Modern Method for Protection of Induction Motor Using Microcontroller and Wi-Fi Technology

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ABSTRACT: This project gives a real time implementation of a wireless protection technology of Induction Motor. A low cost and reliable protection scheme has been designed which monitors the parameters of Induction Motor such as voltage, current, temperature, speed of motor and power factor. System measures these parameters by CT, PT, temperature sensor, IR sensor and Zero Crossing Detector and fed to microcontroller Atmega16 which is to be further given to personal computer. For any fault considered in this project the motor is turned off by relay tripping and also a massage is sent on mobile phone of person in charge for protection of motor through Wi-Fi technology. The protection achieved in this project can be faster than classical methods of protection.

KEYWORDS: Microcontroller, Induction Motor, Wi-Fi Introduction

I.   INTRODUCTION

The induction motors are the most widely used ac motor due to its low cost, simple and extremely rugged construction, high reliability, high efficiency, reasonably good power factor, low maintenance cost and simple starting arrangement. The mechanical system in industries like paper mill, sugar industry and cement industries are driven by induction motors. Thus the values of current, voltage, temperature of winding and speed of motor becomes very important factor for driving the system. These factors directly affects the performance of motor.

There are various types of faults that are encountered during operation of induction motor. Like electrical faults such as over/under voltage, over load, phase reversing, unbalanced voltage, single phasing and earth fault. The rotor winding failure, stator winding failure and bearing faults are most occurring mechanical faults. The vibration of machine, external moisture, contamination and ambient temperature also affect the induction motor performance. So, in order to improve efficiency of induction motor all these faults has to be taken care of by reliable protection scheme. However, the control of machines is very risky and difficult when machine is on continuous duty. In such cases, wireless control is a considerable solution to eliminate these hazards. Hence, wireless data communication is used in various industries. The wireless monitoring and control scheme proposed in this system ensures the improvement in performance of the motor. The monitoring and controlling operations are done by Wi-Fi technology so as to avoid human hazards.

In this paper, we describe the system for monitoring and controlling of induction motor. A low cost system is proposed to monitor the parameters of the induction motor such as voltage, current, temperature of the windings, speed of the motor and power factor. Continuous monitoring is done for all these factors and a warning massage is sent to incharge person in case of exceed in set limited values. This provision in proposed system facilitate the action to be taken before actual fault occurs on motor. And hence improving the performance of the motor by avoiding its tripping followed by fault. In addition with the monitoring, the speed control of the motor is also performed. If an overload occurs i.e. current exceeds the maximum limit the relay circuit will turn on the buzzer.

III. RELATED WORK

Traditionally protection schemes of induction motors suffered from the defect of inflexibility which causes difficulties when dealing with the introduction of special control features which differ from the standard systems, the implementation of unforeseen operational changes after installation of an equipment, the recent trend to depart from standard substation configurations. In such cases relatively high engineering charges and development costs may be incurred. These factors have encouraged the movement towards more flexible approaches; an obvious one is to use programmable sequence controllers. While for many applications it provides economic equipment, for applications above a certain order of complexity the equipment may become bulky with many components.

An alternative approach is the use of microcontrollers systems which offer a number of attractions over other approaches. The approach lends itself to software design and testing aids running either on the microcontroller system itself or on a more powerful large computer. The reliability of such equipment is, of course, of great importance and here again the microprocessor scores well.

Firstly, the principle of the system is such that wide use is made of large-scale integrated circuits which means that the number of components is minimized, resulting in good reliability and small size. Secondly, it is possible to perform a certain amount of self checking in normal operation. The working module mostly consist of analog-to-digital conversion, fault detection, automatic variable time delay achievement, tripping signal generation. The limited dc voltage output of the measuring unit is proportional to the operating current , The voltage is fed to a microcomputer , whose function is to perform the following jobs sequentially through an appropriate programming .

The microcomputer first converts the dc analog input voltage into a digital equivalent in terms of the hexadecimal system. This digital value is tested. If there is a fault, this means that tested value exceeds a stored digital pick-up value, then it will be processed through a software function generator, which consequently determines the action to be performed i.e., relay tripping. The operation time of the relay is determined by a specified time delay subroutine depending upon the value of fault signal. Hence, pulses are generated through an output port of the microcontroller fed to the triggering isolating circuit which triggers the tripping circuit is complete and the fault current will be cleared. If there is no fault, i.e., the digital value of the ADC output is less than the pick-up value, the relay will not operate.

