

## 2026仰望盃全國科學 HomeRun 實作大賽

### 複賽作品說明書

隊伍名稱： 電路水探隊

---

作品名稱： 次元水質解析核心

---

科學概念1： 阿倫尼烏斯理論。

阿倫尼烏斯理論主要包含兩個方面：一是酸鹼理論，認為酸是水中能解離出  $H^+$  的化合物，鹼是水中能解離出  $OH^-$  的化合物；二是電離理論，認為電解質溶於水會自動解離成離子，且離子越多，溶液導電性越強，溶液越稀則電離度越大。此外，阿倫尼烏斯也提出了阿倫尼烏斯公式，用來描述化學反應速率常數與溫度之間的關係。

---

科學概念2： 布倫斯惕-洛瑞理論

是一種酸鹼理論，由丹麥化學家約翰內斯·布朗斯特和英國化學家托馬斯·洛瑞在1923年獨立提出。該理論的核心觀點是：酸是提供質子  $H^+$  的物質，鹼是接受質子  $H^+$  的物質。酸和鹼的反應被定義為質子從酸轉移到鹼的過程，且酸和鹼成對出現，形成共軛酸

---

驗對。

註：複賽作品說明書內文總頁數最多4頁(不含本封面)，請勿寫上可辨識學校名稱之資訊。

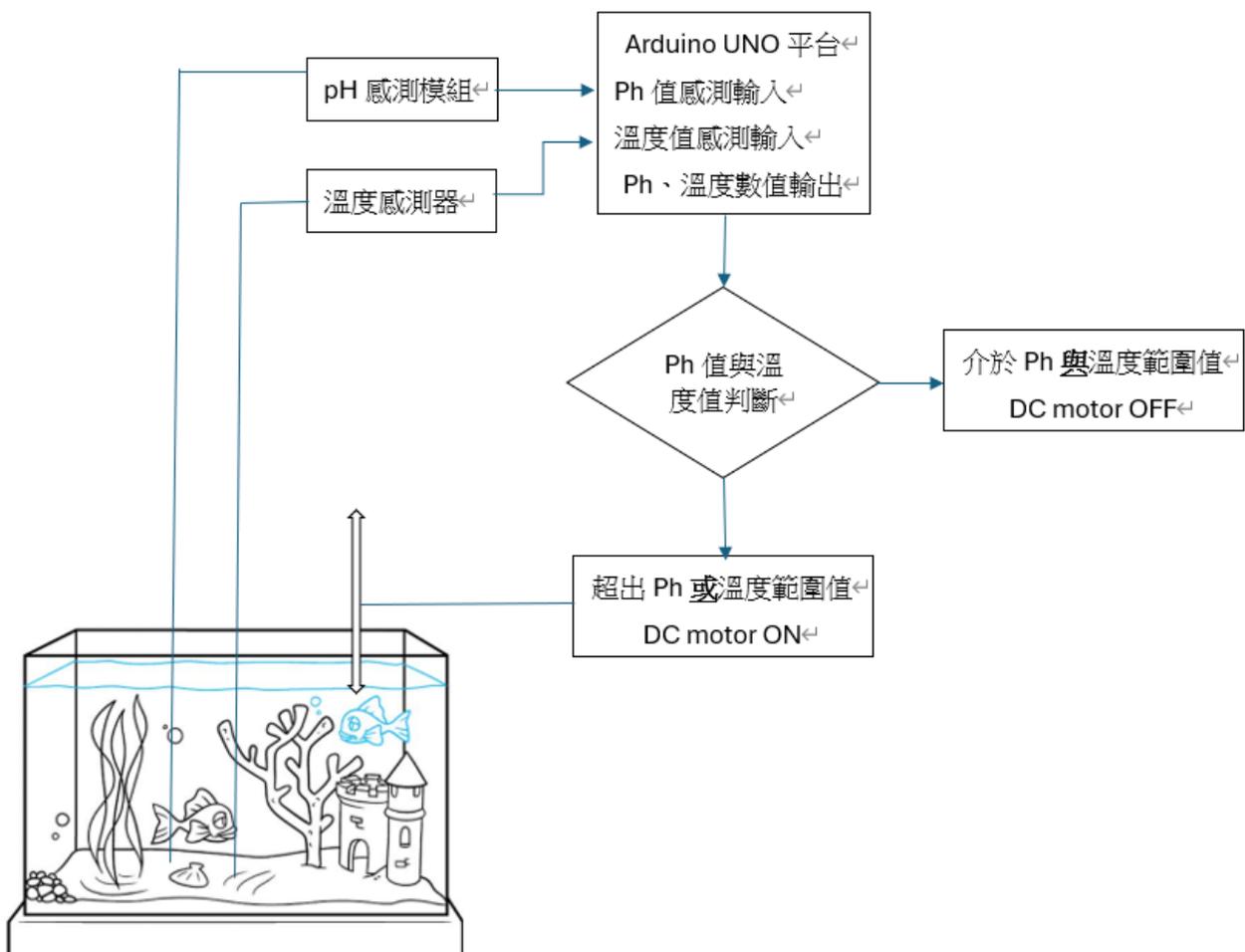
# 複賽作品說明書內文

(最多4頁)

## 1. 研究目的：

現代社會中想養魚的人不在少數，但繁忙的生活使人難照顧，長期的打氧也使電費的問題對於上班族來說是個負擔，於是利用開發板來監督水質就可以判斷出是否要換水或打氧，透過程式控制馬達打水，讓馬達不需要整日運作也能供給魚群足夠的氧氣，還能減少不必要的能源消耗，從中達到省錢及成本的效果。

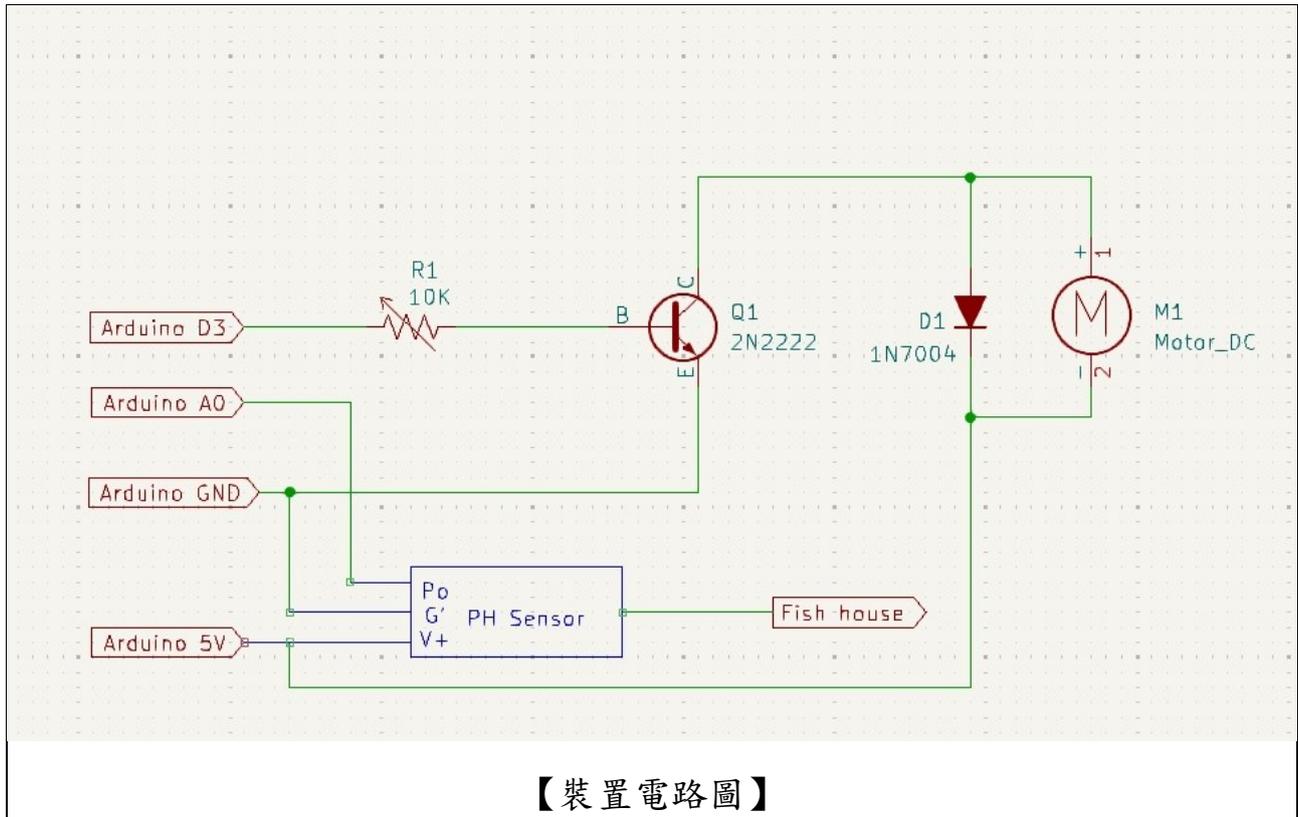
## 2. 裝置架構圖：



## 3. 作品成果說明：(可透過圖表或照片說明之)

本作品使用 Arduino 控制板以及 ph\_Sensor 與檢測棒並用程式來控制，當魚缸裡的 ph 值低於6.95時，馬達就會啟動利用打水來進行氧氣交換使水中含氧量

