Final Report – Little WALK

Design and Practices of Embedded Systems

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Agenda

- Concept
- Objects
- Program
- UI
- Demo
- References

Concept

- 8x8 LED Display:
  a 2x2 block at the center of the LED matrix (the robot).
- Ultrasonic Sensor:
  Implement distance measurement and obstacle avoidance functionality.
  The robot's behavior will depend on whether an obstacle is detected.
- LCD Display Emotion:
  on the LCD based on its status (happy or sad).

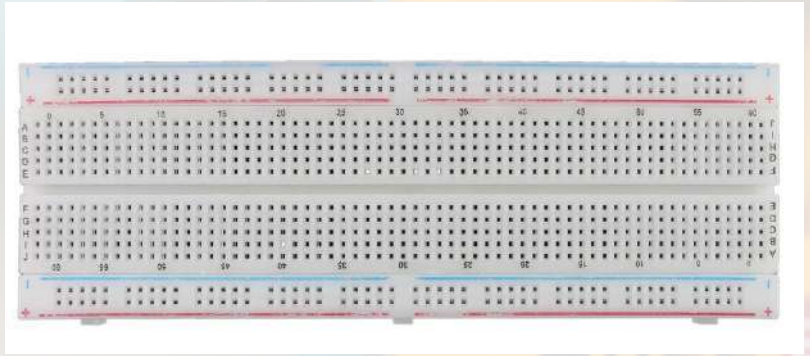
Concept

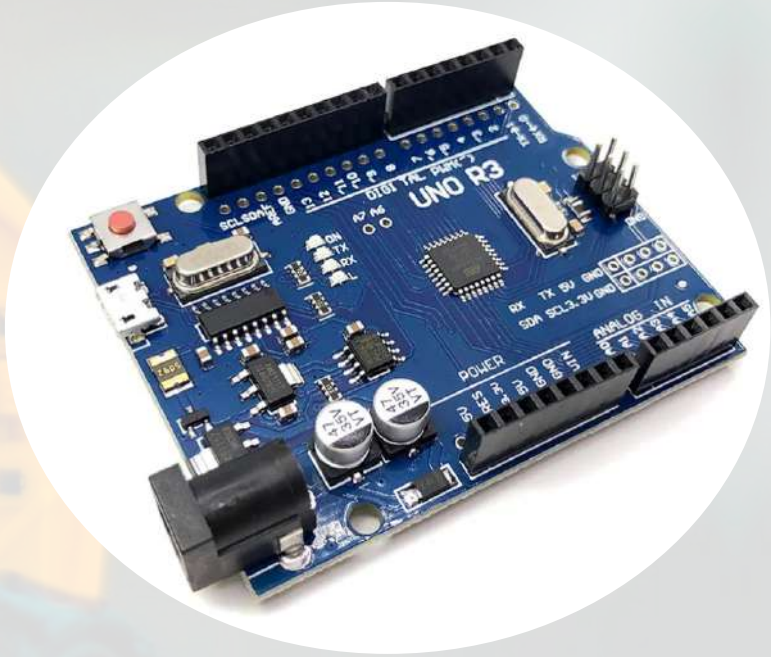
- **Control Method:**
  manual control of the robot’s movement
  (forward, backward, left turn, right turn).
  will continue executing the chosen command until it hits an obstacle and bounces back, with its current state continuously displayed.
- **State Management:**
  Use variables to track the robot's current state (e.g., moving, avoiding obstacles).
  Trigger corresponding functions based on the robot’s status.
- **Distance Data Logging:**
  When the ultrasonic sensor returns distance data, it will be logged and available for user query.

