Smart Home Automation with Cloud Integration

SURE Trust industrial automation

The domain of the Project: IOT automation

Team Mentors (and their designation):
Shri Kumar Shubhashis

Team Members:

1. Aromal (Robotics & Automation), Final Year-- Team Leader
2. Jainendra Singh (Mechanical Engineering), 3rd Year-- Member

Period of the project

November 2025 to December 2025

Smart Home Automation with Cloud Integration

Declaration

The project titled **"**Smart Home Automation with Cloud Integration" has been mentored by Shri Kumar Shubhashis, organised by Sure Pro Ed in association with SURE Trust, from June 2024 to November 2024, for the benefit of the educated unemployed rural youth for gaining hands-on experience in working on industry-relevant embedded systems and IoT projects that would take them closer to the prospective employer. I declare that to the best of my knowledge the members of the team mentioned below have worked on it successfully and enhanced their practical knowledge in the domain.

Team Members:

1. Mr. Aromal
2. Mr. Jainendra Singh

Shri Kumar Shubhashis

Prof. Radhakumari
Executive Director & Founder
SURE Trust

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Smart Home Automation with Cloud Integration

Executive Summary

The primary objective of this project is to design and implement a low-cost, scalable smart home automation system with **dual controllability: offline voice control and cloud-based remote access**. The system allows users to control home appliances such as lights, fans, and doors through **voice commands (using android built in voice engine)** and a **cloud dashboard (Adafruit IO)**. Built using **ESP8266 (NodeMCU)**, the system integrates **WebSocket for real-time local control** and **MQTT for cloud synchronization**, ensuring reliable operation even in varying network conditions.

The project successfully demonstrates a **hybrid architecture** that combines offline functionality with online accessibility, making it especially useful for elderly individuals and those with physical limitations. The innovation lies in its **dual-mode operation**, providing both convenience and flexibility. The system enhances energy efficiency, safety, and remote manageability for residential, industrial, and workplace environments.

Smart Home Automation with Cloud Integration

Introduction

Background and Context of the Project:

With the growing adoption of IoT in daily life, there is a rising demand for affordable and reliable smart home solutions. This project addresses that need by developing a system that works both offline (via voice) and online (via cloud), ensuring uninterrupted control and accessibility.

Goals of the Project:

Develop a voice-controlled home automation system and app for controlling it.

- Integrate cloud-based remote control via Adafruit IO.
- Enable real-time synchronization between local and cloud states.
- Create a user-friendly web interface for local network control.
- Ensure system affordability, scalability, and reliability.

Scope and Limitations of the Project:

Scope:

- Voice control for lights, fan, and door using android native voice to text .
- Cloud control via Adafruit IO dashboard.
- Local web control panel hosted on ESP8266.
- Real-time status updates and synchronization.

Limitations:

- Voice module requires specific wake words and command phrases.
- Cloud control depends on Wi-Fi availability.
- System currently supports three devices (expandable).

Innovation Component in the Project:

Offline voice control possible without internet

Smart Home Automation with Cloud Integration

Project Objectives

Project Objectives:

Design and implement a voice-controlled home automation system using MIT app inventer and ESP8266.

Integrate Adafruit IO cloud platform for remote monitoring and control.

Develop a local web-based control panel using HTML, CSS, and JavaScript.

Ensure real-time synchronization between voice, local, and cloud control interfaces.

Make the system energy-efficient, user-friendly, and scalable for future expansion.

Expected Outcomes and Deliverables:

Android app for controlling without touch

Fully functional smart home automation prototype controlling three appliances.

Voice control operational with predefined commands.

Cloud dashboard for remote access and control.

Local web interface with real-time feedback.

Complete documentation and code repository.

Methodology and Results

Methods/Technology Used:

- Microcontroller: **ESP8266 NodeMCU**
- Programming Language: **C++ (Arduino Framework)**
- Voice (offline voice recognition)
- Cloud Platform: **Adafruit IO** (MQTT-based)
- Communication Protocols: **WebSocket** (local), **MQTT** (cloud)
- Web Technologies: **HTML, CSS, JavaScript**
- Database: **Adafruit IO Feed** for cloud logging

Tools/Software Used:

- Arduino IDE
- Adafruit IO Web Dashboard
- VS Code (platform io)
- MIT app inventer

Project Architecture:
The system is built on a **dual-layer architecture**:

1. **Local Layer:**

- VC02 voice module → ESP8266 GPIO pins
- WebSocket server for local web control
- Real-time GPIO control for appliances

2. **Cloud Layer:**

- Adafruit IO MQTT broker
- Web/mobile dashboard for remote access
- Data logging and state synchronization

3. **Synchronization Mechanism:**

- Any change (voice/local/cloud) updates all interfaces in real time.

