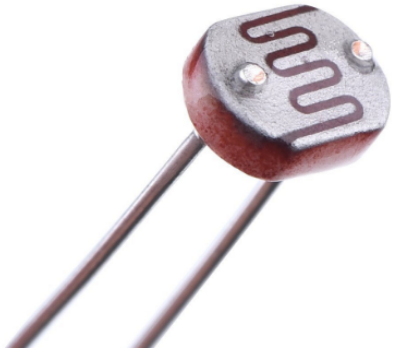
Computer Engineering Design

CSE 308 – California State University, San Bernardino – CSUSB , Dr. Fadi Muheidat

Photoresistor (LDR/Photocell) Interfacing to Raspberry Pi



Lab Schedule

Activities

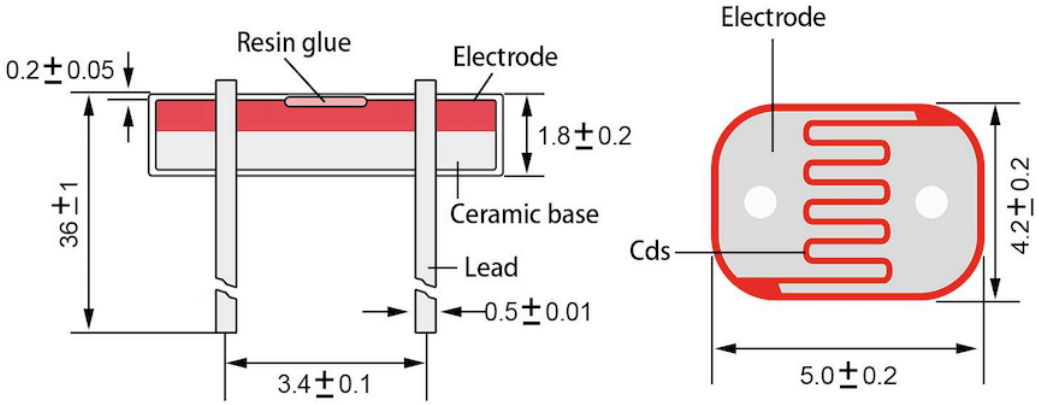
- **This Week**
  - Interfacing Sensor to Raspberry Pi
  - Python data manipulation and visualization

Assignments Due

- **Lab 2**
  - **Demo: Tueday 18th 11:00am**
  - **Report: Monday 24th 11:50 pm**

Photoresistor

- **LDR:** Light Dependent Resistors
  - Photocells are sensors that allow you to detect light.
  - measure the light intensity
  - They are basically a resistor that changes its resistive value (in ohms Ω) depending on how much light is shining onto the squiggly face.
  - High resistance in the dark (MΩ), low resistance when exposed to light (Ω)
  - Sensitivity varies with the wavelength of the light



