MINI PROJECT REPORT
EMBEDDED SYSTEM DESIGN LAB (ICE 3144)

FIFTH SEMESTER B.TECH. CYBER-PHYSICAL SYSTEMS

HOME AUTOMATION USING ESP32 : VOICE-CONTROLLED FAN AND LED SYSTEM WITH TEMPERATURE MONITORING

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INTRODUCTION

Home automation has gained significant momentum with the advent of IoT, enabling users to control devices through various platforms such as mobile applications and voice assistants. These systems bring convenience, energy efficiency, and remote accessibility to the modern household.
This project aims to automate a simple home environment using the ESP32 microcontroller paired with Sinric, an IoT platform that supports both mobile app control and voice commands. The system controls two main devices—a fan and an LED bulb—and monitors environmental data using a DHT11 sensor, which records the temperature and humidity in real time.
Key Objectives:

1. Automate the switching of appliances using voice commands.
2. Monitor room temperature and humidity in real-time through the mobile app.
3. Explore the benefits of integrating Sirnric as a control interface.

STATEMENT OF THE PROBLEM

Modern homes typically lack automation systems that are both affordable and easy to use. The primary issues include:

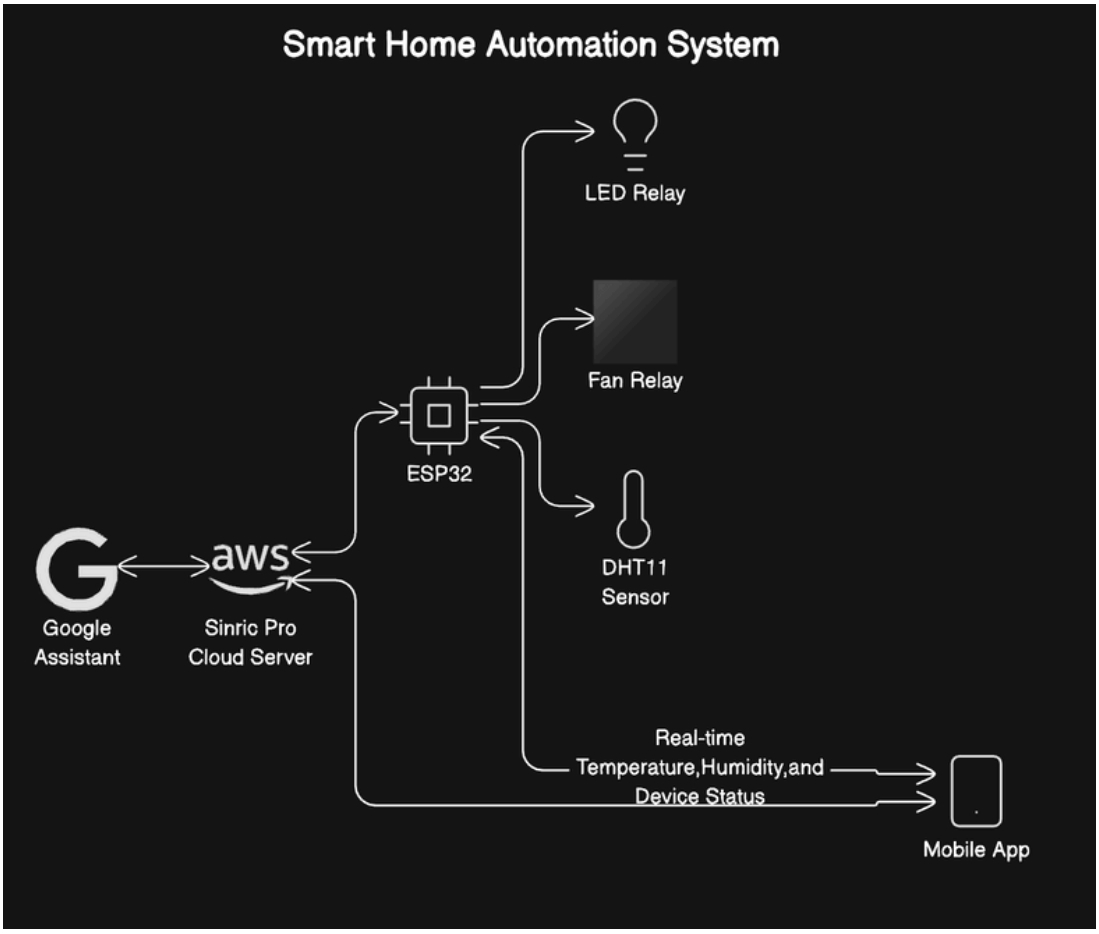
- Manual Operation of Appliances: Traditional home systems require manual control, which is time-consuming and less efficient.
- Lack of Environmental Monitoring: Most home automation setups do not include sensors to monitor important environmental parameters like temperature and humidity.
- High Cost of Automation: Commercially available smart home systems are often expensive, limiting their adoption.
- Complexity of Setup: Many smart systems require professional installation and are not user-friendly, which deters widespread use.

