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# MODELING OF A BIPOLAR STEPPER MOTOR DRIVER ON ATTINY261 MICROCONTROLLER

**Yemelyev Alikhan Kadyrzhanovich[1], Amangul Talgat[2]**
98_alikhan@mail.ru
[1]L.N. Gumilyov, 1th year master's student of the Department of «Space Technique and Technology»,
[2]Kazakh University of Technology and Business, master of technical science, senior teacher Department of «Information Technologies», Kazakhstan
Supervisor – Khuralay Moldamurat

**Intoduction**

Stepper motors are brushless DC motors that can rotate from 00 to 3600 in discrete steps. With each control signal, the axis of such a motor rotates by a fixed value (step). The rotation of such motors is controlled by a sequence of special signals. Unlike servomotors, stepper motors can be controlled by general-purpose I/O pins, not just PWM modulation pins, and can rotate at (+3600) and (-3600). The sequence of control signals determines whether the stepper motor rotates clockwise or counterclockwise. To control the speed of rotation of such a motor, you simply need to change the level of control signals. Stepper motors have several modes of stepper (discrete) rotation – full-step, half step, and micro-step.

This 4-wire bipolar stepper motor driver can find many applications in the design of automation systems. Despite the simplicity of the design, a number of useful functional features characterizes the system.

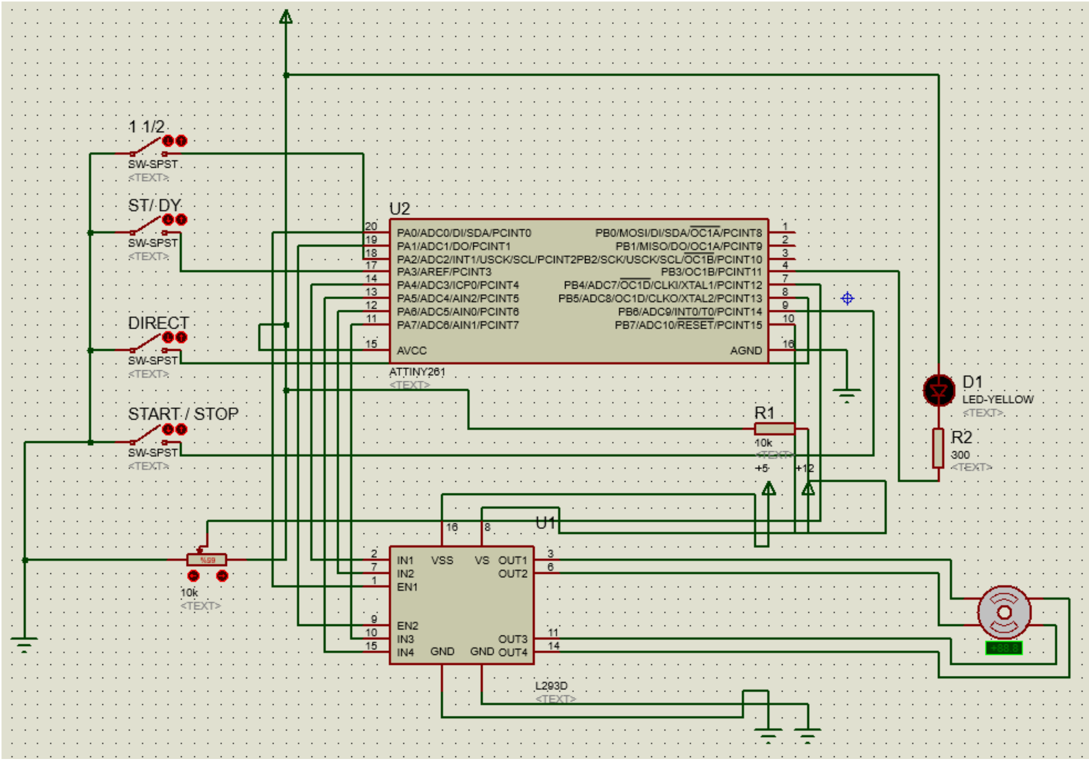

Figure 1. Schematic diagram of the bipolar stepper motor driver

The driver is powered by a DC 12V power supply. The VD1 diode protects the circuit from erroneous connection of the input voltage polarity, and the capacitors C2...C5 act as a power filter.

The input voltage is applied to the voltage stabilizer DA1 (78L05), which provides the required voltage of +5 V for the operation of the microcontroller. The stepper motor driver is controlled by the DD1 microcontroller (ATtiny261), which is powered by an internal clock generator.

Direct power control of the stepper motor is carried out by the DD2 chip (L293D), which is an assembly of two H-bridges.

The R1 potentiometer is used to adjust the rotation speed. The HL1 LED indicates the operating status of the device.

The Direct and Start/Stop switches are used to control the selection of the direction of rotation and the braking of the engine, respectively.

The jumpers 1/0,5 and ST/DY are used to configure the driver operation mode. The 1/0.5 jumper is used to select the engine operating mode. If there is no jumper-step-by-step operation, the jumper is installed-half a step.

