Six-servo Robot Arm

1, Introduction

1.1 ， Function Briefing

Servo robot, as the name suggests, is the six servo motor-driven robot arm. Since the arm has a few joints, we can imagine, our human arm, in addition to shoulder, elbow, and wrist, coupled with the finger joints; there are a lot of joints. So this robot is the same, with six servo motors to achieve a simple structure, no one apart from so many joints, but also lack some of nerve tissue and the nervous system, however, "dexterous hand" (which can be complexly Assembly, handling or catching eggs), "Humanoid" robot is a robot on the forefront.

And our six servo arm with wonderful mechanical structure, and its control system, displayed the 6-DOF robot arm movements control principle. It uses three pieces of 13 kg torque metal gear, a 3.2 kg, two pieces of 2.3 kg of servo and some sophisticated combination of aluminum alloy processing components. At present, our company's robot arm is mainly 390 mm length, use 32-way controller to control the operation of arm action, the controllers use atmega168 MCU, and computer RS232 COM communications, and at the same time it can control 32 servo motors, dual - Power Supply (6 ~ 12 V SCM power, 4.8 ~ 6 V servo motor power [servo motor power supply Road

1-16 respectively, a 17-32 road supply port]), also a wi-fi Wireless control

module, reserve the ISP downloaded, you can download the MCU controller

program using the STK500 ISP cable.

1.2, Main Board Power Connector Introduction
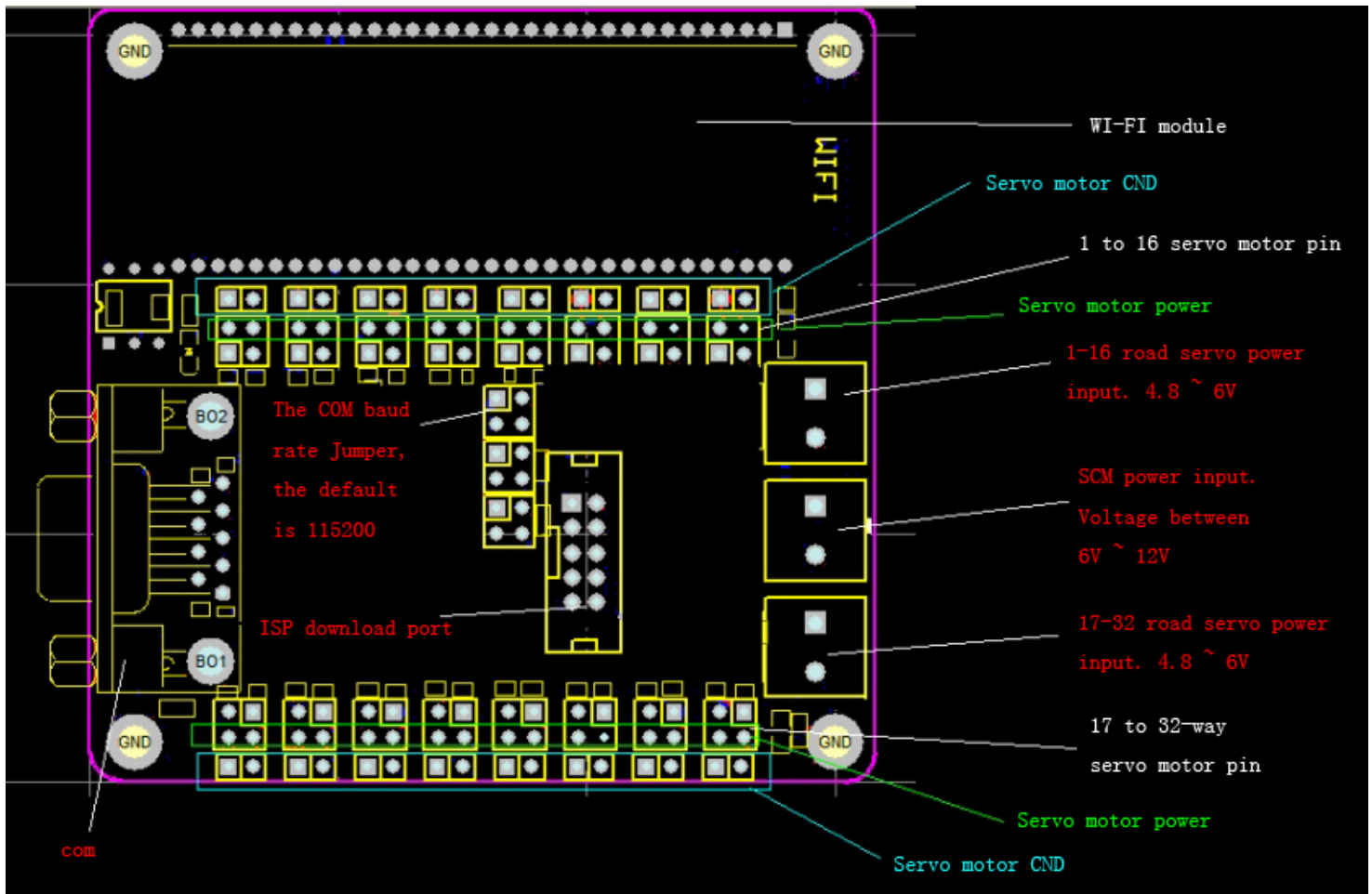
Road32 controller shows as Figure NO.1:

Figure NO.1

Note: See the above picture, dots mean connect to positive, squares connect to negative.

As shows Figure No.1: Read from the top, the board has three positive power inputs, in the middle there is a MCU power input. Using a voltage regulator to stable at 5 V. So the voltage is between 6 V to 12 V. The both sides supply power to Road 16 servo motor respectively. Input the voltage between 4. 8 V ~ 6V.

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1.3 ， Attention for Servo motor connector when plug into the motherboard

The contact pin of Servo motor has 32 lines, each line owns 3 pins. See the above Figure in blue words; the pins in the most lateral connect to GND. Power shows in the middle. The signal pin lays in the most inner (connect to the white or orange wires of servo motor).

1.4, Jumper Settings

The jumper in the middle is used to set baud rate, to plug the two jumpers, it represent the value is 11, baud rate is 115.2 k. To set up another baud rate, Please refer Figure No.5. (PC software the default setting is 115.2 K). The controller, as shown in Figure No.2:
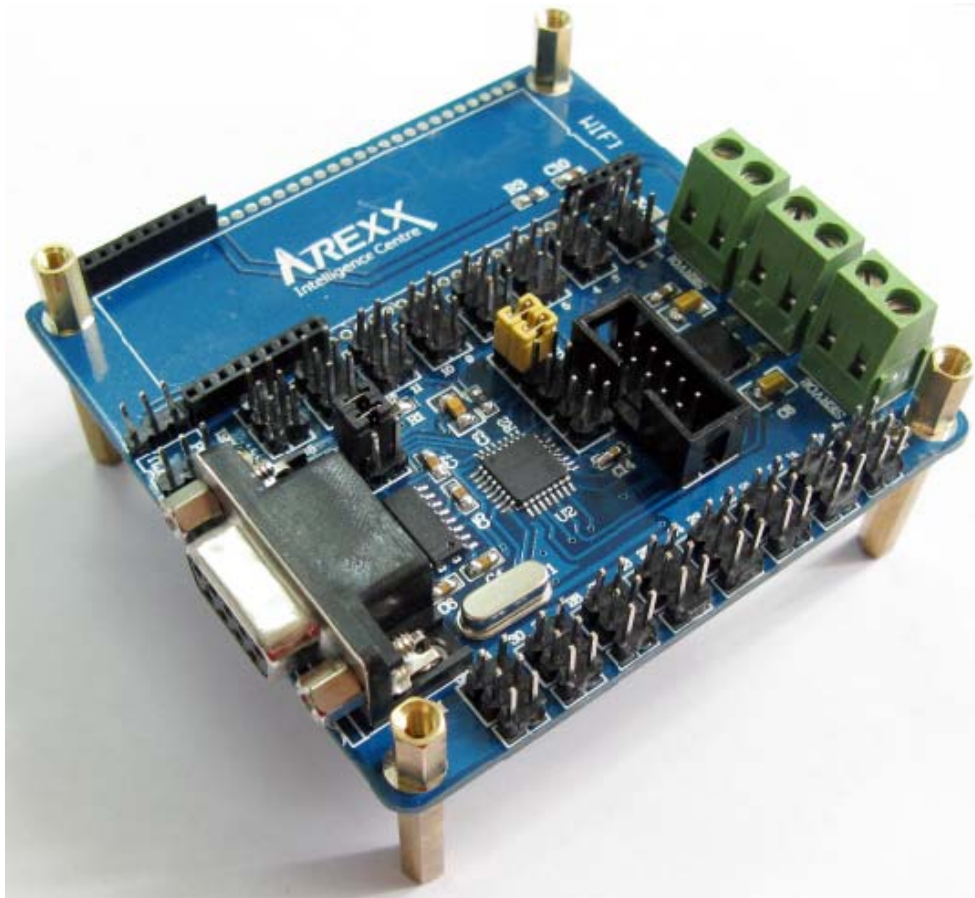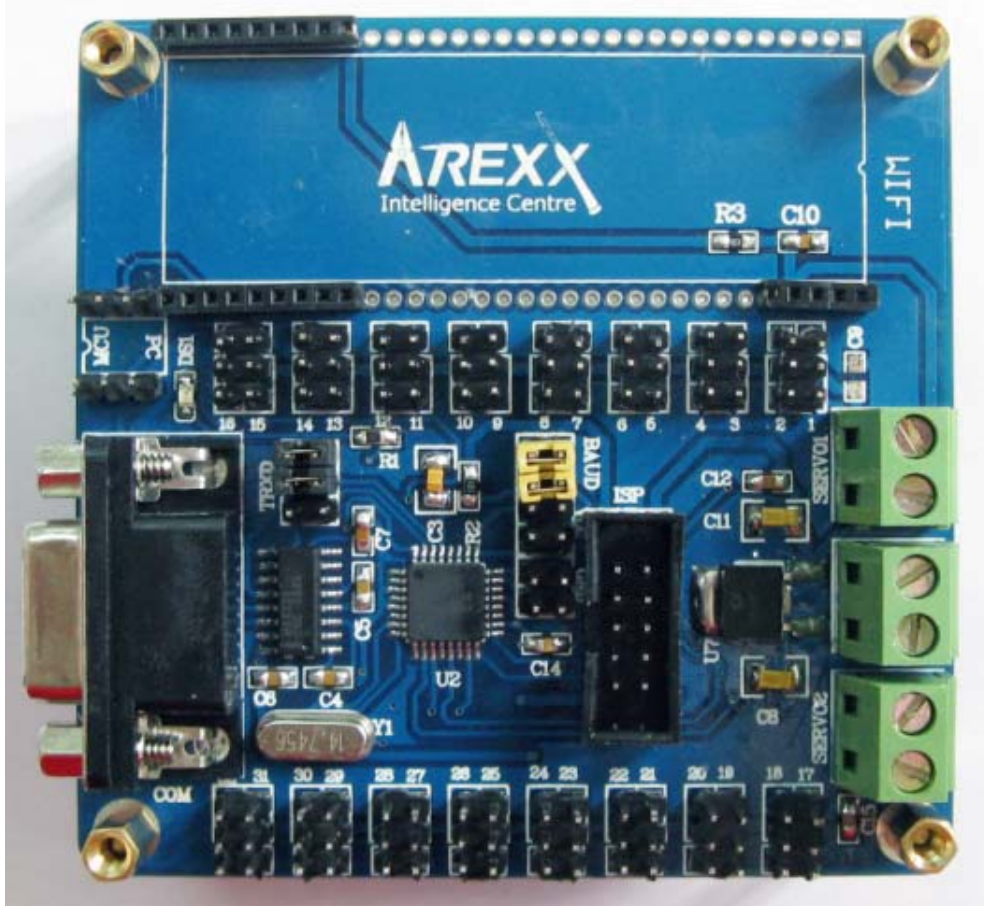
Figure No.2

