Automatic Switching of Three Phase Induction Motor during Fault Condition

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Abstract - Three-Phase Induction Motor Automated Transition in Defective Conditions Maintaining the effective operation of three-phase induction motors is crucial in a variety of industrial contexts. However, malfunctions such as phase inconsistency, voltage drop, and overcurrent can seriously impair motor performance, leading to loss of operation and possible damage. This article introduces an automatic switching method designed to improve the fault-tolerance capacity of induction motors in order to address these issues. The system uses advanced fault detection algorithms to identify abnormal conditions quickly and enable a seamless transition to backup power or other configurations. It also incorporates preventive measures to guard against phase abnormalities and voltage variations that could harm the motor. a three-phase induction motor must be automatically switched on. A two-motor system a primary motor and a backup motor is shown in this study. If the primary motor fails, the backup motor is automatically turned on. Microcontroller design controls the entire switching process

Index Terms-Three phase Induction motor, Contactor, Microcontroller (ATMEGA328P).

I. INTRODUCTION

Industrial and agricultural activities both depend on the transfer of water, and induction motors are the most used technology for this purpose. These motors are used to supply a constant flow of water, which is essential for efficient and safe industrial processes. Any issue with the motor, whether it is operated manually or automatically, has the potential to obstruct the entire system and have an impact on the general operations of the consumer or the industry.

Innovative solutions are needed to solve this problem economically and successfully . Implementing a unique control algorithm to enable fault-free industrial operations even in the midst of a malfunction is one such idea. The purpose of this control method is to prevent process interruptions by guaranteeing the induction motor's continuous operation.

Furthermore, the control algorithm is expanded to guard against overheating, which can happen when an induction motor runs continuously. Temperature sensors can be used to track the motor's temperature and take appropriate action to keep it from overheating by integrating a microcontroller into the system.

Modern industry uses induction motors (IM) the most because of their affordability, durability, and low maintenance costs. A review of earlier research revealed that these IM consume between 40 and 50 percent of the energy produced in an industrialized nation . The majority of the production processes in a developed country were revolutionized by IM in the global economy. Even though induction motors are dependable, malfunctions can still happen. Since these malfunctions could seriously damage the motor, it's important to find them early on before they have an impact on the operation as a whole. As a result, unexpected malfunctions in the IM may have a significant impact on the related processes.

To sum up, the combination of a microcontroller technology and new control algorithm provides a workable way to guarantee uninterrupted effective industrial operation and induction motor performance . Industries can improve their safety protocols and production by protecting the motor from overheating and malfunctions . The most important issue under consideration in the most recent research period is the fault identification and control of 3-phase induction motors. The motor's operating status is continuously recorded, and when a overheating or fault occurs, the microcontroller (ATMEGA328P)is programmed to take effective mitigation measures, but this is not cost-effective for small-scale industries, which is a concern. However, it is clear from the literature review that a great deal of research has been done in the field of induction motor defect analysis, so that a better model must be presented in order to address this constraint issue in an efficient manner.

II. PROPOSED METHODOLOGY

The model is presented in Fig. 1,the proposed strategy have micro controller to detect the fault such as Over voltage ,Under voltage , Line voltage , Temperature and humidity.

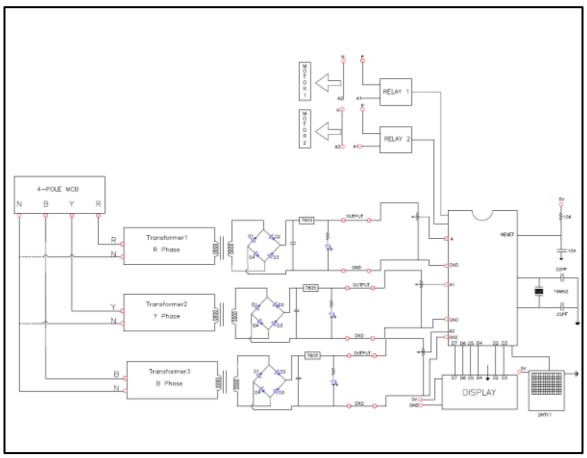

Fig.1.Circuit diagram of proposed Module

A. Three Phase Induction Motor

Three phase induction motor operates on the electromagnetic induction principle. When an electrical conductor is put in a rotating magnetic field, an effect known as electromagnetic induction occurs as the electromotive force induces around the conductor. The motor's main parts are the stator and rotor. The overlapping windings are carried by the stator, which is the fixed component. whereas the field or main winding is carried by the rotor. The stator's windings are constructed 120° apart from each other consistently.

