

FT-6DOF-NB

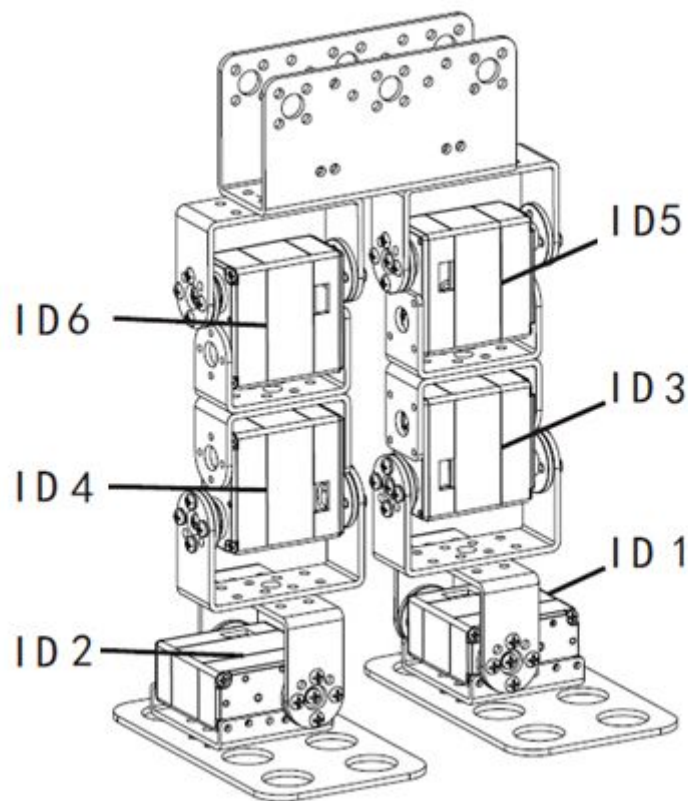
FEETECH 6 Degrees of Freedom Nano Biped kit

FEETECH 6自由度双足机器人套件

Instruction Manual

使用说明手册

Version 1.00



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勘误Errata

我们尽力让本使用手册更加完整且正确地表达我们希望用户了解的信息，然而难免仍有疏漏之处。为了让使用手册提供最新最详细的信息，我们会持续改善增加手册内容。如在本手册中发现错误之处，欢迎利用电子邮件 infofeetechrc@gmail.com 与我们联系。如有任何相关信息更新都会在网站上公布，请经常浏览我们的公司网站 www.feetechrc.com 以便获知最新信息。

We have put tremendous efforts in making this instruction manual complete and correct; however, there may be unavoidable missing parts or errors. With a view to providing the user updated and complete information in the instruction manual, we keep improving and supplement the contents of this instruction manual. If you find any error in this manual, please contact us via the e-mail infofeetechrc@gmail.com any related update information will be disclosed on our website. Please visit our website <http://www.feetechrc.com> for more updated information.

注意事项Precautions

请确认TTLinker_mini的输入电压于6-9V之间。

Make sure the input voltage of TTLinker_mini is within the 6-9V range.

本套件提供的舵机支持电压6-8.4V。过高或过低的电压将造成无法完成预期的动作，甚至烧坏舵机，连接电源前请确认提供的电压值。

Servos provided in this kit are rated 6-8.4V. Over or under voltage may cause unpredictable results, even burning of the motor. Make absolutely sure of the correct voltage before connecting the power supply.

本套件含六个舵机，所有舵机同时动作时需要较大电源，请确认连接到舵机的电源或电池，能提供4A以上的电源值，以让套件能正常动作。提供电流不足时，可能造成无法达到预期的动作，或损坏套件。







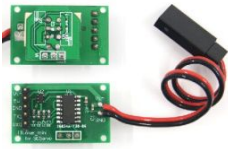
The kit provides a total of 6 servos. When operated simultaneously, they consume a large current; make sure the power supply or battery connecting to servo is capable of providing 4A of current, so as to properly operate the kit. Insufficient current may cause unexpected results and damage of the kit.

如果使用电池作为套件的电源，在操作一段时间后，电池电压降低会造成套件无法正常动作，此时请将电池取出，在充电完成后再使用。如果需要长时间的测试或操作，建议使用电源适配器以

维持电压一致的效能。

When using a battery power supply to the module, the voltage may lower after some while of operation and cause abnormal actions of the kit. In such case, remove and fully charge the battery before using again. If prolonged testing and operation is required, we suggest you use a power supply unit to ensure uniform performance.

套件清单 Part list

Item	Illustration	Quantity	Specifications and instructions
Aluminum Main U-shape Bracket FK-MU-001		1	Aluminum Main U-shape Bracket for linking robot electronic modules with its leg parts
Aluminum Foot Plate FK-FP-001		2	For connecting with servo-side bracket to fit the ankle servo
Aluminum Servo-side Bracket FK-SB-001		2	For connecting with the ankle servo and the foot bracket
Aluminum U-shape Bracket 37mm FK-UB-001		6	Provides connection with the servo round horn and movement space of the Servo; It also provides connection with two U-shape brackets for different applications.
Aluminum U-shape Bracket 27mm FK-UB-001		4	Provides connection with the servo case; It also provides connection with two U-shape Brackets for different applications.
NANO Shield		1	The NANO Shield board is used to connect the Arduino NANO board and TTLinker_mini signal conversion board, include two used to indicate the LED1 and LED2, two input buttons S1 and S2.
TTLinker_mini		1	TTLinker_mini is a signal conversion board, connect to Arduino Nano TX1 and RX0 two digital serial ports

Item	Illustration	Quantity	Specifications and instructions
SCServo (SCS15)		6	<p>SCServo is meaning that Smart Control Servo. SCServo can work at servo mode and wheel mode, has a unique ID number to identify on BUS network, have kinds of baud rate available, and can feedback the value of Position, Temperature, Load, Speed and Input Voltage. SCServo is easy to be controlled by Arduino.</p> <p>Dimensions (LxWxH): 40.0x20.0x40.5mm Weight: 56 g, Speed: 65RMP (7.4V) Torque: 16.5kg.cm (7.4V)</p>
Screw 1		10	ISO 3 x 10 mm
Screw 2		30	ISO 3 x 6 mm
Screw 3		50	ISO 3 x 4 mm
Screw 4		40	TP1P 2 x 6 mm
Screw 5		10	ISO 3 x 6 mm
Nut A		40	3 x 5 mm
Black Cable		6	5264 connector 100mm *4 150mm *2

使用工具Tools

十字螺丝起子（需要使用3 mm）Cross Screwdriver (3 mm) 尖嘴钳 Long Nose Pliers

螺丝胶（可选择性使用在螺母与铝板接合处，减缓螺母松脱）Screw Glue (selectively used)

between nut and bracket joints, to prevent the nut from loosening.)

