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Monitoring the direction of Three Phase Induction Motor Using PLC-Micrologix 1100 series B and SCADA

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Abstract*: Automation or automatic control is the use of various control systems for operating equipment such as machinery and other applications with minimal or reduced human intervention. Some processes like speed control and directional control, etc have been completely automated. AC motors used in industries for various operations due reliable, low cost and simple operations. The implementation of condition monitoring system for the 3-phase induction motor based on programmable logic controller (PLC) & Supervisory control and data acquisition (SCADA) technologyis described. All the required control and motor performance monitoring data will be taken to a personal computer by SCADA Software Wonderware InTouch via PLC RS Linx and RS 500 logix for further analysis.*

Keywords: *Forward and Reverse Induction Motor, PLC, SCADA etc.*

I. Introduction

In any industry the induction motor plays an important role due to its low cost and simplicity.

In an induction motor, there is no electrical connection to the rotor, but currents are induced in the rotor circuit. The rotor conductors carry current in the stator magnetic field and thereby have a force exerted upon them tending to move them at right angles to the field. When testator winding of a three phase AC supply, a rotating magnetic field is established and rotates asynchronous speed. The direction of rotation of the field can be reversed by interchanging the connection to the supply of any two leads of a three phase induction motor. [1]

A SCADA system includes input/output signal hardware, controllers, Human Machine Interface (HMI), networks, communication, database and software. The term SCADA usually refers to a system with a central unit that monitors and controls a complete site or a system spread out over a long distance. The bulk of the site control is actually performed automatically by a Remote Terminal Unit (RTU) or by a Programmable Logic Controller (PLC). [1, 2] A PLC-SCADA based monitoring and control system for a Variable Frequency Drive system was developed which controls a three-phase induction motor. The combination of PLC and SCADA for industrial automation comprises of: a human-machine user interface which is the device presenting processed data to a human operator, who monitors and controls the process; a Remote Terminal Unit collects the information by connecting to sensors in the process, converting sensor signals to digital signals and sending digital signals to the supervisory system after which that information is displayed on a number of operator screens; PLC used as field devices for their economical, versatile, flexible and configurable assign. The control of equipment has been executed through the use of computers. The greater number of equipment's use programmable logic controllers (PLC) to connect with computers to monitor each load. PLC interacts with the external world through its inputs and outputs. reacts with the external world through its inputs and outputs. Especially in manufacturing companies, an automaton network concept developed under the name of Totally Integrated Automation (TIA).[2]

II. Programmable Logic Controller (PLC)

Programmable Logic Controllers (PLCs), also referred to as programmable controllers, are in the computer family. They are used in commercial and industrial applications. A PLC monitors inputs, makes decisions based on its program, and controls outputs to automate a process or machine. This course is meant to supply us with basic information on the functions and configurations of PLCs. A PLC is user-friendly microprocessor-based specialized computer that carries out control functions of many types and levels of complexity. Its purpose is to monitor crucial process parameters and adjust process operations accordingly.[4] Programmable Logic Controller (PLC) With the advent of technology and availability of motion control of electric drives, the application of Programmable Logic Controllers with power electronics in electrical machines has been introduced in the manufacturing automation systems. The use of PLC in automation processes increases reliability and flexibility and also reduces production costs. To obtain accurate industrial electric drive systems, it is necessary to use PLC interfaced with power converters, personal computers and other electric equipment. A PLC based control system was set up comprising of an Allen-Bradley PLC, an Allen-Bradley micrologix 1100 series B three-phase induction motor and workstation has been delivered, configured and integrated together for the monitoring and control of a motor . Various control schemes have been used to operate the induction motor in speed and direction control modes of operation using PLC programming developed on the work station[5].

III. Block Diagram

The block diagram shows in fig.(1) the representation of the whole project in simple manner. Firstly, 240 AC from mains is given to the SMPS. SMPS converts this 240V AC into 24V DC this signal are given to the PLC unit because PLC units is operates only on 24V DC supply. This signals are required only actuates the relays.

