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Three Phase Induction Motor Protection from Phase and Temperature

Komal D Dodmani[*1], Sharvari D Shinde[*2], Kaushal D.Chalekar[*3], Prakash D Dodmani[*4], Nagane Poonam B[*5]

Department of Electrical, TSSM BSCOER POLY, Pune, Maharashtra, India[1]

Department of Electrical, TSSM BSCOER POLY, Pune, Maharashtra, India[2]

Department of Electrical, TSSM BSCOER POLY, Pune, Maharashtra, India[3]

Department of Electrical, TSSM BSCOER POLY, Pune, Maharashtra, India[4]

Lecturer, Department of Electrical, TSSM BSCOER POLY, Pune, Maharashtra, India[5]

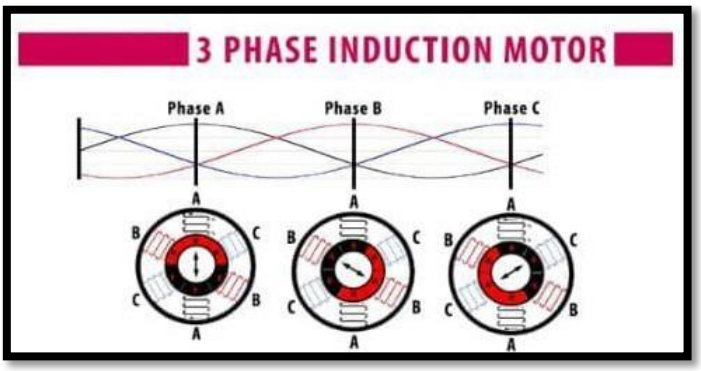
ABSTRACT: As three phase induction motor is one of the important electrical device in present scenario of automation. Three phase induction motor are commonly used as drive for industrial purpose because they are, reliable, easy to operate. But the faults in the induction motor may lead to breakdown of motor and an increase in expense. In the present paper, automatic fault detection and analysis for protection of three phase induction motor has been investigated and experimental set up have been carried out for the required detection analysis by using (AVR) ATMEGA 328 microcontroller. Experimental setup results shows AVR microcontroller based fault detection and protection of induction motor with safety and the higher accuracy.

I. INTRODUCTION

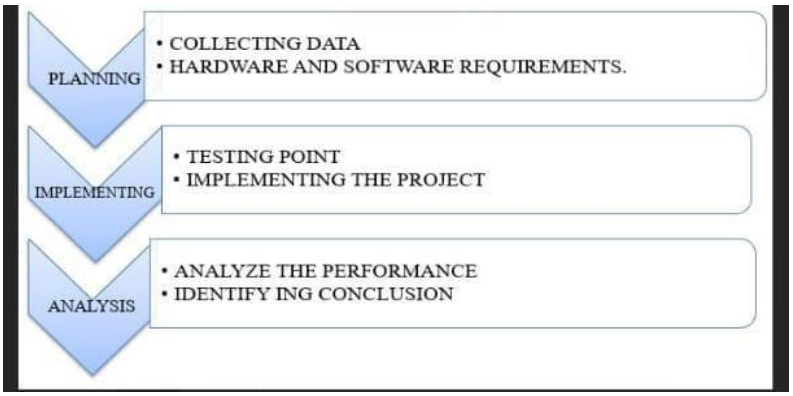
Three phase induction motor plays very vital role in the industry, it is the work horse of the industry converting up to 80 – 90 % of the all electrical energy into mechanical energy and it may include many important application like fans , blowers, conveyors. The induction motor work in very stress type of an environment So this induction motor are experience various faults and the abnormal condition. The faults occur in the induction motor are over voltage, under voltage . over current, over temperature, single phasing. The main concept of the project is to develop an induction motor protection system for protecting the motor from any damages occurring from above abnormal condition. The induction motor is one of dominant application of the industry it is mainly used as an drive for the industrial application. This project helps us to provide protection to the industrial motors if any of the phases is missed out of three phases or if the voltage of the motor exceeds the threshold value. The proposed system uses three-phase power supply where in three single-phase transformers are connected to it. The system has a set of op-amps used as comparators for comparing input voltages. The motor is operated by switching the main relay, which is operated by other set of relays by sensing single phasing and over /under voltage, over/under current conditions. The project in feature can be enhanced by using current sensors for overload protection and phase-sequence sensor for protecting the motor from applying wrong phase sequence. A large number of motors are being used for general purposes in our surrounding from house- hold equipment to machine tools in industrial facilities. The electric motor is now a necessary and important source of power in many industries. Three phase induction motor generally suffers from under voltage, over voltage, overheating, vibration problems. Due to this electrical fault the winding of motor get heated which lead to insulation failure and thus reduce the life time of motor. When the three phase induction motor supply with higher voltage than is rated then induction motor starts overheated. This fault is generated in induction motor due to variation in induction motor parameters. When three phase induction motor runs continuously, it is necessary to protect the motor from these anticipated faults.

