

ARM based protection system for induction motor against faults

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Abstract-This paper deal with protection of an induction motor against faults like over voltage, under voltage, single phasing, voltage unbalance, over temperature. In this system 3 PT's are connected to each phase of induction motor. The electrical signal is acquired by the ARM LPC2148 and 10 bit digital equivalent values of these electrical and temp signals are compared with the reference values by the means of software. The 10bit digital equivalent parameters are send to COM port of PC When any fault is detected, the system activated relay and thus cuts the power supply to the induction motor. The corresponding faults are displaced on LCD display of ARM processor as well as the graphs plotted on console of a PC with the help of LABVIEW 2014 software. LABVIEW 2014 also stores a database file of the electrical signals along with graphs.

I. INTRODUCTION

Three phase induction motors are very popular in industrial applications because of their simple and safe structures. Towards the end of the 20th century, development in electronics and computer technology has started new progress in control technology. Electrical related faults are frequently occurring faults in three phase induction machine which will produce more heat on stator and rotor winding. To protect the machine from more heating due to these electrical faults, a reliable, low cost protection scheme for three phase induction motor is developed using ARM LPC 2148.

The faults come under electrical related faults are over voltage, under voltage, voltage unbalance, single phasing. Voltage and temperature. data are measured in fault detection system and this measured data is transferred to LPC 2148 and through COM port to PC. Hence we can monitor motor operating parameters through designed LABVIEW 2014 software.

If any fault is found in the system, it becomes necessary to detect and diagnose the fault. Soft computing techniques are more advanced in error detection and diagnosis problems than classical methods.

II. Electrical faults in induction motor

- 1) Unbalance voltage: Voltage unbalance of a three phase induction motor is expressed as a percentage value and defined as the maximum deviation from the average of the three phase voltages divided by the average of the three phase voltages.

$$\text{Unbalance (\%)} = \frac{(\text{Max deviation from avg value})}{(\text{Average voltage})} \times 100$$

- 2) Single phasing: It occurs when one of the three phase supply is open. Single phasing is worst case of voltage unbalance.

- 3) Under voltage: it occurs when phase voltage is greater than 110% of rated value.
- 4) Over temperature: Temperature rise is the change in temperature of the critical electrical parts within a motor when it is being operated at full speed.

$$\%(\text{Temp rise}) = 2 * (\text{voltage unbalance})^2$$

III. HARDWARE DESIGN

Fig 3. Shows the overall block diagram of the protection scheme. It consists of three parts

Part A: voltage and Temperature sensing module.

Part B: ARM LPC 2148 Module.

Part C: LABVIEW VISA 2014.

3phase supply

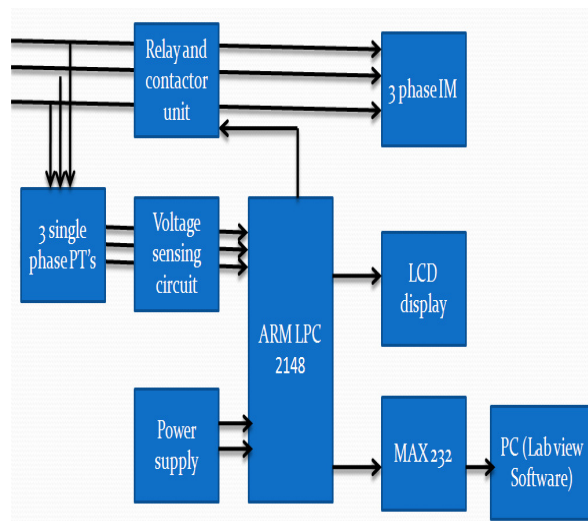


Figure 1-Block diagram of Motor protection scheme.

A. Voltage and temperature sensing module

In this module, three PTs are connected to each phase of IM. The low ac signal is taken from transformer secondary windings and converted into DC using precision rectifier.

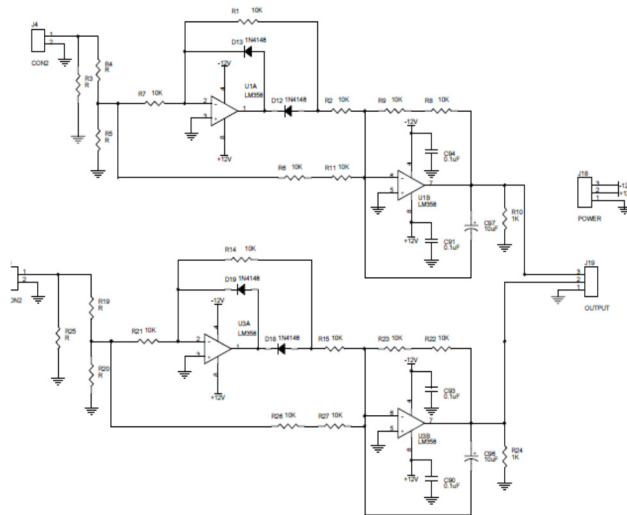


Figure 2-Dual Precision rectifier.