Photoresistor: eBoot Model GM5539 source: Amazon.com

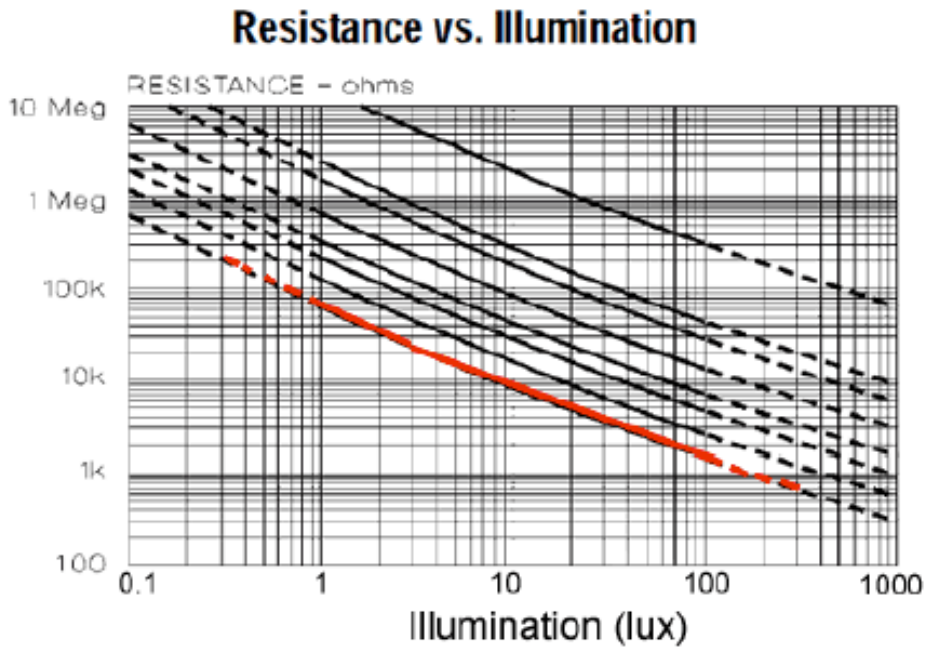
Model		5539
Maximum voltage	VDC	150
Maximum power consumption	mw	100
Ambient temperature	℃	-30℃- +70℃
Spectral peak	nm	540
Bright resistance(10Lux)	KΩ	50-100
Dark resistance	MΩ	5
100 γ10		0.8
Performances and Features		Coated with epoxy Good reliability Small volume High sensitivity Quick response Good spectrum characteristic
Range of application		Camera auto metering Photoelectric control Indoor light control Alarm industrial control Light control switch Light control lights electronic toy

What is LUX

- to indicate the resistance at certain light levels. But whatis lux ?
- The **lux** (symbol: **lx**) is the SI derived unit of illuminance, measuring luminous flux per unit area.[1][2] It is equal to one lumen per square metre. In photometry, this is used as a measure of the intensity, as perceived by the human eye, of light that hits or passes through a surface.

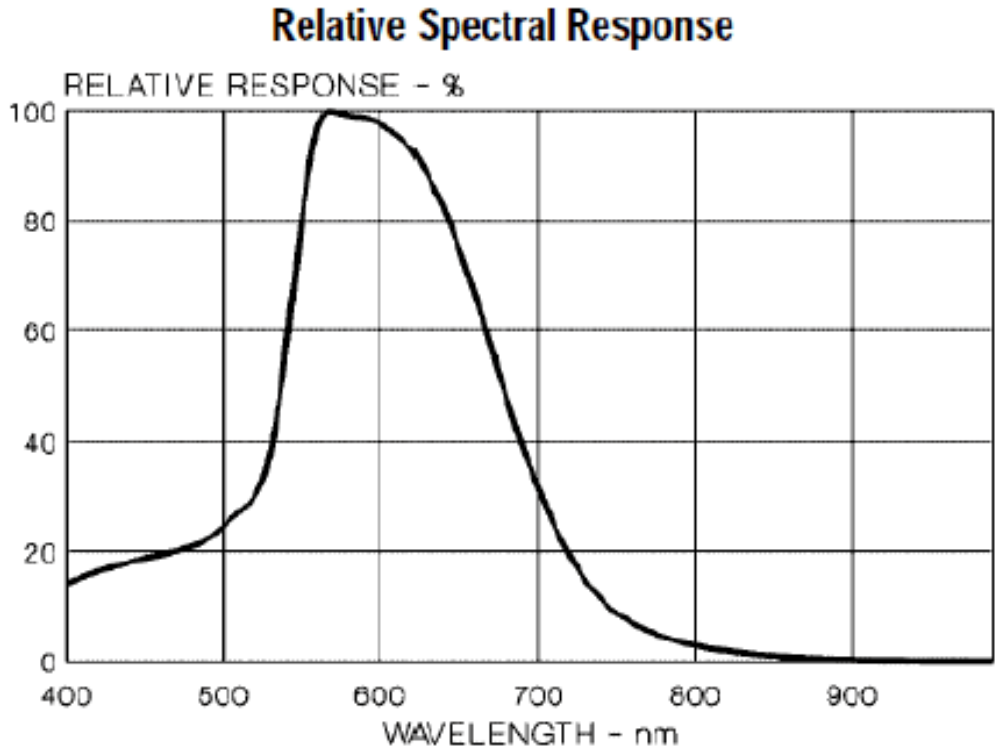
Illuminance	Example
0.002 lux	Moonless clear night sky
0.2 lux	Design minimum for emergency lighting (AS2293).
0.27 - 1 lux	Full moon on a clear night
3.4 lux	Dark limit of civil twilight under a clear sky
50 lux	Family living room
80 lux	Hallway/toilet
100 lux	Very dark overcast day
300 - 500 lux	Sunrise or sunset on a clear day. Well-lit office area.
1,000 lux	Overcast day; typical TV studio lighting
10,000 - 25,000 lux	Full daylight (not direct sun)
32,000 - 130,000 lux	Direct sunlight

