

Flood Detection using Raspberry Pi

PRESENTED BY,

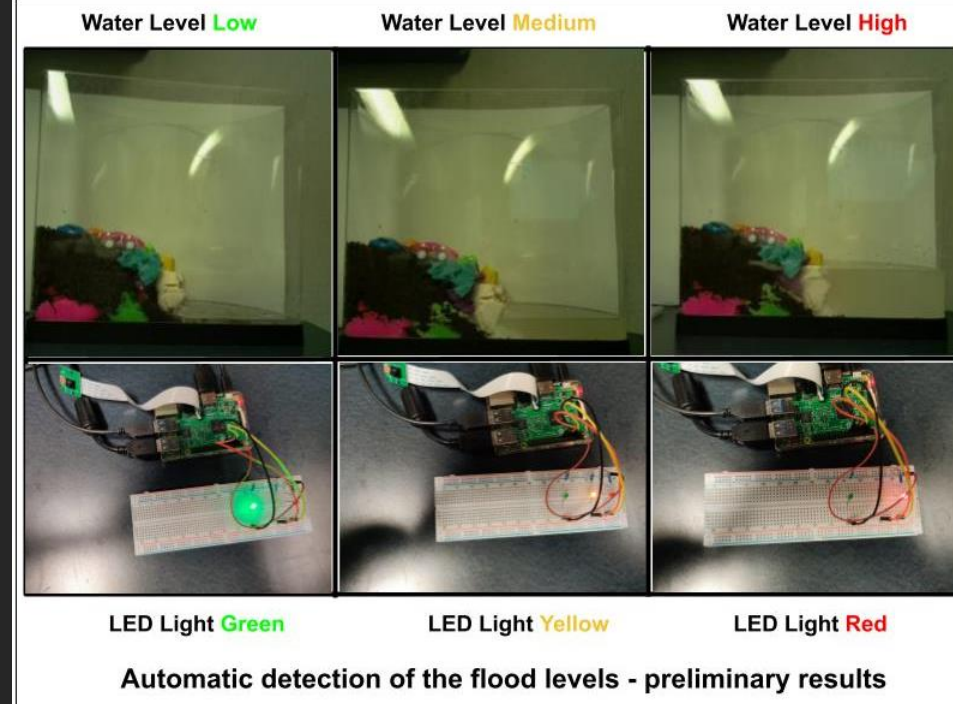
MOHAMMED NAUMAN SIDDIQUE

DEPARTMENT OF COMPUTER SCIENCE

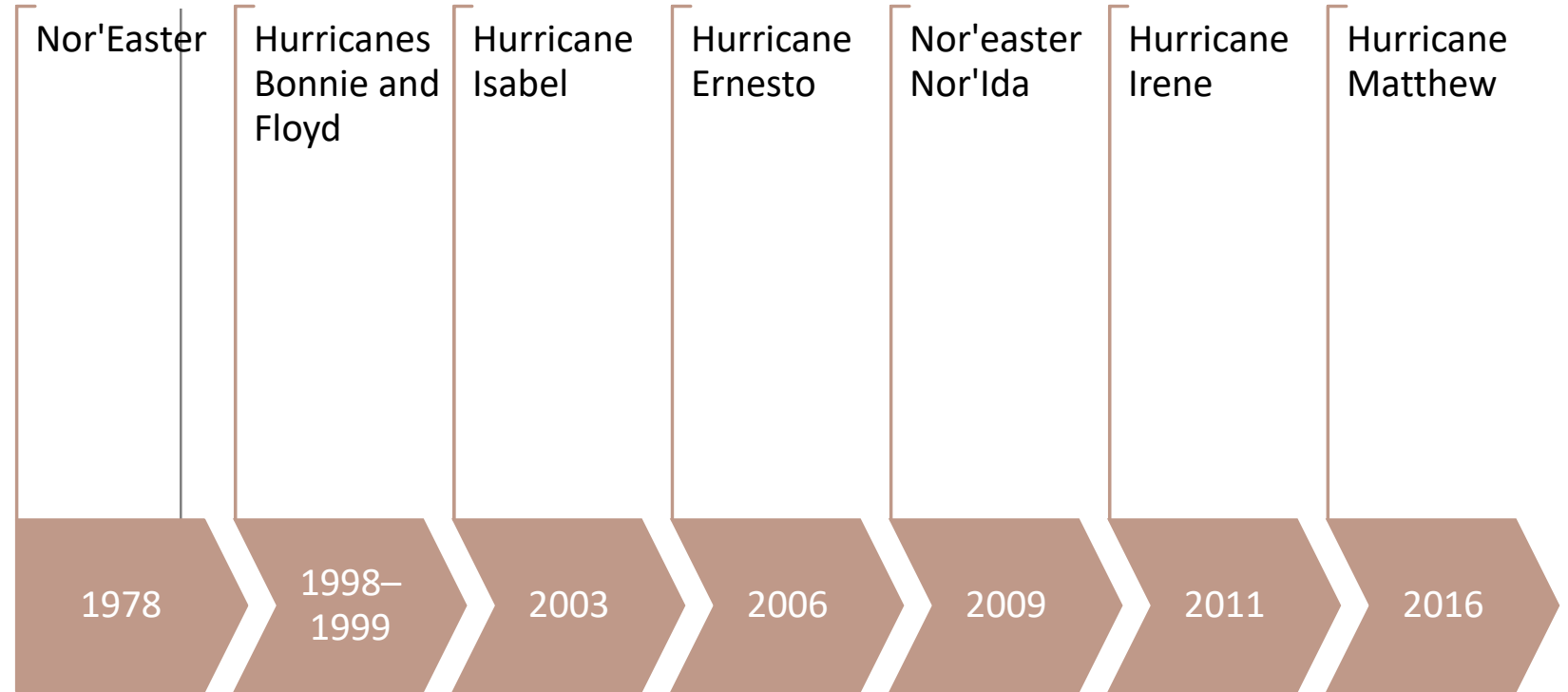
OLD DOMINION UNIVERSITY

SPRING 2021

2021-04-05



Timeline of Historical Flooding in Norfolk



Reference: <https://data.norfolk.gov/stories/s/FEMA-National-Flood-Insurance-Program-Redacted-Cla/gi5t-nkzw/>




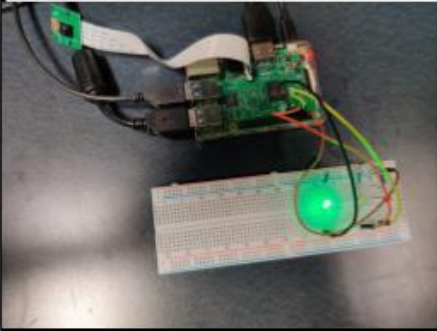
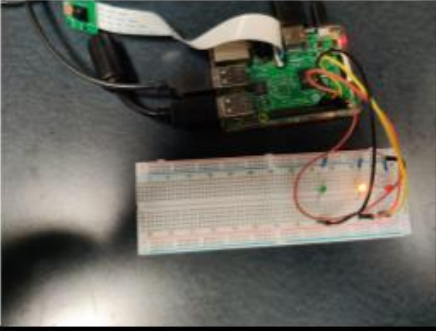
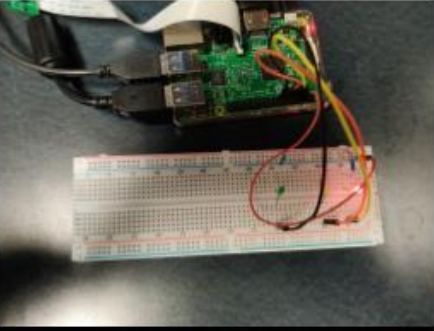
Introduction for the Project

Measure flooding levels using the Raspberry PI board and alert users by turning on the LEDs.

