Speed Measurement for a Stepper Motor Based on a Programmable Logic Conroller

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Abstract

In order to realize the precise positioning of the moving equipment, this paper controls the speed of the stepping motor by using the programmable logic controller (PLC), which has achieved the purpose of accurate positioning. In the case of non-overload, the speed and stop position of the motor depend only on the frequency and the number of pulses of the pulse signal, and are not affected by the change of the load. According to different working conditions, the rotor rotates at a fixed angle step by setting the step angle of the stepping motor. Through the setting of the specific pulse, the accurate and stable operation of the stepping motor is realized.

Keywords

Programmable logic controller(PLC); speed measurement; stepper motor; impulse.

1. Introduction

As been widely used, but stepping motor cannot be used as ordinary DC motor. It must be made up of double ring pulse signal, power drive circuit and so on. Therefore, it is not easy to make good use of stepper motor. It involves a lot of professional knowledge, such as machinery, motor, electronics, computer and so on. Stepping motor, as an executive component, is one of the key products of mechatronics. It is widely used in various automatic control systems. With the development of microelectronics and computer technology, the demand for stepping motor is increasing day by day.

2. Principles and Methods

2.1 Principle of Measuring Rotational Speed of Stepping Motor

The two methods of measuring the rotational speed of stepping motor in this experiment are based on the principle of "number of rotation coils / rotation time", but in the process of PLC programming, two different programs can be designed to measure the rotational speed:

In the process of experiment, the rotation speed is obtained by measuring the number of rotation coils and rotation time of stepping motor. The principles of this method are easy to understand and to think of:

$$v = \frac{n}{t}$$

In the application of the SPD instruction of pulse frequency detection, the number of pulses received by the external pulse input is equal to the number of cycles rotated by the motor within the specified time of receiving the pulse. The main purpose of this instruction is to find out the proportional value of the speed of rotation, and the measured result of D is proportional to the speed of rotation. The following formula can be used to obtain the speed of the motor:

$$N = \frac{60(D0)}{nt} \bullet 10^3$$

Where: in the unit of: rpm

N -- the number of pulses generated by the rotation of a stepping motor.

T - S2 specified detection time (MS)

D0- the total number of pulses received by the receiver specified by S1 (such as X0) within the detection time specified in S2 at 4000ms.

2.2 Speed Measuring Method

Experimental method I:

In the course of the experiment, the number of rotation coils and the rotation time of the stepping motor are collected, and the speed of the motor is calculated. First of all, given the total number of pulses 15, 000 high-speed output 1000 pulses per second.

Every time the stepping motor rotates around, the sensor that approaches the switch generates a pulse signal along the rising edge. In this experiment, the stepping motor rotates 30 cycles, the motor rotation time is measured, and the motor speed is obtained. As is shown above Fig.1 PLC program.

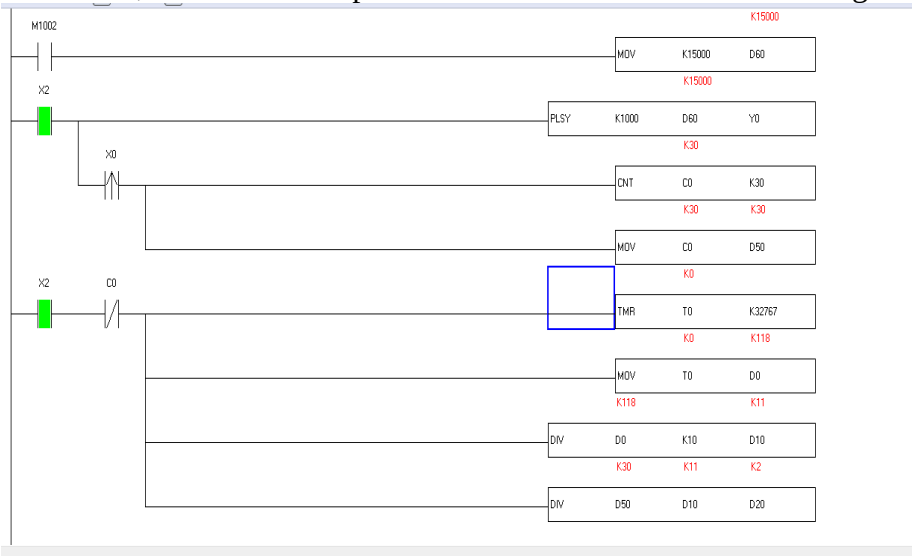

Fig 1. PLC program

Experiment method 2: there are two methods for measuring rotational speed with SPD instruction.

