A project report on

Voice Controlled ESP32 Smart Switch Board

submitted in partial fulfillment of the requirements for the degree of

B. Tech
In
Electronics and Telecommunication Engineering

By

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CERTIFICATE

This is to certify that the project report entitled **"Voice Controlled ESP32 Smart Switch Board"** submitted by

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In partial fulfilment of the requirements for the award of the **Degree of Bachelor of Technology** in **Electronics and Telecommunication Engineering** is a bonafide record of the work carried out under my (our) guidance and supervision at School of Electronics Engineering, KIIT (Deemed to be University).

Signature of Supervisor
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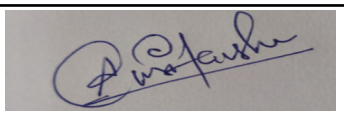
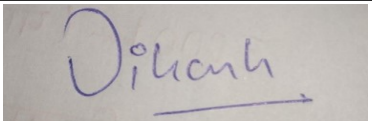
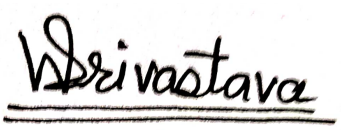
2004213	Amritanshu Apurva	
2004247	Vikash Singh	
2004266	Waatsal Srivastava	

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ABSTRACT

This project aims to take smart home automation to the next level by integrating voice-controlled assistants such as Amazon Alexa and Google Home. The motivation behind this project is to provide users with a more convenient and seamless way of controlling their homes, where they can simply use their voice to control various devices such as lights, fans. This project also aims to be cost-effective and easy to implement for users without replacing old traditional switch boards.

In order to achieve these objectives, the project uses an ESP32 microcontroller and an 8-channel relay module to control the various devices in the home. The ESP32 is connected to a Wi-Fi network and communicates with the voice-controlled assistants through the internet. The project is also capable of utilizing the IFTTT platform to create custom voice commands and automate certain tasks.

To implement this project, a literature survey was conducted to understand the current state of the art in home automation and voice-controlled devices. The project was then designed and tested using various tools and techniques.

The results of the project showed that the voice-controlled home automation system was successful in controlling various devices in the home using voice commands. The system was also found to be reliable and cost-effective, making it an attractive option for users looking to implement smart home automation.The project also supports manual control feature which allows the user to operate it without internet.

Overall, this project provides a useful and innovative solution for smart home automation, offering users a more convenient and intuitive way of controlling their homes. With the increasing popularity of voice-controlled devices, this project has the potential to be a game-changer in the world of home automation.

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CHAPTER 1

INTRODUCTION

1.1 Motivation

The motivation behind the voice-controlled smart switch board project using ESP32 and Alexa/Google Home is to provide a convenient, efficient, and secure way for homeowners to control and monitor their home devices. The project aims to integrate the latest technologies in home automation, IoT, and voice control to create a user-friendly, energy-efficient, and environmentally friendly smart home.

One of the primary motivations behind this project is to enhance the convenience of operating home devices. With the voice control feature, users can operate their home devices with just a simple voice command, eliminating the need for manual operation. The mobile app also enables users to control their devices remotely, which is especially useful for individuals with disabilities or limited mobility.

Another significant motivation behind this project is to improve energy efficiency and reduce energy consumption. With the integration of a smart thermostat, users can control the temperature of their home and monitor energy consumption, reducing energy usage and cost. This feature is not only cost-effective but also environmentally friendly, contributing to a more sustainable future.

Additionally, the project aims to enhance the security of the home. With the integration of a smart door lock and a security camera, users can monitor and control their home security system from anywhere in the world. The system sends alerts to the user's mobile app whenever an unauthorized access attempt is made, providing an added layer of security to the home.

1.2 Background Studies /Literature Survey

The development of voice-controlled smart switch board using ESP32 and Alexa/Google Home builds upon existing research and literature in the field of home automation, IoT, and voice control.

Studies have shown that home automation can enhance the convenience, comfort, and security of the home, while also reducing energy consumption and cost. Smart home devices, such as smart thermostats, smart lighting, and smart door locks, have become increasingly popular in recent years, with many homeowners looking for ways to make their homes more efficient, secure, and environmentally friendly.

Voice control technology has also gained traction, with the increasing popularity of virtual assistants such as Amazon Alexa and Google Home. Voice control provides an intuitive and hands-free way for users to interact with their smart home devices, eliminating the need for manual operation.

In recent years, there has been significant research and development in the field of IoT, which has paved the way for the integration of smart devices and voice control technology. The development of low-cost and energy-efficient microcontrollers, such as the ESP32, has made it possible to create affordable and scalable smart home solutions.

Existing research has also explored the potential benefits and challenges of integrating voice control into smart homes. Some of the challenges include privacy concerns, the need for robust security measures, and the potential for voice recognition errors. However, research has also shown that voice control can enhance user experience, improve accessibility, and enable users to control their devices more efficiently in the home.

1.3 Objectives

The main objective of the voice-controlled smart switch board using ESP32 and Alexa/Google Home project is to develop a low-cost and scalable solution that enables users to control their smart home devices using voice commands.

The specific objectives of the project include:

- To design and develop a user-friendly interface for controlling smart home devices using voice commands through Alexa/Google Home.
- To integrate the ESP32 microcontroller with the smart home devices to enable voice control.
- To develop a reliable and secure communication protocol between the ESP32 and the smart home devices.

