



機器人組裝體驗

Daniel Liao



Agenda

- 前置準備
- 馬達套件預先組裝與預鎖零件
- 歸零組裝

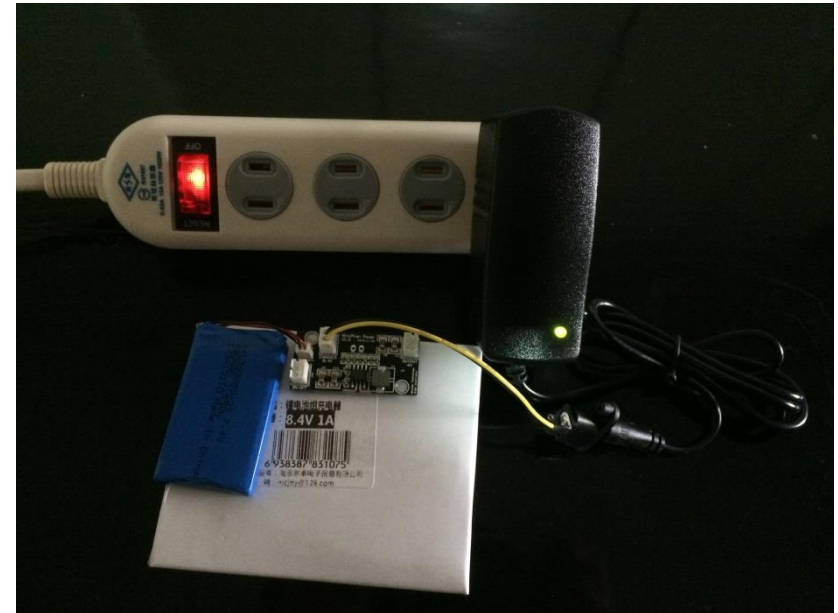
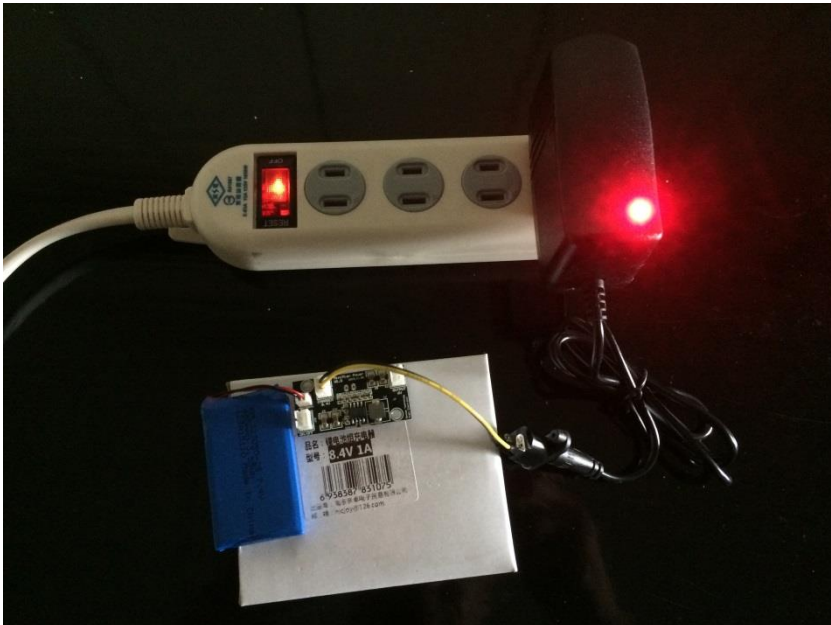


注意事項

- 機器人操作注意事項：
 1. 使用者應特別注意使用方式，避免受傷或產品損壞。
 2. 充電時電池會微微發燙，此為正常現象。(避免過度充電)
 3. 請勿於高溫、潮濕環境中操作。
- 操作時發現機器人運轉異常，先確認電源供應是否正常，嘗試校準伺服馬達。

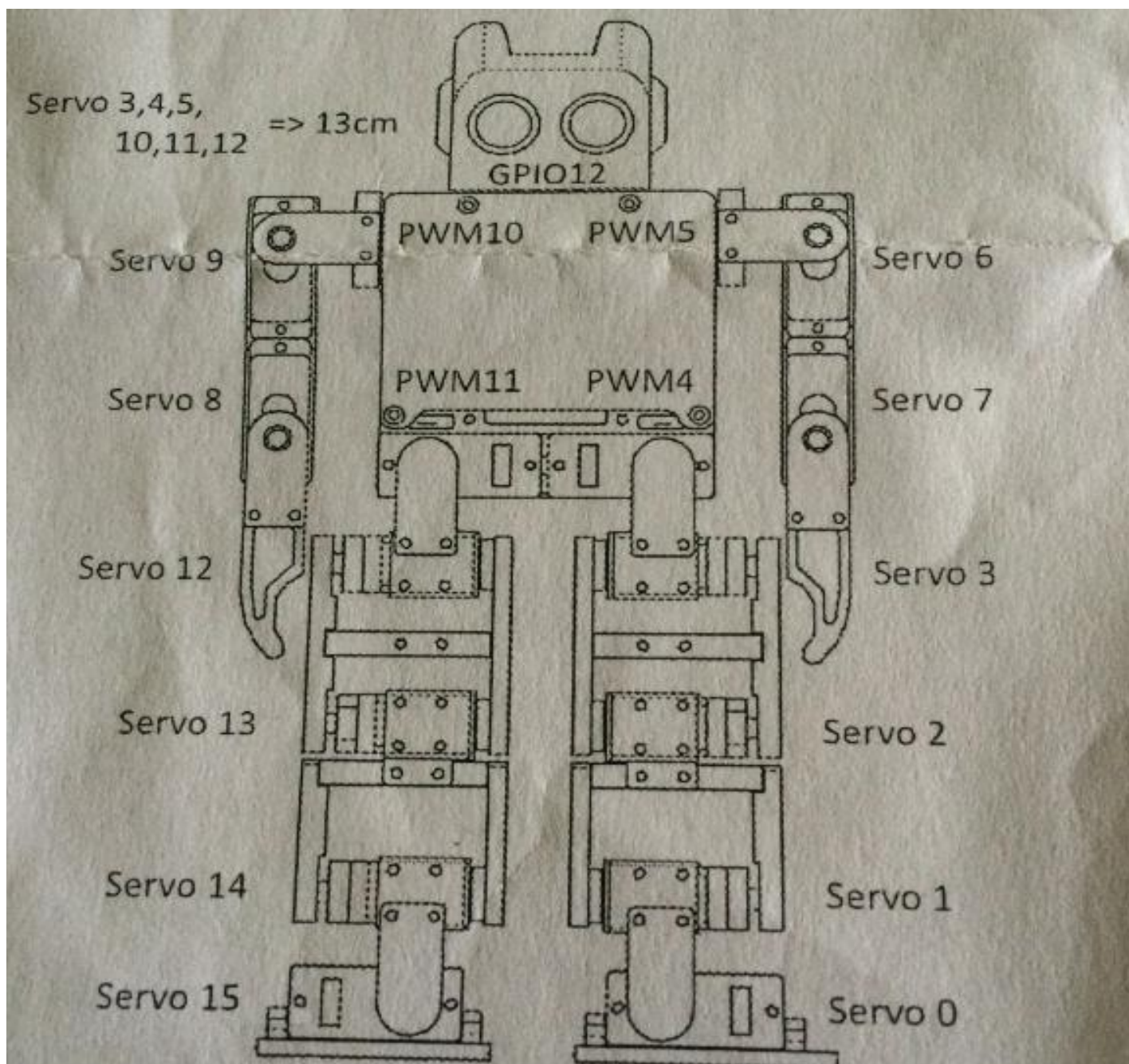
前置準備-充電

- 8.4V/1A Lithium battery charger
- 7.4V/480mAh Lithium Polymer battery with PCM
- DC to DC power board
- DC Jack cable assembly





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前置準備-伺服馬達

EMAX/ES08MDII

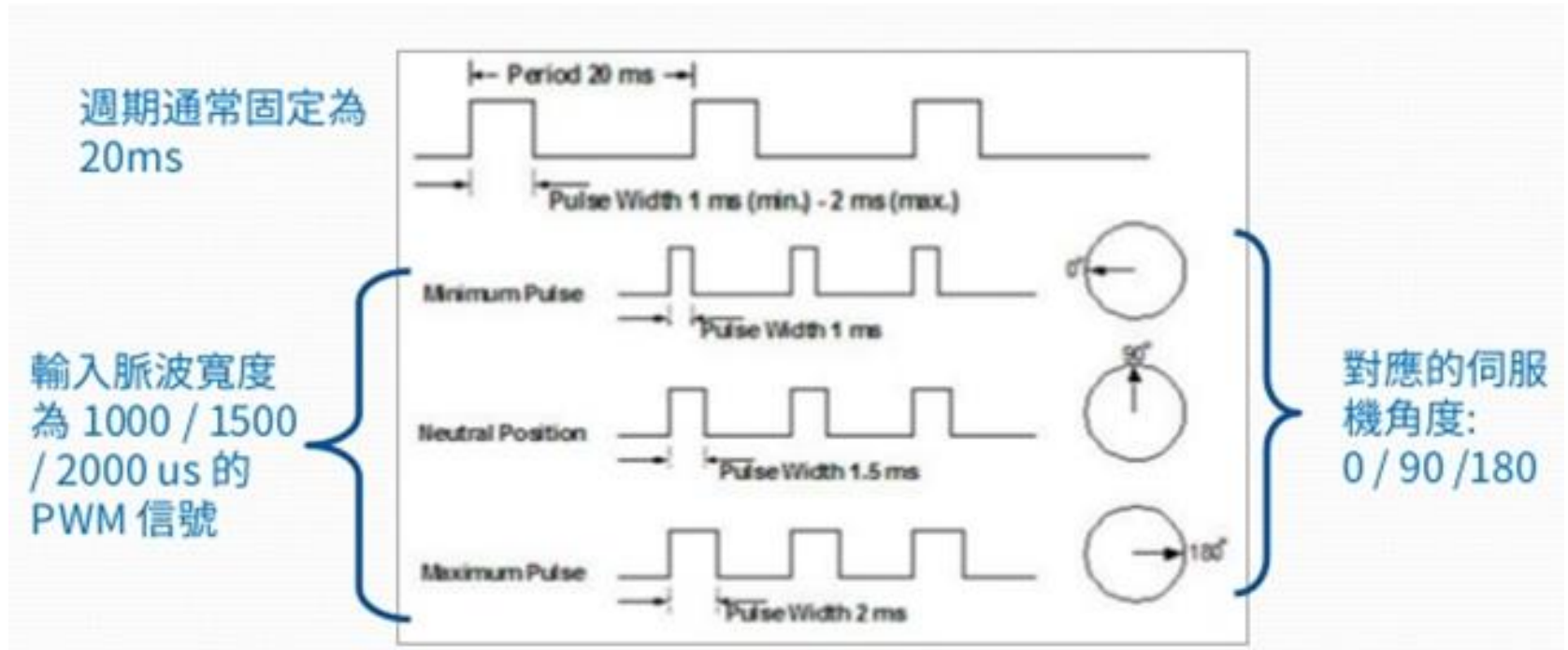
- 伺服馬達(servo motor)裡含有直流馬達、齒輪箱、軸柄、以及控制電路，我們可透過訊號控制軸柄的停止角度，**ES08MDII動作範圍160度**一般市面上為**120度**，但不同廠牌型號會有不同的範圍；經由齒輪箱降速後，變成適當可用的轉速，並且提供更高的轉矩(扭轉力)。

透過訊號線傳送PWM脈波來控制軸柄的停止位置旋轉角度，**這個訊號脈波必須每秒重複50次(也就是50Hz；20ms)**，而脈衝持續時間長短便代表了馬達該將軸柄轉到什麼位置，範圍從540us ($\mu\text{s} = \text{micro second}$, 10^{-6} sec ，微秒)到2.0ms ($\text{ms} = \text{mini second}$, 10^{-3} sec ，毫秒)，若想置中則是1.5ms；也可將1.0ms當做角度0度，那麼1.37ms會是80度，2.19ms則是轉到底160度。注意，也有可能反過來。

前置準備-伺服馬達

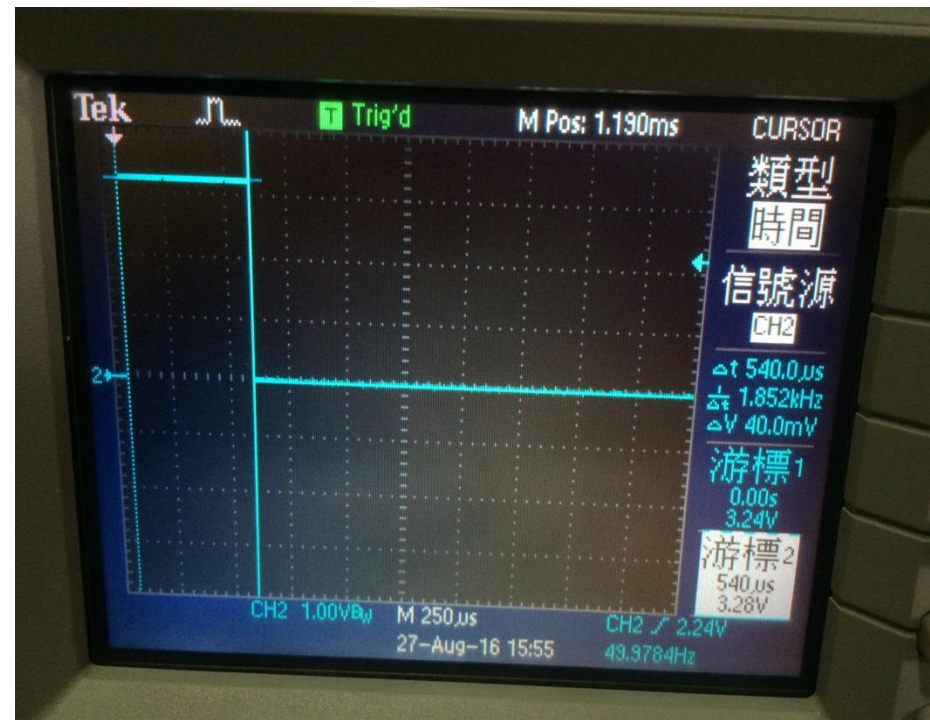
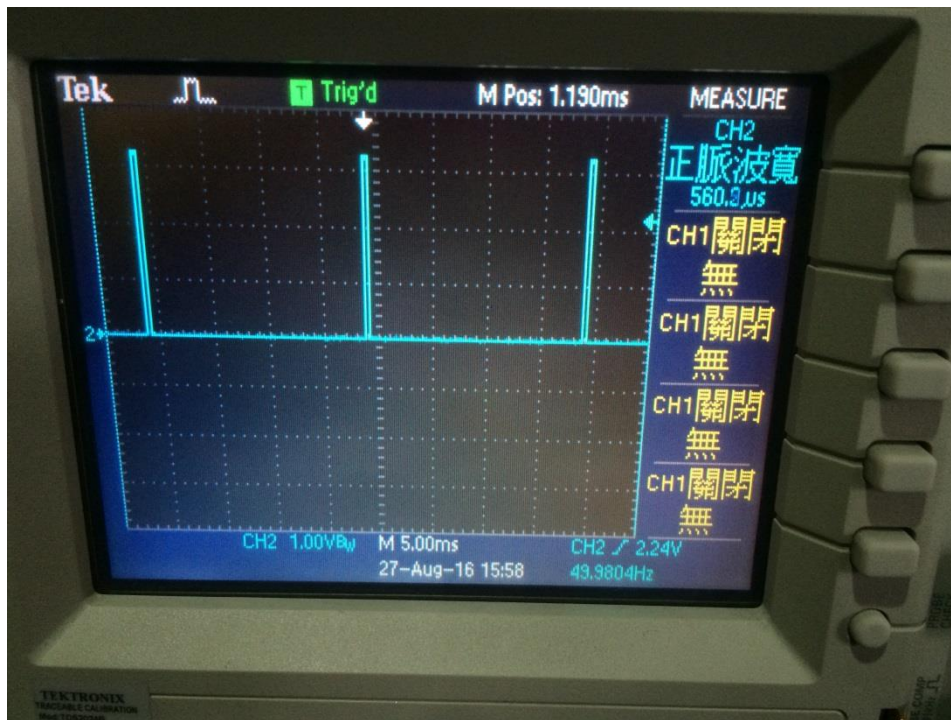
EMAX/ES08MDII

- PWM 控制伺服馬達(servo motor)



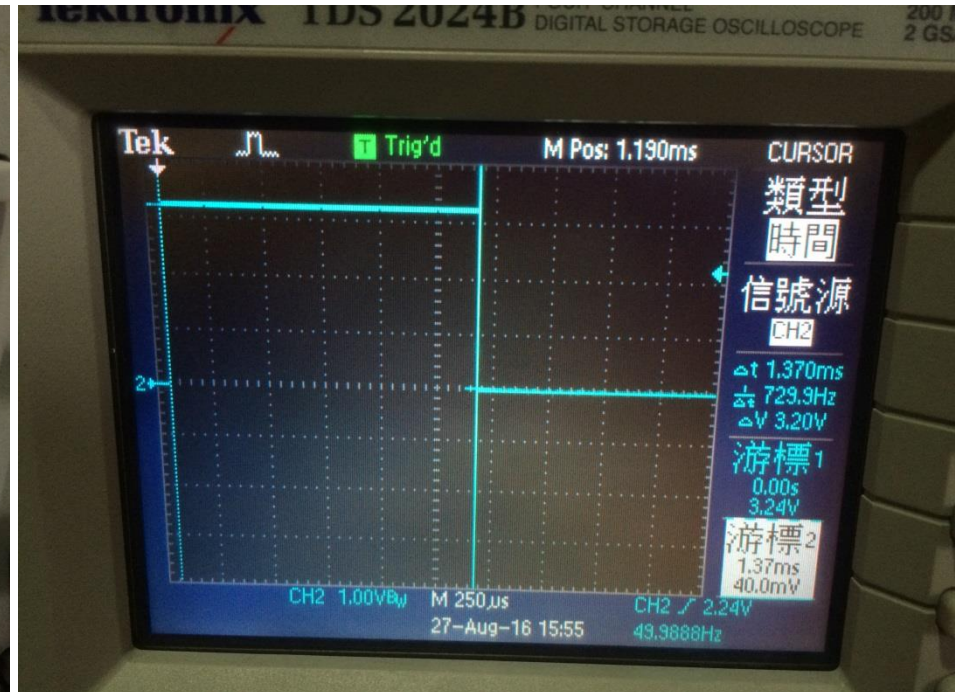
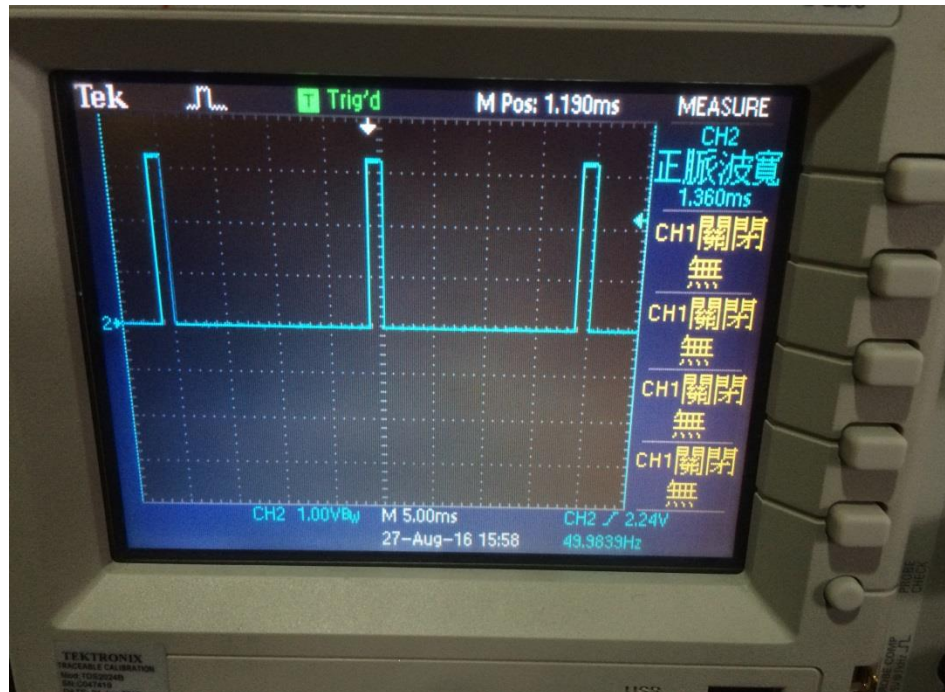
前置準備-伺服馬達 EMAX/ES08MDII

- $0^\circ = 540\mu s$



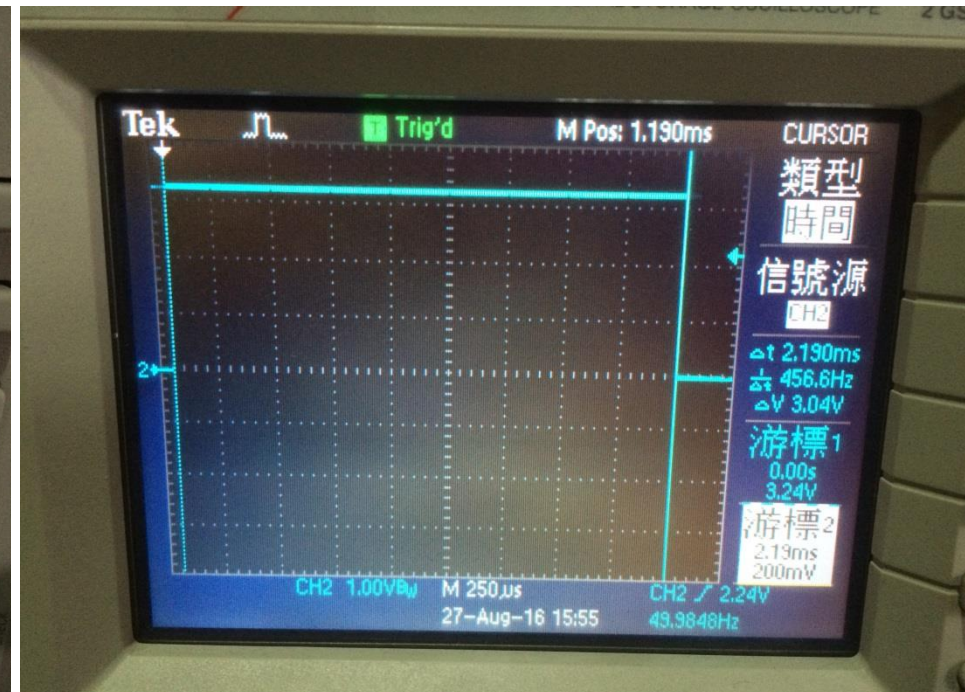
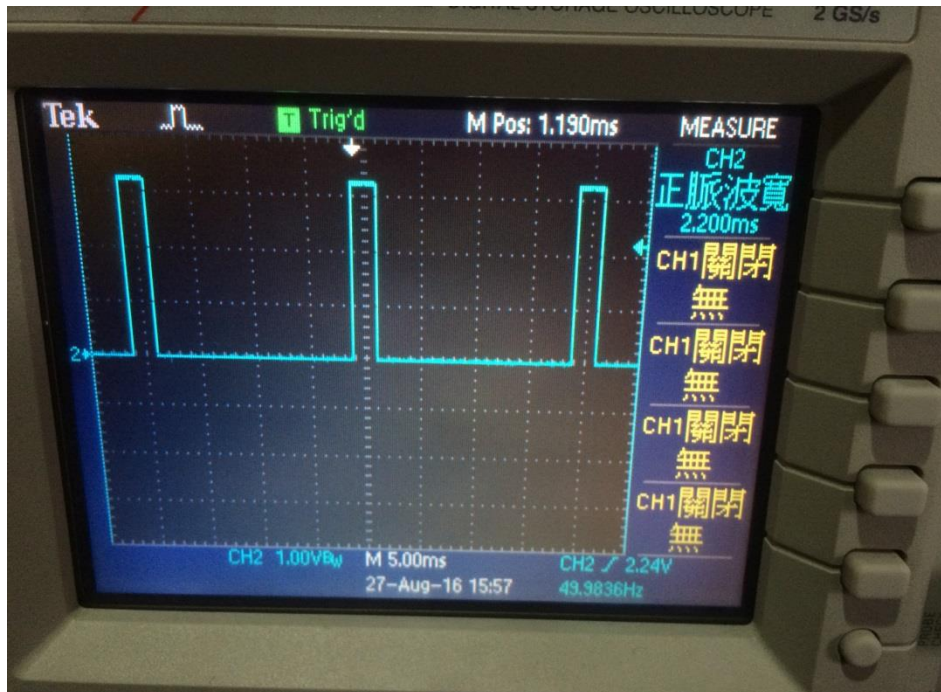
前置準備-伺服馬達 EMAX/ES08MDII

- $80^\circ = 1.37\text{ms}$



前置準備-伺服馬達 EMAX/ES08MDII

- $160^\circ = 2.19\text{ms}$



前置準備-伺服馬達

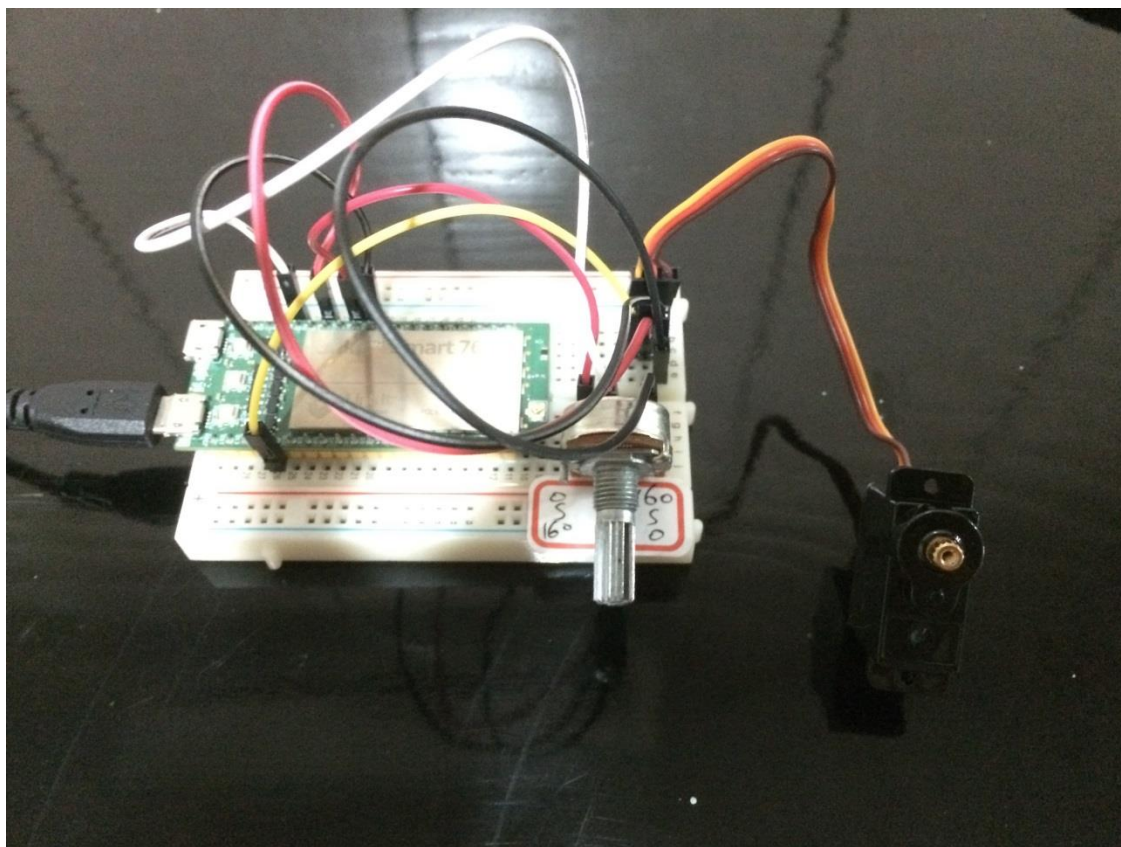
EMAX/ES08MDII

- - Operating voltage: 4.8-6.0V.
- STD direction: Counter Clockwise /Pulse Traveling 1500 to 1900usec.
- Stall torque: 4.8V: 1.6 Kgf.cm (21 oz.in); 6.0V: 2.0 Kgf.cm (28 oz.in).
- Operating speed: 4.8V: 0.12 Sec/60-degree at no load; 6.0V: 0.10 Sec/60-degree at no load.



