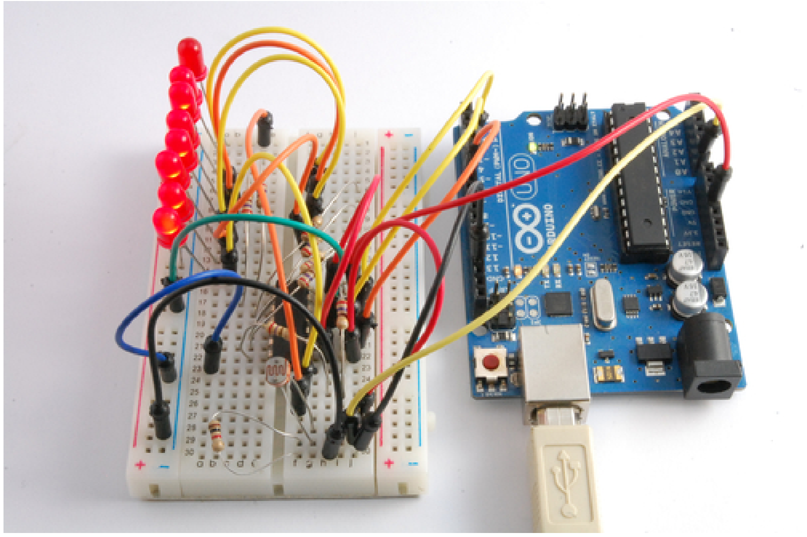
adafruit learning system

Arduino Lesson 9. Sensing Light

Created by Simon Monk

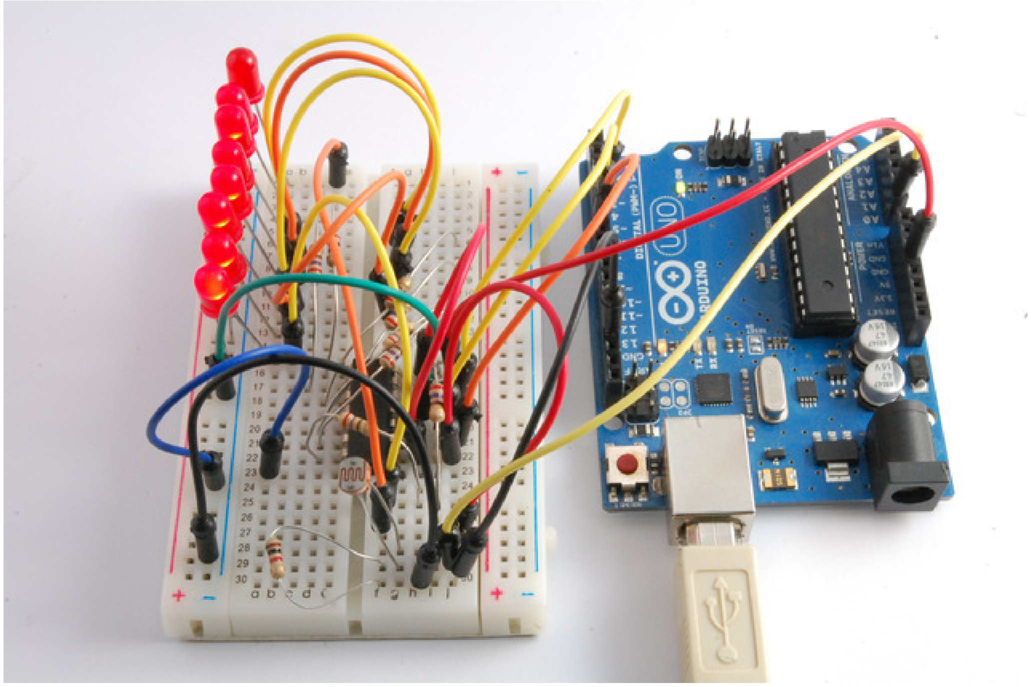


Last updated on 2018-08-22 03:32:16 PM UTC

Guide Contents

Overview

In this lesson, you will learn how to measure light intensity using an Analog Input. You will build on lesson 8 and use the level of light to control the number of LEDs to be lit.



The photocell is at the bottom of the breadboard, where the pot was in lesson 8.