As we see in the block diagram there are three current sensors are used for the three phases of the supply to detect the current in the three phases. This voltage sensor are generally perform its operation on voltage divide rule means the voltage sense by the voltage sensor are divide by the voltage divider rule . And this is given to the microcontroller and as command given to the controller the controller takes the action and it shows on the LCD display. Also the voltage sensor are given to the every phase of the supply R, Y,B phases respectively . The step down transformer are used which are connected to the three phases of the supply this step down transformer are converted the 230 V supply into the 6 V supply. This 6 V supply it is an required to perform the operation for the microcontroller because microcontroller it is an operated on the 5V DC . The step down 6V AC it is an converted into DC by using bridge rectifier. The bridge rectifier converts AC into DC. In front of the Bridge rectifier the filter capacitor it is an placed . The DC supply it is an given from the bridge rectifier it is an pulsating DC this pulsating DC it is an filter by filter capacitor. The microcontroller which is used in the circuit are ATMEGA 328 this is an 28 pin microcontroller which have 20 M Hz crystal frequency. This microcontroller

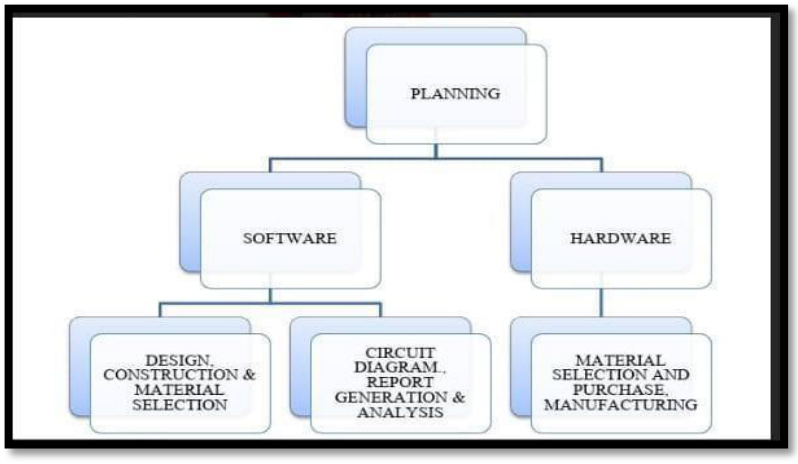
have 8 analog to digital converter pins . To this microcontroller the relay driver and the buzzer are connected to the output pins of the controller. The 16 *2 LCD it is an used in the circuit for the showing the live voltage, current, RPM value of the motor . The RPM sensors are also used in the circuit to measure the RPM of the motor. Temperature sensor are also used in the circuit to the measure the temperature of the motor .When the motor it is an running for very long period of an time the temperature of the motor gets increases , due to increase in the temperature the winding gets damaged for protection from this the temperature sensor LM 35 it is an used . It is analog temp sensor which is an connected to analog to digital pins of the controller. This analog to digital conversion is takes place at the controller end. The relay it is an also connected to the controller , For operation of the relay the relay driver it is an connected to it . Relay it is an operated at 12 V of an supply for the operation of an relay the 12 V supply it is an extract through the one step down transformer for this the potentiometer it is an placed in the circuit for operation of this .The relay driver it is an operated at normally open and the normally closed position. The buzzer it is an also in the circuit to alert the system from the fault occurred in the system . As this the components are placed in the circuit for their specific operation.



II. METHODOLOGY



PLANNING



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III. METHODOLOGY

The overall block diagram of the proposed motor protection system is shown in Figure 3.2.1. Arduino block stands for which is developed by Microchip Co.US. Since it adopts RISC (Reduced Instruction set Computing) as kernel structure, it behaves more excellent than the average 8-bit single chip. It is easy to learn and supports ICD (In Circuit Debug). Voltage and current measuring circuit blocks stand for relative measuring circuits. The measured results are transmitted to corresponding pins of controller through interface circuit, which is designed to interface the measuring circuit and controller. Protecting circuit block represents the corresponding protecting circuit. Once needed, the controller will output an operating signal, the protecting devices act immediately and correctly to protect the motor, by operating the drive circuit. The setup consists of step-down transformer, current sensor, voltage sensing circuit and relay and contactor unit along with controller.

