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RESEARCH ARTICLE OPEN ACCESS

# IoT Based Monitoring and Speed Control of an Induction Motor

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**ABSTRACT**
Today's IoT plays an essential role in our day to day life. This paper thesis deals with the hardware part for monitoring the continuous parameters and speed control part of Induction Motor. In that monitored parameters with the help of sensors is a voltage sensor, current sensor, speed sensor, and temperature sensor. And by controlling the speed part of the induction motor with the help of PWM techniques. By monitoring the parameters of the induction motor, it should help to maintain the before any fault occurs and prevent delay in production, which is the reliability of the induction motor obtained. If there is any fault takes place in the induction motor should be automatically disconnected from the supply by using IoT applications. Also analysis the results in graphical form. simulation perform on Proteus software regarding parameter monitoring And speed control of an induction motor.

***Keywords*** **-** Induction Motor, Internet of Things, Arduino Uno, Proteus software.

## I. INTRODUCTION

Presently Induction Motor is the most common type of motor in all over fields. The invention of an induction motor by the great scientists Nikola Tesla. About 50% of global electric power consumption is due to the induction motor. In industry 90% of uses the induction motor because of necessary characteristics such as it is inherently 'self-start' motor, it does not require permanent magnet, No brushes, No commutator rings, No position sensor. Induction motor also has a simple and robust operation, maintains a good power factor, less maintenance, highly efficient, small in size, reliable, and cheaper than another type of motor. The essential advantage part of an Induction motor is that its speed can be control easily as it has good speed regulation, sustainable overload capacity, and high starting torque. Due to all of these advantages, Induction Motor is frequently used in an all-over application like industry, electric train, electric Vehicles, crane, elevator, domestic, agriculture motors, etc.[1][6] [15]
.In Induction Motor number of types of fault that occur widely, it is subdivided into three most important parts such as
1. Electrical faults: In electrical fault normally occurs a single phasing fault, Reverse phase sequencing fault, oversupply voltage, overload fault, Earth fault, etc.[1][14].

2.Mechanical Faults: In mechanical fault normally occurs a rotor broken bar fault, stator and rotor winding defect, Bearing fault, etc.[1][14].

3.Environment Faults: In environment fault normally occurs the vibration of the motor, Induction Motor surrounding environment affects the performance of an Induction Motor such as moisture, temperature, etc.[1][14].This paper represented IoT-based Induction Motor monitoring parameters are as voltage, current, speed, and temperature based on sensor and cloud and controlling the speed of induction motor with the help of the PWM technique as its speed can be controlled easily by controlling the input power of frequency. By continuous monitoring the parameters maintain the continuity of production in industries, making the motor reliability that is the production of an industry can be increased. Also, prevent any abnormality that takes place in the induction motor and detect the early fault in the induction motor. If there is any fault takes place in this motor it should be determined by a sensor sense parameter values of voltage, current, speed, and temperature, and this sense value of the sensor gives a signal to Arduino Uno then from the cloud gives a command to the motor should automatically be disconnected from the system. And it gives an alert message in mobile

after the fault has cleared for further future work that should not repeat once again.

**1.1 The specific objectives research of the thesis are as:**

1. for safe and economic data communication in industry or any other fields, Monitoring and controlling the operation of an induction motor depend on the internet of Things (IoT) is to do.
2. By Early fault detection, process interruption of the motor can be reduced, also reduced damages of the motor in an industrial process to a larger extent which makes motor should be more reliable.
3. To protect Motor from overloading, over-current, and high temperature.
4 .To avoid system failures by start and stop the operation of an Induction Motor by Automatic or manual control methods.
5. The widely used method for the detection of faults in the motor can be Analysis in the Graphical form of current, voltage, speed, and temperature waveform [2].

## II. BLOCK DIADRAM OF THE SYSTEM

Below block diagram shows overall monitoring parameters and it's proposed speed controlling system of an induction motor.

