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Fault Detection, Protection and Monitoring of Induction Motor Using Zigbee

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Abstract : Protection of an induction motor (IM) against possible problems, such as overvoltage, over current, overload, over temperature, and under voltage, occurring in the course of 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. Moreover, the voltages, the currents, the speed, and the temperature values of the motor, and the problems occurred in the system, are monitored and warning messages are shown on screen. Motor Current Signature Analysis (MCSA) is being the most widely used method to identify faults in Induction Motors.

Keywords: Induction motor (IM), Peripheral interface controller(PIC), Motor Current Signature Analysis (MCSA)

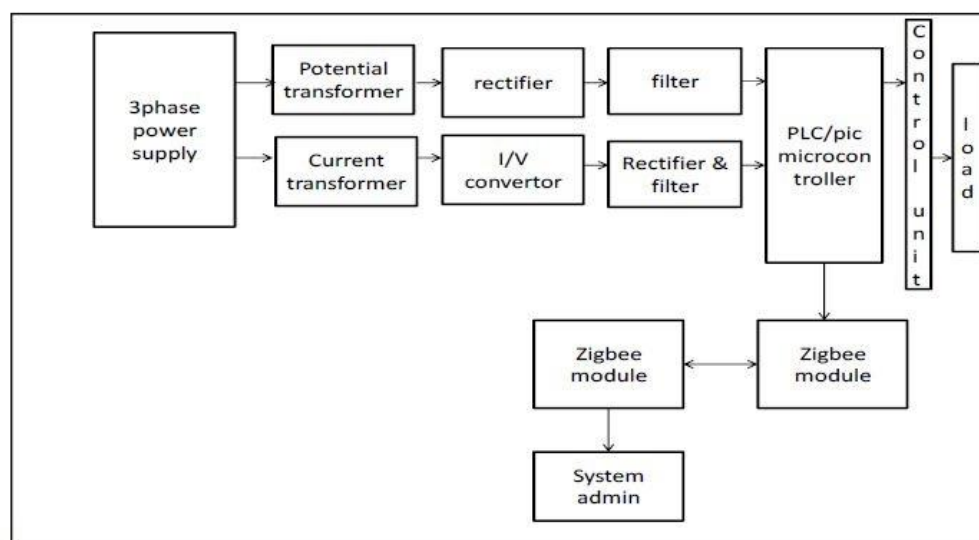
I. Introduction

The induction motors are most widely used motors in industrial, commercial and residential sectors because of enormous merits of these over other types of available electrical motors. The early detection of these deteriorating conditions in incipient phase and its remove correction is very necessary for the prevention of any external fault failure of induction motors reducing repair costs and motor outage time. Fault detection using analytical methods is not always possible because it requires a per feet knowledge of the motor model. The various types of faults have been considered. Three phase instantaneous voltages and currents are utilized in proposed approach. Simulated fault current and voltage data have been used for testing of trained network.

II. Block diagram

This project is mainly used to find and rectify the faults of three phase induction motor using PIC (peripheral interface controller) Microcontroller

Fig. 1: Block diagram of fault detection and protection of induction motor using zigbee



In this project able to find the following various types of external fault :

1. Overload
2. Single, two, three phase over voltage (19-39V)

3. Single, two, three phase under voltage (19-39UV)
4. Unequal single, two phase angle displacement (19-A)
5. Unequal two phase angles displacement (29-A)
6. Single, two phase open circuit <(19-29C)

In this project to find the stator and rotor faults, some methods are followed. After finding faults should give protection against that fault is very important. To control and measure each voltage, current value here used control unit and voltage & current measurement unit.

III. Induction Motor Tests

A. Experimental Setup and Simulink Model

The steady-state operating characteristics of a three-phase induction motor are often investigated using a per-phase equivalent circuit as shown in Fig. In this circuit, and represent stator resistance and leakage reactance, respectively; and denote the rotor resistance and leakage reactance referred to the stator, respectively.

