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Protection of 3 Phase Induction Motor using Microcontroller

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ABSTRACT: Three-phase induction motors are industry's workhorses and widely used as electromechanical energy conversion devices. Although induction machines are considered relatively reliable and robust due to their simple design and well-developed manufacturing technologies, failures do occur and may severely disrupt industrial processes and even lead to disastrous accidents. To prevent these failure happen, many techniques have been developed for early condition monitoring. The computer based protection methods are costlier and the electrical parameters cannot be visualized by Programmable Logic Controller (PLC) based method. The old classical methods are complex. Hence to protect an Induction motor easily, a microcontroller based fault detection and protection of Induction motor is proposed. This paper tends to develop for protection of three phase induction motor from over voltage, over current, temperature, Vibration sensing unit. The proposed system is tested with the setting of various preset values of parameters. From the results, it is observed that the results are satisfactory, reliable, gives quick response, cost effective and highly versatile.

KEYWORDS: Fault, Microcontroller, Protection, Sensing Circuit and Three Phase Induction Motor.

I. INTRODUCTION

The main concept of the project is to develop an induction motor protection system for protecting the motors from any damages occurring from single phasing, over current and over voltage. The induction motors are predominant in industrial applications. Thus this project helps to provide protection to the industrial motors if any of the phases misses out of the three phases, or if the voltage of the motor exceeds the threshold value.

The proposed system uses three-phase power supply where in three single-phase transformers are connected to it. The system has a set of op-amps used as comparators for comparing input voltages. The motor is operated by switching the main relay, which is operated by other set of relays by sensing single phasing and over /under voltage, over/under current conditions. The project in feature can be enhanced by using current sensors for overload protection and phase-sequence sensor for protecting the motor from applying wrong phase sequence.

A large number of motors are being used for general purposes in our surrounding from house- hold equipment to machine tools in industrial facilities. The electric motor is now a necessary and indispensable source of power in many industries. Three phase induction motor generally suffers from under voltage, over voltage, overheating, single phasing and phase reversal problems. Due to this electrical fault the winding of motor get heated which lead to insulation failure and thus reduce the life time of motor. When the three phase induction motor supply with higher voltage than is rated then induction motor starts overheated. This fault is generated in induction motor due to variation in induction motor parameters. When three phase induction motor runs continuously, it is necessary to protect the motor from these anticipated faults.

The rest of the paper is organized as follows. Section II discusses literature survey. Section III describes our proposed system. Section IV introduces the flowchart of system, and section V concludes this paper.

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II.LITERATURE SURVEY

Different alternatives to detect and diagnose faults in induction machines have been proposed and implemented in the last years. These new alternatives are characterized by an on-line and non-invasive feature, that is to say, the capacity to detect faults while the machine is working and the capacity to work sensor less [1]. Although induction machines are considered relatively reliable and robust due to their simple design and well-developed manufacturing technologies, failures do occur and may severely disrupt industrial processes and even lead to disastrous accidents. To prevent these failure happen, many techniques have been developed for early condition monitoring. The computer based protection methods are costlier and the electrical parameters cannot be visualized by Programmable Logic Controller (PLC) based method [2].

This paper is for monitoring the speed, torque and protection of three phase induction motor from overload by implementing ZigBee based wireless sensor network. The design of the system maintains security, provides high reliability and is susceptible to many types of faults [3]. The main aim of this project is to detect faults of three phases IM and control the faults. This project deals with speed control of Induction Motor. 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, speed variation, over-temperature etc [4]. In this paper, they present the Induction motor easily, a microcontroller based fault detection and protection of Induction motor is proposed. This paper tends to develop for protection of three phase induction motor from temperature by using temperature sensor and also use of single phase to three phase convertor circuit to prevent from over voltage and under voltage, over current, over speed, Line frequency and phase failure [5].

