STEM_7

自　學　教　材

編著：劉偉成 (Lau Wai Shing)

專案一：四輪驅動機械車

目錄

1. 主要硬件清單

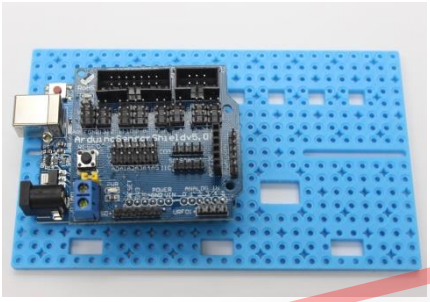
- Arduino Uno R3 兼容主板
- Arduino Uno R3 感應器擴展板 v5.0
- SG90 伺服電動機（360 度連續轉動）連配件[1]
- HC-SR04 超聲波感應器
- HC-05 藍牙模組
- 鋰聚合物電池（3.7V 650mAh）
- 水陸兩用橡膠輪
- 多孔固定膠板（8.5cm x 14cm）
- 多孔塑膠角碼
- 鋰聚合物電池充電器
- 鋰聚合物電池母接線
- USB 線
- M2 螺母
- 10mm 及 20mm M2 螺絲
- 6mm M3 尖頭螺絲
- 軸套墊片
- 索帶
- 寶貼（需自備）
- Android 系統的智能手機或平板電腦（需自備）

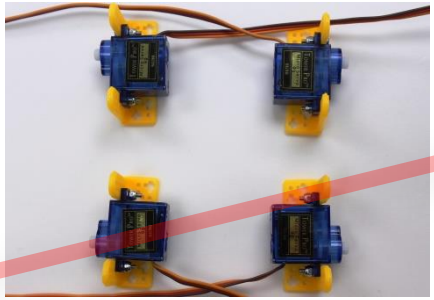
(本專案所含圖片只供參考)

[1] 配件包括伺服臂和螺絲。

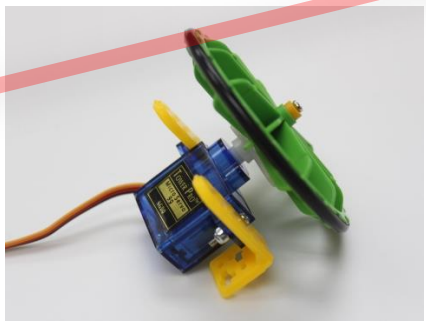
2. 組裝四輪驅動機械車

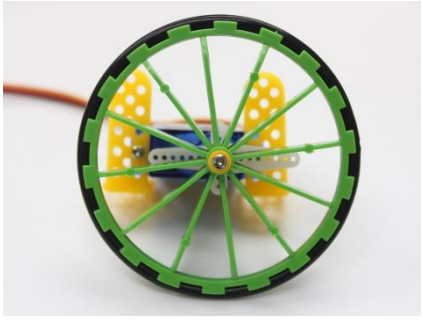
首先，參考本套件基礎知識《組裝機械主體》第 1 至 3 節，組裝 Arduino Uno R3 兼容主板、感應器擴展板 v5.0 及多孔固定膠板和四組 360 度連續轉動的伺服電動機與多孔角碼。





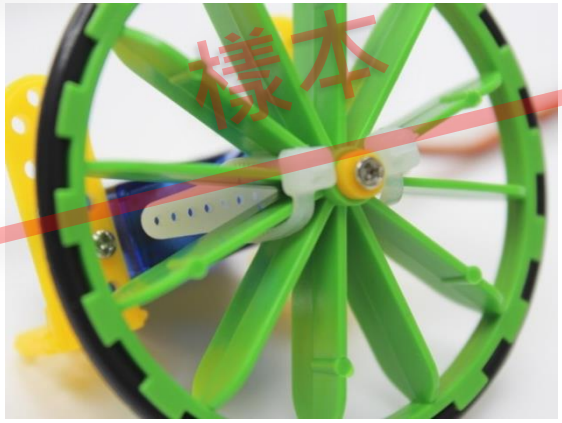
之後，用一顆 20mm M2 螺絲和一塊軸套墊片把橡膠輪與伺服電動機固定。





然後，用兩條索帶把每組伺服電動機固定在水陸兩用橡膠輪上。

接著，把索帶多餘的部份剪掉。



[資源檔案: assembling-tetrabot-part-1.mp4 /]