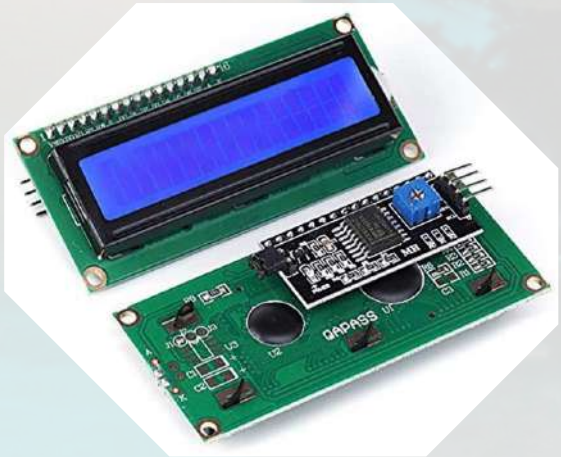
Concept - PyQt

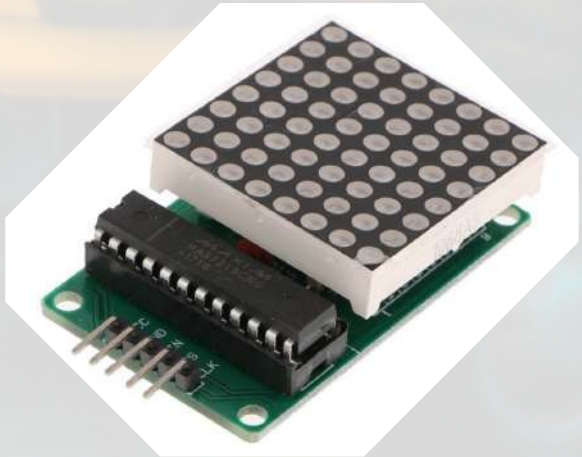
- Select robot’s movement
  (forward, backward, left turn, right turn).
- Control whether to stop the robot’s activity.
- Query current distance data.
- Restart the device.

