

Detection of Fault of Three Phase Induction Motor Using Arduino Uno R2 Microcontroller

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Abstract— The main concept of the project is to develop an induction motor protection system for protecting the motors from any damages occurring from single phasing, over current and over voltage. The induction motors are predominant in industrial applications. Thus this project helps to provide protection to the industrial motors if any of the phases misses out of the three phases, or if the voltage of the motor exceeds the threshold value. The proposed system uses three-phase power supply where in three single-phase transformers are connected to it. The system has a set of op-amps used as comparators for comparing input voltages. The motor is operated by switching the main relay, which is operated by other set of relays by sensing single phasing and over /under voltage, over/under current conditions. The project in feature can be enhanced by using current sensors for overload protection and phase-sequence sensor for protecting the motor from applying wrong phase sequence.

Keywords— *Three Phase Induction Motor Protect From Over/Under Voltage, Over/Under Current, Single Phasing Fault*

I. INTRODUCTION

A large number of motors are being used for general purposes in our surrounding from house- hold equipment to machine tools in industrial facilities. The electric motor is now a necessary and indispensable source of power in many industries. The function and performance required for these motor are wide-ranging. IM are the most widely used motor for appliances, induction control, and automation; hence they are roust, reliable and durable.

Three phase induction motor generally suffers from under voltage, over voltage, overheating, single phasing and phase reversal problems. Due to this electrical fault the winding of motor get heated which lead to insulation failure and thus reduce the life time of motor. When the three phase induction motor supply with higher voltage than is rated then induction motor starts overheated. When supply voltage is lower than rated then voltage drop across the resistance is higher than it protects the motor from this fault. When supply voltage is lower than voltage drop across the resistance is lower than specified value and motor fails to start. When supply is only one phase, this is single phasing problem and supply voltage fall the rated and once again motor fails to start. It is highly desired that 3 phase induction motor works freely from the seal types' of faults. This fault is generated in induction motor due to variation in induction motor parameters. When three phase induction motor runs continuously, it is necessary to protect the motor from these anticipated faults.

The protection of induction motor plays an important role in its long life service. Researchers have done costly and limited protection for the stator windings protections, broken rotor bars protection, thermal protection etc. Mainly the induction motor needs protection from the variation of the input supply for small motors which is in common use not only in big

industry but also in small scale industries. The small scale industries are not able to provide costly protection to the drives in use as it will increase their capital cost. Hence a cheap and compact design has been done for protection of induction motor against under voltage, over voltage, over current, under current. It has been also designed for critical loads which need to be run even under single phasing condition. Due to the poor power quality the damage of induction motors in small scale industries needs to be taken care of.

II. LITERATURE SURVEY

A. William H. Kersting [1]

William H. Kersting stated that three phase induction motor can continue to run when one phase of the supply gone out of service. This may be due to any fuse blowing or opening of protective device of the motor, at step-down transformer or at feeder end. At this condition the three-phase induction motor continue to run but the motor will heat up quickly and it should be protected by removing it from the service at the instant of single phasing. When phase opens at step down transformer or at feeder end, the stator and rotor losses increases to ten times and the shaft output power decreases to negligible. But if the single phasing occurs at motor terminals the losses increases twice as compare to steady state losses and the shaft power reduces to nearly 70%. To protect the motor all the terminal should be open.

B. Sutherland P. E. [2]

Sutherland P. E. and Short T.A. described that the for single phase fault the three phase reclosers are widely employed on distribution feeders. The majority faults are single phase. Its negative effect occurs on the other two phase customers, because the distribution line is mainly supplying the load to single phase customers. If three phase recloses did not open from the service, and the problem arises for three phase industry. On an average single phase fault occurs at 70%, two phase fault occurs at 20% and three phase fault occurrence is 10%.

C. Sudha M. and Abalagan [3]

Sudha M. and Abalagan proposed a technique to save the three phase induction motor from single phasing. In this technique, PIC16F877 microcontroller has been used to sample the values of each phase and converted them to low voltage ac by means of transformer. The signals are converted to digital value using ADC converter. The controller continuously compares the digital value with the reference value and when the fault occurs, it opens the normally close contactor and disconnects it from the power supply. Single phasing, under voltage and over voltage protection is done practically on a 2kW motor and the motor is isolated if any of these condition occurs.