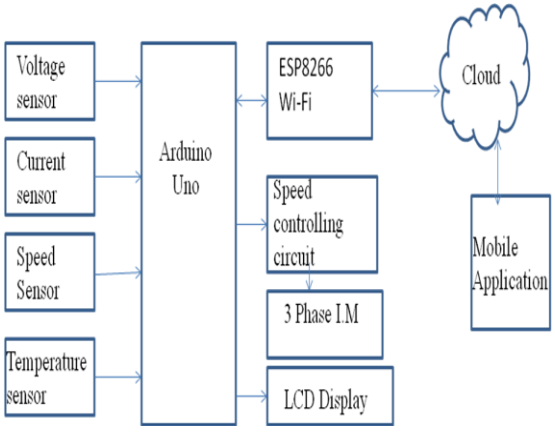



**FIG. 1 BLOCK DIAGRAM OF AN I.M MONITORING SYSTEM**

The block diagram shows four sensors for sensing the respective four parameters that are voltage, current, speed, and temperature. with the help of that sensor monitoring the condition parameters of motor and gives the current status of induction motor to the Arduino Uno and from Arduino Uno through the wi-fi, the module gives information to the cloud where the information stored and from the cloud, it will receive information on mobile application whenever necessary with the help of things speak. In case any fault takes place in Induction Motor it should be automatically disconnected from the supply. Whatever parameter is monitored that should be displayed on LCD one by one [1][3].

## III. PROPOSED SYSTEM

The below block diagram represented the detailed view of the proposed system. It gives complete information about this proposed system. This diagram clarifies how the existing working system takes place and how the actual signal flow's from one system to another and which are the main components used in this proposed system. Here in actual working firstly 3 phase AC supply comes into the system, from that AC supply, it will give to 3 phase Induction Motor through speed controlling device and gate driver circuit. Here gate driver circuit acts as a logic circuit to on-off the switches for controlling the speed of the motor. There are so many methods for controlling the speed of the motor uses, but here in this paper uses the PWM technique to control the speed of an induction motor. PWM technique is very sophisticated to use and most sophisticated to operate than any other methods. by adjusting the ON-OFF period of Triac switches controlling the firing angle and from that, firing angle controlling the speed of induction motor peacefully [4][5]

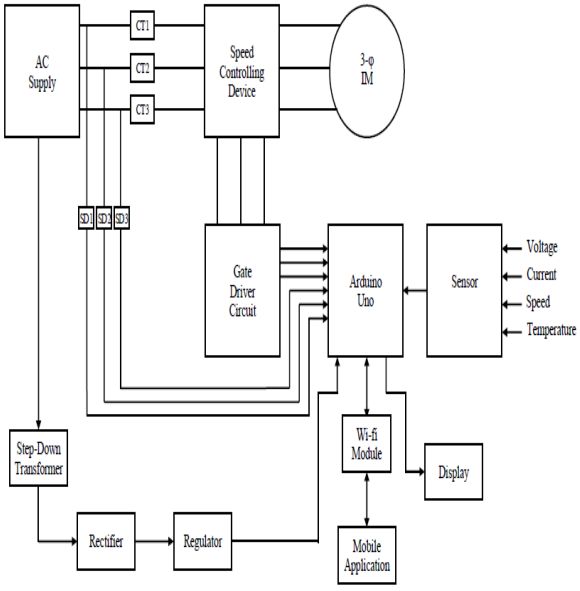


**Fig . 2 overall Block Diagram of the proposed system**

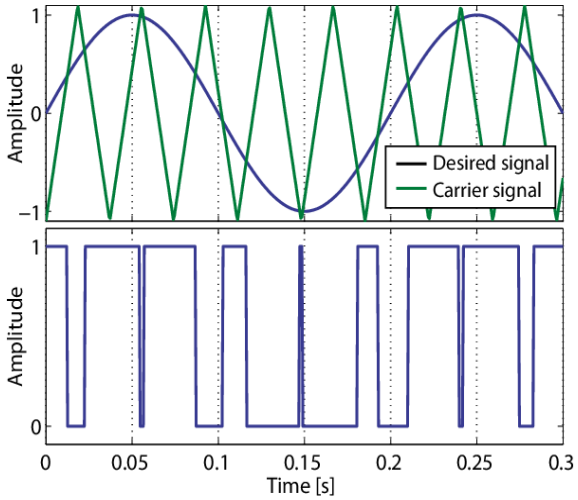



**Fig. 3 PWM Technique for Speed control**

In this project heart of the system is an Arduino Uno, for its operations required a 5v dc supply. Here for Arduino Uno, get supply from step down transformer with rectifier and regulator for conversion and filter purposes used. The above diagram shows the PWM technique for speed control of the induction motor. By controlling the on-off period of Triac(Switch) voltage of the induction motor can be controlled easily, with the help of controlling the voltage speed of the induction motor that can also be controlled [5].

