Chapter 12

Using Sensors with Arduino

Sensors gives us measurement about a quantity of this real world. They give answers the questions like:

a) What is the temperature of this room?
b) What is the amount of light of your environment?
c) How much is the humidity today?
d) What is the air pressure?
e) What is the speed of air?
f) Is there anyone present in this room?
g) Is there any smoke in the air?
h) Is there any poisonous gas in the air?
i) Amount of moisture in the water?
j) Level of water in the water tank?

Here, things start being interesting. Let's start with the simplest form of a sensor: The **Potentiometer.** Actually, it is not a sensor. It gives data about the position of a knob.
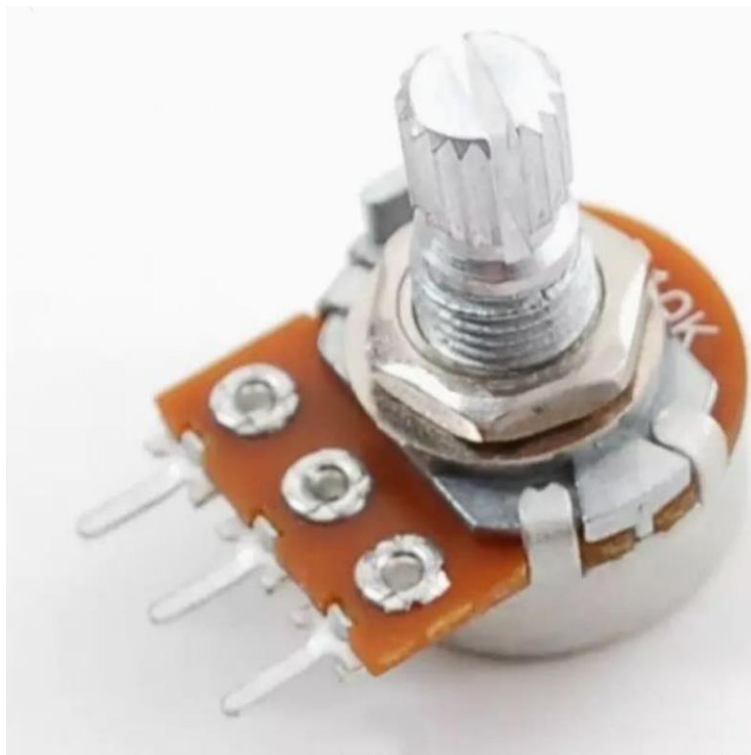
This is a 10K ohm potentiometer. It is actually a variable resistor. The total amount of resistance is 10K ohms and it is fixed between the left and the right leg. The variable resistance appears at the middle leg based on the knob's position. If you rotate the knob. The resistance at middle pin changes. Enough theory let's go to Arduino IDE.