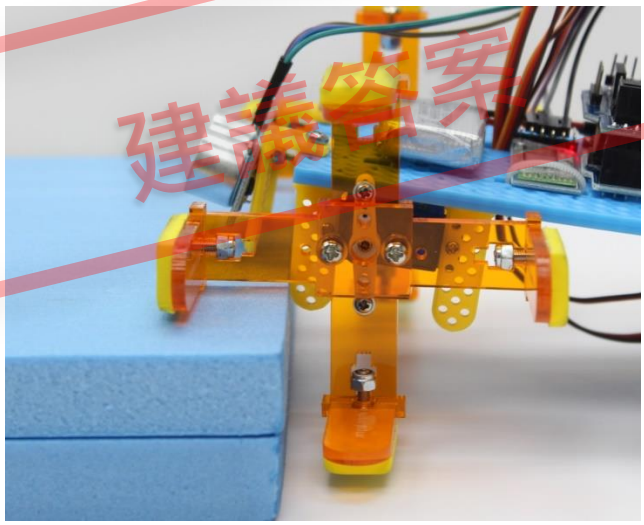
4. 作業 1

1. 試建議一種方法，把四驅爬行機械車改裝為可攀過障礙物，甚至能上、下樓梯的機械。

專案 1 作業 1 建議答案

問題 1：

把四驅爬行機械車的四個橡膠輪改成輪爪，使機械與地面接觸面積增加，從而加強磨擦力。輪爪上凹陷的部份與樓梯凸出的 90 度梯級邊緣互相配合，令機械更有效地釋放動力，提升它的攀爬能力。



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自　學　教　材

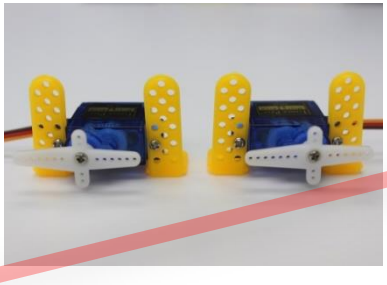
編著：劉偉成 (Lau Wai Shing)

專案二：水陸兩用機械

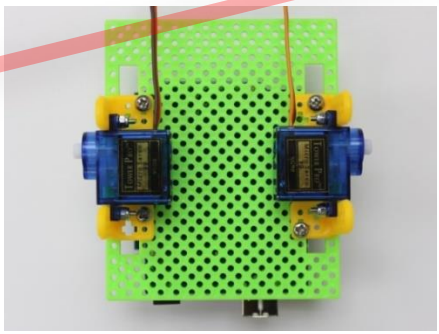
目錄

2. 組裝水陸兩用機械

首先，參考本套件基礎知識《組裝機械主體》第 1 至 3 節，組裝 Arduino Uno R3 兼容主板、感應器擴展板 v5.0 及多孔固定膠板和兩組 360 度轉動的伺服電動機與多孔角碼。

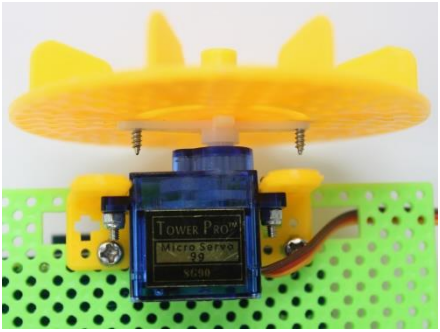


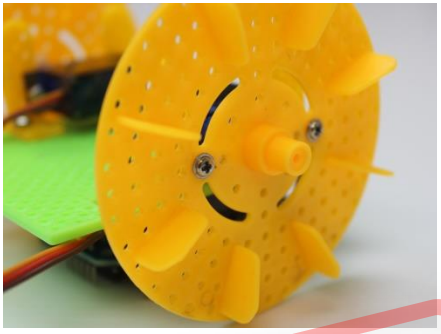
接著，用兩顆 6mm M3 尖頭螺絲每組伺服電動機多孔角碼固定在多孔固定膠板的左右兩邊中間的位置。



