VIVA-TECH IJRI
ANNUAL RESEARCH JOURNAL
VIVA-TECH INTERNATIONAL JOURNAL FOR RESEARCH AND INNOVATION
ANNUAL RESEARCH JOURNAL
ISSN(ONLINE): 2581-7280

Speed Control of DC Motor by Various Methods

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Abstract : *DC motors are easier to control than AC motors; hence they are widely used in industries where speed is varied according to the requirement. Speed Control mechanism in DC motor is that we cannot change their speed like the way we change the speed of synchronous motor or induction motor by changing their input voltage frequency. Instead, methods like flux control, voltage control are applied to control speed. Therefore, DC motors are preferred over AC motors. 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, Armature Voltage Control, MOSFET.*

I. INTRODUCTION

As compared to AC motors, DC motors are widely utilized in industries, electrical traction systems, cars, etc. they're widely utilized in industries due to their low price, less advanced control structure, and big selection of speed range and force. DC motors give high beginning torque that is needed for traction applications. Since speed varies with the variety of tasks, speed management is critical to control the DC machine with efficiency. DC motors are used extensively in adjustable-speed drives and position management applications. As speed management strategies for DC motors are easier and less costly than those for AC motors, DC motors are most well-liked used wherever wide speed vary is needed. DC chopper gives a variable DC output voltage from a set DC input voltage. The output voltage and current will be controlled each in magnitude and in direction; therefore, the power flow will be in either direction. The best advantage of DC motors is speed management. Since speed is directly proportional to armature voltage and reciprocally proportional to the magnetic flux made by the poles, adjusting the voltage or the field current can change the rotor speed. Here we focus on making an educational kit that will be useful for students to learn about different speed control methods using PWM. In this system, we use three methods of speed control that can be used simultaneously the speed is measured by the IR sensor and is displayed on the LCD. In the first method, we use an Arduino Nano and an L293D Motor Driver IC. The second method contains a Chopper circuit based on NE555 Timer IC and MOSFET. And the third method has a Voltage Regulator.

II. BLOCK DIAGRAM

Here system includes three completely different ways for speed control of a DC Motor. the first technique uses Arduino Nano at the side of L293D Motor Driver IC. With the help of the Potentiometer a signal is applied to an analog pin of Arduino that generates a PWM Signal at the PWM pin of the Arduino which once varied varies the speed of the motor connected to the L293D Motor Driver IC. A speed device is employed 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 once more speed is controlled by varying the value of the potentiometer that generates a PWM signal using the Timer IC. The T on & T off is varied which successively provides variable speed within the system. The last technique uses a potentiometer directly connected to a

voltage regulator IC LM317. The variable voltage generated is then applied to the armature so as to vary the speed of the motor.

