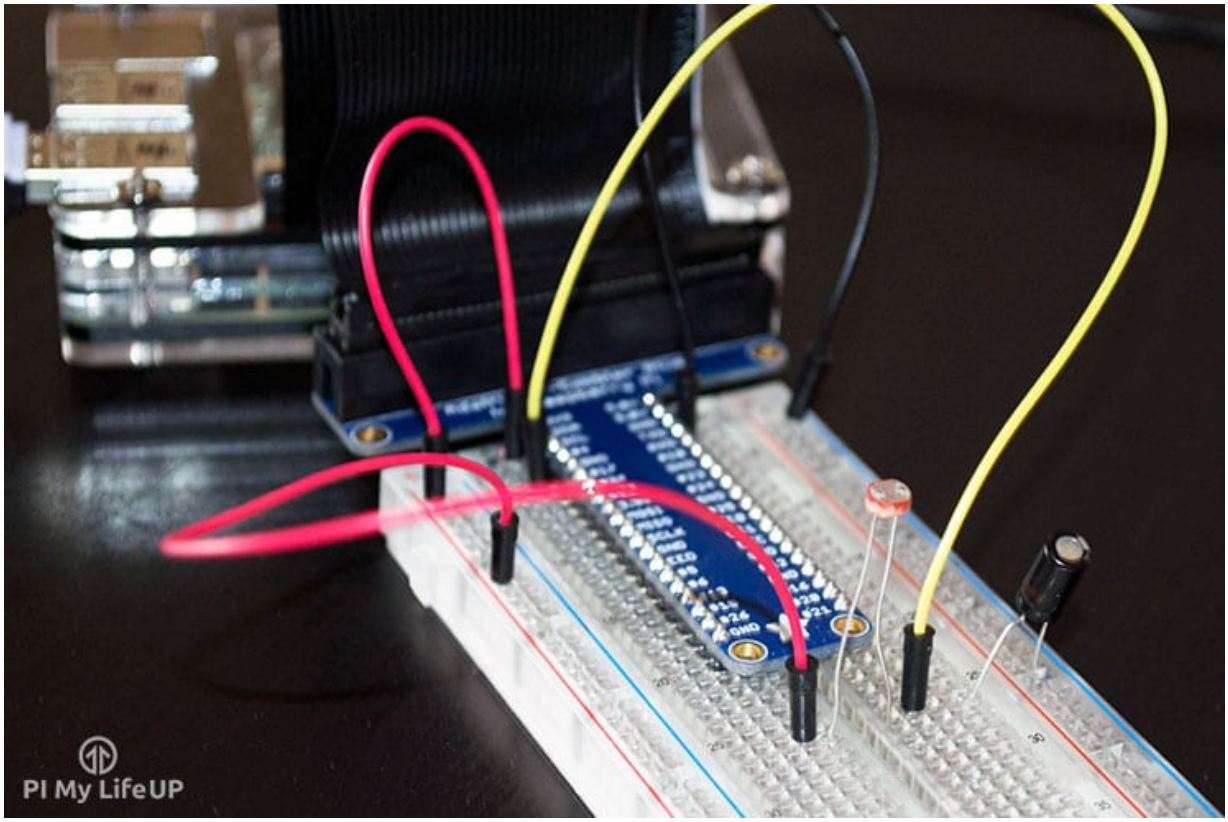
PiMyLifeUp

Raspberry Pi Light Sensor: A Simple LDR Tutorial

by Gus | Jan 31, 2016 | Guides, Sensors | 15 comments



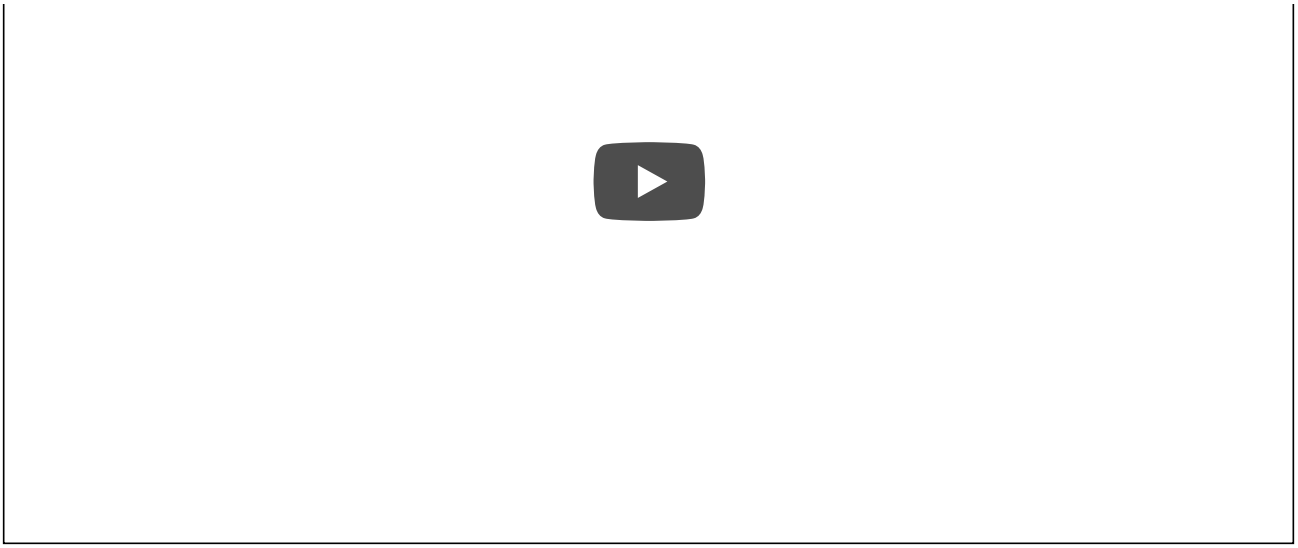
In this Raspberry Pi light sensor tutorial I show you how to correctly connect the photo resistor sensor up to the GPIO pins. Lastly I show you how it can be used in a simple python script so you're able to gather and use the data from it.

This is yet another sensor that I will be looking at incorporating into future projects such as a light activated alarm clock.

I explain a bit further down each of the parts that I will be using in this circuit. Be sure to read up on it if you need more information on these. It is important to note for this tutorial I am just using a simple photocell sensor whilst these are perfect for some tasks they might not be as accurate as you would like.

If you want to see visually step by step on how to set up the light sensor circuit & code, then be sure to check out the video below. It contains almost everything the text version of this tutorial does. You can find text instructions & information right underneath the video.

Raspberry Pi Light Sensor: A Simple LDR Tutorial
21K views • 12 comments



Equipment:

You will need the following equipment to be able to complete this Raspberry Pi light sensor tutorial. You can do this without any breadboard gear but I would highly recommend investing in some if you plan on doing a lot of circuitry work.

Recommended:

Raspberry Pi

8GB SD Card or Micro SD Card if you're using a Raspberry Pi 2 or B+

Ethernet Cord or Wifi dongle

Light sensor (LDR Sensor)

1 1uF Capacitor

Optional:

Raspberry Pi Case

USB Keyboard

USB Mouse

GPIO Breakout Kit

Breadboard

Breadboard Wire

The Raspberry Pi Light Sensor Circuit

The circuit we are going to make for this tutorial is super simple and is great for anyone who is just starting out with circuitry.

The light dependent resistor or also known as the LDR sensor is the most important piece of equipment in our circuit (obviously). Without it we wouldn't able to detect whether it is dark or light. In the light this sensor will have a resistance of only a few hundred ohms whilst in the dark it can have a resistance of several megohms.

The capacitor in our circuit is there so we're able to measure the resistance of the LDR sensor. A capacitor essentially acts like a battery charging up whilst receiving power and then discharging when no longer receiving power. Using this in series with the LDR we can work out how much resistance the LDR is giving out thus whether it is light or dark.

To get the light sensor circuit built correctly follow the steps below or check out the circuit diagram right underneath the steps. In the following steps I am referring to the physical numbers of the pins (Logical order).

