CONDITION MONITORING OF MOTOR USING IOT

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ABSTRACT

Now a days the induction motor has became the most popular type of motor for industrial and commercial applications. The condition monitoring have become a growing technology in recent years. The industrial sectors are widely using automation platforms to increase the productivity. The condition monitoring helps to avoid unwanted shutdown of motor and improve performance of the operating efficiency and life of motor .Monitoring is usually done based on IOT which is a system of interconnected device that offers the capabilities of real time data collection, visualizing the collected data in the form of charts, ability to create plug in and apps for collaborating with web services, social network and other APIs. The aim of this paper is to monitor the real time data of three phase induction motor based on Internet of Things for safe and economic data communication in industrial fields This data monitored is stored on a things speak channel from serial monitor .This monitored data can also be accessed from different location through web page .Also controlling of the three phase induction motor is possible by two ways i.e controlling the three phase motor from motor end and also controlling the three phase motor at remote end.

Keywords— Internet of Things, Parameter Monitoring, Induction Motor, Parameter Controlling.

1. INTRODUCTION

Induction motors are most widely used machines in industrial sector as well as commercial sectors due to its various advantages such as reliability, ruggedness, economical ,compactness and the main advantage is its a maintenance free motor .The induction motor is a self excited machine in which the power is supplied to the rotor winding and the voltage is induced in the stator winding of the motor so this motor is called induction motor, on principle of rotating magnetic field(RMF). As they have remained the most popular type of machine used in industrial sector such as squirrel cage motor is used in various industrial drives as well as used as fixed speed and variable frequency applications .As all motors generate noise and vibration, analysis of this can help to give information on condition of motor ..As 95 percent of motors in industries are three phase induction motors the monitoring of these motor is very essential. So monitoring and control of induction motor is very essential to increase reliability, maintaining performance. Condition monitoring means monitor the real time data of a machine as well as continuous evaluation of health of machine throughout its serviceable life. Due to this the operating efficiency of the machine will increase and ultimately the electricity bill will reduce ,due to continuous monitoring the unexpected failures occurred on machine will reduce and the life of the machine will increase, most important the human efforts will reduce. The various methods of monitoring are model based techniques such as signal processing techniques, fast fourier transform, short time fourier transform , gabor transform, winger ville distribution and other soft computing techniques such as artificial neural network techniques ,fuzzy interference system, adaptive fuzzy neuro interference technique, wavelet transform analysis [8]. Faults and failures of induction machines can lead to excessive downtimes and generate large losses in induction motors. Even small fault can causes increased losses such as reducing efficiency and increasing temperature, which will reduce insulation lifetime, and increasing vibration, in turn may reduce bearing life time. All they are due to the operating environment condition and machine internal factors. The different type faults which are commonly occurred in the induction motor are electrical faults and

mechanical faults [13]. Electrical faults include stator and rotor faults such as inter turn faults, line to ground faults whereas mechanical faults includes bearing faults. So with the help of proper knowledge and study of these faults go for condition monitoring of the motor and also control the motor from different faults occurred on it. To achieve both the monitoring and controlling of three phase induction motor Thingspeak (IOT) platform can be used effectively.IOT platform is recently used in industrial automation in order to increase the productivity by monitoring the induction motor.Thingspeak is a open source which provides various services such as offers the capabilities of real time data collection, visualizing the collected data in the form of charts,ability to create plug in and apps for collaborating with web services, social network and other APIs. So IOT base system is used to monitor the different parameters of data using arduino and this monitored data is transferred from serial monitor to things speak , and if any type of fault occure on induction motor with the help of things speak we can control the on and off of induction motor.

2. HARDWARE AND SOFTWARE ARDUINO.

Arduino is an open source physical computing platform based on easy to used hardware and software.