增加直到 pH 值達到7便會停下並持續測量 pH 值，待 pH 值再次下降到預設值馬達就會作動，藉由此循環使融液中的物質均勻分布而調整 pH 值。



```

0227
const int pHPin = A0;
const int motorPin = 3; // 馬達控制腳

int buf[20];
int temp;
unsigned long avgValue;

float pHValue;
float voltage;
float calibrationOffset = 0;

// ===== 抗干擾 =====
float lastValidPH = 7.0;
float lastVoltage = -1;
float smoothPH = 7.0;

const int STABLE_READS = 2;
const float THRESHOLD = 0.12; // 放寬電壓穩定判斷

// ===== pH 控制範圍 =====
float lowerLimit = 6.95; // pH < 6.95 → 馬達啟動
float upperLimit = 7.05; // pH ≥ 7.05 → 馬達停止
bool ledState = false;

void setup() {
  上傳完畢。
  草稿碼使用了 5410 bytes (16%) 的程式儲存空間。上限為 3225
  全域變數使用了 569 bytes (27%) 的動態記憶體，剩餘 1479 by

```

```

Voltage = 1.222 V | pH = 7.84 | Status = Alkaline | Motor = OFF
=== Gravity V2 pH Sensor Motor Test Version ===
Place electrode in pH 6.86 solution...
Voltage in pH6.86 = 1.218 V
Calibration offset = 13.805
Calibration complete.
Voltage = 1.218 V | pH = 6.99 | Status = Acidic | Motor = OFF
Voltage = 1.217 V | pH = 6.97 | Status = Acidic | Motor = OFF
Voltage = 1.220 V | pH = 6.96 | Status = Acidic | Motor = OFF
Voltage = 1.215 V | pH = 6.95 | Status = Acidic | Motor = OFF
Voltage = 1.219 V | pH = 6.94 | Status = Acidic | Motor = ON
Voltage unstable, using last value
Voltage spike ignored
Voltage = 1.219 V | pH = 6.93 | Status = Acidic | Motor = ON
=== Gravity V2 pH Sensor Motor Test Version ===
Place electrode in pH 6.86 solution...
Voltage in pH6.86 = 1.472 V
Calibration offset = 15.248
Calibration complete.
Voltage = 1.386 V | pH = 7.03 | Status = Alkaline | Motor = OFF
Voltage = 1.339 V | pH = 7.09 | Status = Alkaline | Motor = OFF
Voltage = 1.306 V | pH = 7.16 | Status = Alkaline | Motor = OFF
Voltage = 1.284 V | pH = 7.24 | Status = Alkaline | Motor = OFF
Voltage = 1.267 V | pH = 7.32 | Status = Alkaline | Motor = OFF
Voltage = 1.251 V | pH = 7.40 | Status = Alkaline | Motor = OFF
Voltage = 1.244 V | pH = 7.47 | Status = Alkaline | Motor = OFF
Voltage = 1.242 V | pH = 7.54 | Status = Alkaline | Motor = OFF
Voltage = 1.236 V | pH = 7.61 | Status = Alkaline | Motor = OFF
Voltage = 1.236 V | pH = 7.67 | Status = Alkaline | Motor = OFF
Voltage = 1.232 V | pH = 7.73 | Status = Alkaline | Motor = OFF
Voltage = 1.225 V | pH = 7.78 | Status = Alkaline | Motor = OFF

```

**【PH value-DC motor ON】**

```

0227
int buf[20];
int temp;
unsigned long avgValue;

float pHValue;
float voltage;
float calibrationOffset = 0;

// ===== 抗干擾 =====
float lastValidPH = 7.0;
float lastVoltage = -1;
float smoothPH = 7.0;

const int STABLE_READS = 2;
const float THRESHOLD = 0.12; // 放寬電壓穩定判斷

// ===== pH 控制範圍 =====
float lowerLimit = 6.95; // pH < 6.95 → 馬達啟動
float upperLimit = 7.05; // pH ≥ 7.05 → 馬達停止
bool ledState = false;

void setup() {

  Serial.begin(9600);
  Serial.println("=== Gravity V2 pH Sensor Motor Test Version ===");
}

// 上傳完畢
草稿碼使用了 5410 bytes (16%) 的程式儲存空間。上限為 3225
全域變數使用了 569 bytes (27%) 的動態記憶體，剩餘 1479 bytes

