International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 04 Issue: 04 | April -2020 ISSN: 2582-3930

# Fault Monitoring and Protection system for Induction Motor

**Mr. R. U. Ghanmare[1], Ms. S. L. Tiwari[2], Mr. P. G. Shewane[3] Mr. N. R. Kadu[4]Mr. YogeshItankar[5]**

*[1]Assistant Professor, [2]Assistant Professor, [3]Assistant Professor, [4]Assistant Engineer, [5]Assistant Engineer, DBACER, Nagpur, YCCE, Nagpur,DBACER, Nagpur,MAHATRANSCO Nagpur, MAHADISCOM Nagpur*

---

**Abstract -***In the electrical motor there are several types of faults are occurs. Broadly the motor faults are classified into two category external and internal faults. The external faults may due to environmental condition or some other reasons while the internal faults are due to circuit faults. In this paper, try to eliminate the some of the faults in the motor. This paper explains the protection of motor from overheating, overvoltage and under voltage. Reason of overheating in motor is overloading of motor. For sensing the temperature DS1820 sensor is used. Similarly the upper and lower limit of the motor also is defines so that working of the motor must be smooth. For controlling the temperature and voltages level of the motor ARDUINO Nano controller is used. This controller senses the temperature of winding and the voltage level. If the sensors sense the any values which are out of the set values, sends the signal to ATmega328P for shut down the motor. ATmega328P is high performing 8-bit, 32KB Flash, microcontroller, part of the AT mega AVR MCUs series, developed by Atmel.*

*Keywords: - Temperature sensor, Arduino-Nano.*

## 1. INTRODUCTION

This paper is regarding the internal and external fault occurring in motor. As we know motor is the very important factor for every industry. Failure of the machine is due to heavy duty cycle, poor grounding condition, installation, mounting and manufacturing factors etc.

Normally in the motor the faults are cause due to electrical circuit problem, working that is mechanical problems and working condition of the motor. Electrical-related faults: Faults under this classification are unbalance supply voltage or current, single phasing, under or over voltage of current, reverse phase sequence, earth fault, overload, inter-turn short-circuit fault, and crawling. Similarly Mechanical faults: Under these faults are broken rotors bar, mass unbalance, air gap eccentricity, bearing damage, rotor winding failure, and stator winding failure. Some of faults are related to environmental like ambient temperature as well as external moisture will affect the performance of induction motor. Due to any installation defect, foundation defect, etc. machine get vibrate, so vibrations faults in the machine. In this paper overvoltage, under-voltage and temperature faults are try to remove by using microcontroller and some sensor.

The overheating problem may be increase due to over current flowing due to sustained overload or fault, higher ambient temperature, obstructed ventilation, unbalanced supply voltage, etc. If the motor phase having highest current in the winding temperature will increase by 25 %, if voltage is unbalance of 3.5% per phase again the temperature rises. Temperature of winding will also rise, within a small span of time if a number of starts and stops are made in the motor. Under such condition if winding temperature increases and the motor is operated over its temperature limit, the best insulation may also fail quickly.

## 2. CAUSE of FAULTS

There are many reasons for overheating in the motor some of the problems are discuss below

1. Size of the motor: as per the application of the motor the size of a motor is also important. The motor must be properly sized for the application, place of working and duty cycle. If the motor size is small motor will not be able to dissipate the heat due to which overheating effect appear.
2. Working Temperature: as per the environment condition motor insulation must be used before installing the motor check the insulation class on the motor.
3. The motor must be runs for the intermittent duty application or at below the duty cycle. In order for the motor to run at its rated performance specs, it needs to have time to cool-down completely between cycles. If the motor is run more frequently than it is supposed to, the motor will still be warm and will become increasingly hotter with each cycle, eventually overheating the motor.
4. Supply voltage problem: if power supply may be insufficient due to the current draw for overcome load or inertia at standstill, in this condition the motor running current will be much higher than the normal current rating. Improper supply of the power may cause the overheating condition.
5. Operating electric motors in poor environmental conditions may also leads to excessive heat. If the ventilation holes on your motor must be open to allow heat to escape.

For overcome the problem of overheating in the motor first the temperature of a motor winding is measured by measuring the resistance of the winding. This is done by Introducing a small direct current component into the motor current, which can be done by connecting an asymmetric resistance device in the motor circuit? The resistance of the motor winding can then be determined from measurements of the direct current component andthe corresponding voltage. A signal or indication can

thenbe obtained when the current falls below a level which indicates resistance corresponding to an over temperature condition.

$$T_t = T_c + \frac{R_h - R_c}{R_c * (T_c + 234.5)} \dots\dots (1)$$

Where:

T(t) = total winding temperature,

T(c) = Cold motor (ambient) temperature,

R(h) = Hot motor resistance,

R(c) = cold motor resistance,

234.5 = constant for copper windings.

