嵌入式系統設計 期末專案--水塔控制

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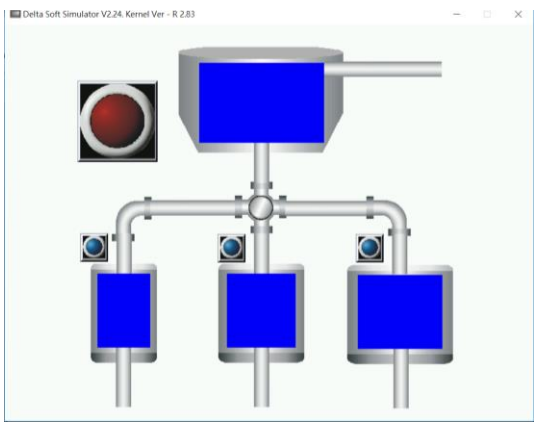
一、作業完成之功能

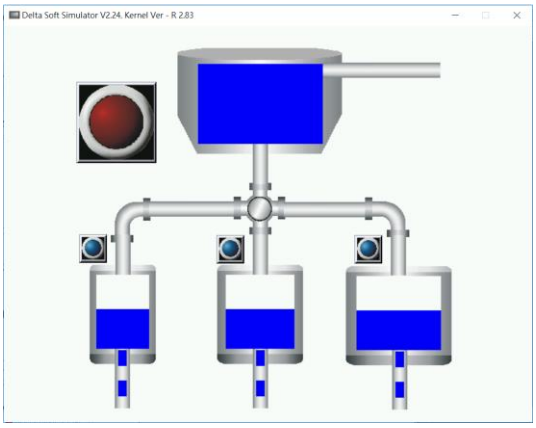
人機介面與硬體實作，在畫面上顯示水塔、水流狀態，且利用 8051 電路板按鈕控制是否放水、加水，並用 LED 顯示供水水塔目前水量，若水量過低則發出警示聲。

