Innovative Journal for Opportunities and Development in Science & Technology,
Volume 6, Issue 5, April 2026
Paper Id: – IJ2025V6I5 -6A-B
ISSN 2582-6026

MICROCONTROLLER BASED PROTECTION OF INDUCTION MOTOR AGAINST OVERHEATING AND SINGLE PHASING

[1]Samriddhi Ravindra Gandhale, [2]Shivani Sham Londhe, [3]Pavan Ashok Kshirsagar, [4]Waghmare Siddharth Santosh, [5]Prof. Shelar A

[1]UG Scholar, Electrical Dept. Vishwbharati Polytechnic College, Ahilyanagar,
[2]UG Scholar, Electrical Dept. Vishwbharati Polytechnic College, Ahilyanagar,
[3]UG Scholar, Electrical Dept. Vishwbharati Polytechnic College, Ahilyanagar,
[4]UG Scholar, Electrical Dept Vishwbharati Polytechnic College, Ahilyanagar,
[5]Asst. Prof. Electrical Dept. Vishwbharati Polytechnic College, Ahilyanagar,

ABSTRACT- An essential component of contemporary power systems is the electrical protection of induction motors. Industries make extensive use of induction motors, which are extremely susceptible to anomalous circumstances like single phasing and overheating. Severe damage, insulation failure, and a decrease in motor life are possible outcomes of these situations.
A microcontroller-based protective system is created to address these issues. Phase detecting circuits and an LM35 temperature sensor are used by the system to continually check the existence of all three phases and motor temperature. Real-time fault condition detection and input signal processing are handled by a PIC16F72 microcontroller.When any abnormal condition such as phase failure or high temperature is detected, the system automatically disconnects the motor using a relay. This improves system reliability, reduces maintenance cost, and increases the lifespan of the motor.

***Keywords* -** Microcontroller, Single Phasing, Overheating, Protection System, Phase Detection

I. INTRODUCTION

The design and implementation of a microcontroller-based protection system for an induction
This work presents a motor. Because of their straightforward design, dependability, and great efficiency, induction motors are frequently utilized in both home and commercial settings. Nevertheless, these motors are extremely vulnerable to anomalous circumstances like overheating and single phasing. Unbalanced current and excessive heating come from single phasing, which happens when one phase of the three-phase supply is lost. Overloading, inadequate ventilation, or variations in voltage can all lead to overheating.Damage to the insulation, decreased efficiency, and even total motor failure might result from these circumstances. Consequently, it's essential to create a reliable protection system. In this paper, a PIC16F72 microcontroller is used to monitor motor conditions continuously. The system uses phase sensing circuits to detect the availability of all three

phases and an LM35 temperature sensor to measure motor temperature. Based on these inputs, the microcontroller controls a relay to protect the motor during fault conditions.

I. OBJECTIVES

- To create an induction motor protection system
- To identify a single phasing condition
- To use an LM35 sensor to track the temperature of the motor
- To use a microcontroller to safeguard the motor
- To automatically cut off the motor when there is a problem.

II. SYSTEM OVERVIEW

The suggested method is made to continuously monitor and safeguard an induction motor from anomalous operating circumstances like overheating and single phasing. A phase detecting circuit, an LM35 temperature sensor, a PIC16F72 microcontroller, a relay unit, and a regulated power supply make up the majority of the system. The availability of the supply's three phases (R, Y, and B) is tracked by the phase detecting circuit. It continually determines if each phase is present or absent and sends the microcontroller the appropriate signals. The circuit recognizes a fault state when any phase is absent and signals the controller to take additional action. The LM35 temperature sensor is used to measure the temperature of the motor continuously. It produces an analog output voltage that is directly proportional to the temperature. This analog signal is given to the microcontroller through its input pin, where it is processed and converted into a temperature value.

