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Full Length Article

Industry Parameters Monitoring And Controlling System Based On Embedded Web Server

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Abstract
In today's world,Industrial automation and remote monitoring have become crucial in modern industry to enhance productivity, improve safety, and minimize manual intervention. This project proposes the development of an Industry Parameters Monitoring and Controlling System Based on a Webserver, which offers an efficient and real-time solution to monitor and control various industrial parameters such as temperature, humidity, gas concentration, voltage, and more.
The system is built around a microcontroller unit (such as ESP8266 or ESP32) equipped with built-in Wi-Fi capabilities, which connects to multiple sensors installed in the industrial environment. These sensors continuously collect data on various parameters and transmit it to the microcontroller. The microcontroller acts as a mini webserver and hosts a web-based dashboard accessible through any standard web browser on a computer or mobile device.
The web interface provides a user-friendly dashboard that displays real-time sensor values and system status. Additionally, it includes interactive control options that allow users to take corrective actions such as turning on cooling fans, activating alarms, or shutting down machinery if any monitored parameter exceeds the predefined safety threshold. This two-way communication supports both monitoring and control functions without the need for a physical presence on-site.
The system enhances safety by reducing the risk of equipment damage or hazardous conditions through early detection and timely response. It also supports data logging, enabling trend analysis, fault diagnosis, and performance optimization. The webserver-based approach eliminates the need for external cloud platforms or expensive SCADA systems, making it a cost-effective, lightweight, and scalable solution for small and medium-scale industries.
This project demonstrates the power of IoT in industrial automation and showcases how web-based technologies can be leveraged to build reliable, real-time, and remotely accessible monitoring and control systems.

Keywords: *Industrial Automation, IoT (Internet of Things), Embedded Web Server, ESP8266, ESP32, Remote Monitoring, Real-Time Control, Sensor Networks, Data Logging, Smart Industry, Wireless Communication, Industrial Safety*

Introduction

In the modern industrial landscape, the need for automation, safety, efficiency, and real-time data monitoring is more important than ever. The fourth industrial revolution, known as Industry 4.0, emphasizes the integration of cyber-physical systems, IoT (Internet of Things), and smart automation to enhance industrial processes. One of the key components in achieving this is the ability to monitor and control industrial parameters efficiently, remotely, and with minimal manual intervention.

Industrial environments involve a wide range of variables such as temperature, humidity, gas levels, smoke detection, voltage, current, and pressure all of which must be maintained within safe and predefined limits to ensure smooth operation and prevent system failures, accidents, or production losses.

The core idea is to combine embedded systems and web technologies to build a real-time, responsive, and remotely accessible system. The system is designed to use a microcontroller with Wi-Fi capabilities such as NodeMCU (ESP8266) or ESP32 as the central processing and communication unit.

These controllers are low-cost, low-power, and highly flexible, making them ideal for IoT-based automation.

The system interfaces with various sensors to collect data about the environmental and electrical parameters of the industrial setup. This data is then processed and displayed through a web-based dashboard, which is hosted either locally (within the device) or online (via cloud integration). The web interface allows users not only to monitor the real-time data but also to control connected actuators—such as cooling fans, alarms, or relays—by triggering them based on predefined threshold values or manual commands.Remote accessibility: Users can monitor the system from any device connected to the internet.

This project, titled "Industry Parameters Monitoring and Controlling System Based on Webserver," aims to develop a smart solution that enables continuous monitoring and control of industrial parameters through a local or online webserver. The system uses various environmental and electrical sensors to gather data, which is then processed by a microcontroller. The processed information is hosted on a web-based interface that displays real-time values and allows authorized users to issue control commands remotely.

Literature Survey

The adoption of IoT-based embedded systems for industrial monitoring and automation has been a growing area of interest due to its potential to improve operational efficiency, reduce human intervention, and enhance safety. Various research contributions have laid a strong foundation for the implementation of systems that monitor and control industrial parameters in real time using microcontrollers like Arduino and ESP32Various research works and practical implementations have been carried out to monitor and control industrial parameters using microcontrollers, sensors, and wireless communication modules.