Build the circuit below:
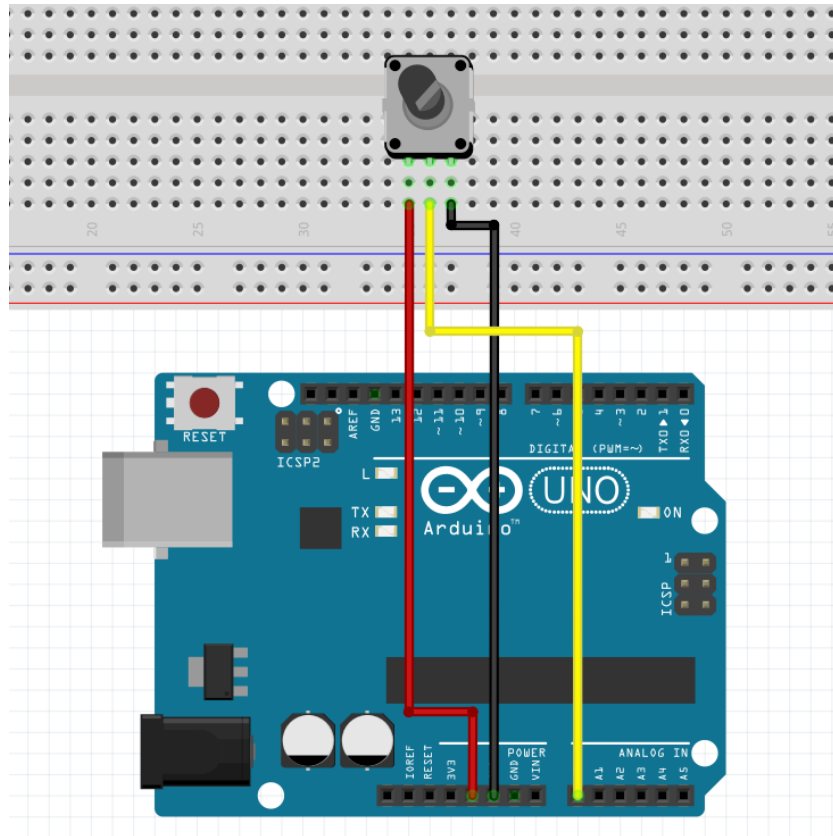
You see that the 5V wire is red and the GND wire is black. This is a tradition. Always try to follow this. It will save you from a lot of trouble in future.
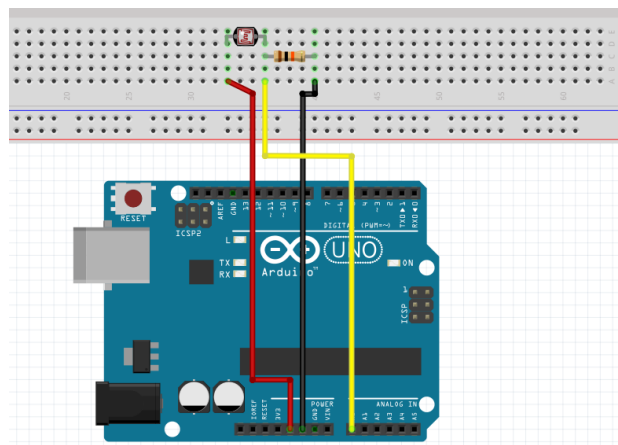
Upload this code to Arduino:

```
File   Edit   Sketch   Tools   Help

      Arduino Uno                    ▼

sketch_jul1a.ino
   1   int sensorPin = A0;    // This is the pin that will take reading
   2   int sensorValue;       // This variable will store the sensor reading.
   3
   4   void setup() {
   5     Serial.begin(9600);
   6     pinMode(sensorPin, INPUT);   // INPUT pins takes signal from outside.
   7   }
   8
   9   void loop() {
  10     sensorValue = analogRead(sensorPin);   // Reading from the pin and storing it into the variable
  11     Serial.println(sensorValue);           // Printing the result
  12     delay(100);                            // Just to make the printing slow
  13   }
```

Open the Serial monitor and rotate the potentiometer.

Well, that was not interesting. A potentiometer is not a sensor. Let's use a real sensor:

Take the **LDR** from your box and build the below circuit: (Find the resistor on your own. The third color is orange not red.)
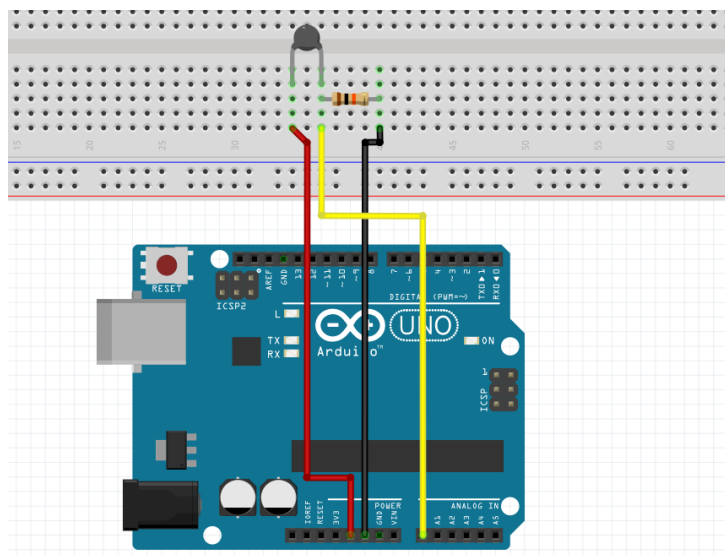

