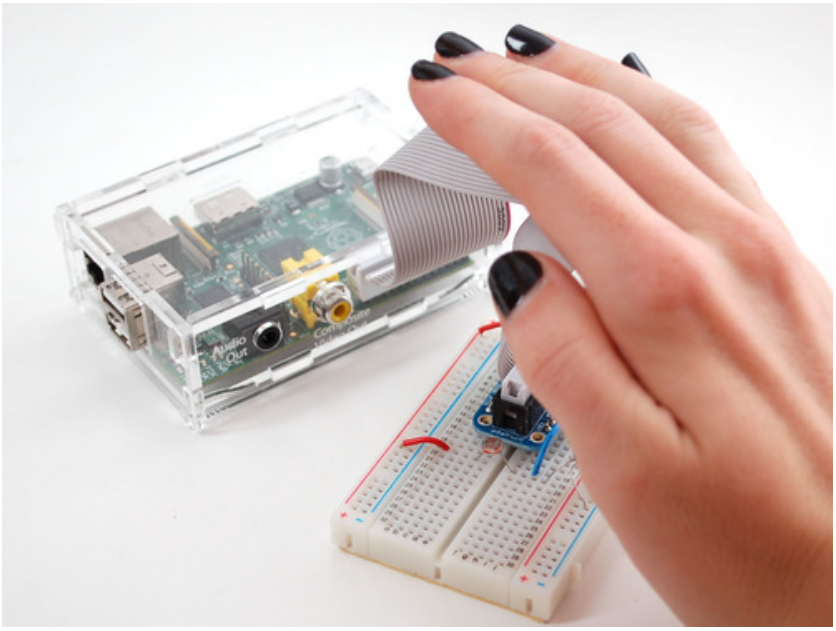
adafruit learning system

Basic Resistor Sensor Reading on Raspberry Pi

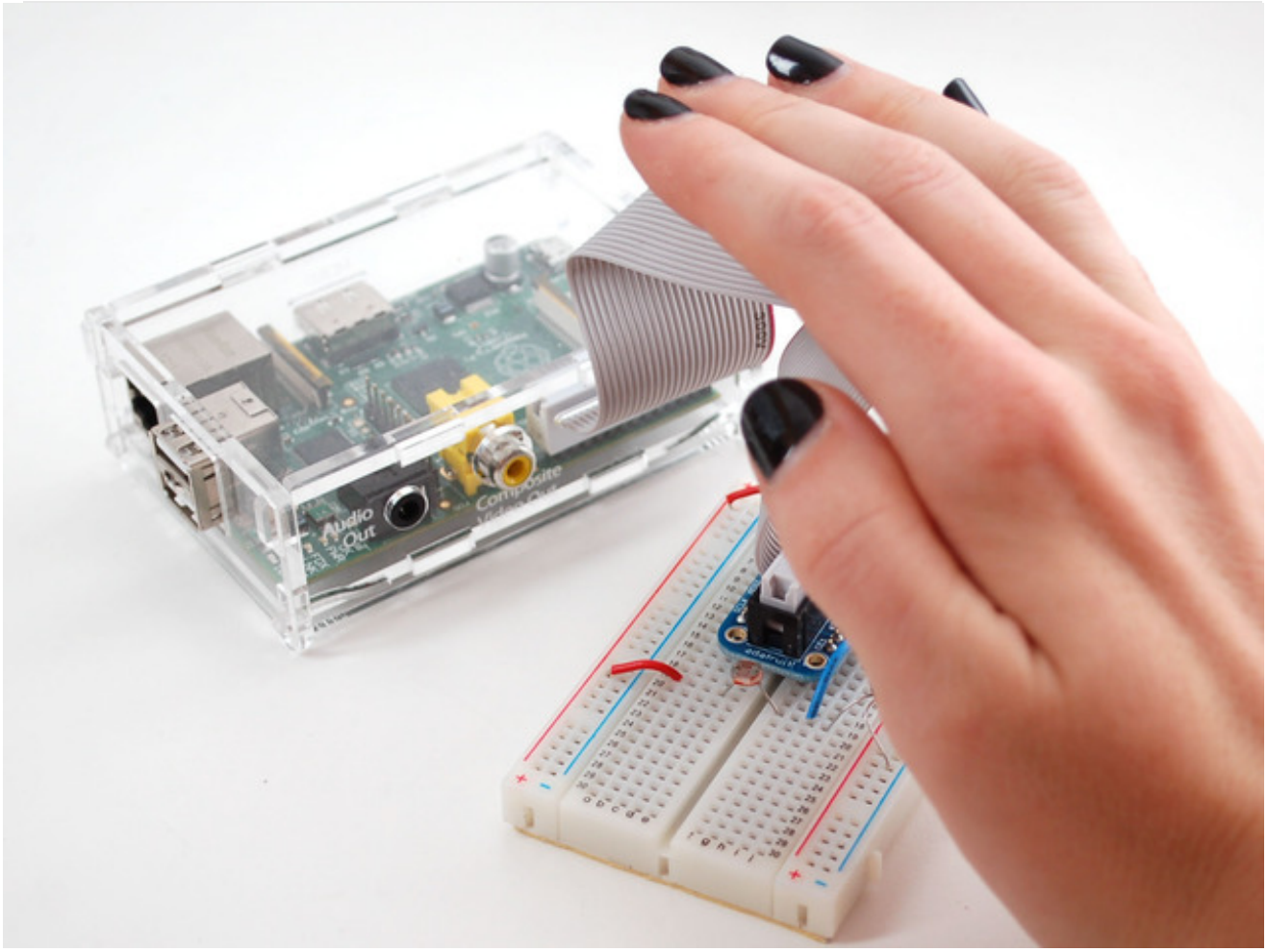
Created by lady ada



Last updated on 2014-12-11 12:15:20 PM EST

Guide Contents

Overview



We've already covered how to use an Analog-to-Digital Converter chip with a Pi. These chips are the best way to read analog voltages from the Pi. However, there's a way to read many sensors **without** an ADC! By measuring the sensor as a resistor that is used to 'fill up' a capacitor, we can count how long it takes. It's not nearly as precise as an ADC and its a little flakey (since it depends on the Pi timing itself which can vary based on how 'busy' the computer is)

