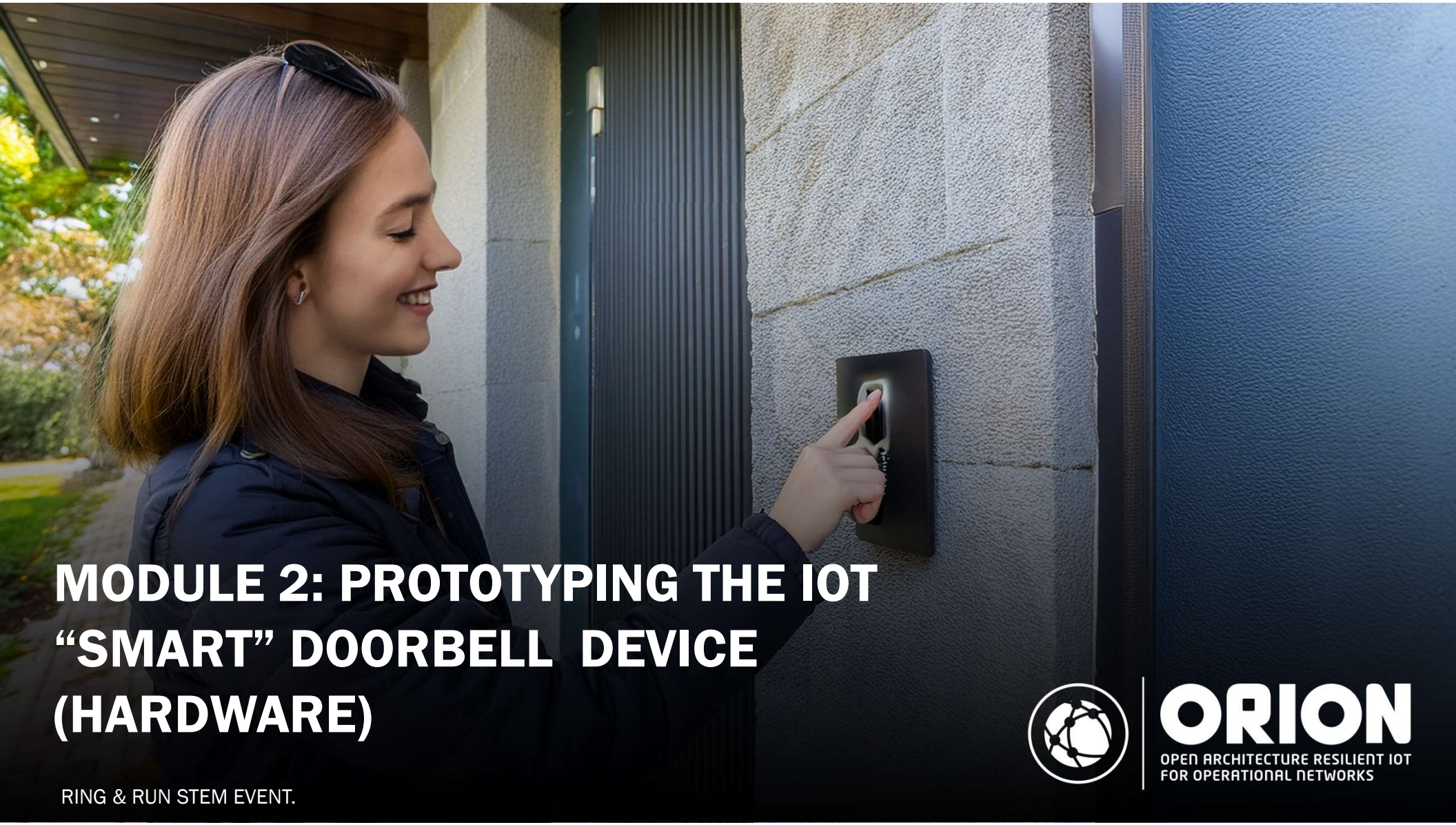


MODULE 2: PROTOTYPING THE IOT “SMART” DOORBELL DEVICE (HARDWARE)

RING & RUN STEM EVENT.

ORION
OPEN ARCHITECTURE RESILIENT IOT FOR OPERATIONAL NETWORKS

IoT enabled “Smart” Doorbell Concept

Client App (Front-End)

Web app: (based on HTML5 CSS and JavaScript)

HTTPS MJPG video stream

Python Back-end

Publish to topic: *ring/#*

device command set

Subscribe to topic: *ring/#*

Publish to topic: *ring/#*

device command set

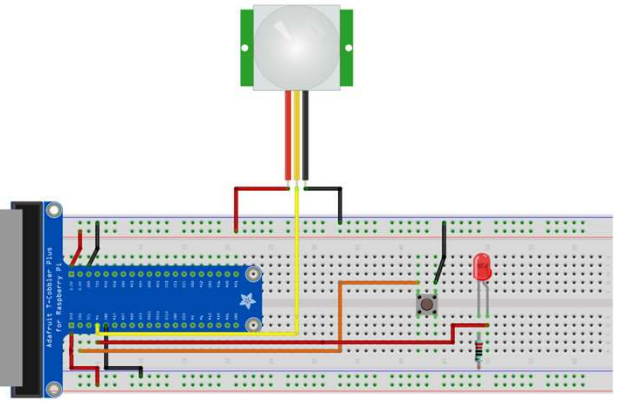
Subscribe to topic: *ring/#*

Mosquitto (MQTT)Broker

MQTT over WebSockets

Raspberry Pi 4B

Supported modes: motion and manual (button press)