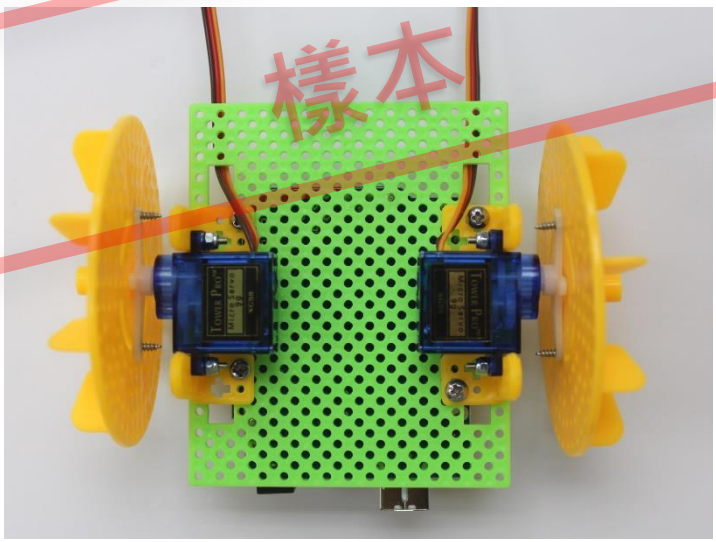
[資源檔案: assembling-amphibot-part-1.mp4 /]

然後，用隨伺服電動機附送的尖頭螺絲把伺服電動機臂固定在八葉塑膠螺旋槳上。



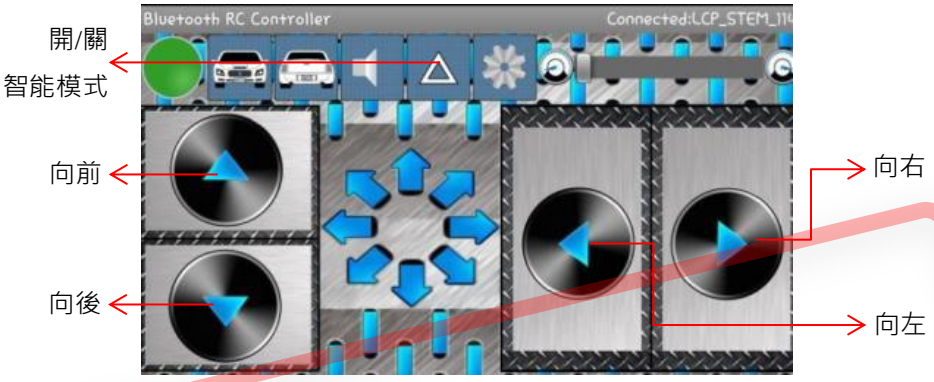


以同樣方式把另一個伺服電動機臂安裝在八葉塑膠螺旋槳上。



3. 控制水陸兩用機械

參考本套件基礎知識《上載程式及設定應用程式遙控機械》把程式上載到水陸兩用機械的 Arduino 底板，再用應用程式遙控它活動。



[資源檔案: project2-amphibot.sb2]

