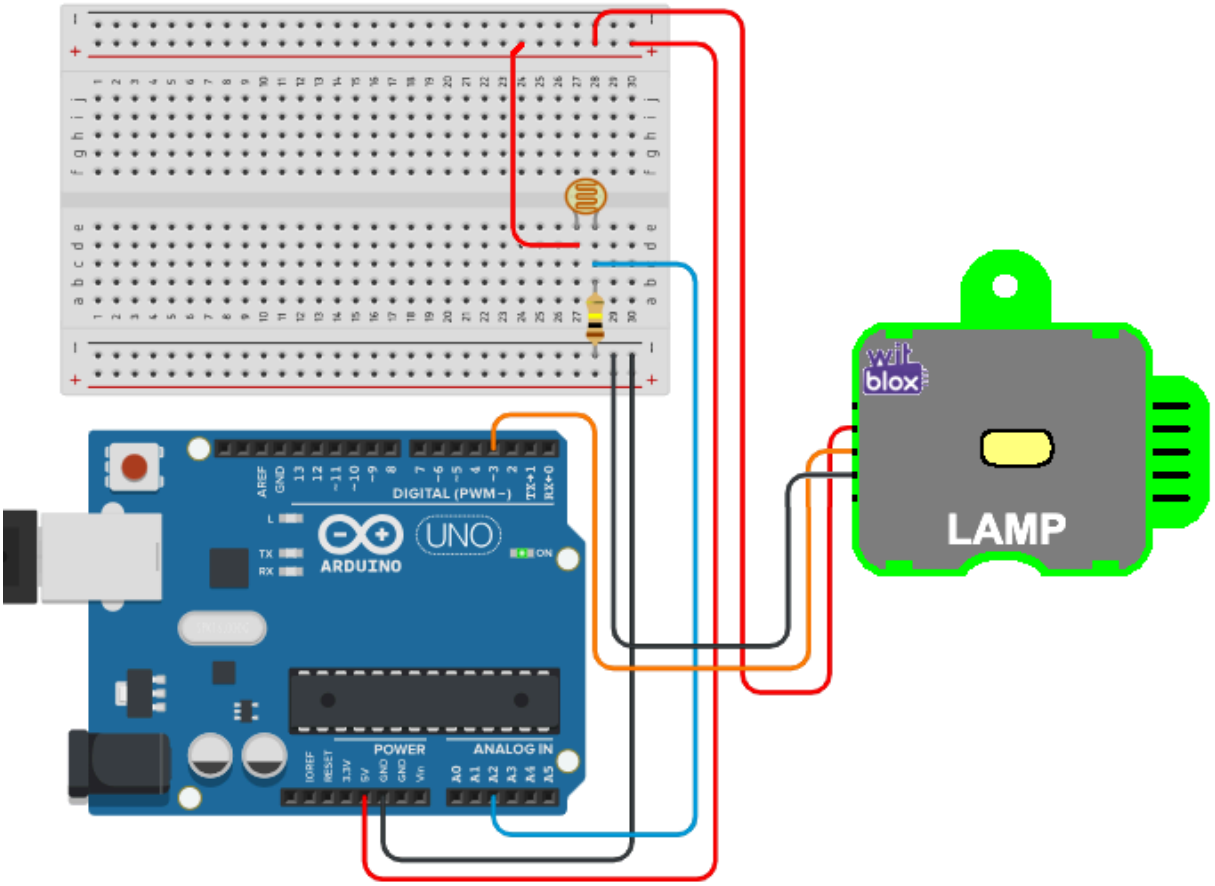
Activity: Make a Dimmable LED Lamp Using Analog Input

Objective:



