PERFORMANCE ASSESSMENT OF INDUCTION MOTOR BY CONDITION MONITORING WITH IOT

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Introduction:

Induction motors play a vital role as the workhorses driving various machinery and processes. The reliable operation of these motors is crucial for ensuring smooth production and preventing unexpected downtime, which can result in substantial financial losses. To address this challenge, the integration of Internet of Things (IoT) technology with induction motor condition monitoring has emerged as a groundbreaking solution.

Condition monitoring, in its essence, refers to the continuous assessment of a motor's health, encompassing variables such as temperature, vibration, current, and power consumption. Traditionally, this process has been carried out through periodic manual inspections, which are time-consuming, resource-intensive, and prone to human errors. However, with the integration of IoT, real-time monitoring and data-driven analysis have revolutionized the field.

By leveraging IoT sensors and connectivity, induction motors can now be closely monitored and analyzed remotely, providing valuable insights into their performance and condition. These sensors collect and transmit crucial data to a central system, enabling predictive maintenance strategies and facilitating proactive decision-making.

Moreover, the benefits of induction motor's condition monitoring with IoT are multifaceted. First and foremost, it allows for early detection of anomalies, enabling timely intervention and preventing catastrophic failures. This predictive maintenance approach optimizes maintenance schedules, reduces downtime, and minimizes repair costs.

Objectives:

1. To design and fabricate the fault detection system by condition monitoring of motor with IoT.
2. To study and analyze the induction motor.
3. To study and live condition tracking of induction motor with ESP32 (Microcontroller).

Methodology:

- **Objectives defined and requirements:** The first step is to define the objectives and requirements of the performance assessment for project. This includes identifying the specific performance parameters that need to be monitored and the required accuracyand resolution of the data.
- **Selecting the sensors and monitoring equipment**: The next step is to select the sensors and monitoring equipment that will be used to collect the data. This includes selecting sensors that are suitable for the specific performance parameters being monitored and that are compatible with the IoT system.
- **Installing the hardware**: The sensors and monitoring equipment are then installedin the motor or in the surrounding environment, depending on the specific application.
- **Connecting the hardware to the IoT network**: The sensors and monitoring equipment are then connected to the IoT network using a suitable communication protocol, such as Wi-Fi or Bluetooth.
- **Collection and analyzing of data**: The sensors and monitoring equipment are used to continuously collect data on the performance and condition of the motor. The datais then analyzed using appropriate methods and techniques, such as vibration analysis, temperature monitoring, and electrical current monitoring, to identify any potential issues or trends.
- **Reporting and interpreting the results:** The results of the performance assessmentare then reported and interpreted and recommendations are made for any necessary maintenance or repairs.

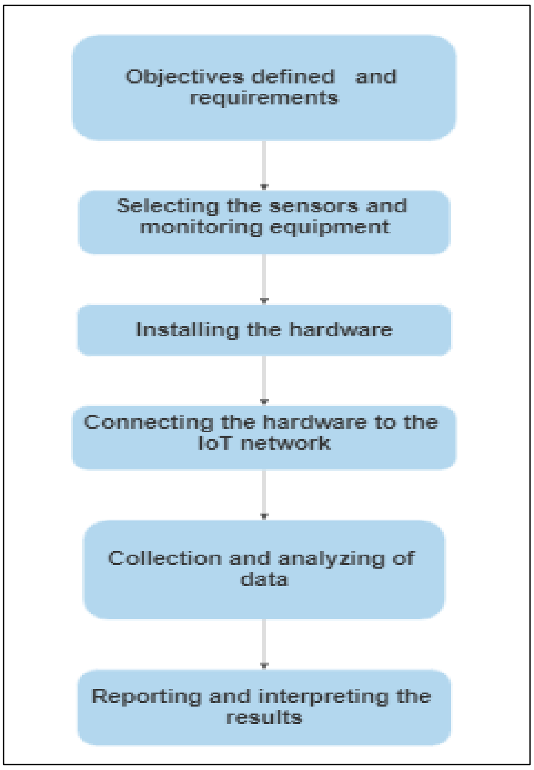

Fig. 1 Methodology of project work

Components used:

1) **ESP32:** The ESP32 microcontroller is utilized for data acquisition, processing, and wireless connectivity, enabling seamless integration of the induction motor with the IoT ecosystem.

2) **IR Sensor:** The IR sensor plays a crucial role in detecting the rotational speed (rpm) of the induction motor, providing valuable input for condition monitoring and predictive maintenance.

3) **Temperature Sensor:** Temperature sensors are employed to monitor the motor's thermal performance, enabling early detection of overheating and preventing potential failures or damage.

