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Protection of Induction Motor Using PLC

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Abstract: ***Protection of an induction motor (IM) against possible problems, such as over voltage, over current, overload, over temperature, and under-voltage, occurring during its operation is very important, because it is used intensively in industry as an actuator. IMs can be protected using some components, such as timers, contactors, voltage, and current relays. This method is known as the classical method that is very basic and involves mechanical dynamic parts. Computer and programmable integrated circuit (PIC) based protection methods have eliminated most of the mechanical components. However, the computer-based protection method requires an analog to digital conversion (ADC) card, and the PIC-based protection method does not visualize the electrical parameters measured. In this study, for IMs, a new protection method based on a programmable logic controller (PLC) has been introduced. In this method, all contactors, timers, relays, and the conversion card are eliminated. Moreover, the voltages, the currents, the speed, and the temperature values of the motor, and the problems occurring in the system, are monitored and warning indicators are shown using colored LED's. Experimental results show that the PLC-based protection method costs less, provides higher accuracy as well as a safe and visual environment compared with the classical, the computer, and the PIC-based protection systems.***

Keywords: programmable logic controller, induction motor, motor protection, ladder diagram, protection system

I. INTRODUCTION

Induction motors are perplexing electro-mechanical devices used in most industrial applications for the transformation of power from electrical to mechanical form. Induction Motors are utilized worldwide as the workhorse as a part of mechanical provisions. Such motors are robust machines utilized for general purposes, as well as in risky areas and serious situations. Broadly useful provisions of induction motors incorporate pumps, transports, machine instruments, diffusive machines, presses, lifts, and bundling supplies. Induction motor is the most modest electrical machine from a construction point of view. Induction motors are highly reliable, require low maintenance and have high efficiency. The motor fault is due to mechanical and electrical stress. Mechanical stress is caused by overload and sudden load change, which can produce vibration in the motor. Electrical stress is caused by short circuit, temperature rise and some other fault like speed, single phasing. Hence the fault occurs in the motor. Suchfailure is costly and can lead to increased maintenance cost and wasted raw material. To overcome the above problem, the fault detection and protection of the induction motor by using PLC (Programmable Logic Control) method can be used.

II. LITERATURE SURVEY

PLC based Monitoring and Protection of 3 phase Induction Motor against various abnormal conditionsDOI: 10.1109/ICOMET.2019.8673497
Author name: Dileep Kumar, Abdul Basit, Aisha SaleemYear of Publication- 2017
In this manuscript, low-cost and efficient protection scheme for three phase induction motors is designed against the most commonly occurring abnormal conditions – over current, over voltage and over temperature. This protection scheme makes use of the modern control equipment used in the industrial processes. The brain of the scheme – Programmable Logic Controller (PLC) – continuously monitors the different parameters of an induction motor and gives an alert message on Human Machine Interface (HMI) about any abnormal condition detected and trips the induction motor if no troubleshooting action is taken withindefined time. The design has an additional feature of automatically starting the induction motor when fault is removed which mitigates the need of a recloser. The design has been tested on different three phase induction motors of different parameters available in the laboratory. Keeping operating time in consideration the design replaces the old mechanical relays with modern solid-state relays, and the same relay has been used for signaling for all abnormal conditions which again makes this design an economically low-cost.

Induction Motor Protection SystemCorpus ID: 54046506
Author Name: Vikram Singh, Abhishek Gupta, Akshay GuptaYear of Publication: 2017
Induction motors are used in many industrial applications in a wide range of operating areas because of their simple and robust

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structure, and low production costs. Providing a protection system is very important in industries. The purpose for development of this project is to provide safety to industrial motors, lift motors, pumps etc. The main purpose of this project is to protect an induction motor from faults such as single phasing, overvoltage, over temperature and under voltage. In this project they are using a three-phase supply by using three single phase transformers. If any of the phases, out of the 3 phases is missing or if temperature of the motor during operation exceeds threshold value or if the voltage exceeds/drops threshold value motor stops immediately. If any of the phases is not available, the corresponding transformer stops supplying power to the circuit. The main relay which ispowered through a set of four relays gets disconnected because of one relay not being powered. And they are using a microcontroller for detection of these faults and a LCD display to show which type of fault has occurred.

Protection of Induction Motor from Abnormal Conditions using PLCCorpus ID: 212589103
Author Name: Ambili Pradeep, Kavya Mohan, Elizabeth ThomasYear of Publication: 2019
System for protection of System for protection of induction motor from abnormal conditions using PLC is built and tested. PLC scan be used even in unclean circumstances and environments of high temperature, humidity and chemicals and thus suitable in an industry than any other logic devices. They have direct interoperability to other industrial devices such as relays, valves, actuators, transmitters, motor starters etc Simplicity in programming of PLC makes the system more popular. The project can bemodified by implementing SCADA, which provides real time monitoring of various parameters of the motor on a computer screen. Further, the protection can be implemented with large three phase motors used in industries.

