A Mini Project Report on

HANDS FREE SWITCHING SYSTEM

Submitted to the

DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

In partial fulfillment of the requirement of

Bachelor of Engineering in Electronics and Instrumentation Engineering

By

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CERTIFICATE

This is to certify that the project work entitled **"HANDS FREE SWITCHING SYSTEM"** is carried out by **KHUSHI KUMARI (1MS22EI022),RAJA KUGUNNAVAR (1MS22EI038),SRI LAKSHMI K G (1MS22EI049), VARSHA K S (1MS22EI056)**, are bonafide students of Ramaiah Institute of Technology, Bengaluru in partial fulfillment of the requirement of the course EIP67-Mini project of **Bachelor of Engineering** in **Electronics & Instrumentation Engineering** of the Visvesvaraya Technological University, Belagavi, during the year 2024-2025. It is certified that all the corrections/suggestions indicated during Internal Assessment heve been incorporated in the report deposited in the department library. The project report has been approved as it satisfies the academic requirements with respect to Mini-Project work.

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Declaration

We hereby declare that the dissertation ***HANDS FREE SWITCHING SYSTEM*** submitted by us to the department of Electronics and Instrumentation Engineering, RIT Bengaluru-560 054 in partial fulfillment of the requirement of the course EIP67-Mini project of **Bachelor of Engineering** in **Electronics & Instrumentation Engineering** is a bona-fide record of the work carried out by us under the supervision of ***Dr Nishi Shahnaj Haider***.

We further declare that the work reported in this Mini-project report, has not been submitted and will not be submitted, either in part or in full, to this institute or of any other institute or University.

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Abstract

In an age of intelligent automation, simplifying the control of household appliances is becoming increasingly important for comfort, security and accessibility. This mini project explores a voice-controlled system for operating a fan and light using the VC- 02 offline voice recognition module, without involving any microcontroller. The VC-02 module, pre-programmed with custom voice commands, directly interfaces with relay modules to switch the appliances ON and OFF based on the user's voice input. This setup eliminates the need for complex programming or microcontroller integration, making the system inexpensive and easy to implement .The voice commands are processed locally on the VC-02 chip, ensuring fast response and offline functionality, which is beneficial in areas with limited internet access. The project showcases how standalone voice modules can be utilized in basic home automation tasks to improve user convenience and support hands-free operation, particularly for the elderly or physically challenged. Overall, the system presents a practical and accessible approach to voicecontrolled automation, highlighting minimal hardware, simplicity and usercentric design. Additionally, this project highlights the scalability and adaptability of using standalone voice modules like the VC-02 in real-world home automation scenarios. The system can be easily extended to control more appliances by adding additional relay channels and configuring new voice commands, all without altering the core hardware setup. This modular approach allows users to customize and expand their home automation system according to their needs, while maintaining the advantages of low cost, offline operation, and minimal technical complexity. Such fexibility makes the solution not only suitable for basic control but also a foundation for more comprehensive smart home ecosystems in the future.

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Chapter 1

Introduction

1.1 Problem Statement

In today's technology world, there is a growing demand for intelligent, accessible systems that reduce physical effort in the operation of household appliances. Traditional switch-based systems require manual interaction, which may not be convenient or possible for elderly individuals, physically challenged users, or people multitasking in home or work environments. Existing smart automation solutions often rely on microcontrollers or internet connectivity, increasing cost, complexity, and dependency on external platforms.

The primary problem this project addresses is the lack of a cost-effective, microcontroller-free, and voice-activated system to control electrical appliances such as fans and lights. The proposed Hands-Free Switching System uses the VC-02 offline voice recognition module to directly control devices through spoken commands. This enables users to operate appliances with minimal physical interaction, making the system ideal for enhancing convenience, safety, and accessibility in everyday life.

1.2 Objective

1. To develop a voice-controlled switching system for a fan and light.
2. Enable hands-free use via predefined offline language commands.
3. To implement the hardware and train the module.
4. To demonstrate reliable switching through relay activation based solely on voice input.

1.3 Scope of Project

The scope of this project involves the design and implementation of a basic home automation system that allows users to control a fan and a light using voice commands through the VC-02 module. The system operates offline and does not rely on a microcontroller or internet connection. It is intended for use in homes, especially to assist users with limited mobility. The project is limited to controlling two appliances with fixed voice commands and does not include dynamic speech recognition or app-based control.

1.4 Motivation

The motivation behind this project is that in today's fast-paced world, convenience and accessibility have become essential in daily living. For people with disabilities, it can be difficult or uncomfortable to use switches. While smart home automation systems exist, they often require complex programming or internet connectivity, making them inaccessible to many users. This project is motivated by the need for simpler, cheaper, offline, hands-free configurations, providing straightforward solutions without relying on microcontrollers.

1.5 Literature Survey

Find below the summary of different research articles referred to during the project implementation.

[1]**Voice-activated open-loop control of wireless home automation system for multi-functional devices** This paper introduces voice control for multifunctional devices through an open-loop wireless system. It enabled appliance control via voice commands. However, it lacked a feedback mechanism, making the system open-loop and limiting its ability to confirm action execution.

[2]**Mobile voice recognition based for smart home automation control** This study presented smartphone-based voice processing for home automation. Users could issue commands via a mobile app. The system's dependency on internet connectivity and smartphone functionality was a noted limitation.