D. Pragasen Pillay et.dal.[4]

Pragasen Pillay et.dal. Examines the three phase induction motor under the influence of under voltage and over voltage.

The voltage at motor terminals may be higher than the nominal value in a complex industrial system and can be well below from nominal value in a heavily loaded industrial system. IEEE, NEMA and other power communities have different defined the voltage unbalance. The complex algebra is avoided in these definitions.

III. METHODOLOGY

A. Block diagram and Working

The overall block diagram of the proposed motor protection system is shown in Figure 3.2.1. Arduino block stands for which is developed by Microchip Co.US. Since it adopts RISC (Reduced Instruction set Computing) as kernel structure, it behaves more excellent than the average 8-bit single chip. It is easy to learn and supports ICD (In Circuit Debug). Voltage

and current measuring circuit blocks stand for relative measuring circuits. The measured results are transmitted to corresponding pins of controller through interface circuit, which is designed to interface the measuring circuit and controller. Protecting circuit block represents the corresponding protecting circuit. Once needed, the controller will output an operating signal, the protecting devices act immediately and correctly to protect the motor, by operating the drive circuit. The setup consists of step-down transformer, current sensor, voltage sensing circuit and relay and contactor unit along with controller.

Initially, controller is programmed using development tool. The voltage sensing and current sensing circuits are used for monitoring line current and line voltage under running condition.

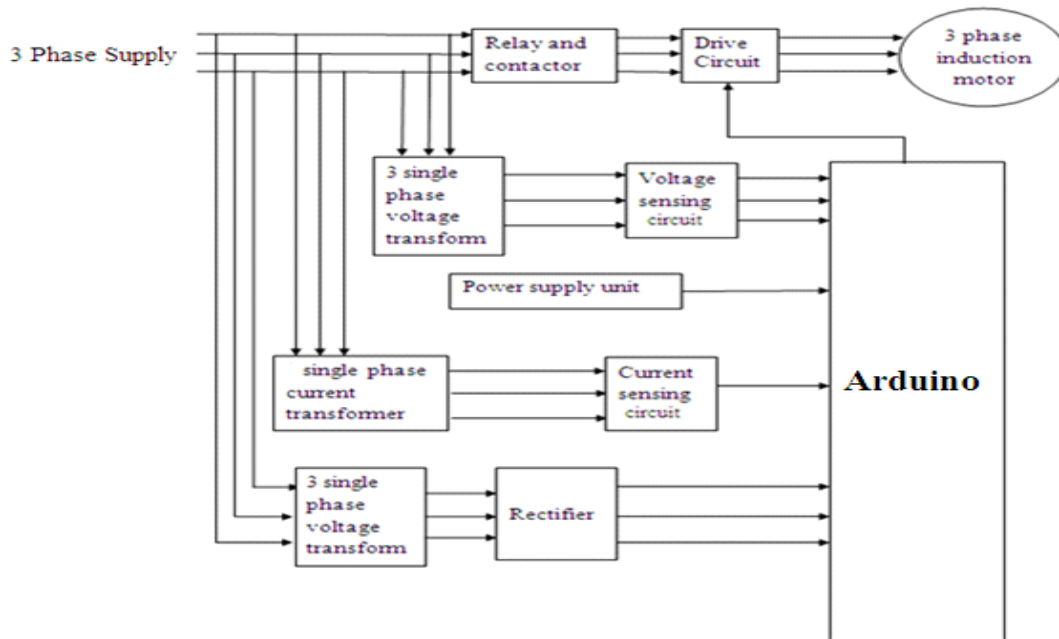


Figure 1:

The data gathered from voltage sensing and current sensing circuits are transferred to the controller digitally by passing through the current and voltage measuring circuits. The controller having in build analog to digital (ADC) converter. So, no need of external ADC unit. Normally controller A/D converter (ADC) is capable of processing input, which is less than 5V signal. So, sensors should be selected as per the controller design value.