2.1 ARDUINO UNO.

Figure 1. Shows Arduino Uno is a micro controller board based on ATmega328 (data sheet). The ATmega has 32KB of flash memory for storing codes. It also has a 16 MHz crystal oscillator, ICSP header and a reset button. It has also 2KB of SRAM and 1KB of EEPROM. Its operating voltage is 5 volts. With the help of analog pins different sensors are connected to monitor the real time data of the machine and through digital pins the controlling of this machine can be done. Arduino Uno usually has 14 digital pins an six analog pins.

- Vin- This pin is use to supply or accesses the voltage.
- 5 Volt – This pin is used to provide regulated 5 volt supply to the Arduino or other sensor connected
- Ground- This pin is use to ground all the grounds of the sensors.
- LED- This pin is driven by digital 13 pin when the logic to this pin is HIGH the led is ON and when its logic is Low the led is OFF.

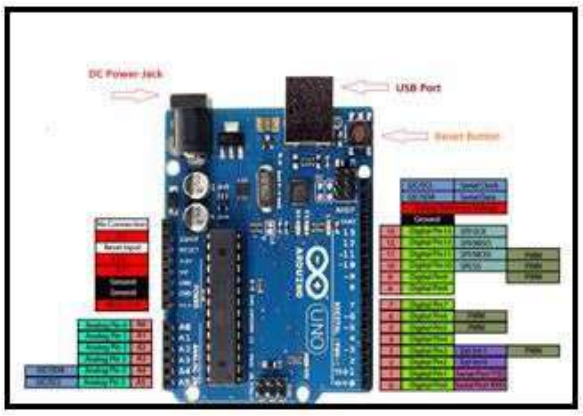

Figure 1. Arduino Uno Board

2.2 VOLTAGE SENSOR (ZMPT101B)

This voltage sensor is use to measure all the three phase voltages of the motor. This sensor can measure both the AC and Dc voltages and can measure voltages upto 250 volts shown in figure 2. This sensor has high accuracy to measure the voltage and power

2.3 Output Signal: Analog 0-5V

2.4 Operating Voltage: DC 5V-30V

2.5 Measure within 250V AC

2.6 Rated input current: 2mA

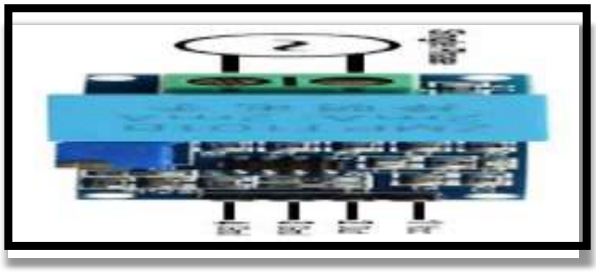

Figure. 2 Voltage Sensor (ZMPT101b)

2.3 CURRENT SENSORS (ACS712)

ACS712 sensor is used to measure the current of all the three phases of an induction motor shown in figure 3. This sensors are available for different ratings such as 5 Amp, 20 amp,30 amp. This sensors are able to measure the RMS value of the current of the motors. This sensor uses indirect method to measure the current and the IC used in this sensor has 2.1 KV RMS voltage isolation along with a low resistance current conductor. This sensor consist of three pins Vcc , output and ground . They are connected in series with each phase of the motor.

Figure 3. Current Sensors (ACS712)

2.4 TEMPERATURE SENSOR (DHT11)

Figure 4 Shows the Dht11 is a low cost digital temperature and humidity sensor . This sensor can measure from 0 to 50 C and humidity from 20% to 90%. It consist of three pins such as Vcc, Data and ground . It uses capacitive humidity sensor and the mister to measure the air in the surrounding. The advantage of this sensor is that we get new data every 2 second.

