SMART HOME AUTOMATION USING ARDUINO

Group Number: 4

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Outline

Abstract

Objective:

- To Develop a Smart Home Automation system for remote appliance control via a mobile app, including Smart Climate Control for automatic fan/AC adjustment based on temperature.

Key Technologies Used:

- Arduino microcontroller (central controller)
- ESP32 Wi-Fi module (app communication)
- Relay modules (appliance control)
- DHT11 sensor(temperature,humidity monitoring)

Outcome:

- Functional prototype enabling remote appliance control and energy-efficient climate regulation.

Introduction

What is Smart Home Automation?

- Technology-driven system for remote automatic control of home appliances.
- Enhances comfort, convenience, and energy efficiency using IoT sensors.

Why is it important?

- **Convenience:** Control appliances via mobile app.

- **Energy Efficiency:**Automates devices to reduce power consumption.

- **Smart Climate Control:**Adjusts fan/AC based on room temperature.

Background Information

- **Arduino:**
  Controls appliances based on input from the app and sensors.
- **Wi-Fi Module (ESP32):**
  Enables remote control via the internet.
- **Relay Module:**
  Switches appliances (lights,fans) on/off.
- **DHT11 Sensor:**
  Measures temperature for Smart Climate Control.
- **Mobile App:**
  The app (e.g., Blynk) is used to send ON/OFF commands to Arduino to control appliances remotely.

Proposed System

Overview

Remote appliance control via a mobile app with automated fan/AC operation based on temperature.

Components

1. Arduino ESP32:Controls appliances connects to the app.
2. Relay Modules:Switch appliances ON/OFF.
3. DHT11 Sensor:Monitors temperature for climate control.
4. Mobile App (Blynk):User interface for remote control.

Working

- Users control appliances via the app.
- DHT sensor monitors temperature.
- Fan/AC turns ON automatically if the temperature exceeds the set threshold.
- Relays switch appliances based on user input or automation.

Literature Survey 1

Smart Home Automation: A Literature Review

Authors:

Vaishnavi S. Gunge, Pratibha S. Yalagi (Walchand Institute, Solapur)

Methods:

1. Reviewed home automation technologies: Arduino, Raspberry Pi, ZigBee, Cloud, Bluetooth
2. Evaluated user control methods: Web-based, Mobile-based, SMS-based

Key Findings:

- Wireless automation reduces installation costs
- Scalability and expandability are major advantages

Pros:

- Dual control (Desktop app + Automation)
- Energy-efficient with auto shut-off

Cons:

- Requires desktop for manual control (No mobile app)
- Complex integration of multiple sensors

Literature Survey 2

Intelligent Smart Home Automation and Security System Using Arduino and Wi-Fi

Authors:

J. Chandramohan, R. Nagarajan, K. Satheeshkumar, N. Ajithkumar, P. A. Gopinath, S. Ranjithkumar (Gnanamani College of Technology, Namakkal)

Methods:

1. Wi-Fi-based home automation using Arduino
2. Integrated LDR for automatic lighting control
3. Used LM35 temperature sensor for fan regulation

Key Findings:

- No need for a dedicated server PC
- Smartphone-based real-time monitoring control

Pros:

- Wi-Fi control offers better flexibility

Cons:

- Lacks advanced security measures

Literature Survey 3

Design of a Home Automation System Using Arduino

Authors:

Nathan David, Abafor Chima, Aronu Ugochukwu, Edoga Obinna (University of Nigeria)

Methods:

1. Integrated Bluetooth and Wi-Fi for dual communication
2. Used gas, motion, and temperature sensors for real-time monitoring

Key Findings:

- Bluetooth and Wi-Fi allow dual-mode appliance control
- Motion detection enhances security

Pros:

- Supports both online and offline control

Cons:

- Higher power consumption due to multiple sensors

Literature Survey 4

Arduino-Bases Smart Home Automation System

Authors:

Ma Naing, Ni Ni San Hlaing – Technological University, Myanmar

Methods:

1. Implemented dual-Arduino Nano system for smart home control.
2. integrated LDR, temperature, and smoke sensors for automated control.

Key Findings:

- GSM-based alert system enhances security by sending SMS notifications.
- Hybrid AC/DC power supply allows uninterrupted operation.
- I2C communication protocol reduces wiring complexity.

Pros:

- Improved security with RFID and GSM alerts.

Cons:

- Slight latency in sensor response time.

