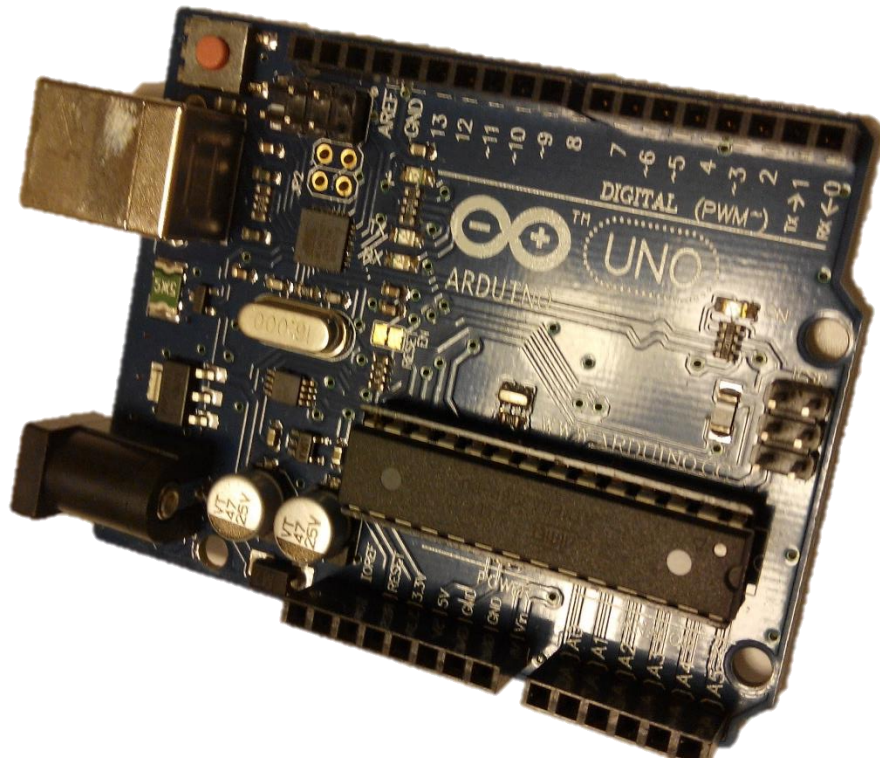# HKACE

Arduino – The First Encounter

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What is an Arduino?

Arduino is an open-source micro-controller which with lots of input and output port for connecting sensors, switches, lights, motors etc for sensing and controlling. You can upload a program you written in PC to the Arduino for manipulate the sensors and lights or motors.

The family of Arduino

There are various Arduino boards, namely are Arduino Uno, Arduino Nano, Arduino mini, Arduino Lilypad, etc.   They serve different applications and implementations, but they share the same IDE and programming style because they use the ATMEL controller chip.

Software for using Arduino

All software and tutorials can be found on http://www.arduino.cc.

The most important thing is to install the Arduino USB driver, of which you may encounter problem if you are using Windows XP.   (If you use DCcduino which is a compatible Arduino UNO board, you may need to download a driver from http://www.wch.cn/downloads/file/65.html and install it in your computer)

The IDE can be stored on USB thumb drive without installation.

What you can learn in this bootcamp

A. 0.   Use the Arduino, breadboard and jumpers

     1.   Install and using the Arduino IDE

     2.   upload your first project (Blink – using onboard LED)

