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Induction Motor Fault Protection and Monitoring System Using IoT Technology

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Abstract— **In today's world, the induction motors play a vital role in many applications. The protection of electrical machines especially induction motors are very much essential for any industries, factories etc. This project proposes a system which protects and monitors the single-phase induction motor using IoT technology. It comprises an IoT (Internet of Things) network to gather the essential information such as voltage, current, speed, temperature of the induction motor and presents the essential details to the user through IoT mobile application. Using this, the designed architecture reads and sends the parameters of the induction motor to the microcontroller. It also protects the induction motor at any abnormal conditions like over voltage, low voltage, high speed, high current and high temperature with the help of microcontroller in addition, to this if any of these faults occurs it changes the motor connection to another supply circuit which step-up or step-down the voltage according to the fault for uninterrupted working or turns off the motor automatically.**

Keywords— ***Induction motor, voltage, current, speed arduino, monitoring, protection, Internet of things, relay.***

I. INTRODUCTION

Many motors are used in industrial machine tools. Electrical motors are essential in industrial applications. In the beginning era of motors, industries and people used DC motors. After the invention of AC motors particularly the induction motors, peoples started using those motors. In the advancement of electrical technology, the induction motor has a inevitable place. Induction motors are used in productions, automation etc. Induction motors are robust, has strong construction, robust and has wide range of advantages when compared to DC motors.

It is an AC electric motor and induction motors are asynchronous type of motor because it always runs at a speed less than the synchronous speed. This type of motors works on the principle of induction. When the supply is given to the stator part, it will produce a rotating magnetic field which gets induced in the rotor part of the motor which makes the rotor to rotate. These motors can never at the synchronous speed level efficiency also the motor may get damaged. Many electrical faults can occur in induction motors such as over voltage, under voltage, unbalanced supply voltage, overloading etc. Therefore, the fault protection and

monitoring of motors helps us to detect and overcome those faults and can able to avoid the unanticipated failures. Hence condition monitoring of motors is recommended. Because of the variations beyond the rated level of those parameters may cause damage to the motors. The performance of the motors solely depends on those parameters. In many areas the induction motors are widely used. In order to ensure reliability in the operation of motors, advanced technologies should be employed. So that fault protection and motor monitoring can be done automatically. Using Internet of things, the monitoring of the motor can be viewed from the remote areas. By monitoring those parameters if any abnormal condition is detected the motor turns off automatically and gets start automatically when the condition is right.

II. AIM AND SCOPE

The prime objective of this project is to improve the reliability of the motor applications with the help of latest technology advancements. This project ensures the ceaseless monitoring and fault protection of the single-phase induction motor. By establishing the methodologies, the abnormal conditions are identified easily and can be rectified automatically. Also, the data monitoring should be economical. By taking preventive steps the fault can be rectified and failures of the system is stopped. The aim and scope of the projects are

- To protect and monitor the induction motor using Internet of things, for data communication in industrial areas.
- To stop the induction machine to avoid the failure of the system automatically.
- To measure the various motor parameters and displays the information to the user about the motor's present condition.
- To protect the motor from under voltage and over voltage.

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A. Fault protection

Protection of induction motors is very essential in the industrial field in order to avoid the motor damage and also for the uninterrupted production, operation. Here the protection of motor is carried out using the relay, voltage sensor and current sensor. These components analyze the motor condition and performs the protection operation according to the pre-defined instructions through the microcontroller board. [11] discussed because of various appealing focal points, agreeable correspondences have been broadly viewed as one of the promising systems to enhance throughput and scope execution in remote interchanges.

B. Motor Monitoring

The monitoring of induction motor is carried out using the current sensor, voltage sensor, and IR sensor for monitoring the speed. The continuous monitoring and controlling process can be viewed through the IOT application.

