Sonifying the brightness of the stars

Javier Sanchez Gonzalez. jsanchezg@unal.edu.co
Santiago Vargas Domínguez svargasd@unal.edu.co
Universidad Nacional de Colombia-Observatorio Astronómico Nacional

- Introduction: The need to implement inclusive strategies towards the social and scientific development of our society, motivated us to create technological devices to bring science, and in particular astronomy, to visual impaired-people. Taking advantage of developments in electronics and data acquisition, we have created a tool for transforming the brightness of the stars into audible sounds.

- Theory: Based on the equation for the determination of the magnitudes:

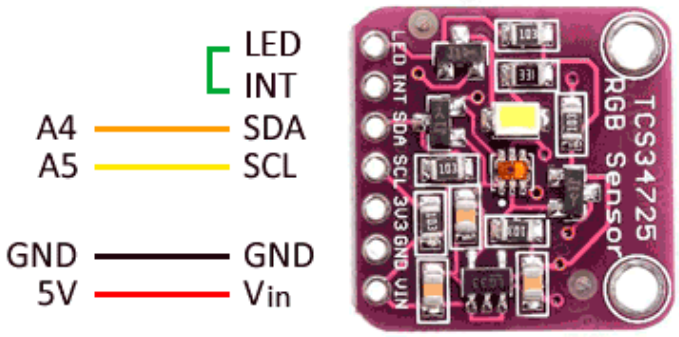
$$m_1 - m_2 = -2.5 \cdot \log_{10}\left(\frac{F_1}{F_2}\right)$$

m_2 = *-26.8* is the apparent magnitude of the Sun F_2 = *130000 lux* which is the approximate flow that comes from the Sun to the earth's surface , F_1 is the approximate flow that comes from the star and m_1 is the apparent magnitude of the star

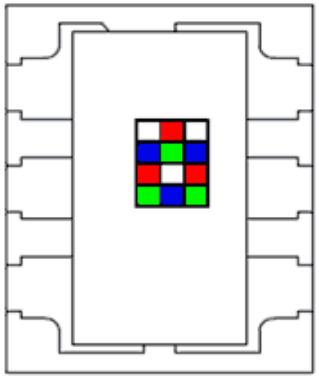
UNIVERSIDAD NACIONAL DE COLOMBIA

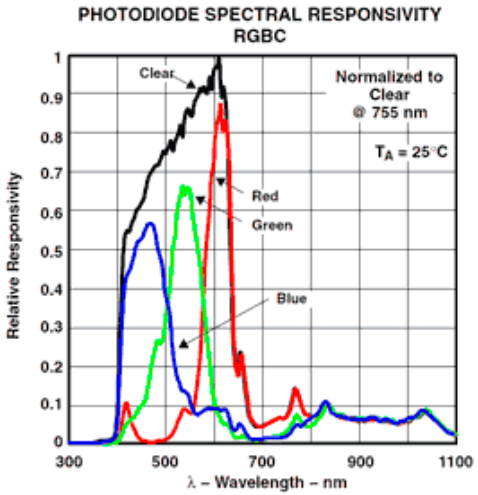
OBSERVATORIO ASTRONÓMICO NACIONAL DE COLOMBIA

GOSA GROUP OF SOLAR ASTROPHYSICS UN - COLOMBIA



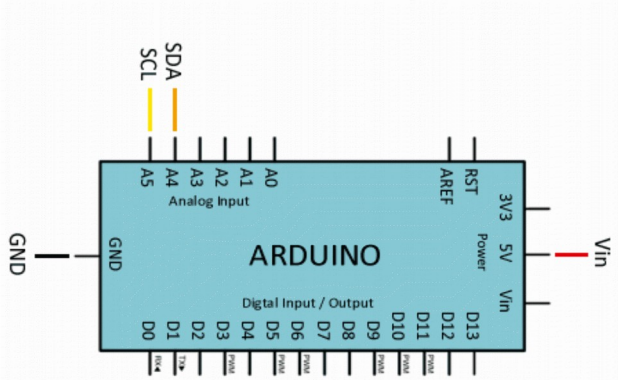
chip connection TCS34725





Chip operation scheme

Practice: The TCS34725 is an optical sensor that incorporates a 3x4 photodiode array, along with 4 16-bit analog-digital converters (ADC) that perform the measurement of the photodiodes, improving the Arduino's 10-bit response.



