Time Industrial Parameters Monitoring and Controlling Through Smartphone

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ABST RAC T:

Over past decade, the industrial landscape has evolved exponentially Because of rapid technology Progress. Real-time monitoring and control of critical industrial parameters such as temperature, humidity, air quality, and OT (object temperature) have become one of the most important ways to optimize operations, guarantee safety, and achieve sustainability objectives. Factory parameter monitoring and controlling had a high dependence on manual data collection, adjustment, and analysis. Engineers would travel to equipment every so often, take measurements with a pen and paper, and adjust things when necessary, but it took time and was prone to errors. Contemporary systems take advantage of the widespread availability of smartphones to deliver users live access to these critical metrics and flexible control of the parameters. This allows users to generate informed decisions, take preventive action, and maintain continuous operational flow

Keywords: Sensors, Remote Monitoring, Remote Control, Relays.

1. Introduction:

IoT (Internet of Things) connects devices, sensors, and systems with collecting, analyzing, and real time data control, which is restructuring industries. This connectivity Allows organizations to monitor the situation, optimize operational factors such as temperature, humidity, and air quality in real-time, and inform decision-making."

These hosted data can be accessed, visualized, and managed remotely via smartphone applications that allow for real-time decision-making, predictive maintenance, and dynamic adjustment of parameters. This paper delves into the concept of real-time industrial parameter monitoring and controlling, highlighting its significance and potential benefits. It explores the underlying technologies, including IoT sensors, wireless communication protocols, cloud computing, and mobile applications, that facilitate the seamless integration of data collection, processing, visualization, and control to improve efficiency. Real-time monitoring and controlling of critical industrial parameters offer a powerful tool for enhancing efficiency, productivity, and safety. By leveraging IoT technologies, industries can now collect, control, and analyze data on various parameters to optimize performance. Additionally, the paper discusses the potential challenges and security considerations associated with implementing such systems, emphasizing the need for robust data security measures and reliable communication networks. By addressing these challenges and leveraging the power of IoT and smartphone technologies, industries can unlock new. Opportunities for optimizing operations, improving product quality, and ensuring worker safety. The processed data is subsequently visualized in a user-friendly format, accessible through smartphone applications. This enables authorized

personnel to remotely monitor and control industrial processes, receive real-time alerts, and make informed decisions, regardless of their physical location. The integration of IoT and smartphone technologies empowers industries to optimize resource utilization, reduce downtime, and improve overall productivity. By proactively addressing potential problems and dynamically controlling critical parameters, industries can minimize operational disruptions, enhance their competitive edge, and ensure more sustainable operations.

2. Recent Works:

This system is implemented with ESP32by interconnecting with distinctive sensors like temperature, humidity, gas sensor, and air quality sensor is interfaced to the cloud by enabling an inbuilt Wi-Fi module of ESP32, the system is connected to the cloud as well as Android mobile loaded with Blynk IoT application tool kit for controlling the parameters. Blynk IoT account Stores and visualizes the received data. Provides APIs for data access and analysis. The sensor parameter variation is uploaded to the cloud. Through the Cloud, all sensors in industrial applications are monitored easily and efficiently. The processed data is transmitted to Blynk IoT using the Wi- Fi module. In this application, the user's mobile is connected using Blynk IoT, which is an Android application tool kit. Thing Speak can be accessed through mobile or Laptop and also used as the cloud. If the sensor parameters limit is exceeded then the buzzer provides an audible alert when abnormal conditions are detected, such as equipment malfunction, current, and other critical deviations. In this system, industrial processes like Temperature, Humidity,
Object Temperature, and Air quality if any are monitored through Android mobiles, and parameter data can be updated periodically by using the cloud. The basic block diagram for industrial process monitoring using IoT is shown in the figure.

3. Proposed Work Explanation

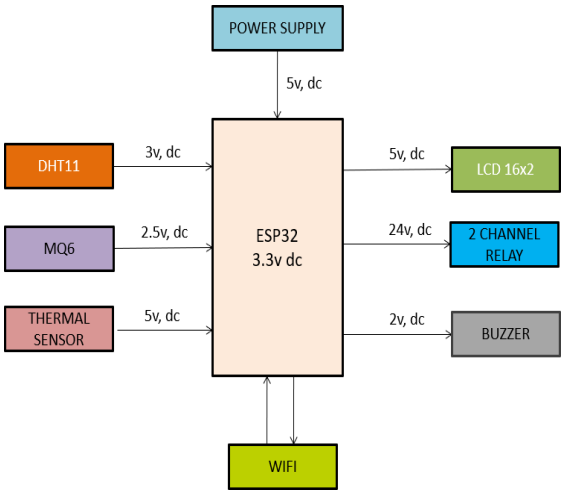

Fig.1 Block diagram for IOT-Based industrial parameter monitoring.