B. 3.   modify BLINK to blink an external LED on breadboard

     4.   Exercise – Traffic light (controlling 3 LEDs)

C. 5.   Using potentiometer (a knob to control the brightness of a LED)

     6.   ON/OFF knob

D. 7.   Using push button

     8.   Mono stable indicator

E. 9.   using sensors (digital and/or analog input) – photo sensor

     10. Exercise – Wardrobe lighting system

F. 11. using sensors – ultra-sonic sensor

     12. Exercise – Vehicle backing distance detector

Components used in this course :-
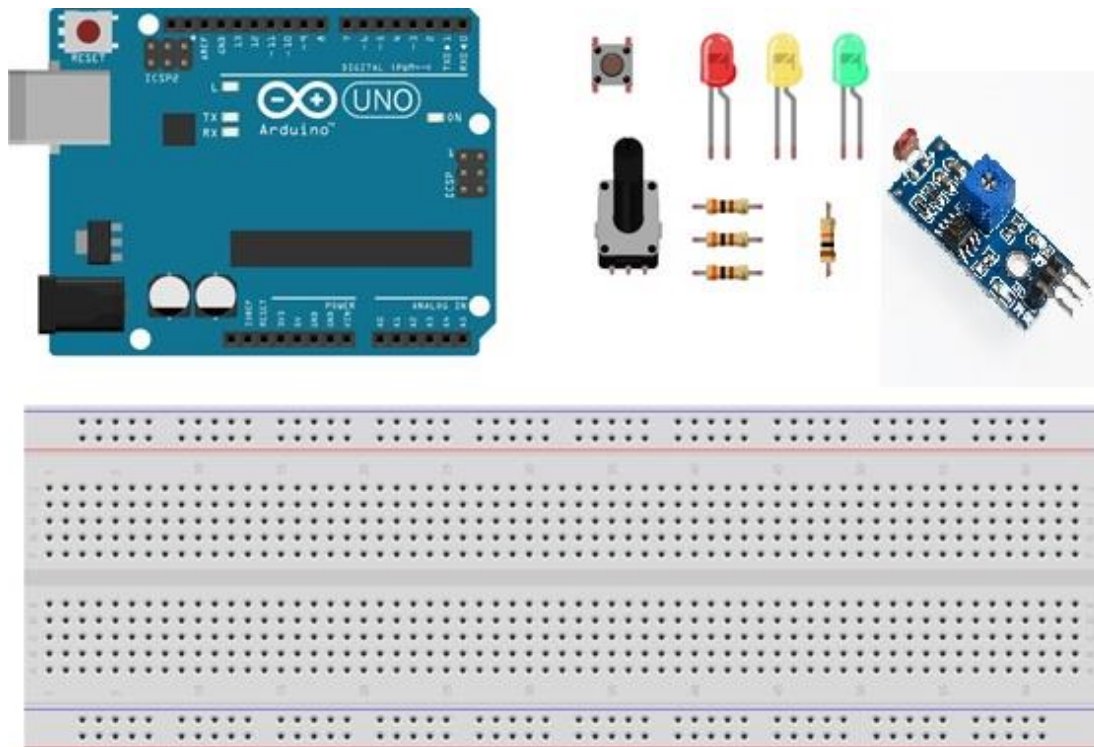
Arduino board with USB cable 1

Breadboard x 1

LED (red x 1, yellow x 1, green x 1)

Photo resistor module x 1 (some are 3 pins and some are 4 pins)

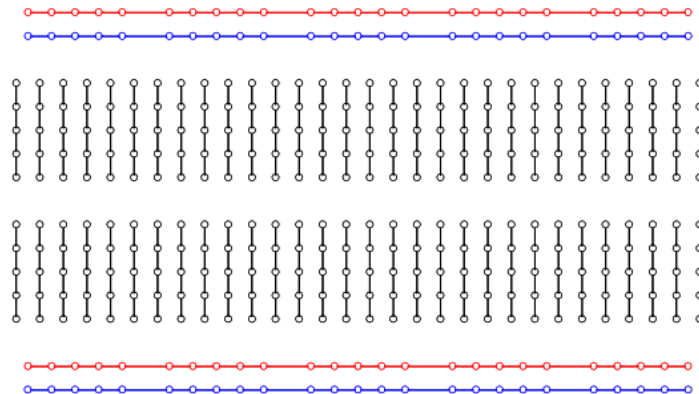Potentiometer / Variable resistor (50Kohn) x 1

Resistor (300 ohm x 3, 10K ohm x 1)

Jumping cables x 8

A. 0. The breadboard

The connection and arrangement of the breadboard

1. Download the Arduino IDE and driver
fromhttp://arduino.cc/download.php?f=/arduino-1.0.6-windows.zip
It can be run from a USB drive. (the .EXE version need to be installed)