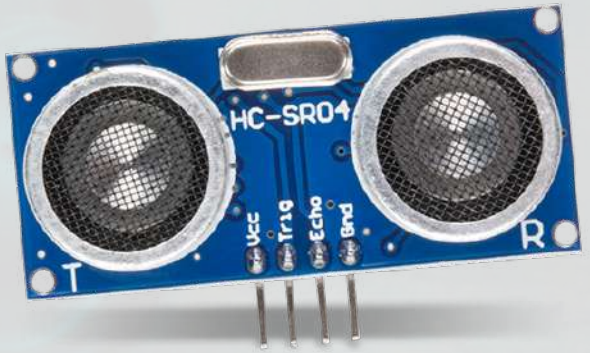
Objects







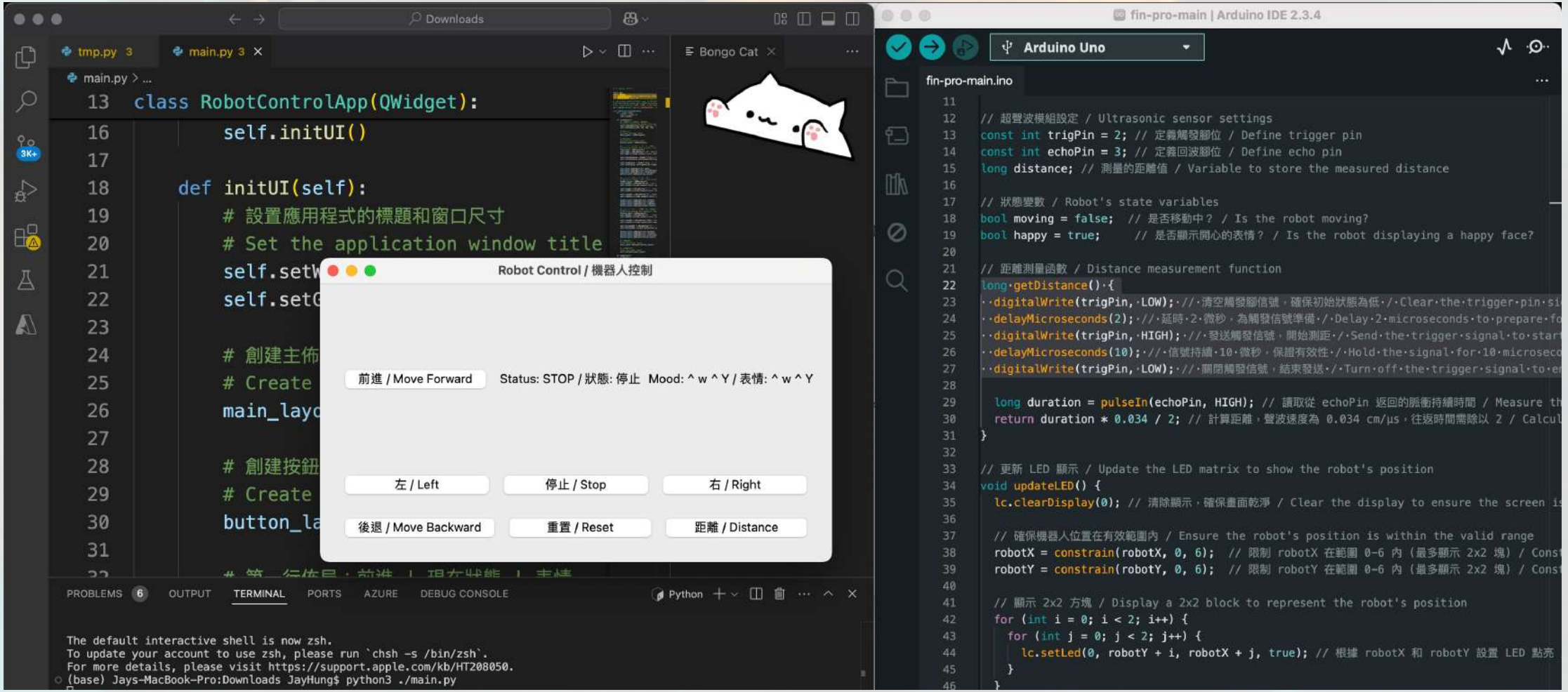




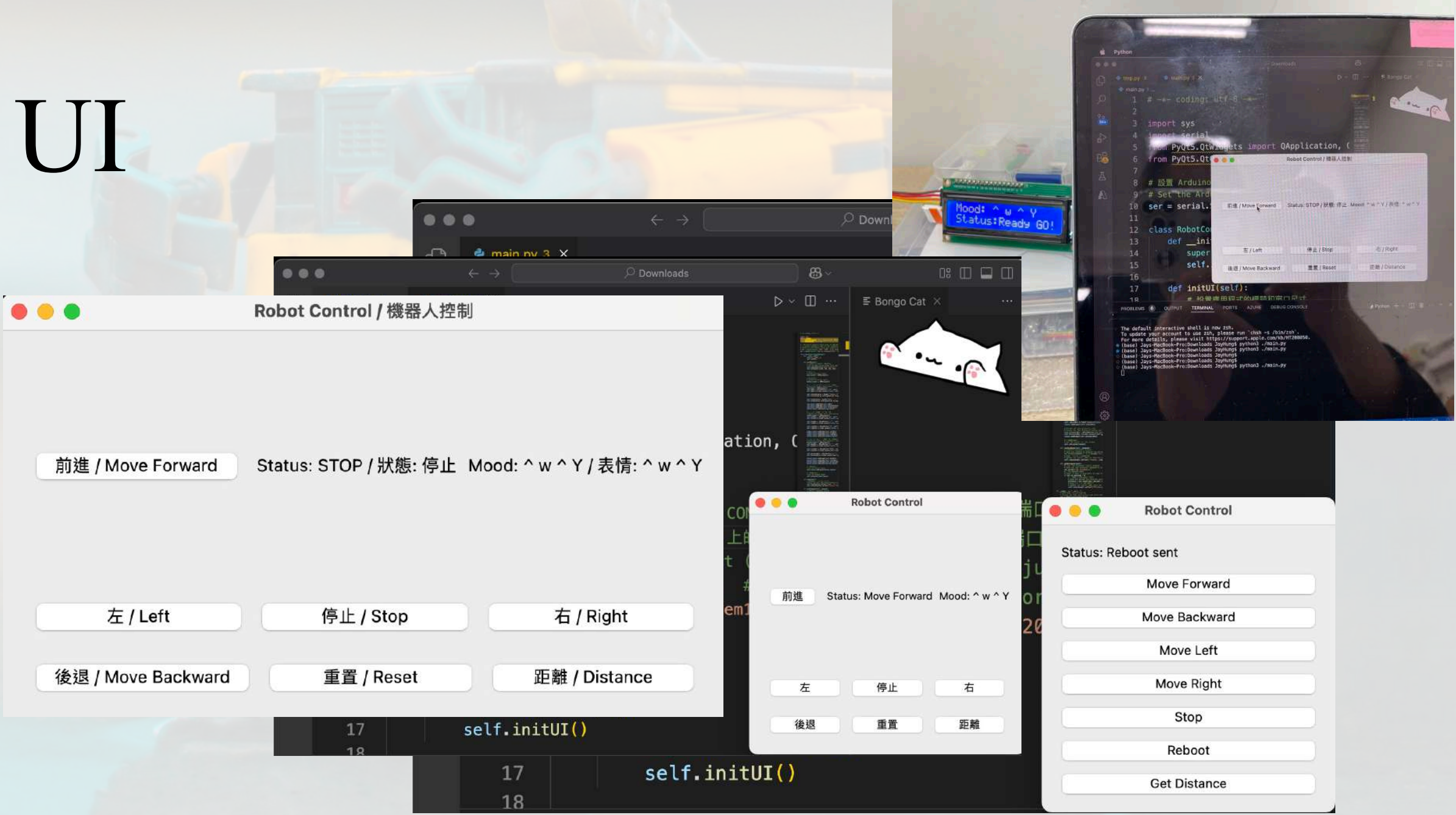
Objects

Component	Pin	Arduino Pin	Description
HC-SR04	**Trig**	Pin 2	Trigger pin for initiating distance measurement
	Echo	Pin ~3	Echo pin for receiving reflected signal
	VCC	5V	Power supply for the ultrasonic sensor
	GND	GND	Ground connection for the ultrasonic sensor
I2C LCD Display	**SDA**	A4	I2C Data line for communication
	SCL	A5	I2C Clock line for communication
	VCC	5V	Power supply for the LCD
	GND	GND	Ground connection for the LCD
MAX7219 8x8 LED Matrix	**DIN**	Pin ~11	Data input pin for sending data to the LED matrix
	CLK	Pin 13	Clock signal for data transfer to LED matrix
	CS	Pin ~10	Chip select pin to enable the LED matrix
	VCC	5V	Power supply for the LED matrix
	GND	GND	Ground connection for the LED matrix

