IVE | Engineering 工程

SOPHIE

SGOC

新能源新世代2024
「玩轉海陸空」挑戰賽

「電與力 工作坊 I」

細車,船及 滑翔機組別

IVE Engineering 工程

SOPHIE

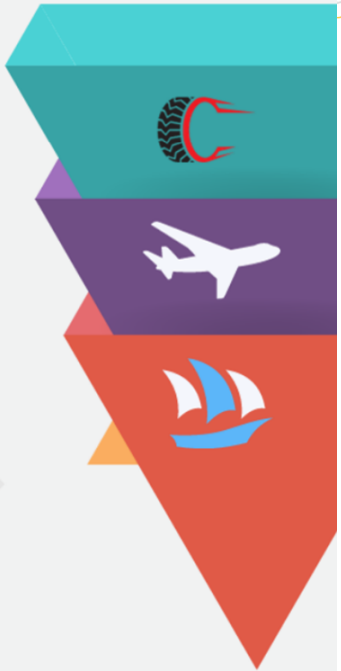
SGDC

工作坊內容

01 1)「印」出個未來
2月24日

02 電與力工作坊 I
3月16日

03 電與力工作坊 II
7月13日



IVE Engineering 工程

SOPHIE

SGDC

上回重溫

- 太陽能應用
- 3D 打印技術

今堂內容：細車,太陽能船及滑翔機的延伸

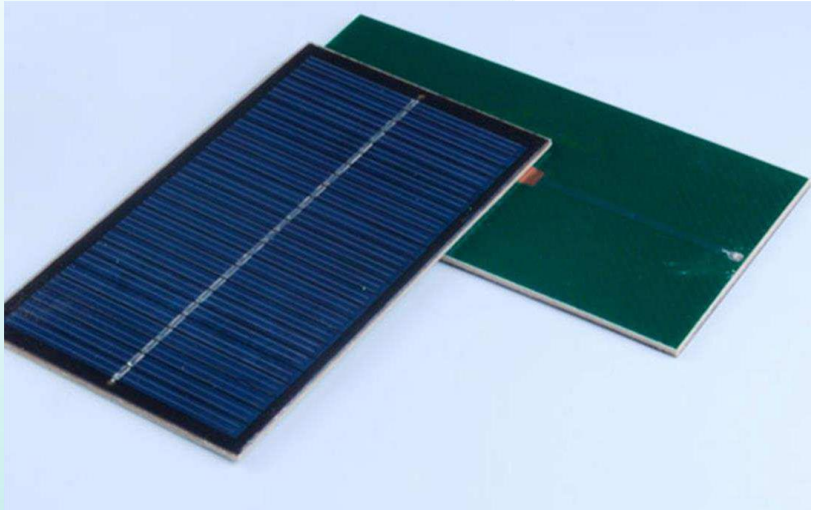
太陽能板

細車,船及 滑翔機

輸出電壓: 2V

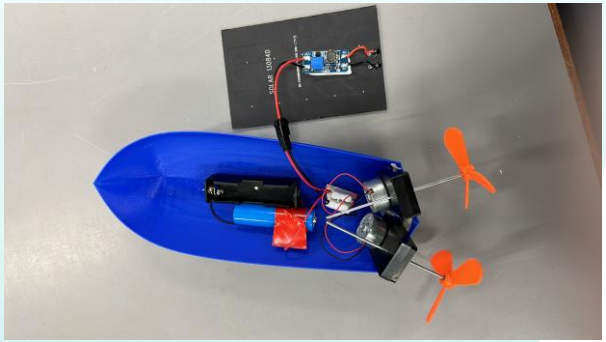
功率: 1W

面積: 210mm x 120mm



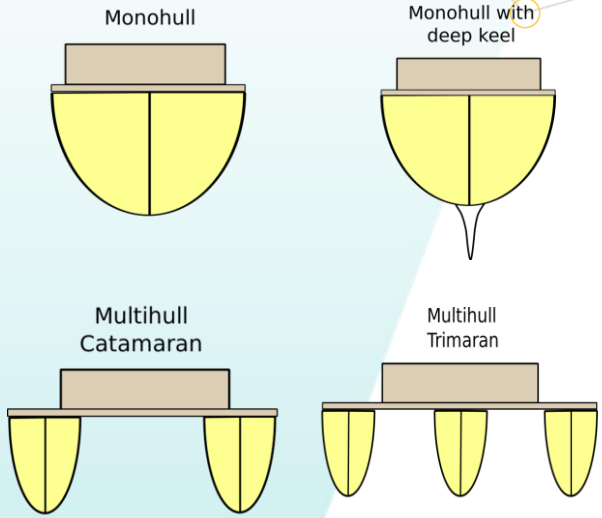
太陽能船內容

- 船身部件介紹
- 船身結構介紹



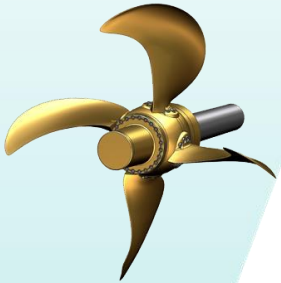
船架設計

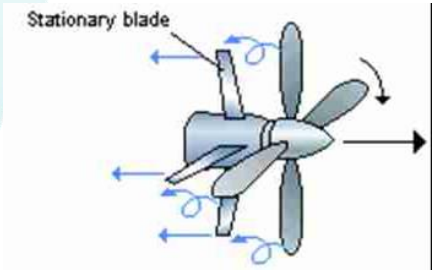
- 船身尺寸和形狀
- 材料（重量）
- 螺旋槳
- 船艉



螺旋槳設計

- 螺旋槳尺寸和形狀
- 材料（重量）





IVE Engineering 工程

SOPHIE

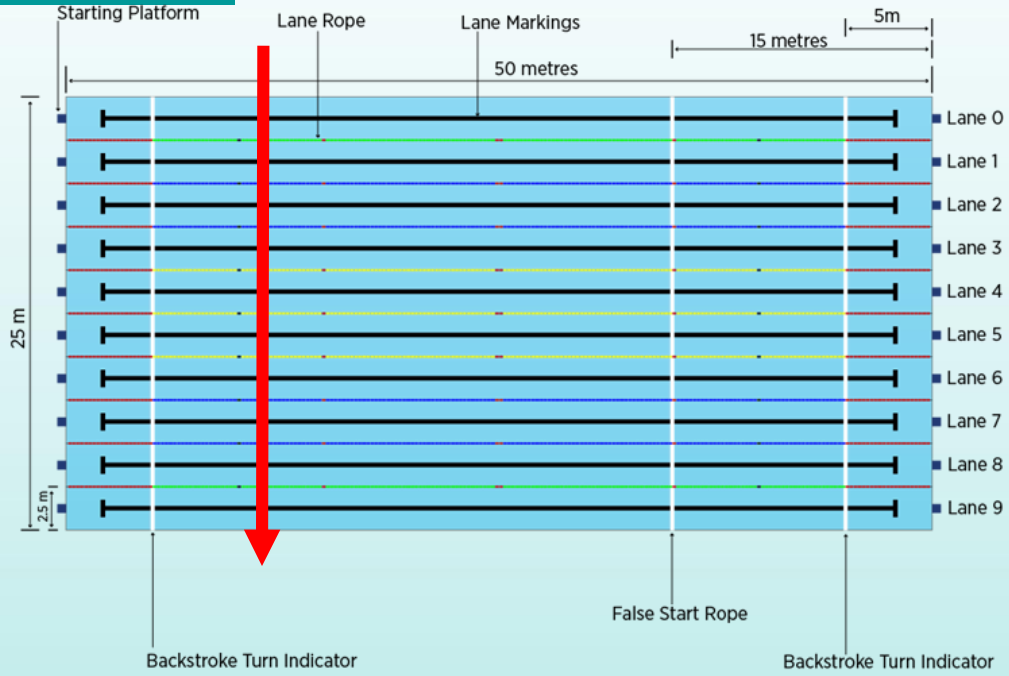
SGDC

船身材料

材料重量及強度

- PVC(膠樽?)
- Polystyrene(發泡膠)
- 3D Print物料(PLA, PVA)