4) **Gyro Sensor:** Gyro sensors are utilized for vibration detection, allowing for the assessment of motor stability and identifying potential mechanical issues that may impact its performance.

5) **Capacitor:** Capacitors are used to regulate and stabilize electrical signals, ensuring accurate data acquisition and transmission for precise condition monitoring of the induction motor.

6) **Resistor:** Resistors are employed for signal conditioning and protection, maintaining the integrity of the data collected from various sensors and facilitating accurate analysis for effective condition monitoring.

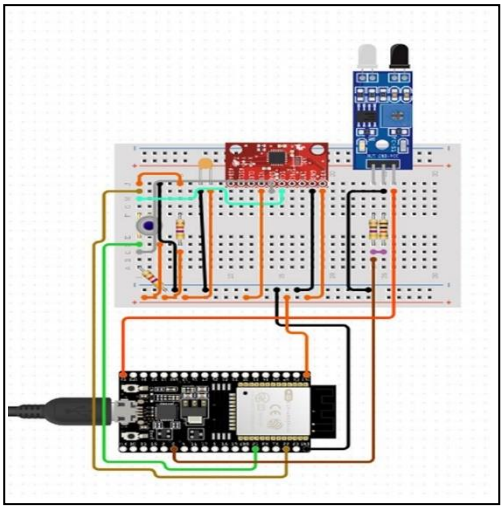

Fig. 2 Circuit Diagram

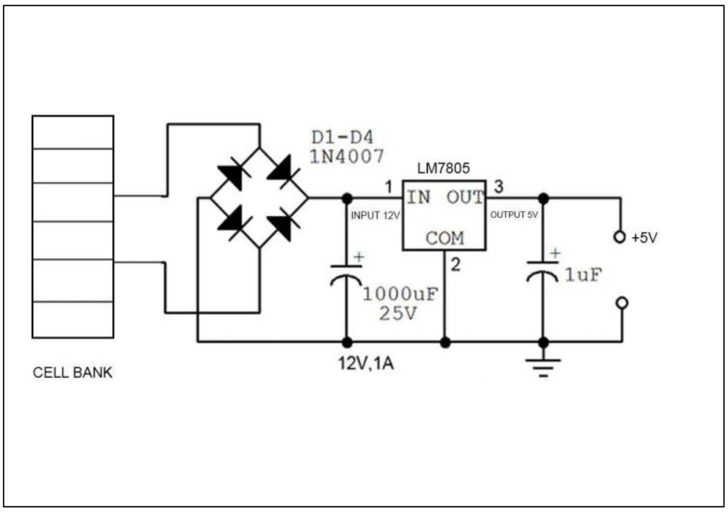

Fig. 3 Power Supply Circuit Diagram

Advantages

- Efficient monitoring of agricultural machinery
- Predictive maintenance
- Automation
- Improved productivity and reduced downtime
- Extended equipment lifespan
- Cost savings
- Enhanced operational efficiency
- Environmental impact reduction
- Scalability and adaptability

Innovation

The innovation in this project lies in its utilization of IoT technology and a combination of sensors, such as the IR sensor, gyroscopic sensor, and temperature sensor, to create a motor pre-maintenance system. By integrating these sensors with the ESP32 microcontroller as the IoT module, the system enables real-time monitoring and analysis of RPM, vibrations, and temperature data. This approach allows for early detection of potential motor issues, predictive maintenance, reduced downtime, and improved motor lifespan. The comprehensive and proactive nature of this IoT-based system sets it apart as an innovative solution for efficient and timely motor maintenance.

