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The Novel IOT-Enabled Protection For Three Phase Induction Motor

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Abstract: In today's increasingly interconnected world, the integration of internet of things (IOT) technology into industrial systems is revolutionizing how we approach safety and protection mechanisms. this project presents an IOT-enabled protection system specifically designed for three-phase induction motor, addressing critical hazards such as overcurrent, overvoltage, over vibration, and overtemperature. we utilize an android application that connects to the wi-fi modem of the control circuit that is connected to the motor over the internet. the node MCU is connected to the wi-fi modem. the node MCU receives the signals fron sensors and sent to the appropriate relays. the relays then switch between overtemperature and over vibration and the sent notification to the user via blynk app. also, a three phase voltage and current protection device is used for the protection of motor from over/under voltage and over current protection.

Index Terms - Internet of Things(IOT), Induction Motor, Node MCU, Relay.

I. INTRODUCTION

Three-phase induction motors are widely used in industrial applications due to their durability, efficiency, and simplicity of operation. However, these motors are vulnerable to various faults such as overvoltage, overcurrent, overheating, and excessive vibration, which can lead to significant operational downtime and costly repairs. To ensure the reliable and safe operation of these motors, it is essential to implement a comprehensive protection system.

This project focuses on developing a microcontroller-based protection system that can continuously monitor these critical parameters and take corrective actions to prevent motor damage, thereby enhancing the longevity and reliability of the motors while minimizing maintenance costs and downtime. Protection of three phase induction motor from over/ under voltage, over current, over Vibration and temperature provide the smooth running of motor which also improves its lifetime and efficiency. The project's major goal is to develop a low-cost, effective protection system for Three Phase induction motors.

Three-phase induction motors are the backbone of modern industrial systems due to their robustness, simplicity, and reliability. However, they are still vulnerable to various operational faults that can significantly impact performance, reduce lifespan, and even lead to catastrophic failures if not detected early. Common issues such as overcurrent, overvoltage, excessive vibration, and overheating are critical parameters that require constant monitoring and protection.

This project, titled "The Novel IoT-enabled Protection for Three-Phase Induction Motor," proposes a smart, real-time protection system that integrates Internet of Things (IoT) technology to enhance the safety and efficiency of motor operations. The system continuously monitors key parameters using appropriate sensors and microcontroller-based control logic. When abnormal conditions are detected—such as a surge in current or voltage, abnormal vibrations, or excessive temperature—the system not only takes corrective actions like

motor shutdown but also sends instant alerts to the user via cloud-based platforms or mobile applications. By leveraging IoT, the proposed system allows remote monitoring, predictive maintenance, and data logging, making it a comprehensive and cost-effective solution for industrial motor protection.

This novel approach significantly reduces the risk of unplanned downtime and enhances the reliability and safety of motor-driven operations.

II. LITERATURE REVIEW

1. Overvoltage and Overcurrent Protection

[1]. Kumar, P., et al., "Automatic Overvoltage Protection of Induction Motor," International Journal of Electrical Engineering & Technology, 2017.Traditional protection methods include voltage sensors and relays. A study by Kumar et al. (2017) introduced an automatic overvoltage protection system using voltage sensors and microcontroller-based relay control.

[2]. Sharma, R., et al., "Design and Implementation of Overcurrent Protection for Induction Motors," International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, 2018. Overcurrent: Overcurrent protection prevents motor overloads. Sharma et al. (2018) used current transformers (CT) with a microcontroller to monitor current levels and disconnect the motor when thresholds are exceeded.

2. Vibration and Overheating Protection

[3]. Mishra, S., et al., "Vibration Monitoring of Induction Motors Using Piezoelectric Sensor," IEEE Transactions on Industrial Electronics, 2015. Vibration monitoring is essential for detecting mechanical issues like imbalance or bearing failures. Mishra et al. (2015) utilized piezoelectric sensors to detect abnormal vibrations in motors, triggering alarms before significant damage occurred.

[4]. Patel, M., et al., "Temperature Monitoring and Overheating Protection of Electric Motors," International Journal of Advanced Research in Computer Science and Engineering, 2016. Overheating due to overload or poor ventilation is a common cause of motor failure. Patel et al. (2016) implemented a system using temperature sensors (LM35) and microcontrollers for Realtime temperature monitoring to avoid thermal damage.

3. IoT Integration for Motor Protection

[5]. Singh, S., & Kumar, R., "IoT-Based Monitoring and Protection System for Three-Phase Induction Motor," International Journal of Engineering & Technology, 2019. The integration of IoT allows for remote monitoring and control. Singh and Kumar (2019) proposed an IoT-enabled protection system using sensors for voltage, current, temperature, and vibration, with data sent to the cloud and alerts sent to mobile devices. The Novel IOT-Enabled Protection For Three Phase Induction Motor.

