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IOT BASED INDUSTRIAL CLOUD MONITORING SYSTEM FOR HAZARDOUS EMISSIONS

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ABSTRACT:
Internet of Things (IoT) is a fast-growing innovation. IOT is a network of physical objects or things that are embedded with electronics, software, sensors, and network connectivity, allowing them to obtain and exchange data. Industrial monitoring and control is required to collect all relevant information, statistics, and data pertaining to the various industrial processes, motors, machines, and devices used in manufacturing facilities. this aims to provide controlled access, increased productivity, and high-quality results in the manufacturing of industrial period. Remote control and monitoring via communication methods such as ZigBee, RF, and infrared have been widely used in various industries in this new age of technological developments. However, because of their slow communication speeds, distances, and data security, these wireless communication procedures are frequently limited to simple applications. Furthermore, they are easily influenced by noise and inclement weather, including snow, fog, and rain.the main microcontroller in this model is an Arduino Mega, which is also connected to a Wi-Fi module for internet access, a barometer sensor for temperature and pressure, a humidity sensor for humidity sensing, and a gas sensor for detecting smoke and toxic emissions. these elements are used to construct a monitoring system. apart from these components, a variety of other sensors are used to monitor temperature, gas leakage, pressure, humidity, and other factors in the workplace to ensure safety regulations.
Keywords: - Internet of Things, Monitoring system, Sensor, Wireless Communication.

INTRODUCTION:

The Internet of Things is a significant phase in the evolution of the information age and a component of the new generation of information technology [Mohammad Monirujjaman Khan et al, 2022]. The term "Internet of Things" refers to the Internet in which everything is connected. In a more specific sense, the Internet still serves as the core and foundation of the Internet of Things, as it is a network that has been extended and expanded based on the Internet and whose user base has the propensity to expand to include any item as well as the trend of information exchange and communication between items, which is also informational [Hemlata Yadav et al., 2022]. IOT is referred to as the third wave of development in the history of the global information industry, following computers and the Internet, since it is extensively employed in the integration of the network through intelligent sensing, identification technology, and communication sensing technology like pervasive computing [Mohammad Monirujjaman Khan, et al., 2021]. The degree of equipment standardisation and system self-adaptation is greatly enhanced; professional system integration is greatly enhanced; standardised sensors and components are becoming more and more adaptive; and more and more control system integration functions are being transferred to product

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manufacturing with the growth of IoT technology [Safayat Reza Anan et al., 2021].Cloud platform networking administration and operation are inevitable in the future. Intelligent building system integration and on-site debugging are becoming less demanding and complex, and they will eventually become incidental projects for construction companies [QingQing Chang et al., 2021]. Through the integration of smart technology and connectivity, the Industrial Internet of Things, or IIoT, has arisen as a transformational force that is altering old industrial processes. In the current Industry 4.0 age, firms that want to remain efficient and competitive must now prioritise having automated control, predictive analytics, and real-time monitoring [Shengwen Wang, et al., 2021]. This introduction lays the groundwork for investigating an inventive remedy, the Industrial Monitoring and Control System (IMCS), that is based on the Internet of Things [Aixia Hou, 2022]. Industrial management has undergone a paradigm shift with the introduction of the IMCS, which uses IoT capabilities to build a dynamic, networked environment. Conventional industrial settings frequently struggle with issues of inefficiency, unscheduled downtime, and inadequate resource use. By combining the power of sensors, actuators, and advanced analytics, the IMCS tackles these problems and offers a complete solution for improved monitoring and control. The IMCS is primarily dependent on a network of sensors that are thoughtfully placed across the industrial setting. Critical characteristics like temperature, pressure, humidity, and other pertinent variables are captured in real-time by these sensors. Next, the gathered data is sent to a centralised cloud-based platform, where advanced machine learning algorithms are used to thoroughly analyse it [Kazy Noor-e-Alam Siddiquee et al., 2022]. The IMCS's brains, the cloud-based platform, provide for a comprehensive picture of industrial processes Massive volumes of data are processed by this centralized hub, which produces insights that can be put to use immediately, providing decision-makers with the knowledge they need for operational and strategic planning. The cloud infrastructure's scalability and security are utilised to manage the ever-increasing amount of data produced by the numerous sensors.