Literature Survey 5

Smart Home Automation System Based on Arduino

Authors:

Bouzid Mohamed Amine, Chaib Fatima Zohra, Hamani Ilyes, Aid Lahcen, Allaoui Tayeb (Djilali Liabes University, Algeria)

Methods:

1. Developed a C-based desktop application for home automation
2. Integrated DHT11 sensor for climate control

Key Findings:

- Multi-sensor integration enhances security automation
- Desktop interface allows manual control alongside automation

Pros:

- Dual control system (Desktop app + Automation)
- Energy-efficient with auto shut-off for appliances

Cons:

- Requires a desktop for manual control (No mobile app)
- High complexity in integrating multiple sensors

Comparison Table

S.No.	Paper Details	Methodology	Advantages	Disadvantages
1	Title: "Smart Home Automation: A Literature Review" Published in: International Journal of Computer Applications[RTDM 2016] Authors: Vaishnavi S. Gunge, Pratibha S. Yalagi	Arduino, Raspberry Pi, Wi-Fi, ZigBee, Bluetooth, GSM, SMS, Cloud computing,web interfaces	Remote monitoring and control, Energy efficiency, Improved security, Scalable integration of devices	High setup cost, Requires internet, Compatibility issues, Security risks
2	Title: "Intelligent Smart Home Automation and Security System Using Arduino and Wi-Fi" Published in: IJECS, Vol. 6, Issue 3 [March 2017] Authors: J. Chandramohan et al	Arduino, ESP8266, Sensors (LDR, LM35, PIR), Relay Circuits, Android App	Low cost, remote access, energy-efficient, scalable	Needs internet, complex setup, security risks
3	Title: "Design of a Home Automation System Using Arduino" Published in: IJSER, Vol. 6, Issue 6 [June 2015] Authors:Nathan David,Abafor Chima, Aronu Ugochukwu, Edoga Obinna	Arduino Mega 2560, Wi-Fi shield, Bluetooth, and sensors for automation via web and mobile apps.	Low cost, remote access, energy-efficient, secure, scalable	Internet dependency, security risks,compatibility issues

Comparison Table Cont.

S.No.	Paper Details	Methodology	Advantages	Disadvantages
4	Title: "Arduino-Based Smart Home Automation System" Published in: IJTSRD, Vol. 3, Issue 4[May-Jun 2019] Authors: Ma Naing, Ni Ni San Hlaing	Dual Arduino Nano setup with sensors (LDR, temperature, smoke, PIR) and modules (GSM, RFID). C programming used for automation and monitoring	Cost-effective, reliable, hybrid power support, SMS alerts, RFID door security	Dependent on power supply, limited wireless capabilities
5	Title: "Smart Home Automation System Based on Arduino" Published in: IJRA, Vol. 7. No.4[2018] Authors: Bouzid Mohamed Amine et al	Arduino Uno with C desktop app and sensors (DHT11, PIR, LDR, IR)	Affordable, user-friendly, manual/automated control, security features	Wired setup, limited scalability, no wireless or real-time alerts

System Design

Architecture

- Data Sources: DHT11 for temperature and humidity
- Processing Control: Arduino processes data and controls appliances
- Communication: Wi-Fi (ESP32)
- User Access: Mobile app/web interface for remote monitoring

