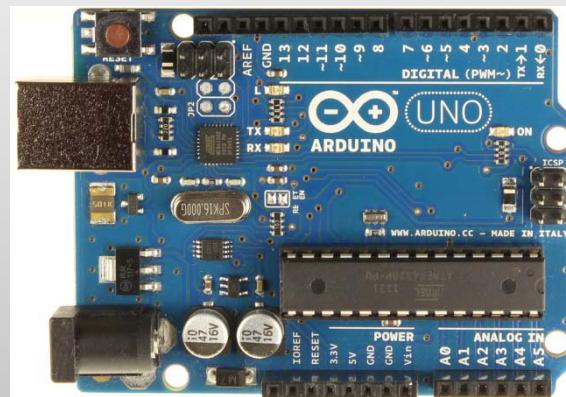
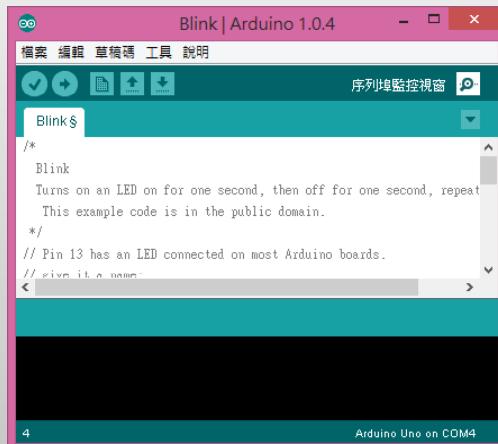


INTRODUCTION OF ARDUINO



WHAT IS ARDUINO

- *Arduino is an open-source electronics prototyping platform based on flexible, easy-to-use hardware and software.* From arduino.cc
- 開源的平臺：
 - 軟體：整合開發環境(IDE)，程式語法類似C語言
 - 硬體：開發板，微控器(microcontroller)，其它週邊元件(ex: 無線網路模組)



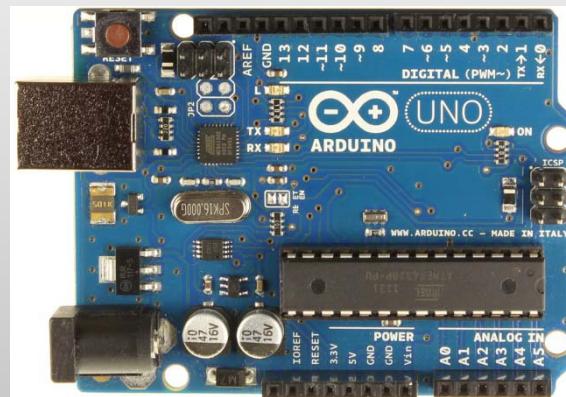
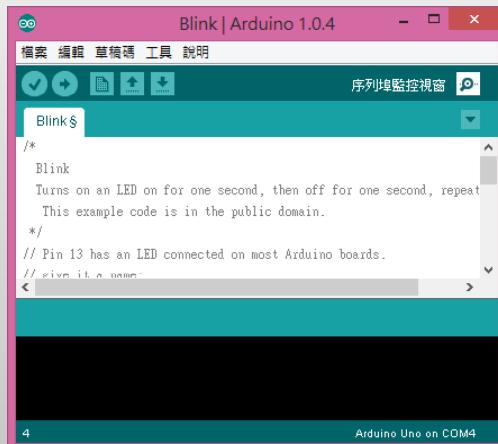
MICROCONTROLLER (MCU)

- A Microcontroller (MCU) contains:
 - controllable logic
 - program memory



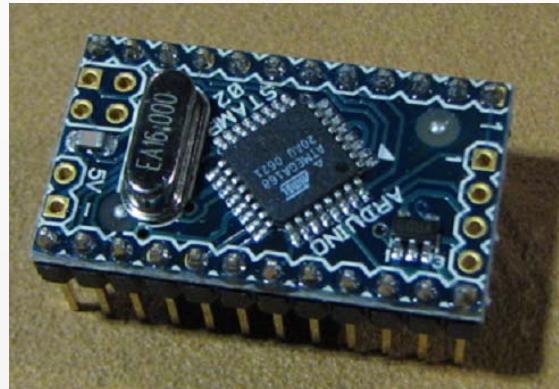
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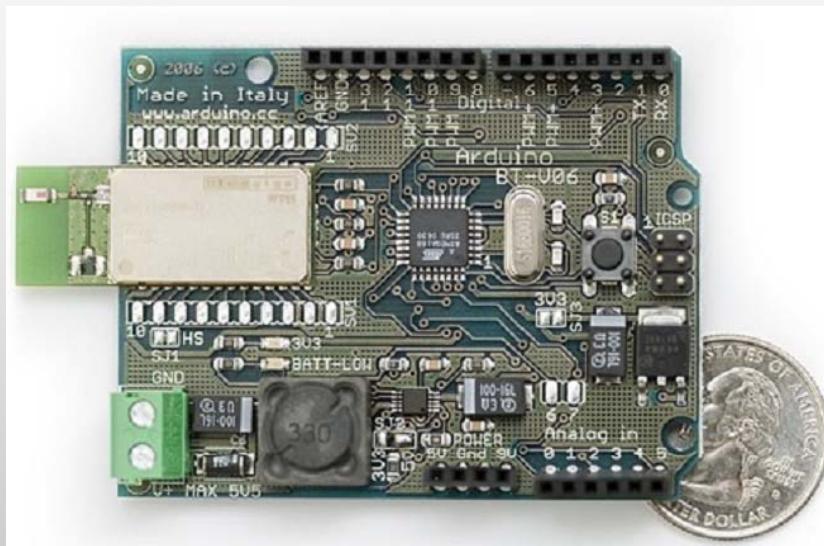


