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INDUCTION MOTOR PROTECTION USING PLC

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Abstract : *Induction motor is rotating type of electro-mechanical device. Induction motor convert electrical energy into mechanical energy. Induction motor is highly reliable, require less maintenance and have high efficiency. Induction motor are wide in range of operation and it used in many application because its construction is simple and robust. In past induction motor can be protected by manual operation of component such as timer, contactor, electromagnetic switch, voltage and current transformer. Protection of an induction motor against problem such as short circuit, temperature rise, single phasing and motor vibration occurring in the operation is very important. Manual operation of protection system are very slow and is not accurate. Looking to this issues, in this paper PLC based protection method is used. Which operated automatically, provide higher accuracy and quick response.*

Keywords : *Economical, Fault analysis, Induction motor, PLC, Reliable*

1. INTRODUCTION

Induction motors are perplexing electrical machine used in most of the industrial applications for the transformation of power from electrical to mechanical. Induction Motors are utilized worldwide as the workhorse as a part of the mechanical provisions. Such motors are robust machines utilized for general purposes, in risky areas and serious situations. Broadly useful provisions of induction motors in corporate pumps, transports, machine instruments, diffusive machines, presses, lifts. Induction motor is the most moderate electrical machine from construction point of view. Induction motor are highly reliable, require less maintenance and have high efficiency. The motor fault is due to mechanical and electrical stress. Mechanical stress is caused by overload and suddenly load changes, which can produce vibration in motor. Electrical stress is caused by Short circuit, temperature rise and some other faults like speed, single phasing etc., Hence the failure is occurs in the motor, such failure is costly, increase maintenance cost and wasted raw material. To overcome the above problem, the fault detection and protection of induction motor by using PLC (Programmable Logic Control) method can be used. [1]

2. METHODOLOGY

The following is the design methodology for the project Induction motor protection using PLC.

2.1 Block Diagram

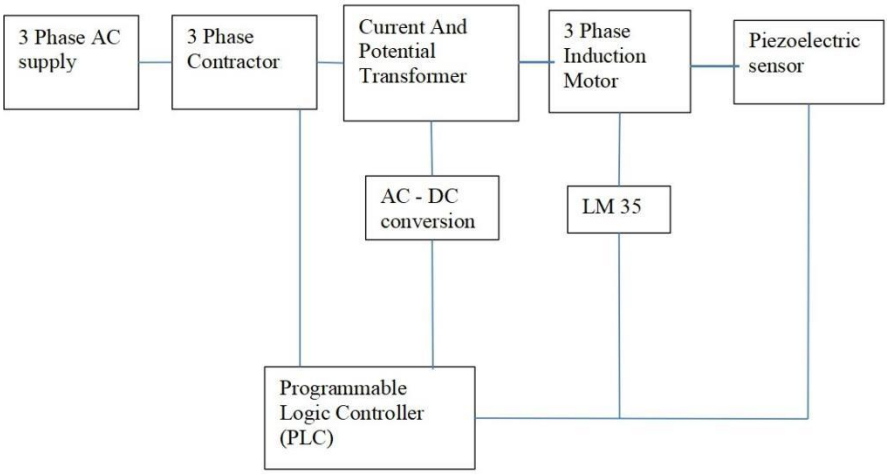

Figure 1: Block Diagram [2]

2.2 Working Principle

As per shown in the block diagram, CT (current transformer) & PT (potential transformer) are used for current and voltage measurement, any temperature sensor for measuring temperature and speed by using incremental encoder /optimal sensor. The output of these sensors are given to PLC. In this method of protection, the online monitoring of induction motor is done and all the necessary electrical parameters – voltage, current and temperature, speed are monitored. If the parameters are bounded which mean all the parameters are within their normal operating range, the PLC will continuously be allowing the induction motor to be connected with the three phase supply. However, if there is any disturbance found, PLC will trip the induction motor by giving a tripping- signal to magnetic contactor and relay as per the programmed conditions.

- **Types of faults with their normal and abnormal magnitude:**

Table 1: Motor normal and abnormal fault magnitude [3]

Fault Type	Normal	Abnormal
Over Voltage	220 V	235 V
Under Voltage	220 V	190 V
Over Temperature	27 ºC	40 ºC