IV. BLOCK DIAGRAM

The design objectives are fault protection and monitoring of the induction motor using Internet of Things, technology

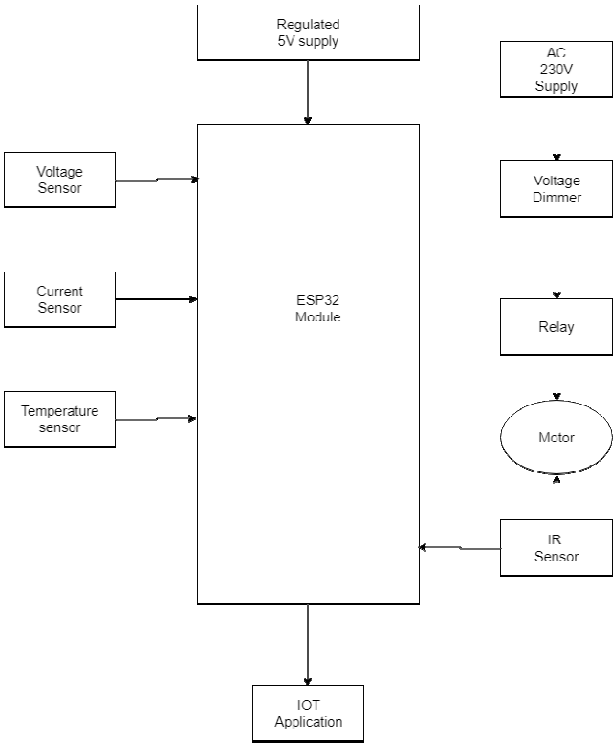

Figure 1. Block diagram

By setting the threshold values of voltage, current and these values are compared with the ongoing motor condition and the are voltage, current, speed and these are connected to arduino microcontroller that sends the data through Wi-Fi module that shows the relevant information of motor to the user.

The hardware model is designed using ESP32 for data communication through internet, single phase induction motor, current sensor, voltage sensor, IR sensor, relay, voltage dimmer for voltage regulation and a LCD display.

S.NO	Components	Voltage rating	Current rating
1.	Single phase motor	270V	0.65 A
2.	Voltage sensor	5V	2mA
3.	Current sensor	5V	10mA
4.	Relay	12V	10A

Single phase induction motor is simple, reliable, robust in construction, cheap in cost, easy to repair and maintain. It has a single-phase winding on stator and a cage winding on the rotor and it operates on single-phase AC supply. The stator has the main winding and the auxiliary winding placed in a manner perpendicular to each other. In the auxiliary winding a capacitor is attached for the starting of the motor.

The ESP32 is a low cost and user-friendly module to provide connectivity to the projects. It can be connected to the microcontroller and work both as a access point and as a station, so it easily fetch data and upload it to the IoT cloud easily. The operating is 5V.

Internet of Things.

The internet of things, a big network of connected things and people. It is the concept of connecting any device for controlling automatically to the internet and to other connected devices. IoT collects and share data from devices around them to IoT cloud. It can be any device like ovens, fans, lights etc. The IoT platforms are connected to sensors and devices which sends the data to the platform built to address specific needs. In industries the IoT concept is employed for automation, parameter monitoring, protection from failures and also for controlling the machines, equipment, from the remote places. [14] discussed that Helpful correspondence is developing as a standout amongst the most encouraging procedures in remote systems by reason of giving spatial differing qualities pick up.

V. SOFTWARE COMPONENTS

Arduino IDE: It is an integrated development environment exclusively for arduino microcontroller boards. It is an open-source software makes it easy to program for the arduino boards for the embedded projects.

Proteus 8: Proteus professional is a simulation software that can be used to draw schematics, PCB layout, code and simulate the designed models. In Proteus we can internally add arduino libraries, it has sensor libraries so that we can interface arduino, sensors with proteus and simulate those design for desired output.

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through mobile from remote areas.