LED Lights Interpretation

LED Light	Water Level	Threat Level
Green	Low	Safe
Yellow	Medium	Alert
Red	High	Danger

Results from the Project

Water Level Low	Water Level Medium	Water Level High
		
		
LED Light Green	LED Light Yellow	LED Light Red

Automatic detection of the flood levels - preliminary results

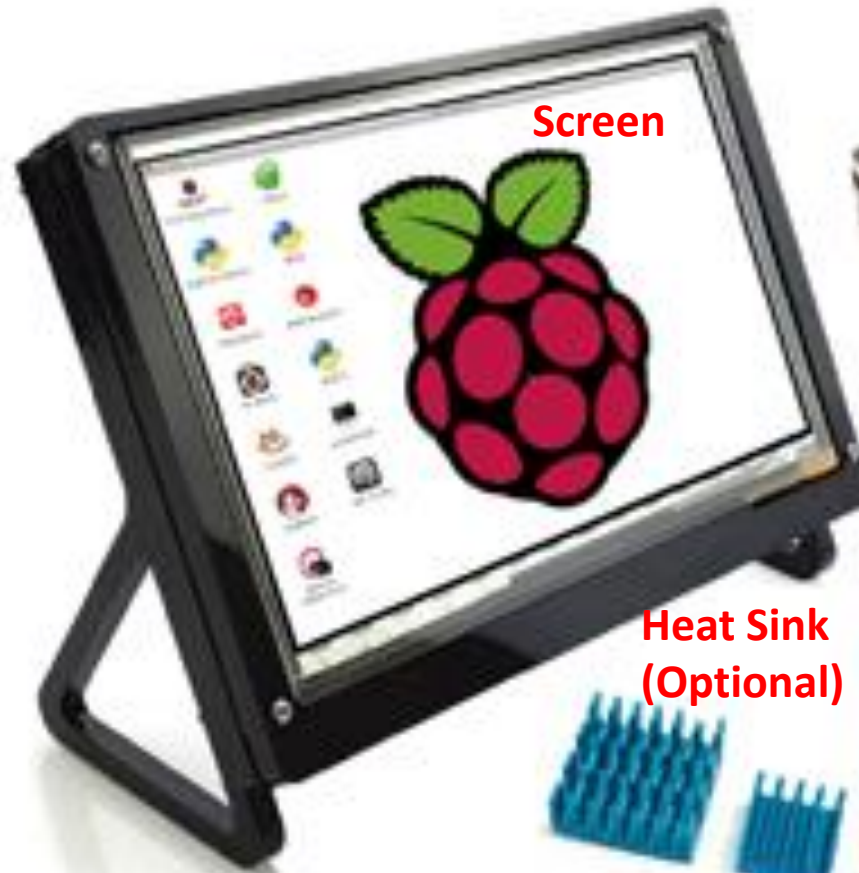
Equipment for the project

1. Fish Tank
2. Raspberry Pi Kit (3 or 4)
3. Raspberry Pi Camera
4. Bread Board
5. Three LED Lights (Red, Yellow, and Green)
6. Resistors (Minimum 3)
7. Jumper Wires

Raspberry Pi Kit

Taken from:

<http://www.eleduino.com/Raspberry-Pi-3-Super-Integrated-Computer-Kit-p10572.html>



Screen

Pi Case

Heat Sink (Optional)

Pi Board



SD Card and SD Card Reader (optional)



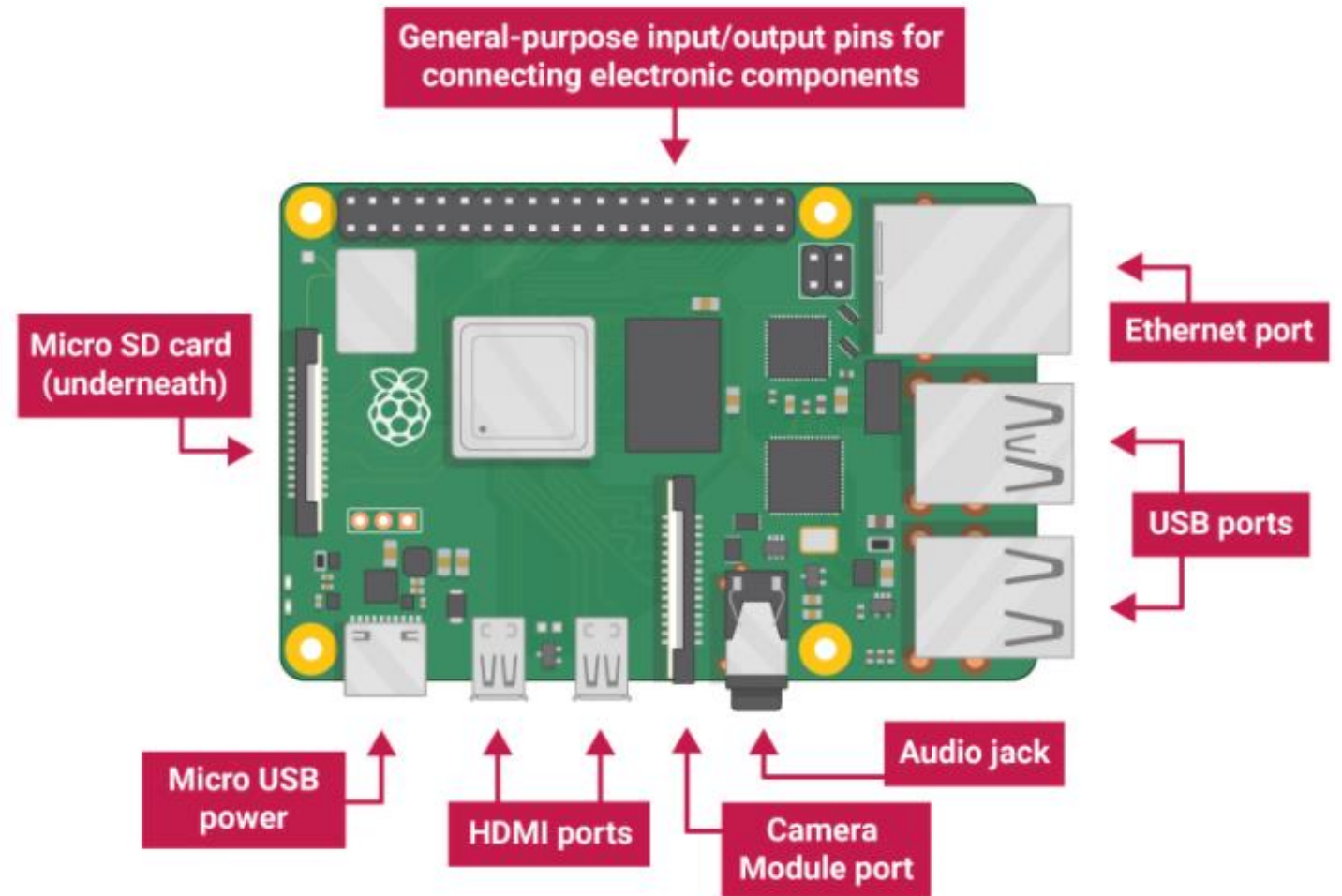
HDMI

Power Adapter and cable

Raspberry Pi

Taken from:

<https://projects.raspberrypi.org/en/projects/raspberry-pi-getting-started/2>



How to power up your Pi board?