比賽賽道



賽道為青衣IVE泳池作藍本
全長約50米，闊約25米。

IVE Engineering 工程

SOPHIE

SGDC

滑翔機內容

- 歷史
- 原理
- 設計
- 部件

滑翔機歷史

1809年英國的喬治凱利爵士試製了一架滑翔機

1847年，76歲的凱利製作了一架大型滑翔機

德國土木工程師利林塔爾1891年製作了第一架固定翼滑翔機，翼展為7米

萊特兄弟飛行者一號

1914年德國人哈斯研製出第一架現代滑翔機

德國空軍更是把滑翔機用於傘兵機降作戰並製造了歷史上最巨大的Me 321滑翔機

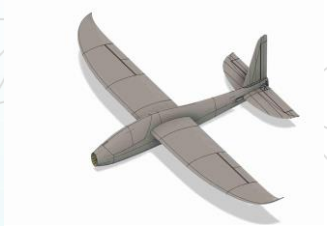
IVE Engineering 工程

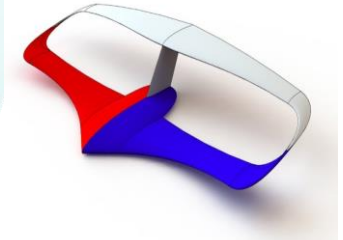
SOPHIE

SGDC

滑翔機結構

- 尺寸大小
- 滑翔機結構(機翼, 角度)
- 面積及體積





IVE Engineering 工程

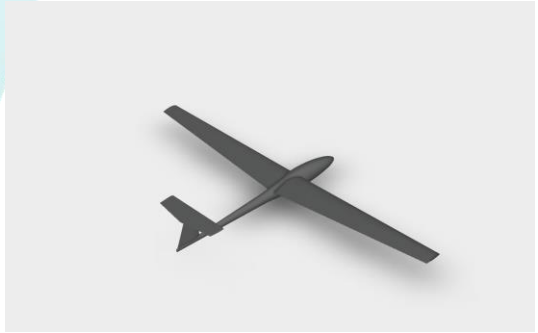
SOPHIE

SGDC

材料

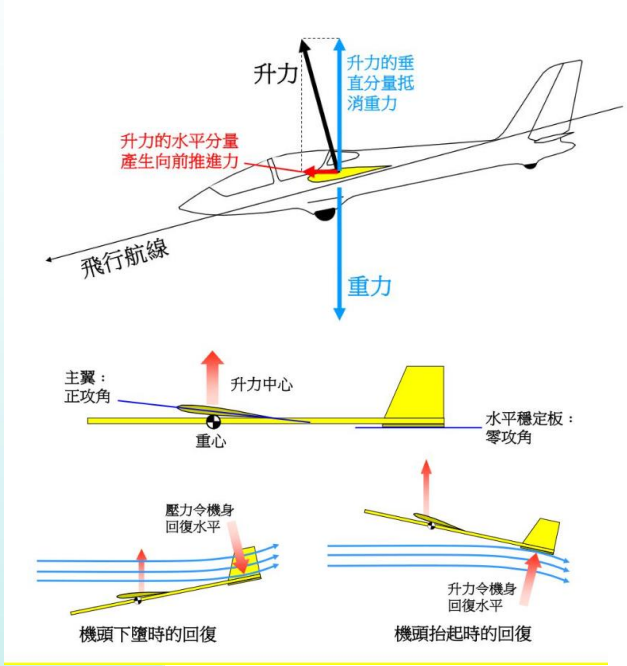
材料重量及強度

- PVC(膠櫈?)
- 木
- 3D Print物料(PLA, PVA)



運作原理

- 主要依靠上升氣流進行持續飛行
- 在無風情況下，下滑飛行過程中依靠自身重力獲得前進動力
- 在有上升氣流時，可以籍此實現平飛或升高



小休

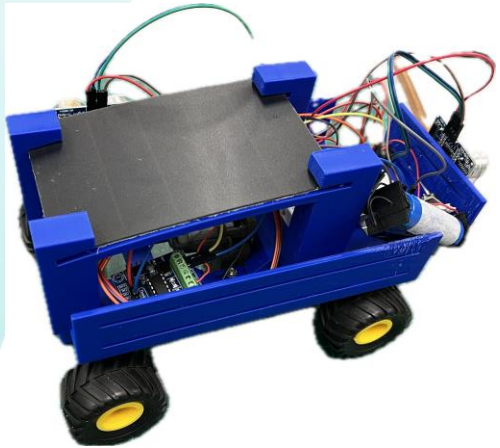
IVE Engineering 工程

SOPHIE

SGDC

細車內容

- 遙控車部件介紹
- 控制器及寫程式軟件
- 手機搖控方式



IVE Engineering 工程

SOPHIE

SGDC

遙控車部件

- 控制器
- 感應器及驅動馬達
- 面包板
- 連接線
- 電池
- DC-DC轉換器
- 太陽能板
- 車輛結構
- 轉向結構

整一部遙控車需要什麼？

控制器

- 編寫程式方便
- 網上資源多
- 硬件及軟件開源
- 大量傳感器

官網 : https://www.arduino.cc/en/software

Arduino IDE 2.3.2

The new major release of the Arduino IDE is faster and even more powerful! In addition to a more modern editor and a more responsive interface it features autocompletion, code navigation, and even a live debugger.

For more details, please refer to the **Arduino IDE 2.0 documentation**.

Nightly builds with the latest bugfixes are available through the section below.

SOURCE CODE

The Arduino IDE 2.0 is open source and its source code is hosted on **GitHub**.

DOWNLOAD OPTIONS

Windows Win 10 and newer, 64 bits
Windows MSI installer
Windows ZIP file

Linux AppImage 64 bits (X86-64)
Linux ZIP file 64 bits (X86-64)

macOS Intel, 10.14: "Catalina" or newer, 64 bits
macOS Apple Silicon, 11: "Big Sur" or newer, 64 bits