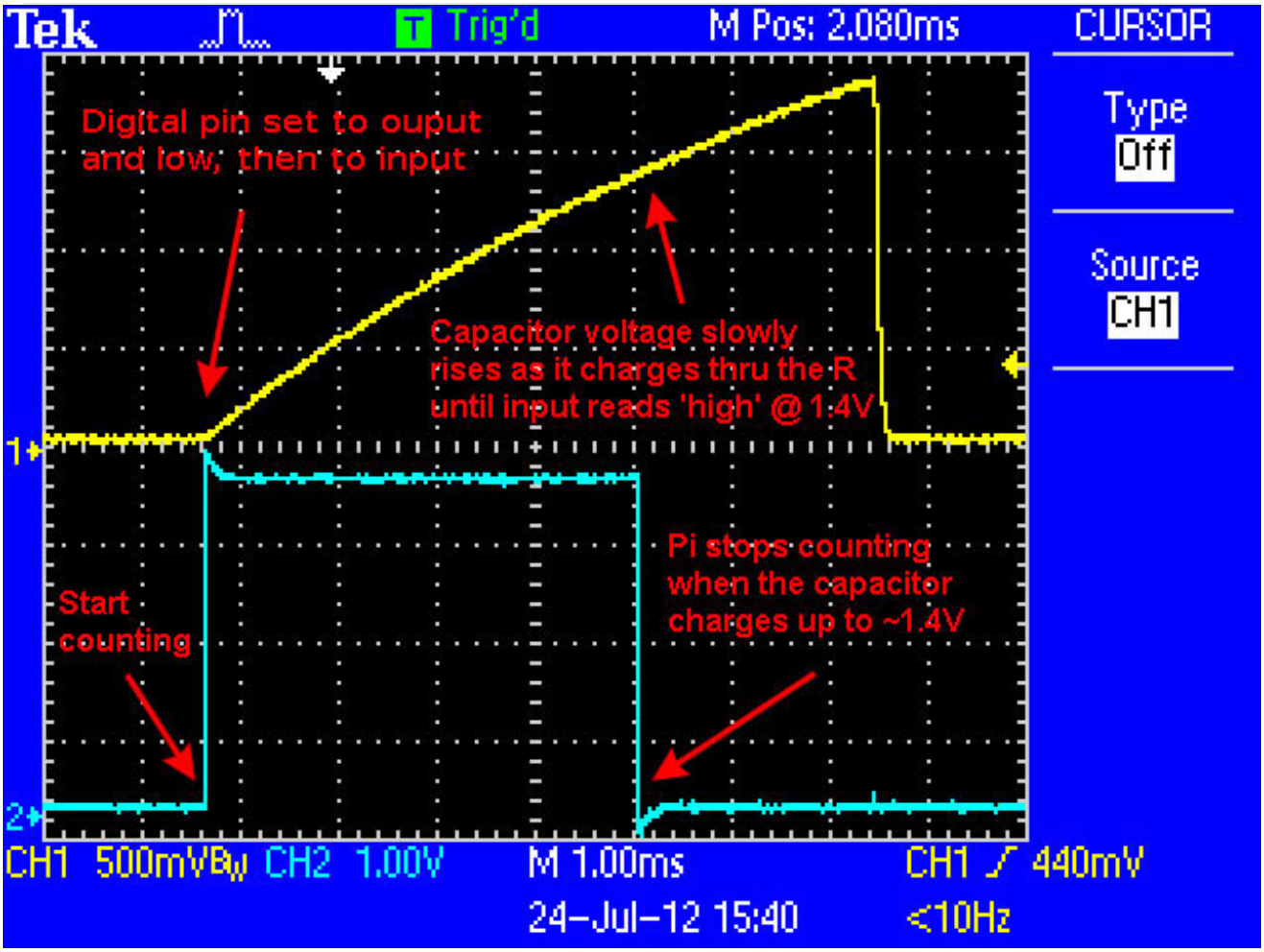
The way we do this is by taking advantage of a basic electronic property of resistors and capacitors. It turns out that if you take a capacitor that is initially storing no voltage, and then connect it to power (like 3.3V) through a resistor, it will charge up to the power voltage slowly. The bigger the resistor, the slower it is.

This technique only works with sensors that act like resistors. however, there are quite a few fun sensors that act this way: photocells (http://adafru.it/161), thermistors (temperature sensors) (http://adafru.it/372), flex sensors (http://adafru.it/182), force-sensitive resistors (http://adafru.it/166), and many more.

It cannot be used with sensors that have a pure analog output like IR distance

sensors (http://adafru.it/164) or analog accelerometers (http://adafru.it/163).