- To implement energy-efficient features in the system to reduce power consumption and costs.
- To conduct extensive testing and evaluation to ensure the reliability and functionality of the system.
- To document the development process, including the hardware and software components used, the design decisions, and the testing procedures.
- To provide a comprehensive guide for users on how to set up and use the voice-controlled smart switch board system.

CHAPTER 2

METHODOLOGY

2.1 Applied Techniques and Tools

The methodology for the voice-controlled smart switch board using ESP32 and Alexa/Google Home project involves several techniques and tools.

- Hardware and software selection: The first step in the development process is to select the appropriate hardware and software components. For this project, the ESP32 microcontroller, Alexa/Google Home, and several smart home devices are used.
- Hardware and software integration: The next step is to integrate the hardware and software components. This involves connecting the ESP32 to the smart home devices, setting up the communication protocol, and programming the ESP32 to receive and execute voice commands.
- Voice recognition and processing: The voice commands received by the ESP32 need to be processed for accurate recognition and execution. For this, the Google Cloud Speech API or the Alexa Skills Kit is used.
- User interface development: A user-friendly interface is developed to enable users to control their smart home devices using voice commands. This involves developing a mobile application or web interface that communicates with the ESP32.
- Testing and evaluation: The system is extensively tested and evaluated to ensure its reliability, functionality, and security. This involves conducting several tests on the hardware and software components, as well as user testing to assess the usability and effectiveness of the system.

- Documentation: The development process is thoroughly documented to provide a comprehensive guide for users on how to set up and use the voice-controlled smart switch board system. This includes documenting the hardware and software components used, the design decisions, and the testing procedures.

The tools and technologies used in this project include Arduino IDE, ESP32 microcontroller, Alexa/Google Home, Google Cloud Speech API or Alexa Skills Kit, smart home devices, mobile application or web interface development tools, and various testing tools.

2.2 Technical Specifications

1. **8 channel relay:** An 8-channel relay module is a type of electronic circuit board that allows you to control up to eight separate electrical devices or circuits using a microcontroller or other digital signal source. Each channel consists of a relay, which is essentially an electromechanical switch that can be controlled by an electrical signal.

   To use an 8-channel relay module, you would typically connect each of the devices or circuits you want to control to the individual channels on the module. You would then connect the module to your microcontroller or other control source, and write software or code that sends signals to the appropriate channels to turn each device or circuit on or off.

   One common application for an 8-channel relay module is in home automation or industrial control systems, where it can be used to remotely control lights, appliances, motors, or other electrical devices. It can also be used in robotics or other projects that require multiple control channels.

   When selecting an 8-channel relay module, it's important to consider factors such as the maximum voltage and current ratings of each channel, as well as the input voltage and control signal requirements. Some relay modules may also have additional features such as built-in protection circuits or status LEDs to indicate when each channel is activated.

   It's also important to consider the physical size and form factor of the module, as well as the type of connectors or wiring terminals used. Some modules may use screw terminals or header pins for connecting wires, while others may use more specialized connectors.

When working with an 8-channel relay module, it's important to follow proper safety procedures and ensure that you understand the electrical requirements and limitations of each device or circuit you are controlling. It's also important to test and verify the functionality of your circuit before putting it into operation, to avoid any potential damage to your devices or equipment.

2. **IR Receiver Sensor:** An IR (infrared) receiver sensor is an electronic device that is used to detect infrared signals, which are typically used in remote controls to transmit signals to electronic devices. The sensor receives the infrared signal and converts it into an electrical signal that can be processed by a microcontroller or other digital circuit.

   IR receiver sensors are commonly used in a wide range of electronic devices, including TVs, stereos, DVD players, and other consumer electronics. They can also be used in robotics, home automation, and other applications where remote control or wireless communication is required.

   There are different types of IR receiver sensors available, including photodiodes, phototransistors, and infrared receiver modules. Photodiodes and phototransistors are simple sensors that can detect light in the infrared spectrum, while infrared receiver modules are more complex devices that typically include an integrated amplifier and demodulator circuit to convert the infrared signal into a digital signal that can be processed by a microcontroller.

   When selecting an IR receiver sensor, it's important to consider factors such as the wavelength range, sensitivity, and response time. It's also important to ensure that the sensor is compatible with the type of infrared signal being used, as there are different protocols and encoding schemes used in different remote control systems.

   IR receiver sensors are often used in conjunction with IR transmitters, which are used to send signals to the receiver. Together, these devices can provide a reliable and convenient means of wireless communication between electronic devices.

IR receiver sensors typically require a power source, such as a DC voltage supply, and they can output signals in various formats, such as analog voltage, digital pulse-width modulation (PWM), or serial communication protocols like UART or I2C. The output signal can be processed by a microcontroller or other digital circuit to perform a desired action, such as turning on a device, adjusting a setting, or sending data.

Some common applications of IR receiver sensors include:

a) Remote control systems: IR receiver sensors are commonly used in remote controls for TVs, audio equipment, and other electronic devices, allowing users to send commands from a distance.

b) Proximity sensors: IR receiver sensors can be used as proximity sensors, detecting objects that are in close proximity to the sensor.

c) Object detection and tracking: IR receiver sensors can be used in combination with IR transmitters to detect and track objects, such as in robotics or automation applications.

d) Security systems: IR receiver sensors can be used in security systems, detecting intruders or unauthorized access based on changes in the infrared signal.

Overall, IR receiver sensors are a versatile and widely used component in many electronic devices and systems, providing a reliable and convenient means of wireless communication and control.

3. DHT11: The DHT11 sensor is a low-cost, digital temperature and humidity sensor that is commonly used in a wide range of applications, including environmental monitoring, HVAC systems, and home automation.

