INTERFACING OF STEPPER MOTOR WITH PLC

Abhishek Kumar Mishra, Karan Muley, Lakshmi Gautam, Burhanuddin Sabuwala, Dr. D.S. Bankar

***ABSTRACT*- This paper presents a cheapest method to control the step of stepper motor via PLC and to provide information required to understand the control of stepper motor using PLC, its main hardware components and how it administrate the speed, direction, and step size. This paper includes working, designing and controlling of stepper motor interfacing with PLC (programmable logic circuit). The purpose of this paper is to enlighten the use of PLC with stepper motor. The paper proposes a method of programming and controlling of stepper motor as PLC as a driver.**

***Index Terms*- connection diagram of stepper motor with PLC, ladder diagram, Programmable logic controller.**

I. INTRODUCTION

Earlier in industries heavy machines are controlled by mechanical means and there used to be complex relay wire system. Before the introduction of PLC in industry there is heave complex relay and switch wire system. The PLC designed to be rugged. The advantage of PLC over personal computers are that they can withstand vibration, shock, elevates temperatures, and electrical noise to which manufacturing equipment is exposed. The use of stepper motor is increased in industry for precision control in manufacturing, printing, robotics, printers. Stepper motor is used anywhere precise positioning is required. With the advent use of stepper motor in industry because of its many excellent features make it expensive also. Stepper motor is same as dc motor without commutator. Most steppers as they are additionally known, can be ventured at sound frequencies, enabling them to turn rapidly, and with a fitting controller, they might be begun and halted "on a dime" at controlled introductions.

II. . PLC

Programmable logic controllers are a solid state, digitally electronic device that controls the operation of a machine. It uses logic functions, which are programmed into its memory via programming software (codesys v2.3 used here). A PLC monitor inputs, make decisions based on its program, and control outputs to automate a process or machine. The processor modules consist of CPU and memory. Notwithstanding a chip, the CPU additionally contains no less than an interface to a programming gadget.The power supply is a separate module, and the I/O modules are separated from processor. The IEC 61131-3 standard defines a memory and program model that follo ws modern software engineering concept.