The use of microprocessors in protection relays started a new era in which three main problems are overcome i.e. speed, accuracy and cost, all of which hinder the extensive application of computer relaying devices. With the advent of more and more powerful microprocessors and the development of analytical algorithms, the microprocessor based protective relays may provide considerable correspondences in protection relaying speed, accuracy, reliability, and cost effective schemes to the modern sophisticated power systems.

III. PROPOSED SYSTEM

It is essential that the motor should be monitored continuously so as to improve its performance. The monitoring systems are particularly useful because the systems are able to capture the information from the motor, both real-time and historical over the motor's life. These real time data is continuously monitored by microcontroller and it is also displayed on Liquid Crystal Display i.e., LCD. The protection of induction motor by monitoring and controlling with Wi-Fi technology has proposed in this System. Continuous monitoring of various factors is done by different devices as follows:
- ✓ Voltage monitoring by potential transformer
- ✓ Current monitoring by current transformer
- ✓ Temperature monitoring by LM35
- ✓ Speed monitoring by IR sensors

The systems also have the ability to keep power factor maintained, which leads to better performance of the motor.

IV. HARDWARE DESCRIPTION

The Fig.1 Shows the block diagram of the proposed system. The each block of the proposed system is explained further.
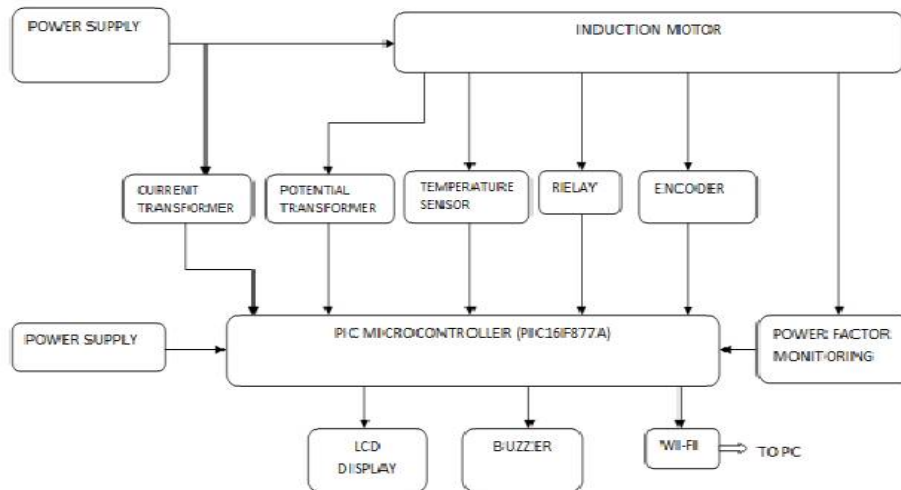
Figure 1. Block Diagram of Proposed System

A. VOLTAGE AND CURRENT MEASUREMENT UNIT

The voltage transformer is used to measure the voltage of the induction motor. The voltage given to the induction motor

is measured using the voltage transformer with the transformation ratio of 230/5V. The current transformer acts like as current sensor as it receives the current signal. The current signal thus received from CT is converted into proportional voltage signal, as microcontroller accepts signals in voltage form only.

B. PIC MICROCONTROLLER

The microcontroller IC which we used is ATMEGA16. It is a 40 pin IC. The Microcontroller receives signal from various monitoring units of the induction motor. protection can be done more effectively and with this microcontroller. Analog inputs are converted into digital signals by ADC within the microcontroller. The data collected from the motor are displayed in Liquid Crystal Display (LCD).

C. LM35 TEMPERATURE SENSOR

The temperature of the motor windings is measured using the LM35 temperature Sensor. The LM35 series are type of precision integrated-circuit temperature sensors. The output of this sensor is linearly proportional the Celsius. For every 10mv, the temperature value will be increase in 1 degree.It can measure the temperature from -55° to +150°C range. The measured temperature from the sensor unit was displayed in LCD and stored in PC through the controller circuit.

D. IR SENSOR

This sensor is used for measurement of speed of motor. It is pair of two LED's, one which radiates infrared waves and the other one absorbs them. The radiated infrared wave is reflected because of obstacle in its path which is nothing but the white spot set on the cross sectional area of shaft. These reflected waves are absorbed by other LED. The time measured between radiation and absorption generates pulses for microcontroller which are directly proportional to speed of motor.