3.1 Design and Implementation Results:

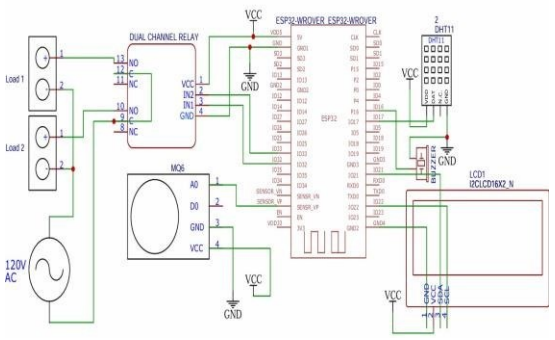

Fig 2: Schematic Representation

Hardware and software requirements for prototype module implementation with respect to[Fig-1] i. ESP32 ii. Thermal Sensor iii. DHT11 Sensor iv. MQ2 Sensor v. MQ135 Sensor vi. LCD vii. Buzzer viii. Dual Channel Relay Module ix.4x4 Keypad x.

Blynk Application.

ESP32:
The ESP32 microcontroller serves as the central hub in real-time industrial parameter monitoring humidity, systems. It integrates with a diverse array of sensors, including temperature, air quality, and thermal sensors, to collect critical data. The ESP32 processes this data and transmits it wirelessly via Wi-Fi or Bluetooth to a smartphone app or cloud platform. Users can then remotely monitor and analyze these parameters in real time, enabling timely decision-making and remote control of industrial processes. Additionally, the ESP32 can trigger alarms or notifications based on predefined thresholds, ensuring immediate response to potential issues.

Temperature sensor: Temperature sensors accurately measure the ambient temperature, providing critical data for various applications. By integrating with the ESP32 microcontroller, the temperature sensor enables real-time monitoring of temperature fluctuations, allowing for timely adjustments to optimize processes and prevent potential issues. This information can be transmitted wirelessly to a smartphone app or cloud platform, enabling remote monitoring and analysis. Temperature sensors contribute to increased efficiency, improved product quality, enhanced safety, and reduced operational costs in a wide range of industries.

Humidity sensor: Relative humidity in the environment is measured effectively, they measure both moisture and temperature in the air and gives relative humidity as percentage. by providing accurate and timely data on moisture levels within various industrial environments. This data is essential for maintaining optimal conditions, preventing damage, and ensuring efficient operations.

MQ135 Sensor: The MQ135 sensor is widely used in industrial and environmental applications for detecting various gases, including CO2, ammonia, nitrogen oxides, alcohol, and smoke. Integrating it with a smartphone for real-time monitoring offers a smart solution for industries like chemical processing, oil refining, and environmental safety.

MQ2 Sensor: Detects gas concentration in the air such as LPG, methane, hydrogen, and smoke. Integrating this sensor into industrial settings for real-time parameter monitoring via a smartphone requires a combination of hardware and software solutions.

Thermal Sensor:
Measure a wide range of temperatures, commonly used in high-temperature applications. Measure surface temperatures without contact, ideal for moving parts or hazardous environments. Detect temperature changes With high sensitivity, suitable for lower temperature ranges.

LCD: Displays textual data (parameter values, alerts).LCD for local display, and a smartphone for remote monitoring. Real-time data from industrial parameters (e.g., temperature, pressure, gas concentration) is processed, displayed on the LCD, and transmitted wirelessly to the smartphone.

Buzzer: Integrating a buzzer in real-time industrial parameter monitoring provides an immediate audible alert for critical

conditions. This is particularly useful in industrial environments where quick action is required to prevent accidents or damage.

Dual Channel Relay Module: This module allows the ESP32 to control two separate AC loads (devices that run on 120V AC). Each channel has a relay that can switch between on and off states, enabling remote control of appliances.