二、介面說明

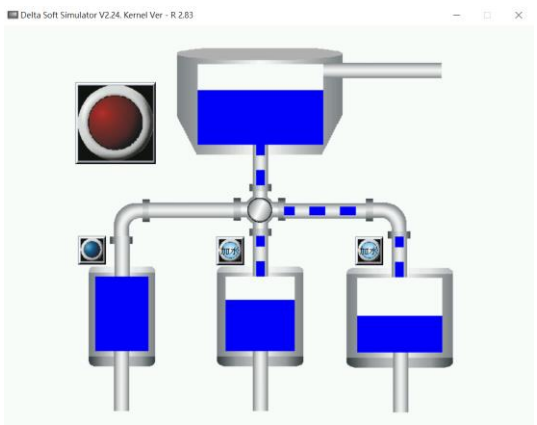
1.初始狀態



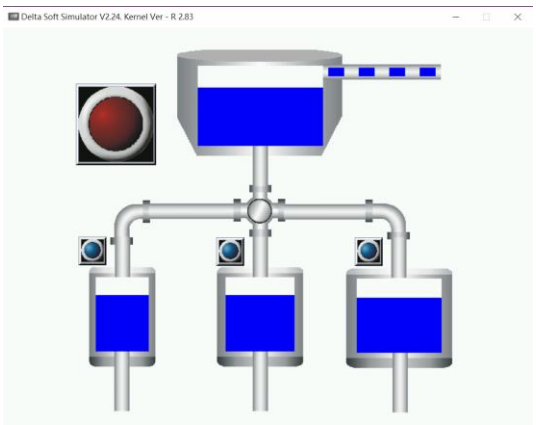
2.下方水塔放水中



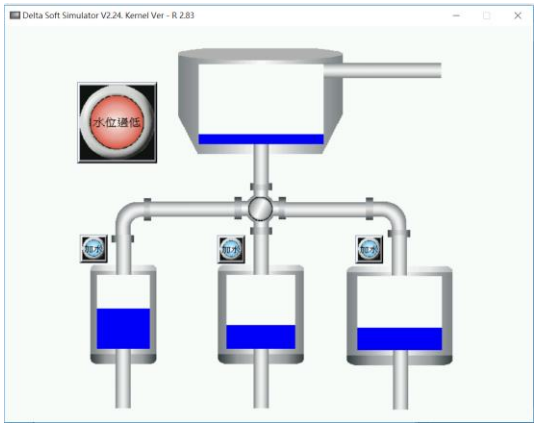
3.下方水塔水量不足(加水指示燈亮)，由上方水塔加水



4.上方水塔加水中



5.上方水塔水量過低(紅色指示燈亮)，
無法為下方水塔加水



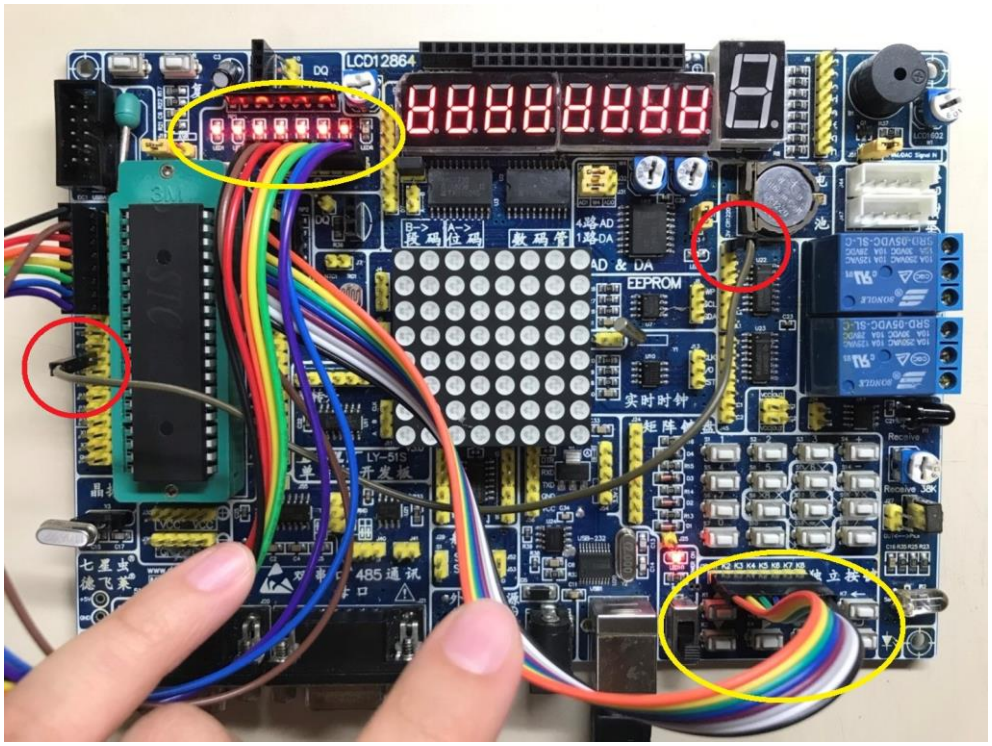
6.電路板接線狀況

左上黃圈: 供水水塔水量

右下黃圈: 控制水塔

(1~8 按鍵功能: 上水塔加水、左水塔放水、中水塔放水、右水塔放水、
左中水塔放水、左右水塔放水、中右水塔放水、左中右水塔放水)

兩紅圈: 警示聲接腳



三、程式碼片段說明

1. 接腳

```
sbit LED0 = P1^0;
sbit LED1 = P1^1;
sbit LED2 = P1^2;
sbit LED3 = P1^3;
sbit LED4 = P1^4;
sbit LED5 = P1^5;
sbit LED6 = P1^6;
sbit LED7 = P1^7;
#define ON 0
#define OFF 1

sbit BOT0 = P0^0;
sbit BOT1 = P0^1;
sbit BOT2 = P0^2;
sbit BOT3 = P0^3;
sbit BOT4 = P0^4;
sbit BOT5 = P0^5;
sbit BOT6 = P0^6;
sbit BOT7 = P0^7;

sbit SPK=P3^2;     //定義喇叭端口
```