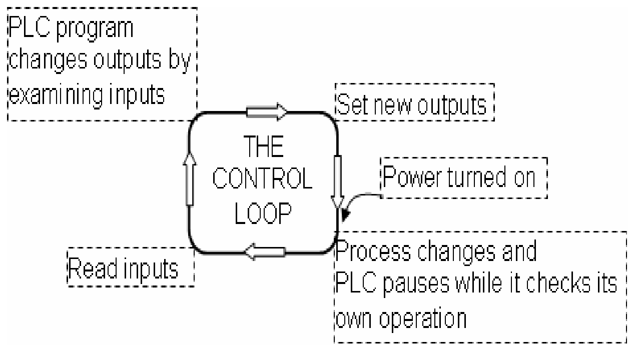


Fig. Program Execution

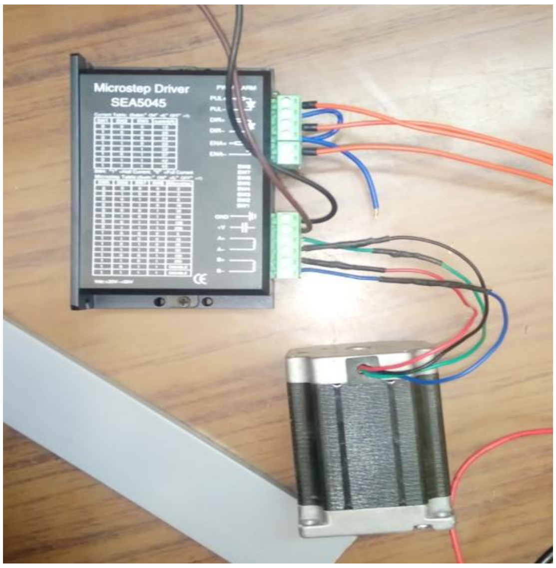
III. Stepper motor working

A stepper motor is a brushless DC electric motor which partitions the full revolution into various equivalent advances. These motors can be hold at one stage with no sensors. The controller circuit can be microcontroller, stepper motor controller or programmable logic circuit can be used to activate the drive in right order. Servomotors and venturing engines both offer comparative open doors for exact situating, yet they contrast in a few ways.. Steppers mtors are of two types: permanent magnet and variable reluctance also known as hybrid motors. There are three or sometimes four winding present in variable reluctance motors, on the other hand permanent magnet motors generally have two independent windings, with or without centre taps. Centre-tapped windings are used in unipolar permanent magnet motors. Stepper motors come in a wide range of angular resolution. The maximum angle of turn per step can be 90 degree per step and can reach minimum to 0.72 degree per step. With a proper controller, most perpetual magnet and mixture engines can be keep running into equal parts steps, and a few controllers can deal with littler fragmentary advances or smaller scale step. The stepper motor used in this project is 4 wire bipolar motor with 4 lead. There are some set of coils in a stepper motor forming known as phase. If any one of the coil is energised, the motor will make one step, then stays in that place i.e. one step is completed. To complete full revolution stepper motor need to make more steps. The coils need to be energized in the proper sequence to achieve this. The driver used to give pulse to motor is "SEA 5045".

A. Micro step Driver SEA 5045

4 lead motors are the least flexible but easiest to wire. Winding inductance is responsible for control of its speed and torque.

Peak output current= 1.4 × specified phase current



.

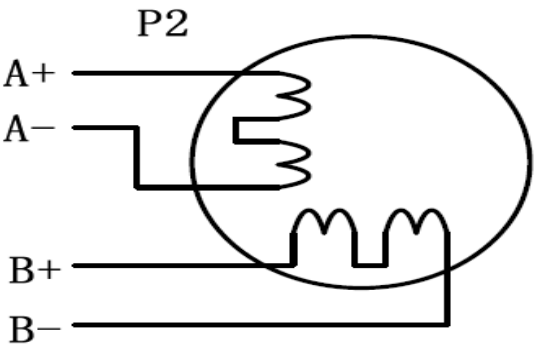


Fig. 4- lead motor connection

IV. Connection diagram

The connection of various hardware is shown in figure below. The red and blue wire are connected to B+ and B- respectively while green and black wire connected to A+ and A- respectively. Q0, Q1, Q2 are the inputs of PLC which are connected to pulse, direction, and enable of driver respectively.

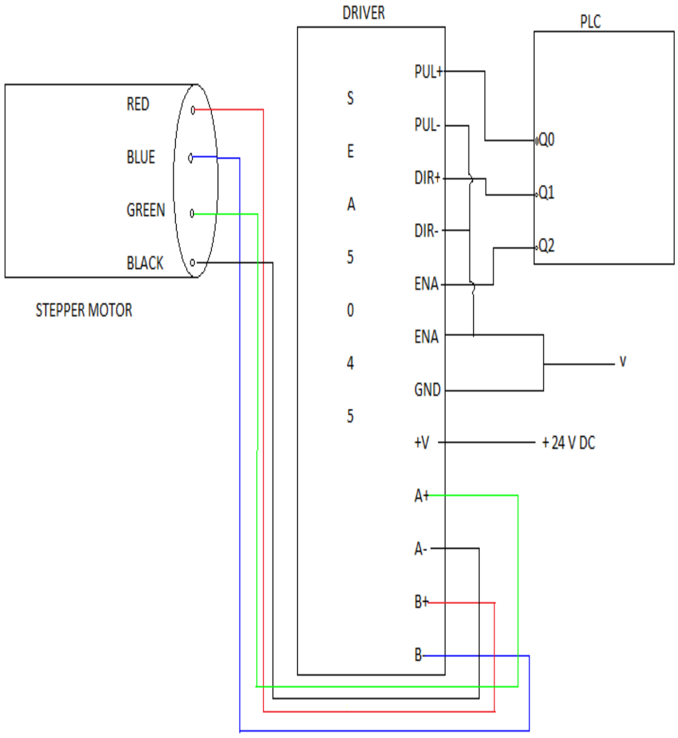
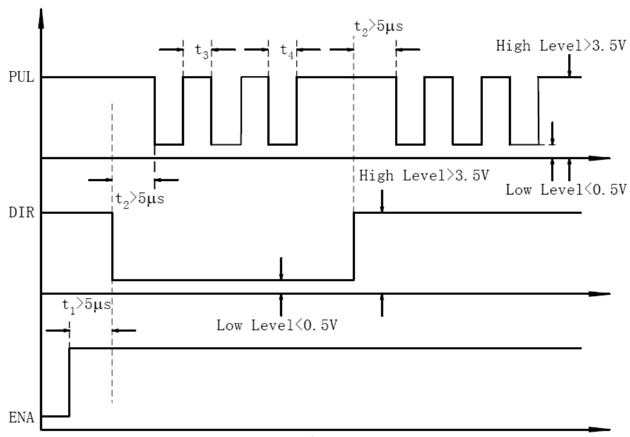