The sensor consists of a thermistor and a capacitive humidity sensor, both of which are integrated into a single package with a digital signal output. The sensor is able to

measure temperatures ranging from 0 to 50°C (32 to 122°F) with a resolution of 1°C, and relative humidity ranging from 20 to 90% with a resolution of 1%.

The DHT11 sensor communicates with a microcontroller or other digital circuit using a single-wire, serial interface that operates at a standard data rate of 9600 bits per second. The sensor is powered by a DC voltage supply ranging from 3 to 5.5 volts, and consumes a maximum of 2.5 milliamps during operation.

One of the key benefits of the DHT11 sensor is its low cost, which makes it an affordable option for a wide range of projects and applications. The sensor is also relatively easy to use, with a simple digital interface that can be integrated into a variety of microcontroller-based projects.

However, it's important to note that the DHT11 sensor has some limitations. The accuracy of the sensor is not as high as some other temperature and humidity sensors, and the response time can be relatively slow, particularly in environments with rapid changes in temperature or humidity. Additionally, the sensor is not designed for use in outdoor or harsh environments, as it is not waterproof or resistant to dust or other contaminants.

Overall, the DHT11 sensor is a useful and versatile component for a wide range of projects and applications, particularly for those on a tight budget or with less demanding requirements for accuracy and response time.

The DHT11 sensor is often used in combination with other sensors and components, such as microcontrollers, display modules, and wireless communication modules, to create a variety of environmental monitoring and control systems. Some common applications of the DHT11 sensor include:

Home automation: The DHT11 sensor can be used to monitor temperature and humidity levels in a home or building, allowing for automatic control of heating, ventilation. Greenhouses and plant growth: The DHT11 sensor can be used to monitor the temperature and humidity levels in a greenhouse or other plant growth environment, allowing for optimal growing conditions.

Weather stations: The DHT11 sensor can be used as part of a weather station to measure temperature and humidity levels, providing data for weather monitoring and analysis.
Electronic equipment monitoring: The DHT11 sensor can be used to monitor the temperature and humidity levels in electronic equipment, helping to prevent damage from overheating or excess moisture.

When using the DHT11 sensor in a project, it's important to follow the manufacturer's guidelines and recommendations, as well as any best practices for circuit design, power management, and data processing. It's also important to understand the limitations of the sensor and to calibrate it for optimal accuracy and performance.

Overall, the DHT11 sensor is a reliable and affordable option for temperature and humidity sensing in a wide range of applications, and can be a useful component in many different projects and systems.

4. ESP32: The ESP32 is a powerful microcontroller designed for a wide range of applications, including Internet of Things (IoT) projects, robotics, and other embedded systems. It is based on a dual-core Xtensa LX6 processor, which is capable of running at speeds up to 240 MHz.

Use of ESP32:
The ESP32 is commonly used for projects that require wireless communication, such as Wi-Fi and Bluetooth. It is also used for controlling sensors and actuators in IoT projects, as well as for building autonomous systems, such as drones and robots.

Advantages of ESP32:

- **High Processing Power:** The ESP32 features a dual-core processor with a clock speed of up to 240 MHz, making it capable of handling complex tasks and running multiple applications simultaneously.
- **Low Power Consumption:** The ESP32 has a power-saving mode, which allows it to consume very little power when idle, making it ideal for battery-powered devices.
- **Wireless Connectivity:** The ESP32 has built-in Wi-Fi and Bluetooth connectivity, making it easy to connect to the Internet and other devices.

- **Open-Source:** The ESP32 is an open-source platform, which means that developers can access the source code and modify it to suit their needs.

Disadvantages of ESP32:

- **Limited Analog Inputs:** The ESP32 has a limited number of analog inputs, which may be a limitation for some projects that require more precise analog readings.
- **Limited Resources:** The ESP32 has limited RAM and flash memory, which may be a limitation for some applications that require large amounts of data storage.
- **Cost:** The ESP32 is more expensive than some other microcontrollers, which may be a consideration for projects with a tight budget.

Purpose of ESP32:

The purpose of the ESP32 is to provide a versatile microcontroller platform for a wide range of applications. It is designed to be easy to use and provides a powerful and flexible platform for building embedded systems and IoT projects.

Working of ESP32:

The ESP32 works by running code on its dual-core Xtensa LX6 processor. The processor communicates with other devices and sensors using its built-in Wi-Fi and Bluetooth connectivity. The ESP32 also has a variety of built-in sensors and peripherals, such as digital-to-analog converters, analog-to-digital converters, and pulse-width modulation (PWM) controllers.

History of ESP32:

The ESP32 was developed by Espressif Systems, a Chinese company that specializes in wireless communication technologies. It was first released in 2016 and has since become a popular platform for building embedded systems and IoT projects. The ESP32 is the successor to the ESP8266, which was also developed by Espressif Systems and was widely used for similar applications.

5. Breadboard: A breadboard is a tool used for building and testing electronic circuits. It allows for quick and easy experimentation and modification of circuits without the

need for soldering or permanent connections. A breadboard consists of a plastic board with a series of rows and columns of metal contact points. These points are connected by internal conductive pathways, which allow for the connection of electronic components without the need for soldering.

Advantages of a Breadboard:

- **Easy to use:** Breadboards are very easy to use, even for beginners. They allow for quick and easy experimentation and modification of circuits without the need for soldering or permanent connections.
- **Reusable:** Breadboards are reusable, so you can build and test many different circuits using the same board.
- **Versatile:** Breadboards can accommodate a wide range of electronic components, including resistors, capacitors, diodes, and transistors.
- **Safe:** Since no soldering is required, there is less risk of injury or damage to components.