1.5 ，Introduction of chips powered by Servo motor

MCU power supply, we have adopted six pieces AA batteries and it works. Showed as below ():
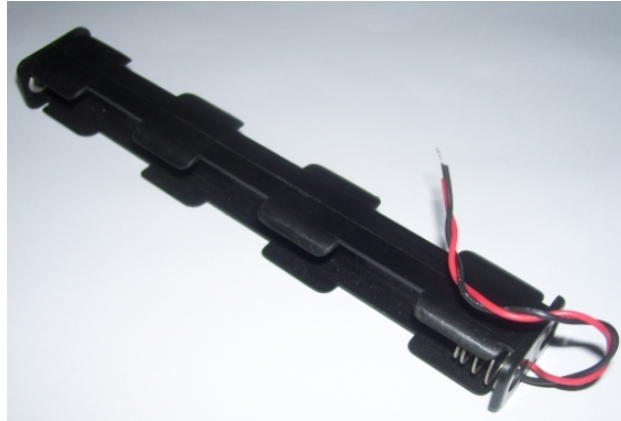

Figure No.3

Servo motor power is 4.8 ~ 6 V, 1.2A. As shows in Figure No.1, connect the positive and negative after confirmation, please do not make mistake.

2 Interfaces

2.1, Interface Briefing

At the same time, PC software, and just a few simple steps can make the robot move; it is easy and fast for the operator to learn.
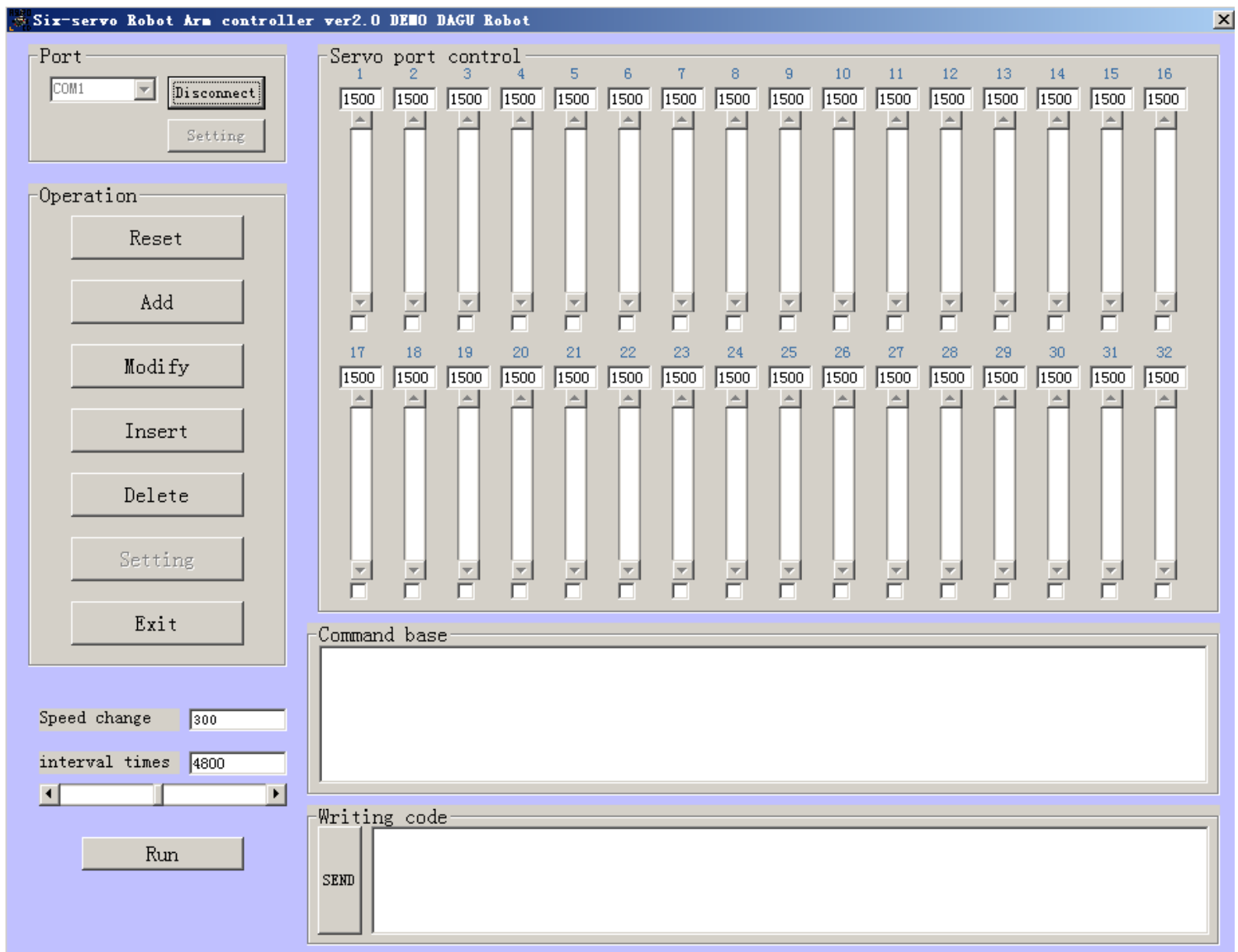