## IV.HARDWARE REQUIREMENT

Following is the required component for this proposed system that is as:

- 1. Induction Motors
- 2. Arduino UNO
- 3. ESP8266 (WI-FI Module)
- 4. Condition Monitoring Sensors
- Voltage Transformer
- Current Transformer
- Temperature Sensor
- Speed sensor
- 5. Speed controlling device
- 6. Gate Driver Circuit
- 7. LCD Display
- 8. Mobile Application

### 4.1. Induction Motor:

The induction motor is also known as an asynchronous motor. As already knows, induction motor advantage, its necessary characteristic, robustness, and effectiveness than any other type of Motor. Here in this project induction motor is an essential part of the system. The following is the required parameter and the specification of an induction motor that used in this project as:

**Fig.4 Induction Motor**

| Parameter | Specification |
|---|---|
| Volts | 415v |
| Amps | 7.5 A |
| Frequency | 50 Hz |
| Speed | 1440 rpm |
| Kw/Hp | 3.7/ 5 hp |
| Connection | Y-Delta |
| Efficiency | 85% |

**TABLE .I. SPECIFICATION OF AN I.M TABLE**

### 4.2. Arduino Uno:

Simply Arduino Uno is nothing but a development board. It has itself RAM, ROM, PCB, and analog to the digital controller. Arduino Uno also is known as an open-source microcontroller as it doesn't require any license for its uses. Arduino Uno Commonly uses an ATmeg328 type Arduino Uno microcontroller, It having 14 digital and 6 analog pins. Arduino Uno is a hardware as well as software combination. Arduino Uno makes entry smooth in IoT. It uses assembly language as c++ language uses for communication to the cloud. Arduino Uno has high integration, less power consumption, and more flexibility to operates. Arduino Uno is nothing but a small computer on a single chip. It required a 5 v DC supply for its working operations [2].


**Fig.5 Arduino Uno**

### 4.3. ESP 8266 WI-FI Module:

For communication with the cloud uses the Wi-Fi module. This paper deals with the esp8266 Wi-Fi module used for exchanging the information between devices to the cloud without connecting to any wire. Each device having itself I.P address. For connection to cloud putting I.P address on Android application, the devices in system i.e induction motor, sensors, speed controlling device connected to the cloud and sending information to cloud without any wired connection i.e through the Wi-Fi module send information for further process. Analysis and visualization can be possible by storing data information on the cloud [2][13][16].

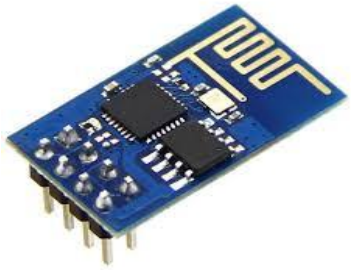


**FIG.6 ESP8266 WI-FI MODULE**

### 4.4. Condition Monitoring Sensors:

There are four sensors used for health monitoring and evaluation management in the system i.e. the sensors used in this proposed work system are as firstly for measuring the supply voltage uses voltage transformer it acts as a step down as well as sensing purposes of supply voltage, second is a Current Transformer for measuring motor current, the third sensor is IR Sensor for measuring speed and the last one is temperature sensor i.e LM35 for measuring temperature [2].

**I. Voltage transformer:**

A voltage transformer uses for measuring high alternating voltage purposes, here in this proposed system it also acts as a sensor for sensing the supply voltage of an Induction Motor. It is a step-down transformer that converts 230 v to 4 v supply. for conversion of 230 v to 4 v dc supply with rectifying and filter uses [12].

