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Monitoring and Controlling of Induction Motor Temperature using IoT

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Abstract

The development of technology today is rapidly related to the Internet of thing (IoT), keeping things connected efficiently. In this paper, the design of IoT technology is presented to monitor and diagnose the performance of a single and three phase induction motor & recording critical operating parameter. The methods offered include an IoT based platform in order to collect and process induction motor parameters. The parameter is composed of sensor such as voltage sensor, current sensor, temperature sensor, and vibration sensor. This information can be stored in a cloud platform, accessed via web pages, and displayed on a smartphone device. It will be notified timely manner when excess of performance limits. An induction motor can be examined carried out immediate action to avoid motor downtime so it can be saved time and cost. The advantages of monitoring induction motor by using IoT are notification for fault alert and historical data for predictive maintenance.

1. Introduction

Currently, the industrial sector is using a lot of electrical energy which lead to increasing the cost of energy. It also has an impact on electrical equipment. Especially, large three-phase induction motor is the most popular motor for driving industrial machinery and production system. The advantages of a three- phase induction motor are self-starting, durability in structure, good power factor, and low cost without compromising on performance. There is three- phase power unsymmetrical fault, unbalances voltage, over-voltage, over-load, or mechanical-related faults such as broken rotor shaft, air gap faults, and bearing damage. This may cause a vibration and a loud which damages the stator winding. Therefore, the efficiency of an induction motor depends on the electrical and mechanical factors. As a result, an induction motor is needed to monitor continuously for safety and reliable operation of industrial induction motors, which electrical, mechanical, and environmental factors are including voltage, current, vibration, temperature, and ambient humidity of the motor affect the good performance of the motor. These faults may cause severe damage to the induction motor. This type of motor is used all the time, which may degrade over time. It may damage the motor, workpiece or product. Therefore, it is necessary for maintenance the large motor to achieve maximum power consumption by monitoring the conditions of induction motor which large data is recorded daily in order to diagnose motor malfunctions. It may not able to be corrected immediately, causing motors are damaged.

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Motor malfunctions (fault system) were analyzed through various systems such as induction assessment using motor infrared imaging , anomalies in the vibration force distribution model , and offline monitoring of electric motor condition (Check List Form) by manipulating program data to analyze the cause of the malfunction. These problems are conceptualized on motor faults using Internet of Things (IoT) systems. It can store test results on a cloud server by monitoring certain parameters of motors using internet networks, embedded devices, micro-computer boards, saints, and wireless communication modules such as sensors of voltage, current, temperature, and vibration. The most popular cloud servers are ThingSpeak server. It is a platform server that provides services specifically for building loT applications. It is real-time data collection, chart visualization, plug-ins, and application creation capabilities for integration with web services, social networks, and other APIs. The use of IoT systems can diagnose problems by debugging three-phase induction motor in order to increase efficiency, reduce energy consumption, and lower operating costs. In this study, three-phase induction motor was tested and demonstrated with IoT using energy consumption sensors, vibration, temperature sensors, and microcontrollers to obtain electrical energy data and transmit. The data is stored to the cloud via a wireless connection. After that, the information can be viewed in graphs via web application on smartphone anytime. The use of IoT for monitoring three-phase induction motor can analyze the energy, temperature, vibration, and safety performance of an induction motor while in use with on-load or no-load.

2. System Design and Development

2.1 System Overall

Monitor and display of three-phase induction motor (Misubishi : SF-JR 1 HP) using voltage sensors (Single Phase Voltage Sensor ZMPT101B), current sensors (CT Sensor 30A SCT-013-030), vibration sensors (piezoelectric piece knocking vibration switch), and temperature sensors (Digital Temperature Sensor Probe DS18B20 for thermometer waterproof 100CM) via a wireless network was developed to allow displaying current value, voltage value, power value, vibration value, and temperature value of the induction motor while operating with NodeMCU microcontroller (Node MCU ESP32). The program has to be created for controlling the function as receive- send signal parameters, then sending the results to the ThingSpeak cloud platform to save the information. Also, displaying the results on website and MIT application on smartphone to check the electricity parameters and the traceability results as shown in Figure 1. MIT App inventor is an application on smartphone. It can show real time information and login for many users at the same time by QR code.

2.2 Proposed System

Fig.2. Proposed system, Firstly, setting up the microcontroller to acquaint parameters from sensors (in Fig.1). After that, the sensors measure and send the parameters to microcontroller for processing. Then, the microcontroller sends information to ThingSpeak cloud platform which links to MIT Application. So, it will send information to show on

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smartphone. When the parameter is overload, the microcontroller will alert in Line application on smartphone.

