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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. Through simulation and real-world testing, the suggested system's dependability and effectiveness are confirmed, highlighting its potential to guarantee continuous motor running in industrial applications, 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.
Keywords: Three phase Induction motor, Micro-controller (ATMEGA328P), Contactor

I. INTRODUCTION

Induction motors are crucial components of household and industrial appliances. They are employed in numerous industrial facilities, including mines, factories, ironworks, and refineries. The mentioned industrial plants must have exceptional reliability and cost savings.

The quantity of electrical motors grows yearly. An electrical motor that is often utilized is the induction motor. Induction motors are highly reliable and reasonably priced. They require little upkeep as well. Any malfunction of an electrical motor results in production loss.

An electrical motor may also permanently fail as result of it. Electrical motor operators can avoid unplanned breakdowns by utilizing early fault diagnosis systems.

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.

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.

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.

II. LITERATURE SURVEY

1) In paper “Automatic Switching of Three Phase Induction Motor during Fault Condition” written by Aswin. S, Jagadesh .P, Keerthi Aravind. S.P , Kesava Suriyan. P , Baranilingesan .I has stated that ‘The automatic switching of a three-phase induction motor was suggested in this study in order to offer continuous motor operating for industrial applications. Two motors are used to achieve this goal: a primary motor and a backup motor that is automatically turned on in the event that the primary motor fails. The Arduino controller design governs every step of the operation. Furthermore, the suggested controller design, which automatically alternates the primary and backup motor every 24 hours, effectively manages the rising motor temperature caused by prolonged operation of the motors. Through the use of GSM technique, the operator get automatic updates on the motor's operational status.’
2) In paper “Fault diagnosis of three-phase induction motor: A review” published by Malik Abadulrazzaq Alsaedi has mentioned that ‘ For diagnosing faults in induction motors remains a difficult problem. Research on motor current signature analysis is still ongoing. The vast majority of research was focused on induction machines, frequently with constant speed, as proven by the references that are given. Artificial intelligence systems are being designed with neural networks, genetic algorithms, and fuzzy logic. Although using digital signal processors to monitor and diagnose problems has shown noticeable advances, there is still much work to be done in the near future to cope with induction motors that have adjustable speed drives.’
3) In paper “Automatic Fault Detection And Protection In Three Phase Induction Motor” by Mr. Anil Tekale ,Mr. Amardeep Potdar, Prof. Swapna God Dr. Harikumar Naidu have stated that ‘ An induction or asynchronous motor is an AC electric motor in which the electric current in the rotor needed to produce torque is obtained by electromagnetic induction from the magnetic field of the stator winding. Various studies have shown that anywhere from 70%, to as high as 90%, of faults on most overhead lines are transient. Three-phase induction (asynchronous) motors are industrial work-horses, responsible for consumption of 40–50% of generated electrical power. There are different kinds of induction motor faults, broadly classified as rotor and stator faults. The source of such faults could be external and/or internal due to various electrical, environmental, mechanical reasons. A transient fault, such as an insulator flashover, is a fault which is cleared by the immediate tripping of one or more circuit breakers to isolate the fault, and which does not recur when the line is reenergized. Faults tend to be less transient (near the 80% range) at lower, distribution voltages and more transient (near the 90% range) at higher, sub transmission and transmission voltages. In the present paper, automatic fault detective analysis for protection of three phase induction motor has been investigated and experimental set up have been carried out for the required detective analysis by using PIC18F452 microcontroller and has also been shown in C Programming. The normal and abnormal conditions of voltage and current parameters for 3ϕ, 415V,1/2⁄ HP induction motor have been discussed based upon the performance of present investigation. It has been found that under short circuit and under/over voltage conditions, the current/voltage through the respective phases are differ from the normal operating conditions.’
4) In the paper “Fault Detection in Three Phase Induction Motor” written by A.Selvanayakam, W.Rajan Babu 2, S.K.Rajarathna discussed about ‘To avoid an induction motor failing entirely and incurring unforeseen manufacturing costs, induction motor problems can be identified early on. In light of this, this project offers 3 techniques for identifying induction motor problems. The first technique is a diagnostic approach for motor defects that finds issues such as inter-turn short circuits in broken stator rotor and bars windings, which aid in finding the air gap eccentricity and severity of the motor defect. 40 to 50 percent of all reported defects are of these categories. An induction motor's operational status is classified as either faulty or healthy using a motor fault monitoring method.’

