

CNC球體寫字機

組員: 7號 余仲恩 15號 施丞祐 26號 陳奕為 30號 陳毅恩

指導老師: 林家德老師

目錄

前言

理論探討

專題設計

成果展示

結論

前言

The background is a dark blue gradient with a field of small white stars. Overlaid on this are several technical diagrams in a lighter blue color. In the top right, there is a large circular gauge with concentric rings and numerical markings from 80 to 210. In the bottom right, there is a diagram with dashed lines and arrows forming a circular path. In the bottom left, there is another diagram with solid lines and arrows. In the top left, there is a simple circular diagram with a partial line.

製作背景

近期幾年來，自動化越來越普遍，其中最廣為人知的一個技術叫 **CNC(computer numerical control)**，他可以依照使用者的需求來進而進行高精度的作業，進而達到使用者所需要的結果。

製作動機

我們想為了一些手殘黨，也可以體驗到球體繪畫的樂趣，所以利用**Python**和 **Arduino** 組合再透過**步進馬達**與**伺服馬達**的配合，達到 **CNC**的功能，在具有弧度的球形物體的表面上進行寫字、作畫等動作。

預期成果

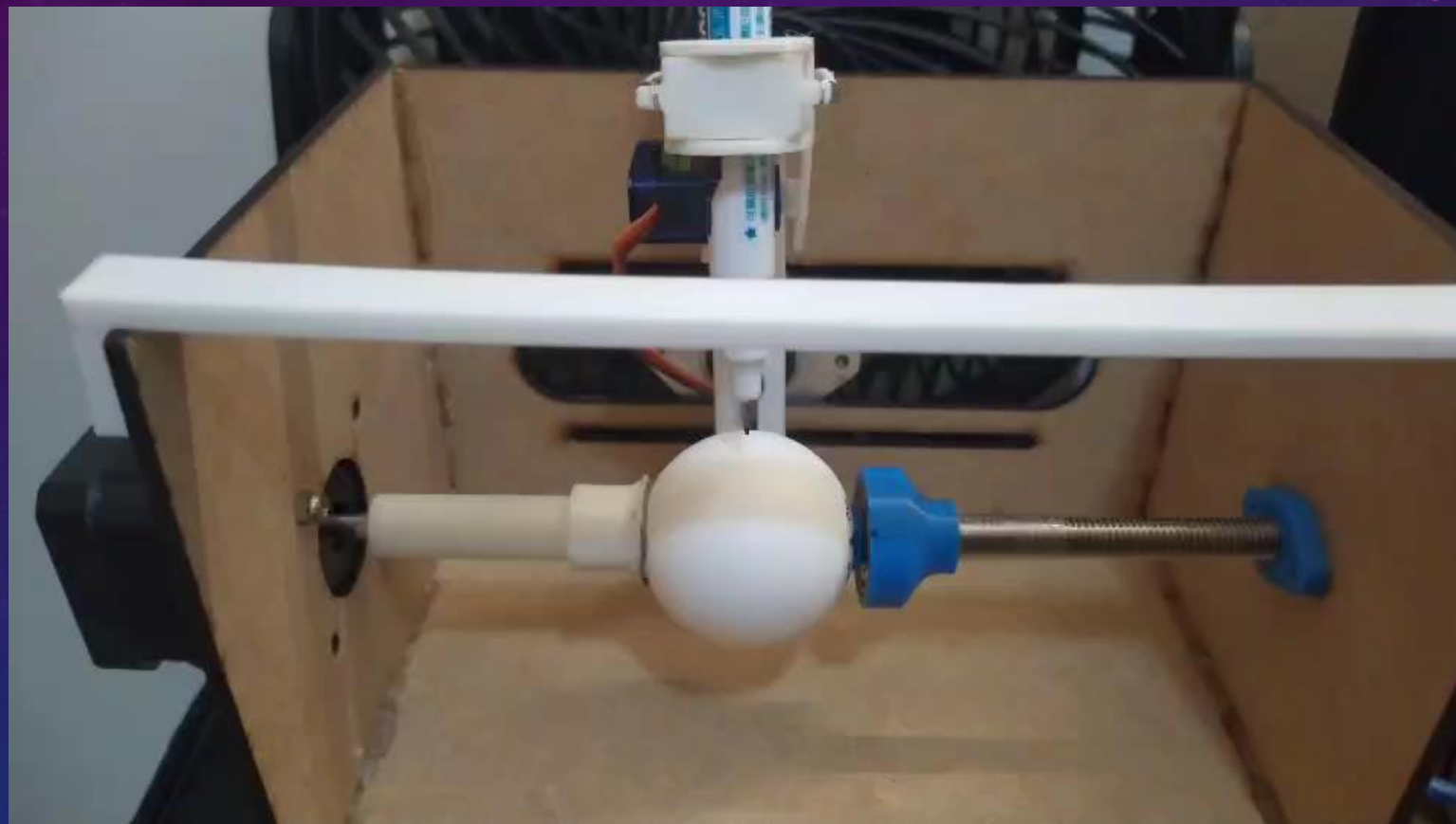
步進與伺服馬達的控制

球形物體的固定結構

