

# IOT BASED BOILER TEMPERATURE AND PRESSURE MONITORING SYSTEM

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**Abstract:** Boilers are widely used in industries such as The proposed system integrates temperature and pressure sensors with a microcontroller unit connected to the internet. Sensor data is continuously collected and transmitted to a cloud platform such as ThingSpeak for storage, visualization, and analysis. Users can monitor boiler parameters remotely through a web or mobile interface, enabling early detection of faults and abnormal variations. The system also supports alert notifications when the parameters exceed predefined safety thresholds.

power plants, food processing, and manufacturing, where maintaining safe temperature and pressure levels is critical for efficient operation and accident prevention. Traditional boiler monitoring methods often rely on manual inspection, which can lead to delays in detecting abnormal conditions. This paper presents an Internet of Things (IoT) based boiler temperature and pressure monitoring system designed to provide real-time data monitoring, remote access, and improved safety.

Traditional boiler monitoring relied on manual checks and analog gauges, which were prone to delays and errors. Modern IoT-based systems overcome these limitations by enabling continuous tracking, remote access, and instant alerts. This project builds on these advancements, combining proven components into a compact, cost-effective solution for smart boiler monitoring.

## I. INTRODUCTION

Boilers are widely used in industries and households, where maintaining safe temperature and pressure levels is crucial for efficient and reliable operation. Conventional monitoring methods often depend on manual checks and analog instruments, which can be slow, inaccurate, and lack remote accessibility. These limitations increase the risk of unsafe conditions, equipment damage, and energy loss.

With the rise of the Internet of Things (IoT), smart monitoring systems have become a practical solution to overcome these challenges. This project introduces an IoT-based boiler monitoring system using ESP32, DHT22 sensor, OLED display, buzzer, and potentiometer. The ESP32 provides Wi-Fi connectivity for real-time data transmission, while the OLED display shows local readings, and the buzzer alerts users to unsafe conditions. The potentiometer allows easy calibration of thresholds. Together, these components create a cost-effective, reliable, and connected system that enhances safety and efficiency in boiler operations.

## II. LITERATURE SURVEY

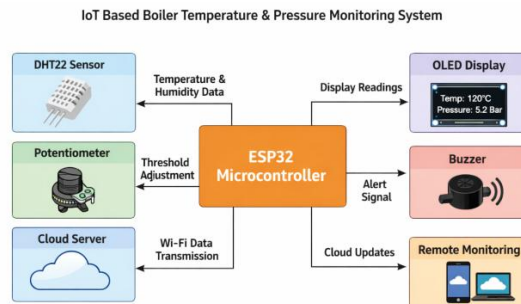
Recent studies show that IoT technology is increasingly applied in industrial monitoring to improve safety and efficiency. Microcontrollers like the ESP32 are popular due to their built-in Wi-Fi and low cost, making them ideal for real-time data transmission. Sensors such as the DHT22 are widely used for accurate temperature and humidity measurement, while OLED displays provide clear local visualization. Buzzers and potentiometers are simple yet effective components for alerts and calibration.

Traditional boiler monitoring relied on manual checks and analog gauges, which were prone to delays and errors. Modern IoT-based systems overcome these limitations by enabling continuous tracking, remote access, and instant alerts. This project builds on these advancements, combining proven components into a compact, cost-effective solution for smart boiler monitoring.

**III. PROBLEM STATEMENT**

Boiler systems are critical in industrial and domestic applications, where maintaining safe temperature and pressure levels is essential. Traditional monitoring methods depend on manual checks and analog instruments, which are often inaccurate, slow to respond, and lack remote accessibility. These limitations increase the chances of unsafe operating conditions, equipment damage, and energy inefficiency. To address these issues, there is a need for a smart IoT-based monitoring system that can provide real-time data, instant alerts, and remote access. The proposed system, using ESP32, DHT22, OLED display, buzzer, and potentiometer, offers a cost-effective and reliable solution for enhancing safety, efficiency, and ease of operation in boiler monitoring.

**IV. BLOCK DIAGRAM**



**V. CIRCUIT DIAGRAM**

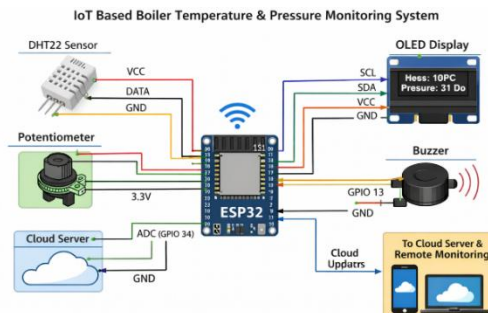


FIG2: CIRCUIT DIAGRAM

**VI. FLOW CHART**

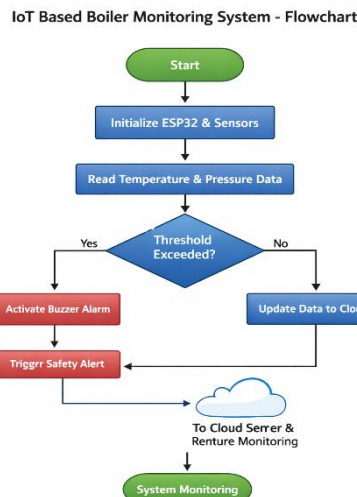


FIG3: FLOW CHART

**VII. SYSTEM ARCHITECTURE OVERVIEW**

The architecture of the IoT-based boiler monitoring system is built around the ESP32 microcontroller, which serves as the central processing unit. It collects temperature and humidity data from the DHT22 sensor and receives threshold input from a potentiometer. The ESP32 processes this data and compares it against predefined safety limits. If the readings exceed the threshold, it activates a buzzer to alert nearby personnel. Simultaneously, the system displays real-time values on a 4-pin OLED screen for local monitoring. The ESP32 also uses its built-in Wi-Fi to transmit data to a cloud server, enabling remote access via smartphones or computers. This architecture ensures continuous monitoring, instant alerts, and remote supervision, making boiler operations safer and more efficient.

