FAULT DETECTION OF 3 PHASE INDUCTION MOTOR USING PIC MICROCONTROLLER AND SCADA MONITORING SYSTEM.

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ABSTRACT:

In most of the induction motor industry (I.M..), it has been used in low cost and high efficiency. During working condition of three phases I.M following faults are occurred such over voltages, over current, overheating and vibration. Suchfailureare overcome by the use of voltage transformer (V.T), current transformer (C.T), a temperature sensor and an accelerometer correspondingly. Microcontroller detects the fault and supervising by the SCADA system.

KEYWORDS: Microcontroller, Induction Motor (I.M) protection, Fault diagnosis, Programmable control.

INTRODUCTION:

Three phase induction motors are widely used for many industrial processes. Fault occurs when they are subjected to undesirable stresses and resulting in failure, which may cause production shutdown.

The faultin motor is due to mechanical and electrical stress. Mechanical stresses can generate an overload and bearing failure and bar fracture rotor is due to a sudden change of load.

Electrical faults are because of extra voltage stress on stator winding, also involve insulation failure due to the temperature rise and over current due to the overload, single phasing on I.M

This project has been introduced by the programmable integrated circuit (PIC) based protection system. The PIC based protection method has excluded most of the mechanical components. Troubleshooting various faults of phase current, phase voltage, vibration and winding temperatures of an I.M occurring in operation have been attained with the help of a microcontroller. The PIC microcontroller (PIC16F877A) is one of the most popular microcontrollers in the industry. This controller is very appropriate to use the programming of this controller is also easier. The ADC is inbuilt in PIC microcontroller.

Zigbee is wireless communication device like Bluetooth and wireless local area network (WLAN). Basic difference between Zigbee and other communication protocol like Bluetooth is Bluetooth based network can exist up to 10 meters and Zigbee based network can exist 10 to 100 meters.

SCADA system means Supervisory Control and Data Acquisition system. It control and monitor the industries such as telecommunication. It gathers the information and send back to the centre.

I. LITERATURE REVIEW:

Many problems in the asynchronous motor to operate, we can vary the voltage and input current to bring the motor back to the normal condition at fault condition like stator fault, rotor fault, bearing fault etc. Also, before damaging stator and rotor parts, we can turn off the motor. [1]

SCADA system monitors and controls the equipment in this industrial sector for example, telecommunications, transport, waste water management. The main purpose of SCADA is data transmission between the SCADA control of the host computer and the remote terminal unit. [2]

The main purpose of this project purpose is to develop parameter monitoring system based on Zigbee for the asynchronous motor offers a wireless control and monitoring system for safe and economic data communication in industry. Cable communication

systems are expensive because of the physical conditions, it is not possible. [3]

With increasing load voltages, as well as the obligation of short circuit in the distribution system, over current protection is becoming increasingly important today. The system's throughput requires protection not only for economic reasons, but also consumers just expect reliable service. Thus, a protection relay called a device was created to serve this purpose. This paper includes the objectives, scope and benefits of a PIC microcontroller. [4]

Three phase induction motor are the workhorse of industry and single phase induction motor are the workhorse of home .thus ,we can say that induction motor are widely used motor but these motor faces various problem during its course of operation. This article overheats problems faced by IM during their operation, such as overvoltage, over current and over temperature. There are several methods for detecting faults and protecting IM. Some online fault detection, stator fault monitoring methods, the microcontroller based protection system, the PIC-based security system and the PLC-based protection system. [5]

Today more faults occur in IM to overcome this fault need protection of IM. We usually design protection circuit by using timer, contactor, voltage sensor, current sensor or relays in order to reduce mechanical components we use personal computer. In this we are using PIC controller instead of using PLC as the cost of PLC is very high. [6]

Misalignment of the bearing is additionally normal result of defective bearing installation. Regardless of the failure mechanism, defective bearings generate mechanical vibration at a rotational speed of each component. Vibrations are arises due to misalignment of foundation, supply is of having harmonics and sudden increase in load. [7]

This paper is to distinguish problems of 3 ph. IM and control the faults. The different faults are under voltage, single phasing, over current. The important parameters are voltage and current. There are several techniques to identify defects and IM protection. Part of PLC based protection system and microcontroller based protection system. [8]

II. PROGRAMMABLE INTEGRATED CONTROLLER (PIC):

PIC Microcontroller has one of the main advantage is that it can be write-erase as many times as possible because it use FLASH memory technology. It is 40 pins integrated circuit (IC) in which there is 33 pins for input and output.