簡單的寫字作畫

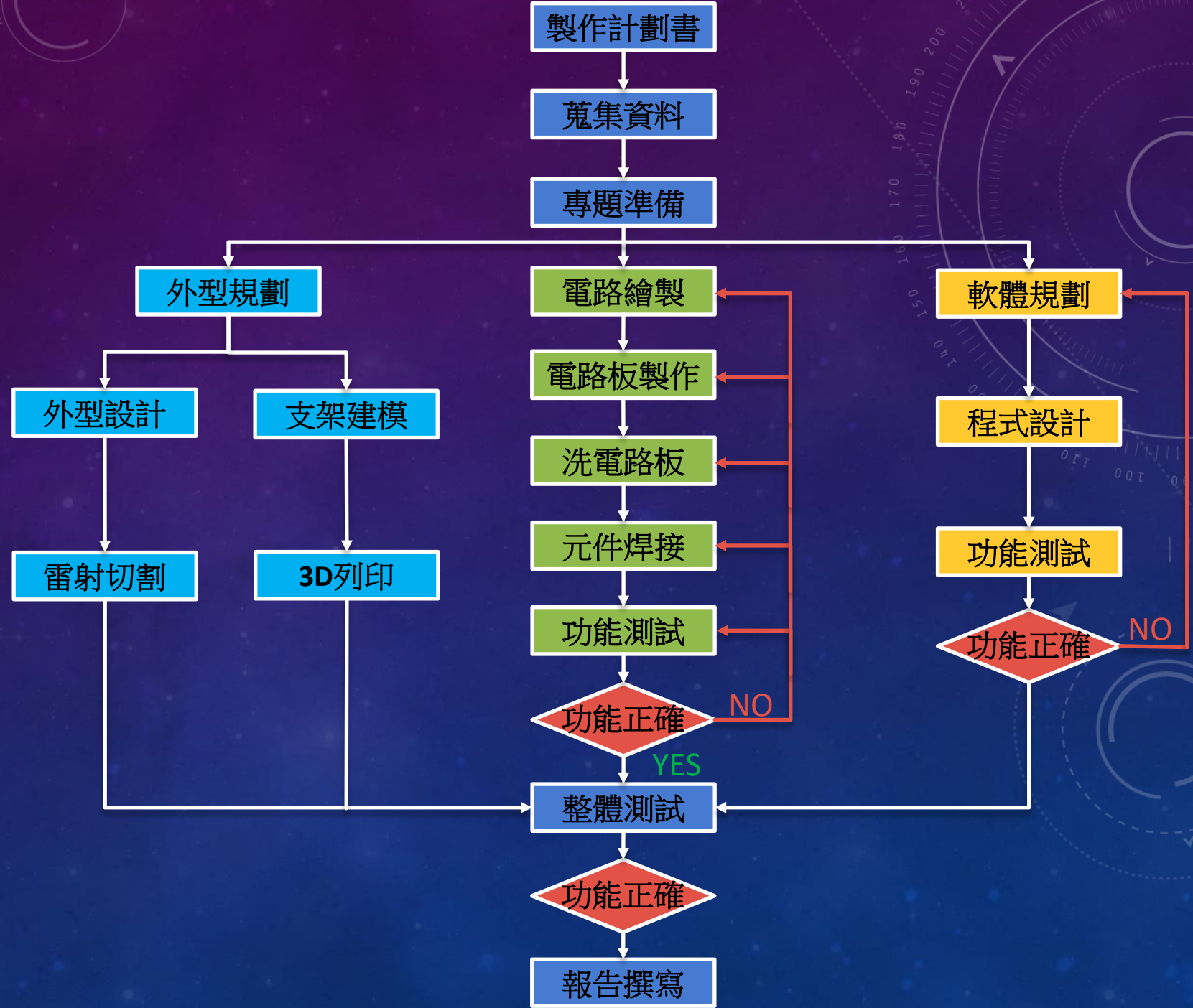
預期成果影片

一樣是我們的裝置喔
只有程式不一樣喔



製作流程

- 外型規劃
- 電路繪製
- 軟體規劃



理論探討

The background features a dark blue gradient with a subtle pattern of white stars and faint technical diagrams. On the right side, there are several circular diagrams with concentric lines and arrows, resembling a radar or a complex data visualization. The text '理論探討' is centered in a bold, yellow font.

CNC技術

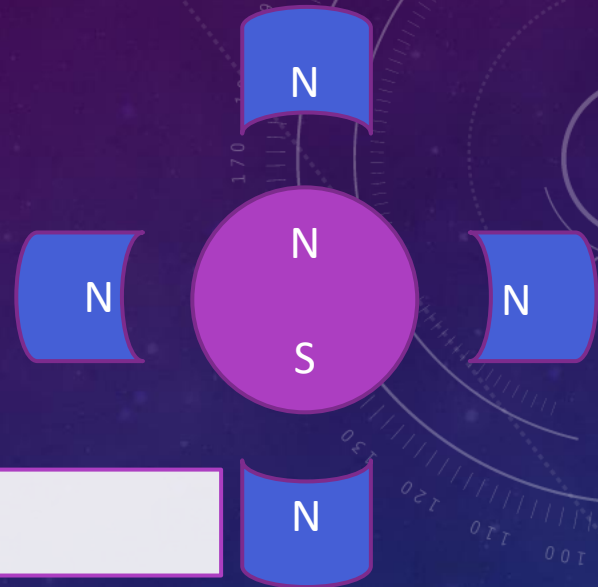
- 數值控制
- x，y方向上移動的工作檯
- 和z方向上移動的主軸
- 設計2D或3D的物件或立體圖
- 現今有使用這項技術的裝置
:車床,3D列印,雷射切割



G代碼(G CODE)

G-Code	說明
G1	直線運動
G2	順時針圓弧運動
G3	逆時針圓弧運動
G4	暫停命令
G17	選擇 XY 平面作圓弧運動
G18	選擇 XZ 平面作圓弧運動
G19	選擇 YZ 平面作圓弧運動
G90	絕對位置模式
G91	相對位置模式
G92	坐標系偏移

步進馬達



運用電流會產生磁場控制永久磁鐵吸附

高精度的定位

扭力較強

使用四相50齒的步進馬達

單向全步激磁



GRBL

The logo for GRBL, featuring the lowercase letters 'grbl' in a bold, black, sans-serif font on a white rectangular background.