Now upload the same code as before:

```
sketch_jul1a.ino
1   int sensorPin = A0;    // This is the pin that will take reading
2   int sensorValue;       // This variable will store the sensor reading.
3
4   void setup() {
5     Serial.begin(9600);
6     pinMode(sensorPin, INPUT);   // INPUT pins takes signal from outside.
7   }
8
9   void loop() {
10    sensorValue = analogRead(sensorPin);   // Reading from the pin and storing it into the variable
11    Serial.println(sensorValue);           // Printing the result
12    delay(100);                            // Just to make the printing slow
13  }
```
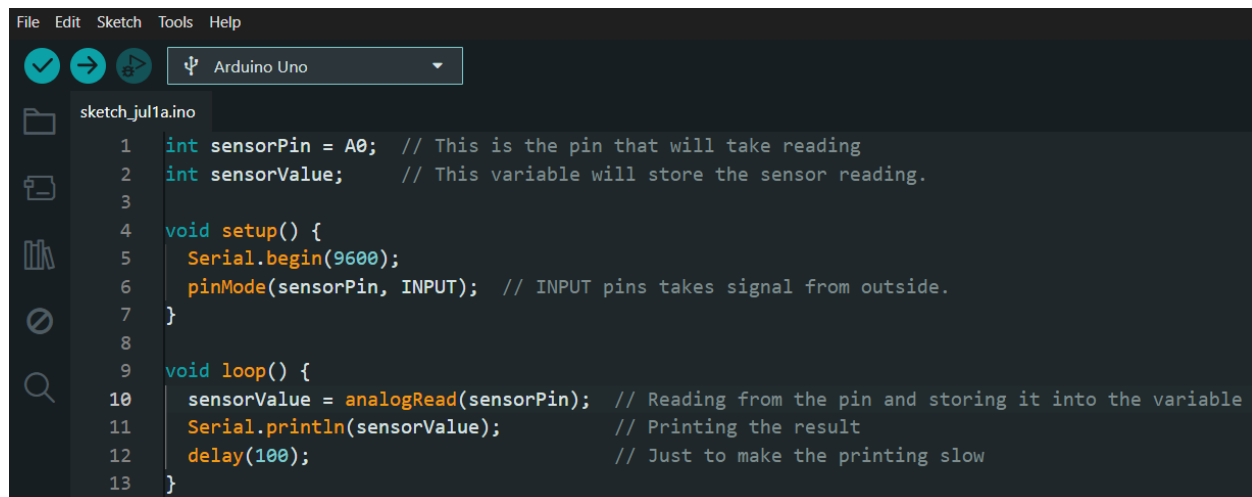
Now see the result in the Serial monitor. Turn off the light of your room. Now turn on the light. See what is happening? One thing to mention here, **LDR means Light Dependent Resistor.**

Let's try the temperature sensor:

Build this circuit below:

Now, upload the same code as before:

```
File  Edit  Sketch  Tools  Help

                Arduino Uno

sketch_jul1a.ino
    1   int sensorPin = A0;   // This is the pin that will take reading
    2   int sensorValue;      // This variable will store the sensor reading.
    3
    4   void setup() {
    5     Serial.begin(9600);
    6     pinMode(sensorPin, INPUT);  // INPUT pins takes signal from outside.
    7   }
    8
    9   void loop() {
   10     sensorValue = analogRead(sensorPin);  // Reading from the pin and storing it into the variable
   11     Serial.println(sensorValue);          // Printing the result
   12     delay(100);                           // Just to make the printing slow
   13   }
```
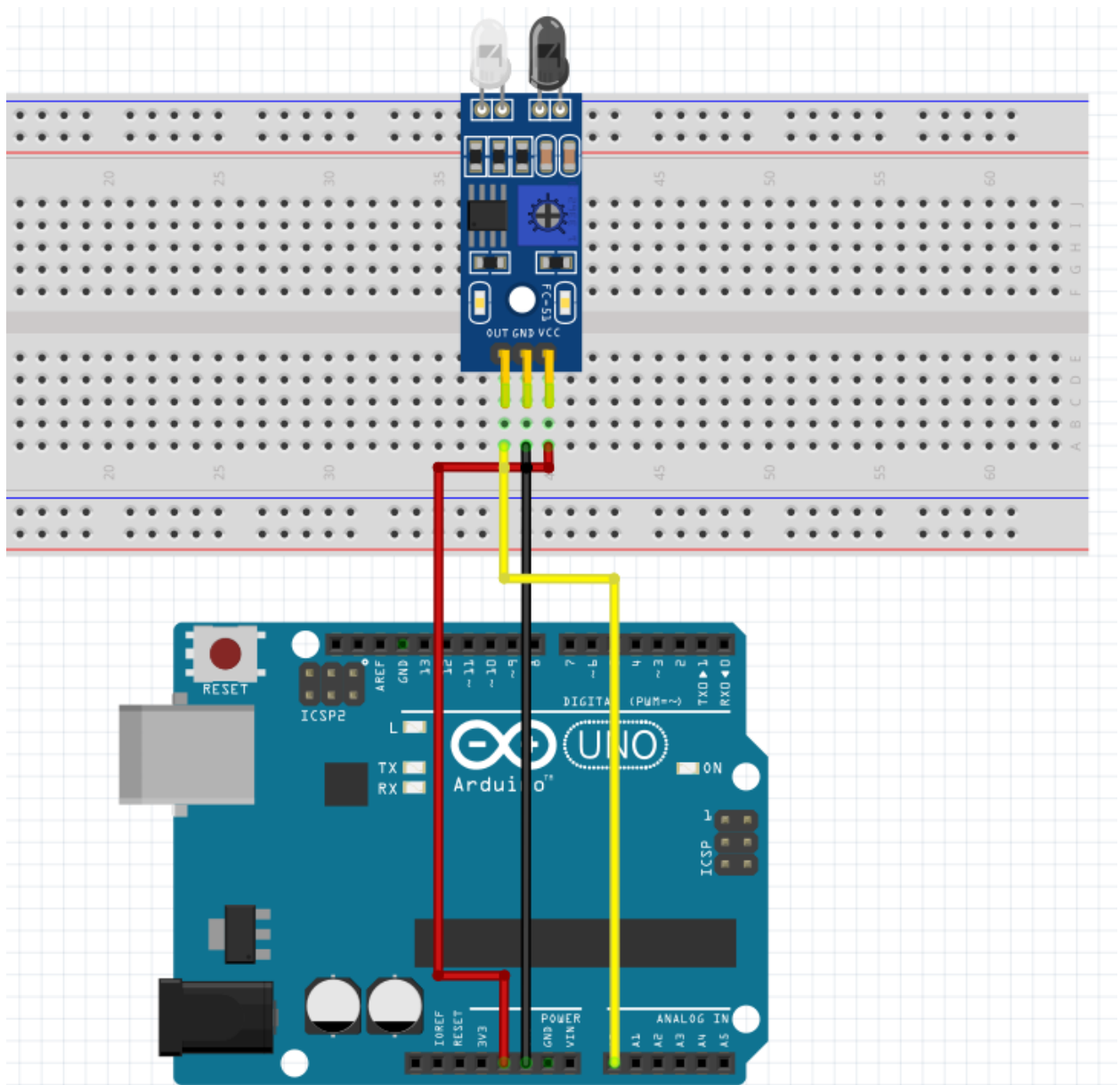
Open the Serial monitor and see the temperature of your room. But wait. That's not the temperature of the environment. But it is an equivalent measurement by our Arduino.

