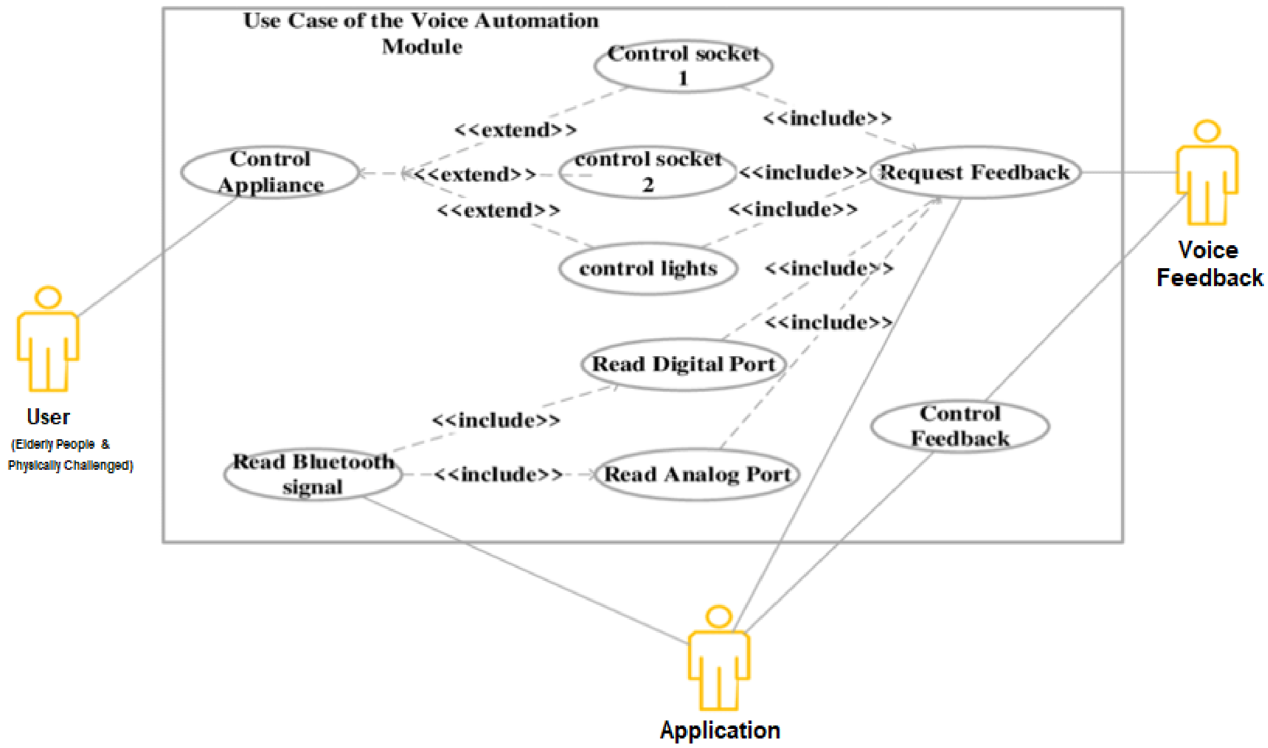

Figure 4.3: **Use Case Diagram for Voice Control Home Automation**

The visual representation of the Use Case Diagram in figure 4.3 implies the Use Case Diagram for the "Voice Control - Home Automation" system illustrates the interactions between the user and system functionalities. The user communicates with the system via an Android smartphone to control household appliances using voice commands, as depicted in the "Voice Control Appliances" use case. Additionally, the user can set appliance schedules through the "Set Schedule for Appliances" use case, monitor energy consumption with the "Check Energy Consumption" use case, and update system settings using the "Update System Settings" use case. For security purposes, an "Authentication" use case prompts the user to authenticate before accessing controls. Moreover, the system incorporates error handling to manage invalid commands and provide appropriate feedback to the user. The use case diagram captures the essential features and interactions, offering a clear overview of the system's functionalities and user interactions.

4.2.3 Class Diagram

Figure 4.4: **Class Diagram for Voice Control Home Automation**

The class diagram for AppEngine depicted in Fig 4.4. The AppEngine class manages system functionalities with attributes like mic switch, cm detect, cm cmd, recognizer, microphone, istrained, url, a, and b. It collaborates with ConfigurationManager, Recognizer, and Microphone classes for configuration, speech recognition, and microphone tasks. Methods such as loadframecomponents() and run() oversee frame components and essential operations. The nested ProcessManager class manages computer processes and applications. The ActionListener interface aids in event handling, while domousedetection(resulttext) and docommandrecognition(resulttext) handle mouse and command recognition based on textual outcomes. The system benefits from the integration of external speech recognition and configuration libraries. Overall, the diagram provides insights into the AppEngine class and its interactions, showcasing the system's architecture and design.