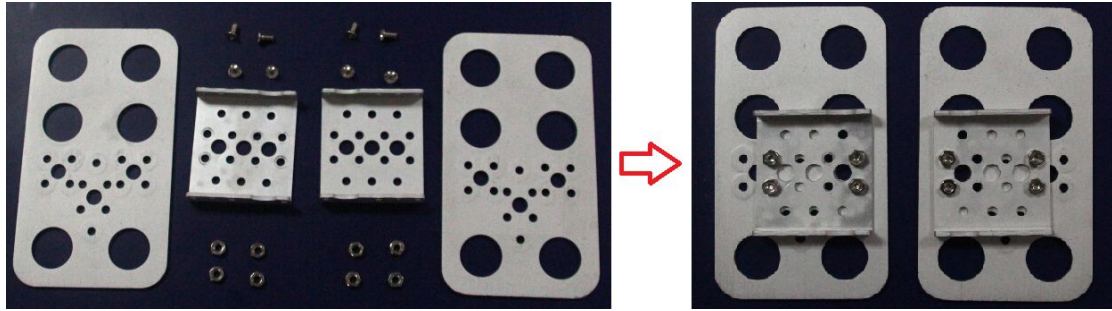
组装步骤 Assembly Procedure.

套件包装及所有零部件 Kit packaging and all components



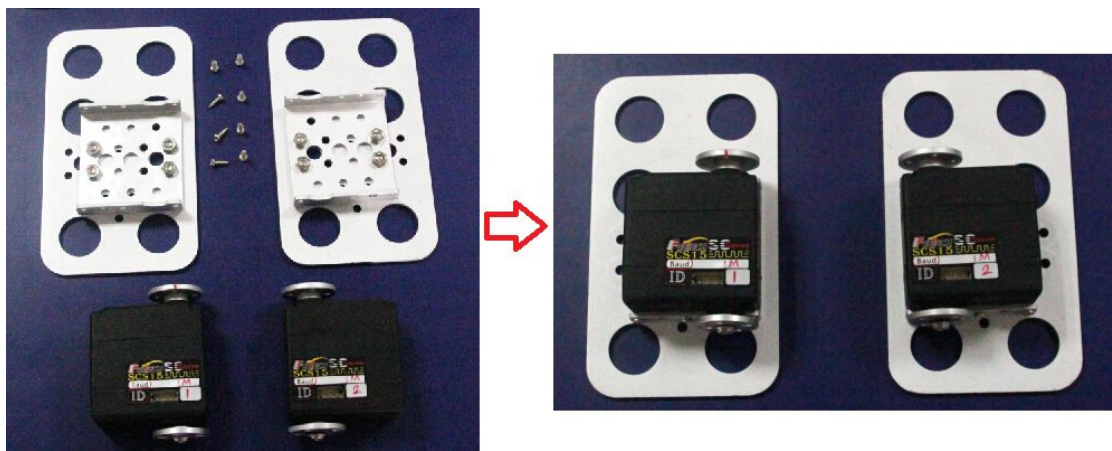
步骤 1 安装脚板与脚踝舵机侧面支架 Installation of Foot Bracket and Servo-side Bracket

- | | |
|----------------------------|-----|
| 需要脚板(Foot Bracket) | x 2 |
| 舵机侧面支架(Servo-side Bracket) | x 2 |
| 沉头M3螺丝 (ISO F 3 x 6 mm) | x 8 |
| M3螺母 (Nut 3 x 5 mm) | x 8 |



步骤 2 安装两个脚踝舵机 Installation of two ankle servos

- 步骤 1 组件(Part of step 1) x 2
 SCS15 左脚踝舵机ID1,右脚踝舵机ID2(Left ankle servo use ID1; Right ankle servo use ID2) x 2
 自攻螺丝(TP1P 2 x 6 mm) x 8



步骤 3 安装长 U 型支架 Installation of U-shape Bracket 37mm

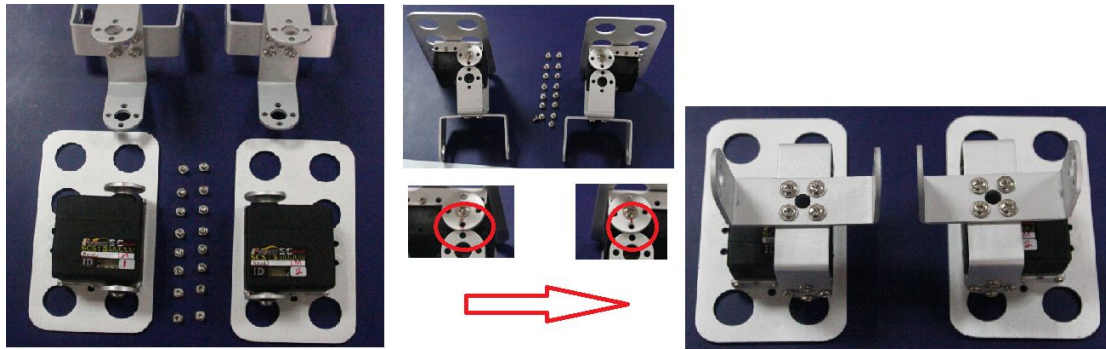
- 长U型支架(U-shape Bracket 37mm) x 4
 M3x6机牙螺丝(ISOP 3 x 6 mm) x 8
 M3 螺母(Nut 3 x 5 mm) x 8