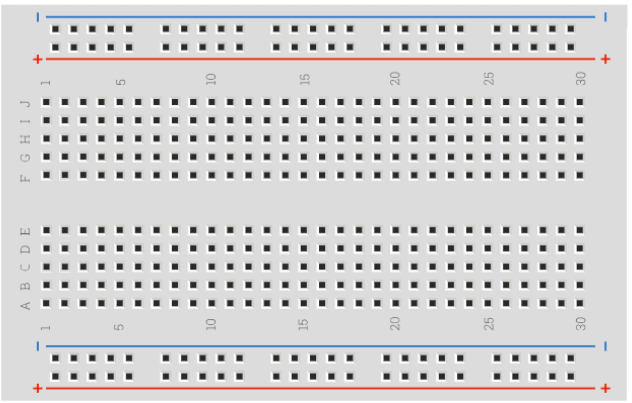
In today's rapidly evolving world of technology and automation, the demand for energy-efficient lighting solutions has led to the widespread adoption of Light Emitting Diode (LED) lamps. These lamps are not only energy-efficient but also highly versatile. However, to maximize their efficiency and utility, it is essential to control their brightness or intensity. This is where Arduino and Light Dependent Resistors (LDRs) come into play.

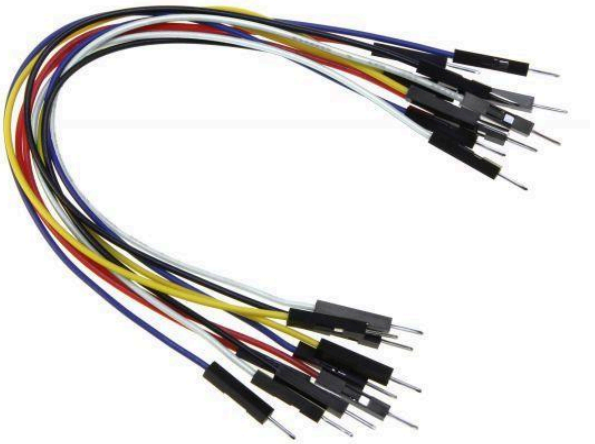
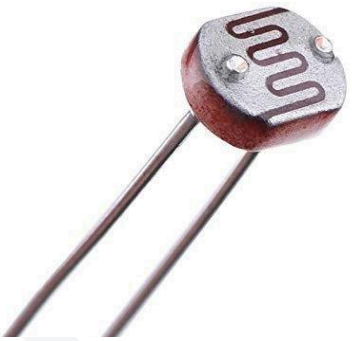
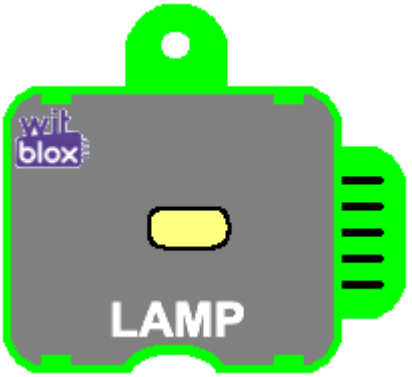
Dimmable LED lamps offer the flexibility to adjust the brightness according to specific needs, whether it's creating ambiance in a room, conserving energy, or simply adapting to changing lighting conditions.

The activity uses the Lamp blox in place of white LED and is connected to the Arduino, and the Arduino controls the brightness of the white LED in the Lamp blox.

So, in today’s activity we will learn how to make a Dimmable LED lamp which will be controlled by the LDR light sensor and an Arduino. The brightness of the Lamp will increase and decrease according to the LDR light sensor.