4x4 Keypad: This keypad allows the user to interact with the circuit, for example, to change settings, trigger actions, or control the relays manually

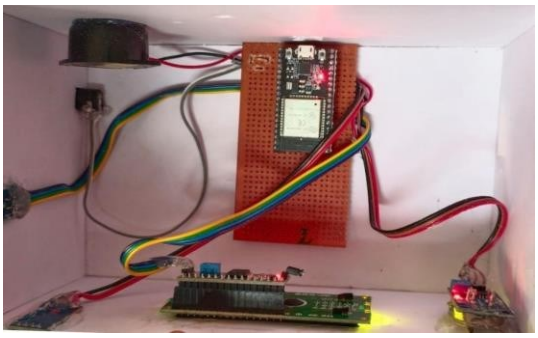

Fig 3: The internal structure of the proposed system is shown in Fig2

Circuit Functionality: Sensor Data Acquisition: The DHT11 and MQ32 sensors continuously monitor temperature, humidity, and gas levels in the environment.

Data Processing and Display: The ESP32 receives and processes the sensor data. It then displays the readings (temperature, humidity, gas levels) on the LCD. Alarm System: If the gas level detected by the MQ32 sensor exceeds a predefined threshold, the buzzer is activated, alerting the user of a potential gas leak.

Relay Control: The user can interact with the keypad to manually control the relays, switching AC loads on or off. This provides flexibility in controlling appliances.

Communication: The ESP32's Wi-Fi/Bluetooth capabilities enable remote control and monitoring of the circuit. This allows users to control the system and access data from a distance.

Power Supply: The circuit requires a power source to operate. The 120V AC input needs to be properly isolated and fused for safety.

Note: The specific behavior and features of the circuit are determined by the software program running on the ESP32 microcontroller..

Blynk IOT:

By integrating Blynk with industrial sensors and actuators, users can monitor. The Blynk application allows for customizable dashboards with graphical representations. Furthermore, Blynk allows for the operation of various industrial controllers, such as lights and fans so that the needed control is efficient, cost-effective, and efficient. In general, Blynk eases the monitoring and control of industry processes leading users to incorporate data strategies and improve the business.

4. Results and Discussion:

As we advance in the modern world, the habit of using wireless technologies is becoming convenient and safe for people. Many wireless technologies like IOT, AR, AI etc are in good demand for the adaption of a new lifestyle. With these

breakthroughs in mind, we aimed to establish a sensor network aimed at hazard prevention and detection employing wireless sensors and then neutralizing the root causes of the catastrophe. The sensors encapsulated in the prototype are for fire, gas, temperature, and humidity. "IOT Based Industrial Parameters Monitoring and Control" International Research Journal of Engineering and Technology (IRJET), vol. 11, issue 5, May 2024, pp. 2130-2135.[1]

Technology is constantly evolving, making it essential to stay updated with new advancements. Automation and web technology have simplified daily life, enabling remote management of embedded devices via the Internet of Things IoT. Web controllers or E-controllers are widely used for monitoring and controlling devices through distributed web systems, replacing large server systems. IoT-based web control systems offer benefits like energy saving, comfort, and efficiency, allowing global access via the internet. The prototype system demonstrated flexibility by letting users set limits, making it adaptable to various scenarios and scalable by integrating additional sensors and subsystems."IoT Based on Industrial Parameters Monitoring and Controlling Systems"Eurasian Journal of Engineering and Technology, Vol. 6, Issue May2022, ISSN: 2795-7640.[2]

The survey highlights monitoring devices for electrical machines, focusing on IoT-based systems . The GSM module for monitoring has limitations, which IoT systems, like the ESP32 Wi-Fi module with its stack, address effectively. Node MCU, with its built-in Wi-Fi and microcontroller, simplifies programming and integration. Data can AWS be captured using platforms like Blynk IoT. The main challenge lies in integrating multiple subsystems (sensors, microcontrollers, Wi-Fi modules) to ensure synchronized and accurate operation . Familiarity with programming is critical for success. "Review on IOT Based Industrial Parameters Monitoring and Controlling Systems", International Journal of Creative Research Thoughts(IJCRT), Vol.10, Issue 5 May 2022 , ISSN: 2320-2882.[3]