[3] **Design of an intelligent voice controlled home automation system** The system utilized simple voice commands for device control. It supported basic command

recognition and operations. However, inflexible command structures, limited language support, and poor accuracy in noisy conditions restricted its performance.

[4]**Smart home automation—use cases of a secure and integrated voice-control system** This work focused on privacy and integration, providing a secure voice control framework for smart home environments. Despite its security benefits, it was limited in terms of command recognition flexibility.

[5]**Touch-less home automation system with voice and gesture control** This paper presents a dual-interface system using both voice and hand gestures for controlling home appliances without physical contact. It improved accessibility and hygiene, especially relevant during the pandemic. However, simultaneous voice and gesture interpretation posed challenges in user recognition and required a controlled environment for optimal performance.

[6]**Voice controlled home automation system** This study proposed a microcontroller-based system for appliance control using voice commands via Android devices. It demonstrated ease of use and implementation with low-cost components. However, the system relied on consistent internet connectivity for speech-to-text conversion, limiting offline functionality.

[7] **IoT based smart home automation system using sensor node** The authors developed an IoT-enabled automation system using sensor nodes and a central server to monitor and control home appliances. It emphasized energy efficiency and remote access. Despite its scalability, the system required constant internet access and lacked robust user authentication.

[8]**Interactive IoT-based speech-controlled home automation system** This paper designed a speech-driven IoT home automation framework integrating Google Assistant and cloud platforms. It allowed real-time voice control over the internet. The system was highly responsive but heavily dependent on third-party services and cloud APIs, which raised concerns about privacy and data security.

[9]**Voice-Controlled Home Automation using VC-02 module** This work presents an offline voice-controlled home automation system utilizing the VC-02 module to directly interface with relay modules for switching household appliances. The system eliminates the need for a separate microcontroller, reducing hardware complexity and enabling quick response to voice commands. The current project implements this approach, demonstrating its effectiveness for simple and reliable offline voice control, while also addressing limitations like restricted command flexibility and lack of system feedback.

Chapter 2

Methodology

2.1 Introduction

The hands-free switching system presented in this project is designed to provide a voice-controlled solution for managing basic home appliances, with an emphasis on accessibility, convenience, and automation. Leveraging the capabilities of the VC-02 offline speech recognition module, this system enables users to control electrical devices such as lights and fans through predefined voice commands, thereby reducing reliance on physical interaction and promoting smarter energy usage. This project aims to enhance user interaction with electrical systems by integrating voice command technology into daily household operations. By enabling commands such as "Turn on light 1" or "Turn off fan," the system allows seamless operation of appliances, offering particular benefit to individuals with mobility limitations or those seeking a more automated living environment. The system is built using a combination of the VC-02 module, relay modules, and a simple power control mechanism that interfaces directly with standard home appliances. The implementation is centred around the recognition of voice input and translation into control signals that activate or deactivate relays, which in turn operate the connected devices. The use of offline recognition ensures privacy, low latency, and operation without the need for an internet connection. The modular nature of the setup allows for easy expansion, where more appliances can be added with additional voice commands and relays. This project demonstrates a practical and cost-effective approach to home automation, highlighting the growing relevance of embedded systems and voice interfaces in modern smart home environments.

2.2 Block Diagram and Working of the System

The main goal of this system is to offer a hands-free solution for operating household electrical devices such as light bulbs and a fan using voice instructions. This approach is particularly beneicial for enhancing user comfort and providing accessibility for individuals who may have physical limitations or prefer contactless control. The system functions by receiving voice commands from the user, which are then interpreted by the VC-02 speech recognition module. This module is trained with a predefined set of commands. When a command is recognized, the module generates a corresponding output signal through a specific GPIO (General Purpose Input/Output) pin. This signal activates a relay connected to an electrical appliance, thereby switching it ON or OFF as instructed. In this configuration, Relay Module-01 manages two bulbs—Channel 1 controls Bulb 1, and Channel 2 manages Bulb 2. Meanwhile, Channel 2 of Relay Module-02 is responsible for operating the fan. For instance, when the user says "Turn on light 1," the VC-02 module identifies the command, sends a signal via the appropriate GPIO pin, and Channel 1 of Relay Module-01 is triggered, switching ON Bulb 1. Similarly, a voice command to control the fan will activate or deactivate Channel 2 of Relay Module-02. This system ensures that each appliance is controlled individually through distinct relay channels, based on voice input. It offers a user-friendly and efficient way to automate home appliances, reducing the need for manual interaction and making it ideal for modern smart home environments.