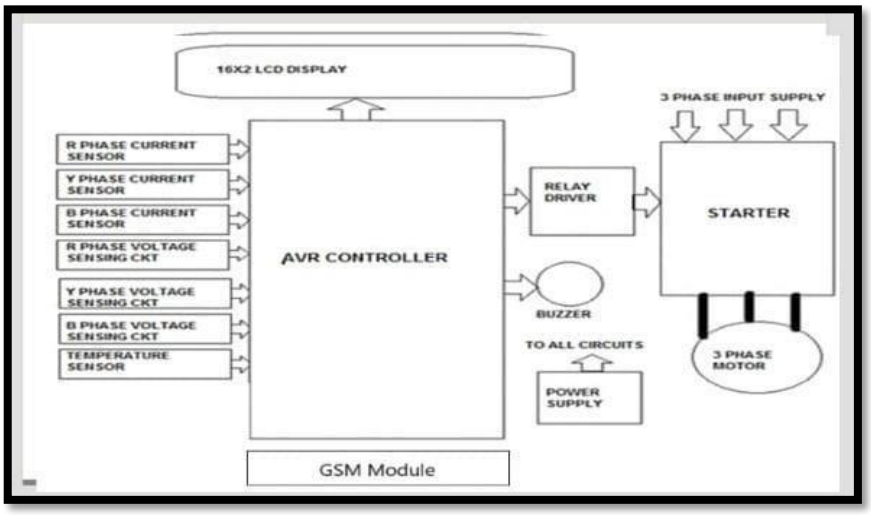
Initially, controller is programmed using development tool. The voltage sensing and current sensing circuits are used for monitoring line current and line voltage under running condition.
The data gathered from voltage sensing and current sensing circuits are transferred to the controller digitally by passing through the current and voltage measuring circuits. The controller having in build analog to digital (ADC) converter. So, no need of external ADC unit. Normally controller A/D converter (ADC) is capable of processing input, which is less than 5V signal. So, sensors should be selected as per the controller design value.

The needed comparisons are made in controller according to limit values, which are previously entered or programmed. When an unexpected situation is encountered, the motor is being stopped by means of the control signal. The motor parameters like the full load current in amperes, service factor and class of motor, etc
,are needed to be entered into the relay programming unit to automatically calculate the correct motor protection curve. The following protective functions are provided by this system

The Controller based motor protection system combines control, monitoring and protection function of induction motor from incipient faults in one assembly setup. The system provides over overload, single phasing, under and over voltage schemes. The controller of the system is implemented using controller. The input data (Limit values) to the system is given through the keypad. Display unit is used as an output device to display the output data and fault condition. The system works with any motor design with high degree of accuracy. The method is very sensitive, fast and detects faults while running and before start. The prototype model is developed and tested on a three phase induction motor with rated current of 5A and the test results are satisfying the design criteria.

When the limits of the maximum allowable under voltage and over voltage are exceeded, controller generates trip signal, which in turn switch off the induction motor and display message as under voltage or over voltage fault and hence induction motor is protected from heavy over and under voltage condition. All the data is given to operator through SMS Similarly other faults are monitored and Induction motor is protected from those faults. The overall circuit diagrams of all faults are given below

BLOCK DAIGRAM



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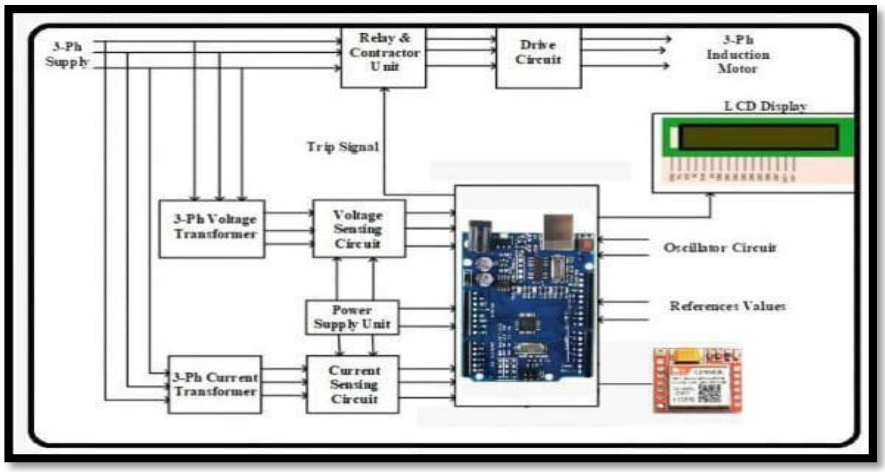
IV. CIRCUIT DIAGRAM



V. PROJECT OBJECTIVES

The main objectives for this project are:

1. To design a closed-loop control for a three phase induction motor.
2. To design a combination of PI-Fuzzy controller to control the speed a three phase induction motor
3. To develop the hardware (inverter and gate driver) of the controller to control a three phase induction motor

VI. CONCLUSION

A system has been designed for the detection and protection of induction motor under abnormal conditions. Some concluding observations from the designing are given below.