Release Notes

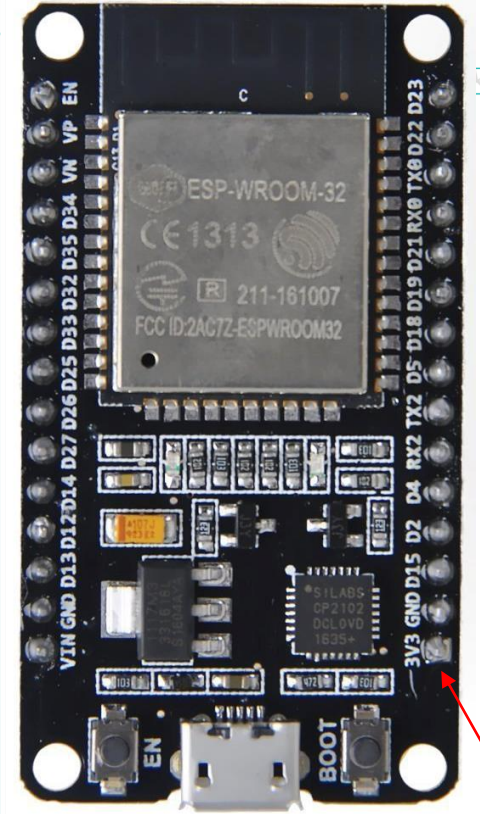
IVE Engineering 工程

SOPHIE

SGDC

控制器

ESP32-WROOM-32



好處

- 內置藍芽功能
- 引腳多(30pin)
- 可使用Arduino IDE編程

壞處

- 需要額外下載驅動程式
- 電源只可輸出3.3V

控制器驅動程式

arduino.esp8266.com/stable/package_esp8266com_index.json
dl.espressif.com/dl/package_esp32_index.json
raw.githubusercontent.com/espressif/arduino-esp32/gh-pages/package_esp32_index.json

傳感器

超聲波傳感測距模組
型號：HC-SR04
使用電壓：DC 5V
感應角度：不大於15度
探測距離：2CM - 450CM
接線方式：VCC、trig（控制端）、 echo（接收端）GND

伺服馬達

伺服馬達
型號：SG90
使用電壓：DC 4.8V - 6V
靜態電流：小於300mA
角度：最大270度
接線方式：VCC、GND、SIGNAL

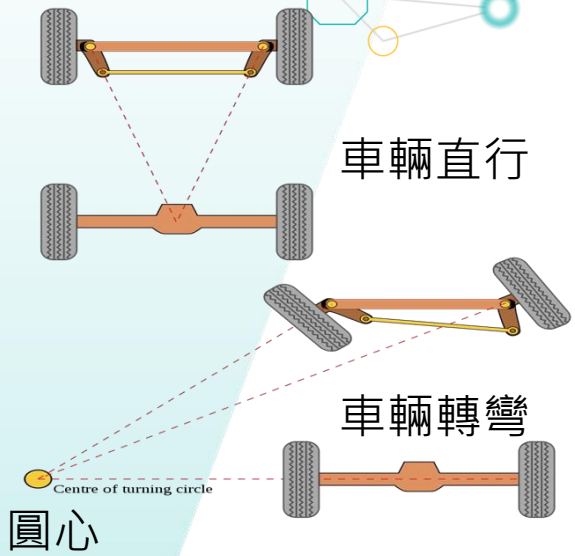
阿克曼轉向

阿克曼轉向(Ackermann Steering)

1. 車輛轉彎時通過調整車輛的轉向角度
2. 內側車輪的轉彎角度>外側車輪
3. 令所有車輪垂線均指向圓心

↓

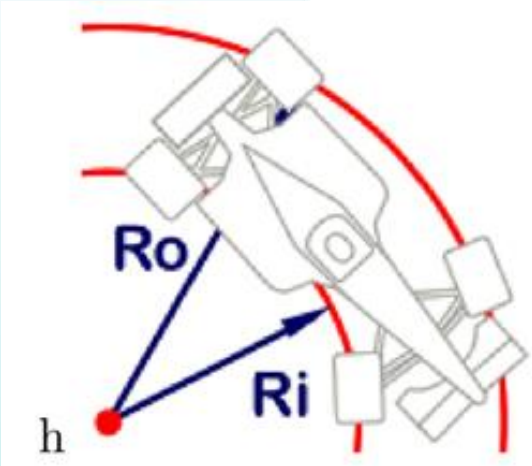
轉彎更順暢



阿克曼轉向原理

當車輛轉彎時

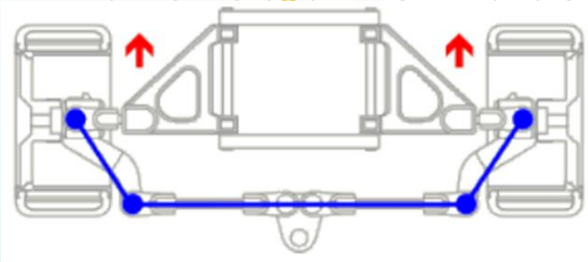
兩個前輪以不同圓半徑轉向



前輪半徑

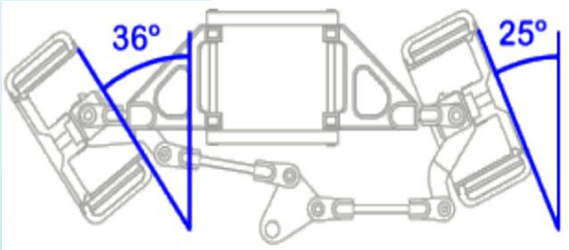
阿克曼轉向原理

車輛的轉向臂會向內傾斜



傾斜轉向臂

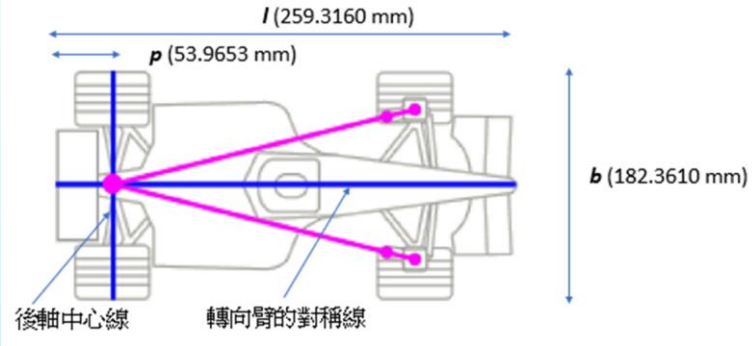
以允許車輪角度以不同的速率轉向



轉向角度鴉不一

阿克曼轉向原理

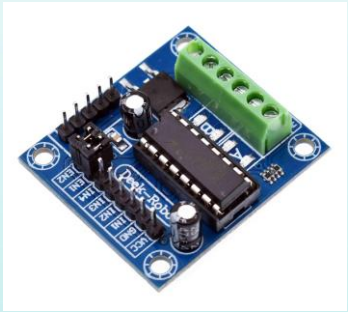
1. 調整車輛轉向臂的角度
2. 轉向臂的對稱線和後軸中心線相交
3. 量度最佳的弧線半徑

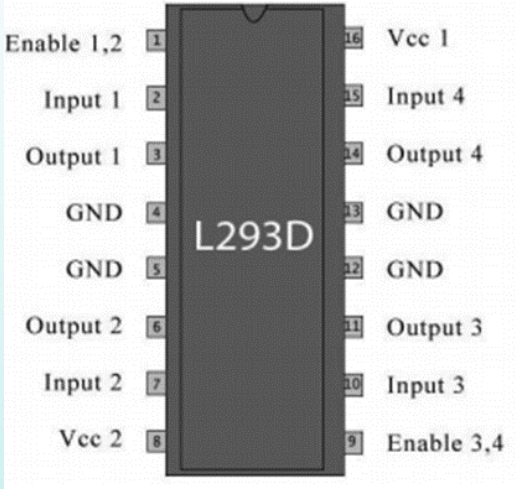


車輛轉向臂的對稱線&後軸中心線相交

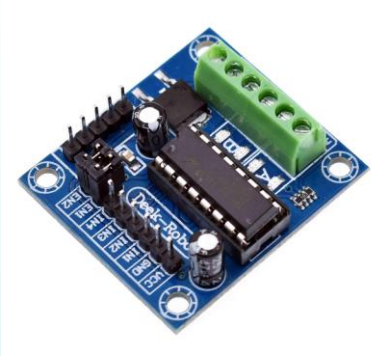
馬達驅動器

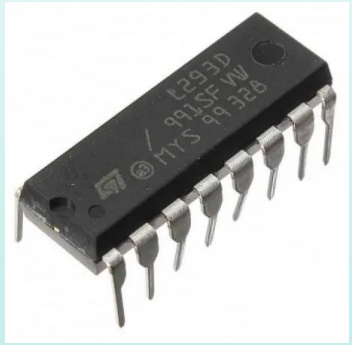
名稱：DC 馬達驅動器
型號：L293D
寬電源電壓範圍：4.5V - 36V
輸出電流：600 mA
運作供電電流：2 mA
可控制最多兩個DC馬達