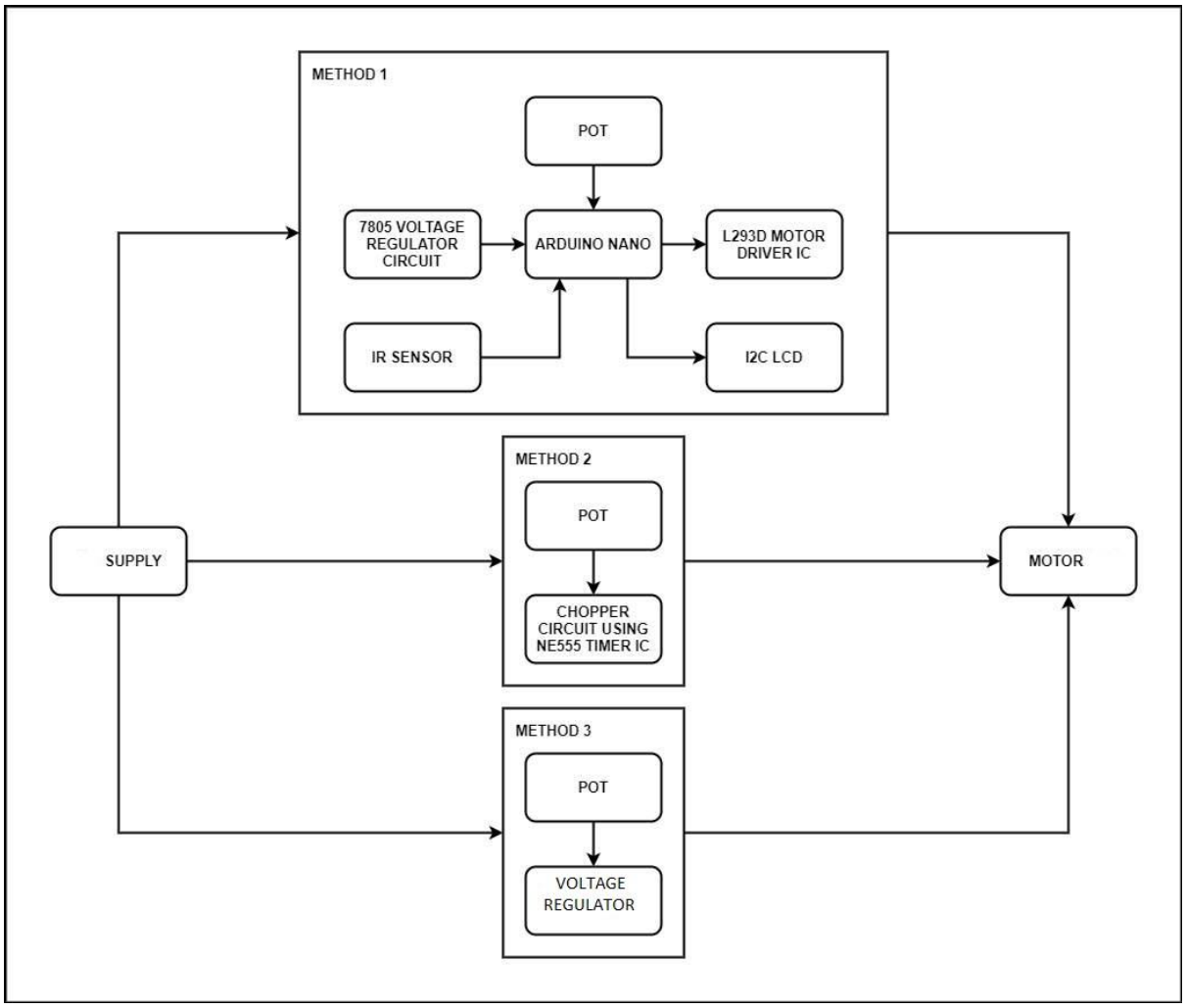


Fig.1: block diagram of the system

III. METHODOLOGY

In this system, all the controlling ways used work on PWM (Pulse Width Modulation). The PWM is employed for making digital pulses to regulate analog circuits. The PWM will be achieved by varying the duty cycle. Thus because the duty cycle changes the speed of the motor also changes. A duty cycle is the fraction of 1 period when a system or signal is active. A period is a time it takes for a sign to conclude a full ON-OFF cycle. If the duty cycle is 50%, then the circuit is conducted for the halftime of the whole period. Within the planned system, we use 3 different methods for speed control.

3.1 Speed Control Using Arduino Nano

The first method we use here is the Arduino 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 employed to reduce the voltage that is given to Arduino. Using a Potentiometer we apply an analog signal to the analog pin of the Arduino that generates a PWM signal. This signal is given to the motor driver at the input of the L293D Motor Driver IC. And therefore the motor starts. If we modify the potentiometer value consequently the speed of the motor is modified. Hence if the value of the potentiometer is reduced the speed of the motor conjointly changes. To measure the speed of the motor here an IR device is connected. The sensing element measures speed. The sensor is connected to the Arduino. Then the measured speed is shown on the digital display with the assistance of Arduino.