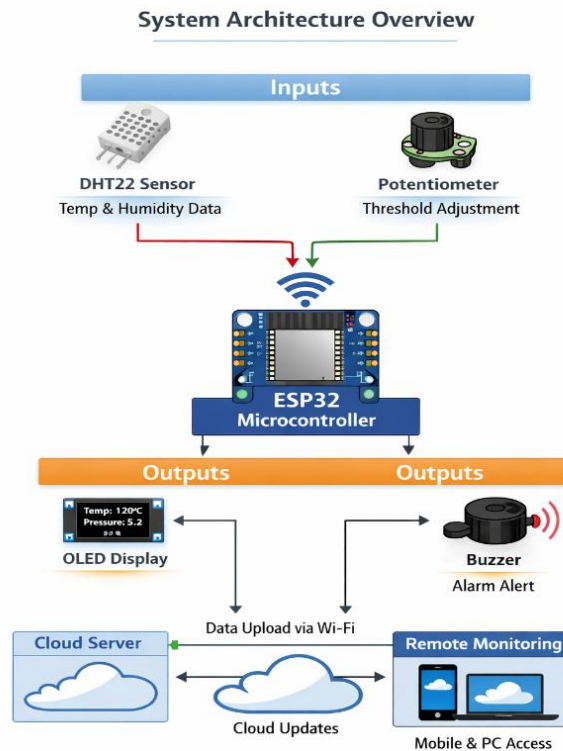


FIG.4: System Architecture

The efficient communication between hardware components and the cloud ensures continuous data flow, enabling accurate monitoring and better decision-making. This enhances overall system performance and reliability

**VIII. WORKING PRINCIPLE**

The IoT-based boiler monitoring system operates by integrating sensor data acquisition, threshold comparison, alert generation, and cloud communication through the ESP32 microcontroller. Upon startup, the ESP32 initializes all connected peripherals including the DHT22 sensor, OLED display, buzzer, and potentiometer. The DHT22 sensor continuously measures the ambient temperature and humidity within the boiler environment and transmits this data to the ESP32 via a digital input pin. Simultaneously, the potentiometer provides an adjustable analog input that sets the threshold limit for safe operating conditions. The ESP32 reads this value through its ADC pin and uses it as a reference for comparison.

Once the sensor data is received, the ESP32 processes it and checks whether the measured temperature or pressure exceeds the user-defined threshold. If the readings remain within safe limits, the system updates the OLED display with real-time values and transmits the data to a cloud server using Wi-Fi. This enables remote monitoring through mobile devices or computers. However, if the readings surpass the threshold, the ESP32 immediately activates the buzzer to alert nearby personnel of a potential hazard. The OLED display also highlights the breach, and the system continues to log and transmit the data to the cloud for remote access and historical analysis. This architecture ensures continuous, automated monitoring with instant local alerts and remote supervision, enhancing both safety and operational efficiency in boiler systems.

**IX. RESULTS AND DISCUSSION**

The IoT-based boiler monitoring system was successfully implemented using the ESP32 microcontroller, DHT22 sensor, OLED display, buzzer, and potentiometer. The system was tested under varying temperature and humidity conditions to evaluate its performance. The DHT22 sensor provided accurate real-time readings, which were displayed clearly on the OLED screen. The potentiometer allowed flexible adjustment of threshold values, enabling the system to adapt to different boiler operating ranges.

During testing, when the measured temperature exceeded the preset threshold, the buzzer was activated immediately, providing an effective local alert. This demonstrated the system's ability to respond quickly to unsafe conditions. In normal operating ranges, the system transmitted data to the cloud server via Wi-Fi without interruption, allowing remote monitoring through mobile and PC interfaces. The cloud integration ensured that operators could access live data and historical logs, improving decision-making and preventive maintenance.

The results confirm that the system enhances boiler safety by reducing reliance on manual checks and analog instruments. It provides continuous monitoring, instant alerts, and remote accessibility, which are critical for industrial applications. However, some limitations were observed, such as dependency on stable Wi-Fi connectivity and the need for calibration of the potentiometer for precise threshold settings. Future improvements could include integrating additional sensors for pressure measurement, implementing mobile notifications, and adding data analytics for predictive maintenance.

Overall, the system proved to be a cost-effective, reliable, and scalable solution for boiler monitoring, combining local safety mechanisms with modern IoT-based remote supervision.



FIG5: IOT Based Temperature and Pressure Monitoring System



FIG6: Boiler temperature and pressure display in Real time

## X. CONCLUSION

The IoT-based boiler monitoring system successfully demonstrates how modern embedded technology can enhance safety, efficiency, and accessibility in industrial operations. By integrating the ESP32 microcontroller with the DHT22 sensor, OLED display, buzzer, and potentiometer, the system provides accurate real-time monitoring of boiler parameters, immediate local alerts during unsafe conditions, and seamless remote supervision through cloud connectivity. The results confirm that the system reduces reliance on manual checks and traditional instruments, offering a cost-effective and scalable solution for continuous monitoring.

Although the system depends on stable Wi-Fi connectivity and requires calibration for precise threshold settings, its overall performance highlights the potential of IoT in industrial safety applications. Future improvements, such as adding pressure sensors, mobile notifications, and predictive analytics, could further strengthen its capabilities. In conclusion, the project achieves its objectives by combining local safety mechanisms with IoT-based remote monitoring, making boiler operations smarter, safer, and more reliable.

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