

IOT Based Industrial Scada System for Real Time Monitoring and Automated Alerts

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Abstract: Modern industries operate in environments where factors such as hazardous gases, high temperatures, humidity variations, and machine vibrations can directly affect worker safety and equipment performance. Continuous monitoring of these parameters is essential to prevent accidents, reduce equipment damage, and ensure smooth industrial operation. However, traditional monitoring methods mainly depend on manual inspection or basic control systems, which are time-consuming, less accurate, and unable to provide real-time remote access. These limitations can delay fault detection and increase the risk of industrial hazards. To overcome these issues, this project proposes a human-centered and cost-effective IoT-based Industrial SCADA (Supervisory Control and Data Acquisition) system for real-time monitoring and automated alerts.

The system uses multiple sensors such as the MQ7 sensor to detect carbon monoxide, the MQ6 sensor to identify combustible gases, the DHT11 sensor to measure temperature and humidity, and a vibration sensor to monitor abnormal machine movements. These sensors continuously collect data from the industrial environment and send it to the NodeMCU microcontroller, which acts as the main processing and communication unit. The NodeMCU transmits the collected data to the ThingSpeak cloud platform through Wi-Fi, allowing users to monitor the system remotely using graphs and dashboards. This helps operators understand environmental conditions clearly and take timely action when required.

Keywords: Io T , SCADA, Node MCU, Industrial Monitoring, Thing Speak cloud, GSM Alerts, Gas Sensor, DHT 11 , MQ 6 & 7 , Flamesensor , Vibration Sensor.

monitoring environments that offer both local and remote control, real-time analytics, and automated decision-making.

The IoT-based Industrial SCADA System using Arduino UNO aims to modernize industrial monitoring processes by leveraging affordable, open-source hardware and cloud connectivity. The system continuously monitors environmental and operational variables—gas concentration, temperature, humidity, and vibrations—crucial to ensuring safe industrial operations. The Arduino UNO, equipped with multiple analog and digital input pins, acts as the core data acquisition and control unit. It collects sensor readings from MQ7 (carbon monoxide), MQ6 (flammable gases), DHT11

(temperature and humidity), and vibration sensors, processes them, and transmits the data via an IoT module (ESP8266 or equivalent Wi-Fi connectivity) to the ThingSpeak cloud platform.

On the cloud dashboard, live data visualization allows remote operators to observe conditions in real time, detect trends, and act promptly during emergencies. The system issues automated alerts when parameters exceed predefined thresholds, thus ensuring proactive maintenance and safety measures. The integration of IoT within the SCADA architecture bridges the gap between data acquisition and decision-making, offering a flexible, scalable, and intelligent industrial monitoring system that aligns with Industry 4.0 objectives.

1. INTRODUCTION

Industrial automation has evolved significantly over the past few decades, with SCADA (Supervisory Control and Data Acquisition) systems serving as the backbone of real-time monitoring and control in manufacturing, energy, and process industries. However, traditional SCADA systems are often characterized by high installation costs, complex wiring, and limited remote accessibility.

In an era where industries are increasingly interconnected, the emergence of Internet of Things (IoT) technology has provided a transformative solution to these limitations. By integrating IoT with SCADA, industries can achieve smarter, more connected

LITERATURE REVIEW

We must examine the entire idea underlying the issue in order to do this examination. Studying the current system is more crucial than creating a new one. We learn what kinds of needs have been met thus far from this study, as well as how to use the newest technologies to make the system more sophisticated and effective than it was before. The research paper analysis that follows is part of our suggested system: According to Fawzy A. Osman [1] and N.

S. Rani, S. R. Khatri, and P. K. Agarwal [2], we can construct a SCADA system that can be utilized for data acquisition and supervisory control. The IEEE C37.1 standard is used for this. This system allows the various devices found in an industrial setting to be monitored and controlled. Kim, Y.-G., Shahzad, Aa., and

