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IoT Based Industrial Machine Health Monitoring and Control

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Abstract: *Machine health monitoring in today's complex plant systems has gained more prominence than ever before because of steep increase in machinery costs, plant investments and maintenance expenses. A breakdown in any one machine or a component in a plant could mean huge losses coupled with safety and environmental threats as in the case industrial and commercial plants. The advances in manufacturing technology and the competition in the market necessitate the continuous availability of machinery for production. This has created a need for integrating maintenance with other manufacturing activities for better plant availability and efficiency. The objective of present research work is to present one such Machine health monitoring (MHM) system developed using knowledge-based systems. The proposed model can be a useful maintenance tool in majority of small and medium scale manufacturing plants. A comprehensive knowledge-based system (KBS) could be developed over a period of time for industrial machinery which can monitor the major machinery faults and provide expert maintenance solutions through measurement and analysis of machine parameters such as current, voltage, vibration, temperature*

Keywords: Machine health, condition monitoring, voltage, temperature, Vibration Analysis, Sensor-Based Monitoring

I. INTRODUCTION

Industrial Internet of Things (IoT) is the best way of connecting industrial machineries and sensors, to each other, over the internet, allowing the authorized user of the industry to use information from these connected devices to process the obtained data in a useful way. IoT-connected applications typically support data acquisition, aggregation, analysis, and visualization. The IoT architecture includes latest technologies such as computers, intelligent devices, wired and wireless communication and cloud computing [1]. Previously Bluetooth and RF (Radio Frequency) technologies were used to control and monitor the industrial applications but were limited to short distance. The operator had to be in the range of the Bluetooth connectivity or in the Radio Frequency area [2]. For monitoring and control of various industrial applications has some limitations in form of long distance communication, data acquisition, fidelity and cost. Thus, there is a stringent requirement of a system that can monitor as well as control the industrial applications using a reliable protocol that enables a wireless communication over long distances. This paper designs and realizes the effective monitoring and controlling of Industrial application using the newly introduced concept of Internet of Things. In modern manufacturing and industrial operations, ensuring machinery reliability and efficiency is crucial. Machine Health Monitoring (MHM) has evolved significantly with the integration of the Internet of Things (IoT), enabling real-time diagnostics and predictive maintenance. Traditional maintenance methods often rely on scheduled inspections or reactive responses to failures, which can lead to costly downtime and inefficiencies.[3]The integration of IoT with MHM transforms this approach by providing continuous monitoring, automated alerts, and intelligent control mechanisms. The design presents many advantages as described.[6] First of all the different sensors employed in

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industry helps to detect the physical conditions and environmental abnormalities of required industrial applications to be accessed .

II. LITERATURE REVIEW

Bruel & Kjaer :Measuring Vibration -Elementary Introduction (1982)

This project serves as a fundamental guide to vibration measurement principles and techniques, making it an excellent starting point for beginners. It introduces the core concepts of vibration, such as amplitude, frequency, and phase, and explains how they relate to the behavior of mechanical systems. The document outlines common types of vibrations including free, forced, and damped vibrations, helping readers understand real-world scenarios where these occur. It discusses basic measurement tools like accelerometers, velocity sensors, and displacement probes. The working principles of these instruments are explained in a simple, comprehensible manner. Additionally, the project covers signal processing basics, including filtering and frequency analysis, which are essential for interpreting vibration data. Practical applications in machine condition monitoring, fault detection, and predictive maintenance are also introduced. The content emphasizes the importance of proper sensor placement and data acquisition methods for accurate measurements. Although it provides a solid foundation, the material is somewhat outdated and may not include recent technological advancements or digital analysis techniques. Modern tools like wireless sensors, AI-based analysis, and real-time monitoring systems are largely absent. As a result, while the project is informative for students and early professionals, it may fall short for those seeking advanced or up-to-date insights. It remains a useful educational resource due to its clear structure and beginner-friendly language. Readers looking to deepen their expertise will need to supplement it with current literature. Nonetheless, it effectively bridges the gap between theory and practical understanding. Overall, this guide is a valuable starting point for those new to vibration measurement.

Chhaya, L., Sharma, P.,Kumar, A., &Bhagwatikar, G.: IoT-based Implementation of Field Area Network Using Smart Grid Communication(2018)

This project explores the integration of smart grid communication using IoT technologies within field area networks (FANs). It highlights how IoT can improve data exchange between distributed energy resources, substations, and control centres. By enabling real-time monitoring and automation, the system enhances the efficiency and reliability of the smart grid. The project discusses various communication technologies such as LoRa, Zigbee, and LTE that support scalable and flexible network structures. It also emphasizes the role of sensors and smart meters in collecting and transmitting energy data. The use of IoT in FANs helps in early fault detection, load balancing, and demand-response management. Security measures and data integrity are also addressed, given the critical nature of energy systems. This approach supports sustainable energy management and grid modernization. However, deploying such systems may require a high initial investment in infrastructure and devices. The project outlines these cost implications and potential challenges in implementation. Despite this, the long-term benefits such as reduced operational costs and better energy utilization are promising. The project serves as a valuable reference for understanding modern energy communication systems. It bridges the gap between traditional grids and future smart energy networks.