步骤 4 安装 U 型支架到脚踝舵机 Installation of U-shape Bracket to ankle servos

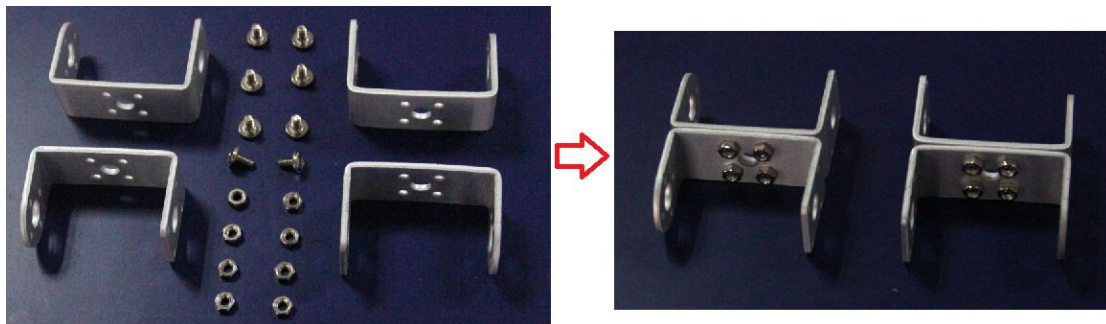
- 步骤 2 组件(Part of step 2) x 2
 步骤 3 组件(Part of step 3) x 2
 M3x4机牙螺丝(ISOP 3 x 4 mm) x 16

安装时请注意舵盘上的红色中点标志 Pay attention to the red midpoint marks on the round servo horn



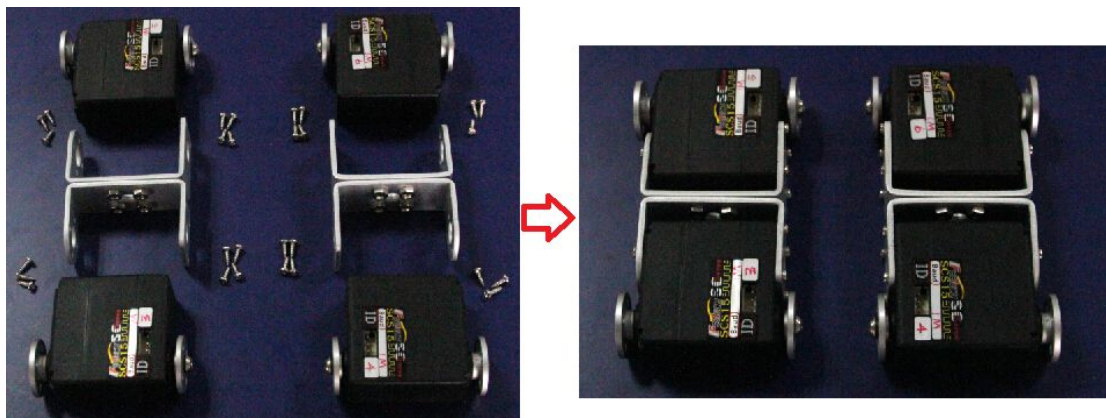
步骤 5 安装短 U 型支架 Installation of U-shape Bracket 27mm

- 短U型支架(U-shape Bracket 27mm) x 4
- M3x6机牙螺丝(ISOP 3 x 6 mm) x 8
- M3 螺母(Nut 3 x 5 mm) x 8



步骤 6 安装 U 型支架到舵机 Installation of U U-shape Bracket to servos

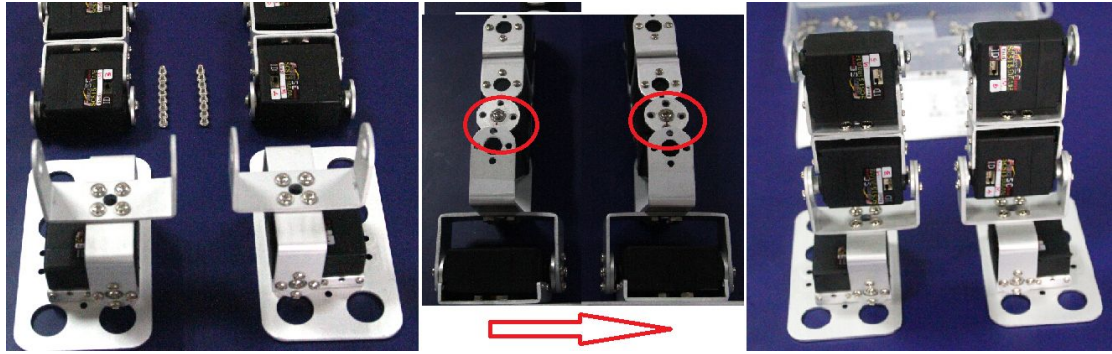
- 步骤 5组件(Part of step 5) x 2
- SCS15舵机ID3、ID4、ID5、ID6 (Servo ID3,ID4, ID5,ID6) x 4
- 自攻螺丝 (TP1P 2 x 6 mm) x 28



步骤 7 安装 U 型支架到舵机 Installation of U-shape Bracket to servos

- 步骤 4组件(Part of step 4) x 2
- 步骤 5组件(Part of step 5) x 2
- M3x4机牙螺丝 (ISOP 3 x 4 mm) x 16

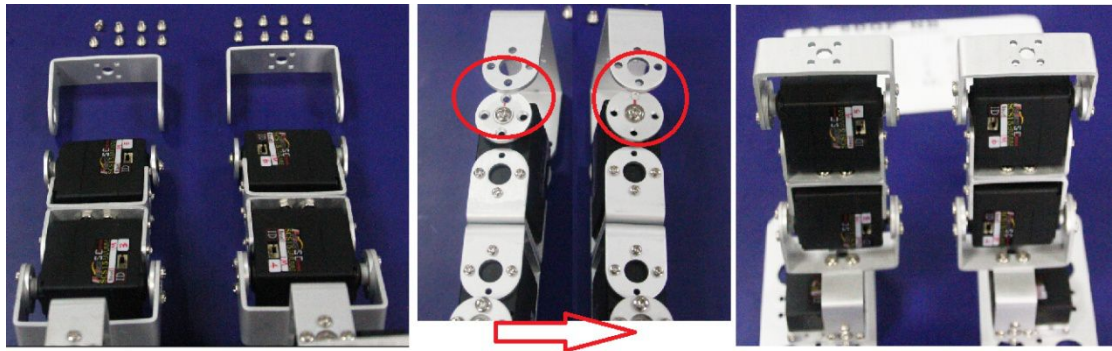
安装时请注意舵盘上的红色中点标志 Pay attention to the red midpoint marks on the round servo horn