1. Insert SD Card into your Pi Board
2. Connect Pi Board to a monitor screen using HDMI Cable
3. Connect Mouse and Keyboard to the USB Ports
4. Power Up your Pi board

Connect Pi Board to Internet

1. Connecting Pi Board to Wi-Fi using User Interface

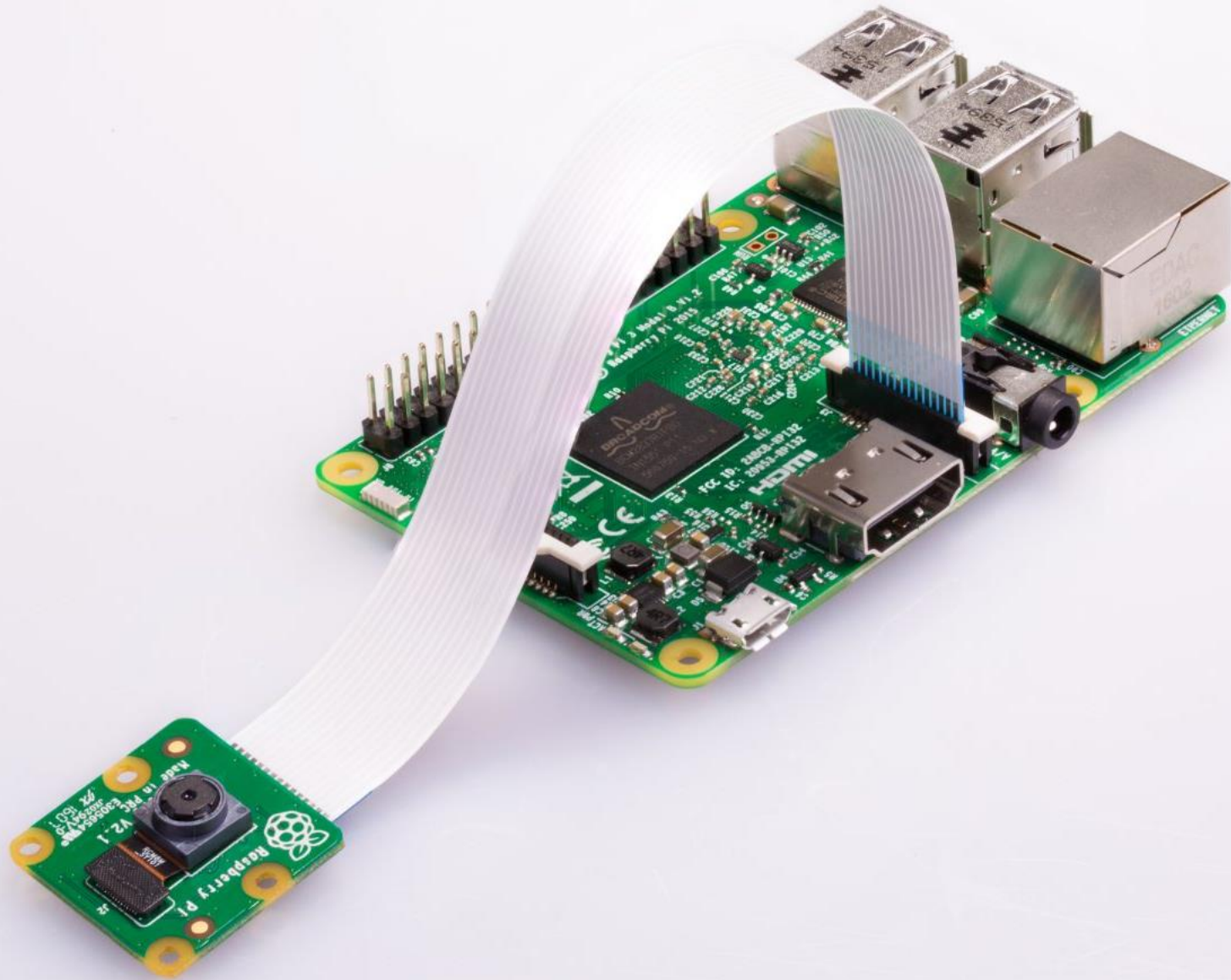
<https://www.raspberrypi.org/documentation/configuration/wireless/desktop.md>

2. Connecting Pi Board to Wi-Fi using CLI

<https://www.raspberrypi.org/documentation/configuration/wireless/wireless-cli.md>

3. Connect Pi Board to LAN using Ethernet Port

<https://raspberrypi.stackexchange.com/questions/11684/how-can-i-connect-my-pi-directly-to-my-pc-and-share-the-internet-connection>



