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A Novel Approach to Protection of Induction Motor by using Arduino

Megha M. Titarmare[1], Om R. Borikar[2], Nidhi S. Fukatkar[3], Sandeep K. Mude[4], Abhay M. Halmare[5]
Department of Electrical Engineering, Rashtrasant Tukadoji Maharaj Nagpur University

Abstract: ***Now a days, an important goal for the modern industries is to increase the productivity as well as decrease the production loss in order to stay economically competitive. For this purpose, a system for efficient fault management and also for the quick amendment of faults in the production line is necessary. The major roles of the fault detection and the fault diagnosis system for uninterrupted industrial processes is to make an effective indicator which is capable of identifying the fault status of a particular process and then afterwards taking an appropriate action in order to prevent the future failures and unfavourable accidents. Overloading is one of the major faults that occur in an electrical system, mostly within the industrial premises. Overloading, overvoltage, overcurrent causes harm to the electrical installations. These kind of faults are quite general to occur in industries and therefore, a proper protection scheme is needed. The most commonly used machines in any industry are induction motors. The very foremost step is to analyze the main reason behind the occurrence of the burning out of 3ph Induction Motor. There are various causes that can eventually lead to the failure of motor. Hence after multiple researches, it was studied that one of the most common cause of burning of 3ph induction motor inside the industrial premises was due to overloading. The concept of overloading is quite vast. In order to overcome this general problem of burn-out, an industry needs to install a protection scheme for the induction motor. The protection circuitry must contain of the indication at full load including the provision of tripping circuit at the occurrence of overloading.***

Keywords: Arduino, Induction Motor, Protection, Overloading, Indication

I. INTRODUCTION

The three phase Induction motors are the most commonly and widely used electrical drives. As an important part of the industrial operations and productions, the normal operation of three-phase induction motors plays a pivotal role in continuous production and economic benefits. For any motor, any potential failure that cannot be treated within the time may produce damage on it, resulting in downtime along with potentially huge economic losses. This can be prevented by using a adequate protection circuitry.

II. PROBLEM STATEMENT

Many industries that employ induction motor faces the problem of overloading. This causes motor to draw extra current than its rated current. This excessive current increases the temperature due increased power losses. Moreover this will also damage the insulation of winding. If this overload is for long period or if frequent overloading is occurring then it will reduce the machine life. The worst that could occur is that the winding of the motor will get burn. Hence a fast operating and reliable circuit for protection is necessary.