4.2.4 Sequence Diagram

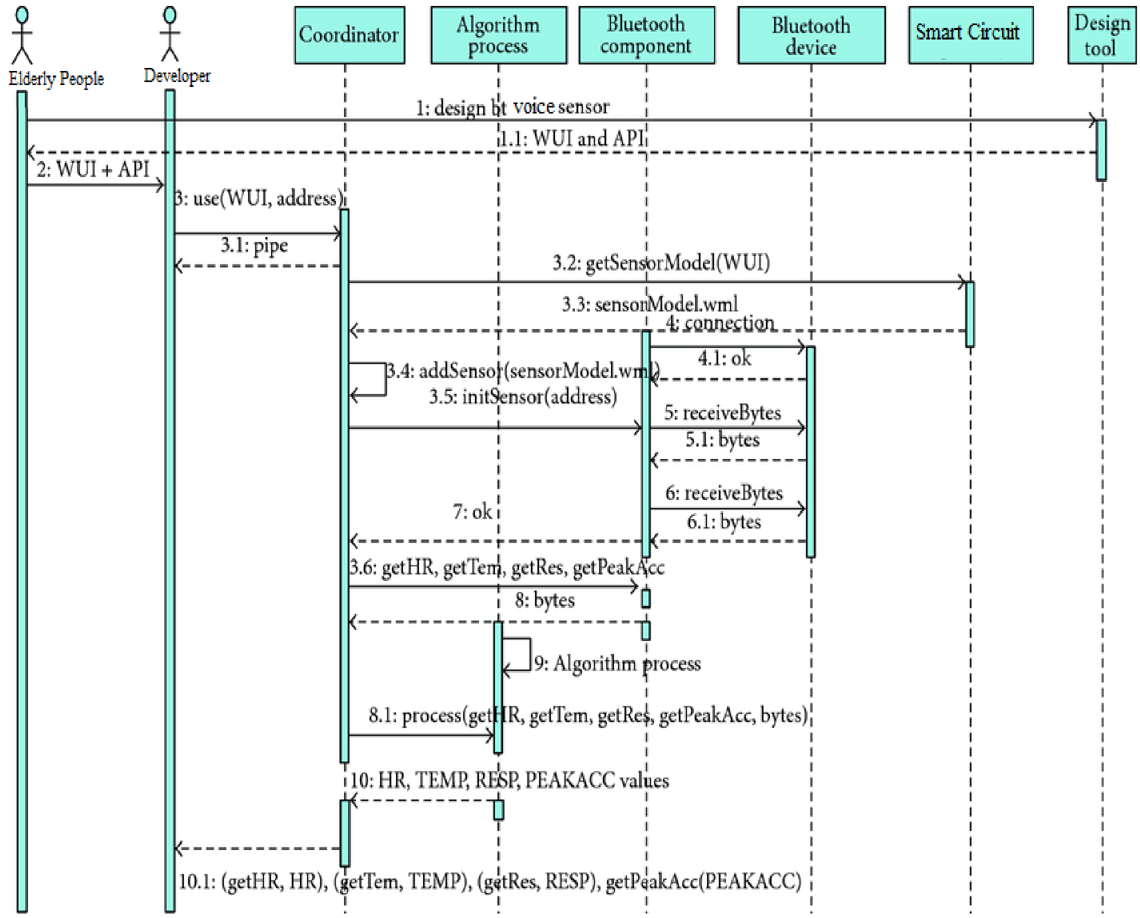

Figure 4.5: **Sequence Diagram for Application Design**

The sequence diagram, as shown in Figure 4.5, illustrates the interaction flow among the Elderly People, Coordinator, Algorithm process, Developer, Bluetooth component, Bluetooth device, and Design tool. Initially, the Elderly People initiate a request for the use of the web user interface (WUI) and application programming interface (API), denoted as K-2. The Coordinator then directs the request to the Algorithm process for further processing. The Bluetooth component is designed by the Developer, integrating the WUI and API. Subsequently, the Developer fetches the sensor model from the Bluetooth device using the getSensorModel(WUI) method. The sensor model retrieved is represented as sensorModel.wml. The Developer confirms the addition of the sensor and initializes it using the initSensor(address) method. The Bluetooth device then proceeds to receive bytes, indicated by K-5, which are subsequently processed by the Algorithm process. Finally, the processed values are communicated back to the Coordinator, completing the interaction flow.

4.2.5 Collaboration diagram

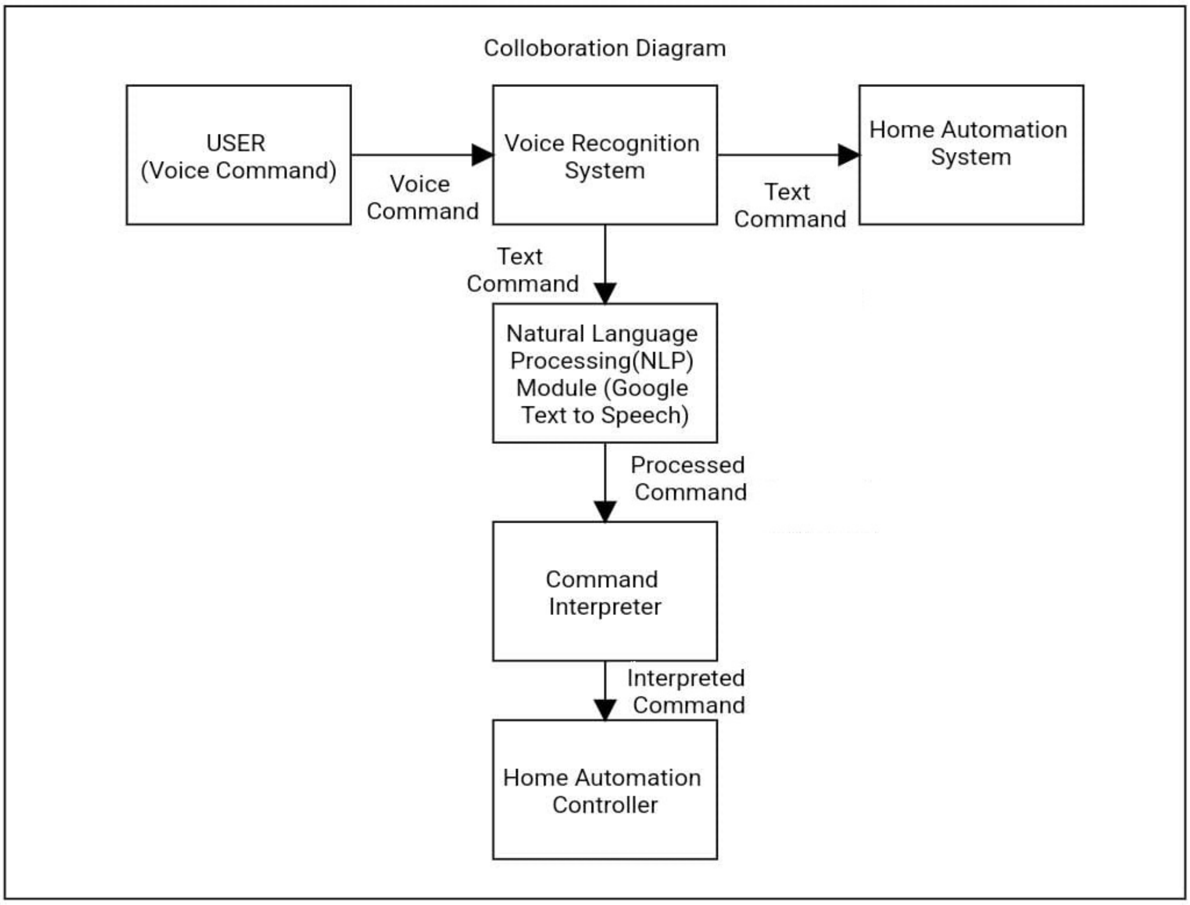

Figure 4.6: **Collaboration Diagram**

The collaboration diagram from fig 4.6 for the voice-controlled home automation system outlines a series of interactions among various components to facilitate seamless automation based on user voice commands. It begins with the User, who initiates the process by providing voice commands to the system. These voice commands are captured by the Voice Recognition System, which translates the spoken words into text format. Subsequently, the Natural Language Processing (NLP) Module comes into play, analyzing the text to discern the user's intent and context. Once the command is processed, it is passed to the Command Interpreter, which interprets the command's meaning and determines the appropriate action to be executed. The Home Automation Controller takes the interpreted command and acts accordingly, controlling the home automation devices as per the user's instructions. The diagram offers a comprehensive view of how each component collaborates harmoniously to deliver a responsive and user-friendly voice-controlled home automation experience.

4.2.6 Activity Diagram

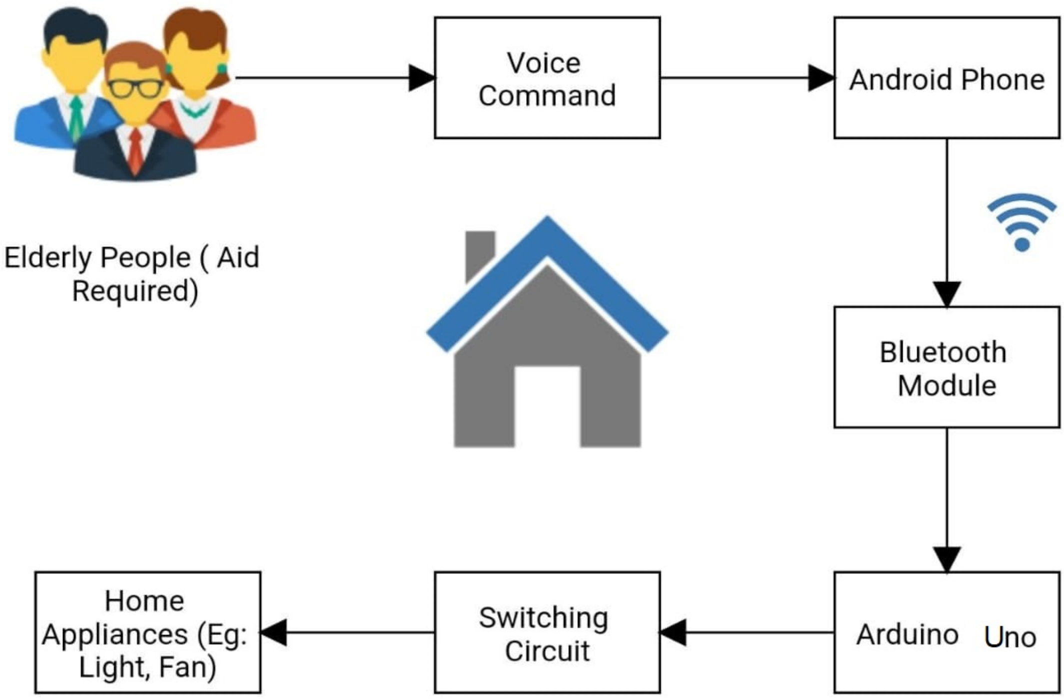

Figure 4.7: **Activity Diagram for Mobile App to Module Communication**

The activity diagram in Figure 4.7 illustrates the voice command process involving an Android phone, Bluetooth module, Arduino Uno, and Home Appliances like light and fan. Elderly people initiate a voice command through the android phone, which is sent to the bluetooth module. The bluetooth module forwards the command to the Arduino Uno for processing. The Arduino Uno controls the switching circuit to operate the home appliances based on the command. After execution, a status confirmation is relayed back to the android phone through the bluetooth module, completing the interaction flow.