Figure No.4

Open the PC operating software, see the interface shown in Figure No.5, first is to set up the port, see Figure No.5. This interface contains the

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following five parts:

1,Connecting the port and settings.

2, Access control.

3, Operation options.

4,The directive.

5, Adjust the speed and spacing of regulation

6, Commands input by hand

2.2, Port connections and settings.

Here we fully introduce the five parts and how they operate from each other.
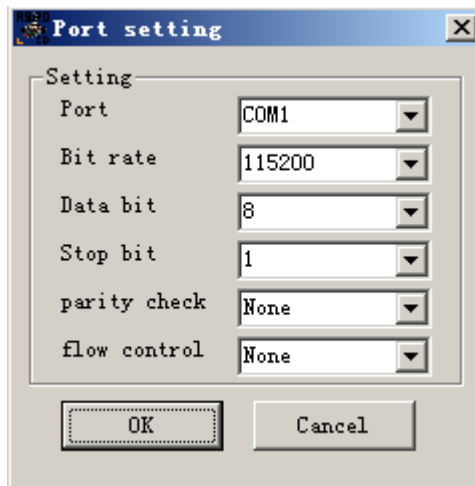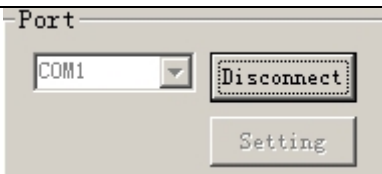
2.2.1, The port connector and settings.

Figure No.5

Com1 is a normal port. For most desktops, connect "com1" it will be successfully linked. If it fails, try to use com2, after click the connect button,

If the "Connections" button to shows "disconnected", "Settings" button is in failure state.

Note: Please note that not "connect" button showing the "disconnect" is successful.

If you want to use portable computers to control the robot arm, (the majority of portable computer does not have COM), so you need have a USB port to the RS232 COM cable, when successfully connect to the computer, com1 and com2 are invalid, then, you can try to find the controller the COM number display in the computer. After connecting the MCU power supply, click "My Computer" and then click "management" menu, enter the "Computer Management" to set up user interface (see Figure No.5), click on the left " Device Manager "menu to start the right of" port (COM and LPT) ", you will find a" USB COM Port (com10) ", as this example.   In the "com1" changed to "com10", click "OK" button to select "connect" button, so it finishes the communications.

Note: the cable connecting from USB to RS232 COM can be bought from the market, but all the chips are not useful for the cable.