III. METHODOLOGY AND IMPLEMENTATION

A new protection method based on a programmable logic controller (PLC) has been introduced. The voltages, the current, and the temperature values of the motor, and the problems occurring in the system, are monitored and warning lights are shown on the designated LED Fault Indicators. This PLC based protection method costs less, provides higher accuracy as well as safe a visual environment compared with the classical, and the PIC-based protection systems

In this project we are using PLC for controlling and detecting the variation of current, voltage and temperature of the induction motor. The process of the project is such that a three-phase supply is given to the machine. Voltage transformer, current transformer and ntc temperature sensor is used to measure voltage, current and temperature respectively. These sensors provide data to be compared against the initial value set with the PLC. The PLC is connected to a protection Relay which senses the change in voltage and current. The ntc temperature sensor is directly connected to the PLC. whenever a voltage, current or temperature is sensed that is not within the limits provided to the PLC, the PLC send a signal through the protective relay to the 3-phase contactor that is connected to the motor to disconnect the motor from the mains power supply

A PLC can be associated for motor protection and de-rating indication and control apart from regular automation function to have overall control of process and keeping healthy condition to reduce breakdown time. Any number of motors can be monitored for unbalanced, low or high voltage along with current and respective temperature which are used in the process. The voltage and current will be sensed by line sensors i.e., CT / PT. It will then be interpreted by the PLC and appropriate action will be taken asper ladder program

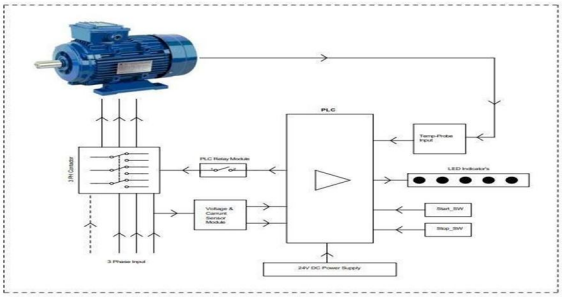
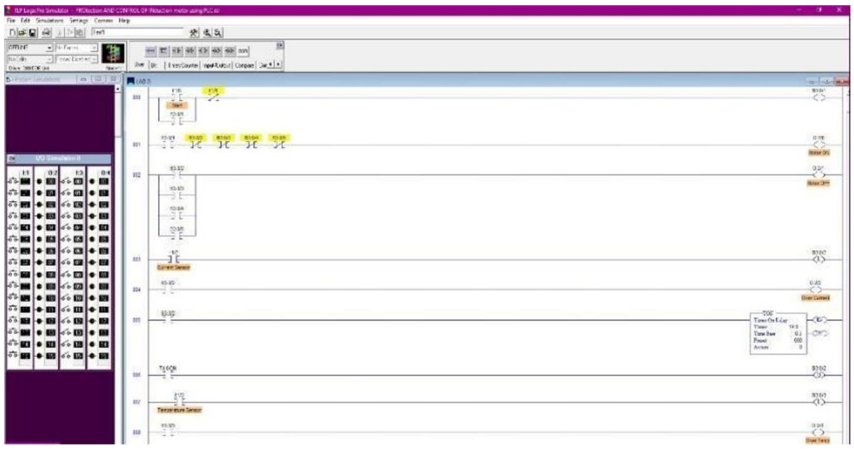
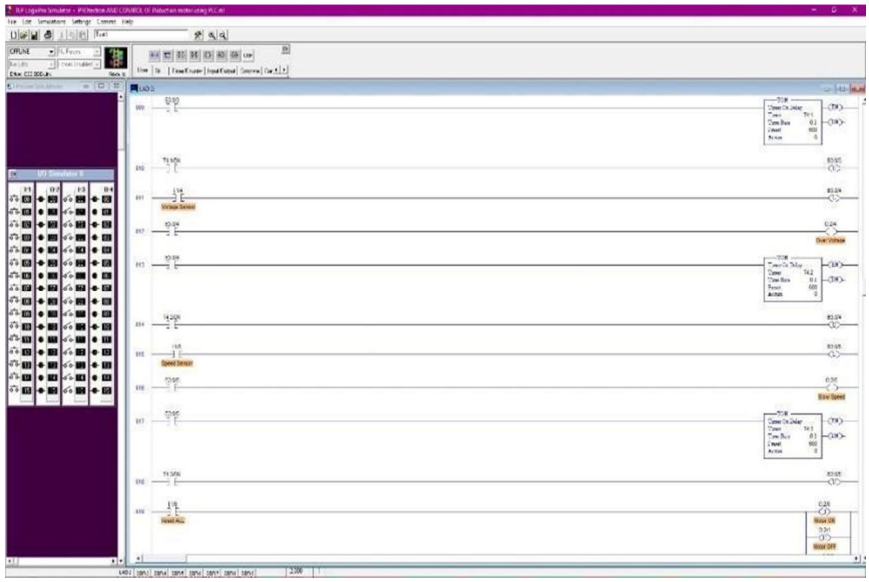


Fig. 1 Circuit Diagram for Fault detection and Protection of Induction motor using PLC.