III.PROPOSED SYSTEM DEVELOPMENT

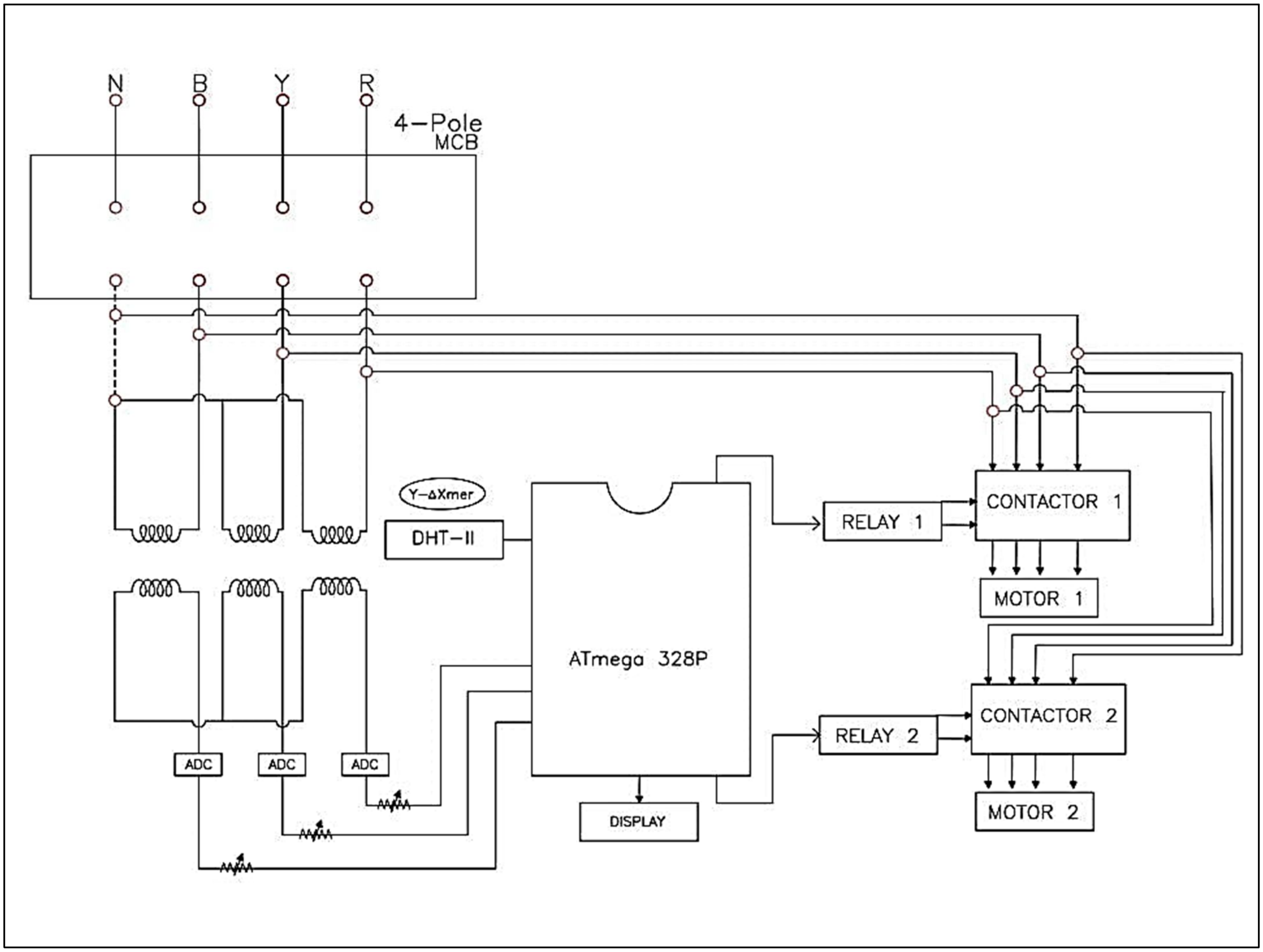

Fig. Block Diagram of Automatic Switching of Three Phase Induction Motor during Fault Condition

A. MCB

A 4-Pole MCB is primarily used in three-phase supply systems that have neutral connections. This arrangement makes it possible for an electricity supply to be more consistent and dependable, which guarantees that appliances and other electrical machinery run smoothly. Modern electrical installations require the 4-Pole MCB because it adds an extra degree of efficiency and protection. It is the perfect option for applications that need a dependable and stable power supply because of its distinctive design and functionality.

B. Step-Down Transformer

The Centre-Tapped Step Down Transformer. This general-purpose chassis mounting mains transformer features a 230V primary winding and centre-tapped secondary winding, making it perfect for a wide range of applications. The step down transformer is used, to get AC voltage at required level.