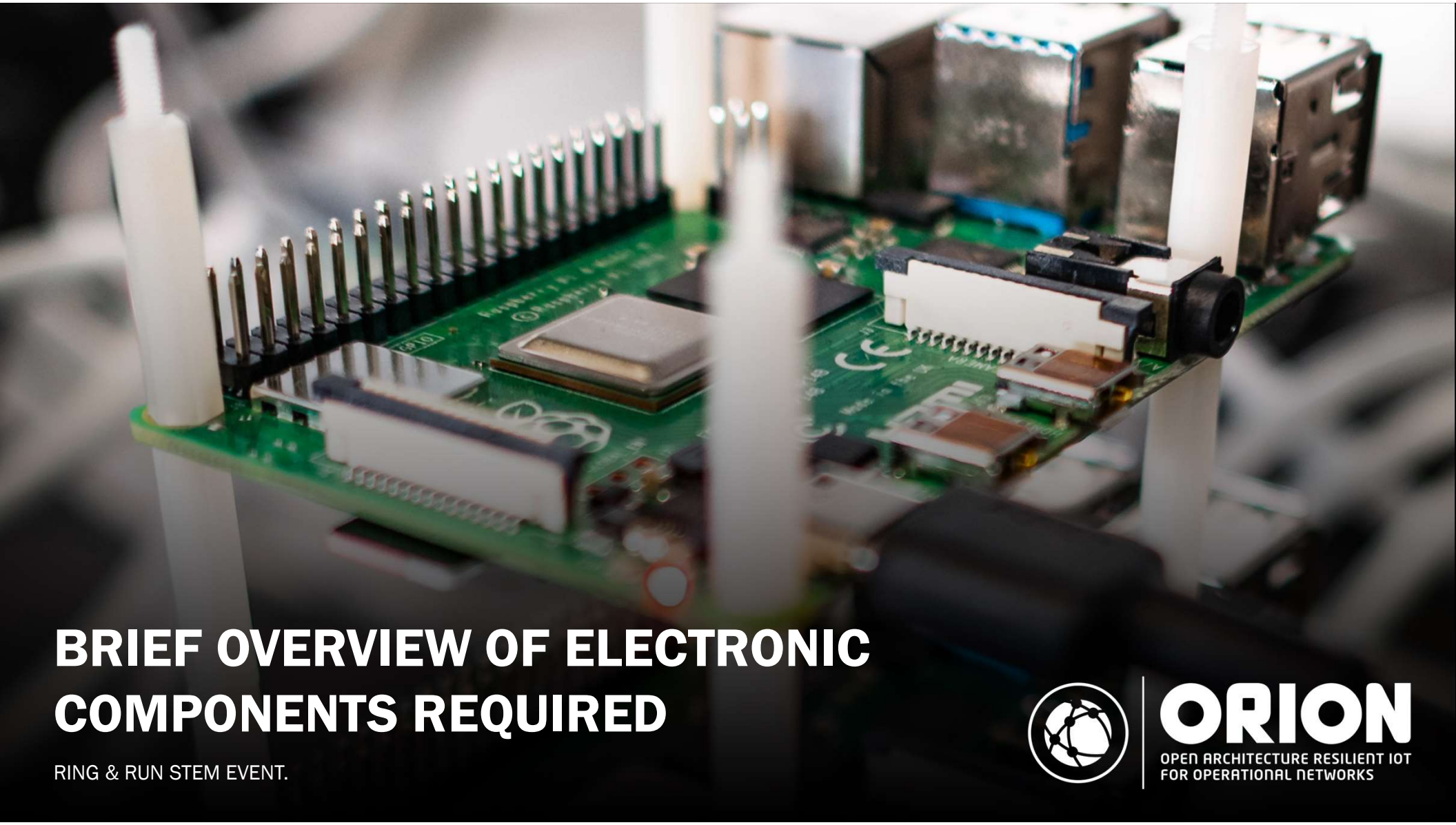


Doorbell Prototype Device

fritzing

OpenAI

https://openai.com/

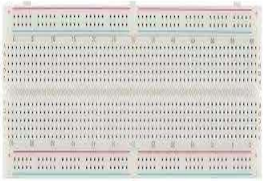


BRIEF OVERVIEW OF ELECTRONIC COMPONENTS REQUIRED

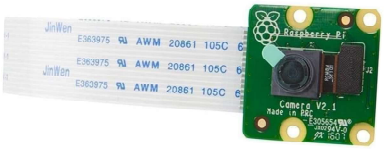
RING & RUN STEM EVENT.