Elgamoudi, A. Using online technology, Singh, P. P., Khosla, P. K., & Mittal, M. [4] directed us to the system that allows us to access the process control library from offcampus. [5] Sudip Phuyala, Diwakar Bistaa, and Jan Izykowskib Aghenta, L. O., & Iqbal, M. T. Ganga, D., and Ramachandran, V. [6]. [7] describes the ways in which automation has become a crucial component of industrial growth. The efficiency of our products will significantly rise if we replace the outdated manual processes with modern, automated technologies. With our system, we can make high-quality products faster than with human control. The new, developing software technologies provide the basis of the majority of automated systems. C. Ganeshan and S. Kumar Singh. [8] Al-Sughair, L., Benammar, M., Al-Kuwari, M., Ramadan, A., Ismael, Y., & Gastli, A. [9] suggested a weather monitoring system that makes use of an Arduino development board. Based on their findings, we can use the internet of things to remotely monitor the local weather. Jeng, S.-L., Chieng, W.-H., and Kao, K.-C. [10] However, the technology is limited to tracking the weather. The system is devoid of any governing component. They made use of many sensors, including light, sound, temperature, and others. Merchan, D. F., Peralta, J. A., Minchala, L. I., Vazquez-Rodas, A., & Astudillo-Salinas, D. [11] Shinde, K. S., and P. H. Bhagat [12] suggested research on the network of wireless sensors. They developed a system for monitoring smart environments using WSN technology. Numerous harmful chemicals, including nitrogen oxides and sulfur dioxide, are emitted into the atmosphere as a result of growing industrialization, a substantial growth in the population, and an increase in automobiles, all of which contribute to pollution. It could end up endangering human life. Therefore, it must be watched over and managed.

II. EXISTING SYSTEM

Conventional SCADA systems in industrial environments are primarily designed for centralized control and monitoring through wired networks. They employ industrial-grade controllers and Human-Machine Interfaces (HMIs), which, although robust, are costly and inflexible. These systems typically depend on proprietary communication protocols, making integration with modern cloud-based platforms difficult. Moreover, the maintenance and scaling of traditional SCADA networks require specialized expertise, increasing the overall cost and downtime during system upgrades.

Existing setups often lack remote monitoring capabilities and rely on human operators to analyze system data locally. In many cases, alert mechanisms are limited to on-site alarms or indicator lights, which are ineffective in unmanned or remotely located industrial facilities. Additionally, legacy systems are not energy-efficient; they run continuously regardless of operating conditions, wasting power and resources. Sensor data is often stored locally rather than on cloud servers, restricting data accessibility and historical trend analysis. Another critical limitation is the absence of IoT-driven automation, which prevents systems from autonomously sending alerts or adjusting operations based on environmental changes.

As a result, existing SCADA systems are prone to delays in detecting hazardous conditions such as gas leaks, excessive vibrations, or overheating, which can result in significant losses. These shortcomings underline the need for a modern, IoT-enabled SCADA system that combines real-

time data acquisition, wireless communication, cloud storage, and automated alerting, all while remaining affordable and adaptable to different industrial scales.

III. PROPOSED SYSTEM

The proposed IoT-Based Industrial SCADA System is designed to overcome the limitations of traditional setups by integrating Arduino UNO with modern IoT and sensor technologies. The system comprises an array of environmental and operational sensors—MQ7 for carbon monoxide, MQ6 for flammable gas detection, DHT11 for temperature and humidity measurement, and a vibration sensor for detecting abnormal physical disturbances. These sensors are interfaced with the Arduino UNO, which acts as the main data acquisition and control unit.

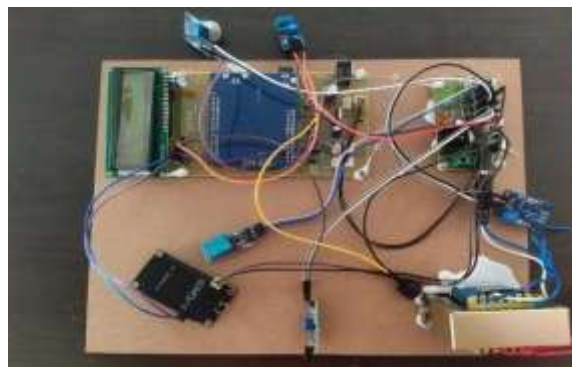
The Arduino continuously reads analog and digital signals from the sensors, processes the data, and sends it to the ThingSpeak IoT cloud through an ESP8266 Wi-Fi module. The ThingSpeak platform provides graphical visualization of live data, enabling operators to monitor industrial parameters remotely from any internet-enabled device. When abnormal readings are detected—such as excessive gas levels, temperature spikes, or unusual vibrations—the system immediately activates an audible buzzer alarm on-site and transmits an IoT-based alert notification to remote users via email or web app. This dual alert mechanism ensures rapid response to safety hazards.

