On Load Fault Detection of Im Using Microcontroller

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Abstract: *In working AC Induction motor problems that arise are common nowadays. The main aim of this project is to detect faults of three phases IM and control the faults. The three phase induction motor may experience many incipient faults due to various reasons. So the protection of these motors from such faults is very important. The various faults are over-voltage/current, under-voltage/current, overload, single phasing, over-temperature etc. The most important parameters are voltage, current, and temperature. Here a new protection method is implemented, which is low cost and reliable. The fault that occurs normally in the motor are high temperature, over load, over voltage/current, under voltage/current etc. Insulation failure of motor and life of the motor is reduced due to the electrical faults that are mentioned above. This protection system is implemented by using microcontroller PICF16F866. Experimental results shows microcontroller based fault detection, real time observation of parameters at normal and abnormal conditions and protection method which provides higher accuracy with safe environment also it reduces failure risk of I.M.*

Keywords: *Microcontroller PIC16f886, Induction Motor, temperature sensor*

I. Introduction

Protection of three phase operating devices against over voltage, under voltage, overload, over temperature, open circuit, short circuit, unbalanced voltage, single phasing and earth fault, occurring in the course of its operation is very important, because it is used intensively in industry for various purposes. Computer and microcontrollers based protection methods have eliminated most of the components required for protection. We are introducing accurate monitoring of the parameter and protecting the load from undesired values of the parameter. Moreover, the voltages, currents and temperature values of the device and the problems occurred in the system, are monitored and warning messages are shown on the computer screen. Microcontroller had developed less cost, provides higher accuracy as well as safe and visual environment. The three phase devices experiences several types of electrical faults like over/under voltage, over load, open circuit, unbalanced voltage, single phasing and earth fault. In our project we are going to monitor and control the load using single controller with various faults measuring techniques related to the three phase power. We will also give a provision to auto reset the system after faults restores. In industries, the transformation of power from electrical form to mechanical form is done by using the induction motor. Induction motors are broadly used to incorporate transports, presses, pumps and bundling supplies, etc. In the market there are various types of motors available, which are used for different applications. Induction motors are reliable, but during working they are subjected to some faults and resulting in failure. The motor faults are due to over voltage/current, under voltage, and over temperature, etc. are typically concerned with the power supply. The induction motor generally suffers from high temperature, which leads to insulation failure and also from overload. In this protection method, the speed of the motor is also sensed. When the induction motor is supplied with a higher voltage than, its rated, the motor starts overheating. In this project Microcontroller is used. If supply voltage, current, temperature and load are lower or higher, then the Microcontroller sends signal to relay and relay trip the signal and stops the motor. In case of motor get overheated, to sense the temperature of winding, sensor is used which sends signal to Microcontroller.

II. Types of Motor Failure and Protective Features

Any electrical system is affected by electrical & Mechanical faults occurring in the system. The faults can lead to overloading, overheating and other effects. Every fault incident is indicated by the machine with various symptoms & behaviors. Faults in induction motors can be categorized as follows:

• Overload

• Voltage unbalance

• Voltage too high/low

• Bearing disappointment

• Single staging
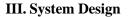• Restricted ventilation
• Moisture and vibration

On the off chance that mechanical disappointments are wiped out, shielding the engine windings from over temperature is the prime function of motor protection. But even bearing failures can result in motor winding failure if not detected in time. There are a number of ways that motors can be protected with respect to the needs of plant management. Table 1 below classifies Causes, there effects and damage due to faults.
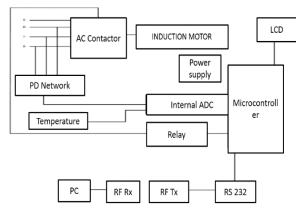
Table 1:- Fault causes, effects and possible motor damage.

Causes	Effect	Possible damage
Thermal overload: Extreme starting condition Locked rotor High overload Under-voltage Intermittent operation	over-current and thus unacceptable heating-up of windings	soldered joint damage rotor cage burnt windings stator windings
Cooling problems: Restricted cooling Ambient temperature too high	unacceptable heating-up	burnt windings stator windings
Electrical causes: Single phase condition Unbalanced voltage Earth fault Shorted turns Winding short circuit	unbalance over-current of windings heating-up depending on motor size and bearing damage load	individual windings or parts burnt
Mechanical causes: Imbalance Miss-alignment Improperly installed drive(e.g. bearing load of V-belts too high)	uneven wear of bearings	bearing damage

The approximate percentages of by these individual faults are:
• Overload 30%
• Insulation damage 20%
• Phase failure 14%
• Bearing damage 13%
• Ageing 10%
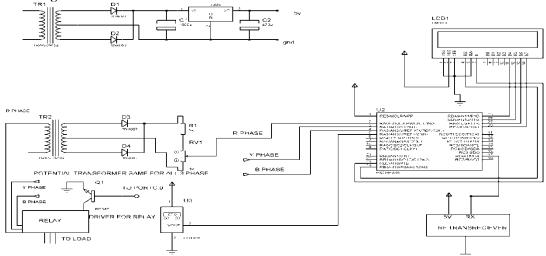• Rotor damage 5%
• Others

III. System Design

1. Overall System Structure:

The design aims are detecting the faults then monitoring and controlling the motor from these faults. First find out tolerable limit values of voltage, current, speed, temperature. Then these parameters are measured and are compared to these tolerable limit value. The three phase inverter is used to convert DC voltage obtained from rectifier into AC. The gating signals using microcontroller PIC16F886. When parameters are out of range by using microcontroller programming we protect the motor from faults. Here we use CT for current measurement. LM35 for temperature measurement. The whole system can be divided into three parts. The first part concerned with rectifier. The rectifier can be three phase. The second part is concerned with the parameters measurement of the motor like voltage, current, temperature. The third part concerned with the heart of the system i.e. PIC microcontroller. The analog parameter are converted into digital using PIC microcontroller which consist of inbuilt 10 bit ADC of PIC16F886.