馬達驅動器





升壓模組

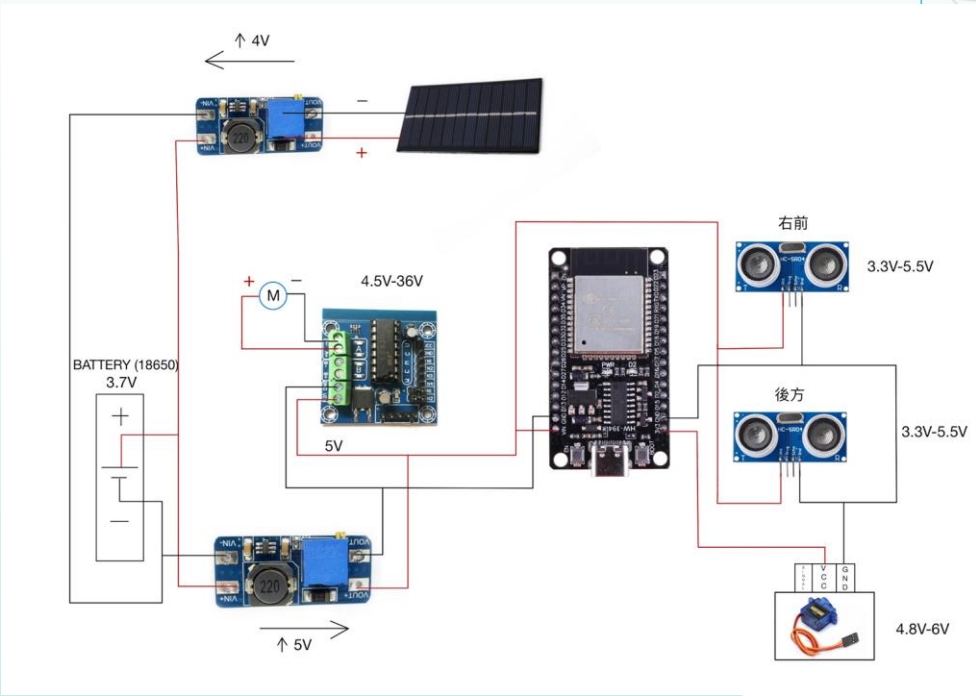
名稱：2A DC-DC升壓模組
型號：MT3608
最大輸出電流:2A
輸入電壓:2V ~24V
最大輸出電壓:28V

IVE Engineering 工程

SOPHIE

SGDC

電路圖



IVE Engineering 工程

SOPHIE

SGDC

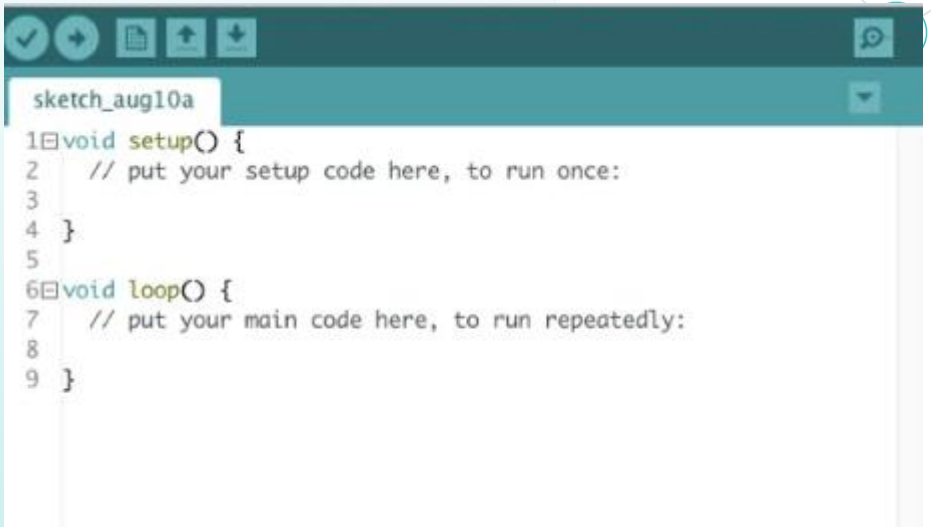
小休

Arduino程式碼

電腦做特定的工作需要寫程式

如何寫程式?

定義變量 → 想電腦做的動作 → 變成程式碼 → 上傳



貼士：單超聲波遙控小車的ESP32程式碼示範

貼士程式碼

```
//引入數據庫
#include "BluetoothSerial.h"
#include <ESP32Servo.h>
//藍芽設定
BluetoothSerial SerialBT;
//馬達驅動器設定
int motorFoward = 5;   //馬達向前
int motorBack = 18;    //馬達向前
//伺服馬達設定
#define PIN_Servo 13  //SG90 DATA PIN
Servo myServo;
//超聲波模組設定
int trig = 22;  //發送超聲波腳
int echo = 23;  //接收超聲波腳
```

```
//聲音與距離參數
#define SOUND_SPEED 0.034
long duration_us;
float distanceCm;
bool autoparking = false;
//ESP32-WROOM-32 設定
void setup() {
 Serial.begin(115200);
 SerialBT.begin("ESP32");  //遙控車名
 pinMode(motorFoward, OUTPUT);
 pinMode(motorBack, OUTPUT);
 myServo.attach(PIN_Servo);
 pinMode(trig, OUTPUT);
 pinMode(echo, INPUT);
}
```

IVE Engineering 工程

SOPHIE

SGDC

貼士程式碼

```
//藍芽控制
void readBluetoothData() {
 if (SerialBT.available()) {
   char c = SerialBT.read();
   SerialBT.println(c);
if (c == '8') {  //向前
    Serial.println("前");
    digitalWrite(motorFoward, HIGH);
    digitalWrite(motorBack, LOW);
  } else if (c == '2') {  //向後
    Serial.println("後");
    digitalWrite(motorFoward, LOW);
    digitalWrite(motorBack, HIGH);
  } else if (c == '4') {  //向左
    Serial.println("左");
    myServo.write(60);     //可更改角度
  } else if (c == '6') {  //向加
    Serial.println("右");
    myServo.write(120);    //可更改角度
  }
else if (c == '0') {  //自動泊車
    Serial.println("泊車中");
    Autoparking();
  } else if (c == '9') {  //停止
    Serial.println("停");
    myServo.write(90);
    digitalWrite(motorFoward, LOW);
    digitalWrite(motorBack, LOW);
  }
 }
}
```