1. First connect pin #1 (3v3) to the positive rail on the breadboard.

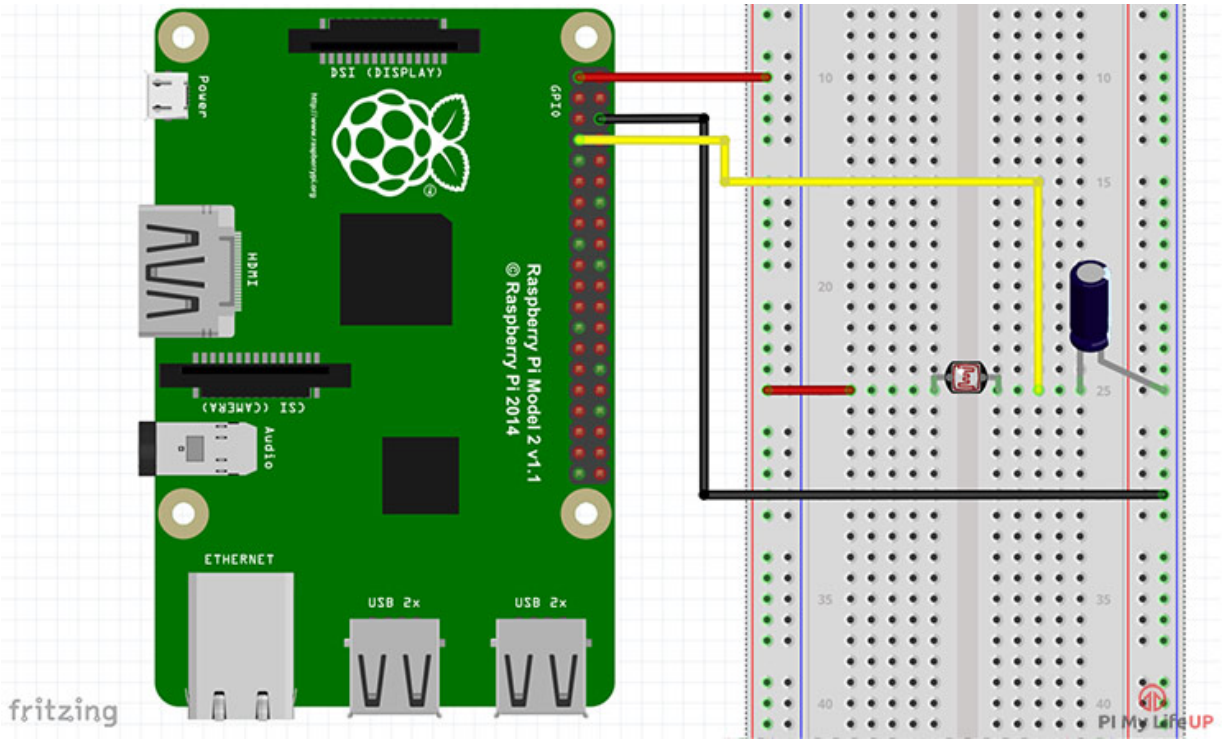
2. Next connect pin #6 (ground) to the ground rail on the breadboard.

3. Now place the LDR sensor onto the board and have a wire go from one end to the positive rail.

4. On the other side of the LDR sensor place a wire leading back to the Raspberry Pi. Hook this to pin #7.

5. Finally place the capacitor from the wire to the negative rail on the breadboard. Make sure you have the negative pin of the capacitor in the negative rail.

We're now ready to move onto the Python code, if you have any trouble with the circuit refer to the diagram below.



The Code

The code for this project is pretty simple and will tell us roughly whether it is light, shady or completely dark.

The biggest problem we face with this circuit is the fact that the Pi doesn't have any analogue pins. They're all digital so we can't accurately measure the variance in resistance on our input. This wasn't a problem in the motion sensor tutorial since the output from it was either high or low (Digital). Instead we will be measuring the time it takes for the capacitor to charge and send the pin high. This is an easy but inaccurate way of telling whether it is light or dark.

I will briefly explain the Raspberry Pi light sensor code and what it does, if you just want the code you can simply copy and paste it below or download it from my github.

To begin we import the GPIO package that we will need so that we can communicate with the GPIO pins. We also import the time package so we're able to put the script to sleep for when we need to.

```
#!/usr/local/bin/python

import RPi.GPIO as GPIO
import time
```

We then set the GPIO mode to GPIO.BOARD this means all the numbering we use in this script will refer to the physical numbering of the pins. Since we only have one input/output pin we only need to set one variable. Set this variable to the number of the pin you have acting as the input/output pin.

```
GPIO.setmode(GPIO.BOARD)

#define the pin that goes to the circuit
pin_to_circuit = 7
```

Next we have function called rc_time that requires one parameter which is the pin number to the circuit. In this function we initialise a variable called count, we will return this value once the pin goes to high.

We then set our pin to act as an output and then set it to low, we then have the script sleep for 10ms.