步骤 8 安装 U 型支架到舵机 Installation of U-shape Bracket to servos

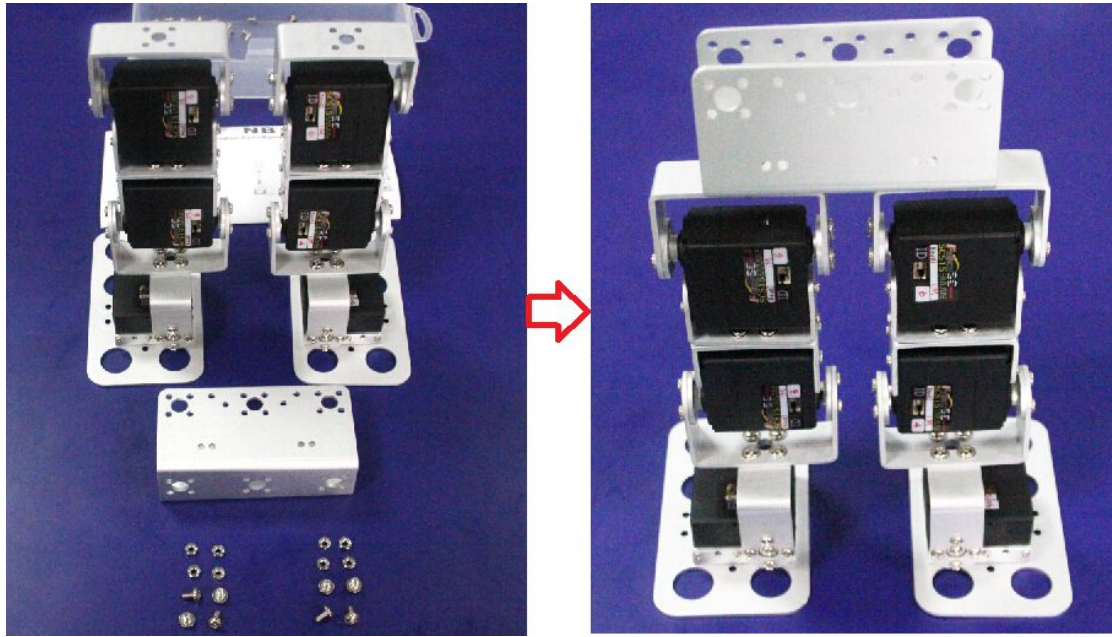
- 步骤 7 组件(Part of step 7) x 2
- 长U型支架(U-shape Bracket 37mm) x 2
- M3x4 机牙螺丝 (ISOP 3 x 4 mm) x 16

安装时请注意舵盘上的红色中点标志 Pay attention to the red midpoint marks on the round servo horn



步骤 9 安装主 U 型支架到舵机 Installation of Main U-shape Bracket to servos

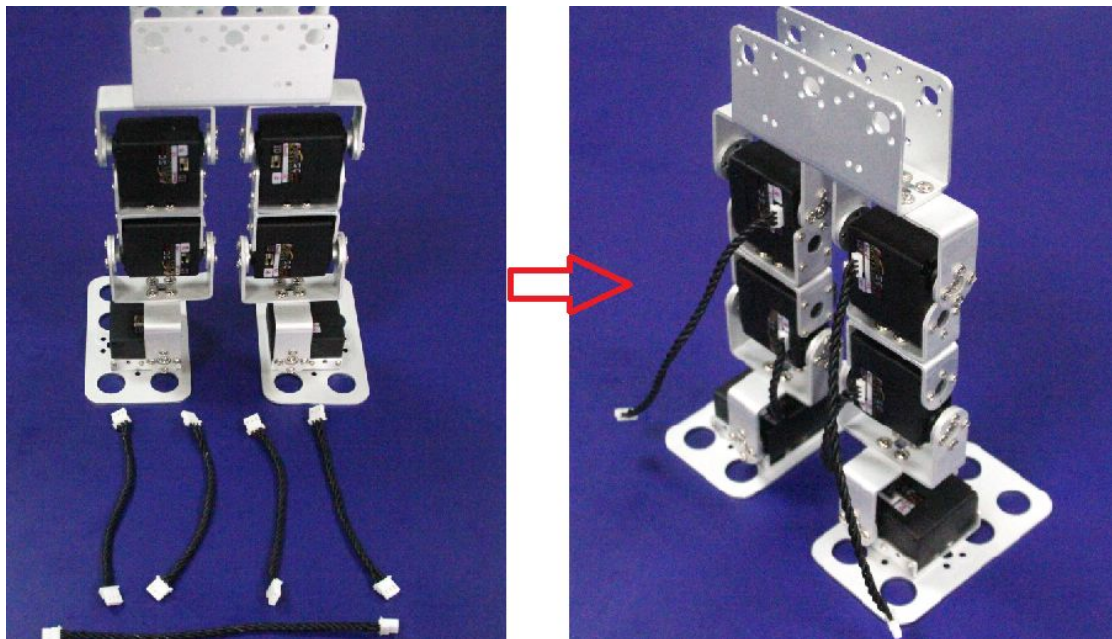
- 步骤 8 组件(Part of step 8) x 2
- 主U型支架 (Main U-shape) x 1
- M3x6 机牙螺丝 (ISOP 3 x 6 mm) x 8
- M3 螺母(Nut 3 x 5 mm) x 8



