

National Textile University Faisalabad



Documentation

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Project Title:

Gesture based light control system

1. Introduction:

With the rapid growth of smart home technologies, gesture-based control systems are gaining attention due to their ease of use, touch-free operation, and accessibility. This project presents a gesture-controlled smart automation system using an ESP32 microcontroller and the APDS-9960 gesture sensor. The system allows users to control household appliances such as lights and fans using simple hand gestures. An OLED display provides real-time feedback, while Blynk Cloud enables remote monitoring and control.

Key Highlights:

- Touch-free appliance control using hand gestures
- Integrated digital recipe assistant for hands-free cooking
- Real-time appliance status display on OLED
- Cloud connectivity using Blynk IoT
- Low-cost and energy-efficient solution
- User-friendly and scalable design

2. Objectives:

- To design a **gesture-based control system** for home appliances
- To eliminate physical switches using **contactless interaction**
- To provide a hands-free interface for reading recipes while cooking
- To display real-time appliance status on an **OLED screen**
- To enable **remote monitoring** using cloud services
- To provide a simple and efficient smart home prototype

3. Project Overview

The system uses the APDS-9960 gesture sensor to detect hand movements. Each gesture is mapped to a specific action:

1. Up Gesture → Light ON/OFF
 2. Down Gesture → Fan ON/OFF
 3. Left Gesture → Cycle between different recipes (e.g., Omelette, Tea
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4. Right Gesture → Advance to the next cooking step

The ESP32 processes the gesture data and controls the appliances via relay modules. Appliance status is shown on an OLED display. The Blynk IoT platform allows users to monitor and control appliances remotely using a mobile application

Common features:

- Gesture-based appliance control
- Real-time OLED status updates
- Cloud-based monitoring
- Wireless connectivity via Wi-Fi
- Expandable architecture for future device

4. Technologies Used

Hardware Components

- ESP32 Development Board
- APDS-9960 Gesture Sensor
- OLED Display (SSD1306)
- Relay Module
- Light and Fan (Load)

- Buzzer (for acoustic feedback)

Software Technologies

- Arduino Framework
- Blynk IoT Cloud
- I²C Communication Protocol 5

5. Pin configuration:

| Component | ESP32 Pin | I/O Type | Connection / Role |
|-------------|-----------|-------------|-----------------------------|
| LED | GPIO 2 | Output | Status Light |
| Buzzer | GPIO 19 | Output | Audio feedback for gestures |
| Fan (Relay) | GPIO 25 | Output | Active LOW (Low = ON) |
| OLED SDA | GPIO 32 | I2C (Bus 0) | Data line for display |
| OLED SCL | GPIO 33 | I2C (Bus 0) | Clock line for display |
| Sensor SDA | GPIO | I2C | Data line for |

| Component | ESP32 Pin | I/O Type | Connection / Role |
|------------------|------------------|-----------------|--------------------------|
| | 21 | (Bus 1) | APDS9960 |
| Sensor SCL | GPIO 22 | I2C (Bus 1) | Clock line for APDS9960 |

6. Development Tools

- PlatformIO (VS Code Extension)
- Arduino Framework for ESP32
- Blynk IoT Mobile Application
- Serial Monitor for Debugging

Conclusion

This project successfully demonstrates a gesture-controlled smart home system that enhances user convenience and accessibility. By integrating ESP32, APDS-9960, OLED display, and Blynk cloud, the system provides both local and remote control of appliances alongside a digital kitchen assistant. The solution is cost-effective, scalable, and suitable for modern smart home applications...