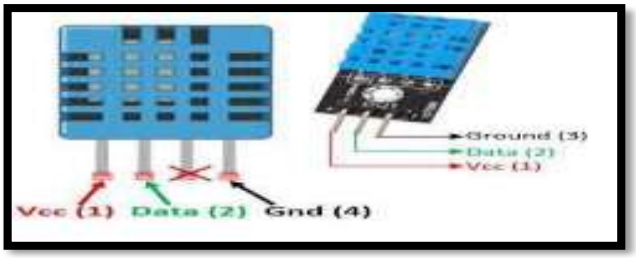

Figure 4:Temperature Sensors (DHT 11)

2.5 VIBRATION SENSOR (LM393)

Vibration sensor is also called as piezoelectric sensor and uses the piezoelectric effect while measuring changes in the pressure , acceleration is shown in figure 5 . This sensors can also be used to detect the fragrance . The operating voltage of this sensor is 3.3 V to 5V .When this sensor detects the vibration it gives a logic as HIGH and if there is no vibration then this sensor give a logic LOW. This sensor consist of three pins Vcc, ground , and digital input. This sensors are very reliable and easy to use.

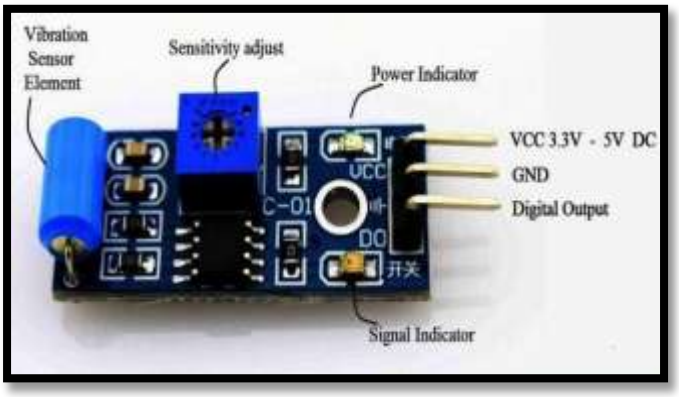

Figure 5: Vibration sensor (LM393)

2.6 RELAY BOARD.

Figure 6 shows the 5V relay is used in the proposed work. 5V relay is directly connected to the Arduino. Pulse from the Arduino is given to relay, the output of relay is the input of contactor. If any abnormal condition is detected by the Arduino from acquired data the command is given to Arduino to relay to open the contactor. In this work single pole single throw switch relay is used. The relay has the 5pins NO (normally open), NC (normally closed) ,5V,GND and common pin.different sensors can be seen on the serial monitor of Arduino IDE. The collected data can be stored on the IoT platform using ESP 8266. wi-fi module. Then using wi-fi functionality the data available is uploaded to Thingspeak cloud platform. In order to upload the data to Thing speak platform, an account is to be created in it and then a new channel is to be created.

Figure: 6 Relay Board.

3. ALGORITHMS USED FOR MONITORING AND CONTROLLING OF 3 PHASE INDUCTION MOTOR.

In this system two operations are performed.

A) Monitoring of Electrical Parameter of 3 phases IM on IOT and its control from Remote end as shown in figure 9.