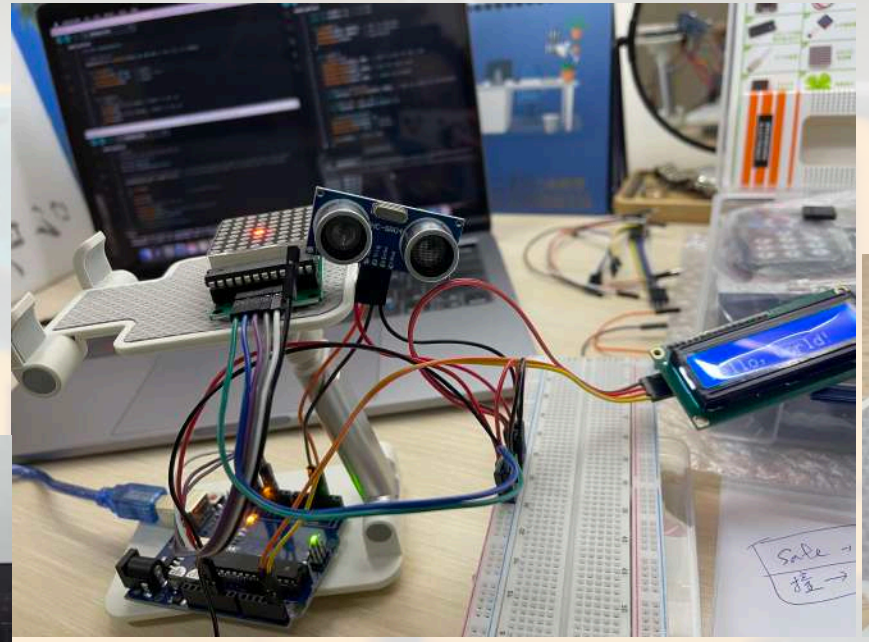
Program

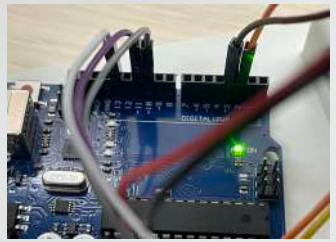

Downloads
tmp.py 3
main.py 3
Bongo Cat
main.py > ...
13 class RobotControlApp(QWidget):
16 self.initUI()
18 def initUI(self):
19 # 設置應用程式的標題和窗口尺寸
20 # Set the application window title
Robot Control / 機器人控制
前進 / Move Forward
Status: STOP / 狀態: 停止 Mood: ^ w ^ Y / 表情: ^ w ^ Y
左 / Left
停止 / Stop
右 / Right
後退 / Move Backward
重置 / Reset
距離 / Distance
PROBLEMS 6 OUTPUT TERMINAL PORTS AZURE DEBUG CONSOLE
Python
The default interactive shell is now zsh.
To update your account to use zsh, please run `chsh -s /bin/zsh`.
For more details, please visit https://support.apple.com/kb/HT208050.
(base) Jays-MacBook-Pro:Downloads JayHung$ python3 ./main.py
fin-pro-main | Arduino IDE 2.3.4
Arduino Uno
fin-pro-main.ino
// 超聲波模組設定 / Ultrasonic sensor settings
const int trigPin = 2; // 定義觸發腳位 / Define trigger pin
const int echoPin = 3; // 定義回波腳位 / Define echo pin
long distance; // 測量的距離值 / Variable to store the measured distance
// 狀態變數 / Robot's state variables
bool moving = false; // 是否移動中？ / Is the robot moving?
bool happy = true; // 是否顯示開心的表情？ / Is the robot displaying a happy face?
// 距離測量函數 / Distance measurement function
long getDistance() {
digitalWrite(trigPin, LOW); // 清空觸發腳信號，確保初始狀態為低 / Clear the trigger pin si
delayMicroseconds(2); // 延時 2 微秒，為觸發信號準備 / Delay 2 microseconds to prepare fo
digitalWrite(trigPin, HIGH); // 發送觸發信號，開始測距 / Send the trigger signal to start
delayMicroseconds(10); // 信號持續 10 微秒，保證有效性 / Hold the signal for 10 microseco
digitalWrite(trigPin, LOW); // 關閉觸發信號，結束發送 / Turn off the trigger signal to en
long duration = pulseIn(echoPin, HIGH); // 讀取從 echoPin 返回的脈衝持續時間 / Measure th
return duration * 0.034 / 2; // 計算距離，聲波速度為 0.034 cm/μs，往返時間需除以 2 / Calcul
}
// 更新 LED 顯示 / Update the LED matrix to show the robot's position
void updateLED() {
lc.clearDisplay(0); // 清除顯示，確保畫面乾淨 / Clear the display to ensure the screen is
// 確保機器人位置在有效範圍內 / Ensure the robot's position is within the valid range
robotX = constrain(robotX, 0, 6); // 限制 robotX 在範圍 0-6 內（最多顯示 2x2 塊） / Const
robotY = constrain(robotY, 0, 6); // 限制 robotY 在範圍 0-6 內（最多顯示 2x2 塊） / Const
// 顯示 2x2 方塊 / Display a 2x2 block to represent the robot's position
for (int i = 0; i < 2; i++) {
for (int j = 0; j < 2; j++) {
lc.setLed(0, robotY + i, robotX + j, true); // 根據 robotX 和 robotY 設置 LED 點亮
}
}