Measuring Light



- a photocell's resistance changes as the face is exposed to more light. When its dark, the sensor looks like an large resistor up to 10MΩ, as the light level increases, the resistance goes down.

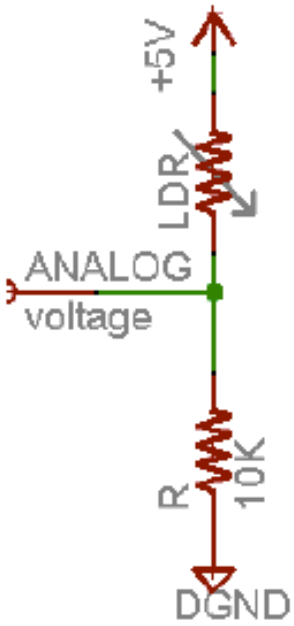
Measuring Light



- Photocells, particularly the common CdS cells that you're likely to find, are not sensitive to all light. In particular they tend to be sensitive to light between 700nm (red) and 500nm (green) light.

Using the Photocell/Photoresistor/LDR

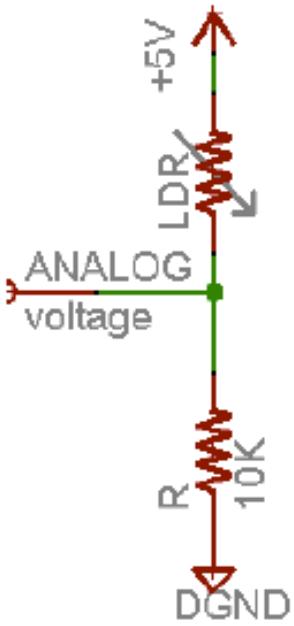
- How to determine that the LDR works ?
- Analog Voltage Reading Method
  - Pulldown Resistor: R=10 KΩ



Ambient Light (Lux)	LDR(Ω)	Current through both Resistors	Voltage V_{out}
Dim hallway (0.1 LUX)	600KΩ	0.008 mA . Why ?	0.08V , why ?
Dark room (10 LUX)	10 KΩ		
Dark overcast day / Bright room (100 LUX)	1.5 KΩ		
Overcast day (1000 lux)	300 Ω		

Using the Photocell/Photoresistor/LDR

- How to determine that the LDR works ?
- Analog Voltage Reading Method
  - Pulldown Resistor: R=1 KΩ



Ambient Light (Lux)	LDR(Ω)	Current through both Resistors	Voltage V_{out}
Moonlit night(1 LUX)	70KΩ	0.07 mA	0.1 V
Dark room (10 LUX)	10 KΩ	0.45 mA	0.5 V
Dark overcast day / Bright room (100 LUX)	1.5 KΩ	2 mA	2.0 V
Overcast day (1000 lux)	300 Ω	3.8 mA	0.8 V
Full daylight(10,000 lux)	100 Ω	4.5 mA	4.5 V