針對Arduino晶片製作

類型:嵌入式G代碼編譯和運動控制器

特點:性能高，成本低等

用於:CNC雕刻

DRV8825

最高為步劃分1/32

操作電壓3.3~5V

輸出電壓45V

電流2.5A

微步控制

休眠時間

移動步數

旋轉方向



Enable

M0

M1

M2

Reset

Sleep

Step

DIR



VMOT

Gnd

B2

B1

A1

A2

Fault

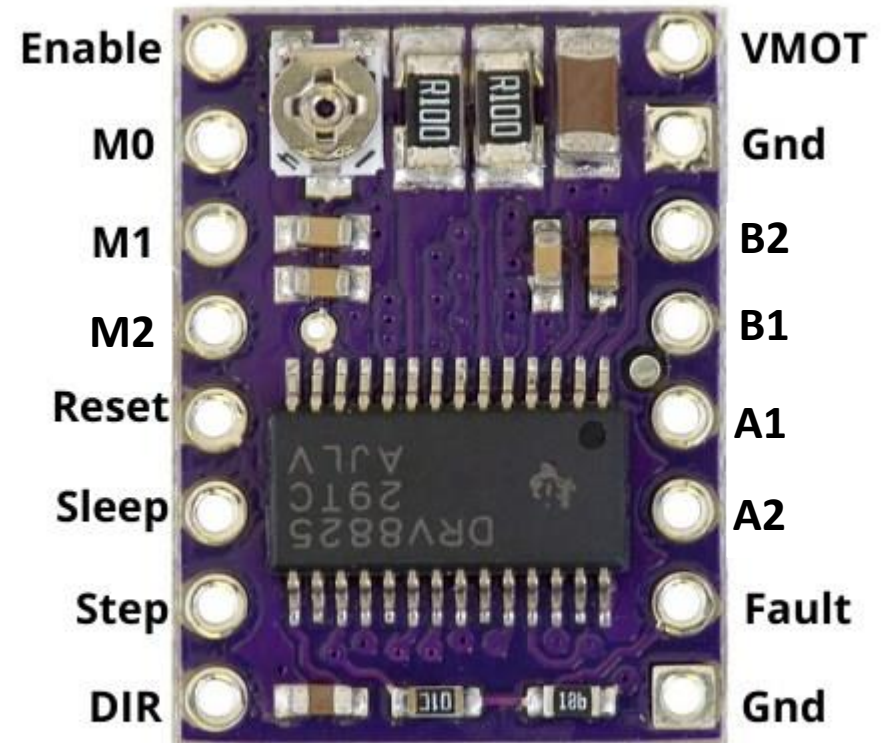
Gnd

步進馬達控制線



微步控制

M0	M1	M2	微步劃分	每圈幾步
0	0	0	1	200
1	0	0	1/2	400
0	1	0	1/4	800
1	1	0	1/8	1600
0	0	1	1/16	3200
1	0	1	1/32	6400



使用軟體



Arduino IDE

讀取GCODE
馬達控制



inkscape

生成GCODE



使用者介面
傳輸GCODE

專題設計

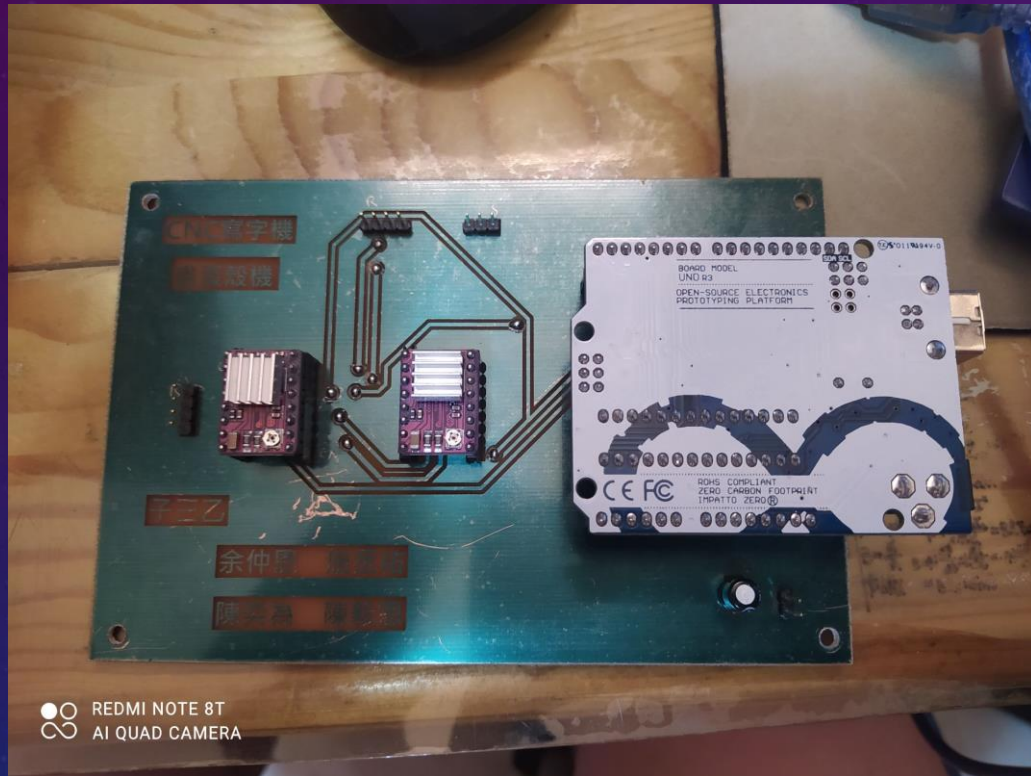
The background is a dark blue gradient with a subtle pattern of white stars and technical diagrams. On the right side, there are several circular diagrams: a large one with a scale from 0 to 210 degrees and an arrow pointing left, and a smaller one below it with a dashed circle and an arrow pointing right. In the bottom left corner, there is another diagram with a dashed circle and an arrow pointing left. The overall aesthetic is clean, modern, and technical.