```

```

Voltage = 1.215 V | pH = 7.86 | Status = Alkaline | Motor = OFF
Voltage = 1.221 V | pH = 7.86 | Status = Alkaline | Motor = OFF
Voltage = 1.212 V | pH = 7.86 | Status = Alkaline | Motor = OFF
Voltage = 1.214 V | pH = 7.86 | Status = Alkaline | Motor = OFF
Voltage = 1.215 V | pH = 7.86 | Status = Alkaline | Motor = OFF
Voltage = 1.213 V | pH = 7.86 | Status = Alkaline | Motor = OFF
Voltage = 1.215 V | pH = 7.86 | Status = Alkaline | Motor = OFF
Voltage = 1.215 V | pH = 7.86 | Status = Alkaline | Motor = OFF
Voltage = 1.213 V | pH = 7.86 | Status = Alkaline | Motor = OFF
Voltage = 1.215 V | pH = 7.87 | Status = Alkaline | Motor = OFF
Voltage = 1.217 V | pH = 7.86 | Status = Alkaline | Motor = OFF
Voltage = 1.213 V | pH = 7.86 | Status = Alkaline | Motor = OFF
Voltage = 1.210 V | pH = 7.87 | Status = Alkaline | Motor = OFF
Voltage = 1.219 V | pH = 7.86 | Status = Alkaline | Motor = OFF
Voltage = 1.213 V | pH = 7.87 | Status = Alkaline | Motor = OFF
Voltage = 1.216 V | pH = 7.86 | Status = Alkaline | Motor = OFF
Voltage = 1.215 V | pH = 7.87 | Status = Alkaline | Motor = OFF
Voltage = 1.212 V | pH = 7.87 | Status = Alkaline | Motor = OFF
Voltage = 1.214 V | pH = 7.87 | Status = Alkaline | Motor = OFF
Voltage = 1.214 V | pH = 7.87 | Status = Alkaline | Motor = OFF
Voltage = 1.217 V | pH = 7.87 | Status = Alkaline | Motor = OFF
Voltage = 1.223 V | pH = 7.86 | Status = Alkaline | Motor = OFF
Voltage = 1.221 V | pH = 7.86 | Status = Alkaline | Motor = OFF
Voltage = 1.226 V | pH = 7.85 | Status = Alkaline | Motor = OFF
Voltage = 1.220 V | pH = 7.85 | Status = Alkaline | Motor = OFF
Voltage = 1.216 V | pH = 7.85 | Status = Alkaline | Motor = OFF
Voltage = 1.217 V | pH = 7.85 | Status = Alkaline | Motor = OFF
Voltage = 1.219 V | pH = 7.85 | Status = Alkaline | Motor = OFF
Voltage = 1.217 V | pH = 7.85 | Status = Alkaline | Motor = OFF
Voltage = 1.224 V | pH = 7.85 | Status = Alkaline | Motor = OFF
Voltage = 1.218 V | pH = 7.85 | Status = Alkaline | Motor = OFF

```

## 【PH value-DC motor OFF】

```

0227
/*
 * Gravity V2 pH Sensor
 * Single Point Calibration (pH 6.86)
 * Motor Control Version (pH 6.95-7.05)
 */

const int pHPin = A0;
const int motorPin = 3; // 馬達控制腳

int buf[20];
int temp;
unsigned long avgValue;

float pHValue;
float voltage;
float calibrationOffset = 0;

// ===== 抗干擾 =====
float lastValidPH = 7.0;
float lastVoltage = -1;
float smoothPH = 7.0;

const int STABLE_READS = 2;
const float THRESHOLD = 0.12; // 放寬電壓穩定判斷

// ===== pH 控制範圍 =====
float lowerLimit = 6.95; // pH < 6.95 → 馬達啟動
float upperLimit = 7.05; // pH ≥ 7.05 → 馬達停止
bool ledState = false;

void setup() {

  Serial.begin(9600);
  Serial.println("=== Gravity V2 pH Sensor Motor Test Version ===");
  delay(1000);

  Serial.println("Place electrode in pH 6.86 solution...");
  delay(2000);

  float voltage686 = readStableVoltage();

  Serial.print("Voltage in pH6.86 = ");
  Serial.print(voltage686, 3);
  Serial.println(" V");

  calibrationOffset = 6.86 + 5.70 * voltage686;
}