前置準備-伺服馬達驗證

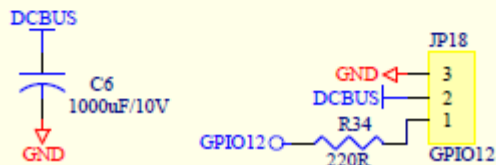
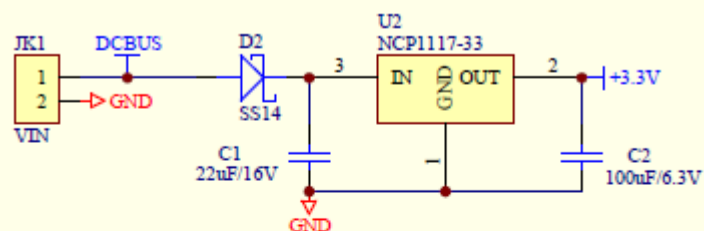
- 訊號線（橘）、電源（紅色）、接地（棕色）。
- 注意棕色要對應到測試板黑色線位置



前置準備-伺服馬達

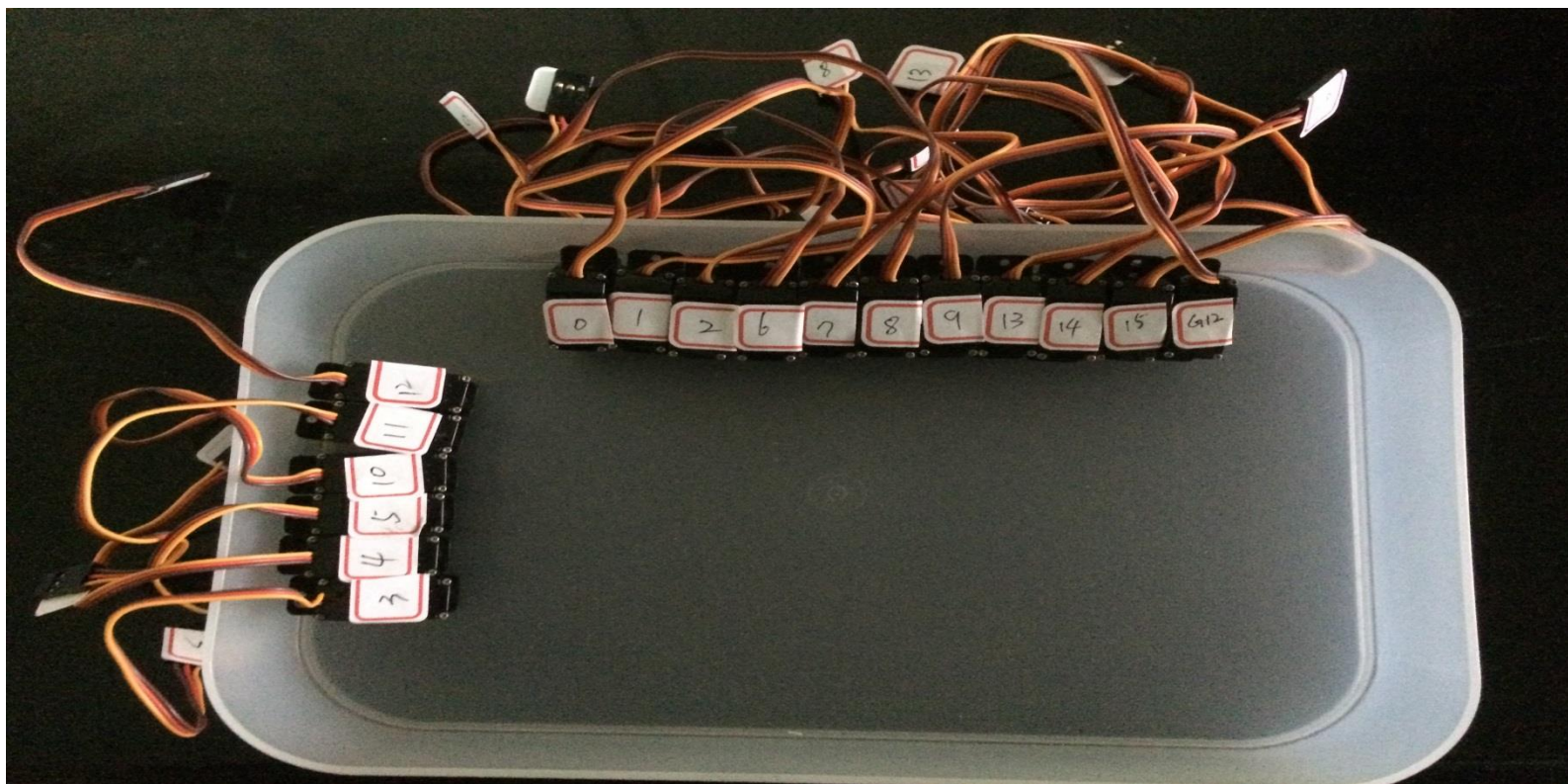
EMAX/ES08MDII

- 一般伺服馬達有三條線，電源（紅色）、接地（黑或棕色）、訊號線（白、黃、橘、藍，甚至是黑色）。注意線色方向(棕色外側)



前置準備-馬達分類

- EMAX ES08MD-II servo motors分類:
6*13cm, 11*26cm



前置準備-十字舵柄黏合

- 頭部MiniPlan5_42 x 1 PCS (面朝上)

MiniPlan5_42, Fill Density 100%



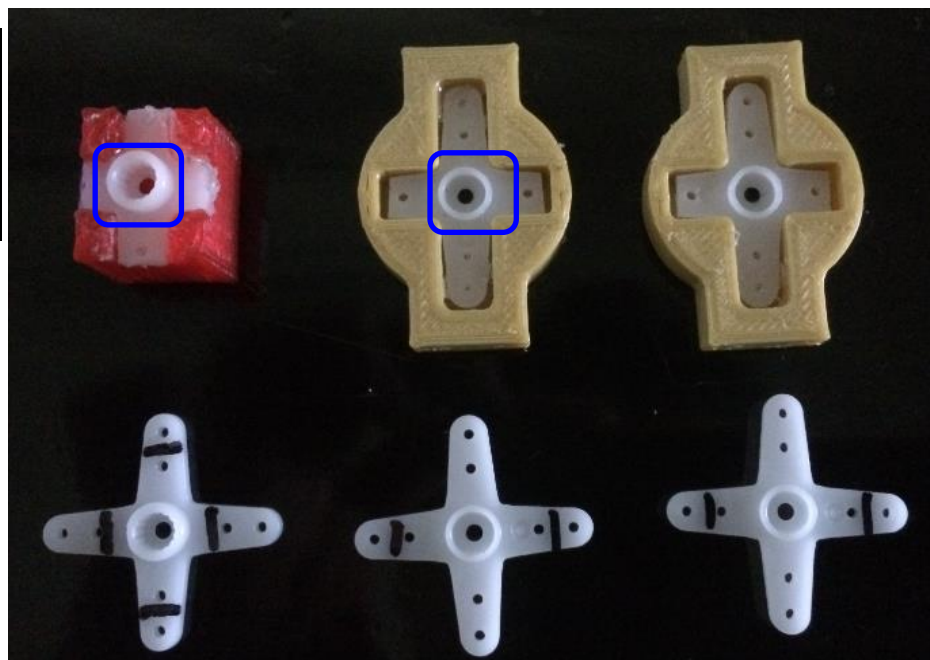
MiniPlan5_42

- 手臂MiniPlan51_23 x 2 PCS(面朝下)

MiniPlan51_23, Fill Density 100%

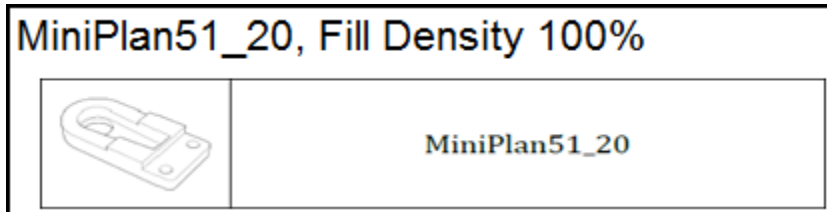


MiniPlan51_23

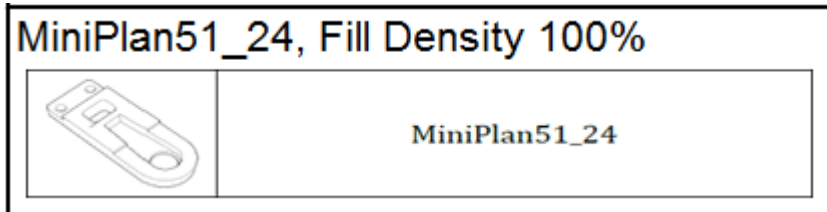


前置準備-小舵柄黏合

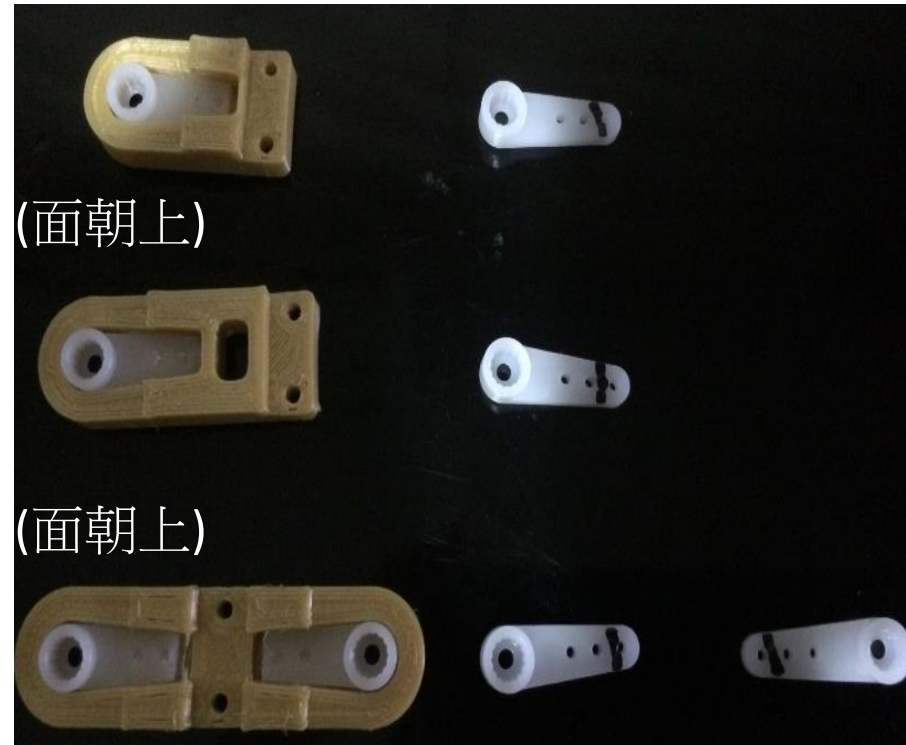
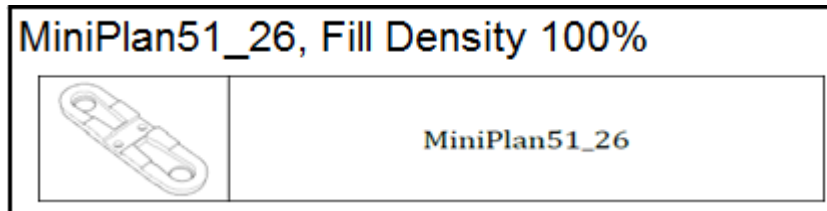
- MiniPlan51_20 x 8 PCS (手臂*4,左腳*2,右腳*2) (面朝上)



- MiniPlan51_24 x 2 PCS (左腳*1,右腳*1) (面朝上)



- MiniPlan51_26 x 2 PCS (左腳*1,右腳*1) (面朝上)



前置準備-軸承培林

- MiniPlan5_21 x 8 PCS (手臂*4,左腳*2,右腳*2)

MiniPlan5_21, Fill Density 100%



MiniPlan5_21

- MiniPlan5_25 x 2 PCS (左腳*1,右腳*1)

MiniPlan5_25, Fill Density 100%



MiniPlan5_25

- MiniPlan5_27 x 2 PCS (左腳*1,右腳*1)

MiniPlan5_27, Fill Density 100%

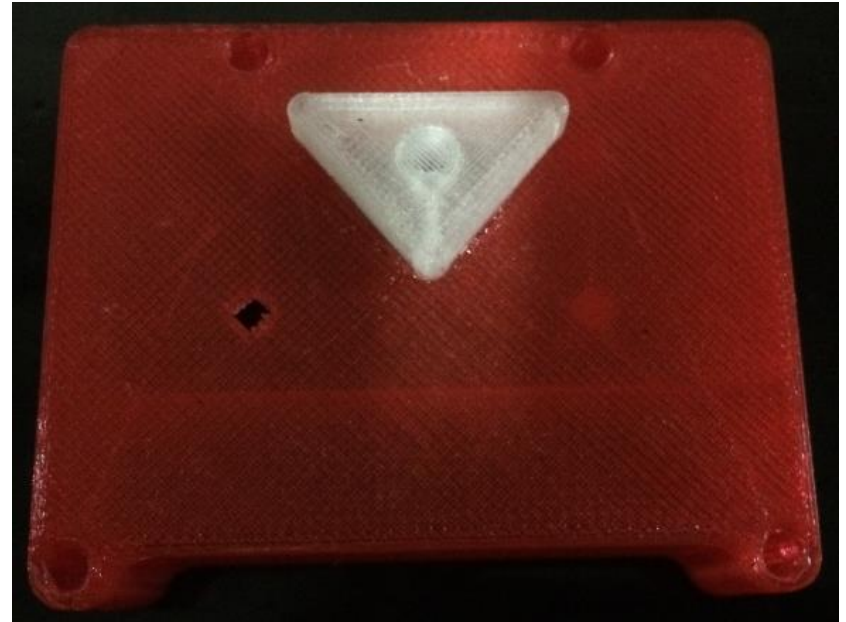


MiniPlan5_27



前置準備-燈飾黏合

- 胸前蓋燈飾組裝





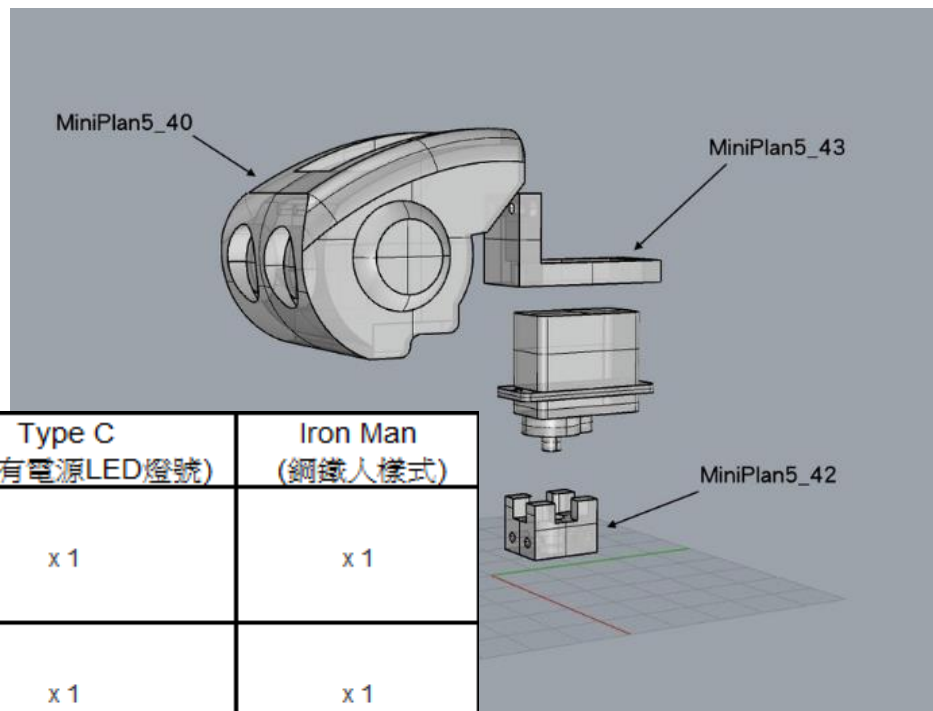
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馬達套件預先組裝與預鎖零件

- 頭部馬達組裝
- 身體馬達組裝
- 雙臂馬達組裝
- 雙腳馬達組裝
- 螺絲預鎖零件
- 雙腳踝預鎖零件
- 雙臂預鎖零件

頭部馬達組裝

- 自攻螺絲 x 4 PCS
- 伺服馬達編號G12



Head Parts List (Move)	Type A (胸前無LED燈號)	Type C (胸前有電源LED燈號)	Iron Man (鋼鐵人模式)
 <div>MiniPlan5_40</div>	x 1	x 1	x 1
 <div>MiniPlan5_42</div>	x 1	x 1	x 1
 <div>MiniPlan5_43</div>	x 1	x 1	x 1
 <div>MiniPlan51_70</div>	x 2	x 2	x 2

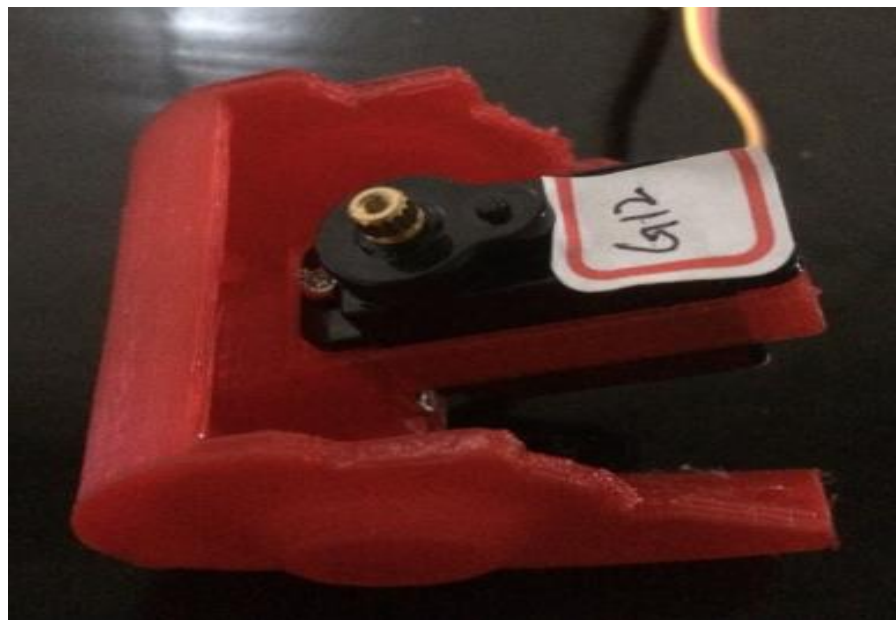
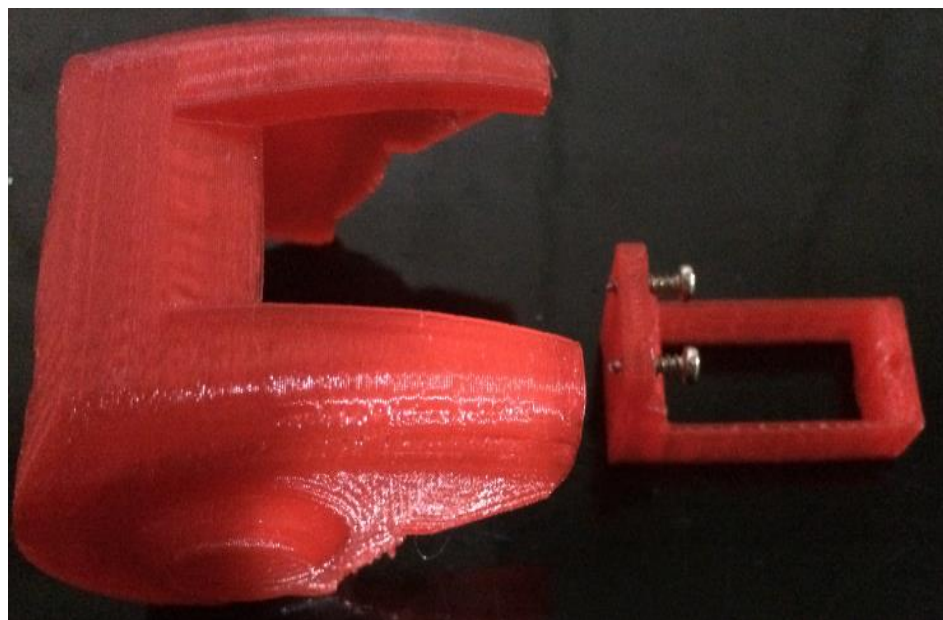
頭部馬達組裝