After this we then set the pin to become an input and then we enter a while loop. We stay in this loop until the pin goes to high, this is when the capacitor charges to about 3/4. Once it goes high we return the count value to the main function. You can use this value to turn on and off an LED, activate something else or just log the data and keep statistics on any variance in light.

```
def rc_time (pin_to_circuit):
    count = 0

    #Output on the pin for
    GPIO.setup(pin_to_circuit, GPIO.OUT)
    GPIO.output(pin_to_circuit, GPIO.LOW)
    time.sleep(0.1)

    #Change the pin back to input
    GPIO.setup(pin_to_circuit, GPIO.IN)

    #Count until the pin goes high
    while (GPIO.input(pin_to_circuit) == GPIO.LOW):
        count += 1

    return count

#Catch when script is interrupted, cleanup correctly
try:
    # Main loop
    while True:
        print rc_time(pin_to_circuit)
except KeyboardInterrupt:
    pass
finally:
    GPIO.cleanup()
```

Deploying & Running the Code on your Raspberry Pi

This step is incredibly easy but I will quickly go through the steps so you can have it up and running on your Pi as quickly and smoothly as possible. Like all the tutorials on this website I am using Raspbian, if you need help on getting Raspbian installed then check out my guide on installing Raspbian.

Whilst all the software packages should already be installed in some cases it may not be. If you want to learn more about the GPIO pins and how to update/install the software be sure to check out my tutorial on setting up the GPIO pins on the Raspberry Pi.

You can simply download the code by using git clone. The following command will do exactly just that:

```
git clone https://github.com/pimylifeup/Light_Sensor/
cd ./Light_Sensor
```

Alternatively, you can copy and paste the code just make sure the file is a python script.

```
sudo nano light_sensor.py
```

Once you're done in the file simply use ctrl x then y to save and exit.

Finally run the code by using the following command:

```
sudo python light_sensor.py
```

I hope you now have the script working and you're receiving data that correctly reflects the changes in light on the sensor. If you're having trouble, please don't hesitate to leave a comment below.

◎ Improving Accuracy & Possible Uses

There are countless uses for a light sensor in a circuit. I will just name a few that I thought of whilst I was writing up this tutorial.

- **Light Activated Alarm –** I mentioned this one earlier but you can use the LDR to detect when it starts to get light so you can sound an alarm to wake up. If your program & sensor is accurate enough, you could have it slowly get louder as it gets lighter.

- **Garden monitor –** A light sensor could be used in a garden to check how much sun a certain area of the garden is getting. This could be useful information if you're planting something that needs lots of sun or vice versa.

- **Room Monitor –** Want to make sure lights are always turned off in a certain room? You could use this to alert you whenever light is detected where it shouldn't be.

There is so much you can do with this cool little sensor but also remember if you require something a little more accurate than the photocell try looking at something like the Adafruit high dynamic range digital light sensor.

I hope you have been able to set up this Raspberry Pi light sensor without any issues. If you do come across a problem, have feedback, I have missed something or anything else you would like to say then feel free to drop a comment below.

Credit: This tutorial is based off Adafruit's Resistor Sensor tutorial.

Raspberry Pi Temperature Sensor: Build a DS18B20 Circuit

Raspberry Pi Motion Sensor using a PIR Sensor

Raspberry Pi ADC: MCP3008 Analog to Digital Converter

15 Comments

The_stig on April 14, 2016 at 12:46 pm

I did this and when the sensor is in a pitch black room, it takes forever to respond. I'm trying to use this in a project where the monitor turns on/off based on if the room is dark, and when the room is pitch black, it basically just sits and if it does ever come back, the number is insanely high. Into the hundreds of millions.

However as soon as I turn the light on, the numbers start flowing in. I tried a few other scripts and I still can't get it to perform the way I want. Is there anyway to change the amount of time it takes for it to return a value?

Reply

The_stig on May 6, 2016 at 1:35 am

BTW I figured this out. What I did was set a timeout Bash script that ran the python script. if it took longer than 2 seconds to return a variable, it turned the monitor off and exited the script. If it didn't take 2 seconds, it turned it on. It works well!

Reply

Kevin G on January 17, 2017 at 6:57 am

Any chance you could share the script? I've been looking everywhere but can't find the right script for the solution.

Shreyansh on May 6, 2016 at 1:33 am

Hi
Can I substitute capacitor of some other capacitance here(say 100uF)

Reply

Wayne Thomason on August 21, 2016 at 4:41 am

I want to use an LDR or photo-transistor for a dimmer on my clock project, which uses an Adafruit 1.2″ LED display and a Raspberry Pi Zero.

Instead of using the RC circuit with an RC timing routine in the Python code, I'm thinking about using a comparitor circuit instead. I figure I can choose a resistor value for the detector side of the comparitor that will set the threshold properly. Alternatively I could use a potentiometer as the resistor for the detector side so the threshold can be adjusted.

Reply

Wayne Thomason on August 21, 2016 at 4:45 am

Additionally, I already have added the code to the code which will dim the display if GPIO pin 18 is pulled low. I only need to output a Hi/Lo signal based on the detector compared to a reference voltage (vcc/2) using a resistor based voltage divider (VCC to 10K+10K to GND).