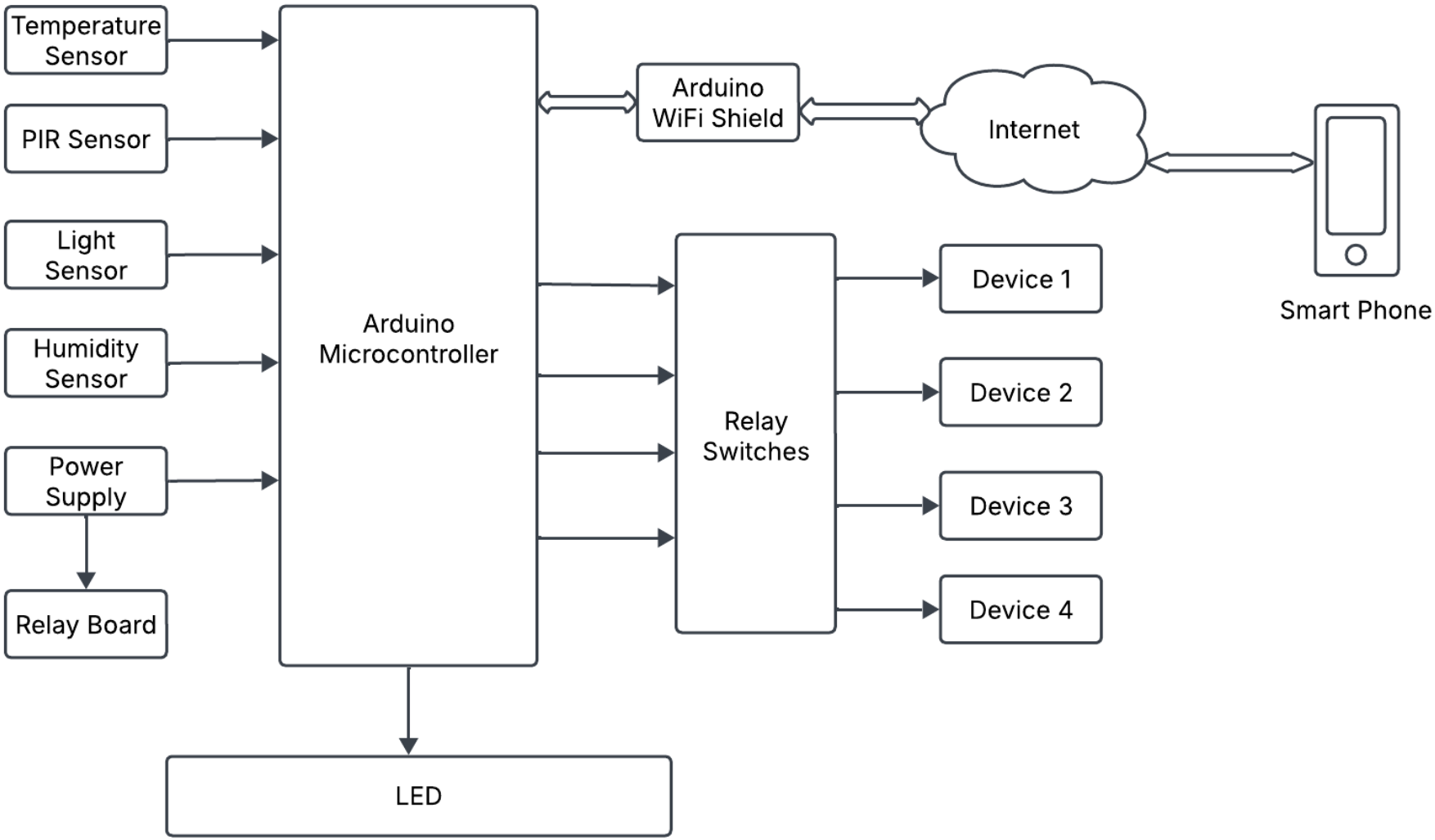
Modules

- Sensor Module: Reads temperature and humidity
- Appliance Control: Automates fans, AC, humidifiers via relays
- Remote Monitoring: Sends data to app for control