Fig. 2. Induction Motor

If the primary motor fails, the backup motor is automatically turned on. Microcontroller design controls the entire switching process

B. MICRO-CONTROLLER (ATMEGA328)

ATMEGA stands for Advance technology for memory and logic. The ATMEGA328P is a single chip microcontroller created by Atmel in the mega AVR family. The ATMEGA328P is high performance low power controller from microchip.

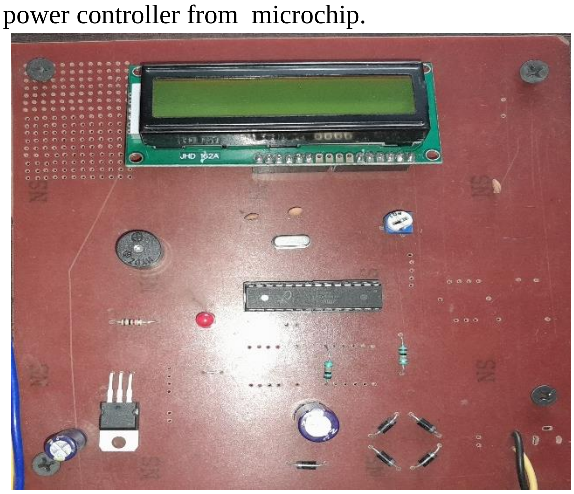

Fig. 3. Microcontroller PCB Board

ATMEGA328P is 8 bit microcontroller based on AVR RISC architecture. It is most popular of all AVR controller as it used in ARDUINO Boards. AVR is an automatic voltage regulator , an electronic device that maintain a constant voltage level to electric equipment on the same load. AVR regulates voltage variation to delivers constant, reliable, power supply.

C. CONTACTOR

An electromechanical tool called a contactor is used to create or break electrical circuits. Though built to withstand higher current and voltage levels, it resembles a Contactors are made up of an electromagnetic coil that, when turned on, draws a moving armature and generates a magnetic field. A set of contacts, either generally open or normally closed, are attached to the armature

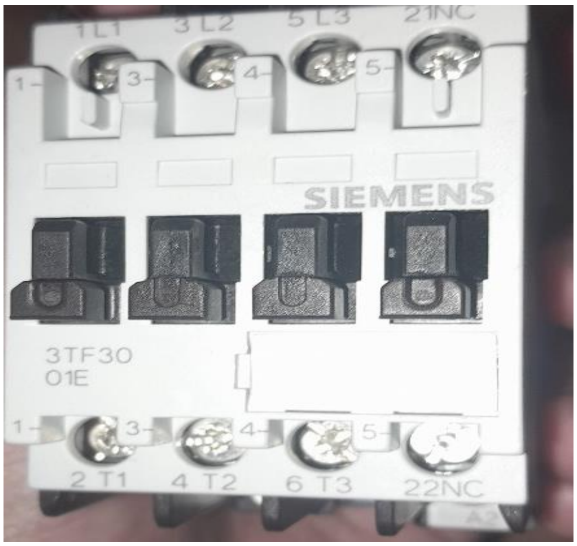

Fig. 4. Contactor

D. RECTIFIER UNIT

A rectifier circuit is designed to convert the AC to DC that is utilized for the powering of the controller circuit and sensor modules fixed in the system

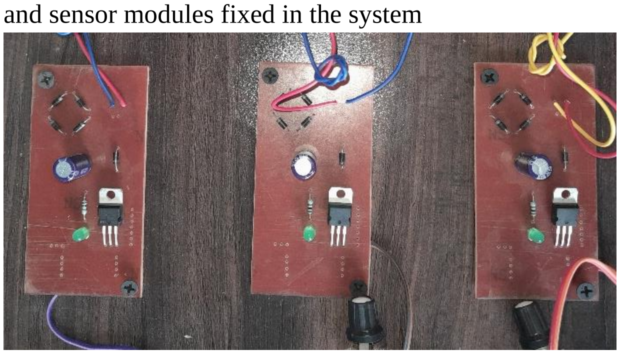

Fig. 5. Rectifier Unit

E. LED INDICATOR

LED indicators are illuminated components used to show the status if any fault occurs in the circuit and when motor get switched

