Lesson1 Introduce of MG996R Servo

Table

1. What's the Servo

Servo motors are commonly referred to as servos, which are small devices with output shafts. When we send a control signal to the server, the output shaft can be turned to a specific position. As long as the control signal remains constant, the servo mechanism will maintain the angle position of the shaft unchanged. If the control signal changes, the position of the output shaft will also change accordingly.

A servo is a type of position servo driver, mainly composed of a casing, circuit board, coreless motor, gears, and position detector. Its working principle is that the receiver or microcontroller sends a signal to the servo, and there is a reference circuit inside it that generates a reference signal with a period of 20ms and a width of 1.5ms. The obtained DC bias voltage is compared with the voltage of the potentiometer to obtain a voltage difference output. The direction of rotation is determined by the IC on the circuit board, and then the non core motor is driven to start rotating. Power is transmitted to the swing arm through the reduction gear, and a signal is sent back by the position detector to determine whether the positioning has been reached. Suitable for control systems that require constant angle changes and can be maintained. When the motor speed is constant, the potentiometer is driven to rotate by a cascaded reduction gear, causing a voltage difference of 0 and the motor to stop rotating. The general rotation angle range of a servo is from 0 degrees to 180 degrees.

In daily life, servos are often used for remote control of airplanes, cars, robots, and other fields. Servo motors are very useful in the field of robotics. Because servo motors have built-in control circuits, although their size is small, their output force is large enough. A standard servo like the Futaba S-148 can provide a torque of 0.3 N/m, which is already powerful enough compared to its external size. Meanwhile, the energy consumed by the servo is directly proportional to the mechanical load. Therefore, a lightweight servo system will not consume too much energy.

2. Physical map, pins and parameters of the Servo

2.1Physical map

As shown in the figure below, a single MG996R Servo consists of three parts: servo, servo plate, and screws

2.2 Pins

2.3 Parameters

2.3.1 Electrical parameters

No.	Item	Specification
2.3.1.1	Operating Voltage	6V
2.3.1.2	No Load Speed	0.2sec/60degr ee
2.3.1.3	Running Current(no load)	220mA
2.3.1.4	Stall Torque(at locked)	10.1kg.cm
2.3.1.5	Stall Current(at locked)	≧2100mA
2.3.1.6	Idle Current(at stopped)	10mA
2.3.1.7	Input Voltage	4.8~7.2v
2.3.1.8	Rated Torgue	0.75kg.cm
2.3.1.9	Rated Current	400mA
2.3.1.10	Kt	3.5kg.cm/A

2.3.2 Structural parameters

No.	（Item）	Specification
2.3.2.1	Size	40.5X20X39.3mm
2.3.2.2	Limit Angle	360degree
2.3.2.3	Case material	Nylon fiber
2.3.2.4	Gear material	Copper
2.3.2.5	Type	25T/5.9mm
2.3.2.6	Wire length	550±5mm
2.3.2.7	The Weight	60± 1g
2.3.2.8	Horn Type	25T/5.9mm
2.3.2.9	Gear Ratio	1/260
2.3.2.10	Back Lash	≦2.0°
2.3.2.11	Life	100000Cycles Min

2.3.3 Control parameter

No.	（Item）	Specification
2.3.3.1	Command Signal	Pulse width modification
2.3.3.2	Control System Type	Digital Comparator
2.3.3.3	Operating Travel	180° (at 500→2500 μ sec)
2.3.3.4	Left&Right Travelling Angledeviation	≤ 5°
2.3.3.5	Centering Deviation	≦2°
2.3.3.6	Neutral Position	1500 μ sec
2.3.3.7	Dead Band Width	≤8 μ sec
2.3.3.8	Rotating Direction	Counterclockwise(在 1500→2000 μ sec)
2.3.3.9	Pulse Width Range	500→2500 μ sec