Then relays gives 230V AC supply to the contactors and gives this signals to induction motor. Three phase induction motor starts running when it taken 440 AC supply from mains. The SCADA is only the animation process.

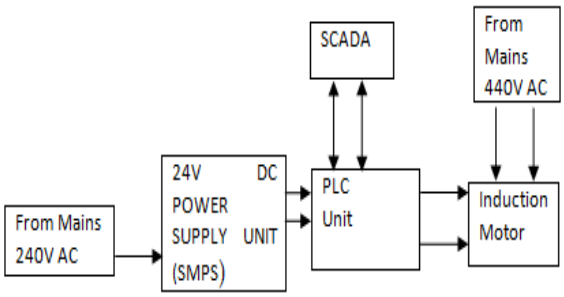


fig1): Block Diagram

IV. Three Phase Induction Motor

The device which converts electrical energy into a mechanical energy is known as electric motor. For AC operation, most widely used motor is three phase induction motor as this type of motor does not require any starting device or we can say they are self starting induction motors. For understanding, the principle of three phase induction motor, the essential constructional feature of this motor must be known to us. It has two major parts:

- *Stator*: Stator of induction motor is made up of numbers of slots to construct a 3-phase winding circuit which is connected to 3 phase AC source. The winding of motor is arranged in such a manner in the slots that they produce a rotating magnetic field after 3Ph. AC supply is given to them.
- *Rotor***:** Rotor of three phase induction motor consists of cylindrical laminated core with parallel slots that can carry conductors. Conductors are of heavy copper or aluminum bars which fit in each slot & they are short-circuited by the end rings. The slots are not parallel to the axis of the shaft but are slotted a little skewed because this arrangement reduces magnetic humming noise & can avoid stalling of the motor.[2]

V. Hardware Design

*(a). Contactor***:**When a relay is used to switch a large amount of electrical power through its contacts, it is designated by a special contactor.Contactors typically have multiple contacts, and those contacts are usually (but not always) normally-open, so that power to the load is shut off when the coil is de-energized. Contactor is an electrically-controlled switch used for switching an electrical power circuit. A contactor is typically controlled by a circuit, which has a much lower power level than the switched circuit, such as a 24-volt coil electromagnet controlling a 230-volt motor switch. fig.(2)

*(b). Relay***:**A relay is an electromagnetic switch operated by a relatively small electric current that can turn on or off a much larger electric current. The heart of a relay is an electromagnet (a coil of wire that becomes a temporary magnet when electricity flows through it.fig.(2)

(c).Single Line Diagram:

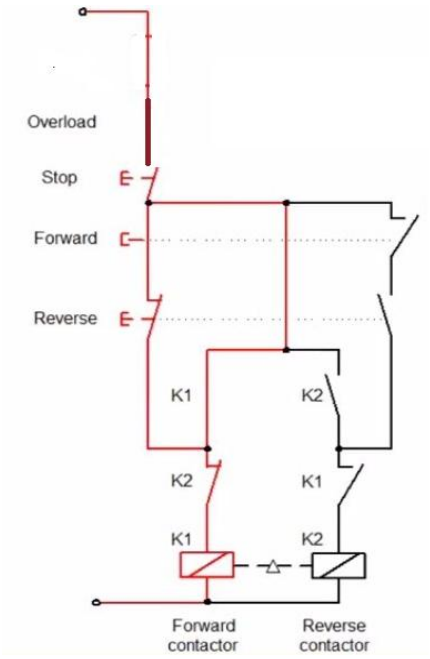
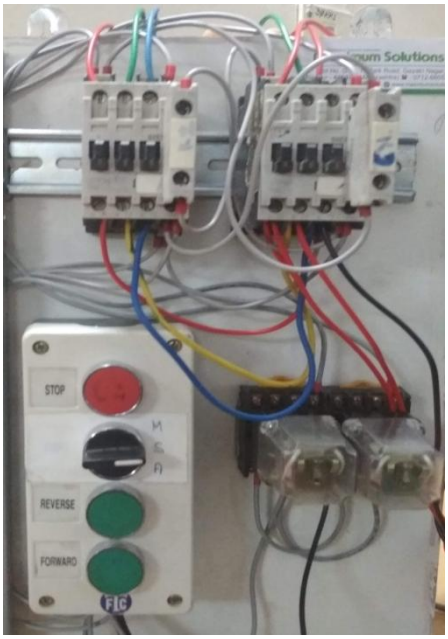


