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Elimination of Interruption in Operation of Induction Motor from Overloading

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Abstract: Modern industries over a few decades primarily seek for enlarging their productivity and simultaneously minimizing the production loss. The foremost motive behind this approach is to stay economically well established and be recognized as one of the prominent industries among the competitive world. In order to attain this goal, a system for efficient fault management along with the thorough optimization of faults in the production line is necessary. The major purpose of this is to have an uninterrupted industrial process by designing such an effective indicator, which would be capable of identifying the fault status during a particular process and thereby taking an appropriate action in order to prevent system failures and avoid unfavorable accidents.

***Index Terms* - Induction Motor, Overloading, DOL Starter, Arduino UNO, Hooter, 16x2 LCD.**

I. INTRODUCTION

The reasons behind the failure of any machine could be many, like mechanical defect, electrical overloading, poor power factor, improper earthing etc. Thus, to identify the cause, the surveyor should go through interpretation of the faults in mechanical as well as electrical means.[1] The faults in mechanical though can cause a great impact on electrical system to cause malfunction. Not only mechanical but also environmental impacts have a role to discuss for the faults occurrence in any industry. The industrial premises hence must be surveyed in order to analyze about what modifications are required to provide adequate solutions. Burning out of Induction motor, interruption in operation, earthing, grounding, improper insulation, overloading, and voltage imbalance are few of the faults that generally occur in an industry. The electrical equipment and circuits installed in a power system must be protected in order to limit the damages caused due to sudden occurrence of faults such as abnormal currents and over voltages. All equipment installed in a power electrical system have standardized ratings for short-time withstand current and short duration power frequency voltage.[2] The role of the protection is to ensure that these withstand limits can never be exceeded, therefore clearing the faults as quick as possible

II. RESEARCH METHODOLY

One of the recurring complications that a 3ph Induction Motor experiences is the winding burnout. Out of many possible causes, motor overloading is a frequently occurring phenomena within the industrial premises where heavy loads are being dealt. The initial approach behind designing a model for the protection of motor is to know the protection requirements of that motor. The principle is to incorporate a direct acting trip device such as an overload relay what would be able to sustain the starting current of that motor.[3] Generally, the rated current is a little higher than the full load current. In order to acquire deep insights upon this protection model, a detailed information on the components and devices to be utilized was gathered. The foremost step to propose any model is to first illustrate the circuitry with the help of a connection diagram. The method to design the desired protection circuitry is by compiling an Arduino based program in C/C++ language, that would comprise of the setup, loop and break commands according to the functions given. Hence, a flowchart of the program has been made such that it would be able to distinguish between normal operating, threshold (90% of the rated current), and overload condition (exceeding the rated current value). Eventually, the proposed model proves out to be a preventive measure against burnout.

III. WORKING PRINCIPLE

A 3ph Induction motor works on the principle of Faraday's Law of Electromagnetic Induction; a phenomenon in which emf is induced across the electrical conductor, as long as it is placed in a rotating magnetic field.[4] The winding of motor could burnout due to a frequently occurring phenomenon called motor overloading. The protection model is designed in such a manner that it displays the initial values of current (starting current) of motor and the power drawn due to load when the supply is turned ON, with the provision of an alarm indication at threshold condition and ultimately, the tripping at overload. These three operating conditions can be executed with the help of programming. The flowchart of program is as shown in fig.2. When supply to the motor is turned ON, this supply is to be fed through DOL starter (as motor comes under 10KW). One of the phases will be fed through CT, which will then stepdown the current and run the designed circuitry model. The starting high inrush current in transient stage will flow when motor (induction motor) will start.[5] Subsequently, the DOL starter will operate as the transient stage high inrush current takes place. This transient stage will likely last for the initial 2-3 minutes. Following this, when the motor works under normal load, the power along with the current drawn is displayed on the 16x2 LCD monitor, with the help of Arduino Uno. The

LCD would display the simultaneous values of parameters like current and power once it is uploaded with the Arduino based programming. The programming could be done in languages like C or CPP and can be uploaded at the Arduino Genuino based software. The machine would work uninterrupted during the normal operating condition, i.e., under the bearable capacity of motor. On gradually increasing external load on the motor, the subsequent rise in the values of 'I' and 'P' could be observed through the LCD screen. This indicates that the pressure due to the increase in load directly causes the load current to increase. By the time when load current reaches its threshold condition which means 90% of its rated current, the relay will detect and will provide a signal to the hooter (1018 decibels). This hooter buzzer gives an alarm indication to the operator, and LCD displaying the respective 'I' and 'P' values. This acts as a warning signal for the operator to either decrease the load or turn the supply off. Another possible condition could occur if the load is still being added, there will be a subsequent rise in the Amp value too. This rise in current (above 90%) will again be detected by the relay, which is connected to one of the phases of the motor by means of DOL starter. It is detected only when the relay has been set to a pre-set value; here at 90% of the rated capacity and beyond. When the load current reaches its max/overload value, a trip signal is actuated with simultaneous buzzer alarm. This would directly make the contactors of relay to open and hence motor will be safeguarded.