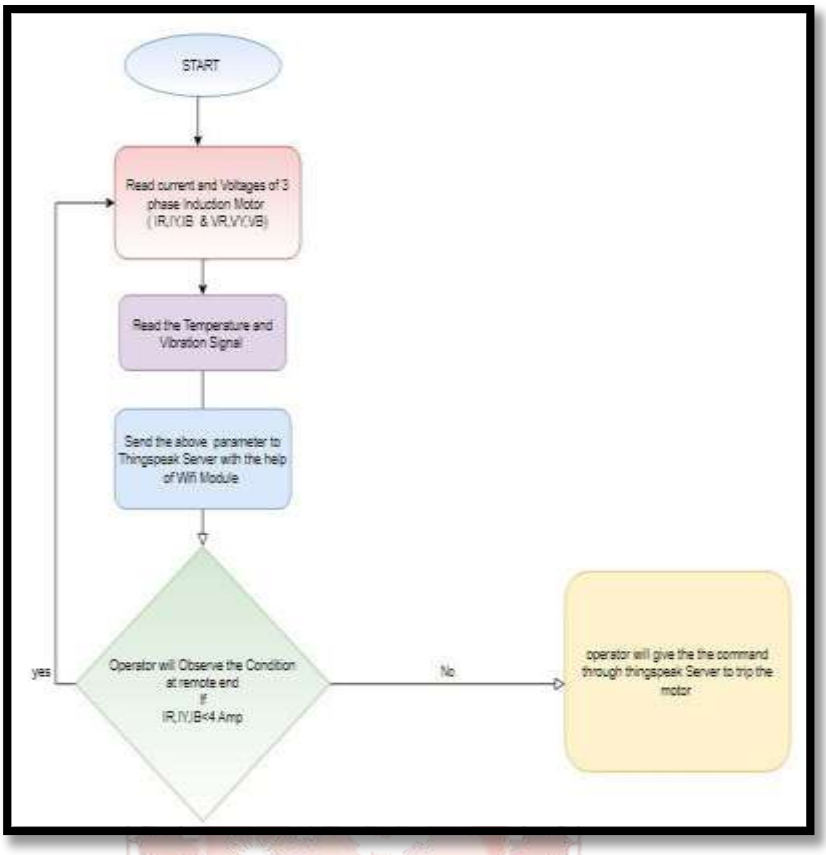

Figure 9:Flowcharts for Controlling from Remote Side Steps for monitoring and controlling of 3 Phase Induction Motor from Remote Side.

Read the RMS value of Voltages and Currents of Three Phase Induction Motor also read Temperature and Vibration Signal with the help of Various Sensors.

1. Send the Sensed value to ThingSpeak Server using ESP 8266 Wi-Fi Serial Wi-Fi Module
2. The operator will observe the various parameter obtained on ThingSpeak server and if detect any abnormal condition about respective parameter.
3. If abnormal condition detect on IoT Cloud with the help of Thingspeak Server using Read API key of Controlling Chanel operator takes the decision to OFF the motor by giving the command to digital pin of Microcontroller board. The relay is connected to the same digital pin with the help of single phase contactor 3 Phase Induction Motor will stop.
4. If motor is running on normal conditions the monitoring process will continue till any faults or abnormal conditions.

B) Monitoring of Electrical Parameter of 3 phase IM on IOT and its control from Motor end per given in figure 10.

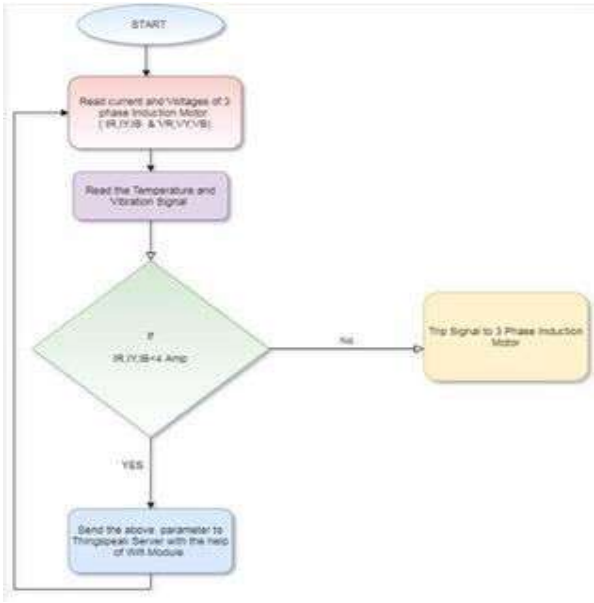

Figure 10: Flowcharts for Controlling from Motor Side. Steps for monitoring and controlling of 3 Phase Induction Motor from Motor Side

1. Read the RMS value of Voltages and Currents of Three Phase Induction Motor also read Temperature and Vibration Signal with the help of Various Sensors.
2. Send the Sensed value to Thing Speak Server using ESP 8266 Wi-Fi Serial Wi-Fi Module
3. The Digital pin of Microcontroller board will read the various parameter obtained Serial Monitor Window and if detect any abnormal condition about respective parameter.
4. If abnormal condition detect on serial Monitor window with the help of Relay driver Circuit Controlling of motor by giving the command to digital pin of Microcontroller board. The relay is connected to the same digital pin with the help of single phase contactor 3 Phase Induction Motor will stop.
5. If motor is running on normal conditions the send the various parameter on thingspeak Server for monitoring of 3 phase Induction Motor.

