

Al-Mustaqbal University

Science College

Dep. Medical Physics



Medical Physics

Second Stage

Lab3

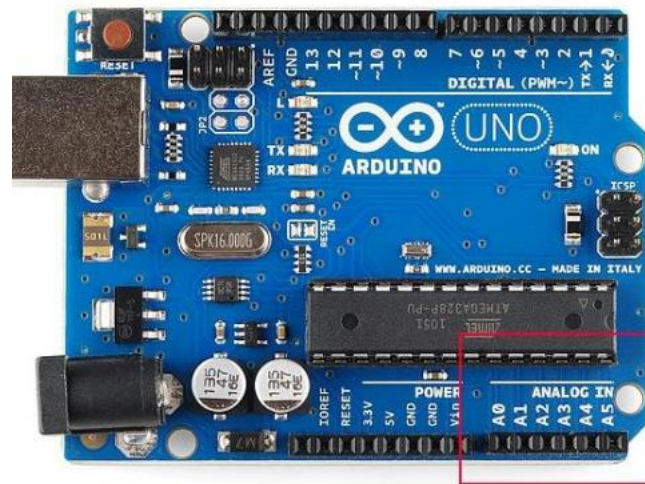
Computer 4

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Programming Arduino with Analog Signals:

Analog signals can be used with the Arduino. Where the Arduino board contains special pins to perform this purpose called analog pins. But when these pins receive an analog signal, they converted it into a digital signal in order to microcontroller can understand it. So it is names as ADC pins. Arduino UNO board has six ADC Pins from A0 to A5, as show in figure below (The number of the pins varies with Arduino model but the coding remains the same.). Among those any one or all of them can be used as inputs for analog voltage.



There are special commands to handle analog signals:

analogRead(pin): Reads the value from the specified analog pin.

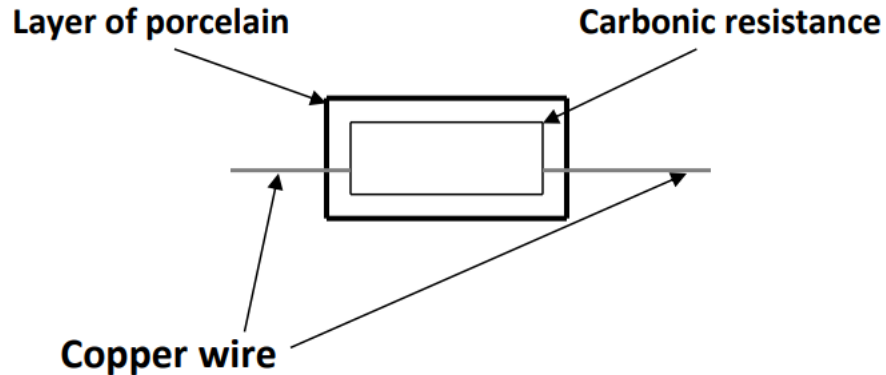
analogWrite(pin, value): Writes an analog value (PWM wave) to a pin.

analogReference(type): Configures the reference voltage used for analog input.

Resistors

Resistor is an electrical element useful for impedes passage of the current to a certain extent proportional to the value of the resistance. The current passing through 100 ohms resistance is greater than the current passing at 10 kohm resistance when applying the same voltage value to them. The resistance is measured in the unity of the ohm and symbolizes this symbol Ω : There are two types of resistors:

- 1- Constant resistors:** Is a constant resistance value and varies in use according to its ability to pass current, where there are large and small sizes. And come in many forms, including carbonic resistors, which we will use in our laboratory. Carbonic resistance is covered with a layer of porcelain to protect it and its edges are made of copper, which is considered a very good conductor and resist rust.



- 2- Potentiometer:** The internal voltage is divided into a smaller voltage, so the variable resistance differs from the normal resistance in that it can change its value in a given range, for example, from 1 k Ω to 10 k Ω