- MiniPlan51_70效果差異

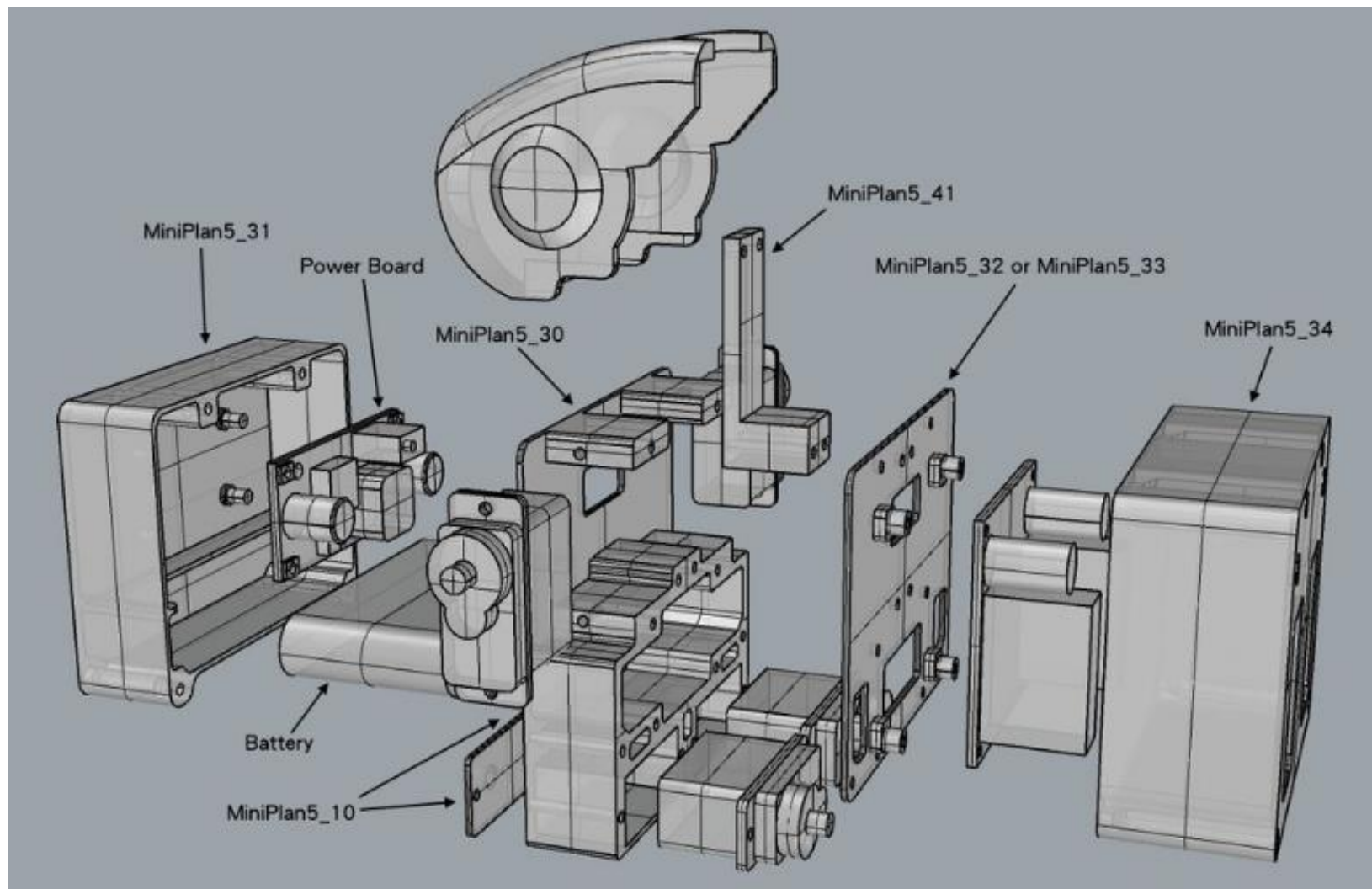


頭部馬達組裝






- 注意馬達轉軸位置於頭部中間 (G12)
- 伺服馬達黑色M2 x 5 螺絲 X 1PCS
- 已黏合十字舵柄MiniPlan5_42



身體馬達組裝



身體組裝零件

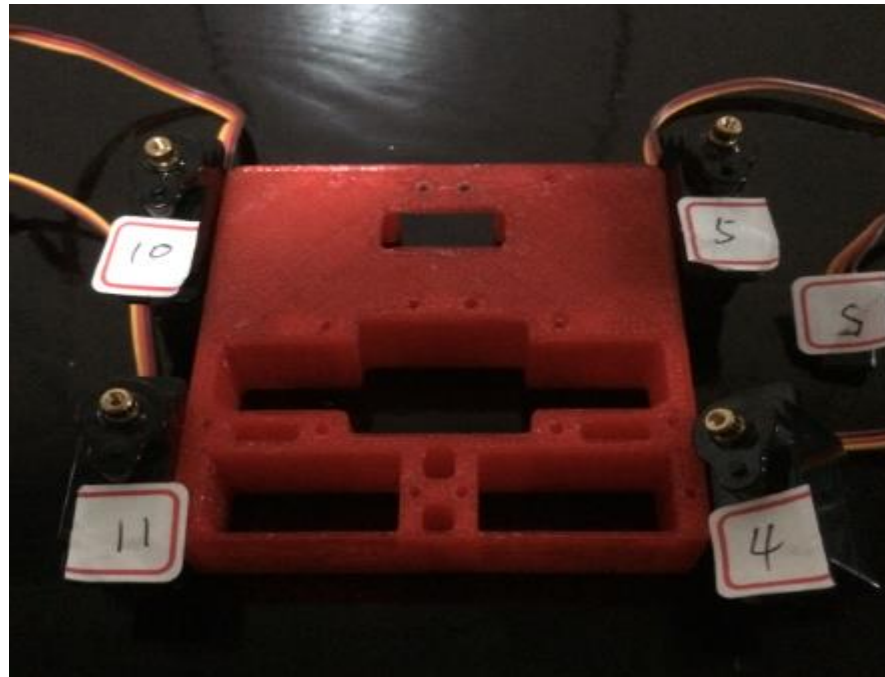
Prototype Body Parts List	Type A (胸前無LED燈號)	Type C (胸前有電源LED燈號)	Iron Man (鋼鐵人樣式)
MiniPlan5_10, Fill Density 100%  MiniPlan5_10	x 2	x 2	x 2
MiniPlan5_30, Fill Density 30%  MiniPlan5_30	x 1	x 1	x 1
MiniPlan51_31_A, Fill Density 100%  MiniPlan51_31_A	x 1	MiniPlan51_31_C	MiniPlan51_31_B
MiniPlan5_32, Fill Density 100%  MiniPlan5_32	x 1	x 1	x 1
MiniPlan51_34, Fill Density 100%  MiniPlan51_34	x 1	x 1	x 1

身體版本差異

Iron Man (鋼鐵人樣式)		
	MiniPlan51_31_B	
	MiniPlan51_71 (透明材料)	
Type C (胸前有電源LED燈號)		
	MiniPlan51_31_C	1

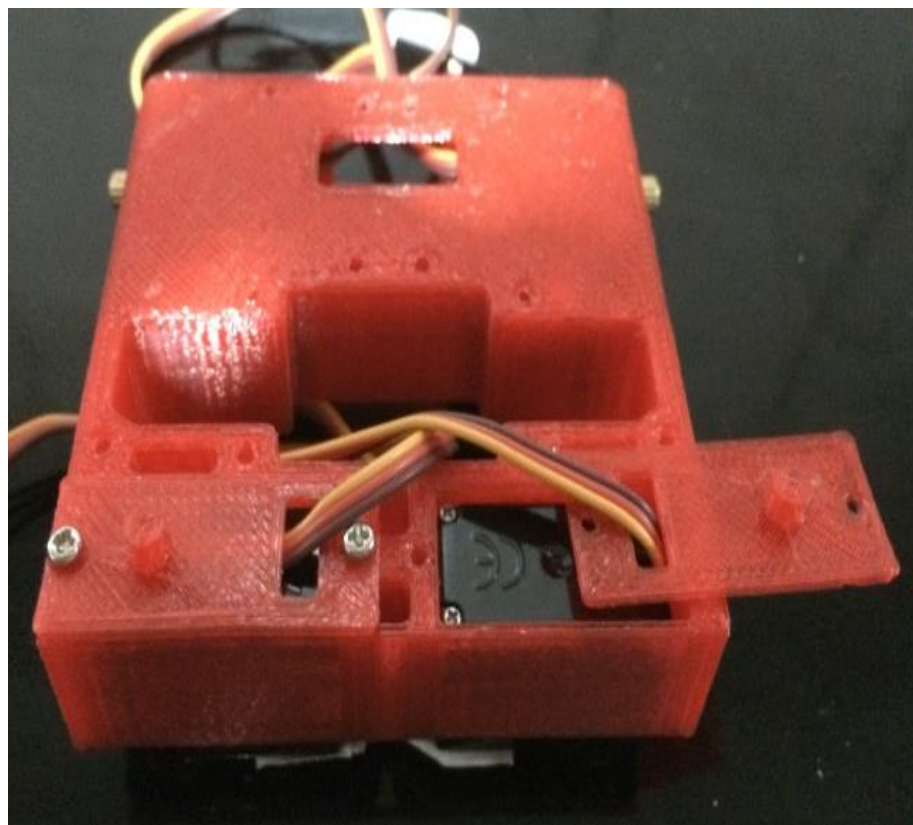
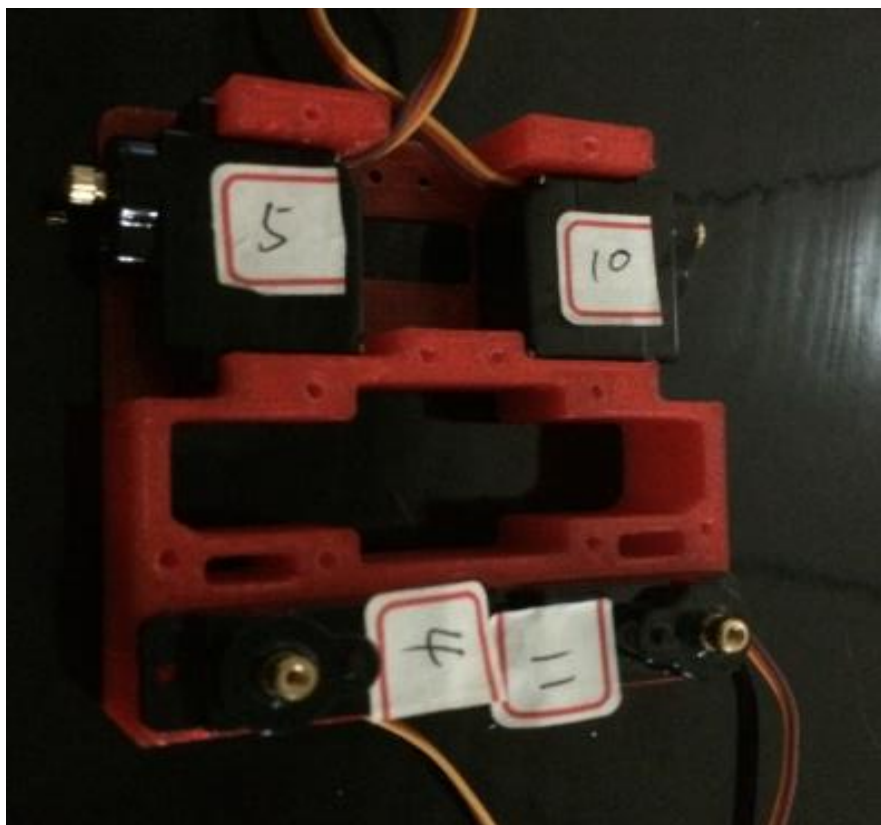
身體馬達組裝

- MiniPlan5_10 x 2 PCS
- MiniPlan5_30 x 1 PCS
- 自攻螺絲 x 12 PCS
- 伺服馬達編號4, 5, 10, 11










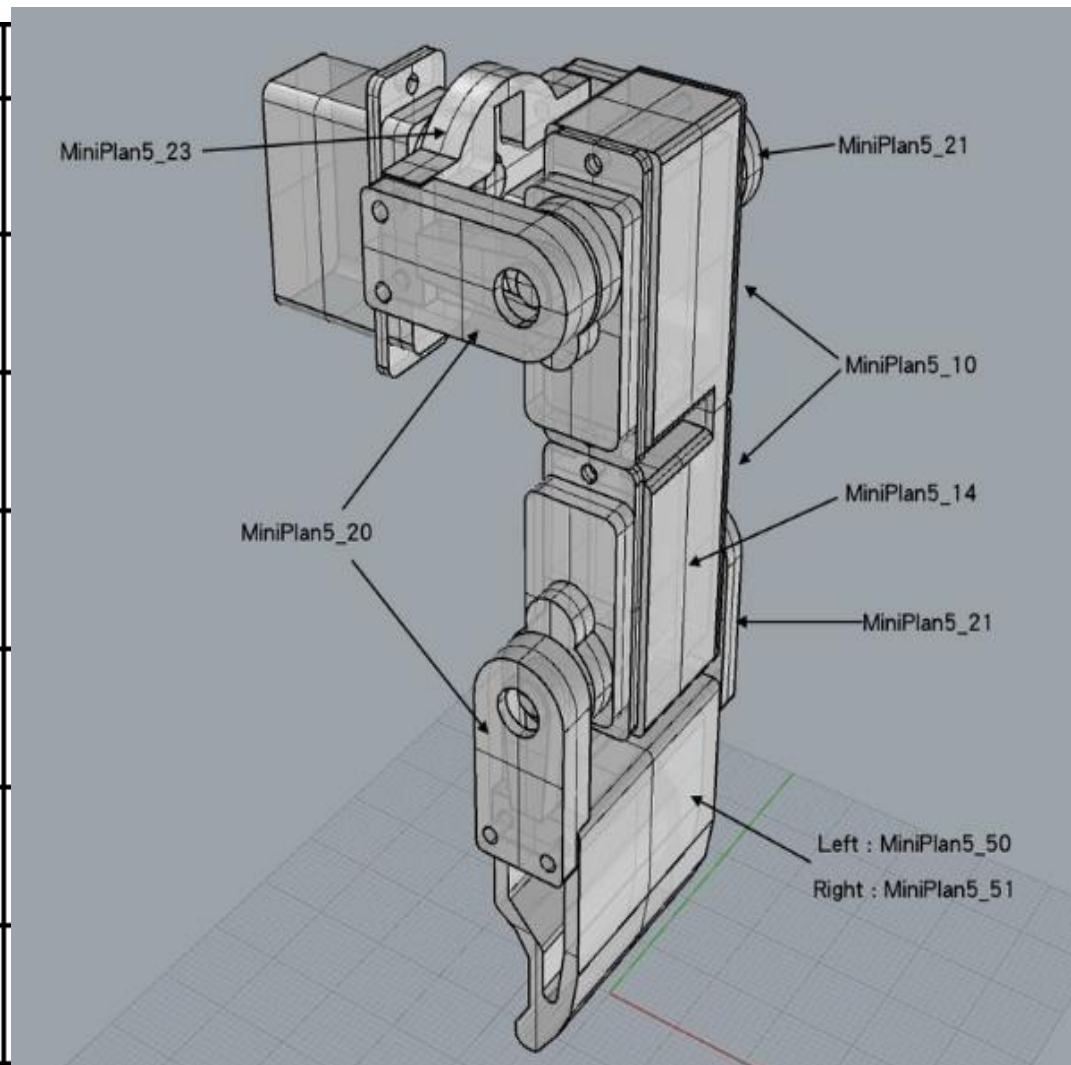
身體馬達組裝

- 伺服馬達編號4及11轉軸靠外側鎖固



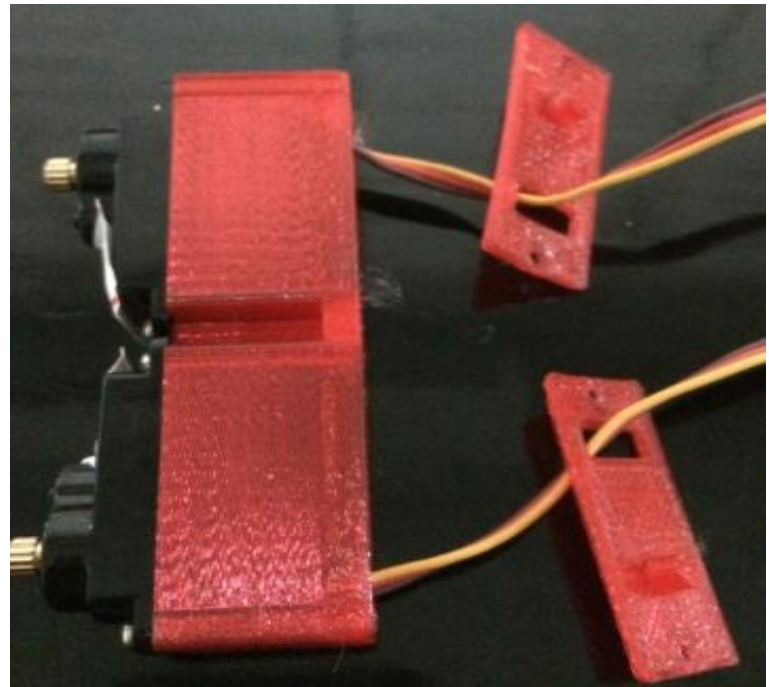
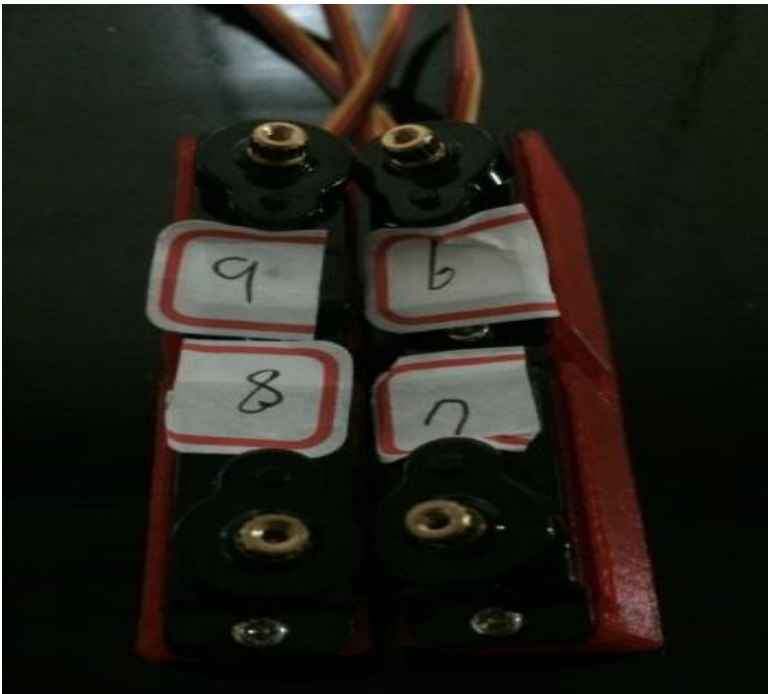
雙臂組裝零件

Arms Parts List	Type A (胸前無LED燈號)
MiniPlan5_10, Fill Density 100%  MiniPlan5_10	x 4
MiniPlan5_14, Fill Density 50%  MiniPlan5_14	x 2
MiniPlan51_20, Fill Density 100%  MiniPlan51_20	x 4
MiniPlan5_21, Fill Density 100%  MiniPlan5_21	x 4
MiniPlan51_23, Fill Density 100%  MiniPlan51_23	x 2
MiniPlan5_50 (Left), Fill Density 30%  MiniPlan5_50	x 1
MiniPlan5_51 (Right), Fill Density 30%  MiniPlan5_51	x 1








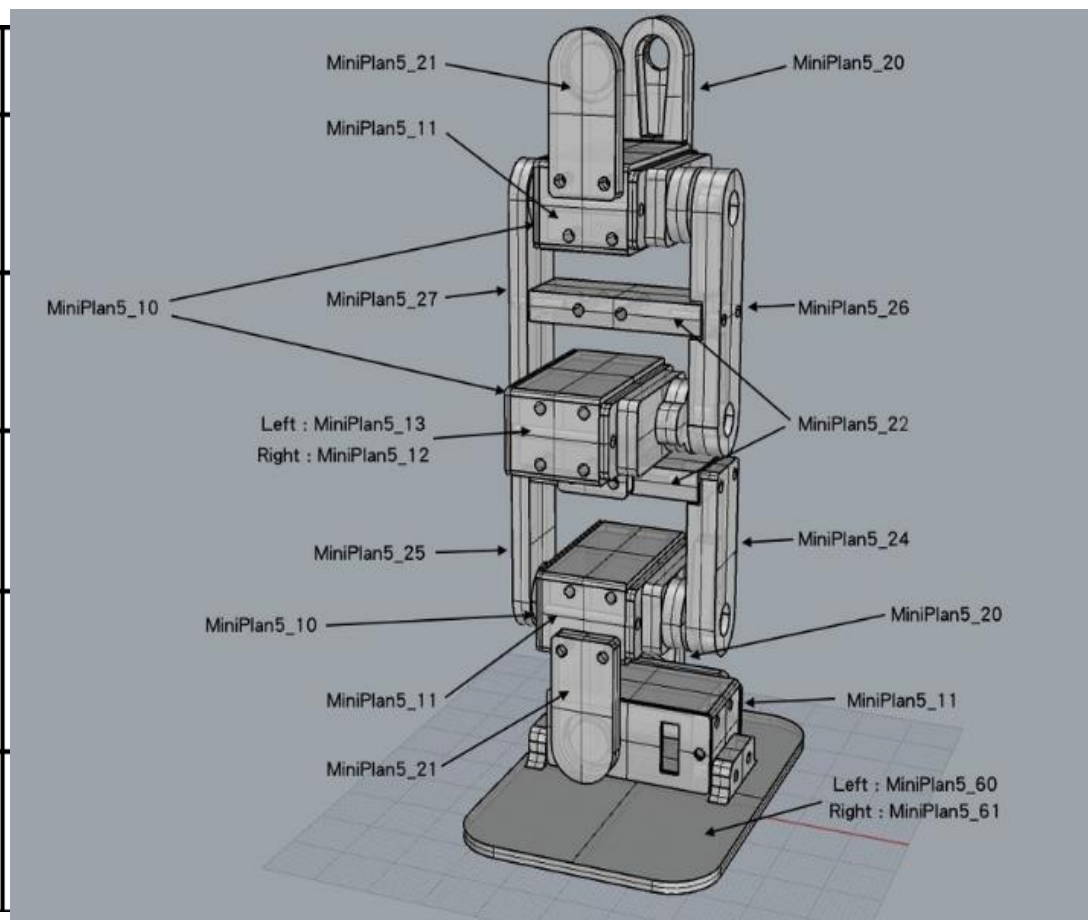
雙臂馬達組裝

- MiniPlan5_10 x 4 PCS
- MiniPlan5_14 x 2 PCS
- 自攻螺絲 x 16 PCS
- 伺服馬達 右手 (編號6, 7), 左手 (8, 9)









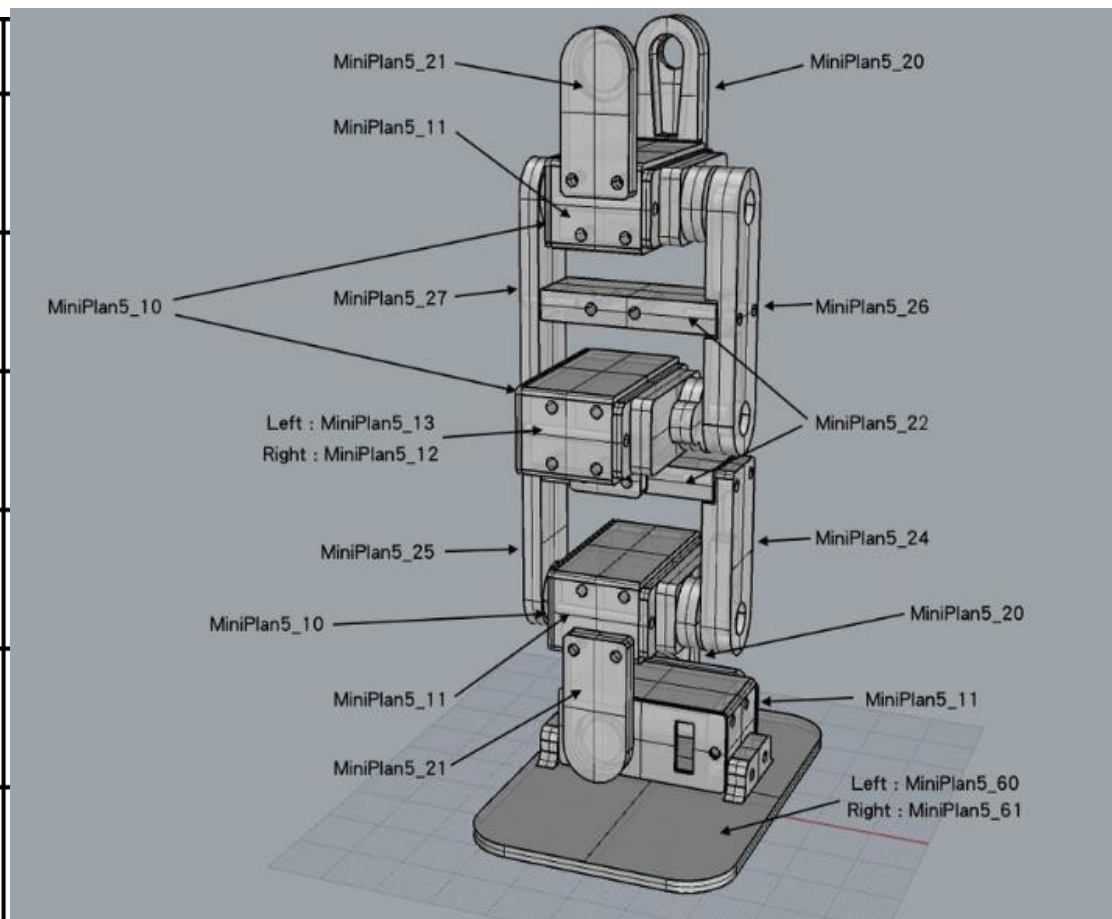
左腳組裝

Left Leg Parts List	Type A (胸前無LED燈號)
 MiniPlan5_10	x 4
 MiniPlan5_11	x 3
 MiniPlan5_13	x 1
 MiniPlan51_20	x 2
 MiniPlan5_21	x 2








