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Advanced Motor Fault Detection and Live Dashboard Reporting

Ms. Mukta M. Magdum[1], Ms. Neha V. Mohite[2], Ms. Kavita G. Mahajan[3], Mr. Darshan A. Birnale[4], Prof. Mr. A. M. Shelke[5]
[1, 2, 3, 4]*Student At Electrical Department, DKTE's Yashwantrao Chavan Polytechnic, Ichalkaranj, Maharashtra, India*
[5] *Professer At Electrical Department, DKTE's Yashwantrao Chavan Polytechnic, Ichalkaranji, Maharastr, India*

Abstract:** Electric motors play a crucial role in industrial processes, and their unexpected failure can lead to significant downtime and financial losses. This project, "Advanced Motor Fault Detection and Live Dashboard Reporting," aims to provide a proactive solution for motor monitoring and fault prevention. The system continuously tracks critical motor parameters such as current and voltage.When these parameters approach dangerous levels, it generates early warnings to alert operators. If the fault condition persists, the system automatically trips the motor to prevent severe damage. Additionally, a live dashboard displays real-time motor data, enabling operators to monitor performance remotely and take timely actions.This innovative solution enhances safety, reduces downtime, and ensures the efficient operation of motors in industrial environments. The project's combination of fault detection, real-time reporting, and automated protection makes it a valuable tool for modern industries.

Keywords: Arduinomega, PZEM-004T, Temperature Sensor, Vibration Sensor Module, Relay Contactor, Wi-Fi Module ESP8266, LCD Display, Buck Converter W103

I. INTRODUCTION

The increasing reliance on electric motors across industries necessitates robust systems for fault detection and maintenance to ensure operational efficiency and prevent costly downtimes. This project, Advanced Motor Fault Detection and Live Dashboard Reporting, proposes a comprehensive solution that combines state-of-the-art fault detection techniques with real-time monitoring capabilities.

The system leverages advanced signal processing methods, machine learning algorithms, and Internet of Things (IoT) integration to identify anomalies in motor performance. By analyzing key parameters such as vibration, temperature, current, and speed, the system provides early warnings for faults like bearing failure, rotor imbalance, and insulation degradation.

A centralized live dashboard offers real-time visualization of motor health, providing actionable insights for predictive maintenance. It includes features such as trend analysis, fault prioritization, and remote access, ensuring prompt decision-making and efficient resource allocation. This innovative approach not only enhances motor reliability but also minimizes unplanned downtime, reduces maintenance costs, and optimizes overall system performance, making it a valuable asset for industries embracing Industry 4.0.

II. NEED OF THE STUDY

Electric motors are critical components in various industries, powering essential machinery and processes. However, unexpected motor failures remain a persistent challenge, leading to costly downtime, production delays, and potential safety hazards. Traditional monitoring systems often react only after a fault occurs, leaving limited scope for prevention.One of the primary issues is the lack of real-time data and proactive fault detection systems capable of identifying early warning signs,such as abnormal current or voltage levels. Without timely intervention, these minor issues can escalate into significant failures, resulting in expensive repairs and reduced equipment lifespan. This project addresses these challenges by developing a system that not only detects early signs of motor faults but also provides live performance monitoring and automated fault response mechanisms. By incorporating these features, the proposed solution ensures enhanced motor safety, operational efficiency, and reduced maintenance costs in industrial applications.

III. DATA AND SOURCES OF DATA

Several studies and technologies focus on motor fault detection, but most are reactive rather than preventive. Key references include: Research on IoT-based motor monitoring systems for industrial applications.Papers highlighting the limitations of traditional fault detection systems.Case studies where real-time data prevented catastrophic equipment failures.

This project builds on existing knowledge by integrating fault prediction, real-time data visualization, and automated protection mechanisms.

IV. THEORETICAL FRAMEWORK

The theoretical framework of this project combines electrical engineering principles for monitoring motor parameters, IoT technology for real-time data transmission and visualization, control system concepts for automated motor protection, and preventive maintenance strategies to detect faults early and ensure efficient operation.

V. METHODOLOGY

The system is built around the Arduino Mega board. It is used as main controller to read the different parameters of motor though the sensors and find the faults. Also upload all the parameters on the website.