2. Component Used in System Circuit:
- Microcontroller PIC16F866
- Bridge rectifier
- Induction Motor
- Temperature sensor LM35
- Relay 12V ICO
- LCD Display (16×2)
- Three potential Transformer
- Transformer
- RF transceiver

3. Circuit Diagram:

IV. Components Description
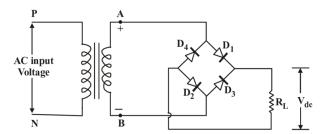
4.1: Microcontroller PIC16F866-
Microcontroller receives data from temperature sensor and CT then converts it from Analog to Digital LCD.
Features:
- 5V DC , 10bit ADC
- 40pin IC
- Flash Memory 32k
- On-chip RAM - 1536 bytes
- EEPROM - 256 bytes
- 4 Timers

4.2: Bridge rectifier-

We use bridge rectifier to get pure DC signal. Bridge rectifier is highly efficient than others. It consist of 4 diodes D1, D2, D3 and D4. When we gives AC supply to the circuit in positive half cycle D1 and D2 become forward biased and it will start conduction at the same time D3 and D4 are reverse biased hence it does

not conduct. In negative half cycle D3 and D4 become forward biased and start conduction and D1, D2 become reverse biased and stop conduction.

4.3: Induction Motor-

An electrical motor is such an electromechanical device which converts electrical energy into mechanical energy.

Specification: 3phase squirrel cage induction motor, 415V, 0.5HP,50Hz, 4Pole, speed up to 1500rpm, Insulation class E or B.

4.4 Temperature Sensor

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature.

4.5 Relay:

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal.

4.6 LCD display

Liquid Crystal Display is used for display the measured readings and if fault occur it also show on LCD. 16×2 LCD is used in circuit. It having 16 character and 2 rows.

V. Working of System

5.1 Fault Detection and Protection System:

This system consists of various sensors and measurement circuits which measure the parameters of the motor continuously. These sensors have to be compatible with the Microcontroller i.e., their output voltage range should be between 0-5V DC. So, some of the sensors needs signal conditioning equipment as we are measuring the AC.
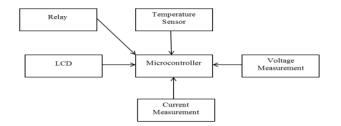

Fig. - Fault detection and protection.

5.2 Current:

In our system, current is measured using which can measure the current between +5A to -5A. It requires a 5V supply for its operation and its output voltage varies linearly with respect to the current.
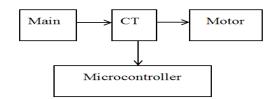
Fig.- Current measurement

5.3 *Voltage:*

In our system, voltage is measured using the potential transformer whose ratings are 230V/9V AC which can handle a current of about500 mA. But thisvoltage is AC therefore we require a rectifier circuit for the conversion of AC into DC. This voltage still is greater than 5V. Hence we need a potential divider circuit order to further reduce the voltage to measurable range.
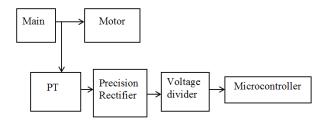

Fig.-Voltage Measurement

5.4 Temperature:

In our system, temperature is measured using the LM 35 which also operates on a voltage of 5V. The range of the sensor is -55oC to 150oC. Its output voltage varies linearly with respect to current. This can be connected to one of the analog pins of the microcontroller

Fig.- Temperature Control

230V 50Hz supply is given to the step down transformer it convert 230 volt in 12-0-12V AC. 12V directly given to relay because our relay work on 12V AC remaining 12V AC is given to bridge circuit. Bridge circuit converts that 12V AC into 12V DC. As our all component like microcontroller, LCD display is work on 5V AC. The 5V Ac supply given through IC to the other component. Once the circuit is energized tachometer continuously take the readings of speed, CT gives reading of current and LM35 take the readings of temperature. All these data fed to microcontroller and microcontroller continuously compare the measured value with predetermine values if the measured value cross the specified limit then microcontroller gives command to the relay to trip immediately and through GSM the message send to the person who work on it. It will take fraction of second and motor will be completely isolate from faulty section immediately

VI. Practical Implementation:

The system described in this paper works on thefollowing procedure:

1.First of all both the system and the motor are started.

2. Then the potentiometer is checked for the value of all parameters

3. Setting will remain same until and unless the user changes the setting from the microcontroller.

4. Then the current, voltage and temperature are measured.

5.Then it is checked whether the parameters are withinsafe range.

6.If they are approaching the danger zone, warningsare displayed on the LCD.

7.If they are completely out of the safe range the motor is isolated from the supply.

8.Then parameters of the fault are sent to the data for data logging.

VII.   Conclusion

From the above system we can detect and control the faults (over-voltage/current, under-voltage/current, over-temperature, single phasing) of Induction motor. To achieve above purpose we use PIC16f886 which is hart of project.

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