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INDUCTION MOTOR CONDITION MONITORING AND CONTROLLING BASED ON IOT

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Abstract In today's scenario, the induction motor plays a predominant role in the industrial applications. The major superiority in induction motors is rugged and simple in construction. It can operate in any environmental condition and the cost is inexpensive. This paper grants the information regarding IoT (Internet of Things) based remote control and monitoring system of an induction motor in industries for implementation, In order for protected and economic conditions. The Transducer modules and sensors observe the parameters like Temperature, vibrations, external moisture RPM, induction machine load current and voltage and send to the (Arduino) processing unit. It will inspect and exhibit the parameters. To send information for remote monitoring, the processing unit (Arduino) conveys with the gateway module to cloud database. To eschew system failure, this paper presents the induction machine start and stop control by both automatic and by manual. It also provides an industrial application to make the system become faster and user friendly.

Key Words: Induction Motor, Internet of Things, Ardunio, Vibration ,Temperature

1. INTRODUCTION

In the evolution of electrical technology, the dc motors were widely used different industrial applications. After the invention of ac motors especially ac induction motors the view of industry become changed due to the wide advantage of induction motors. An induction motor has two main parts such as stationary part and rotating part. Two parts are interlinked by mutual induction that is transformer principle. An induction is known as rotating transformer. The main advantage of the 3phase induction motors are self - starting, rugged in construction, good power factor and low cost but without sacrificing the efficiency the speed cannot be controlled. The different faults occur in induction motors are,

Electrical-related faults: The electrical faults may occur due to the following factors such as unbalanced 3phase supply, over voltage, over loading.

Mechanical-related faults: The mechanical fault may occur due to rotor bar broken, air gap eccentricity, damage in bearing, rotor and stator winding failure

The performance of the induction motor depends upon the above electrical and mechanical parameters. So the continues monitoring of induction motor is needed for safe and reliable operation of industrial induction motors. The electrical and environmental parameters such as voltage, current, temperature and surrounding humidity of the motor, affects the good performance of motor. And also the mechanical factors such as vibration and abnormal speed affect the good performance of the motor. Some electrical and mechanical factors cause the severe damage to the health of induction motor and also cause severe problem to application where the induction motor is used.

Today scenario the industry work as fast as possible to finish the product /service. In many industries, the induction motors very widely used to process the product .To ensure the reliable operation of induction motors recent advancement techniques are used. Due technology development the monitoring and controlling are done automatically. Internet of things is the recent development to control and monitor the motor from remote location. This method provides easy control and reliability. The reliability of motor is obtained by continuous monitoring of electrical and mechanical parameters. If any abnormal value of electrical and mechanical factors may be detected, the motor is controlled automatically (i. e) motor is suddenly turn off to reduce the severe faults.

2. LITERATURE SURVEY

Shyamala.D "IoT platform for condition monitoring of industrial motors" [1], Numbers of things are efficiently interconnected**,** which leads to condition and controlled monitoring to increase productivity. Continuous monitoring of the equipment, receiving alerts and data availability for predictive maintenance. Motor is effectively and continuously monitored by using web location. Kunthong, Jakkrit, et al. "IoT-based traction motor drive condition monitoring in electric vehicles: Part 1." Power Electronics and Drive Systems (PEDS), 2017 IEEE 12th International conference[2]. In electric vehicles, The motor drive condition for traction was supervised by applying the implementation of a wireless Internet of Things(IoT). The design and testing of the prototype using an ESP8266 microcontroller module to acquire motor condition is presented. Prakash, Chetna, and Sanjeev Thakur. "Smart Shut-Down and Recovery Mechanism for Industrial Machines Using Internet of Things." 2018 8th International Conference on Cloud Computing, Data Science & Engineering (Confluence). IEEE[3], For predictive

