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IoT Based Induction Motor Parameters Monitoring and Protection

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ABSTARCT

The quick advancement of innovation at present rotates fundamentally around Internet of Things (IoT). Rotating current motors are to a great extent utilized in all ventures. It is essential to shield these motors from unexpected faults and breakdowns at their early dimension with a goal that is very much prepared and in arranged mannered support system. The aim of this project is to plan and usage of IOT innovation to screen and analyse the state of Induction engines and there control. The proposed strategy involves a microcontroller based system in addition to IOT platform and real time sensors. The information gathered by sensors and microcontroller system can be put away in the cloud stage and same can be retrieve through the page, so that quick move can be made against undesirable problems occurred during operation of motor. This will help to reduce analytical time and cost towards faulty conditions.

Keyword*: -* *Internet of things, induction motor, Atmega328P MCU.*

I. INTRODUCTION

The Internet of things (IoT) is the expansion of Internet network into physical gadgets and regular articles. Installed with gadgets, internet availability, and different types of equipment (for example sensors), these gadgets can import information and communicate with other devices over the internet. They can be remotely monitored and controlled in advanced way because of the assembly of numerous innovations, constant investigation, AI, real-time sensors and predesigned systems.

An induction motor or asynchronous motor is an AC electric motor where the electric flow in the rotor expected to deliver torque is obtain by electromagnetic induction from the magnetic field of the stator winding. An induction motor can along these lines made without electric associations with the rotor. The attractive highlights of induction motor like powerful in development, low maintenance cost, high beginning torque, productivity and unwavering quality makes distinction from different motors.

In any case, doing certain support schedules over and over again can really abbreviate the helpful existence of some gear. Furthermore, doing support time and again implies more personal time and extra cost. This is the place condition observing becomes possibly the most important factor. Firmly watching the state of modern hardware can show when support to be performed.
Condition Monitoring takes a gander at the key conditions that demonstrate how well a given bit of gear is working. A few instances of this sort of observing incorporate oil investigation, vibration checking, or acoustic discharges testing. The precise elements required with condition observing will change starting with one bit of gear then onto the next.

II. HARDWARE

A. Block Diagram

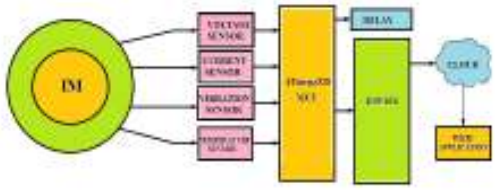


Figure 1 Block Diagram

Figure 1 demonstrates the whole image of the work. The goal of condition monitoring of induction motor is accomplished by ceaselessly recording the considered parameters utilizing different sensors. Accelerometer is utilized to record vibrations, LM35 temperature sensors are utilized to record winding and bearing temperatures, ACS712 current sensor for current, and a voltage detecting circuit to quantify voltage. Each of the sensors is associated with Arduino small scale controller board which is to be introduced at the motor site. The sensors will detect the parameters and are broke down by the miniaturized scale controller board as per the coded guidance. The information detected by various sensors can be seen on the sequential output screen of Arduino IDE.

The gathered information can be put away on the IoT stage utilizing ESP8266 Wi-Fi module. Utilizing sequential correspondence between the controller and the hub board, the information is firstly transferred to mcu board whose output can be seen on the sequential screen. At that point utilizing Wi-Fi usefulness the information accessible at hub mcu is transferred to Thingspeak cloud stage. So as to transfer the information to Thingspeak stage, a record is to be made in it and afterward

another channel is to be made. While making a channel numbers of fields are to be chosen relying upon the quantity of parameters under checking. Each field is doled out with one parameter which is spoken to in the graphical structure. A web application is created for ceaseless observing of parameters. Moment ready will be gotten on the page for any irregular task of motor.

B. Components

I. Atmega328p MCU:-

Figure 2 I.Atmega328p Standalone system

It is a microcontroller chip created by Atmel Company. The microcontroller was presented in the hardware business to make our undertakings simple that accompany even a remote association with robotization in any way. Microcontrollers are broadly utilized in inserted frameworks and make gadgets work as indicated by our needs and prerequisites. Arduino development board is an entirely important expansion in the hardware that comprises of USB interface used for programming the microcontroller chip. It has 14 digital I/O pins, 6 analogue pins, and 2 serial communication pins as Rx and Tx.