Fig.(2). Single Line Diagram



(d). Power Diagram:

The power diagram represents the basic connection of motor .fig.(3)

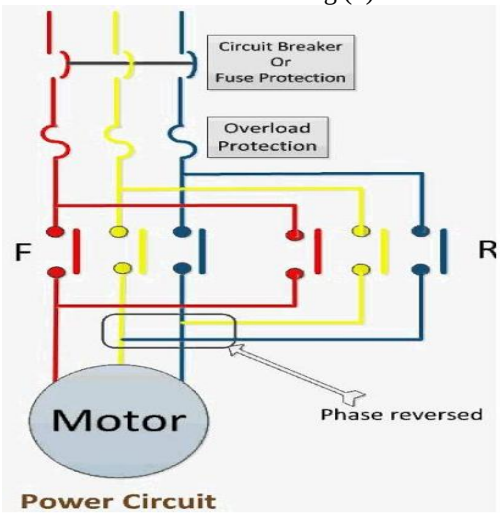


Fig.(3) Circuit Diagram of Motor

(E)Ladder Diagram:

The ladder diagram language is a symbolic instruction set that is used to create PLC programs. The ladder instruction symbols can be formatted to obtain the desired control logic, which is then entered into memory ladder diagram shown in fig(4).

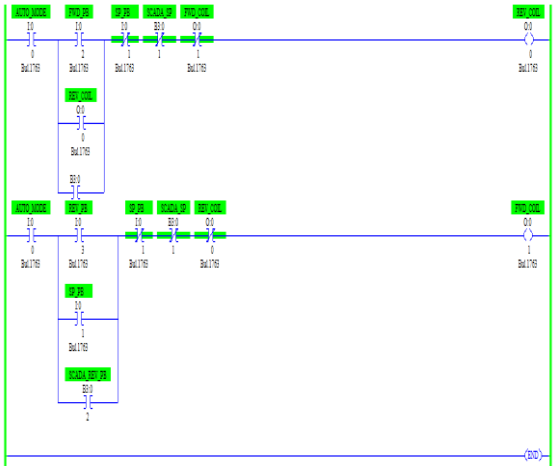


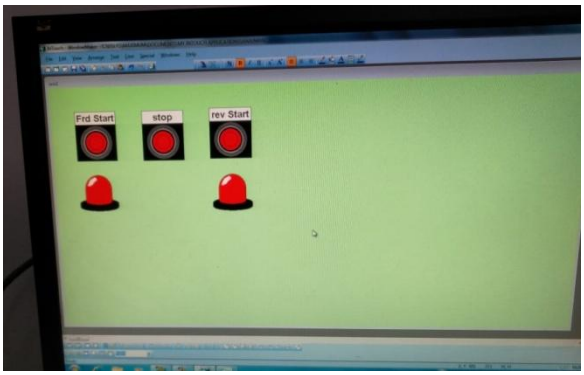
Fig.(4) Ladder Diagram

VI. Objectives

To reduce the type of work changes manually. In future the direction control becomes very simple and it is useful for various applications. The main advantage of PLC is to do the work automatically and complete the work and reduce the damage that occur for motor.

VII. Working Of The System

Through this project, the induction motor will start running in forward direction at rated speed when we press the start button on SCADA screen. The motor direction can be changed by forward and reverse button on screen as shown in fig.(5)



Fig(5) SCADA Controlling Programm

VIII. Conclusion

In this paper the three phase induction motor direction is controlled by using PLC and SCADA. The motor is controlled with some automated system and becomes the work very easier. The man power is reduced and it

So if direction of three phase induction motor can be controlled then whenever there is a use of three phase induction motor its direction can be controlled. Therefore the control method discussed in this project can be applied to everywhere, where three phase induction motor is used.

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