Results of Condition Monitoring of Motor on a Web-page

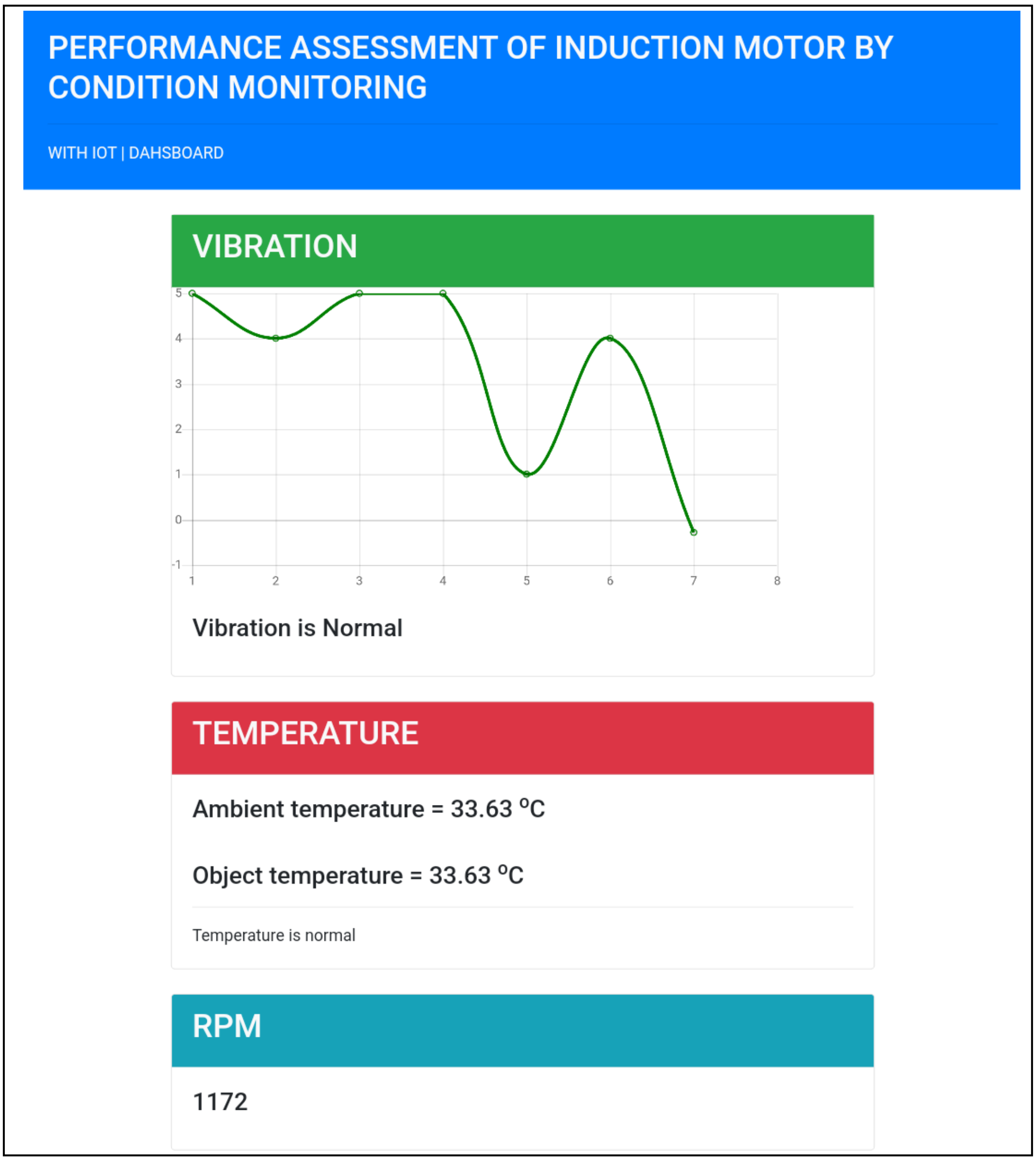

Fig. 4 Result web-page 1

1) **Vibration:** Its Normal (below +2 and above -2 in graph) and then vibration is less than 8.9mm/s
2) **Temperature:** Normal close to Ambient Temperature
3) **Rpm:** 1172, Normal.

The graph (Fig. 4) provided represents the performance of a motor that was operated at its normal RPM for a duration of 10 minutes. It depicts the relationship between various parameters and time, showcasing how the motor behaved under standard operating conditions. This data can be analyzed to assess the motor's efficiency, power consumption, or any other relevant performance metrics.