ORION
OPEN ARCHITECTURE RESILIENT IOT FOR OPERATIONAL NETWORKS

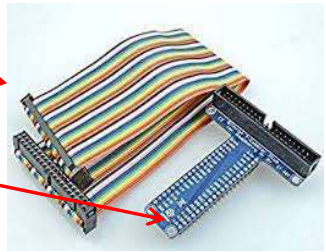
- List of components:
  - 1 x Raspberry Pi 4B
  - 1 x half size bread board
  - 1 x 40-pin ribbon cable
  - 1 x T-cobbler (GPIO extender)
  - 1 x 220 Ohm resistor
  - PIR Motion Sensor
  - 1 X 5mm LED
  - Jumper wires
  - Switch button



Mini bread board

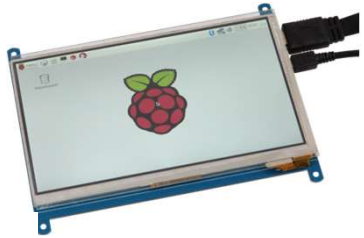


Camera module

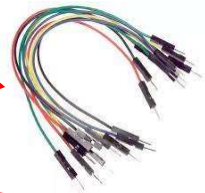


USB microphone

Bluetooth speaker

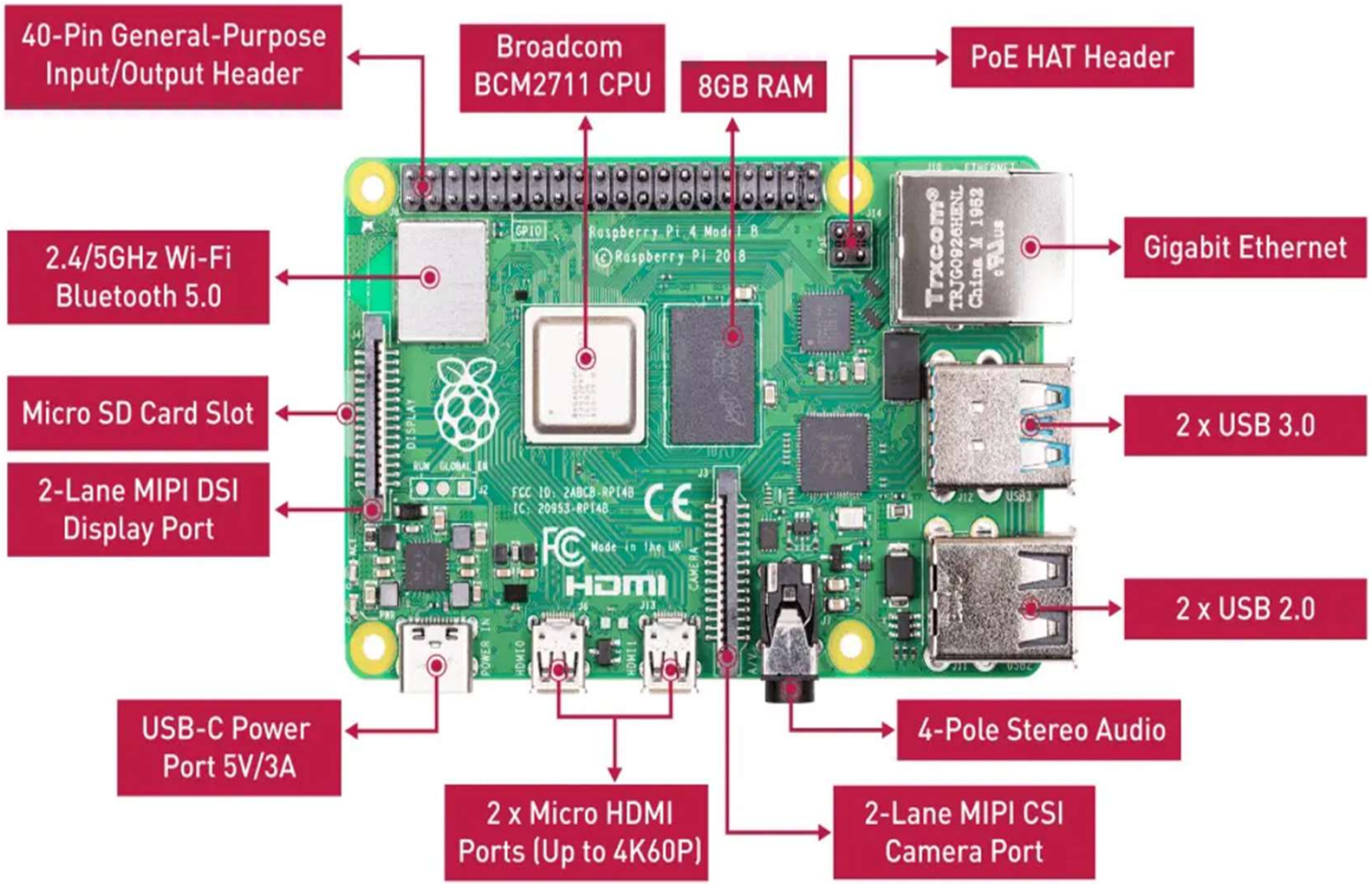


LCD Display

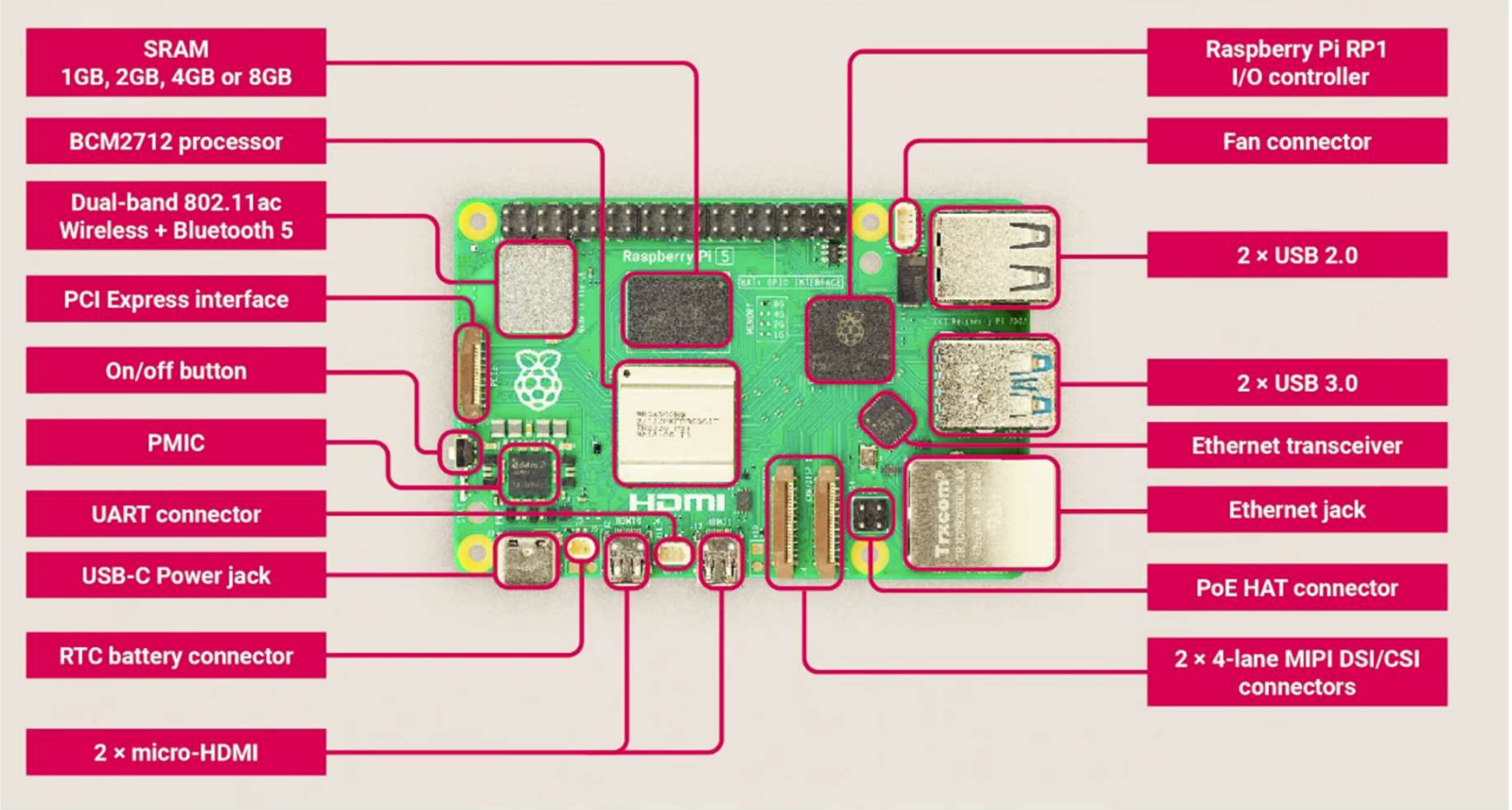


Mini keyboard

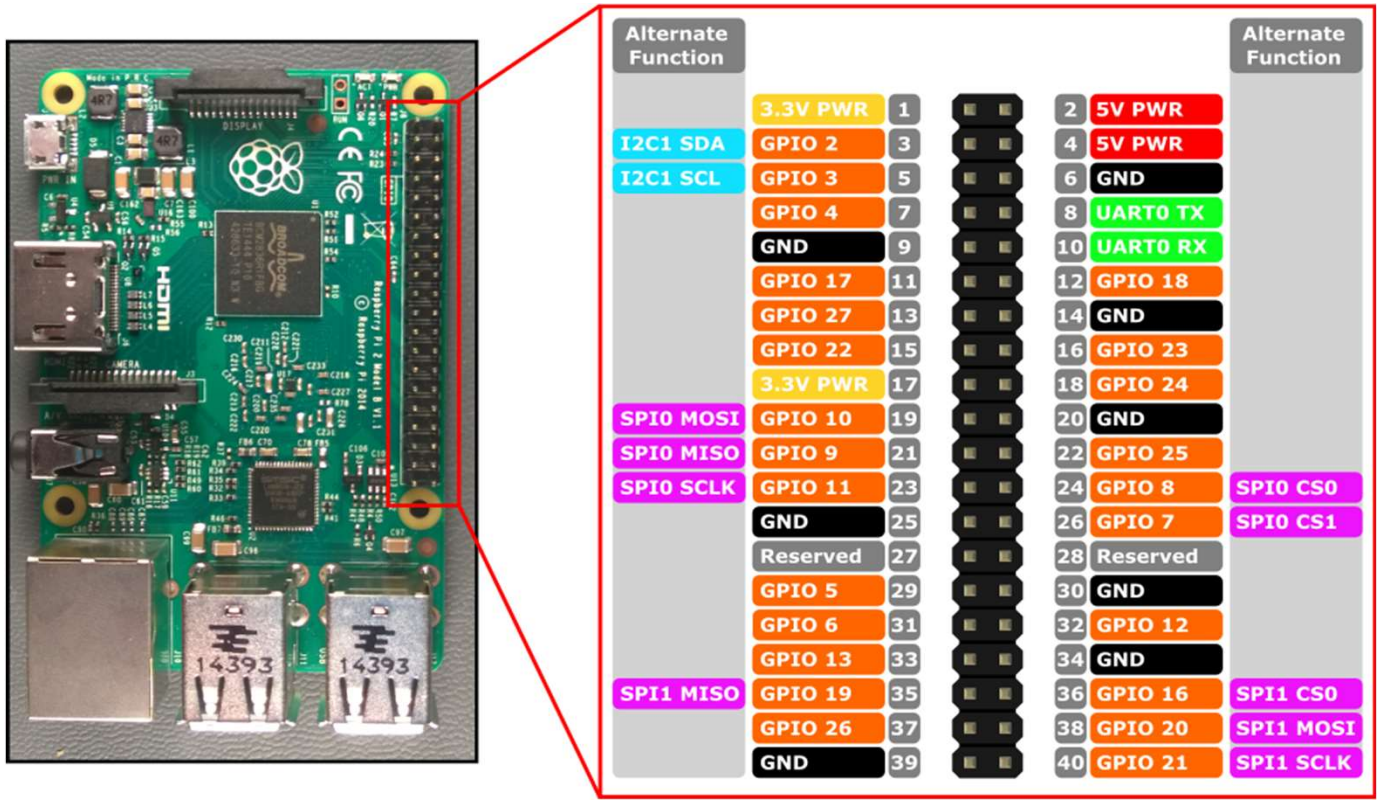
Raspberry Pi 4B



Raspberry 5 Pi



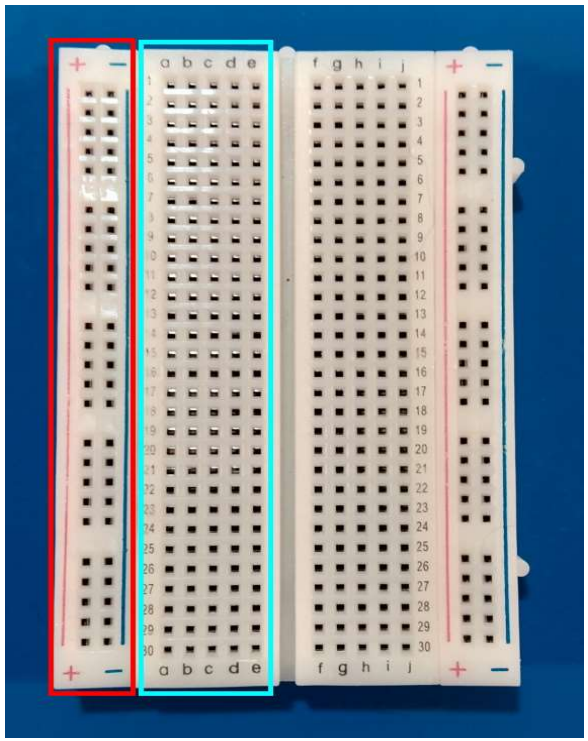
40-pin GPIO (General Purpose Input/Output) Header Overview



- Allows the code running on Raspberry Pi to interact with the outside world…