B. No-Load Test

The no-load test on an induction motor is conducted to measure the rotational losses of the motor and to determine some of its equivalent circuit parameters. In this test, a rated, balanced ac voltage at a rated frequency is applied to the stator while it is running at no load, and input power, voltage, and phase currents are measured at the no-load condition. The input block (*terminal Tm*) is the mechanical torque at the machine's shaft. This torque is set to be zero to simulate the no-load condition. These measurements enable the approximate computation of the sum of the magnetizing reactance and the stator leakage reactance as follows.

$$|Z_{nl}| = \frac{V_\phi}{I_\phi} \approx X_1 + X_M \quad \text{or} \quad |Z_{nl}| = X_1 + X_M = \frac{Q_a}{I_\phi^2}$$

C. Blocked-Rotor Test

The blocked-rotor test on an induction motor is performed to determine some of its equivalent circuit parameters. In this test, the rotor of the induction motor is blocked, and a reduced voltage is applied to the stator terminals so that the rated current flows through the stator windings. The input power, voltage, and current are measured. For some design-class induction motors, this test is conducted under a test frequency, usually less than the normal operating frequency so as to evaluate the rotor resistance appropriately.

IV. Equivalent Circuit Parameters of Induction Motor Tested

The equivalent circuit under blocked-rotor condition, the following expression achieves the desired approximation

$$R_2 = (R_{br} - R_1) \left[\frac{X_2 + X_M}{X_M} \right]^2.$$

A. Comparison of Equivalent Circuit Parameters

To illustrate the effectiveness of the proposed simulation models, one compares the equivalent circuit parameters determined by simulations with those obtained from hardware experiments. The resulting parameters are presented in Table I.

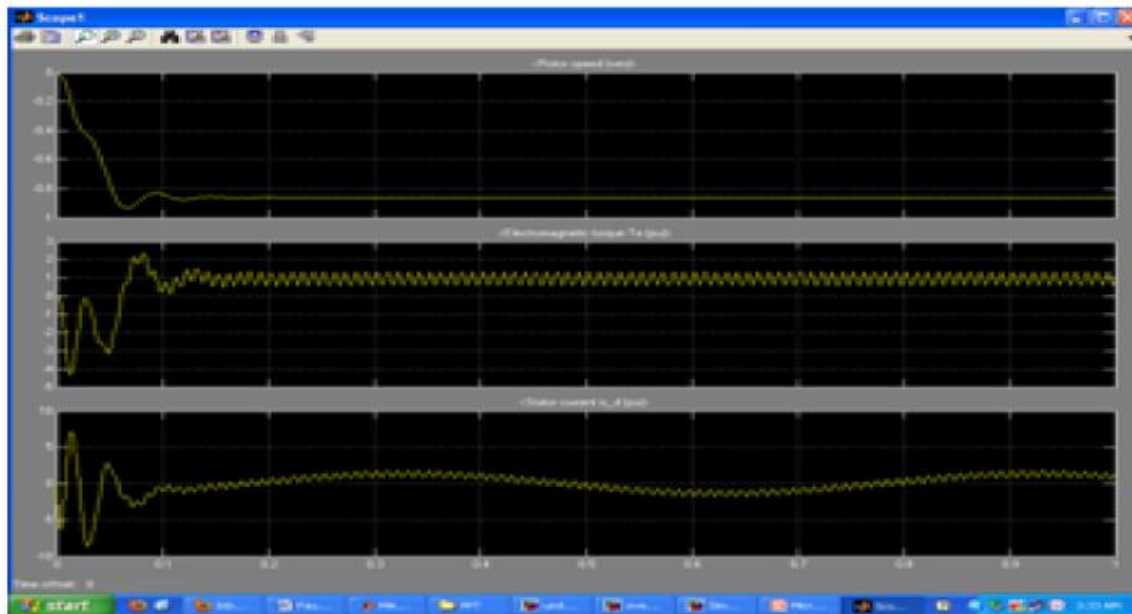
Table 1: Simulation results of the induction motor tests for motor

	I _a (A)	I _b (A)	I _c (A)	V _a (V)	P _a (W)	Q _a (VAR)	W _m (rad/s)
No-load test	9.220	9.231	9.226	121	34.8	1105	188.5
Blocked-Rotor test	15.74	15.74	15.72	26.59	212.58	360.50	0.00

V. Result and Analysis

Protection of an induction motor (IM) against possible problems, such as overvoltage, over current, overload, over temperature, and under voltage .Here we used Alarm and reset to stop the motor at any failure.

Fig. 3: Simulation results of motor



VI. Conclusion

The proposed PLC-controlled protective relay deals with the most important types of these failures, which are summarized as the phase lost, the over/undercurrent, the over/under voltage, the unbalance of supply voltages, the overload, the unbalance of phase currents, the ground fault, and the excessive repeated starting. If any fault is observed during operation of the motor, the motor is stopped. When an undefined fault occurs, the motor stops without giving any description. In this case, the fault can be described and found by the operator. The test has been found successful in detecting the faults and in recovering them.

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