Modern environmental monitoring involves collecting data and the status of ecological parameters to prevent damage to industries and workers . IoT-based remote monitoring systems enable data collection, communication, and storage without human intervention, helping to avoid accidents . The system uses a PIC microcontroller to control sensors globally, with embedded C programming and a website for user interaction . This IoT-based framework is cost-effective, compact, and capable of monitoring industrial and environmental parameters . The ARM-based embedded system allows autonomous monitoring of these parameters, enhancing safety and efficiency in industrial applications. "Industrial Parameters Monitoring Using Embedded System Biosc.Biotech.Res. Comm . Special Issue Vol 13 No (2) 2020 Pp-34-37.[4]

Fire hazards significantly contribute to global warming, and modern " , technologies like IoT and wireless sensor networks (WSN) can help mitigate these risks . WSN uses small, low-power

devices to monitor re-prone areas, with sensors like temperature, re, gas, and LDR detecting hazards . IoT enhances re monitoring, early warning, and rescue operations by enabling real-time communication and remote control . The system uses Arduino to control mechanisms such as water pumps for re extinguishing and audio, alerts for gas leaks . The integration of IoT and an Android app allows for remote monitoring and timely responses, improving re safety and emergency management." IOT Based Industrial Parameter Monitoring System" , Pramana Research Journal, Vol. 9, Issue 2,
2019,ISSN NO: 2249-2976.[5]

To achieve industry goals, maintaining industry standards and improving operations are essential . Real-time monitoring systems enable precise communication between machines and manufacturers, ensuring proactive detection of issues and efficient operation. These systems, using embedded modules, GSM networks, and sensors, measure parameters like temperature, current, and voltage, converting them into digital outputs.
Remote access via web pages allows global monitoring, reducing the need for costly and risky human visits . With IoT advancements, systems have unmanned and cost-effective monitoring been developed, offering accurate, user-friendly, and economical solutions . This system enhances industrial productivity and efficiency, surpassing traditional onsite observation methods. "Industrial Parameters Monitoring System based on Embedded Web Server", International Journal of Innovative Technology and Exploring Engineering (IJITEE),Vol.8
Issue-9, July 2019, ISSN: 2278-3075.[6]

In recent studies, internet of things applications for monitoring and controlling industrial parameters have attracted some attention as an improvement things are done in an industrial environment. of how Other research papers have tackled different fronts of this technology . "IOT Based Industrial Parameters Monitoring and Control," International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering (An ISO 3297: 2007 Certified Organization) Vol. 5, Issue 7,July 2016.[7]

The parameter for hazard is re . Temperature, gas, and humidity are the parameters that can be monitored at prior notice to prevent the occurrence of a huge re . If these parameters are under control, it might versa prevent re and vice . For the elimination and extinguishing of the re, we have Used water as the extinguishing element . For example, if there is of any harmful gas like carbon the presence monoxide, or butane in the surroundings, the gas is detected by the sensor module and gives alerts. Thus, this prototype can be very beneficial for workers in industries, power plants, etc a hazard that might destroy machinery for the prevention of as well as can risk the life of the workers. U . Eswaran, "Realizing Internet of Things Using Arduino, ESP8266 & Its Server and Mysql Db for Real-Time Monitoring & Controlling Multiple Fire Alarm Systems Over a Wireless Tcp/Ip Network," Journal on Software Engineering, vol. 11, 2016. [8]

Table 1: *Environmental parameters and sensors readings in different areas*

Location	Air Quality	Temperature	Humidity	Object Temperature
EV Lab	0	30	67	29
Simulation Lab	0	31	64	3
Classroom	0	25.5	79	27.91

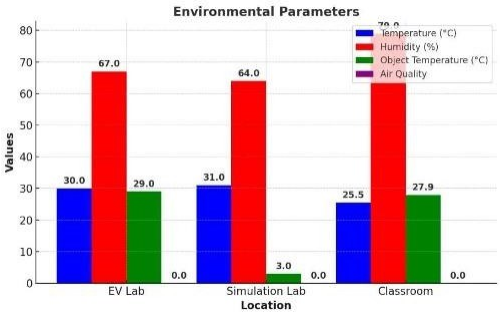

Fig 4: Bar graph representation of the environmental parameters from the Table-1

Analysis of Environmental Parameters in Different Locations

The data collected from three distinct locations-EV Lab, Simulation Lab, and Classroom-represents key environmental parameters measured through sensors. The recorded values for Air Quality, Temperature, Humidity, and Object Temperature provide insights into the conditions within these environments.