III. DESIGN OF EXPERIMENT

A. Block Diagram

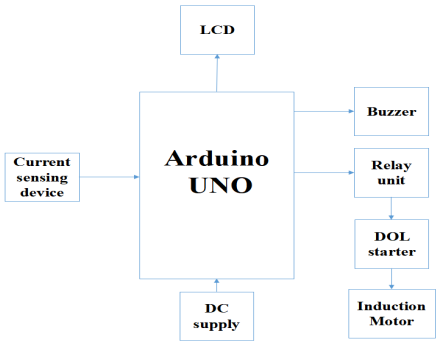

Fig. 1 Block Diagram of overload protection circuit using Arduino

B. Circuit Diagram

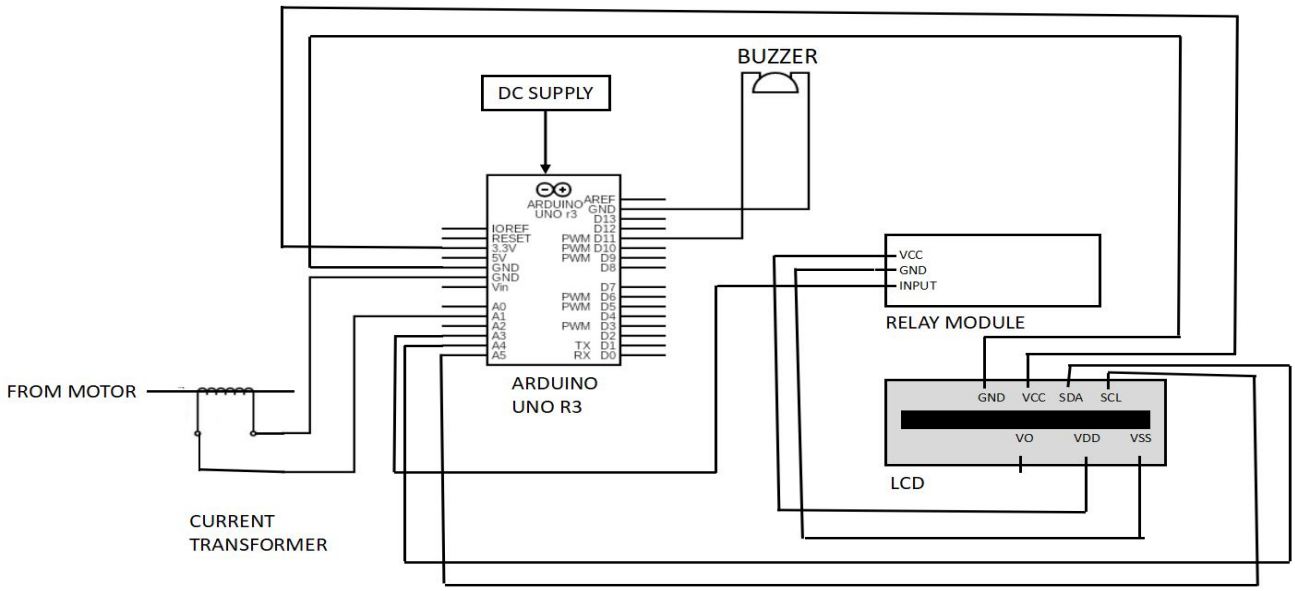

Fig. 1 Circuit Diagram of overload protection circuit using Arduino

C. Working

The Arduino board is powered by 5V DC adapter. The current sensing unit consists of current transformer in order to measure the current flowing in motor. As a current carrying conductor is passed through the secondary of CT, the CT secondary will give a proportional stepped down output as an input signal to analog pins of Arduino board. The Auduino Uno consists of an in-built microcontroller Atmega 328p which execute commands as well as make certain decision based on various inputs given to it. The microcontroller Atmega 328p will display parameters like current and power on LCD screen. There is a time delay of 12 seconds which will be displayed on LCD screen at the beginning. This time delay is programmed for those loads which draws high inrush current at starting. In this case, the protection circuitry is designed for induction motor which takes heavy current at starting (generally five to seven times rated full load current).

After completion of this delay, the microcontroller will continuously supervise the parameters and will display on LCD. The relay is set to send tripping signal at a predetermined value of current. As soon as, the current reaches the predetermined value, say 90% of full load current, relay will execute an alarm signal. The buzzer will give an alarm. With further increase in load, current drawn by motor will also increase. When the load will reach to its full load capacity, it will draw full load current, simultaneously the relay will sense it and will generate a tripping signal. The power to the motor is cut off and hence the equipment is under safety.

D. Observation Table

TABLE I

VARIATION OF CURRENT W.R.T. CHANGE IN LOAD

Sr. No.	Current (in Amp)	Load (in Kgs)
1.	2.81 A	00 Kgs
2.	2.82 A	02 Kgs
3.	3.20 A	09 Kgs
4.	3.90 A	13.5 Kgs
5.	4.35 A	14 Kgs
6.	4.63 A	15 Kgs
7.	5.04 A	18 gs

IV. RESULT

The experiment were conducted using 3 H.P., 50 Hz, 415 Volts, 1420 RPM three phase induction motor whose full load capacity in terms of current is 4.9 A. The buzzer gives beep alarm when the current crosses the ninety percent of its full load current which is 4.49 A. Further, if the motor is operated at its full load taking current of 5 A or above (overloaded), then relay sends tripping signal and hence, motor shuts down and gets protected. The graph showing relation between the load imposed on motor and the current drawn by motor is formed below based on the observations.

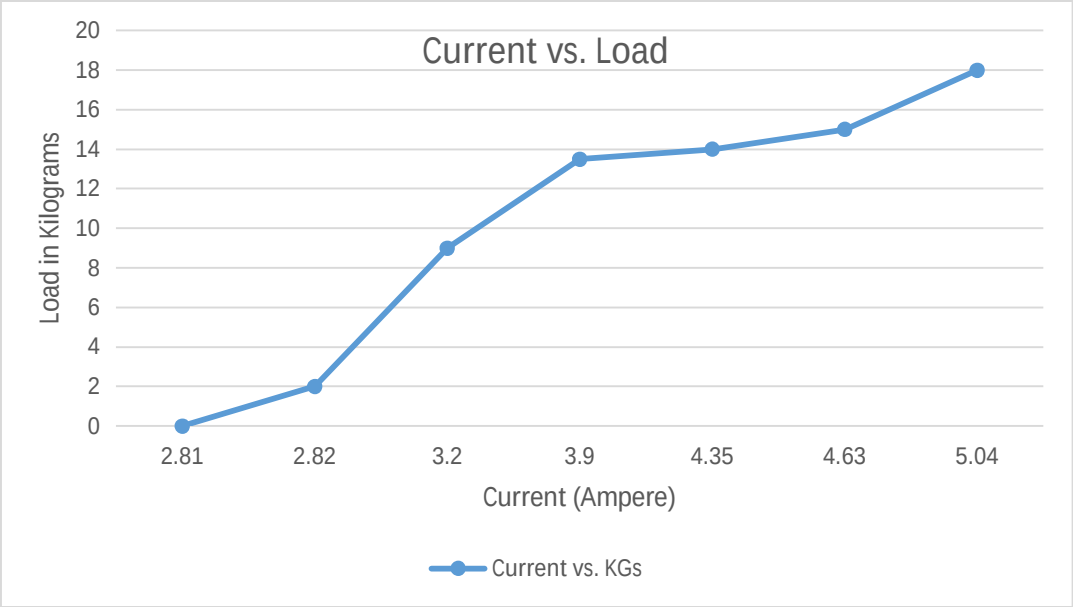

Fig. 3 Relation between load current in amperes and load in kgs.