4. RESULT AND DISCUSSION

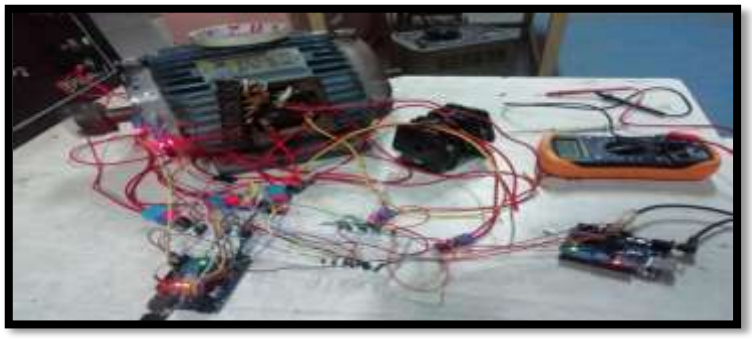

Figure 11: Experimental setup

Fig 11 Shows Experimental setup. It consist of 3 Phase Induction Motor having configuration 2 H.P., 415 V , 3.5 Amp. A sensor Unit having Voltage (V), Current(I) Vibration and Temperature Sensors are connected to Microcontroller Arduino Uno and serial communication arrangement is made between the Arduino and ESP 8266 Wi-Fi Module.Using its Wi-Fi connectivity, the data is uploaded to cloud platform and each

parameter is represented in the form of graphs as shown in the Fig.and Fig below.Web application is designed in such a way that it needs an authentication for cyber security. Only Authorized personnel is provided with login credentials to enter and monitor the motor condition and performance.Fig 12. Shows the voltage and Current of R phase of three phase Induction motor sense with the help of sensors obtain on ThingSpeak and this match with actual Values.

Figure 12. VRrms & IRrms

Figure 13. VYrms and IYrms

Fig 13. Shows the voltage and Current of Y phase of three phase Induction motor sense with the help of sensors obtain on Thing and Speak and this match with actual Values.

Fig. 14. Shows the voltage and Current of B phase of three phase Induction motor sense with the help of sensors obtain on Thing and Speak and this match with actual Values.

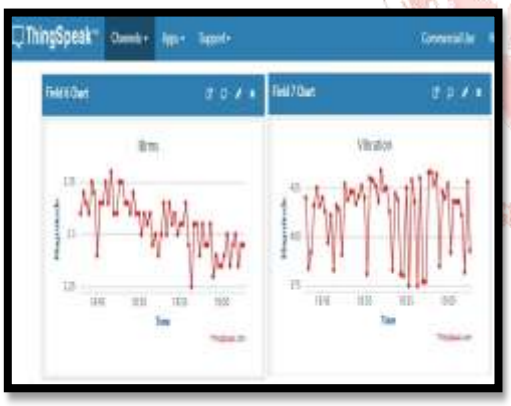

Figure 14. VBrms & IBrms

Figure 15. Vibration and Temperature Signal

Figure 16. ON/OFF Status

5. CONCLUSION

In this Paper3 Phase Induction motor is effectively and continuously Monitored by using Different sensors and obtained data is stored in the cloud platform and is accessed from different location using web application. The health of motor is assessed by analyzing the continuous parameter. In addition to continuous condition monitoring, Controlling remote end and as well as motor end is developed.

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