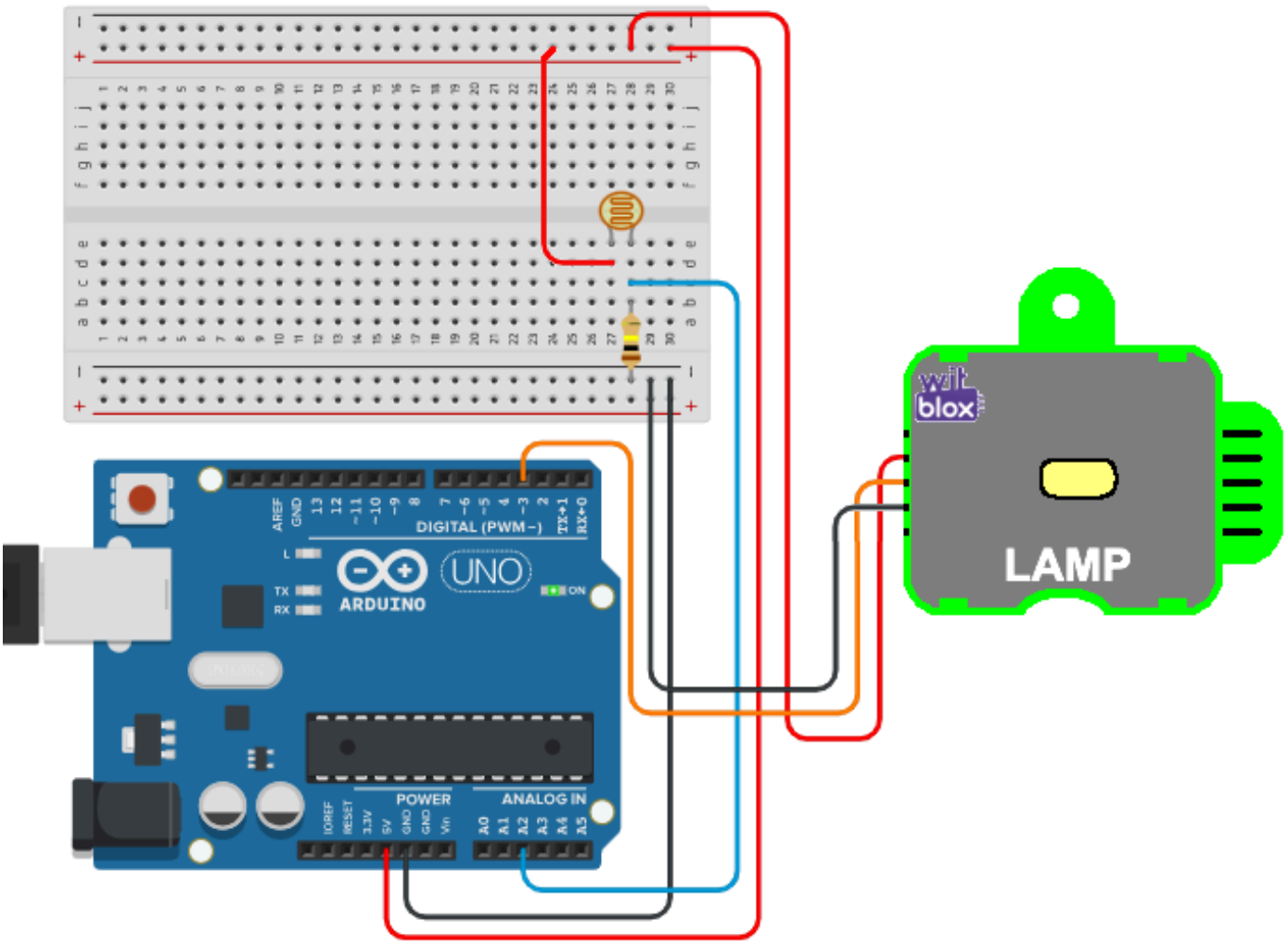
Materials Required:

S.no.	Part	Qty	Image
1	Arduino (Nano / UNO)	1	
2	Breadboard	1	
3	USB cable for Arduino	1	

4	Connection Wires (M - M)	10	
5	LDR Light Sensor	1	
6	100k resistor (Brown Black Yellow Golden)	1	
7	Lamp Blox	1	

Connection Diagram:

The connection diagram shown in the image below is based on the Arduino UNO.



Explanation:

The connection diagrams shown in both the images show the connections between the Arduino, the Input and the Output. The LDR, which is the analog light sensing component, is the Input for the Arduino while the Lamp blox is the Output for the Arduino.

When we closely observe the connection diagrams, it becomes quite clear that:

1. The LDR is connected such that its one end is connected to the +ve of the breadboard and the other end is connected to one side of the 100k resistor.

2. The 100k resistor is connected such that its one end is connected to the LDR while the other side is connected to the -ve of the breadboard.

3. The junction, where the LDR meets the 100k resistor, is where the Arduino analog input pin 2 (A2) is connected with a connection wire for sensing the analog changes in Light intensity.

4. The Lamp blox is connected such that its +ve power pin (2nd pin from the top) is connected to the +ve of the breadboard and its -ve power pin (4th pin from the top) is connected to the -ve of the breadboard. The Data input pin of the Lamp blox (3rd pin from the top) is connected to Arduino digital pin 3 (D3).