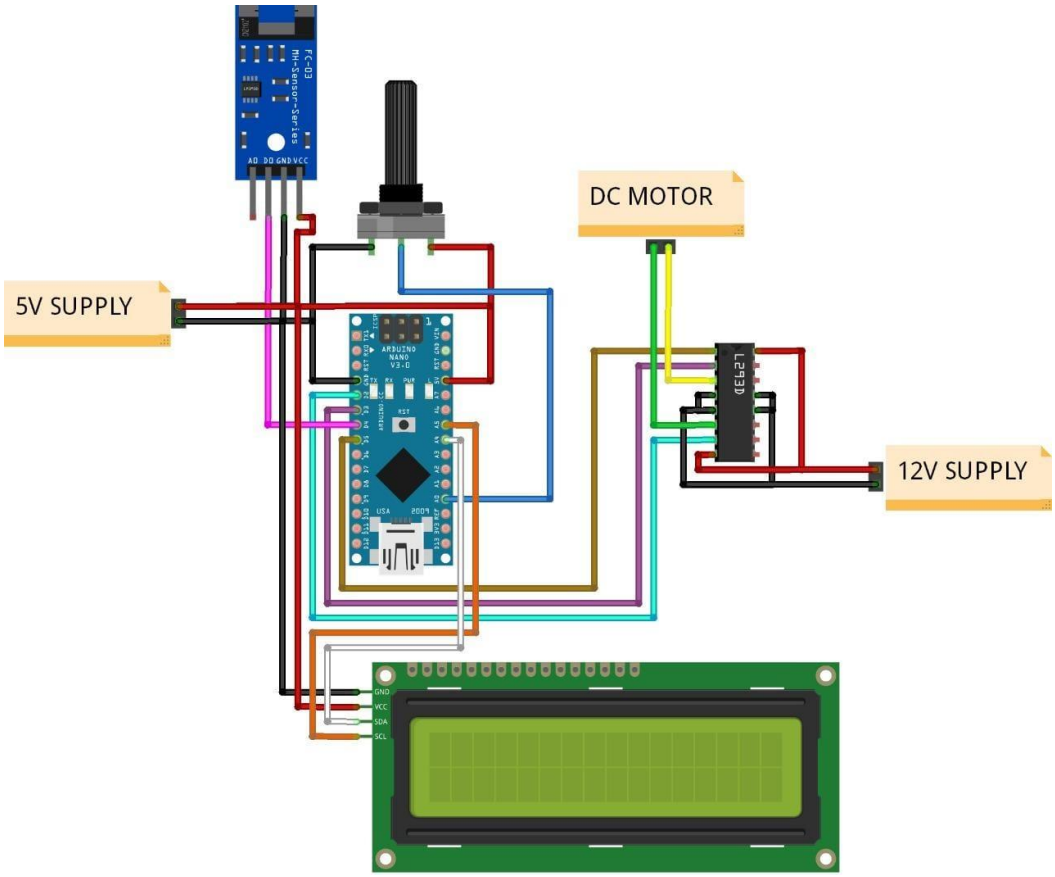


Fig. 2: circuit diagram of speed control using arduino nano

3.2 Speed Control Using Chopper

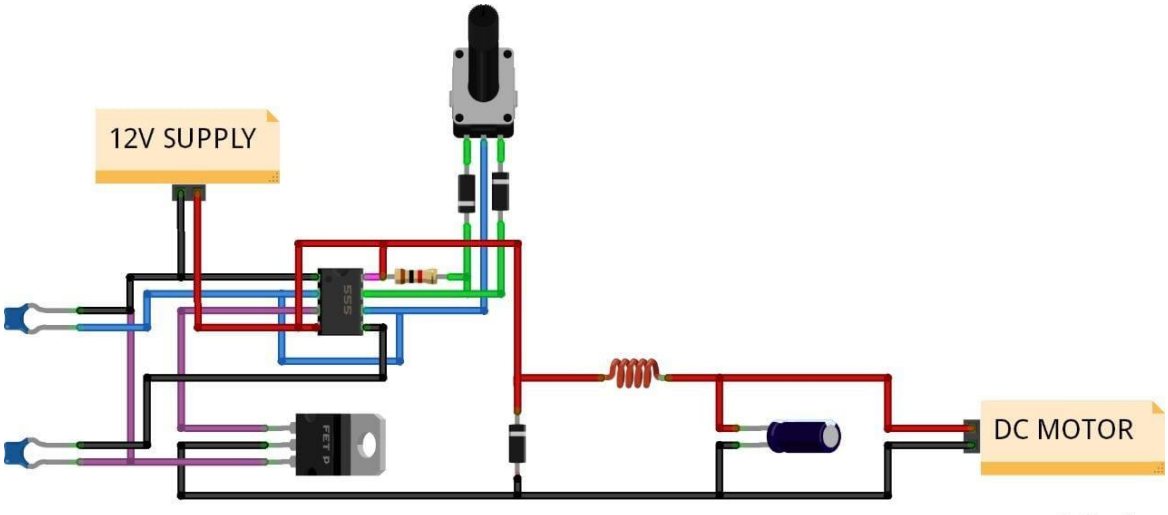


Fig. 3: circuit diagram of speed control using chopper

The second technique used for speed control right here is the speed control using Chopper. Here the duty cycle is modified in order that the voltage can be controlled. As shown within side the diagram above, an IC 555 and a Mosfet are used. IC555 is used to generate pulses that are given to the Mosfet. And the potentiometer is attached to the IC555. The value of the potentiometer is modified and accordingly, the IC555 gives the pulses to the Mosfet. The capacitor is used right here to stabilize the output. Also as in Fig.3, the IR sensor is attached to measure the speed.