VI. METHODOLOGY

The main objective of this project is the fault protection and monitoring of single-phase induction motor. In this project we are using voltage sensor, current sensor, temperature sensor and a speed sensor for measuring voltage, current, temperature and speed respectively. The voltage and current sensors are connected to the ESP32 microcontroller for the data communication. Temperature sensor, IR sensor and LCD are connected to Node MCU. These sensors sense the corresponding signal and sends the data to the microcontroller which process those signals in to human readable output. With the collected data we are then determining the power consumed, power factor of the induction motor. Then the microcontroller board sends the information to the ESP32 Wi-Fi module connected to it which sends the information to the internet cloud. Using the IoT application users can view the present condition on the motor in mobile application or laptop from the remote areas. In addition to the monitoring of the motor this project incorporates fault Protection of the motor. The fault protection works on two modes. In the first mode if the motor experiences low- voltage then high current will be drawn it may damage the winding. In this stage by setting a certain voltage level, if the voltage goes down the predefined level the motor automatically turns off and a message low voltage will be displayed IOT application and speed, temperature of the motor will be printed in the LCD. Likewise for the over-voltage if voltage crosses the threshold level the motor turns off and high voltage message will be printed in mobile application and if the supply voltage become normal the induction motor automatically turns ON for the operation. In the other mode the operation is shifted to another supply circuit in which if any of these faults arises the voltage is stepped-up or stepped down for low voltage and over voltage respectively and the motor is able to get the required voltage for uninterrupted operation. These preventive measures are useful for the protection of the motor and also able to avoid the failure of the system. Hence user can continuously monitor the condition of the motor. [2] proposed a secure hash message authentication code. A secure hash message authentication code to avoid certificate revocation list checking is proposed for vehicular ad hoc networks (VANETs). [4] proposed a novel method for secure transportation of railway systems has been proposed in this project. In existing methods, most of the methods are manual resulting in a lot of human errors. This project proposes a system which can be controlled automatically without any outside help. [9] discussed that the activity related status data will be communicated consistently and shared among drivers through VANETs keeping in mind the end goal to enhance driving security and solace.

VII. SIMULATION MODEL

The simulation design of the fault protection and monitoring is carried out in proteus 8 professional software. The LCD in the simulation displays motor parameter such as voltage, current, speed, power, power factor and also displays the motors present condition. If fault occurs the cause of the fault will be presented in the LCD and motor will be stopped automatically.

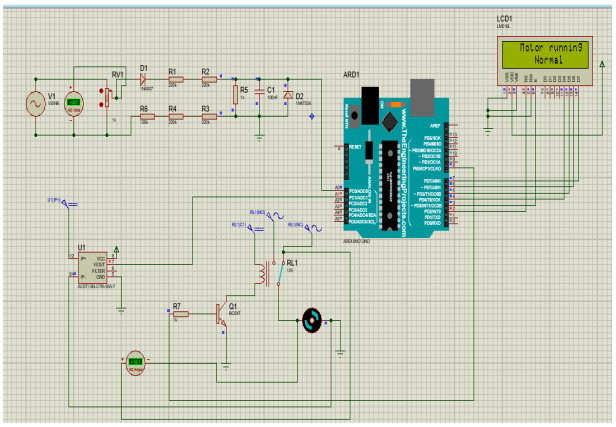

Figure 2. Simulation model for normal working condition.

If the voltage is high or low the motor will be stopped and it displays the respective cause in LCD. In the simulation relay and a transistor is used for the switching of the circuit for turning ON and OFF of the motor. In this if the motor experiences any fault condition the motor automatically turns OFF. If the conditions become normal the motor automatically turned ON for the operation.

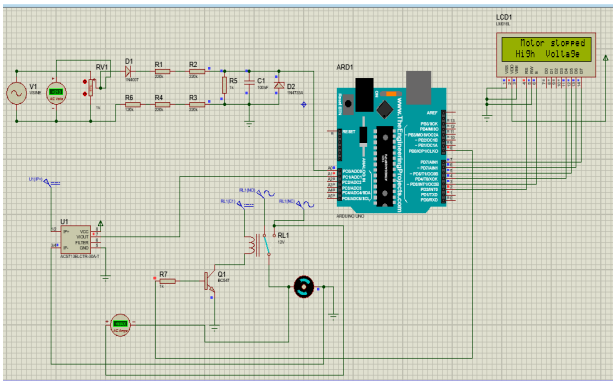

Figure 3. Simulation model for High voltage condition

VIII. HARDWARE MODEL

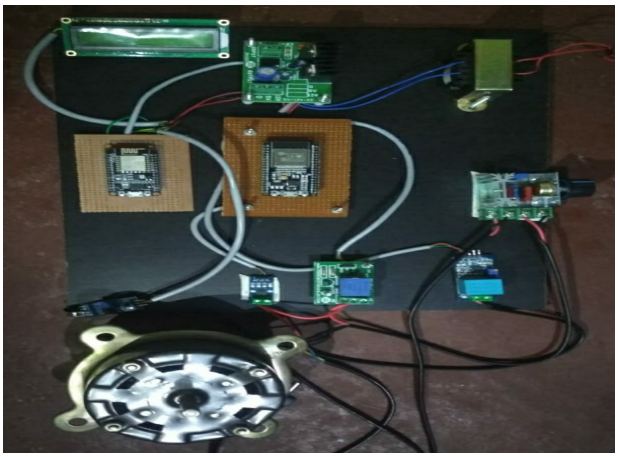

Figure 4. Hardware setup

This is the hardware setup of the induction motor fault protection and monitoring system.

