International Journal of Research in Advent Technology (IJRAT) (E-ISSN: 2321-9637)
Special Issue
National Conference "CONVERGENCE 2016", 06th-07th April 2016

Microcontroller based fault detection and protection of three phase induction motor

Neha Yevale, Yogesh karhe, Priyanka Sawant, Akash Tayade, Prof. P. B. Shelke
Electrical Engineering (Electronics and power), PLITMS Buldhana (India)
Email: nehayevale112@gmail.com, karheyogesh@gmail.com

Abstract- The vital aim of this paper is that to identify the incipient fault that may cause due to various reason and protect the induction motor from such fault. The three phase induction motor suffer from various fault which are overvoltage, under-voltage, over-current, temperature and single-phasing to overcome this type of fault protective method using microcontroller is used. This electrical fault mainly takes place due to variation in the induction motor parameters. They are current, voltage, temperature. Due to this electrical fault the winding of motor get heated which leads to insulation failure and thus reduce the life of motor. Hence protection method using microcontroller is used which cheap and reliable method.
Index term: induction motor, PIC microcontroller, over-current, under-voltage, over-voltage, temperature, single-phasing

1. INTRODUCTION

Induction motor is one of the most common electrical motor used in most applications. This motor is also called as asynchronous motor. Induction motors are generally utilized as part of industry as they are roust, reliable, durable, simple, low-priced and easy to maintain. They run at essentially constant speed from zero to full-load. The three-phase induction motor is a self-starting motor and protection of this motor from various electrical faults is need. Induction motor is most widely used motor hence protection of induction motor plays important role in its long life service. [1] In this way, the problem of induction motor protection involved many researches. This project aim is the protection of three phase induction motor. There are various techniques for fault detection and protection of induction motor. Some of fault detection using artificial neural network and programmable logic controller (PLC) based protection system. In this project technique utilized is microcontroller based protection system. This microcontroller based protection system identifies and control the three phase induction motor from electrical fault. They are over-current, over-voltage, under-voltage, temperature and single-phasing. [2] The sources of over-voltage and over-current will be manmade or natural. Possible causes for over-current include short circuits, excessive load and incorrect design. The circuit of over-voltage and over-current, single-phasing are completely controlled by microcontroller. Microcontrollers which provide the control over the motor and it monitor the voltage of three phases. When faulty conditions take place or in case of abnormal condition motors stop. With the help of over-current relay which senses the current if the current exceeds the predetermined value then signal are send to the microcontroller and it stop the motor and type of fault is displayed on the LCD display. Microcontroller used in this paper is AT89S52 and it is 40 pin IC. [3] The overall cost of the protection equipment should not be more than 15% of the total cost of actual machine. Keeping this in mind design has been proposed.

2. LITERATURE REVIEW

Induction motors are used in household and industrial application. Different types of ac induction motor are available in the market. In spite of that ac induction motor are simpler in design then the dc motor but various types of electrical fault take place. For example over-voltage, over-current, under-voltage, under-current, over-temperature. Such fault occur due to most essential parameters current, voltage, temperature this fault damage the motor. [1] classical monitoring techniques for three phase induction motor are generally provided by some combination of mechanical and electrical devices such as timers, contactors, voltage relay, current relay, and earth fault relay etc. these techniques are very basic and involve some mechanical dynamic parts of the equipment can cause problem in the course of operation and can reduce the life and efficiency of system.[2] A PlC based system which deals with monitoring control system of Induction motor is introduced, in these system the parameters are sensed with the help of analog modules, processed and displayed on PC. The ladder programming and SCADA software is used to monitor the parameters on the PC, In case faults are detected the alarms are blown and the motor is stopped. But it requires

separate PLC module, analog modules and software which are costly. Microprocessor based protection systems are developed but they do not provide control action, they only display information on screen and blow alarm. [4] William H. Kersting stated that three phase induction motor can continue to run when one phase of the supply gone out of service. This may be due to any fuse blowing or opening of protective device of the motor. At this condition the three-phase induction motor continue to run but the motor will heat up quickly and it should be protected by removing it from the service at the instant of single phasing. [5] Sudha M. and Anbalagan proposed a technique to save the three phase induction motor from single phasing. In this technique, PIC16F877 microcontroller has been used to sample the values of each phase and converted them to low voltage ac by means of transformer. The signals are converted to digital value using ADC converter. The controller continuously compares the digital value with the reference value and when the fault occurs, it opens the normally close contactor and disconnects it from the power supply. Single phasing, under voltage and over voltage protection is done practically on a 2kW motor and the motor is isolated if any of these condition occurs.

3. TYPES OF MOTOR FAULT

There are two separate types of fault with electric motors: faults in the motor itself and faults with external causes.

- Faults in the motor

- Phase to ground short circuit,
- Phase to phase short circuit,
- Internal winding short circuit,
- overheating of windings,
- Broken bar in squirrel cage motors,
- Problems in windings,

- Faults with external causes

Their sources are located outside the electric motor but their effects can damage it

Hence following table of electrical fault shows its causes and effects.