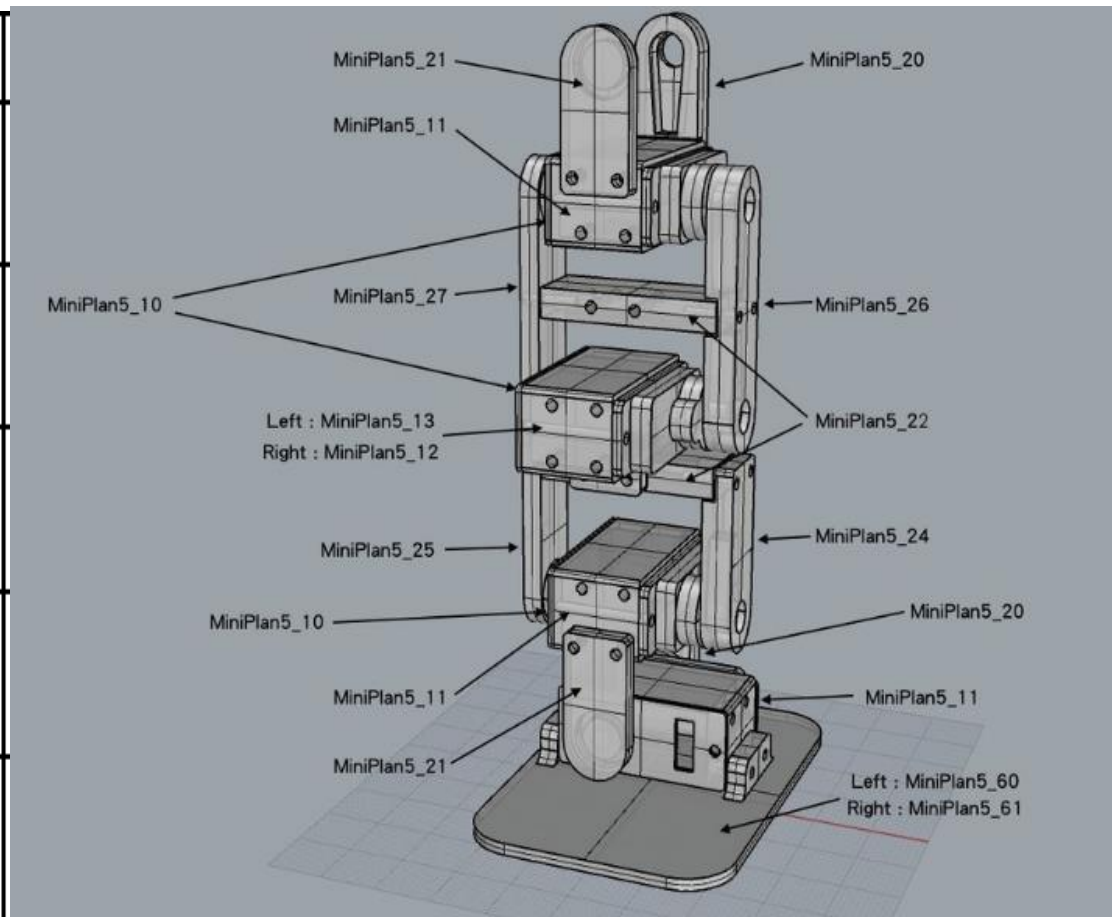
左腳組裝

Left Leg Parts List	Type A (胸前無LED燈號)
MiniPlan51_22, Fill Density 100%  MiniPlan51_22	x 2
MiniPlan51_24, Fill Density 100%  MiniPlan51_24	x 1
MiniPlan5_25, Fill Density 100%  MiniPlan5_25	x 1
MiniPlan51_26, Fill Density 100%  MiniPlan51_26	x 1
MiniPlan5_27, Fill Density 100%  MiniPlan5_27	x 1
MiniPlan51_60 (Left), Fill Density 100%  MiniPlan51_60	x 1









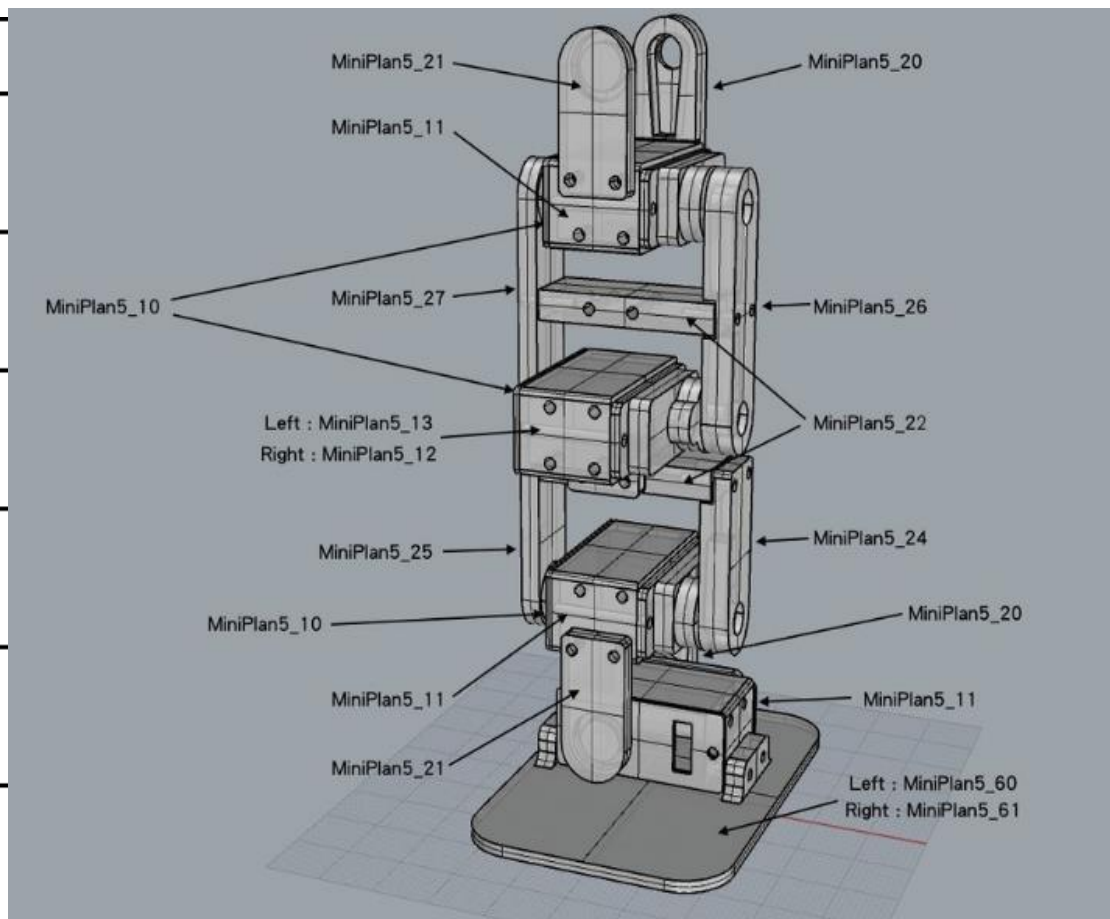
右腳組裝

Right Leg Parts List	Type A (胸前無LED燈號)
MiniPlan5_10, Fill Density 100%  MiniPlan5_10	x 4
MiniPlan5_11, Fill Density 100%  MiniPlan5_11	x 3
MiniPlan5_12 (Right), Fill Density 100%  MiniPlan5_12	x 1
MiniPlan51_20, Fill Density 100%  MiniPlan51_20	x 2
MiniPlan5_21, Fill Density 100%  MiniPlan5_21	x 2



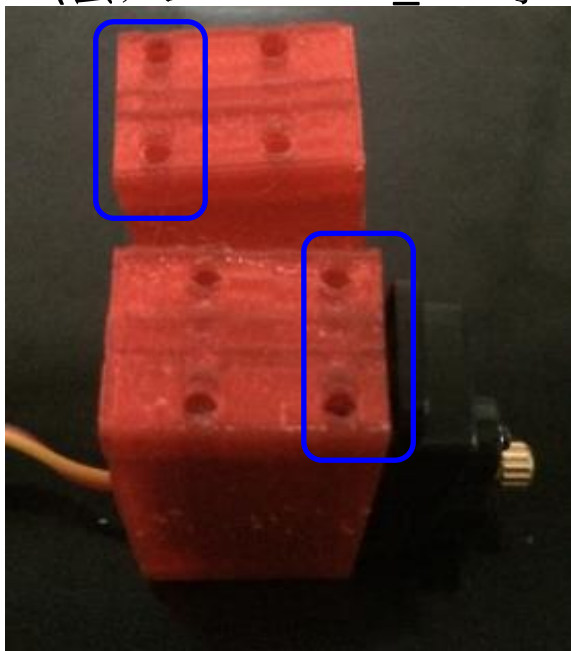
右腳組裝

Right Leg Parts List	Type A (胸前無LED燈號)
MiniPlan51_22, Fill Density 100%  MiniPlan51_22	x 2
MiniPlan51_24, Fill Density 100%  MiniPlan51_24	x 1
MiniPlan5_25, Fill Density 100%  MiniPlan5_25	x 1
MiniPlan51_26, Fill Density 100%  MiniPlan51_26	x1
MiniPlan5_27, Fill Density 100%  MiniPlan5_27	x 1
MiniPlan51_61 (Right), Fill Density 100%  MiniPlan51_61	x 1



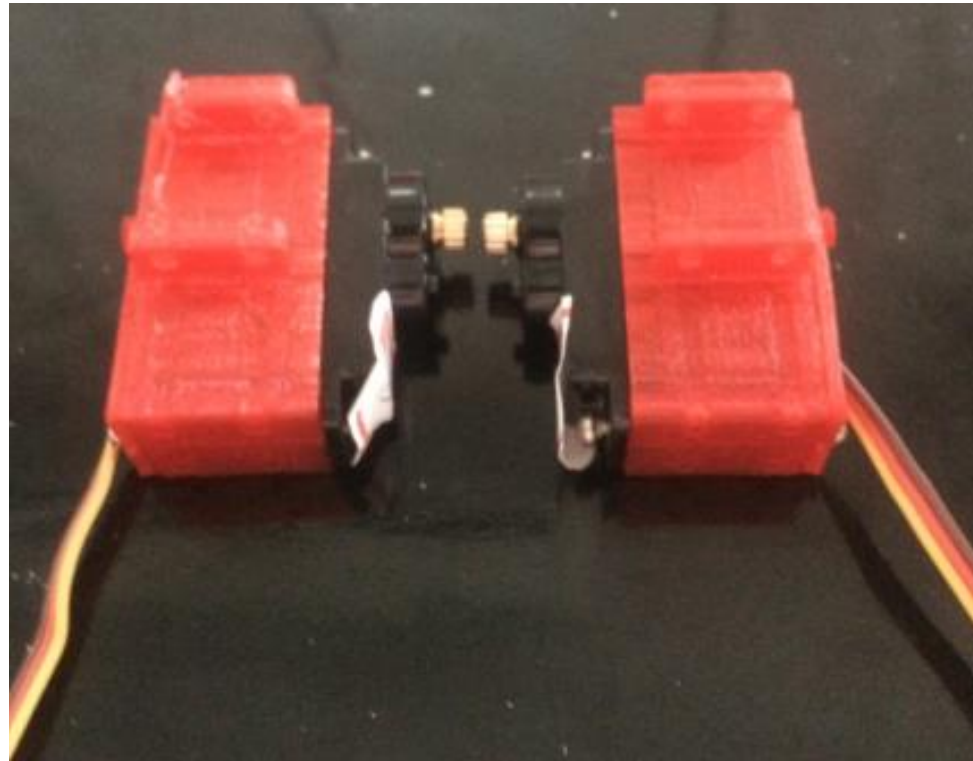
雙腳馬達組裝

- MiniPlan5_10 x 6 PCS
 - MiniPlan5_11 x 6 PCS
 - 自攻螺絲 x 24 PCS
 - 伺服馬達編號0, 1, 3, 12, 14, 15
- (套入MiniPlan5_11時，請選擇側邊螺絲孔短邊)



雙腳馬達組裝

- MiniPlan5_10 x 2 PCS
- MiniPlan5_12 x 1 PCS
- MiniPlan5_13 x 1 PCS
- 自攻螺絲 x 8 PCS



- 右腳MiniPlan5_13 配合伺服馬達編號 2
- 左腳MiniPlan5_12 配合伺服馬達編號 13

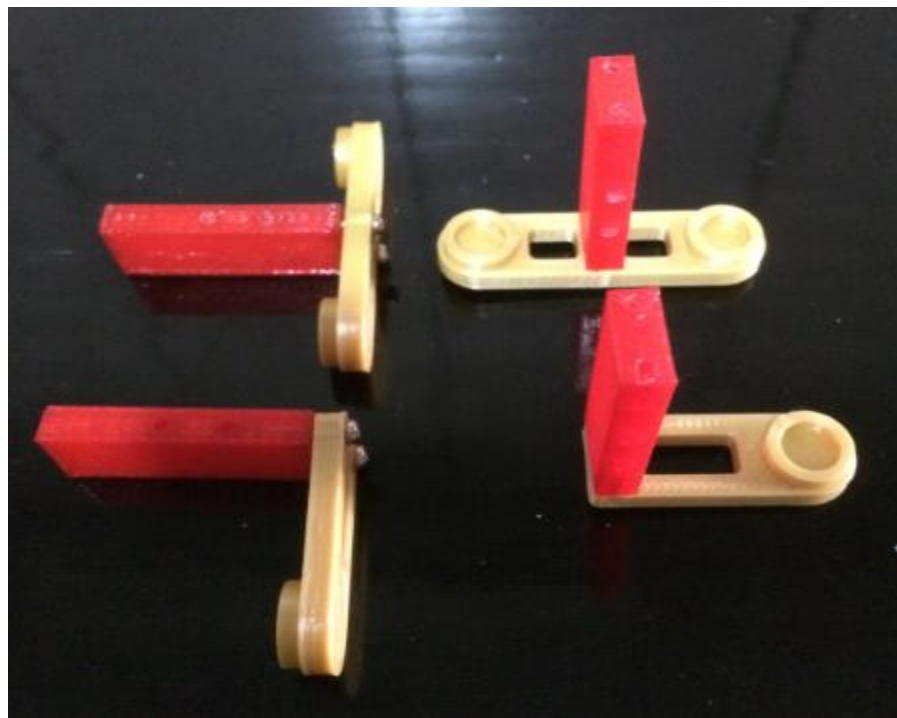
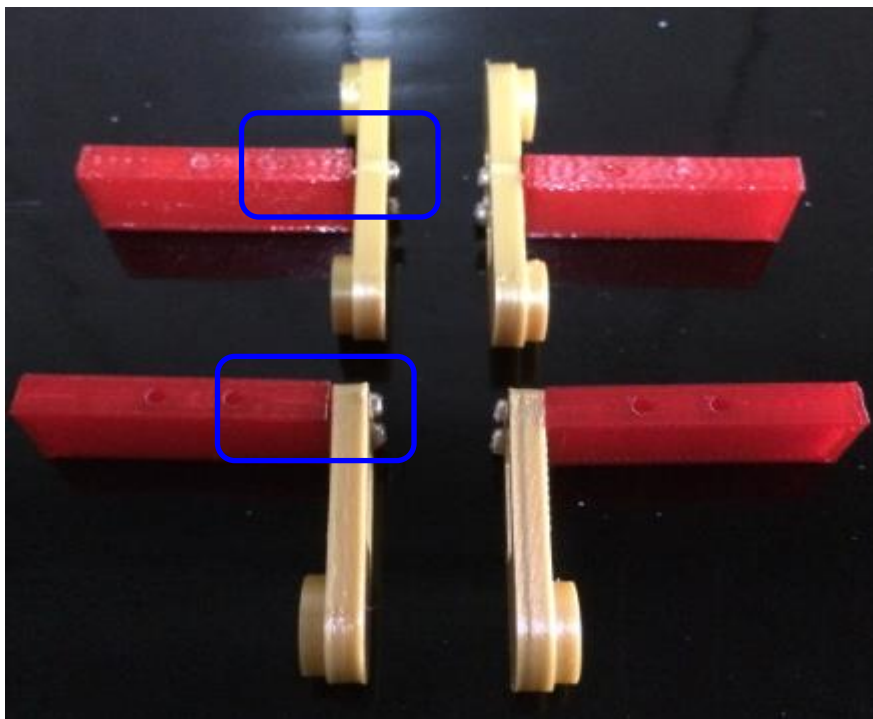
螺絲預鎖零件

- 3D列印件：
- MiniPlan51_20 x 8 PCS
- MiniPlan51_24 x 2 PCS
- MiniPlan51_26 x 2 PCS
- MiniPlan5_21 x 8 PCS
- MiniPlan5_25 x 2 PCS
- MiniPlan5_27 x 2 PCS
- 自攻螺絲 x 48 PCS



雙腳踝預鎖零件

- MiniPlan51_22 x 4 PCS (鎖固時請固定短邊)
- MiniPlan5_25 x 2 PCS
- MiniPlan5_27 x 2 PCS



雙臂預鎖零件

- MiniPlan5_21 x 2 PCS
- MiniPlan5_50 x 1 PCS
- MiniPlan5_51 x 1 PCS

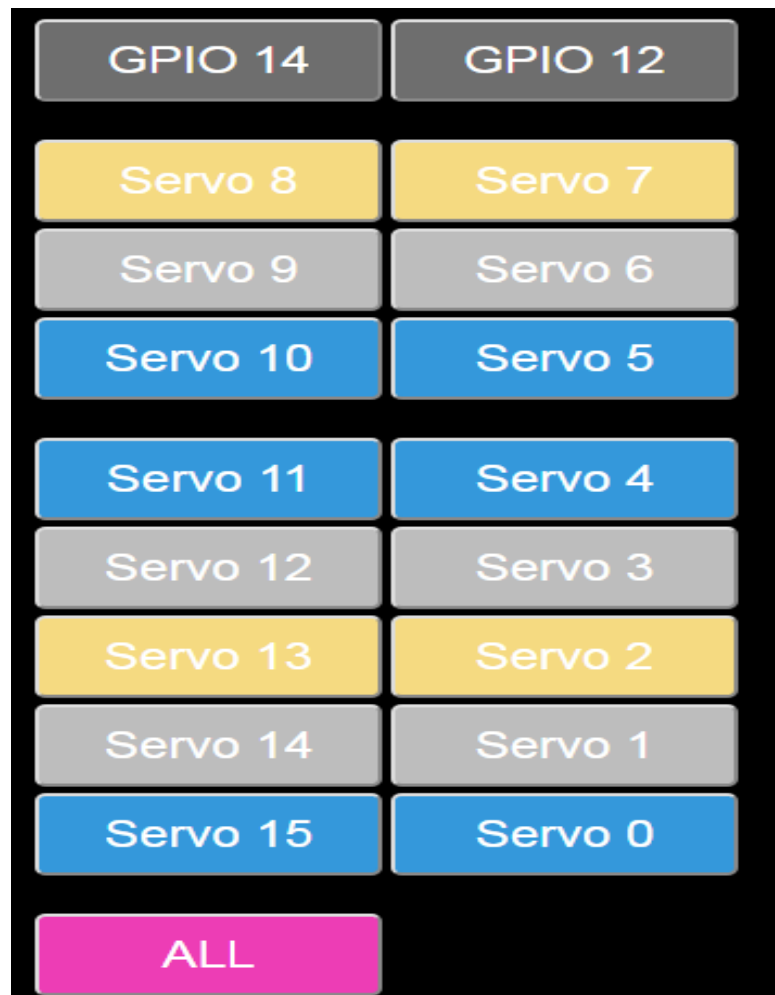
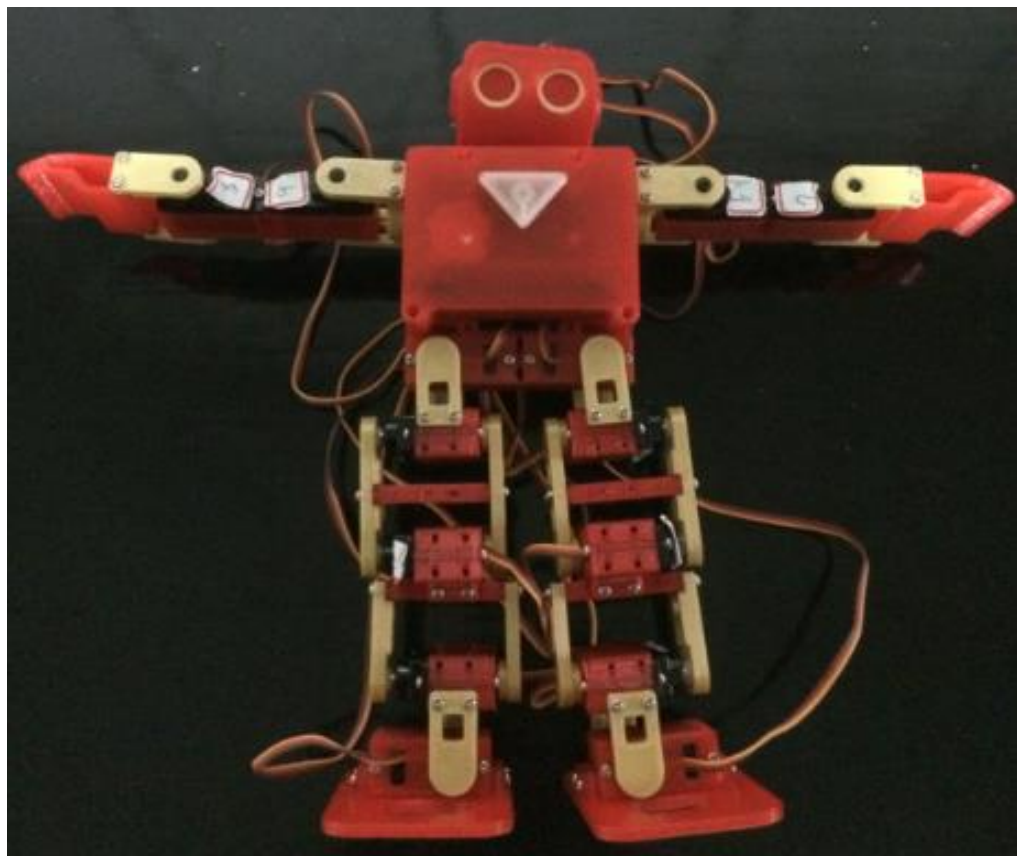


歸零組裝

- 達文西姿勢
- 頭部歸零組裝
- 腳底歸零組裝
- 腳踝歸零組裝
- 腳底腳踝組裝
- 膝關節歸零組裝
- 雙腳總組裝
- 雙臂歸零組裝
- 身體歸零組裝
- 肩膀歸零組裝

達文西姿勢

- <http://192.168.4.1/zero>
- 伺服馬達歸零網頁 (組裝步驟需要使用)