Fig. 6. Indicator

Table-1:LED Indication

Sr. No.	Working	Indication
1	M1	ON
2	M2	ON
3	M1	FAULT
4	M2	FAULT

III. RESULT AND DISCUSSION

The design that is being considered aims to achieve two goals: firstly, it will deliver continuous power, and secondly, it will have a auxiliary motor that is programmed with using microcontroller (ATMEGA328P) to take over in the event that the default motor fails. In addition, a switching algorithm between the motors is designed to control the temperature created in the motor by alternating the default and auxiliary motors function after reaching 45 C.

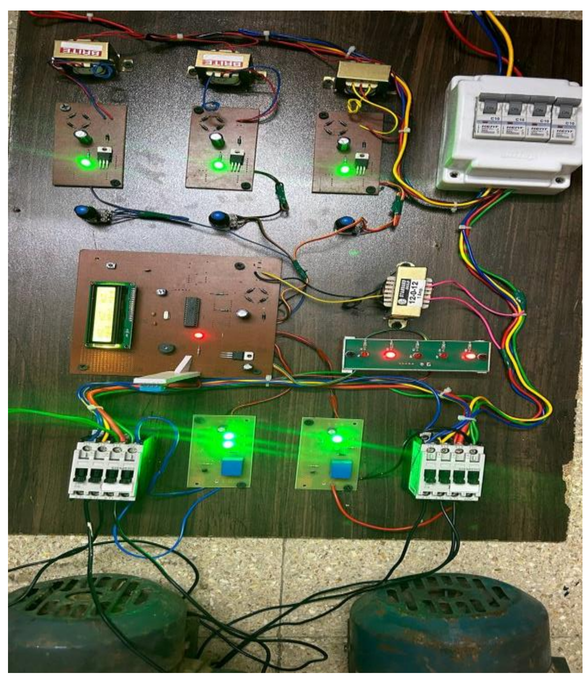

Fig. 7. Experimental Setup of the Proposed model

The Microcontroller is interfaced with the induction motor through R, Y, and B Phase line. Initially , the 230 V supply is stepped down with the help of Three 6-0-6 1Amp Step-Down Transformer of R, Y, and B phase line . Then stepped down voltages is then provided to Three rectifier unit . Rectifier unit with convert AC 230 V into DC Regulated 5 V. then is 5 volt then feed to microcontroller .

Microcontroller is programmed to display the lines voltage of 1) R, Y, B phase line 2)Over voltage fault 3)Under voltage fault 4) Temperature 5) Humidity

Fig. 8. Over Voltage Fault Detection

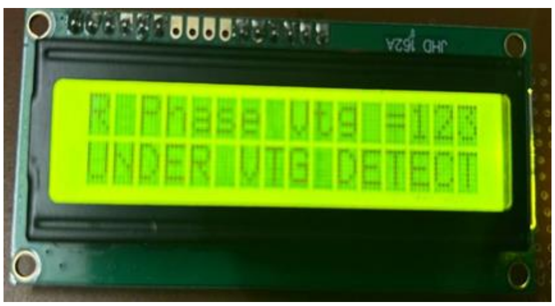

Fig. 9. Under Voltage Fault Detection

Fig. 10. Temperature Fault Detection

Table- 2 : Hardware Specification

Component	Ampere Rating	Voltage Rating
MCB	10000A	240/415V
4 Pole Contactor	9A	415V
Relay	230A	12V
Induction motor	1.1A,0.5HP	415V

CONCLUSION

In the areas of motor operating safety, efficiency, and dependability, the automatic switching mechanism designed for the three-phase induction motor under fault conditions has a number of important advantages. It has been proven via thorough testing and analysis that the system is capable of detecting the fault conditions, including under voltage and over voltage, and over heating guarantee continuous functioning and that it can quickly initiate the necessary switching actions to minimize any damage using microcontroller (ATMEGA328P). The proposed module is designed the application of intelligent control algorithms improves reactivity and the system's flexibility, allowing it to minimize downtime and maximize motor performance while responding quickly to dynamic fault scenarios.

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