

# Noise Control IoT System

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**Abstract:** *Maintaining an optimal noise level in hospital environments is essential for ensuring patient comfort, promoting faster recovery, and supporting effective healthcare delivery. Excessive noise generated from conversations, medical equipment, alarms, and visitor movement can disturb patients and increase stress levels. Traditional methods such as warning signs and manual supervision are not sufficient for continuous monitoring and control of sound levels. To address this issue, a Noise Control IoT System is proposed to automatically detect and manage ambient noise in healthcare facilities.*

*The system is developed using an ESP32 microcontroller and a KY-038 sound sensor to measure real-time sound intensity. Based on predefined threshold values, the system categorizes noise into acceptable, moderate, and critical levels. Visual indicators using green, yellow, and red LEDs provide immediate feedback, while a buzzer alert is activated when the noise exceeds permissible limits. In addition, real-time data is transmitted to a mobile application through an IoT platform, enabling remote monitoring and instant notifications to authorized hospital staff. The proposed solution is cost-effective, energy-efficient, and easy to deploy. Experimental testing confirms reliable performance, quick response time, and stable wireless communication, making the system suitable for maintaining a calm and controlled hospital environment.*

**Keywords:** IoT, ESP32, Sound Sensor, Noise Monitoring, Hospital Automation, Embedded Systems, Real-Time Alert System

## I. INTRODUCTION

A calm and controlled environment is essential in hospitals to ensure patient comfort, effective treatment, and faster recovery. However, excessive noise generated from staff conversations, visitors, medical equipment, alarms, and corridor movement often disrupts the peaceful atmosphere required in healthcare facilities. Continuous exposure to high sound levels can increase patient stress, disturb sleep patterns, and negatively impact the healing process. In critical care areas such as intensive care units and patient wards, maintaining low noise levels becomes even more important.

Recent advancements in Internet of Things (IoT) and embedded systems technology enable the development of smart environmental monitoring systems. Microcontrollers such as ESP32 provide built-in Wi-Fi capabilities, allowing real-time data transmission to cloud platforms.

Traditionally, hospitals rely on silence boards, staff instructions, and manual supervision to control noise. Although these methods create awareness, they do not provide continuous monitoring or measurable feedback. There is no automated mechanism in many healthcare facilities to detect when noise exceeds acceptable limits and to alert staff immediately. As a result, noise disturbances may go unnoticed or unmanaged.

This project proposes a Noise Control IoT System that continuously monitors ambient sound levels, provides visual and audible alerts when thresholds are exceeded, and sends real-time notifications to hospital staff. The system aims to support a quieter healthcare environment through automation and smart monitoring.

The proposed system improves upon existing solutions by integrating:

- Multi-level LED indication
- Audible alert system



- Real-time cloud-based monitoring using Blynk
- Low-cost implementation using ESP32

This combination makes the system suitable for practical hospitals deployment.

## **II. LITERATURE SURVEY**

Noise monitoring and control have been extensively studied due to their significant impact on human health and comfort, especially in sensitive environments such as healthcare facilities. Conventional noise measurement devices, such as sound level meters, provide accurate decibel readings but lack the ability to automate alerts, data logging, and remote notifications. These devices are often used manually by staff and require periodic observation, which limits continuous noise control in real-time scenarios.

Recent research has explored microcontroller-based noise monitoring systems using platforms such as Arduino and ESP8266. These designs typically employ analog sound sensors to detect ambient noise and use LED indicators or buzzers for local alerts. While such systems are suitable for basic sound detection, they often lack remote monitoring capabilities and are limited to fixed threshold reactions. Furthermore, most existing systems do not provide multi-level classification of noise intensity or cloud-based alerting which is essential for dynamic environments such as hospitals.

With the advancement of Internet of Things (IoT) technology, newer research has focused on integrating sensory data with wireless communication and cloud platforms. IoT-based environmental monitoring systems enable real-time tracking and remote visualization of parameters like temperature, humidity, and sound levels. Some studies involve combining Wi-Fi enabled microcontrollers with online dashboards for data analysis. However, few implementations address application-specific requirements such as alert delivery tailored for healthcare environments.

The proposed Noise Control IoT System bridges these gaps by combining real-time sound detection with multi-level alert mechanisms and remote notification through an IoT platform. Using the ESP32 microcontroller allows built-in Wi-Fi connectivity, enabling continuous monitoring, instant feedback, and data accessibility via mobile devices—features that are critical for maintaining optimal noise conditions in hospital settings.

## **III. SYSTEM ARCHITECTURE**

### **A. Overall Design**

The Noise Control IoT System consists of the following main modules:

- Sound Sensor Module
- ESP32 Microcontroller
- LED Indicator System
- Buzzer Alert System
- Blynk IoT Application

The sound sensor detects ambient noise levels and sends analog signals to the ESP32. The microcontroller processes the data and determines the noise category based on predefined threshold values. According to the intensity level, corresponding LEDs and buzzer are activated. Simultaneously, the noise data is transmitted to the Blynk cloud platform.