The motor temperature may also be obtained by using transducer also.

**Voltage variation: -** Motor works on suitable voltage level. Both over and under voltage condition is occurring due to variation in the supply voltage. Over voltage causes stress on insulation, on other hand under voltage causes excessive line current increasing temperature of the winding. Normally these faults are detected by over/under voltage relays.

In this paper DS1820 sensor and voltage sensor are used for the temperature and voltage finding purpose.

## 3. DESIGN

The overheating protection of motor means protect the motor from overheating of its winding. For monitoring the temperature of the motor DS1820 sensor is used.

This sensor is connected to the ARDUINO Nano controller. With the help of these sensor we sense the temperature of winding and its temperature exceeds to some particular level then DS1820 sends the signal to ATmega328P which is high performing 8-bit, 32KB Flash, microcontroller with the help of this controller we can stop the motor when it exceeds the temperature.

The block diagram consists of three phase supply, three phase induction motor and the control unit.

Basically the control unit contains the DC power supply which is requiring for the microcontroller circuit and temperature sensor.

Arduino Nano: - Arduino Nano is a small, compatible, and flexible and breadboard friendly Microcontroller board, developed by Arduino.cc in Italy, based on ATmega328p.It comes with exactly the same functionality as in Arduino UNO but quite in small size. It comes with an operating voltage of 5V, however, the input voltage can vary from 7 to 12V.

Arduino Nano pin diagram contains 14 digital pins, 8 analog pins, 2 reset pins & 6 power pins each of these Digital & Analog Pins are assigned with multiple functions but their main function is to be configured as input or output.

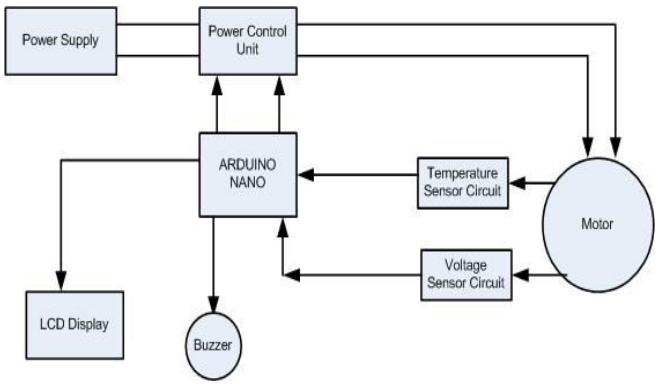


**Figure:-1** System Block Diagram of Protection System

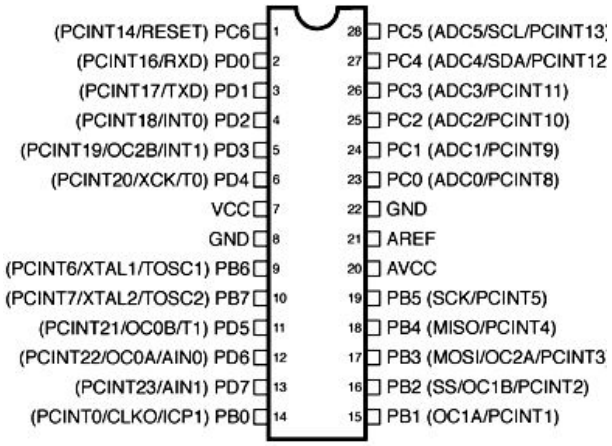


**Figure:-2** Pin Diagram of Arduino Nano

DC power circuit:- For rectifier circuit diode is used. In circuit diode 1N4007 diode is used. The basic function of the diode is allow the current flow in Anode to cathod direction. The

cathod terminal is identified by ring of grey in colour.

Diode 1N4007 has the maximum current carrying capacity is 1A it withstand peaks up to 30A. Hence we can use this in circuits that are designed for less than 1A. The reverse current is 5uA which is negligible. The power dissipation of this diode is 3W.

Temperature sensor:- The DS18S20 is used for the temperature sensing purpose. It is digital thermometer provides 9-bit Celsius temperature measurements and has an alarm function with nonvolatile user-programmable upper and lower trigger points. The DS18S20 communicates over a 1-Wire bus that by definition requires only one data line and ground for communication with a central microprocessor. In addition, the DS18S20 can derive power directly from the data line, with this function sensor eliminating the need for an external power supply. Each DS18S20 has a unique 64-bit serial code, which allows multiple DS18S20s to function on the same 1-Wire bus. Thus, it is simple to use one

microprocessor to control many DS18S20s distributed over a large area. Applications that can benefit from this

feature include HVAC environmental controls, temperature monitoring systems inside buildings, equipment, or machinery, and process monitoring and control systems.