How it works

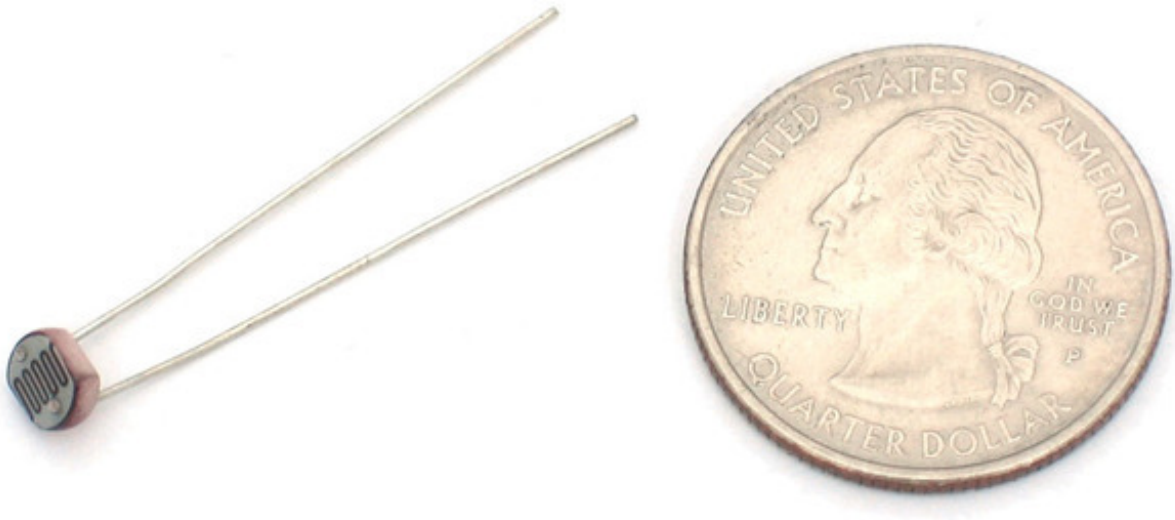


This capture from an oscilloscope shows whats happening on the digital pin (yellow). The blue line indicates when the Pi starts counting and when the counting is complete, about 4.5ms later.

This is because the capacitor acts like a bucket and the resistor is like a thin pipe. To fill a bucket up with a very thin pipe takes enough time that you can figure out how wide the pipe is by timing how long it takes to fill the bucket up halfway