步骤 10 连接舵机线 Connect black cable to servos

步骤 9组件(Part of step 9) x 1

黑色舵机3P纹线 (Black 3P cable) x 6



步骤 11 安装 NANO 扩展板与 TTLinker_mini Installation of NANO Shield and connect TTLi

nker_mini

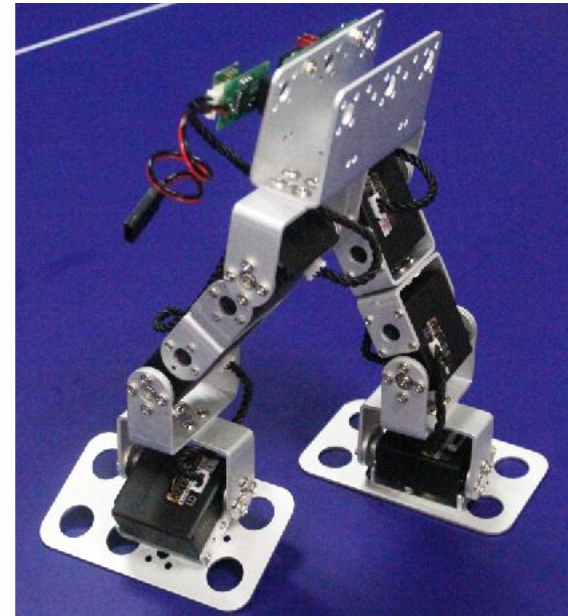
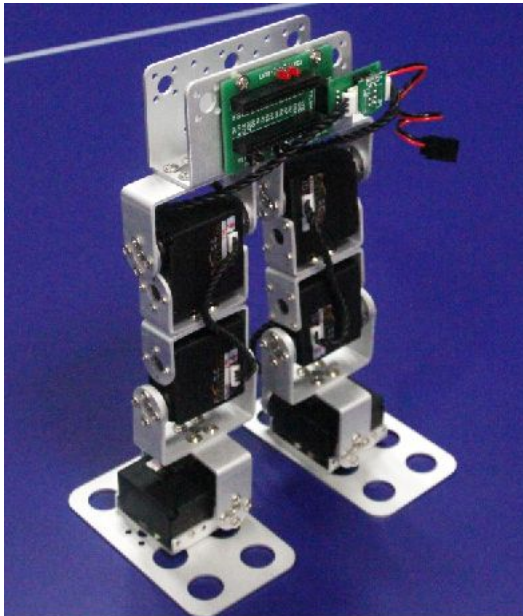
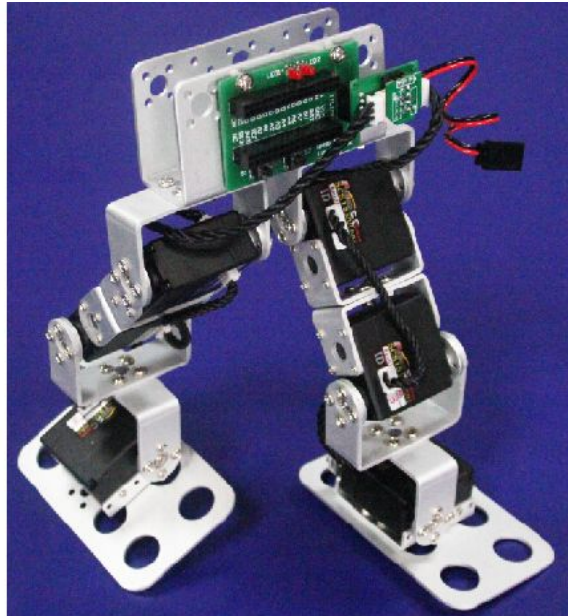
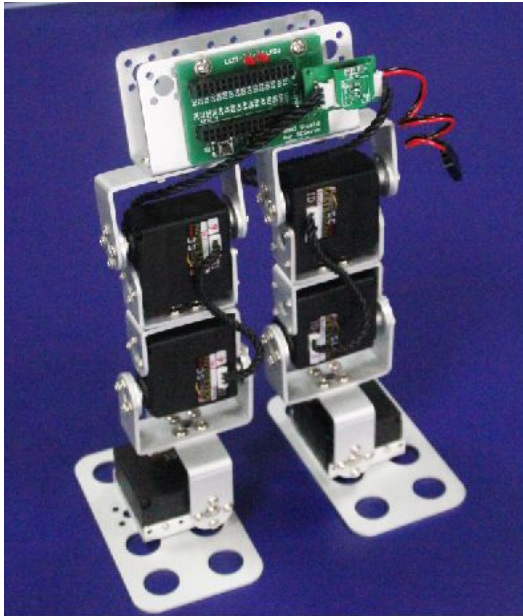
步骤 10组件(Part of step 10) x 1

NANO 扩展板 (NANO Shield) x 1

TTLinker_mini x 1

M3x10机牙螺丝 (ISOP 3 x 10 mm) x 3

M3 螺母(Nut 3 x 5 mm) x 6



下载安装SCServo Arduino库文件 Download and install SCServo Arduino lib

在编辑及下载 Arduino程序之前，如果没有将SCServo 库文件放入Arduino软件安装路径的libraries文件夹，请先到<http://www.feetechrc.com/download/>下载SCServo 库文件到本地电脑，然后放解压放入libraries文件夹内。然后再运行Arduino软件。

Before editing and download the Arduino program, if there is no SCServo library file in the Arduino libraries folder of software installation path, please go to <http://www.feetechrc.com/download/> to

download SCServo library files to the local computer, and then put decompression into the libraries folder. At last run the Arduino software.

SCServo Arduino 库文件使用说明 SCServo Arduino lib instructions

先将SCServo 库引入程序头文件 #include <SCServo.h>

初始化必须设置串口通讯波特率，SCServo 出厂默认波特率设置是1M。

```
Serial.begin(1000000); //init Serial baudrate
```

SCServo 扭力输出使能指令有两个输入参数 (SCServo.EnableTorque(ID, bit))，输入参数一是 ID (0~255)，其中0xfe是广播ID；输入参数二是使能标志位，其中“1”为使能打开，“0”为使能关闭。如使能处于关闭状态，那么舵机将没有任何扭力输出，但通讯正常工作。

```
SCServo.EnableTorque(1, 1); //Enable ID 1 SCServo output torque; ON
```

```
SCServo.EnableTorque(1, 0); //Enable ID 1 SCServo output torque; OFF
```

```
SCServo.EnableTorque(0xfe, 1); // Enable ALL SCServo output torque; ON
```

```
SCServo.EnableTorque(0xfe, 0); //Enable ALL SCServo output torque; OFF
```

读取SCServo 舵机当前位置信息指令有一个输入参数并返回一个参数。输入参数为SCServo ID，一次只能读取一个ID的当前位置信息，此指令ID 不可以使用广播ID。**使用广播ID时指令是不作数据返回的**。返回一个参数的数据类型是short型（即两个字节以上）。

```
#define s16 short
```

```
s16 pos = SCServo.ReadPos(1); //read Servo ID:1 position
```

写位置指令需要三个输入参数。输入参数一是 ID (0~255)，其中 0xfe 是广播 ID；输入参数二是位置数值 (0~1023 有效对应转动角度是 0~215 度，但实际转动角度会受到位置限制参数设置影响)；输入参数三是舵机运行速度级别 (1~100)，“1”对应舵机最慢转动速度级，“100”对应最高转动速度级。当此指令对应 ID 的舵机收到指令后马上执行动作，不作任何等待。

```
SCServo.WritePos(0xfe, i, 100); //All Servo(broadcast) rotate to the position i with max speed
```