Pi Camera

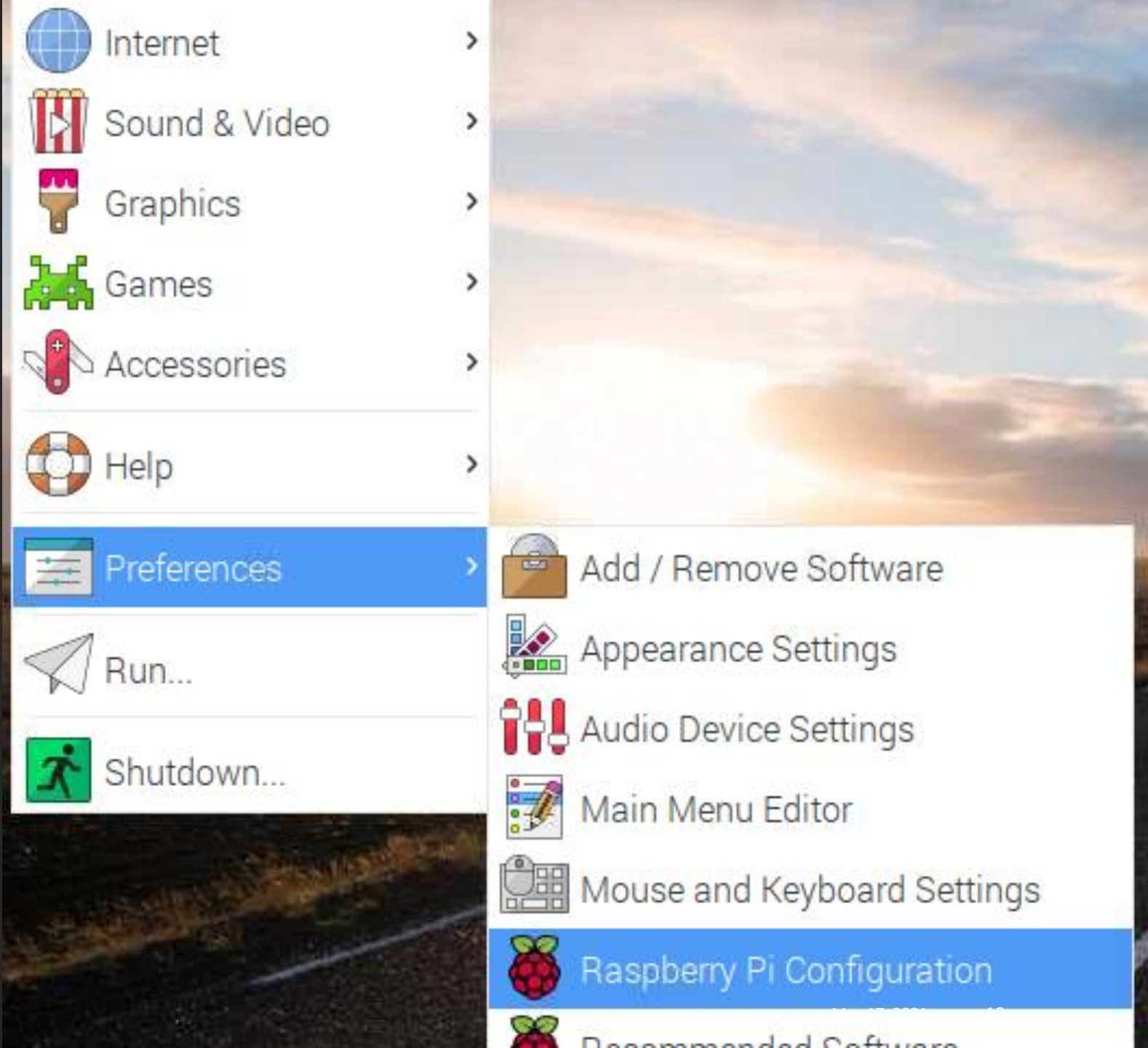
Taken from:

<https://projects.raspberrypi.org/en/projects/getting-started-with-picamera>

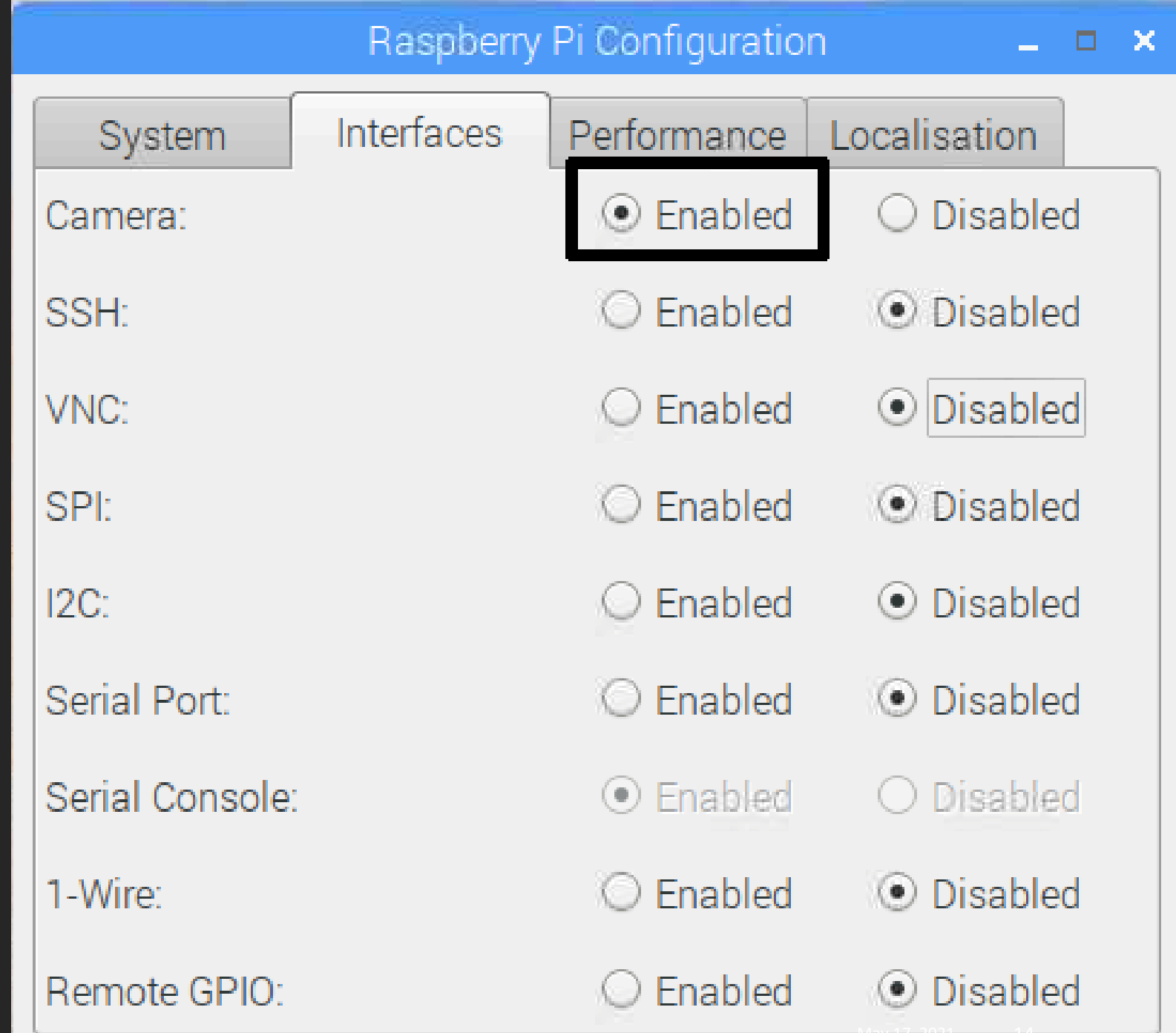
How to connect Pi Camera to Pi Board

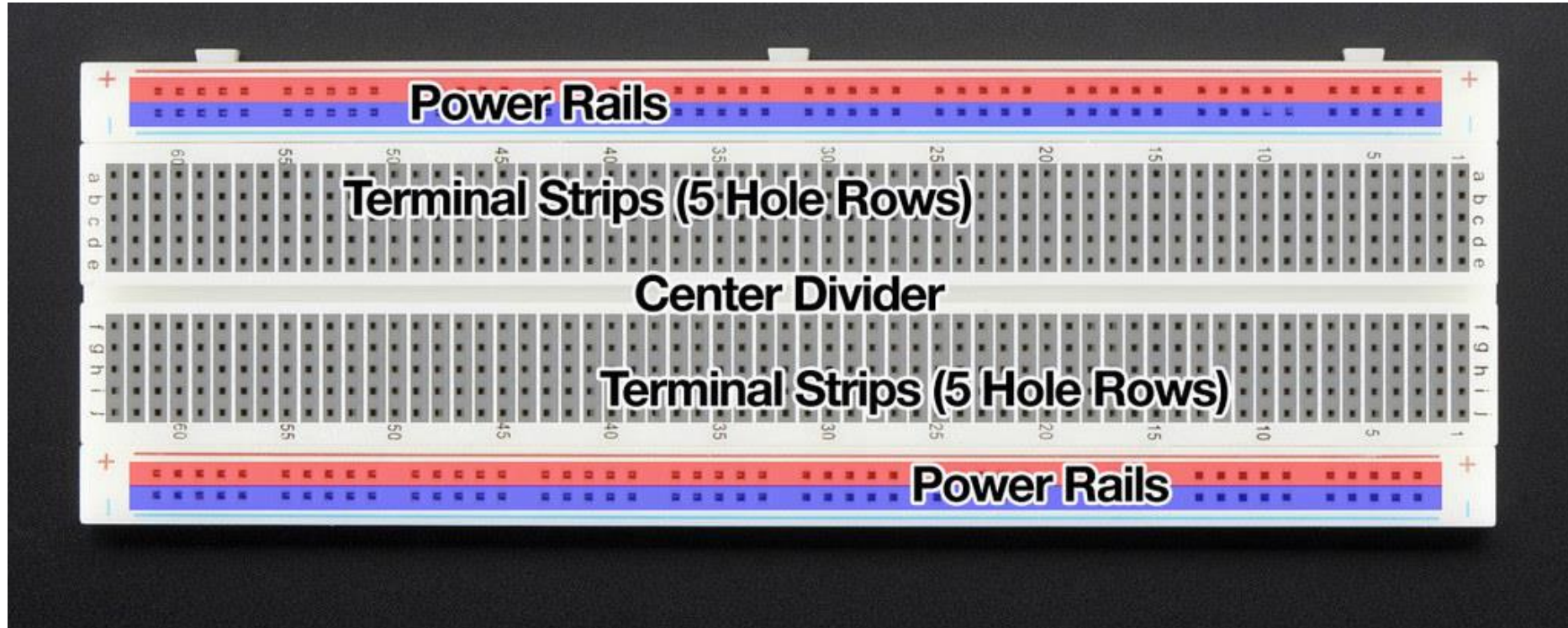
1. Power Off your Pi Board
2. Find the camera port on the Pi Board
3. Pull up the camera port plastic clip
4. Insert the Pi Camera ribbon and make sure the cable was inserted in the correct manner
5. Push the plastic clip back into place
6. Power Up your Pi Board

Main Menu -> Raspberry Pi Configuration



Interfaces -> Camera (Enabled)





Bread Board

Taken from: <https://learn.adafruit.com/breadboards-for-beginners?view=all>

Components for using a breadboard

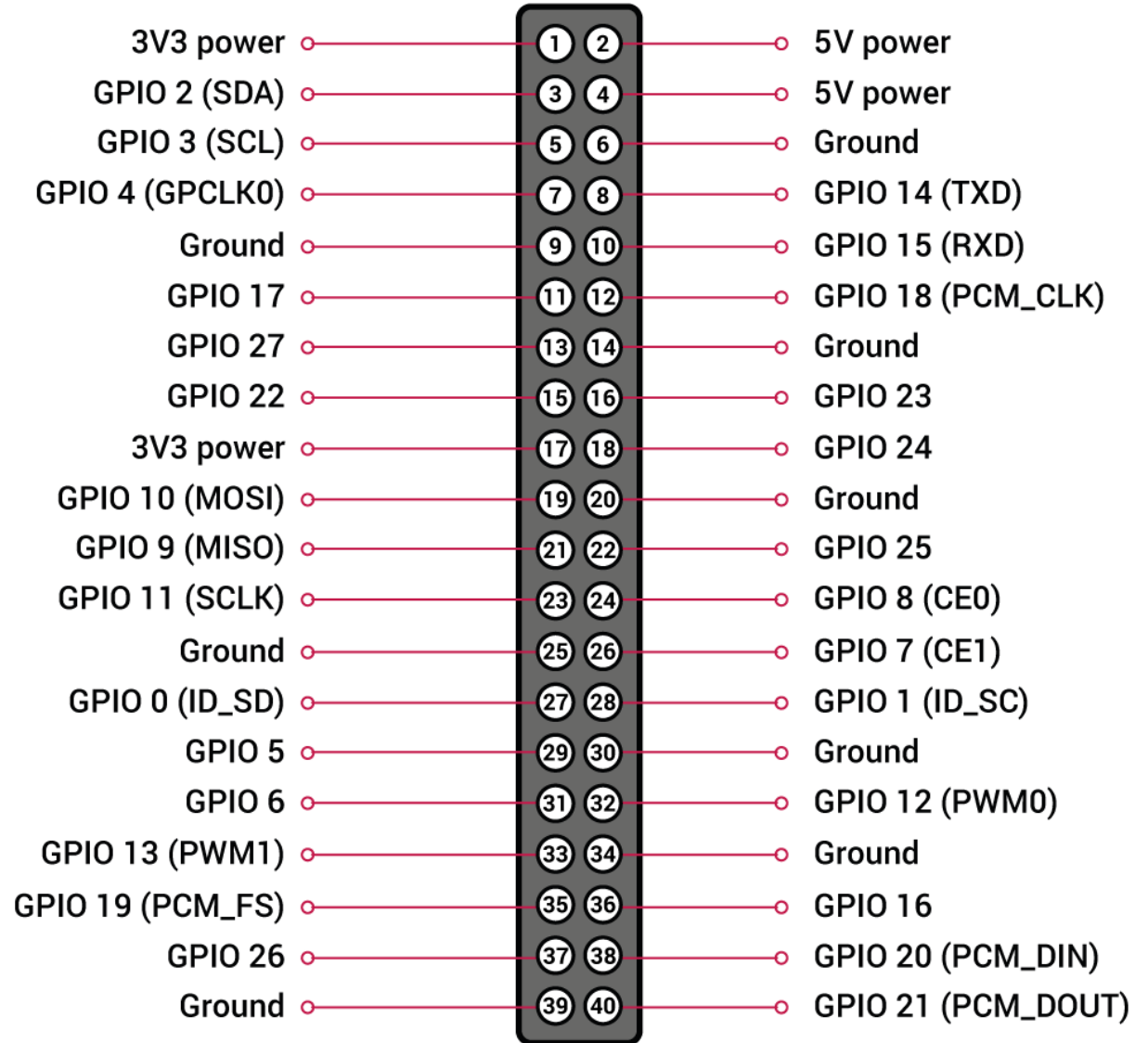
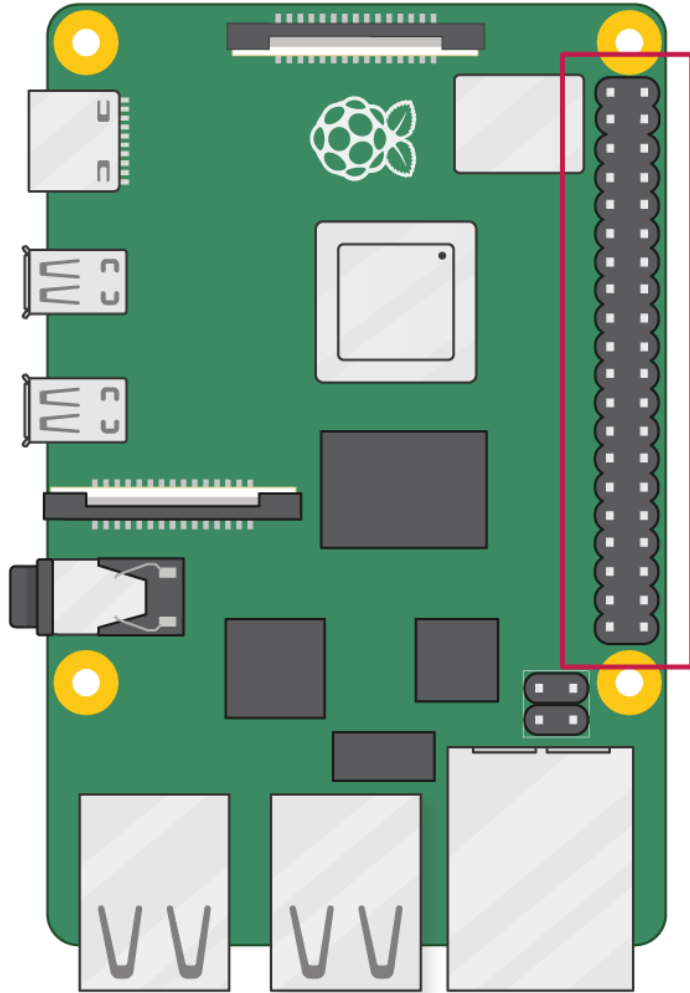
1. Breadboard
2. LED lights (Red, Yellow, and Green)
3. Resistor (Atleast three)
4. Male-to-female jumper leads
5. Male-to-male jumper leads