運作結構圖

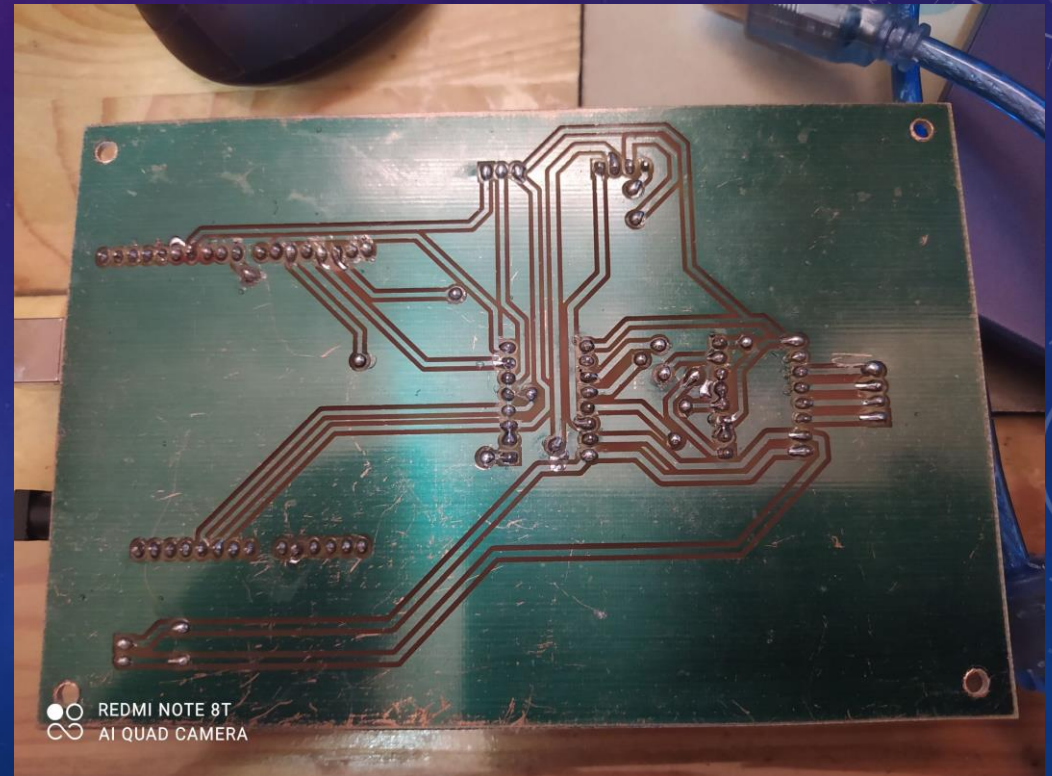


硬體

The background is a dark blue gradient with a subtle pattern of small white dots. On the right side, there are several technical diagrams. One is a large circular gauge with a scale from 0 to 210 and a white needle pointing to approximately 190. Another is a smaller circular gauge with a scale from 0 to 100 and a white needle pointing to approximately 80. There are also dashed lines and arrows indicating movement or flow.

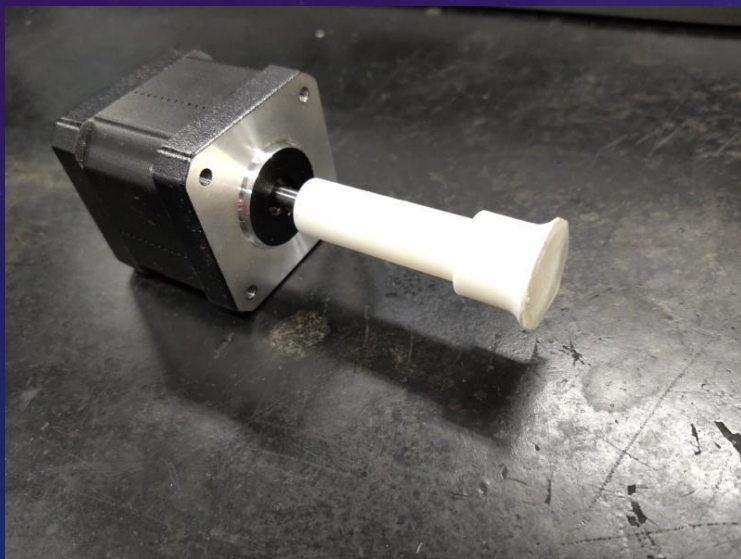
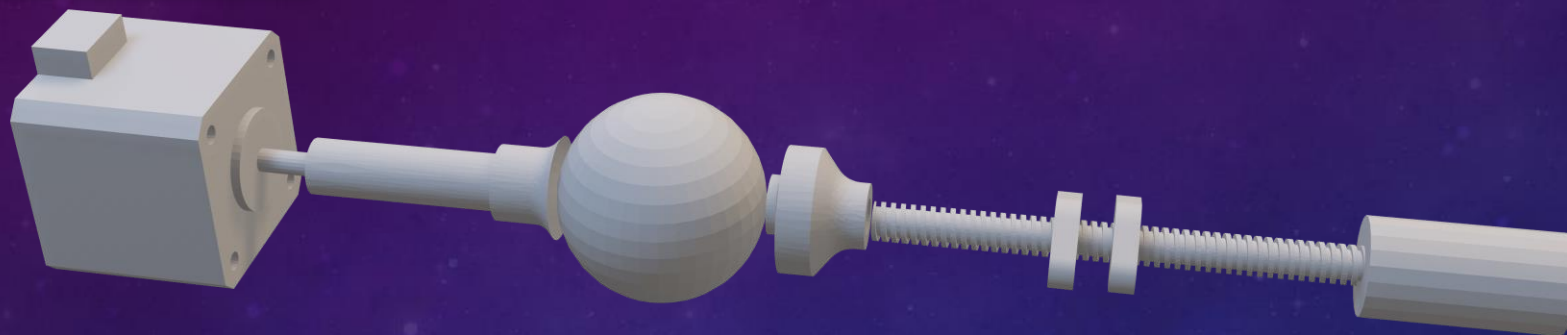