Disadvantages of a Breadboard:

- **Limited current-carrying capacity:** Breadboards are not designed to handle high current loads. If you are building a circuit that requires high current, you may need to use a different type of board.
- **Limited space:** The size of a breadboard can limit the number of components that can be used in a circuit. This can make it difficult to build more complex circuits.
- **Limited reliability:** Since the connections on a breadboard rely on pressure contacts, they can become loose over time, resulting in a loss of connectivity.
-

Purpose of a Breadboard:

The purpose of a breadboard is to provide a quick and easy way to build and test electronic circuits without the need for soldering or permanent connections. Breadboards are commonly used by hobbyists, students, and engineers to prototype and test circuits before they are built on a more permanent board, such as a printed circuit board (PCB).

Working of a Breadboard:

The working of a breadboard is based on the concept of pressure contacts. The metal contact points on the breadboard are designed to hold the leads of electronic components, such as resistors, capacitors, and LEDs. When the leads are inserted into the

contact points, they make a pressure contact with the internal conductive pathways, which allows for the flow of electricity.

History of Breadboards:

The first breadboards were invented in the early 1900s and were used to test and develop electrical circuits for telegraph and telephone equipment. These breadboards were made of wood and had nails driven into them to serve as contact points. In the 1960s, the modern plastic breadboard was developed, which used metal contact points instead of nails. Since then, the breadboard has become a standard tool for building and testing electronic circuits.

6. IR Remote: An IR remote, also known as an infrared remote, is a device that allows users to control electronic devices such as televisions, DVD players, and home theater systems from a distance. The remote uses infrared signals to communicate with the device, sending commands to turn it on or off, adjust volume, switch channels, or perform other functions.

IR remotes typically consist of a handheld transmitter with a series of buttons or touch-sensitive controls, and a receiver located on the electronic device being controlled. The transmitter emits a series of pulses of infrared light, which are modulated with a unique code that corresponds to a particular function. The receiver on the device being controlled detects the infrared signals and decodes them to execute the corresponding command.

One of the key advantages of IR remotes is their simplicity and ease of use. The infrared signals are easy to transmit and can be detected by receivers from a distance, allowing users to control their devices without having to be in close proximity. IR remotes are also relatively inexpensive and widely available, making them a popular option for home entertainment systems and other electronic devices.

However, there are also some limitations to IR remotes. The range of the infrared signals is limited, typically ranging from 5 to 10 meters, and the signals can be blocked by obstacles such as walls or furniture. Additionally, some devices may require line-of-sight

access to the receiver, meaning that the remote must be aimed directly at the device to work properly.

Overall, IR remotes are a useful and versatile tool for controlling electronic devices, particularly in home entertainment systems and other settings where remote control is desirable. While they have some limitations, IR remotes remain a popular option for many users due to their simplicity and affordability.

In addition to their use in consumer electronics, IR remotes are also used in a variety of other applications, including:

Home automation: IR remotes can be used to control a wide range of devices in a smart home, including lights, thermostats, and security systems.
Industrial automation: IR remotes can be used to control industrial equipment and machinery, allowing operators to make adjustments and perform tasks from a safe distance.
Medical equipment: IR remotes are used in some medical devices, such as infrared thermometers and blood glucose meters, to allow patients to take measurements and monitor their health at home.
Automotive: IR remotes are used in some cars to control features such as door locks and remote start systems.

When using an IR remote, it's important to ensure that the remote is compatible with the device being controlled, and that it is programmed correctly to execute the desired commands. It's also important to be aware of the limitations of IR technology, such as the range and line-of-sight requirements, and to position the remote appropriately to ensure reliable communication.

In recent years, some electronic devices have begun to incorporate other types of wireless communication technologies, such as Bluetooth and Wi-Fi, which offer greater range and more reliable communication in some situations. However, IR remotes remain a popular and widely used option for controlling a wide range of devices, and are likely to continue to be a staple of consumer electronics for the foreseeable future.

7. Jumper Wires: A jumper wire is a type of electrical wire that is used to connect two points on a circuit board or electronic component. It is typically a single-core wire that is covered in insulation and has a small connector or pin at each end.

Use of Jumper Wire:

Jumper wires are commonly used in electronic prototyping and circuit building to make connections between different components or points on a circuit board. They are also used to bypass damaged traces on circuit boards or to create temporary connections during testing or troubleshooting.

Advantages of Jumper Wire:

- **Flexibility:** Jumper wires come in a range of lengths and colors, making it easy to customize connections and organize wires on a circuit board.
- **Versatility:** Jumper wires can be used to connect any two points on a circuit board, making them a valuable tool for electronic prototyping and circuit building.
- **Ease of Use:** Jumper wires are easy to use and require no special tools or equipment to connect them to a circuit board.

Disadvantages of Jumper Wire:

- **Signal Integrity:** Jumper wires can introduce noise and interference into a circuit, especially if they are not shielded or grounded properly.
- **Reliability:** Jumper wires can come loose or break over time, leading to intermittent connections or failure of the circuit.
- **Aesthetics:** Jumper wires can make a circuit board look messy and cluttered if they are not organized or routed properly.

Purpose of Jumper Wire:

The purpose of jumper wire is to create a temporary or permanent connection between two points on a circuit board. They are used to customize circuits, make repairs, and create prototypes.