Seetharaman, A.,Patwa,N.,Saravanan,A.S.,& Sharma, A.: Customer Expectation from Industrial Internet of things (IIoT). (2024)

This paper discusses customer expectations and adoption challenges related to the Industrial Internet of Things (IIoT). It sheds light on how industries perceive IIoT and what they expect from its integration into their operations. The study captures key market demands such as improved operational efficiency, real-time monitoring, and predictive maintenance. It also explores the barriers industries face, including data security concerns, lack of skilled workforce, and integration with legacy systems. The paper emphasizes the growing need for flexible and scalable IIoT solutions to meet diverse industrial needs. It provides valuable insights into how businesses weigh the benefits against the costs and risks of adoption. The role of customer awareness and education in successful implementation is also discussed.[4]However, the paper falls short in offering technical insights into how IIoT systems are actually implemented. Details on architecture, protocols, and deployment strategies are limited. This limits its usefulness for

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readers seeking technical guidance. Still, it serves well as a strategic overview for stakeholders exploring IIoT opportunities. It contributes to understanding user perspectives and market trends. Overall, the paper is informative but lacks depth in engineering and implementation aspects.

PROBLEM STATEMENT

In industrial environments, machines often operate without continuous condition monitoring, making it difficult to detect abnormal behavior such as overheating, overloading, or irregular operation in real time. This lack of visibility can result in unexpected breakdowns, safety risks, and costly downtime. Furthermore, the absence of remote access and control capabilities limits timely intervention and preventive maintenance. There is a clear need for a system that enables real-time health monitoring and remote control of industrial machines to ensure reliable and operation.

REMEDIES:

To address the challenges, a comprehensive system for real-time health monitoring and remote control of machines can be implemented. This system would utilize sensors to continuously collect data on key parameters such as temperature, vibrations, voltage, and current. The data can be processed using IoT (Internet of Things) technologies and transmitted to a centralized platform for real-time analysis and visualization. Integration with alert mechanisms and automated control functions allows for immediate response to abnormal conditions, reducing the risk of equipment failure, enhancing safety, and minimizing downtime. Additionally, remote access capabilities enable timely maintenance and operational adjustments, ensuring greater reliability and efficiency in industrial operations.

III. OBJECTIVES AND SCOPES

OBJECTIVE :

The IoT-Based Machine Health Monitoring System aims to enhance industrial machine performance by providing real-time insights into their condition. The key objectives include:

- Predictive Maintenance: Identifying potential failures before they occur, reducing downtime.
- Data-Driven Insights: Using analytics and machine learning to optimize operations and improve efficiency.
- Cost Reduction: Minimizing maintenance and repair costs by detecting early signs of malfunction.
- Remote Accessibility: Allowing engineers and operators to monitor equipment from anywhere using IoT-enabled dashboards.
- Real-Time Monitoring: Continuous tracking critical parameters like temperature, vibration, pressure, and energy consumption.

SCOPES

This system can be applied to various industries

- Energy Sector: Tracking the health of generators, transformers, and turbines.
- Healthcare: Observing the condition of medical equipment like MRI machines and ventilators.
- Automotive & Aerospace: Ensuring the reliability of engines, hydraulic systems, and other critical components.
- Smart Infrastructure: Managing HVAC systems, elevators, and building automation for improved operational efficiency.
- Manufacturing: Monitoring CNC machines, conveyor belts, and robotic arms to ensure optimal performance

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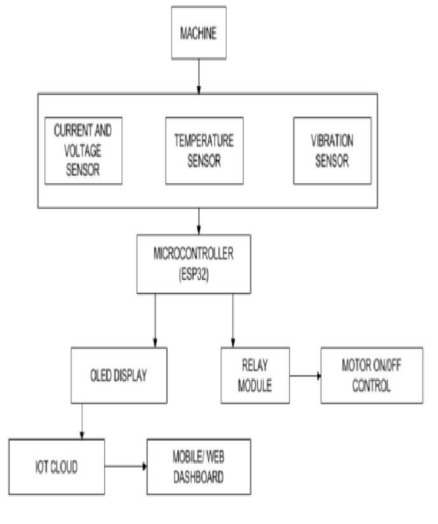
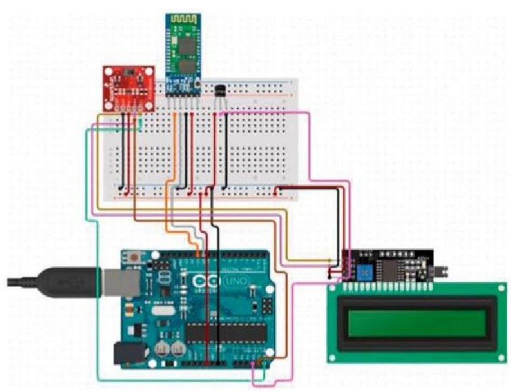
IV. BLOCK DIAGRAM



Block Diagram

CIRCUIT DIAGRAM



Circuit Diagram

V. SENSORS AND THEIR SPECIFICATIONS

Sl No	Sensors	Specifications	Quantity
1	Voltage Sensor	0-25Volt	01
2	Current Sensor	5Volt DC	01
3	DHT11	0-50 degrees	01
4	Vibration Sensor	3.3-5Volt DC	01

VI. WORKING

Working of the Project is mainly classified by following sections:

Display Unit

Control Unit.