● ○ REDMI NOTE 8T
● ○ AI QUAD CAMERA

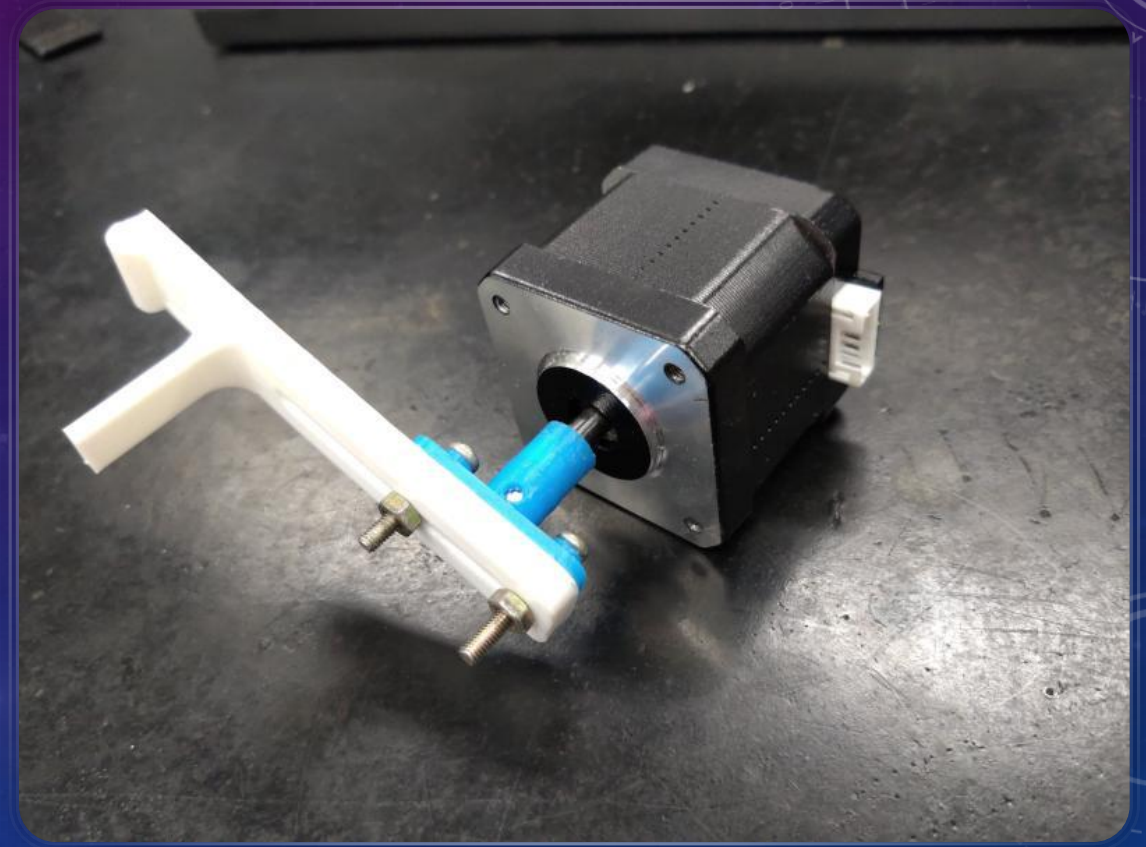
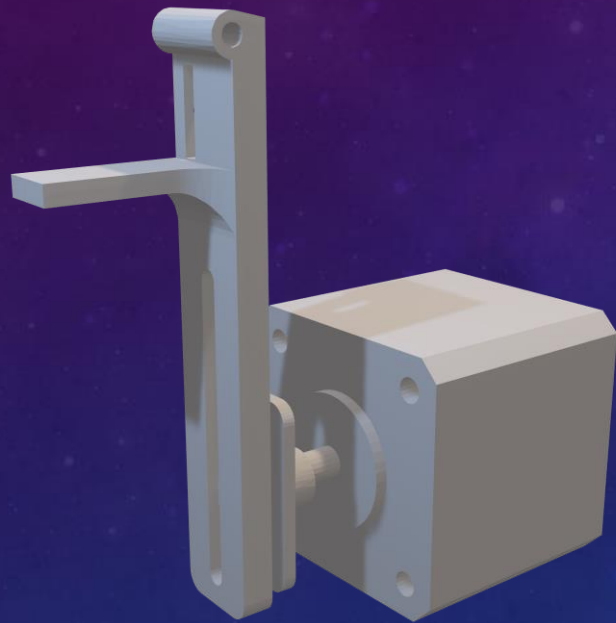


● ○ REDMI NOTE 8T
● ○ AI QUAD CAMERA

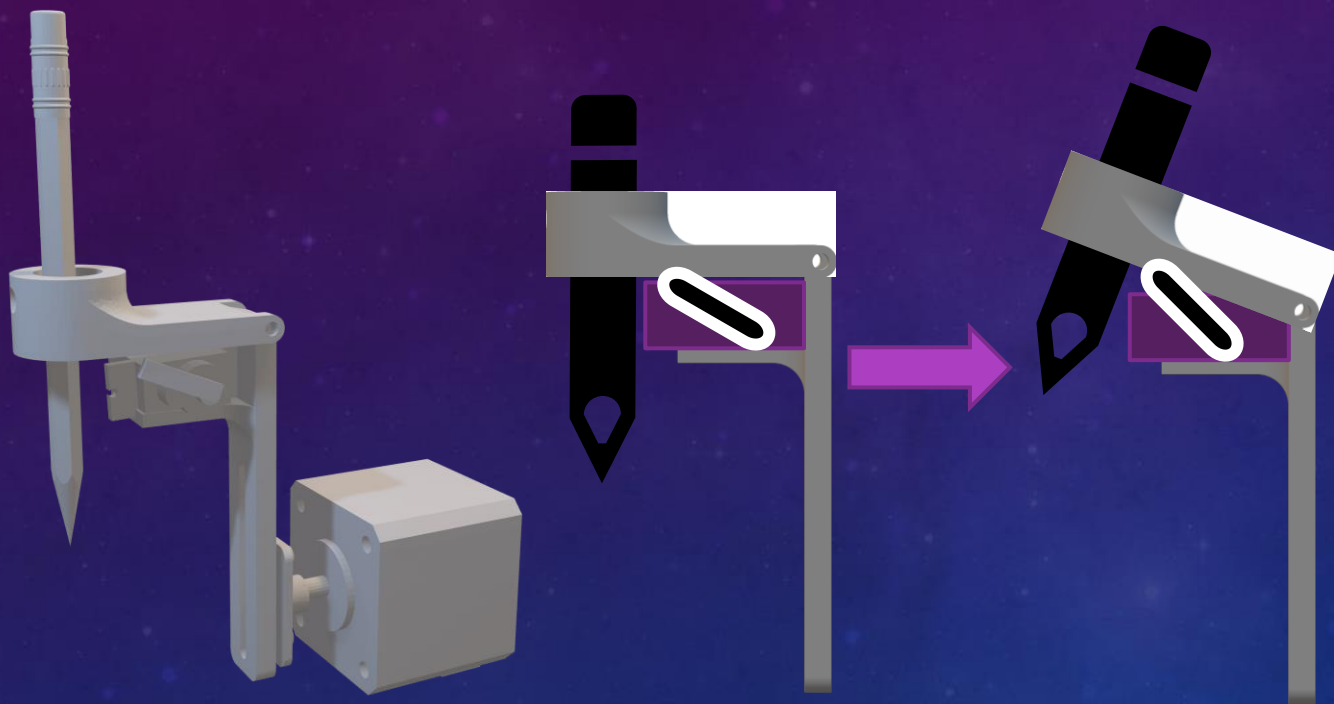
轉蛋結構(X軸)