Hardware Setup:

- **ESP8266 GPIO Pins:**

- D1 → Door Relay
- D2 → Light Relay

- D5 → Fan Relay
- **VC02 Pins:**
- B2 → D4 (Light Control)
- B3 → D6 (Fan Control)
- B7 → D3 (Door Control)

Final Outcome:

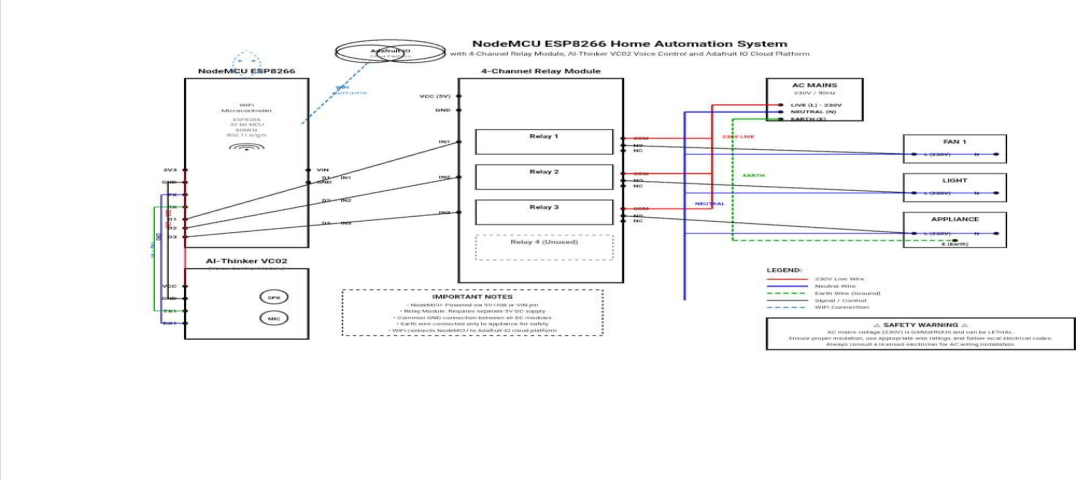
The system successfully controls three home appliances via:

1. **Voice Commands** (e.g., “kiki turn on lights”)
2. **Local Web Interface** (http://ESP_IP)
3. **Adafruit IO Cloud Dashboard**

All modes are synchronized in real time.

GitHub Repository:

Project Architecture




Smart Home Control
WiFi: Connected
Cloud: Connected
WebSocket: Connected
Door Control
ON
OFF
Light Control
ON
OFF
Fan Control
ON
OFF
Last sync: 18:43:35

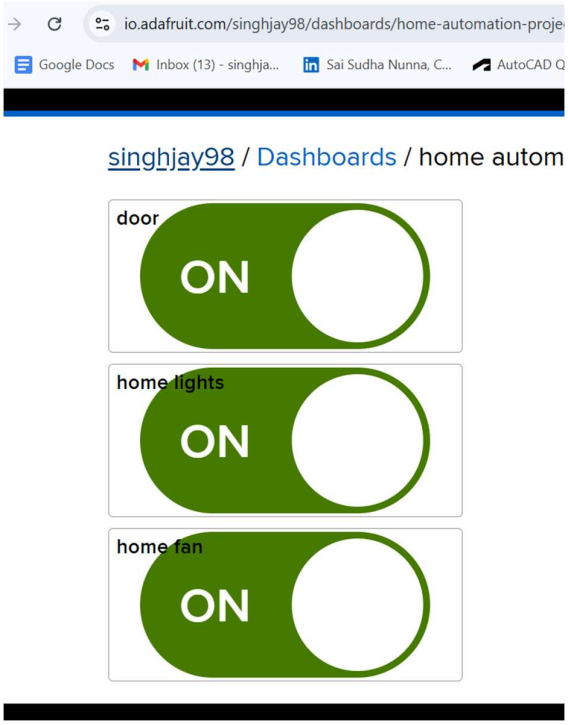
Smart Home Automation with Cloud Integration

Final project working screenshots along with supporting explanation

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS Platfc

```
* Executing task in folder sure trust home automation: C:\U
ts\platformio.exe device monitor
```

```
=== Smart Home Control System ===
Connecting to WiFi: Selfuse
..............
WiFi connected!
IP address: 10.218.171.200
Connecting to Adafruit IO.........
Connected to Adafruit IO!
HTTP server started on port 80
WebSocket server started on port 81
System ready!
[0] Connected from 10.218.171.64
[0] Received: {"type":"control","device":"door","state":0}
Cloud → Door: 0
[0] Received: {"type":"control","device":"light","state":0}
Cloud → Light: 0
[0] Received: {"type":"control","device":"fan","state":0}
Cloud → Fan: 0
[0] Received: {"type":"control","device":"fan","state":1}
Cloud → Fan: 1
[0] Received: {"type":"control","device":"door","state":1}
Cloud → Door: 1
```



- **Aromal** **P:**
  "This project gave me hands-on experience in embedded programming, IoT integration, and hardware-software interfacing. Working with the VC02 module and Adafruit IO enhanced my understanding of offline and online control systems. The internship strengthened my problem-solving and project management skills."

•Jainendra Singh:
"I learned how to integrate cloud services with microcontroller-based systems. The challenge of synchronizing voice, local, and cloud controls taught me the importance of robust system design and debugging. Collaborating on this project improved my teamwork and technical communication skills."

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Conclusion and Future Scope

Conclusion:
The **Smart Home Automation with Cloud Integration** project successfully demonstrates a functional, affordable, and user-friendly IoT system with dual controllability. It highlights the practical application of embedded systems and cloud computing in daily life, aligning with the vision of making technology accessible and beneficial for all.

Future Scope:

1.Integrate more sensors (motion, temperature, gas) for enhanced automation.
2.Develop a mobile app for better user experience.
3.Implement AI-based voice recognition for natural command processing.
4.Add energy monitoring and automated scheduling features.
5.Extend the system to industrial automation and smart farming applications.
6.integrate LLM so we can command it in natural language