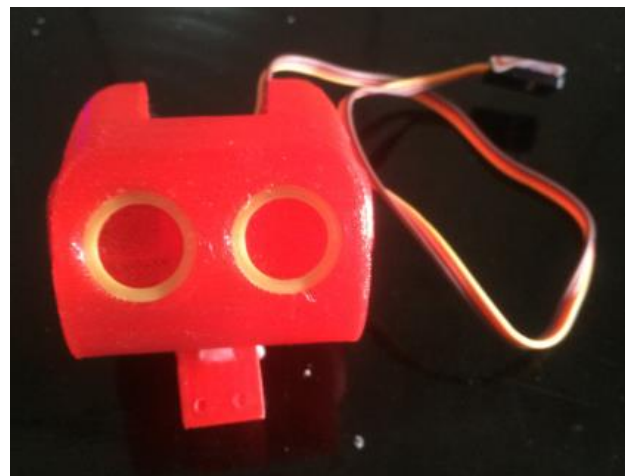
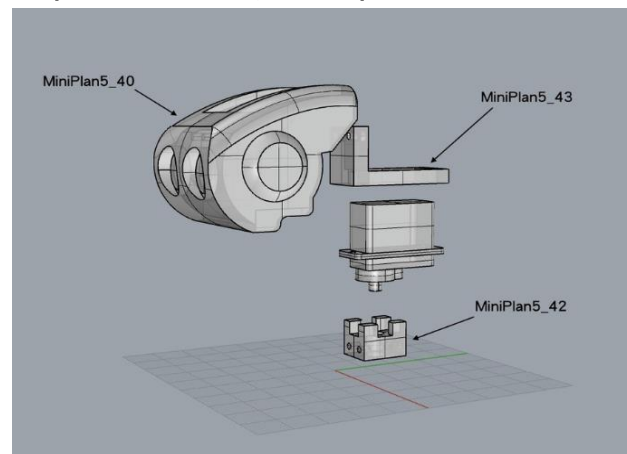
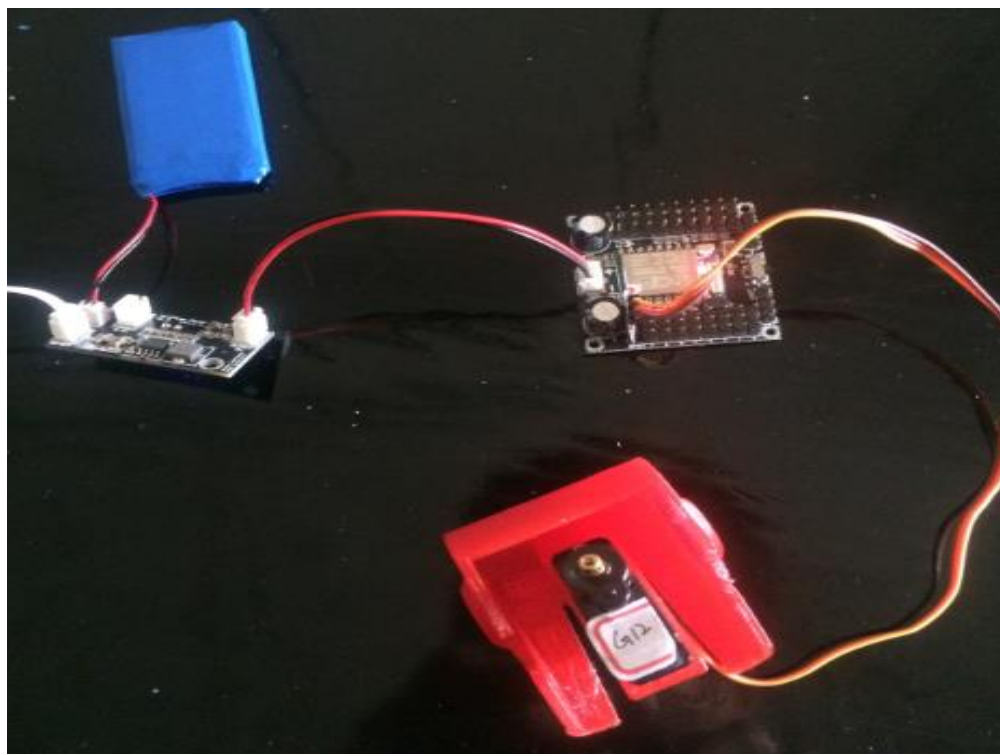
調整伺服馬達角度

- <http://192.168.4.1/editor>

GPIO 14 , Default value = 90		GPIO 12 , Default value = 90	
90	SEND	92	SEND
Servo 8 , Default value = 40		Servo 7 , Default value = 80	
40	SEND	80	SEND
Servo 9 , Default value = 100		Servo 6 , Default value = 20	
105	SEND	25	SEND
Servo 10 , Default value = 20		Servo 5 , Default value = 100	
27	SEND	109	SEND
Servo 11 , Default value = 30		Servo 4 , Default value = 80	
37	SEND	80	SEND
Servo 12 , Default value = 55		Servo 3 , Default value = 60	
55	SEND	60	SEND
Servo 13 , Default value = 35		Servo 2 , Default value = 80	
35	SEND	75	SEND
Servo 14 , Default value = 75		Servo 1 , Default value = 35	
75	SEND	33	SEND
Servo 15 , Default value = 50		Servo 0 , Default value = 65	
55	SEND	65	SEND
STANDBY POSE			

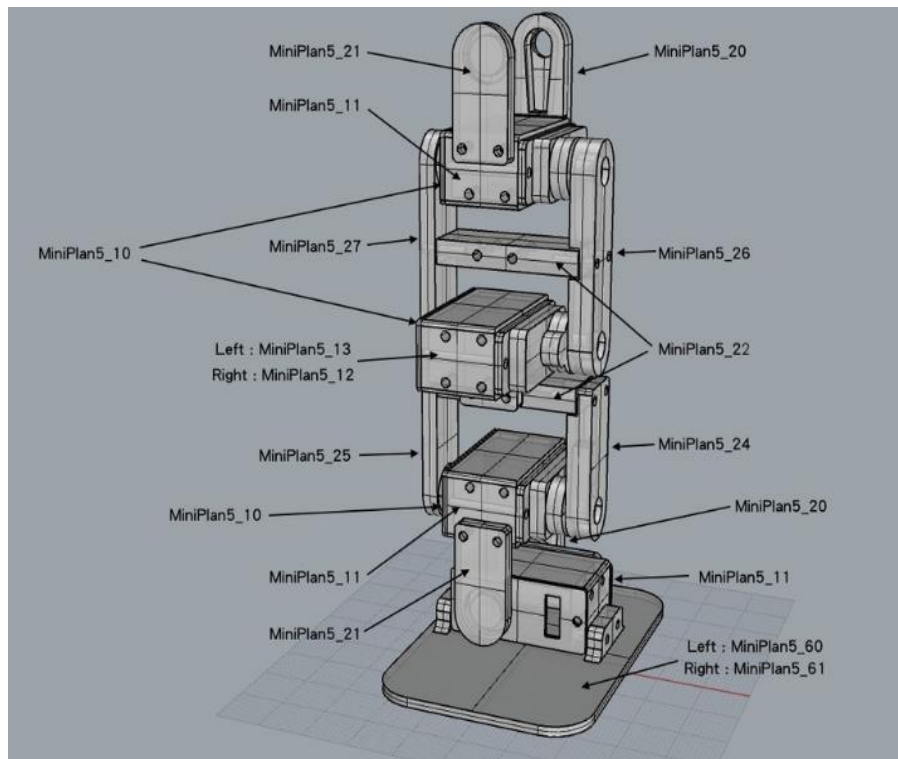
頭部歸零組裝

- 搭配<http://192.168.4.1/zero> 歸零馬達後才組裝 (GPIO 12 按鈕)
- 伺服馬達黑色M2 x 5 螺絲 X 1PCS
- 已黏合十字舵柄MiniPlan5_42



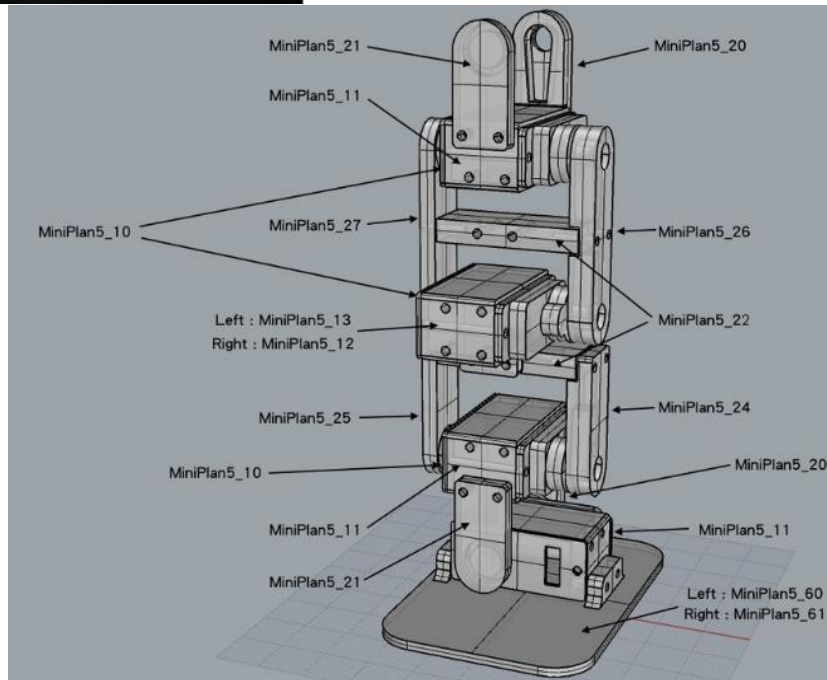
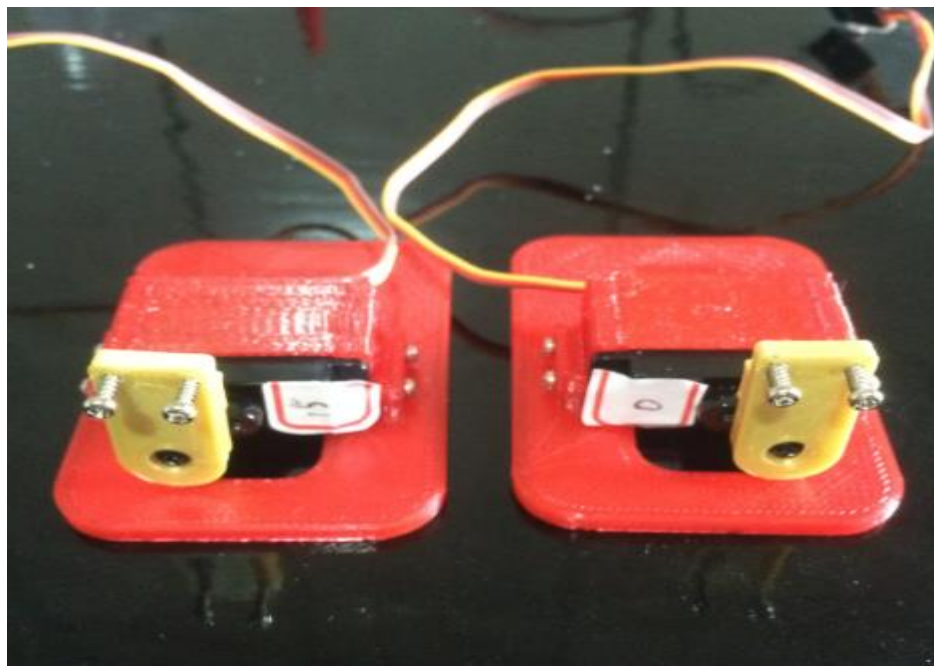
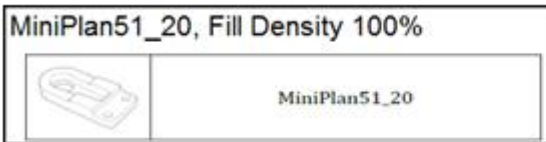
腳底歸零組裝

- 右腳MiniPlan51_60 與編號0 伺服馬達組裝
- 左腳MiniPlan51_61與編號15 伺服馬達組裝
- 伺服馬達歸零網頁的Servo 0, Servo 15 按鈕



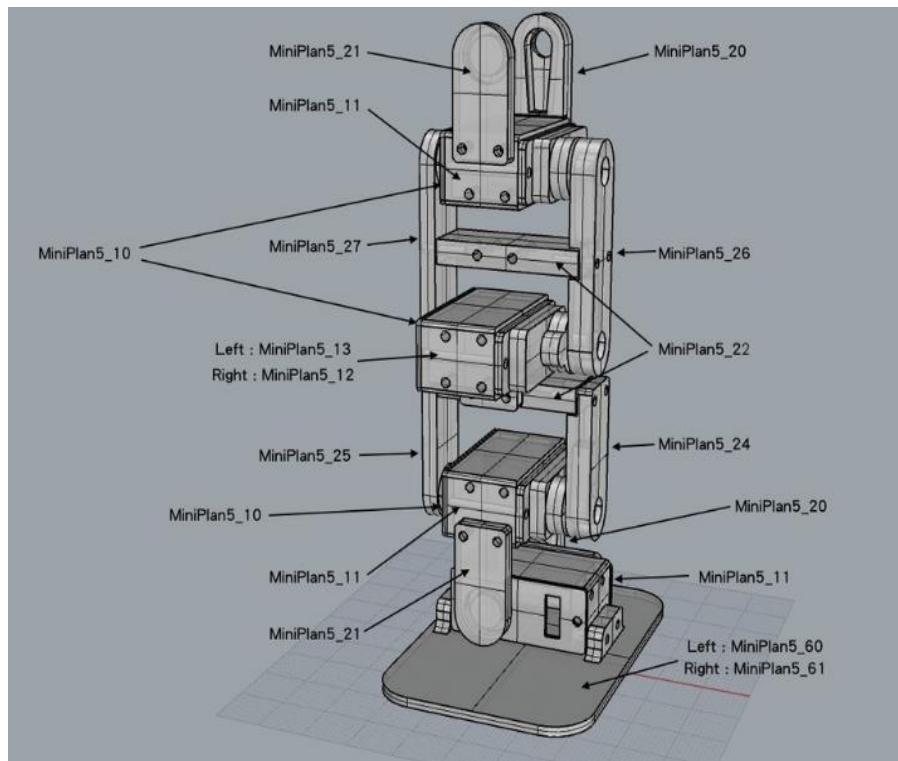
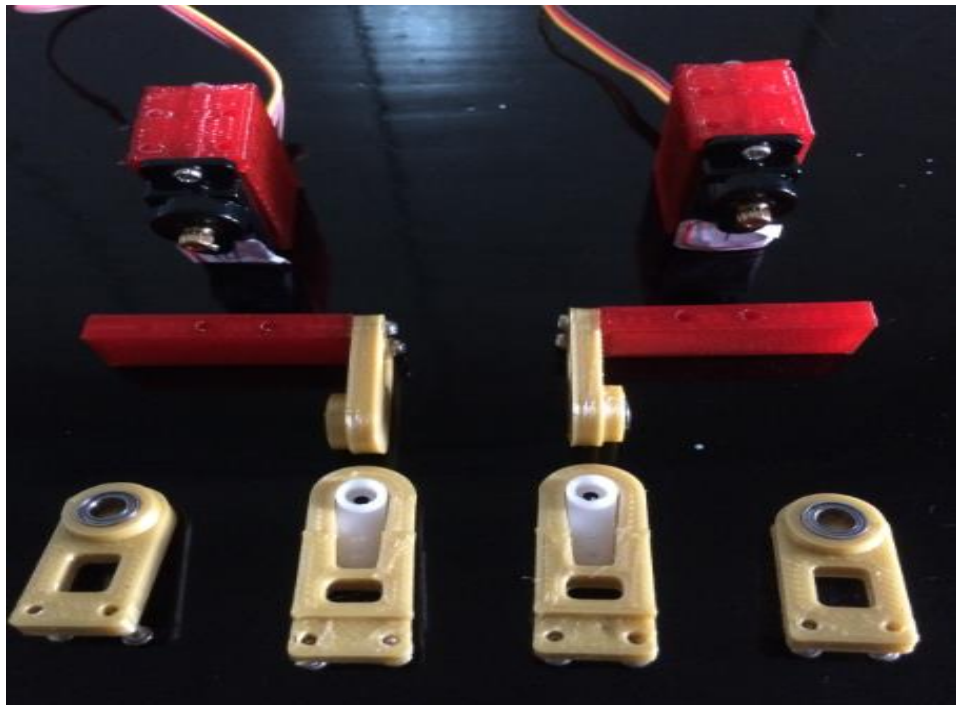
腳底歸零組裝

- 將MiniPlan51_20 組裝伺服馬達軸上，盡量垂直於腳底板90 度。
- 伺服馬達黑色M2 x 5 螺絲 X 1PCS



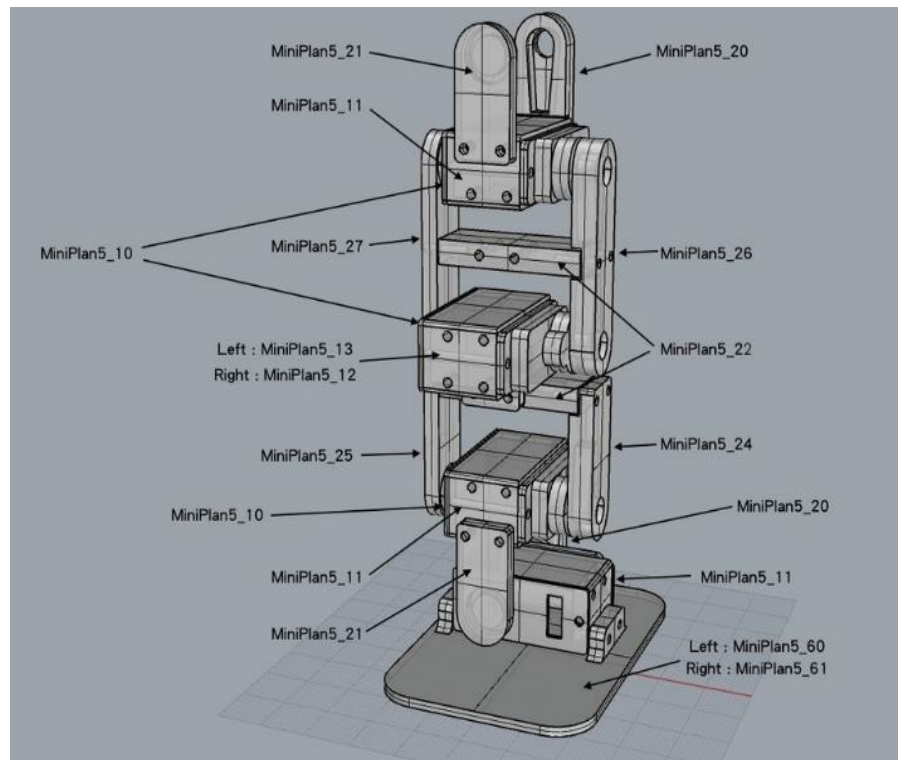
腳踝歸零組裝

- 已黏合小舵柄MiniPlan51_24 x 2 PCS
- 組裝軸承培林MiniPlan5_21 x 2 PCS
- 預鎖MiniPlan51_22 及MiniPlan5_25
- 編號1, 14 伺服馬達組裝



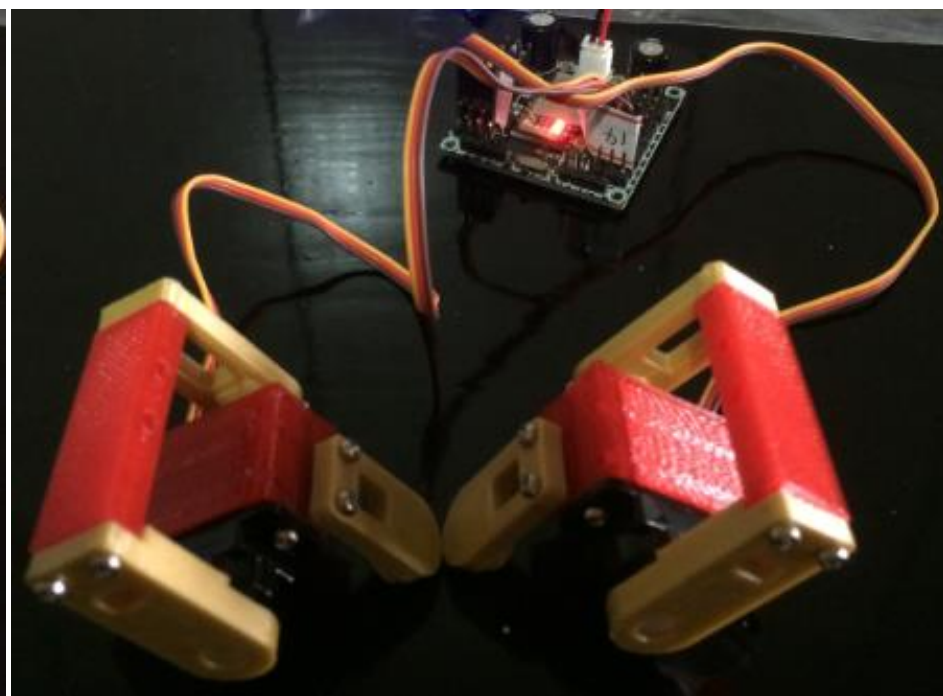
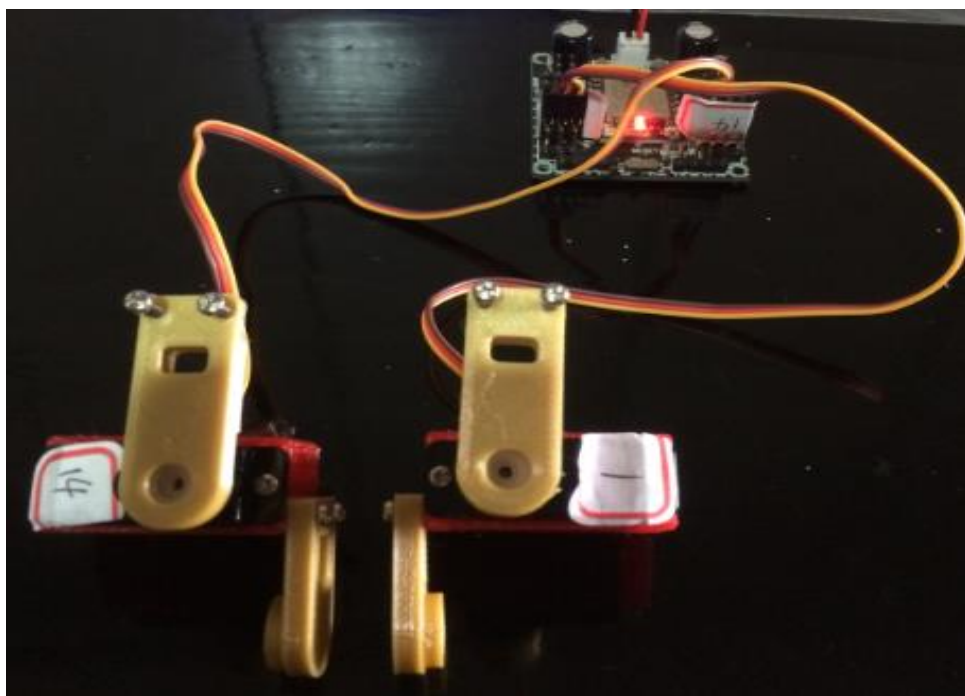
腳踝歸零組裝

- 鎖上組裝軸承培林MiniPlan5_21



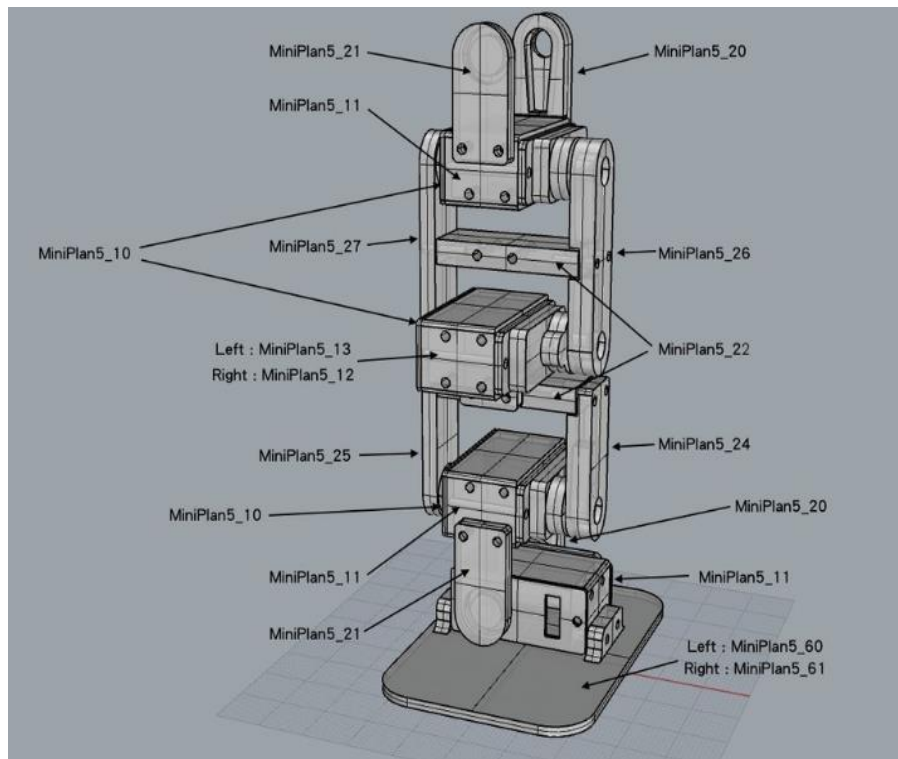
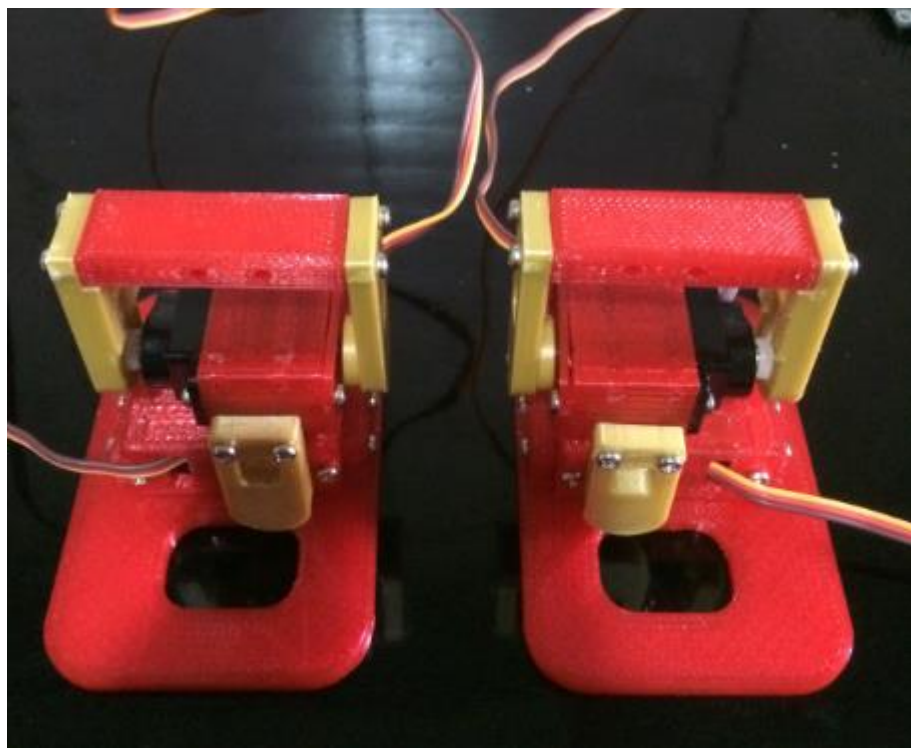
腳踝歸零組裝