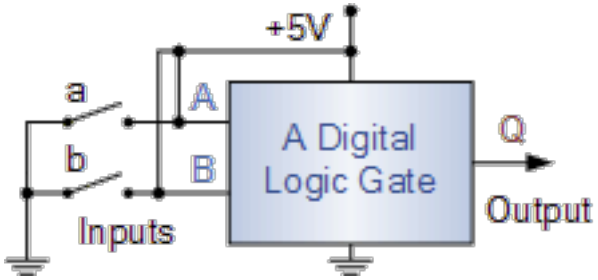
- You can also use the "Axel Benz" formula by first measuring the minimum and maximum resistance value with the multimeter and then finding the resistor value with: **Pull-Down-Resistor = squareroot(Rmin * Rmax)**, this will give you slightly better range calculations.

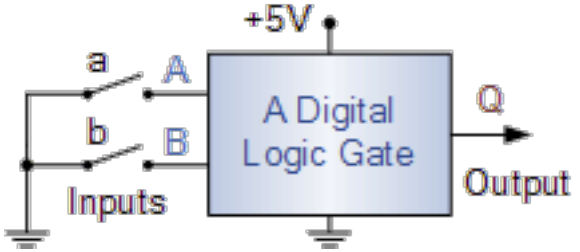
- Vo = Vcc (R / (R + Photocell))

Ambient light like...	Ambient light (lux)	Photocell resistance (?)	LDR + R (?)	Current thru LDR+R	Voltage across R
Moonlit night	1 lux	70 KΩ	71 KΩ	0.07 mA	0.1 V
Dark room	10 lux	10 KΩ	11 KΩ	0.45 mA	0.5 V
Dark overcast day / Bright room	100 lux	1.5 KΩ	2.5 KΩ	2 mA	2.0 V
Overcast day	1000 lux	300 Ω	1.3 KΩ	3.8 mA	3.8 V
Full daylight	10,000 lux	100 Ω	1.1 KΩ	4.5 mA	4.5 V

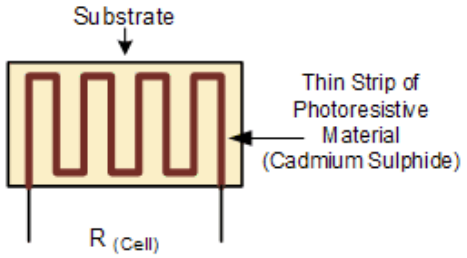
Extra

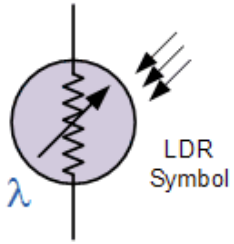
Pull-up, Pull-down

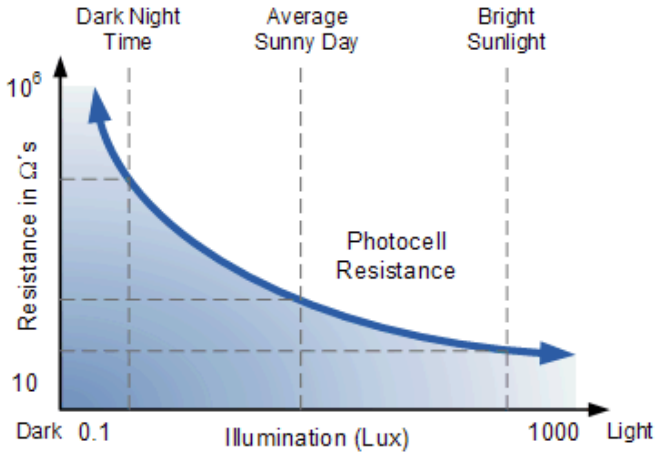




LDR


Substrate
Thin Strip of Photoresistive Material (Cadmium Sulphide)
R (Cell)


λ
LDR Symbol


Dark Night Time
Average Sunny Day
Bright Sunlight
10^6
Resistance in Ω's
Photocell Resistance
10
Dark
0.1
Illumination (Lux)
1000
Light