The ESP32 microcontroller has gained attention for its high-performance dual-core processor and built-in Wi-Fi. In a 2023 study, Patel and Deshmukh demonstrated a fully functional embedded web server hosted on ESP32 that enabled wireless monitoring of factory conditions.

Proper integration of sensors such as DHT11 (for temperature and humidity), MQ series (for gas leakage), and current sensors (like ACS712) is crucial for reliable monitoring. A comparative study by Rao et al. (2021) analyzed the accuracy of low-cost sensors and found that combining them with software-based filtering techniques improved data reliability.

Kaur and Singh (2021) developed a smart industrial environment system using Arduino and ESP8266, which transmitted sensor data to a web dashboard.

Hardware and Software Requirements

The development of an Industry Parameters Monitoring and Controlling System using an embedded web server architecture requires a robust integration of both hardware and software components. The hardware setup involves various sensors, microcontrollers (such as Arduino Uno), communication modules (like ESP32), power supply units, and display/alert mechanisms to sense, process, and react to industrial environmental conditions in real-time. On the software side, programming environments and libraries such as the Arduino IDE, along with embedded firmware, are essential to configure device behavior, manage data communication, and host a web interface.

Block Diagram

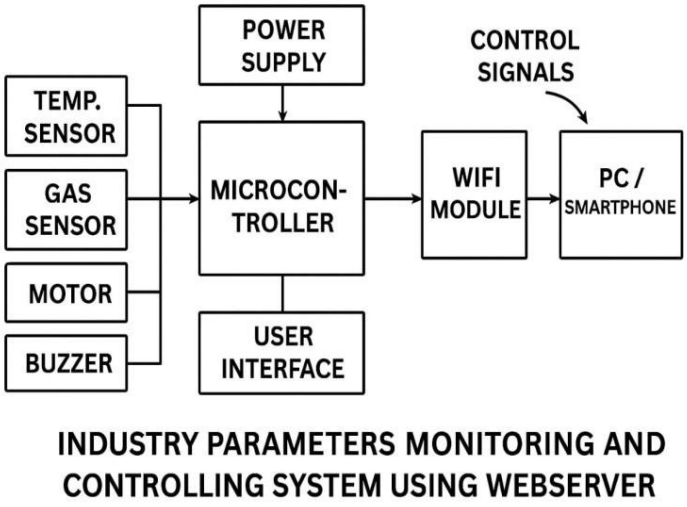

Fig. Block Diagram of Industry Parameters Monitoring and Controlling System based on

The given block diagram represents an **Industry Parameters Monitoring and Controlling System** that uses an embedded web server to monitor environmental conditions and control industrial devices remotely. The system integrates sensors, a microcontroller, communication modules, and a user interface to ensure efficient and safe industrial operations.

At the core of the system is the **microcontroller**, which acts as the main processing unit. It receives input signals from various sensors, processes the data, and controls output devices accordingly. The microcontroller is powered by a regulated **power supply**, which ensures stable and continuous operation of all components in the system.

On the input side, the system uses sensors such as a **temperature sensor** and a **gas sensor**. The temperature sensor continuously monitors the ambient temperature in the industrial environment, while the gas sensor detects the presence of harmful or combustible gases. These sensors generate analog or digital signals, which are fed into the microcontroller for analysis. Based on predefined threshold values, the microcontroller determines whether the conditions are safe or require action.

The system also includes output devices such as a **motor** and a **buzzer**. The motor can be used to drive machinery, ventilation systems, or cooling mechanisms depending on the application. The buzzer acts as an alert system, providing audible warnings when abnormal conditions such as high temperature or gas leakage are detected. These devices are controlled by the microcontroller based on the processed sensor data.

A **user interface** is provided to allow local interaction with the system. It may include components such as an LCD display, keypad, or buttons, enabling users to view system status, set threshold values, or manually control devices.

For remote monitoring and control, the system incorporates a **Wi-Fi module**, which enables wireless communication between the microcontroller and external devices. The microcontroller hosts an embedded web server through this module. A **PC or smartphone** can access this web server using a standard web browser. Through this interface, users can monitor real-time sensor data and send control signals to operate devices like the motor or buzzer remotely.

