FAULT FINDING AND PROTECTION OF LOADED INDUCTION MOTOR USING MICROCONTROLLER.

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***Abstract:** In the working of Induction motor many faults arise that damages the motor. The main aim of this project is to detect faults of three phases IM and protect the motor from these faults. The three phase induction motor may experience many 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 easy to understand, low cost and reliable. The fault that occurs normally in the motor are high temperature, over load, over voltage/current, under voltage/current etc. Because of this many faults the insulation of motor damages and this hampers the life of motor. 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.*

***IndexTerms** - Microcontroller PIC16f886, Induction Motor, temperature sensor*

I. INTRODUCTION

Protection of motors against over voltage, under voltage, overload, over temperature, open circuit, short circuit, unbalanced voltage and single phasing, 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 and live monitoring of the parameters 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. Microcontrollers have low cost, provides higher accuracy as well as the readings can be viewed properly. The three phase devices experiences several types of electrical faults like over/under voltage, over load, open circuit, unbalanced voltage, and single phasing. 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 many faults and results 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. When the induction motor is supplied with a higherVoltage 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. 0VERVIEW OF SYSTEM

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 and temperature. Then these parameters are measured and are compared to these tolerable limit value. 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 is three phase. The second part is concerned with the parameters measurement of the motor like voltage, current, and temperature. The third part concerned with the heart of the system i.e. microcontroller PIC16F886. The analog parameter are converted into digital using microcontrollerPIC16F886 which consist of inbuilt 10 bit ADC.

III. OVERALL HARDWARE DESIGN

The system can be divided into four main parts that are step down transformer, voltage regulation stage, over/under voltage sensing circuit and temperature sensor. These four stages explains the whole working and the hardware design of the structure.

i. STEP DOWN TRANSFORMER

The primary winding of transformer is rated of 230V andat secondary 12V. I.e., 230V AC is stepped down to 12V. The secondary winding is rated of 12V, which is the RMS Value of the waveform, then the peak value will be 12*1.414=16.8V. This peak value limits a rectifier diode choice as IN4007, because this diode has a PIV rating more than 16V. This stage is very important because when the voltage is step-downed it gets easy for the rectifier to convert it into DC and also gets readable by the instruments without damaging them.

ii. VOLTAGE REGULATION

In this stage we obtain +5V from +12V DC. To get +5V DC output, the LM7805 is used and for +12V output, the rectifier is used. This IC has three terminals, pin1 is input, pin2 common pin, and pin3 gives stabilized DC output. In this stage, the capacitors C1 and C2 are connected which are decoupling capacitors, these two capacitors provide ground to noise signals of high frequency. This 5V and 12V obtained is supplied to the RF transceiver and the microcontollerPIC16F886.

iii. OVER/UNDER VOLTAGE

The over voltage occurs, when any one of the line voltage increases above the rated voltage and it leads to harmful effect on machine insulation. In order to overcome this problem, over voltage sensing unit is designed. The designed unit consists of three potential transformers to step down the line voltage to 12V. This step down voltage is rectified and filtered to get a DC voltage proportional to the line voltage. This DC voltage is compared with reference voltage which has set by the preset value. Under voltage occurs, when the supply voltage goes below rated voltage, these increases stator and rotor losses. The under voltage sensing circuit uses the DC output from the over voltage sensing circuit and compared with the reference voltage in the comparator. The other important section is the voltage sensing circuit the voltage transformer is used as a voltage sensor for the single phase supply. The primary of transformer is used in parallel with the supply and the secondary conducts by mutual induction phenomenon. The transformer with the turns ratio of 100:1 is used in order to step down the voltage and further the voltage divider network is connected so as to get the required voltage for the energy IC. This process enables us to detect the voltage dependent faults in the system all the balanced and unbalanced fault in the system can be detected.