. Under short circuit conditions, current flowing through each phase is different and more than normal current rating.

· When the motor run for very long duration of time the temperature gets increased and leads to the abnormal condition.

· During the under voltage or overvoltage faults voltage across motor get vary.

· As per new designed protection technique motor get disconnect during faulty condition and after clearing these faults motor get starts automatically without any damage.

This system helps to detect electrical fault occurred in the system and prevent the motor from damaging. Due to this protection system the motors reliability is increased.

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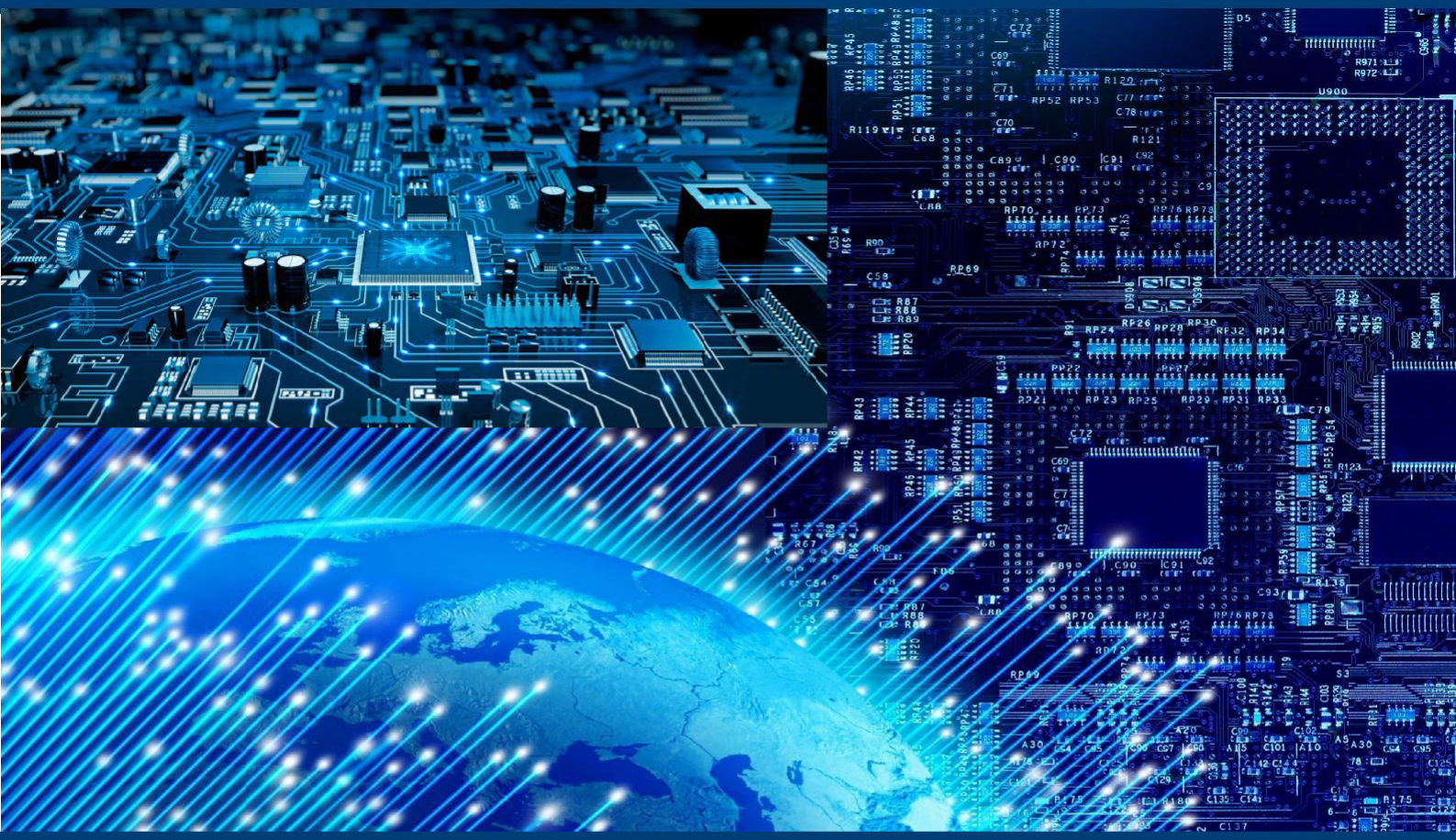

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