TYPES

- Arduino Mini

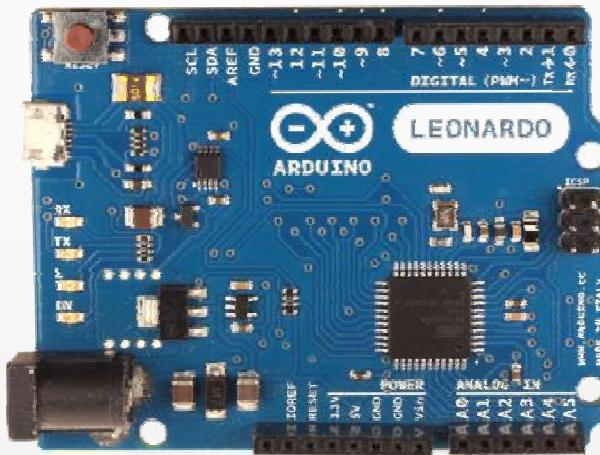


- Arduino Bluetooth

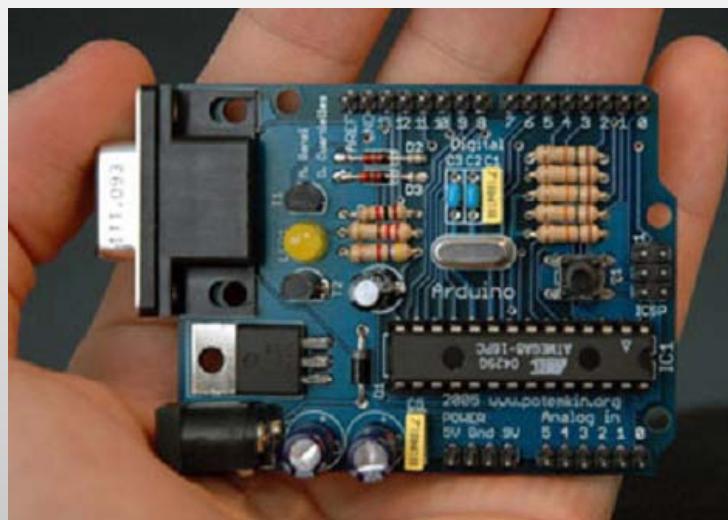


TYPES

- Arduino Leonardo
 - Keyboard
 - Mouse

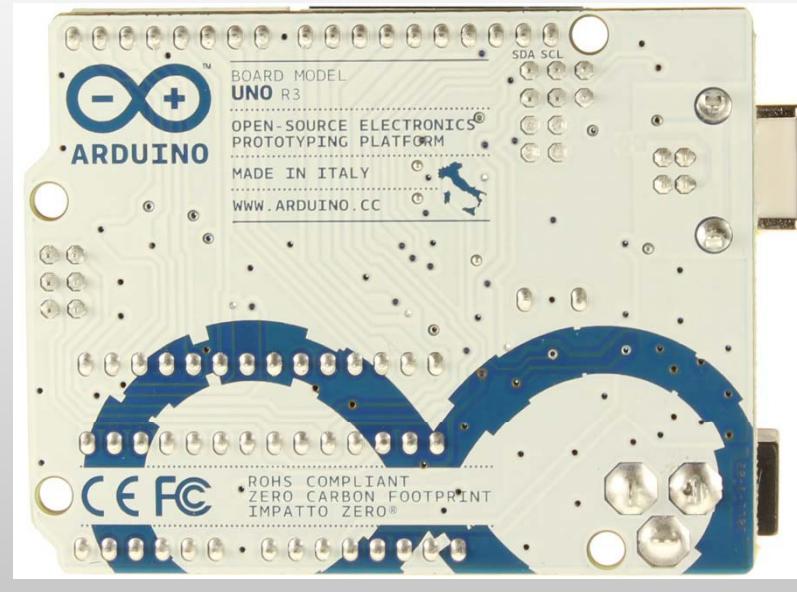
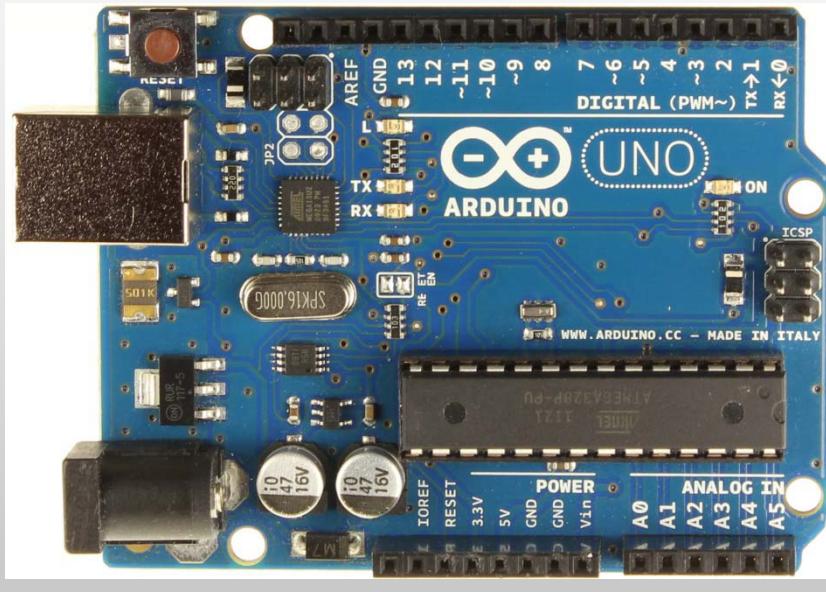


- Arduino Serial



ARDUINO UNO R3

- Digital I/O Pins: **14** (**6** provide PWM output)
- Analog **I****O** Pins: **6**
- **Clock** Speed: **16 MHz**
- Operating Voltage: **5V**
- DC Current per I/O Pin: **40 mA**



SUMMARY1 - ARDUINO

- 一個能快速製作電子電路原型(prototyping)的開發平臺
- 撰寫程式碼讓**微控制器**循序(循環)執行 – 如同PC的CPU
- 加上一些額外電路使微控制器能夠控制周邊或從外界擷取訊號
- **微控器**開發流程：



GETTING START- BOARD TESTING

- 一個全新的、正常的arduino UNO在出廠前已燒入一個Blink 程式，通電後，pin 13的LED燈會閃爍



waihung.net



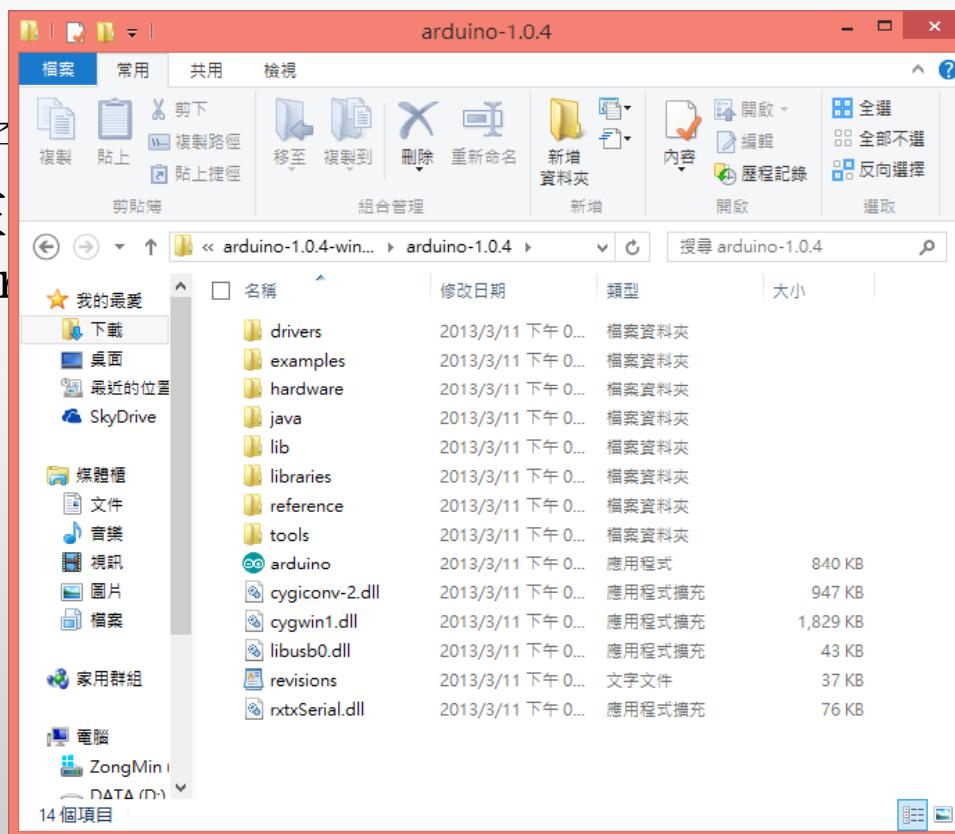
GETTING START- ENVIRONMENT SETTING

1) 安裝Arduino IDE (OS: Wins, others)