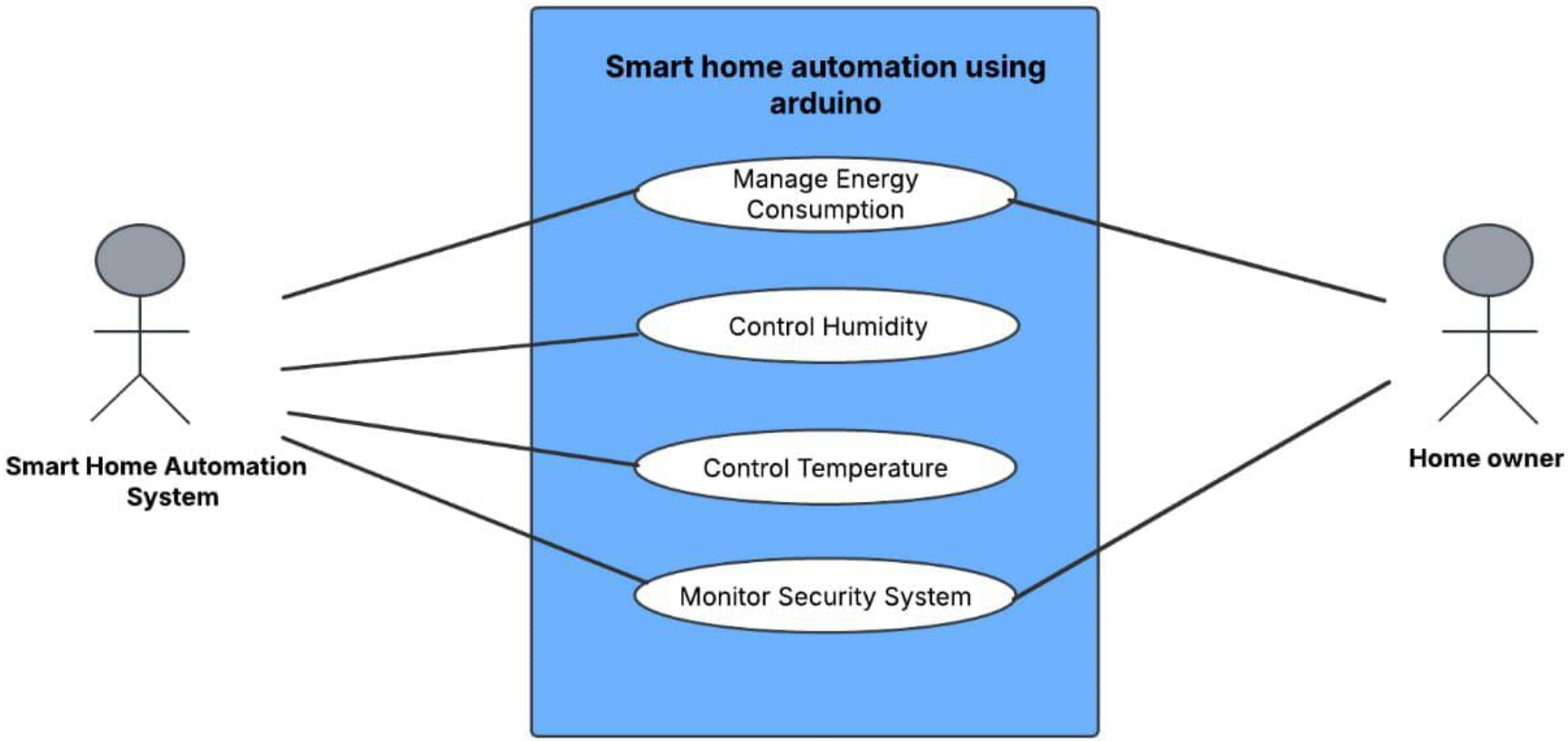
Technology Stack

1. Arduino
2. DHT11
3. ESP32
4. Relays
5. Blynk

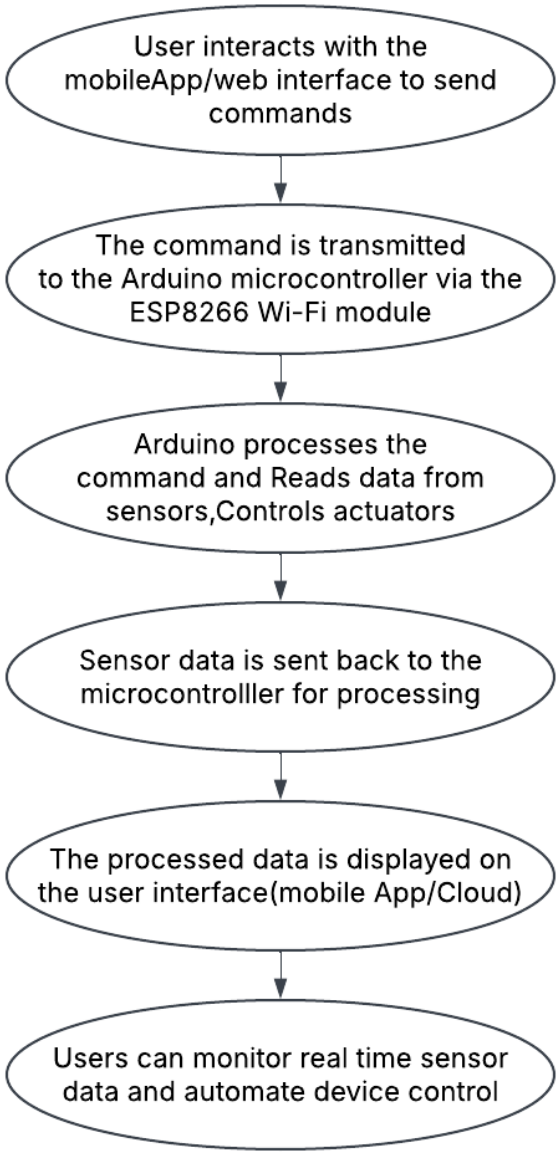
Architectural Design



Usecase Diagram



Dataflow Diagram



Implementation

Hardware Components Used:

1. Arduino Uno – Main microcontroller for processing data
2. DHT11 Sensor – Measures temperature and humidity
3. Relay Module – Controls appliances (lights, fan)
4. ESP32 Wi-Fi Module – Enables IoT connectivity
5. Power Supply – Provides required voltage to components

Software Components Used:

1. Arduino IDE – Used for programming and uploading code
2. Blynk App – Provides remote control via smartphone
3. Embedded C / C++ – Programming language used for automation logic
4. Wi-Fi Communication – Connects Arduino to the Blynk cloud for real-time monitoring

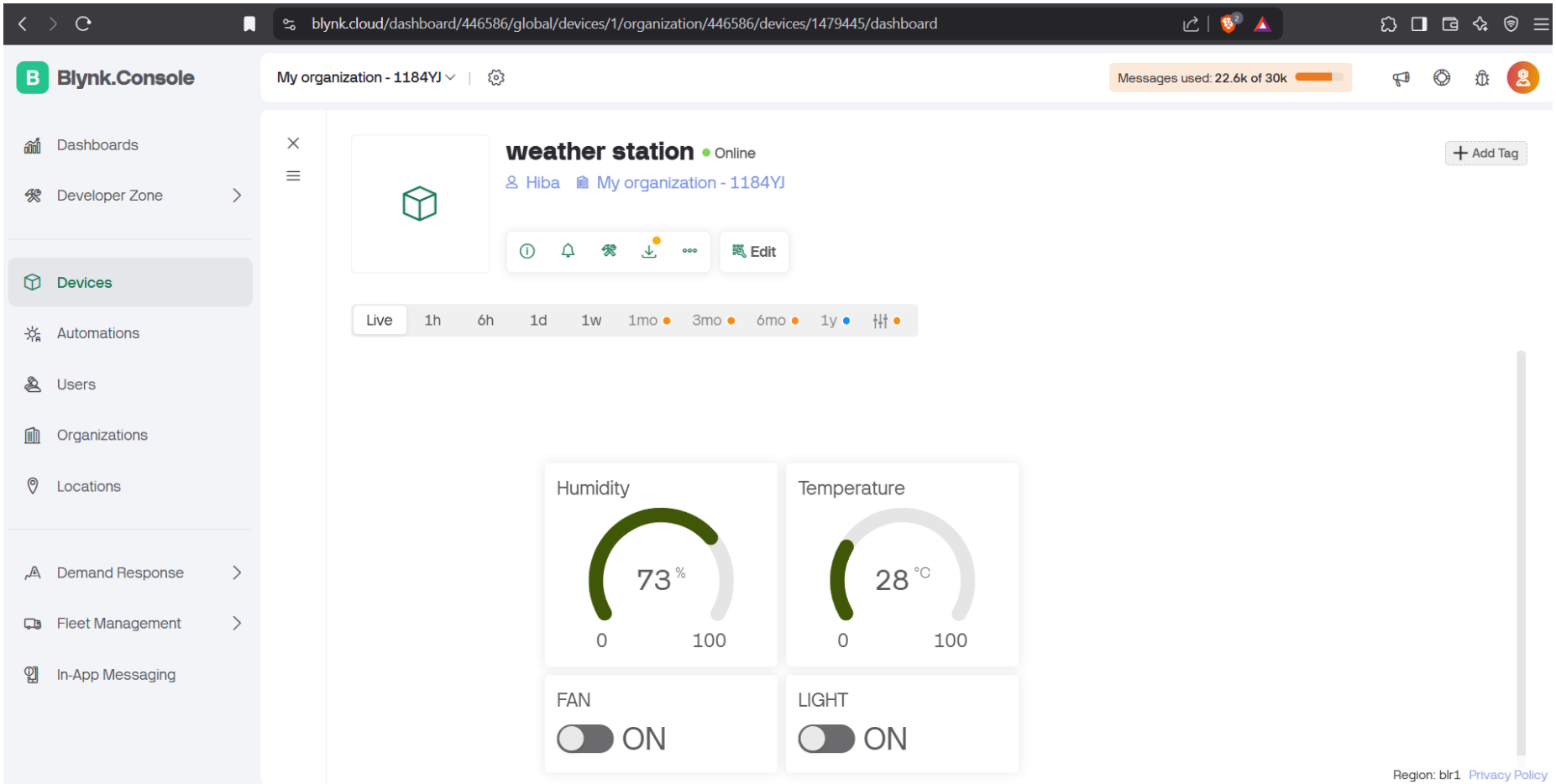
Implementation

Working Flow:

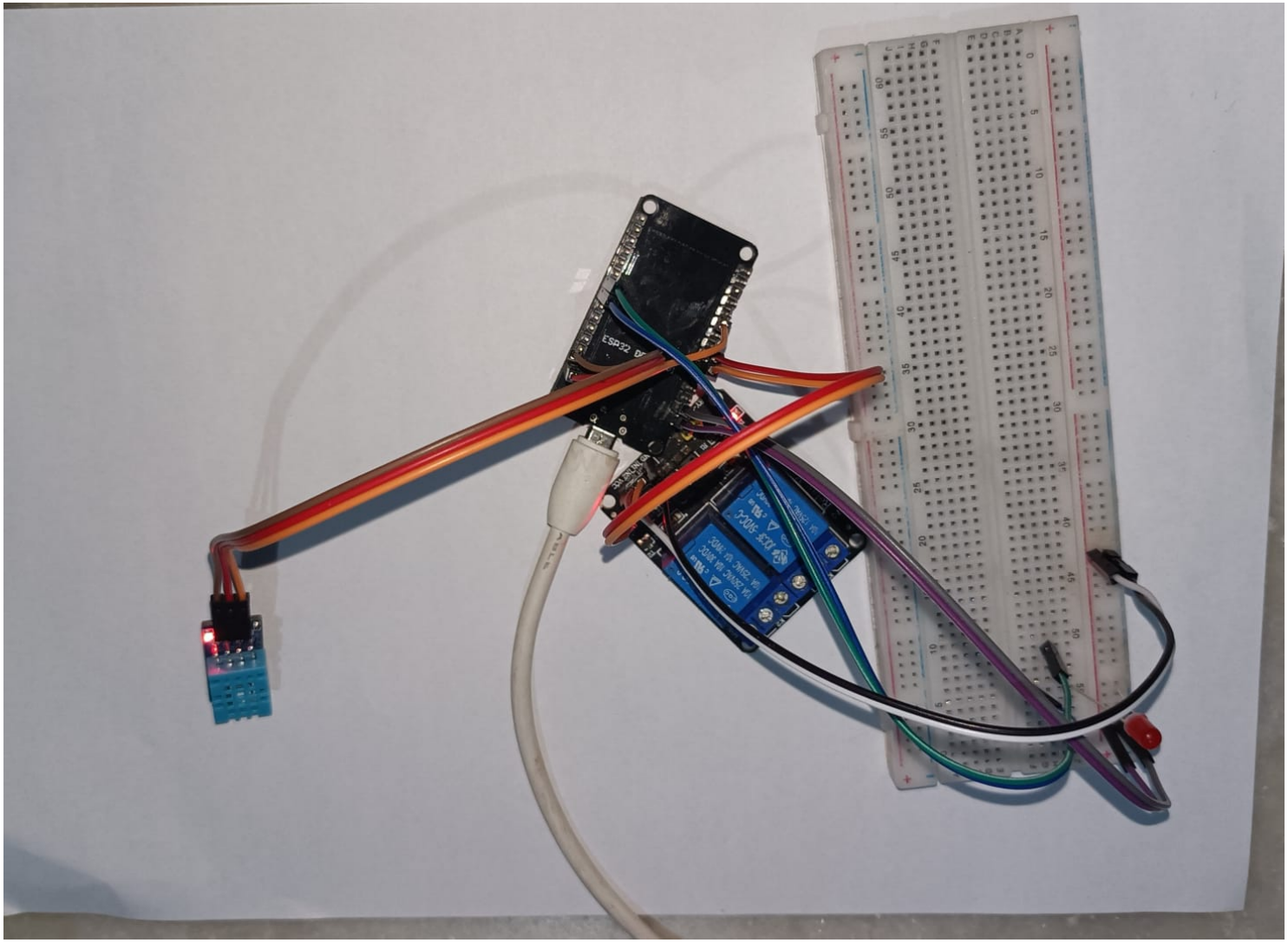
- Sensors collect real-time temperature and humidity data.
- Arduino processes the data and decides the necessary actions.
- If temperature exceeds a threshold, the fan switch adjusts accordingly.
- User can manually control appliances via the Blynk app.
- Relays switch electrical appliances ON/OFF based on automation logic or user commands.
- The system provides remote access automation, enhancing energy efficiency.

