QRE-1113 Reflectance Sensor

Line following sensor

Used on the Raspberry Pi

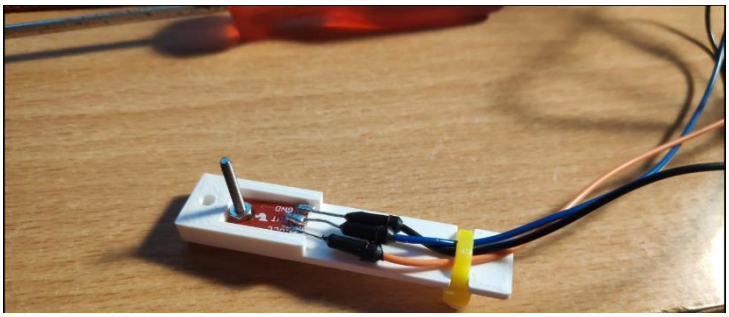
Introduction

The QRE-1113 is a reflection sensor with great use in the field of robotics, mainly in the section of line following. The sensor uses an IR LED which shines down on a surface and the phototransistor that it contains determines how much of that light bounces back. Using the fact that dark colors absorb more of the emitted light and reflect less of it than lighter colors we can deduct whether the sensor is facing a black or a white surface.

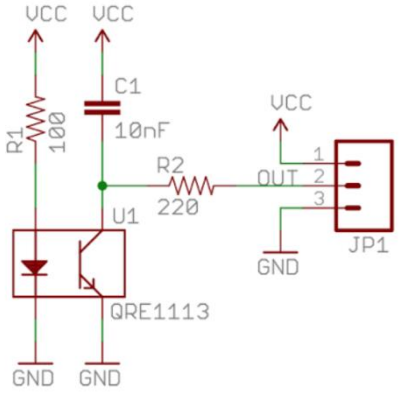
Analog and Digital version

For the analog version things are simple, since the sensor just outputs an analog voltage on the signal pin that is relative to the reflectiveness of the surface. This however is not compatible with an rpi since the board doesn't have analog inputs and requires an ADC converter.

For the digital version it is more complicated than that since displaying HIGH or LOW voltage is not enough to conclude the shade of the surface. This problem can be resolved by using a capacitor.



An 100Ω resistor is embedded on the PCB and placed in series with the LED to limit current. The output of the phototransistor is tied to a 10nF capacitor. Initializing the connected PIN as an output and setting it to HIGH we let the capacitor charge. After that we set the PIN as an input and wait for a LOW voltage to appear (indicating that the capacitor has discharged). Then by measuring how much time it takes to discharge the capacitor we can determine the shade of the surface. The faster that capacitor discharges, the more reflective the surface is, since reflectivity is inversely proportional to the resistance that appears between the phototransistors leads which in turn is proportional to the discharge time.



Code

Here I present the Python code for the digital version. [import GPIO is required]

```
def time_to_ref_func(x,charge_time):
    return (1/x)

def readQRE1113_digital(pin,charge_time):
    GPIO.setup(pin,GPIO.OUT)
    GPIO.output(pin,GPIO.HIGH)
    time.sleep(charge_time)
    GPIO.setup(pin,GPIO.IN)
    t1=time.time()
    while(True):
        if GPIO.input(pin)==GPIO.LOW:
            break
        else:
            continue
    t2=time.time()
    time_frame=t2-t1
    reflectivity=time_to_ref_func(time_frame,charge_time)
    return reflectivity
```

Comment: The time_to_ref_func function can be different that $\frac{1}{x}$. The main idea is that reflectivity is inversely proportional to time, but we can adjust it to our problem needs. For example $\frac{1}{x^3}$ makes the distinction between light and dark very clear, but for the shades in between the `reflectivity` value is not as representative.

Typical charge_time is 0.00001 seconds.

VCC should be connected to a 3V pin , GND to a GND pin and OUT to a GPIO pin.

Bibliography

[1] «Line Sensing. QRE1113 Reflectance Sensor + Arduino,» 27 July 2011. [Ηλεκτρονικό]. Available: http://bildr.org/2011/06/qre1113-arduino/.

[2] TRB, «QRE1113 Analogue Line Sensor With Raspberry Pi,» QRE1113 Analogue Line Sensor With Raspberry Pi, 8 January 2017. [Ηλεκτρονικό]. Available: https://theraspberryblonde.wordpress.com/2017/01/08/qre1113-analogue-line-sensor-with-raspberry-pi/.

[3] For analog Code : <script

src="https://gist.github.com/frogwoo/7e27f127323f5d1f3d44998b6d6ca6ea.js"></script>.

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