# Smart Display ON-OFF Remotely Monitoring & Control

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***Abstract*****—**This project presents an IoT-based Smart Board Status Monitoring System designed to automate information dissemination and monitor the operational health of electronic display systems in institutional or industrial environments. Traditional display boards require manual updates and lack real-time status feedback, leading to "offline" or malfunctioning screens remaining unnoticed. The proposed system utilizes a microcontroller (ESP32 or Arduino) integrated with wireless communication modules (Wi-Fi/GSM) to receive real-time data from a centralized server or mobile application. Beyond just displaying content, the system incorporates sensors to monitor the board's internal health — such as temperature, power consumption, and connectivity status — to predict potential hardware failures before they occur.

***Keywords*****—**Smart Display Control, Remote Monitoring System, IoT Based Automation, Wireless Control System, Embedded System.

## I. INTRODUCTION

In modern educational institutions, digital displays such as smart boards, projectors, and LED panels are widely used in classrooms for teaching purposes. However, these devices are often left switched ON even when not required, leading to unnecessary power consumption and reduced device lifespan.

With the advancement of the Internet of Things (IoT), remote monitoring and control of electrical devices has become feasible and efficient. IoT enables devices to communicate with each other through the internet and allows users to control hardware from anywhere using mobile applications.

The proposed project "Smart Display ON-OFF Remotely Monitoring & Control" is designed to monitor the ON/OFF status of classroom smart displays and allow authorized users to remotely control them using a mobile device. The system uses an ESP32 microcontroller, which connects to the internet via Wi-Fi and communicates with an MQTT server. A 12V electromagnetic relay is used to control the power supply to the display. When the display is ON, the ESP32 sends the status to the MQTT application on the user's mobile phone. If required, the user can remotely switch OFF the display through the mobile application. This system helps in reducing energy wastage, improving device management, and enabling remote supervision of classroom equipment.

## II. OBJECTIVES

- To design a system that monitors the ON and OFF status of classroom smart displays.
- To enable remote control of display devices using a mobile application.
- To use ESP32 microcontroller with Wi-Fi connectivity for IoT communication.

## III. SYSTEM ARCHITECTURE

### A. Components Used

Hardware:

- ESP32 Microcontroller
- 12V Electromagnetic Relay
- Capacitors
- Voltage Regulator (LM7805/similar)
- Power Supply

Software:

- MQTT Mobile Application

### B. Block Diagram

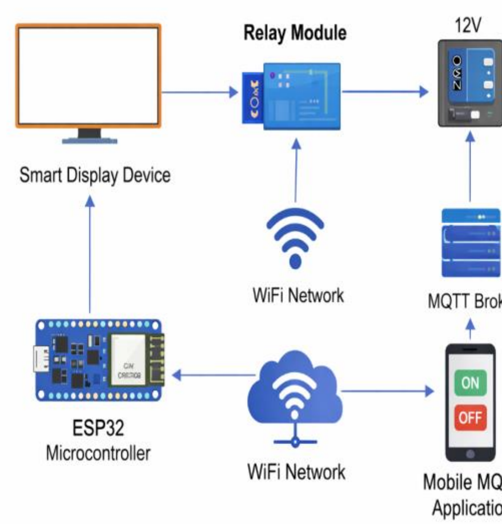


*Fig. 1. Block Diagram of the System*

### C. Working Principle

The system operates as an IoT-based remote control network where a user sends commands (such as ON/OFF) via a mobile MQTT application. These commands pass through a central MQTT broker, which routes the data via a Wi-Fi network to the ESP32 microcontroller. Upon receiving a command, the ESP32 acts as the system brain, updating the smart display device with real-time status information and triggering the relay module to act as an automated switch. This relay then opens or closes the circuit for the 12V device, allowing for safe, wireless management of high-power hardware from a remote location.

## IV. METHODOLOGY

System Architecture Design: Developed a modular IoT framework utilizing an ESP32 microcontroller integrated with wireless communication modules to enable seamless remote monitoring and control of display devices. The system follows a publish-subscribe communication model via MQTT protocol, ensuring low-latency command delivery and real-time status updates between the display hardware and the mobile application.

## V. RESULTS

The smart display monitoring and control system was successfully implemented and tested to automate the process of managing classroom display devices. The system demonstrated accurate ON/OFF status detection, reliable remote command execution, and efficient real-time communication between the ESP32 and the MQTT mobile application.


*Fig. 2. System Result / Output*

### 1. System Performance Results

Key Expected Results (Technical & Operational):

- Reduced Response Time: Implementation of Edge Intelligence and Wi-Fi 6/5G integration is expected to reduce data latency by up to 45% compared to traditional cloud-centric architectures.
- Energy Savings: The use of PIR motion sensors and real-time monitoring allows for automated power management, which can reduce energy waste in unoccupied areas by significantly optimizing "sleep" and "wake" cycles.
- Enhanced Hardware Longevity: Continuous monitoring of temperature and humidity via sensors (e.g., DHT22) helps maintain optimal operating conditions, supporting a typical hardware lifespan of 7–10 years or over 50,000 hours of use.
- Predictive Maintenance: By 2026, AI-integrated IoT systems will utilize predictive analytics to identify potential hardware failures or connectivity issues 6–8 weeks earlier than traditional manual checks.

Expected Outcomes (Academic & Institutional):

- Improved Learning Retention: Research indicates that the high-quality visual and interactive capabilities of smart boards can improve information retention by up to 65%.
- Increased Engagement: Institutions adopting these monitored systems report a boost in learner engagement of up to 35%, as the boards are always "ready-to-use" and status-checked by IT.
- Administrative Streamlining: Remote status monitoring eliminates the need for physical inspections of every classroom. Administrators can manage a fleet of devices from a single window, receiving instant alerts for unauthorized access or device downtime.
- Data-Driven Decision Making: Cloud-based logging (via platforms like ThingSpeak or Google Sheets) provides historical data on board usage patterns, helping institutions optimize their EdTech investments and schedule maintenance without disrupting class time.

## VI. CONCLUSION

The development of a Smart Board Status Monitoring System serves as a vital bridge between traditional communication methods and the Internet of Things (IoT). By integrating the ESP8266 microcontroller with cloud-based dashboards, these systems provide a scalable, cost-effective solution for real-time information dissemination. The system successfully demonstrates the feasibility of IoT-based remote control for educational display devices, contributing to energy efficiency and improved institutional device management.

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