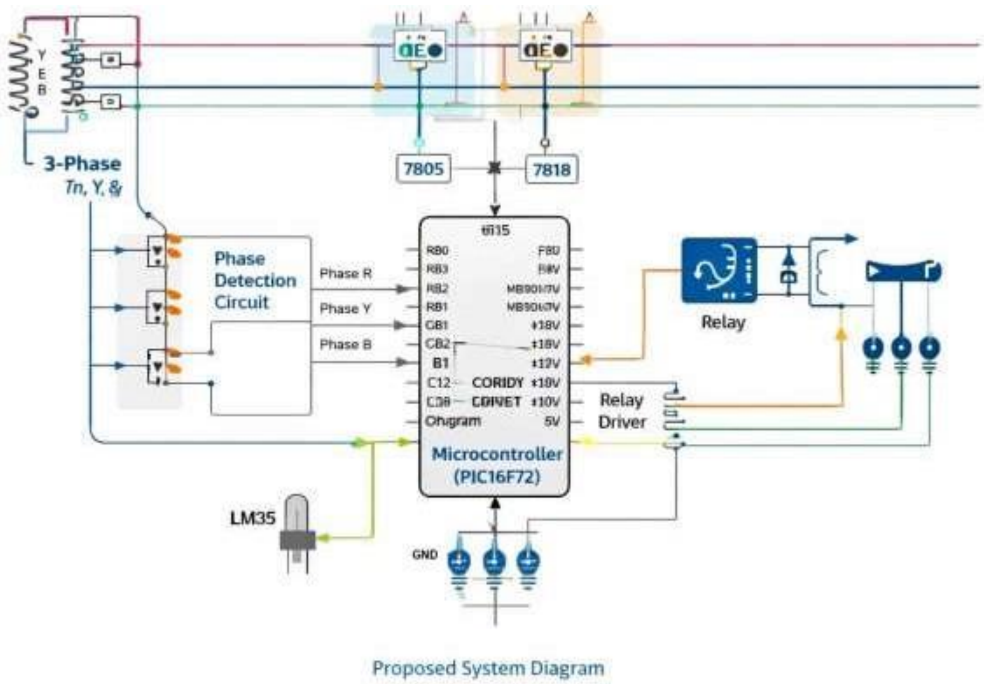


Fig. 1- Proposed System Diagram

The system's core control unit is the PIC16F72 microcontroller. Both the temperature sensor and the phase sensing circuit provide it with constant input signals. These input values are compared by the microcontroller to the system's pre-programmed safe limits. It ascertains whether the motor is functioning normally or under fault circumstances based on this comparison. The microprocessor permits the motor to run continuously under typical circumstances when all three phases are present and the temperature is within the safe range. On the other hand, the microcontroller promptly detects any abnormal state, such as phase loss or high temperature. The microcontroller transmits a control signal to the relay unit in reaction to the identified malfunction. Overall, the system provides a simple, efficient, and cost-effective solution for protecting induction motors. It improves system reliability, reduces maintenance requirements, and increases the operational life of the motor.

III. HARDWARE COMPONENTS

- **PIC16F72 Microcontroller**

Fig.2- Microcontroller PIC16F72

The PIC16F72 microcontroller is the main control unit of the system. It is responsible for processing all input signals received from the phase sensing circuit and temperature sensor. The microcontroller compares these inputs with predefined safe limits and makes decisions accordingly. Based on the condition of the motor, it sends control signals to the relay unit. Due to its fast processing capability and reliability, it plays a crucial role in ensuring proper system operation and protection..

- **LM35 Temperature Sensor**

Fig 3 – LM35 Temperature Sensor

The LM35 is a precision temperature sensor used to measure the temperature of the induction motor. It produces an analog output voltage that is directly proportional to the temperature in degree Celsius. The sensor provides accurate and linear output, which makes it suitable for real-time monitoring. The output of the LM35 is given to the microcontroller, which continuously

Innovative Journal for Opportunities and Development in Science & Technology,
Volume 6, Issue 5, April 2026
Paper Id: – IJ2025V6I5 -6A-B
ISSN 2582-6026

checks whether the temperature is within the safe limit or not.

- **Regulated Power Supply**

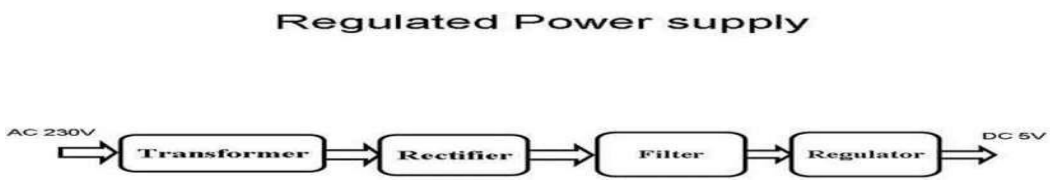


Fig 4 – Regulated Power Supply

. The regulated power supply is used to provide a stable DC voltage to the microcontroller and other electronic components. It converts AC supply into DC and maintains a constant output voltage regardless of input variations. A stable power supply is essential for the proper functioning of the system.