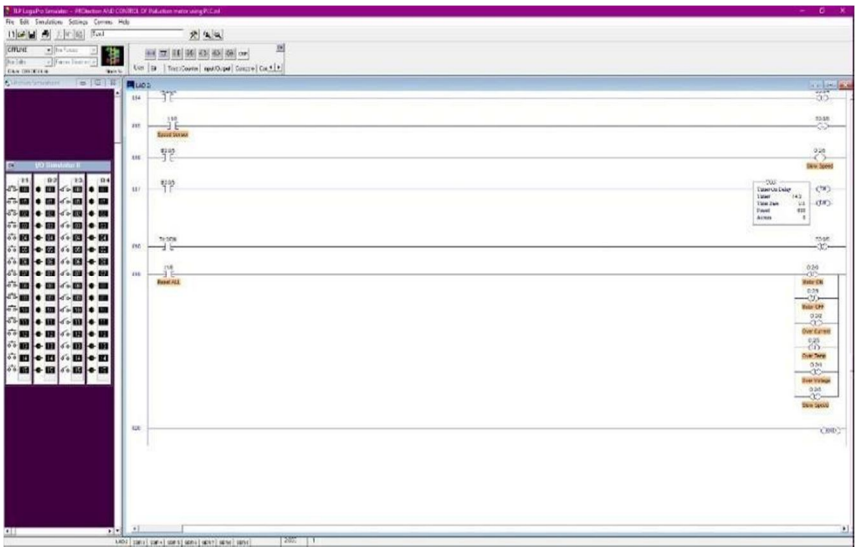
In the above circuit diagram, the three-phase supply is given to the motor through a trip coil. The phase voltage, phase current, temperature is monitored using PLC. These monitored values are continuously compared with their rated value stored in PLC. If any fault occurs, the program automatically stops the motor immediately. The motor is shut down by the control signal sent from PLC. When the motor is turned off an indication is shown. The ladder diagram simulation and the project model are shown below.



(a)



(b)

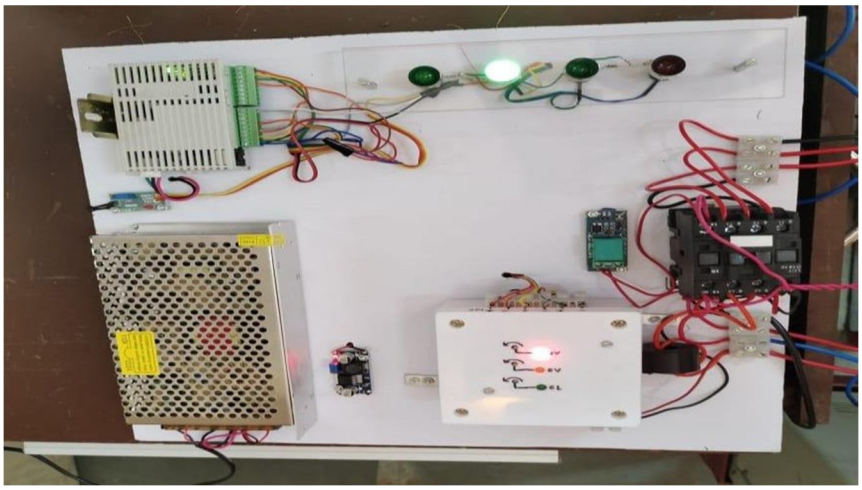


(c)

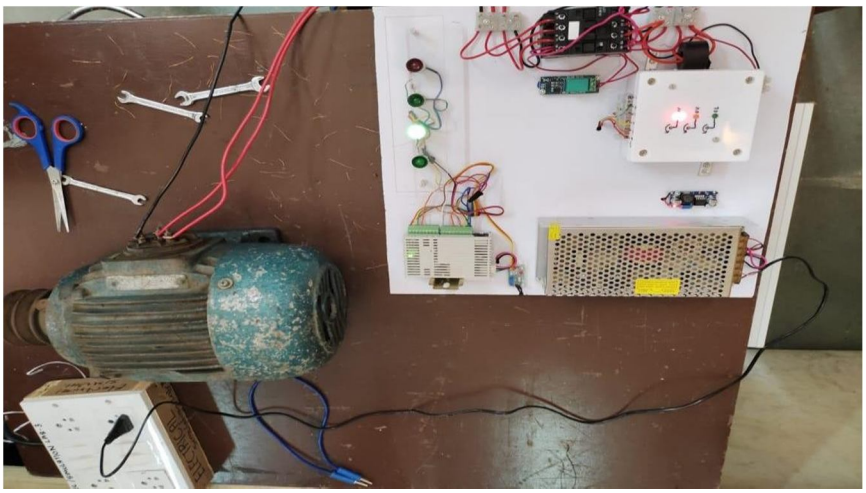
Fig. 2 Simulation of Ladder diagram



(a)