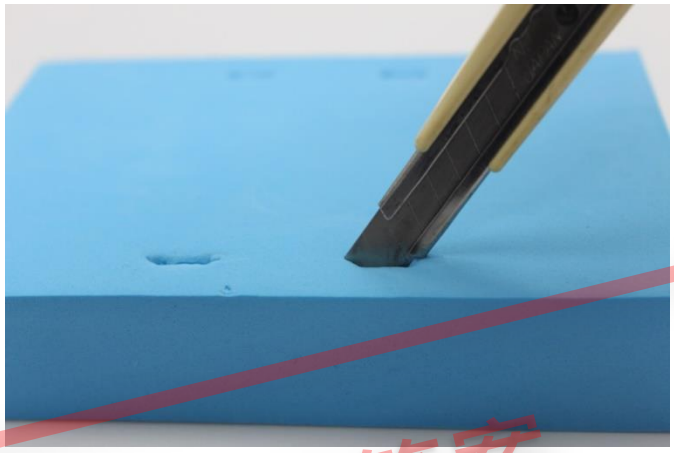
4. 作業 1

1. 試建議一種切割泡棉珍珠板的方法，水陸兩用機械能固定在泡棉珍珠板上。

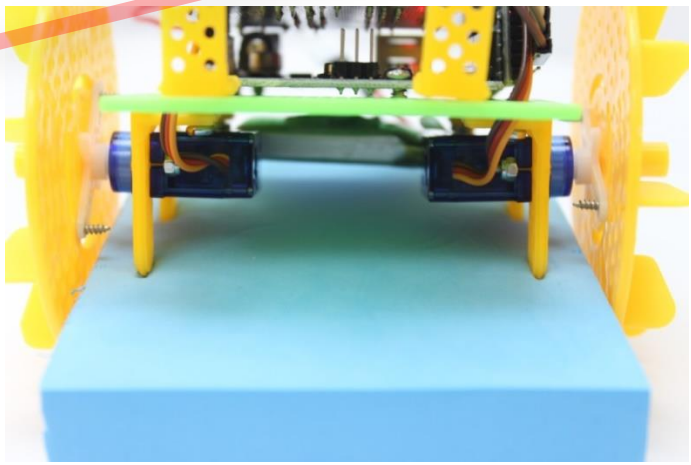
2. 試建議一種方法，令到用來把八葉塑膠螺旋槳安裝在伺服電動機上的尖頭螺絲不會因接觸到泡棉珍珠板表面而產生磨擦力並降低螺旋槳轉速。

專案 2 作業 1 建議答案

問題 1：



可用美工刀在泡棉珍珠板表面割出 4 道 1 厘米長的直線刀痕（上圖），用來插入安裝在多孔固定膠板左右兩旁連接着伺服電動機的角碼，使它們固定在泡棉珍珠板上（下圖）。



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Self-learning Guide

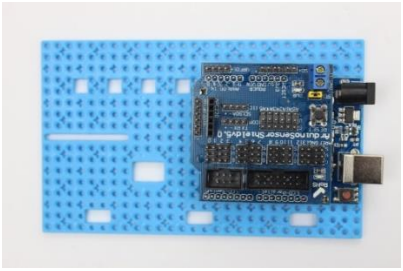
Author：Lau Wai Shing (劉偉成)

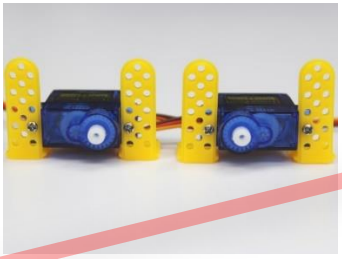
PROJECT 3: HEXABOT

Contents

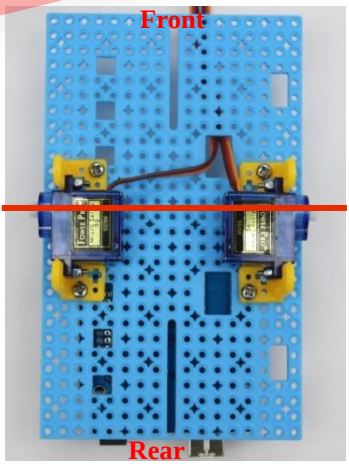
2. Assembling Hexabot

First, follow the instructions in Sections 1 to 3 in *Assembling SmartBot's Main Body* Basic Knowledge Booklet in this Kit to fit together the Arduino Uno board with its sensor shield and the perforated plastic panel, and attach two 360-degree servo motors to perforated angle brackets.