maintenance of motors in the industries, monitoring needs to be performed continuously so as to determine any degradation in performance or failure of the motors. The recovery mechanism provides a back-up machine which is started when the main motor is shut down. This helps in decreasing the loss that would occur during the downtime. This increases the reliability. Şen, Mehmet, and Basri Kul. "IoT-based wireless induction motor monitoring. " Scientific Conference Electronics (ET), 2017 XXVI International. IEEE, 2017.[4], In this way, the production process is not impeded and the required maintenance or replacement can be performed with the least possible disruption. This study has provided statistics not only for creating mathematical models but also for enabling the CMS operator to establish a motor maintenance schedule. Xue, Xin, V. Sundararajan, and Wallace P. Brithinee. "The application of wireless sensor networks for condition monitoring in three-phase induction motors." Electrical Insulation Conference and Electrical Manufacturing Expo, *2007*. IEEE, 2007.[5], The most commonly used technique for the detection of faults in large three-phase induction motors is to measure the supply current fed into the motor and analyse the signal spectrum. This aspect allows companies to reduce downtime when repairing machinery and ensures that productivity does not suffer.

3. OBJECTIVES AND SCOPE

The main objective is to increase the reliability of the motor application by using the recent technology advancement. This work ensure the continuous monitoring and easy control of high horse power induction motors used in variety of industrial fields. By ensuring the system reliability abnormal conditions are easily identified and easily rectified. As Induction machines are used nearly 90% in industries, the economic data monitoring is required. The productivity of industries can be increased by doing the preventive maintenance of induction machines. By taking preventive measures the failure of system and cost of high horse power motors is protected.

- To monitor and control an induction motor based on internet of Things (IoT) for safe and economic data communication in industrial fields.
- To start or stop the induction machine to avoid system failures by **Automatic and manual** control methods.
- To monitor and control the motors used in Electric vehicles(to make EV vehicle as automatic one).

4. Block diagram:

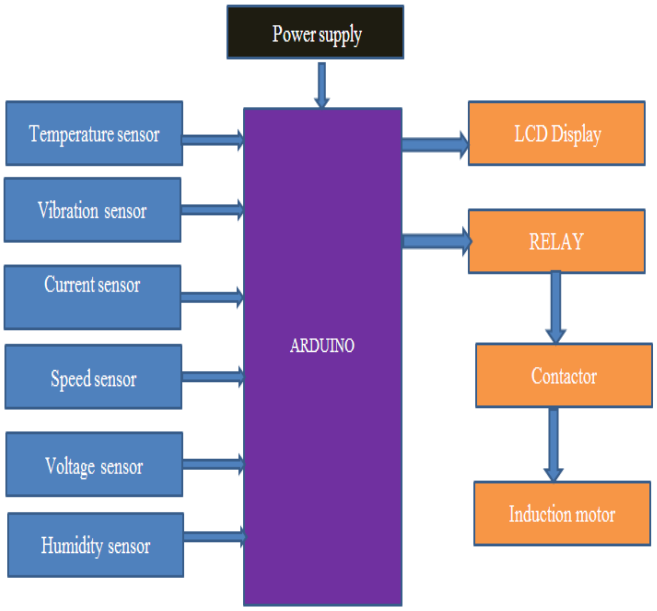


Fig1. Block Diagram

5. COMPONENTS DESCRIPTION:

A. Arduino UNO:

The advantage of Arduino over other type of microcontroller is, it's open source and cost is less compare to other type of microcontrollers. The simple in programming it is used many more professionals. Arduino (Fig2) is a type of ATmega328. Arduino has analog and digital input/output pins. Arduino board need 5v dc supply to operate. Arduino UNO is the heart of this work for data acquisition and controlling of motor. The condition monitoring sensors, LCD display are interfaced with input/output pins of Arduino. The control circuit are added are also interfaced with output pins of Arduino. Arduino board has the reset button, pins for connecting external source (i. e battery) and USB cable. It's also has transmitter and receiver pin for serial monitoring. Arduino produce a output of 3.3V and 5V.

Fig2. Arduino UNO

B. Remote monitoring and controlling:

Acquired data is continuously monitored in local center and also in server .The server application provide the remote monitoring of acquired data. The program set up in the Arduino is used in processing the data continuously and send the processed to the server. By using thinks speak website the data is seen from remote locations via internet. If any abnormal condition is noted the is controlled from remote locations (i. e ON and OFF the motor to reduce severe faults).

C. Power supply:

Power supply is the circuit (Fig 3) from which we get a desired de voltage to run the other circuits. The voltage we get from the main line is 230V AC but the other components of our circuit require 5V DC. Hence step-down transformer is used to get 12V AC which is later converted to 12V DC using a rectifier. The output of rectifier still contains some ripples even though it is a DC signal due to which it is called as Pulsating DC. To remove ripple in output voltage the filter circuit is required. Here a capacitor is used. The 12V DC is rated down to SV using a positive voltage regulator chip 705. Thus, a fixed DC voltage of 5V is obtained.

