Stepper Motor Experiment

Introduction of Stepper Motor

Stepper motor is an open-loop control element stepper motor which converts electrical impulses into angular displacement. Generally, when the stepper driver receives the pulse signal, it will drive the stepper motor to rotate by a certain Angle according to the set direction (i.e. stepper Angle). You can control the angular displacement by controlling the pulse amount, so as to achieve the purpose of accurate positioning, and also by controlling the pulse frequency to control the motor speed and acceleration, so as to achieve the purpose of speed control.

Classification of Stepper Motor

Permanent Magnet (PM) : It is generally with two phase, torque and volume are low, the stepping angle is 7.5 degrees or 15 degrees.

Reaction (VR) : It is generally with three phase, which can realize large torque output, the stepping angle is 1.5 degrees commonly, but the noise and vibration are quite enormous.

Hybrid (HB) : It combines the advantages of permanent magnet and reaction and is divided into two and five phase: two phase stepping angle is 1.8 degrees and five phase stepping angle is 0.72 degrees in general. This kind of stepping motor is more widely used.

Technical Parameters

The static indicators of stepper motor

Step Angle:

This means that each time the control system sends out a stepper pulse signal, the fixed Angle of a permanent magnet stepper motor is 3.75 ° 7.5 °(1/2 °) .The step drive value is 3.75 °and the full step drive is 7.5 °). Stepper Angle can be called "stepper motor fixed Angle", it is not necessarily working electricity .The actual Angle of the machine, the actual Angle depends on the driver.

The phase number:

It refers to the number of coils in the motor. At present, the commonly used stepper motor is two - phase, three - phase, four - phase and five - phase motor. The step Angle of the motor varies with the phase number. Generally, two-phase motors have a stepping Angle of 0.9 ° 1.8 °, a three-phase of 0.75 ° 1.5 °, and a five-phase of 0.36 ° 0.72 °. When there is no

subdivided driver, users mainly choose different phase number motors to meet the stepper Angle requirements. If you use a subdivision driver, the "number" of phase digits becomes meaningless, and the user only needs to change the subdivision number of drives and then can move the step Angle.

Clap number:

It refers to the number of pulses or conduction state required to complete the periodic change of the magnetic field. It can also be defined as the number of pulses at a certain step Angle of the motor rotation. Let's take A four-phase motor as an example. The four-phase and four-beat modes are ab-bc-cd-da-ab, and the four-phase and eight-beat modes are a-ab-b-bc-c-cd-d-da-a.

The dynamic indicators of stepper motor

The precision of stepping angle

It refers to the error between the actual value and the theoretical value when a motor turns a certain step angle. Expressing as a percentage: the angle error / step angle* 100%. This value varies with the number of beats, when the motor runs by 4 beats, it should be within 5%, 8 beats within 15%

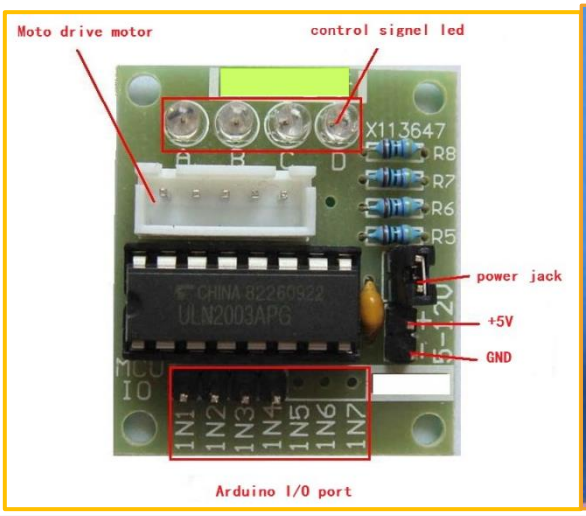
Out of step

When the drive pulse number for the motor is not equal to the steps during operation, we will call this out of step.

The misalignment angle

When the rotor tooth axis is offset from the stator tooth axis, the motor must have misaligned Angle. The error caused by misaligned Angle cannot be solved by subdivision drive.

The stepper motor used in this experiment is 28byj-48, and the voltage is dc5v-dc12v. When a series of continuous control pulses are applied to the stepper motor, it can rotate continuously. Each pulse signal corresponds to a change in the electrified state of a phase or two-phase winding of the stepper motor, which corresponds to a certain Angle of rotation of the rotor (a step Angle). When the change in the energized state completes a cycle, the rotor turns a pitch.



parameter

Diameter: 28 mm

Voltage: 5 v

Step Angle: 5.625 x 1/64

Deceleration ratio: 1/64

Positioning torque >300g.cm

Stepper motor no-load power consumption is less than 50mA, equipped with 64 times reducer, namely 64 drive pulse.If the outer belt rotates once,

Since the reduction gear in the motor is 1:64, the spindle of the stepping motor needs to be rotated 64 times. Output torque is large, so can drive heavy load, suitable for development board.Note: the stepper motor is equipped with a 64 - speed reducer, with

The speed is slower when there is no reducer.For easy observation, we can paste a piece of cardboard on the output shaft.