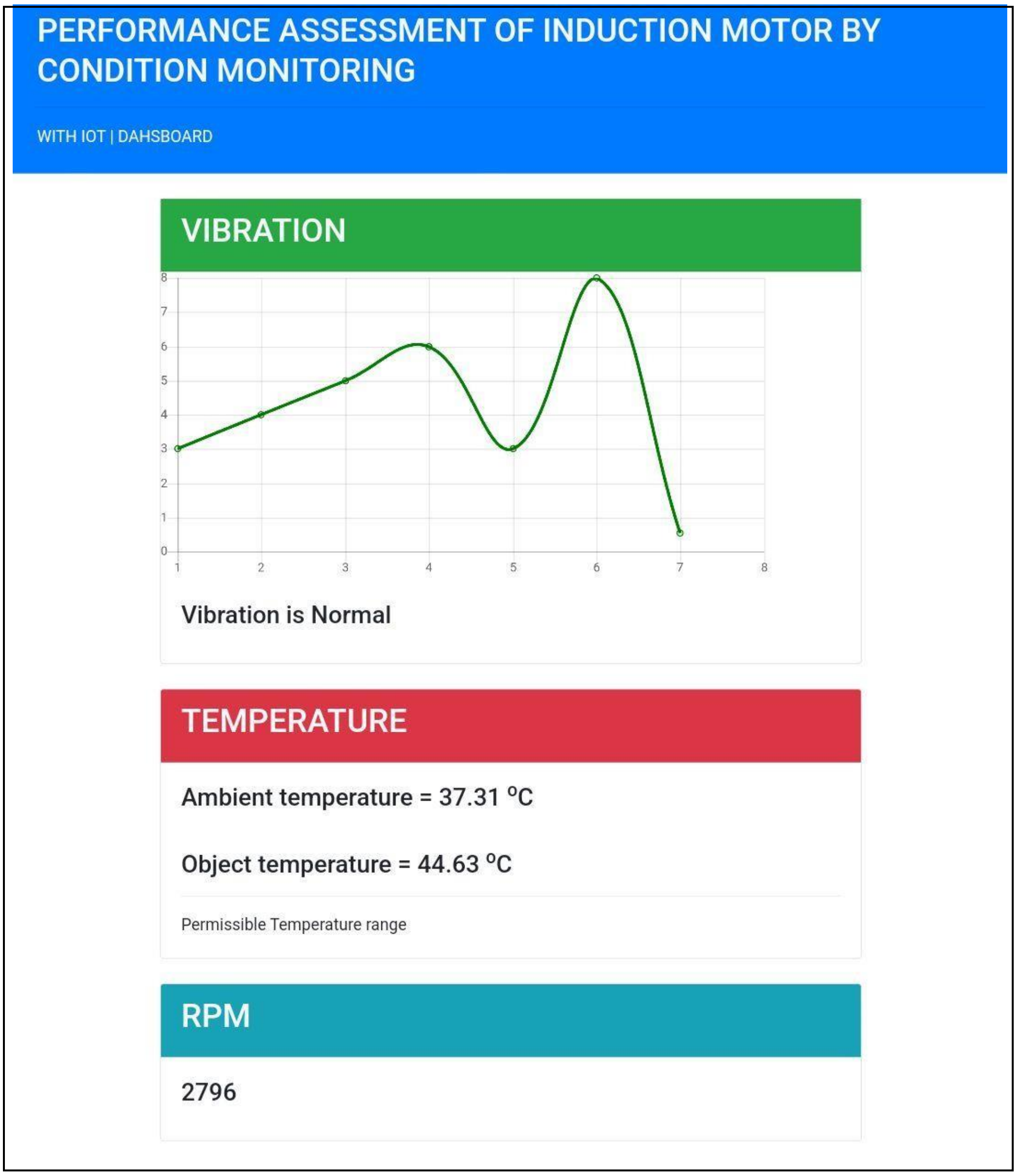

Fig. 5 Result web-page 2

1) **Vibration:** Its Normal (below +2 and above -2 in graph) and then vibration is less than 8.9mm/s
2) **Temperature:** Permissible little higher than Ambient Temperature
3) **Rpm:** 2796, Near to Maximum.

The graph (Fig. 5) shown corresponds to the motor's performance when it was subjected to high RPM for a prolonged period of 62 minutes. By examining this graph, the insights into how the motor responded to increased rotational speeds and assess factors such as temperature, vibration, or power output during extended high-speed operation. This information is valuable for evaluating the motor's capabilities under demanding conditions.

CONCLUSION

In conclusion, the IoT-based motor pre-maintenance system project aims to efficiently and promptly maintain motors and rotating equipment by monitoring and analyzing RPM, vibrations, and temperature data in real-time. By utilizing the ESP32 microcontroller as the IoT module and integrating various sensors, such as the IR sensor, gyroscopic sensor, and temperature sensor, the system provides a comprehensive approach to motor maintenance. The project's methodology involves data collection, processing, and analysis using the ESP32 microcontroller, with the relevant information transmitted to a remote monitoring or control system for further action. The system offers benefits like early issue detection, predictive maintenance, reduced downtime, and improved motor lifespan. However, it is important to consider potential limitations such as sensor accuracy, power requirements, connectivity issues, implementation challenges, cost considerations, and data security and privacy concerns. Adequate planning, design, and testing are essential to overcome these limitations and ensure the system's effectiveness and success.

SCOPE OF FUTURE DEVELOPMENTS

- **Artificial intelligence and machine learning:** The use of artificial intelligence (AI) and machine learning algorithms could enable the system to analyses and interpret thedata collected by the sensors in real-time, providing more accurate and timely insights into the condition of the motor.
- **Remote monitoring and control:** The use of IoT technology could enable remote monitoring and control of the motor, allowing for the motor to be monitored and controlled remotely from anywhere with an internet connection.
- **Integration with other systems:** The use of IoT technology could enable the integration of the condition monitoring system with other systems, such as manufacturing systems, logistics systems, and other systems, allowing for a more seamless and efficient operation.