

## One Kind of Control Method Based on PLC of Stepper Motor

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**Abstract**—This paper discussed a method of PLC controlling motor. Including the start and stop, forward and inversion of motor, Positive &negative switching in the process of Running. And realizing low speed, high speed, medium speed and switch operation, accurate control of step motor number. it was elaborated the programming block diagram and ladder diagram of the implementation status in detail.

**Keywords**-PLC; stepping motor; ladder diagram.

### I. THE INTRODUCTION

Due to good control and accurate localization features of the stepper motor, it is widely used in accurate location, such as CNC machine, drawing machine, steel machine, automatic control computing device, such as automatic recording instrument automatic control field.

PLC as a simplified computer, has fully functional, flexible, general, control system simple, cheap characters. It can modify the program. The volume of PLC is small. Hardware maintenance is convenient and the price is cheap. PLC are widely used all over the world. It brings great benefits for production and life. Therefore, by studying the use of PLC to control the step motor, can achieve precise positioning control, and can reduce the control cost, and maintenance. Before stepping motor need to rely on the drive to control, with the continuous development of technology is perfect, PLC has directly by its output pulse stepper motor function, so it is helpful for accurate control of stepping motors.

### II. THE DESIGN OF THE PLC PROGRAM

#### A. The connecting way of PLC and drive

There are two main connection ways between stepper motor and PLC: one is the stepper motor at both ends of the wire winding to the output points of PLC, as shown in figure 1, by writing program control electricity, each coil in a certain order to achieve positive &negative; Another way is to use PLC high-speed pulse output (PLS), received the circular distributor, again by annular pulse distributor of output control the movement of the stepper motor, including the speed and direction, as shown in figure 2. The former requires more dots, programming more troublesome, not suitable for high speed stepping motor; The latter only need two dots, a pulse supply, a control steering, easy to use, simple wiring, easy programming.



Fig.1. PLC and stepping motor directly connected

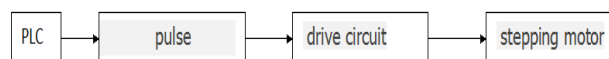


Fig.2. PLC and stepping motor connected with drive circuit

#### B. Three-phase six stepper motor control

For three phase six take control of the stepper motor, mainly in three aspects: on and off of the three-phase winding of sequence control, step motor stepper speed control steps and control. Forward order: BC - C - A - AB - B - CA - A; Reverse order: AC - C - A - CB - B - BA - A; Each step from the Angle of speed; Pulse frequency and the number.

Can around these a few respects, can make the following specific requirements:

- (1) May be started forward and inversion.
- (2) The operation process, positive &negative kept switching from time to time;
- (3) Every start from A phase operation;
- (4) The stepper motor can start properly, and can achieve high speed, medium speed and low speed three gear control, and can be controlled variable speed;
- (5) Steps can realize the control of step motor;

### III. CONTROL PROGRAM BLOCK DIAGRAM

Controlled by the specific requirements, can make a step motor in starting the program diagram of run time, as shown in figure 3. By a diagram of the work as the fundamental basis, consider to the specific requirements of the control, the first ladder diagram program can be divided into four programming module, the module 1: stepper motor step speed selection (low speed, medium speed and high speed); Module 2: displacement shift register; Module 3: three-phase circular distributor; Module 4: pulse generator; Module 5: A, B, C three-phase winding object control; Module 6: steps of stepper motor control. Then, connect each module, and finally after debugging, perfect, solid control requirements.