Results

BEFORE SENSING

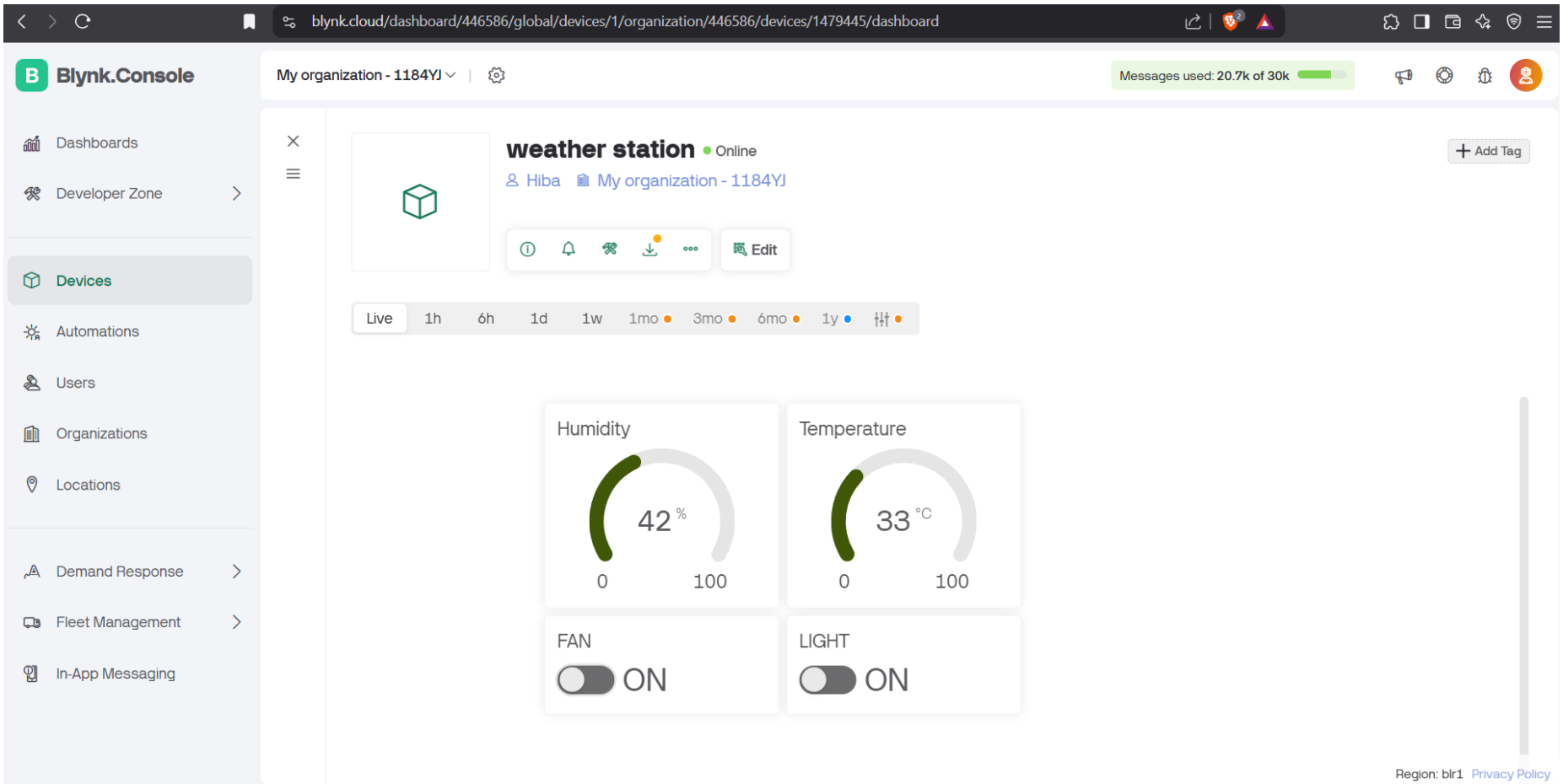


Results

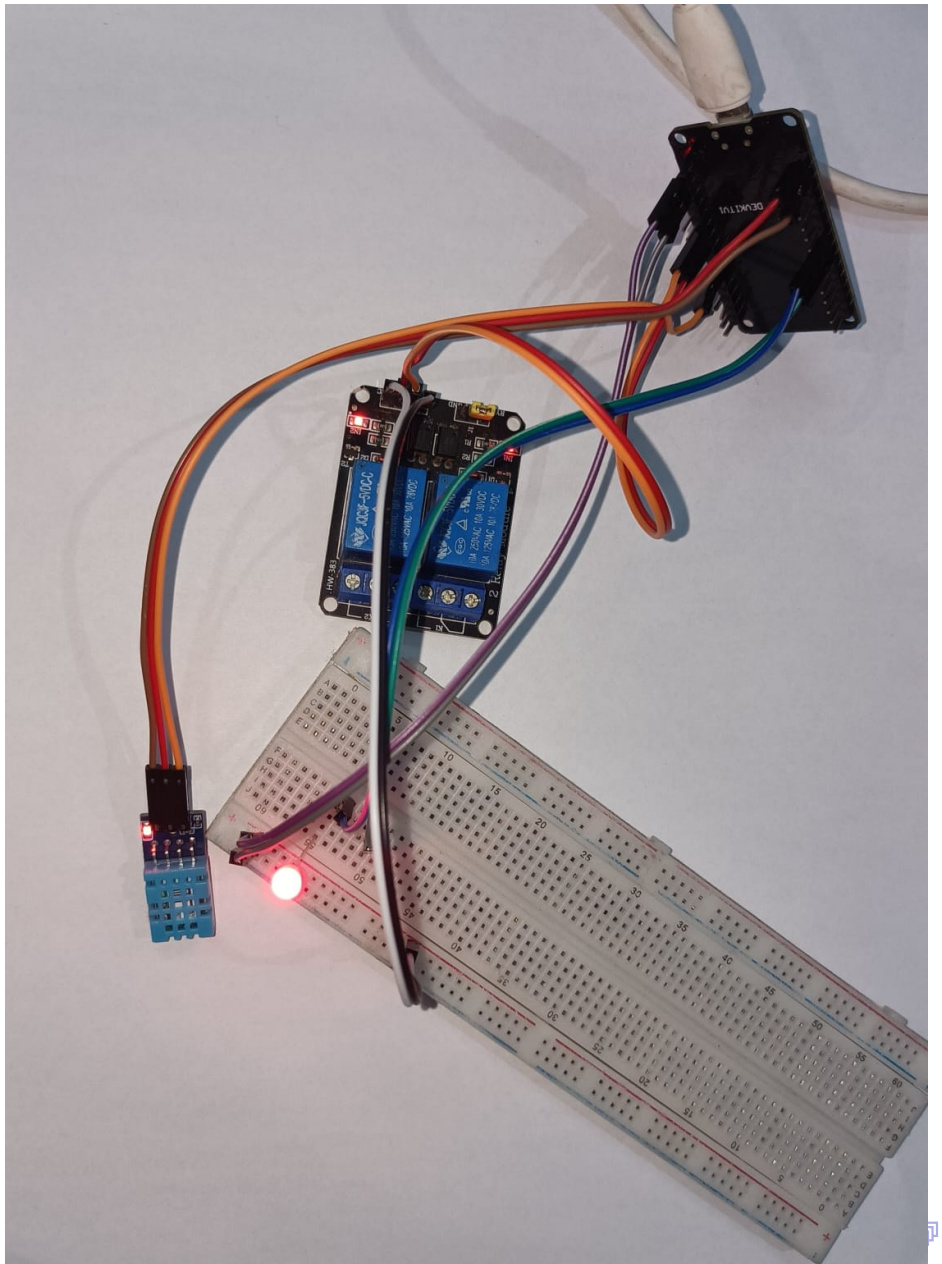


Results

AFTER SENSING



Results



Conclusion and Future Scope

Project Summary:

- Smart Home Automation enables appliance control via a mobile app.
- Smart Climate Control automates fan/AC based on room temperature.

Outcome:

- Enhances comfort and energy efficiency
- Automates climate control, reducing manual effort

Future Scope

- AI Voice Integration – Implement AI assistants like Alexa or Google Assistant for voice control.
- Advanced Security – Add biometric authentication (fingerprint/face recognition) for enhanced security.
- IoT Cloud Connectivity – Store and monitor real-time data on the cloud for remote access.
- Smart Appliance Integration – Connect with smart refrigerators, ACs, and other IoT-enabled devices.

References

References Books:

Exploring Arduino: Tools and Techniques for Engineering Wizardry – Jeremy Blum

Websites:

- Arduino Documentation
- Blynk Documentation

Research Papers:

1. IoT-Based Smart Home Automation Systems Using NodeMCU – John Smith, Jane Doe (IEEE IoT Journal, 2020)
2. Temperature and Motion Sensors for Home Automation – A. Kumar, B. Sharma (Int. Journal of Engineering Research, 2019)
3. Optimizing Energy Usage in Smart Homes through IoT – M. Lee, S. Park (Journal of Smart Systems and Technologies, 2021)