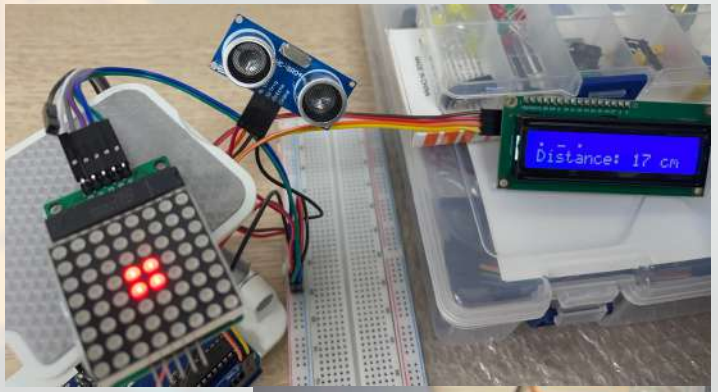
UI

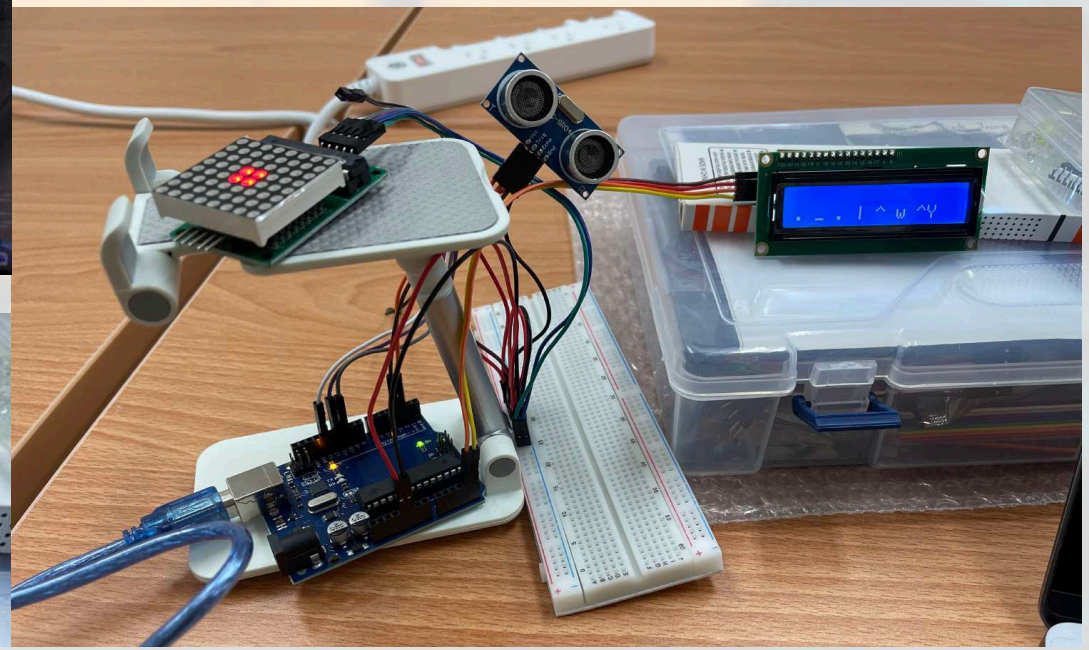

Mood: ^ w ^ Y
Status:Ready GO!
Robot Control / 機器人控制
前進 / Move Forward
Status: STOP / 狀態: 停止 Mood: ^ w ^ Y / 表情: ^ w ^ Y
左 / Left
停止 / Stop
右 / Right
後退 / Move Backward
重置 / Reset
距離 / Distance
Bongo Cat
self.initUI()
Robot Control
前進
Status: Move Forward Mood: ^ w ^ Y
左
停止
右
後退
重置
距離
Robot Control
Status: Reboot sent
Move Forward
Move Backward
Move Left
Move Right
Stop
Reboot
Get Distance

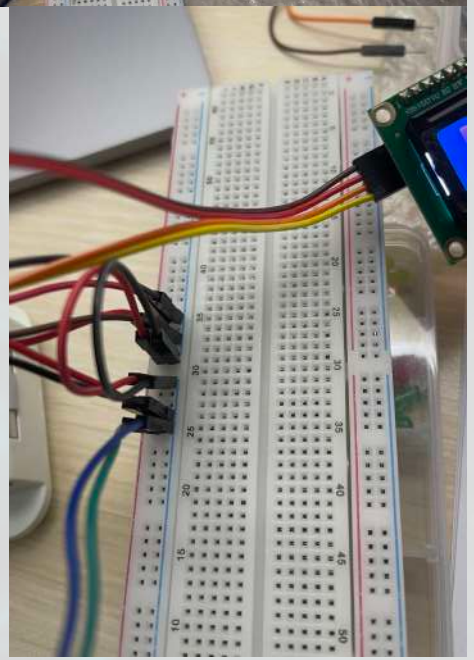
Demo











References

- Class Learn - Arduino ＆ PyQt
- “Arduino 互動式設計入門”
  by 趙英傑 Course materials from 旗標 Official
- Web data
- YouTube

Thank you for listening

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