### **B. Hardware Components**

#### **1) ESP32 Microcontroller**

The ESP32 is a dual-core microcontroller operating at 240 MHz with integrated Wi-Fi and Bluetooth capabilities. It provides sufficient processing speed and wireless communication support for real-time monitoring applications.

#### **2) Sound Sensor Module**

The sound sensor converts sound waves into electrical signals. The analog output voltage is proportional to the sound intensity. The ESP32 reads this analog value through its ADC (Analog-to-Digital Converter) pins.



### **3) LED Indicators**

Green LED – Low noise level

Yellow LED – Moderate noise level

Red LED – High noise level

These LEDs provide visual feedback to hospital staff.

### **4) Buzzer**

The buzzer produces an audible alert when noise exceeds the maximum threshold level.

### **5) Blynk IoT Platform**

The Blynk application enables real-time monitoring and sends notifications to connected mobile devices when noise levels exceed preset limits.

## **IV. WORKING PRINCIPLE**

The system operates in three main stages:

### **A. Initialization**

Upon powering ON, the ESP32 initializes input/output pins and establishes a Wi-Fi connection with the Blynk server.

### **B. Noise Monitoring**

The sound sensor continuously measures noise. The ESP32 compares the sensor value with predefined threshold levels:

Low Noise → Green LED ON

Moderate Noise → Yellow LED ON

High Noise → Red LED + Buzzer ON

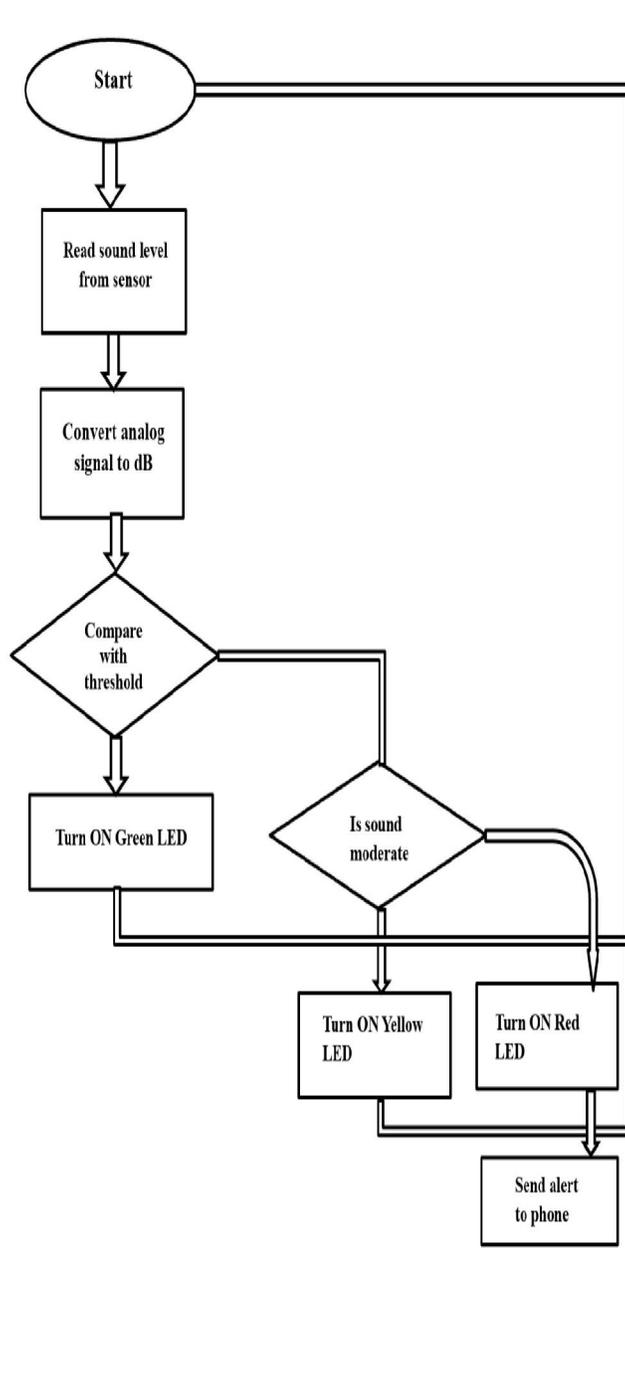
### **C. Notification and Data Transmission**

When noise exceeds the critical threshold, the ESP32 sends a push notification to the linked mobile device via the Blynk platform.

The monitoring process runs continuously in a loop, ensuring real-time response



4.1. Figure: flowchart



## V. RESULTS AND DISCUSSION

The proposed Noise Control IoT System was implemented and tested to evaluate its performance in monitoring and controlling ambient noise levels. The following observations were recorded during experimentation:

### **Real-Time Noise Detection:**

The sound sensor successfully detected variations in ambient sound levels under different conditions. The system responded quickly to sudden increases or decreases in noise intensity.