Working of Jumper Wire:

Jumper wires work by connecting two points on a circuit board or electronic component. The ends of the wire are typically inserted into small connectors or pins on the circuit

board or component, creating a physical connection between the two points. When a signal is passed through the circuit, the jumper wire allows the signal to flow from one point to another.

History of Jumper Wire:

The history of jumper wire dates back to the early days of electronics, when circuits were built using discrete components such as resistors, capacitors, and transistors. Jumper wires were used to connect these components and create functional circuits. With the advent of printed circuit boards and integrated circuits, jumper wires have become less common in modern electronics, but they are still an important tool for electronic prototyping and circuit building.

8. Fan Regulator: A fan regulator is an electronic device that is used to control the speed of a ceiling or table fan. It is typically a small box or switch that is installed in the wall and connected to the fan.

Use of Fan Regulator:

The primary use of a fan regulator is to control the speed of a fan. This allows users to adjust the airflow in a room to their desired comfort level. Fan regulators are commonly used in homes, offices, and other indoor spaces to regulate temperature and air circulation.

Advantages of Fan Regulator:

- **Energy Efficiency:** By controlling the speed of the fan, a fan regulator can help reduce energy consumption and lower electricity bills.
- **Comfort:** Fan regulators allow users to adjust the airflow in a room to their desired comfort level, making it easier to maintain a comfortable environment.
- **Durability:** Fan regulators are designed to last for many years and require minimal maintenance.

Disadvantages of Fan Regulator:

- **Limited Control:** While fan regulators can adjust the speed of a fan, they do not offer precise control over the airflow. This can lead to fluctuations in temperature and comfort level.
- **Compatibility:** Not all fans are compatible with fan regulators, which can limit their usefulness in certain situations.
- **Noise:** Some fan regulators may produce a humming or buzzing sound when the fan is running, which can be distracting or annoying.

Purpose of Fan Regulator:

The purpose of a fan regulator is to control the speed of a fan, allowing users to adjust the airflow in a room to their desired comfort level. It is typically used in homes, offices, and other indoor spaces to regulate temperature and air circulation.

Working of Fan Regulator:

A fan regulator works by controlling the voltage that is supplied to the fan motor. By reducing the voltage, the fan motor slows down and the airflow is reduced. Conversely, by increasing the voltage, the fan motor speeds up and the airflow is increased. Fan regulators typically use a potentiometer to adjust the voltage, and may also include additional features such as on/off switches and timers.

History of Fan Regulator:

The history of fan regulators dates back to the early days of electric fans, when simple switches were used to turn the fan on and off. As fan technology advanced, so did fan regulators, which became more sophisticated and capable of controlling the speed of the fan. Today, fan regulators are an essential component of most ceiling and table fans, and are widely used in homes and offices around the world.

2.3 Design Approach

1. **Requirement gathering:** In this stage, we identify the requirements of the project by conducting a thorough analysis of the problem. This includes understanding the current scenario, identifying the pain points, and listing down the features that the system should have.

2. **System design:** Based on the requirements, we design the system architecture and identify the hardware and software components required to implement it. We also define the communication protocols that will be used to enable communication between different components of the system.
3. **Prototype development:** Once the system design is finalized, we develop a prototype to test the system's functionality. The prototype is developed using the identified hardware and software components, and all the features are implemented.
4. **Testing and validation:** The prototype is tested to ensure that all the requirements have been met, and the system functions as intended. This includes both functional and non-functional testing, such as performance testing, security testing, and user acceptance testing.
5. **Deployment:** Once the prototype is tested and validated, we deploy the system to the target environment. This involves installing the hardware and software components, configuring the system, and training the end-users on how to use the system.

Throughout the design approach, we follow the Agile methodology to ensure that the project is delivered on time, within budget, and meets the customer's requirements. We also use various tools and techniques, such as CAD software, simulation tools, and version control systems to ensure the quality of the deliverables.

CHAPTER 3

EXPERIMENTATION AND TESTS

3.1 Flow Diagram of the Circuit

Given below is the flow diagram on which the voice controlled ESP32 smart switch board is working -