Connect LEDs using Breadboard to Pi Board

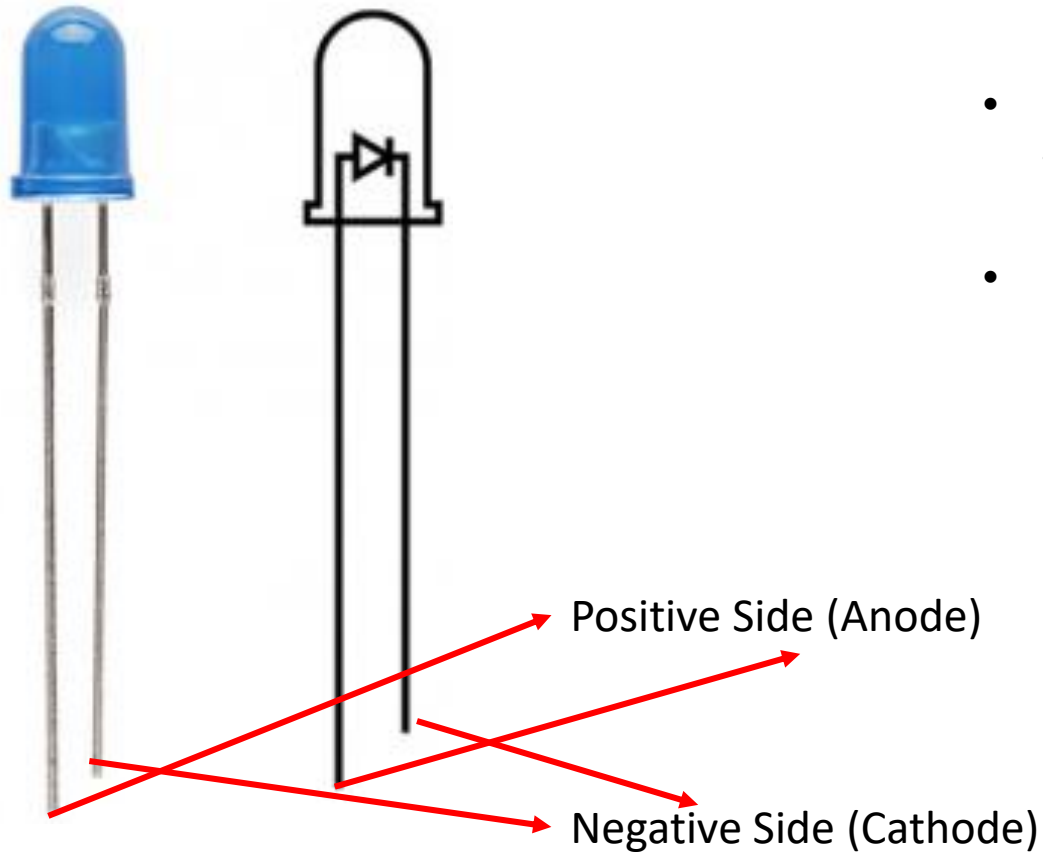
1. Power off the Pi Board
2. Connect a jumper wire from GPIO pins and breadboard voltage rail
3. Connect a jumper wires from GPIO pins and breadboard ground rail
4. Connect the LED to a terminal strip
5. Connect a resistor between voltage rail and LED terminal strip, if the LED strip is 5 connect resistor between terminal strip 5 and voltage rail
6. Connect a resistor between ground rail and LED terminal strip, if the LED strip is 5 connect resistor between terminal strip 5 and ground rail
7. Connect other LEDs by repeating the steps 2, 4, and 5.

Reference and further read: <https://magpi.raspberrypi.org/articles/breadboard-tutorial>

Raspberry Pi GPIO Pins



LEDs and its connection on breadboard



- Connect the Positive Side to the voltage rail of the breadboard
- Connect the Negative Side to the ground rail of the breadboard