Because the Internet of Things (IoT) is smarter than the Internet, it can create, evaluate, and make judgements using data about linked items. This means that IoT technology has the potential to drastically alter the world. It's extensively employed in the industrial sector as well [Jing Chen, 2022]. We are going to create an industrial monitoring system utilising IoT to stop unintentional explosions brought on by gas leaks since safety and security are increasingly crucial in the industrial sector.It will function as a security system as well. This system will indicate the concentration of the gas and the point at which it becomes harmful, in addition to sounding an alert when there is a leak. It will subtract everyone who enters the room in the interim. Advances in technology have led to the replacement of conventional methods with automated and sophisticated groupings. Furthermore, industrial automation benefited immensely from the availability of sensitive, reliable, and fast-processing items Modern communication technologies have made it possible for

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systems to be automatically monitored and controlled by computer-controlled or remote-controlled devices, as opposed to being manually operated by workers as in the past [Hina Alam, 2023]. Industrial climate conditions have been improving every day thanks to recently developed automated techniques, which have eliminated traditional production processes and increased enormous workloads.

MATERIALS AND METHODS:

The gas detection system employs a gas sensor, Wi-Fi-connected microcontroller, and cloud server to monitor gases and send notifications. The IoT gas monitoring circuit integrates an ESP8266 Wi-Fi module, Arduino Uno microcontroller, MQ2 gas sensor, and IoT cloud platform for versatile gas monitoring. The microcontroller implementation in IoT systems involves reviewing client needs, building hardware interfaces, and using communication protocols like RS485. The movement intelligent monitoring system optimization utilizes over-zero detection and wavelet transform for accurate motion counting and period calculation.

Internet of Things

Figure 1 shows The gas detection system is made up of a gas sensor that sends analogue output to a microcontroller, which uses a Wi-Fi module to connect to the internet. [Xueya Song, and Shengchao Sun, 2022] After analysing the data from the gas sensor, the microcontroller sends the information to a distant cloud server, indicating the presence of gas. [Liang Zhao, 2022] When gas is found, the data is processed by the cloud, which then sends out notifications. The microcontroller turns on LEDs to show the presence of gas visually when it receives an alarm. [Abdur Rab, et al., 2021] This integrated system may be used in a variety of environments, including residences, companies, and industrial sites. It provides a flexible way to monitor different gases, such as carbon monoxide, methane, or propane.

The illustrated breadboard circuit functions as an Internet of Things (IoT) gas monitoring system, combining parts such as an ESP8266 Wi-Fi module, an Arduino Uno microcontroller, a MQ2 gas sensor, and a IoT cloud platform. [Feng Shi et al., 2022] Upon detecting different gases, the gas sensor transmits voltage signals to the microcontroller, which then transforms them into digital data. The microcontroller connects to the internet via the ESP8266 Wi-Fi module, allowing gas sensor data to be sent to the cloud platform. [Lei Hu., 2022] Additional temperature and humidity data are provided by the DHT11 sensor, and visual indicators of the circuit state are provided by LEDs. This adaptable system may be used for a variety of purposes, such as gas leak detection or residential air quality monitoring, and the cloud-based dashboard on cloud allows for remote data access and analysis [Inam Ullah Khan et al., 2021].