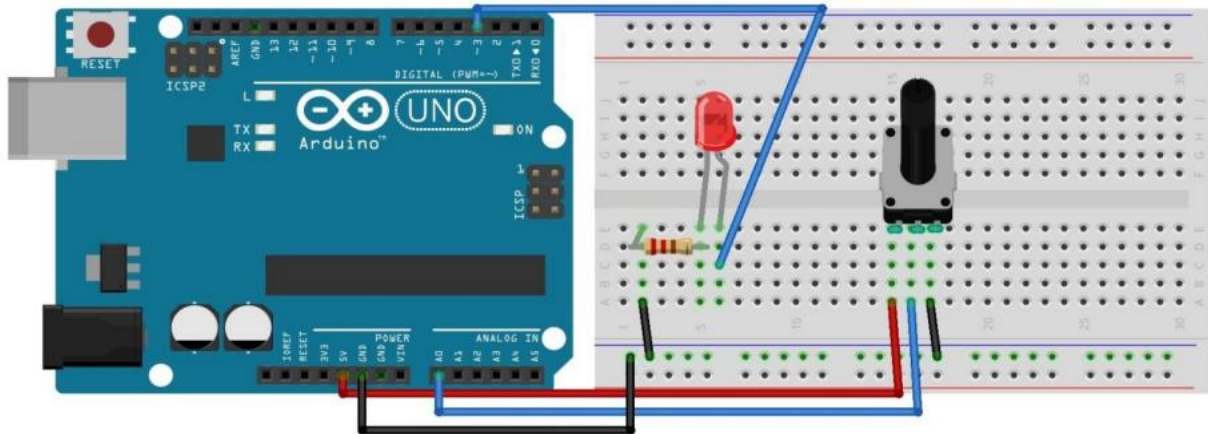


Example:

(Control the brightness of light by Potentiometer)

Requirements: Arduino, BreadBoard, Led, Potentiometer, Resistors, wires.

Connection map:



Code:

```
int led = 3;
int res = A0;
int vin = 0;
void setup() {
  pinMode(led, OUTPUT);
}
void loop(){
  vin = analogRead(res);
  vin=map(vin, 0, 1023, 0, 255);
  analogWrite(led, vin);
}
```

Note!!

Map: Re-maps a number from one range to another. That is, a value of **fromLow** would get mapped to **toLow**, a value of **fromHigh** to **toHigh**, values in-between to values in-between, etc
map(value, fromLow, fromHigh, toLow, toHigh)

PWM

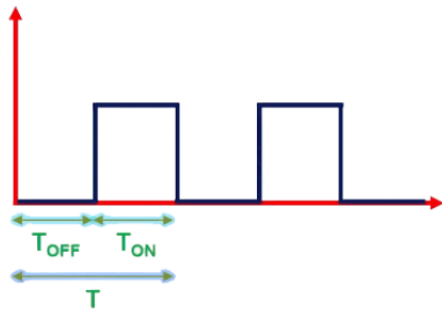
Pulse Width Modulation, or PWM, is a technique to changes the duty cycle of a square wave to alter how much power is supplied to the attached component with a varying high and low time.

There are various terms associated with PWM

- ❖ **On-Time** – Duration of time signal is high.
- ❖ **Off-Time** – Duration of time signal is low.
- ❖ **Period** – It is represented as the sum of on-time and off-time of PWM signal ($T_{total}=T_{on}+T_{off}$).
- ❖ **Duty Cycle** – It is represented as the percentage of time signal that remains on during the period of the PWM signal ($D=T_{on} / T_{on}+T_{off} \rightarrow =T_{on}/T_{total}$).

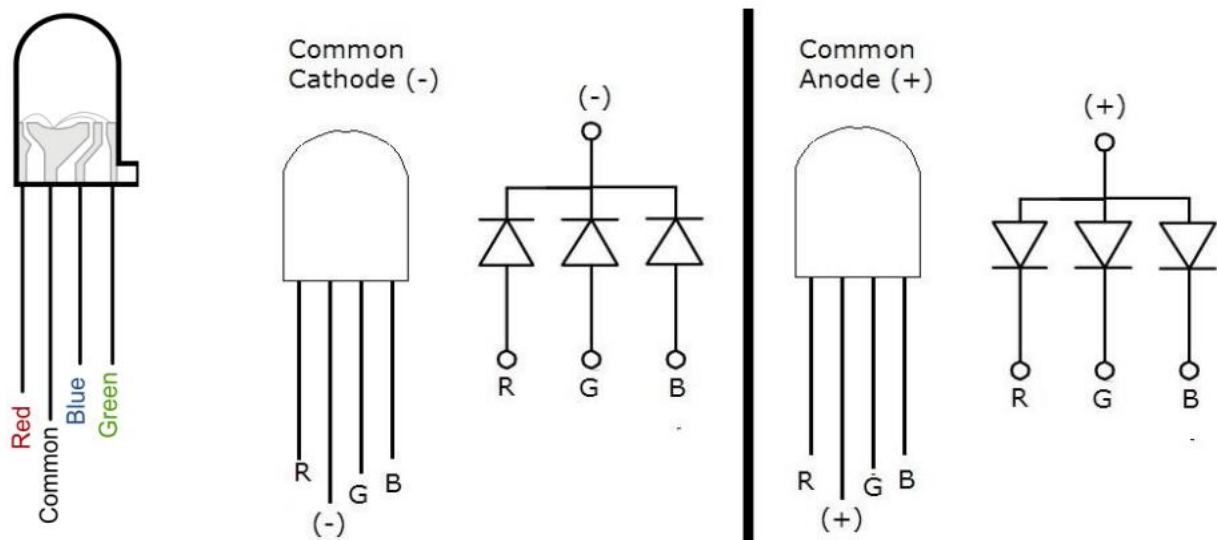
$$\text{Duty Cycle} = \frac{T_{\text{ON}}}{T_{\text{OFF}} + T_{\text{ON}}}$$