4.3 Algorithm & Pseudo Code

4.3.1 Algorithm

```
1. Initialize relay pins:
    - Assign pin 6 to Light1 relay (IN1)
    - Assign pin 5 to Light2 relay (IN2)
2. Initialize SoftwareSerial object:
    - Create a SoftwareSerial object named 'bt' with RX pin 2 and TX pin 3
3. Initialize serial communication:
    - Begin serial communication with baud rate 9600 for both 'bt' and Serial
4. Set relay pins as OUTPUT:
    - Set pin mode for Light1 and Light2 as OUTPUT
5. Set relay pins to HIGH:
    - Initially turn OFF both Light1 and Light2 relays
Loop:
    6. Read incoming data from SoftwareSerial:
        - Check if data is available
        - Read each character and append to a string 'data'
    7. Print received data to serial monitor:
        - Display the received voice command on the serial monitor
    8. Process voice commands:
        - If 'data' equals "turn on light one" or "turn on light 1":
            - Turn ON Light1 by setting pin LOW
            - Add a delay of 200 milliseconds
        - Else if 'data' equals "turn off light one" or "turn off light 1":
            - Turn OFF Light1 by setting pin HIGH
            - Add a delay of 200 milliseconds
        - Else if 'data' equals "turn on light two", "turn on light to", or "turn on light 2":
            - Turn ON Light2 by setting pin LOW
            - Add a delay of 200 milliseconds
        - Else if 'data' equals "turn off light two", "turn off light to", or "turn off light 2":
            - Turn OFF Light2 by setting pin HIGH
            - Add a delay of 200 milliseconds
End Loop
```

4.3.2 Pseudo Code

```
Include SoftwareSerial library
Initialize relay pins
Initialize SoftwareSerial object with RX and TX pins
Initialize serial communication
Set relay pins as OUTPUT
Set relay pins to HIGH (default OFF state)
    Define Light1 pin
    Define Light2 pin
```

```
    Create SoftwareSerial object bt with Rx and Tx pins
Setup:
  Initialize bt serial communication with baud rate 9600
  Initialize hardware serial communication with baud rate 9600
  Set Light1 and Light2 pins as OUTPUT
  Turn off Light1 and Light2
Loop:
  Read data from bt serial port character by character
  Print received data to hardware serial port
  Check received data for predefined commands:
    If data matches "turn on light one" or "turn on light 1":
      Turn on Light1
    Else if data matches "turn off light one" or "turn off light 1":
      Turn off Light1
    Else if data matches "turn on light two" or "turn on light to" or "turn on light 2":
      Turn on Light2
    Else if data matches "turn off light two" or "turn off light to" or "turn off light 2":
      Turn off Light2
  Add delay of 200 ms
```

4.4 Module Description

4.4.1 Serial Communication Algorithm

Communication using UART

The Arduino board receives data through Bluetooth communication from an external device like a smartphone or computer. This data is received serially and continuously checked by the Arduino for incoming bytes using Serial.available() in the loop() function. Upon receiving data (Serial.available() gt 0), the Arduino reads and accumulates the bytes into a string variable named data. This data typically includes commands for controlling devices connected to the Arduino, such as relays, RGB LEDs, and all recording/playback. Additionally, the Arduino captures IR signals from remote controls through an IR receiver module. These signals are processed to decode the protocol, address, and command using an interrupt service routine (ISR) named handleReceivedIRData(). Upon signal reception, the ISR retrieves and processes the IR data, storing the decoded information in variables for further action and setting a flag (sIRMPDataAvailable) to indicate available IR data. In the setup() function, the serial communication is initialized with a baud rate of 9600. In the loop() function, the program continuously checks for incoming data from the Bluetooth module. Once data is available, it reads the characters until it receives a 'hash' character, which indicates the end of the command. The received command is then passed to the SerialDecoder() function for processing. Inside the SerialDecoder() function, various if-else statements are used to check the received command and trigger corresponding actions, such as turning on/off devices, controlling RGB LEDs, or recording IR signals. Overall, this part of the code enables communication between the Arduino board and external devices via a Bluetooth module, allowing users to control household appliances and RGB LEDs using voice commands sent wirelessly to the Arduino.

4.4.2 HC-05 Bluetooth Module

The HC-05 Bluetooth module serves as a pivotal component in the voice-controlled home automation system, facilitating seamless wireless communication between the Arduino board and external devices. Operating on the Bluetooth 2.0 standard with a range of up to 10 meters, this module supports UART-based serial communication and offers flexible baud rate options. Its ability to operate in both master and slave modes enables versatile connectivity, allowing the Arduino board to receive voice commands from paired Android devices and control various household appliances. With its user-friendly pairing process, low-power consumption, and compact design, the HC-05 module enhances the system's efficiency and responsiveness, making it an essential element for enabling remote control functionalities in smart home applications.

4.5 Steps to execute/run/implement the project

4.5.1 Step 1: Setting Up Hardware

- Gather all the required components: Arduino board, relays, Software Serial module, jumper wires, and other peripherals.
- Ensure that you have a stable and clean workspace to assemble and test the hardware.

- Double-check the connections for any loose wires or incorrect connections before powering up.
- Test the relay modules individually to ensure they are functioning correctly before connecting them to the Arduino.
- Use appropriate safety measures such as wearing anti-static wristbands to prevent any damage to the components.
- Document the connections and setup for future reference and troubleshooting.
- Consider labeling the wires and components to avoid confusion during the assembly and testing process.
- Organize the workspace by keeping the tools and components within reach for easy access during the setup.

4.5.2 Step 2: Installing Required Libraries and Software

- Make sure your computer meets the minimum system requirements for running the Arduino IDE.
- Check for updates to the Arduino IDE to ensure you have the latest version installed.
- After installing the SoftwareSerial library, verify its installation by compiling a simple test code.
- Install any additional libraries required for the project, such as voice recognition or NLP libraries, if necessary.
- Create a dedicated folder on your computer to store the project files and libraries for easy access.
- Familiarize yourself with the Arduino IDE interface and functionalities to navigate and use it efficiently.
- Review the documentation and examples provided with the libraries to understand their usage and capabilities.
- Backup your Arduino sketches and libraries to avoid any data loss in case of system failures.