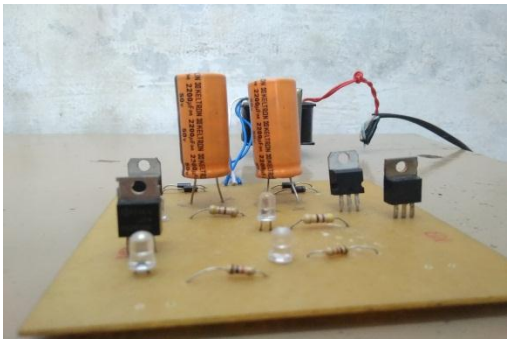
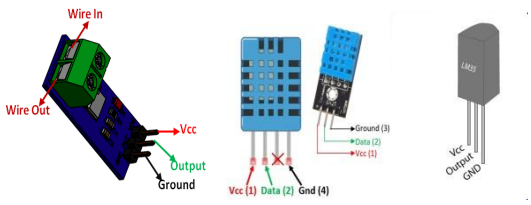


Fig3.power supply circuit

D. Condition monitoring sensors:

The running condition of 3phase induction motor is continuously monitored by easily configurable and light weight sensors are mostly used. The sensors (Fig 4) in the proposed work are DHT11 sensor for measuring humidity, LM35 for measuring temperature, Piezoelectric sensor for measuring vibration, Acs712 for measuring motor current, voltage divider for measuring supply voltage and IR sensor for measuring speed. In this work the data is acquired by the Arduino. The Arduino has the ability to process the data, send the data to cloud storage, store the result in local center, give the alert message to user and used in control the applications.



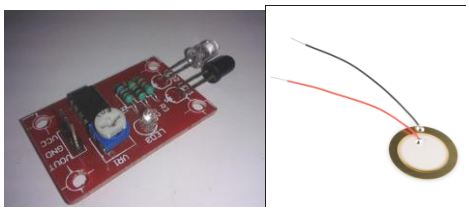


Fig 4 Sensors

E. LCD display:

In this work 16*2 LCD display (Fig 5) is used for continuously display a data which is acquired from sensors. The display contains 16 pins. The supply of 5V is given across the Anode and cathode pins of LCD display. Pins 3, 4 and 5 are connecting to pot, for change the brightness of the LCD display. The LCD display contains 8data pins and 2 control pins. By programming the process, the data is continuously displayed in the LCD screen. To interface LCD display to Arduino 4 data pins, 2 control pins and 2 supply wires (i. e 5V and Ground) must be connect to Arduino. The processed data is displayed in the LCD display one by one. And also the additional requirement of smooth motor operation is displayed.

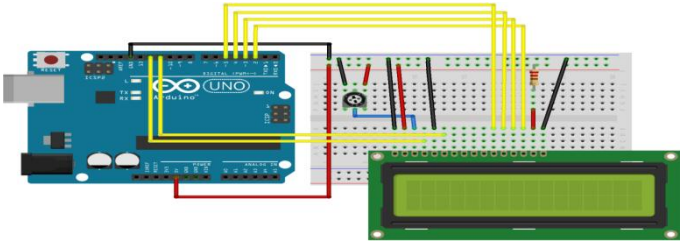


Fig 5 LCD Display

F. ESP8266 (WI-FI Module):

ESP8266 is a WI-FI Module (Fig 6), used for wireless communication. It is interfaced with micro controller (Arduino) by connecting 5 pins. It needs two 3.3V supplies and one ground to operate. Also this module requires two soft serial ports. The data acquired by the Arduino are processed and send to server by using ESP8266. ESP8266 require additional library file to operate. By programming the microcontroller the data is updated every second. It has advantage over Bluetooth module (i. e) the data is send to remote locations. ESP8266 work depends upon the AT commands.