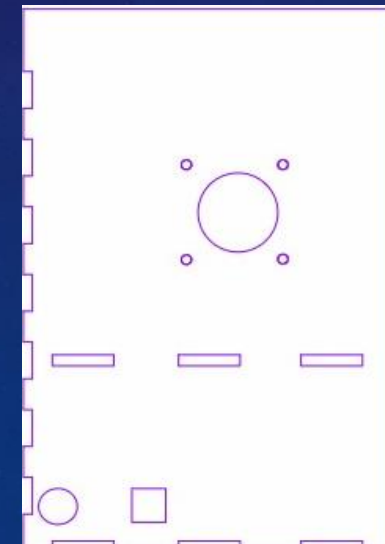
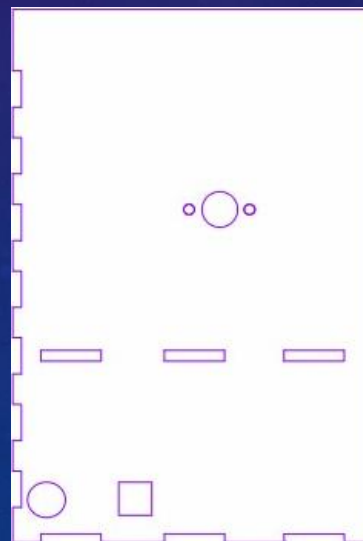
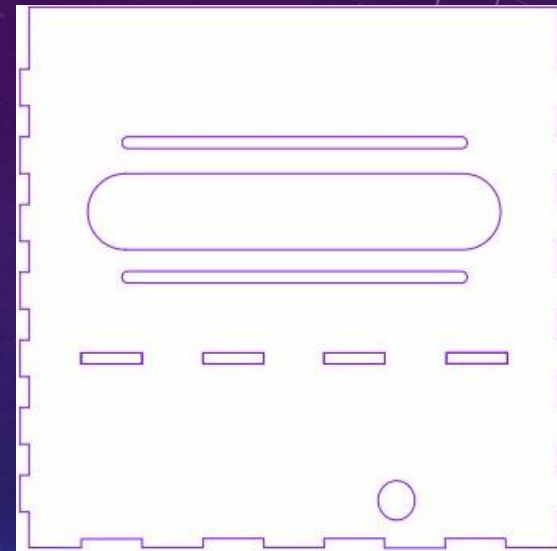
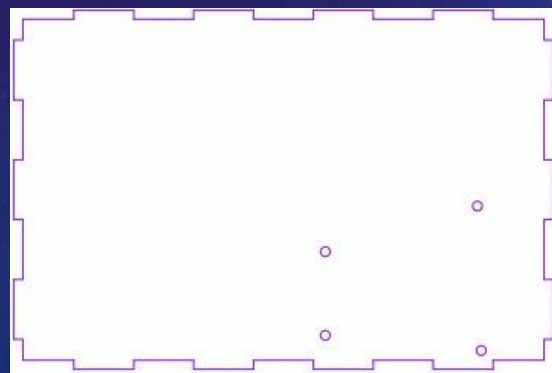
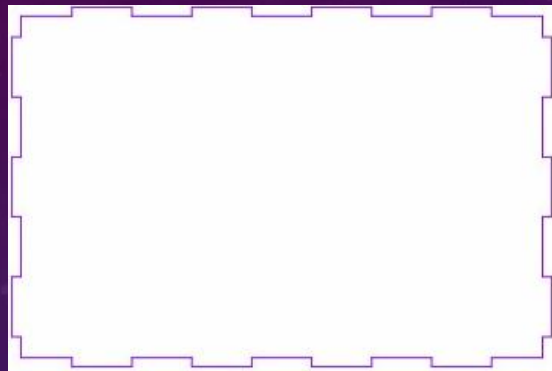
轉筆結構 (Y軸)