A. Block Diagram

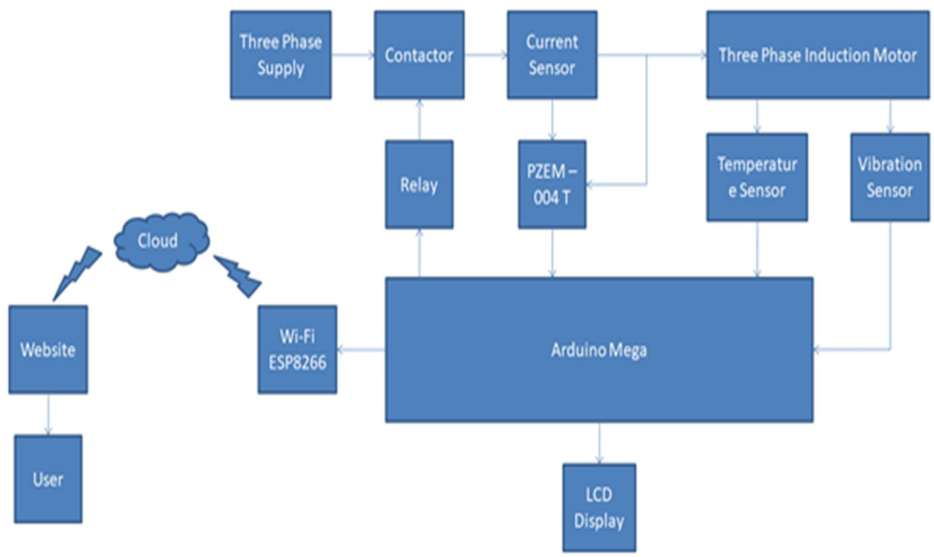

Fig 1:- Functional block Diagram

B. Circuit Diagram

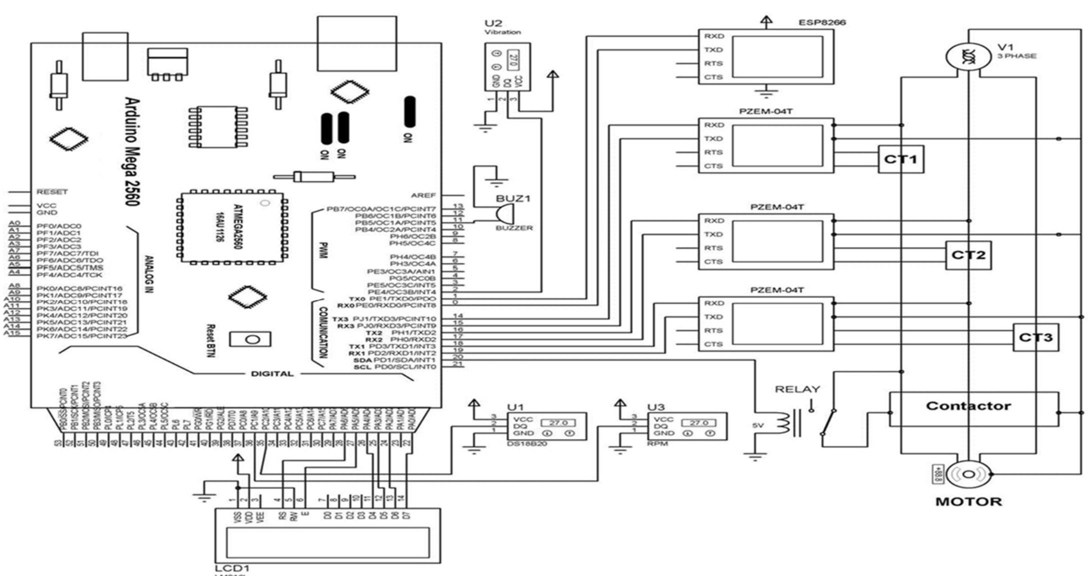

Fig 2: Circuit Diagram

VI. HARDWARE RESULTS

The hardware system accurately monitors motor parameters, generates early warnings at predefined thresholds, and automatically trips the motor during critical faults. Testing confirmed its reliability, ensuring effective motor protection and operational safety.