- 分別組裝螺絲預鎖MiniPlan51_22 及MiniPlan5_25
- 伺服馬達歸零網頁的Servo 1, Servo 14 按鈕



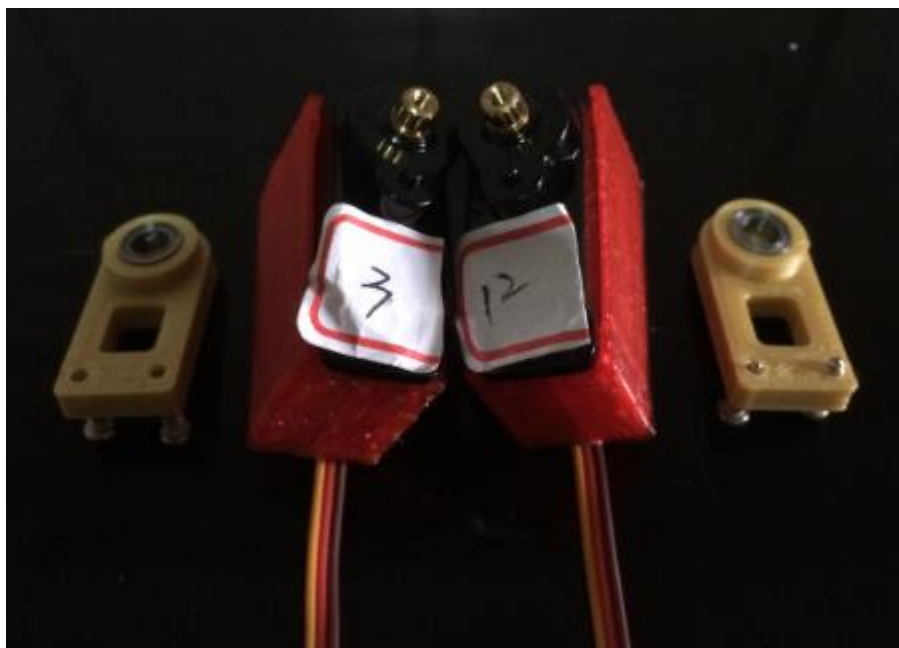
腳底與腳踝組裝

- 注意右腳編號0 與1，左腳編號14 與15。



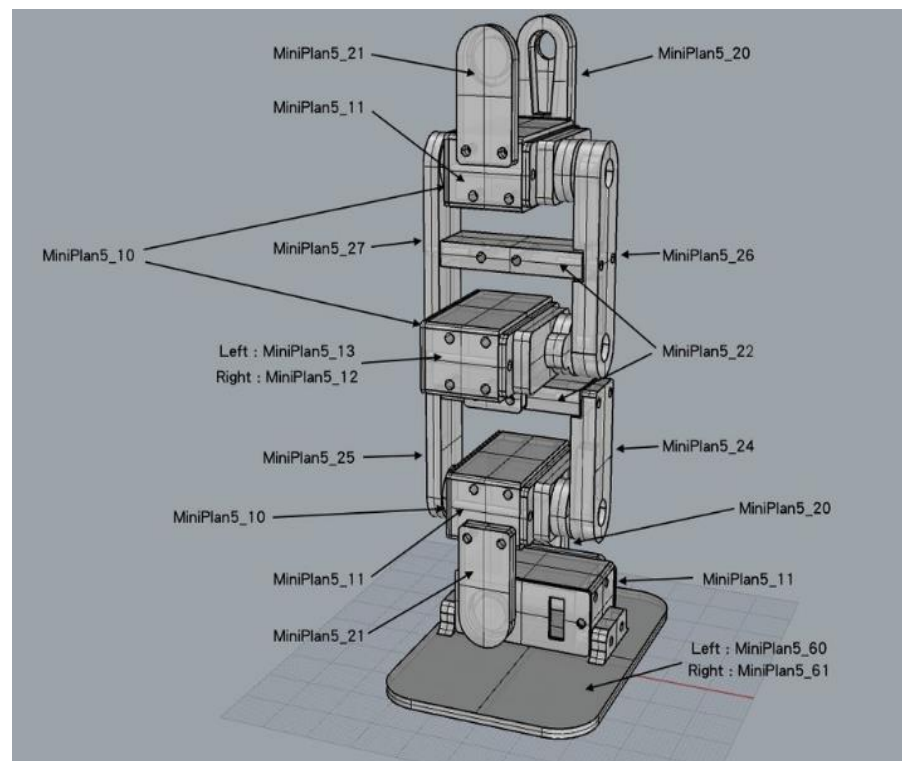
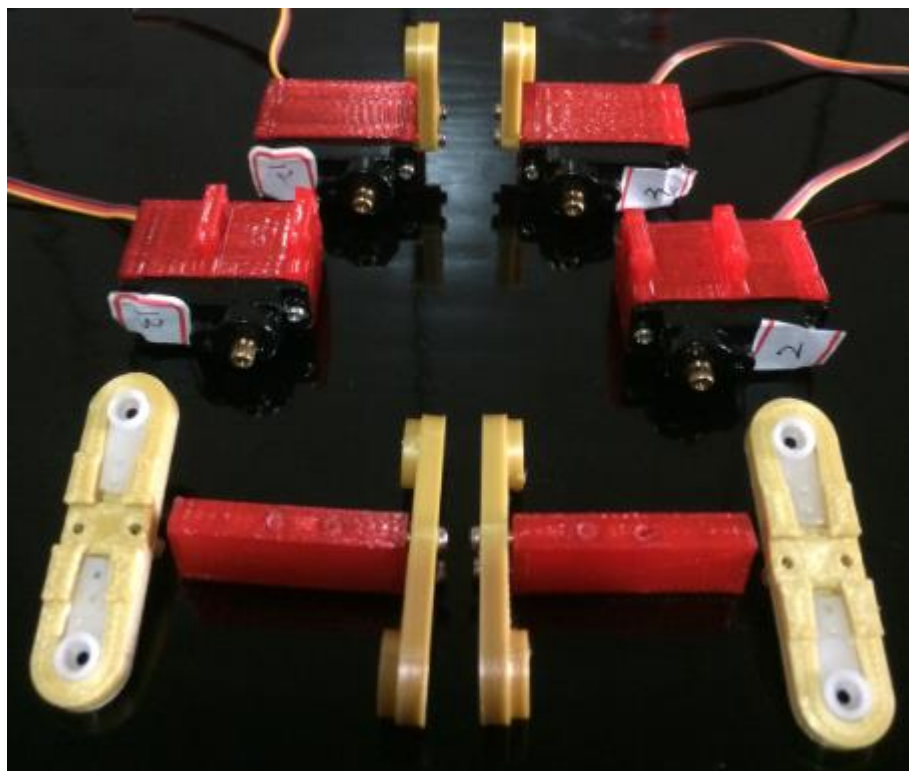
腕關節軸承培林組裝

- 編號3, 12 伺服馬達, 注意左右軸承培林MiniPlan5_21 組裝方向。



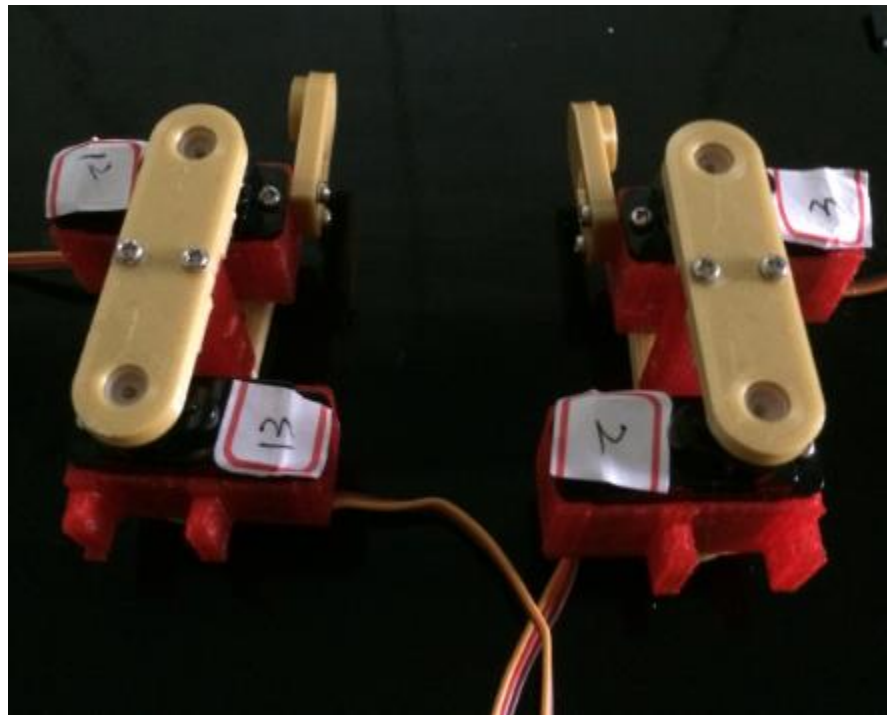
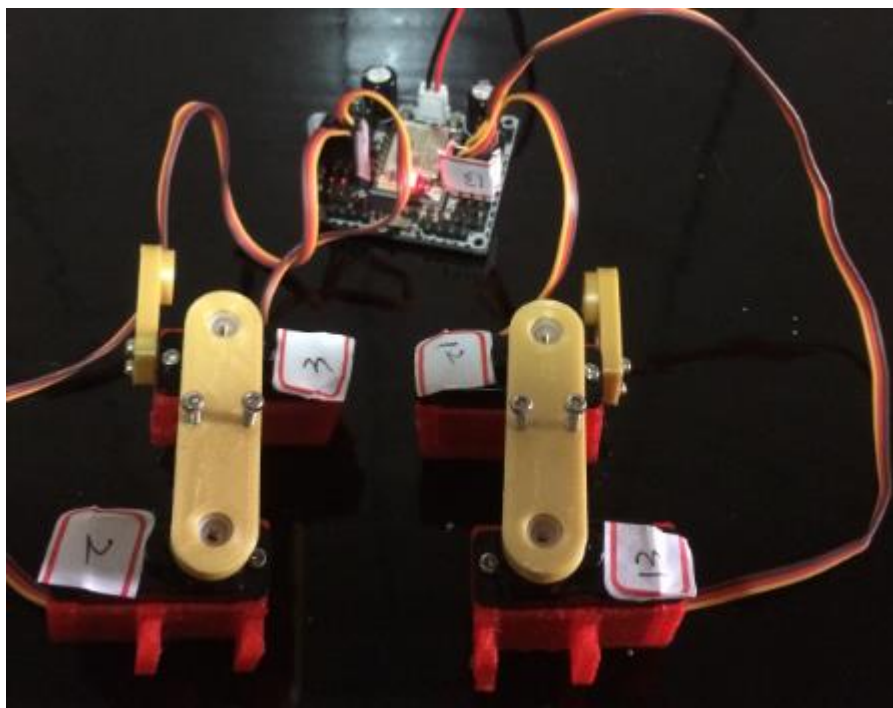
膝關節歸零組裝

- 已黏合小舵柄MiniPlan51_26 x 2 PCS
- 組裝螺絲預鎖MiniPlan51_22 及MiniPlan5_27
- 編號2, 13 伺服馬達與髖關節軸承培林組裝馬達(編號3, 12)



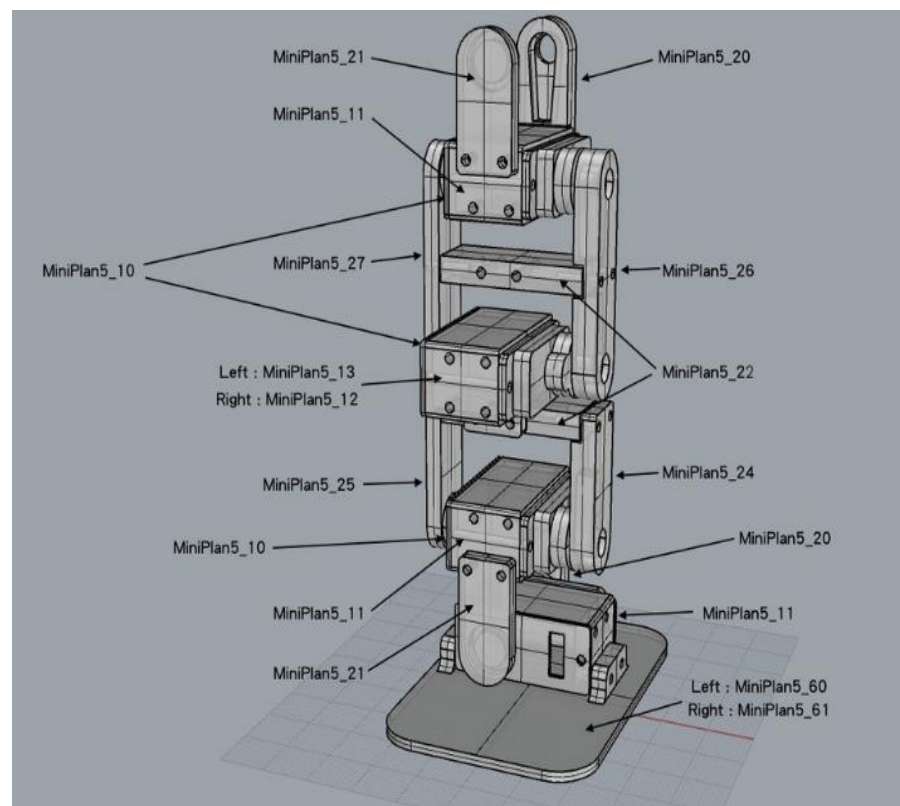
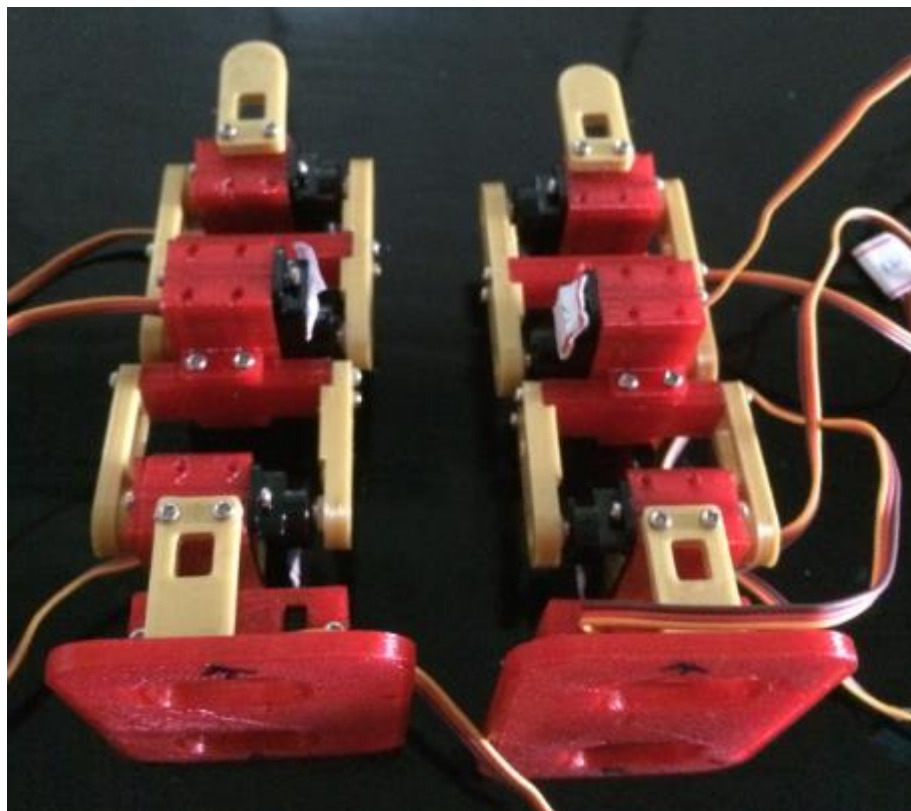
膝關節歸零組裝

- 歸零網頁的Servo 2, Servo 3 , Servo 12, Servo 13按鈕，再與培林組裝



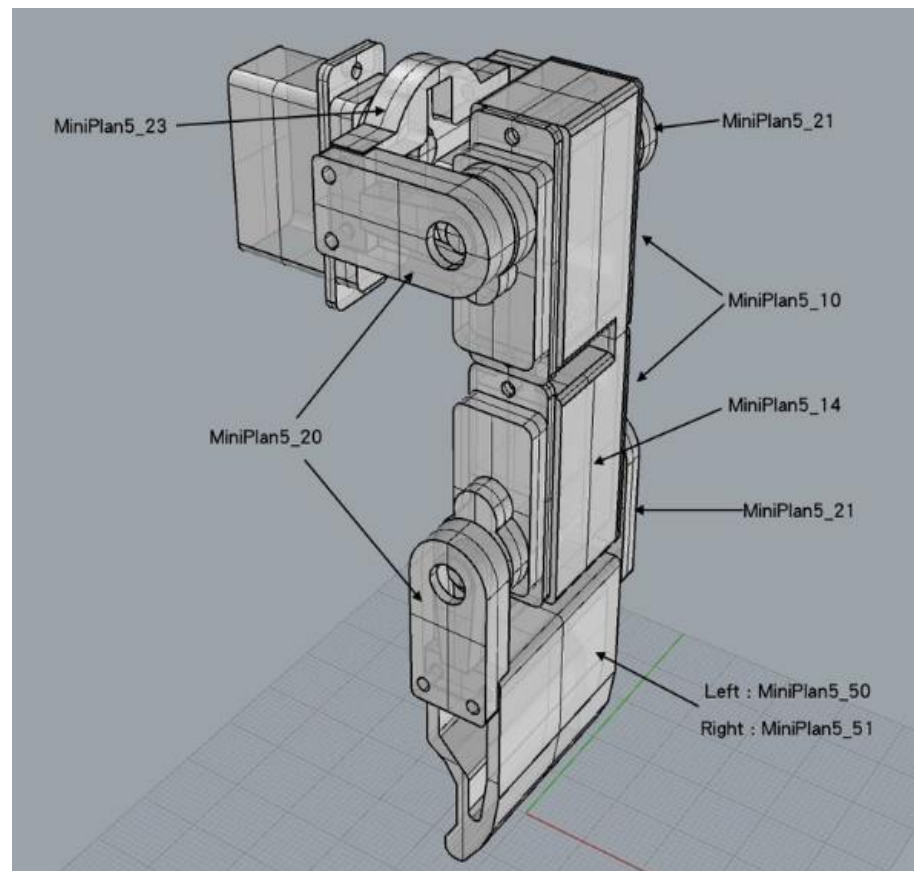
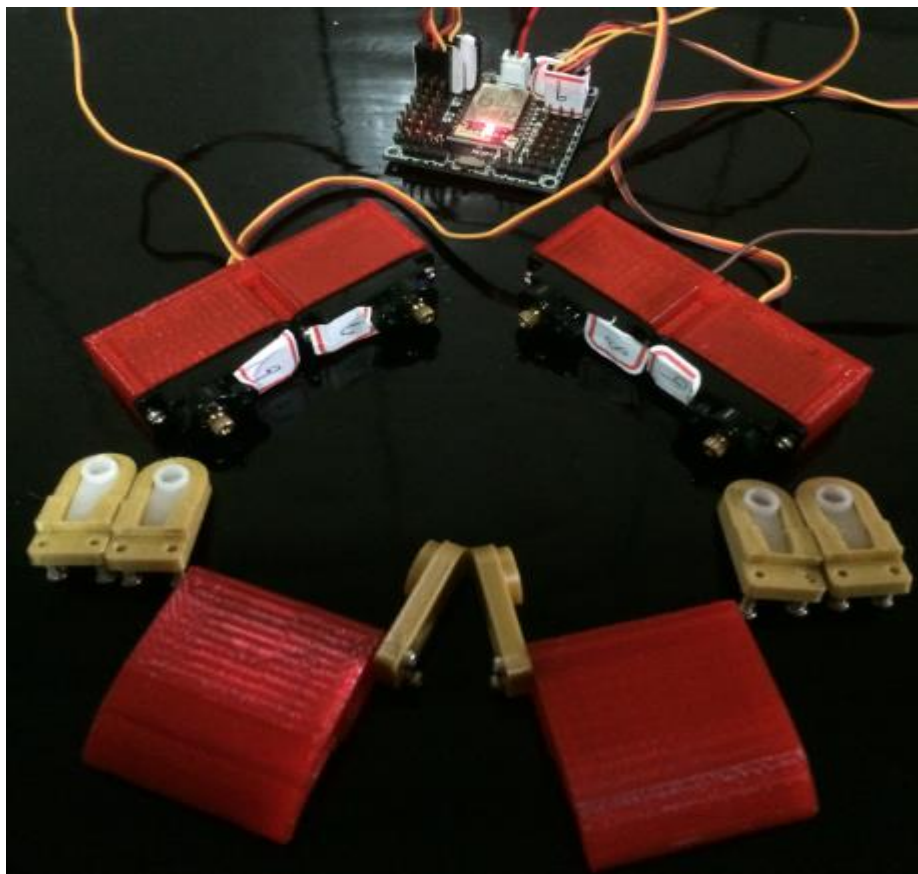
雙腳總組裝