2.2.2, Access Control

32 servo controllers can control 32 servo motors. As shown in Figure No.6, access control bar has 32 numbers, this 32 numbers showing in the interface is corresponding to the board of the 32 pin position, and each number below, and there is a corresponding value. This amount changes between 500 and 2500. 1500 is the numerical zero state. Below each value, there is a corresponding numerical value; below the value there is still a reselected box. When select the box, the value is effective, inserted the plug if the control board is also in accordance with this order on the motherboard, this control on the software interface code is also 1-6. When the double power connects, there is no problem for the communication, to pull any 1-6 numerical drags, the robot will move up. If the six servo motors, in numerical drag can be fixed up, at this time of the communication is OK.
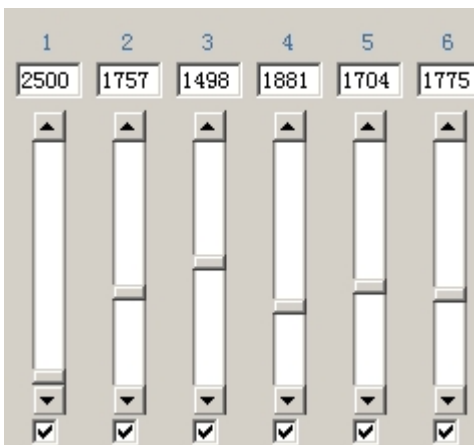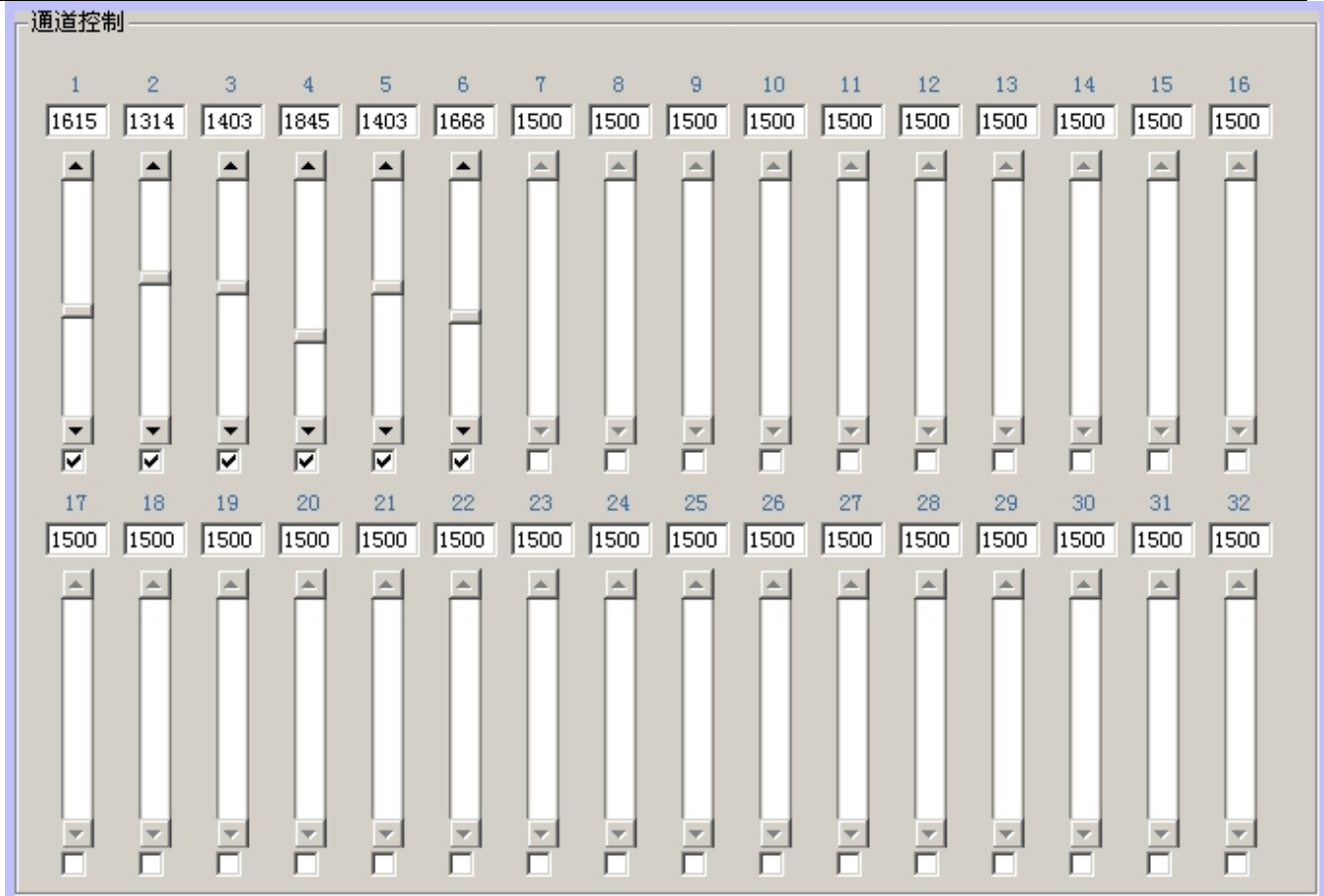
图 No.6

