

# Thyristor Based Speed Control of AC Motor

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**Abstract**— The A.C motors in industries is widely used for many applications and the major factor is controlling its speed at very low cost and high efficiency. As D.C motors used for speed control applications, the introduction by power electronics circuits solved the limitations in A.C motors, now it is easy to control the A.C motor very easy and reliable. Single-phase induction motors does not have slip ring and brushes, so it have very simple construction. By using voltage control method the speed of motor is controlled using triac. A controller is used to set timing gap between the firing angles to triac.

**Key words:** A.C Motors, Triac, Speed Control, Controller, Firing Angle

## I. INTRODUCTION

### A. General Background

Nowadays motor are being used for many applications like domestic purposes, household equipment's, machine tools in industries. Motor is now playing major role in industries and it cannot avoided purposely. From automobile to manufacturing, it depends on different kind of motors based on application. The main factor in motor is speed controlling, as it is an essential part in process control. Speed control is very important in manufacturing a well in other applications. Hence, the motor requires wide-ranging function and performance.

### B. Problem Statement

The electric supply that are common used is Alternating Current in home appliances, offices and even in small-scale industries. In these areas, the motor used for applications also related to A.C source then D.C motors. The A.C motors are widely used in domestic and industries like automation, robotics etc. because of its long life and reliable characteristics. It is known as "workhouse of industries" as they work on very small power rating with more efficiency.

Industries are in need of motor in which the speed control should be simple and easy factor without any losses, Based on this criteria industries started to use D.C motors, which is easy to control the speed.

But the major problem is maintenance in the D.C motor. To overcome this a new invention gave hand is power electronics, as the D.C motors is replaced with A.C induction motors and also the power electronics drivers runs the motor at its rated speed. Motors run with its rated speed based on the power supply with respective to its specifications, even some appliances are in need of variable speed.

### C. Problem Justification

In order to reduce the cost of operation, speed control is major factor along with efficient power control. The controlling methods of speed of motor is also based on the speed - torque characteristics.

If speed-torque character has been studied it is easy to control its speed based on the three methods below

- 1) depending on the number of poles
- 2) fixed frequency with varying voltage
- 3) Changing the voltage and frequency of input.

The triac-based 220V AC motor speed controller circuit is considered for controlling the speed of small household motors like drill machines. The speed of the motor can be controlled by varying the setting of Potentiometer. The setting of potentiometer decides the phase of the trigger pulse that fires the triac. The circuit includes a self-stabilizing method that maintains the speed of the motor even when it is loaded. The variable value in potentiometer is mapped from 0-255 with the microcontroller and the PWM output pin of controller is connected to Triac for.

## II. OBJECTIVE & SCOPE OF PROJECT

### A. Problem Identification

The problem has been identified commonly in the industries where the use of A.C motor has been replaced with D.C motor because of the efficiency method to control the speed regulation and smoothness of D.C motor is easy than compared to A.C. As the major source of appliances is A.C and for a factor of speed regulation the A.C source is converted into D.C source. This is major problem identified in domestic and industry applications. Hence, to overcome this problem, this project is designed with help of power electronics devices to control the speed regulation of A.C motor.

### B. Objective of Project

In electric motors, generally, with induction motors, the speed control factor has major problem, but which is one of the important factors in industries. Because, the applications are in need of smooth operation and with economical range of operation. In this consideration D.C motor is superior to A.C motor, as it can be operated in wide range of speed regulation with high efficiency. However, this is very difficult with A.C motors. In this project, we propose a speed control method as main objective for A.C motor with increased efficiency.

## III. EXECUTION

### A. Block Diagram

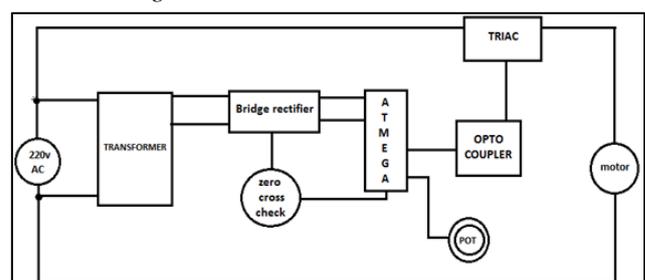


Fig. 1: Block Diagram

#### IV. WORKING

The speed of motor can be controlled with the help of the potentiometer fixed with knob as shown below



Fig. 2: Potentiometer

The motor used in project has specification of 6500 RPM 0.5 HP and power source is AC supply, the motor setup in the project is shown below



Fig. 3: Motor Setup

The motor is fixed with a black plate along with a white strip to measure the RPM of motor using as IR sensor as tachometer. IR sensor triggers when white strip crosses each time per revolution. The sensor signal is given to the interrupt pin of Arduino and after the calculation the output is displayed it LCD screen.

The entire circuit is soldered in perforated board and connectons are given as shown in above circuit diagram. After wiring the components the circuit is fixed in wooden frame as shown if figure below

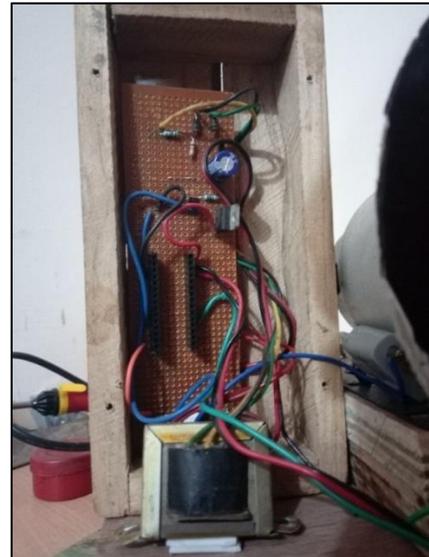


Fig. 4: Complete Circuit Diagram

The RPM of motor can be monitored using IR sensor based tachometer, IR sensor consists of a pairs of transmitter and receiver diode along with a comparator and based on the reflected infrared wave it gives out high voltage (i.e. 5V).