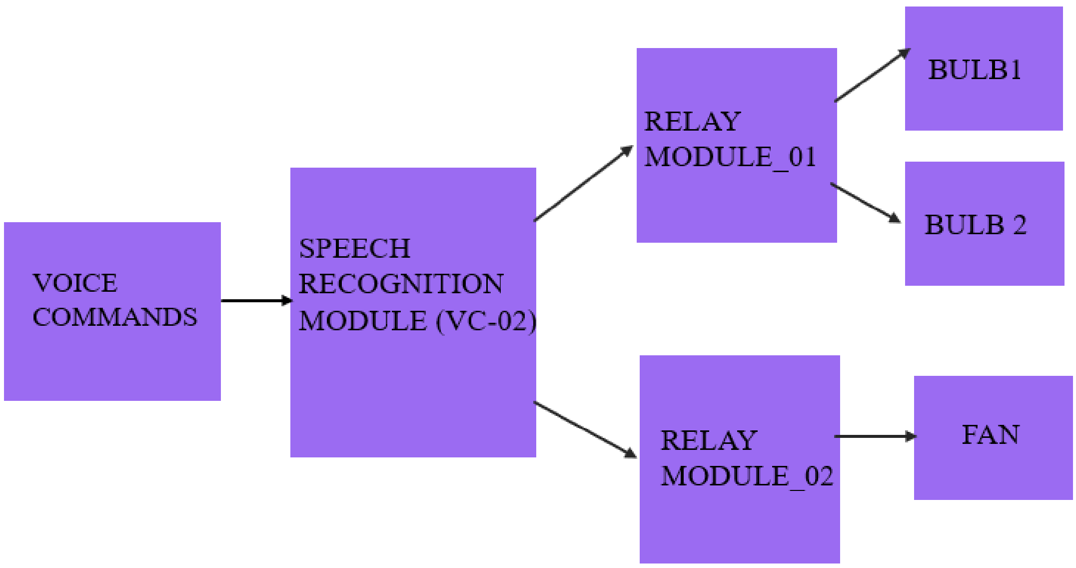

FIGURE 2.1: Block Diagram

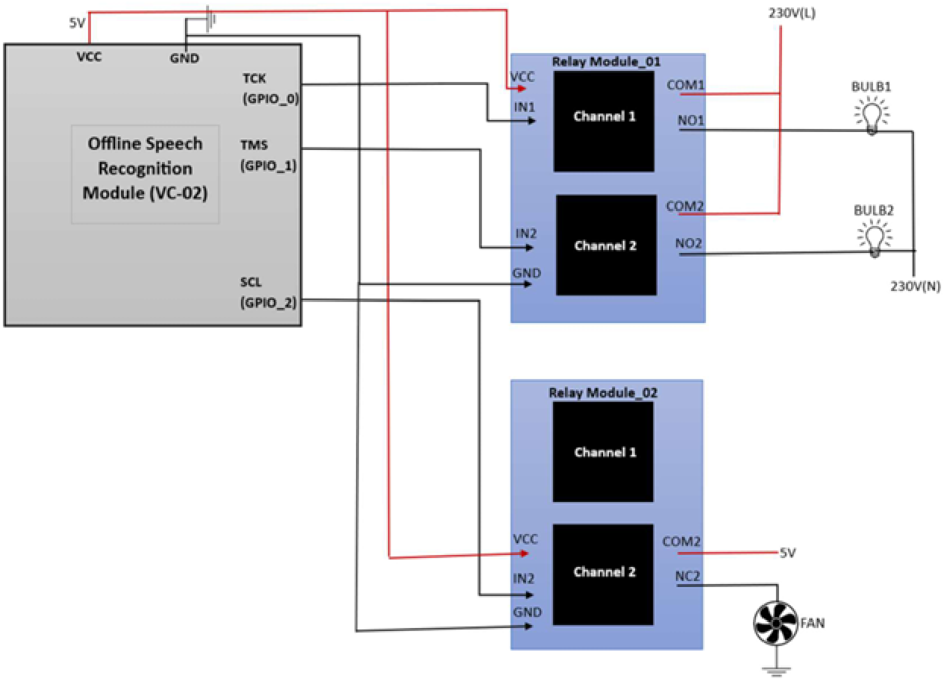

FIGURE 2.2: Circuit Diagram

2.3 Hardware Implementation

2.3.1 Circuit Diagram

As shown in FIGURE 2.2, the speech module setup involves powering the Offline Speech Recognition Module (VC-02) using a 5V and GND connection. The module receives voice input and maps each trained instruction to a corresponding GPIO output pin TCK, TMS, or SCL. These output signals are then used to control relays. In the relay module connections , two relay modules are used: Relay Module-01 is connected to two bulbs Bulb1 and Bulb2 , while Relay Module-02 controls a fan. The VC-02's output pins TCK, TMS, SCL are connected to the IN1 and IN2 pins of these relay modules, which are also powered by a common 5V source and properly grounded. For the appliance interface , the relays controlling the bulbs are wired to a 230V AC power supply through normally open (NO) contacts. When activated, the circuit closes and powers the bulb. The fan, on the other hand, is connected through a 5V DC supply using a normally closed (NC) terminal on the relay, allowing it to be toggled via voice command. The activation flow begins when a command like "Turn on light 1" is spoken. The VC-02 identifies the command and activates the corresponding GPIO pin, which then triggers the relay through the IN1 or IN2 pin, completing the circuit for the appliance. Lastly, in terms of power distribution and safety , a shared 5V supply is used for the VC-02 and both relay modules. Proper grounding ensures operational stability, while the relay's built-in electrical isolation provides protection between the low-voltage control circuit and the high-voltage load.