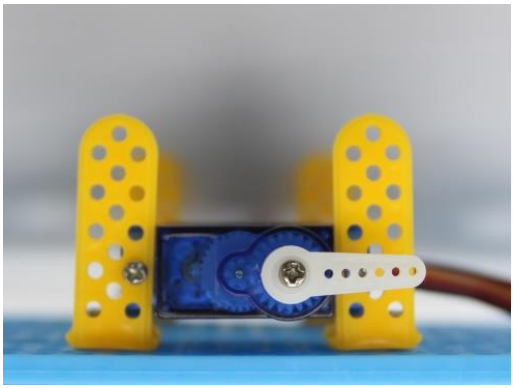




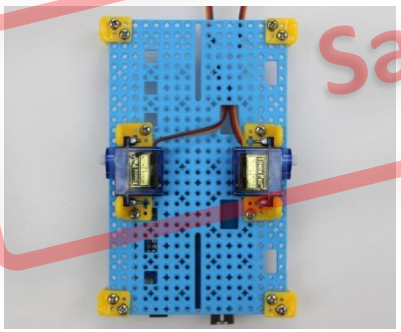
Then, install the two servo motors on the perforated plastic panel midway on the left and right sides with 6mm M3 sharp screws applied to their attached perforated angle brackets. Ensure that both servo motors' output shafts are aligned (on the red line shown in the figure) and positioned closer to the front end. When done, pass the wires of the servo motors through the rectangular hole on the panel for later use.

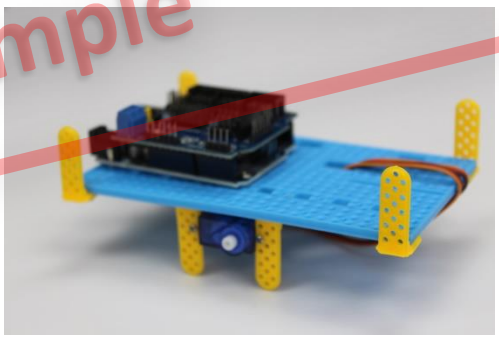


Then install the accessory servo arms on the servo motor shafts and fasten them with the accessory bolts.



In each corner of the perforated plastic panel, attach a perforated angle bracket with 6mm M3 sharp screws as shown in the figures below.

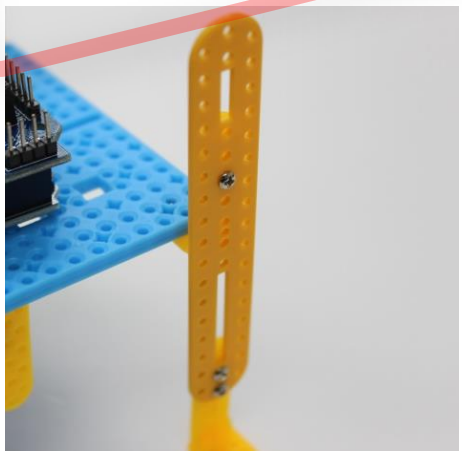


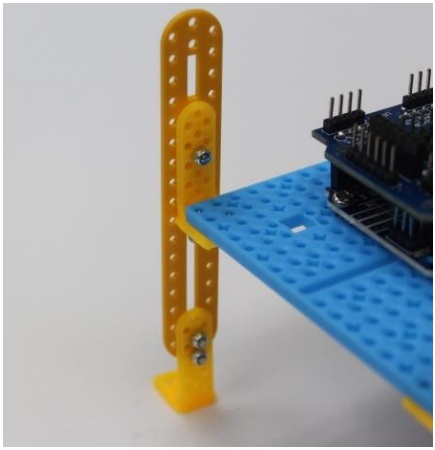


[Resource File: assembling-hexabot-part-1.mp4 /]

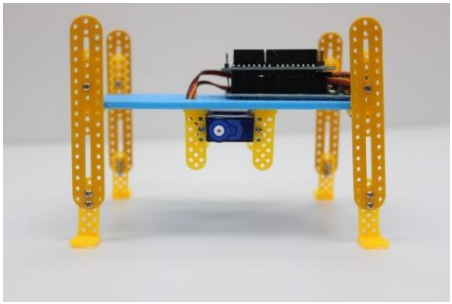
Next, take four perforated plastic strips and four perforated angle brackets. Fix each strip to an angle bracket with two pairs of 8mm M2 nuts and bolts applied to one end of the strip (the end closer to the longer narrow hole).