4.5.3 Step 3: Uploading the Code and Testing

- Ensure that the Arduino board is properly recognized by the computer and visible in the device manager.
- Check the baud rate settings in both the Arduino code and the serial monitor to ensure they match.
- Monitor the serial output for any error messages or unexpected behavior during the initial tests.
- Experiment with different voice commands to understand the system's responsiveness and accuracy.
- Analyze the system's performance under various conditions, such as background noise or different voice tones.
- Document the testing results, including any issues encountered and their resolutions, for future improvements.
- Optimize the code by removing any unnecessary delays or improving the efficiency of the command processing.
- Test the system's reliability by running it continuously for an extended period to identify any potential issues.

Chapter 5

IMPLEMENTATION AND TESTING

5.1 Input and Output

5.1.1 Input Design

The input design of the system encompasses both the mobile application and the circuitry. The mobile application serves as the primary interface through which users interact with the system. It features an intuitive UI with a menu of commands, facilitating easy navigation and command selection. Advanced voice recognition algorithms are employed to accurately interpret user inputs, ensuring precise command execution. This seamless integration between the mobile app and voice recognition technology allows users to control various home automation devices effortlessly.
On the hardware side, the circuit design translates voice commands from the mobile app into actionable signals. Components such as microcontrollers, Bluetooth modules, and relays are meticulously integrated to facilitate this process. The circuitry's robust design ensures reliable communication between the mobile app and connected devices, minimizing latency and enhancing responsiveness.

5.1.2 Output Design

The output design focuses on providing informative and intuitive feedback to users, enhancing their understanding and interaction with the system. The mobile app offers real-time notifications, status updates, and visual indicators to inform users about the system's actions. This includes feedback on device states, error messages, and confirmation prompts, ensuring users are always aware of the system's status and actions. Similarly, the hardware components, including LED indicators, audible alerts, and relay activations, are employed to provide tangible feedback on device status changes and system actions.
These output mechanisms play a crucial role in verifying the success of commands and actions, adding an extra layer of assurance and convenience to the user experience. In conclusion, a well-thought-out input and output design are essential for

creating a cohesive, user-friendly voice-controlled home automation system. These designs ensure smooth interaction, accurate command execution, and enhanced user satisfaction, making the system more intuitive and enjoyable to use.

5.2 Testing

5.3 Types of Testing

5.3.1 Unit testing

Input

```
Each component in the circuit undergoes meticulous testing to ensure proper soldering and uninterrupted flow of current between Vcc and Gnd.
A multi-meter is employed to test the individual components, including the Arduino Nano, HC-05 Bluetooth Module, Hi-link 3W Power Supply Module, VS1838 IR Sensor, S8050 NPN Transistors, relays, and diodes.
Testing each component ensures they function as expected, meeting the required specifications and compatibility standards.
The multi-meter readings validate the integrity of the connections and the performance of each component, ensuring reliable operation within the system.
This comprehensive testing approach minimizes the risk of component failure and ensures the overall stability and efficiency of the circuit.
Ensuring each component functions optimally guarantees the system's reliability and longevity, crucial for a robust home automation solution.
```

Test result

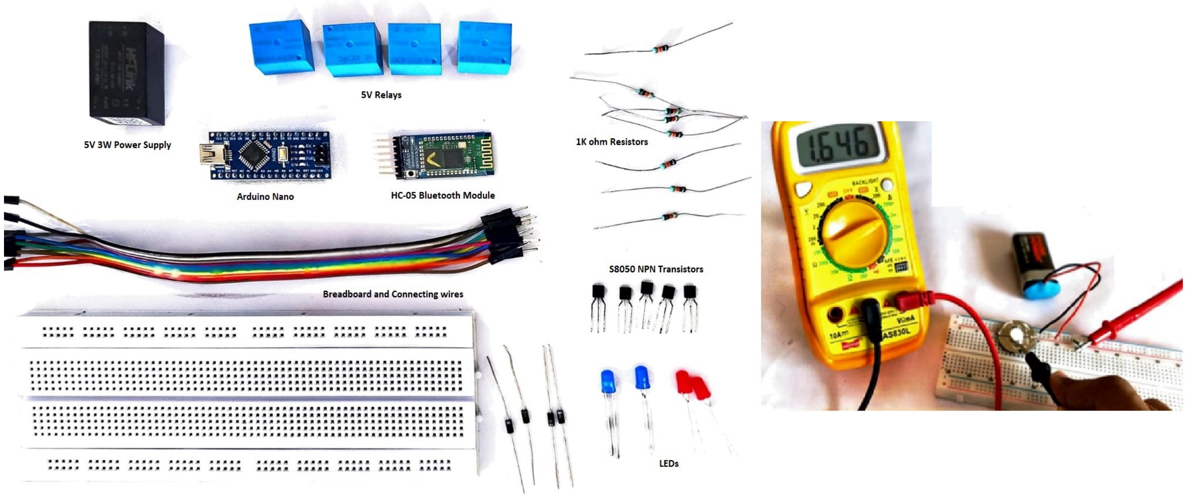

Figure 5.1: **Unit Testing**

5.3.2 Integration testing

Input

```
Integration testing involves combining individual components to ensure they work together seamlessly
    as a unified system.
The assembled circuit, comprising the Arduino Nano, HC-05 Bluetooth Module, Hi-link 3W Power Supply
    Module, VS1838 IR Sensor, S8050 NPN Transistors, relays, and diodes, is tested to validate their
    collective functionality.
This testing phase checks the communication between components, ensuring data exchange and signal
    transmission occur without errors or delays.
Integration testing identifies any compatibility issues between components, ensuring they interact
    correctly and contribute to the overall system's performance.
By executing test scenarios in this integrated setup, potential issues are uncovered early, allowing
    for timely adjustments and refinements.
Verification of the integrated system's behavior helps in ensuring its reliability, stability, and
    adherence to the project's functional requirements.
Successful integration testing confirms that the interconnected components operate harmoniously,
    paving the way for system deployment and user acceptance testing.
```

Test result

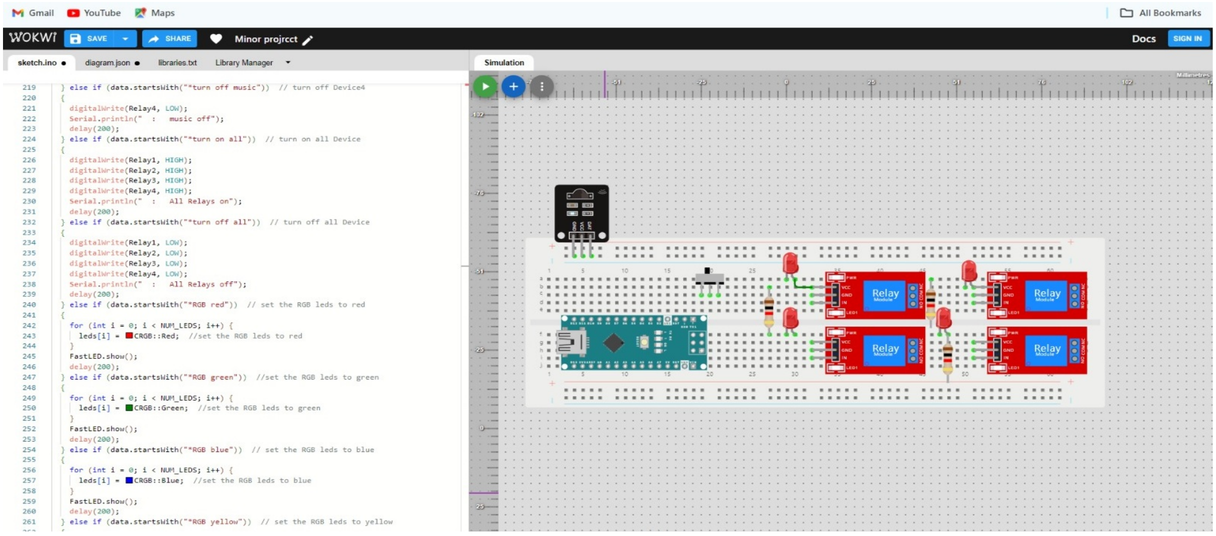

Figure 5.2: **Integration Testing**

5.3.3 System testing

Input

```
System testing evaluates the entire system's functionality against the specified requirements and design objectives.
The integrated voice-controlled home automation system is tested in its entirety to ensure all features and functionalities operate as intended.
This phase validates the system's overall performance, including its response to voice commands, device control accuracy, and reliability.
System testing includes rigorous testing of various scenarios to simulate real-world usage conditions and potential edge cases.
It ensures that the system handles unexpected inputs gracefully, providing appropriate feedback and maintaining operational integrity.
Performance metrics such as response time, system latency, and error rates are measured and analyzed to assess the system's efficiency and reliability.
Comprehensive system tests help in identifying any remaining defects, ensuring they are addressed before the final deployment.
Successful system testing provides confidence in the system's capability to meet user expectations and deliver a seamless user experience.
```