- Supports digital communication using serial bus protocols including: UART, SPI, i2c
- Pin numbering scheme: Board, BCM/GPIO/WiringPi

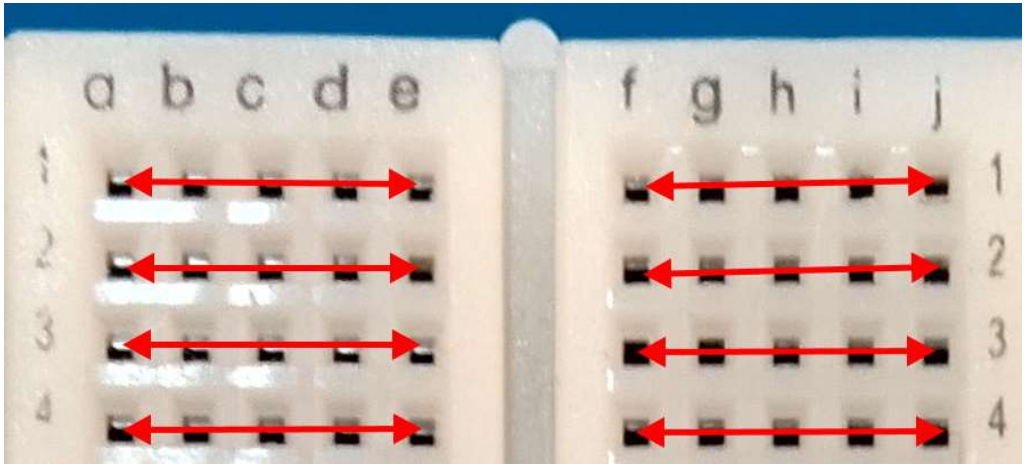
https://learn.sparkfun.com/tutorials/introduction-to-the-raspberry-pi-gpio-and-physical-computing/gpio-pins-overview
https://projects.raspberrypi.org/en/projects/physical-computing/1
https://www.pi4j.com/getting-started/understanding-the-pins/