Driving Modes of Stepper Motor

The driving mode of stepper motor is also called excitation mode, which is divided into full step excitation and half step excitation. The former can also be divided into single-phase (single beat drive) and two-phase (full step drive); The latter also refers to one-phase two-phase excitation (one-step drive)

Drive mode	Step Angle	Power Consumption	Advantages and disadvantages
Single step	5.625	P	Simple control, low consumption, but the minimum output torque, vibration is larger, when step easy alienation
Full step	5.625	2P	Maximum power consumption, large output torque, small vibration, step

			is stable
Half step	2.8125	1.5P	Performance between step taken in single drive and the drive, only half the stepping Angle, smooth operation, the most widely used

The timing tables of the three drive mode:

Wire/step	Step1	Step2	Step3	Step4	Step5	Step6	Step7	Step8
Blue/A	1	1	0	0	0	0	0	1
Pink/B	0	1	1	1	0	1	0	0
Yellow/C	0	0	0	1	1	1	0	0
Orange/D	0	0	0	0	0	1	1	1

(c). Half step

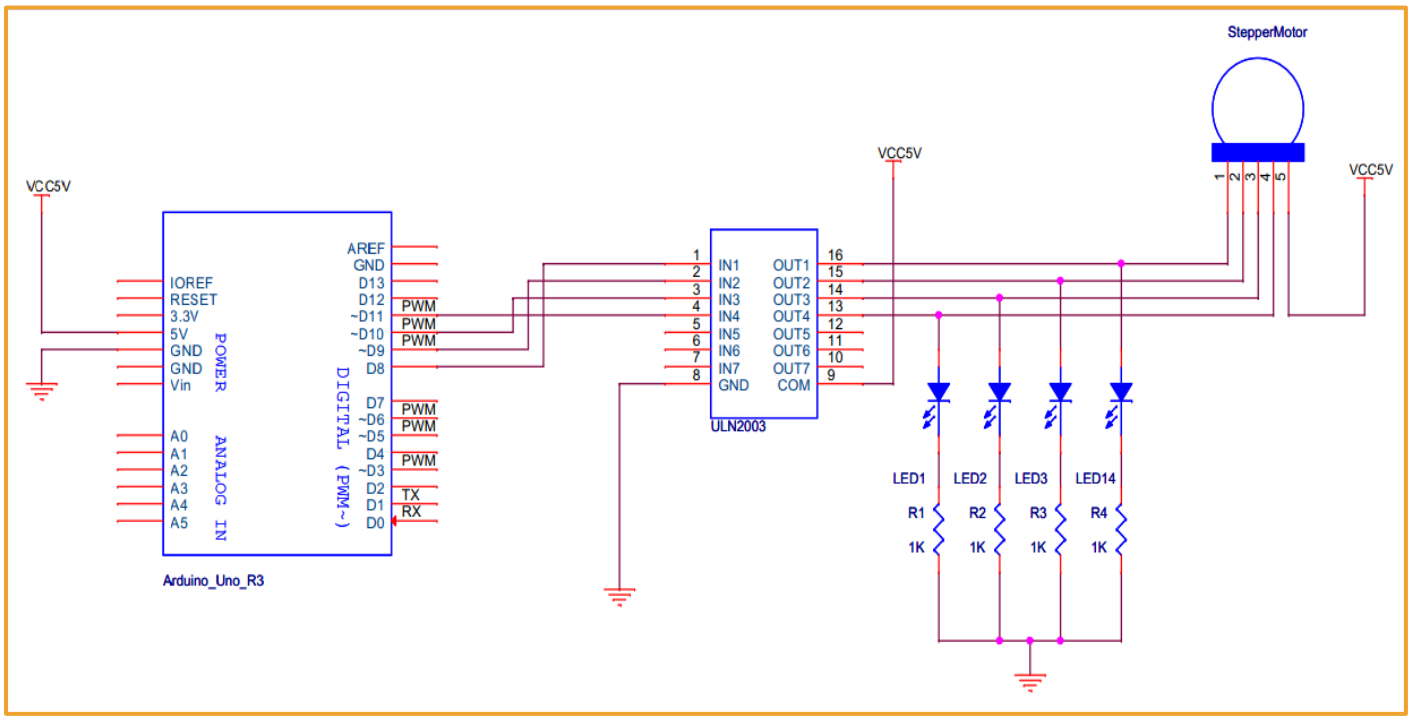
Wire/step	Step1	Step2	Step3	Step4
Blue/A	1	0	0	0
Pink/B	0	1	0	0
yellow/C	0	0	1	0
orange/D	0	0	0	1