2.3 Circuit Diagram

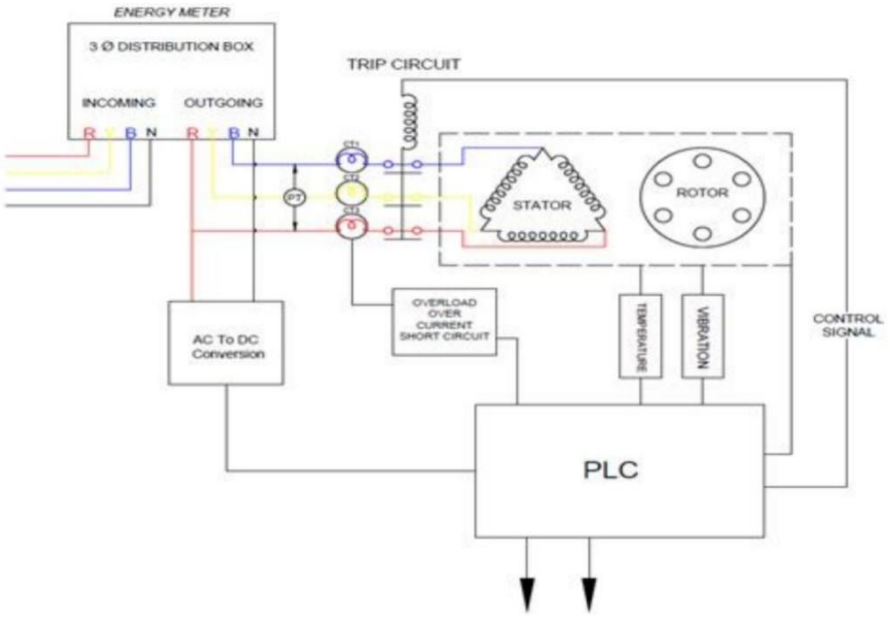

Figure 2: Circuit Diagram[2]

2.4 Components and specifications

Table 2: Components and Specifications

Sr. No.	Components	Specifications
1	DELTA PLC	20.4 to 28.8 VDC I/O 8/6
2	CURRENT TRANSFORMER	RATIO 50:5A
3	POTENTIAL TRANFORMER	RATIO 230:V
4	LM 35 TEMPERATURE SENSOR	4 to 30V DC
5	INDUCTION MOTOR	Three phase,415V,50Hz,5HP

2.5 Mathematical Analysis

Table 3: Mathematical Formula for designing

Sr. No.	Formula	Description
1.	For current Transformer : $\frac{Np}{Ns} \quad \frac{Is}{Ip}$ For full load current of 7A we use CT ratio 50:5A From the above we get output of CT will be 0.7 A	Np = Primary turns Ns = Secondary turns Is = Secondary current Ip = Primary current

2.	For Potential Transformer 230:5 V ratio PT we use	PT = Potential Transformer
3.	For temperature sensor LM35 : 10mV/Degree C, 40*10 = 400mv output we get for 40 Degree C	

3. CONCLUSION AND FUTURE SCOPE

3.1 Conclusion

System for protection of System for protection of induction motor from abnormal conditions using PLC is built and tested. PLC can be used even in unclean circumstances and environments of high temperatures, 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 be modified by implementing supervisory control and data acquisition (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.[4]

3.2 Future Scope

3.2.1 Latest trends in industrial automation

Latest trends in the industrial automation include increased use of analytic, growing use of PLC and increased cloud-based supervisory control and data acquisition (SCADA) systems. These tendency will be effect the industrial automation control market, according to a report. The report also forecast that these trends will also result in an eight percent compound annual growth rate (CAGR) for the Asia region, but the direction are likely to be seen globally. Automation industry is moving towards the future of the unparalleled productivity spurred by superior energy efficiency, better design and operator visualization.[5]

3.2.2 Latest PLC technology

Latest PLC technology helps to monitor and control distributed multiple user applications. It also provides a accurate and overall picture of operations, meeting the demands of multiple stakeholders including maintenance and production information technology (IT). Reliable and robust functions can be obtained using the latest technologies of PLC. These technologies enable you to take the advantage of visualization and other new technologies, meeting various challenges in operation, discrete applications and delivering critical visibility when you need it.

3.2.3 Scope of PLC programming

PLC's are continuously growing and evolving to be the best option for a variety of industrial automation applications. Scope of PLC programming is increasing rapidly because of greater programming flexibility and ease, more memory, smaller sizes and built-in wireless features, less time consuming. PLC's are getting benefits from USB technology and thus make it easier than other methods and monitor your control systems. PLC programming will evolve, and with the availability of smaller micro and mini USB connectors, you can expect to see this option on more of the smaller PLC's. In the future, PLC will continuously evolve because of adapting technology increases in communications, hardware, and software. [6]

3.2.4 SCADA system

SCADA stands for Supervisory Control and Data Acquisition. SCADA is a system that collects data from various sensors at a industry or in other remote locations and then sends this data to a central computer which then manages and controls the data. SCADA is a term that is used broadly to properly control and management solutions in a wide range of industries in worldwide.

One of the special feature of SCADA is the ability to monitor an entire system in real time. The main purposes for the use of a SCADA system would be to collect the data from remote sites and even the local site, displaying them on the monitor screen in the control room, storing the appropriate data to the hard drive of the master computer and allowing the control of field devices (remote or local) from the control room.[7]

SCADA systems are equipped to make instant corrections in the operational system, so that they can increase the life-period of component and save on the need for costly repairs and saves time. It also translates into saved man-hours and enabled to focus on tasks that require human involvement.

3.2.5 Different types of protection

- There are various other methods for the control of IM, like Advance vector control , Direct torque control, Sensor less direct torque control. The monitoring system can be connected to the web, making the system control from any place or from control room. The system would be more adaptive so that it can be configured for different type of application such as servo motors, stepper motors etc.[8]
- In next some years GSM service are often added during this system to understand consumer, when fault occurred.
- The fault is automatically detected but by extending this we will automatically clear the fault in future and in minimum time.
- By using his type of PLC based system the cost effective automation system for residence scan be developed in future and it is very user friendly for the operator.
- Similar kind of work can be done with the help of SCADA, DCS etc. Other types of faults can also be considered such power factor problems ground faults etc.[9]

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