Breadboard



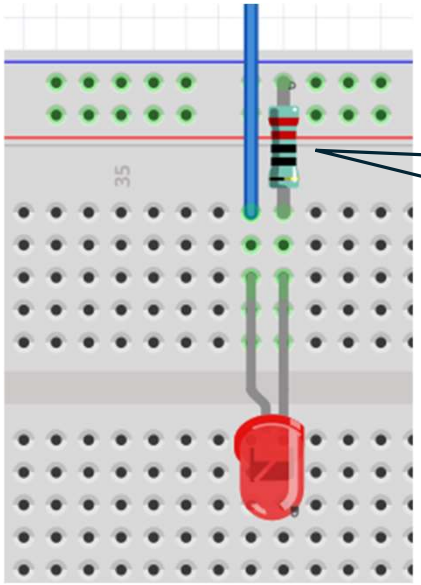
Source: https://learn.microsoft.com/en-us/training/modules/create-iot-device-dotnet/2-construct-iot-hardware - [2]

- The breadboard is organized in rows and columns called socket strips (shown in cyan)
  - *Socket strips are connected vertically*
- The bus strips on the edges (shown in red) are using connecting a power source (3.3v and 5v for the Pi)
  - *Edge strips connect horizontally over the length of the breadboard*
- Socket strips allow components to be connected without soldering or wires. [2]



- Any pin plugged into row 1, column ‘a’ would be connected to any pin plugged into row 1, columns ‘b-e’.
- On the other side of the divider, row 1 columns f-j are similarly connected. [2]

Resistor



Use of 220 Ohm resistor to limit the current through the LED and to prevent excess current that can burn out the LED

A resistor is **a passive two-terminal electrical component that implements electrical resistance as a circuit element**. In electronic circuits, resistors are used to reduce current flow, adjust signal levels, to divide voltages – [3]

[3] - https://en.wikipedia.org/wiki/Resistor

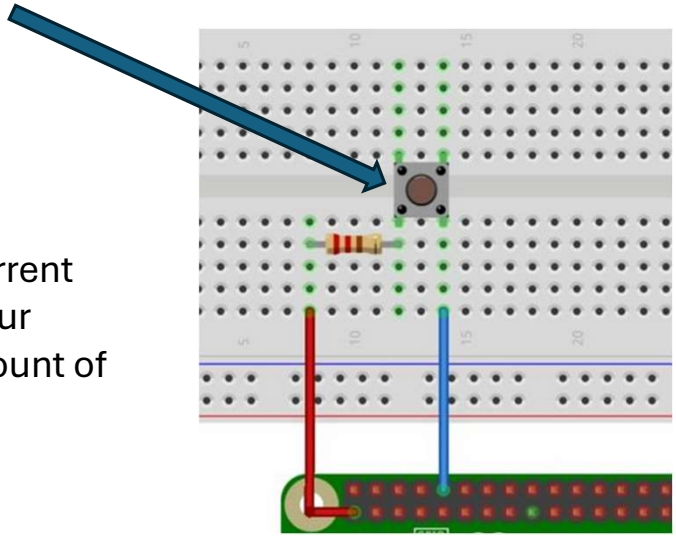
LED and Button Switch

- The longer leg (known as the '**anode**'), is always connected to the positive supply of the circuit. The shorter leg (known as the '**cathode**') is connected to the negative side of the power supply, known as 'ground'.

- **LED** stands for **L**ight **E**mitting **D**iode, and glows when electricity (current) is passed through it. - [2]

- Connect one side of the switch to an input pin on the Raspberry Pi, in this case we use pin 10.