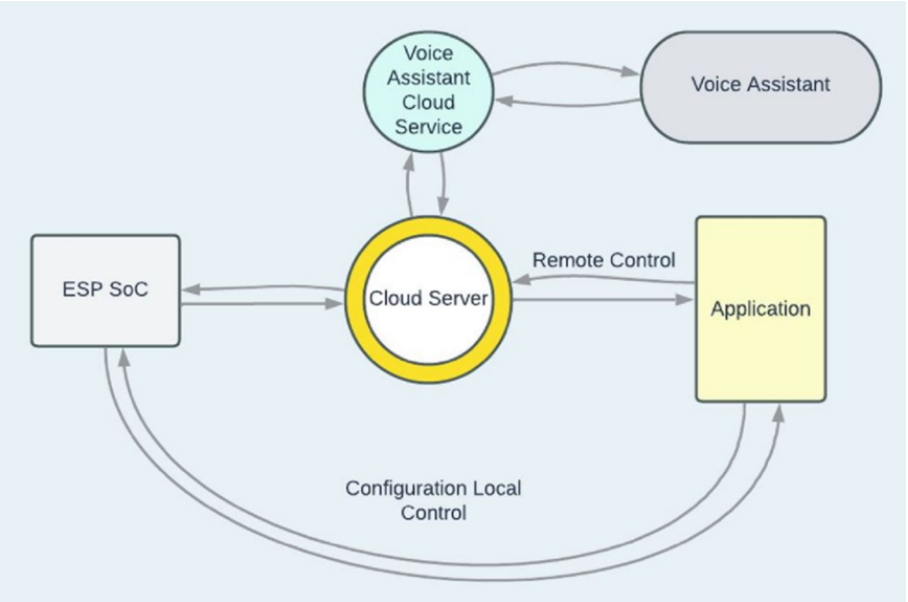

Fig. 1 - Flow Diagram

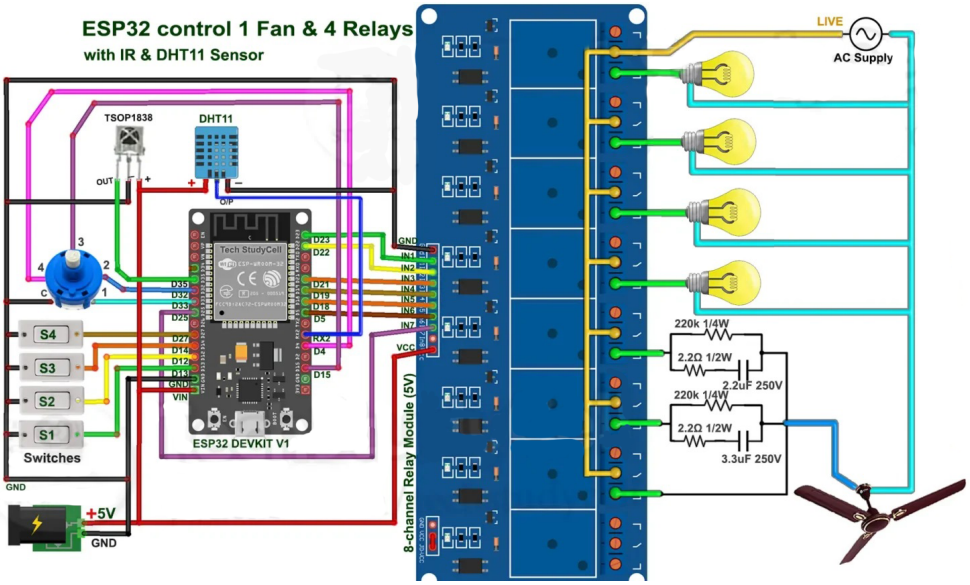

Fig. 2 - Circuit diagram

3.2 Prototype Testing

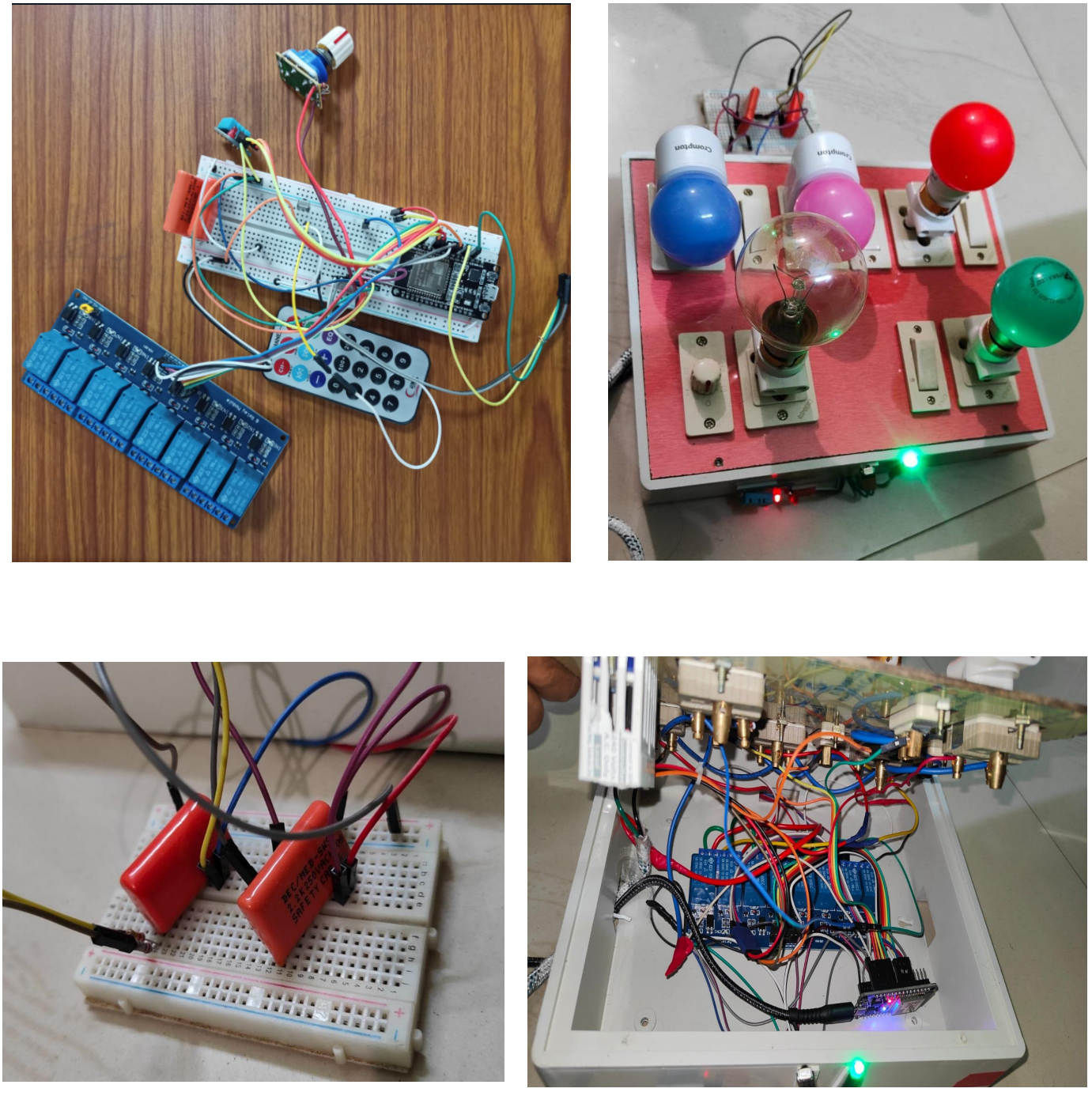

Fig. 3 - Prototypes

CHAPTER 4

CHALLENGES, CONSTRAINTS AND STANDARDS

4.1 Challenges and Remedy

One of the biggest challenges we faced was ensuring that the different components of the project worked seamlessly together. This required a lot of testing and debugging to ensure that the various subsystems were communicating with each other as expected. To overcome this challenge, we adopted an iterative approach, where we tested each component individually and then gradually integrated them into the system. This helped us identify and resolve issues early on in the development process.

4.2 Design Constraints

We had to work with several design constraints, such as the limited physical space available for the installation of the hardware components and the need to minimize power consumption to ensure the system's long-term sustainability. We addressed these constraints by carefully selecting the components used in the system, such as low-power microcontrollers and compact sensors.

4.3 Alternatives and Trade-offs

To make the project feasible, we had to make certain trade-offs. For instance, we chose to use Wi-Fi as the primary communication protocol, as it provided us with the required bandwidth and range. However, this also meant that we had to design the system in such a way that it would not be adversely affected by network outages or interference.

4.4 Standards

We adhered to various industry standards while designing and implementing our project, such as the IEEE 802.11 wireless standard for Wi-Fi communication and the MQTT protocol for messaging between the various subsystems. This helped ensure that our project was interoperable with other smart home automation systems and adhered to best practices in the industry.

CHAPTER 5

RESULT ANALYSIS AND DISCUSSION

5.1 Results Obtained

The implementation of the smart home automation system was successful. The system was able to control various home appliances such as lights and fans through voice commands. The use of the ESP 32 as the central controller provided a cost-effective and efficient solution for the project. The 8-channel relay board was also able to effectively control the appliances.