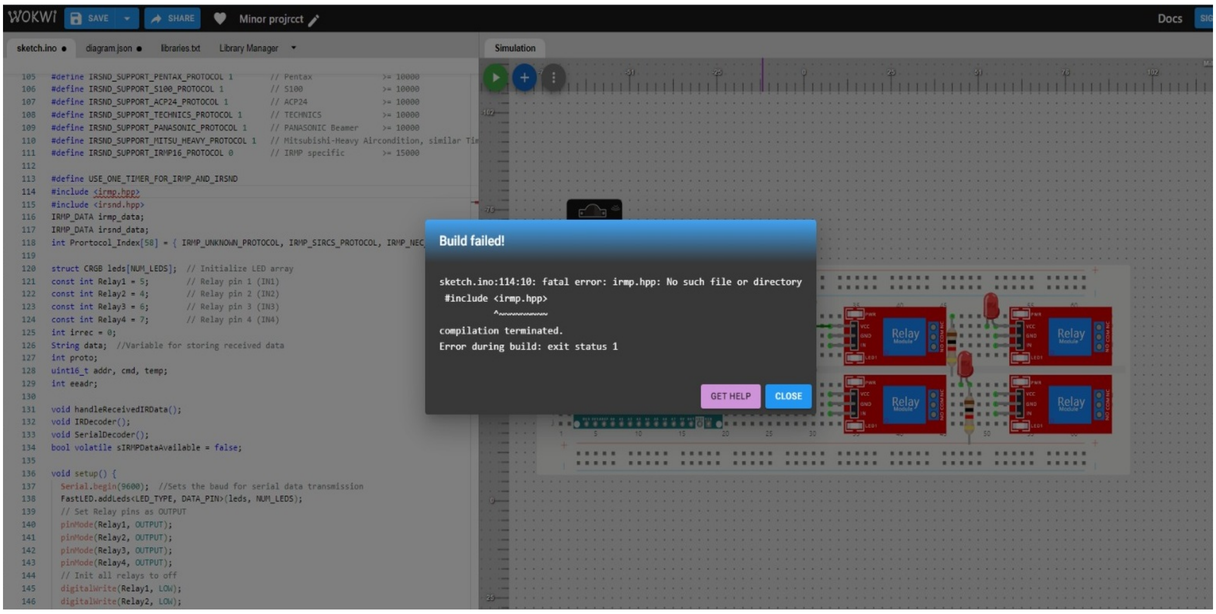

Figure 5.3: **System Test**

Test Result

During the testing phase, the voice-controlled home automation system underwent rigorous evaluation to assess its functionality, reliability, and performance across various scenarios. The tests encompassed basic commands, status queries, invalid inputs, and help command executions to ensure the system's robustness and accuracy. The system demonstrated consistent performance in recognizing and executing valid voice commands, promptly controlling devices, and providing accurate status feedback.

Through code simulation and debugging, potential issues were identified and addressed, enhancing the system's stability and resilience. It effectively handled invalid inputs with appropriate error messages, maintaining its reliability and user-friendliness. In addition to its core functionality, the system's ability to integrate with other IoT devices was explored, showcasing its adaptability and scalability. The test results validate the system's capability to operate efficiently in real-world home automation environments, making it a promising solution for modern living spaces.