**Fig. 7 Step down Transformer**

**II. Current transformer:**

The current transformer uses for measuring high alternating current, here it also acts as a sensor for sensing the current which flows in the Induction

Motor. It has an input current rating is 5A and an analog output current rating is 5mA. It is a 5A range of single-phase AC sensor module. It has 1000: 1 turn ratio. The measure application of this current sensor module is to detect overload, load drop, and shut down of the circuit [12].

**FIG. 8 CURRENT TRANSFORMER**

**III.LM 35 Temperature sensor**:

It is a temperature measuring device having an analog output voltage which is proportional to temperature. It has 3 pin devices as Vcc, Vout, and ground. It has an operating voltage that is 4v to 30 volts. Measuring temperature ranges from -55 to 150 degrees centigrade. As increasing the temperature, the output voltage also increases [6][7].

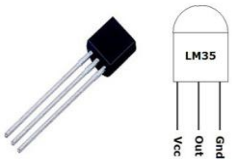



**Fig. 9 LM35 Temperature Sensor**

**IV.IR Sensor Module:**

It is an electronic device to measure and detects infrared radiation from its surrounding atmosphere. It includes LED and an infrared laser diode. It works as a digital tachometer. IR sensor used for measuring the speed of 3 phase Induction Motor in rpm. It has an operating voltage that is 3 to 5v. The Current consumption of the IR sensor is at 3v is 25mA and at 5v is 43mA required [2][17].

**FIG. 10 SPEED SENSOR**

**4. 5. Speed controlling device**:

BT139 Triac is a semiconductor device that has a plastic envelope packaged, high bidirectional transistor, and high blocking voltage capability. BT139 is a Triac switch used for speed controlling purpose of an induction motor. with the help of the gate triggering circuit, these BT139 switches can be operated. The gate driver circuit is for logical purposes to operate the Triac switch. The configuration of BT139 is 16A,600V. Gate trigger is 70mA, 1.5 V [5][8].

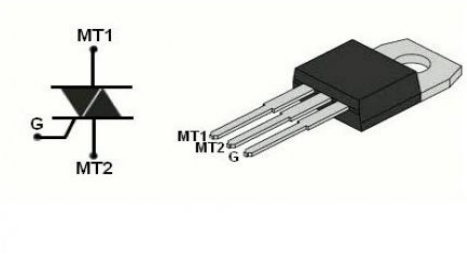



**FIG. 11 BT139 TRIAC**

**4.6. LCD Display**:

LCD is an electronic screen display module. 16*4 type of LCD used in this proposed system for continuously displaying the monitored value of an induction motor. Here 16 values indicate the character on a single line and 4 values indicate the number of lines. For the operation of LCD required 5v dc supply. whatever the value Display in the mobile application is the same as that on LCD hardware set up of IoT based induction motor one by one respectively [2][7].


**Fig. 12 LCD Display Reading**

## V. RESULT

The proposed work results for the Induction motor parameter monitoring system are as follows. Monitored the motor parameters in both ways i.e. hardware as well as software part of the system. In the software configuration Below Simulink model shows the motor parameter on the LCD and also analysis the PWM waveform on the digital oscilloscope of PROTEUS software. From this simulation model getting the idea regarding hardware setup, how actual connection takes place in hardware and component details.
In hardware set-up configuration shows parameter monitoring of motor which is send to the cloud where it is stored on the cloud and displays the motor parameter one by one on an LCD and also visualization of a waveform in graphical form on thingspeak. From hardware set up, we analyze whatever the voltage is given to the induction motor for that getting the current, speed, and temperature value. Also, control the speed of the induction motor with an applied voltage to the motor**.**

