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# *Application of PLC for the Speed Control of DC Motor- A Novel Approach*

*Kiran Kumar G R[1], Shivakumar L N[2], Sukumar S J[3], Bindhu L[4]*
*Department of f Electrical and Electronics Engineering,*
*PES Institute of Technology and Management, Shimoga, SVIT, Bangalore, India*
***Corresponding author's email id:*** *kirankumargr@pestrust.edu.in[1]*

***Abstract***

*This paper presents a simplified technique for speed control of a one by one excited DC motor the usage of Programmable common sense Controller (%). This technique is based on providing a variable dc voltage to armature circuit of dc motor from a set dc supply voltage through p.c. Pang-Pang manage method is used for switching ON or OFF electricity to dc motor (armature circuit) relying at the reference (command) velocity. With this controlling approach, it is straightforward, speedy and powerful to vary the motor speed from 0 to 100% of rated speed. The proposed machine is appropriate for distinctive industrial packages consisting of subway motors, trolley buses, or battery-operated automobiles.*

***Keywords-*** *PLC, DC Motor, Pang-Pang Control Method, Relay*

## INTRODUCTION

Due to the fast performance of DC motors, those automobiles are regulated in a wide range of speeds and can be used in many applications. The principle advantage of using DC vehicles in modern world is the potential to effortlessly manipulate the rate and angle of the motor. There are unique varieties of dc cars like dc series motor, dc shunt motor, dc compound motor and differential motor. The strategies of pace control of DC vehicles are typically less difficult and much less highly-priced than that of ac drives. Because of the commentators, dc vehicles are not appropriate for very high speed packages and require greater preservation than ac motors. Controlled rectifiers provide a

variable dc output voltage from a set ac voltage, while choppers can offer a variable dc voltage from a hard and fast dc voltage. Because of their capability to supply a continuously variable dc voltage, managed rectifiers and dc choppers made a revolution in contemporary business manipulate system and variable-speed drives. Many industrial drives and strategies take electricity from dc voltage sources. In maximum cases, conversion of the dc supply voltage to distinct tiers is required. As an example, subway automobiles, trolley buses, or battery operated vehicles take energy from a fixed dc source. However, their pace control requires conversion of a hard and fast voltage dc source to a variable voltage dc supply for the armature of the dc motor.

In a PMDC motor, permanent magnets that are positioned in stator offer magnetic discipline, rather than stator winding. The stator is commonly made from metal in cylindrical form. Everlasting magnets are commonly crafted from rare earth substances. PMDC motor is appreciably used in which small DC vehicles are required and additionally very effectively manage is not required, including in automobiles starter, toys, wipers washers, hot blowers, air conditioners, computer disc drives and they are also used in a portable electric tool such as drilling machines, hedge trimmers.

A Programmable common sense Controller (percent) is an industrially hardened pc based totally unit that performs discrete or non-stop manages capabilities in a spread of processing plant and factory environments. The controller has more benefits than conventional control circuits. The advantages can be referred to inclusive of decreasing the dimensions of the manage panel, very low power consumption, Durable Equipment, Proper operation in the worst cases. Using PLC for controlling industrial systems is initiated in 1968 and, its development has been greatly accelerated in recent years. Originally, it was intended as relay replacement equipment for the automotive industry. In the world of control, the use of PLC is ever increasing. Industrial process control is one of the very important areas where the PLC is extensively used. The flexibility offered by the system to implement various control laws is great.

## METHODOLOGY

Fig.1 shows the proposed block diagram, which consists of Supply Module, Rectifier, Resistors, Relay Model and DC Motor, which are as described.

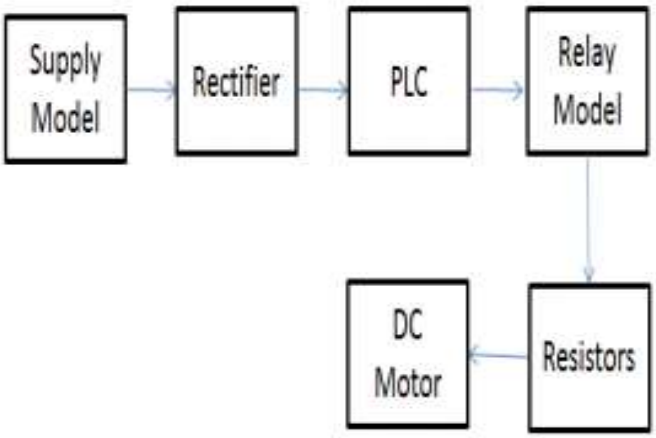


***Fig.1: Block Diagram***

**Supply Model**

Supply model which consists of step down transformer which step downs the voltage level from 230V to 12V AC supply. The transformer which consists of 1260 primary and 72 secondary turns.

**Rectifier**

Bridge Rectifier is used, which is a full wave rectifier used to convert full wave AC to DC. This Rectifier circuit is followed by Capacitor, so that unwanted Harmonics can be removed from the DC output.

**PLC**

PLC is a programmable logic controller .which is also referred to as a commercial virtual pc which is tailored for the manipulate of manufacturing techniques, along with meeting traces or robot gadgets or any hobby that calls for high-reliability control and ease of programming and procedure fault diagnosis. They were extensively followed as excessive reliability automation controllers suitable for harsh surroundings. p.c is an instance for hard actual time device in view that output consequences need to be produced in reaction to enter situations with a limited time, in any other case unintended operation will result.

**Relay Model**

Relay model consists of 6 relays. The Sugar Cube relays are of 19.6x15.6x15.6mm size offers a switching capacity of 10A at 24 V dc on normally open contacts, with a typical electrical life of 100,000operations at rated loads. Power consumption of 360mW for 12 and 24 V

dc coils. Operating temperature of 40-85ºC

**Resistors**

The set of Resistors are next to the Rectifier that are 4 in numbers, each of 10Ω, which are used to get different levels of voltage value for different range of speed.