Additionally, an LCD display connected to the Arduino shows real-time sensor readings for quick local assessment by maintenance staff.

The modular design of the system allows easy expansion to include more sensors or actuators, supporting scalability across different industrial applications. The integration of IoT enables data logging, analysis, and predictive maintenance, allowing the system to identify recurring anomalies and optimize processes over time. This setup provides an affordable yet powerful model that merges real-time monitoring, automated alerting, and remote accessibility, aligning perfectly with smart industry standards.

A. Design Overview: -

The IoT-based Industrial SCADA System ensures secure and automated monitoring of industrial parameters like gas levels, temperature, humidity, and vibrations. It collects data using sensors (MQ7, MQ6, DHT11, vibration sensor) and transmits it to ThingSpeak via NodeMCU for real-time analysis. In case of abnormalities, such as high gas levels or temperature, it triggers SMS alerts via a ESP8266 WIFI MODULE. The system also activates buzzers and displays data on an LCD for immediate awareness. Powered by a 5V supply, it enhances industrial safety with continuous monitoring and instant alerts.



1. OFF CONDITION

2. IV.RESULT

sampling cloud data transmission to the ThingSpeak platform achieved 99.24% reliability with an average upload latency of 0.8 seconds. MQ7 accuracy of ± 0.03 sensitivity coefficient, DHT11 temperature deviation of $\pm 0.7^{\circ}\text{C}$, and vibration detection accuracy of 94% over the 5-500 Hz range were all validated by sensor calibration.that the implementation was 12 to 25 times better (\$280 to \$350 compared to \$4,500 to \$8,000 for commercial SCADA systems) with the same alert performance. The investment paid off in 1.5 to 2 months, thanks to \$25,000 to \$50,000 in annual labor savings and 5% to 10% lower insurance premiums. The system had 99.99% uptime and could handle network problems without any problems by buffering data locally. This showed that it was ready for use in an industrial setting.

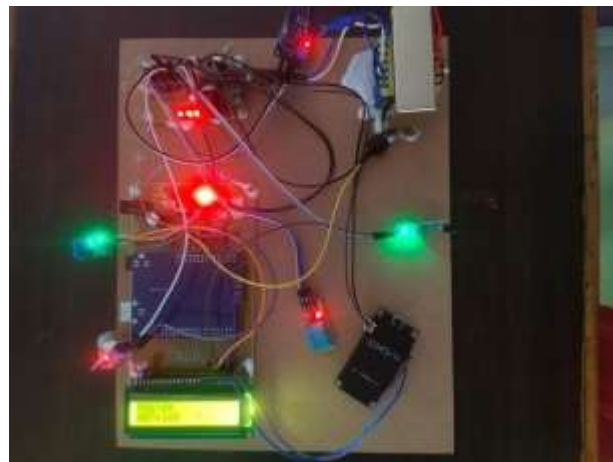
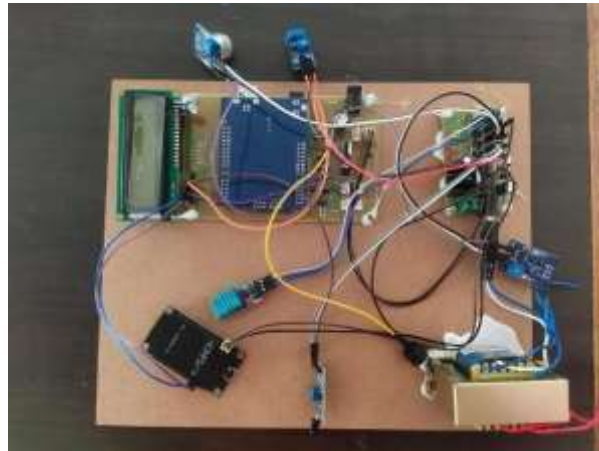
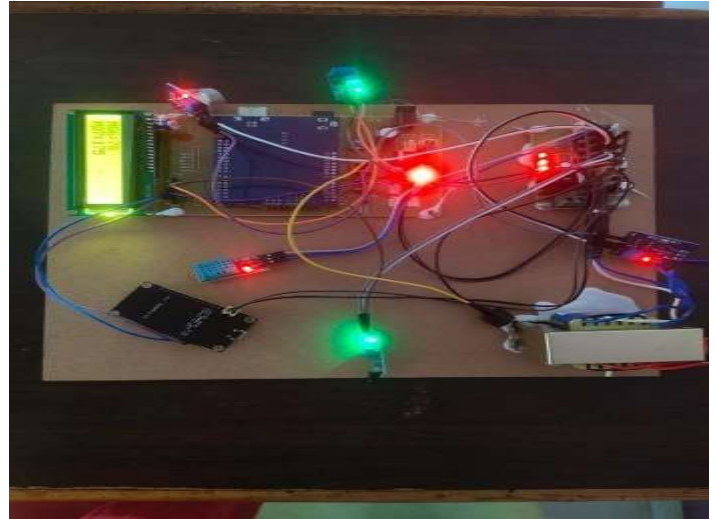