The needed comparisons are made in controller according to limit values, which are previously entered or programmed. When an unexpected situation is encountered, the motor is being stopped by means of the control signal. The motor parameters like the full load current in amperes, service factor and class of motor, etc ,are needed to be entered into the relay programming unit to automatically calculate the correct motor protection curve. The following protective functions are provided by this system

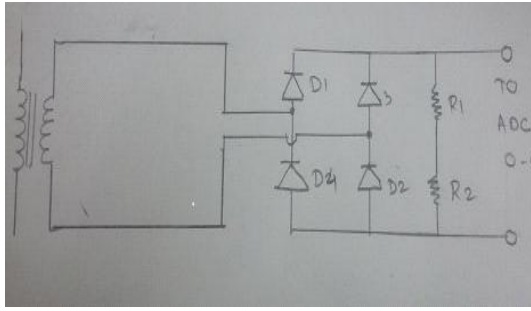
The Controller based motor protection system combines control, monitoring and protection function of induction motor from incipient faults in one assembly setup. The system provides over overload, single phasing, under and over voltage schemes. The controller of the system is implemented using controller. The input data (Limit values) to the system is given through the keypad. Display unit is used as an output device to display the output data and fault condition. The

system works with any motor design with high degree of accuracy. The method is very sensitive, fast and detects faults while running and before start. The prototype model is developed and tested on a three phase induction motor with rated current of 5A and the test results are satisfying the design criteria.

When the limits of the maximum allowable under voltage and over voltage are exceeded, controller generates trip signal, which in turn switch off the induction motor and display message as under voltage or over voltage fault and hence induction motor is protected from heavy over and under voltage condition. Similarly other faults are monitored and Induction motor is protected from those faults. The overall circuit diagrams of all faults are given below.

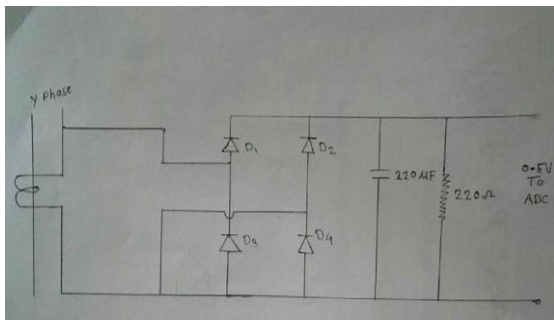
B. Voltage Sensing Circuit:

The voltage sensing circuit using voltage divider circuit is shown in Figure. The output from the step-down transformer is measured by this voltage sensing unit. The output range of voltage sensing unit is from 0 V to 5V. The three phase supply voltage is monitored by step-down transformer, whose output is sensed and measured by voltage sensing circuit as shown in Figure.



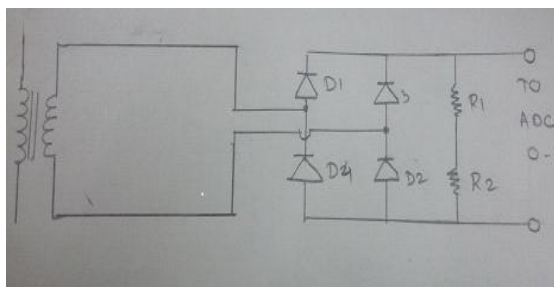
C. Current Sensing Circuit:

The current sensing circuit is shown in Figure. The output from the step-down transformer is measured by this current sensing unit. The output range of current sensing unit is from 0 V to 5V. The three phase supply voltage is monitored by step-down transformer, whose output is sensed and measured by current sensing circuit as shown in Figure



D. Single Phasing Circuit:

The single phasing circuit is shown in figure. This protection is provided to avoid the overheating of motor winding. If the condition of single phasing arises during the running of motor, the winding of motor gets heated due to the negative sequence current in the faulted phase. Two phases of three phase induction motor will get power supply in single phasing condition and they produce negative sequence current in the faulted phase because the internal connection of three phase motor are connected with each other.



Applications: In Industrial and in agriculture sector.

CONCLUSION

The dissertation is based on the protection of three phase induction motor under single phasing condition, over voltage, under voltage, overloading and it is implemented using controller, step down transformers, current transformers, sensing circuits and protective relays.

The system is very cheap as compared to present protective devices available. The protection system can protect three phase induction motor from under voltage, over voltage, overloading and single phasing.

By using sensing circuits we can sense voltage and current and these values given to controller. Controller will give the command to relay to ON-OFF the motor.

FUTURE SCOPE

1. Submersible motor pump protection system.
2. By using dry and auto switch we can protect submersible pump.
3. In this we can avoid the energy loss.

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