IV. CIRCUIT DIAGRAM

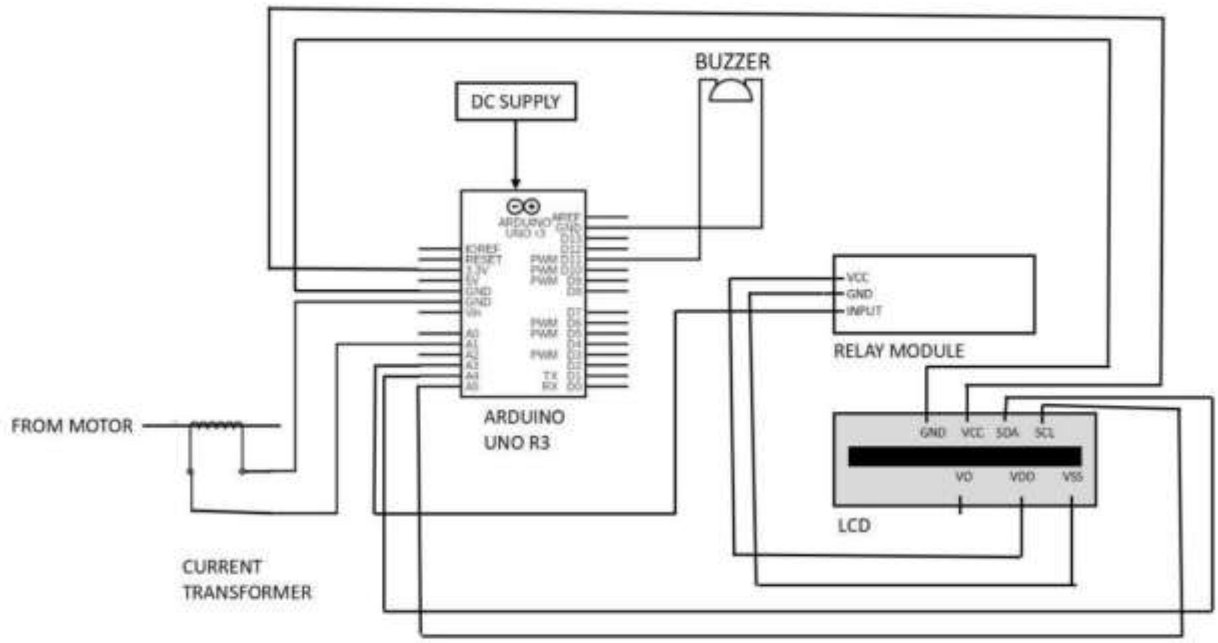

Figure 1: Connection Diagram of Model

V. ADVANTAGES OF THE PROPOSED PROTECTION MODEL

1. It is easily programmable, which means that the threshold value can be adjusted as per the requirement.
2. Frequent overloading causes overheating of induction motor which causes insulation failure resulting into burning of induction motor. As the circuit gives indication before the motor gets overloaded, the continuity of supply is maintained.
3. The cost of rewinding is saved.
4. The model is easy to operate and thus is user-friendly.
5. The designed model is very cost effective.
6. Does not consume much space.
7. The hooter is installed so as to ensure that the alarm indication reaches distance apart even if the operator isn't nearby.

VI. FLOW CHART OF THE PROGRAM

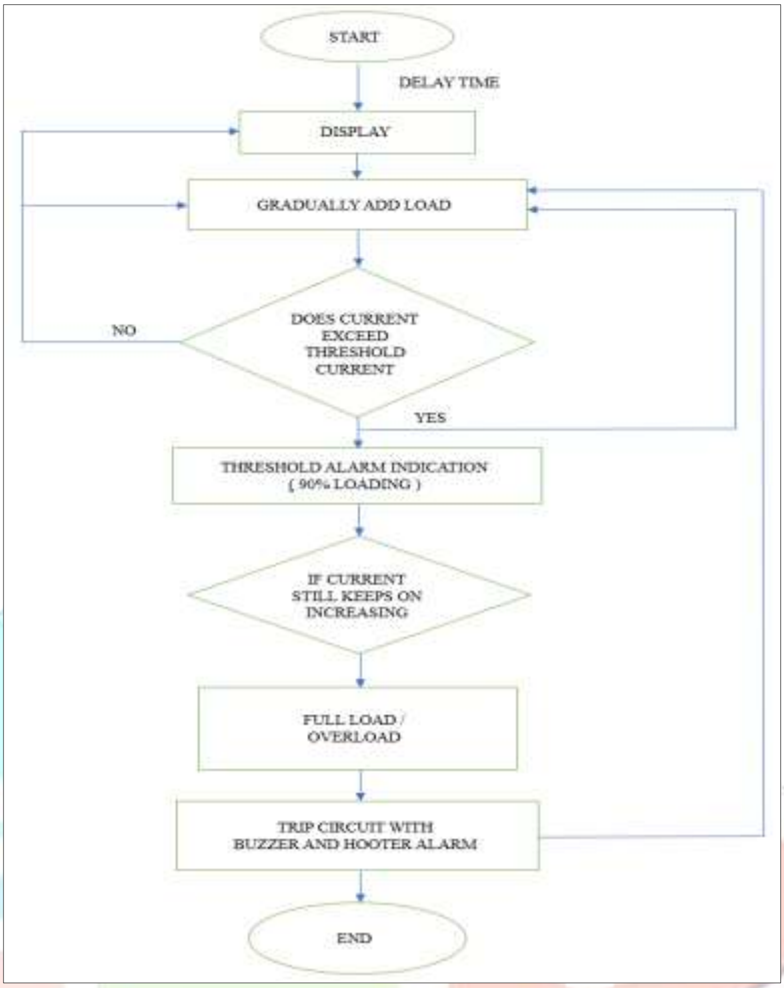

Figure 2: Flow Chart

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