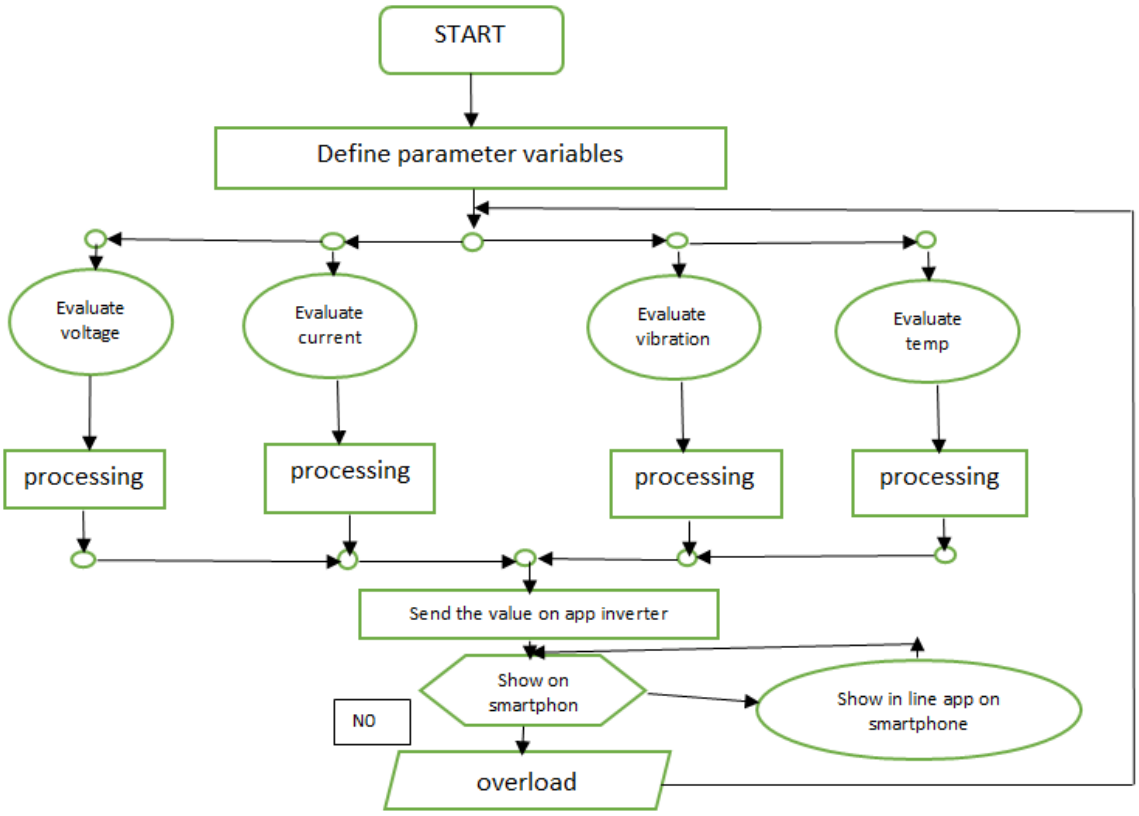

Figure 1 Block diagram for proposed system

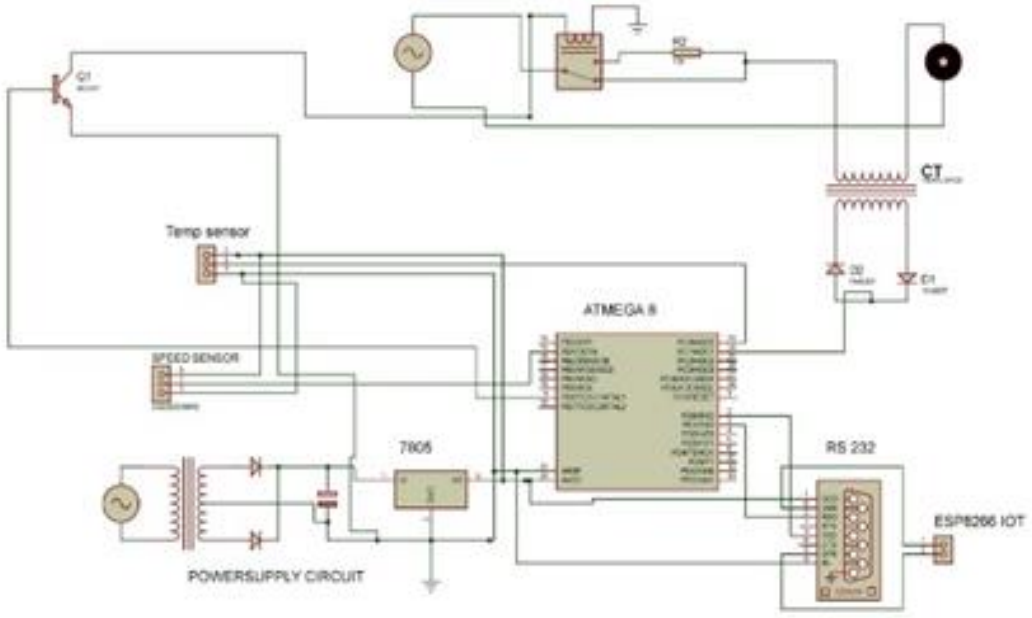

Figure 2 Circuit Diagram

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3. Hardware Description

3.1 Motor

HT motor full form is high tension motor means the motor rating for high voltage 3.3KV, 6.6KV and 11KV. LT motor full form is low tension motor means the motor rated for low voltage operation generally in the ratings of 230V motors single phase and 415V in 3 phase.

3.2 Sensors

3.2.1 Current Sensor

Current sensors are used to detect current in the motor and also the signals which are proportional to that current in the motor. This is needed during the purpose of current control.Basically there are two types of current input but they are two types of current input, they are alternating current input and direct current input.

3.2.2 Temperature Sensor

Thermocouple sensor is used as the temperature sensor. It is made up of two wires with different metals but joined together. A thermocouple gives a temperature dependent voltage. Thermocouple is popularly used temperature sensor. Commercial thermocouples are inexpensive and can measure a wide range of temperatures. It gives output in millivolt signal. The voltage is measured in sense of change in resistance.

3.2.3 Voltage Sensor

A voltage sensor is a sensor used to measure the amount of voltage in the motor. It determines both AC and DC voltage level in the motor. Voltage sensors are Non-saturable, eco-friendly, highly accurate. Voltage sensor works in wide dynamic range. The output of voltage sensor be sine or pulse train.

Figure 3 Voltage Sensor

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3.2.4 Vibration Sensor