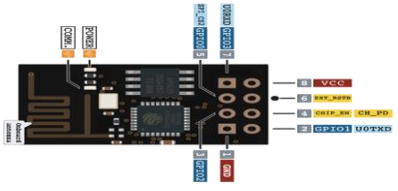


Fig 6 WI-FI Module

G. Thinks speak:

Thingspeak (Fig 7) is a platform providing various services exclusively targeted for building lot applications. It 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 features of given Thingspeak is given below, The element of Thingspeak is a 'Thingspeak' private Channel. The channel is created for our usage, there many number of fields are available which is used for purpose of storing data that is send from Arduino.

- 8 fields for storing data of any type -These can be used to store the data from it sensor or from an embedded device.
- In this work the 6fields are used in the private channel.

To use Thingspeak, signup is required and create a channel. Once channel is selected, Data is needed to be sent, allow Thingspeak to process it and also retrieve the same. Separate username and password is provided for the private channel.

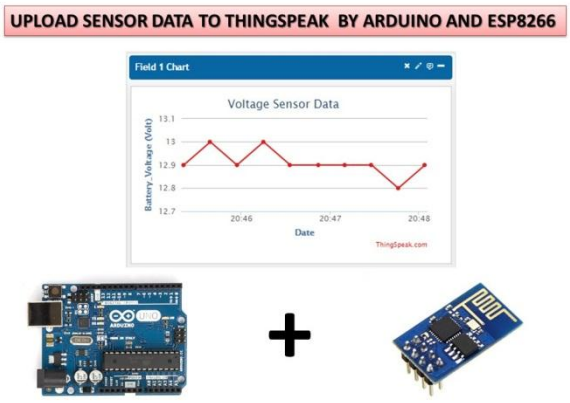


Fig 7. Thinkspeak website

H. Controller:

1. Relay:

The 5V relay is used in the proposed work. 5V relay (Fig 8) 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. There is no need of external itself, Arduino is provide enough supply to relay. The relay is work on the principle of electromagnetism, when supply is given to relay it act as a electromagnet and change the state of the switch. The supply given to Arduino is independent of the supply which to be turn ON and OFF.

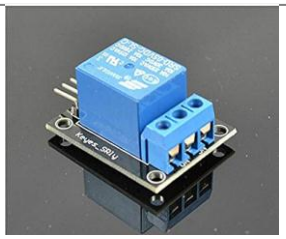


Fig 8.Relay

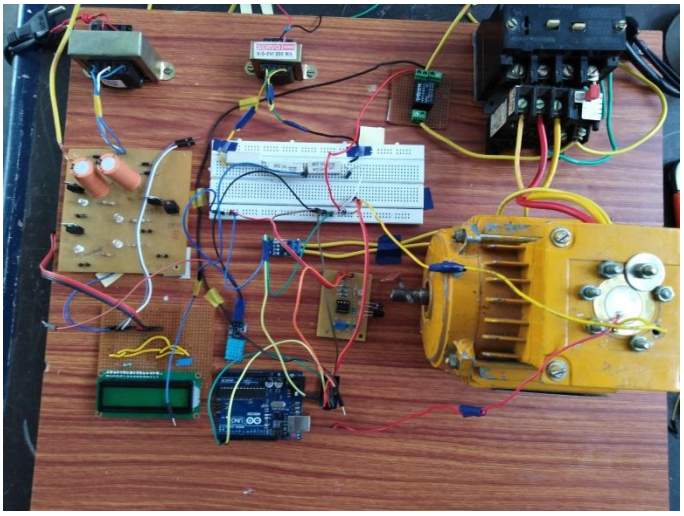
2. Contactor:

The 3phase supply is given to motor through the 3phase contactor (Fig 9) . The contactors are mainly control the motors in industry. It has three input and output path, the supply is given to motor through the contactors. Contactor is a electrically controlled switch, used for switching the motor circuit. Other than relay contactor is directly connected to the high load current. The state of the relay may used both normally open and closed applications. The contactor has the ability to reduce the arc. The rating of contactor depends upon the load current per contact. The switching of 3phase contactor depends upon triggering pulse from the 5V relay. If programming the Arduino depends on the smooth operation motor, the switching signal is given to contactor. The data acquired by the controlled is processed and compare with the normal value and any abnormal condition is sensed then a opening and closing command is given to Arduino. The contactor is helpful maintaining the healthy condition of motor. By switching the motors depends on the data, the motor protect from overloading, over current and high temperature.