Fig. Circuit diagram

ENA must be ahead of DIR by at least 5µs. DIR must be ahead of PUL effectively by 5µs to ensure correct direction. Pulse width not less than 1.5µs. low level width of less than 1.5µs.



PUL/DIR

V. PLC Programming and Ladder Diagram

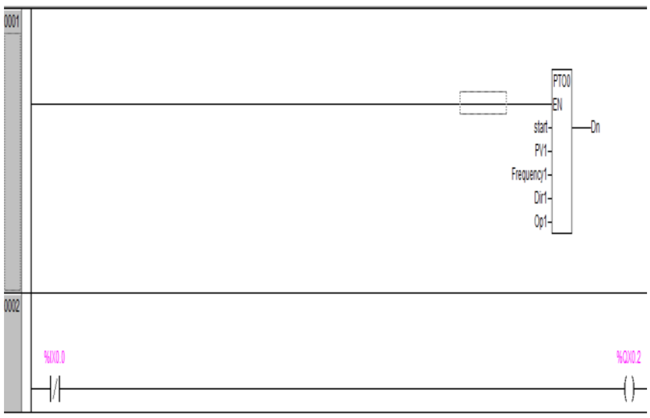
Programming of control of stepper motor consists of 10 lines of coding done in CoDeSys v2.3 software. CoDeSys stands for controlled development system.

```
Step 1:    VAR
Step 2:          start: BOOL;
Step 3:          PV1: DWORD := 100000;
```

Step 4: Frequency1: DWORD := 1000;
Step 5: Dir1: BOOL;
Step 6: Op1: BOOL;
Step 7: Dn: BOOL;
Step 8: Err: BOOL;
Step 9: Cv1: DWORD;
Step 10: END_VAR

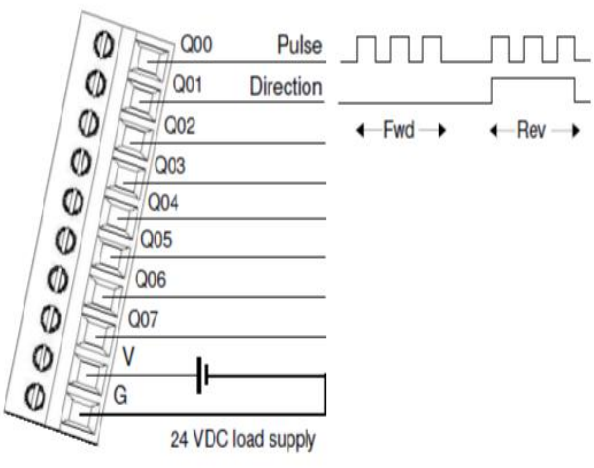
A. Ladder diagram

Ladder diagram (LAD) is one programming dialect utilized with PLC's. Ladder diagram utilizes segments that take after components utilizes as a part of the line chart to depict hard wired control. Ladder diagram is perused from left to right, through and through. The left vertical line speaks to the power or stimulated conductor. The POU with the EN esteem is assessed when EN has the genuine esteem.