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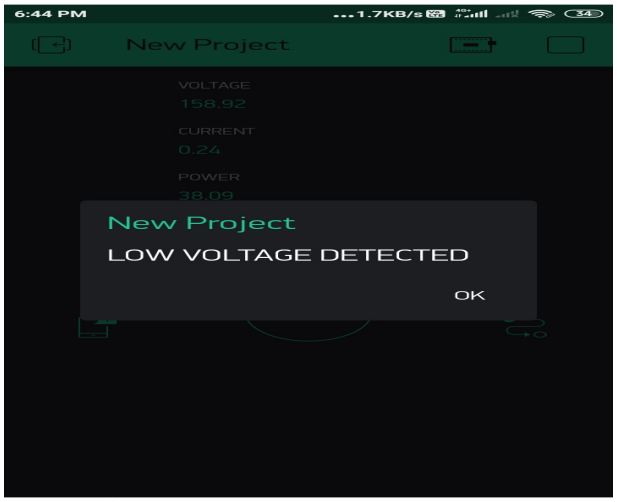

Figure 5. IOT application which indicates Low voltage

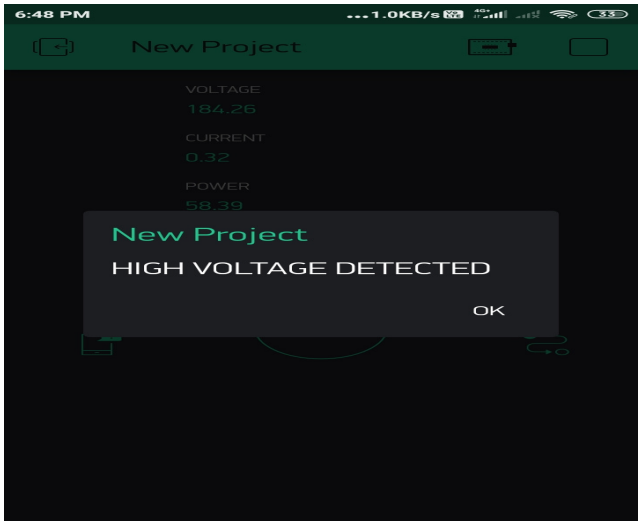

Figure 6. IOT application which indicates High voltage.

The IOT application also sends the motor report to the user through E-mail. A graphical representation of the parameters can also be presented to the user.

IX. CONCLUSION

This work represents the IoT technology is well known and rapidly growing in today's scenario. This concept is widely used in home automation, industrial automations, agriculture, medical field etc. With the help of sensors this project represents induction motor fault protection and monitoring system using IoT technology. Analysis and visualize voltage, current, speed, power, power factor on the LCD display. By analyzing the motor parameters make the induction motor to be operated in safe and protective in nature and the continuous monitoring and displaying of data are very much useful for the users. Through the IoT application if any fault arises in the machine, it rapidly sends the alert message to the user over the internet and preventive measures are taken automatically. In industries continuous monitoring of machine are very essential for the uninterrupted production. In case the motor experiences excess or low voltage than its rated level it will automatically disconnected from the supply.

X. RECOMMENDATIONS

Fault protection, monitoring of the single-phase induction motor was successfully designed with success as per the objective of our project, the followings are the recommended ideas for the enhancement of the project

- The other parameters such as vibration, torque and frequency also can be incorporated with the model for better output.
- The wireless network used in this project has a limited range and which can be improved in future works for excellent monitoring of motor parameters.
- This project only considers single-phase motor, certainly this implementation can also be used with three phase induction motor for monitoring and fault protection.

XI. ACKNOWLEDGEMENT

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