

HALL-EFFECT SENSOR BASED NON-CONTACT AC MOTOR SPEED MONITORING AND DISPLAY SYSTEM WITH HIGH AND LOW SPEED ALERTS

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Abstract

The project “Hall-Effect Sensor Based Non-Contact AC Motor Speed Monitoring and Display System with High and Low Speed Alerts” presents an efficient and reliable method for measuring the speed of an AC motor without physical contact. In industrial applications, accurate speed monitoring is essential for ensuring proper operation, safety, and maintenance of machines. This system uses a Hall-Effect sensor to detect the magnetic field generated by a rotating component attached to the motor shaft. Each rotation produces a pulse, which is processed by a microcontroller to calculate the motor speed in revolutions per minute (RPM).

The calculated speed is displayed in real-time on an LCD or LED display, providing continuous monitoring. Additionally, the system is designed with predefined high and low speed limits. When the motor speed exceeds or falls below these thresholds, an alert is generated using a buzzer or indicator, enabling quick corrective action. The non-contact nature of the system reduces wear and tear, increases safety, and minimizes maintenance requirements

INTRODUCTION

AC motors are widely used in industrial, commercial, and domestic applications due to their simple construction, reliability, and low cost. Monitoring the speed of these motors is very important to ensure proper performance, safety, and efficiency of the system. In many industries, incorrect motor speed can lead to machine failure, reduced productivity, and increased maintenance cost.

Traditional methods of speed measurement often involve mechanical contact with the rotating shaft, which can cause wear and tear, reduce accuracy, and increase the risk of damage. To overcome these limitations, non-contact speed measurement techniques are preferred. One of the most effective methods is the use of a Hall-Effect sensor.

The Hall-Effect sensor works on the principle of detecting magnetic fields. When a magnetic object attached to the rotating shaft passes near the sensor, it generates a signal or pulse. These pulses are

counted by a microcontroller to calculate the speed of the motor in terms of revolutions per minute (RPM). This method provides accurate and reliable speed measurement without physical contact.

In this project, a system is developed to monitor the speed of an AC motor using a Hall-Effect sensor. The measured speed is displayed on a digital display in real-time. Additionally, the system includes high and low speed alert features. If the motor speed exceeds or falls below predefined limits, an alert is generated using a buzzer or indicator.

This system is cost-effective, easy to implement, and suitable for various industrial and automation applications. It improves safety, reduces maintenance, and ensures efficient motor operation.

1. METHODOLOGY

The speed of the motor in terms of revolutions per minute (RPM) using a predefined formula. The calculated speed is then displayed on an LCD or LED display for real-time monitoring.

In addition to speed measurement, the system includes predefined high and low speed limits. The microcontroller continuously compares the measured speed with these limits. The methodology of this project describes the step-by-step approach used to design and implement the motor speed monitoring system using a Hall-Effect sensor.

Firstly, the overall system is designed based on non-contact speed sensing. A small magnet is attached to the rotating shaft of the AC motor. A Hall-Effect sensor is placed near the shaft in such a way that it can detect the magnetic field whenever the magnet passes in front of it.

When the motor rotates, the magnet produces a magnetic field that is sensed by the Hall-Effect sensor. For every rotation, the sensor generates a pulse signal. These pulses are then sent to the microcontroller for processing.

The microcontroller counts the number of pulses within a specific time interval and calculates. If the speed exceeds the maximum limit or drops below the minimum limit, an alert is triggered using a buzzer or indicator.

Finally, the system is tested under different operating conditions to ensure accuracy, reliability, and proper functioning. The results are recorded and analyzed to validate the performance of the system.

2. NEED OF STUDY

- AC motors are widely used in industries, laboratories, and home appliances, where maintaining proper speed is essential for efficient operation.
- Traditional contact-type speed measurement methods cause mechanical wear and reduce system life, creating a need for modern non-contact measurement techniques.
- A Hall-effect sensor allows safe and accurate speed sensing without physically touching the rotating parts.
- Continuous speed monitoring helps prevent motor damage due to overspeed or underspeed conditions.
- Real-time speed display improves operator control and machine performance.
- High-speed and low-speed alert systems help in early fault detection and prevent accidents.
- Industries require low-cost and reliable automation systems for motor monitoring.
- The study helps students understand practical applications of sensors, embedded systems, and motor control.
- The system reduces maintenance costs by avoiding friction-based measurement devices.

- This study supports modernization of motor monitoring systems using digital and sensor-based technologies.

3. OBJECTIVES

1. To design a non-contact motor speed measurement system using a Hall-effect sensor.
2. To measure the rotational speed of an AC motor accurately without mechanical contact.
3. To display real-time motor speed on a digital display such as an LCD display.
4. To develop a system that continuously monitors motor performance and stability.
5. To provide high-speed and low-speed alert indications using buzzer or LED indicators.
6. To reduce mechanical wear and maintenance by using magnetic sensing instead of contact methods.
7. To improve safety by avoiding direct contact with rotating motor parts.
8. To design a compact, low-cost, and energy-efficient monitoring system.
9. To make the system suitable for industrial and educational laboratory applications.
10. To implement a reliable embedded control system using a microcontroller such as Arduino Uno.

4. SCOPE OF STUDY

The proposed system can be further improved and enhanced by incorporating advanced technologies and additional features. Some possible future developments are as follows:

1.IoT-Based Monitoring

Integrate the system with IoT to monitor motor speed remotely using a mobile app or web interface

2.Wireless Communication

Use Bluetooth or Wi-Fi modules for wireless data transmission

3.Data Logging System

Store speed data for analysis and performance tracking

4.Mobile Application Integration

Develop an Android app for real-time monitoring and alerts

5Automatic Speed Control

Implement feedback control to automatically maintain desired speed

6.Multi-Motor Monitoring

Extend the system to monitor multiple motors simultaneously

7.Improved Sensors

Use advanced sensors for higher accuracy and longer sensing distance

8.Graphical Display

Replace LCD with advanced display (TFT/OLED) for better visualization

9.Energy Efficiency Monitoring

Add power measurement to analyze energy consumption

10.Industrial Automation Integration

Integrate with PLC and SCADA systems for large-scale industrial use

REFERENCES

1.Books:

1. B. L. Theraja & A. K. Theraja, A Textbook of Electrical Technology, S. Chand Publications
2. V.K. Mehta & Rohit Mehta, Principles of Electrical Engineering, S. Chand Publications
3. Muhammad Ali Mazidi, The 8051 Microcontroller and Embedded Systems, Pearson Education

2.Datasheets:

1. Hall-Effect Sensor Datasheet (e.g., A3144)
2. ATmega328P Microcontroller Datasheet
3. 16×2 LCD Display Datasheet

3.Journals & Articles:

1. IEEE Papers on Motor Speed Monitoring Systems
2. Research articles on Hall-Effect sensor applications