```

## 【程式架構 I】

```

0227
Serial.print("Calibration offset = ");
Serial.println(calibrationOffset, 3);

Serial.println("Calibration complete.");
delay(2000);

pinMode(motorPin, OUTPUT);
digitalWrite(motorPin, LOW); // 馬達初始關閉
}

void loop() {

  // ===== 讀穩定電壓 =====
  voltage = readStableVoltage();

  // ===== 電壓突波過濾 =====
  if (lastVoltage < 0) {
    lastVoltage = voltage;
  }
  else if (abs(voltage - lastVoltage) > 0.15) {
    Serial.println("Voltage spike ignored");
    voltage = lastVoltage;
  }
  else {
    lastVoltage = voltage;
  }

  // ===== 計算 pH =====
  pHValue = -5.70 * voltage + calibrationOffset;

  // ===== pH 異常值保護 =====
  if (pHValue < 0 || pHValue > 14) {
    Serial.println("Invalid pH ignored");
    pHValue = lastValidPH;
  }
  else {
    lastValidPH = pHValue;
  }

  // ===== 指數平滑濾波 (更穩定) =====
  smoothPH = 0.9 * smoothPH + 0.1 * pHValue;
  pHValue = smoothPH;

  // ===== 馬達控制 =====
  if (pHValue < lowerLimit) {
    digitalWrite(motorPin, HIGH); // pH < 6.95 → 馬達啟動
    ledState = true;
  }
}

```

## 【程式架構 II】

```

0227
}
else if (pHValue >= upperLimit) {
  digitalWrite(motorPin, LOW); // pH ≥ 7.05 → 馬達停止
  ledState = false;
}

// ===== 顯示資料 =====
Serial.print("Voltage = ");
Serial.print(voltage, 3);
Serial.print(" V | pH = ");
Serial.print(pHValue, 2);
Serial.print(" | Status = ");
Serial.print((pHValue < 7.0) ? "Acidic" : "Alkaline");
Serial.print(" | Motor = ");
Serial.println(ledState ? "ON" : "OFF");

delay(2000);
}

// ===== 讀取平均電壓 =====
float readAverageVoltage() {

  for (int i = 0; i < 20; i++) {
    buf[i] = analogRead(pHPin);
    delay(20);
  }

  // 排序取中間值
  for (int i = 0; i < 19; i++) {
    for (int j = i + 1; j < 20; j++) {
      if (buf[i] > buf[j]) {
        temp = buf[i];
        buf[i] = buf[j];
        buf[j] = temp;
      }
    }
  }

  avgValue = 0;
  for (int i = 5; i < 15; i++) {
    avgValue += buf[i];
  }

  float avgAnalog = avgValue / 10.0;
  float voltage = avgAnalog * 5.0 / 1023.0;

  return voltage;
}

```

### 【程式架構 III】

```

}

// ===== 讀取穩定電壓 =====
float readStableVoltage() {

  float lastV = readAverageVoltage();
  float currentV;
  int stableCount = 0;

  unsigned long startTime = millis();

  while (stableCount < STABLE_READS) {

    currentV = readAverageVoltage();

    if (abs(currentV - lastV) < THRESHOLD) {
      stableCount++;
    }
    else {
      stableCount = 0;
    }

    lastV = currentV;

    // 防止卡住
    if (millis() - startTime > 1000) {
      Serial.println("Voltage unstable, using last value");
      break;
    }

    delay(50);
  }

  return lastV;
}

```

### 【程式架構 IIII】

#### 4. 參考文獻：

施士文 (2022)。Arduino 微電腦應用實習。台北市：台科大圖書股份有限公司。

3M 科技改善生活。在家測酸鹼-PH 值酸鹼測試實驗。

[https://www.3m.com.tw/3M/zh\\_TW/company-tw/latest-event/science-at-home/acids-and-bases/](https://www.3m.com.tw/3M/zh_TW/company-tw/latest-event/science-at-home/acids-and-bases/)。

百科知識。阿倫尼烏斯。

<https://www.jendow.com.tw/wiki/%E9%98%BF%E5%80%AB%E5%B0%BC%E7%83%8F%E6%96%AF>。

維基百科。酸鹼質子理論。<https://zh.wikipedia.org/zh-tw/%E9%85%B8%E7%A2%B1%E8%B4%A8%E5%AD%90%E7%90%86%E8%AE%BA>。