Plug the Arduino to the USB of the computer, install driver for Arduino on
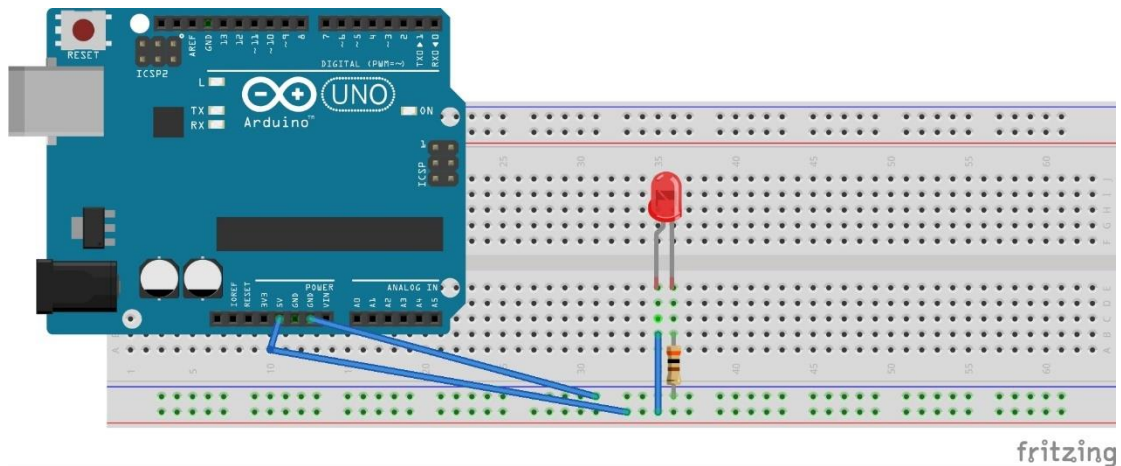\arduino-1.0.6-windows.zip\arduino-1.0.6\drivers

If you are using a low cost DCcduino UNO, you have to download the driver
from http://www.wch.cn/downloads/file/65.html

2. Execute Arduino.exe and ready to start you first project.

3. All Arduino programs has the following structure
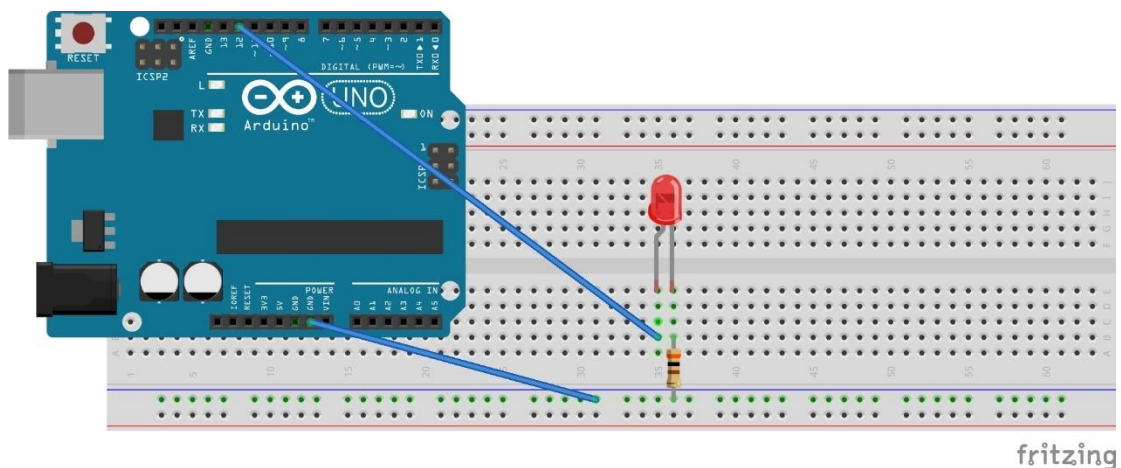
```
void setup() {

}
void loop() {

}
```

B. 3. Setup a simple circuit to light up a LED

In this example, the Arduino provide a 5V to the breadboard only.
The long leg of the LED is the +ve side.   Serial a 300ohm resistor is just for
the protection of the LED, as a LED works at 2V and 10mA.