Single step

Wire/step	Step1	Step2	Step3	Step4
Blue/A	1	0	0	1
Pink/B	1	1	0	0
Yellow/C	0	1	1	0
orange/D	0	0	1	1

Full step

Schematic Diagram



Experiment principle

In this experiment, we choose the single-step drive mode, so the stepper motor is driven according to the figure (c) above. The step Angle is 5.625. In order to make the step-motor equipped with reducer rotate the whole circle, it needs (360/5.625) * 64 = 4096 pulses 28byj-48 step-motor can rotate one circle

The component list

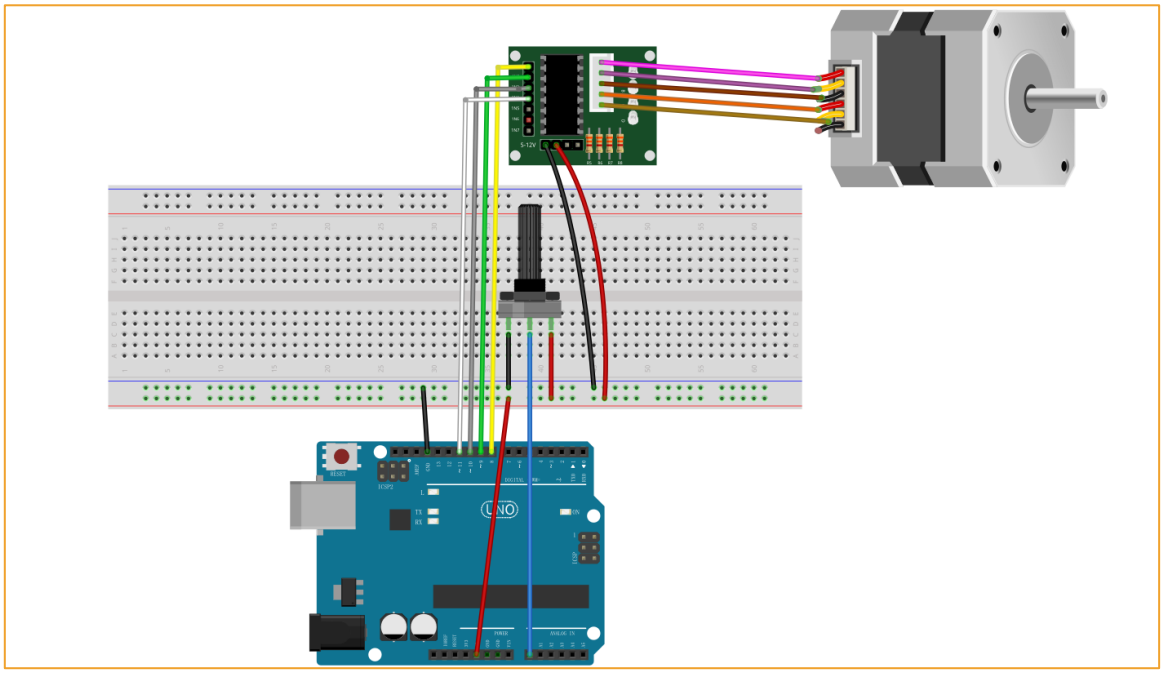
- Arduino UNO mainboard
- 28BYJ-48stepper motor
- ULN2003 stepper motor driving board
- Cables
- Little piece pf papers