II. ESP8266:-

Figure 3 ESP8266

ESP8266 is basically designed as a wi-fi adaptor for IoT applications with an aim to achieve low power consumption needed for wireless communication over a long range.

Its operating voltage is 3.3V which is provided to the module from microcontroller unit. It is low cost Wi-Fi module which is designed for adding Wi-Fi functionality via a UART serial communication with microcontroller unit.

C. Sensors

I. Temperature Sensor:-

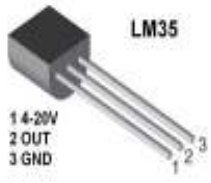


Figure 4 LM35

Here LM35 is used as a temperature sensor. The LM35 datasheet determines that these ICs are accuracy incorporated circuit temperature sensors, whose yield voltage is sprightly relative to the Celsius (Centigrade) temperature. The LM35 accordingly has a preferred position over direct temperature sensors aligned in ˚ Kelvin, as the client isn't required to subtract a huge steady voltage from its yield to acquire advantageous centi-grade scaling.

II. Current Sensor:-

Figure 5 ACS712

ACS712 gives prudent and exact answers for AC or DC current detecting in industrial, commercial, and interchanges systems. The gadget comprises of an exact, low-balance, straight Hall effect sensor circuit with a copper conduction way situated close to the surface of the nearby connected current coursing through this copper conduction way produces an attractive field which is detected by the incorporated hall IC and changed over into a corresponding voltage.

III. Voltage Sensor:-

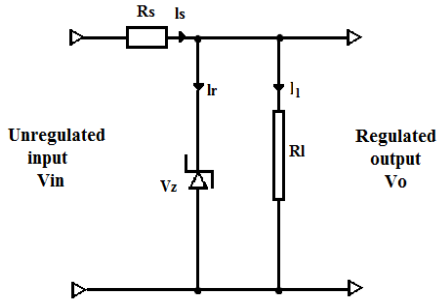


Figure 6 Voltage Sensor

A voltage sensor can in certainty decide, screen and can measure the supply of voltage. It can quantify AC level or/and DC voltage level. The contribution to the voltage sensor is simply the voltage and the yield can be simple voltage signals, switches, audible sign, simple current level, recurrence or even recurrence regulated yields. In this the estimation depends on the voltage divider.

IV. Vibration Sensor:-

Figure 7 Accelerometer

The accelerometer measures as the name indicates the increasing speed that is being exposed to. The models we have utilized are mounted on a breakout board from Spark Fun and utilize the ADXL335 3-pivot accelerometer from Analog Devices. It measures ±3g in three symmetrical pivot named the X, Y and Z heading. It can peruse in the scope of 0.5 Hz to 1600 Hz for the X and Y pivot while the Z hub has a scope of 0.5 Hz to 550 Hz. Anyway the Spark Fun model comes mounted with 0.1µF capacitors that goes about as a low-pass filter and limits the lower transmission capacity of every hub to 50Hz. To work the accelerometer it needs between 1.8 V to 3.6 V so we can't utilize the 5 V yield on the Arduino and need to utilize the 3.3 V. This likewise implies just connecting one of the hub to one of the Arduino. Simple information pins will prompt inconveniences since it anticipates that the most extreme worth should be 5 V.

D. Control Logic (Relay):-

Figure 8 Relay

Features of 5-Pin 5V Relay

Specifications	Quantity
Trigger Voltage	5V
Trigger Current	70mA
Max.AC load current	10A@250/125V AC
Max. DC load current	10A@30/28V DC
Operating Time	10msec
Max. Switching	300 operating/minute

V.Single phase Induction Motor

Specifications:

- Horse Power Rating – 0.35 HP
- Supply Voltage –220V
- RPM speed – 1440rpm
- Current rating – 2A
- Duty Type – Continuous

III. SOFTWARE

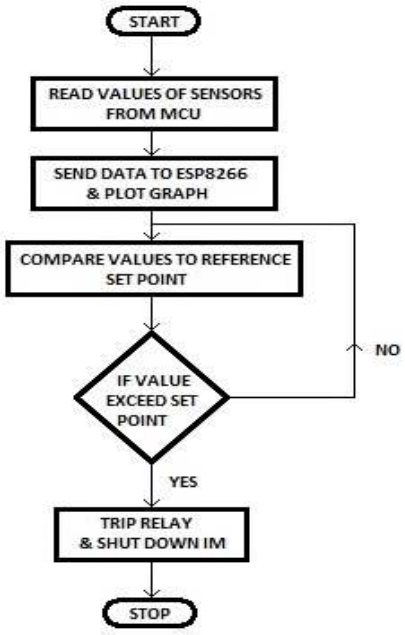
a. Arduino(IDE)