The first method is: 2 phase 4 wire stepping motor 57BYG250-56, its phase number is 2, set 4 thin. The step distance was 0.45 °and the current was 0.3 Ma. Given a pulse frequency of 800 Hz, the rotation time is 5 s. By approaching the switch, the stepping motor produces a pulse at every turn. During the experiment, only how many pulses are generated in the specified time can be detected. As is shown above Fig.2 PLC SPEED MEASUREMENT & Fig.3 PLC program.

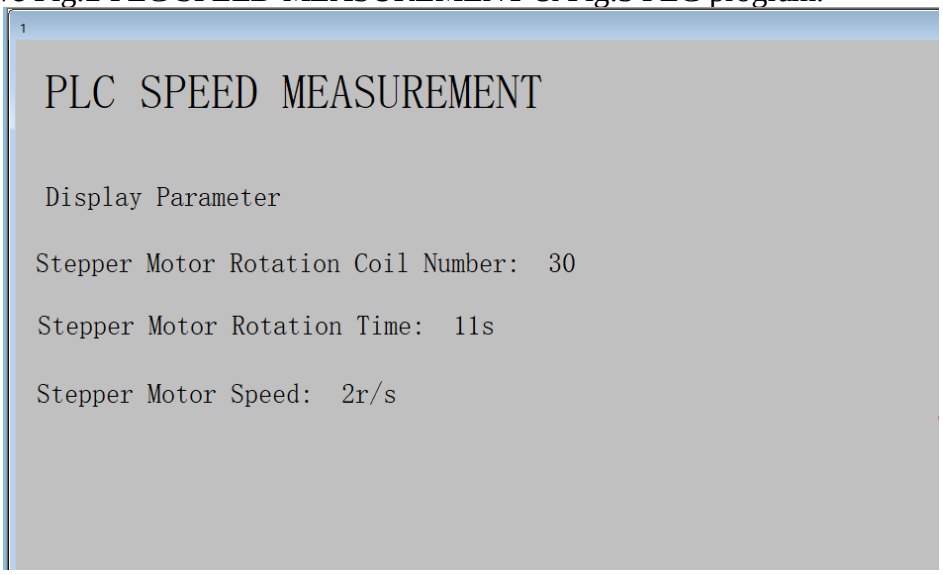

Fig 2. Plc speed measurement

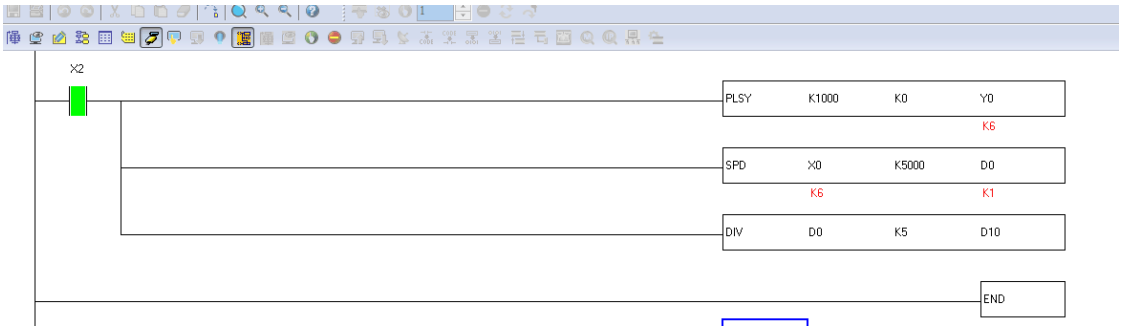

Fig 3. PLC program

The second method: using SPD to measure rotational speed. External pulse input within specified time of receiving pulse. The number of pulses received is equivalent to how many cycles of the motor rotation. The main purpose of this instruction is to obtain the proportional value of the rotational speed, and the result of the measured D is proportional to the speed of the rotation. The main idea of the program is the application of the following formula:

$$N = \frac{60(D0)}{nt} \bullet 10^3$$

Where: in the unit of: rpm

N -- the number of pulses generated by the rotation of a stepping motor.