貼士程式碼

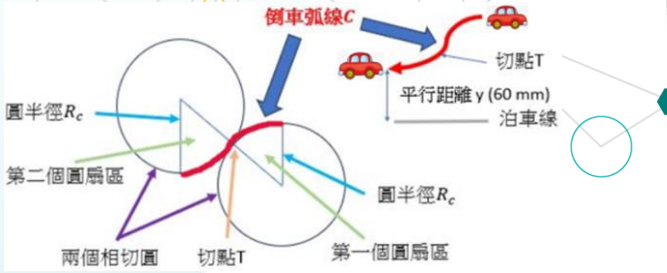
```
//CAR SELFPARKING PROGRAM
void Autoparking(void) {
 autoparking = true;
 while (autoparking == true) {
   digitalWrite(motorFoward, HIGH);
   digitalWrite(motorBack, LOW);
if (distanceCm <= 3.5) {  //根據情況更改
      digitalWrite(motorFoward, LOW);
      digitalWrite(motorBack, LOW);
      delay(10);
      myServo.write(90);
      digitalWrite(motorFoward, HIGH);
      digitalWrite(motorBack, LOW);
      delay(700);  //根據情況更改
      digitalWrite(motorFoward, LOW);
      digitalWrite(motorBack, LOW);
      delay(100);
      myServo.write(140);  //可更改角度
      delay(100);
      digitalWrite(motorFoward, LOW);
      digitalWrite(motorBack, HIGH);
      delay(2600);  //根據情況更改
      digitalWrite(motorFoward, LOW);
      digitalWrite(motorBack, LOW);
      delay(100);
      myServo.write(40);  //可更改角度
      delay(100);
      digitalWrite(motorFoward, LOW);
      digitalWrite(motorBack, HIGH);
      delay(1900);  //根據情況更改
      digitalWrite(motorFoward, LOW);
      digitalWrite(motorBack, LOW);
      autoparking = false;
      break;
   }
 }
}
```

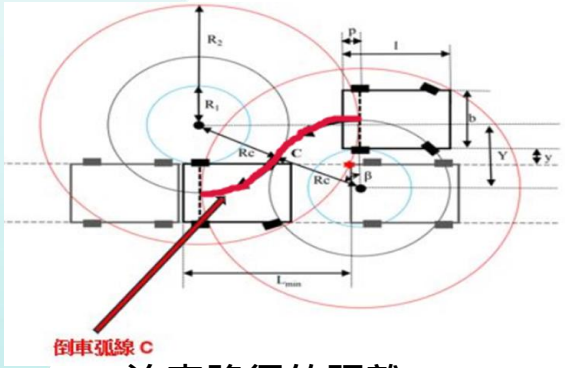
貼士程式碼

```
//ESP32-WROOM-32 SET UP
void loop() {
 readBluetoothData();
  digitalWrite(trig, LOW);
   delayMicroseconds(2);
   digitalWrite(trig, HIGH);
   delayMicroseconds(10);
   digitalWrite(trig, LOW);
   duration_us = pulseIn(echo, HIGH);
   distanceCm = duration_us * SOUND_SPEED / 2;  //計算距離
   Serial.print("右前 (cm): ");
   Serial.println(distanceCm);
   delayMicroseconds(10);
 delay(10);
}
```

泊車路徑

1. 車輛泊車時先與泊車線保持平行距離Y
2. 倒車並沿著第一個圓扇區的圓周行至切點T
3. 車輪會轉向相反的角度
4. 繼續沿著第二個圓扇區的圓周倒車直至與泊車線平行為止
5. 倒車路徑C是一條弧線由二條以圓半徑為Rc相切圓的兩個圓扇區所結合的弧線





泊車路徑的距離

公式計算

假設這輛模型車是一個長方形，長度是l mm，闊度是b mm，

則最小泊車長度計算如下:

1. $$L_{min} = p + \sqrt{R_2^2 - R_1^2}$$

其中 R_1 和 R_2 的計算如下:

2. $$R_1 = R_c - \frac{b}{2}$$

和

3. $$R_2 = \sqrt{\left(R_c + \frac{b}{2}\right)^2 + (l - P)^2}$$

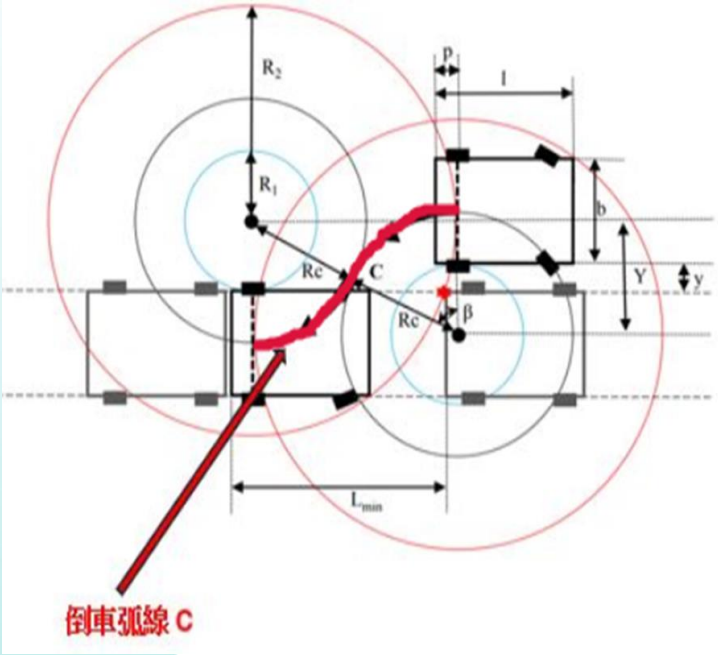
計算結果是最小泊車長度約為 400 毫米，或者是這輛模型車長度的1.54 倍。

這輛模型車沿圓弧線倒車時所行駛的距離 C 計算如下:

4. $$C = 2\beta R_c$$

其中 β角度的計算公式如下:

5. $$\beta = \cos^{-1}\left(\frac{Y}{2R_c}\right)$$



數值

數值的代表：

l　代表車輛長度。

b　代表車輛闊度。

p　代表車輛橫軸與車尾距離。

L_{min}代表最小泊車長度。

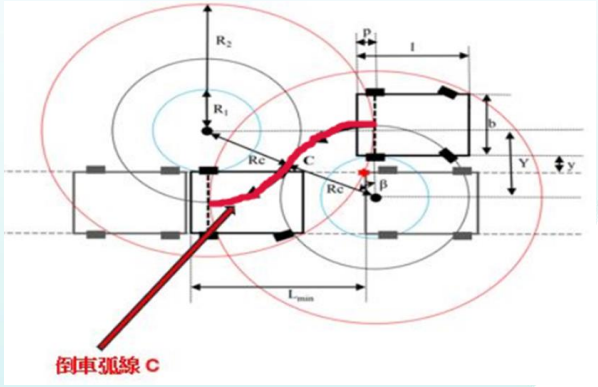
R_1　代表最細圓的半徑。

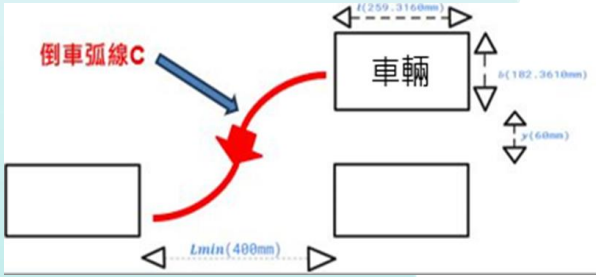
R_2　代表最大圓的半徑。

R_c　代表中間圓的半徑。

Y　用於計算β角度。

y　代表車輛與泊車位的平行距離。

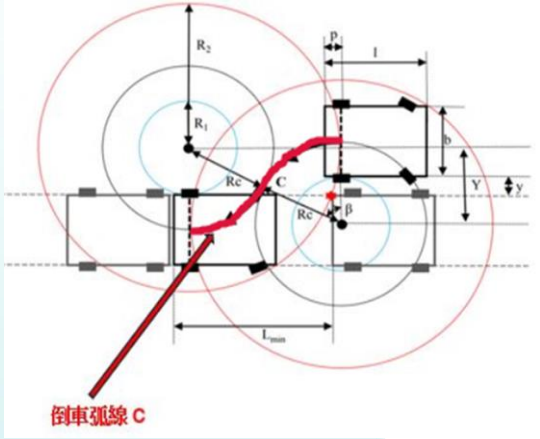


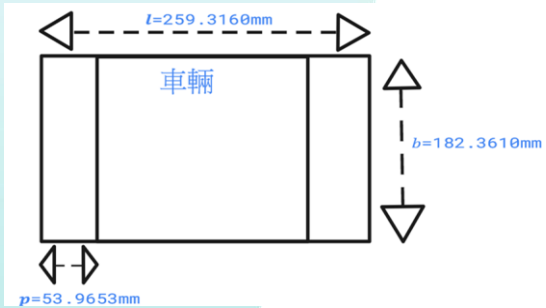


數值

設數值:

- l = 259.3160 mm
- b = 182.3610 mm
- p = 53.9653 mm
- L_{min} = 400 mm
- R_1 = 121.5064 mm
- R_2 = 366.7482 mm
- R_c = 212.6869 mm
- Y = 195.8692 mm
- y = 60 mm





計算公式

計算$\boldsymbol{R_1}$的數值

$$\boldsymbol{R_1 = R_c - \frac{b}{2}}$$

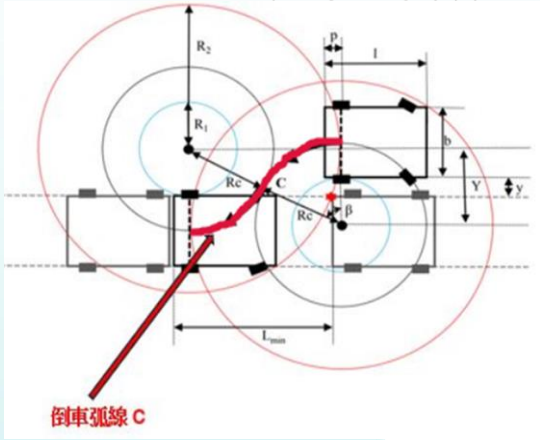
$$\text{L.H.S} = R_1 = 121.5064 \text{ mm}$$

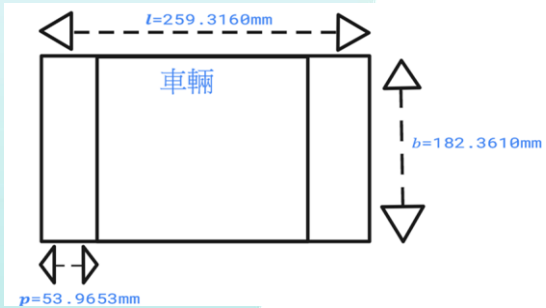
$$\text{R.H.S} = R_c - \frac{b}{2}$$

$$= 212.6869 - \frac{182.3610}{2}$$

$$= 121.5064 \text{ mm}$$

因此 ，L.H.S = R.H.S





計算公式

計算R_2的數值

$$R_2 = \sqrt{\left(R_c + \frac{b}{2}\right)^2 + (l - P)^2}$$

$$\text{L.H.S} = R_2 = 366.7482 \text{ mm}$$

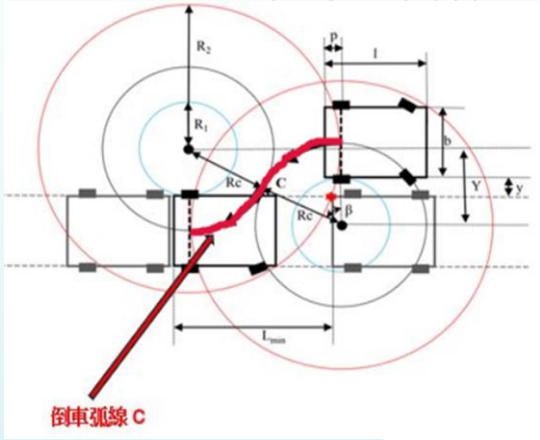
$$\text{R.H.S} = \sqrt{\left(R_c + \frac{b}{2}\right)^2 + (l - P)^2}$$

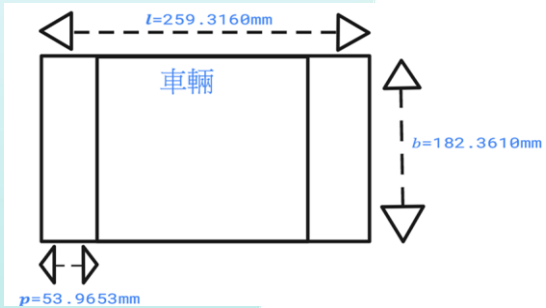
$$= \sqrt{\left(212.6869 + \frac{182.3610}{2}\right)^2 + (259.3160 - 53.9653)^2}$$

$$= 366.7482880304 \text{ mm}$$

$$\approx 366.7482 \text{ mm}$$

因此，L.H.S = R.H.S





計算公式

計算L_{min}的數值

$$L_{min} = p + \sqrt{R_2^2 - R_1^2}$$

L.H.S = L_{min} = 400 mm

R.H.S = $p + \sqrt{R_2^2 - R_1^2}$

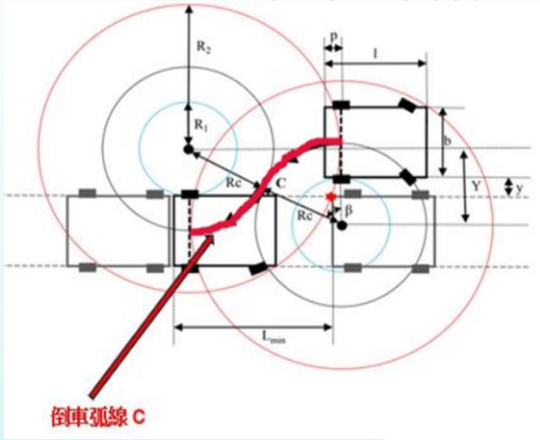
$= 53.9653 + \sqrt{(366.7482)^2 - (121.5064)^2}$

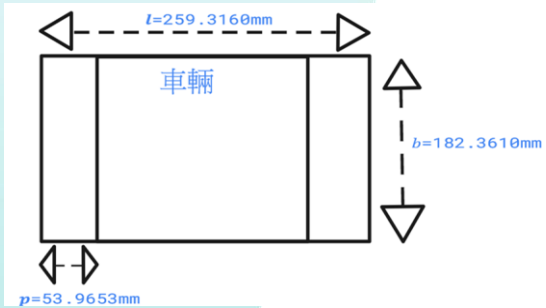
$= 400.00061172$ mm

$\approx$ 400 mm

因此，L.H.S = R.H.S

備註: 最小泊車長度(L_{min})的值是400 mm或約等於1.54倍車輛長度(l),
即$L_{min} = 1.54l = 1.54 \times 259.3160 =$ 399.34664 mm $\approx$ 400 mm