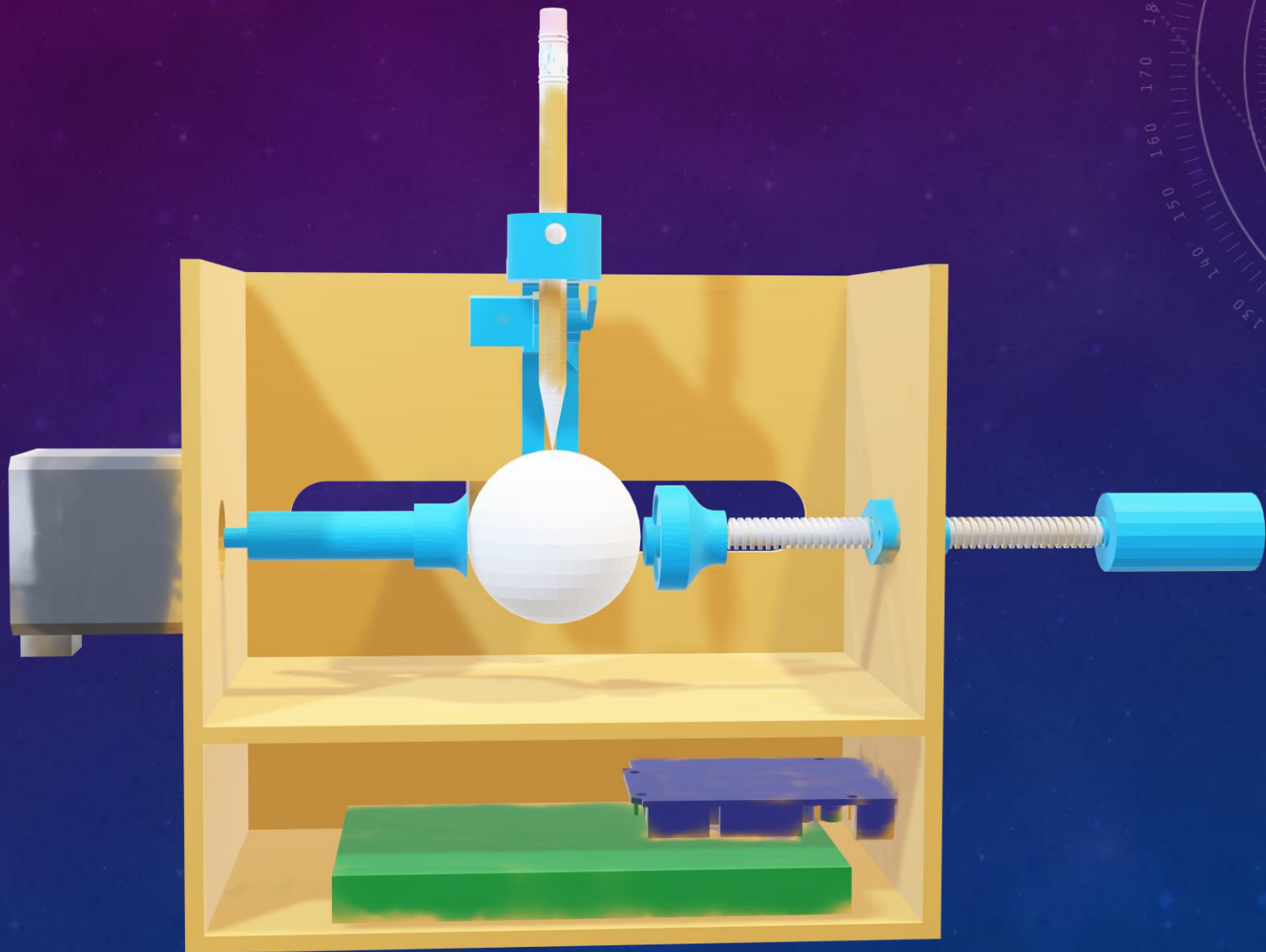
抬/放筆結構



雷射切割



完整3D圖



軟體

The background is a dark blue gradient with a subtle pattern of small white dots. It features several technical-style graphics: a large circular gauge with numerical markings (100, 110, 120, 130, 140, 150, 160, 170, 180, 190, 200, 210) and a dashed arrow pointing counter-clockwise in the upper right; a smaller circular gauge with a dashed arrow pointing clockwise in the lower right; and a circular gauge with a dashed arrow pointing clockwise in the lower left. The Chinese characters '軟體' (Software) are centered in a bold, yellow font.

讀取GCODE

```
//讀取Gcode
    if(c=='G'){ //如果有讀到G
        get_G=true;
    }
    if(get_G==true){
        int Gcmd=Serial.parseInt(); //讀取G後面的第一個數值
        if(Gcmd==1){ //G1 直線運動
            x1= Serial.parseFloat();
            y1= Serial.parseFloat();
            Ready_G1=1; //得到dx dy
            if(x1>20||y1>1){ //大於蛋的大小了
                Ready_G1=0;
            }
        }
    }
}
```

G1 X0. Y0.

數值為1
採直線運動

判斷馬達順逆

```
//計算x,y移動量
dx=delta(x0,x1);           //x分量
dy=delta(y0,y1);           //y分量

if(dx>0){                   //正數=>順時針
    dirX=1;
}else if(dx<0){             //負數=>逆時針
    dirX=0;
}else{
    dx_is_0=1;              //移動量是0
}

if(dy>0){
    dirY=1;
}else if(dy<0){
    dirY=0;
}else{
    dy_is_0=1;
}

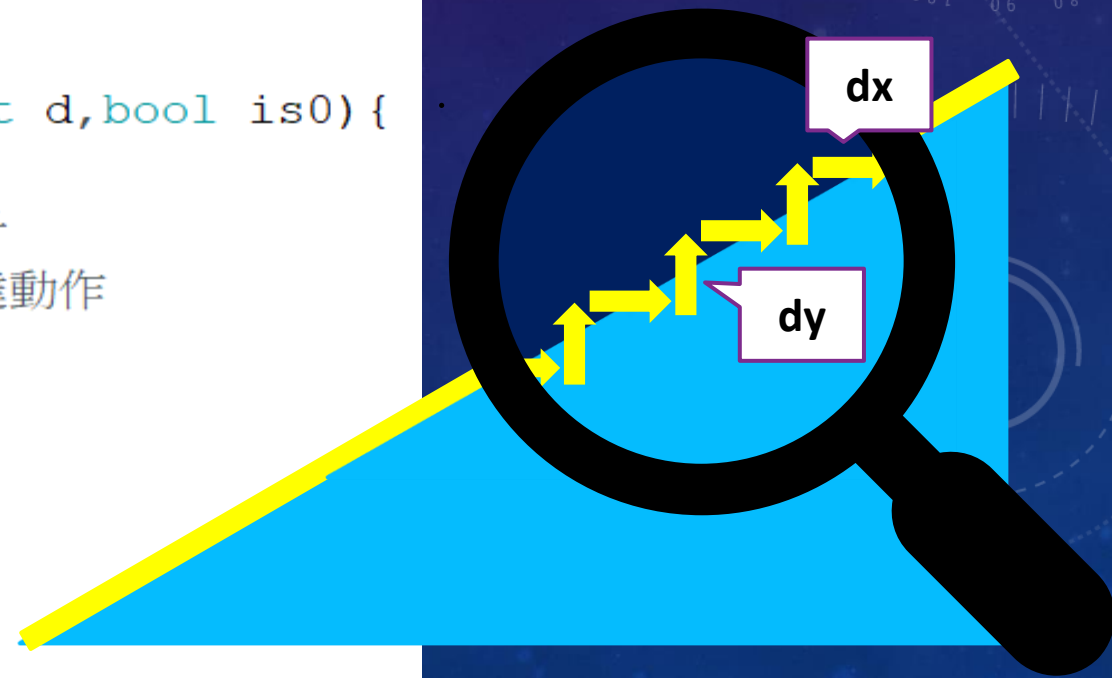
dx=abs(dx);                 //移動的量為正數
dy=abs(dy);
```

>0 : 順時針
<0 : 逆時針
=0 : 禁用馬達

馬達動作

```
//動作
digitalWrite(enable,LOW); //啟用馬達
for(int p=0;p<35;p++){
    Move(dir_x,step_x,dirX,dx,dx_is_0); //x軸馬達動作
    Move(dir_y,step_y,dirY,dy,dy_is_0); //y軸馬達動作
}

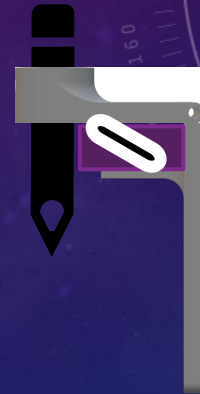
//步進馬達動作
void Move(int dirpin,int stppin,int dir,float d,bool is0){
    if(is0==false){
        digitalWrite(dirpin,dir); //順逆時針
        for(int o=0;o<d*10;o++){ //步進馬達動作
            digitalWrite(stppin,HIGH);
            delayMicroseconds(800);
            digitalWrite(stppin,LOW);
            delayMicroseconds(800);
        }
    }
}
```



