SENSORS : 29/1/19

Photoresistor :

- It is like a potentiometer
- In potentiometer, we turn knob to change resistance & thereby change voltage
- In photoresistor, the light controls the resistance in the device

More light ⇒ less resistance (1.5 KΩ at normal room light)

Less light ⇒ more resistance (10 KΩ when dark)

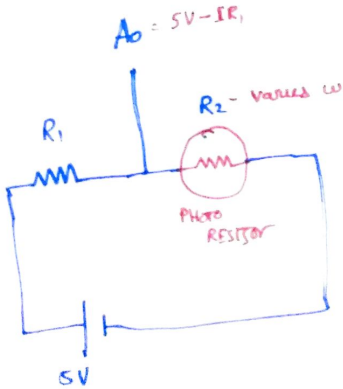
Usage :

- Write down the minimum and maximum Resistance values for your lighting conditions. (This will be needed for programming)

(0.3Ω – 70 KΩ)

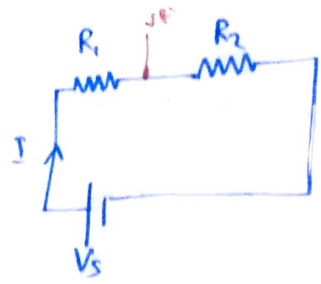
median ambient condition : 1.5 KΩ

Circuit



What should be our choice of R_1?

Recall Voltage Divider Concept



Recall Kirchoffs Voltage law:

Algebraic Sum of potential differences in any loop must be 0

(ie) $V_S + -IR_1 + IR_2 = 0$

($-IR_1$: Potential diff induced by R_1; IR_2: by R_2)

$$V_S = I(R_1 + R_2)$$

$$\boxed{I = \frac{V_S}{R_1 + R_2}} \rightarrow (1)$$

Now

$$V_{R_1} = IR_1$$

(Sub I from (1))

$$\boxed{V_{R_1} = \left(\frac{V_S}{R_1 + R_2}\right) R_1}$$

By varying R_2, we can vary the Voltage ~~at the~~ across V_{R_1}

This is the Key Concept behind potentiometer & photo resistors

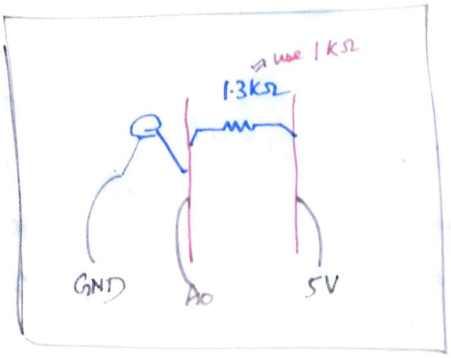
Choise of R_1 for photo resistr Circuit

- At ambient temp, let us have o/p Analog Voltage to be 2.5 V (mid value)
- At ambient temp, Resistance by photo resistr $R_2 = 1.3\,k\Omega$

Then $$V_{out} = \left(\frac{V_{in}}{R_1 + R_2}\right) R_1 = \frac{5}{1.3 + R_1} \cdot 1.3 = 2.5$$

$$\Rightarrow \boxed{R_1 = 1.3\,k\Omega}$$

Circuit



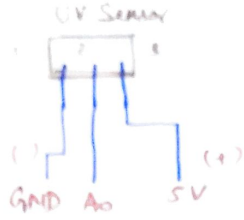
- Ao Value $\in (0, 1023)$
- When Ambient V_o is $5/2$ (at mid port)

  We should see ambient Ao ≈ 500

Analog

UV Sensor

- It is an analog sensor on a Breakout board
- (ie) the output of sensor is read from the analog pin.



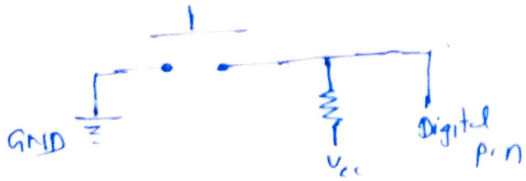
Breakout boards

- Another Integrated Circuit which can be attached to Arduino
- Breakout implies, they are not specific to Arduino boards, but can be used with other boards too (unlike shields)

Pull up / pull-down resistor

: When a circuit is not closed (like open switch, other EM waves can interact & change the state). To prevent that we use pull-up / pull down Resistor

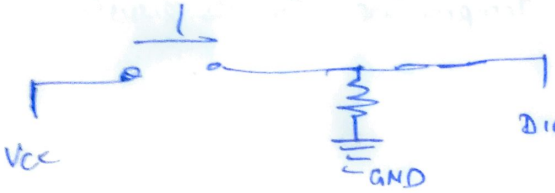
PULL-UP: (Resistor to V_{cc})



SWITCH OFF : PIN IS HIGH

SWITCH ON : PIN IS LOW

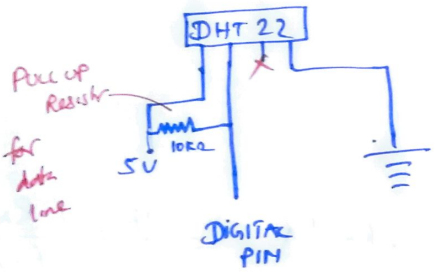
Pull Down



SWITCH OFF : PIN is LOW

SWITCH ON : PIN is HIGH

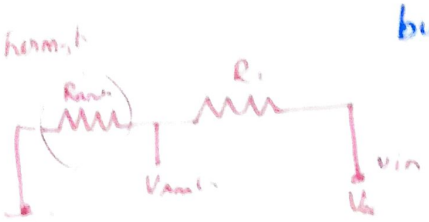
Digital Temperature & Humidity Sensor



- To use this sensor, use the DHT.h library

- The output from a digital sensor is read through variations in digital signals
- These variations in digital pins are captured with external libraries from manufacturers

Thermistor (Analog device, same as photo resistor but temperature controls resistance)



Computing Resistance from analog value 0-1023

$$V_{Analog} = \frac{V_{cc}}{1023} \times A_0 \qquad V_{cc} = 5V \rightarrow (1)$$

From voltage divide eqn.

$$V_{analog} = \frac{V_{cc} \cdot R_{analog}}{R_1 + R_{analog}} \rightarrow (2)$$

Sub (2) in (1)

$$A_0 = \frac{1023 \cdot V_{cc} \cdot R_{analog}}{(R_1 + R_{analog}) V_{cc}} = 1023 \left(\frac{R_{Ana}}{R_1 + R_{Ana}}\right)$$

$$\Rightarrow \boxed{R_{Ana} = \frac{R_1}{\left(\frac{1023}{A_0} - 1\right)}}$$