Support :cokoino@outlook.com

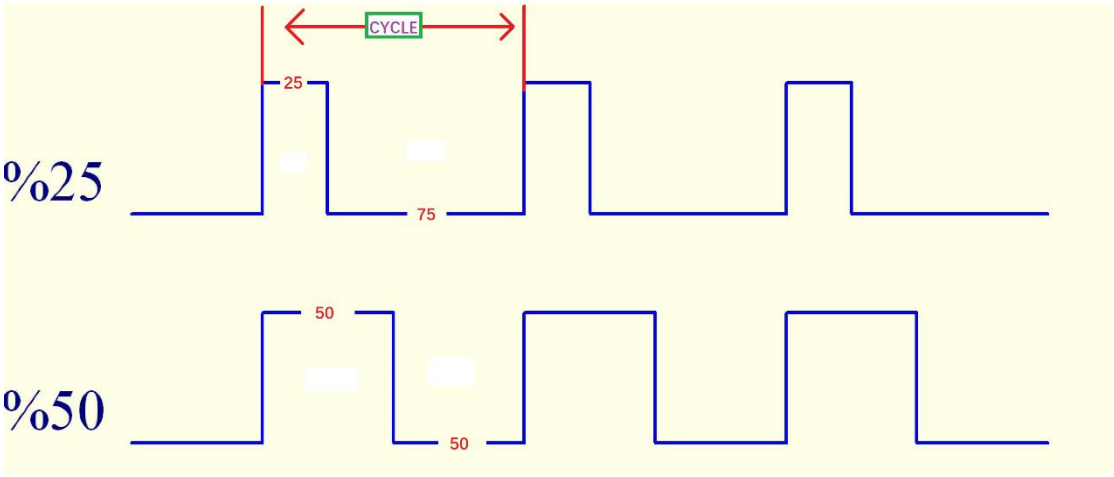
3. Working Principle

The control signal of the servo is a PWM signal with a period of 20ms, in which the pulse width is from 0.5ms-2.5ms, and the corresponding position of the servo is 0-180 degrees, which changes linearly.Provide it with a certain pulse width, and its output shaft will remain at a corresponding angle, no matter how the external torque changes, until a new pulse signal of different width is provided to it, it will change the output angle to the new corresponding position. There is a reference voltage inside the servo, which generates a reference signal with a period of 20ms and a width of 1.5ms. There is a comparator that compares the applied signal with the reference signal to determine the direction and size, thereby generating the rotation signal of the motor. The internal control circuit board of the servo receives the control signal from the signal line, and controls the rotation of the motor. The motor drives a series of gear sets, which are driven to the output steering wheel after deceleration. The output shaft of the servo is connected to the position feedback potentiometer. When the steering wheel rotates, it drives the position feedback potentiometer. The potentiometer will output a voltage signal to the control circuit board for position feedback. The control circuit board determines the rotation direction and speed of the motor according to the position of the output shaft, so that the output shaft stops when it reaches the target.