异步写指令 (RegWritePos (ID, X, Y)) 必须与执行指令 (RegWriteAction()) 配合使用才可以达到写指令的效果，即异步写指令输入同写指令一样三个参数后，接收到此指令的舵机必须还要收到执行指令后才进行对异步写指令动作，否则保持前一指令动作。

```
SCServo.RegWritePos(1, 512, 100);
```

```
SCServo.RegWritePos(2, 512, 100);
```

```
SCServo.RegWriteAction(); When SCServo receive this instruction will action to rotation
```

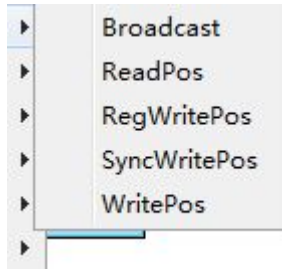
同步写指令 (SyncWritePos (ID, I, X, Y)) 需要四个输入参数。输入参数 ID 是含 1 个或含多个 ID 的数组，输入参数二定义第一个参数 ID 的数值个数，输入参数三是位置数值 (0~1023 有效对应转动角度是 0~215 度，但实际转动角度会受到位置限制参数设置影响)；输入参数四是舵机运行速度级别 (1~100)，“1”对应舵机最慢转动速度级，“100”对应最高转动速度级。当此指令对应 ID 的舵机收到指令后马上执行动作，不作任何等待。

```
ID[0] = 1;
```

```
ID[1] = 2;
```

```
SCServo.SyncWritePos(ID, 2, 100, 50);  
delay(2000);  
SCServo.SyncWritePos(ID, 2, 900, 100)
```

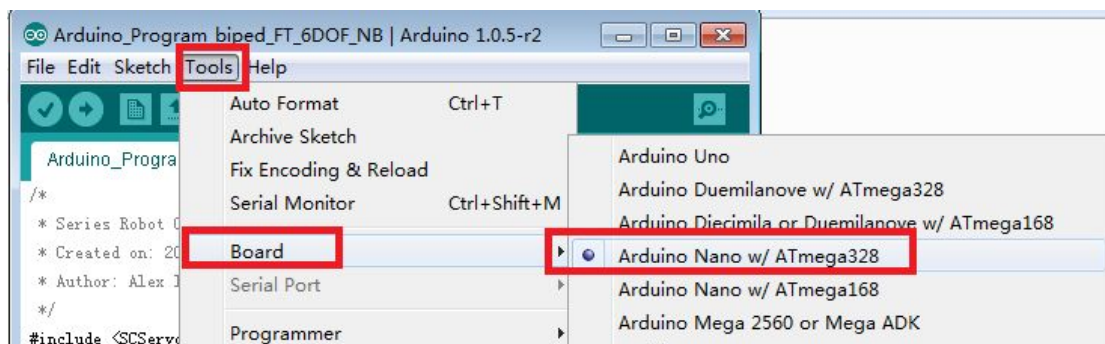
以上指令的具体运用可直接将SCServo库文件中示例下载到Arduino 控制板中，然后接上 TTLInker 信号转换板与SCServo舵机，即可以试验其功能。

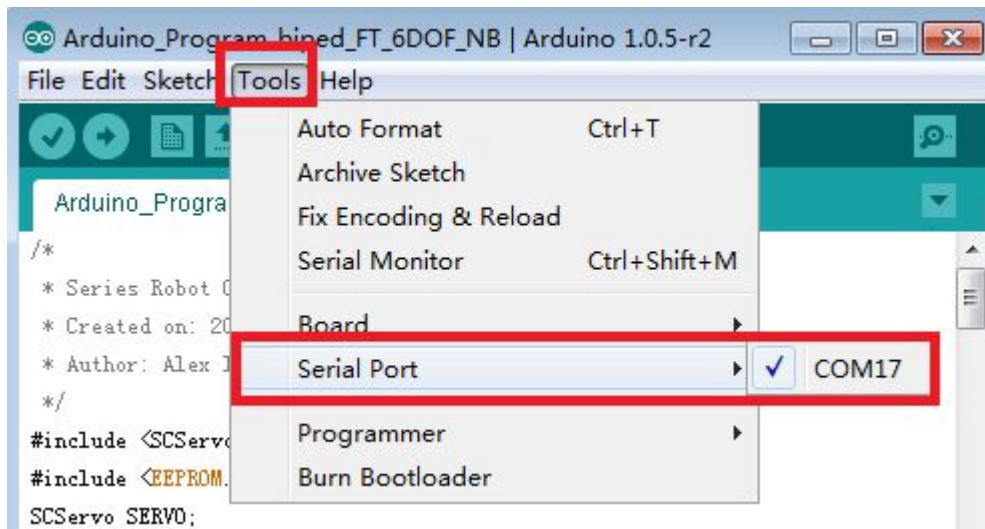


下载Arduino 程序 Download Arduino Program

请先到<http://www.feetechrc.com/download/>下载Arduino_Program_biped_FT_6DOF_NB.rar到本地电脑。然后解压。另外，请确认已将SCServo 库文件放入Arduino软件安装路径的libraries 文件夹，并且Arduino软件与控制板（Arduino Nano 需要另外购买）正常联接可以工作。打开Arduino_Program_biped_FT_6DOF_NB.ino运行Arduino软件。选择控制板型号与联接端口（端口号随不同Arduino Nano而不同）。

Please go to <http://www.feetechrc.com/download/> to download Arduino_Program_biped_FT_6DOF_NB. Rar to the local computer. Then unpack. In addition, please confirm SC Servo library file in the Arduino libraries folder of software installation path, and the Arduino software and control board (Arduino Nano is not include in this kit) connection can work normally. Open Arduino_Program_biped_FT_6DOF_NB. Ino running the Arduino software. Select board model with connection port (port number varies with different Arduino Nano and different).