A. Code Features

1) *Arduino Mega:* The system is built around the Arduino Mega board. It is used as main controller to read the different parameters of motor though the sensors and find the faults. Also upload all the parameters on the website.
2) *PZEM-004T:* The sensor PZEM-004T is used to read current, voltage, power factor, power, frequency of motor. It is connected to motor and supply. Its output is connected to Arduino.
3) *Temperature Sensor:* Temperature sensor DS18B20 is used to sense the temperature of motor. It is connected to body of the motor. Its output is connected to Arduino board.
4) *Vibration Sensor Module:* Vibration sensor is used to detect the vibration in motor. It is also placed on the motor. Its output is connected to Arduino Mega.
5) *Relay Contactor:* Contactor is used to control the motor. That is turn on or off the motor. It is connected between supply and motor. Contactor is controlled by Arduino through the relay.
6) *Wi-Fi module ESP8266:* Wi-Fi module ESP8266 is used to provide internet connectivity to the system. It is connected to Arduino board. It communicates through serial port.
7) *LCD Display:* An LCD (Liquid Crystal Display) screen is an electronic display module and has a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits.
8) *Buck Converter W103:* This buck converter provides a stable, regulated voltage to power sensors, microcontrollers, and communication modules in your motor fault detection system, ensuring efficient operation and accurate live data reporting.

VII. ADVANTAGES

1) Continuously tracks motor health and performance
2) Identifies potential motor issues before they lead to failures
3) Provides instant alerts for abnormal conditions
4) Reduces repair and replacement costs by preventing major failures.
5) Lowers operational and maintenance expenses.
6) Reduced down time
7) Increased motor lifespan
8) Remote monitoring and alerts

VIII. RESULT

The IoT-based motor fault detection system effectively monitors critical parameters of a three-phase motor, including voltage, current, power, energy consumption, and temperature, using sensors like PZEM-004T and DS18B20. Real-time data collection and fault detection, such as over-voltage, under-voltage, phase imbalance, and overheating, are achieved through Arduino or ESP32 integration. Data is transmitted to IoT platforms like ThingSpeak or Blynk for remote monitoring, with alerts sent via mobile apps, SMS, or email when thresholds are exceeded. The system enables predictive maintenance by analyzing trends, improving energy efficiency, and ensuring timely actions to prevent motor damage, enhancing reliability and lifespan.

A. Actual Model

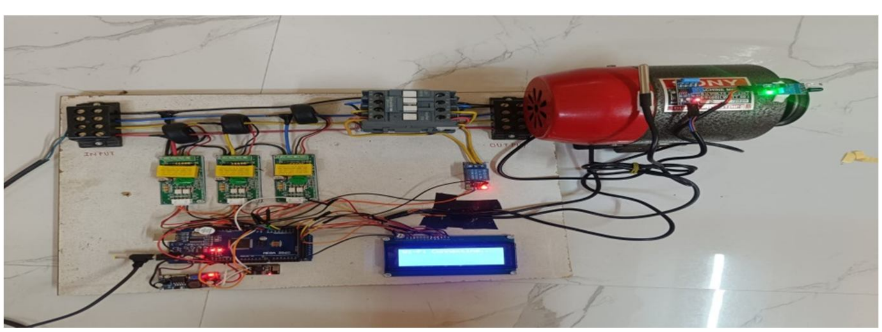

Fig 3: Result Diagram

IX. FUTURE SCOPE

The future scope of motor fault detection systems lies in integrating advanced technologies like AI and machine learning to enhance prediction accuracy, allowing for more precise fault diagnosis and preventative maintenance.

The use of 5G and cloud computing will enable faster data transfer and remote monitoring, making it possible to monitor motors from anywhere in real time.

Additionally, incorporating energy-efficient sensors and autonomous repair systems could lead to fully automated maintenance, further improving motor longevity and reducing operational costs.

