Smart Three-Phase Motor Protection System Using Single Phase Preventer, Voltage, Current and Temperature Monitoring

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Abstract—

Three-phase induction motors are widely used in industrial applications because of their reliability, efficiency, and simple construction. However, these motors are vulnerable to faults such as single phasing, over-voltage, under-voltage, over-current, and overheating. These faults can cause motor damage, production loss, increased maintenance cost, and reduced motor life. This project proposes a smart three-phase motor protection system that monitors voltage, current, and temperature. A single- phase preventer detects phase failure, and sensors send data to a microcontroller. When abnormal conditions occur, the system disconnects the motor supply and provides an alert indication, improving safety and reliability

Keywords: Three-phase induction motor, motor protection, single phasing protection, microcontroller, fault detection, voltage monitoring, temperature monitoring.

I. INTRODUCTION

Three-phase induction motors are widely used in industries because of their reliability, efficiency, and ability to operate under heavy load conditions. They are commonly used in pumps, compressors, conveyors, and other industrial machines. However, these

motors are sensitive to electrical and thermal faults that can affect their performance and reliability. One of the most common and dangerous faults is single phasing, which occurs when one of the three supply phases fails. This condition causes excessive current in the remaining phases and leads to overheating of motor windings, which can damage the motor if not detected in time.
Traditional protection devices such as fuses and thermal relays provide limited protection and do not offer real-time monitoring. Therefore, a smart protection system is required to detect faults quickly and take preventive action. This project proposes a compact and cost-effective solution to protect three-phase motors and increase their operational life.

II. PROBLEM STATEMENT

Three-phase induction motors are widely used in industries, but they are vulnerable to faults such as single phasing, voltage imbalance, overload, and overheating. These faults can damage motor windings, reduce efficiency, and lead to unexpected shutdowns. Motor failures also cause production downtime, increased maintenance costs, and energy losses.
Conventional protection devices like fuses and thermal relays provide only basic protection and may not detect faults immediately. Therefore, there is a need for a smart and reliable motor protection system that can continuously monitor motor parameters and automatically protect the motor from abnormal operating

conditions.

III. OBJECTIVES

The objectives of the proposed system are: 1] To protect three-phase motors from single phasing faults

2] To monitor voltage, current, and

temperature continuously

3] To automatically disconnect the motor during fault conditions

4] To increase motor life and reduce maintenance cost

5] To provide a smart and reliable motor protection system for industrial use.

IV. LITERATURE SURVEY

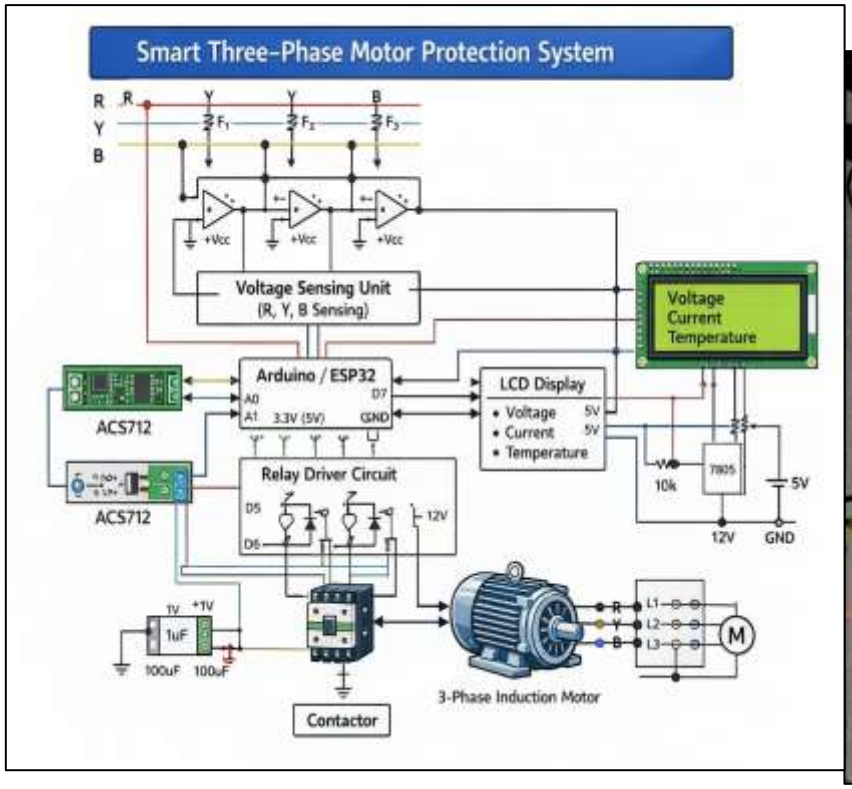
Many researchers have worked on protection systems for three-phase induction motors to improve safety and reliability.