3.3 Speed Control Using Armature Voltage Control

This speed control method has a very simple circuit design. An LM317 voltage regulator and potentiometer are used here. The potentiometer is connected to the voltage regulator. Power is supplied to the voltage regulator. The variable voltage is applied to the motor armature. By changing the potentiometer value accordingly, the motor speed is changed. Motor speed is measured using the IR sensor.

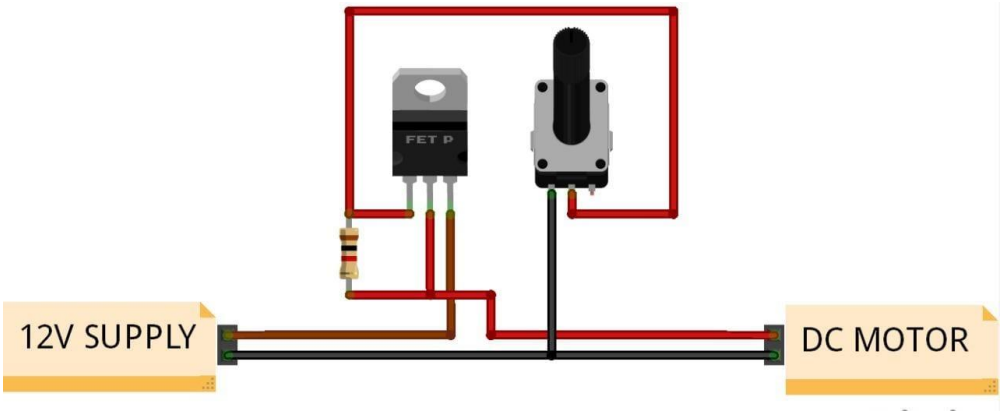
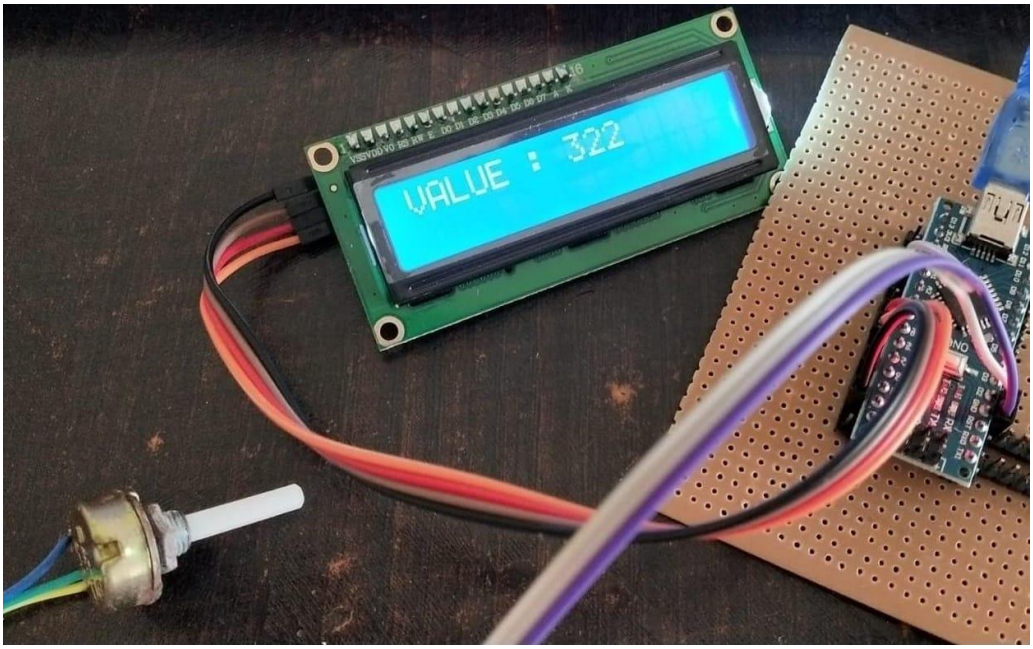


Fig. 4: circuit diagram of speed control using armature voltage control



IV. CONCLUSION

This project demonstrates various speed control methods for DC motors, which is an important issue in control systems, and the analysis is performed by comparing the performance of designed controllers. Initially, the analysis will be carried out without disturbing effects, then carried out under variable conditions. A kit for the above speed control methods will be designed. Speed measurements are also made using the IR speed sensor while an LCD display is used to display the speed.

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