2.2.3, Operation Choices

Figure NO.7

For operation, we use the "reset", "add"," amend", "delete" and "Exit."

When you click the "reset" button, the robot would return to the initial state, in the initial state, the current value will return to the neutral position. In addition, the following numerical programming shows 1500. At the same time, if you want the robot to open arm, input 700 in the No. 1 position and the hand will open. At the same time, please note that No. 1 servo motor, unlike the other servos that can turn around 180 degrees, because the No. 1 Servo moving a small distance can open and close the hand. There is a rule that, if you use the numerical to let the arm to move, enter the numerical required between the ranges 500-2500, when the operator to enter the scope of the value of the corresponding joint robot will move up.

Note: the robot arm standard debugging before factory, the No. 1 server value is 660-1300. When the robot arm is not in this range, the No. 1 server, in a long time action of the pulse, the heat will increase, if it goes on, it would shorten the life of this servo motor. However, other servo motors do not have such situation; it will not have the heat between 500 and 2500.
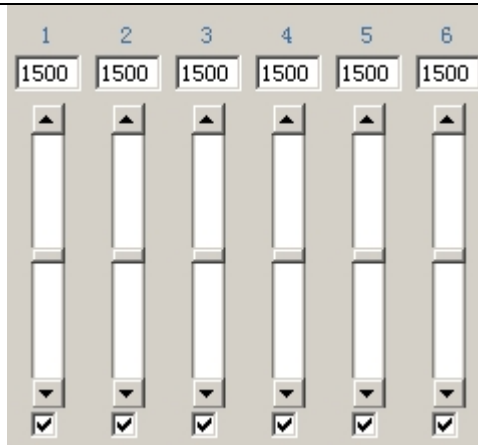
Figure No.8

When the operator clicks the "add" button, this control system will automatically save the corresponding code servo motor movements. (Arm of each instructions, interval, servo speed and angle of rotation)

"Modify" button is to modify a command that has been generated. First to select on e command, and click the "Modify" button, the system will automatically save the current corresponding code and keep the servo motor movements.

"Delete" button is used to remove the current selection of command.
"Exit" button is to withdraw from the current interface.

2.2.4, The Directive

The directive is designed to preserve the corresponding code servo motor movements (arm of the instructions per line interval, servo speed and angle of rotation) a space for save one or more lines of command.

2.2.5, Adjust the Speed and Spacing of Regulation

Adjust the speed of each servo motor to control the rotational speed. The default system for 300 is better; making the numerical too big is bad for robot usage.
Regulation time adjustment is to adjust the interval of movements.

2.2.6，Commands input by hand

As shown in Figure No.9, in the column, enter "# 5 P1200" and then click "send" button, they can control one of the servo motor to move.