E. ZERO CROSSING DETECTOR

It senses the zero crossing of voltage and current waves. The difference between the time of zero crossing of two waves gives the phase angle between them and thus the power factor on induction motor.

V. RESULT AND DISCUSSION

The Fig.2 represents the complete view of the Proteus Software implementation of the induction motor monitoring and control system.
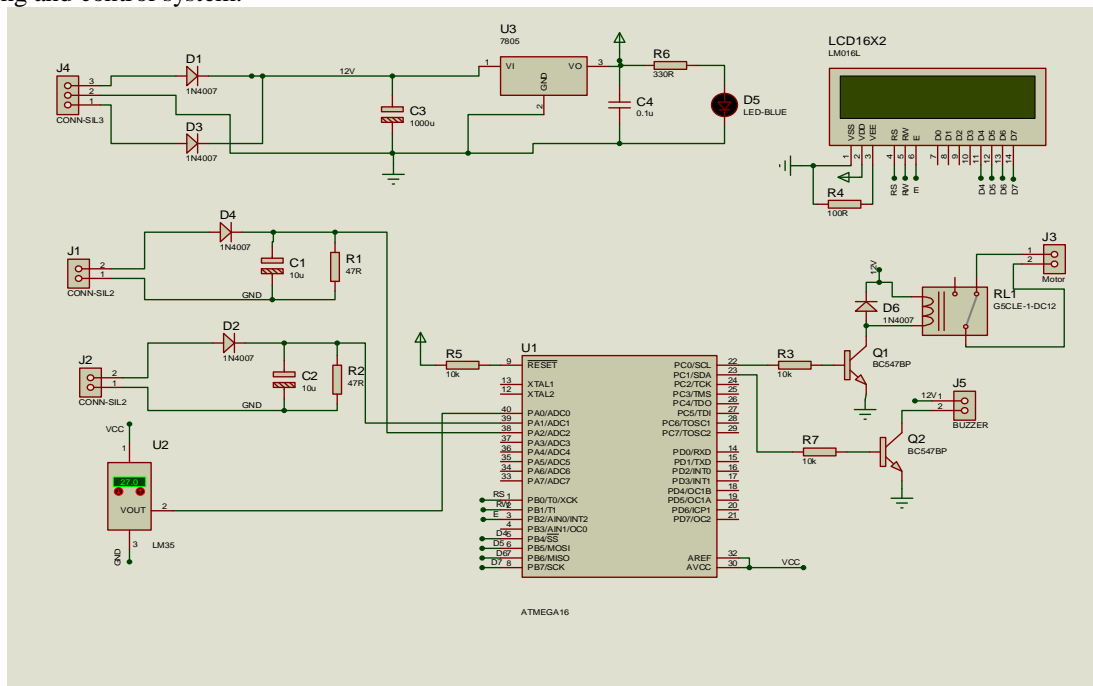

Figure 2. Simulation Representation of Proposed System

The temperature of the motor windings is measured using LM35 temperature sensor. The current and voltage rating of the induction motor, speed of the induction motor are measured using appropriate measuring unit and it can be displayed on LCD display. This paper is based on ongoing project whose testing is yet to be done. Thus actual results have not been presented. The system is expected to monitor the parameters of induction motor and send message on mobile phone when the values of those parameters crosses the limitations prescribed in programming of microcontroller. Hence, preventative action can be taken for protection of motor before actual fault occurs in the system.

VI. CONCLUSION

The induction motors have now become very popular as compared to other motors for many of the industries because its low cost, simple and extremely rugged construction, high reliability, high efficiency, reasonably good power factor, low maintenance cost. Induction motors are used in various industries such as, paper mill, Sugar industry, for driving the mechanical systems. The maintenance of an induction motor is very essential. The monitoring of induction motor through wired communication is not only expensive but also the data communication may affect due to physical conditions like human hazards.   Hence wireless communication becomes a praiseworthy substitute for not only monitoring but also the control of induction motor. It enhances the performance of the motor. The proposed system can measure, monitor and control the most important parameters like voltage, current, temperature, speed and Power factor of the induction motor. These real values are

transferred through the Wi-Fi technology to the mobile phone and also to PC. Thus the system facilitates guidance for preventive maintenance and predictive failure analysis.

VII. FUTURE SCOPE

The monitoring and controlling system of the induction motor can be implemented in the industries and the monitoring values are updated in industrial website for providing the easy maintenance. The automatic torque and efficiency of the induction motor can be calculated to improve the performance of the Induction motor.

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BIOGRAPHY

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