- **Display Unit**: This section provides real-time updates on all connected devices. It presents vital electrical parameters such as voltage, current, vibration, and temperature, ensuring operators have instant access to machine health data.
- **Control Unit:** The ESP32 microcontroller gathers sensor readings, processes them, and transmits the data to an IoT cloud platform for remote monitoring. The system generates automated alerts when any parameter deviates from set limits, enabling predictive maintenance to prevent machinery failures.

1. Microcontroller:
ESP8266: Dual-core, Wi-Fi & Bluetooth-enabled microcontroller for edge processing and cloud connectivity.
2. Sensors Used: Voltage Sensor,DHT11, Current Sensor, Vibration Sensor
3. Cloud Platform: Blynk
Dashboards for visualization, alerts, and remote access
4. Additional Components: Relay Module, Power Supply, Connecting Wires, LCD, GSM Module, Buzzer, DC BO Motor.

Working Description:
For Data Acquisition, Sensors measure voltage, current, DHT11, and vibrations from industrial equipment and ESP8266 reads sensor values periodically using its analog and digital input pins. In Data Processing, ESP8266 processes and filters sensor data locally. Thresholds are defined to detect anomalies (e.g., overheating, overcurrent, excess vibration).ESP8266 sends real-time data to the IoT cloud via Wi-Fi using MQTT for IoT Cloud Communication. Each sensor's data is uploaded with timestamps for trend analysis. Users access dashboards through web/mobile apps to view real-time values and also Graphs, gauges, and logs help track machine health for monitoring purpose. For Control Capabilities, Users can remotely control actuators (fans, motors, emergency stop) via the dashboard. ESP8266 receives cloud commands and toggles relays or GPIOs accordingly.

VII. FUTURE SCOPE

In proposed system, there is a flexibility of adding new technologies like Predictive Maintenance IoT sensors will enable real-time monitoring of machinery, predicting failures before they occur, reducing downtime, and optimizing maintenance schedules, and advanced equipment's like advanced sensors for example, waterproof sensors can be employed for application like Jack well or Submerged motors, etc.

VIII. CONCLUSION

The transition from traditional monitoring systems to an IoT-based industrial health monitoring and control framework marks a transformative shift in industrial management. By leveraging real-time data, predictive analytics, and automated correction protocols, this approach not only minimizes faults but also optimizes overall operational efficiency. The integration of diverse sensors, robust network connectivity, and advanced data processing technologies ensures that every electrical parameter is monitored continuously, enabling proactive maintenance and reducing the risk of unexpected downtime.
In summary, the IoT-based industrial health monitoring and control system embodies a reliable, efficient, and forward-thinking solution that transforms maintenance strategies, enhances productivity, and drives the next generation of smart industrial operations.

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REFERENCES

[1] Korkua S, Jain H, Lee W-J, et al. Wireless health monitoring system for vibration detection of induction motors. In: 2010 IEEE industrial and commercial power systems technical conference - conference record, pp.1–6. New York: IEEE.

[2] Renold AP, Venkatalakshmi B. IoT-based decision support system for health monitoring of induction motors.(2023)

[3] Chhaya, L., Sharma, P., Kumar, A., & Bhagwatikar, G. (2018). IoT-based implementation of field area network using smart grid communication infrastructure. Smart Cities, 1(1), 176-189.

[4] Seetharaman, A., Patwa, N., Saravanan, A. S., & Sharma, A. (2019). Customer expectation from industrial internet of things (IIOT). Journal of Manufacturing Technology Management, 30(8),1161-1178

[5] Khan, W. Z., Rehman, M. H., Zangoti, H. M., Afzal, M. K., Armi, N., & Salah, K. (2020). Industrial internet of things: Recent advances, enabling technologies and open challenges. Computers & electrical engineering, 81, 106522.

[6] Zhang, W., Yang, D., Xu, Y., Huang, X., Zhang, J., & Gidlund, M. (2020). DeepHealth: A self-attention based method for instant intelligent predictive maintenance in industrial Internet of Things. IEEE Transactions on Industrial Informatics, 17 (8), 5461-5473

[7] Zheng, H., Feng, Y., Gao, Y., & Tan, J. (2018). A robust predicted performance analysis approach for data-driven product development in the industrial internet of things. Sensors, 18(9), 2871.

[8] Jaloudi, S. (2019). Communication protocols of an industrial internet of things environment: A comparative study. Future Internet, 11 (3), 66

[9] Hanafi, D., & Aziz, Z. (2022). Health Monitoring System for Machine by using Internet of Things (IoT). International Journal of Electrical, Energy and Power System Engineering, 5 (1), 19-23