2) USB接上 Arduino board

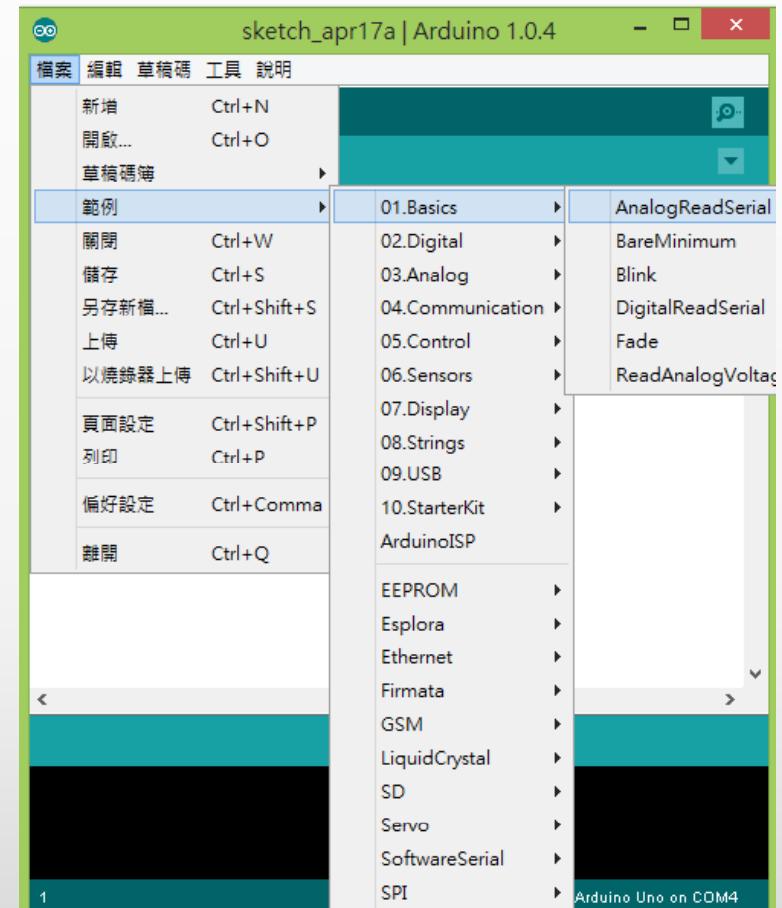
3) 安裝驅動程式：

- Wins OS: 接上板子
動程式安裝路徑(在 [FTDI USB Driver])
- 其它 OS: 參考



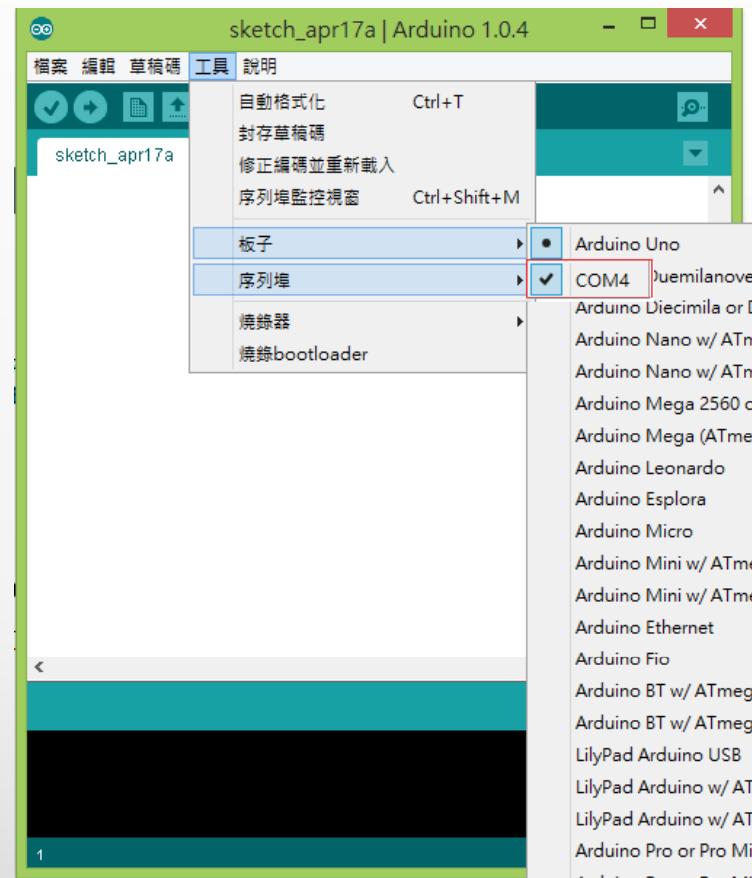
GETTING START- IDE

- 開啓arduino程式
- “檔案”中有很多範例檔可參考



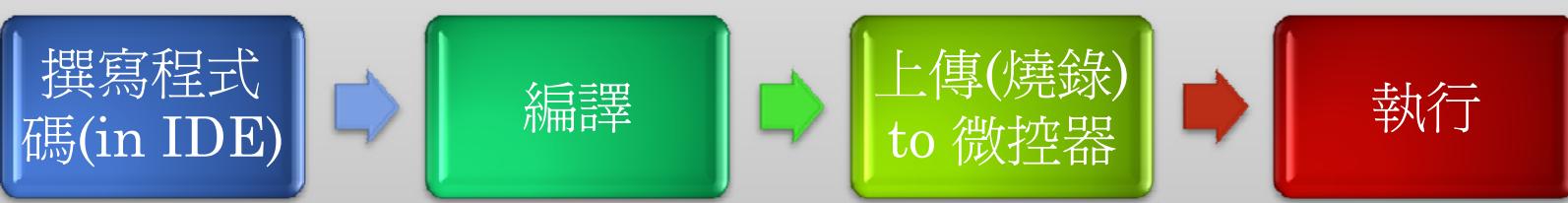
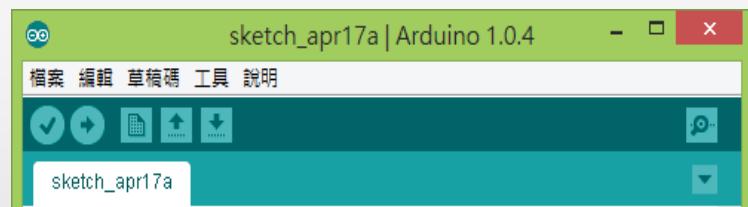
GETTING START- IDE