Reply

Wayne Thomason on August 21, 2016 at 4:54 pm

I successfully got the LDR (Cadmium Sulfide photocell) circuit working using the LM339 comparator. The negative input connects between two 10K resistors (between 3.3v and GND). From the positive input a 56K resistor connects to 3.3v and the photocell connects to GND.

I put in a female header for the resistor so it can be changed for different values as necessary. I started with 4K7 but it didn't switch to bright at a low enough light level. I tried a 15K with better results, and then tried the 56K. Subdued ambient lighting keeps the display bright but turning off the lights causes the display to dim.

Peter on December 6, 2016 at 8:32 am

Excellent tutorial. So simple and it just works. I've used it in a simple CCTV setup using a raspberry pi camera that takes pictures every 2 seconds after someone has switched on the lights in my office. Caught the guy on the first day.

Reply

Faisal on January 3, 2017 at 2:16 am

I am trying to use this sensor in node red. And I am not sure how to get input from the sensor. I tried using rpi-gpio node but it only gives 1/0 value not ldr value. What should I do?

Reply

Wayne Thomason on January 3, 2017 at 12:53 pm

I used GPIO 18 (which takes 0-1 values) and I used the LDR in a comparator circuit (digital). This circuit could be tweaked via a variable resistor (potentiometer) to my desired ambient light threshold level to turn the comparator output on or off.

If you want a numeric value instead, I believe you have to use the LDR in parallel to a capacitor of fixed value. Then the RPi will first charge the cap, then stop charging and time how long it takes the LDR to drain the cap below threshold. It repeats this charge/discharge process over and over continuously. For help with this method (analog), someone else will have to assist.

Reply

Wayne Thomason on January 3, 2017 at 12:56 pm

Okay, so my statement about the R/C in parallel is wrong (I just looked at the diagram above). I will defer to those who have used the R/C (LDR/CAP) method and back out now. ☺

Ian Leitch on February 5, 2017 at 12:43 am

In very broad terms; how many shades of dark do you require? a test inside the while loop to ascertain that the count had exceeded a "dark" count value is probably sufficient, to trigger an early exit from the while loop. This will tell you what you need to know; it's DARK and return in a reasonable time period.

Reply

Akash on February 18, 2017 at 9:27 pm

This circuit works well . I can able to determine the time taken by the capacitor to charge and discharge. But i need to find the resistance across the photoresistor at every instance because i am trying to give a feedback loop. So how to find the resistance from the time. Kindly tell me the relation.

Reply

Ian Leitch on February 20, 2017 at 1:40 am

How to find the resistance from the time?

Because you know the time then you will be able to calculate the frequency and therefore use the standard formula.

The relationship is:
1/R = 2 Pi f C

Where
Pi is 3.142
f is the frequency in Hz
C is the capacitance in Farads

Failing that, substitute the photo resistor for a 10M variable resistor and make measurements with which to make your comparisons.

I believe that you are stretching your understanding at the moment and so that last option may be your best option.

Good luck with the feedback loop . . .

Reply

Neil_Pi-Noob on April 28, 2017 at 9:32 am

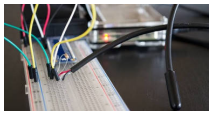
Complete noob here and in the process of building my programmable crimbo light show. Now I am assuming this can be used in conjunction with a relay board and other jems like lightshow pi. So it gets to a certain ambient lighting level sensors powers the replays at which point light programs kicks voila magical chistmas light show.

Reply

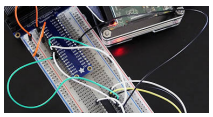
Follow us on social

Search for Tutorials!

Search

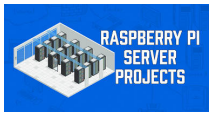


Raspberry Pi Sensors: Learn...

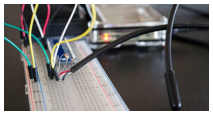


Raspberry Pi ADC Tutorial

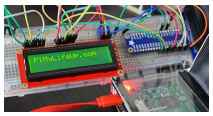
49+ Awesome Raspberry Pi...



14+ Raspberry Pi Server Projects

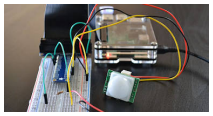


Setup a Raspberry Pi Temperature...



Raspberry Pi LCD Tutorial

Raspberry Pi GPIO Tutorial



Raspberry Pi Motion Sensor...