- 右腳 編號0, 1, 2, 3
- 左腳 編號15, 14, 13, 12



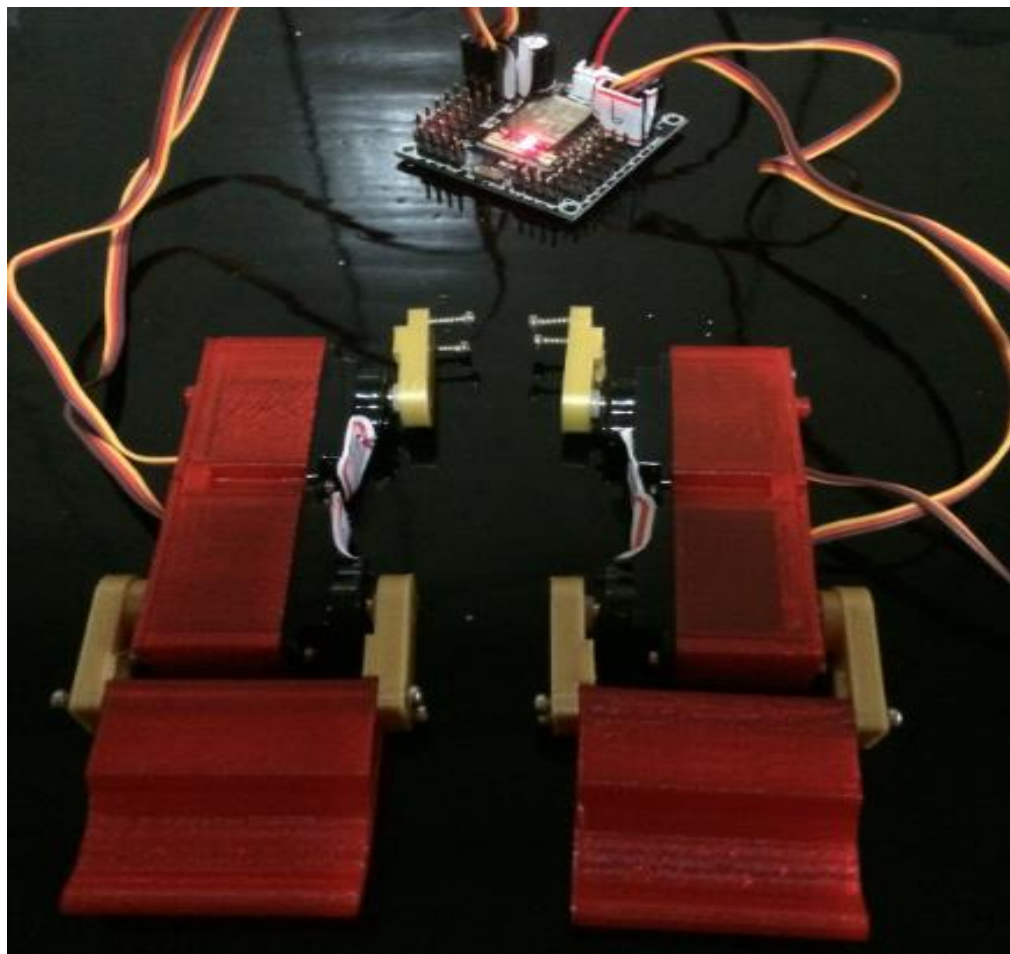
雙臂歸零組裝

- 右手編號 6, 7
- 左手編號 8, 9

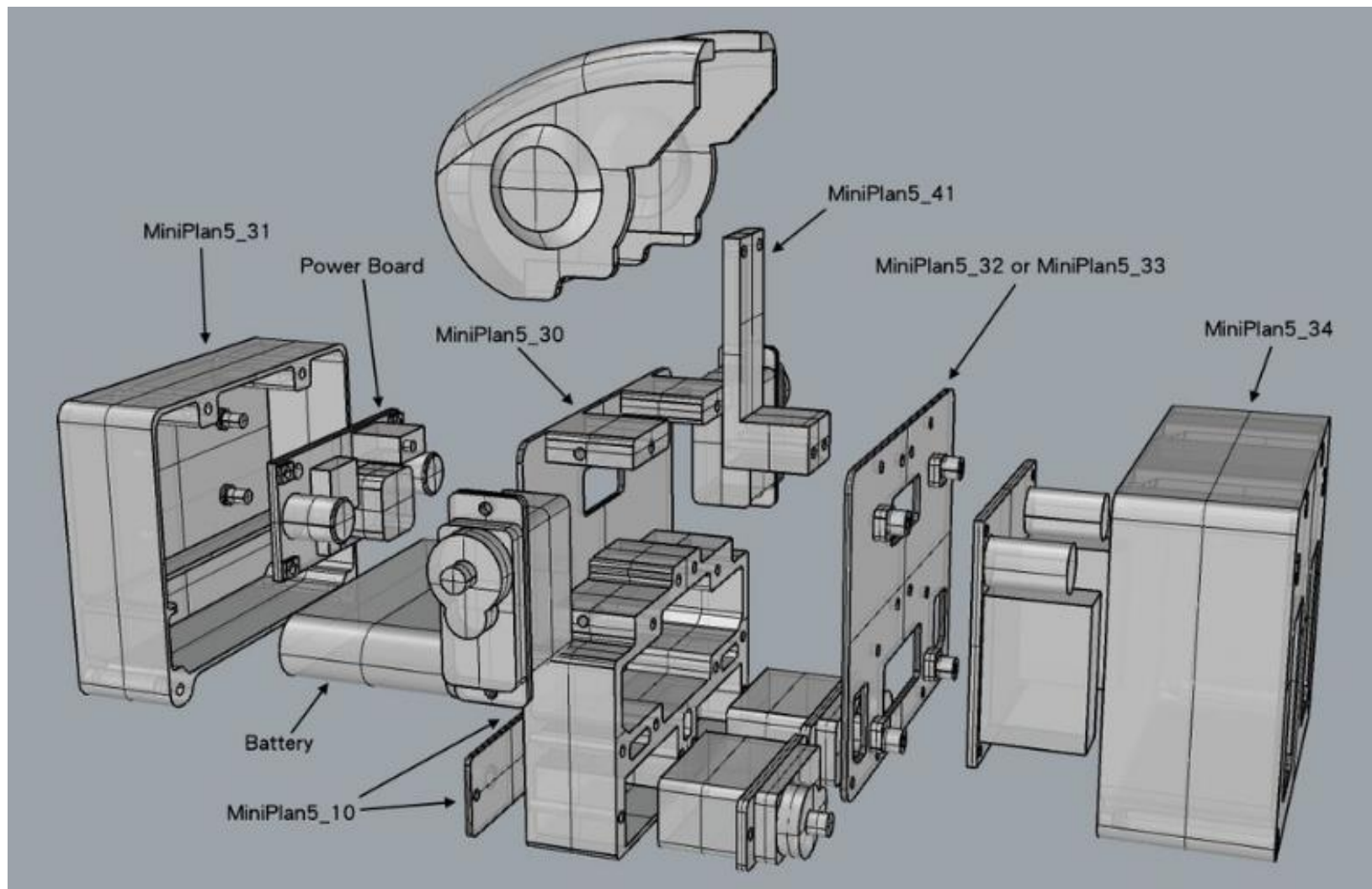


雙臂歸零組裝

- 歸零網頁的Servo 6, Servo 7, Servo 8, Servo 9

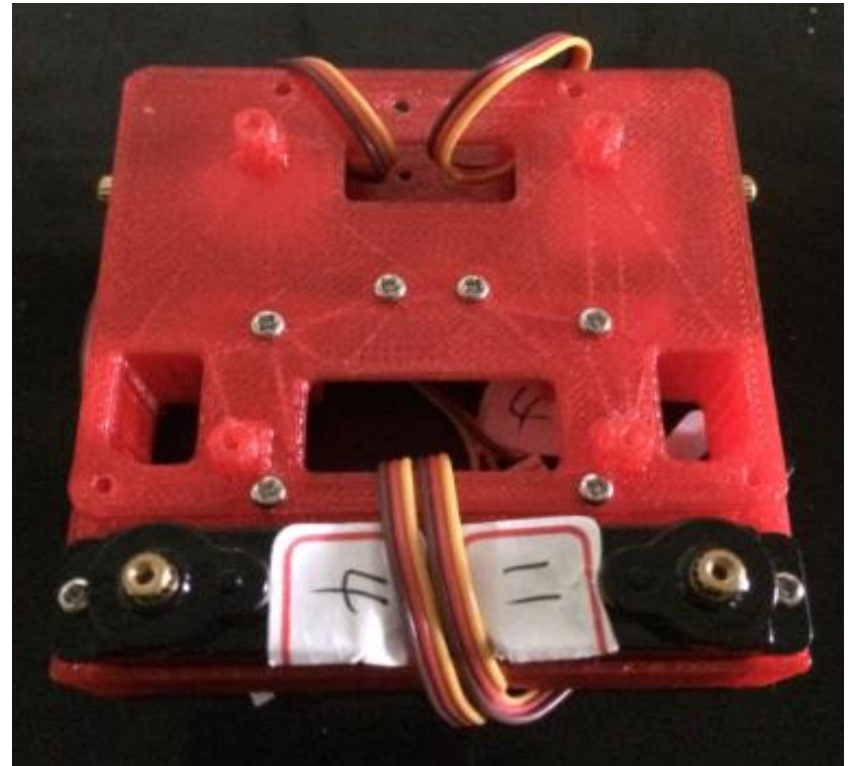
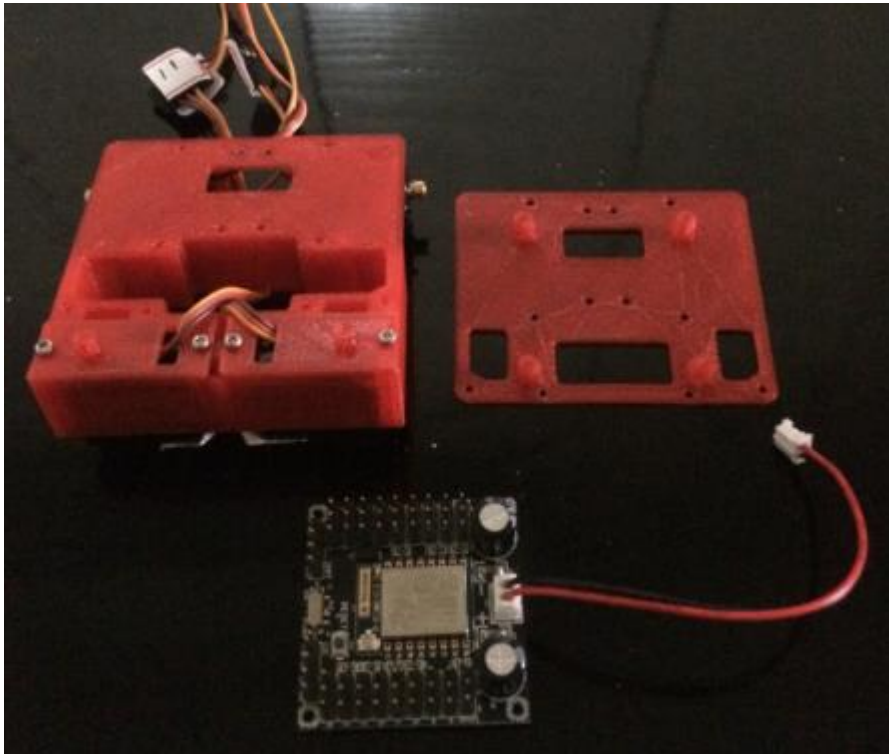


身體歸零組裝



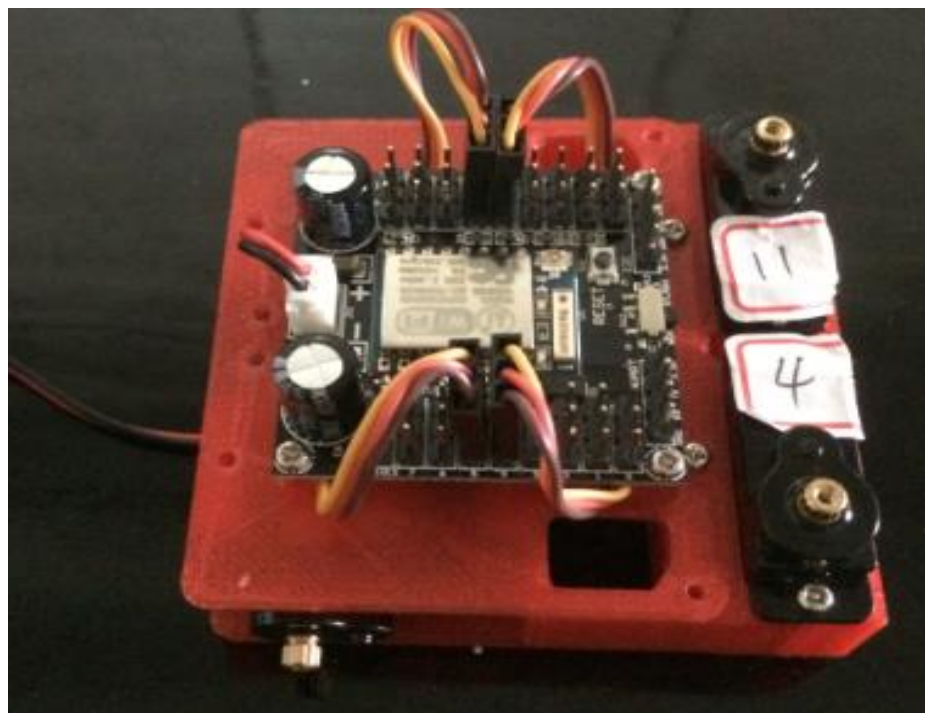
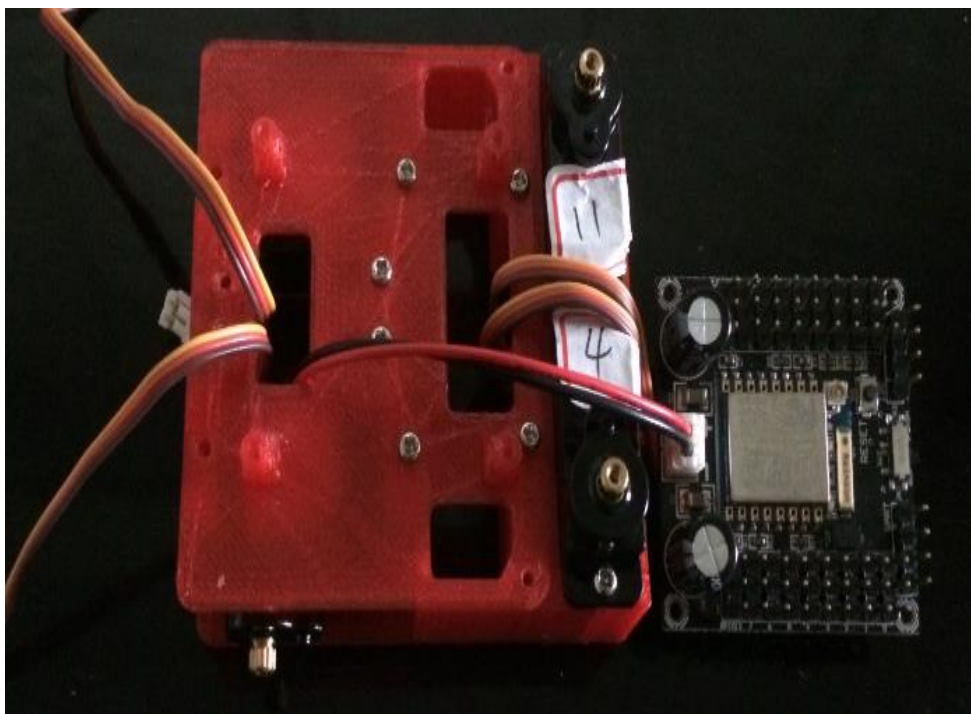
身體歸零組裝

- 3D列印零件:MiniPlan5_32 x 1 PCS



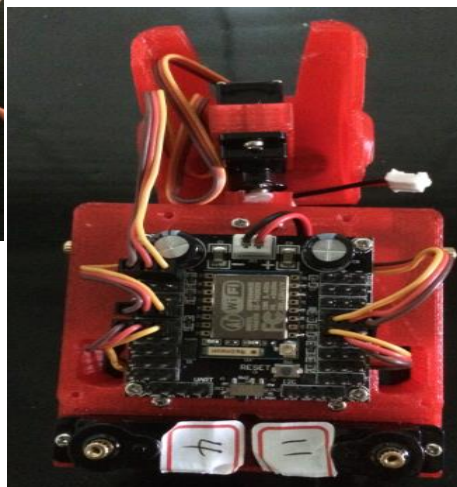
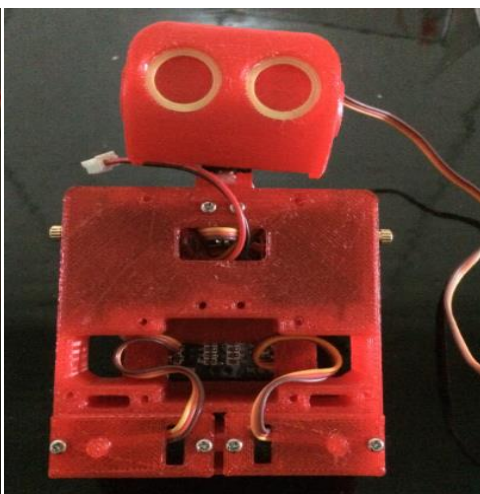
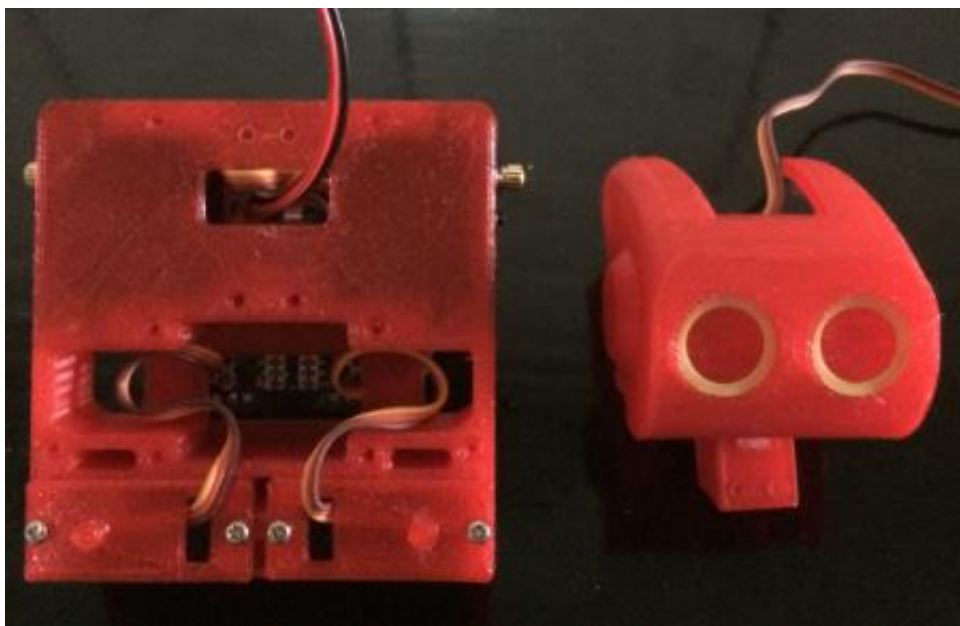
身體馬達組裝

- ESP8266主板組裝
- 馬達線穿過MiniPlan5_32，再鎖自攻螺絲x 6 PCS



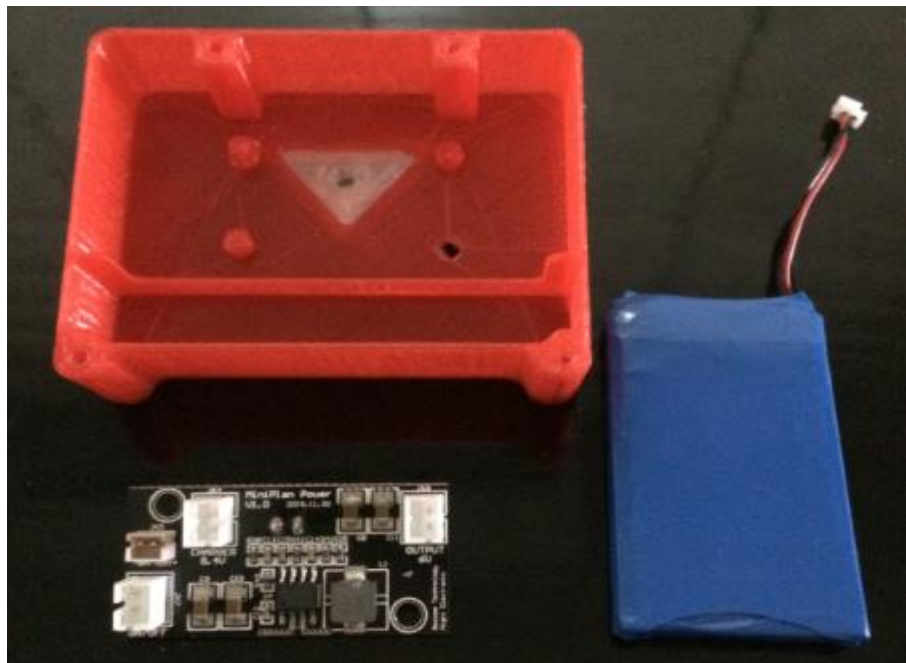
身體馬達組裝

- 頸部鎖固組裝
- 鎖固頸部自攻螺絲時，注意頭部水平避免歪斜



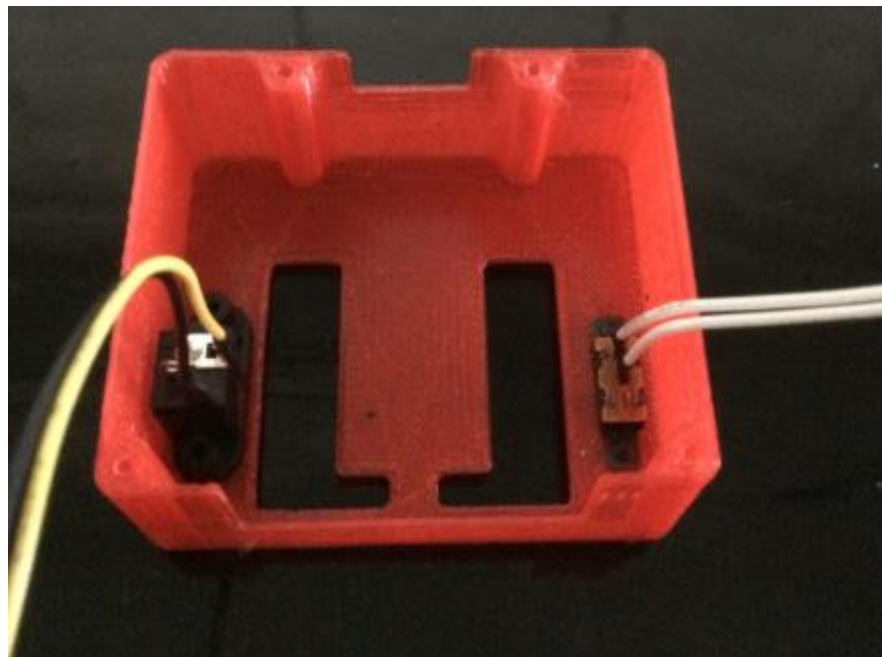
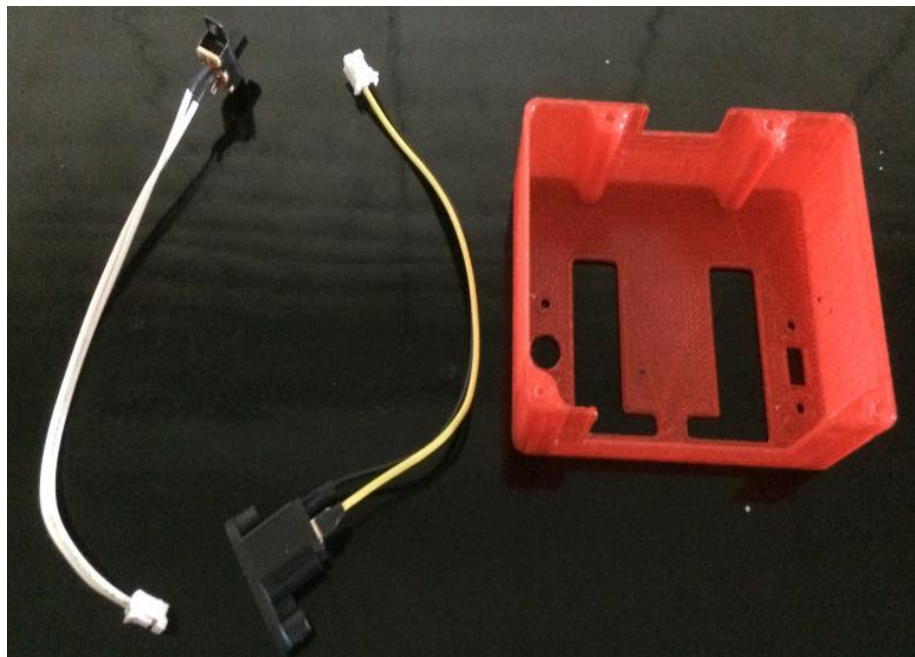
身體馬達組裝

- 前胸蓋組裝 (依搭配的胸蓋有LED差異性)
- 電源電路板 x 1 PCS, 鋰電池 x 1 PCS
- 用雙面膠固定鋰電池，並將電池端子插上。



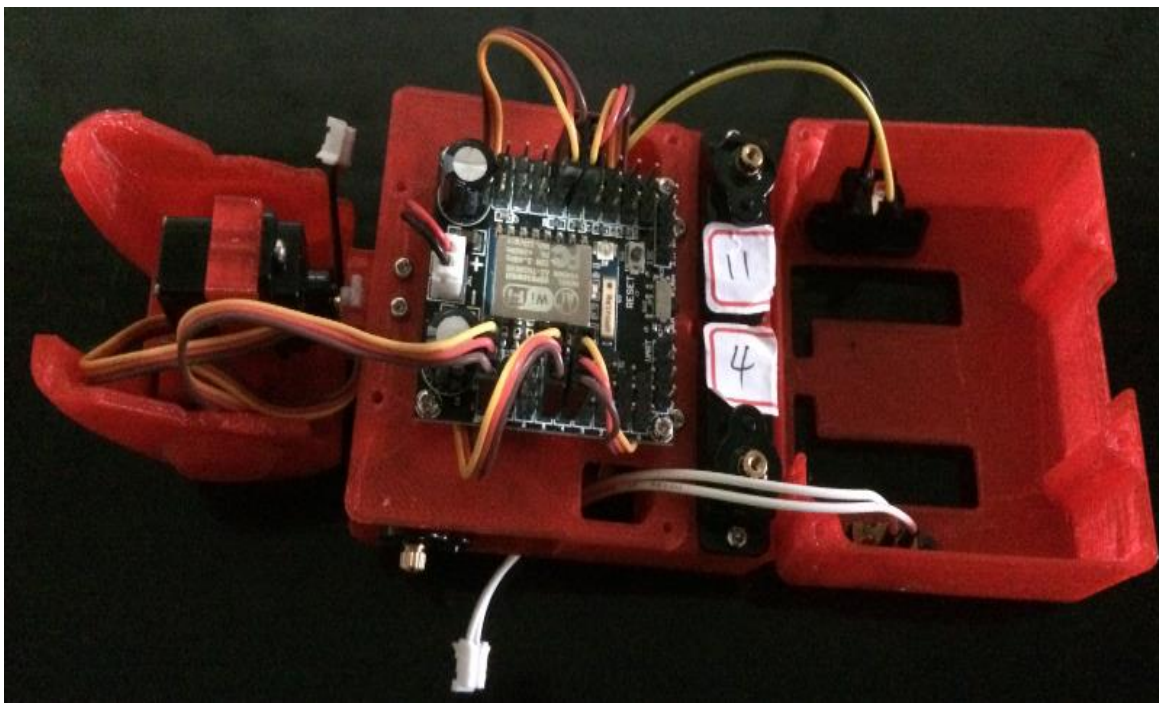
身體馬達組裝

- 後背蓋組裝
- 充電線組 x 1 PCS, 開關線組 x 1 PCS
- 伺服馬達黑色M2X5 螺絲 x 4 PCS
- 需要列印件： MiniPlan51_34 x 1 PCS