Fig 9. Three phase contactor

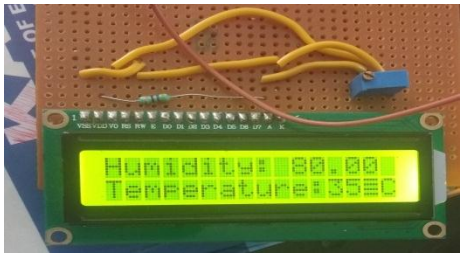
6.Methodology:

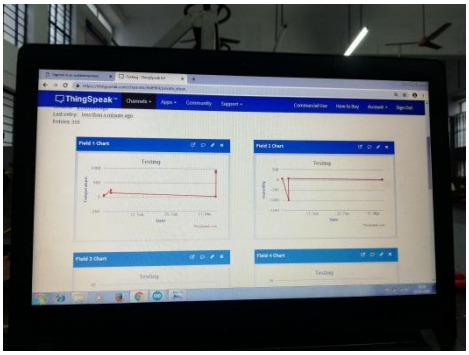
The power supply is turn ON , the Arduino and all the interface components get the required supply. Sensor unit senses the corresponding motor parameters and feed to the Arduino. Arduino reads the data from various sensors and analyses according to the given instructions, Then sends the sensor information to LCD and network gateway through Wi-Fi. In Parallel, Arduino reads the commands from internet and provides control signals to the relay via contactor, which will control the induction motor. The sensor information's are displayed visually in server. The Induction motor control is based on the sensed parameters and in manual mode the control is based on alert messages received from the web. The control is done by relay and contactor circuit. The motor is turn ON/OFF when abnormal value is detected.

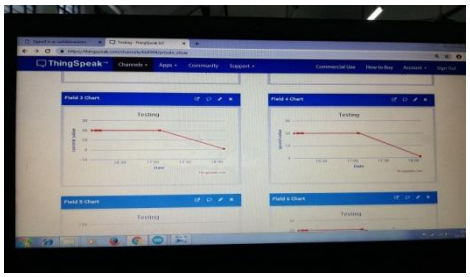


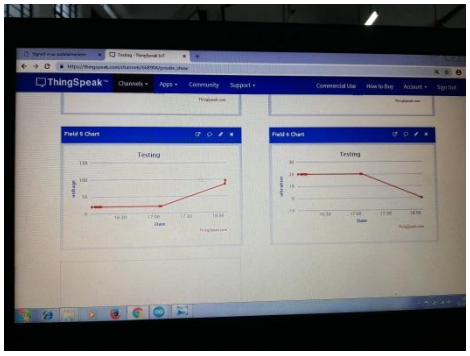
6. Result :

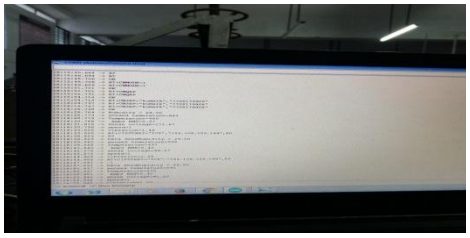
In this work , each sensors are tested individually and implemented .The WI-FI module and LCD display are correctly interfaced. In the running condition of the motors ,the sensed value are displayed continuously in serial monitor and also in thinkspeak website graphically. The motor is tested for abnormal condition. The sensor information displayed in serial monitor, LCD display and Thinkspeak website are given below,











7. Conclusion:

In this project the concept of Internet of Things for early detection and monitoring of motor system failures remotely. The system has the ability to combine various sensed parameters in real time and improve accurate detection of different faults occur in motor. The monitoring of the motor system presents the measurement of different parameters namely vibration of the motor, temperature, speed, surrounding humidity, supply voltage and motor current. Thus, compared to other conventional methods this system has more number of fields which enables alarm, alert messages and quick controlling. The concept of IoT is presented here for remote monitoring and controlling the motor. By using visual basics the data received from the controller node represent by graphically .The data is also displayed serially. The work is updated to extra fields for precious control. The application of the system is needed today for every electrical system (i. e EV vehicle and automation of industries where greater safety is needed). The system has the specific advantage less maintenance, easy and quick controlling and accessing of data remotely. Experimental results confirm the feasibility of the implementation of the system.

9.References:

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