Reference: <https://learn.sparkfun.com/tutorials/light-emitting-diodes-leds/all>

Fish Tank Model

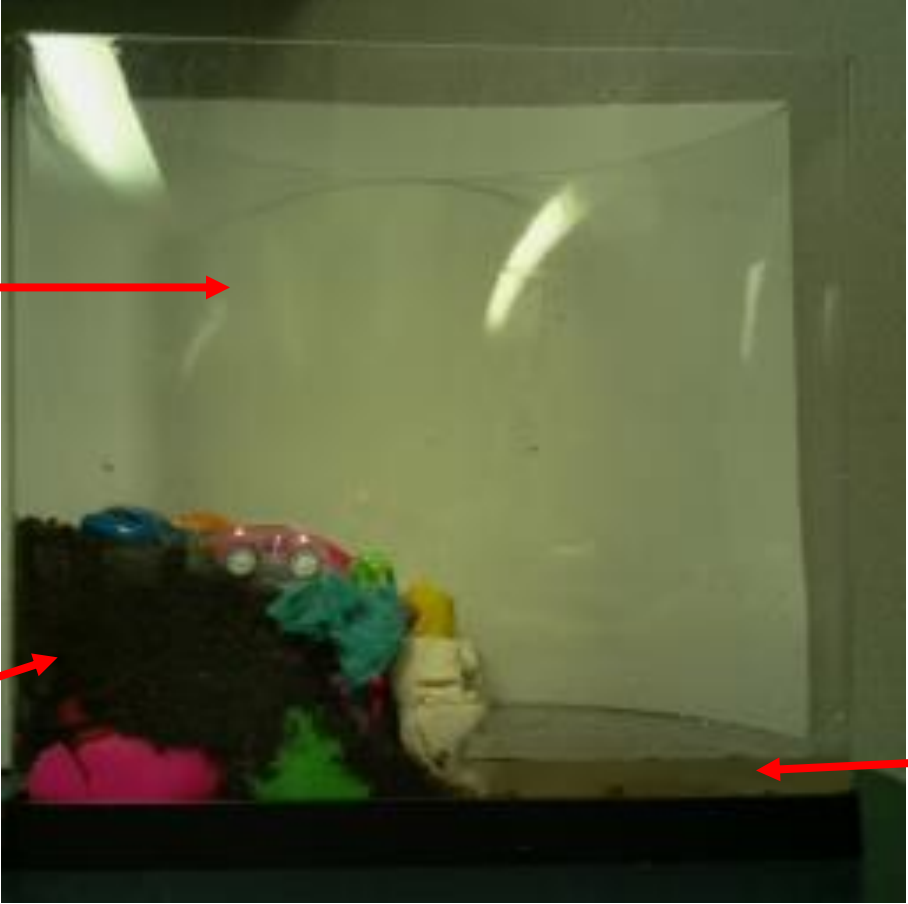
White Background



Land



Water



Code Snippet for capturing Images

```
1. camera = picamera.PiCamera() # Setup a Picamera Object
2. camera.resolution = (256, 256) #Capture 256*256 resolution images
3. camera.start_preview() # Open Camera Preview
4. time.sleep(2) # Freeze the preview for 2 seconds
5. camera.capture(os.path.join(os.getcwd(), "images", "testing",
    imageName)) # Capture images and write to a file location
```

Image Name	Water Level	Expected LED Light	Predicted LED Light	Pass/Fail
testImage1.jpg	low-mid	green	green	Pass
testImage2.jpg	low	green	green	Pass
testImage3.jpg	empty	green	green	Pass
testImage4.jpg	empty	green	green	Pass
testImage5.jpg	low	green	green	Pass
testImage6.jpg	mid	yellow	yellow	Pass
testImage7.jpg	mid	yellow	yellow	Pass

Truth set of captured images
Available at:

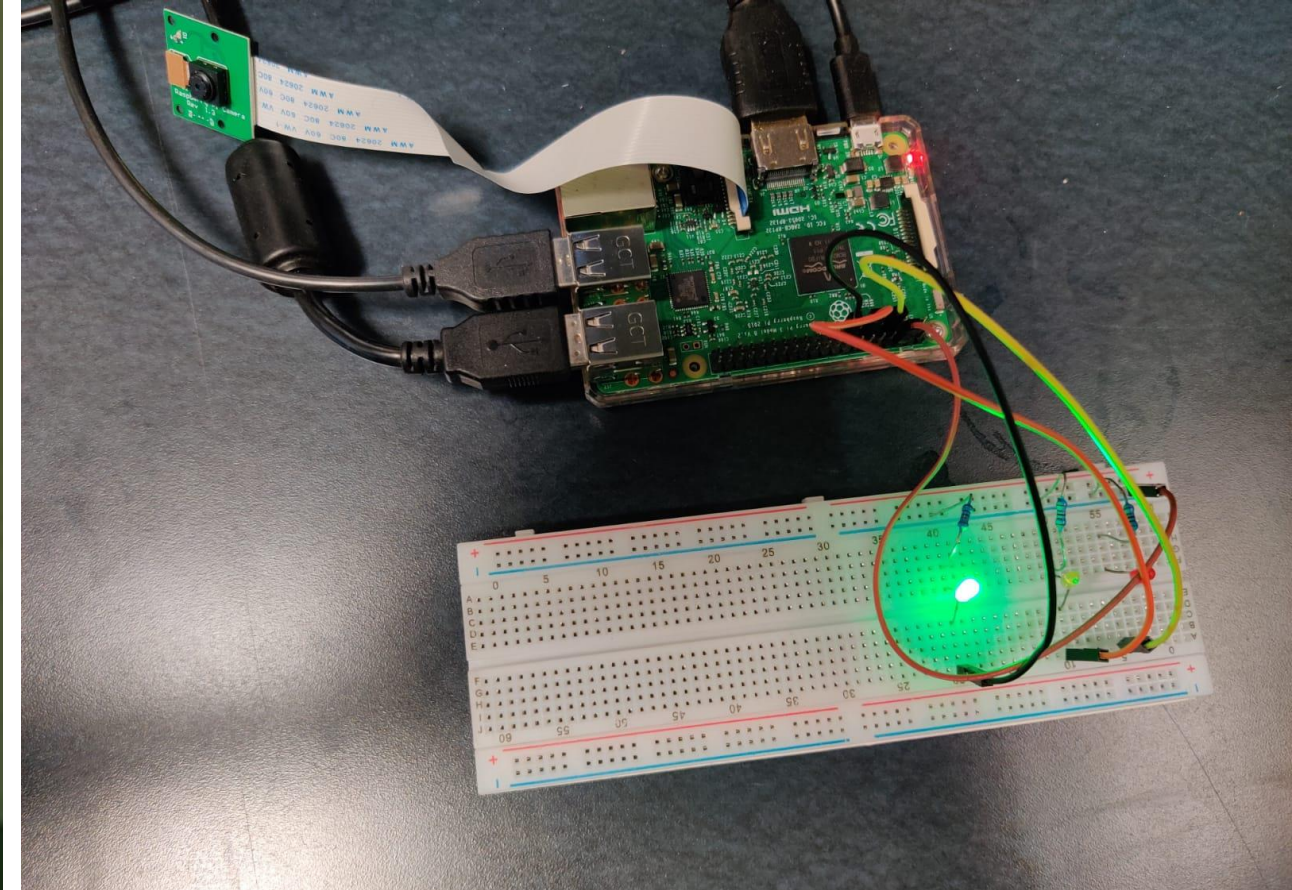
<https://github.com/isaki001/PiCamUtils/tree/master/floodDetection>