Recorded Parameters:

1. Air Quality:
The values remain zero across all locations, suggesting either a lack of pollutants or an absence of recorded data for air quality monitoring.

2. Temperature (°C):
The EV Lab has a measured temperature of 30°C.
The Simulation Lab shows a slightly higher temperature of 31°C.
The Classroom records a comparatively lower temperature of 25.5°C.

3. Humidity (%):
The Classroom exhibits the highest humidity level at 79%, indicating a more humid atmosphere.
The EV Lab records 67%, while the Simulation Lab shows a humidity level of 64%.

4. Object Temperature (°C):
The EV Lab registers an object temperature of 29°C, aligning closely with the ambient temperature.
The Simulation Lab records a significantly lower object temperature of 3°C, likely due to the presence of a cooler surface or object. The Classroom shows an object temperature of 27.91°C.
Interpretation of the Graph:
• Humidity (red bars) is consistently higher across all locations compared to other parameters.
• Temperature (blue bars) remains relatively stable across the three areas, with minor fluctuations.
Object Temperature (green bars) varies significantly, particularly in the Simulation Lab, where it is notably lower than in other locations.
Air Quality (purple bars) consistently shows a zero reading, suggesting minimal or no pollutants detected in these areas.
The bar graph visually represents these variations, making it easier to compare environmental conditions in different locations. This analysis provides valuable insights for monitoring industrial and educational environments, ensuring optimal conditions for various applications.

The key parameters and how they are typically monitored:

Air Quality: Monitoring air quality in industrial environments is crucial, particularly in factories or places where emitted. hazardous gases or particles might be By using air quality sensors, real- time data can be collected on levels of pollutants like carbon dioxide (CO2), particulate matter (PM), and volatile organic compounds (VOCs). The data is transmitted to the smartphone for instant analysis, allowing for timely interventions if the air quality exceeds safe levels.

Object Temperature: This refers to the monitoring objects or machinery within the industrial space of the temperature of specific For instance, temperature sensors can be attached to machines to ensure they don't overheat, could lead to malfunctions or safety hazards . Smartphone apps can provide alerts if any object reaches dangerous temperatures, allowing corrective action.

Humidity: Humidity plays an essential role in the performance of various machines and processes in industries such as pharmaceuticals, food production, and electronics manufacturing. Using humidity sensors, real-time data can be monitored and controlled . If the humidity levels go beyond the optimal range, smartphones can alert operators so they can take Corrective actions like adjusting ventilation or humidity control systems

Temperature: Ambient temperature in an industrial facility impacts both machine performance and worker safety . Temperature sensors can monitor the overall temperature of the environment, ensuring that conditions stay within a safe and efficient range. Smartphones can provide real-time data, helping managers remotely monitor and adjust cooling or heating systems.

5. Conclusions:

This system provides comprehensive insights into the operational conditions of industrial facilities . These parameters are crucial for maintaining optimal working environments, ensuring equipment health, and protecting workers from hazardous situations. Temperature and humidity monitoring helps prevent equipment malfunctions, working conditions in ensuring product quality, and maintaining safe industries like manufacturing, food processing, and pharmaceuticals. Air quality monitoring, including the detection of harmful gases, ensures compliance with environmental standards and reduces health risks for workers . Smoke detection serves as an early warning system for potential res, allowing for timely intervention to prevent damage and ensure safety. The integration of sensors with a microcontroller and a smartphone app allows for real-time data visualization, instant alerts, and remote monitoring On-site personnel bene t from immediate visual (via LCD) and audible (via buzzer) alerts, while remote operators notifications, enabling quick are decision-making and response system enhances operational control and ensures that critical situations . kept informed through smartphone . This dual-layered are addressed promptly, reducing the risk of accidents and minimizing downtime . In addition to real-time monitoring, the system can be extended to include cloud integration for historical data storage and analysis. This enables industries to identify trends, predict potential failures,

and implement predictive maintenance strategies . By leveraging smartphone-based monitoring, industries can achieve greater flexibility, improve operational efficiency, and enhance safety, making it a vital tool in modern industrial operations.

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