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INDUCTION MOTOR HEALTH MONITORING AND PROTECTION SYSTEM

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ABSTRACT- This paper introduces a novel method for using an Arduino Nano to monitor and safeguard a three-phase induction motor. The goal is to continuously monitor the motor's voltage, current, and temperature in order to identify anomalous conditions instantly. An Arduino Nano, a current and potential transformer, a relay, a three-phase contactor, and an LCD display for real-time data visualization were used to create a protective system. Results from experiments demonstrate that the suggested approach is effective in monitoring and safeguarding three-phase induction motors, extending their lifespan by shielding them from a variety of fault scenarios.

Keywords - Induction motor, Overvoltage, Protection, Overcurrent, Single phasing. Arduino.

I. INTRODUCTION

Three-phase induction motors have a straightforward design, are incredibly durable, and are efficient. They are crucial to manufacturing, commercial appliances, and industrial automation processes. However, if not fixed right away, these motors are susceptible to a number of environmental and electrical issues that could cause irreversible harm. Motor performance and lifespan can be significantly impacted by common problems such overvoltage, undervoltage, overcurrent, overtemperature, and single phasing. For small- to medium-sized applications where cost and efficiency are crucial, traditional protective mechanisms—which can include intricate and costly relay systems—are not necessarily

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the best option. This research suggests a novel and affordable motor protection solution based on an Arduino Nano-based protection system.

By using the capabilities of Arduino Nano microcontroller this method enables real-time monitoring and protection of the motor against the mentioned fault conditions. The system is designed to detect deviations in voltage, current, temperature, and phase imbalance, triggering appropriate actions to prevent damage. This approach offers a flexible, scalable, and reliable solution for enhancing the longevity and reliability of three- phase induction motors in various operational environments.

The simplicity and affordability of Arduino Nano-based systems make this solution particularly appealing for small-scale industries, where both performance and cost efficiency are prioritized. The key objectives of this research are:

1. Create an efficient and cost-effective for three-phase induction motor monitoring and protection system using Arduino Nano.
2. To monitor motor parameters (current, voltage and temperature) in real-time and detect fault conditions

II. METHODOLOGY

A. Block diagram and working

To monitor the several motor parameters, the suggested system includes an Arduino Nano, current and potential transformers, a relay, a contactor, an NTC thermistor, and an LCD display. With the aid of rectifier circuits, the data gathered from current and potential transformers was first transformed into DC values before being digitally sent to the Arduino Nano. An analog to digital (ADC) converter is included into the Arduino Nano. Therefore, an extra ADC unit is not required.

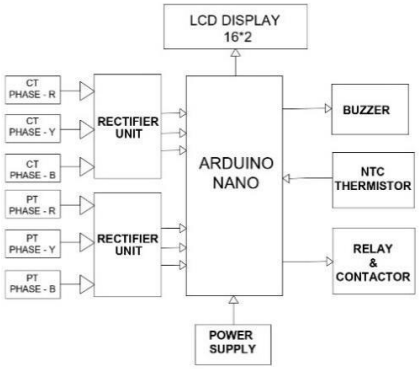

Figure 1: Block Diagram of motor protection unit.

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The proposed protection system can protect the three-phase induction motor against over-current, over- voltage, over-temperature and single phasing problem. LCD display is used to monitor the parameters of motor and display fault condition. The proposed protection system is very quick, sensitive and reliable.

When the values of current, voltage and temperature are increased and surpass the predefined programmed values of the Arduino Nano then Arduino Nano generates trip signal which switches of the three-phase induction motor with the help of relay and three-phase contactor. LCD display shows the fault condition.

B. Hardware Implementation

Key components of the system:

1. Arduino Nano: The microcontroller to process the input data from current and potential transformers.

2. Display: Display the motors parameters on LCD and fault detection.
3. Current and potential transformers: To monitor the current and voltage in each phase.
4. Relay and contactor: To disconnect the motor from the power supply in case of faults.

5. LCD display: For real time data monitoring of motor parameters and display faulty conditions.

C. Software implementation

1. Data Acquisition: Read the analog inputs from the CT, PT and NTC thermistor.
2. Fault detection: Check for faults like overcurrent, overvoltage, over temperature and single phasing
3. Relay control: If a fault is detected, activate the relay to stop the motor.
4. Display: Display the motors parameters on LCD and fault detection.
5. Relay control: If a fault is detected, activate the relay to stop the motor.
6. Display: Display the motors parameters on LCD and fault detection.

III. RESULT

Hardware system:

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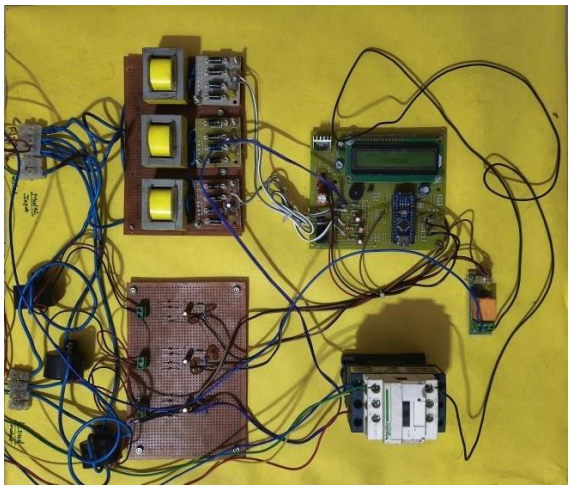

Figure 2: Hardware System of motor protection Unit.

Result on LCD:

- Over Voltage:

Displays the per phase voltage level. If the motor operating within the range: Line 1: R Y B
Line 2: 245V 243V 245V

If the voltage exceeds the threshold: Line 1: Over Volt. R. Y. B
Line 2: Temp: = 29.96

Figure 3. Over voltage fault detection on LCD display

- Over current:

Displays the current flowing through the motor in ampere. If the motor operating within the range: Line 1: R Y B
Line 2: 0.95 0.96 0.99

If the current exceeds the threshold:

Line 1: O. C. trip Phase - Y Line 2: Temp: = 29.79

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Figure 4. Over current fault detection on LCD display

- Over temperature:

Displays the temperature of the motor. If the motor operating within the range: Line 1: Temp: 44.36
If the temperature exceeds the threshold: Line 1: Over Temp
Line 2: 67.63

Figure 5. Over temperature fault detection on LCD display

- Under Voltage:

Displays the per phase voltage level. If the motor operating within the range: Line 1: R Y B
Line 2: 240V 242V 240V

If the voltage decreases than the threshold:
Line 1: Low Vtg R-Y-B Line 2: 29.71

Figure 6. Under voltage fault detection on LCD display

- Single Phasing:

If one of the phases is disconnected from the supply:
Line 1: Low vtg Phase- B Line 2: Temp: 30.46

IV. CONCLUSION

This study effectively demonstrates a low-cost and practical technique for using an Arduino Nano to monitor and safeguard a three-phase induction motor. The suggested method makes it possible to monitor and protect three-phase induction motors in real time with speed, accuracy, and dependability.

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