2.4 Algorithm

The proposed system utilizes an offline speech recognition module to control electrical appliances through GPIO signals. Unlike traditional systems that assign separate GPIO pins for ON and OFF commands, this design simplifies control by assigning a single GPIO pin per device, which toggles its state (HIGH or LOW) based on voice input. This approach creates a compact and efficient mechanism for voice-controlled switching, ideal for home automation. The setup function initializes the speech recognition module specifically the AI Thinker VC-02 by training and storing multiple voice commands in its memory. Each device is linked to one GPIO output pin that handles both ON and OFF operations through state toggling. In the command recognition and output control process, the module continuously listens for voice input, and upon recognizing a valid command, it toggles the logic level of the assigned GPIO pin changing it from HIGH to LOW or vice versa. This change is then passed to the relay activation logic, where the toggled signal drives the input of a relay. Based on the relay's internal configuration (Normally Open or Normally Closed), the appliance connected to it is either powered ON or OFF. Following the command execution, the module reverts to continuous listening mode, remaining ready to process the next instruction, which ensures a seamless and hands-free user experience. The entire system operates on a regulated 5V supply, with power management and isolation maintained through relay modules that electrically separate the low-voltage control circuit from high-voltage appliances. This ensures safety, protects the speech module from electrical disturbances, and supports reliable long-term operation.

2.5 Software Implementation

The system setup involves training the VC-02 offline speech recognition module using the Voice AI Thinker web interface with six custom voice commands, each corresponding to turning ON or OFF a specific appliance such as Light One, Light Two, or a Fan. Instead of assigning separate GPIO pins for each command, a single GPIO pin is allocated per device: Light One is linked to GPIO-B0, Light Two to GPIO-B1, and the Fan to GPIO-B2. Upon recognizing any relevant voice command, the associated GPIO pin toggles its logic state (from LOW to HIGH or vice versa), which in turn activates the corresponding relay to change the state of the appliance. During the loop function, the VC-02 remains in continuous listening mode. When a command is recognized, it identifies the target device, toggles the linked GPIO output, and thereby switches the appliance ON or OFF depending on the relay's configuration. This toggle-based mechanism simplifies the control logic and reduces hardware complexity. The VC-02 firmware internally maintains the state of each GPIO pin and updates it accordingly with each new command. The system supports both Normally Open (NO) and Normally Closed (NC) relay configurations, enabling flexible control of AC or DC loads. As the entire operation is managed offline by the VC-02, no microcontroller is required. Furthermore, trained commands are stored in non-volatile memory, ensuring that the module retains functionality even after a power cycle.

2.6 Implementation Workflow

1. **Hardware Setup:** Connect VC-02 to 5V power. Link its GPIOs to relay inputs. Connect relay outputs to appliances.

2. **Software Development:** Train six voice commands using the AI Thinker website. Assign each to a specific GPIO. Upload to VC-02.

3. **Calibration and Testing:** Power the system, test each command, and verify GPIO toggling and relay activation.

4. **System Validation:** Confirm reliability, recognition accuracy, and safety of relay operations.

Chapter 3

Results and Discussions

3.1 Results and Assessments

In our hands-free switching system, we have three appliances connected: Light 1, Light 2, and a 5V DC Fan. These devices are controlled using voice commands detected by the VC-02 speech recognition module. Each device is assigned a specific voice command: When the user says "Turn on light 1", the VC-02 module recognizes the command , which then activates Relay 1, turning Light 1 ON. When the user says "Turn on light 2", the system processes the command similarly, activating Relay 2, which switches Light 2 ON. For the fan, the user says "Turn on fan". This command triggers Relay 3, which powers the 5V DC Fan. To turn off any of these devices, the user can say the corresponding command such as "Turn off light 1", "Turn off light 2", or "Turn off fan", and the system will deactivate the relevant relay, switching off the device. This setup allows the user to control appliances simply by speaking, without the need for physical switches, making the system convenient and accessible. The results of the system were analyzed under three distinct operating conditions to evaluate its functionality. In the first condition, only Light 1 was turned ON, indicating the system's ability to control individual appliances effectively. In the second scenario, both Light 1 and Light 2 were turned ON while the fan remained OFF, demonstrating the system's capability to manage multiple loads simultaneously. In the third condition, all devices including both lights and the fan—were turned OFF, confirming that the system could successfully deactivate all connected appliances based on the given voice commands.

3.1.1 Only Light One is On

In the first test condition, only Light 1 was switched ON. The user gave the voice command "Turn on light one," and the yellow bulb responded by lighting up immediately.

This action was followed by an audible confirmation from the system, indicating successful execution. Additionally, the command "Turn off light two" was given, ensuring that the green bulb remained OFF. During this process, only a single relay channel—assigned to Light 1—was activated through the VC-02 voice recognition module, confirming the system's accurate response to individual voice commands.