Blink (the Hello World in Arduino)

Open the Arduino IDE and open the example BLINK from the File menu,
upload the sketch to the Arduino without modification on the sketch.   The
LED on the board should blinks, but not the LED on the breadboard.
(The following is the essential and effective statements of the program)

```
void setup() {
  pinMode(13, OUTPUT);
}

void loop() {
  digitalWrite(13, HIGH);
  delay(1000);
  digitalWrite(13, LOW);
  delay(1000);
}
```

Modify the sketch to blink the LED on breadboard at a faster rate.

4. In the last exercise you learned `pinMode(),digitalWrite()` and `delay()`. Using them to create your first project --- a traffic light with the 3 LEDs (red, yellow and green).
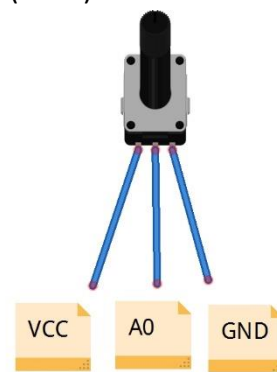
Project – Traffic light

Modify the above program to a traffic light control program.

You may use for loop statement in this project to quickly declare pin 5, 6 and 7 to OUTPUT.

```
For (int i=5; i<=7; i++) {
  pinMode(i, OUTPUT);
}
```

C.   5.   Using Potentiometer (Knob)

VCC A0 GND

The middle pin of the potentiometer connects to A0 (analog pins) is used to provide a voltage to analog pins.   The analog pin returns a value from 0 to 1023 according to the voltage on the analog pin. The value can be used for control other devices or output to the screen through the serial monitor.
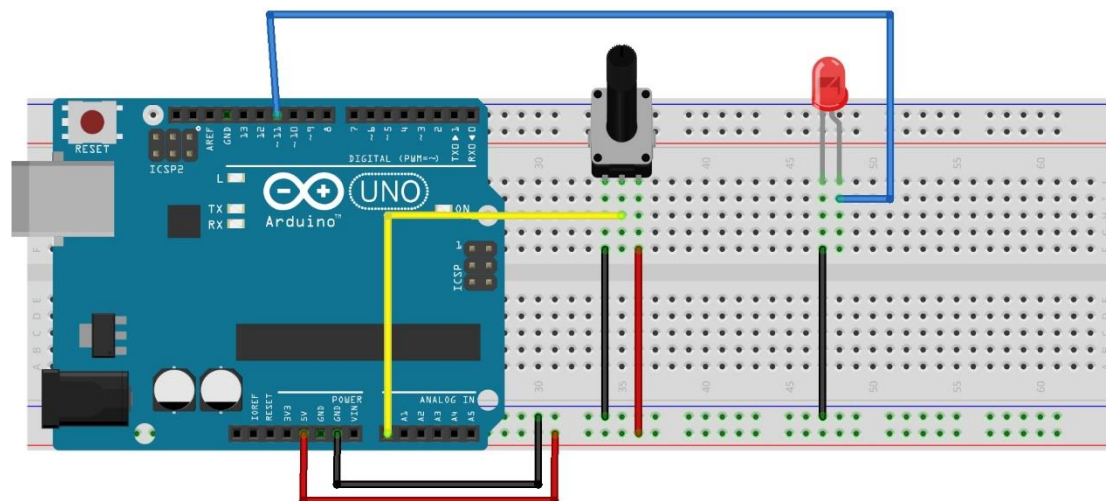
The value of the potentiometer can be used for controlling the brightness of a LED by using `analogWrite()` to the digital pins.   However, the digital pin can accept value range from 0 to 255 as parameter in the `analogWrite()` statement.

Example program :

```
// Dimmer
// by leungsir@leungsir.com

int sensorPin = A0;
int ledPin = 11;
int brightness = 0;
int sensorValue = 0;

void setup() {
  pinMode(ledPin, OUTPUT);
  Serial.begin(9600);
}

void loop() {
  sensorValue = analogRead(sensorPin);
  Serial.println(sensorValue);
  brightness = map(sensorValue,0,1024,0,255);
  analogWrite(ledPin,brightness);
}
```

`analogWrite()` only effective on digital pins with ~ (that is pin 3, 5, 6, 9, 10, and 11 only)

`Serial.begin(9600)` is needed for output messages to the serial monitor.

`Serial.println( )` is a output statement for output message to the serial monitor.

