



Arduino Nano Controlled Monitoring and Protection of Three–Phase Induction Motor

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Abstract: This paper presents an innovative approach to monitoring and protection of three-phase induction motor using Arduino Nano. The objective is to continuously monitor motor parameters (voltage, current and temperature) to detect abnormal conditions in real time. A protection system was developed using Arduino Nano, current and potential transformer, relay, three phase contactor and LCD display for real-time data visualization. Experimental results show the success of the proposed method in monitoring and protection of three-phase induction motor and improves motor's lifespan by providing protection from various fault conditions.

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

I. INTRODUCTION

Three-phase induction motors are very robust, efficient and have simple design. They play an important role in industrial automation processes, manufacturing, and commercial appliances. However, these motors are vulnerable to several electrical and environmental faults, which can lead to permanent damage if not addressed promptly. Common issues such as overvoltage, under voltage, overcurrent, over temperature, and single phasing can severely affect motor performance and lifespan. Traditional protection mechanisms, often involving complex and expensive relay systems, are not always ideal for small- to medium-scale applications where cost and efficiency are critical. This paper proposes an innovative and cost-effective solution for motor protection using 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

3. To evaluate the performance of the proposed system in terms of operational reliability under various faulty conditions.

II. LITERATURE REVIEW

The protection of three-phase induction motors has been a significant area of research due to the susceptibility of these motors to various electrical faults. Several approaches have been proposed to improve the reliability and safety of these motors under various faulty conditions.

A. R. Bayindir[1]

R. Bayindir explains a PLC-based protection method for three-phase induction motor which provides solution for various faults. He used 1.5 KW three-phase induction motor in this research and various sensors and PLC to provide protection to the motor.

B. Rupali Shivpuje[2]

Rupali Shivpuje proposed method of protecting AC induction motor by using microcontroller 89C51. The motor is protected against the faults like, overvoltage, over temperature, over current and under voltage.

C. Dileep Kumar[3]

Dileep Kumar used PLC to provide protection to the three-phase induction motor. Monitoring of three-phase induction motor parameters like voltage, current and temperature is done online. Solid state relays were used in the protection scheme. The drawbacks of mechanical relays are eliminated.

III. METHODOLOGY

A. Block diagram and working

The proposed system consists of an Arduino Nano, Current and potential transformers, relay, contactor, NTC thermistor and LCD display to monitor the various parameters of the motor. The data collected from current transformers and potential transformers first converted into DC values with the help of rectifier circuits and then digitally transferred to the Arduino Nano. Arduino Nano has inbuilt analog to digital (ADC) converter. Hence no need of additional ADC unit.

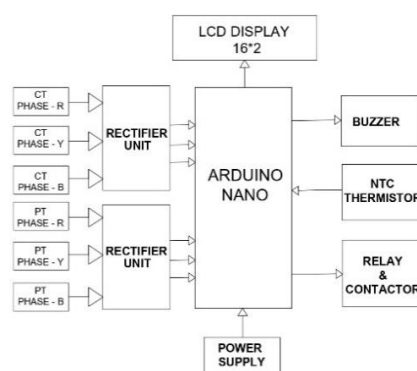


Figure 1: Block Diagram of motor protection unit.

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 off 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.

IV. RESULT

Hardware system:

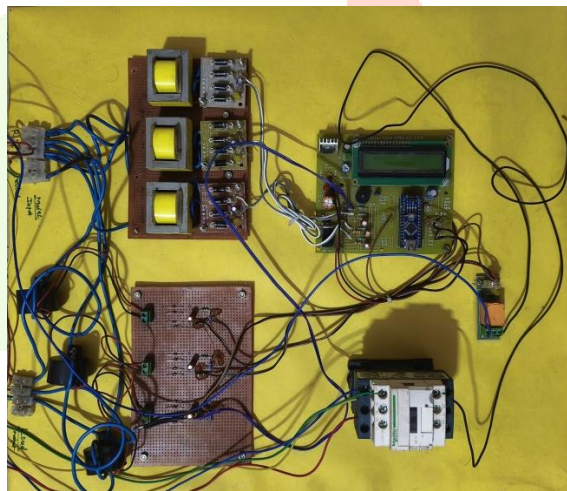


Figure 2: Hardware System of motor protection Unit.

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



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



Figure 7. Single phasing fault detection on LCD display

V. CONCLUSION

This research successfully shows a cost effective and efficient method for monitoring and protection of three-phase induction motor using an Arduino Nano. The proposed system enables quick, accurate and reliable real time data monitoring and protection of three-phase induction motor.

VI. ACKNOWLEDGEMENT

We would like to express our sincere gratitude to everyone who contributed to the successful completion of this project on **Arduino Nano Controlled Monitoring and Protection of Three-Phase Induction Motor**. We would like to express our gratitude to our respected guide, **Prof. A. M. Halmare** for his guidance and support.

REFERENCES

- [1] R. Bayindir , "Fault Detection And Protection Of Induction Motor Using Sensors " Dept. of Electrical Educ., Gazi Univ.,Ankara IEEE Transactions on Energy conversion (Volume:23, Issue: 3) ,ISSN :0885-8969.
- [2] Rupali Shivpuje, "Microcontroller based fault detection and protection system for induction motor", 2017 *International Conference on Intelligent computing and control systems(ICICCS)* , Madurai, India, 15-16 June 2017.
- [3] D. Kumar, A. Basit, A. Saleem and E. G. Abbas, "PLC Based Monitoring & Protection of 3-Phase Induction Motors against Various Abnormal Conditions", 2019 *2nd International Conference on Computing Mathematics and Engineering Technologies (iCoMET)*, pp. 1-6, 2019.

- [4] Ganapathy Subramanian, "Fault Detection and Protection of Induction Motors Using Sensors", *IEEE IFET College Of Engineering Villupuram III-BE Department*.
- [5] Nagesh Bhakare, Laxman Ghanvat, "Detection of fault of three phase induction motor using Arduino uno R2 Microcontroller" *International Journal of Trend in Research and Development*, Volume 3(5), ISSN: 2394-9333
- [6] SudhaM. and AnbalganP., "A Novel Protecting Method for Induction Motor Against Fault to Voltage Unbalance and Single Phasing," *33rd Annual Conference of the IEEE Industrial Electronics Society*, 2007, pp.1144- 1148, 5-8 Nov. 2007, Taipei.