The vibration sensor is otherwise called as piezoelectric sensor. Vibration sensors are the sensors used to display, analyze the linear velocity, displacement and proximity. It is also used to detect problems in the motor. The abnormal vibrations in the sensor indicate the problems in the industrial machines.so this can reduce time and cost requirement.

Figure 4 Vibration Sensor

3.2.5 Speed Sensor

Speed sensor is the sensors used to read the speed of the motor. The output of this sensor is send to the motor control unit to monitor the motor speed. There are two speed sensors one is input shaft speed sensor and another one is output speed sensor. These two sensors are works together activate relay and send back the relay information to the control unit.

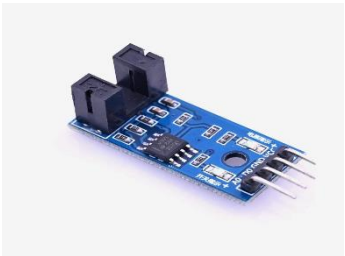

Figure 5 Speed Sensor

3.2.6 Wi-Fi- Module

The ESP8266 Wi-Fi module is one of the leading platforms in internet of things. It is connected to micro control board to access the web. The wifi module is a very cheap and available in low cost. However this module is already preloaded in firmware with set up 9600 baud rate. This module consists of 8 pins Tx, Rx, Vcc, reset, CH-EN CPIO-0, 1 pin. The CPIO pin is connected to receiver pin through USB board. They communicate arduino configuration is employed to attach with wifi module. It requires 3.3v only. The main

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exciting feature of ESP8266 module that can be programmed using the arduino IDE which makes it a lot more user friendly.

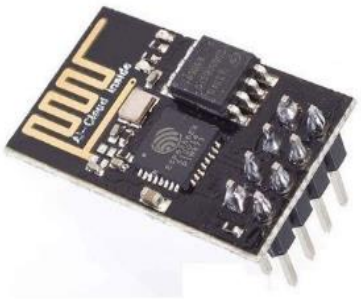

Figure 6 Wi-Fi- Module

3.2.7 LCD

An LCD is used for continuously displaying a data. In this project use 16*2 displays. The LCD display contains 16 pins. The microcontroller is connected through LCD the motor is running condition the measured sensor values are displayed in the LCD display. In LCD display the brightness can be changed.