5. The 5v pin of the Arduino is connected to the +ve of the breadboard and the Gnd pin of the Arduino is connected to the -ve of the breadboard.

6. Finally, the USB cable from the Arduino is connected to the Computer's USB. This cable serves for providing power, program uploading, as well as bi-directional serial data communication.

Arduino Code:

Here is the complete Arduino code for making a Dimmable LED Lamp using an Arduino , a Lamp blox and an LDR.

```
#define LDR A2
#define Lamp 3

int ldr_value;

void setup()
{
  pinMode(LDR, INPUT);
  pinMode(Lamp, OUTPUT);
}

void loop()
```

```
{
  ldr_value = analogRead(LDR);

  if((ldr_value>0)&&(ldr_value<200))
    {
      analogWrite(Lamp,250);
    }

  if((ldr_value>200)&&(ldr_value<400))
    {
      analogWrite(Lamp,200);
    }

  if((ldr_value>400)&&(ldr_value<600))
    {
      analogWrite(Lamp,150);
    }

  if((ldr_value>600)&&(ldr_value<800))
    {
      analogWrite(Lamp,100);
    }

  if((ldr_value>800)&&(ldr_value<900))
    {
      analogWrite(Lamp,50);
    }

  if(ldr_value>900)
    {
      analogWrite(Lamp,0);
    }
}
```


Explanation:

```
#define Lamp 3
#define ldr A2

int ldr_value;
```

Here, we are declaring that analog pin 2 (A2) will be referred to as “ldr” and digital pin 3 (D3) will be referred to as “Lamp” and then we take an integer type variable and call it “ldr_value” for storing the analog value of the light intensity.

```
void setup()
{
 pinMode(Lamp, OUTPUT);
 pinMode(ldr, INPUT);
}
```

Here, inside the setup function, we are declaring that the “ldr” pin will be used as an Input pin and the Lamp pin will be used as an Output pin. These need to be done just once.

```
void loop()
{
  ldr_value = analogRead(LDR);

  if((ldr_value>0)&&(ldr_value<200))
    {
      analogWrite(Lamp,250);
    }

  if((ldr_value>200)&&(ldr_value<400))
    {
      analogWrite(Lamp,200);
    }

  if((ldr_value>400)&&(ldr_value<600))
    {
      analogWrite(Lamp,150);
    }

  if((ldr_value>600)&&(ldr_value<800))
    {
      analogWrite(Lamp,100);
    }

  if((ldr_value>800)&&(ldr_value<900))
    {
      analogWrite(Lamp,50);
    }
```

```
  if(ldr_value>900)
    {
      analogWrite(Lamp,0);
    }
}
```

Here, in the loop function, first the light intensity is stored in the “ldr_value” variable using an “analogRead()”.

Then this stored value is compared against a threshold value. Here, we have chosen the threshold value for comparison to be 5 different values because we want 5 different brightness levels.

If the reading from the LDR light sensor is found to be in the range of 0 - 200 then the Lamp is turned On with brightness level of 250.

If the reading from the LDR light sensor is found to be in the range of 200 - 400 then the Lamp is turned On with brightness level of 200.