PIC microcontrollers are widely used for industrial purpose due to its high performance ability at lower power consumption. It is also very famous due to moderate cost and easy availability of its supporting software. It is 8 bit microcontroller.
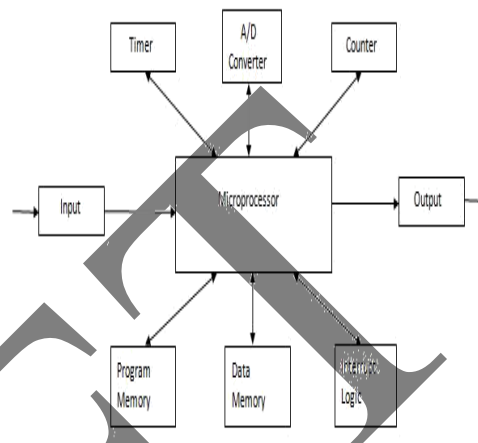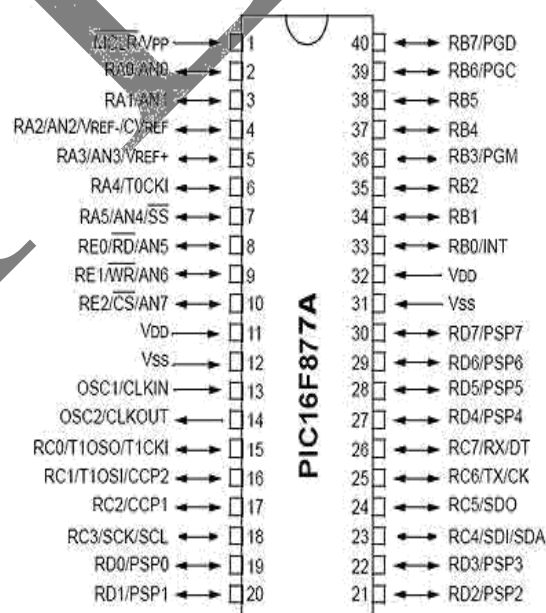

Fig1. Basic structure of PIC

Fig.2. Pin dia. of PIC16F877A

III. PROTECTION SYSTEM OF INDUCTION MOTOR:

In figure, a block diagram of the protection system is illustrated. It consist of the measurement of current, the voltage, the vibration, and the winding temperature. The protection system proposed can be analyzed in three categories as the hardware, the instrumentation and the software which will be discussed in following sections.

A. HARDWARE:

The protection system used in this study consist of 3 HP or 2.2 KW/1440 rpm 3 phase I.M, three voltage transformer with transformation ratio of 230/5 volt,

three current transformer with current ratio of 1000:1, a temperature each 1 deg. C increasing temperature, and an accelerometer as a vibration sensor. The photograph of the proposed system is demonstrated in fig.

B. INSTRUMENTATION:

The use of a current transformer and three voltage transformers is for measurement of voltage and current of the motor in the protection system. Output of the measured values to be applied to the AC / DC converter. The acceleration sensor is used as a vibration sensor, which acts on the piezoelectric effect.

The motor temperature is measured by the LM-35 sensor. LM-35 sensor is linear device which generates 10mV / ℃.
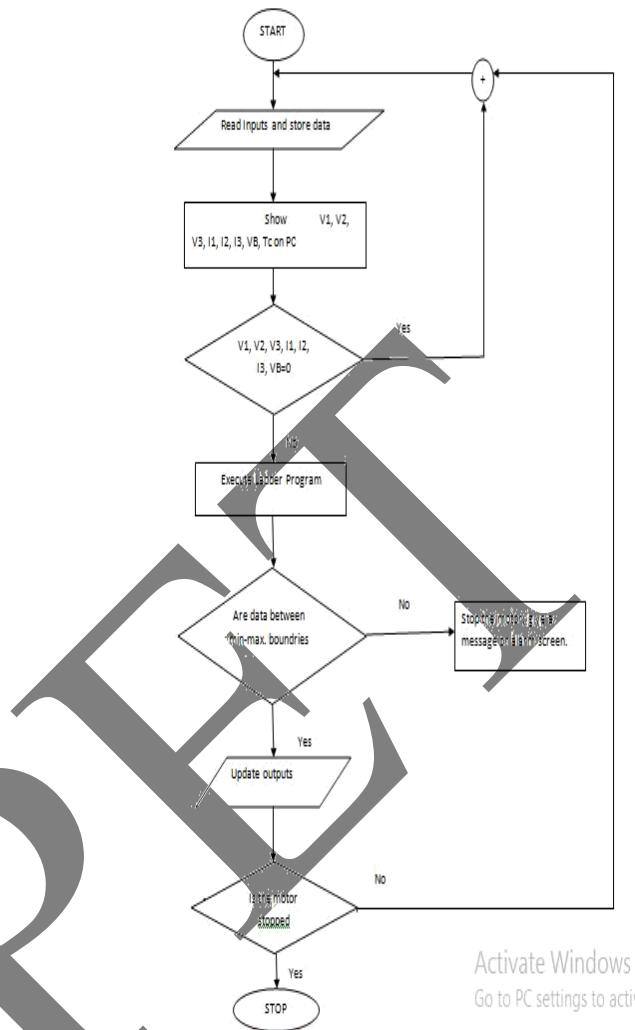
C. SOFTWARE:

In order to achieve protection of IM easily, PIC program was developed in micro software. We use Ladder programming method. The first program is written by a boy. As it can be stored in RAM or erasable programmable memory (EPROM), the LAD is then converted to opcode in binary code. Each next instruction is decoded and executed by the CPU. Each point of the connection input and output of the PIC is abit of I/O which is used to identify the address. Flowchart of the program shown in Fig.1.Data achieved from the PIC. These data are three phase voltages (V1,V2,V3), three phase currents (I1,I2,I3),vibration (VB),temperature (T) of the induction motor

The motor variables and their descriptions are given in table:

Table No. 1 Motor variables.