B. Pulse Train Output

Numerous lower end mechanization applications require Pulse Train Output up to 2 KHz to control stepper engine. Nexgenie 1000 PLC base unit offers savvy answer for such applications. Aside from typical computerized yield, initial two yields on base unit can be arranged as Pulse Train Output channel (heartbeat and bearing). Yield Q00 is the beat yield and yield Q01 is the bearing yield. It gives 24 V DC source kind of PTO. It can produce PTO from 1 Hz to 2 KHz. The figure beneath demonstrates association chart for base unit NG16DL



Only transistor outputs can function as PTO.

If relay outputs are configured as PTO and pulses are generated, relay contact of output Q00 may get damaged. Pulse Train Output duty cycle varies across the frequency range. It varies from 50% to 70% as output frequency changes from 500 Hz to 2 KHz. As output LED indications are updated after an interval of 130ms, output LED indications for Q00 and Q01 has no relevance when configured as PTO channel

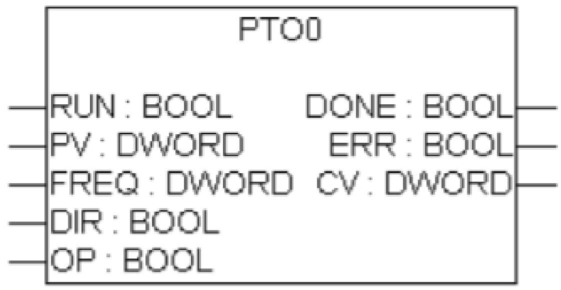


Fig. PTO block diagram

Regularly base yields Q00 and Q01 go about as would be expected computerized yields. When program square PTO0 is called and executed in the application program, base yields Q00 and Q01 get arranged as PTO channel and are controlled by executing program piece PTO0 as it were. A while later regardless of whether PTO0 isn't executed, yields Q00 and Q01 are not refreshed (turned ON/OFF) according to yield picture (%QX0.0 and %QX0.1) in yield filter. At the point when RUN is TRUE, program piece creates pulse prepare yield according to customized recurrence (FREQ) and preset number of pulses (PV). When pulse duration is finished, DONE bit turns out to be TRUE. DIR chooses course and if DIR is FALSE, Q01 stays OFF and if DIR is TRUE, Q01 stays ON. Pulse generation methods are decided by OP. In the event that it is FALSE, program blocks produces number of signals according to PV. On the off chance that it is TRUE, beats are created persistently insofar as RUN is TRUE. Status of DIR and OP is recognized at rising edge of RUN as it were. When pulses is begun, any change in DIR and OP is disregarded.

VI. Conclusion

Programming and speed controlling of stepper motor is possible through PLC. When PLC contains relays on outputs, the coils of stepper motor can be supplied with different values of voltage and current. The only disadvantage of using PL over relay as a driver may be high limit of frequency for coil switching. The PLC used for experiments has cycle time between 30 and 3000 milliseco nds. It follows that range of speed at stepper motor shaft ca n have large limits.

REFERENCES

[1] www.isa.org
[2] Bogdan, Laurean Lacrurea Analog control and Programming with a PLC.
[3] Nexgenie 1000 PLC User Manual.
[4]Driver manual

DR. D.S. BANKAR , Bharati Vidyapeeth Deemed to be University, Pune.
ABHISHEK KUMAR MISHRA, Bharati Vidyapeeth Deemed to be University, Pune.
KARAN MULEY, Bharati Vidyapeeth Deemed to be University, Pune.
LAKSHMI GAUTAM, Bharati Vidyapeeth Deemed to be University, Pune.
BURHANUDDIN SABUWALA, Bharati Vidyapeeth Deemed to be University, Pune.