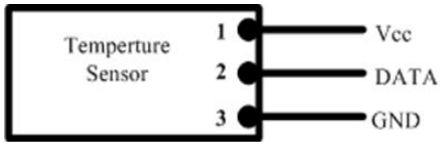


**Figure:-3** Pin Diagram of Temperature Sensor

**Figure:-4**Temperature Sensor DS18S20

A relay is an electrically operated switch. Many relays use an electromagnet to operate a switching mechanism mechanically, but other operating principles are also used. Solid-state relays control power circuits with no moving parts, instead using a semiconductor device to perform switching—often a silicon-controlled rectifier or triac. The analogue switch uses two MOSFET transistors in a transmission gate arrangement as a switch that works much like a relay, with some advantages and several limitations compared to an electromechanical relay.

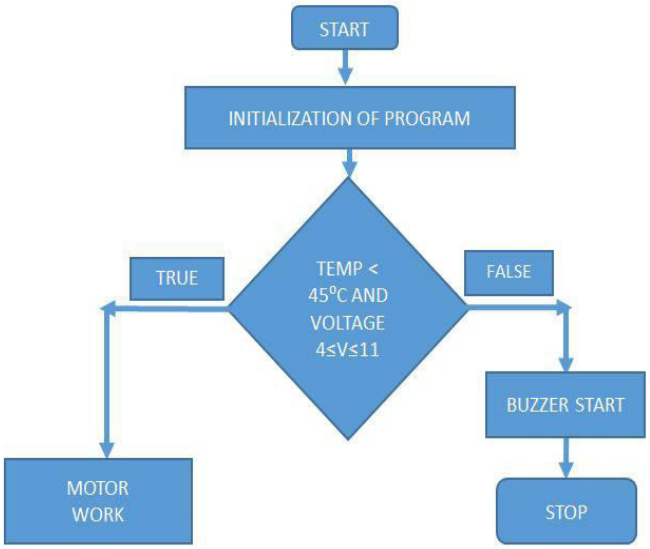


**Figure:-5** Flow chart

For constructing a system for the protection of motor from under voltage over voltage and temperature fault the circuit consisting of voltage sensor, temperature sensor DS1820, relays, LCD display, buzzer, ArduinoNano, ATmega328P, DC buck, POT, DC motor, etc. The complete hardware set up is shown in figure.

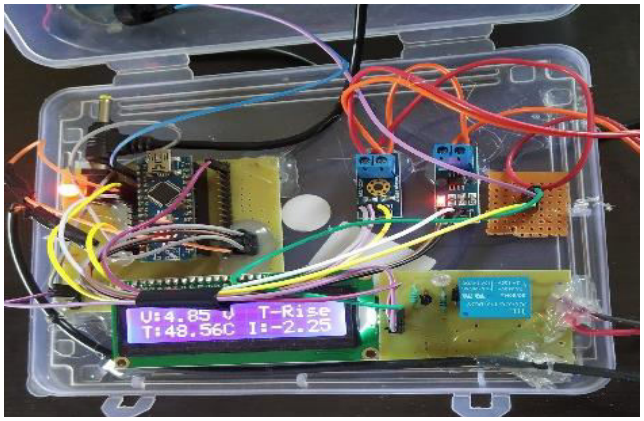


**Figure:-6** Hardware Implementation

## 4. RESULT and CONCLUSION

The working temperature on the motor is increases due to the overloading of motor, bearing seizes up something locked the motor shaft from turning. Sometime the motor fails to start properly, a failure to start of motor may cause by faulty start in winding in motor. In this paper we are trying to eliminate the temperature fault. For detecting the heat of the winding DS1820 is used. This sensor is connected to comparator inputs. With the help of sensor which sense the temperature of winding and its temperature exceeds to some particular level then comparator sends this signal to microcontroller.