- **Voltage Regulator**

Fig 5 – Voltage Regulator

A voltage regulator is used to maintain a constant output voltage even if the input voltage changes. In this project, a 7805 voltage regulator is used to provide a fixed 5V DC supply from the rectified DC voltage. It ensures a stable and reliable power supply to the microcontroller and other components, protecting them from voltage fluctuations and ensuring proper operation

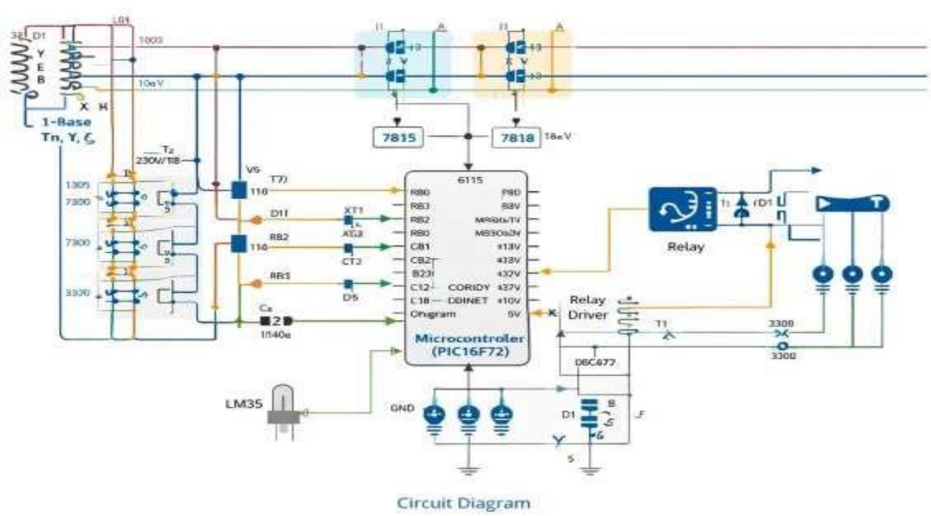
IV. WORKING PRINCIPLE

The proposed system diagram represents a microcontroller-based protection system designed to detect single phasing and overheating conditions. The system is powered by a three-phase supply (R, Y, B), which is continuously monitored using a phase detection circuit. This circuit checks the availability of each phase and sends corresponding signals to the microcontroller.

The phase detection circuit is interfaced with the PIC16F72 microcontroller, which acts as the central processing unit of the system. Each phase input (R, Y, B) is given to the microcontroller through input pins, enabling it to continuously monitor the condition of the supply.A temperature sensor (LM35) is also connected to the microcontroller. It provides an analog voltage proportional to the temperature, allowing the system to detect overheating conditions. The microcontroller processes both phase and temperature inputs and compares them with predefined threshold values programmed in the system.The system includes a regulated power supply section using voltage regulators such as 7805 and 7818, which provide stable DC voltage required for the operation of the microcontroller and associated components.Based on the processed input conditions, the microcontroller controls the relay driver circuit. The relay driver amplifies the control signal and operates the relay unit. Under normal conditions, the relay remains energized, allowing the load (LED bulbs) to operate.When a fault condition such as single phasing or excessive temperature is detected, the microcontroller sends a signal to the relay driver to deactivate the relay. This results in disconnection of the load, thereby protecting the system. The LED bulbs act as a visual representation of the load status, turning OFF during fault conditions.

Circuit Diagram

The circuit diagram represents a microcontroller-based protection system designed to detect single phasing and overheating conditions. The system operates using a three-phase supply (R, Y, B), which is connected to the phase detection circuit. This section consists of diodes, resistors, and associated components that convert the AC input into suitable signals for the microcontroller. Each phase is monitored separately, and the corresponding signals are provided to the input pins of the PIC16F72 microcontroller. A regulated power supply section is included in the circuit using voltage regulators such as 7815 and 7818. These regulators convert the input voltage into stable DC outputs required for the proper functioning of the microcontroller and other electronic



components. Capacitors are used in this section for filtering and smoothing the voltage.

Fig – 6 Circuit Diagram

The PIC16F72 microcontroller acts as the central processing unit of the system. It continuously receives input signals from the phase detection circuit and the temperature sensor (LM35). The LM35 sensor provides an analog voltage proportional to temperature, which is given to the microcontroller for monitoring overheating conditions. The output section of the circuit consists

of a relay driver circuit, which includes a transistor and diode. The microcontroller sends control signals to the relay driver, which amplifies the signal and operates the relay. Under normal conditions, the relay remains energized, allowing the load to function.

The load is represented using LED bulbs connected through the relay. When a fault condition such as single phasing or excessive temperature is detected, the microcontroller sends a signal to deactivate the relay. This disconnects the load from the supply, thereby providing protection. Overall, the circuit ensures continuous monitoring, fast fault detection, and automatic disconnection of the load, making the system reliable and effective for protection purposes.