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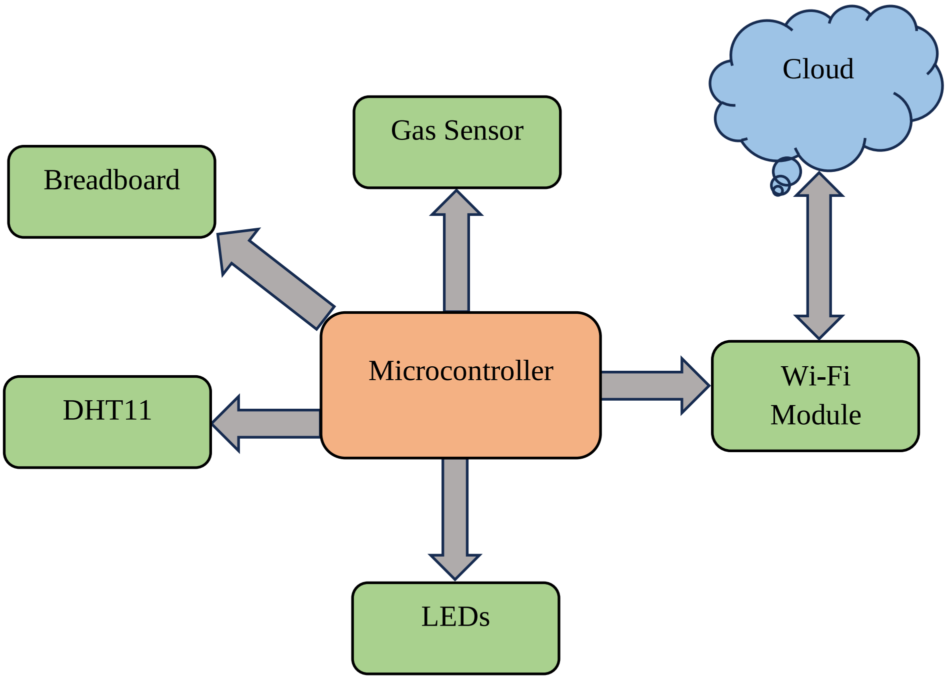

Figure 1. Internet of Things

Microcontroller Implementations in IoT Systems

Figure 2 shows the microcontroller to access the sensor data, the hardware interfaces must first be built[Hairong Wanget al., 2022]. The microcontroller, on the other hand, is where the logical functions belong.In this way, the sensor data could be analysed, and a control command might be produced. Lastly, the communication protocol of the microcontroller has to be ascertained [Muhammad Saifullah et al., 2022]. This includes the two aspects that follow. Microcontrollers communicate with each other in the first instance, while microcontrollers and management software communicate in the second. Protocols for communication such as RS485 can be used [L. Chitra et al., 2022].

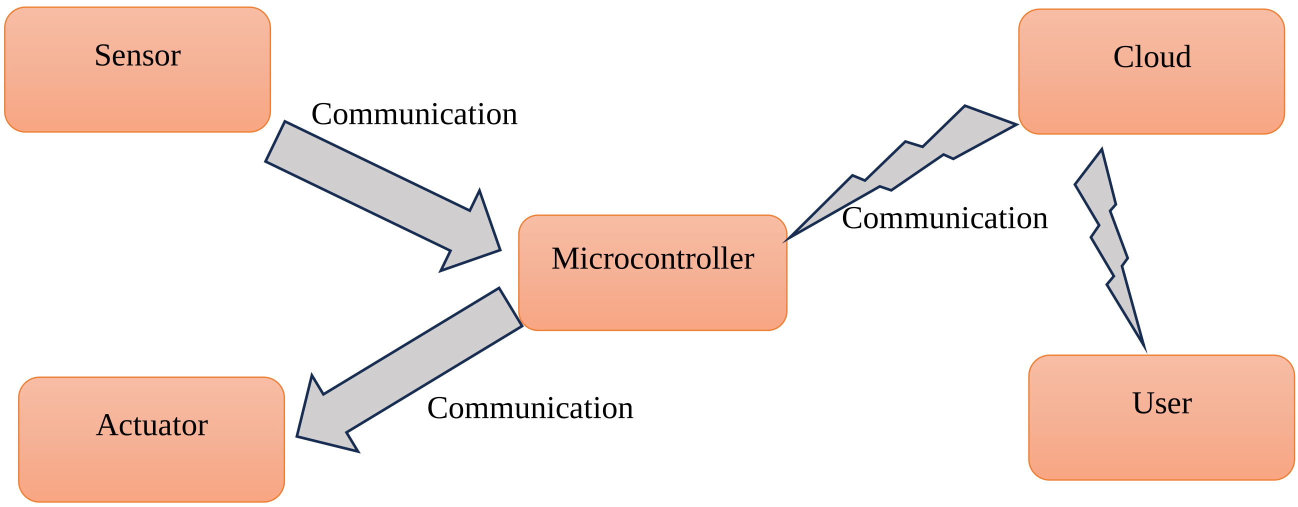

Figure 2. The overview of an IoT system

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Movement Intelligent Monitoring System Optimization