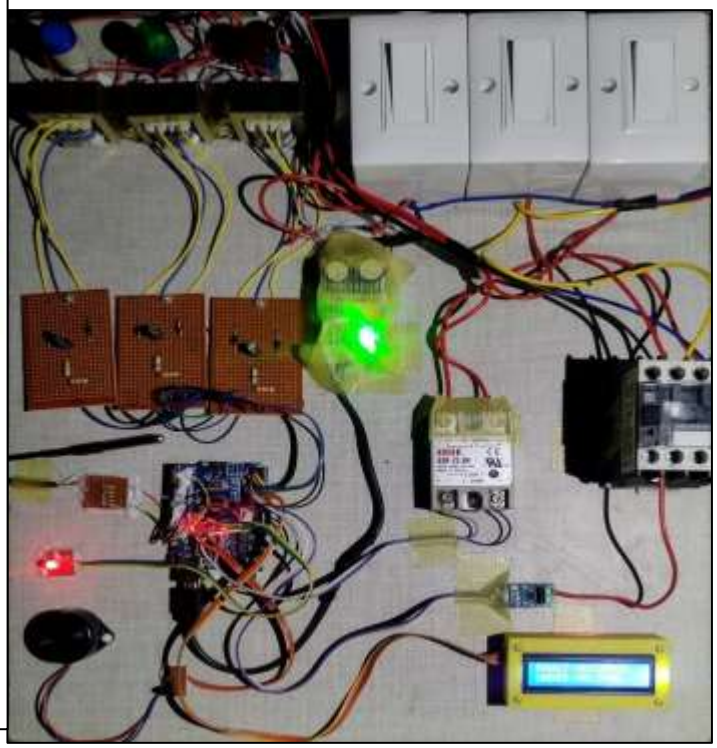
Traditional protection devices such as fuses, circuit breakers, and thermal relays provide basic protection but cannot detect faults like single phasing and overheating in real time. Recent studies focus on microcontroller- based protection systems that use sensors to monitor voltage, current, and temperature. These systems can detect abnormal conditions quickly and disconnect the motor

supply to prevent damage and improve motor life.

❖ **DIAGRAM**

BLOCK DIAGRAM OF SMART THREE PHASE MOTOR PROTECTION SYSTEM





V. SYSTEM DESIGN

The proposed system consists of voltage sensing, current sensing, control, and protection units. The voltage sensing unit monitors the R, Y, and B phases of the three-phase supply. Current sensors (ACS712) measure the motor current and send signals to the Arduino/ESP32 controller. The controller processes the voltage, current, and temperature data and displays the values on an LCD Display. If any abnormal condition such as overload, voltage imbalance, or overheating is detected, the relay driver circuit activates the contactor to disconnect the three-phase induction motor from the supply, protecting the motor from damage.

VI. WORKING PRINCIPLE

The three-phase supply is given to the motor and sensing circuits. Voltage sensors measure the R, Y, and B phase voltages, while the current sensor and temperature sensor measure motor current and motor temperature. All sensor signals are sent to the microcontroller, which compares them with preset safe limits. If any abnormal condition such as over/under voltage, overload, single phasing, or overheating occurs, the controller turns OFF the SSR, causing the contactor to disconnect the motor supply. The fault is displayed on the LCD and indicated using an LED and buzzer.

VII. ADVANTAGES AND APPLICATIONS

The system offers reliable protection for three-phase motors, reduced maintenance costs, improved safety, and increased motor life. It also provides continuous monitoring of voltage, current, and temperature with automatic disconnection during fault conditions. Applications include industrial motor protection, pumps, compressors, conveyors, manufacturing plants, and agricultural motor systems.

FUTURE SCOPE

The **Smart Three-Phase Motor Protection System** can be further enhanced by integrating advanced technologies for improved monitoring and control. In the future, IoT technology can be incorporated to enable remote monitoring of motor parameters such as voltage, current, and temperature through mobile applications or cloud platforms. This will allow operators to receive real-time alerts and monitor the motor from any location. Data logging and analysis features can also be added to store operational data, which can help in predictive maintenance and early fault diagnosis.

Additionally, advanced sensors can be integrated to improve the accuracy and reliability of fault detection. The system can also be expanded to support protection for multiple motors in large industrial environments, making it suitable for smart industrial automation and energy management systems.

VIII. RESULTS AND DISCUSSION

The **Smart Three-Phase Motor Protection System** successfully monitored voltage, current, and temperature of the motor. It detected fault conditions such as overload, voltage imbalance, single phasing, and overheating, and automatically disconnected the motor supply. The system provided reliable protection & improved motor safety.

IX. CONCLUSION

The **Smart Three-Phase Motor Protection System** was successfully designed and implemented to protect motors from faults such as overload, voltage imbalance, single phasing, and overheating. The system continuously monitors important parameters like voltage, current, and temperature, and automatically disconnects the motor during abnormal conditions. This helps reduce motor damage, improve safety, and increase the operational life of the motor.

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