III.PROPOSED SYSTEM

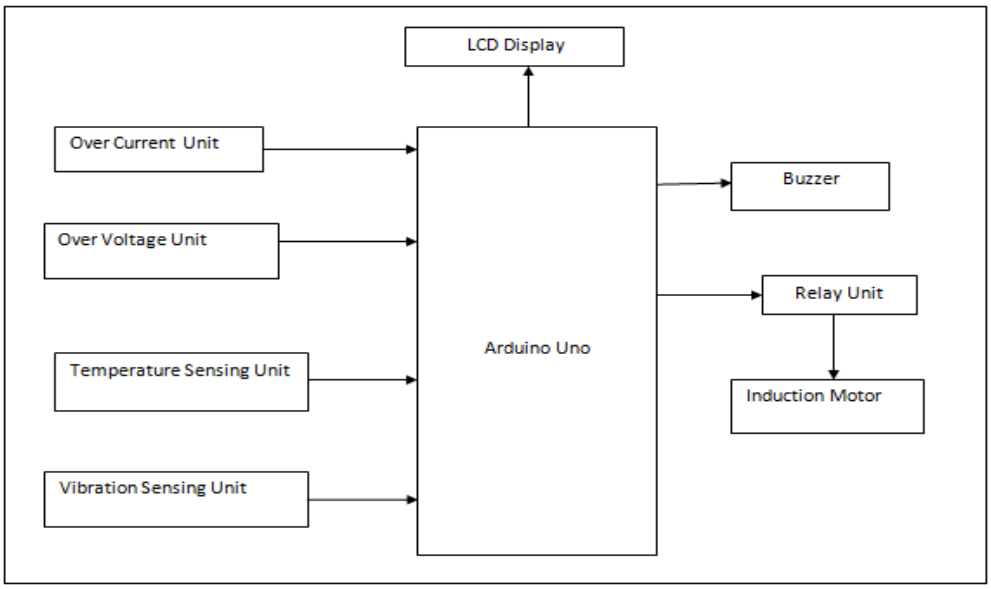

Fig 3: Block diagram of system

3.1Block diagram Description

The block diagram of proposed system is above shown. It consists of different units such as over voltage protection unit, overloads current protection unit, Vibration Sensing Unit, temperature sensing unit, control unit, voice recorder and speaker, relay circuit and Liquid Crystal display (LCD). In the proposed system variable resistance (preset) is used for adjusting reference voltages for different parameters such as over voltage, over current, over temperature. The values are set for the max. 430v, current 7.1amp, temperature50ºC.

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If the value of any parameter goes beyond the reference value than the relay unit releases the contact of the motor from the circuit. Hence the motor automatically turned–off. This is how the Induction Motor can be protected easily from the faults using this microcontroller based protection system. This system can be tested with various different rated Induction Motors.

1) AVR Microcontroller:

The AVR has Harvard Architecture where program and data memory are separately placed with an 8-bit RISC single chip microcontroller. It is the heart of the agricultural robot here. It is one of the first microcontroller families to use on-chip flash memory for program storage while other controllers used programmable ROM, EPROM or EEPROM. RISC-Reduced Instruction Set Computing, this is a CPU designed strategy based on the insight that simplified instruction can provide higher performance. AVR is most appropriate for battery powered appliances. The main advantages of using this ATmega32 are its 8-bit high performance with low power consumption and that it is based on enhanced RISC architecture with 131 powerful instructions of which most of the instructions execute in one machine cycle.

Highly Developed RISC Architecture:

- 131 Efficient and Powerful Instructions
- Most Execution in 1(Single) Clock Cycle
- 32 x 8 Working Registers for General Purpose
- Completely Static Operation

2) ACS712 current sensor:

This is a breakout board for the fully integrated linear ACS712 current sensor. The sensor gives precise current measurement for both AC and DC signals. Thick copper conductor and signal traces allows for survival of the device up to 5 times over current conditions. The ACS712 outputs an analog voltage output signal that varies linearly with sensed current. ACS712 is based on Hall detection principle; please try to avoid the magnetic field, when using as it may impact the reading accuracy.

3) Relay:

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically drive a switch, but added operating principles also are used, such as solid-state relays. Relays are employed where it is essential to switch a circuit through an independent low power signal, or when many circuits must be switched by a single signal. Initially relays were installed in long distance telegraph circuits as amplifiers: these relays repeated the signal entering in from a circuit and re-sending it to a different circuit.

4) Vibration Sensor:

The SW18010P, SW18015P, SW18020P, etc Vibration sensors are effectively just a delicate spring with a sturdy piece of metal in the middle. When moved, the spring wobbles around and touches the metal, momentarily making contact. These are very useful little devices as they draw absolutely no power. They could easily be used in something like a toy, causing it to be activated when shaken, but otherwise not causing the battery to run down.

5) LCD Display:-

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

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IV.FLOWCHART

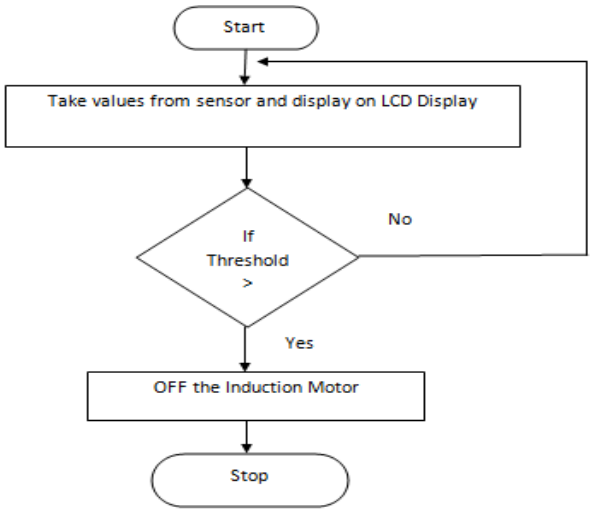

Fig. 4.1 Flowchart of system

V.CONCLUSION

Protection of three phase induction motor from over/ under voltage, over current, over speed, temperature, frequency and phase failure provide the smooth running of motor which also improves its lifetime and efficiency. To make induction motor run efficiently and to protect it from various faults, different sensing circuits have been designed. All sensor information will be display on LCD display and also update the actual value such as current, voltage and temperature.

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