Flow Chart OF The System

The block diagram represents the overall working of the proposed microcontroller- based protection system designed to detect single phasing and overheating conditions. The system is powered by a three-phase supply consisting of R, Y, and B phases. The three-phase input is first given to the phase detection circuit. This block continuously monitors the availability of each phase and converts the AC supply signals into suitable forms for the microcontroller. It detects any phase failure and sends corresponding signals to the control unit.The microcontroller (PIC16F72) acts as the central processing unit of the system. It receives input signals from the phase detection circuit as well as from the temperature sensor (LM35). The temperature sensor provides an analog output proportional to the temperature, which is processed by the microcontroller to detect overheating conditions. Based on the input signals, the microcontroller compares the values with predefined limits programmed in the system. If all phases are present and temperature is within the safe range, the system operates under normal conditions. The output of the microcontroller is connected to the relay unit through a driver circuit. The relay acts as a switching device that controls the connection of the load. Under normal conditions, the relay remains energized, allowing the LED bulbs (used as load) to glow. In case of any abnormal condition such as single phasing or excessive temperature, the microcontroller sends a signal to the relay to disconnect the load. This ensures protection of the system and prevents damage. Thus, the block output control. diagram clearly shows the flow of signals from input to processing and finally to the

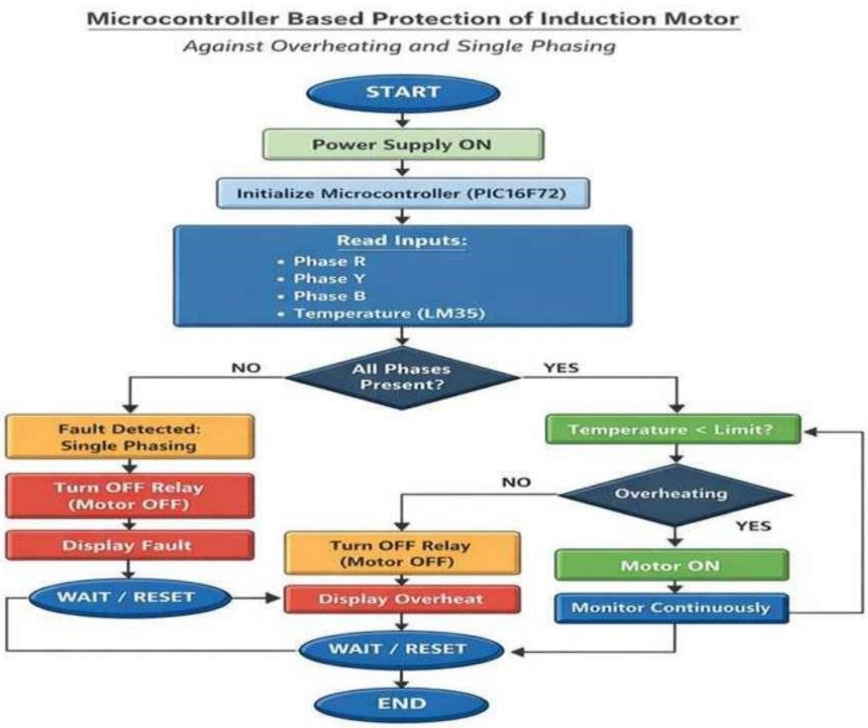


Fig – 7 Flow Chart

Innovative Journal for Opportunities and Development in Science & Technology,
Volume 6, Issue 5,April 2026
Paper Id: – IJ2026V6I5 -6 A-E
ISSN 2582-6026