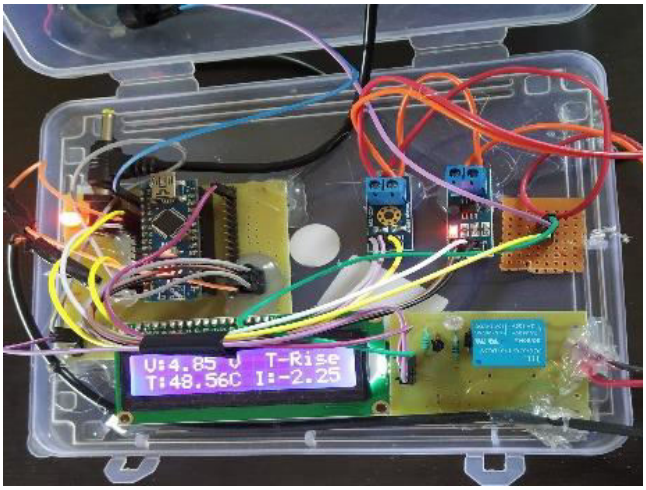


**Figure:-7** Temperature sensor results

In this circuit it is shown that temperature exceeds beyond its limit it goes on more than 45°C hence relay sense and give signal to the Arduino nano and then circuit trip and motor Stop. In this way we protect form over temperature. In this circuit it is shown that Voltage exceeds beyond its limit it goes on more than 11V hence relay sense and give signal to the Arduino nano and then circuit trip and motor Stop. In this way we protect form Overvoltage.

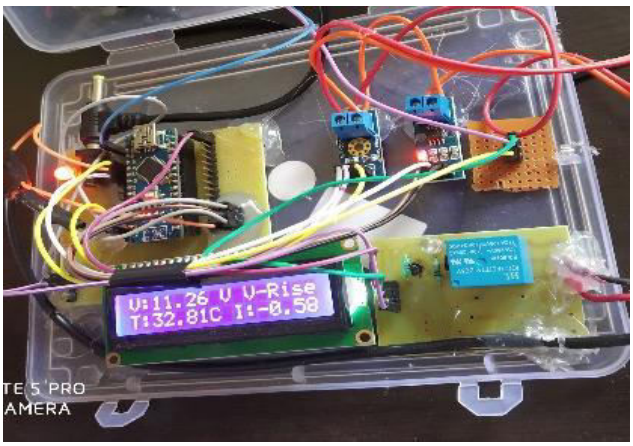


**Figure:-8** Output of Overvoltage

In this circuit it is shown that Voltage exceeds beyond its limit it goes on more than 4V hence relay sense and give signal to the Arduinonano and then circuit trip and motor Stop. In this way we protect form under voltage.

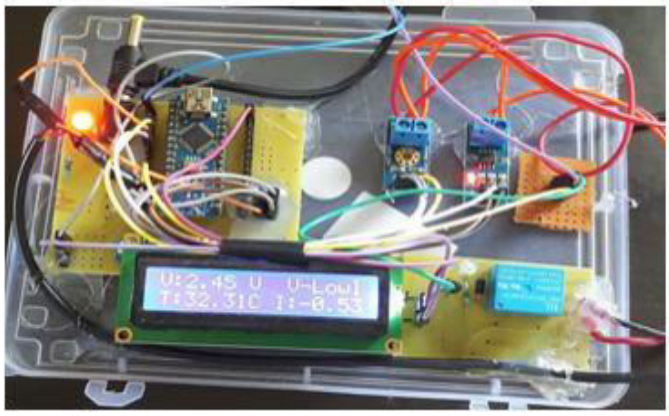

**Figure:-9** Output of under voltage

## REFERENCES

[1] Ransom D.L. and Hamilton R., "Extending Motor Life With Updated Thermal Model Overload Protection," IEEE Transactions on Industry Application, vol. 49, no. 6, pp. 2471 2477, Nov.-Dec. 2013.

[2] Kersting W.H., "Causes and effects of single-phasing induction motors," IEEE Transactions on Industry Applications, vol. 41, no. 6, pp. 1499-1505, Dec. 2005.

[3] Cunkas M., Akkaya R. and Ozturk A., "Protection of AC motors by means of microcontrollers," 10th Mediterranean Electro technicalConference, MELECON, vol.3, pp. 1093-1096 vol. 3, May 2000.

[4] "IEEE Guide for AC Motor Protection", IEEE Std C37.96-2012", pp. 1-160, Feb. 2013.

[5] Stone G.C., Sasic M., Dunn D. and Culbert I "Recent problems experienced with motor and generator windings," 56th Annual Petroleum and Chemical Industry Conference, PCIC 2009, pp. 1-9, 14-16 Sept. 2009, Anaheim, CA.

[6] Bonnett A.H., Soukup G.C., "NEMA motor-generator standards for three-phase induction motors, "Industry Applications Magazine, IEEE ,vol. 5, no. 3, pp. 49-63, Jun 1999.

[7] RamazanBayindir, Ibrahim Sefa, IlhamiColak and AskinBektas "Fault Detection and Protection of Induction Motors Using Sensors". IEEE Transactions on Energy Conversion,Vol. 23, No. 3, September 2008