(b)



(c)

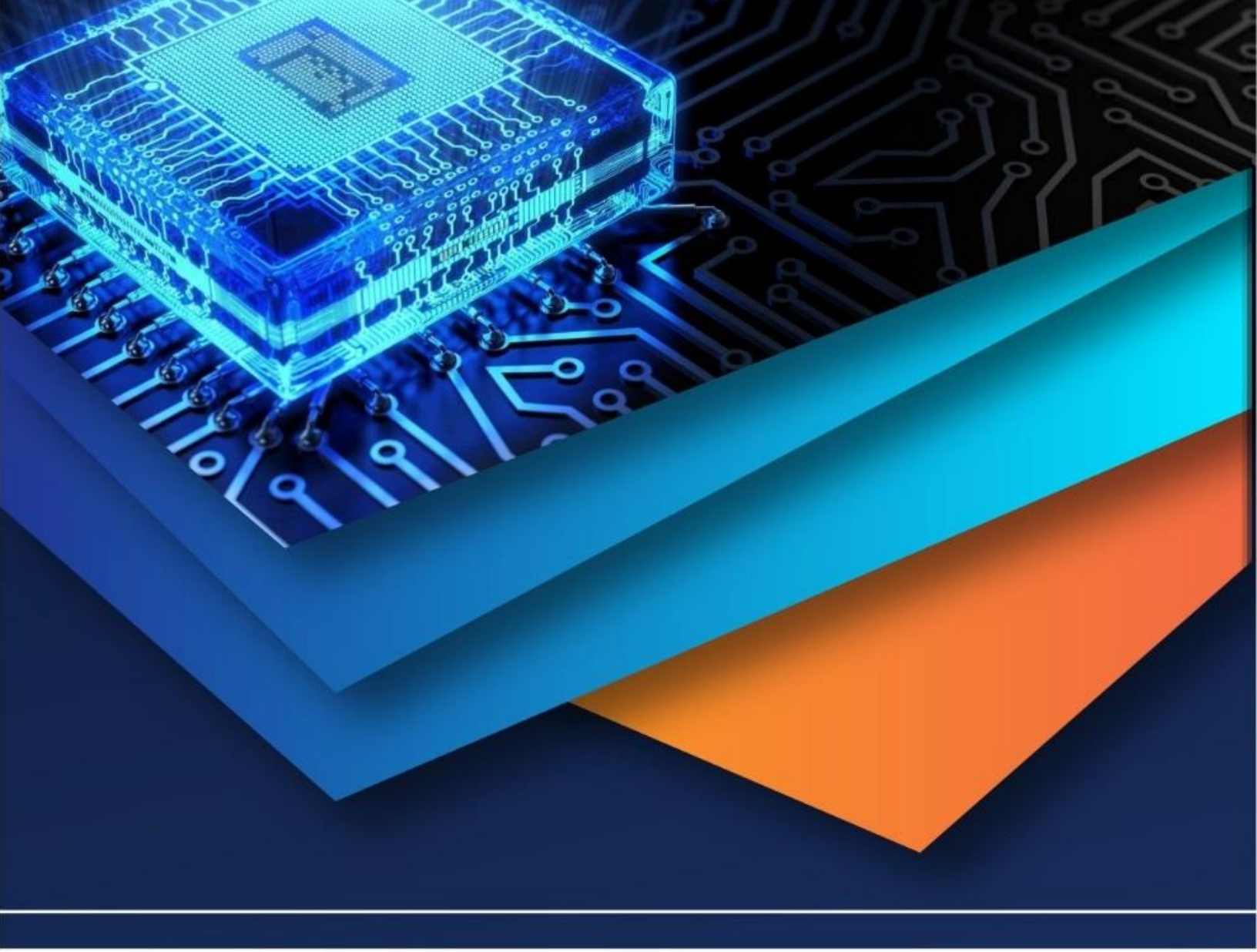
Fig.3 Project model

IV. CONCLUSION

Protection of the induction motor is achieved; operation is very reliable and highly efficient. Without changing any hardware connection just by simply changing the program in the PLC; the motor can be protocetid against any value of temperature, currentand voltage. Using a programmable logic controller, this work aimed to propose a cost-effective and real-time monitoring and protection solution for industrial three-phase induction motors against overcurrent, overvoltage, and over temperature problems.

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