SOLUTION AND SUGGESTIONS

This project offers a solution by:

- Introducing an easy-to-use, voice-controlled system for home appliances that can be installed without professional help.
- Incorporating environmental monitoring with a DHT11 sensor, allowing users to adjust appliance usage based on real-time room conditions.
- Using the ESP32 microcontroller, which is affordable and highly capable for IoT projects.
- Leveraging the Sinric platform for voice-based control, offering an intuitive interface for home automation. This project addresses the primary challenges faced by existing systems and provides an accessible, scalable alternative.

BLOCK DIAGRAM



COMPONENTS REQUIRED

Component	Specification	Description
ESP32	WiFi/Bluetooth-enabled microcontroller	Provides wireless communication capabilities for IoT projects.
Relay Module	2-channel, 5V relay module	Controls the fan and LED based on commands from the ESP32's GPIO pins.
Fan	12V DC fan	Cooling fan used in home automation scenarios, controlled by the relay.
LED Bulb	5W LED bulb	Low-power light bulb controlled via the relay.
DHT11 Sensor	Temperature and humidity sensor	Provides environmental data for monitoring room conditions.
Jumper Wires	Male-to-male and male-to-female connectors	Used to connect the ESP32, relay module, and sensors.
Power Supply	12V adapter for fan, USB power for ESP32	Provides power to the components, ensuring continuous operation.

METHODOLOGY

Steps followed

01

Designing the System Architecture

A clear architectural design is the first step. We selected the ESP32 microcontroller as the hub for all communication. The relay module, controlled by the ESP32, manages the power to the fan and LED, while the DHT11 sensor is used for temperature and humidity sensing.