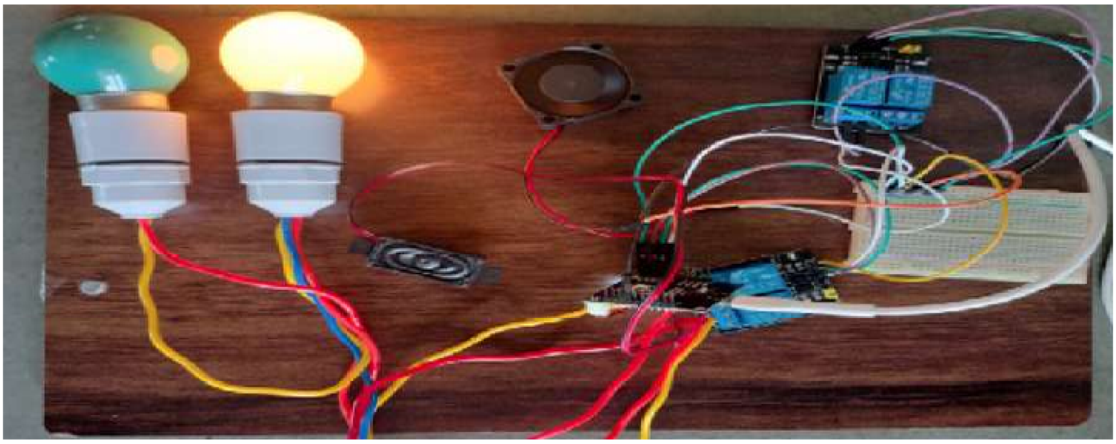

FIGURE 3.1: Only Light One is On

3.1.2 Both Lights Are On , Fan is Off

In the second test scenario, both Light 1 and Light 2 were turned ON while the fan remained OFF. The voice command "Turn on light one" successfully activated the yellow bulb, followed by the command "Turn on light two," which turned on the green bulb. As a result, both relay channels connected to the respective lights were triggered via the VC-02 voice module. Although the fan was not turned ON in this specific condition, additional commands such as "Turn on light 2" and "Turn on fan" were verified and found to be functioning correctly, demonstrating the system's capability to handle multiple voice inputs and selectively operate devices as instructed.

FIGURE 3.2: Both Lights Are On, Fan is Off

3.1.3 All Devices Are Off

In the third test condition, all connected devices were turned OFF through voice commands. When the user said ”Turn off light one,” the yellow bulb was deactivated, and the command ”Turn off fan” successfully switched off the fan. Although both relay modules remained powered, none of the output channels were active, confirming that all appliances were effectively turned OFF. The system reliably executed each ”Turn off” command within 1 to 2 seconds of recognition. Additionally, the VC-02 speech module provided audible feedback after processing each instruction, further improving user interaction and confirming successful command execution.

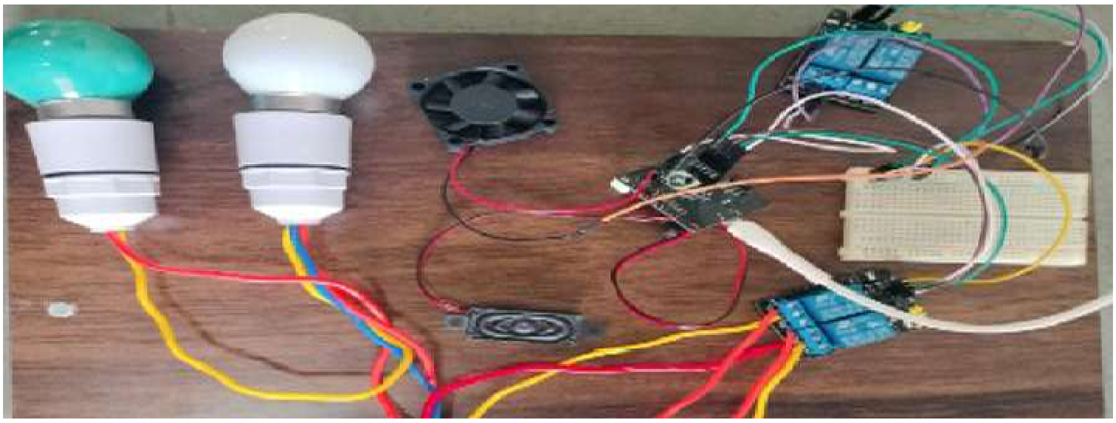

FIGURE 3.3: All Devices Are Off

The system responded within 1–2 seconds of receiving a valid voice command. The VC-02 module provided voice feedback after executing each command, enhancing usability. The system is designed to handle simultaneous voice inputs efficiently. When two individuals speak different commands at the same time, it prioritizes and executes the louder command, ensuring smooth operation without confusion. In terms of range, the speech module performs effectively within a distance of 1 to 5 meters under quiet indoor conditions, making it suitable for typical home or small-room environments. Additionally, the system is secure in its command processing—if an unrecognized or untrained command is spoken, it simply does not respond. This ensures that only predefined and authorized commands are executed, maintaining reliability and preventing unintended actions. The system demonstrated high accuracy in recognizing voice commands, particularly in quiet environments where users spoke with clear pronunciation. Its reliability was evident through consistent responses from appliances across repeated trials, indicating stable and dependable performance. In terms of responsiveness, the system processed commands swiftly, typically within 1 to 2 seconds, ensuring a smooth user experience. However, its recognition capability tends to decline in noisy surroundings or when commands are spoken unclearly, reflecting a degree of sensitivity to background noise. It can recognise any person's voice, but only if they give the commands which where pretrained to the VC-02 module. Another limitation is its restricted vocabulary, as it only accepts predef ined phrases. Natural or varied expressions, such as "Switch on the fan," are not recognized unless they match the trained command set. Despite these constraints, the user experience is enhanced by a voice confirmation feature that provides immediate feedback, reassuring users that their commands have been successfully received and executed.