Wiring of Circuit

Arduino Uno R3	ULN2003
8	IN1
9	IN2
10	IN3
11	IN4

GND	-
VCC	+

ULN2003	Stepper Motor
A	Blue
B	Pink
C	Yellow
D	Orange
VCC	Red



Code

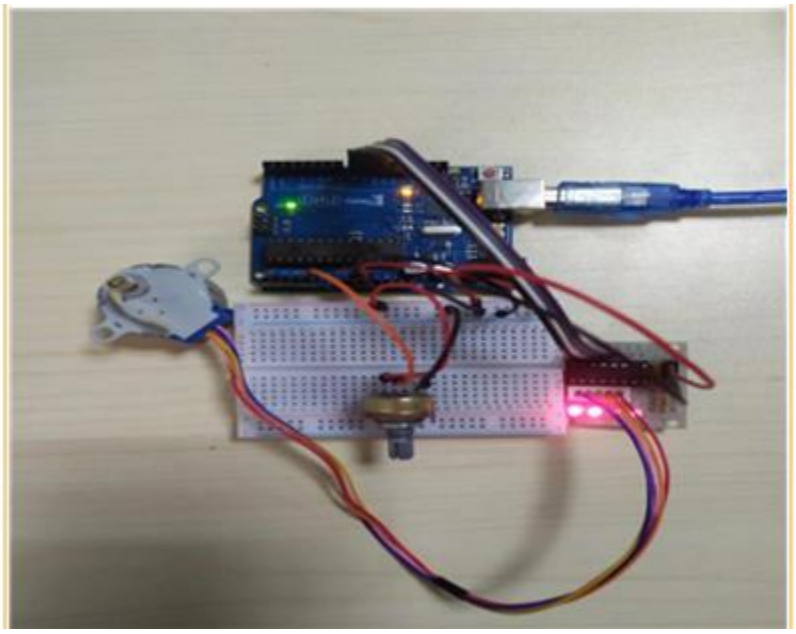
```
#include <Stepper.h>
#define STEPS 64   // create an instance of the stepper class, specifying// the number
of steps of the motor and the pins it's// attached to
Stepper stepper(STEPS, 8, 9, 10, 11);// the previous reading from the analog input
int previous = 0;

void setup() {
  stepper.setSpeed(200);
  pinMode(A0, INPUT);
}
void loop() {
  // get the sensor value

  int val = analogRead(A0);
  stepper.step(val - previous);  // remember the previous value of the sensor
  previous = val;
}
```

Stepper. Step (int steps) this function is used to turn the motor by how many steps. When steps are positive, the stepper motor turns forward; when steps are negative, the stepper motor reverses

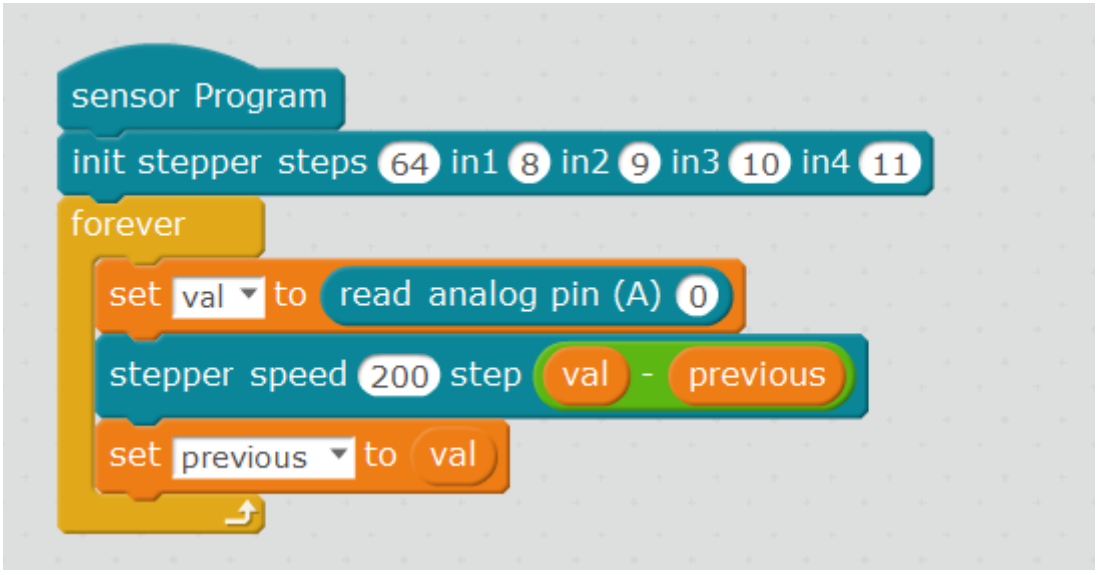
If we want to give in to the motor for one turn then we need to give steps = (360/5.625) *64(reduction ratio)/4(4 beats per step)=1024

In other words, stepper.step (1024) stepper motor is rotating one turn. Stepper. step (-1024) stepper motor is reversing one turn.

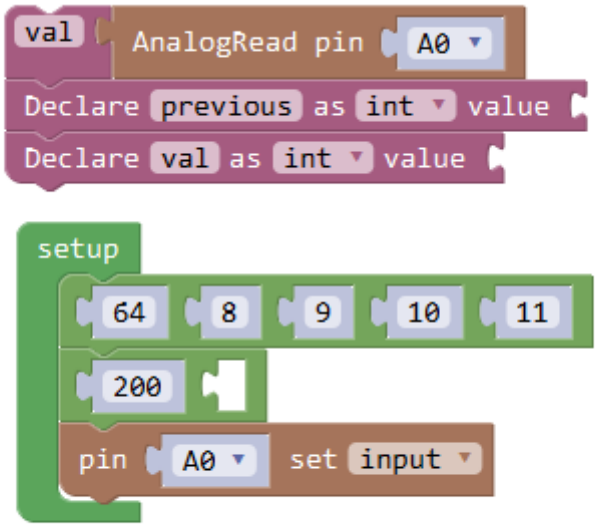
Experiment Result



Mblock programming program



Mixly graphical programming



MagicBlock graphical programming