02

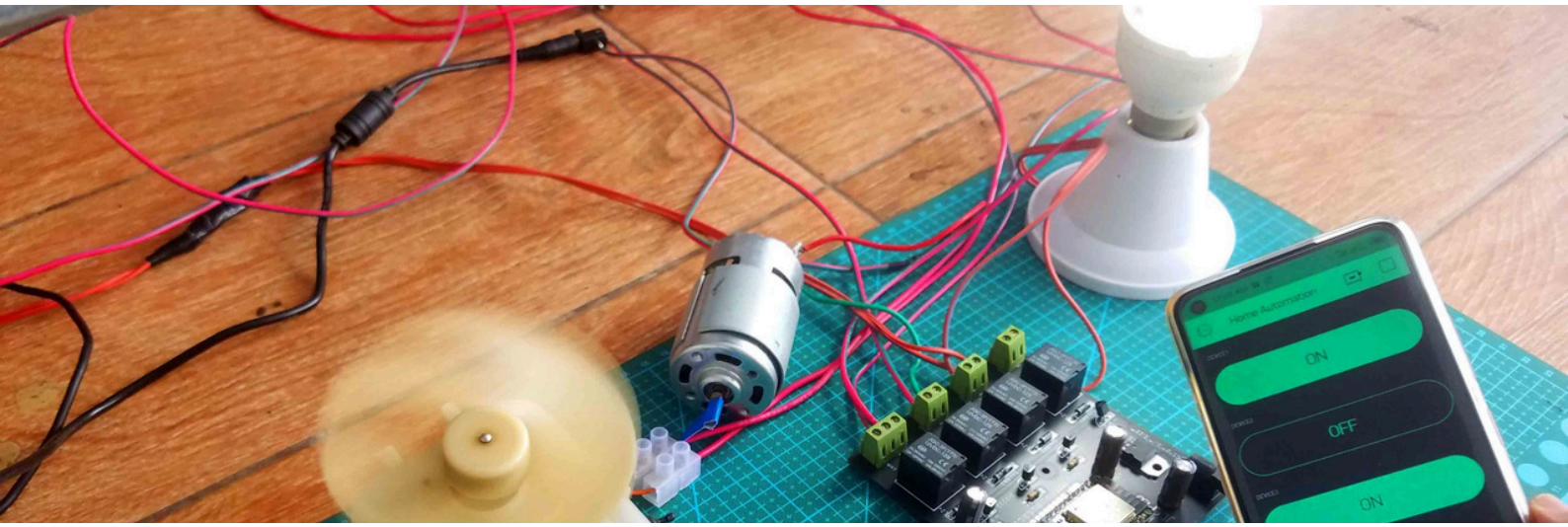
Setting Up the ESP32 and Relays

GPIO pins 18 and 19 of the ESP32 are assigned to the IN1 and IN2 pins of the relay module, respectively. This allows the microcontroller to turn the fan and LED on or off based on user input.

03

Connecting the DHT11 Sensor

The sensor is connected to one of the digital input pins on the ESP32. The sensor data (temperature and humidity) is read and displayed on the google home app, providing the user with real-time room conditions.



04

Voice Control via Sinric

The Sinric platform is integrated for voice commands. The platform communicates with the ESP32 via WiFi, enabling users to control the fan and LED remotely using simple voice commands like “Turn on the fan” or “Switch off the light.”