計算公式

計算β角度的數值

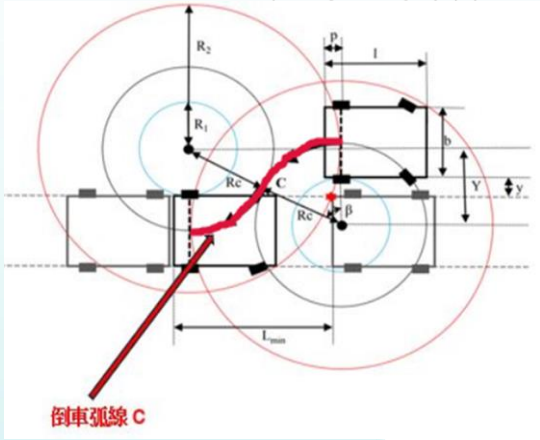
$$\beta = \cos^{-1}\left(\frac{Y}{2R_c}\right)$$

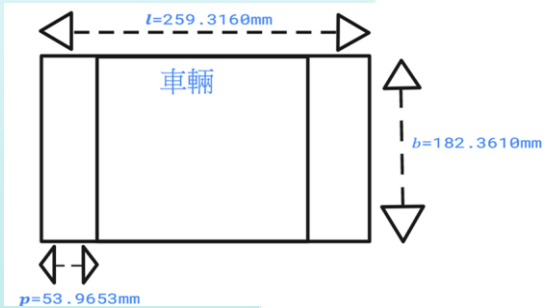
$$\beta = \cos^{-1}\left(\frac{195.8692}{2\ x\ 212.6869}\right)$$

$$= \cos^{-1}(0.4604637145)$$

$$= 1.09227881 \text{ rad 或 } 62.582966°$$

$$\approx 1.0923 \text{ rad 或 } 62.583°$$



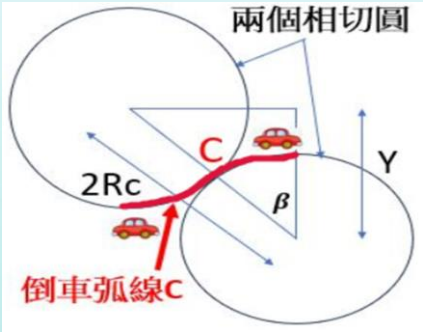


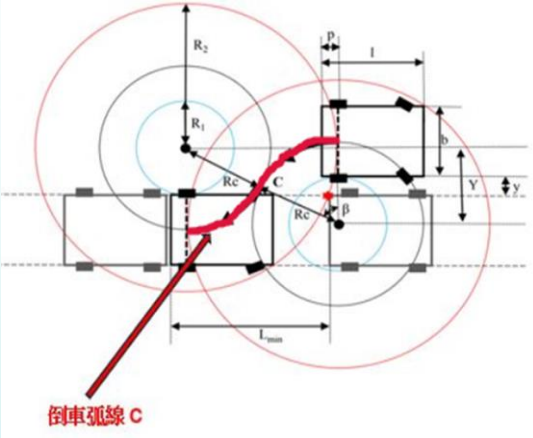
計算公式

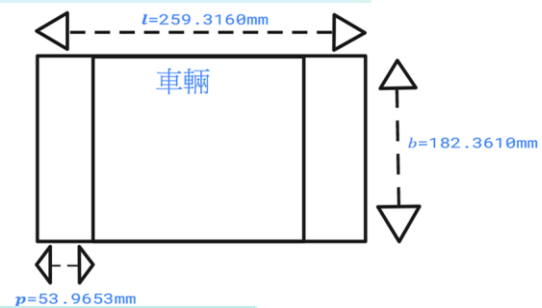
計算弧線長度C的數值

$$C = 2\beta R_c$$

$$C = 2\ x\ 1.09227881 \text{ x } 212.6869$$
$$= 464.6267880692\ mm$$
$$= 0.4646\ m$$





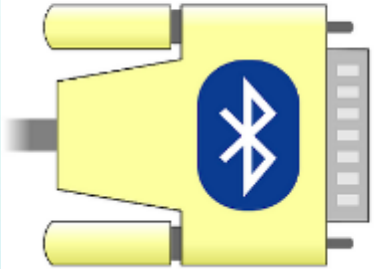


IVE Engineering 工程

SOPHIE

SGDC

如何控制



Serial Bluetooth Terminal

Kai Morich Tools

3+

Offers in-app purchases

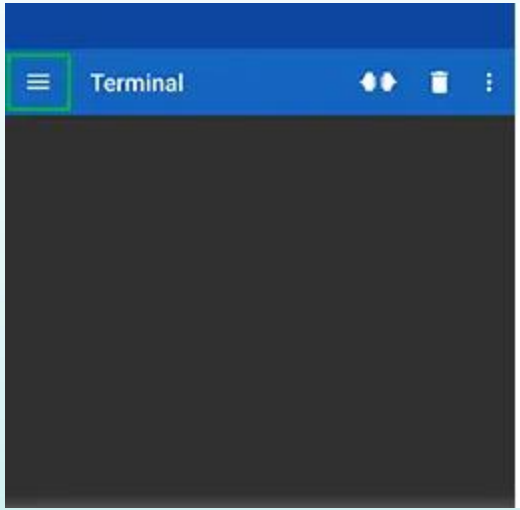
This app is compatible with all of your devices.

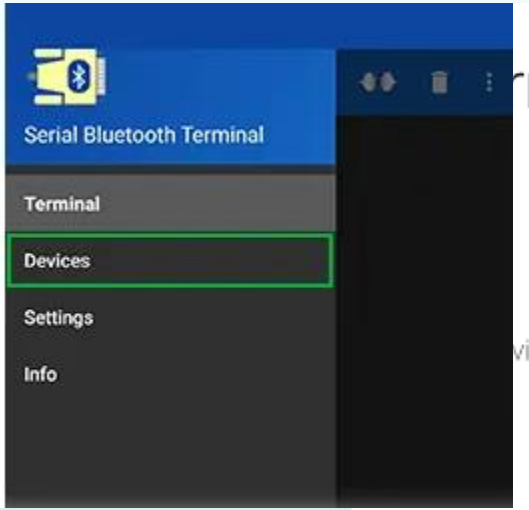
IVE Engineering 工程

SOPHIE

SGDC

如何控制





rminal

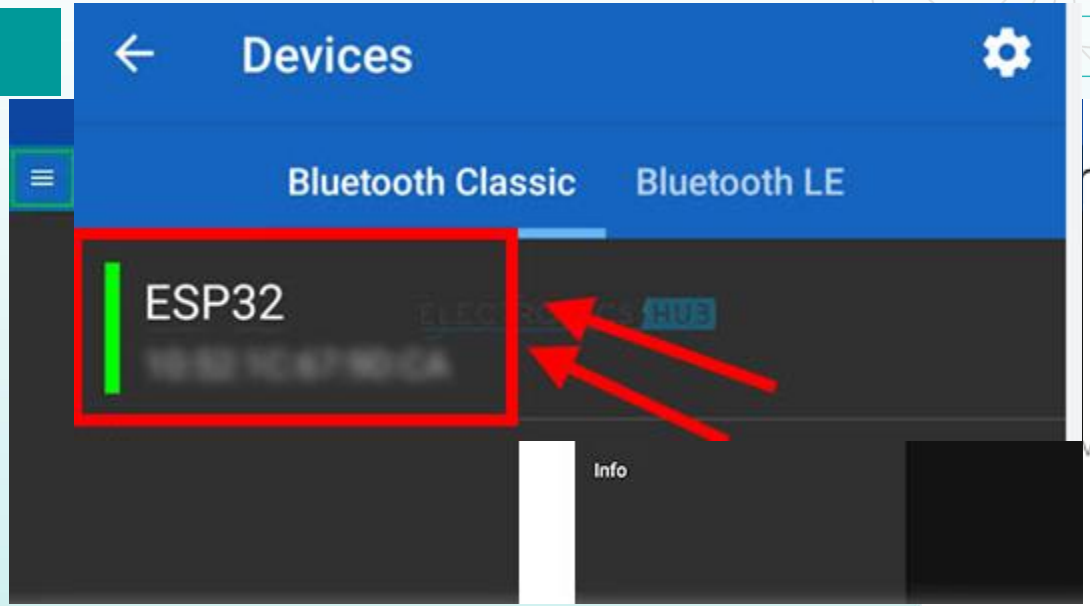
vices.

