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Speed Control of DC motor using Programmable Logic Controller

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Abstract: In this paper, a simplified approach for speed control Of DC motor using Programmable Logic Controller (PLC) is presented. This approach is based on providing a variable dc voltage to dc motor from a fixed dc supply voltage via a PLC. PWM wave are used for switching on or off power to dc motor (armature circuit) depending on the reference (command) speed. By changing the ON and OFF time of PWM wave we can vary the duty cycle of DC motor , Thus by varying the duty cycle we could achieve effective speed and It is easy, fast and effective by this method of control to vary motor speed from 0 to 100% of rated speed. The proposed system is suitable for different industrial applications such as subway cars, trolley buses, or battery-operated vehicles.
Keywords: PLC, DC motor, Speed Control using PLC, PWM.

1. INTRODUCTION

The methods of speed control of DC motors are Normally simpler and less expensive than that of ac Drives. Due to the commentators, dc motors are not Suitable for very high speed applications and require More maintenance than ac motors. PLC output provide a variable dc output voltage , whereas choppers can provide a variable dc voltage from a fixed dc voltage. Due to their ability to supply a continuously variable dc voltage, controlled rectifiers and dc choppers made a revolution in modern industrial control equipment and variable-speed drives. Many industrial drives and processes take power from dc voltage sources. In most cases, conversion of the dc source voltage to different levels is required. For example, subway cars, trolley buses, or battery-operated vehicles take power from a fixed dc source. However, their speed control requires conversion of a fixed voltage dc source to a variable voltage dc source for the armature of the dc motor.

2. METHODOLOGY

Speed control of a motor means the intentional variation of speed according to the requirement of the work-load connected with the motor. This can be done by mechanical means, such as by using stepped pulleys, a set of change gears ,a friction clutch mechanism, etc. However control of speed by electrical means has greater advantages over mechanical speed controls. The dc motors offer easy speed control and that's why dc motors are preferred over other types of motors in many applications. Various speed control method can be obtained from
its expression which is:-
$N=V - IaRa/K$
Where:-
N=speed of motor
Ia=armature current
Ra=armature resistance
Φ=field flux
So it can be concluded that speed of dc motor depends upon
a. The applied voltage
b. The field flux
c. Drop in armature circuit resistance Ia Ra
And accordingly speed can be controlled by varying the above factors.

3. OPERATION AND ALGORITHAM

The hardware implementation of speed control consist the motor driver circuit PLC software and DC motor which speed we are going to control.

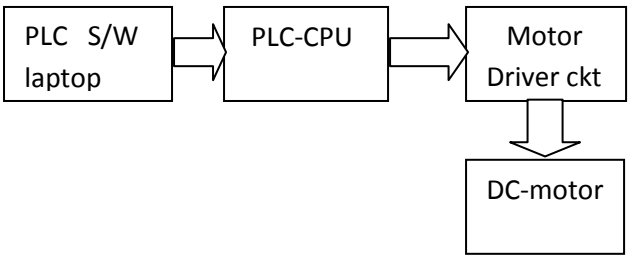
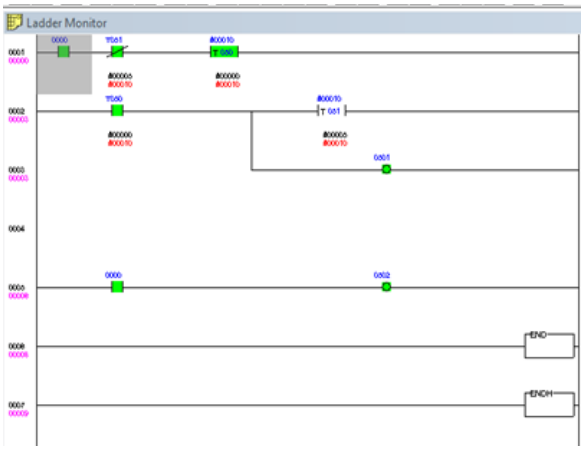


Fig: Block diagram for speed control

3.1 PLC

A programmable logic controller, commonly known as PLC, is a solid state, digital, industrial computer using integrated circuits instead of electromechanical devices to implement control functions. It was invented in order to replace the sequential circuits which were mainly used for machine control. They are capable of storing instructions, such as sequencing, timing, counting, arithmetic, data manipulation and communication, to control machines and processes. Here we are using the **simens S7-1200** the ladder logic which generate the PWM wave which is as shown below.

3.2 Ladder diagram



In ladder logic we have used two timer timer1 and timer2, timer1 for active low and timer2 for active high

3.3 Working

PLC is an important part of industrial systems. We used PLC to control motor speed. At first, then PLC according to the program generate the control signal to reach the desired speed. The analog signal from the motor driver circuit is transmitted to the motor. According to the received control signal, drive transfer required voltage to the motor. Every moment by tachometer measures motor speed at any moment and produces signals for having optimum speed in the shortest time and low steady state error and low overshoot in stable state. Speed control of a motor means the intentional variation of speed according to requirement of the work-load connected with the motor. .However control of speed by electrical means has greater advantages over mechanical speed controls. The dc motors offer easy speed control and that's why dc motors are preferred over other types of motors in many applications. Various speed control method can be obtained.

4. CONCLUSION

The paper proposed a simple, effective and accurate speed controller of dc motor using PLC, which acts as a dc to dc chopper. Using PLC instead of classical controlled switches such as Thyristors, MOSFETs and IGBTs in the proposed system achieves a compact system and avoids the variation of dv/dt and di/dt of the controlled switches. The proposed system gives speed control in a wide range from 0 to 100% of the rated speed. PWM wave are used to change the duty cycle using PLC. It is effective and fast we can vary but the duty

cycle in running operation of motor. we have observed the efficient variation in speed by varying duty ratio from 0% to 100 % thus by using proper duty ratio we could achieve the speed as per load variation and requirement thus we got better result using PLC method and its simplest method.

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