- 開啓arduino程式
- “檔案”中有很多範例檔可參考
- “工具”中設定
 - 板子型號(UNO)
 - 序列埠(連接埠) COM α ,
 α = arduino板的連接埠號碼



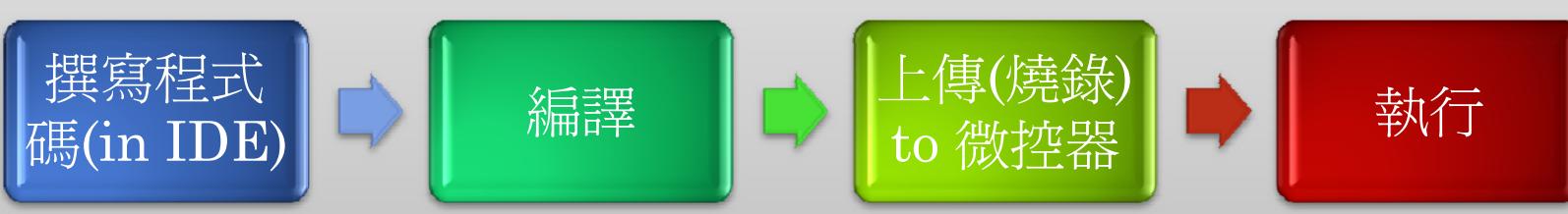
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- 編譯、編譯+上傳、新增、開啓、儲存(檔名全英文，開頭須為英文字母)



GETTING START- IDE

- 開啓arduino程式
- “檔案”中 有很多範例檔可參考
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- 參考文件：函數的使用方法



DEMO1

LED(pin 13) blink under different frequencies. [link](#)



SYNTAX OF PROGRAMMING LANGUAGE

- 類似C語言語法
- 參考語法及函式
- 大小寫有別！
- 2個必要的函式
 - void setup(){...}
 - void loop(){...}
- 資料型態
- 輸入輸出
 - 類比
 - 數位
- 註解
- 參考 “範例程式”

程式結構	變數	函式
■ <code>setup()</code>	常數	數位訊號輸出/入
■ <code>loop()</code>	■ HIGH LOW	■ <code>pinMode()</code>
控制流程	■ INPUT OUTPUT	■ <code>digitalWrite()</code>
■ if	■ true false	■ <code>digitalRead()</code>
■ if...else	■ Integer Constants	類比訊號輸出/入
■ for	資料型態	■ <code>analogRead()</code>
■ switch case	■ boolean	■ <code>analogWrite() - PWM</code>
■ while	■ char	進階 I/O
■ do... while	■ byte	■ <code>tone()</code>
■ break	■ int	■ <code>noTone()</code>
■ continue	■ unsigned int	■ <code>shiftOut()</code>
■ return	■ long	■ <code>pulseIn()</code>
特殊符號	■ unsigned long	時間函式
■ ; (semicolon)	■ float	■ <code>millis()</code>
■ { (curly braces)	■ double	■ <code>micros()</code>
■ // (single line comment)	■ string	■ <code>delay()</code>
■ /* */ (multi-line comment)	■ array	■ <code>delayMicroseconds()</code>
算術符號	■ void	數學函式
■ = (assignment)	■ <code>char()</code>	■ <code>min()</code>
■ + (addition)	■ <code>byte()</code>	■ <code>max()</code>
■ - (subtraction)	■ <code>int()</code>	■ <code>abs()</code>
■ * (multiplication)	■ <code>long()</code>	■ <code>constrain()</code>
■ / (division)	■ <code>float()</code>	■ <code>map()</code>
■ % (modulo)	比較符號	■ <code>pow()</code>
	■ == (equal to)	■ <code>sq()</code>
	■ != (not equal to)	■ <code>sqrt()</code>
	■ < (less than)	三角函數
	■ > (greater than)	■ <code>sin()</code>
	■ <= (less than or equal to)	■ <code>cos()</code>
	■ >= (greater than or equal to)	■ <code>tan()</code>
布林運算	■ <code>&&</code> (and)	亂數函式

範例：BLINK程式碼解說

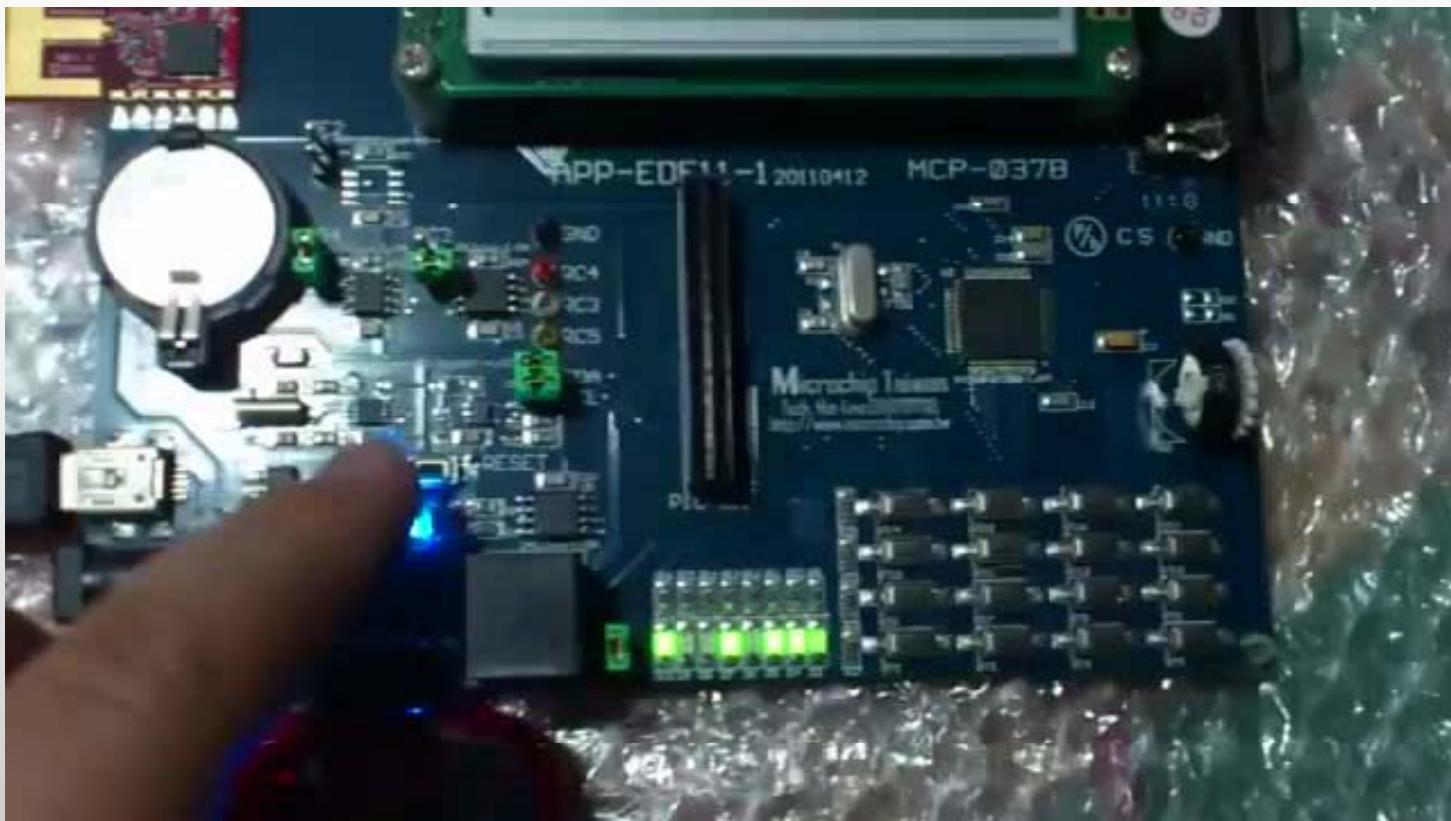
```
1.int ledPin = 13; //設定一全域變數ledPin = 13  
2.void setup(){  
3.    pinMode(ledPin, OUTPUT); //設定ledPin的值指到的pin為輸出  
4.}  
5.void loop(){  
6.    digitalWrite(ledPin, HIGH); //給pin13腳高電壓 (LED亮)  
7.    delay(1000); //延遲1秒鐘(1000毫秒)  
8.    digitalWrite(ledPin, LOW); //給pin腳低電壓 (LED暗)  
9.    delay(1000); //延遲1秒鐘(1000毫秒)  
10.}
```