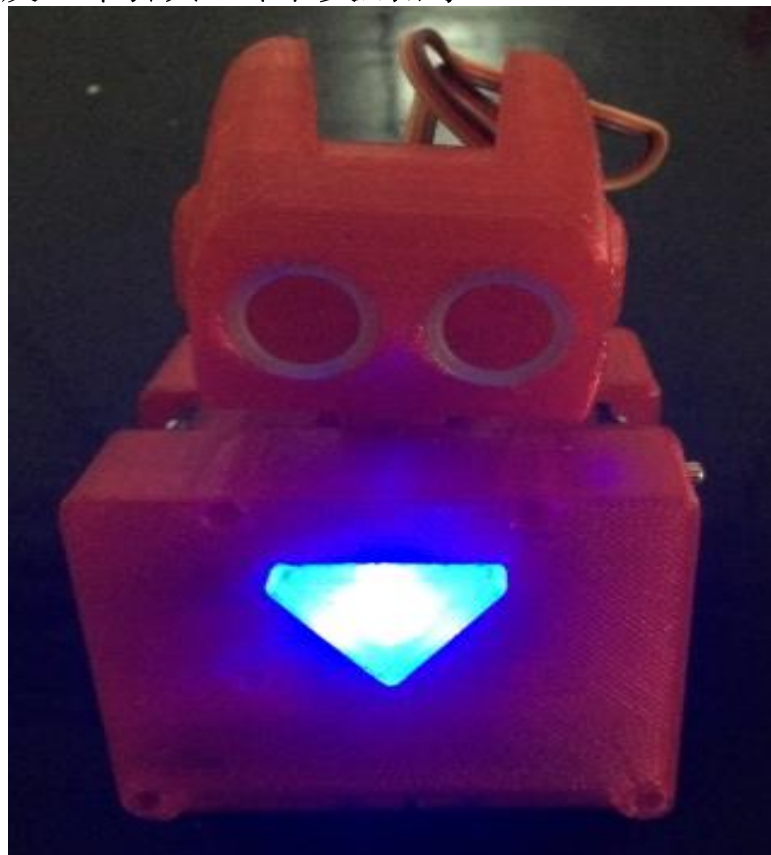
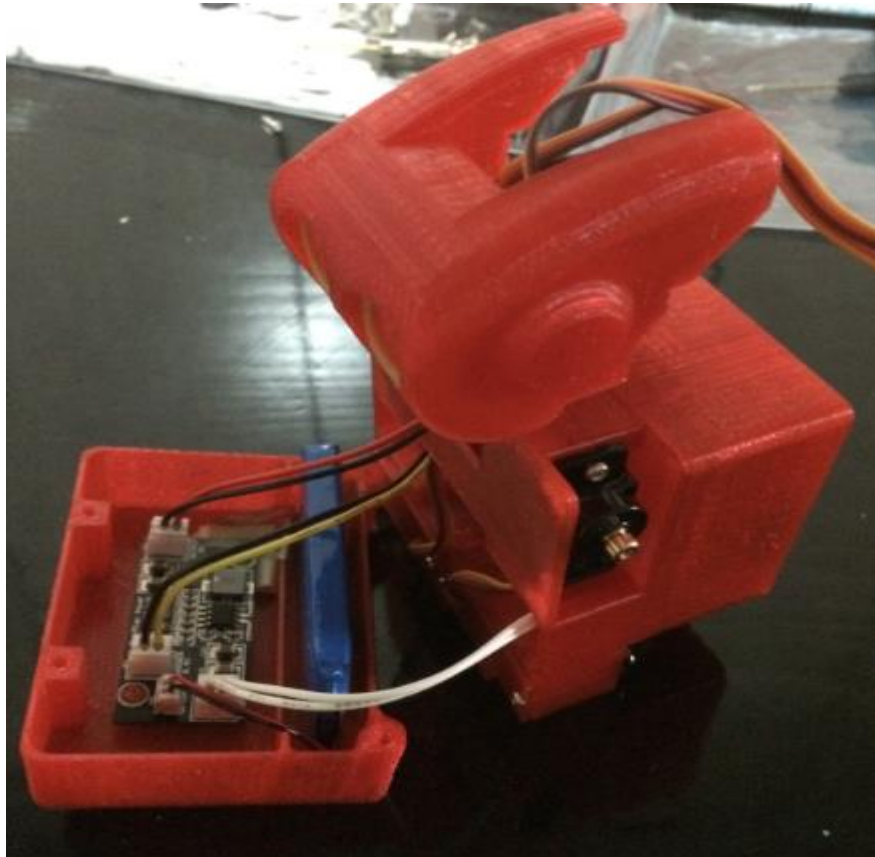
身體馬達組裝

- 總組裝
- 開關線與充電線分別穿過軀幹，再鎖上自攻螺絲 x 4 PCS。



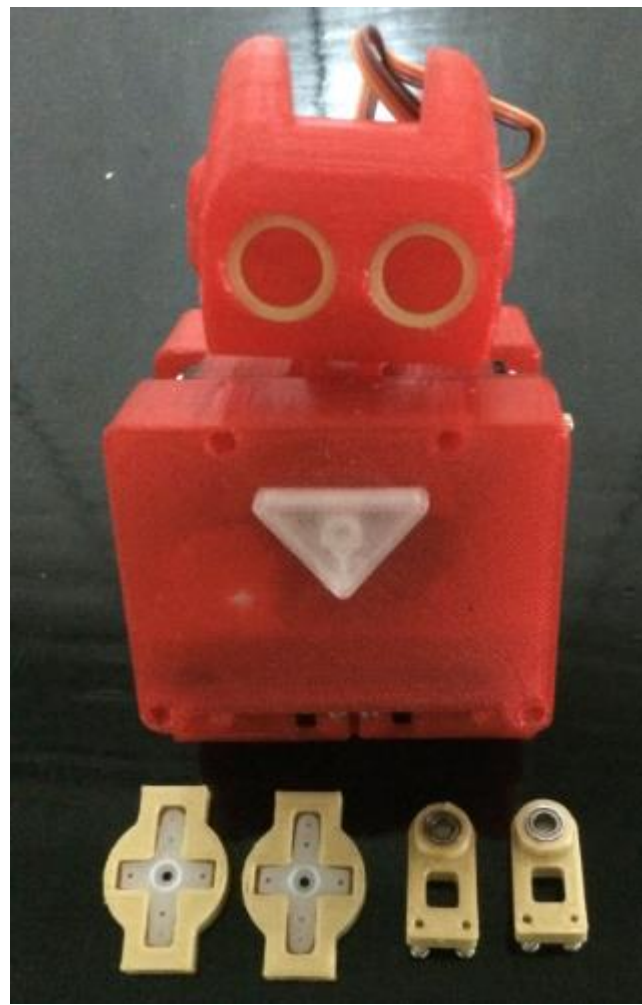
身體馬達組裝

- 總組裝
- 將電源線，開關線與充電線插上電源板，再鎖上自攻螺絲 x 4 PCS。



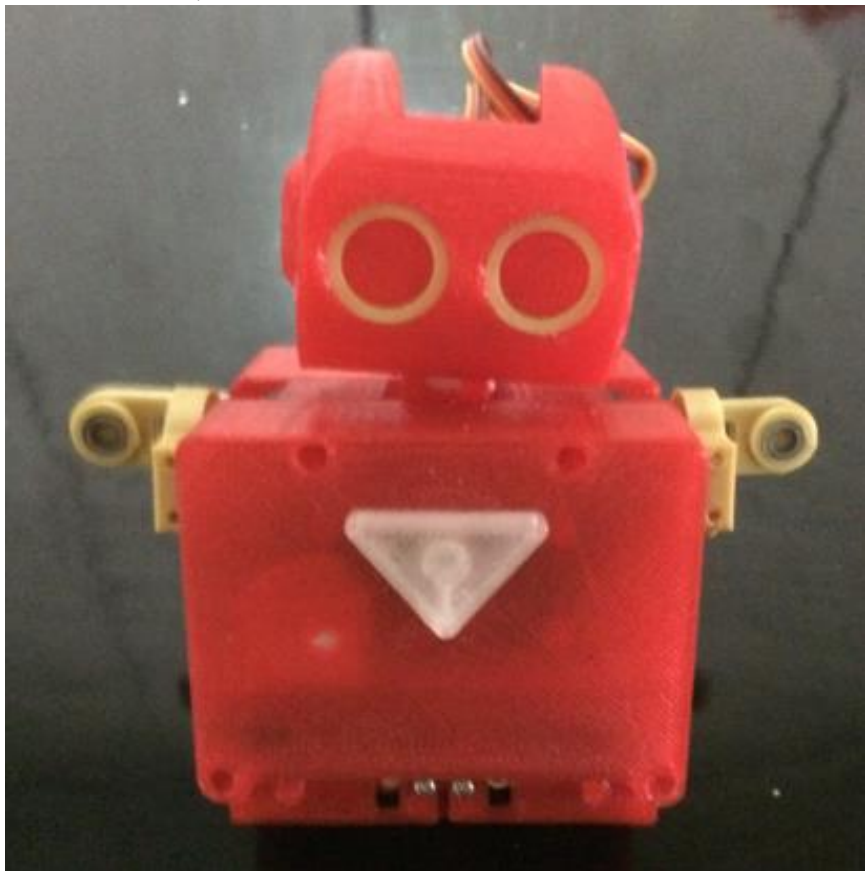
肩膀歸零組裝

- 組裝軸承培林MiniPlan5_21 x 2 PCS
- 舵柄黏合MiniPlan51_23 x 2 PCS
- 歸零網頁的Servo 5 (右), Servo 10 (左)



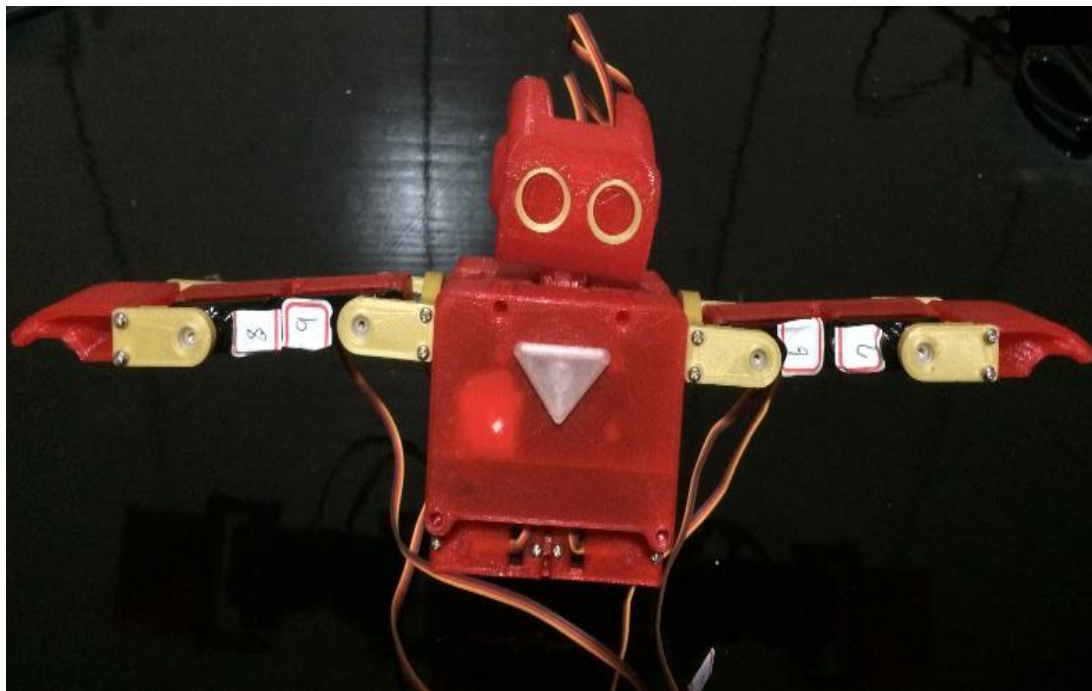
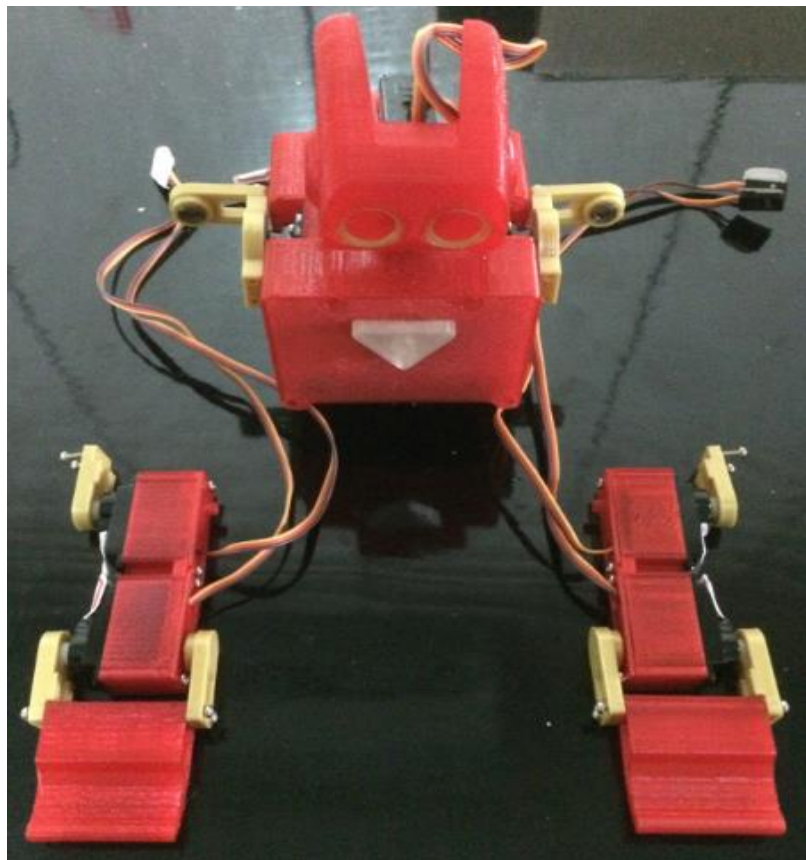
肩膀歸零組裝

- 組裝軸承培林MiniPlan5_21 x 2 PCS
- 鎖上伺服馬達黑色M2x5 螺絲 x 2 PCS



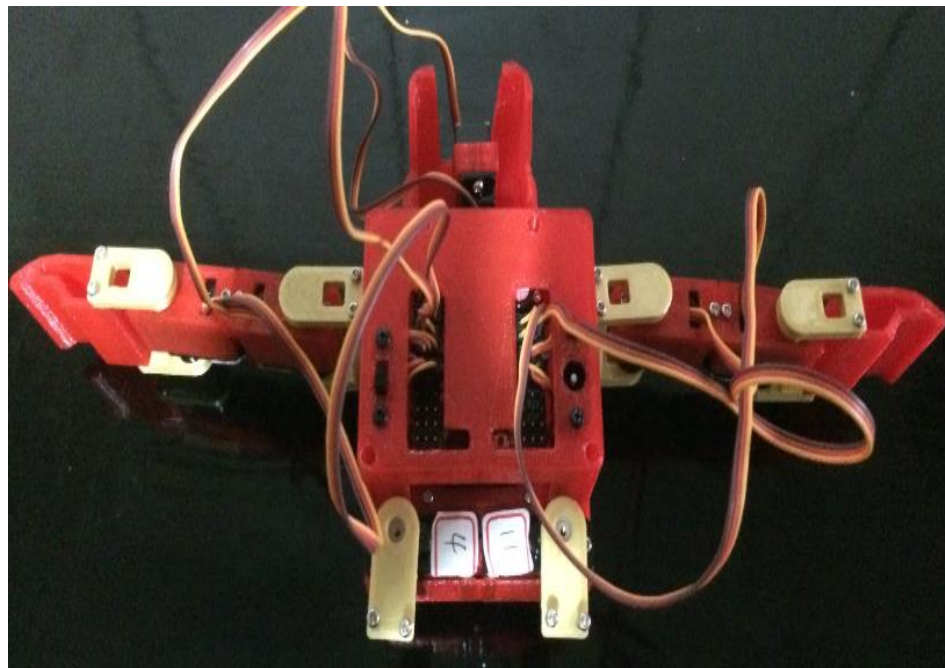
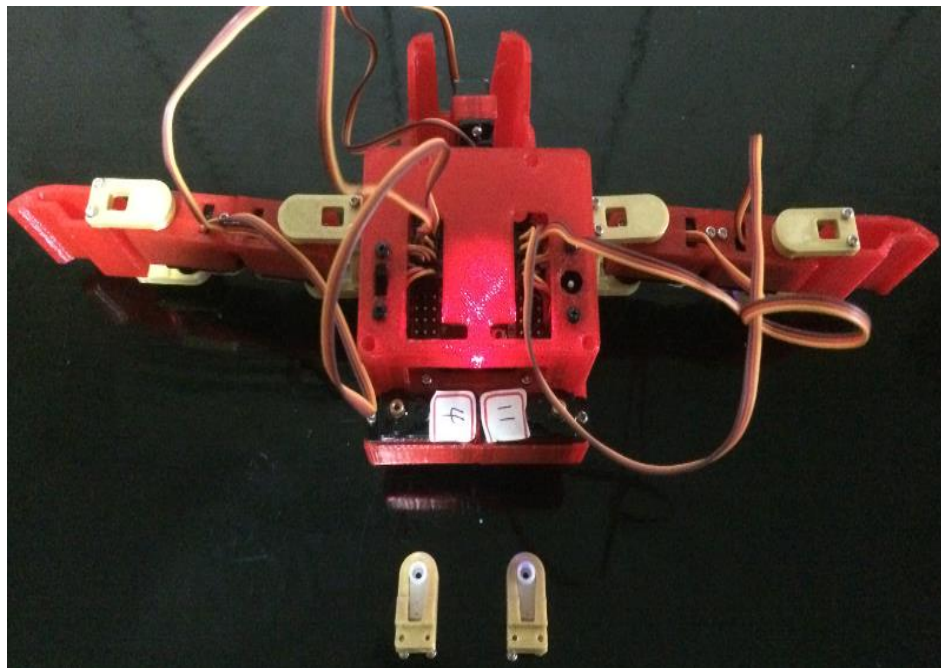
雙手與身體組裝

- 右手編號6, 7, 左手編號8, 9 伺服馬達
- 請將兩手臂以水平方式組裝，如下圖所示。



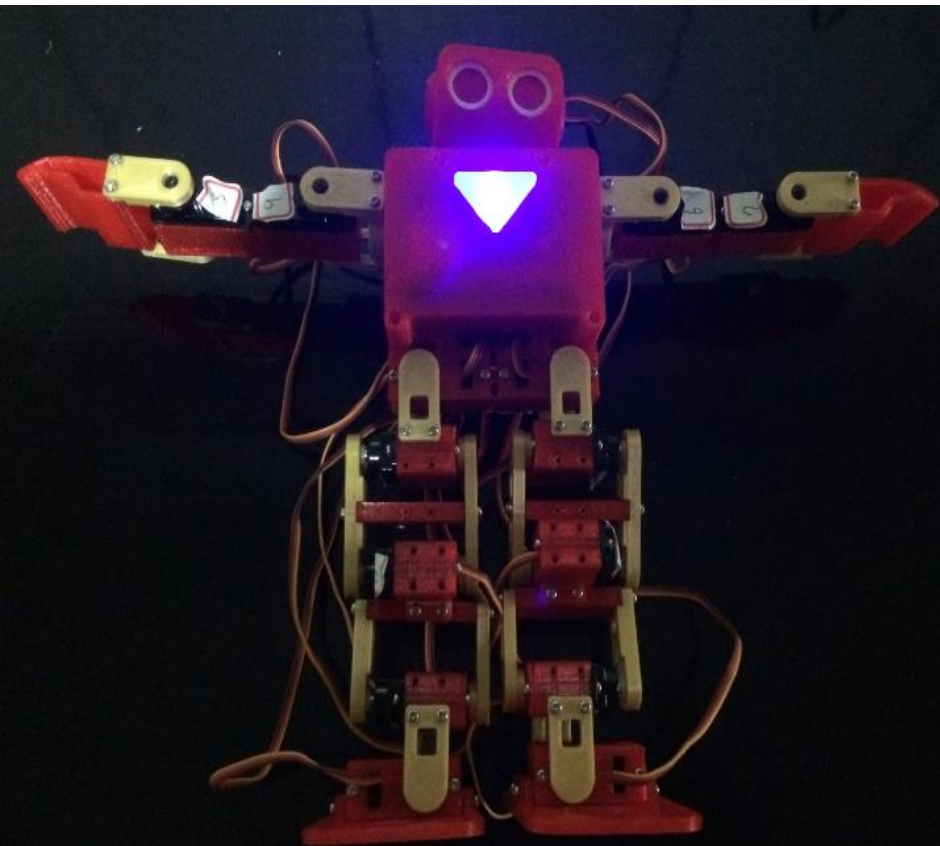
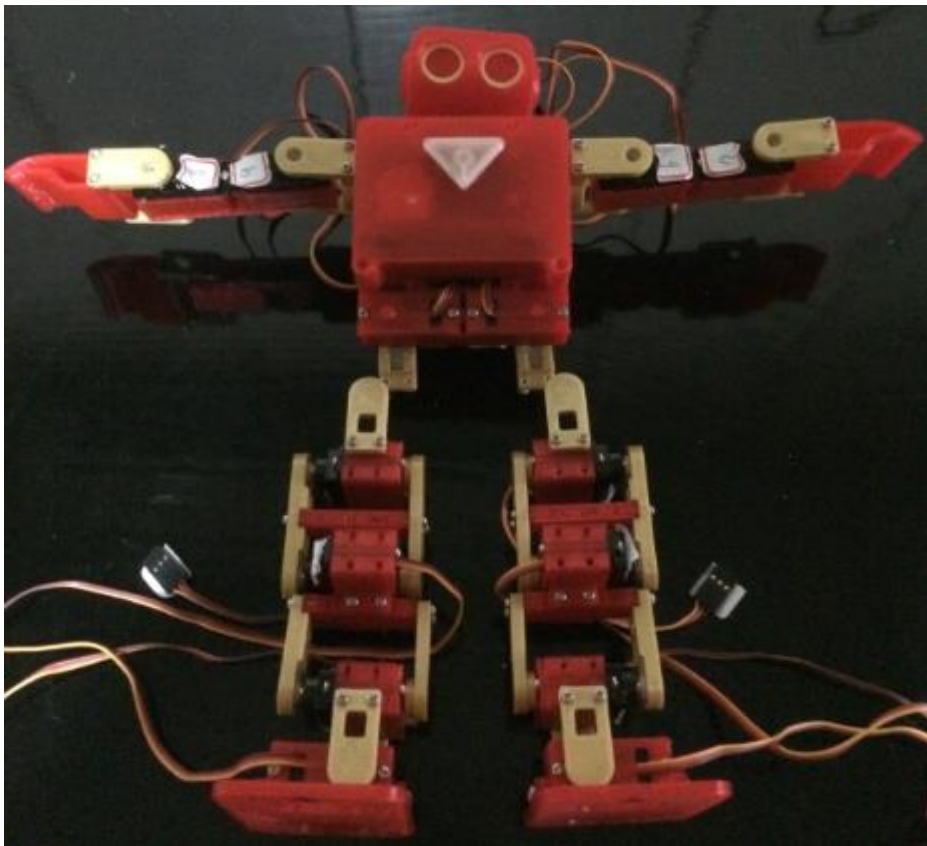
腕關節伺服馬達歸零組裝

- 歸零網頁的Servo 4, Servo 11 按鈕
- 鎖上伺服馬達黑色M2x5 螺絲 x 2 PCS



體關節伺服馬達歸零組裝

- 歸零網頁的Servo 4, Servo 11 按鈕
- 鎖上伺服馬達黑色M2x5 螺絲 x 2 PCS





Thank you