$$T = T_{\text{ON}} + T_{\text{OFF}}$$



RGB LED

The RGB LED can emit different colors by mixing the 3 basic colors red, green and blue. So it actually consists of 3 separate LEDs red, green and blue packed in a single case. That's why it has 4 pins, one pin for each of the 3 colors and one common cathode or anode depending of the RGB LED type.

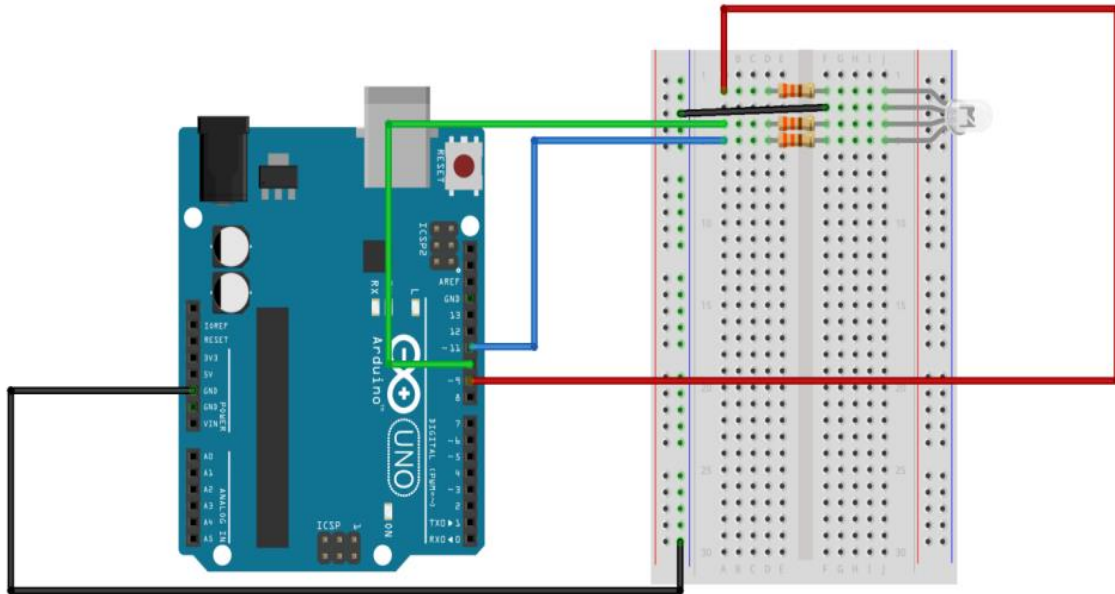


Example:

(RGB led)

Requirements: Arduino, BreadBoard, RGB Led, 3Resistor, wires.

Connection map:



Code:

```
int RED_PIN = 9;  
int GREEN_PIN = 10;  
int BLUE_PIN = 11;  
void setup()  
{  
  pinMode(RED_PIN, OUTPUT);  
  pinMode(GREEN_PIN, OUTPUT);  
  pinMode(BLUE_PIN, OUTPUT);  
}
```

```
void loop()
{
//RED
digitalWrite(RED_PIN, HIGH);
digitalWrite(GREEN_PIN, LOW);
digitalWrite(BLUE_PIN, LOW);
delay(1000);

//Green
digitalWrite(RED_PIN, LOW);
digitalWrite(GREEN_PIN, HIGH);
digitalWrite(BLUE_PIN, LOW);
delay(1000);

//Blue
digitalWrite(RED_PIN, LOW);
digitalWrite(GREEN_PIN, LOW);
digitalWrite(BLUE_PIN, HIGH);
delay(1000);

//Yellow
digitalWrite(RED_PIN, HIGH);
digitalWrite(GREEN_PIN, HIGH);
digitalWrite(BLUE_PIN, LOW);
delay(1000);
```



```
//White
```

```
digitalWrite(RED_PIN, HIGH);
```

```
digitalWrite(GREEN_PIN, HIGH);
```

```
digitalWrite(BLUE_PIN, HIGH);
```

```
delay(1000);
```

```
}
```

H.W

- 1- What are the data types of variables?**
- 2- What are the temperature units?**
- 3- What is the Serial Connection?**
- 4- Why we use library in Arduino?**