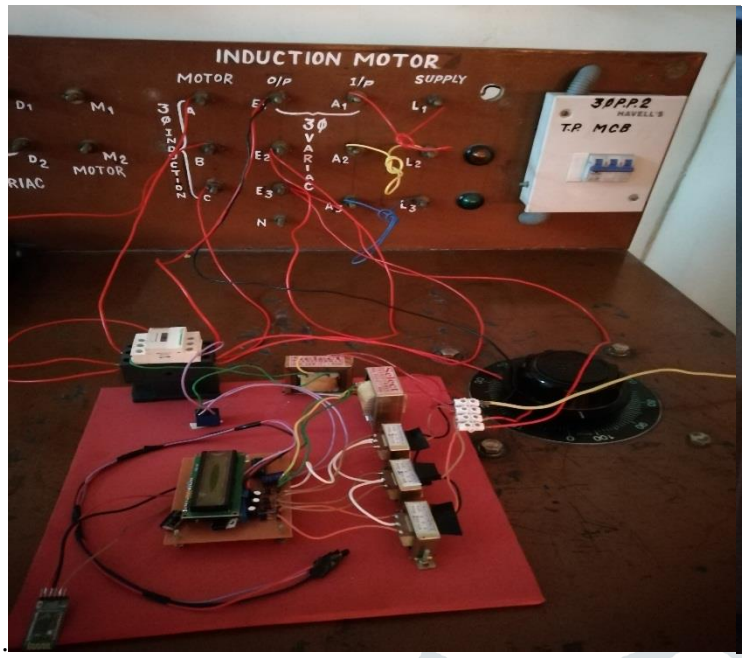
iv. TEMPERATURE SENSOR

When the motor runs for a longer period under load condition and also because of external temperatures and atmosphere, it gets heated up which reduces the efficiency of the motor. In order to sense over temperature, Semiconductor IC LM35 is used. This sensor provides 10mv/^{o}c output voltage proportional to the increased temperature of the motor. The temperature output of the sensor and the reference temperature is compared in the microcontrollerPIC16F886.

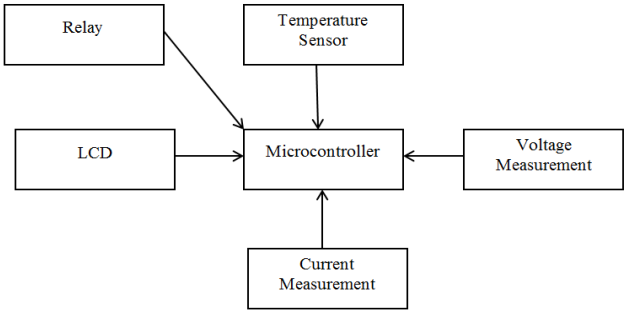
IV. PRACTICAL IMPLEMENTATION:

The system described in this paper works on the following 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 within safe range.
6. If they are approaching the danger zone, warnings are 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.

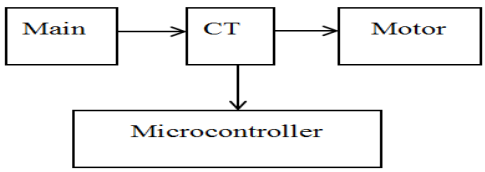


This system consists of various sensors and measurement circuits which measure the parameters of the motor continuously. These sensors have to be compatible with the Microcontroller i.e., their output voltage range should be between 0-5V DC. So, some of the sensors needs signal conditioning equipment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



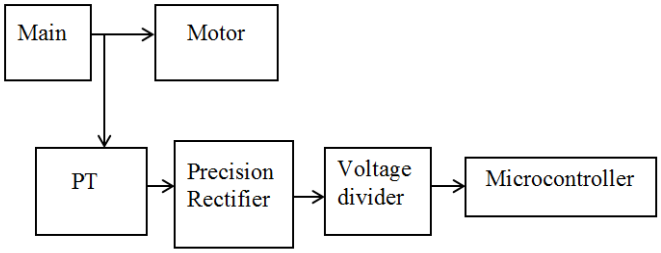
CURRENT MEASUREMENT:

In our system, current is measured using the voltage transformer and 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. And the current is compared using microcontroller and detected for protection.



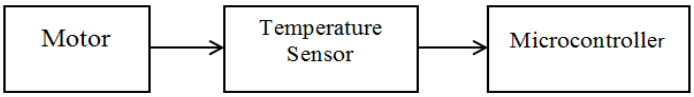
VOLTAGE MEASUREMENT:

In our system, voltage is measured using the potential transformer whose ratings are 230V/9V AC which can handle a current of about 500 mA. But this voltage 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.



TEMPERATURE MEASUREMENT:

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.



V. PRACTICAL RESULT

In this project, a protection system has been designed for safeguarding the induction motors against all possible faults. Sensors are used to keep watch on temperature, voltage and current. A current and voltage transformer is used in the system to check the current and voltage respectively. The point when an undefined surge happens, the motor stops without giving any warnings. Hence, the flaw might be portrayed and found by the human operator. Microcontroller based protection system uses analog to digital conversion card. Therefore, by using microcontroller all the above mentioned components can be eliminated and the operator will be able to visualize the operation of the motor and its electrical parameters. Protection of single phase induction motor from over voltage, under voltage, over current, and overheating provide the smooth running of motor improves its lifetime and efficiency. Generally, these faults are generated when supply system exceeds its rating. If the three phase induction motor when runs at rated voltage, current and load these faults are not generated. The test motor used in this practical method is rated Of 440V, 50HZ, 5HP, 3.7kw, 1440RPM and is roller thrust bearing type motor. Under faulty condition, the running current of motor is 3.4A, under voltage 190V per phase, over voltage 255V per phase, temperature 50ºC. Now the fault that arises is over voltage/under voltage, over load and over temperature. In this condition the health of motor is bad. Now the microcontroller sends signal to relay, relay trips the signal and motor stops.

VI. 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.

VII. ACKNOWLEDGMENT

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VIII. REFERENCES

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