PLC and Sensor Based Protection and Fault Detection of Induction Motor

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Abstract— Problems that arise with the working of an AC induction motor is common these days if left unmonitored. Here a protection system is implemented using which we monitor the working of an AC induction motor during normal conditions and trip conditions. If any problems become evident due to faults that normally happen in the motor like stator faults, rotor faults, bearing faults, eccentricity faults etc., we can either vary the input voltage and current to bring the motor back to normal condition or we can shut down the motor before damaging the stator and rotor components of the motor to point from which recovery is not possible, thus avoiding unexpected failure of the motor and preventing an entire industrial from shutting down all of a sudden which can be dangerous to the people working in the vicinity and helps save unforeseen expenditure that may result from the above mentioned problems.

Keywords: PLC, Induction Motor, Voltage Transformers (VT)

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. Then again, requisitions in unsafe areas incorporate petrochemical and common gas plants, while serious environment provisions for induction motors incorporate grain lifts, shredders, and gear for coal plants. Moreover, actuation engines are very dependable, oblige low support, and have moderately high proficiency. In addition, the extensive range of power of induction motors, which is from many watts to megawatts, fulfils the creation needs of most mechanical methodologies.

The motor faults are because of mechanical and electrical hassles. Mechanical stresses are brought on by overload and sudden load changes, which can generate bearing faults and rotor bar breakage. Then again, electrical faults are typically connected with the power supply. Induction motors could be energized from consistent frequency sinusoidal power supplies or from adjustable speed AC drives. Be that as it may, induction motors are more susceptible to fault when supplied by AC drives. This is because of the extra voltage stress on the stator windings, the high frequency stator current components, and the induced bearing currents, initiated by AC drives

All the faults that occur in an AC induction motor have been analysed. The faults that are likely to happen are rotor faults, stator faults, eccentricity faults, bearing faults, load faults. Advanced Signal Processing techniques have been used to detect the faults. Stator current spectral signature analysis is mostly used to identify the faults, this method used power spectrum of the stator current. Physical parameters like vibration, noise, torque and temperature are measured using sensors, all these parameters are vital in checking the proper working of the motor. PLC is used for protection of induction motor as it can monitor more than one parameter simultaneously.

II. OBJECTIVE

The objectives of the research are outlined as follows:

1) Reduction in supply recovering time.
2) Reduction in fault finding time.
3) Proper working and protection of three phase induction motor
4) If the fault occurs in the system then it display on the indicator
5) Maintain the supply voltage automatically during the Auto reset of the motor.
6) Development of varying voltage level after auto reset.

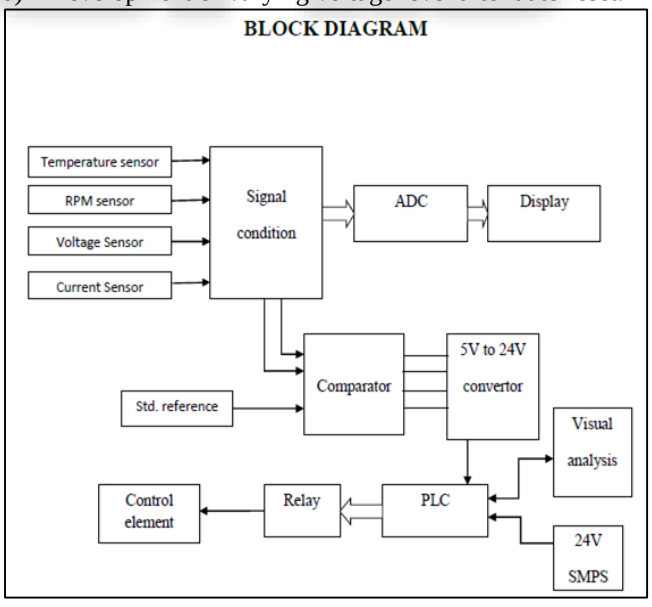

Fig. 1: Block Diagram of PLC and Sensor Based Fault Detection and Protection Technique of I.M

III. PLC BASED FAULT DETECTION AND PROTECTION TECHNIQUE

Programmable logic controller (PLC) is widely used in industry mainly for automation as well as to improve

production rate, quality of product, flexibility to change logic to switch over to different type, reduction in error, reducing breakdown time. The normal function of PLC is to control logical condition as per the program written in it. Related to process condition the various condition of analog and digital deals with logic program. In logic the condition related to motor parameter variations and its nature are not included. Most of a time breakdown occurs with motor and mechanism related to it. It is possible to link the logic related to motor protection to ladder diagram so as to reduce unproductive time.