05

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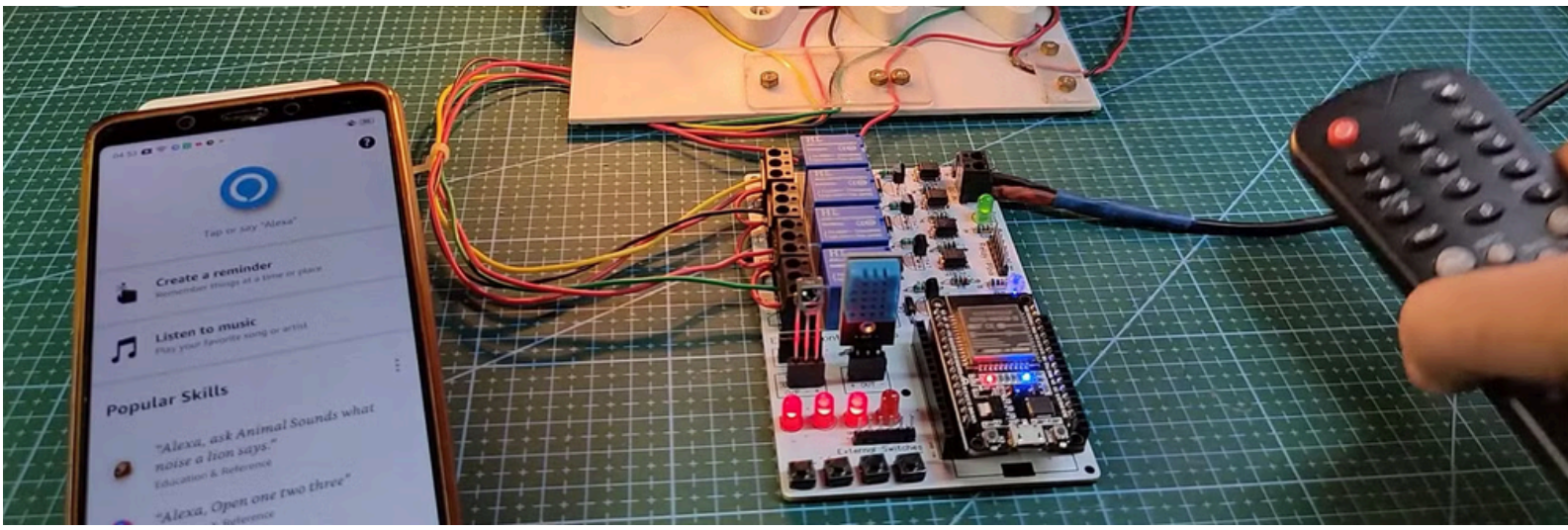
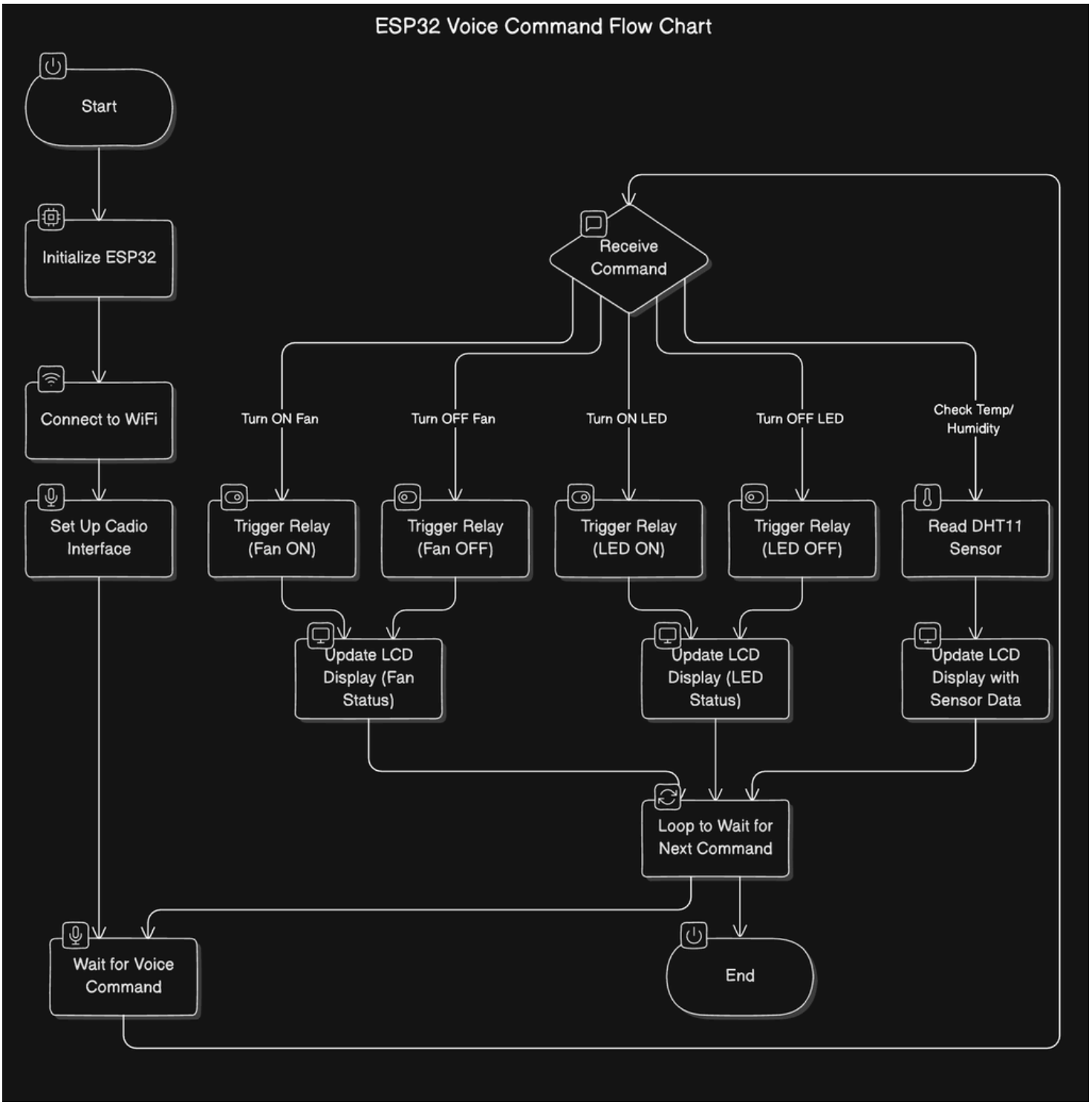
06