[6]. Patel, H., et al., "IoT-Based Motor Protection System Using Blynk App," IEEE Access, 2020.Blynk App for Monitoring: Patel et al. (2020) used the Blynk app in conjunction with an Arduino microcontroller to create an IoT-based motor monitoring system. The app allows for real-time updates and notifications for abnormal conditions.

III. SYSTEM DESIGN & FLOWCHART

3.1 Block Diagram of Protection System

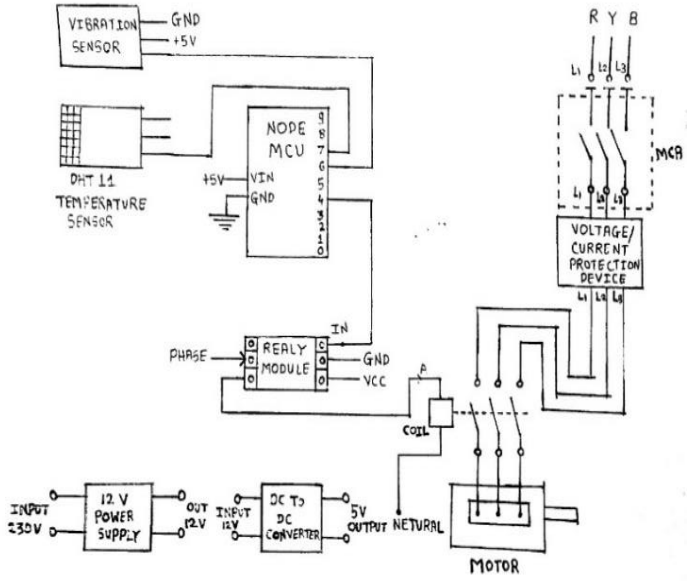

Fig.1 Block Diagram of Protection System

This block diagram illustrates an IoT-based 3-phase motor protection and monitoring system using a Node MCU microcontroller. The system includes a vibration sensor and a DHT11 temperature sensor to monitor the motor's health, with sensor data sent to the Node MCU for processing. If abnormal conditions like excessive temperature or vibrations are detected, the Node MCU triggers a relay module, which in turn deactivates a contactor coil to disconnect the motor from the power supply. The setup also includes a voltage/current protection device to safeguard against electrical faults such as overvoltage, undervoltage, or overcurrent. Power is supplied from a 230V AC source, stepped down to 12V and then to 5V using a DC converter to power the control circuit. This system ensures safe operation of the motor and enables remote monitoring and control via IoT.

3.2 Flowchart

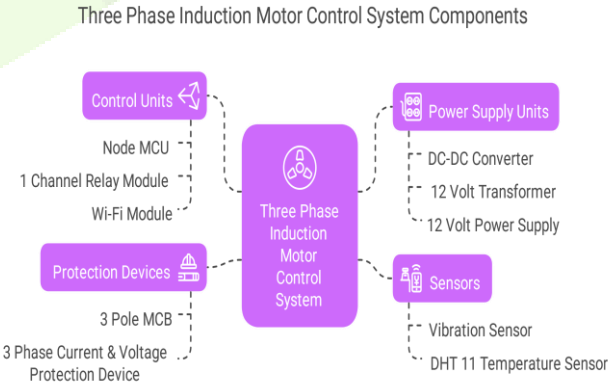

Fig.2 Flowchart of System

Here In the Flow Chart there are four Part as Follows:

1. Power Supply Units-

Here the Converter,12 Volt Transformer and DC to DC Converter used to Provides the Required and Suitable Power Supply to the Devices and the Components Used in the Circuit like Node MCU, Relay, LCD Display and Sensors etc.

2. Control Units-

It consists a Node Microcontroller Unit(MCU),Relay Module and Wi-Fi Module.

3. Protection Devices-

For the Protection of three phase Induction Motor 3 Pole MCB and 3 Phase Voltage and Current Protection Device used.

4. Sensors-

DHT 11 Temperature Sensor and Vibration Sensor used for the protection of Motor from Overheating and Over vibration

IV. SOFTWARE DESCRIPTION & HARDWARE DESCRIPTION

4.1 Software Description

Working of Blynk App in the Project

In this project, the Blynk IoT app plays a vital role in monitoring, detecting faults, and displaying the motor's operational status using real-time sensor data.