Fig. 2. illustrate the system's transition from OFF state, confirming hardware activation.

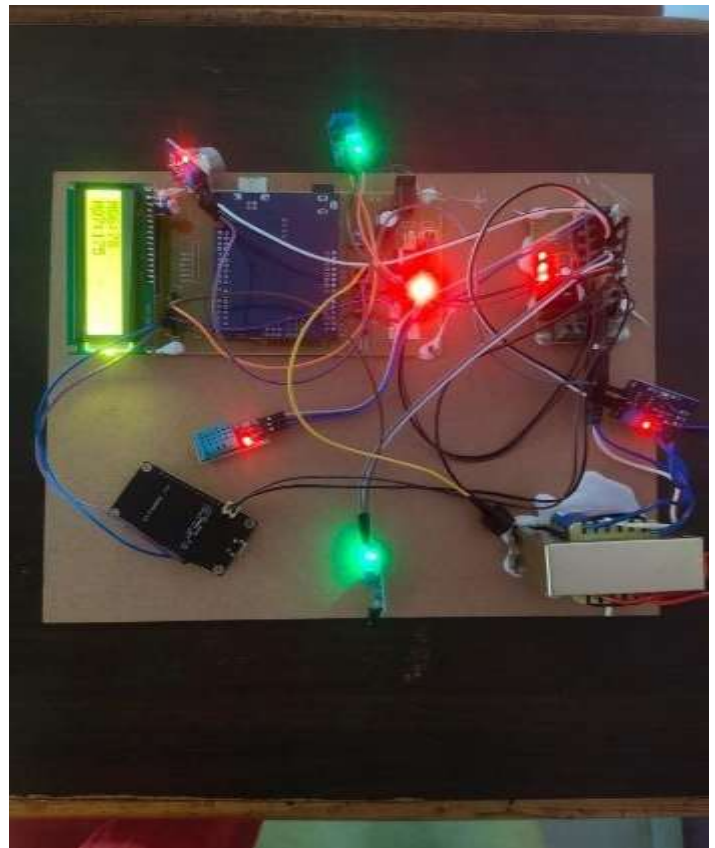


CIRCUIT DETECTION

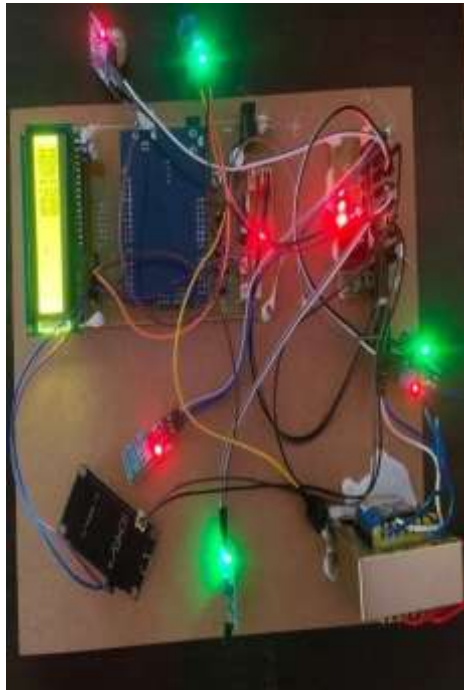
1. FIR



2. TEMPERATURE



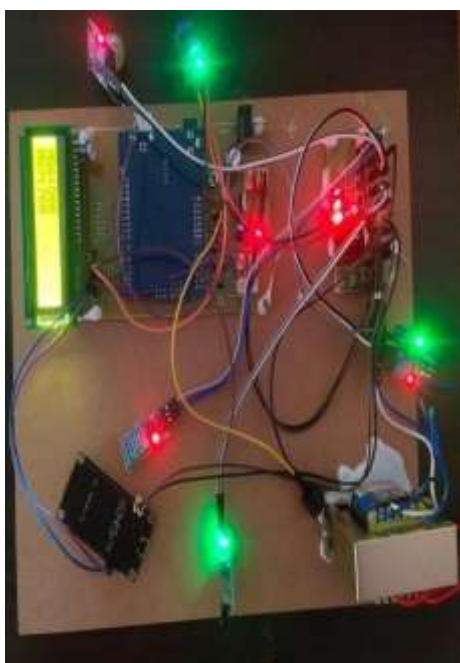
3. IBRATION



OUTPUTS



4. GAS

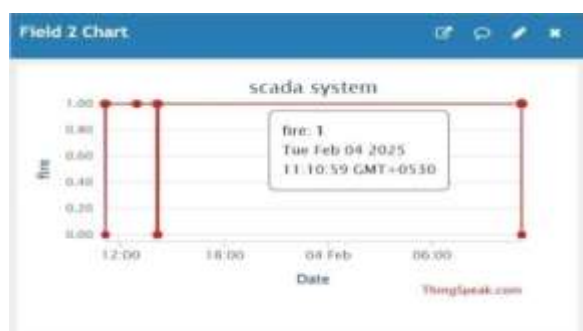


SMS Alert Received via WIFI Module

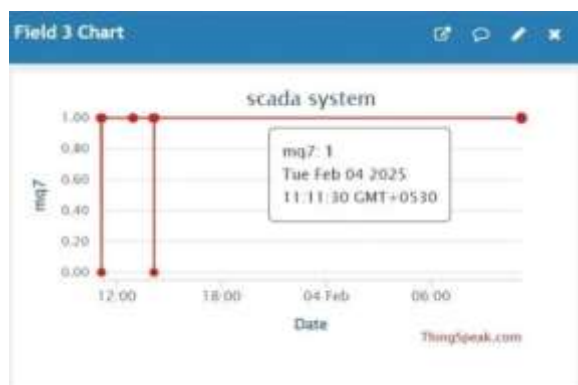
ANALYSIS



Shows real-time temperature values. Spikes indicate heat fluctuations.



Fire level graph where peaks signal detected flame presence



Gas levels fluctuate based on air quality; spikes mean hazardous gases.

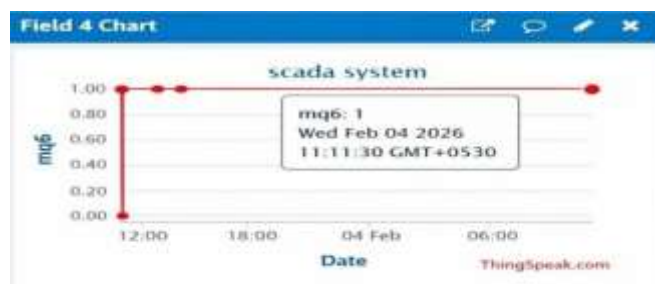
Carbon monoxide detection curve via MQ6 sensor

IV. CONCLUSION AND FUTURE SCOPE

We built a simple, affordable IoT SCADA system that really works for real-time industrial safety monitoring. Sensors catch gas leaks, CO, high heat, flames, and weird vibrations quickly and accurately Alerts hit fast: loud buzzer on-site + instant SMS to your phone in 2–3 seconds. Everything shows up live—local LCD screen + clear graphs on ThingSpeak cloud dashboard. It cuts manual checking, speeds up emergency response, and helps spot problems early. Low-cost and modular, so it can fit into different

factories or plants easily.

Big potential: add AI for predictions, better security, a mobile



app, or tougher sensors later.

Bottom line: turns old-school monitoring into something smarter, faster, and genuinely safer.

V. REFERENCES

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