- The other side of the switch we connect to 3.3V on pin 1 using a resistor.
  - The resistor is used as a current limiting resistor to protect our input pin by limiting the amount of current that can flow. [3]

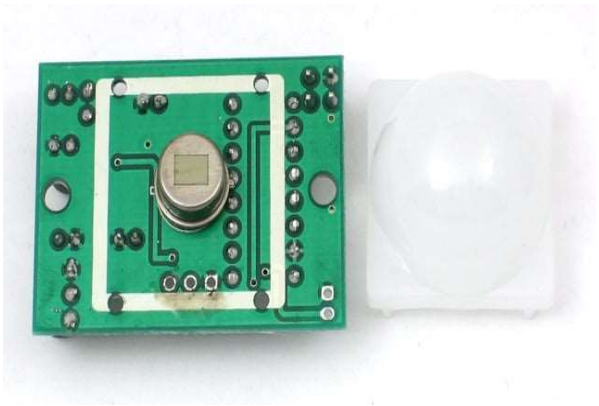


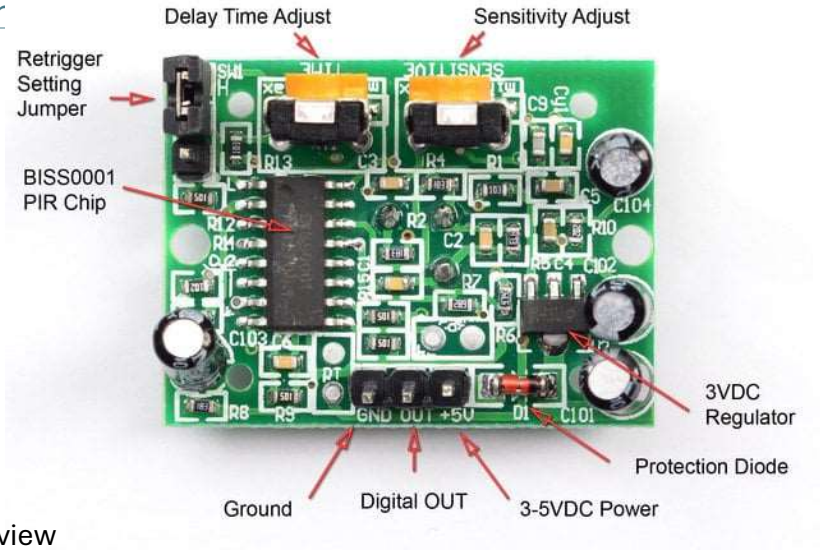
Source: https://thepihut.com/blogs/raspberry-pi-tutorials/27968772-turning-on-an-led-with-your-raspberry-pis-gpio-pins - [2]

Source: https://raspberrypihq.com/use-a-push-button-with-raspberry-pi-gpio/ - [3]

PIR, "Passive Infrared", "Pyroelectric", or "IR motion" sensors

- Sense motion, almost always used to detect whether a human has moved in or out of the sensors range.
- commonly found in appliances and gadgets used in homes or businesses.
- pyroelectric sensor (which you can see below as the round metal can with a rectangular crystal in the center), which can detect levels of infrared radiation.
- Source: https://learn.adafruit.com/pir-passive-infrared-proximity-motion-sensor/overview
  - https://learn.adafruit.com/pir-passive-infrared-proximity-motion-sensor/how-pirs-work



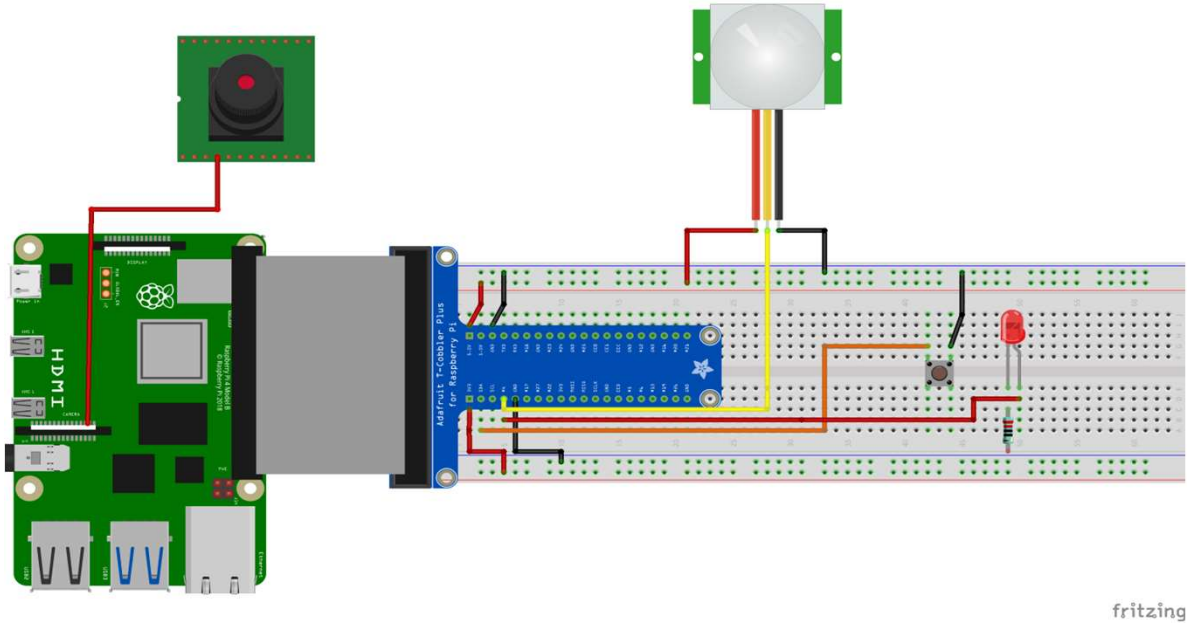


https://learn.adafruit.com/pir-passive-infrared-proximity-motion-sensor/overview

Camera Modules

- https://www.raspberrypi.com/products/camera-module-v2/
- https://www.raspberrypi.com/products/camera-module-3/