Arduino_Program_biped_FT_6DOF_NB.ino 这个是工厂设置最简单的试验程序（程序流程图见附件），用户可自行修改。

确认不修改或修改完成后点击upload

Arduino_Program_biped_FT_6DOF_NB.ino

This is the simplest factory test program (flow chart see attachment), User can modify itself. After the completion of modify or the confirmation not modify click upload

做示范动作 Perform Demonstrative Motions

确认已将以上步骤正确完成操作，以下是利用NANO Shield 上的两个按键及指示灯，来完成手动设置双足机器人腿动作的操作视频。

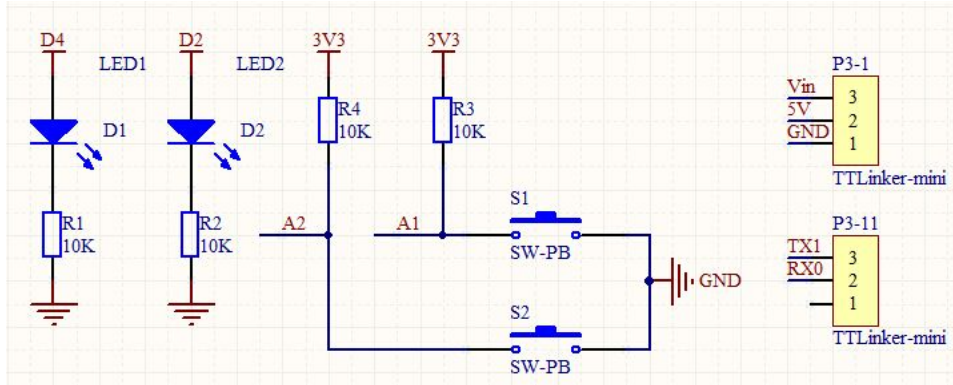
Confirmed will be completed the above steps correctly, the following is the use of NANO shields on the two buttons and indicator lights, to complete the leg movements by manually bipedal machine operation video.

关于 (About) FT-NANO Shied and TTLinke_mini

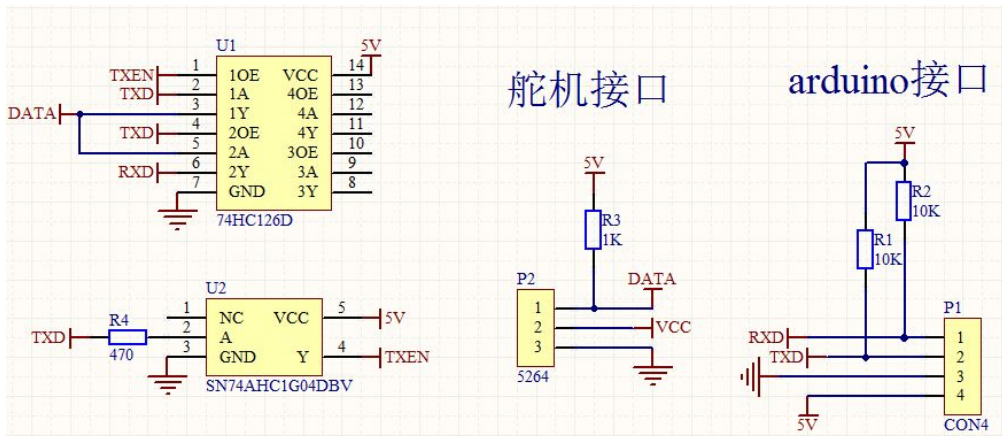
NANO 扩展板是用来连接 Arduino Nano 控制板与 TTLinker_mini 信号转换板 ,扩展板上有两个用来指示的 LED1 和 LED2, 以及用来作功能选择输入的两个按键 S1 和 S2, 两个 LED 分别对应连接 Arduino Nano 的 D4 和 D2 数字端口;另外两个按键分别对应连接 Arduino Nano 的 A1 和 A2 模拟端口。TTLinker_mini 与 Arduino Nano 的 TX1 和 RX0 两个数字端口连接, 并将 Arduino Nano 的串口信号转换成单总线信号从而控制 SCServo。

The NANO Shield board is used to connect the Arduino NANO board and TTLinker_mini signal conversion board, include two used to indicate the LED1 and LED2, two input buttons S1 and S2.Two LEDs corresponding connection Arduino Nano D2 and D4 digital port, two buttons correspond to connect the Arduino Nano A1 and A2 Analog port. TTLinker_mini connect to Arduino Nano TX1 and RX0 two digital serial ports and convert the Arduino Nano control signals into a single bus to control SCServo.