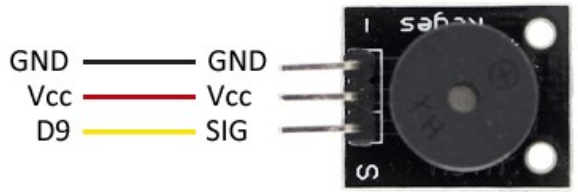
View from Arduino, the TCS34725 chip connection

UNIVERSIDAD NACIONAL DE COLOMBIA

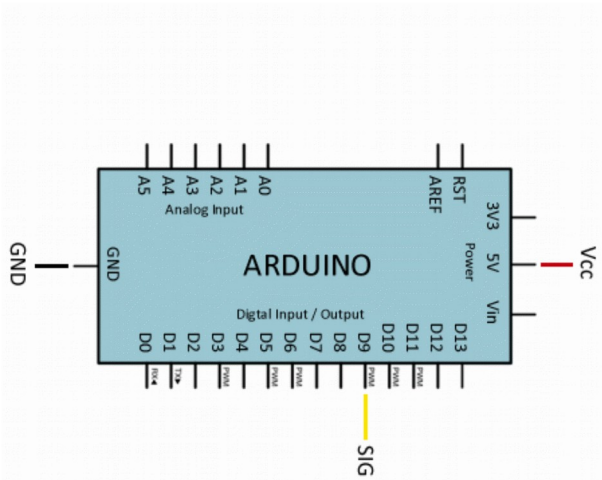
OBSERVATORIO ASTRONÓMICO NACIONAL DE COLOMBIA

GOSA
GROUP OF SOLAR ASTROPHYSICS
UN - COLOMBIA

A healthy, young ear is sensitive to frequencies between *19 Hz* and *19 kHz*. Arduino has two functions that allow us to easily generate electrical signals to convert into sound, using any of the available digital outputs. These functions are *tone ()* and *noTone ()*, they allow you to generate or stop the tone signal on a pin. The ranges of the tone function are *31 Hz* to *65535 Hz*.



buzzer connection



View from Arduino, the Buzzer connection

Finally, we translate the magnitude obtained with the Arduino *map()* function into a sound within the human audible range.

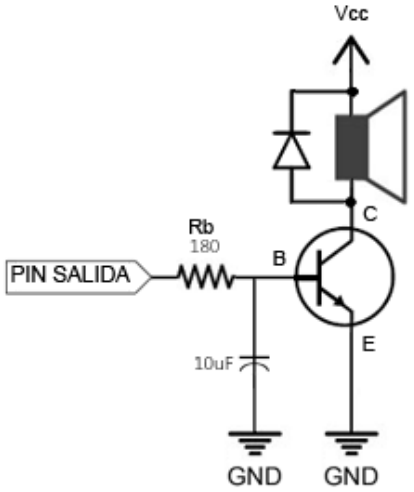
UNIVERSIDAD NACIONAL DE COLOMBIA

OBSERVATORIO ASTRONÓMICO NACIONAL DE COLOMBIA

GOSA
GROUP OF SOLAR ASTROPHYSICS
UN - COLOMBIA

Due to pandemic conditions the calibration of the instrument is still under development.

If you want to use a loudspeaker instead of a buzzer, an amplification stage is Required.



Speaker amplification

Final assembly

It is a simple assembly with a logic consistent with the reception of the eye and ear

UNIVERSIDAD NACIONAL DE COLOMBIA

OBSERVATORIO ASTRONÓMICO NACIONAL DE COLOMBIA

GOSA
GROUP OF SOLAR ASTROPHYSICS
UN - COLOMBIA