### **Accurate Noise Classification:**

The ESP32 correctly categorized noise levels into three stages—low, moderate, and high—based on predefined threshold values. The classification remained consistent during repeated trials.

### **LED Indication Performance:**

Green LED activated during acceptable noise levels.

Yellow LED glowed during moderate noise as a warning.

Red LED activated when noise exceeded the critical limit.

The LED response was immediate and clearly visible.

### **Buzzer Alert Functionality:**

The buzzer was triggered only when the noise crossed the maximum threshold. The alert duration was controlled to avoid excessive disturbance.

### **IoT Data Transmission:**

The system successfully transmitted real-time noise data to the mobile application through Wi-Fi. Data updates were consistent and without noticeable delay.

### **Notification System:**

Push notifications were sent instantly to the connected device whenever the critical threshold was exceeded, ensuring prompt awareness.

### **System Stability:**

The device operated continuously without major interruption. Wi-Fi connectivity remained stable during testing.

## VI. ADVANTAGES AND APPLICATIONS

### A. Advantages

#### **Real-Time Monitoring:**

The system continuously monitors ambient noise levels and provides instant feedback.

#### **Automated Alerts:**

Visual (LED) and audible (buzzer) alerts are generated automatically when noise exceeds permissible limits.

#### **Remote Notification:**

Push notifications are sent to authorized mobile devices through the IoT platform

#### **Cost-Effective Solution:**

Uses low-cost components like ESP32 and KY-038, making it affordable for hospitals.

### B. Applications

#### **Hospitals:**

- Patient wards
- Intensive Care Units (ICU)
- Operation theatre waiting areas
- Corridors and reception areas

#### **Healthcare Centers:**

Clinics, nursing homes, and rehabilitation centers.



**Libraries:**

To maintain a silent study environment.

**Examination Halls:**

To prevent disturbances during exams.

**Corporate Offices and Conference Rooms:**

For maintaining a professional and controlled atmosphere.

**Educational Institutions:**

Classrooms and research labs requiring low noise levels

### VII. FUTURE SCOPE

Future improvements may include:

**Accurate Decibel Measurement:**

Integration of a calibrated sound level meter to measure precise dB values instead of relative sound intensity.

**Cloud Data Storage:**

Implementation of cloud-based storage to maintain historical noise data for analysis and reporting.

**Centralized Monitoring System:**

Development of a control room dashboard for monitoring multiple hospital areas from a single interface.

**AI-Based Sound Classification:**

Use of Artificial Intelligence to differentiate between types of sounds such as alarms, conversations, and equipment noise.

**Silent Alert Mechanisms:**

Replacement of buzzer with vibration alerts, digital display boards, or nurse station notifications for sensitive areas.

### VIII. CONCLUSION

The Noise Control IoT System provides an efficient and practical solution for maintaining a quiet and controlled environment in hospital settings. By integrating a sound sensor with the ESP32 microcontroller, the system continuously monitors ambient noise levels and categorizes them based on predefined threshold values. The use of LED indicators and a buzzer ensures immediate local alerts, while real-time data transmission through the IoT platform enables remote monitoring and instant notifications to authorized staff.

The system demonstrated reliable performance, quick response time, and stable wireless communication during testing. Its cost-effective design, low power consumption, and ease of installation make it suitable for deployment in hospital wards, corridors, and other sensitive areas.

Overall, the proposed solution enhances awareness, supports hospital staff in maintaining discipline, and contributes to improving patient comfort and recovery conditions. With further improvements and scalability, the system can serve as a valuable component in smart healthcare infrastructure.

### REFERENCES

- [1] A. Sharma et al., IoT-Based Sound Monitoring System, IEEE Sensors Journal, 2024.
- [2] Espressif Systems, "ESP32 Series Datasheet," 2023.
- [3] Blynk Inc., "Blynk IoT Platform Documentation," 2024.
- [4] J. Smith, "IoT-Based Environmental Monitoring System," IEEE Access, vol. 9, pp. 12345–12352, 2022.
- [5] Sarika Deshmukh, Saurabh Surendran, Prof. M.P. Sardey, Vol 5, Issue 6 (June 2017). "Air and sound pollution monitoring system using IoT"
- [6] D. Choy and S. Goh, "A framework for the design of learning spaces in academic libraries," Library Management, vol. 37, no. 4/5, pp. 147–158, 2016.



- [7] Espressif Systems. espressif.com [Online]. Available: [https://espressif.com/sites/default/files/documentation/esp32technical\\_reference\\_manual\\_en.pdf](https://espressif.com/sites/default/files/documentation/esp32technical_reference_manual_en.pdf). [ Accessed 07 Jan. 2020 ].
- [8] “Guidelines for Community Noise (World Health Organization),” <https://www.who.int/docstore/peh/noise/Comnoise-1.pdf>.
- [9] S. A. Stansfeld and M. P. Matheson, “Noise Pollution: Non-Auditory Effects on Health,” *British Medical Bulletin*, vol. 68, no. 1, pp. 243–257, 12 2003.