Before we start talking about theory turn on the fan, let the temperature reduce a little, see that the value on serial monitor reduces. Now blow some hot air from your mouth over the sensor, see that the value increases. So, we have a value that changes with temperature but it is not the actual temperature.
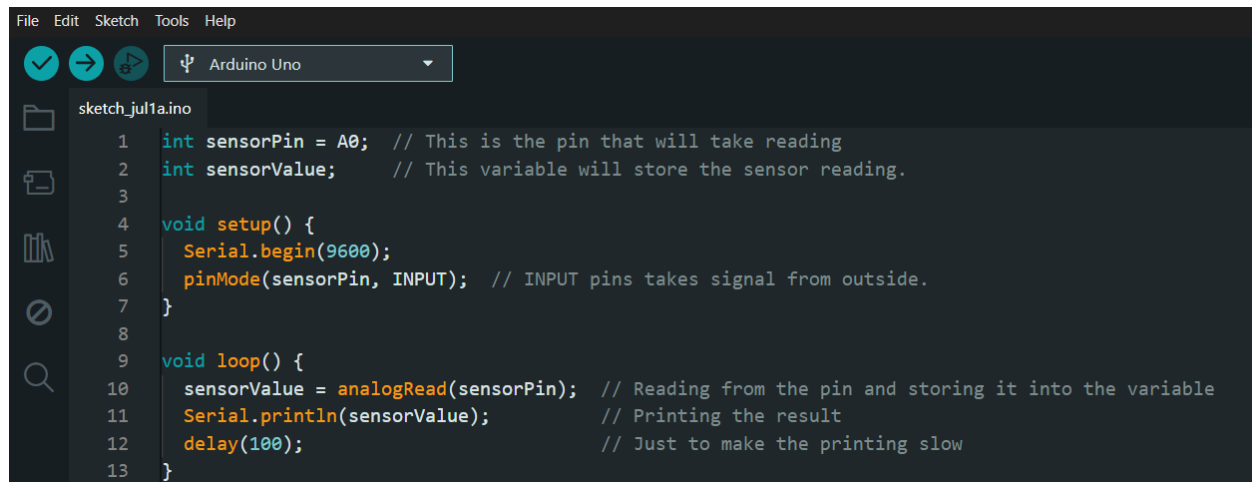
 To know the actual temperature measurement in Celsius, you have to convert this measurement into degree Celsius using some basic math. The exact math depends upon the sensor. Our sensor is a 10K NTC (negative temperature coefficient) temperature sensor. Find the mathematics of conversion on your own. The target is to learn how to use google and YouTube not ChatGPT.

Let's try the IR obstacle sensor.

Build the circuit below: (The sequence of pins in the below image may not match with yours.)

Now upload the same code as before:

```
File  Edit  Sketch  Tools  Help

          Arduino Uno                 ▼

sketch_jul1a.ino
     1   int sensorPin = A0;   // This is the pin that will take reading
     2   int sensorValue;      // This variable will store the sensor reading.
     3
     4   void setup() {
     5     Serial.begin(9600);
     6     pinMode(sensorPin, INPUT);  // INPUT pins takes signal from outside.
     7   }
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    10     sensorValue = analogRead(sensorPin);  // Reading from the pin and storing it into the variable
    11     Serial.println(sensorValue);          // Printing the result
    12     delay(100);                           // Just to make the printing slow
    13   }
```

Open the serial monitor. Put a hand before the sensor LED and the remove your hand. What is happening? Try to understand this on your own.

Also, there is an IR LED on this sensor. This IR can be seen by our phone camera but not by our human eyes. Try this.

Note: we will learn the ultrasonic sonar sensor at the end of this training program.

Assignment 05:

1. Control the SSD with the potentiometer.

Potentiometer reading	SSD
0-100	0
101-200	1
201-300	2
So on	So on

2. Connect LDR and a LED to Arduino. When the light of your room is ON the LED will be off. When the light of your room is OFF the LED will be ON.
3. Find the conversion formula to get reading in Celsius from that NTC temperature sensor.
4. Connect the IR sensor and a Buzzer to Arduino. If you put your hand in front of IR the buzzer should make some noise. (Idea: you can turn it into a thief alarm type of thing. If the door opens the alarm rings)
5. Mask a portion of a white paper with black tape. Now put the black portion Infront of the IR sensor and see the reading, now put the white portion if from and see the reading. If the readings are not different you may have to rotate the knob on the IR module. Or you may have to put the paper a little far/closer to IR. (Moral of the story of Q5: IR can differentiate between white and black paper so they are used in line follower robots). (If you face problem in Q5, feel free to ask.)