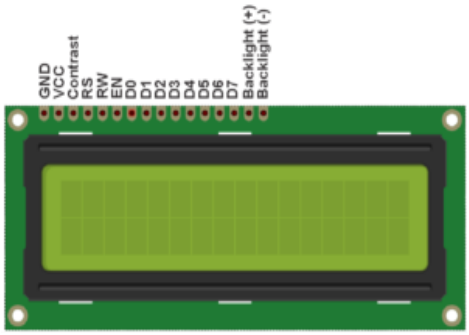

Figure 7 LCD

3.2.8 Microcontroller

The Atmel 8-bit AVR RISC-based microcontroller combines 32 KB ISP flash memory with read-while-write capabilities, 1 KB EEPROM, 2 KB SRAM, 23 general-purpose I/O lines, 32 general-purpose working registers, 3 flexible timer/counters with compare modes, internal and external interrupts ,serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter (8 channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and 5 software-selectable power-saving modes. The device operates between 1.8 and 5.5 volts. The device achieves throughput approaching 1 MIPS/MHz [1].

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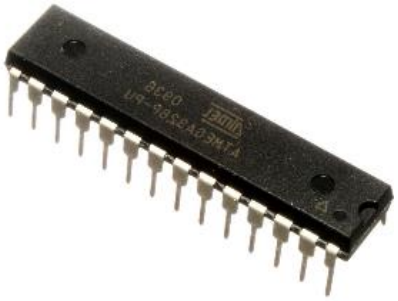

Figure 8 Microcontroller

4. Implementation and Methodology

For continuous monitoring the motor is connected with current sensor, vibration sensor, speed sensor, current sensor and voltage sensor to measure the parameter of the motor. When the supply is given to the motor, it began to operate .the sensor will start to sense the parameter of the motor and the sensed data were given to the controller i.eardunio uno. The parameters of the motor were monitored continuously. From the controller, the data were uploaded in the cloud using WI FI modulo 8266. WI FI modulo is operated with the help of an internet. Here we used GOOGLE platform for upload, view and for controlling. The data or parameter of motor is viewed through mobile. When any parameter values exit its value or range, an intimation will received through mobile app and also can control through it. The relay was connected between the motor and controller. When the parameter of the HT motor exits its limited range or value, the motor get trip through the relay.

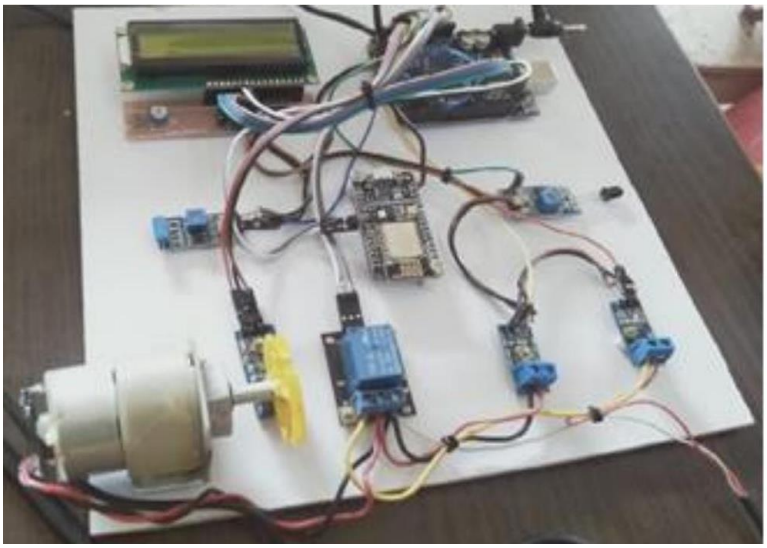

Figure 9 Experimental Setup

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Results and Conclusions

When the motor is running condition the parameter of the motor are viewed in LCD display screen and notification were also send to mobile. Suppose any fault occurs in the motor parameter, we can switch OFF the motor through mobile. The motor data are also displayed serially. So that we can able to monitor the parameters of the motor continuously and protect the motor from failures. A failure of motor leads to a shut down of generating station or in industrial field and there will be a chance of occurrence of heavy loss. To avoid such failure, a continuous monitor had to be done. The advantage of this project is simple and fast monitoring and accessing of data automatically.

Figure 10 Result Display

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