Speed Control of DC Motor Using Various Techniques

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Abstract- *This paper proposes a system where the speed of a dc motor is controlled using three different techniques. DC motors are widely used in industries, traction systems where speed is varied according to the requirement.. Hence, there is a need for a speed control method that will help us control the motor's speed efficiently. In this system, we focus on making a system in which can help students to get to know about the speed control methods used for a dc motor. Here we use three types of speed control methods for DC motors are used viz. Speed Control Using Arduino Nano, Chopper Circuit, and Pot-Transistor Circuit. These speed control methods can be used consecutively.*

Keywords- DC motor, Speed control, PWM, Arduino Nano, Chopper.

I. INTRODUCTION

As compared to AC motors, DC motors are widely used in industries, electric traction systems, cars, etc. They are widely used in industries because of their low cost, less complex control structure, and wide range of speed and torque. The method of speed control used for dc motors is normally simpler and less expensive than speed control used for ac motors. DC motors can provide high starting torque which is required during traction applications. Since speed varies with several tasks so speed control is necessary to operate the DC machine efficiently. DC motors have variable characteristics and hence are used extensively in adjustable-speed drives and position control applications. Their speeds below the base speed can be controlled by armature-voltage control and speeds above the base speed are obtained by field-flux control. As speed control methods for DC motors are simpler and less expensive than those for AC motors, DC motors are preferred where wide speed range control is required. DC choppers also provide a variable dc output voltage from a fixed dc input voltage.

II. BLOCK DIAGRAM

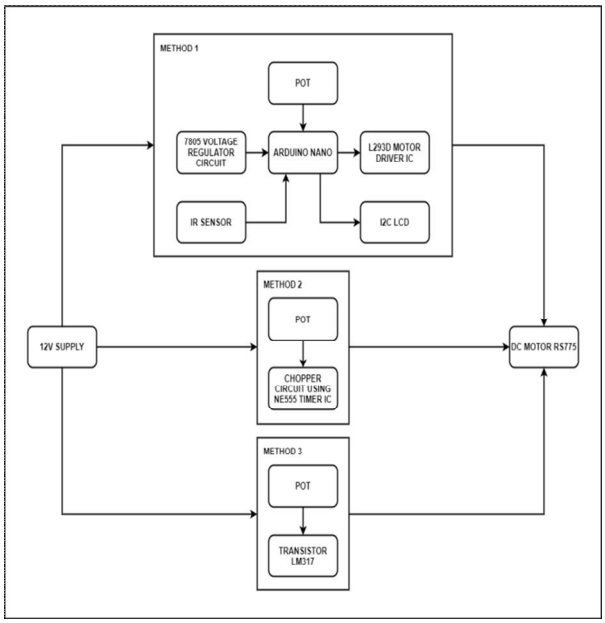

FIG. :-1: BLOCK DIAGRAM

The figure (1) Shows Block diagram of Speed Control methods used in this system. Here system comprises three different methods for speed control of a DC Motor. The first method uses Arduino Nano along with L293D Motor Driver IC. With the help of the Potentiometer a signal is applied to an analog pin of Arduino which generates a in PWM Signal at the PWM pin of the Arduino which when varied varies the speed of the motor connected to the L293D Motor Driver IC. A speed sensor is used to measure the speed of the motor which is then displayed using an I2C LCD Display. The second method uses a chopper circuit based on NE555 Timer IC. Here again speed is controlled by varying the value of the potentiometer which generates a PWM signal using the Timer IC. The T on & T off is varied which in turn provides variable speed in the system. The last method uses a potentiometer directly connected to a Voltage Regulator IC LM317. The variable voltage generated is then applied to the armature in order to vary the speed of the motor.

III. METHODOLOGY

In the proposed system we use three different methods for speed control. The motor used here is a universal motor of 500W which is used in mixer grinders. The motor draws 48V from the supply. The first method we use is the Arduino Nano.