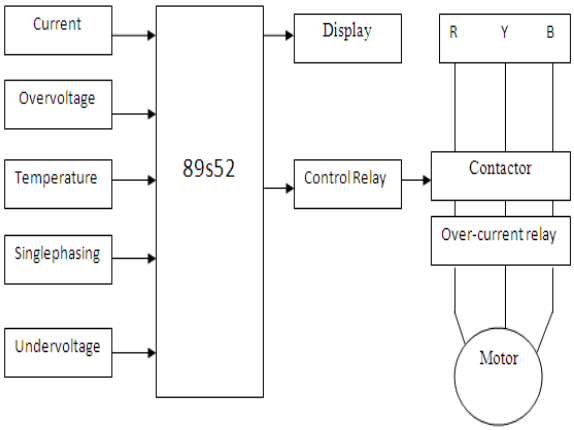
Faults	Causes	Effects	Effects on the motor
Short circuit	Phase to phase Phase to ground Winding to winding	Current surge Electrodynamics stress on conductors	winding destroyed
Voltage surge	Lighting Electrostatic discharge Disconnection of load	Dielectric breakdown in winding	winding destroyed by in loss of insulation
Unbalanced voltage	Phase opening Single phase load upstream of motor	Decreased of the available torque Increased losses	overheating
Voltage drop and dip	Instability in mains voltage Connection of high loads	Decreased of the available torque Increased losses	overheating
Harmonics	Main supply pollution by non linear load	Decreased of the available torque Increased losses	overheating
Starting too long	Too high resistance torque Voltage drop	increased in starting time	overheating
Locking	Mechanical problem	over-current	overheating
Overload	Increase in resistance torque Voltage drop	higher current consumption	overheating

4. PROTECTION DEVICES OF VARIOUS TYPES OF FAULT

1. Protection against short circuit two protection devices are commonly used for this: fuses, which break the circuit by melting and must be replaced afterwards, magnetic circuit breakers which automatically break the circuit and only require to be reset.

2. Protection against overload Depending on the level of protection required, overload protection can be provided by relays: overload, thermal or electronic relay which provide minimum protection against: overload by controlling the current absorbed on each phase, unbalanced or missing phase, by differential device, positive temperature coefficients (PTC) thermistor probe relay, over-torque relays, multifunction relays.

5. BLOCK DIAGRAM



6. DESCRIPTION

Microcontroller based fault detection and protection system consist of various types of circuit which used for detection and protection of system from various types of fault which are over-current, over-voltage, under-voltage, over-temperature, single phasing and different type of circuit used for this are single phasing circuit, over-current relay, contactor, solid state relay, DPDT relay, power supply. Hence for controlling purpose microcontroller AT89c51 having 40 pin IC and LCD display to display the type of fault. In over-current protection of three phase induction motor protects the motor from over-current. When the current exceeds the predetermined value or rated value then this rated value is sensed by the over-current relay and signal is given to the microcontroller. Hence microcontroller may stop the motor and type of fault is shown on the LCD display. Contactors get open. In single phasing protection for 3 phase induction motor system, if any one of the phase is faulted then it is sense by the relay and contactor may open hence motor stop. Generally in single phase supply voltage is lower value than specified value. On this value of voltage motor is unable to start. This lower value of supply voltage of single phase is compare with rated value and this value sensed by the relay driver circuit and signal is send to the microcontroller it stop the motor in case of running and does not allow to start the motor in case of standstill. Single phasing occurs as a result of several possibilities. As a loose wire, a bad connection, bad starter contacts, overload relay problems, a bad breaker, a blown fuse etc. In under voltage protection of 3 phase induction motor protects the motor from the under voltage. When supply system has low voltage than the rated of induction motor then under voltage protection section of protection supply is provided to motor. It has same concept as overvoltage it also provide protection against overvoltage when voltage value is greater than the rated value hence it is sense by the relay driver circuit and information is send to the microcontroller motor stop. And overvoltage, under-voltage fault display on LCD display. In case of over temperature the temperature of motor which is grater then rated one it is sense by sensor PT100. Hence signal send to microcontroller and motor stop through solid state relay and contactor get open. Motor comes to stand still condition. Such various type of fault is detected and protected using microcontroller AT89C52.

7. RESULT

Sr No.	TYPES OF FAULT	NORMAL CONDITION	FAULTY CONDITION
1	OVER CURRENT	3.5 amp	4 amp
2	OVER TEMPERATURE	45°c -55°c	65°c
3	SINGLE PHASING	415 volt	280 volt
4	OVER VOLTAGE	415 volt	480 volt
5	UNDER VOLTAGE	415 volt	280 volt

8. CONCLUSION

To improve lifetime and efficiency of three phase induction motor protection from over voltage, under voltage, single phasing, over temperature, and over current are required. When supply system is violating its rating commonly this fault generated. These type faults are not generated when three phase induction motor run at rated voltage, current and load. For smooth running of motor generally concentration on supply voltage under the prescribe limit and load which is driven by the motor should also be under the specified limit. The thesis is based on the protection of three phase induction motor under single phasing condition and it is implemented using microcontroller, single phasing circuit, relay driver circuit and contactor. The system is very cheap as compared to present protective devices available. The protection system can protect three phase induction motor from under voltage, over voltage, over current, over temperature and single phasing.

REFERENCES

[1] Madhuri Balasaheb Zambre, Vivek Vitthal Waiphale, Bhupali Popat Kumbhar [Volume: 3 Issue: 11] "Microcontroller Based Protection and Control of Three-Phase Induction Motor" International Journal on Recent and Innovation Trends in Computing and Communication.

[2] Patil Smita Jaywant, Patil Sachin sambhaji, Patil Pragati Deepak [Volume 3, Issue 8, August 2014]

"Fault Detection and Correction of 3-phase Induction Motor" International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE)

[3] "An improved method for protection of induction motor using microcontroller"

[4] 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.

[5] Sudha M. and Anbalgan P., "A Novel Protecting Method for Induction Motor Against Faults Due to Voltage Unbalance and Single Phasing," *33rd Annual Conference of the IEEE on Industrial Electronics Society, 2007*, pp. 1144-1148, 5-8 Nov. 2007, Taipei.