NANO Shield 原理图



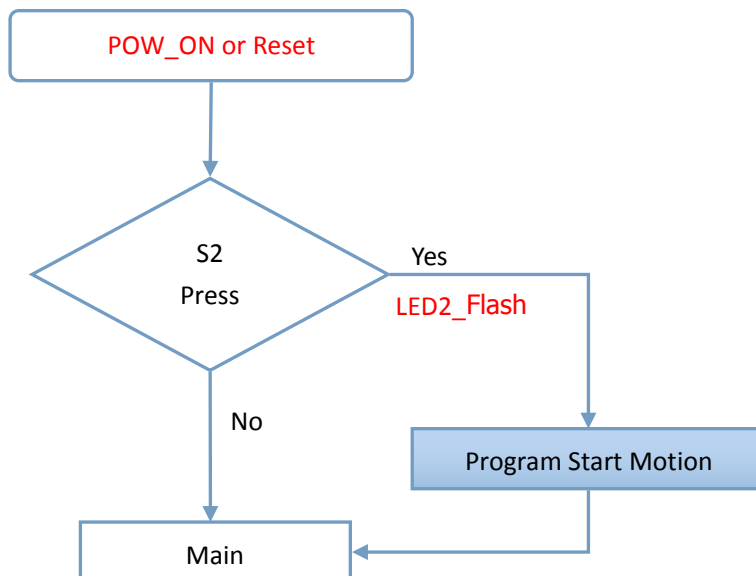
TTLLinker_mini 原理图

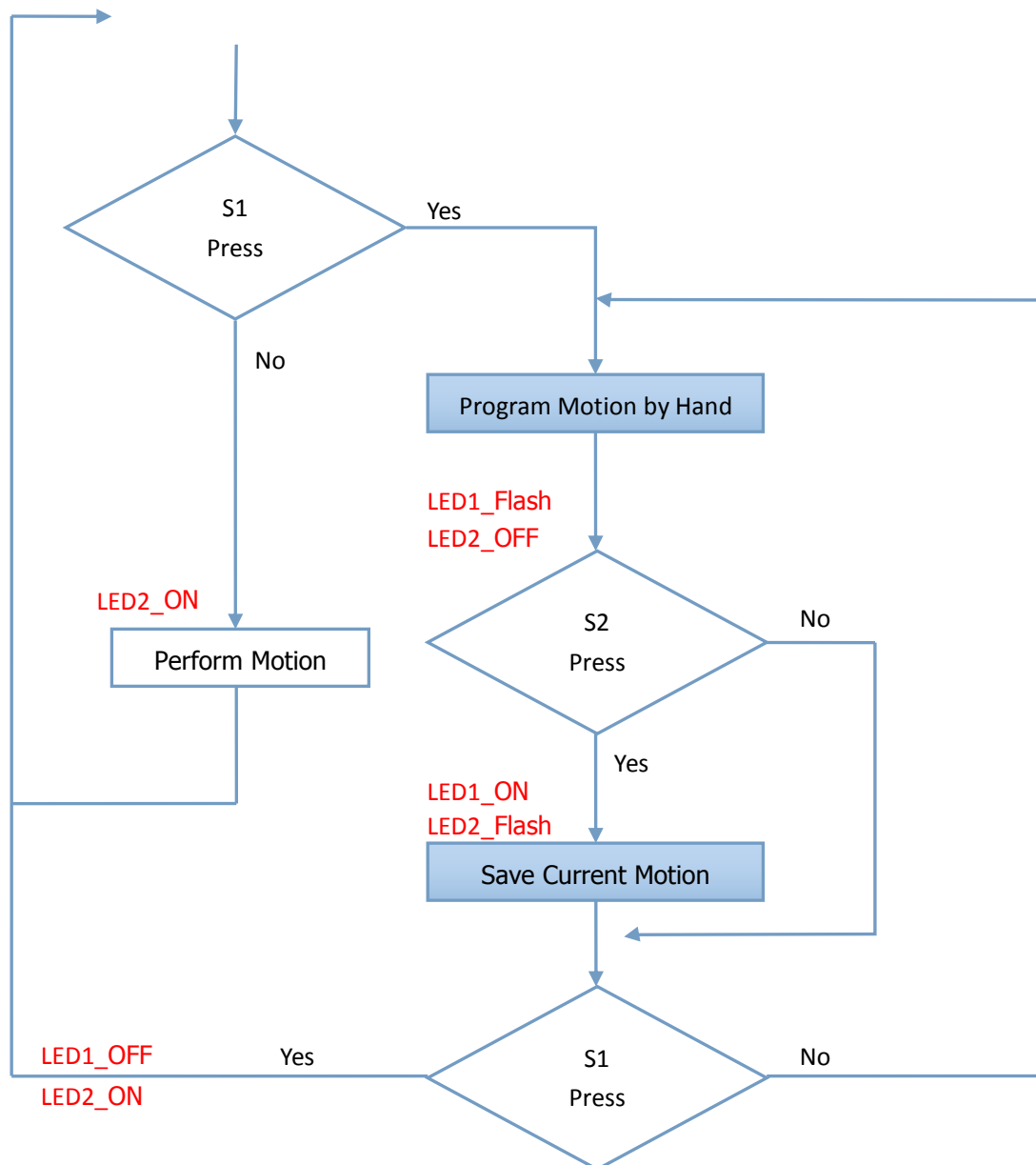


示例程序功能状态表 Sample program function status table

Function	State	S1	S2	LED1	LED2
Program Start Motion	Power on or Reset within 1 second	-	Press	Off	Flash
Program Motion by Hand	Enter	Press	-	Flash	Off
Program Motion by Hand	Exit	Press	-	Off	On
Save Current Motion	Save		Press	ON	Flash
Perform Motion	Power on or Reset after 2 second			Off	ON

程序流程图 Program flow chart





初始动作设置 Program Start Motion

如果在第一次使用或要删除所有保存的动作，重新设置初始姿势，那么在上电或按了复位键后 1 秒内按住 S2 键不放，直到 LED2 闪烁一次再放开。在直到 LED2 常亮为止这段时间内，双足机器人必须保持想设置初始姿势的状态。LED2 常亮说明初始状态设置完成。

备注，如在上电或复位键按下后 1 秒内没有按 S2 键，将跳过初始姿势设置。

If used for the first time or want to delete all saved motion, to set robot's initial position, Please press the S2 button after power on or press the reset button within 1 second, until the LED2 flash one time. The time of between start works to LED2 normally on, biped robot must keep the position to set up initial motion. LED2 normally on is mean that the initial state set up complete. Note. If after power on or press reset button no press S2 key within 1 second, will skip the initial position setting.

用手扳动姿势 Program Motion by Hand

当 LED2 常亮时，按下 S1 键让 LED2 灭同时 LED1 闪烁，此时即进入用手扳动双足机器人姿势状态，所有舵机没有扭力输出，可以用手任意扳动各个关节来设置自己想要的姿势。

备注，为了让动作的连续性，请不要设置两个姿势之间的关节移动角度太大。

When LED2 normally on, press the S1 button to let LED2 off and LED1 flashing, at this time can to set biped robot motion by hand, all SCServo torque output off, can be arbitrary flipping in biped robot's degree of freedom by hand to set up the position you want.

Note. In order to let the continuity of action, please do not set up movement angle too big what between the two positions of joint.

保存当前姿势 Save Current Motion

当前姿势需要保存在 EEPROM 时，按下 S2 键此时 LED1 常亮 LED2 闪烁一次，完成保存返回编程状态 LED1 闪烁 LED2 灭。

When current motion need to be saved into EEPROM, please press S2 button at this time LED1 normally on LED2 flashing one time, complete store return programming state LED1 flashing and LED2 off.

循环执行各种姿势 Perform Motion

当上电后没有进入初始姿势设置或完成后，LED1 灭 LED2 常亮，双足机器人将会循环执行保存在 EEPROM 里各种姿势。如果处于用手扳动姿势状态时，按住 S1 直到 LED1 灭 LED2 常亮松开，则退出编程进行循环执行各种姿势，所有舵机恢复扭力输出。

After power on, if no enter or completed program start motion, LED1 off and LED2 normally on, bipedal robot will cyclically to action motions saved in the EEPROM. If Biped robot works at **Program Motion by Hand**, please press S1 until LED1 off and LED2 normally on, Biped robot will exit programming and to start to perform motion, all SCServo will recovery torque output.