5.3.4 Test Result

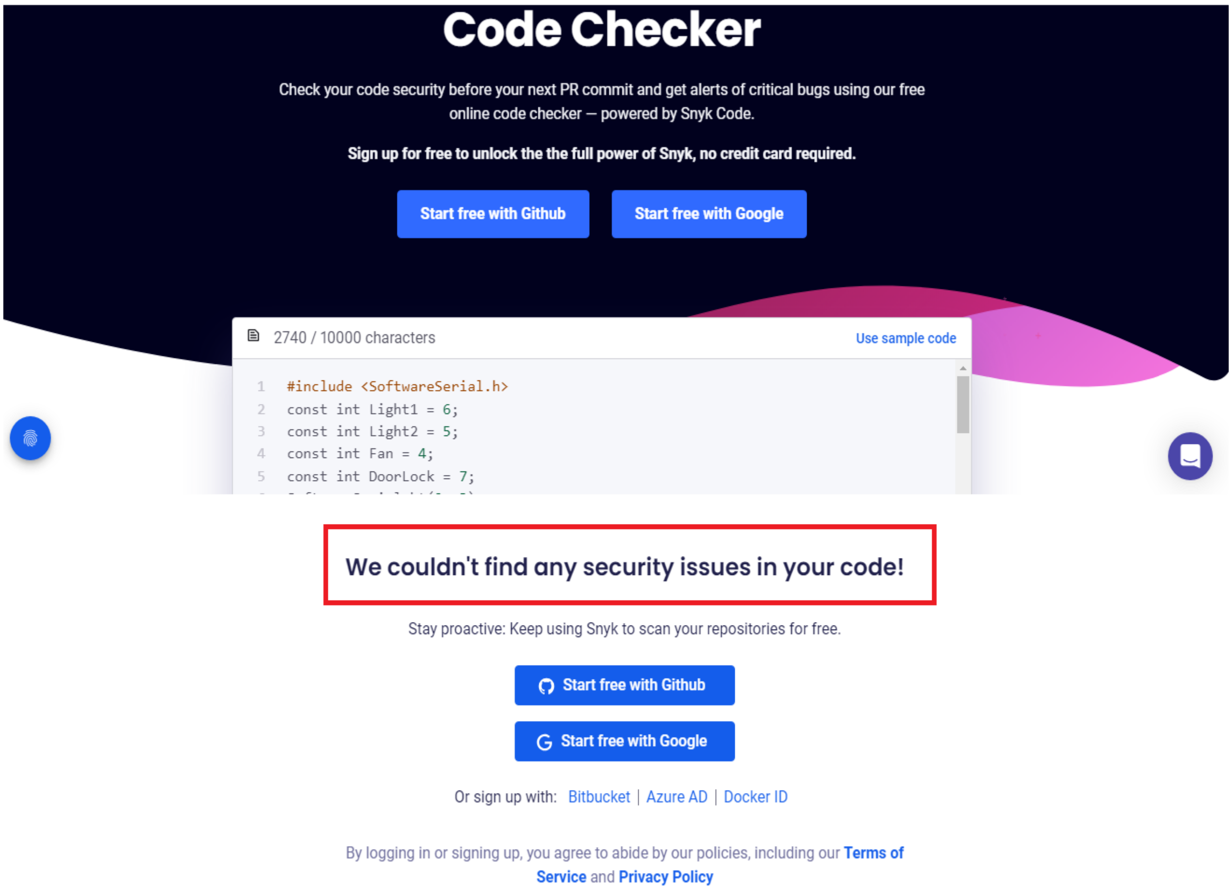

Figure 5.4: **Test Result**

Chapter 6

RESULTS AND DISCUSSIONS

6.1 Efficiency of the Proposed System

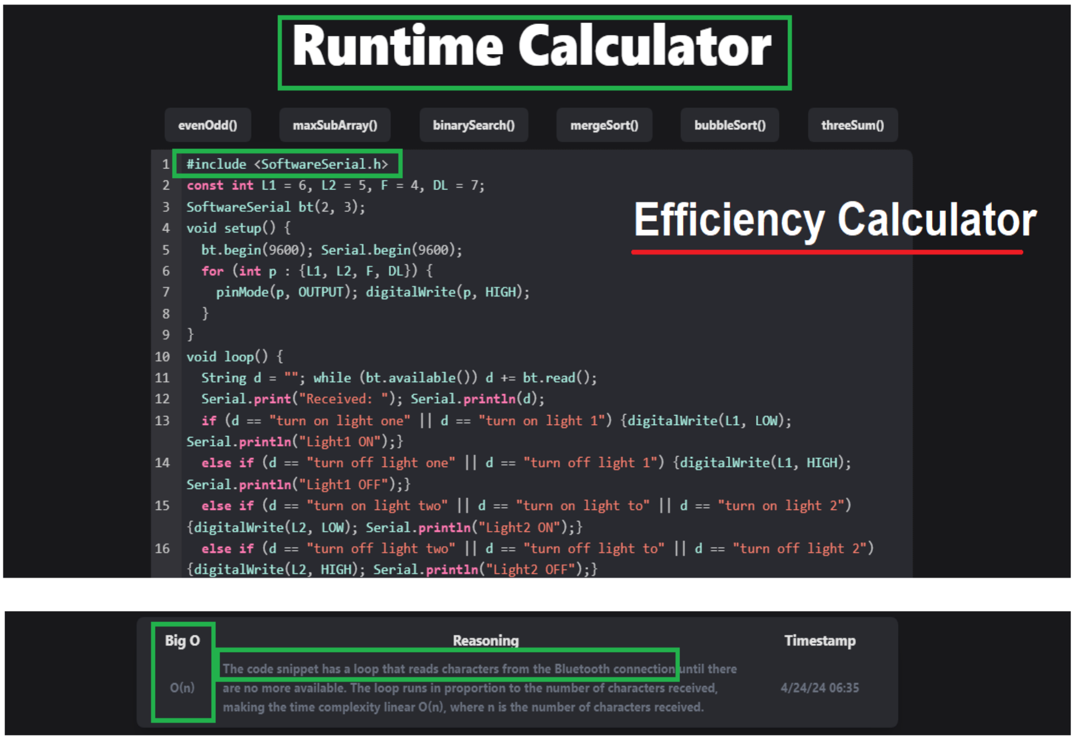

Figure 6.1: **Program Efficiency**

The proposed voice-controlled home automation system demonstrates remarkable efficiency in various aspects, offering a seamless and intuitive user experience. By integrating advanced voice recognition technology, the system significantly reduces the time and effort required to operate home devices and appliances. Users can effortlessly control multiple devices simultaneously using simple voice commands, eliminating the need for manual adjustments and streamlining daily routines. Moreover, the system's ability to recognize and execute personalized commands enhances user satisfaction and convenience, catering to individual preferences and lifestyles.

Furthermore, the proposed system's automation capabilities contribute to optimizing energy consumption and promoting sustainable living. By intelligently scheduling and managing device usage based on user-defined settings and environmental conditions, the system ensures efficient utilization of resources, leading to potential cost savings and environmental benefits. The system's remote access feature allows users to monitor and control their home devices from anywhere, enhancing flexibility and adaptability. Overall, the proposed voice-controlled home automation system offers a highly efficient and user-centric solution for modern home management, setting a new standard for convenience, accessibility, and sustainability.

6.2 Comparison of Existing and Proposed System

i. Existing System

ii. Voice Controlled Automation

Figure 6.2: **Comparison B/W Existing and Proposed System**

Existing system:(Manual Control)

In the existing system, manual control of home devices and appliances is prevalent. Users depend on physical interactions with switches, buttons, or remote controls to operate various devices. This method often results in inefficiencies and inconveniences, requiring users to move between different locations to manage their devices.Traditional voice-controlled home automation systems, like Amazon Alexa and Google Home, have set the standard for smart home integration. These platforms offer a plethora of features, from voice-activated commands to advanced automation routines. High-end systems can be quite expensive, limiting their accessibility to a niche market segment.

Another limitation of these systems is their dependency on smart devices. For Alexa or Google Home to control an appliance, the device must have built-in smart capabilities, such as Wi-Fi connectivity. This requirement excludes a significant portion of existing household appliances that do not possess these features, necessitating costly replacements or additional smart plugs. Moreover, the lack of automation limits the system's adaptability to changing user needs and preferences. The absence of remote access further restricts users from controlling their devices when they are away from home, leading to potential energy wastage and security concerns. Additionally, the dependency on manual operations can be challenging for elderly and physically impaired individuals, limiting their independence and accessibility to home functionalities.

Proposed system:(Voice-controlled home automation)

The proposed voice-controlled home automation system offers a more intuitive and interactive user experience compared to the decision tree-based system. Instead of navigating through predefined pathways, users can control the system using natural language voice commands, providing a more flexible and user-friendly interface. By leveraging voice recognition technology, the proposed system can understand and interpret user commands, allowing for personalized interactions and dynamic control over home devices and appliances. This approach enhances user convenience and accessibility, making it easier for users to interact with their living environment without the constraints of predefined decision paths.

Moreover, the system's intuitive user interface and straightforward setup process ensure a hassle-free user experience, even for those unfamiliar with smart home technology. This user-centric approach enhances the system's accessibility, appealing to a broader audience that values simplicity and convenience. In conclusion, the proposed voice-controlled home automation system represents a significant improvement over traditional decision tree-based systems. It offers a more natural and intuitive user interface, enhanced flexibility, and adaptability, providing a more user-centric approach to home automation.

6.3 Sample Code

```
#include <SoftwareSerial.h>
// Define relay pins
const int Light1 = 6; // Relay pin 1 (IN1)
const int Light2 = 5; // Relay pin 2 (IN2)
// Create a SoftwareSerial object named 'bt' with RX and TX pins
SoftwareSerial bt(2, 3); // RX, TX
void setup() {
  // Start serial communication with a baud rate of 9600
  bt.begin(9600);
  Serial.begin(9600);
  // Set relay pins as OUTPUT
  pinMode(Light1, OUTPUT);
  pinMode(Light2, OUTPUT);
  // Initially set relays to HIGH (OFF state)
  digitalWrite(Light1, HIGH);
  digitalWrite(Light2, HIGH);
}
void loop() {
  // Check if data is available on the Bluetooth connection
  if (bt.available()) {
    // Read the incoming command until a newline character is encountered
    String command = bt.readStringUntil('\n');

    // Check the received command and control the relays accordingly
    if (command == "on1") {
      digitalWrite(Light1, LOW); // Turn ON relay 1
      delay(200);
    } else if (command == "off1") {
      digitalWrite(Light1, HIGH); // Turn OFF relay 1
      delay(200);
    } else if (command == "on2") {
      digitalWrite(Light2, LOW); // Turn ON relay 2
      delay(200);
    } else if (command == "off2") {
      digitalWrite(Light2, HIGH); // Turn OFF relay 2
      delay(200);
    }
  }
}
```