2. LED 控制

```
switch(recbuf[0] + 1)
{
    case 1:
        LED0 = ON;
        LED1 = OFF;
        LED2 = OFF;
        LED3 = OFF;
        LED4 = OFF;
        LED5 = OFF;
        LED6 = OFF;
        LED7 = OFF;
        flag = 1;
        break;
    case 2:LED0 = ON;
        LED1 = ON;
        LED2 = OFF;
        LED3 = OFF;
        LED4 = OFF;
        LED5 = OFF;
        LED6 = OFF;
        LED7 = OFF;
        flag = 0;
        break;
    case 3:LED0 = ON;
        LED1 = ON;
        LED2 = ON;
        LED3 = OFF;
        LED4 = OFF;
        LED5 = OFF;
        LED6 = OFF;
        LED7 = OFF;
        flag = 0;
        break;
    case 4:LED0 = ON;
        LED1 = ON;
        LED2 = ON;
        LED3 = ON;
        LED4 = OFF;
        LED5 = OFF;
        LED6 = OFF;
        LED7 = OFF;
        flag = 0;
        break;
    case 5:LED0 = ON;
        LED1 = ON;
        LED2 = ON;
        LED3 = ON;
        LED4 = ON;
        LED5 = OFF;
        LED6 = OFF;
        LED7 = OFF;
        flag = 0;
        break;
    case 6:LED0 = ON;
        LED1 = ON;
        LED2 = ON;
        LED3 = ON;
        LED4 = ON;
        LED5 = ON;
        LED6 = OFF;
        LED7 = OFF;
        flag = 0;
        break;
    case 7:LED0 = ON;
        LED1 = ON;
        LED2 = ON;
        LED3 = ON;
        LED4 = ON;
        LED5 = ON;
        LED6 = ON;
        LED7 = OFF;
        flag = 0;
        break;
    case 8:LED0 = ON;
        LED1 = ON;
        LED2 = ON;
        LED3 = ON;
        LED4 = ON;
        LED5 = ON;
        LED6 = ON;
        LED7 = ON;
        flag = 0;
        break;
}
```

3. 警示聲控制

```
if(flag == 1)
{
    Init_Timer0();
    while(1){
        DelayMs(1); //延時1ms，累加頻率值
        frq++;
        count++;
        if(count > 5000) break;
    }
    EA = 0;
    ET0 = 0;
    TR0 = 0;
    SPK = 0;
    flag = 0;
}
```

4. 按鍵控制

```
if (BOT0 == ON)
{
    SBUF = 21;
    while(TI == 0);
    TI = 0;
    while(BOT0 == ON);

    SBUF = 0x0;
    while(TI == 0);
    TI = 0;
}
if (BOT1 == ON)
{
    SBUF = 22;
    while(TI == 0);
    TI = 0;
    while(BOT1 == ON);

    SBUF = 0x0;
    while(TI == 0);
    TI = 0;
}
if (BOT2 == ON)
{
    SBUF = 23;
    while(TI == 0);
    TI = 0;
    while(BOT2 == ON);

    SBUF = 0x0;
    while(TI == 0);
    TI = 0;
}
```

```
if (BOT3 == ON)
{
    SBUF = 24;
    while(TI == 0);
    TI = 0;
    while(BOT3 == ON);

    SBUF = 0x0;
    while(TI == 0);
    TI = 0;
}
if (BOT4 == ON)
{
    SBUF = 25;
    while(TI == 0);
    TI = 0;
    while(BOT4 == ON);

    SBUF = 0x0;
    while(TI == 0);
    TI = 0;
}
if (BOT5 == ON)
{
    SBUF = 26;
    while(TI == 0);
    TI = 0;
    while(BOT5 == ON);

    SBUF = 0x0;
    while(TI == 0);
    TI = 0;
}
```

```
if (BOT6 == ON)
{
    SBUF = 27;
    while(TI == 0);
    TI = 0;
    while(BOT6 == ON);

    SBUF = 0x0;
    while(TI == 0);
    TI = 0;
}
if (BOT7 == ON)
{
    SBUF = 28;
    while(TI == 0);
    TI = 0;
    while(BOT7 == ON);

    SBUF = 0x0;
    while(TI == 0);
    TI = 0;
}
```

四、實驗結果

見 final.mp4

五、專案心得

剛開始做這項作業時，遇到很多奇怪的 bug，但在確實的了解整個原理過程後，就變得容易許多。

而透過這次專案的實作，更清楚了解底層的 data 是如何傳送，使得按了電路板按鍵後得以控制人機介面。除了基本控制水塔外，另外在供水水塔水量過低時，會發出鳴笛聲(數秒後自動停止)，且可透過 8 個 LED 燈觀察水量剩餘多寡。

六、問題

1. 原本除了 LED 顯示水量外，亦想透過 LCD 顯示四個水塔的水量數字，然而插上 LCD 後，按鍵及 LED 皆無法作用，不確定是否是排線衝突之問題。

2. 警示聲響第一次並停止後，LED 所顯示的上方水塔水量會有誤，且水量過低時，警示聲無法再次響起，但其餘控制功能皆正常。