Speed Control of 3HP DC Motor by An Electronic Chopping Circuit

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Abstract- *This paper deals with the need of acquiring adjustable speed control through an electronic chopping circuit. In speed control of a self-excited dc motor rheostat is the means to adjust speed of the motor. In this method we use the MOSFET driver to drive the circuit and AT-MEGA 328 as control unit. A variable potentiometer is used to adjust the speed as per the required rate.*

Keywords-3 HP DC Motor , Duty cycle, working of the electronic circuit, PWM, Generic Programing , result analysis

I. INTRODUCTION

An adjustable and accurate speed control of a motor has always been an issue in the various application. The speed control to a particular range is achieved using electronic chopping circuit. There is also a vast range of use of dc motors due to their low cost , less complexity and maximum range of speed and torque. This electronic circuit use, provides it more accurate control over the speed by controlling the terminal voltage.

This speed controlling technique plays an important part in the industries like steel plants, foundry, mills etc.

II. PROBLEM DEFINITION

(i) Nowadays, industries prefer motors whose speed can be controlled within wide range for a better application point of view. This leads to the making of this electronic circuit which has high power electronics devices to control speed.

(ii) Precise, accurate and less complex circuit than the other speed controlling devices used in industries. It helps to provide industries a large variation in speed managing for various applications of production.

(iii) Quick changes in the speed can be achieved through this electronic circuit which is not possible by the earlier practices

III. OBJECTIVE AND WORKING

Today there is a big challenge that how to increase the efficiency to control the speed of dc motor in a minimize cost effective. DC Motor is used in various areas like as Lathe Machines, Centrifugal Pumps, Fans, Blowers, Conveyors, Lifts, Weaving Machine, Spinning machines, etc. Here in this dc motor is being controlled by chopping the signal by PWM techniques.

A design package is being developed to controlled the speed of dc motor having specifications of 3 hp dc motor, 11 A, 1000 rpm by armature and field control of dc motor. When the supply is given to the dc motor through the dc chopper drive , the electrical signal is being chopped by varying the variable potentiometer at whatever the speed is required to the output of the motor load.

As the terminal voltage is being chopped by the chopper circuit the speed is being increased and decreased by variation of terminal voltage and changing of flux in the motor

IV. DESIGN AND SPECIFICATIONS

Specification of various equipments are detailed below -

1. Voltage Regulator LM7805 :- Input voltage range 7V - 35V , Current rating Ic = 1A

2. Transformer :- 220 / 12 volt, 9 - 0 - 9 transformer of current rating 500 mA

3. Bridge Rectifier : - 1A , 24 V

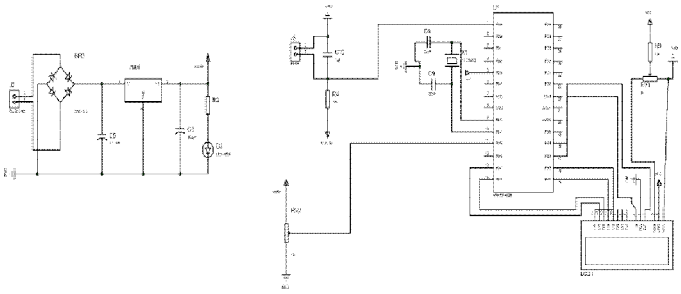
4. Microcontroller :- I/O and Packages i.e. 23 Programmable I/O Lines , Operating Voltage:- 1.8 - 5.5V , Temperature Range:- -40(C to 85(, Power Consumption at 1MHz, 1.8V, 25(C, Active Mode:- 0.2mA , Power-down Mode:- 0.1µA

5. LCD Display :- 16 X 2 display

6. Variable Potentiometer :- Opto- isolator :- 400 V Photo-TRIAC Driver Output , Gallium-Arsenide-Diode infrared source and optically-coupled silicon triac driver , High isolation :– 500 Vpeak , Output driver designed for 220 Vac
7. Mosfet :- 1000V , 30 A

8. DC Motor :- 3HP , 220 V DC Supply , 11A , 1000rpm

VI. CIRCUIT AND BLOCK DIAGRAM



figiv(a) Power and driver circuit diagrams

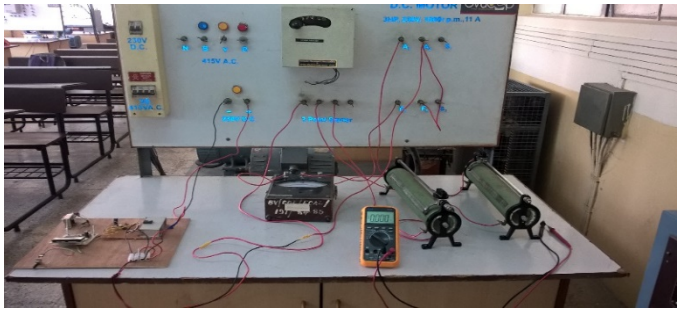


fig iv(b) Main circuit on which the observations were carried upon

V. APPLICATION

1. Requiring Adjustable Speed Control.
2. Lathe Machines, Centrifugal Pumps, Fans, Blowers, Conveyors, Lifts, Weaving Machine, Spinning machines, etc.
3. Braking and Reversing of motor.
4. Ease of setup and operation.
5. Flexibility in operation can be achieved in by this hardware.