The Arduino coordinated advancement condition (IDE) is a cross-stage application (for Windows, macOS, Linux) that is written in the programming language C. The Arduino IDE supports languages C and C++ utilizing extraordinary principles of code organizing. It is an multi- platform application with an integrated development environment. Arduino is designed specifically for Arduino comparable modules and it also supports communication with third party hardware.

b. ThingSpeak

Central piece of the IoT architecture is IoT platform which enables the connection between the real and virtual worlds hence providing communication between objects. The IoT platform used in this paper is Thingspeak which is an analytic platform service that allows visualizing and analysing live data available in the cloud and is operated by Math works. It produces visualizations for the data uploaded by the devices to the platform instantly. Prototyping and proof of concept IoT systems regularly uses Thingspeak.

a) Flowchart



IV. Experimental Setup:-

V. Results:-

We have mounted all the sensors on to the induction motor as per the parameters to be monitored. LM35 temperature sensor has been mounted near the stator winding and the connections are made as per the circuit diagram. Accelerometer is placed on surface of the motor and the supply is provided through current sensor in series with the supply. Voltage sensor circuit is connected in parallel input supply to motor.

Following are the results taken at normal condition by switching ON the motor with rated supply.

1) Normal Conditions:

Figure 9 Current Condition

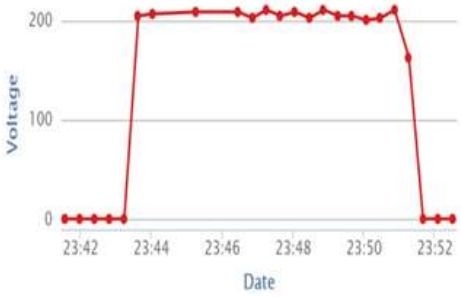


Figure 10 Voltage Condition

Figure 11 Temperature Condition

Figure 12 Vibration Condition

The above graphs are obtained on the ThingSpeak cloud created by the IoT system hardware placed at motor location. The results in the form of graphs which are obtained on ThingSpeak Server are real time simulation of parameters to be monitored.

Above graphs of current, voltage and vibration shows motor ON & OFF time instants. Temperature graph was as at normal room temperature reference.

2) Fault Conditions:

Figure 13 Fault Current Condition

Figure 14 Fault Voltage Condition

Figure 15 Fault Temperature Condition

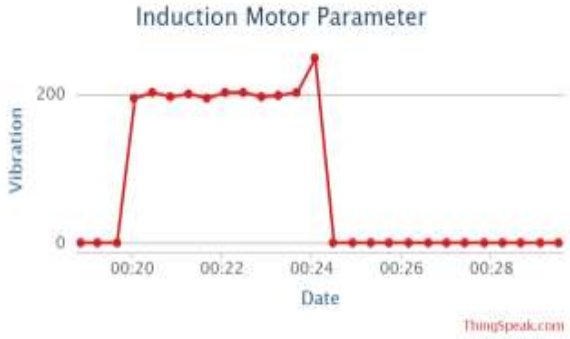


Figure 16 Fault Vibration Condition

Figure 17 Fault Indicator

Figure 12, 13, 14 & 15 shows sudden shut down condition of induction motor at time instant of 00.24. This shut down condition occurred due to fault created by overloading of induction motor. The readings obtained at server are not instantaneous which makes graphs more similar in nature for different parameters.

An indicator lamp at ThingSpeak server shows real time status of induction motor. Faint colour of lamp shows motor OFF state whereas lamp turns red colour at faulty condition.

VI. Conclusion:-

In this paper Industrial motor is adequately and constantly observed by utilizing various sensors. The information obtained is put away in the cloud stage and is obtained from various areas utilizing web application created. The health of the motor is surveyed by investigating the nonstop parameter information acquired.

In addition to constant condition checking, getting of convenient alarms, preventive maintenance can be easily done. Protective relay prevents the motor from damage. With condition monitoring protective relaying helps to improve stability of system.

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