Step-by-step operation is the simplest way to control a stepper motor, and half-step operation is to add intermediate states to the control. In practice, this results in smooth motor operation, but increases current consumption by about 50-60%.

The ST/DY jumper is used to select the engine braking method. There is no jumper — static braking, the jumper is installed-dynamic braking.

When braking the stepper motor in dynamic mode, braking is carried out by applying voltage to the corresponding coil. In practice, this causes the motor axis to lock at one point, but causes significant current consumption and heating of the windings.

Braking in static mode is performed by turning off the engine power. In this case, there is a minimum current consumption (at rest), but the motor axis can turn freely.

All changes to the controller configuration made with the 1/0,5 and ST/DY jumpers will only be active after the power supply voltage is reset.

We can see in Figure 2 that our engine is running.

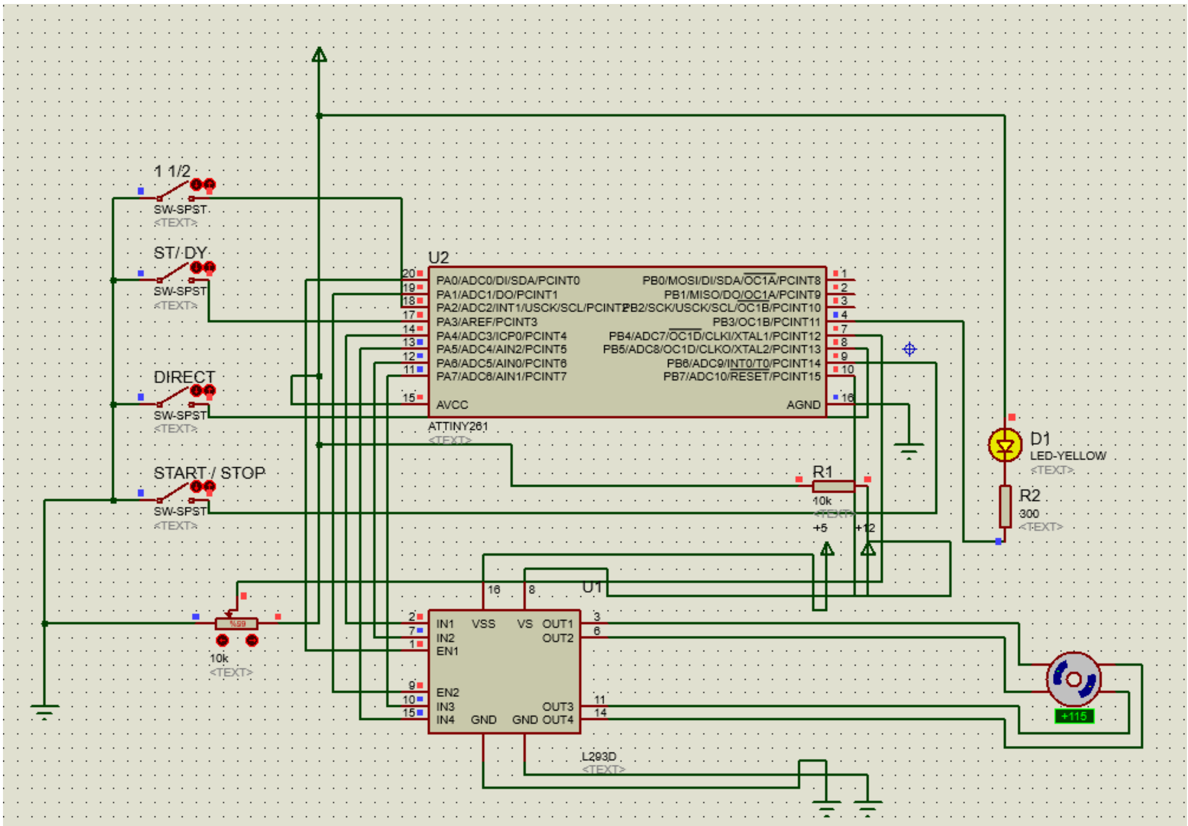


Figure 2. Simulation of a stepper motor in the Proteus programming environment

**Conclusion**

Stepper motors directly convert the control signal in the form of a sequence of pulses to a proportional number of pulses and a fixed angle of rotation of the shaft or linear movement of the mechanism without a feedback sensor. This fact simplifies the drive system and replaces the closed system of the tracking drive (servo) with an open one, which has such advantages as reducing the cost of the device (fewer elements) and increasing accuracy due to the locking of the stepper motor rotor in the absence of signal pulses.

The disadvantage of a stepper motor drive is also obvious: when a pulse fails, further tracking occurs with an error in the angle proportional to the number of missed pulses.

Therefore, in tasks where high performance (accuracy, speed) is required, servomotors are used. In other cases, because of the lower cost, simple operation and good accuracy, stepper motors are usually used.

**Literature**

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