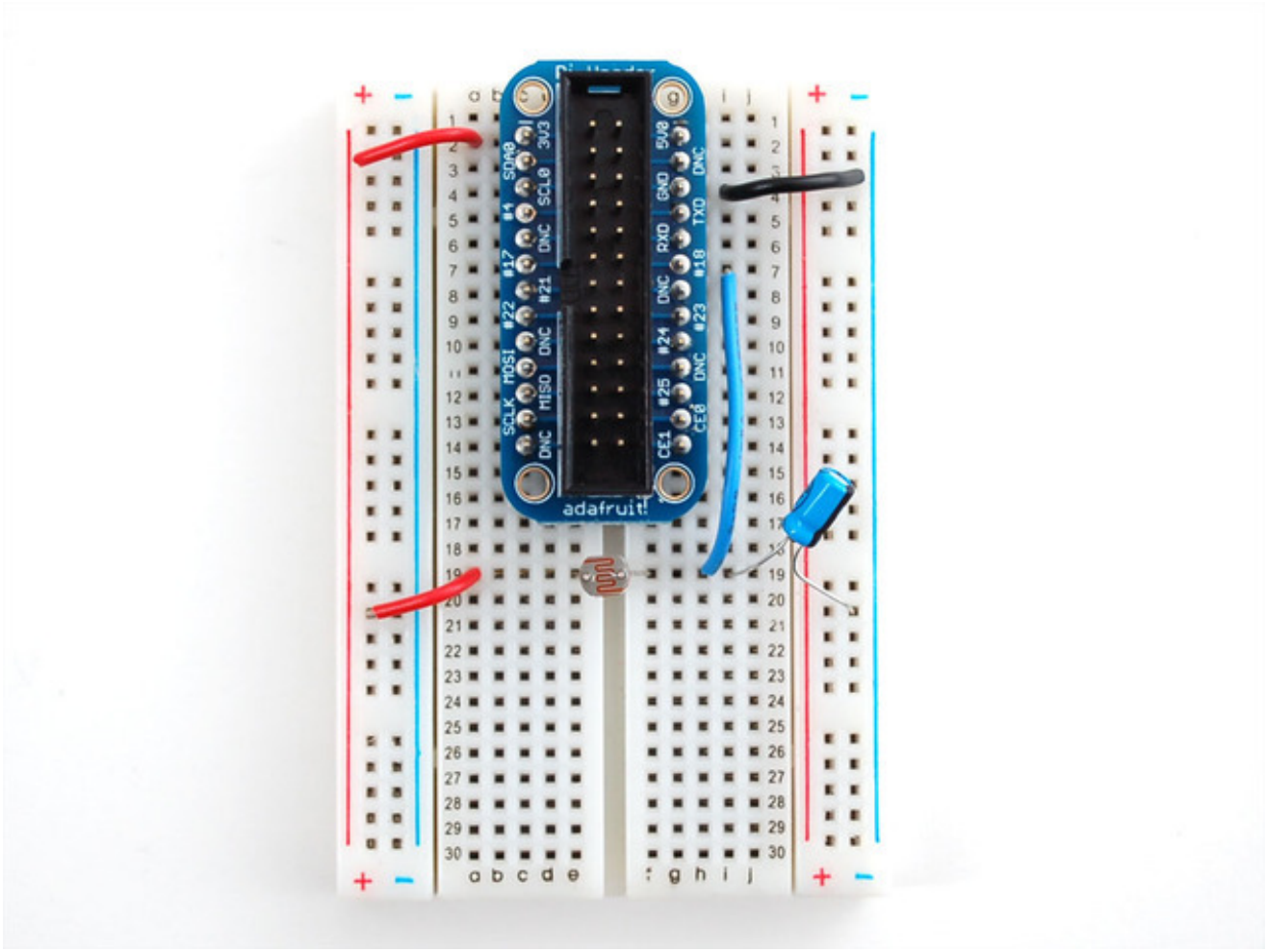
In this case, our 'bucket' is a 1uF ceramic capacitor. You can change the capacitor nearly any way you want but the timing values will also change. 1uF seems to be an OK place to start for most sensors. If you want more range, use a bigger cap - but it will take longer to measure. For faster reads, go with a smaller capacitor