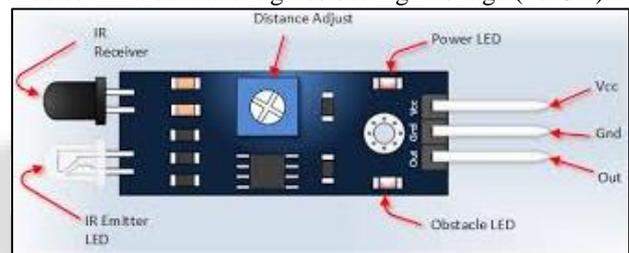


Fig. 5: IR Sensor

The below circuit shows the sensor fixed with the project to detect the white strip in the circular plate in order to calculate the rpm.



Fig. 6: IR Module Fixed

The combination all circuits together is fixed and is shown below.

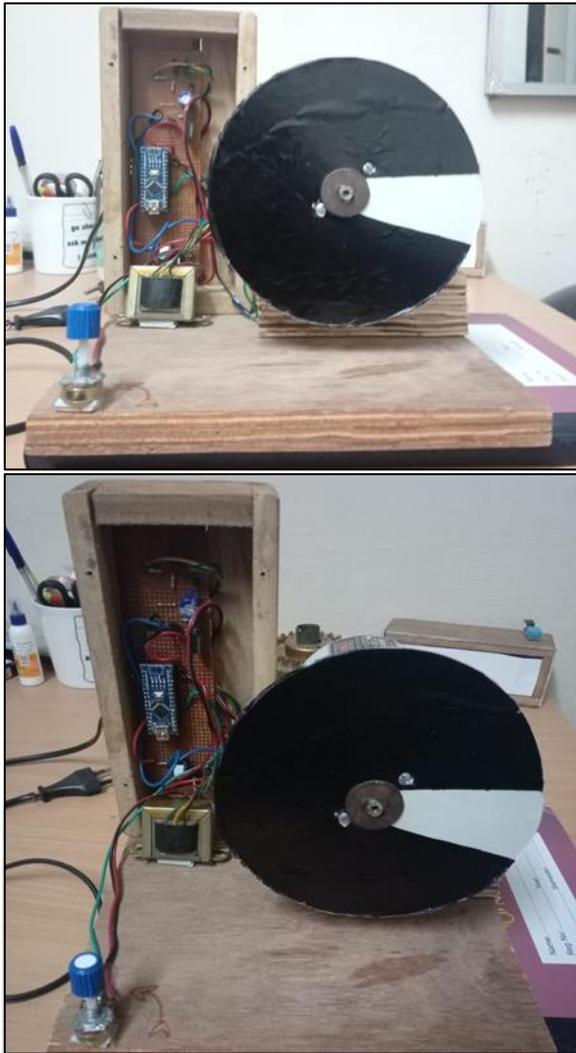


Fig. 7: Finished Model

The output of AC wave altered, because of the triggering circuit and the voltage varies based on firing angle. The time between firing angle determines the output voltage to the motor and based in the voltage speed varies. Thus with potentiometer input the output AC voltage can be controlled which varies the speed of the AC motor. The variation in phase angle based on firing angle is shown in below figure.

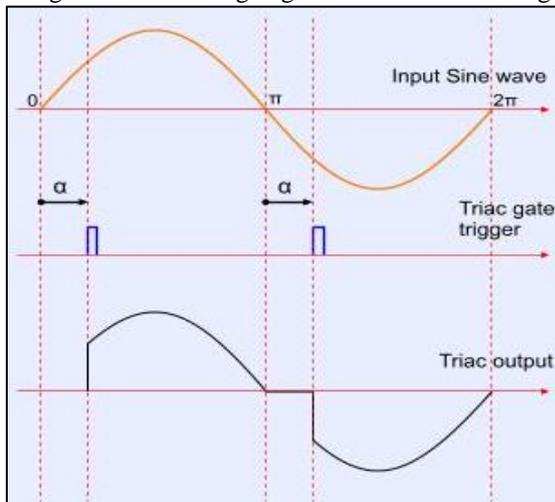


Fig. 8:

## V. DISCUSSION

Most induction motor works with air gap flux with constant hence it has iron losses also constant. Thyristors are used by conventional voltage control method by connecting it series with motor when full flux is not required by load and this method reduce the voltage. This method increases the efficiency and decreases losses. Harmonic pollution affects the power lines that also decrease the efficiency of motor in voltage control method by thyristor. To overcome this new methodology has introduced for single-phase induction motors. In this method dynamic switching in configuration of windings controls voltage.

In a proposal paper the comparative study have been done. In this paper, the different method of control techniques for motor drives is studied. The technique include various methods such as voltage and current control. As motor is used in every domestic and industry appliances it consumes about half the % generated electric power. In this review the authors have compared the different control method techniques like pwm, phase control and vector control methods.

## VI. CONCLUSION

Thus in this project the method to control the speed of motor for different applications to overcome the conventional method which affects the efficiency and power consumption is reduced in this project. This project comprises the driver module for single phase induction motor whereas in future project the driver module for the three phase induction motor will be proposed and published. This project is proposed in order to control the speed, which is the major factor to control in industrial applications as well in domestic appliances.

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