T - S2 specified detection time (MS)

D0- the total number of pulses received by the receiver specified by S1 (such as X0) within the detection time specified in S2 at 4000ms

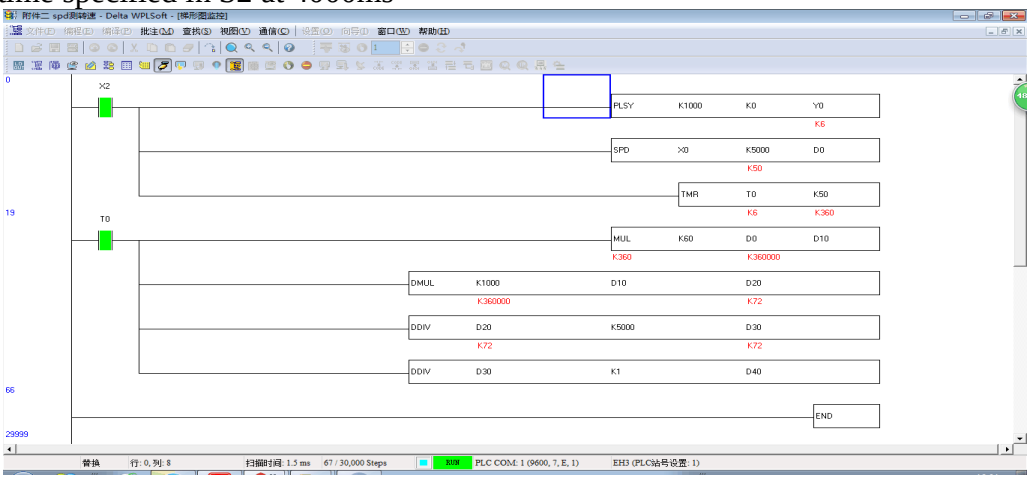

Fig 4. PLC program

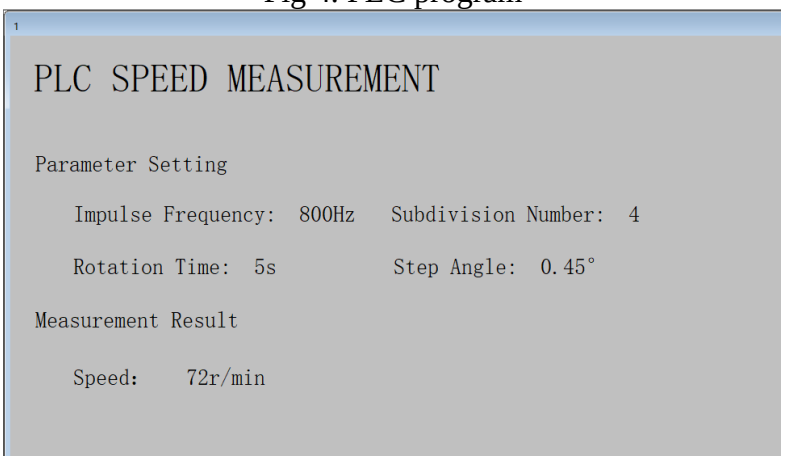

Fig 5. Star configuration interface

3. Analysis and Discussion of the Results

In the course of the experiment, the number of turns on and off is calculated by the close switch, the turning time is calculated by the timer, the rotational speed is calculated directly by the rotational speed formula, and the error is compared within the range of the experimental error.Fig.5 Star configuration interface.

In many experiments, the rotational speed is measured under the condition of constant frequency and different number of rotating circles, and the precision of the test is improved under the condition of constant frequency and different number of rotating circles.

The display of decimal by 3.PLC is insufficient, and the experimental data is rounded to a whole number.

References

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