3.2 Discussions

The developed voice-controlled switching system showcased highly effective performance by reliably identifying and executing predefined voice commands to manage two lights and a 5V DC fan. Utilizing the VC-02 of line speech recognition module, the system eliminated the need for internet connectivity, making it ideal for deployment in areas with unstable or no internet access. This offline capability not only enhances system reliability but also improves data security and privacy as voice data is not transmitted externally.

The system was highly responsive to voice commands such as "Turn on light 1" or "Turn off fan," with prompt and precise activation or deactivation of the corresponding devices. This confirmed the successful integration of the VC-02 module with the relay control circuit, ensuring smooth communication and reliable switching. In addition to executing commands, the system also provided real-time verbal confirmations like "Light 2 turned on," which created a more interactive and user-friendly experience. This feedback loop reassured users that their instructions were processed correctly, reducing the chances of confusion or repeated commands. Several notable advantages emerged from the testing and implementation. The system offers a completely hands-free method of operation, which is particularly beneficial for individuals with mobility challenges, elderly users, or those seeking a more convenient way to control home appliances. The offline processing of voice commands makes it both cost-effective and accessible, as it eliminates the need for complex server infrastructure or internet-based voice assistants. Its simple design and minimal hardware requirements further contribute to its affordability and ease of integration into existing home setups.

Despite its effectiveness, the system does have certain limitations. It can only recognize a limited set of predefined voice commands, which reduces its flexibility. Commands must be spoken clearly and without interruption; otherwise, recognition may fail. Additionally, the system is somewhat sensitive to background noise, which can lead to misinterpretation or missed commands in noisy environments. Moreover, the functionality is restricted to basic ON/OFF control, lacking more advanced features such as brightness adjustment for lights or speed regulation for the fan. This restricts its use to simple automation tasks and may not meet the demands of users looking for more dynamic control.

Overall, this system serves as a practical solution for essential home automation needs, particularly in environments where voice control can enhance accessibility and convenience. It is especially suited for users with physical disabilities, senior citizens, or those looking to modernize their living spaces with affordable automation. Future improvements could include noise filtering algorithms, the ability to recognize a broader range of natural language commands, integration of smart features like dimming and fan speed control, and enhanced feedback mechanisms, possibly including visual indicators or mobile notifications. With such upgrades, the system could evolve into a more robust and intelligent platform for comprehensive smart home control.

Chapter 4

Future Scope and Conclusions

4.1 Future Scope

Expanding the scope of a VC-02 based voice-controlled appliance system introduces a transformative approach to smart home automation and accessibility. Through the integration of advanced AI models and natural language processing (NLP), future iterations of the system can enable more intuitive, context-aware, and multilingual voice interactions. This progression toward more human-like voice recognition enhances user convenience and system responsiveness, especially for individuals with limited mobility or visual impairments.

By incorporating cloud-based machine learning algorithms and real-time analytics, the system can evolve to adapt dynamically to user behaviour patterns. For example, it could learn daily usage routines and activate or deactivate appliances based on contextual cues such as time of day, ambient light, or user presence. Predictive command execution, powered by behaviour modelling, enables the system to anticipate needs, such as turning on lights when someone enters a room, further elevating the level of automation.

Moreover, future systems could include multi-device integration, where complex command sets control multiple appliances simultaneously (e.g., "Good night" could turn off lights, lower the fan speed, and lock doors). This could be facilitated via a centralized smart hub or edge AI processor, enhancing command processing capabilities while maintaining of line operation and user privacy. The integration of wearable interfaces, such as gesture-based wristbands or brain-computer interfaces (BCIs), offers another avenue for expanding accessibility. These interfaces can complement voice commands, enabling users with speech difficulties to interact with the system through alternative control mechanisms, enhancing inclusivity. From a connectivity standpoint, embedding

IoT protocols (e.g., MQTT, Zigbee, Wi-Fi) into the system would allow remote monitoring and control through mobile apps and web dashboards.
This capability supports real-time feedback, power usage tracking, and condition-based alerts, facilitating energy efficiency and smarter device management. In public and healthcare settings, this technology can support assistive infrastructure for elderly care, rehabilitation centres, and hospital wards, enabling patients to control their surroundings without physical exertion. The system can be further enhanced with sensors to detect emergencies, such as falls or ire hazards, and respond autonomously by triggering alarms or notifying caregivers. Finally, scalable deployment and data anonymization can allow developers to collect aggregated voice interaction data (with consent) for continuous improvement of command recognition accuracy, noise robustness, and regional language support. This would make the system not only more reliable across demographics but also resilient in acoustically complex environments. In conclusion, the future scope of the VC-02 voice-controlled system extends well beyond basic appliance switching. With the integration of AI, IoT, behaviour analytics, and multimodal control interfaces, it holds vast potential for reshaping smart living, promoting independence for the differently-abled, and contributing to more adaptive, intelligent environments in both residential and institutional contexts.