IVE Engineering 工程

SOPHIE

SGDC

如何控制



rminal

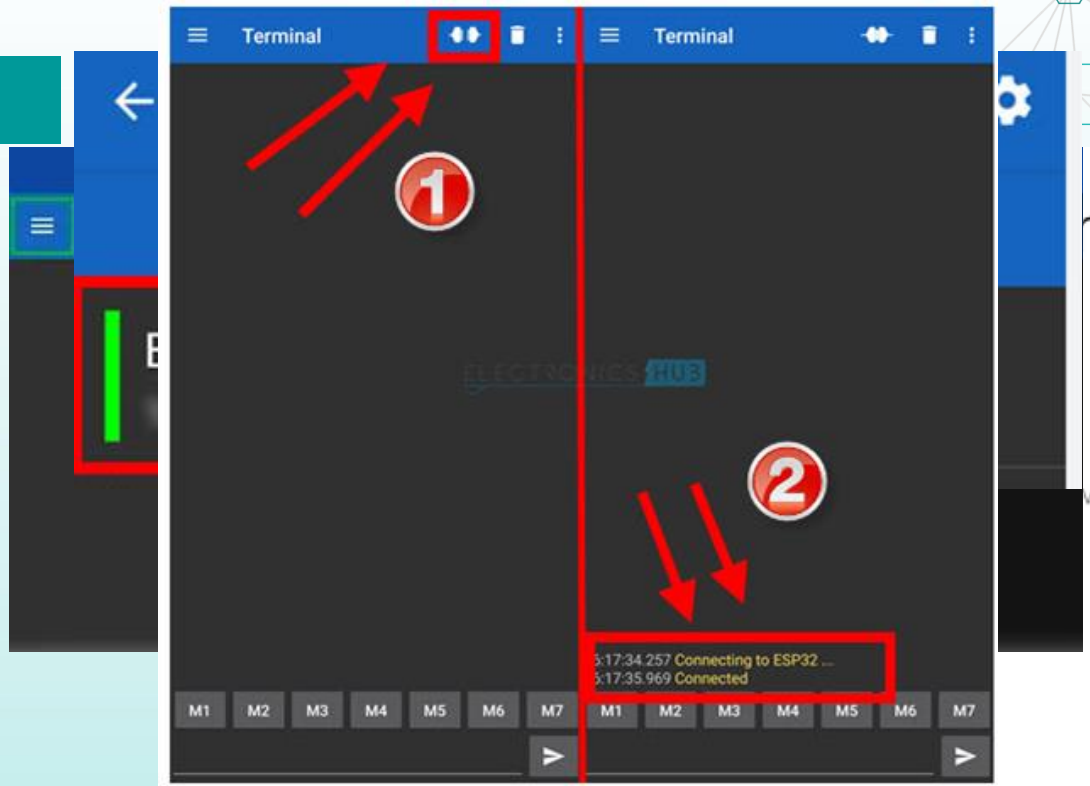
vices.

IVE Engineering 工程

SOPHIE

SGDC

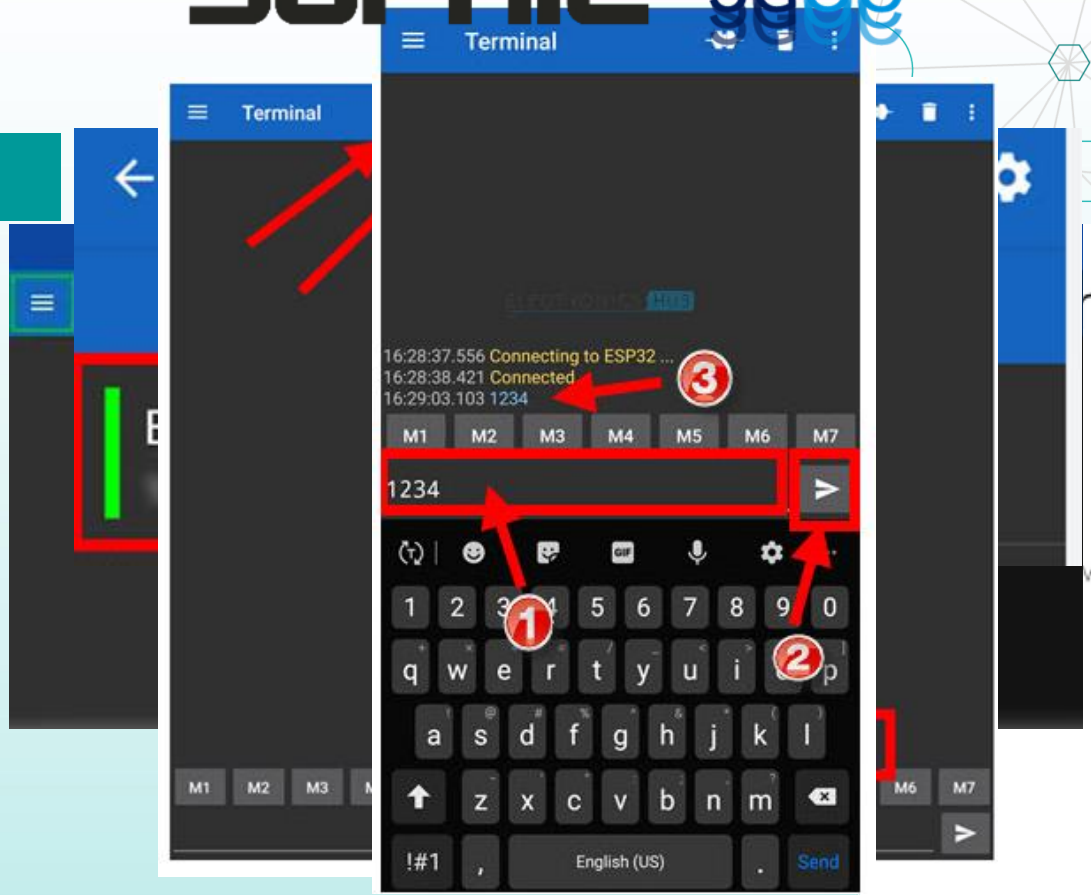
如何控制



IVE Engineering 工程

SOPHIE SGOC

如何控制



如何控制

- 可自訂按鍵
- 實現到基本控制

IVE Engineering 工程

SOPHIE

SGOC

VTC Solar Car Team

Smart Grid Operation Centre

Instagram

@SGOC.IVE

IVE | Engineering 工程

SOPHIE

SGDC

完