In selecting the sensitive axes, three angular (Eulerian) axes are excluded and only one of the remaining six axes is selected and analyzed. The specific selection method of the sensitive axes is as follows:

$$M = [M_1, M_2, M_3, M_4, M_5 x M_6]^2 \quad (1)$$

This equation defines a vector$M$composed of six components [$M_1, M_2, M_3, M_4, M_5, M_6$] The vector issquared element-wise.

$$H_I^2 = \frac{1}{n}\left|\sum_{i=1}^{m}\sum_{j=i}^{n}\left(M_{IJ} - \frac{M_i}{M_j}\right)^2\right| \quad (2)$$

This equation uses stacked summations to calculate H_I^2 . It calculates the squared magnitude of the total of the discrepancies between M_I To M_j The outer summation is performed over i from 1 to m, whereas the inner summation is performed over j from i to n. The total expression is then split by n.

$$F = (m,n) \le f(\varphi(m,n)) \ge \frac{b^{\frac{1}{3}}}{a^{\frac{1}{2}}} \int f(x) \frac{u(x-b)^2}{a} dx. \quad (3)$$

This equation has an integral and a function f. It looks to be a wavelet transformation.

$$F = (m,n) \text{ is compared to } f(\varphi(m,n) Where \varphi(m,n)$$

It is most likely a transformation. (x). The integral contans the function with a weighting term and is related to the wavelet transform.

These equations are part of a motion monitoring system optimisation approach that combines over-zero detection with wavelet transform for counting and calculating the periods of limb motions. Selecting sensitive axes, conducting wavelet transformations on key axis inputs, and producing wavelet coefficient matrices are all part of the procedure.

RESULT & DISCUSSION:

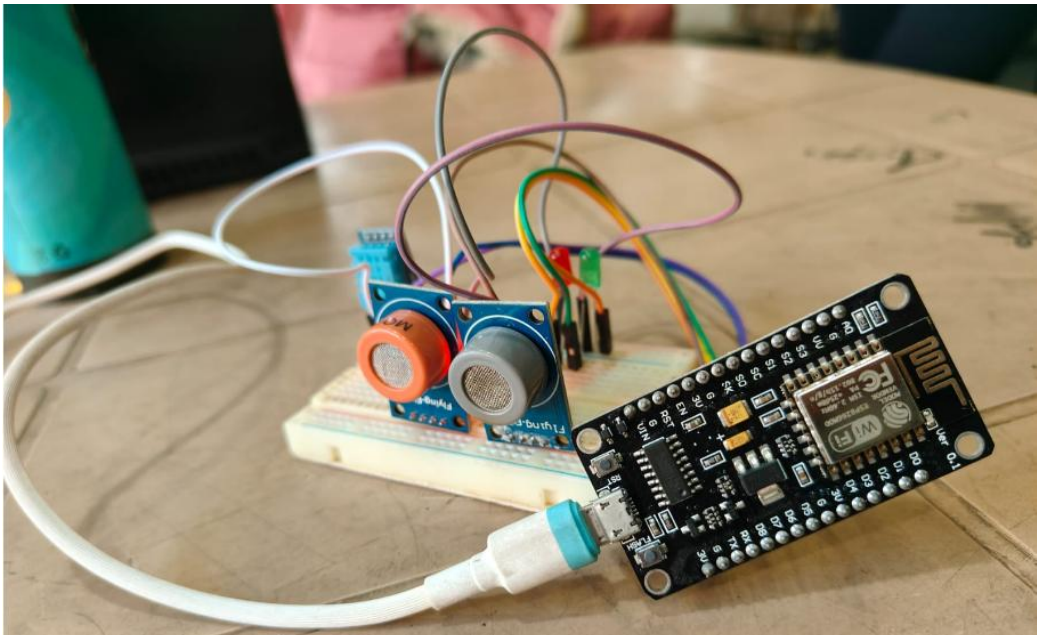

Figure 3. Hardware Setup

Figure 3 shows the MQ3, MQ7, and DHT11 sensors each perform a specific purpose in air quality and environmental monitoring systems. The MQ7 sensor detects carbon monoxide, while the DHT11 monitors temperature and humidity. These sensors, when connected to a microcontroller, can give useful data for safety systems, temperature control, or health-related applications by monitoring ambient conditions and identifying harmful

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substances. The integration of numerous sensors into a single system enables a more comprehensive approach to environmental analysis and control.