Output

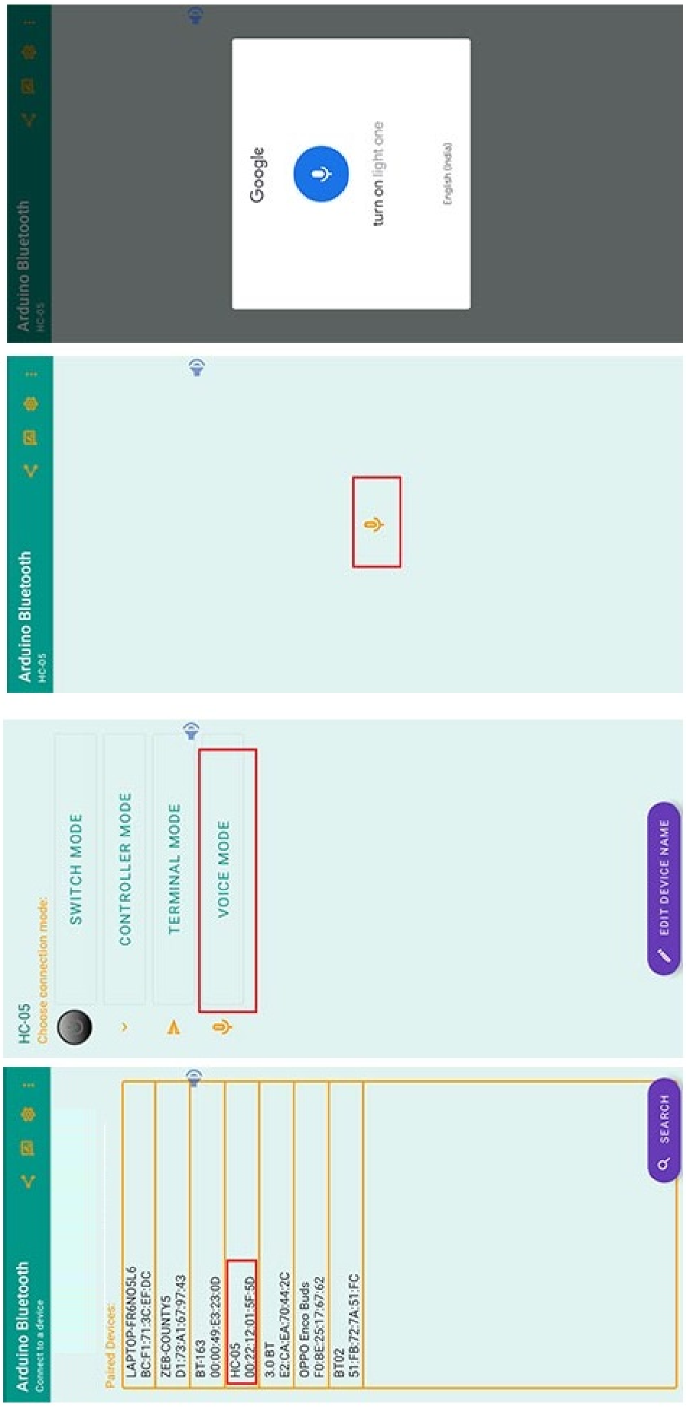

Figure 6.3: **Output of Application**

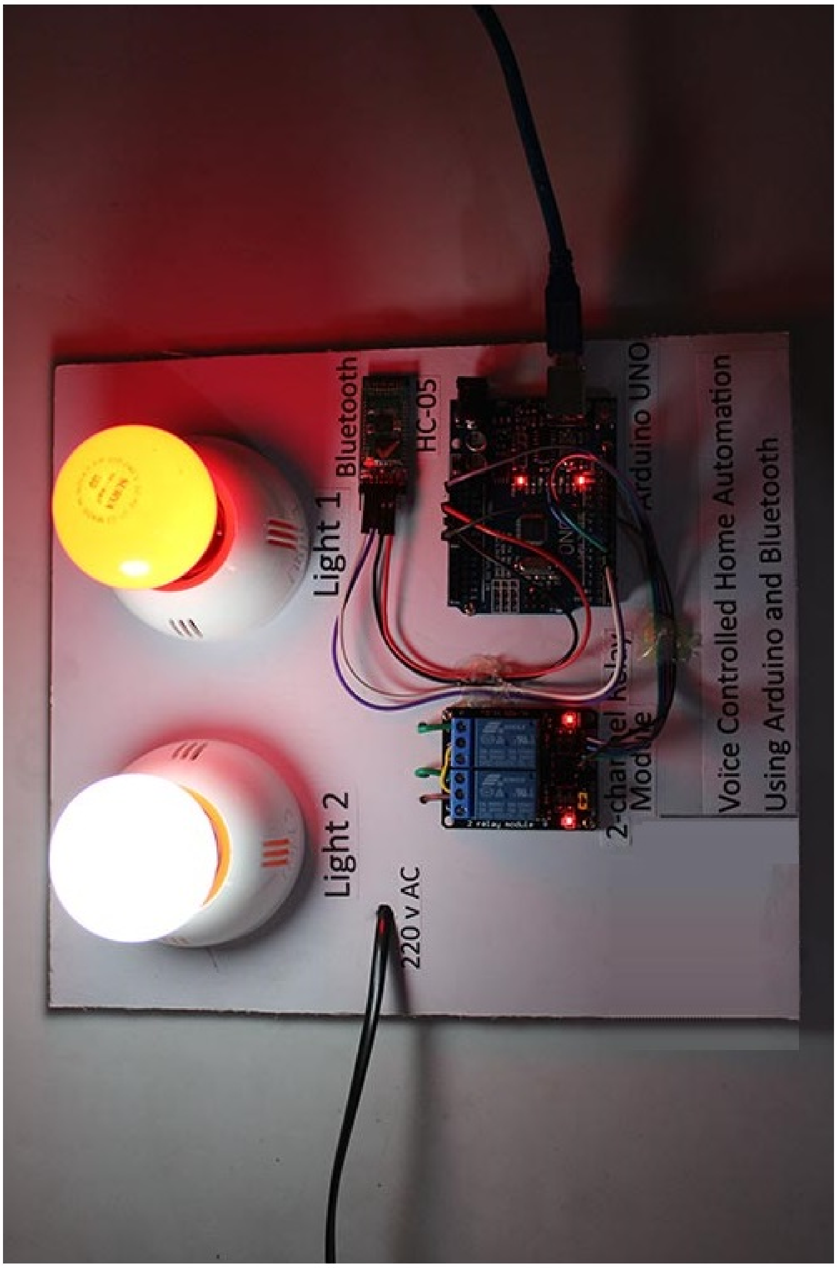

Figure 6.4: **Output of Product**

Chapter 7

CONCLUSION AND FUTURE ENHANCEMENTS

7.1 Conclusion

The voice-controlled home automation system developed in this project harnesses the power of Arduino microprocessors and wireless communication technologies to offer an intuitive and efficient control mechanism for various home appliances. This innovation holds significant promise in simplifying the user experience, enhancing accessibility, and promoting efficiency in household management. By bridging the gap between traditional appliances and smart technologies, the system not only revolutionizes daily routines but also opens new possibilities for personalized and adaptable living environments.

The successful implementation of this project highlights the transformative potential of integrating voice control with home automation systems. Its user-centric design caters to the needs of diverse user groups, including the elderly and physically challenged, thereby contributing to improved quality of life. As smart home technologies continue to evolve, the voice-controlled system stands out as a versatile and scalable solution that adapts to changing lifestyles and technological advancements. This project serves as a foundation for future developments in the field of smart home automation, setting the stage for innovations that prioritize accessibility, efficiency, and user satisfaction.