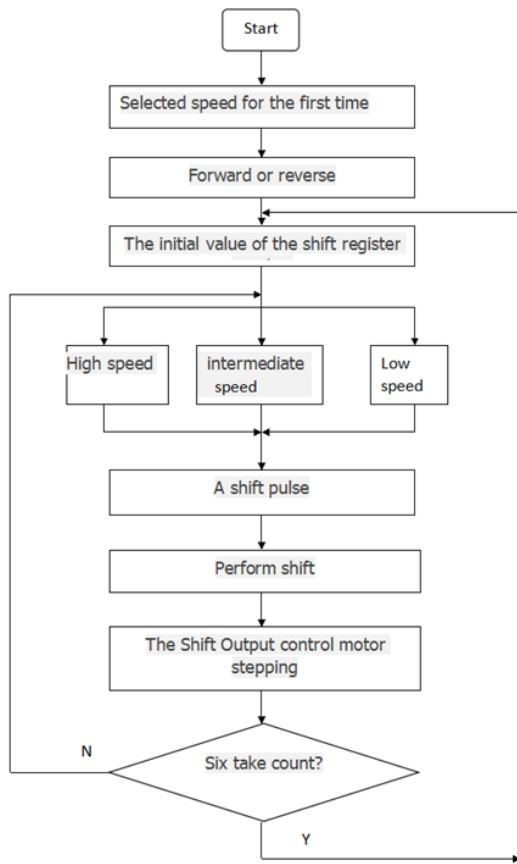


Fig.3. stepper motor control program block diagram

#### IV. LADDER DIAGRAM PROGRAMMING

##### A. I/O addressing

Control stepping motor each input switch and control A, B, C three-phase winding work output in the PLC I/O addressing as shown in table 1.

TABLE 1. INPUT/OUTPUT ADDRESSING

Port	Input	Port	Output
SB0	Start I0.0	Q0.0	A phase
SB1	Low speed I0.1	Q0.1	B phase
SB2	Intermediate speed I0.2	Q0.2	C phase
SB3	High speed I0.3		
SB4	Forward or reverse I0.4		
SB5	Stop I1.1		
SB6	Single Step I0.5		
SB7	Ten step I0.6		
SB8	Hundreds of step I0.7		

##### B. State the truth table

Using shift instruction to stepping control. First designated shift register MB0 (8), according to the three phase six steps taken in order, the initial value of the shift register are shown in table 2.

TABLE 2 SHIFT REGISTER INITIAL VALUE

Shift register MB0						Forward			Reverse		
MO.6	MO.5	MO.4	MO.3	MO.2	MO.1	A	B	C	A	B	C
0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	1	0	0	1	0	0
0	1	0	0	0	0	1	1	0	1	0	1
0	0	1	0	0	0	0	1	0	1	0	1
0	0	0	1	0	0	0	1	1	0	1	1
0	0	0	0	1	0	0	0	1	0	1	0
0	0	0	0	0	1	1	0	1	1	1	0

To draw a three-phase winding control logic relation:

(1) The forward

$$A \text{ phase } Q0.0 = M0.6 + M0.5 + M0.1$$

$$B \text{ phase } Q0.1 = M0.4 M0.5 + M0.3$$

$$\text{Phase C } Q0.2 = M0.2 M0.3 + M0.1$$

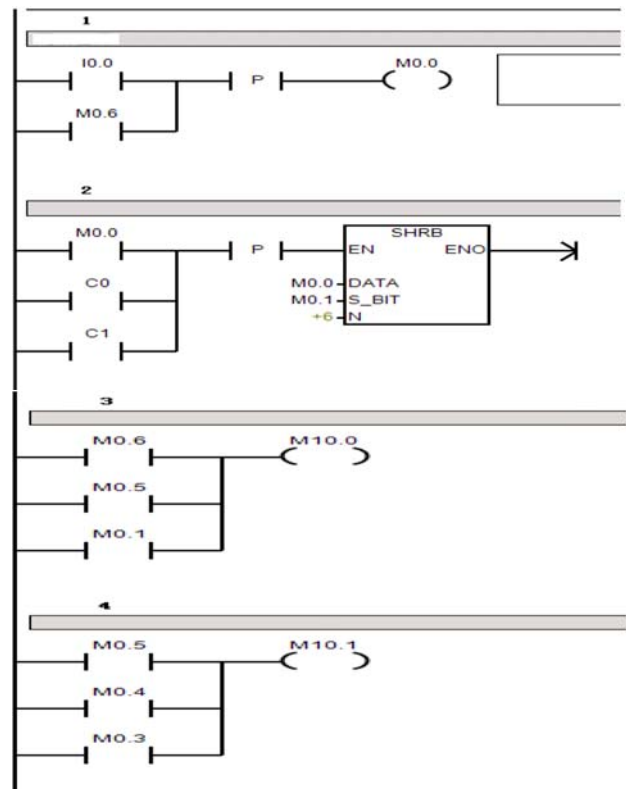
(2) The reversal

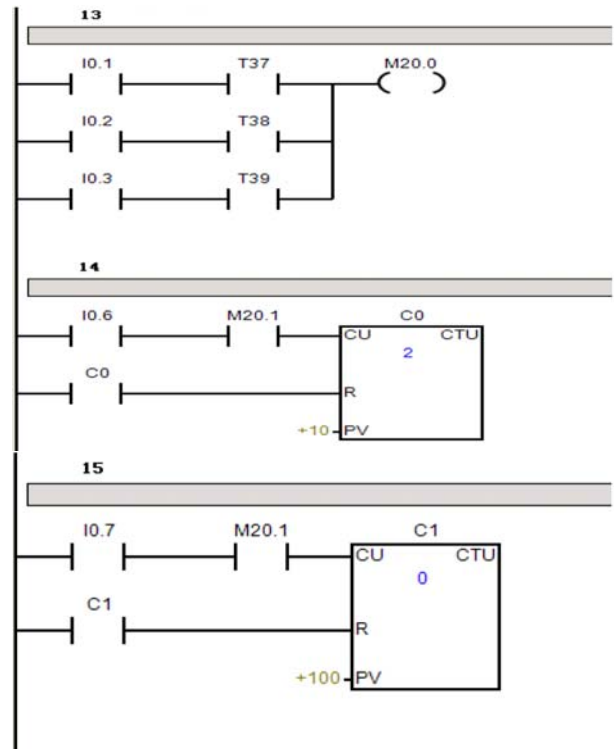
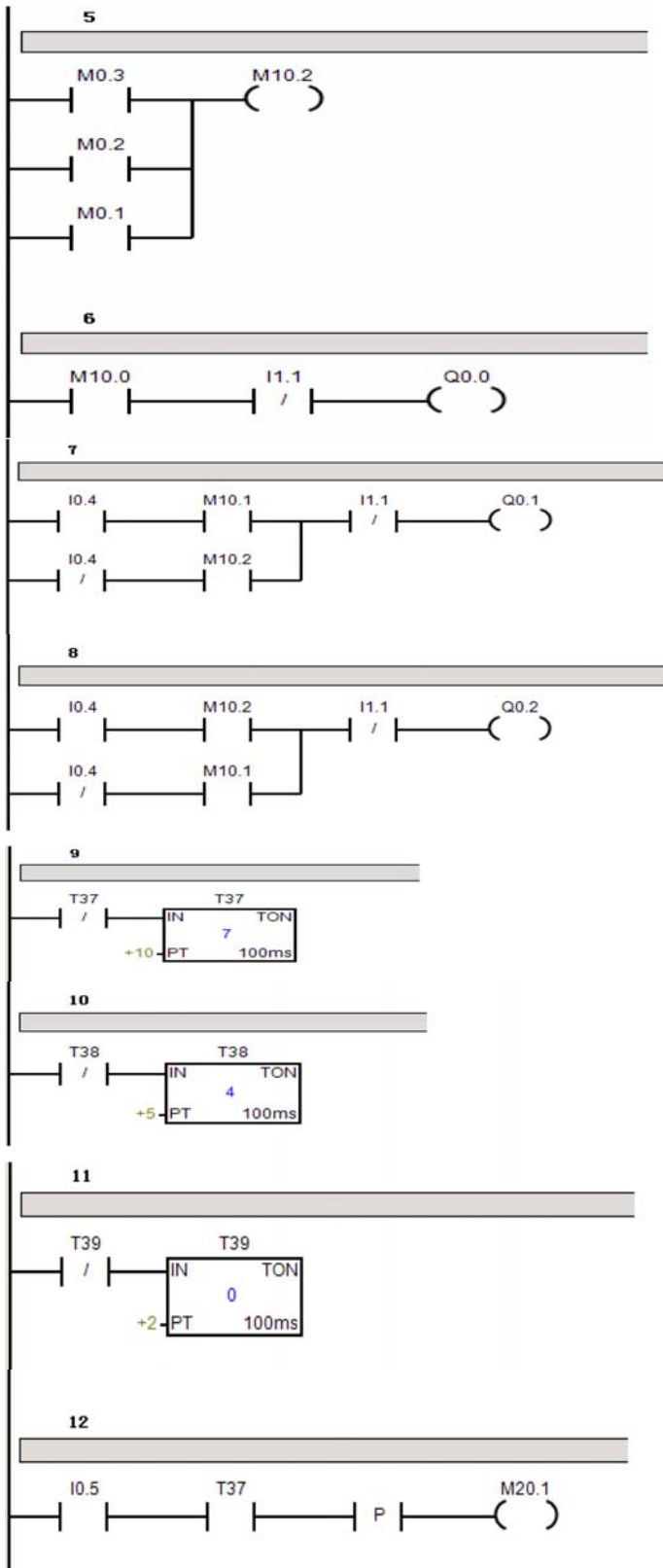
$$A \text{ phase } Q0.0 = M0.6 + M0.5 + M0.1$$