Basic Photocell Reading



We'll start with a basic photocell. This is a resistor that changes resistance based on how bright the light is. You can read tons more about photocells in our tutorial (http://adafru.it/aGS) but basically we'll be able to measure how bright or dark the room is using the photocell. Note that photocells are not precision measurement devices, and this technique is also not very precise so its only good for basic measurements. For precision sensing, you'd want a digital lux sensor like this one (http://adafru.it/439) - we don't have a tutorial on connecting that to the Pi but we do have example code for Arduino.

Wiring is simple using the Adafruit Pi Cobbler. Connect the blue right rail to ground and the red left rail to 3.3V. Then connect one side of the photocell to 3.3V and the other side to Pi **GPIO #18** (you can use any pin but our example code is for #18). Then connect a 1uF capacitor from **#18** to ground. Make sure the negative side of the capacitor (marked with a - down the side if its electrolytic) goes to ground. The capacitor just needs to be rated for 5V or greater, its really unlikely you'll find a 1uF that has less than 16V rating.



Now on your Pi, make sure you've installed RPi.GPIO version 0.3.1a or later. Check here for instructions how (http://adafru.it/aGZ)

Now copy & paste the following code into a new file called **RCtime.py** and **chmod +x** it

```
#!/usr/bin/env python

# Example for RC timing reading for Raspberry Pi
# Must be used with GPIO 0.3.1a or later - earlier verions
# are not fast enough!

import RPi.GPIO as GPIO, time, os

DEBUG = 1
GPIO.setmode(GPIO.BCM)

def RCtime (RCpin):
        reading = 0
        GPIO.setup(RCpin, GPIO.OUT)
```

```
        GPIO.output(RCpin, GPIO.LOW)
        time.sleep(0.1)

        GPIO.setup(RCpin, GPIO.IN)
        # This takes about 1 millisecond per loop cycle
        while (GPIO.input(RCpin) == GPIO.LOW):
                reading += 1
        return reading

while True:
        print RCtime(18)     # Read RC timing using pin #18
```

With the Pi connected to the Cobbler, run the script and shade your hand over the sensor to test it out!

Once you know it works you can change what pin you are using by changing the **RCtime(18)** to **RCtime(***yourpinnumberhere***)** any pin will work