7.2 Future Enhancements

7.2.1 Future Enhancements

- **Enhanced Voice Recognition:** Incorporating advanced natural language processing (NLP) algorithms to improve voice recognition accuracy and expand the range of supported commands.

- **Integration with IoT Ecosystem:** Expanding compatibility with a broader range of Internet of Things (IoT) devices for seamless automation and monitoring capabilities.
- **Energy Optimization:** Implementing energy monitoring and optimization features to promote sustainable living and maximize energy efficiency.
- **User-Centric Design:** Focusing on user-centric design principles to tailor the system to meet individual user needs and preferences.
- **Security Enhancements:** Implementing robust authentication and encryption mechanisms to safeguard user data and enhance system security.
- **Mobile Application Development:** Developing a dedicated mobile application to provide users with remote access and control over their smart home devices.
- **Integration with Smart Assistants:** Integrating the system with popular smart assistants like Amazon Alexa or Google Assistant for enhanced voice control capabilities.
- **Advanced Automation Rules:** Implementing advanced automation rules and scheduling options to allow users to create custom scenarios based on specific conditions or events.
- **Multi-User Support:** Adding multi-user support with personalized profiles to cater to the needs of different household members.
- **Feedback Mechanism:** Implementing a feedback mechanism to collect user feedback and suggestions for continuous improvement.

Chapter 8

PLAGIARISM REPORT

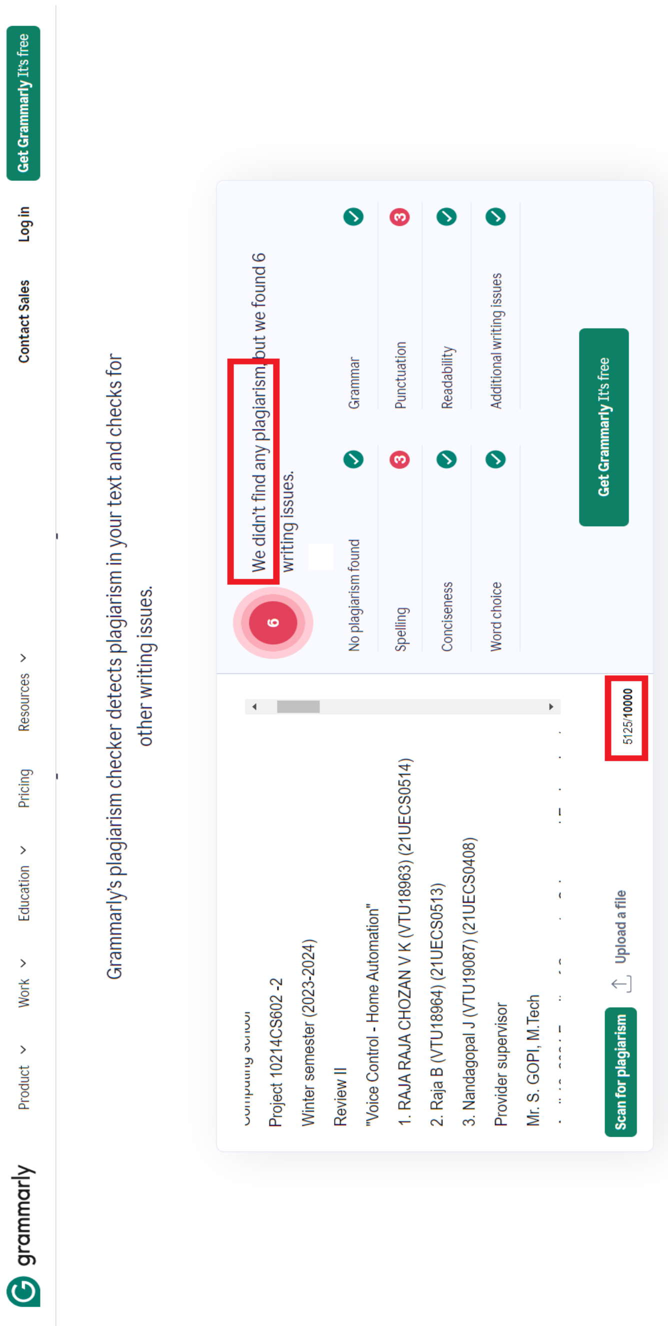

Figure 8.1: **Plagiarism Report**

Chapter 9

SOURCE CODE & POSTER PRESENTATION

9.1 Source Code

```
#include <SoftwareSerial.h>
const int Light1 = 6;
const int Light2 = 5;
const int Fan = 4;
const int DoorLock = 7;
SoftwareSerial bt(2, 3);
void setup() {
  bt.begin(9600);
  Serial.begin(9600);
  pinMode(Light1, OUTPUT);
  pinMode(Light2, OUTPUT);
  pinMode(Fan, OUTPUT);
  pinMode(DoorLock, OUTPUT);
  digitalWrite(Light1, HIGH);
  digitalWrite(Light2, HIGH);
  digitalWrite(DoorLock, HIGH);
}
void loop() {
  String data = "";
  while (bt.available()) {
    ch = bt.read();
    data += ch;
  }
  Serial.print("Received command: ");
  Serial.println(data);
  if (data == "turn on light one" || data == "turn on light 1") {
    digitalWrite(Light1, LOW);
    delay(200);
    Serial.println("Light1 is turned ON");
  } else if (data == "turn off light one" || data == "turn off light 1") {
    digitalWrite(Light1, HIGH);
    delay(200);
    Serial.println("Light1 is turned OFF");
  } else if (data == "turn on light two" || data == "turn on light to" || data == "turn on light 2")
      {
```

```
    Serial.println("Light2 is turned ON");
  } else if (data == "turn off light two" || data == "turn off light to" || data == "turn off light 2") {
    digitalWrite(Light2, HIGH);
    delay(200);
    Serial.println("Light2 is turned OFF");
    Serial.println("Fan is turned ON");
  } else if (data == "turn off fan") {
    digitalWrite(Fan, HIGH);
    delay(200);
    Serial.println("Fan is turned OFF");
  } else if (data == "lock door") {
    digitalWrite(DoorLock, LOW);
    delay(200);
    Serial.println("Door is locked");
  } else if (data == "unlock door") {
    digitalWrite(DoorLock, HIGH);
    delay(200);
    Serial.println("Door is unlocked");
  } else if (data == "status") {
    int light1Status = digitalRead(Light1);
    int light2Status = digitalRead(Light2);
    int fanStatus = digitalRead(Fan);
    int doorStatus = digitalRead(DoorLock);
    Serial.print("Light1 Status: ");
    Serial.println(light1Status == LOW ? "ON" : "OFF");
    Serial.print("Light2 Status: ");
    Serial.println(light2Status == LOW ? "ON" : "OFF");
    Serial.print("Fan Status: ");
    Serial.println(fanStatus == LOW ? "ON" : "OFF");
    Serial.print("Door Lock Status: ");
    Serial.println(doorStatus == LOW ? "LOCKED" : "UNLOCKED");
  } else if (data == "help") {
    Serial.println("Available commands:");
    Serial.println("turn on light one");
    Serial.println("turn off light one");
    Serial.println("turn on light two");
    Serial.println("turn off light two");
    Serial.println("turn on fan");
    Serial.println("turn off fan");
    Serial.println("lock door");
    Serial.println("unlock door");
    Serial.println("status");
  } else {
    Serial.println("Invalid command received");
  }
  delay(1000); // Delay to slow down the loop
}
```

9.2 Poster Presentation

Figure 9.1: **Poster Presentation**

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