If you want to order more than one sever motor at the same time, For example: to control No.1, No.2, No.3, No. 4, No.5, No.6, the motors will rotate from the original position to 0 degrees, 27 degrees, 45 degrees, 63 degrees, 90 degrees, for 180 degrees please enter:

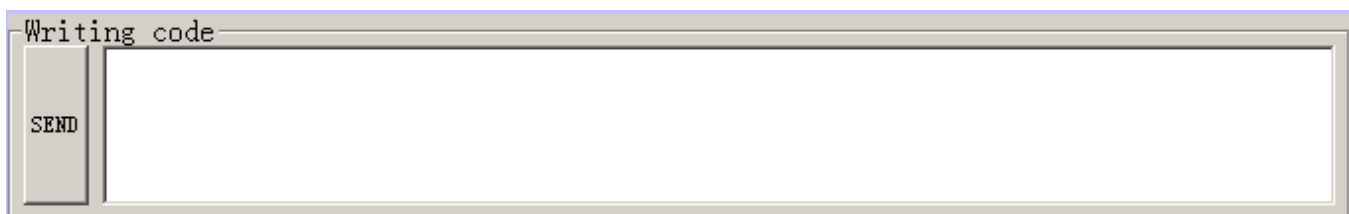# 5 P500 # 6 P800 # 4 P1000 # 3 P1200 # 2 P1500 # 1 2500 and then click the "send" button.

Figure No. 9

3，Programming Robot Control

3.1，Instruction Briefing

As the special design of the control panel, the coding instruction is different from the circuit boards, sending commands to control the pulse. Please refer to the table.

Circuit board NO.	Command NO.		Circuit board NO.	Command NO.
1	5		17	23
m2	6		18	22
3	4		19	21
4	3		20	20
5	2		21	19
6	1		22	18
7	0		23	17
8	7		24	16
9	15		25	24
10	14		26	31
11	13		27	30
12	12		28	29
13	11		29	28
14	10		30	27
15	9		31	26
16	8		32	25

Table1. Motor # Command Tables

For example 1: The circuit board No. 1 for the servo motor movement enter:

5 P1500 + enter.

Explanation of command: P is the short form of POSITION. Take the 180 degrees angle rotation as an example. The minimum is 500, so it is 0 degrees, the maximum for 2500, so it is 180 degrees. accuracy $\frac{180}{2500-500}$ =0.09 degrees.

For example 2: to command more than one motor at the same time, such as control of No.1, 2, 3, 4, 5, 6,   Motors turns from the current rotating position

to 0 degrees, 27 degrees, 45 degrees, 63 degrees, 90 degrees , 180

degrees, enter:

5 P500 # 6 P800 # 4 P1000 # 3 P1200 # 2 P1500 # 1 2500 enter

For example 3: time controlling， When controlling the NO.1 servo motor

from its current location, move 180 degrees, the total time is one second,

5 P2500 T1000 Enter

Explanation of command：T means time, and 1000 is 1000 ms = 1 second. If

0.5 seconds, then change to 500.

3.2, add actions, the system automatically generate coherent actions

3.2.1, through the operation column click the "Add" button to generate coherent actions

when the arm moves to a position that is what you need, click "Add" button, it will

save the rotating angle of each servo motor(that is the robot movement situation),

the current movement speed are kept. When you save more commands, click "run"

button, can produce coherent actions.

3.2.2 To generate coherent actions by input the codes with hands in column.

Like the 2.2.6 operation, input the codes by hands, also allows a number of joints

work continuously.

Servo motor specifications and parameters as follows:

12KG metal gear of the servo motor:
Size: 40.4 * 19.8 * 36 mm
Weight: 48 g
Speed: 0.22 sec/60 °
Output Torque: 13 kg • cm

3.2kg servo motor:
Size: 39.5 x20.0x35.5mm
Weight: 41 g
Speed: 0.27 sec/60 °
Torque output: 3.2 kg • cm

3.2kg servo motor:
Size: 28 x14x29.8mm
Weight: 18 g
Speed: 0.13 sec/60 °
Torque output: 2.3 kg • cm