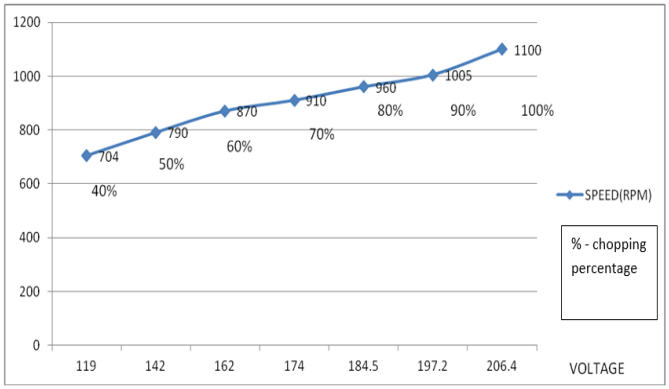
VII. GENERIC PROGRAMMING

The circuit :- momentary switch with one end connected to 5V, the other end connected to GND through a 10-kilohm resistor, and digital pin 2. TIP120 transistor, with the Base connected to digital pin 9, the Emitter to ground, and the Collector to one lead from a 220V DC motor * a 9V battery, with the ground connected to the Arduino's ground, and the power connected to the motor * 1N4001 diode across the motor's leads, with the striped side connected to the 9V The Arduino can provide the required more current and/or voltage to overcome inertia and run. A transistor as a digital switch, enables the Arduino to control loads with higher electrical demands.

*/ #include <LiquidCrystal.h> LiquidCrystal lcd(7, 8, 9, 10, 11, 12); // give a name to digital pin 2, which has a pushbutton attached int pushButton1 = 2; int pushButton2 = 4; int x=0; int y=0; int z=0; // the transistor which controls the motor will be attached to digital pin 9 int motorControl = 5; // the setup routine runs once when you press reset: void setup() { // make the pushbutton's pin an input: pinMode(pushButton1, INPUT); pinMode(pushButton2, INPUT); digitalWrite(pushButton1,HIGH); digitalWrite(pushButton2,HIGH); // make the transistor's pin an output: pinMode(motorControl, OUTPUT); // Serial.begin(9600); lcd.begin(16,2); lcd.clear(); lcd.setCursor(0,0); lcd.print("DC motor control"); lcd.setCursor(0,1); lcd.print("Speed="); // int x=0; //int y=255; } // the loop routine runs over and over again forever: void loop() { // read the state of the button and check if it is pressed if(digitalRead(pushButton1) == LOW){ x= x+1; delay(20); if(x>=255) { x=0; } y = map(x, 0, 255, 20, 255); z= map(y, 20, 255, 0, 100); // ramp up the motor speed // for(int x = 0; x < 255; x++){ analogWrite(motorControl, y); // Serial.print(x); lcd.setCursor(0,1); lcd.print("Speed="); // lcd.setCursor(7,1); lcd.print(z); // lcd.setCursor(11,1); lcd.print("% "); delay(50); Serial.print("\t motor = "); Serial.println(z); delay(20); } if(digitalRead(pushButton2) == LOW){ // ramp down the motor speed // for(int y = 255; y > 0; y--){ x=x-1; delay(20); if(x<=0) { x=255; } y = map(x, 0, 255, 20, 255); z= map(y, 20, 255, 0, 100); analogWrite(motorControl, y); // Serial.print(y); // Serial.print(x); lcd.setCursor(0,1); lcd.print("Speed="); // lcd.setCursor(7,1); lcd.print(z); // lcd.setCursor(11,1); lcd.print("% "); delay(50); Serial.print("\t motor = "); Serial.println(z);

delay(20); } delay(10); // delay in between reads for stability }

VII. CHARACTERISTICS and IT's DESIGN



This graph demonstrates the change in speed when the chopping of voltage is done by the electronic circuit through a variable voltage divider. This method is successful in dropping the speed of the dc motor to 704 rpm when the variable is adjusted to only 40% of its setting.

VII. CONCLUSION

Electronic devices nowadays are reaching heights for their compact and efficient working. the future scope of these are high and that has been kept in mind while the project was initiated. This method of controlling speed is efficient and can be used in many industries as it provides the exact speed required by adjusting the variac.

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