實驗一

LED 霹靂燈

- 實作微控器程式化輸出



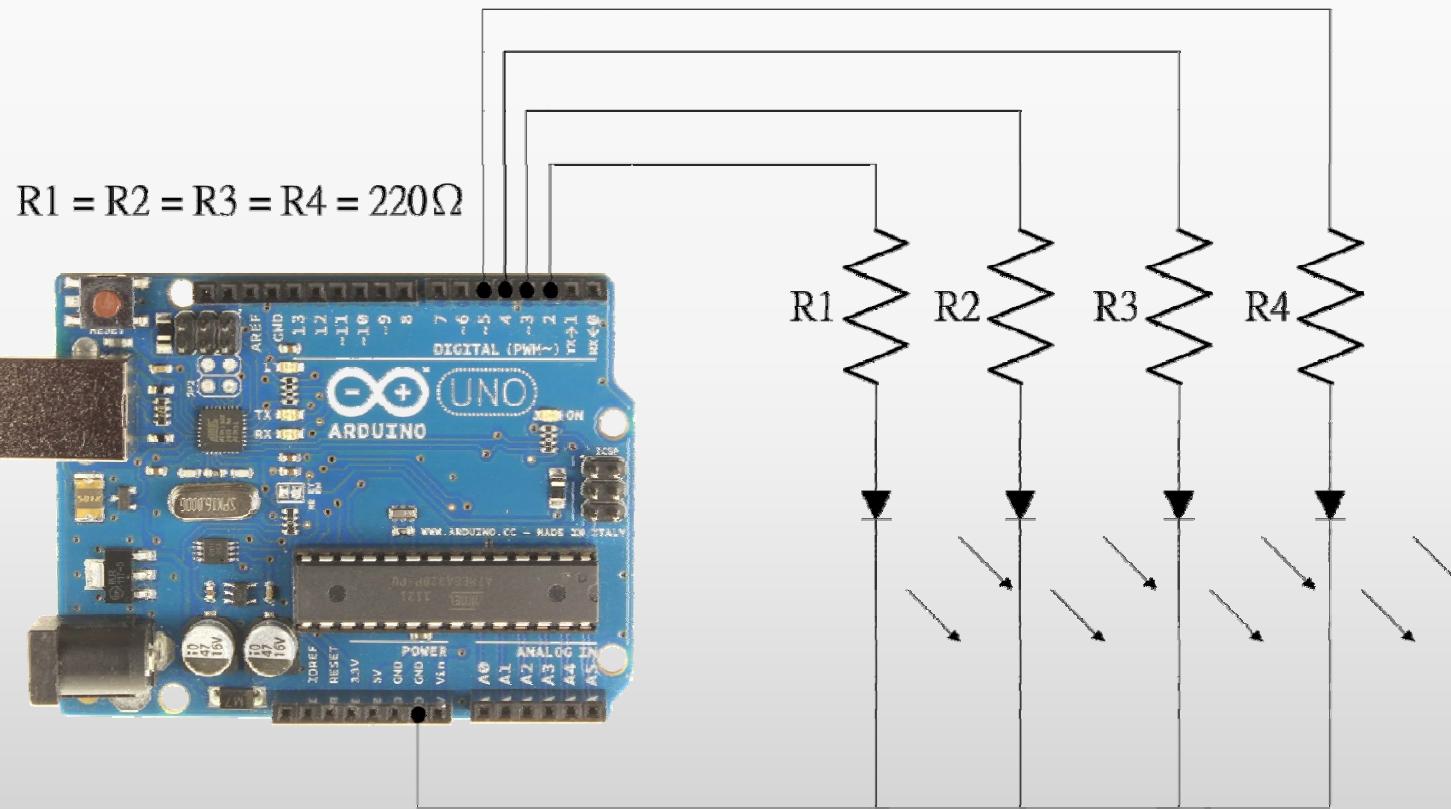
實驗一

LED 霹靂燈

- 實作微控器程式化輸出
- 了解程式化控制輸出腳位的方法
- 輸出: 4個(or more)數位輸出腳位(2~5) – 控制LED燈亮暗
- 材料：
 - 麵包板
 - 電線
 - LED燈 × 4 (or more)
 - 限流電阻(220Ω) × 4 (or more)



實驗一 電路



實驗一 程式碼範例-1

```
const int led1 = 2;
const int led2 = 3;
const int led3 = 4;
const int led4 = 5;
const int delaytime = 100; // assign the waiting time (ms)

// the setup routine runs once when you press reset:
void setup() {
    // set all led pin as output pin
    pinMode(led1, OUTPUT);
    pinMode(led2, OUTPUT);
    pinMode(led3, OUTPUT);
    pinMode(led4, OUTPUT);
    digitalWrite(led1,LOW);
    digitalWrite(led2,LOW);
    digitalWrite(led3,LOW);
    digitalWrite(led4,LOW);
}
```



實驗一 程式碼範例-2

```
// the loop routine runs over and over again forever:  
void loop() {  
    // led 1 on, others off  
    digitalWrite(led1,HIGH);  
    digitalWrite(led2,LOW);  
    delay(delaytime);          // wait for specific time  
    // led 2 on, others off  
    digitalWrite(led2,HIGH);  
    digitalWrite(led1,LOW);  
    delay(delaytime);          // wait for specific time  
    // led 3 on, others off  
    digitalWrite(led3,HIGH);  
    digitalWrite(led2,LOW);  
    delay(delaytime);          // wait for specific time
```