Variables	Symbol	Unit
Voltage of phase 1	V1	Volt
Voltage of phase 2	V2	Volt
Voltage of phase 3	V3	Volt
Current of phase 1	I1	Ampere
Current of phase 2	I2	Ampere
Current of phase 3	I3	Ampere
Vibration	VB	Hertz
Temperature	T	Degree

The software displays the phase voltages, phase currents, vibration and the motor temperature on computer without any human interaction. If afault occurs, the program relates three voltage phases, three-phase currents, vibrations, with respect to its nominal values, the motor is stopped by sending a signal from the PIC motor control circuit, and the Error description message will be displays on screen.

Flowchart of software developed.

IV. EXPERIMENTS ON MOTOR FAULT DETECTION AND PROTECTION:

1. ZIGBEE -

All wireless communication system have the following components:

- Transmitter
- Receiver
- Antenna
- Path between the transmitter and receiver

ZigBee is an additional protocol that uses standard 802.15.4 as the underlying base and creates routing and additional networks. ZigBee's protocol was developed by ZigBee Alliance. ZigBee Alliance is a group of companies that cooperated in developing network protocols that can be used for various commercial and industrial applications of low data rate. ZigBee is ideal for embedded systems as it is designed for low power applications.

ZigBee is basically a communication IC. In our project, it is used for communication between microcontroller and PC.

Basically, ZigBee devices, there are three types.

- ZigBee Coordinator (ZC): The most capable device, coordinator forms of the root of the network, can be connected to other networks. Since it is in the originally started system of the network, each network, there is one ZigBee coordinator. And like to function as a central repository of trust and security key, network information is stored.
- ZigBee router (ZR): In combination with the router application run role to send the data to other devices and will be able to function as an intermediate router.

ZigBee End Device (ZED) : It has enough function to communicate to the parent node. It will not be able to send data from other devices. ZED requires a minimum amount of memory so it is inexpensive than ZR or ZC.

- Comparison of ZigBee with Bluetooth:

Table No. 2 Comparison of ZigBee with Bluetooth

SrNo	Parameter	Bluetooth	ZigBee
1.	Establishment	Bluetooth was launched in the year 1994.	ZigBee was launched in year of 1998.
2.	IEEE Standard	Bluetooth though not under IEEE now was defined under 802.15.1 standard.	ZigBee is defined under IEEE 802.15.4 Standard
3.	Frequency	Bluetooth works under 4.1 GHz.	ZigBee uses 900 MHz in the US 868 in Europe & 2.4 GHz in world wide.
4.	Channel Bandwidth	Bluetooth based channel ingest bandwidth up to MHz	ZigBee based network ingest bandwidth of 0.3 MHz, 0.6 MHz & 2 MHz depending upon the frequency at which network are communicating.
5.	Types of computer network	Bluetooth based communication serves for wide PAN (WPAN)	ZigBee has been designed to communicate under personal area network.
6.	Range	Bluetooth based network can exist up to 10 meters	ZigBee based network can exist from 10 to 100 meters.
7.	Data transfer rate	Bluetooth based network have max data transfer rate up to 1 Mbps.	ZigBee data transfer rate are upto 250 Kbps.

2. SCADA:

SCADA is acontraction for Supervisory Control and Data Acquisition. SCADA systems are used to monitor and control a plant or equipment in industries such as telecommunications, waste water control, power generation and transmission, oil and gas refining and transportation. These systems, data transfer between the SCADA central host computer and a multiple of remote terminal units (RTUs) and / or PLCs ,or any microcontroller terminals and the central host and operator terminals including. The SCADA system collects, transfers information to a central site, then notifies the the home station, controls the necessary analysis, and showing information logically and organized. These systems can be relatively simple.
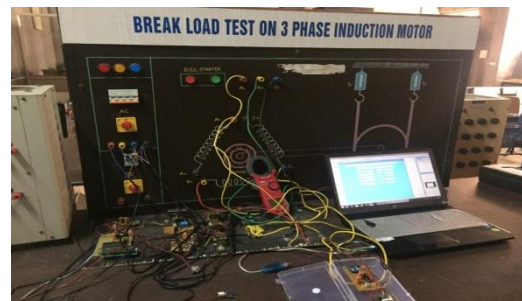
V. WORKING OF THE SYSTEM:

Figure3: Project with hardware & Software SCADA(as monitoring) screen

VI. CONCLUSION:

In this study, a protection system for three phase induction motor has introduced.A 2.2KW three phase induction motor has been connected to the protection system through the measuring components.The system is successfully implemented and tested. In which overvoltage, over current, over temperature and vibration faults are detected. If any interruptionis observed during motor operation, warning message on the LCD screen, then the motor stops.

In this project the software visual basics (VB) has been successfully used for SCADA. With the use of PIC & SCADA control the system is more reliable.

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