V. CONCLUSIONS

Induction motors are incorporated in various residential, commercial as well as industrial applications. In case of industrial applications, the failure of induction motor causes huge losses. Hence its protection is a matter of concern. Previously the induction motor was protected using conventional protective devices which generally include mechanical dynamic parts. The paper covers the protection of induction motor by using a modernize method. It satisfies the aim of achieving indication as well as tripping circuitry to safeguard the motor with the help of Arduino.

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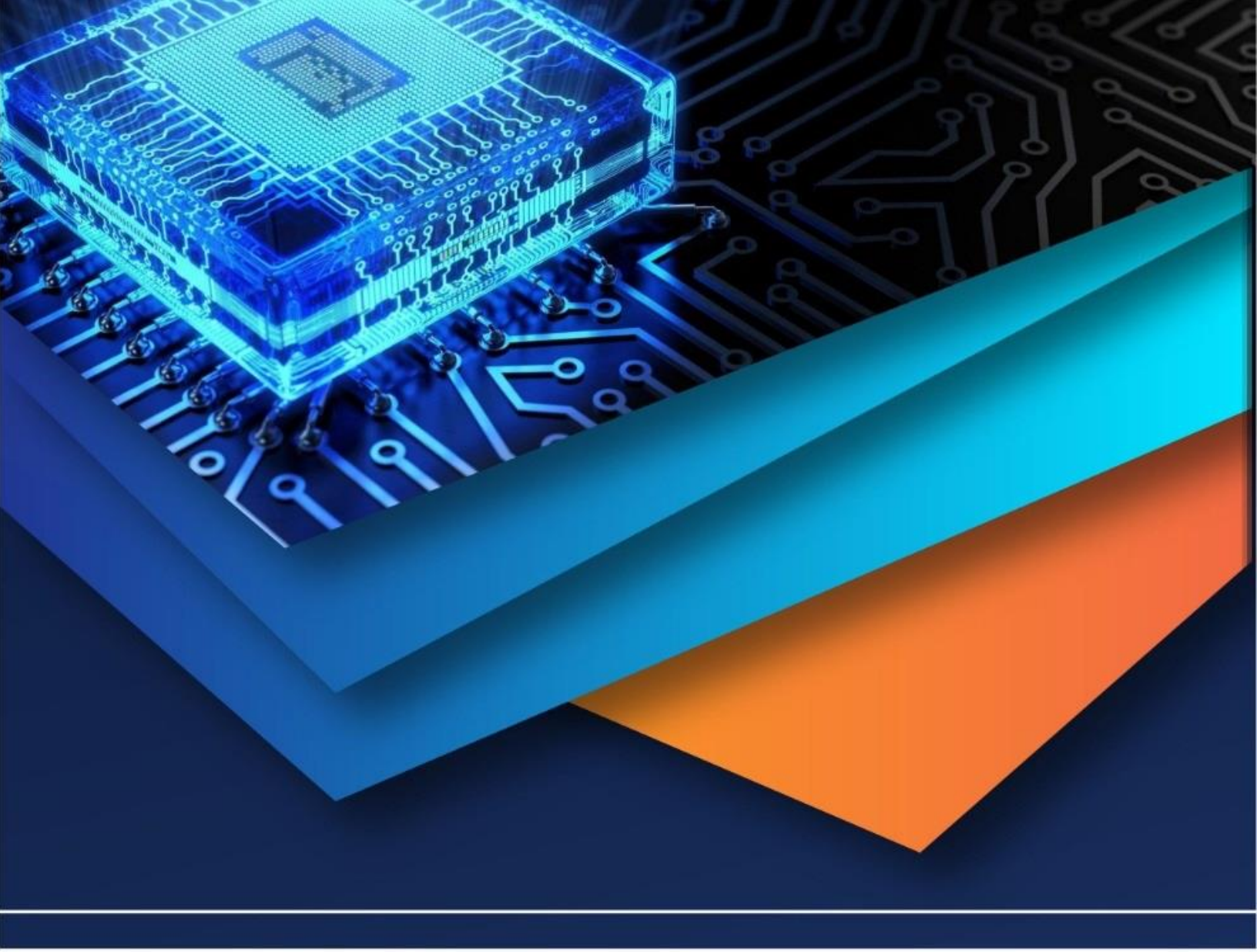

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