`map( )` is a function to convert a value within a certain range to another range
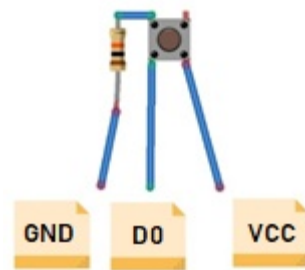
Project – ON/OFF knob

Use the functions you learned together with IF statement to change the dimmer into a on/off knob.

You may use IF statement in this project.   (the following is a demonstration of if statement)

```
if (sensorValue>= 512) {
   digitalWrite(11, HIGH);
   }
else {
   digitalWrite(11,LOW);
   };
```

D.   6.   Using push button

Make a 3 connector module by adding a 10Kohm resistor to the push button. The module is quite similar to the potentiometer.   The legs on the two sides connect ro VCC and GND.   The A0 leg connect to any one digital pin.
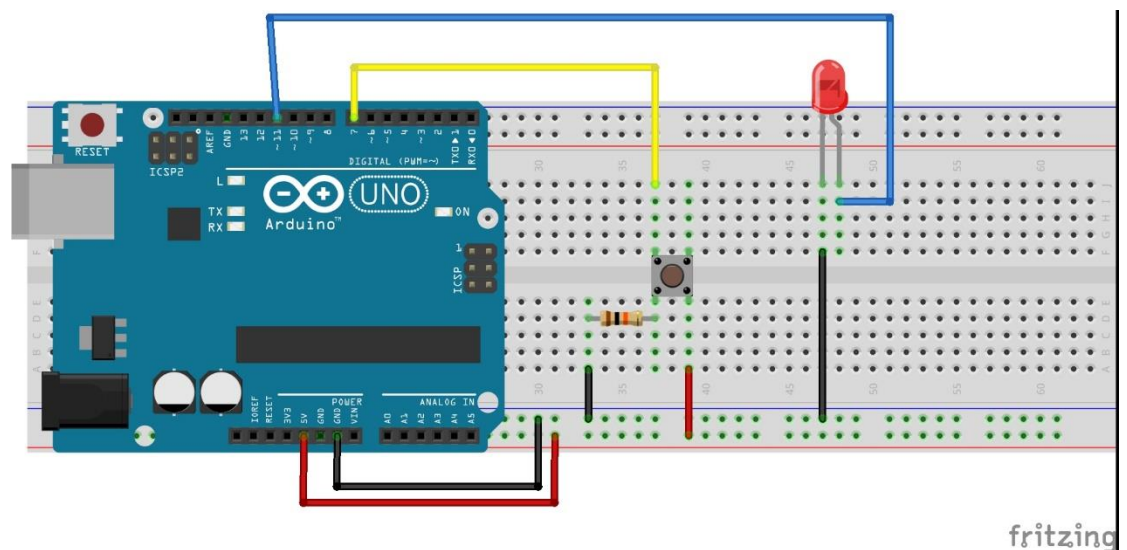

```
int buttonState = 0;

void setup() {
  pinMode(11, OUTPUT);
  pinMode(7, INPUT);
}

void loop(){
  buttonState = digitalRead(7);
  if (buttonState == 1) {
     digitalWrite(11, HIGH);
     }
  else {
     digitalWrite(11, LOW);
     };
};
```

Project – Mono stable LED

Modify the circuit (by adding one green LED) and program to a mono-stable circuit, that is , when you push the button it lights the red LED, and the green LED lights up when the button is released.   The green LED turns off after 1 second.

E.	7.	Using sensor module (photo cell module)

This photo cell module is a typical sensor module, which with 3 pins or 4 pins version.   If you have a 3 pins module, replace the button module in push button exercise with this photo cell module.   That is the D0 pin connect to the D2 of the Arduino.

You may upload the push button sketch to Arduino for test.

There are various kinds of sensor module in the market, such as water level detector, rain drop detector, soil moisture detector, etc.   Most of them have 3 pins design, the third pin can be an A0 or a D0.

Project - wardrobe lighting system

Use the photo cell sensor module to build a wardrobe lighting system, which will turn on the light when you open the door of the wardrobe. It turns the light off when you close the door.   (i.e. when there is light from outside of the wardrobe, then turn on the light in the wardrobe.   It turns the light off when there no light from outside)