These advancements will make motor fault detection systems more reliable, scalable, and cost-effective in the future

X. CONCLUSION

Advanced motor fault detection and live dashboard reporting provide an efficient and reliable solution for real-time motor monitoring. By combining sensors, microcontrollers, and IoT technology, the system ensures early fault detection, minimizes downtime, and protects motors from damage. The live dashboard enables remote monitoring, proactive maintenance, and improved operational efficiency. This innovation is a step toward smarter, safer, and more sustainable industrial systems, paving the way for future advancements in automation and energy management.

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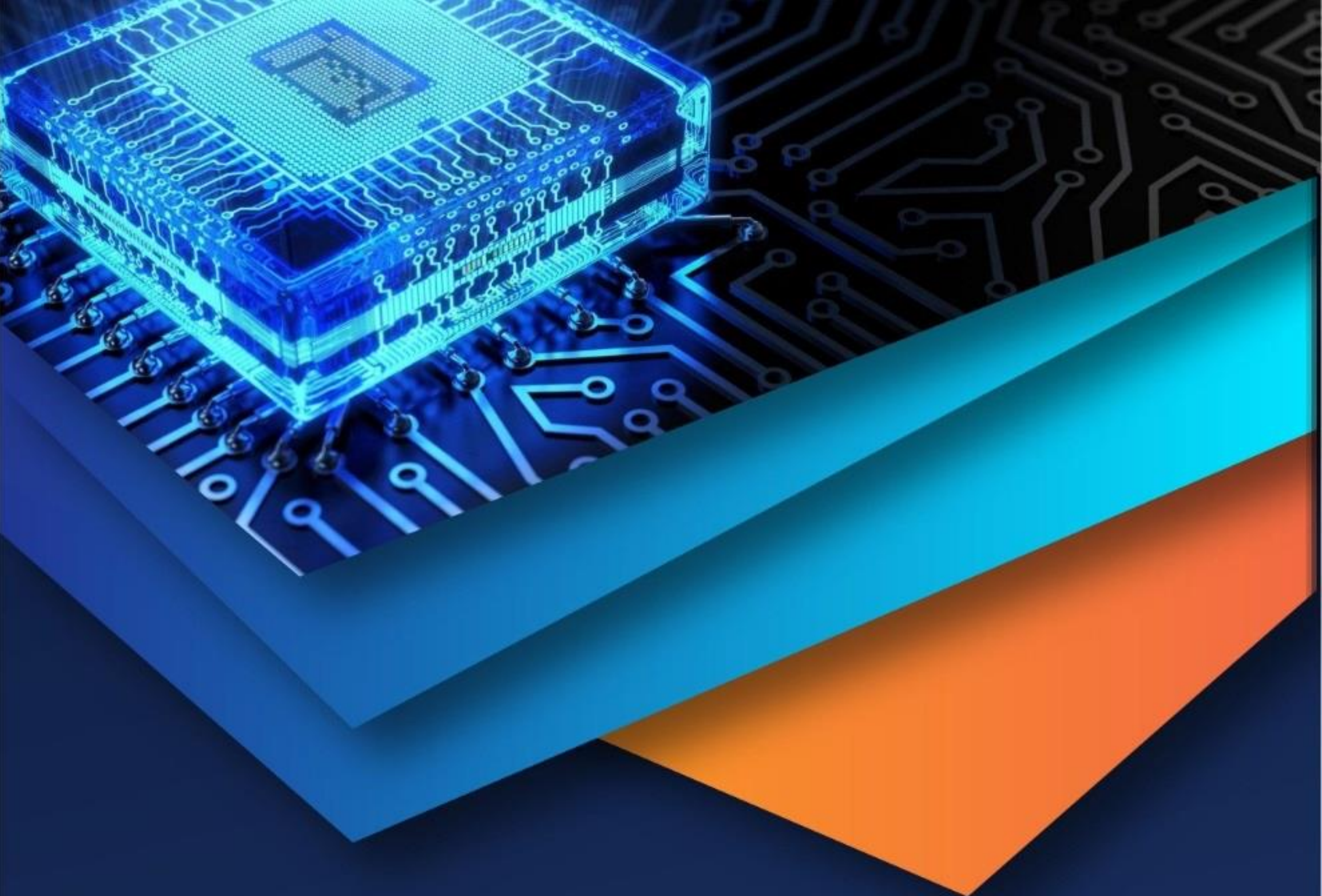

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