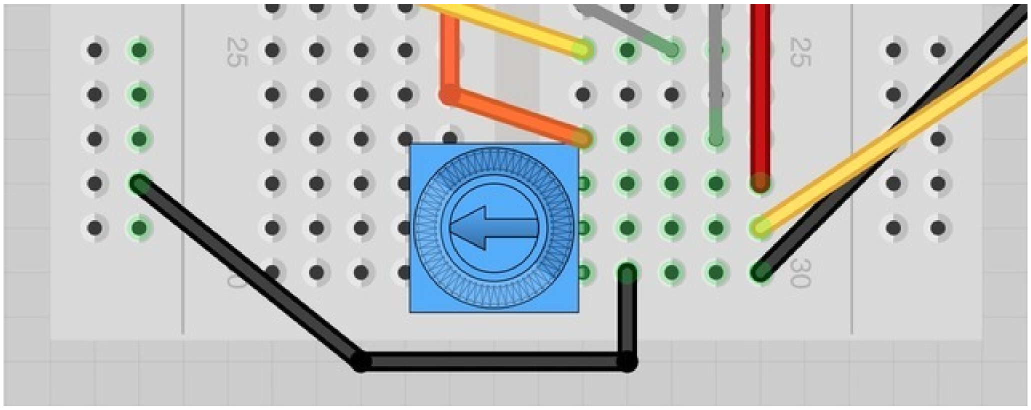
Parts

Part	Qty
5mm red LED	8
270 Ω Resistors (red, purple, brown stripes)	8
1 kΩ Resistor (brown, black, red stripes)	1
74HC595 Shift Register	1
Photocell (Light Dependent Resistor)	1
Half-size Breadboard	1
Arduino Uno R3	1
Jumper wire pack	1

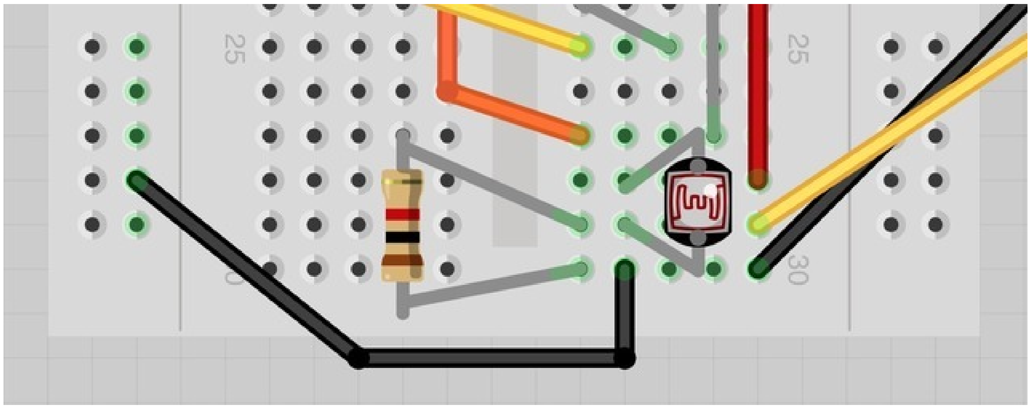
Breadboard Layout

The breadboard layout for this lesson is the same as for lesson 8, except that the pot is replaced by an LDR and a 1 kΩ resistor.

Here is the layout for lesson 8, near the pot.



Simply remove the pot and replace it with the photocell and resistor as shown below:

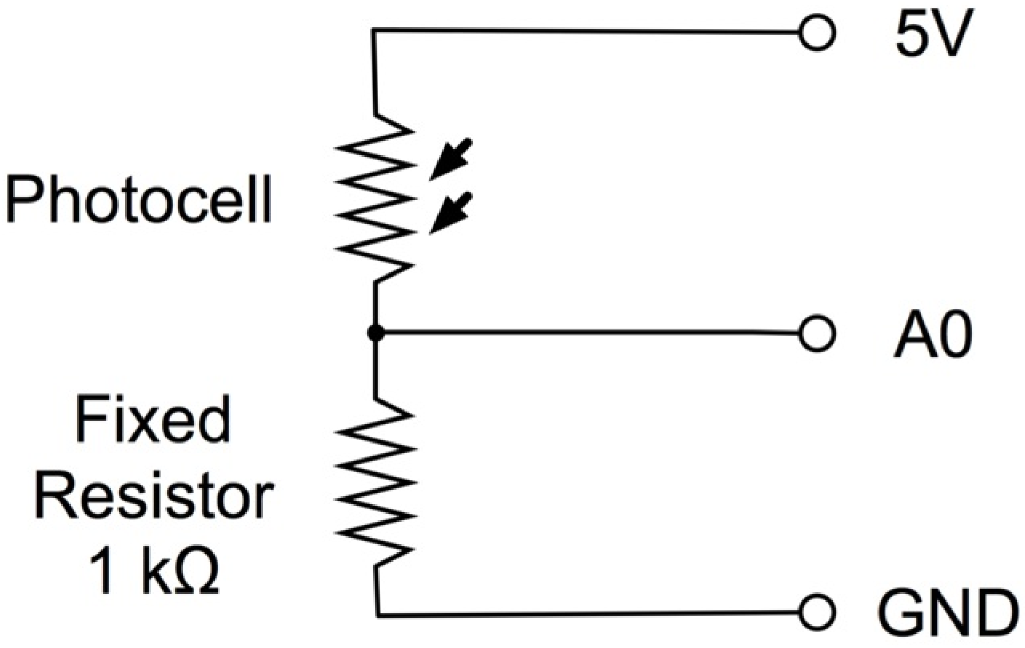


Photocells

The photocell used is of a type called a light dependent resistor, sometimes called an LDR. As the name suggests, these components act just like a resistor, except that the resistance changes in response to how much light is falling on them.

This one has a resistance of about 50 kΩ in near darkness and 500 Ω in bright light. To convert this varying value of resistance into something we can measure on an Arduino's analog input, it need to be converted into a voltage.

The simplest way to do that is to combine it with a fixed resistor.



The resistor and photocell together behave rather like a pot. When the light is very bright, then the resistance of the photocell is very low compared with the fixed value resistor, and so it is as if the pot were turned to maximum.

When the photocell is in dull light the resistance becomes greater than the fixed 1kΩ resistor and it is as if the pot were being turned towards GND.

Load up the sketch given in the next section and try covering the photocell with your finger, and holding it near a light source.

Arduino Code

The sketch that you used in lesson 8, will work, but you will find that you will not be able to find a light bright enough to light all the LEDs. This is because of the fixed resistor, so we need to compensate for the fact that no matter how low the resistance of the photocell falls, there will always be the 1 kΩ of the fixed resistor offsetting it.

The slightly modified lesson 8 sketch is listed below:

```
/*
Adafruit Arduino - Lesson 9. Light sensing
*/

int lightPin = 0;
int latchPin = 5;
int clockPin = 6;
int dataPin = 4;

int leds = 0;

void setup()
{
  pinMode(latchPin, OUTPUT);
  pinMode(dataPin, OUTPUT);
  pinMode(clockPin, OUTPUT);
}

void loop()
{
  int reading  = analogRead(lightPin);
  int numLEDSLit = reading / 57;  //1023 / 9 / 2
  if (numLEDSLit > 8) numLEDSLit = 8;
  leds = 0;   // no LEDs lit to start
  for (int i = 0; i < numLEDSLit; i++)
  {
    leds = leds + (1 << i);  // sets the i'th bit
  }
  updateShiftRegister();
}

void updateShiftRegister()
{
   digitalWrite(latchPin, LOW);
   shiftOut(dataPin, clockPin, LSBFIRST, leds);
   digitalWrite(latchPin, HIGH);
}
```

The first thing to note is that we have changed the name of the analog pin to be 'lightPin' rather than 'potPin' since we no longer have a pot connected.

The only other substantial change to the sketch is the line that calculate how many of the LEDs to light:

```
int numLEDSLit = reading / 57;  // all LEDs lit at 1k
```

This time we divide the raw reading by 57 rather than 114 from lesson 8. In other words we divide it by half as much as we did with the pot, to split it into nine zones, from no LEDs lit, to all eight lit. This extra factor is to account for the fixed

1 kΩ resistor. This means that when the photocell has a resistance of 1 kΩ (the same as the fixed resistor) the raw reading will be 1023 / 2 = 511. This will equate to all the LEDs being lit and then a bit (numLEDSLit will be 9).

Other Things to Do

To vary the sensitivity of the light meter you have just made, try changing the value of the factor (57) that you divide the analog reading by.

Increasing this value will make the reading less sensitive.

Another thing that you could try is to change the sketch so that while the reading is below a certain level, the LEDs are on, but they automatically turn off when a threshold is exceeded. So putting your finger near the photocell to cut out most of the light will turn on the LEDs.

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About the Author

Simon Monk is author of a number of books relating to Open Source Hardware. The following books written by Simon are available from Adafruit: Programming Arduino (http://adafru.it/1019), 30 Arduino Projects for the Evil Genius (http://adafru.it/868) and Programming the Raspberry Pi (https://adafru.it/aM5).