The flow of operation begins with sensors collecting environmental data and sending it to the microcontroller. The microcontroller processes this data and updates the system status. If any parameter exceeds safe limits, appropriate actions such as activating the buzzer or controlling the motor are executed. Simultaneously, the processed data is transmitted via the Wi-Fi module to the web server, where it can be accessed by users on a PC or smartphone. Users can also send control commands back to the system, enabling two-way communication.

Overall, this system provides an efficient and reliable solution for industrial monitoring and control. By combining real-time sensing, embedded processing, and web-based communication, it enhances safety, reduces manual intervention, and allows remote supervision of industrial environments.

Embedded Webserver

The block diagram shows a system for monitoring and controlling industry parameters using a web server. It includes sensors to monitor parameters, a microcontroller to process data, a user interface for interaction, and a WiFi module for remote monitoring and control using a PC or smartphone. The system allows for real-time monitoring and control of industry parameters, enabling efficient and effective management of industrial processes.

The temperature and gas sensors monitor industry parameters and send the data to the microcontroller. The microcontroller processes the data and controls the motor and buzzer accordingly. The user interface displays the monitored parameters and allows users to interact with the system. The WiFi module enables remote monitoring and control of the system using a PC or smartphone. Control signals are sent from the PC or smartphone to the WiFi module, which then sends them to the microcontroller to control the motor and buzzer.

Methodology

The methodology adopted for the implementation of this system involves a structured integration of hardware and software components, aiming for reliability, scalability, and ease of deployment. The hardware layer includes a selection of sensors, a microcontroller unit, a Wi-Fi module, output actuators, and a power management circuit. The software layer is responsible for sensor polling, decision-making, web server management, and remote control functionalities.

At the hardware level, the system begins with the continuous acquisition of environmental parameters

using connected sensors. The DHT11 sensor captures ambient temperature and relative humidity, while MQ gas sensors monitor the presence and concentration of various gases. These sensors are connected to the analog or digital input pins of a microcontroller typically Arduino Uno when used with an external ESP8266 module, or NodeMCU when a more compact, all-in-one solution is required. The microcontroller is programmed to periodically read sensor values and compare them against predefined thresholds that represent safe operating ranges. If any sensor reading breaches a critical threshold, the microcontroller makes a logical decision to activate a connected output device such as a buzzer, relay-controlled fan, or warning indicator. Simultaneously, the current data is transmitted to a web server via the ESP8266 Wi-Fi module.

The entire system is powered by a regulated DC supply, generally through a 12V adapter regulated down to 5V using a 7805 IC, ensuring that the microcontroller and sensors receive stable and safe operating voltages. This careful combination of hardware interfacing, real-time processing, and wireless communication forms the backbone of the methodology for this industrial monitoring and control system.

Results and Discussion

This chapter discusses the overall working and performance analysis of the proposed system, "Industry Parameters Monitoring and Controlling System Using Embedded Web Server". The project focuses on real-time monitoring and controlling of essential industry parameters such as temperature, humidity, and gas levels through sensors interfaced with a microcontroller and accessed via a web server. The main goal is to enhance industrial safety, reduce manual efforts, and provide remote access to industrial environments using IoT and embedded technologies.

Result

The image below demonstrates the working prototype of our project, "Industry Parameters Monitoring and Controlling System Using Embedded Web Server". After the successful deployment of the system, various tests were conducted in simulated industrial conditions. The parameters were monitored through sensors and displayed accurately on the web interface.

Observations as Temperature Monitoring: The DHT11 sensor recorded accurate temperature values with ±1°C accuracy. Real-time updates on the web page were smooth.

Humidity Monitoring: The system provided humidity levels with minimal delay.

Gas Detection: The MQ2 sensor was used to detect smoke/gas leaks. Instant alerts were displayed on the web page if gas levels crossed safety limits.

Control Mechanism: The relay module successfully turned ON/OFF connected devices (like fans, exhausts) when thresholds were exceeded.