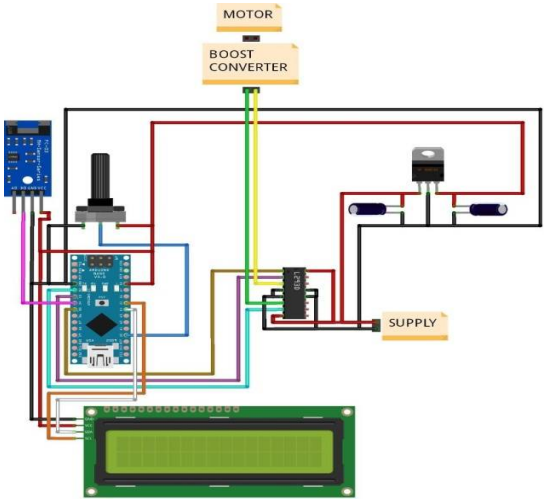

FIG.:-2: CIRCUIT DIAGRAM OF SPEED CONTROL USING ARDUNIO NANO

In this circuit, we use Arduino Nano and A L293D Motor Driver IC. A 24v supply is given to the motor driver and the voltage regulator. The voltage regulator is used to reduce the voltage that is given to Arduino. Using a Potentiometer we apply an analog signal to the analog pin of the Arduino which generates a PWM signal. This signal is given to the motor driver at the input of the L293D Motor Driver IC. A boost converter is used to give the required voltage to the motor. And the motor Starts. If we change the potentiometer value accordingly the speed of the motor is changed. Hence if the value of the potentiometer is decreased the speed of the motor changes. To measure the speed of the motor here an IR sensor is connected. The sensor measures the speed and the sensor is connected to the Arduino. Then the measured speed is displayed on the LCD display with the help of Arduino.

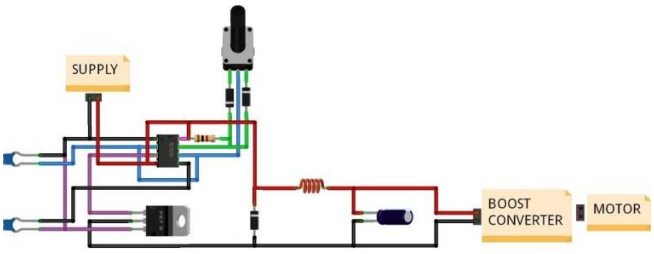

FIG.:-3: CIRCUIT DIAGRAM OF SPEED CONTROL USING CHOPPER

The second speed control method used here is the speed control using Chopper. Here the duty cycle is changed so that the voltage can be controlled. As shown in the diagram above, an IC 555 and a Mosfet is used. IC555 is used to generate pulses which are given to the Mosfet. The potentiometer is connected to the IC555. The value of the potentiometer is changed and accordingly the IC555 gives the pulses to the Mosfet. The capacitor are used here to stabilize the output. And the boost converter is connected to give the required voltage to the motor and the speed of the motor can be changed. Also as shown in the Figure(2), the IR sensor is connected to measure the speed.

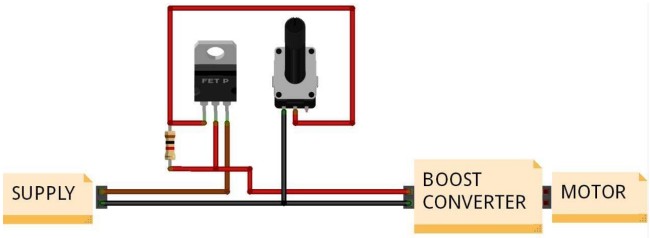

FIG.:-4: CIRCUIT DIAGRAM OF SPEED CONTROL USING ARMATURE VOLTAGE CONTROL

This speed control method has a very simple circuit design. Here a voltage regulator LM317 and a potentiometer is used. The potentiometer is connected to the voltage regulator. The 24v supply is given to the voltage regulator. The variable voltage is applied to the armature of the motor. A boost converter is connected before the motor; the boost converter boosts the voltage to the required voltage of the motor. As we change the value of the potentiometer accordingly the speed of the motor is changed. The speed of the motor is measured using the IR sensor.

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