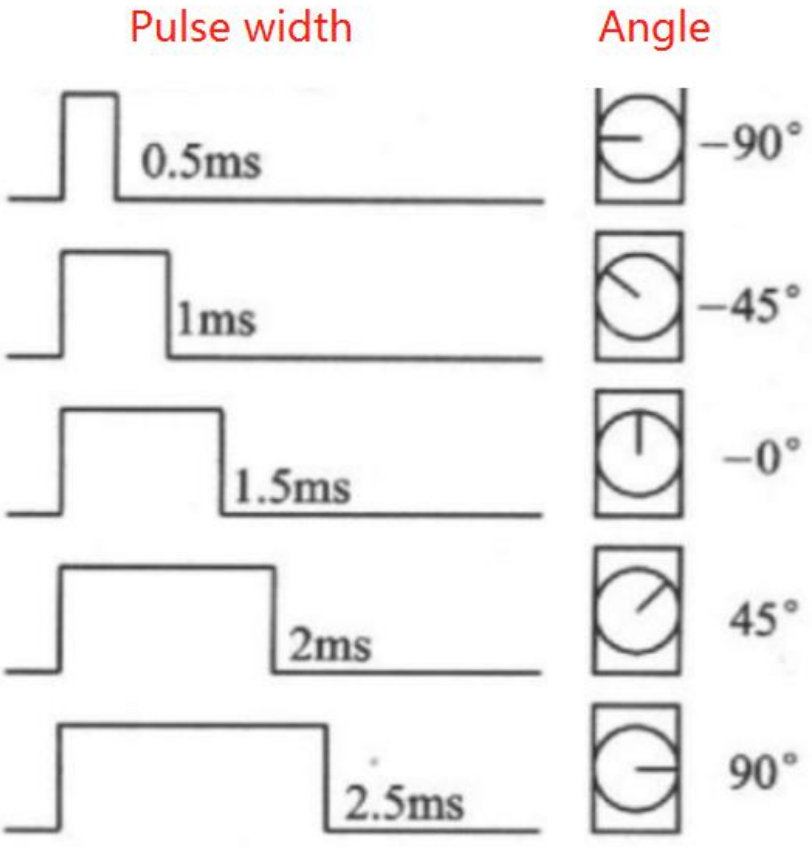
4. PWM Control

4.1 PWM Introduction

Pulse width modulation (PWM) refers to the use of the digital output of a microprocessor to control an analog circuit, and is a method of digitally encoding the level of an analog signal.
PWM (Pulse Width Modulation): Pulse Width Modulation
Pulse: square wave, frequency (freq)
Width: the width of the high level, the duty cycle (duty)
Cycle: CYCLE
Duty cycle: the proportion of high level (100&%)
Duty cycle static diagram:



4.2 The relationship between the output angle of MG996R Servo and the pulse width of the input signal



CYCLE=20ms

Duty_16=65532*Pulse Width/CYCLE

The relationship between the corresponding pulse width and duty_u16:

Pulse Width(ms)	Duty_16
0.5	1638
1	3276
1.5	4914
2	6552
2.5	8192

5. Test

We provide three test methods for your reference

5.1 To test MG996R Servo with Arduino Uno board, please refer to the document "MG996R Servo Kit Tutorial/Testing MG996R Servo by Arduino"

5.2 To test MG996R Servo with Raspberry Pi Pico, please refer to the document "MG996R Servo Kit Tutorial/Testing MG996R Servo by Pico"

5.3 To test MG996R Servo with Raspberry Pi 4b, please refer to the document "MG996R Servo Kit Tutorial/Testing MG996R Servo by Raspberry Pi"

6. Matters needing attention

For MG996R Servo,the input voltage is 4.8v~7.2v， Running Current(no load)is 220mA,Rated Current is 400 mA,Stall Current (at locked)≧2100mA.

During use, it is important to provide sufficient power to the MG996R Servo. If the power is insufficient, the MG996R Servo may not operate or function properly, especially under load.

It is recommended to prepare the corresponding power supply when selecting the development board that drives MG996R Servo.

If using the Arduino Uno Board, it is necessary to prepare both the 18650 battery case and 18650 battery, or prepare an 8V2A adapter.

If choosing Raspberry Pi, it is necessary to also prepare the corresponding Raspberry Pi adapter.

If using Raspberry Pi Pico, please provide both an expansion board and corresponding power supply.

7. Make your suggestion and get support

THANK YOU for reading this document!

If you find errors, omissions or you have suggestions and/or questions about this doucment, please feel free to contact us: **cokoino@outlook.com**

We will make every effort to make changes and correct errors as soon as feasibly possible and publish a revised version.

If you want to learn more about Arduino, Raspberry Pi, Smart Cars, Robotics and other interesting products in science and technology, please continue to visit our Amazon Store by search for "LK COKOINO" on Amazon. We will continue to launch fun, cost-effective, innovative and exciting products.

Thank you again for choosing Cokoino products.

LK COKOINO