**DC Motor**

DC or direct present day motor works at the principle when a modern-day carrying conductor is placed in a magnetic field; it reviews a torque and has an inclination to transport. The speed manipulates for this sort of motors are completed by way of thinking about some elements. pace manage is both done manually by using the operator or by way of a few computerized control tool. one of the crucial capabilities of DC motor is that its velocity can be controlled with relative ease.

We know that the emf equation of DC motor is given as,

$$N = 60A\ E / PZØ$$
$$N = E / kØ$$
where, $k = PZ/60A$
$$N = ( V - I_a R_a )/ kØ$$

Therefore speed (N) of 3 types of DC motor SERIES, SHUNT and COMPOUND can be controlled by changing the quantities on RHS of the expression. So speed can be varied by changing

1) Terminal voltage of the armature V.
2) External resistance in armature circuit Ra
3) Flux per pole φ

**EXPERIMENTAL SETUP**

Recollect the experimental setup as proven in the fig.2. to which single section 230V, 50Hz AC delivery is given and it's miles fed into the step-down transformer to step down the voltage to required degree say 12V, and the output from it will be given to the rectifier circuit.

The rectifier circuit is to transform the entire wave AC to DC deliver, which is connected to the smoothing capacitor that is used to dispose of the harmonics inside the output waveform of the rectifier. From that rectifier circuit the supply is given to the PLC, Rectifier model and to the Relay block separately. The regulated voltage of 12V is used further as source.

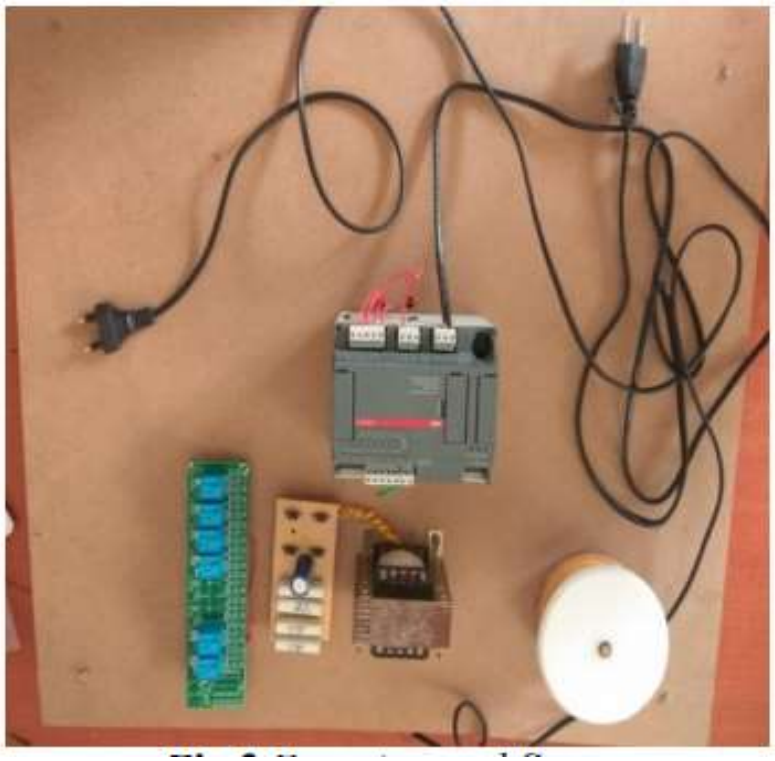

***Fig.2.Experimental Setup***

**RESULTS**

From the proposed system the speed and direction of PMDC Motor can be controlled with respect to time using PLC Programming. The PLC programming is done in such a way that the addressed relay should be actuated according to the need, where the operation time of selected relay is handled by PLC programming. The time duration is nothing but, the particular speed at which the motor has to run for specified time duration, which is managed by PLC.

After programming the program is dumped to the PLC model through serial port, when it is made to run, the motor starts rotating as per the PLC programming instruction, the motor can be made to run in either direction that is clockwise or anticlockwise direction. The Relay block consists of 6 sugar cube relays, the first two relays are used to control the direction of rotation of motor, the other four relays to control the speed of the DC motor. The relays are shorted in such a manner that the required operation should control both the speed and direction of the motor. Then that relay block is connected to the resistors. The 4 set of Resistors available will be used to get different voltage levels.

The short points of the resistor set are linked to relay block. Thus the speed

control can be achieved by selecting the relevant resistor. The proposed system will give the controlling options as per the requirements, thus the rotation of motor in either direction can be achieved with the functioning of relay as addressed by programming through PLC. Then the speed of a motor can be regulated for required duration. After one complete control operation for one direction of the motor, the other direction will be initiated after specified time delay. Thus the proposed system gives speed control in a wide range from 0 to 100% of it rated speed.

## CONCLUSION

A novel control method is employed to control the speed of DC motor via Programmable logic controller (PLC). In some applications we need a type of speed control, where a motor has to run at particular speed for particular time, and should change its speed thereafter. In such applications this proposed system is very needful, also it is simple, effective and found accurate. PLC handles the delay actuations together with relays, which in turn boost the level of accuracy, also provides flexibility such that, as and when the requirement changes that could be changed via programming. The AC31GRAF software is used to build the program, programming language used is quick Ladder Diagram, which is simpler compared to other programming languages. Thus use of PLC instead of classical controlled switches like Thyristors, MOSFETs and IGBTs which raises a problem like, variation of dv/dt and di/dt can also be reduced.

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