Figure 2 shows the standard dual full wave version of the precision rectifier. The tolerance of R1, 2, 3, 4 and 5 are critical for good performance, and all five resistors should be 1% or better. Note that the diodes are connected to obtain a positive rectified signal. The second stage inverts the signal polarity. To obtain improved high frequency response, the resistor values should be reduced. This circuit is sensitive to source impedance, so it is important to ensure that it is driven from low impedance

B.ARM LPC2148 Module.

The data gathered from voltage transformers and temperature sensor is transferred to the LPC2148 digitally using ADC unit. The arm processor continuously monitors the inputs signals VR, VY, VB and Temperature. The needed comparison is made in the ARM according to limit values which are previously entered. When an unexpected situation is encountered, trip signal send by the ARM to the relay and corresponding LED glow on relay circuit. The corresponding fault is displayed on LCD display as well as alerts the operator by glowing LED on relay circuit.

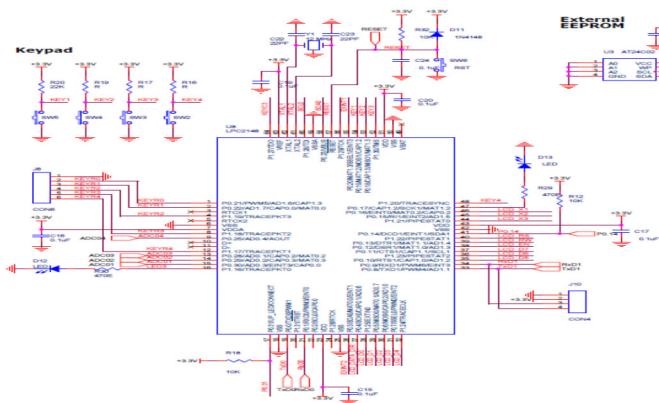


Figure 3 -Schematic of ARM LPC 2148

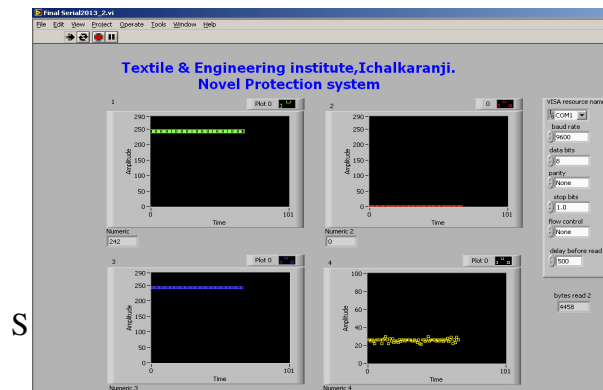


Figure 7-lab view output signals under single phasing fault.

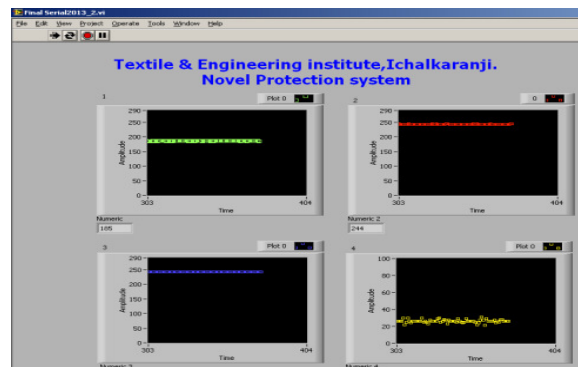


Figure 8-labview output signals under voltage unbalance fault

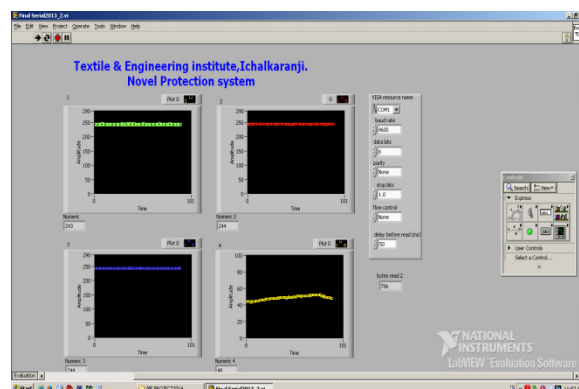


Figure 9-labview output signals under over temperature fault

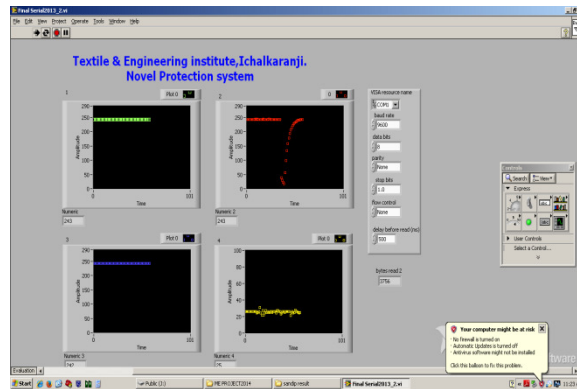


Figure 10-Labview output signals under under voltage fault

V.CONCLUSION

In this paper ARM based fault protection system is designed . The protection system detects the voltage unbalance, single phasing, over temperature, under /over voltage faults thus provide efficient protective scheme.

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