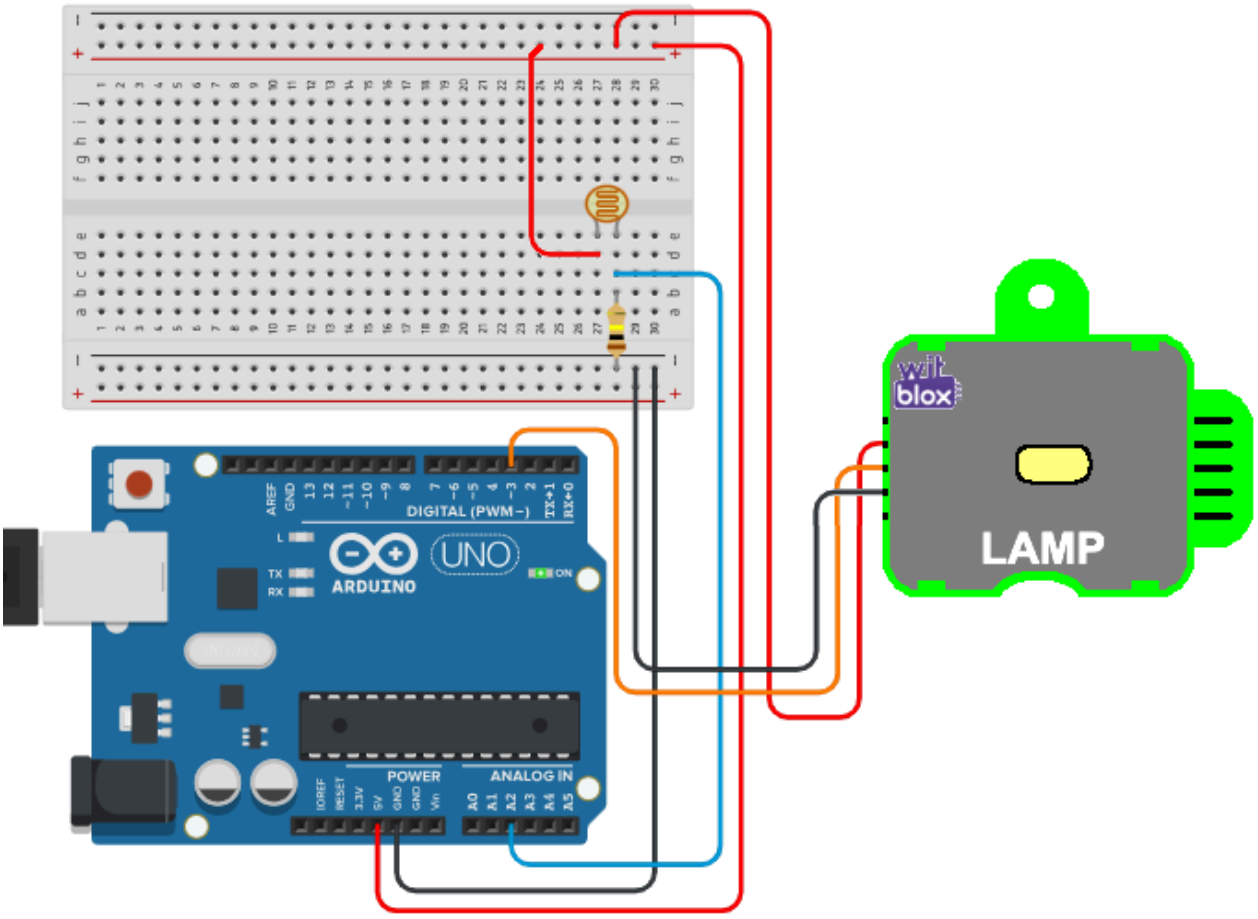
If the reading from the LDR light sensor is found to be in the range of 400 - 600 then the Lamp is turned On with brightness level of 150.

If the reading from the LDR light sensor is found to be in the range of 600 - 800 then the Lamp is turned On with brightness level of 100.

If the reading from the LDR light sensor is found to be in the range of 800 - 900 then the Lamp is turned On with brightness level of 50.

If the reading from the LDR light sensor is found to be more than 900 then the Lamp is turned Off.

Outcome and Observations:



1. Once the Arduino code is compiled and uploaded, place the setup in a brightly lit room or outdoors. The LED should be initially Off or too dimly lit.

2. If we keep moving our hand such that it casts a shadow on the LDR light sensor, the closer we get our hand to the LDR light sensor, the smaller is the amount of Light falling on the LDR light sensor.

   At some point this value will be low enough to cross the thresholds of 900, then 800, then 600 and so on all the way up to 200. As soon as the value goes below these thresholds, the Lamp blox is turned On with successively brighter and brighter and ultimately we get bright white light.

3. Now, if we keep moving our hand farther and farther away from the LDR light sensor, the larger is the amount of Light falling on the LDR light sensor.

   While moving our hand away farther and farther as we keep crossing the same threshold values in the opposite direction, the Lamp blox gets successively dimmer and dimmer and ultimately turns off depending on how bright the place is.