$$B \text{ phase } Q0.1 = M0.2 M0.3 + M0.1$$

$$\text{Phase C } Q0.2 = M0.4 M0.5 + M0.3$$

##### C. Ladder diagram program and their comments





Ladder diagram to explain

Networks 1: assignment of startup for displacement registers its lowest 1; To the highest level displacement register M0 again for the most low fu 1;

Internet 2: M0.0 most data input, S\_BIT to register its lowest, moving six consecutive to the left operation; CO to control the operation of 10 steps; C1 to control the operation of 100 steps;

Network 3-5: according to table 3 logical relationship, for three phase six circular distributor;

Network 6-8: the output signal to realize, is the positive & negative drive (three-phase output);

Network: September 11 by timer pulse transmitter (T37 for slow, T38 for medium speed, T39 for rapid), is the pulse generator;

Network 12: single-step operation;

Network 13: pulse controller;

Network 14 to 15: steps by steps set of control;

## V. SUMMARY AND OUTLOOK

This article will stepper motor at both ends of the wire winding to the output points of PLC, controlled by program each coil electricity, according to certain order to achieve positive & negative, realize low speed, high speed, medium speed and switch operation; A precise control of stepping motor steps, write out the implementation program block diagram and the implementation process. We hope the precise trajectory control will be studied and discussed in the future

## REFERENCES

- [1] Core and Attribute Reduction Algorithms Based on Compatible Discernibility Matrix[A]. Proceedings of the 2009 International Conference on Computational Intelligence and Natural Computing(Volume 2)[C]. 2009
- [2] A Classification Algorithm Based on Simplified Fuzzy Rules Base[A]. Proceedings of 2010 Third International Symposium on Knowledge Acquisition and Modeling (KAM 2010)[C]. 2010
- [3] Simplified Virtual Instrument Design Based on Mini Interface [A]. Proceedings of 2010 First International Conference on Cellular, Molecular Biology, Biophysics and Bioengineering(Volume 1)[C]. 2010
- [4] Simplified Support Vector Machine Method for QRS Wave Detection[A]. Proceedings of 2009 IEEE 10th International Conference on Computer-Aided Industrial Design & Conceptual Design[C]. 2009
- [5] V. V. Athani. Stepper Motors: Fundamentals Applications and Design. . 2007
- [6] Paul Acamley. STEPPING MOTORS: a guide to theory and practice. . 2002
- [7] D.O. Carrica, S.A. Gonzalez, M. Benedetti. A high speed velocity control algorithm of multiple stepper motors. Mechatronics . 2004
- [8] El-Sharkawi, M.A, Yonghong Guo. Adaptive fuzzy control of a belt-driven precision positioning table. IEEE International Conference on Electric Machines and Drives. 2003
- [9] Petar Crnosiga, Branislav Kuzmanovic, Stipe Ajdukovic. Microcomputer implementation of optimal algorithms for closed-loop control of hybrid stepper motor drives. IEEE Trans. Industrial Electronics. 2000