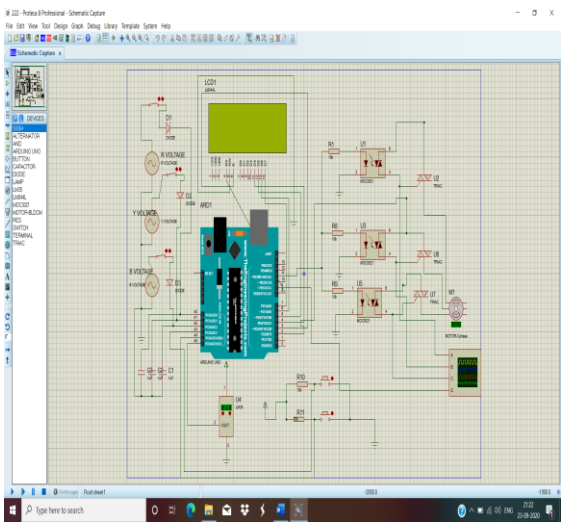
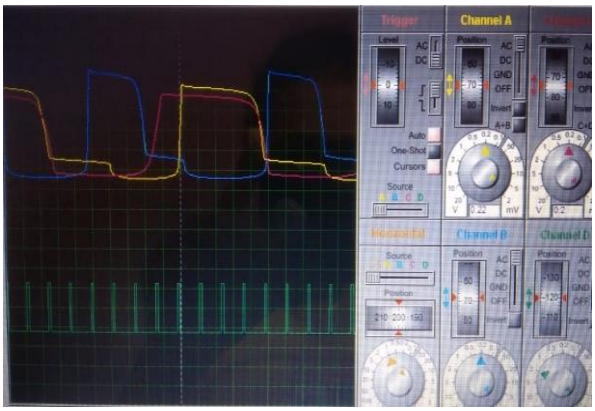


**Fig. 13 Simulation model of IOT based Induction motor**



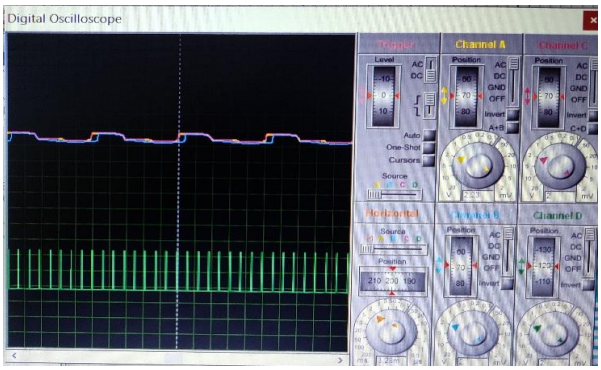




**Fig. 14 wave form of speed control induction motor using PWM Technique**


**Fig. 15 Hardware set up of 3 phase induction motor model**

**Thingspeak waveform:**

First creating the channel on thingspeak through cloud and internet sources. Thingspeak is an open-source application used for storing information and receiving the information from the cloud. The following is the result obtained on thingspeak in the graphical form[9][16][17].


**Fig. 16 Monitoring parameter of per phase voltage and current waveform**


**fig. 17 Monitoring parameter of temperature and speed wave forms**

## VI.CONCLUSION

This paper represents the IoT is well known and rapidly growing technology nowadays. Now IoT becomes a vital part of human life. In the future millionaire of things should be interconnected with the cloud. Recently IoT comes all over the field such as industry, home automation, electric vehicle, traction, agriculture, medical field, etc. with the help of sensors this paper represents IoT-based condition monitoring parameters and controlling the speed of the motor with the help of PWM techniques. Analysis and visualize voltage, current, speed, and temperature parameters on an LCD display. By analyzing the motor parameters make the motor to be operated in safe and protective in nature, It also helps in calculating new data to interact with social media and other devices. From thing speak visualization the waveform of voltage, current, temperature, and speed on the mobile application by connecting to hotspot module. Through thing speak continuously monitored the motor parameter and if any fault takes place it will get an alert message on the mobile application. In industries required continuous monitoring data value for power consumption and maintenance application. In case the motor gets over current, over speed and excessive temperature than its rated value it will get automatically disconnected from the supply. By Simulink model getting ideas regarding hardware setup how actual connection takes place and reading that show on an LCD display.

## VII. FUTURE SCOPE

In the future lot of scope is there for IoT applications. Worldwide wide all overuse the IoT application for human life sophisticated. In 2025 millions of things connect to the cloud. A lot of research also done on IoT and it's more uses for human life's easiest purpose. Some research works on defense services for security and surveillance, some on automatic vehicle control and traffic signal control, some on the medical field for body control and health care, some on electronic devices, smart home, etc.

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