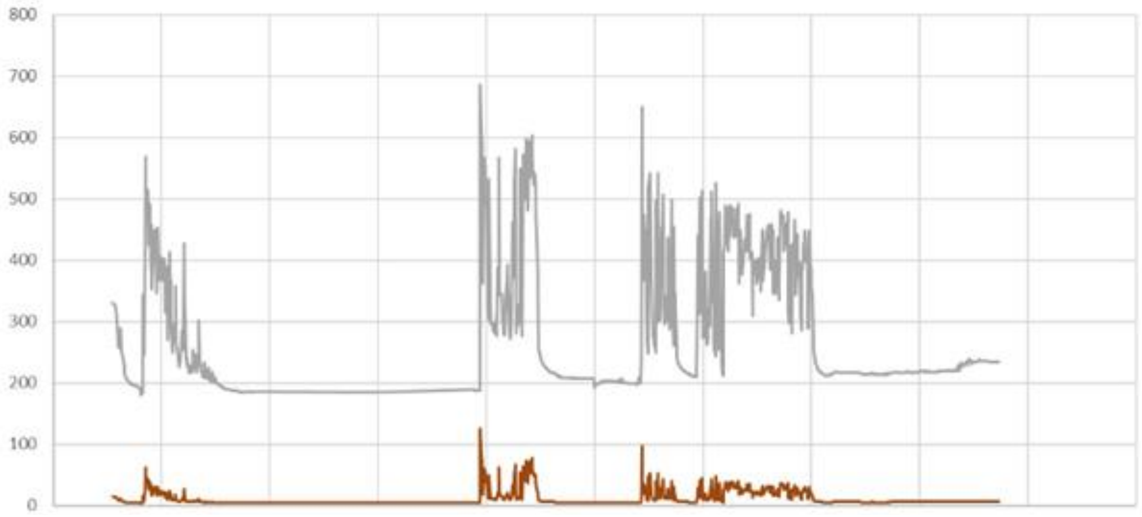

Figure 4. Smoke Sensor Data

The graph you gave appears to show sensor readings over time, with two data sets shown in Figure 4 . The grey MQ-7 line most likely indicates the sensor's raw conductivity in reaction to CO levels. The orange line denotes the concentration of CO in parts per million (ppm). The grey MQ-7 line has strong spikes, which might represent occasions when the sensor recorded greater quantities of CO. This form of data visualisation is beneficial for detecting patterns, detecting possible leaks, and validating the sensor's reaction time and recovery time to variations in CO concentration.