The possible detection methods to identify the motor faults by using PLC are listed as follows:

1) Voltage measurement –by PT
2) Current measurement –by CT
3) Speed measurement –proximity sensor
4) Temperature measurement –LM35

A. Voltage Measurement by PT

Voltage transformers (VT), also called potential transformers (PT), are a parallel connected type of instrument transformer. They are designed to present minimum load to the supply being measured and have an exact voltage ratio and phase relationship to enable exact secondary connected metering. The PT is ordinarily described by its voltage ratio from primary to secondary. A 230:5 PT will provide an output voltage of 5 volts when 230 volts are applied across its primary winding. Standard secondary voltage ratings are 120 volts and 70 volts, can be matched with standard. Hence, when supply voltage increases gradually the voltage across secondary will be high this is when the PLC will detect the fault and disconnect the motor from supply.

B. Current Measurement by CT

Current transformers (CT) are series connected type of instrument transformer. They are designed to present minimum load to the supply being calculated and have an exact current ratio and phase relationship to enable accurate secondary connected metering. Primary current ranges from 1A to 1,000A & secondary current range from 5mA, 10mA, 30mA, 100mA, and 0.33A. The perfect value of secondary current becomes less important ant i.e. one can choose 5mA/30mA secondary current instead of 100mA, 350mA etc. We have selected CT according to requirement of our project is 1A:10V (i.e. when primary current is 1Amp then voltage at secondary side is 10 volt). The resistance of secondary winding is 22Ω. Hence, when supply current increases gradually the current across secondary will be high this is when the PLC will detect the fault and disconnect the motor from supply.

C. Proximity Sensors

A proximity sensor is a sensor which detects the presence of nearby objects without any physical contact. A proximity sensor frequently emits an electromagnetic field or a beam of electromagnetic radiation, and looks for changes in the field or return signal. The object being sensed is frequently referred to the proximity sensors target. Different proximity sensor targets require different sensors.

For example, a capacitive or photoelectric sensor can be suitable for a plastic target; an inductive proximity sensor always requires a metal target.

IV. CONCLUSION

The results showed that a reliable PLC-based protection system including all variables of three phases IM"s and operators has been developed. The total length of the PLC software is about 500 lines. Therefore, PLC software developed is scanned at every 185 microns-sec. the detection of the possible faults was also achieved about 5000 times in a second through the related sensors. Thus it is expected that protection of motor can be more efficient and faster than other techniques such as classical technique because of use of electronic devices instead of mechanical equipment. This protection system can be applied to various ac motors just by adopting small modification in both hardware and software.

REFERENCES

[1] CQolak, BSc, MSc, MPhil, PhD, MemIEEE, R. Bayindir, BSc, MSc, PhD, MemIEEE, A. Bekta,, BSc, I. Sefa, BSc, MSc, PhD and G. Bal, BSc, MSc, PhD, MemIEEE, "Protection of Induction Motor Using PLC"
[2] WT. Thomson and M. Fenger "Current signature analysis to detect induction motor faults", IEEE Ind. Applicat. Mag., vol. 7, July/Aug. 2001. pp. 26-34.
[3] Siddique, GS. Yadava, B. Singh, "A review of stator fault monitoring techniques of IMs", IEEE Transactions on Energy Conversion, vol.20(1), 2005, pp. 106-114.
[4] Maria G. Ioannides, Senior Member, IEEE, "Design and Implementation of PLC-Based Monitoring Control System for IM".
[5] Ganapathy Subramanian III-BE, Department of EEE, IFET College of Engineering, Villupuram, "Fault Detection and Protection of Induction Motors Using Sensors".
[6] M.G. loannides, "Design and implementation of PLC-based monitoring control system for induction motor", IEEE Transactions on Energy Conversion, vol. 19 (3), Sept. 2004, pp. 469-476.