Testing and Debugging

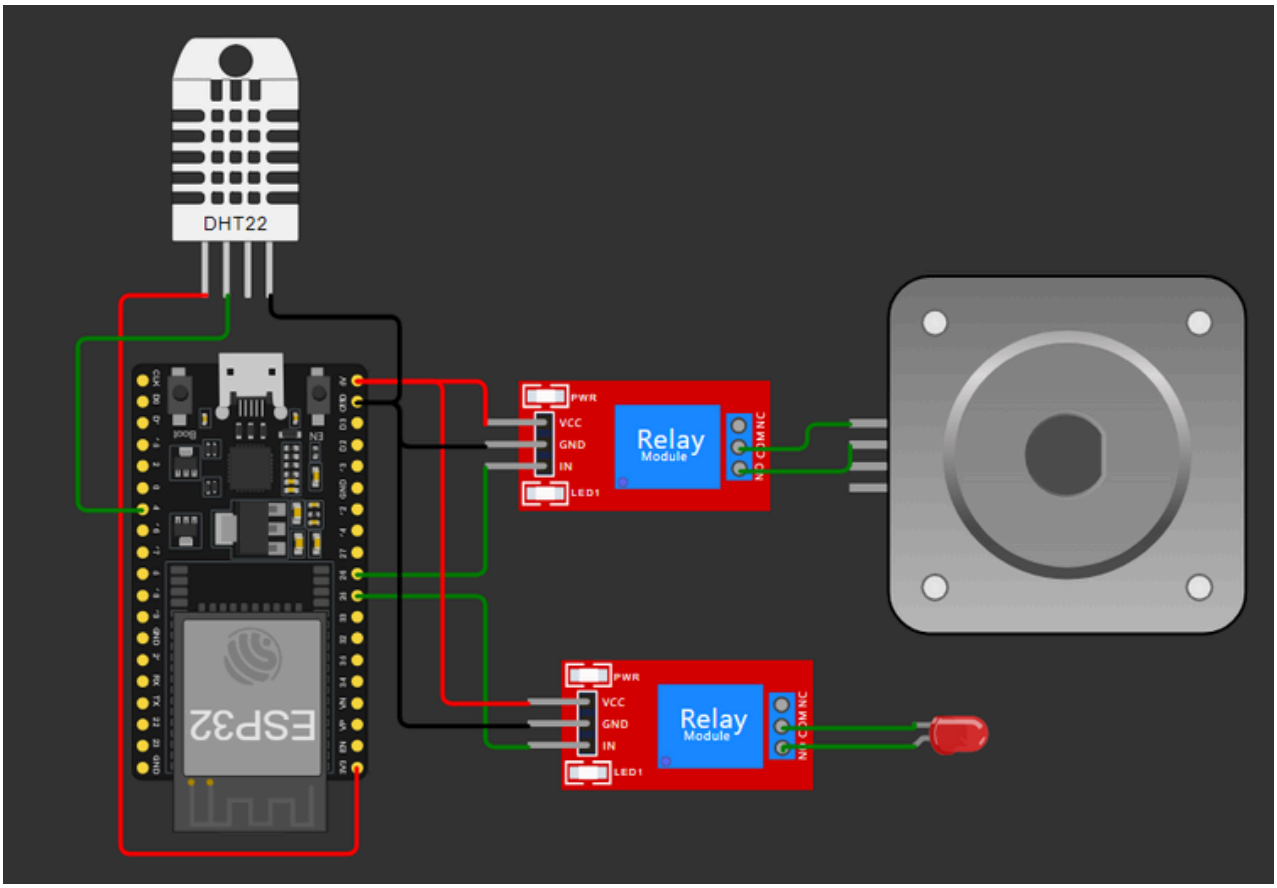
Once all connections were made, the system was tested to ensure correct functionality. Voice commands were issued to test the response time and accuracy of the Sinric platform, while the DHT11 sensor’s readings were monitored to confirm they were displayed correctly on the google home app.