⚙ Step-by-Step Process

1. Sensing Abnormal Conditions
   a) The DHT11 Temperature Sensor monitors the motor's temperature.
   b) A Vibration Sensor (e.g., SW-420) detects unusual mechanical vibrations.
   c) These sensors are continuously monitored by a Node MCU (ESP8266/ESP32) microcontroller.
2. Data Processing & Fault Detection
   a) The Node MCU reads values from the sensors.
   b) It compares them with predefined thresholds:
   - Temperature > set limit → Overheating fault
   - Vibration > set level → Overvibration fault
3. Motor Protection (Relay Control)
   a) When any fault condition is detected:
   - The Node MCU activates a relay connected to the motor circuit.
   - This immediately disconnects power, stopping the motor to prevent damage.
4. Real-Time Monitoring via Blynk App
   - The Node MCU sends sensor values and motor status to the Blynk Cloud via Wi-Fi.
   - The Blynk Mobile App displays:
     - Current Temperature
     - Vibration Intensity
     - Motor Status (Running / Stopped / Fault)
     - Fault Alerts via push notifications

5. User Awareness and Control

- The user is notified in real-time if the motor overheats or vibrates abnormally.
- Users can monitor the entire system from anywhere using their smartphone.

Fig.3 Visual Represention of Blynk app

In the Summary "When the DHT11 temperature sensor or vibration sensor detects an abnormal condition, the Node MCU processes the signal and activates a relay to stop the motor. Simultaneously, the Blynk IoT app displays the fault condition and notifies the user with real-time motor status and sensor data."

4.2 Hardware Component Used

Following Hardware are used in this Project-

1. Three Phase Induction motor
2. Vibration Sensor
3. DHT 11 Temperature Sensor
4. One Channel Relay Module
5. Wi-Fi module
6. Node MCU
7. DC-DC Converter
8. Three Pole Contactor Switch
9. LCD Display
10. Three pole MCB
11. Three phase current & voltage protection device
12. 12 Volt Power Supply

In that important device used for the protection of motor is –

- **Three Phase Current & Voltage Protection Device**

Fig.4 Three phase current & voltage protection device

A combined voltage and current protection device is used to continuously monitor and protect the motor from abnormal voltage and current conditions. This device detects issues such as overvoltage, undervoltage, overcurrent, phase loss, and phase imbalance, which are common causes of motor failure. When any of these parameters go beyond safe limits, it sends a signal to the microcontroller or relay system to disconnect the motor—usually through a contactor.

This is a 3-phase voltage and current protection device used to safeguard motors and other industrial equipment from electrical faults. It continuously monitors the voltage and current of each phase (L1, L2, L3) and displays the values using digital LED indicators. The device protects against overvoltage, undervoltage, overcurrent, phase loss, and phase sequence errors. It has IN terminals for power input and OUT terminals for load connection, typically to a contactor or motor.

The input voltage range is usually AC 380V–400V (±15–20%), and it supports current monitoring up to 100A or 120A, depending on the model. The device includes buttons to set threshold values and delays, ensuring flexible protection settings. It features an automatic cutoff if any parameter exceeds the preset limit and resumes operation once conditions normalize. The built-in relay handles load disconnection during faults.

This protector is DIN rail mountable, making it easy to install in control panels. It requires a neutral (N) connection for accurate phase monitoring. It's widely used in motors, compressors, pumps, and HVAC systems to enhance safety and prolong equipment life.

V. EXPERIMENTAL OUTPUT/ RESULT

Here the image shows the real time working model of the project, titled as “The Novel IOT Enabled Protection for Three Phase Induction Motor”.

By using the Three Phase Voltage and Current Protection Device (Provides the Over and Under Voltage Protection also Overcurrent Protection),Temperature Sensor (Provides Overheating Protection) and Vibration Sensor (Provides Over vibration Protection) We Provides the Protection to the Three phase 0.5 HP induction Motor.

To Enhance the safety of Motor We added the IOT Technology in that Model. In that for the Communication purposes We uses a Blynk app, Which is installed in Android phone.

So In this way we can Provide the Protection to the Three phase motor also Enhance its Safety and reduces the downtime.

Fig.5 Experimental Output of Project

VI. CONCLUSION

This paper represents the IOT is well known and most rapidly growing nowadays .Now IOT is becoming an integral aspect of human life. In the future, many items will be connected to the cloud. IOT has recently gained ground into fields such as industry, home, automation, medical field etc. With help of controllers , sensors this prototype gives IOT based condition monitoring parameters and controlling the speed of motor with help of TRIAC .Visualize and analysis voltage parameters on a LCD display .By analyzing motor parameters make the motor to be operated in protective and safe in nature, It also helps in calculating a new data to interact with social media and other gadgets from blynk app, We operate motor parameters on mobile application by connecting to hotspot module. Through blynk app continously monitored the motor parameters and if fault takes place it will get alert notification on android application. In industries required monitoring data value for maintainance and power consumption. In case the motor gets overvoltage, undervoltage than its rated value it will get automatically disconnected from supply and motor gets off.

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