4.2 Conclusion

In conclusion, this voice-controlled appliance automation system using the VC-02 speech recognition module serves as an accessible and efficient solution for managing household devices through simple voice commands. Designed with a focus on ease of integration and user accessibility, the system enables hands-free operation of appliances such as lights and fans, significantly improving the quality of life for individuals with physical limitations or those seeking enhanced convenience in smart home environments. The system has been thoroughly tested for accuracy, responsiveness, and consistency across all six trained commands - including turning on and off Light One, Light Two, and Fan using distinct GPIOs that toggle the state of connected appliances. The relay-based switching mechanism ensures reliable operation, while the voice commands, configured using the Voice AI Thinker platform, offer an intuitive and user-friendly interface for appliance control. By providing a low-latency, of line-capable voice interface, the system offers immediate device response without the need for internet connectivity, which is particularly beneficial in areas with limited or unstable internet access. Furthermore, the modular design allows for scalability and future enhancements, enabling the addition of more appliances or integration with other smart systems. Looking to the future, the system holds promising potential for integration with more advanced AI-based voice assistants, home automation platforms, and IoT networks. Enhancements such as natural language processing, contextual awareness, and cloud-based analytics could greatly expand its functionality and personalization capabilities. The system may also be adapted for use in specialized environments such as eldercare facilities, hospitals, or accessibility-focused living spaces, where it can support independence and safety. Overall, this voice-controlled appliance system is a meaningful step toward inclusive and intelligent living spaces. With its focus on user empowerment, operational simplicity, and expandability, it paves the way for broader applications in smart home ecosystems and continues to contribute toward a more automated, accessible, and user-centric technological future.

Chapter 5

Appendix

5.1 Pin Configurations

No.	Name	Function description
1	VCC	5V power input
2	NC	No connect
3	TCK	JTAG clock pin
4	TMS	JTAG data pin
5	GND	GND ground
6	DAC_L	Reserve the audio L channel output, which is not supported temporarily
7	DAC_R	Reserve the audio R channel output, which is not supported temporarily
8	3V3OUT	3.3V voltage output
9	GND	GND ground
10	VCC	5V voltage input
11	GND	GND ground
12	TX1	UART1 TXD
13	RX1	UART1 RXD
14	IOB8	UART0 output pin/Log information output
15	IOA27	GPIO_A17 pin
16	SCL	3.3V IIC clock pin / GPIO_B2 / TIM3_PWM (it cannot be used simultaneously with the 5V-level IIC communication port)
17	SDA	3.3V IIC data pin / GPIO_B3 / TIM4_PWM (it cannot be used simultaneously with the 5V-level IIC communication port)
18	SCL_5V	5V IIC clock pin (it cannot be used simultaneous with 3.3V level IIC communication port)
19	SDA_5V	5V IIC data pin (it cannot be used simultaneous with 3.3V level IIC communication port)

Figure 5.1: Pin Details of VC-02 Module

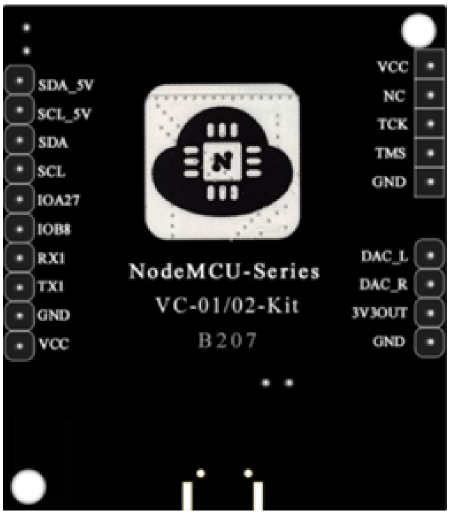

Figure 5.2: VC-02 Module

5.2 Setup and Components

5.2.1 Components used

1. Ai-Thinker VC-02 Module:
The VC-02 is a compact, of line voice recognition module equipped with a 32-bit 240 MHz processor and 2MB lash memory. It uses built-in speech recognition algorithms to detect up to 150 predefined voice commands in English or Chinese. The module supports UART/GPIO/I2C communication and is ideal for integrating speech recognition into embedded systems without internet connectivity. (Fig.5.3)

Figure 5.3: Ai-Thinker VC-02 Module

2. 5V Relay Module (TS0010D):
A 2-channel relay module that operates on 5V input and includes optocoupler isolation. It can switch high-voltage devices (up to 250V AC or 30V DC at 10A) using low-voltage signals from microcontrollers. It provides electrical isolation and safe control of AC loads like lights and fans in the project.(Fig.5.4)

Figure 5.4: 5V 2 Channel Relay Module

3. 15W AC Bulbs:
Two 15-watt incandescent bulbs operating at 230V AC are used to simulate standard household lighting. Each bulb consumes low power and emits about 130–150 lumens, suitable for testing ON/OFF control through voice commands.
4. 5V DC Fan:
A small 5V fan with a current draw of approximately 0.1–0.3 A is used to demonstrate voice controlled fan operation. The fan serves as a low-power load suitable for relay switching and microcontroller interfacing.
5. Plug (2-pin):
A 2-pin AC plug rated for 110–250V and 6–10A is used to safely power the system. It connects to the relay module to deliver AC voltage to the bulbs while maintaining a basic double-insulated safety standard.

5.2.2 Setup

The VC-02 module receives spoken commands and processes them internally. Upon recognizing a valid command (e.g., "Light One ON"), it sends a signal through a designated GPIO pin. This pin is connected to the input of the 5V relay module. The relay switches the corresponding high voltage device (such as a bulb or fan) ON or OFF based on the command. Each relay controls one device (e.g., Light 1, Light 2), with the fan optionally connected to a third GPIO-controlled relay. The AC bulb load is powered through the 2-pin plug connected to the relay's NO (Normally Open) and COM (Common) terminals.