Next, install the four assembled sets of perforated strips and angle brackets to the four corners of the perforated plastic panels with 8mm M2 nuts and bolts applied to the perforated angle brackets in the corners. Given that flexible joints would enable smooth movement for the Hexabot, ensure that the nuts and bolts are not applied too tightly between the strips and the angle brackets in the corners. Allow some room for the strips to swivel.



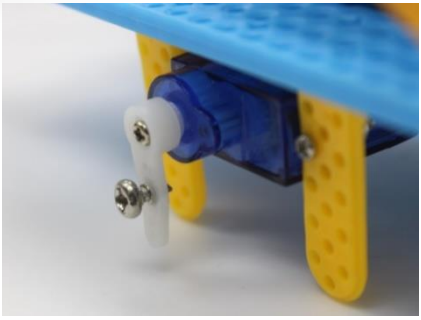


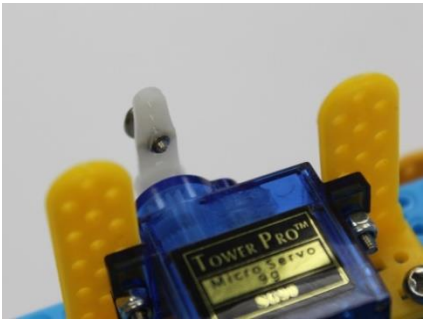
With four legs installed, the Hexabot can now stand.



Next, take two perforated plastic strips and two perforated angle brackets. Fix each strip to one angle bracket with two pairs of 8mm M2 bolts and nuts as shown in the figure below.

Before installing the second left leg of the Hexabot, enlarge a hole on each of the two servo arms using a M3 sharp screw.



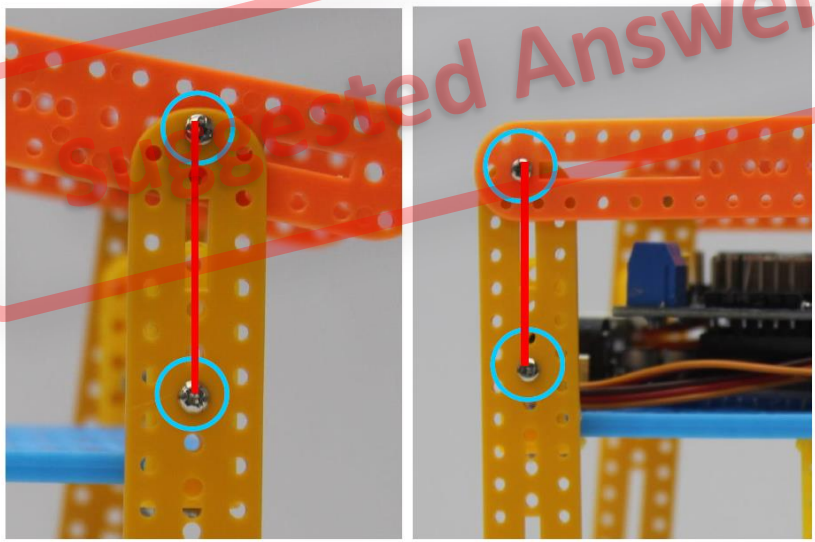


4. Assignment 1

1. Given that the supply voltage and the existing parts remain unchanged, suggest how to increase the walking speed of the Hexapod. (Multiple methods may be suggested.)
2. Given that the supply voltage and the existing parts remain unchanged, suggest how to increase the walking speed of the Hexapod. (Multiple methods may be suggested.)

Project 3 Assignment 1 Answers

Question 1:



(Top left figure) Reduce the joint distances on both forelegs (denoted by the red line) so that the arc length of the foreleg motion increases, and so does the walking speed.