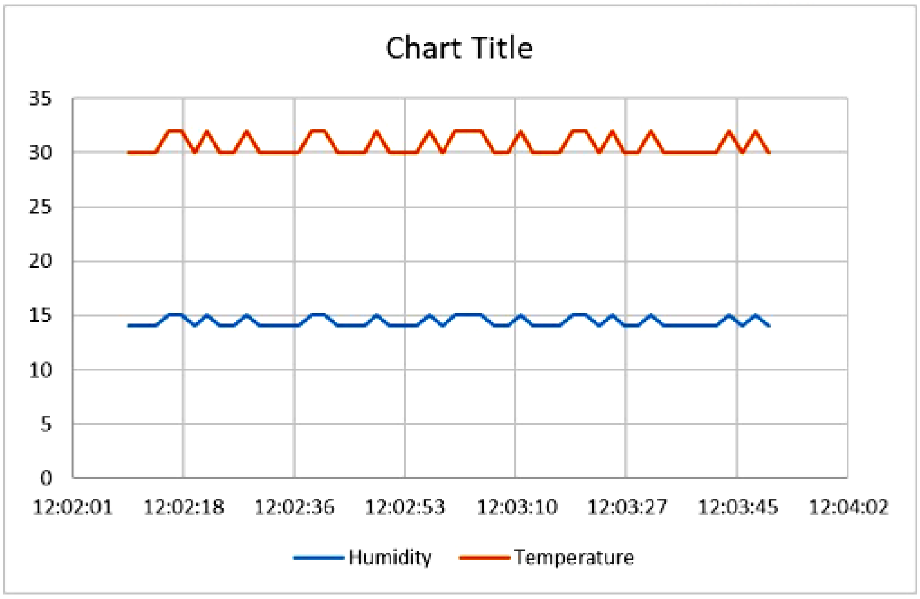

Figure 5. Temperature Humidity Data

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Figure 5 depicts a line chart plotting two datasets over time. The blue line denotes humidity, whereas the orange line denotes temperature. The numbers on the y-axis represent the measurement units for humidity (most likely in percent) and temperature (most likely in degrees Celsius or Fahrenheit). The time on the x-axis represents a limited period, probably a minute or two, suggesting real-time monitoring. The temperature remains relatively steady across the observed period, but humidity fluctuates somewhat, indicating a stable climate within the timeframe of the data reported.

Table 1. Comparative Analysis between Traditional Industrial Systems and IOT-Based Industrial Systems

Aspect	Traditional Industrial Systems	IOT-Based Industrial Systems
Data Collection	Limited and Manual	Automated and comprehensive
Monitoring in real time	Restricted or postponed	Real-time connectivity for data
Interaction confined	Frequently wiredworldwide	wireless connection
Data processing	Basic analytics	Proficient analytics and machine learning
Remote Control	Restricted or manual	Remote observation and management
Decision Making	Depends on the involvement of humans	Data-driven, automated decision-making
Maintaining Predictiveness	Reactive methodology	Proactive maintenance techniques
Reduction of Downtime	Increased likelihood of downtime	Decreased downtime via insights
Economy of Cost	Restricted optimization	Optimum use of available resources
Scalability	Restricted scalability	Scaled with ease using IoT devices
Security	Conventional security methods	Enhanced authentication and encryption
Flexibility	Stiff and fixed systems	Systems that are flexible and adaptive
Total Effectiveness	Reduced effectiveness	Increased productivity and efficiency

Table 1 shows IoT-based industrial systems outperform traditional methods in several critical aspects. They enable automated and comprehensive data collection, real-time monitoring through wireless connectivity, proficient analytics, and machine learning for enhanced decision-making. IoT facilitates remote observation and management, proactive maintenance techniques, and insights-driven reduction of downtime. Optimum resource utilization and scalability are achieved, while enhanced security measures, including

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authentication and encryption, provide robust protection. The flexibility and adaptability of IoT-based systems contribute to increased productivity and efficiency, making them a superior choice compared to traditional industrial approaches characterized by manual data collection, restricted monitoring, and limited scalability. The transition to IoT offers a transformative shift towards a more connected, responsive, and effective industrial landscape.

CONCLUSION

To sum up, this study's IoT-based Industrial Monitoring and Control System (IMCS) marks a substantial development in the field of industrial automation and monitoring. IoT-enabled industrial settings have allowed for a paradigm shift by offering answers to persistent problems with resource utilisation, efficiency, and downtime. The study primarily concentrates on the deployment of an Internet of Things (IoT)-based motion monitoring system, highlighting its function in monitoring important parameters, including the kind, amount, and duration of movement during physical activities.Multiple users may be accommodated simultaneously by the suggested system, which is designed for smart-fit scenarios. A thorough foundation for motion monitoring is created by the system's architecture, which consists of wireless access points, terminals, data processing servers, and active acquisition nodes. The paper investigates categorization algorithms based on deep neural networks and support vector machines (SVM) for active pattern identification in terms of algorithm optimization. Furthermore, a wavelet transform and over-zero detection approach is suggested for period computation, which shows excellent calculation efficiency and accuracy.

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