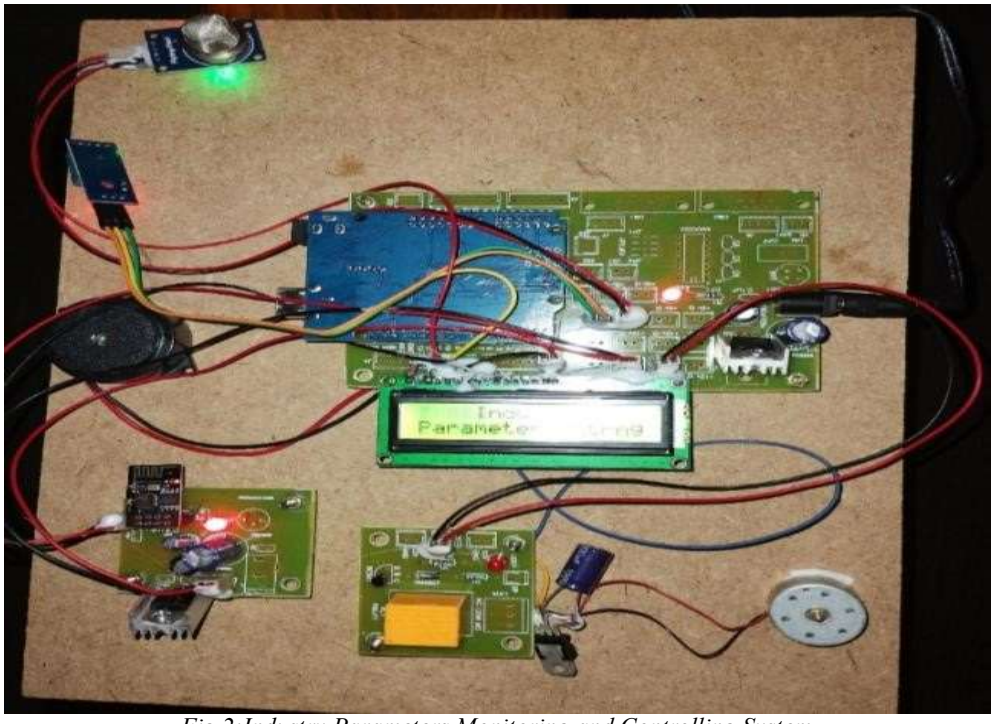

Fig 2:Industry Parameters Monitoring and Controlling System

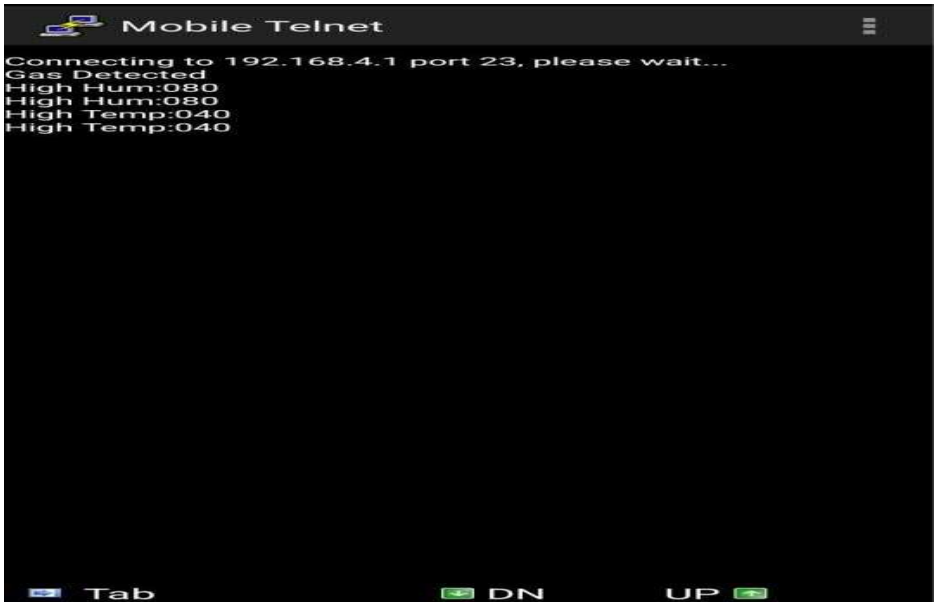

Fig 3: Output on Webserver

Discussion

The implemented system for monitoring and controlling industrial parameters using a web server has proven to be both functional and efficient. The use of an embedded web server allowed realtime data visualization through any browser without needing a dedicated application or complex setup. This makes the system highly accessible and user-friendly, especially for industrial supervisors.