Experimental Set Up

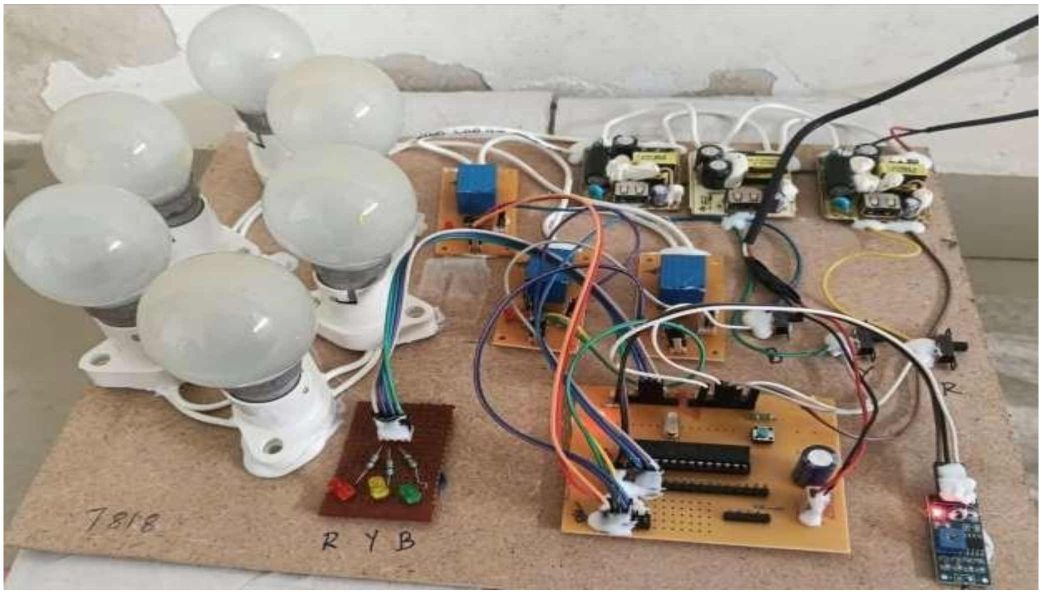


Fig - 8 Experimental Set Up

V. RESULT AND DISCUSSION

A microcontroller circuit, relay modules, a phase indicator unit, a temperature sensor module, and LED bulbs acting as a load were utilized to construct the designed system as a working model. To show how the protective system functions under various operating situations, the whole configuration was put together on a board. The LED lamps were used to mimic the load, and the LED indicators with the labels R, Y, and B were utilized to indicate the existence of a three-phase supply. The system ran well under typical operating conditions when all three phases were present and the temperature was within the safe range. The LEDs used for phase indication lit.properly, and the relay modules remained energized, allowing the LED bulbs to glow continuously. This indicated that the system was functioning correctly without any fault condition.When a single phasing condition was introduced by removing one of the phases, the system successfully detected the fault through the phase detection circuit. The microcontroller processed this condition and immediately de-energized the relay, resulting in the disconnection of the load. This was visually observed as the LED bulbs turning OFF, indicating that the system had taken protective action.Similarly, during overheating conditions, the temperature sensor detected an increase in temperature beyond the preset limit. The sensor sent a signal to the microcontroller, which then activated the protection mechanism. The relay was switched OFF, disconnecting the load and preventing further operation under unsafe conditions.The overall performance of the system was found to be reliable and efficient. The response time of the system was quick, and it accurately detected both single phasing and overheating conditions. The use of LED bulbs for load simulation made it easy to observe the system behavior clearly. The system is simple in design, cost-effective, and easy to implement. It provides automatic protection without the need for manual intervention and can be extended for real-time applications by replacing the simulated load with actual equipment.

VI. CONCLUSION

A microcontroller-based protection system for identifying single phasing and overheating circumstances is effectively shown by the created project. Using the proper sensor circuits, the system continually checks the temperature and supply conditions. By managing the relay unit, it offers automated protection.

This model makes it easier to comprehend how the system operates by simulating the load with LED lamps. The lamps shine constantly under typical circumstances, signifying correct operation. When a fault situation like phase failure or overheating occurs,

The irregularity is promptly detected by the system, which then disconnects the load. This guarantees the system's safe operation and guards against harm in the case of a malfunction. The protective system's precision, speed, and dependability are all improved by the employment of a microprocessor and user-friendly. The overall design is simple, cost-effective, and easy to implement, which makes it suitable for educational as well as practical applications.This paper can be further improved by integrating advanced features such as real-time monitoring, digital display, or IoT-based control systems. It can also be extended for actual industrial applications by replacing the simulated load with real equipment. Thus, the proposed system provides a reliable and effective solution for protection against common electrical faults.

REFERENCES

[1] B. L. Theraja and A. K. Theraja, A Textbook of Electrical Technology, Vol. 2, New Delhi, India: S. Chand & Company Ltd., 2014.

[2] M. A. Mazidi, J. G. Mazidi and R. D. McKinlay, The 8051 Microcontroller and Embedded Systems, 2nd ed., Pearson Education, 2007.

[3] Microchip Technology Inc., PIC16F72 Datasheet, Available: https://www.microchip.com

[4] Texas Instruments, LM35 Precision Centigrade Temperature Sensor Datasheet, Available: https://www.ti.com

[5] P. S. Bimbhra, Electrical Machinery, 7th ed., Khanna Publishers, 2011.

[6] U. A. Bakshi and M. V. Bakshi, Power Electronics, Technical Publications, Pune, India, 2009.

.