C. 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.

D. 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.

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.

E. Relay

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. An electrical device called a rectifier is used to change an alternating current (AC) source into a unidirectional DC supply

F. 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.

G. 3 Phase Induction Motor

3 Phase induction motor is commonly referred since it 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.

IV. CONCLUSION

In this paper, it is presented that the two-motor system a default motor and a helping motor is shown in this study. If the default motor fails then the default motor will automatically switch on the auxiliary motor. Microcontroller design controls the entire switching process to protect motor and hence protect motors from damage and hence motor can provide uninterrupted operation.

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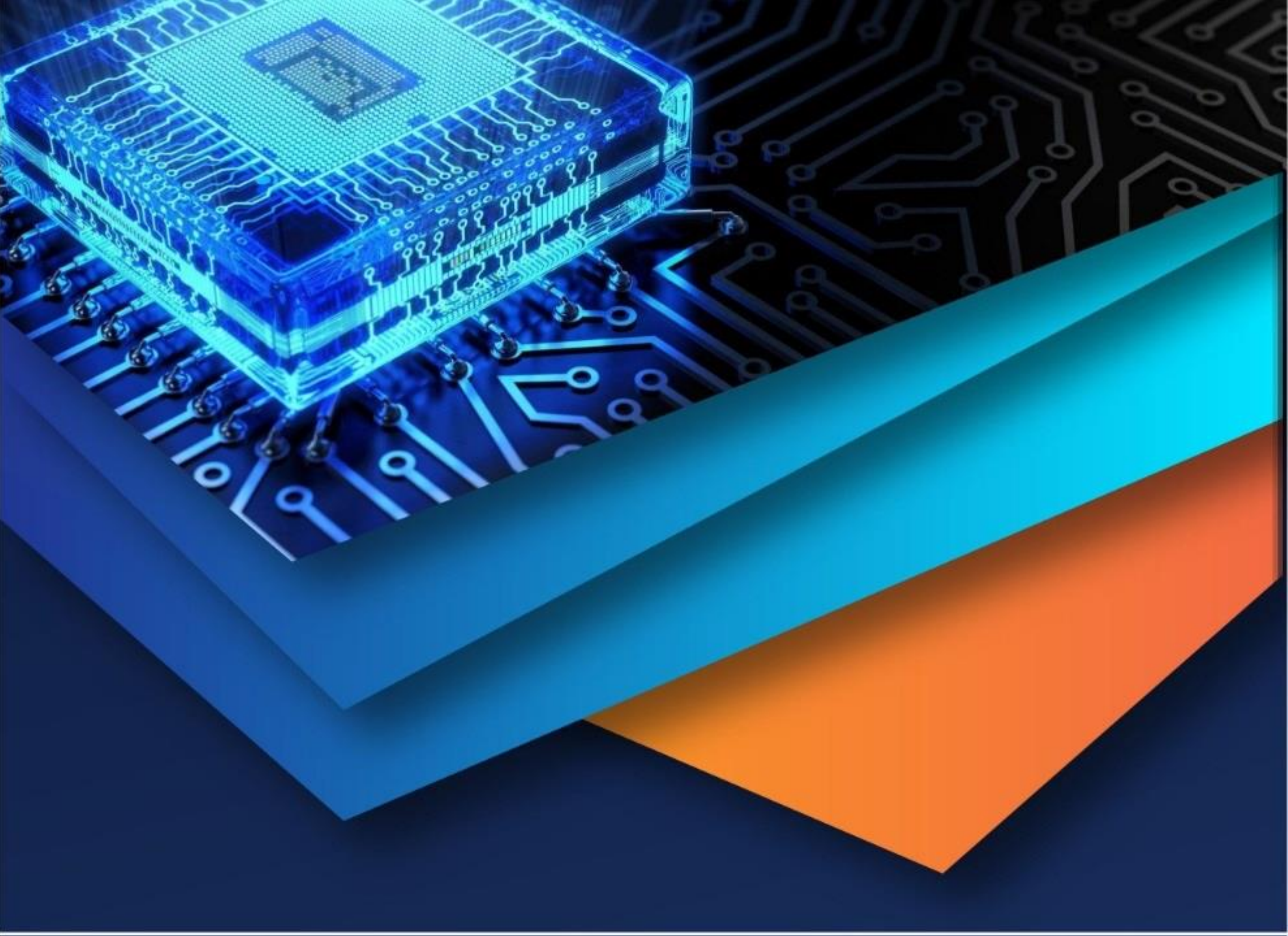

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