5.3 Technical Details

2 Channel 5V Relay Module

- Power Supply Voltage: 5VDC, 12VDC
- Current: Greater than 100mA
- Load: 250V 10A AC or 30V10ADC
- Size: 50.5mm x 38.5mm x 18.5mm (L*W*H)
- Weight: 31g
- PCB Colour: Black

- Equipped with mounting holes around, hole diameter 3.1mm
- Relay Type: Single Pole Double Throw (SPDT)
- Optocoupler isolation, good anti-interference capability

VC-02 Module:

- Power supply Voltage: 3.6V- 5V
- Current: Greater than 500mA
- Size :18*17*3.2(±0.2) mm
- Working Temperature: -40 ℃ 85 ℃
- SPI Flash :2MB (built-in)
- Interfaces: UART/I2C/PWM/SPI/GPIO
- UART Rate: Default 115200 bps
- Storage environment -40 ℃ 125 ℃

5.4 Website Link and Steps to Create an Account

http://voice.ai-thinker.com/

Step1: When the Website is opened it appears as shown in Fig 5.5 , change the language to English , by clicking on “English” on the top corner

FIGURE 5.5: Changing the language of the Website

Step 2: Now it appears to be how shown in Fig 5.6 , To create an account click on "Create Product"

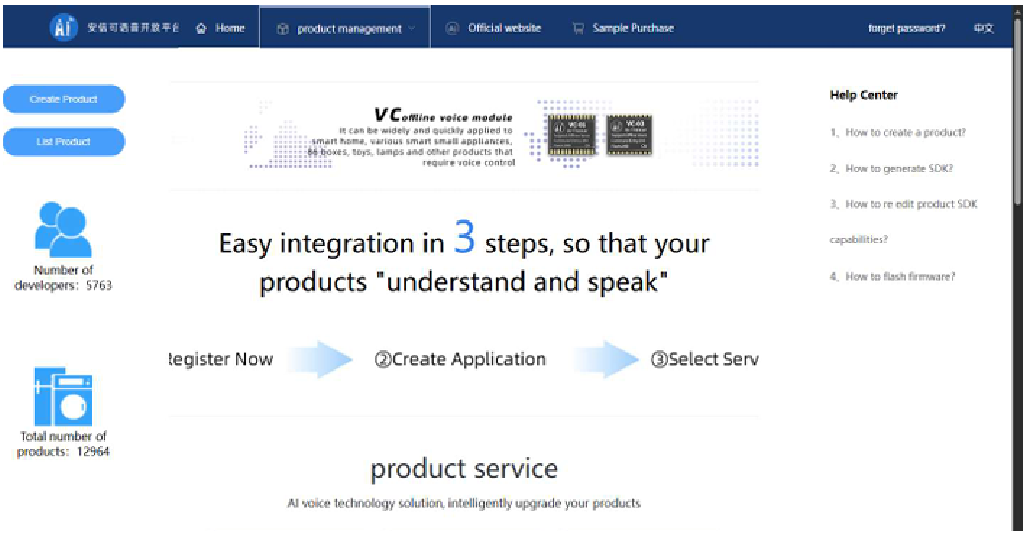

FIGURE 5.6: Create Product

Step 3: When "Create product" is clicked a webpage as shown in Fig .5.7 is opened, Now click on "register now"

FIGURE 5.7: Register Now

Step 4: When register now is clicked , a webpage opens as showns in Fig.5.8,Now Enter all the details and click on send verification code , a verification code will be sent to the email address entered . Enter the verification code and click on “agree and register”

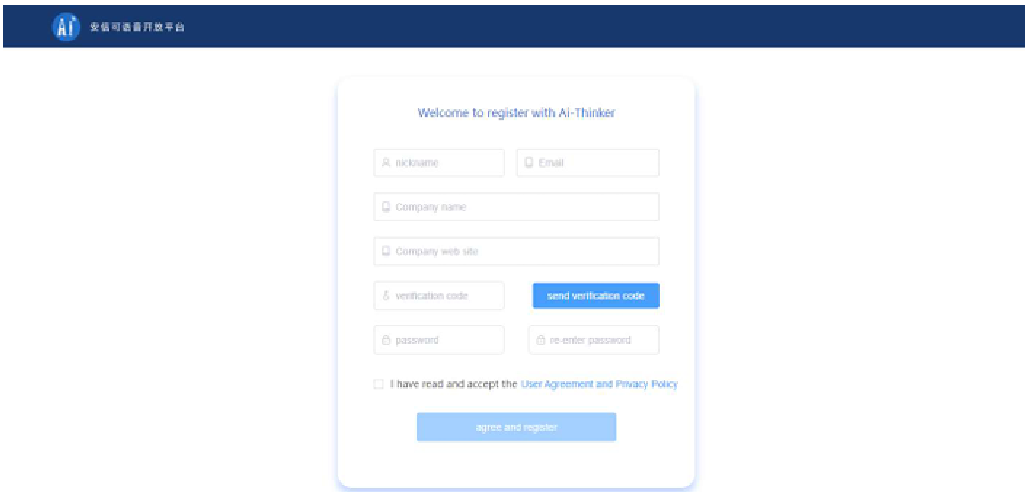

FIGURE 5.8: Entering The Details

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