FLOWCHART


ESP32 Voice Command Flow Chart
Start
Initialize ESP32
Connect to WiFi
Set Up Cadio Interface
Wait for Voice Command
Receive Command
Turn ON Fan
Turn OFF Fan
Turn ON LED
Turn OFF LED
Check Temp/ Humidity
Trigger Relay (Fan ON)
Trigger Relay (Fan OFF)
Trigger Relay (LED ON)
Trigger Relay (LED OFF)
Read DHT11 Sensor
Update LCD Display (Fan Status)
Update LCD Display (LED Status)
Update LCD Display with Sensor Data
Loop to Wait for Next Command
End

CIRCUIT DIAGRAM



RESULTS

The developed home automation system successfully met all the predefined objectives. The system allowed the user to:

- Control the Fan and LED: The user could easily turn the fan and LED on or off using voice commands through Sinric.
- Monitor Environmental Conditions: The DHT11 sensor accurately measured the room's temperature and humidity, and the data was displayed on the google home/Sinric pro app in real-time.
- System Responsiveness: The relay module responded to commands with minimal delay, making the system highly responsive.
- Energy Efficiency: By providing real-time environmental data, the user could control the fan based on actual room conditions, optimizing energy usage.

Graphs/Supporting Data

- Temperature and Humidity Trends: Graphical representations of the sensor readings over time can be plotted using the Sinric platform, offering insights into how room conditions change throughout the day.

CONCLUSION & FUTURE SCOPE

CONCLUSION

The home automation system using the ESP32 microcontroller, relay module, DHT11 sensor, and Sinric platform is a highly effective and affordable solution for modern homes. It provides real-time environmental monitoring, voice-controlled appliance operation, and a user-friendly interface, making it a valuable addition to any smart home.

“ Where comfort meets convenience- let your voice do the talking “

FUTURE SCOPE

- **Integration with More Appliances:** The system can be extended to control additional devices such as air conditioning units, heating systems, and lighting.
- **Advanced Automation:** Incorporating machine learning algorithms could enable predictive automation based on user habits and environmental conditions.
- **Remote Monitoring**: Future versions of this project could allow users to monitor and control their home systems remotely via mobile apps, adding convenience and control from anywhere in the world.
- **Energy-Efficient Algorithms**: Implementing energy-saving algorithms could optimize appliance usage based on the real-time temperature and humidity readings, ensuring minimal power consumption.

REFERENCES

01

ESP32 Official Documentation

https://docs.espressif.com/projects/esp-idf/en/latest/esp32/

02

DHT11 Sensor Details

https://www.adafruit.com/product/386

03

Sinric Platform Overview

https://www.Sinric.io/

04

Relay Module Datasheet

https://components101.com/