實驗一 程式碼範例-3

```
// led 4 on, others off
digitalWrite(led4,HIGH);
digitalWrite(led3,LOW);
delay(delaytime);          // wait for specific time

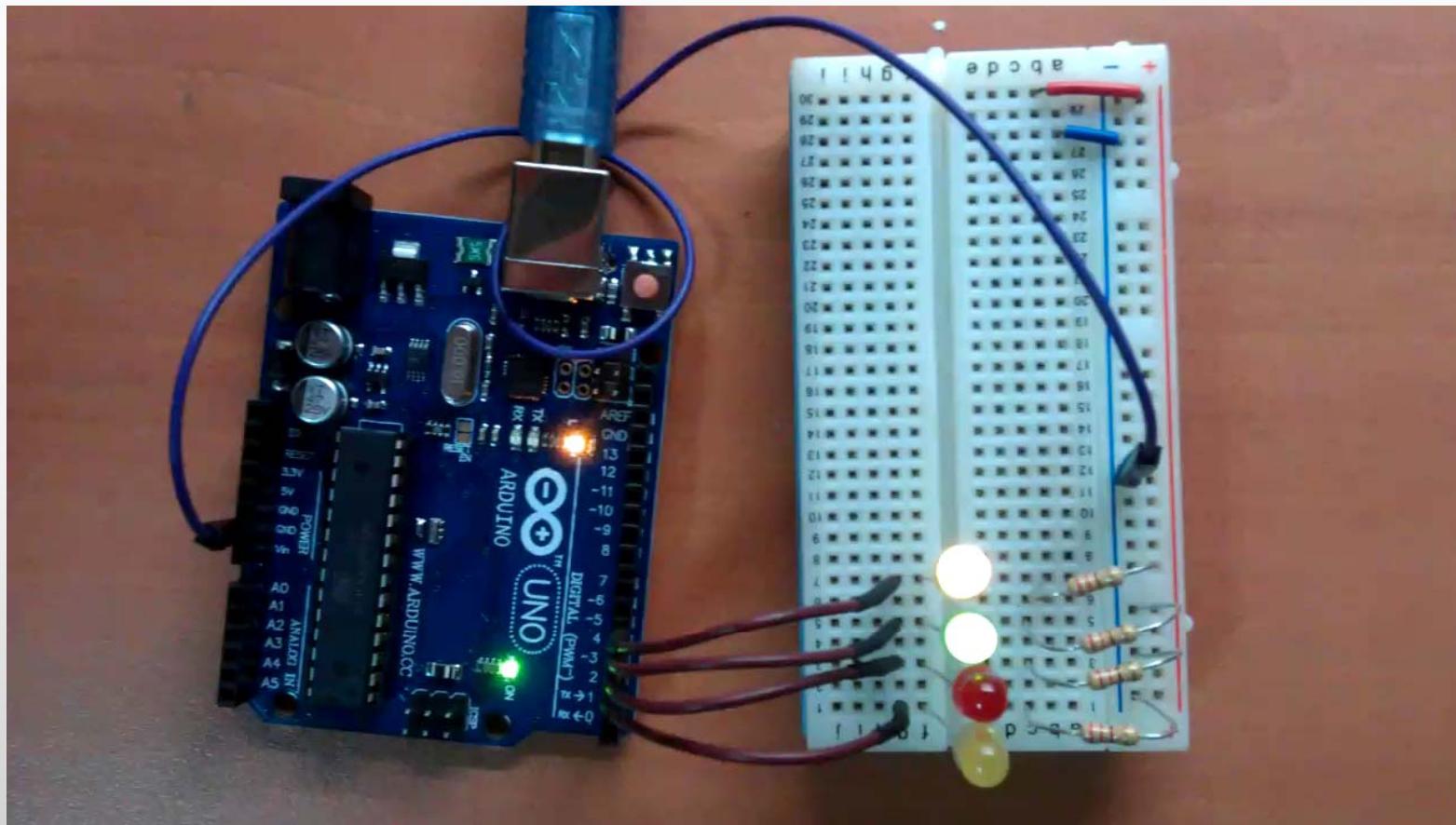
// led 3 on, others off
digitalWrite(led3,HIGH);
digitalWrite(led4,LOW);
delay(delaytime);          // wait for specific time

// led 2 on, others off
digitalWrite(led2,HIGH);
digitalWrite(led3,LOW);
delay(delaytime);          // wait for specific time

// restart from the top of this function ( led 1 on)
}
```