抬筆/放筆

```
//伺服馬達抬筆放筆
if(c=='M'){ //如果讀到M
  int Mcmd=Serial.parseFloat(); //讀取M後面的一個數值
  if(Mcmd==3){
    Serial.println("PEN DOWN");
    penservo.write(45); //M03放筆(45度)
    delay(500);
  }else if(Mcmd==5){
    Serial.println("PEN UP");
    penservo.write(0); //M05抬筆(0度)
    delay(500);
  }
}
```

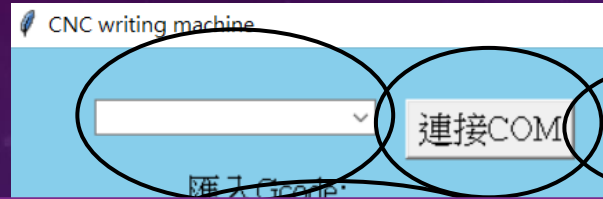
M03



M05



使用者介面



```
def square():  
    global run  
    global line  
    global lines  
    global cnt  
    global row  
    global ser
```

逐行顯示gcode
以及顯示各種指令

```
run=True  
cnt=0  
row=0
```

```
def stop():  
    global run
```

```
def resume():  
    global run
```

```
def cancel():  
    global cnt  
    global row  
    cnt=row  
    print('取消傳輸')  
    btn_resume['state']=DISABLED  
    btn_stop['state']=NORMAL  
    display['state']=NORMAL  
    display.insert(END, '取消傳輸')  
    display.insert(END, '\n')  
    display.yview_moveto(1)  
    display['state']=DISABLED
```

```
def string_transmit():  
    global run  
    global row  
    global cnt  
    global ser  
  
    if (cnt<row):  
        if (cnt<row) and (run == True) :  
            ser.write(lines[cnt].encode('unicode_escape'))  
            print(lines[cnt])  
            display['state']=NORMAL  
            display.insert(END, lines[cnt])  
            display.insert(END, '\n')  
            display.yview_moveto(1)  
            display['state']=DISABLED  
            cnt=cnt+1  
  
            # time.sleep(2)  
            window.after(2000, string_transmit)
```


專題成果

影片展示



各位同學!

今天的課就到這邊

CyberLink
PowerDirector



成果展示

遇到的問題與解決辦法

1. 無法傳輸gcode檔案
2. 固定球體結構不夠穩定
3. 夾筆的裝置容易晃動



解決辦法

1. 解決辦法:

起初因為不知道要將**gcode**先轉換成**unicode**的型態來轉換所以卡了很長一段時間，而且**python 2**和**python 3**的轉換方式又不同所以出現了不少的問題

2. 解決辦法:

我們在夾蛋的兩側加上防滑片

3. 解決辦法:

我們修改了原本夾筆的結構把旁邊加裝了彈簧

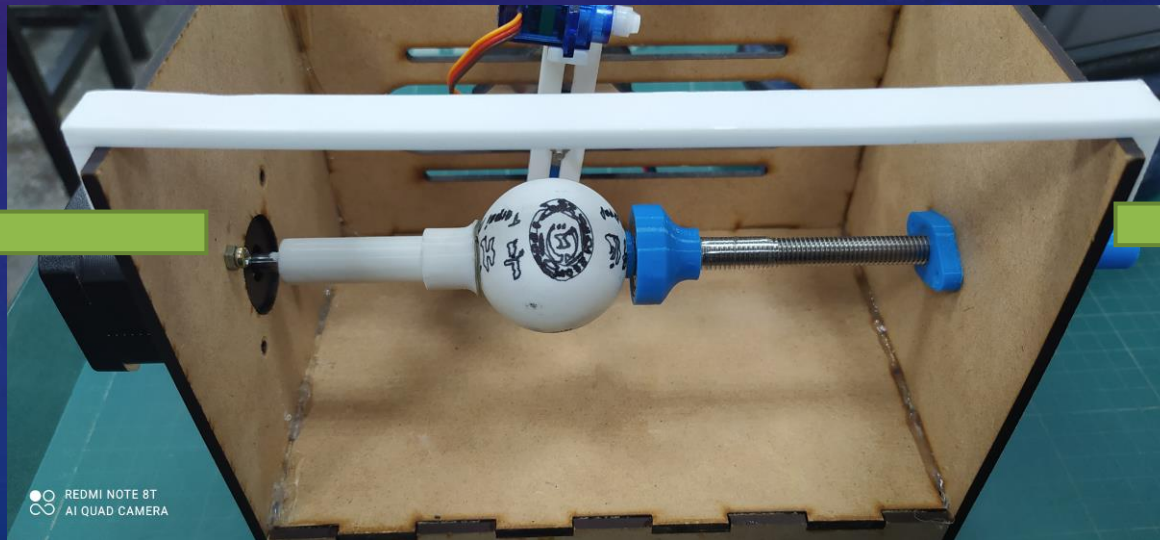
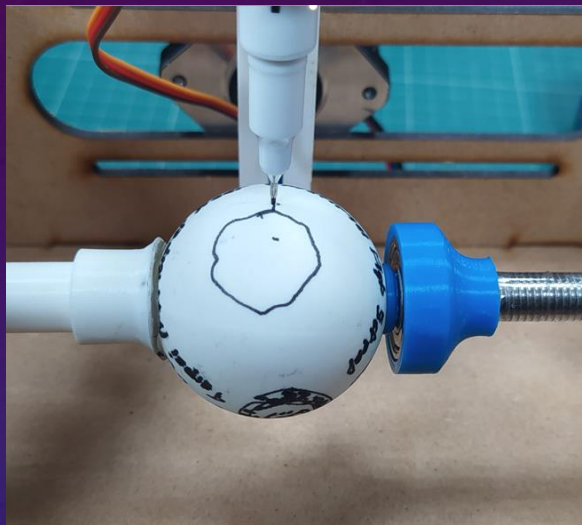


結論



再改進的地方

- 能夠畫出弧線
- 定位更精準
- 機殼選材要在改善



未來展望



可以加入畫弧線的功能以便我們可以畫更多的東西



Bluetooth

可以使用藍芽傳輸gcode給Arduino直接動作

Q&A

The background is a dark blue gradient with a subtle pattern of white stars and technical diagrams. On the right side, there are several circular diagrams. One large diagram features concentric circles with tick marks and numerical labels (100, 110, 120, 130, 140, 150, 160, 170, 180, 190, 200, 210) around its perimeter. Other diagrams include dashed lines, solid lines, and arrows, suggesting a technical or scientific theme.



THE END

謝謝大家