Greyscale Images and its usage in our project

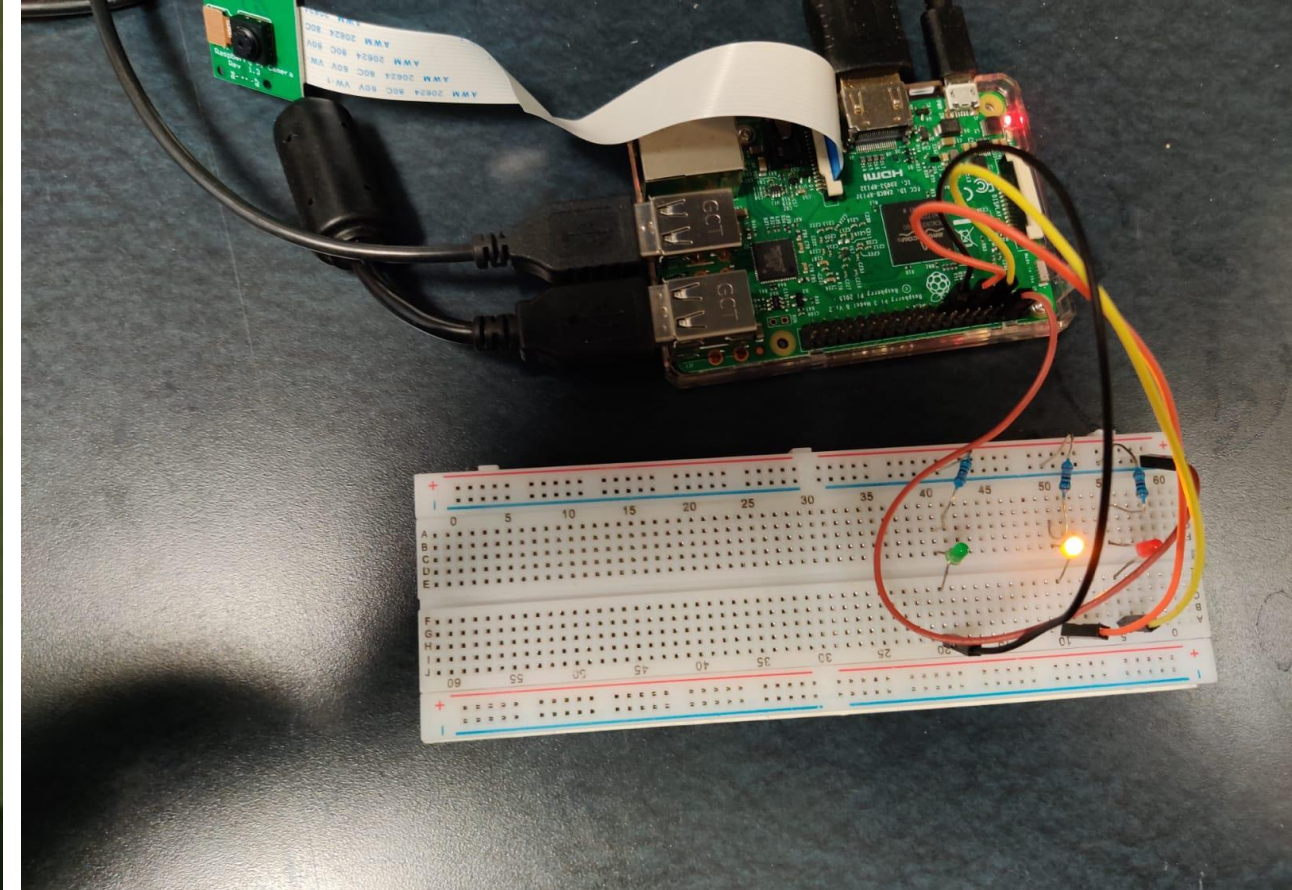
1. Greyscale images are those images whose each pixel stores the shades of grey.
2. Advantage: Converting a RGB image requires less space for storing image pixel values in greyscale images

Usage in our project

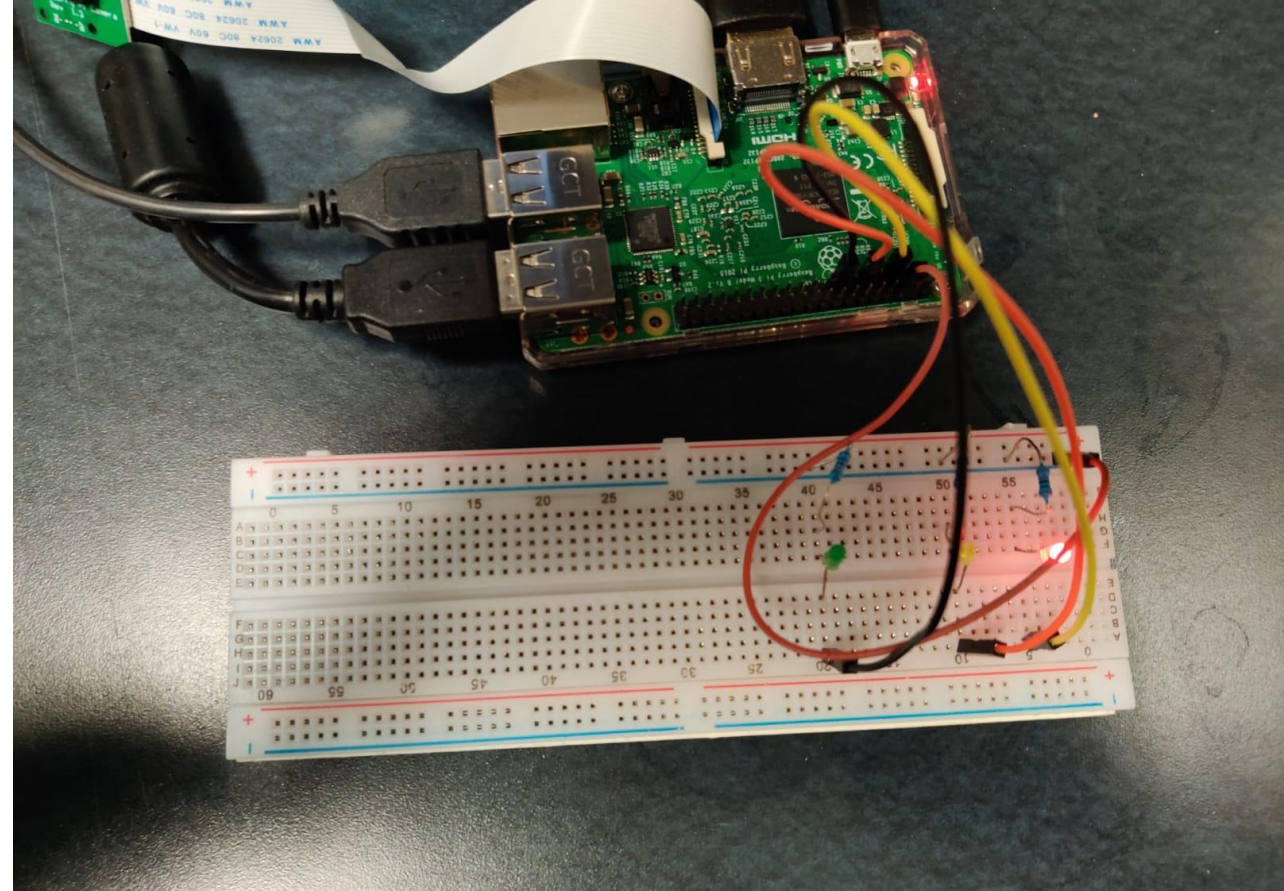
- A. For our project, we convert each image to a greyscale scale image using a threshold value. The pixel values in the image above the threshold is set to 255 while the pixel values below the threshold is set to 0.
- B. The greyscale threshold values convert all the color pixels to 255 and all the white pixel to 0.



Testing Water Level Low



Water Level Medium



Testing Water Level High

Project Dependencies

1. Python3 (Programming Language)
2. picamera (library for capturing images using Raspberry Pi camera)
3. OpenCV (library for image processing)
4. gpiozero (library for using LEDs with Raspberry Pi)