實驗一 測試結果



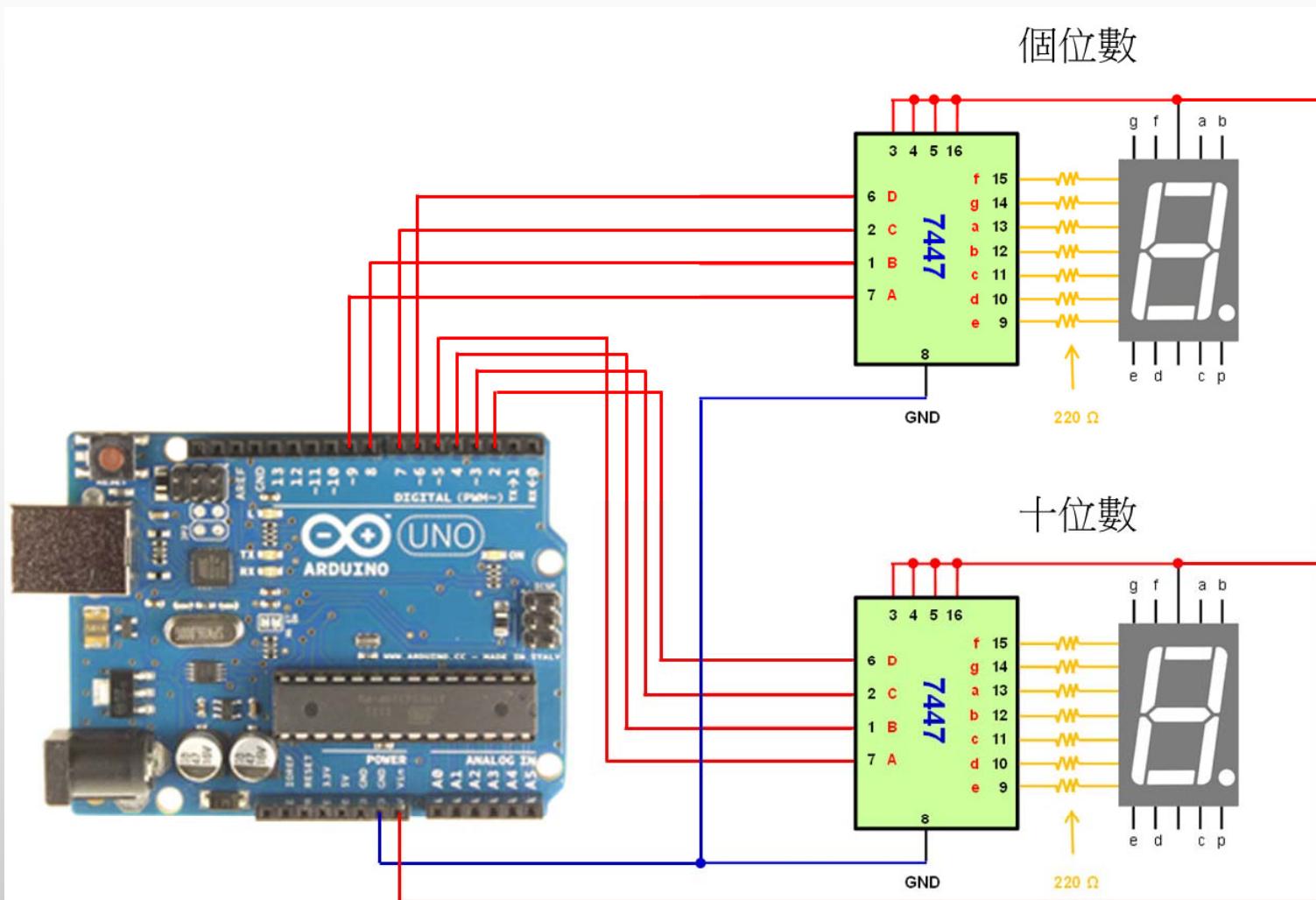
實驗二

自動計數器 - 2位數

- 實作微控器輸出功能
- 比較微控器實作計數器及實驗六之計數器電路，了解微控器的功能、優勢
- 輸出：8個數位輸出腳位(2~9) - 傳送BCD碼至7447顯示電壓大小
- 材料：
 - 麵包板
 - 電線
 - IC 7447 × 2
 - 7段顯示器 × 2
 - 限流電阻(220Ω) × 14



實驗二 電路



實驗二 程式碼範例-1

```
const int tens1 = 2; //MSB
```

```
const int tens2 = 3;
```

```
const int tens3 = 4;
```

```
const int tens4 = 5; //LSB
```

```
const int ones1 = 6; //MSB
```

```
const int ones2 = 7;
```

```
const int ones3 = 8;
```

```
const int ones4 = 9; //LSB
```

```
const int i = 3; // increasing unit
```

```
const int waitTime = 500; // auto counting delay time(ms)
```

```
int value; // the value of the auto-counter
```

```
int tens; // value of ten digit
```

```
int ones; // value of unit digit
```



實驗二 程式碼範例-2

```
void setup() {  
    // set all pins as output pins  
    pinMode(tens1, OUTPUT);  
    pinMode(tens2, OUTPUT);  
    pinMode(tens3, OUTPUT);  
    pinMode(tens4, OUTPUT);  
    pinMode(ones1, OUTPUT);  
    pinMode(ones2, OUTPUT);  
    pinMode(ones3, OUTPUT);  
    pinMode(ones4, OUTPUT);  
    value = 0;  
}
```

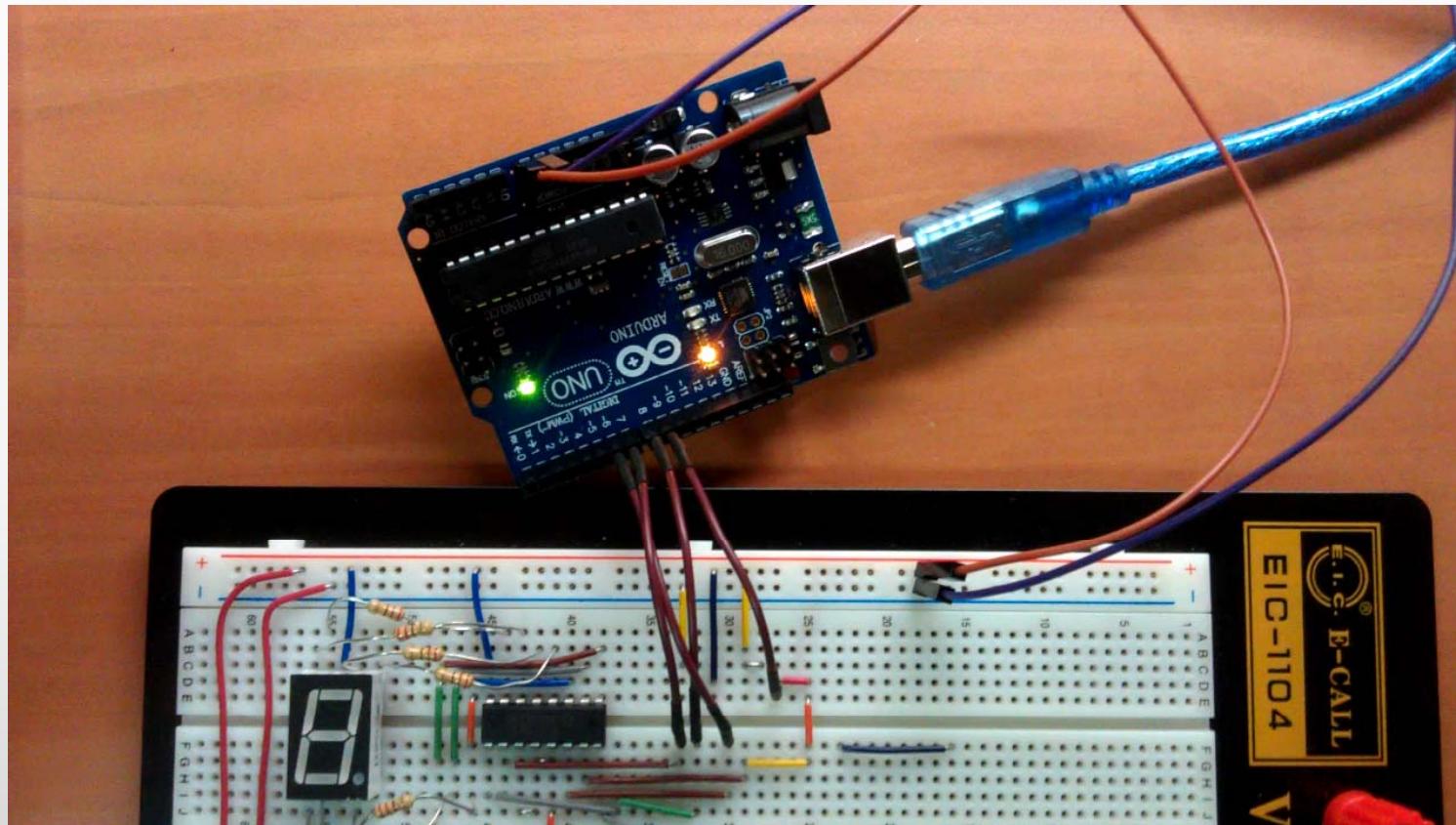


實驗二 程式碼範例-3

```
void loop() {  
    while(value < 100){// if value is less than 100, run....  
        tens = value / 10;  
        ones = value % 10;  
        //change the value of ten digit  
        digitalWrite(tens1, tens & B1000);  
        digitalWrite(tens2, tens & B0100);  
        digitalWrite(tens3, tens & B0010);  
        digitalWrite(tens4, tens & B0001);  
        //change the value of unit digit  
        digitalWrite(ones1, ones & B1000);  
        digitalWrite(ones2, ones & B0100);  
        digitalWrite(ones3, ones & B0010);  
        digitalWrite(ones4, ones & B0001);  
        value = value + i; // value increases  
        delay(waitTime); // pause for specific time  
    }  
    value = 0; // reset value to 0  
}
```