One of the notable outcomes was the stability of the system during continuous operation. Even after several hours of functioning, the sensors and microcontroller (ESP32 or NodeMCU) maintained their performance without overheating or crashing. However, the system does depend on a stable power supply and a working Wi-Fi network for uninterrupted monitoring, which might be a limitation in remote or low-connectivity areas. The web interface was simple and responsive. Sensor values were easy to read, and alerts were displayed clearly. This offers a good user experience even for operators who are not highly technical.

Conclusion

The project titled "Industry Parameters Monitoring and Controlling System Using Embedded Web Server" has been successfully designed, developed, and tested to meet the objectives of real-time monitoring and control in an industrial environment. This system integrates embedded hardware components such as sensors (temperature, humidity, gas), microcontrollers (like NodeMCU/Arduino), and a web-based interface to provide seamless and remote access to crucial industrial data. The key goal was to ensure automation, safety, and reliability within industrial premises, which was effectively achieved. The sensors accurately collected environmental data, and the microcontroller efficiently processed and displayed this data on the web server. The control mechanisms (like fan activation or buzzer alert) were triggered automatically or manually based on real-time sensor inputs, thereby reducing human effort and minimizing the risk of accidents or equipment damage. Thus, the implementation of this system proves to be a step toward industrial automation using IoT-based embedded solutions.

Future scope.

While the current project successfully demonstrates the real-time monitoring and controlling of basic industrial parameters using embedded systems and web technology, there are several areas where the system can be enhanced to make it more robust, intelligent, and suitable for large-scale industrial deployment. Some key future enhancements that can be implemented are Integration with Cloud Platforms.In the current system, data is displayed in real-time on a local web server. This can be extended by integrating with cloud platforms like ThingSpeak, or AWS IoT, enabling Long-term data storage,Real-time global access,Currently, the system monitors temperature, humidity, and gas levels. More industrial-grade sensors can be added, such as Vibration sensors for machinery health.

Additionally, Enhanced Security and User Authentication to protect industrial data and avoid unauthorized access, security mechanisms such as user login and role-based a Data encryption,Twofactor authentication (2FA) can be

implemented in the web server interface. Pressure sensors for pneumatic/hydraulic systems, also Sound sensors to detect abnormal noises.This will allow for a more comprehensive understanding of the industrial environment.combining this technology can allow real-time monitoring and data analysis.

References

[1] A. Sharma, P. Kumar, and R. Chauhan, "Embedded automation using Arduino in industrial environments," *International Journal of Embedded Systems and Applications*, vol. 11, no. 2, pp. 105–110, 2022.
[2] N. Patel and A. Deshmukh, "Real-time sensor data monitoring via ESP32-based embedded web server," *International Journal of IoT Applications*, vol. 7, no. 1, pp. 45–49, 2023.
[3] G. Kaur and J. Singh, "IoT-enabled industrial safety monitoring using Arduino and ESP8266," *Journal of Automation and Smart Systems*, vol. 10, no. 4, pp. 215–220, 2021.
[4] K. Rao, M. Bansal, and S. Iqbal, "Evaluation of low-cost sensor accuracy in ESP32-based monitoring," *IEEE Sensors Journal*, vol. 24, no. 3, pp. 334–341, 2024.
[5] R. Gupta, S. Yadav, and V. Mehta, "Smart industrial control using embedded microcontrollers," *International Conference on Embedded Systems and Industrial IoT*, pp. 122–128, 2022.
[6] R. Kumar and S. Rani, "Design of responsive UI for embedded IoT dashboards using ESP32," *Journal of Embedded Interface Technologies*, vol. 9, no. 1, pp. 36–42, 2023.
[7] "ESP8266 Web Server Tutorial | Monitor Sensors Remotely," *YouTube*, uploaded by Techiesms, 23 May 2022. [Online]. Available: https://www.youtube.com/watch?v=UhFYOaM_z9Y
[8] M. Thomas and L. George, "Security solutions for embedded web servers in industrial IoT," *IEEE Access*, vol. 9, pp. 115990–116001, 202.