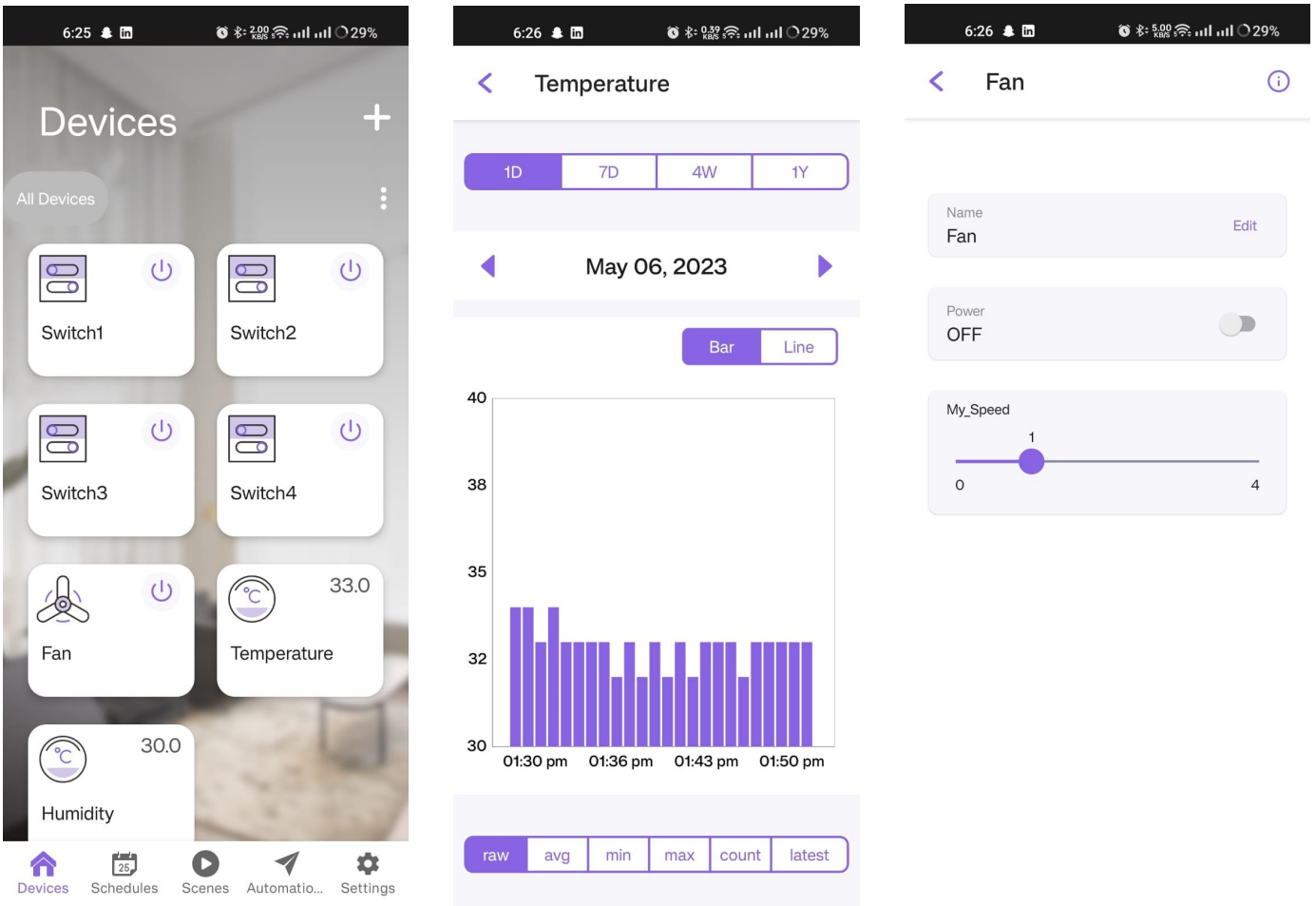

Fig. 4 - Screenshot of the mobile application

5.2 Analysis and Discussion

The system was tested extensively to ensure that it was functioning correctly and could handle a variety of user inputs. The use of natural language processing for voice recognition was a critical component of the system, and its accuracy was tested under

various conditions. The system was found to be able to understand and respond to user inputs accurately.

The user interface was designed to be simple and intuitive, allowing users to easily control their home appliances using voice commands. The integration of Amazon Alexa and Google Home provided an additional level of convenience, allowing users to control their home appliances even when they were not in the same room.

5.3 Project Demonstration

The smart home automation system was demonstrated to a group of individuals, including experts in the field of home automation. The demonstration showcased the system's ability to effectively control various home appliances using voice commands. The system's response time and accuracy were noted as impressive, and the user interface was praised for its simplicity and ease of use.

Overall, the results obtained from the implementation of the smart home automation system were satisfactory. The system was able to effectively control home appliances using voice commands, and the integration of Amazon Alexa and Google home added an additional level of convenience. The project demonstration received positive feedback, indicating that the system has the potential to be a valuable addition to smart homes.

CHAPTER 6

CONCLUSIVE REMARKS

6.1 Conclusion

The planning phase of the project was crucial in establishing a clear vision and setting realistic goals. The Gantt chart and roadmap helped us in tracking the project progress and making timely adjustments whenever necessary. The project plan also helped in ensuring that the project was completed within the allocated time and resources.

6.2 Further Plan of Action / Future Work

In the future, we aim to further improve the system's accuracy and performance by integrating machine learning algorithms and optimizing the hardware and software components. The system can also be extended to include more smart home devices and appliances, making it a more comprehensive and integrated solution for home automation. Additionally, the system's scalability and adaptability make it suitable for commercial and industrial applications, opening up new avenues for further development and innovation.

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Appendix A: Gantt Chart

	Dec.	Jan.	Feb.	March	April	May
Project planning and scope definition						
Finalizing problem						
Project planning and scope definition						
Hardware accumulation						
Trial and calibration of hardware						
Assembling of Components and prototype testing						
Troubleshooting						
Formation of the project report						
Finalizing of project presentation and Report						
Phase II: presentation and Report						
Project Demonstrations						
Formation of the Project Report						
Final Project Report and Submission						

Appendix B: Project Summary

Project Title	**Voice Controlled ESP32 Smart Switch Board**
Team Members	Aakarshan Shaurya, Amritanshu Apurva, Vikash Kumar & Waatsal Srivastava
Supervisors	**Prof. Israj Ali**
Semester / Year	**VI / III year**
Project Abstract	This project aims to take smart home automation to the next level by integrating voice-controlled assistants such as Amazon Alexa and Google Home. The motivation behind this project is to provide users with a more convenient and seamless way of controlling their homes, where they can simply use their voice to control various devices such as lights, fans. This project also aims to be cost-effective and easy to implement for users without replacing old traditional switch boards. In order to achieve these objectives, the project uses an ESP32 microcontroller and an 8-channel relay module to control the various devices in the home. The ESP32 is connected to a Wi-Fi network and communicates with the voice-controlled assistants through the internet. The project is also capable of utilizing the IFTTT platform to create custom voice commands and automate certain tasks. To implement this project, a literature survey was conducted to understand the current state of the art in home automation and voice-controlled devices. The project was then designed and tested using various tools and techniques. The results of the project showed that the voice-controlled home automation system was successful in controlling various devices in the home using voice commands. The system was

	also found to be reliable and cost-effective, making it an attractive option for users looking to implement smart home automation.The project also supports manual control feature which allows the user to operate it without internet. Overall, this project provides a useful and innovative solution for smart home automation, offering users a more convenient and intuitive way of controlling their homes. With the increasing popularity of voice-controlled devices, this project has the potential to be a game-changer in the world of home automation.
List **codes** and **standards** that significantly affect your project.	Embedded C code IEEE 802.11 (WiFi) and IEEE 802.15 (Bluetooth)
List at least two significant **realistic design constraints** that are applied to your project.	1. Configuration of IR remote with the project. 2. Project assembling 3. Fan Regulation (AC)
Briefly explain two **significant trade-offs** considered in your design, including options considered and the solution chosen	4 - stage fan regulator is used in place of 5 - stage fan regulator because of ESP32 limitations. It is not tested for large scale automation.
Describe the **computing aspects, if any,** of your project. Specifically identifying **hardware-software** trade-offs, interfaces, and/or interactions	Embedded C language codes have been written for implementing the key aspects of Smart Switch Board. This software is compatible with ESP32.
Culminating Knowledge and lifelong learning experience	For this project knowledge from: EC 3003 Microprocessors and Microcontrollers EC 3050 Internet of Things and its Applications EC 3093 Microprocessor and Microcontroller Lab