實驗二 測試結果



因僅有1個七段顯示器，所以僅顯示個位數字變化
影片中為每0.5秒增加3的個位數變化。

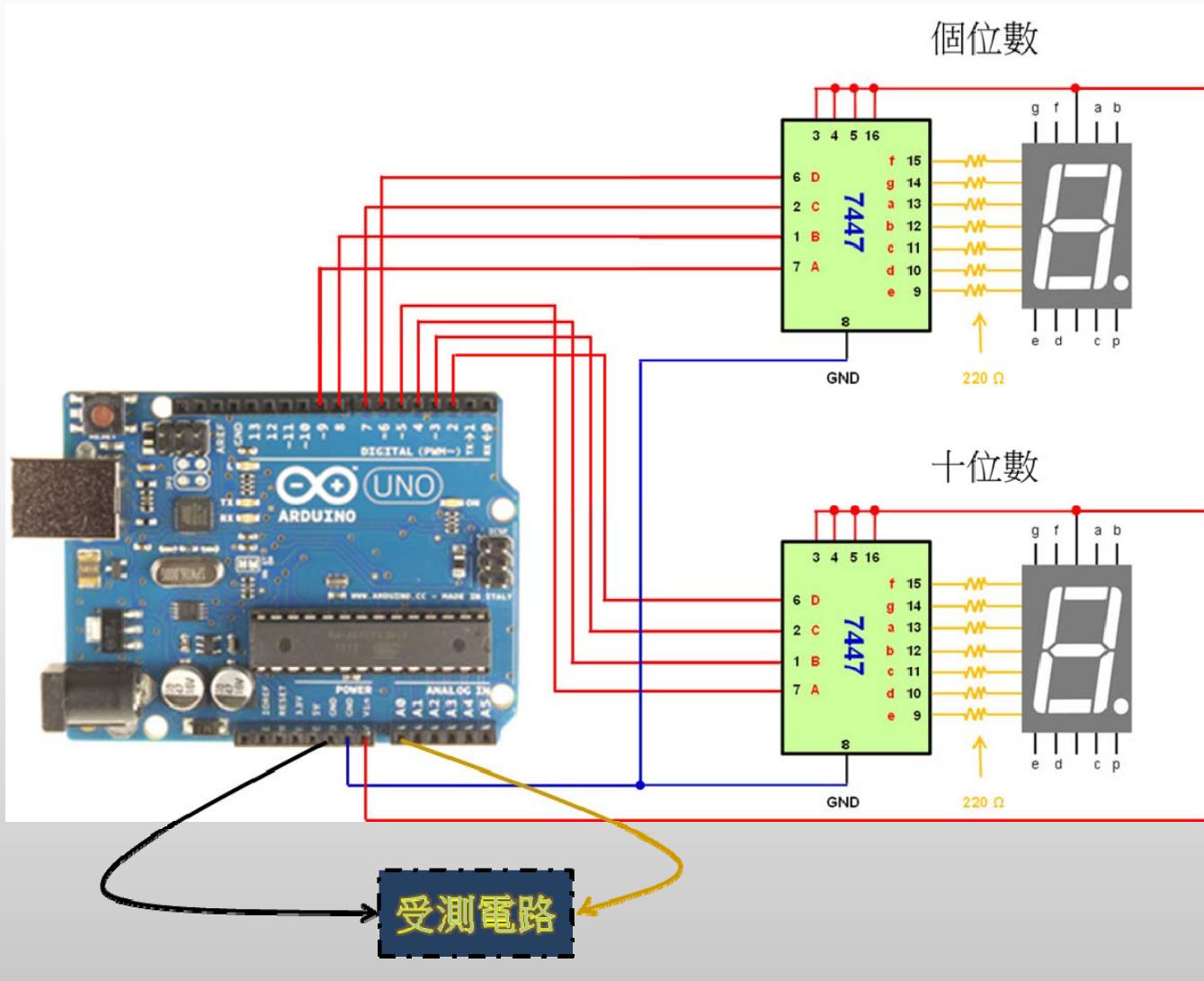
實驗三

5V 數位電表

- 實作微控器輸入與輸出
- 學習使用電表分析電子電路狀況
- 輸入: 1個類比腳位(A0) - 輸入電壓值
- 輸出: 8個數位輸出腳位(2~9) - 傳送BCD碼至7447顯示電壓大小
- 材料：
 - 麵包板
 - 電線
 - IC 7447 × 2
 - 7段顯示器 × 2 (顯示個位數及小數)
 - 限流電阻(220Ω) × 15 (2個七段顯示器 + 小數點)
 - 受量測之電路(ex: 量測一顆電池電壓)



實驗三 電路



實驗三 程式碼範例-1

```
const int tens1 = 2; //MSB
const int tens2 = 3;
const int tens3 = 4;
const int tens4 = 5; //LSB
const int ones1 = 6; //MSB
const int ones2 = 7;
const int ones3 = 8;
const int ones4 = 9; //LSB
const int pinVin = A0;

int Vin; // save the raw sampled value (0 ~ 1023)
int value; // the value of the auto-counter
int tens; // value of ten digit
int ones; // value of unit digit
```

實驗三 程式碼範例-2

```
void setup() {  
    // set all pins as output pins  
    pinMode(tens1, OUTPUT);  
    pinMode(tens2, OUTPUT);  
    pinMode(tens3, OUTPUT);  
    pinMode(tens4, OUTPUT);  
    pinMode(ones1, OUTPUT);  
    pinMode(ones2, OUTPUT);  
    pinMode(ones3, OUTPUT);  
    pinMode(ones4, OUTPUT);  
}
```



實驗三 程式碼範例-3

```
void loop() {
    delay(5); // prevent sampling too fast
    Vin = analogRead(pinVin); // read the voltage of A0
    value = map(Vin,0,1023,0,50);
    tens = value / 10;
    ones = value % 10;
    //change the value of ten digit
    digitalWrite(tens1, tens & B1000);
    digitalWrite(tens2, tens & B0100);
    digitalWrite(tens3, tens & B0010);
    digitalWrite(tens4, tens & B0001);
    //change the value of unit digit
    digitalWrite(ones1, ones & B1000);
    digitalWrite(ones2, ones & B0100);
    digitalWrite(ones3, ones & B0010);
    digitalWrite(ones4, ones & B0001);
}
```



實驗三 結果

DEMO



THE END