“Smart” Doorbell device (Fritzing circuit design) concept

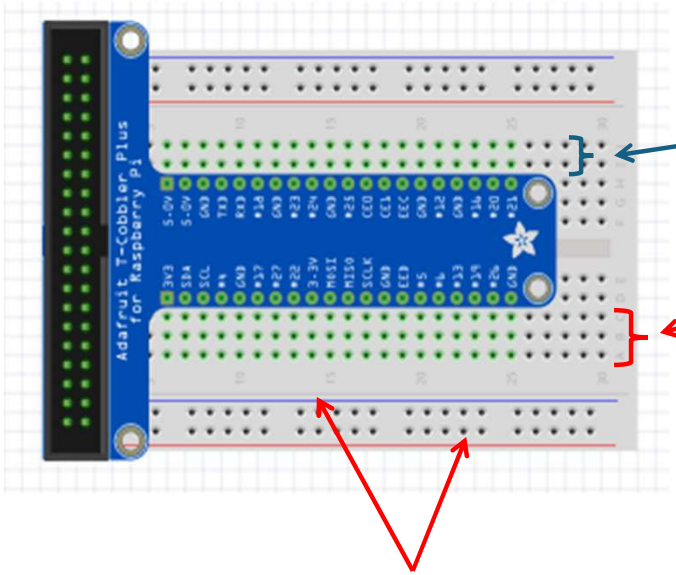


https://fritzing.org/

Fritzing is an open-source hardware initiative that makes electronics accessible as a creative material for anyone

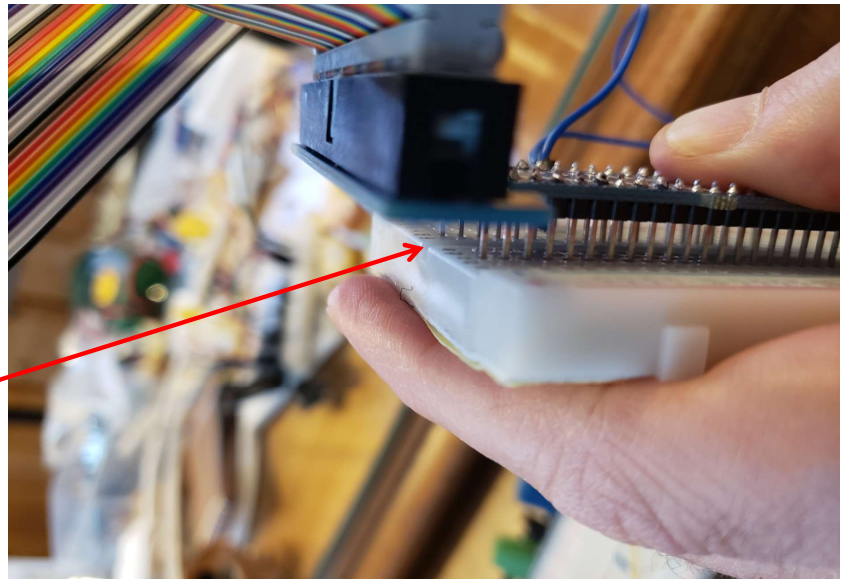
Attach the T-Cobbler to the breadboard

*** Note of the rows on exposed on each side of the t-cobbler (3 on one side, and 2 on the other. Your design should look like this too.**

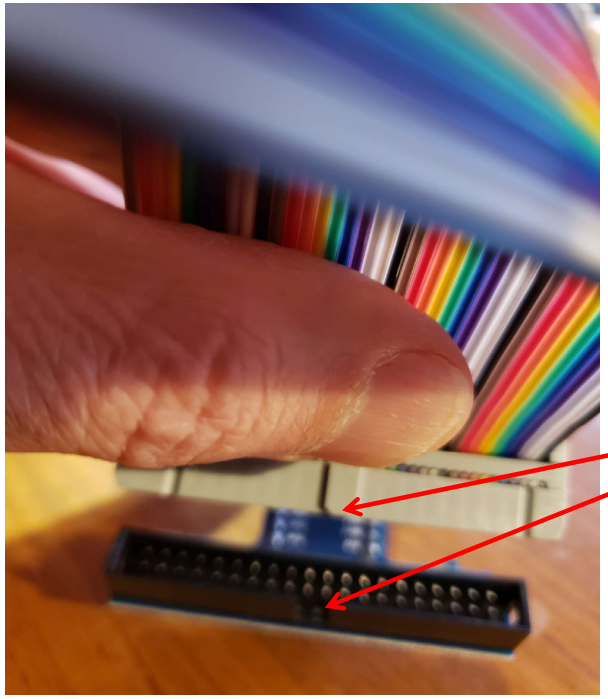


**** Note the orientation to negative/positive (power) terminal strips**

***** Insert the t-cobbler beginning in the first column of sockets in the breadboard**



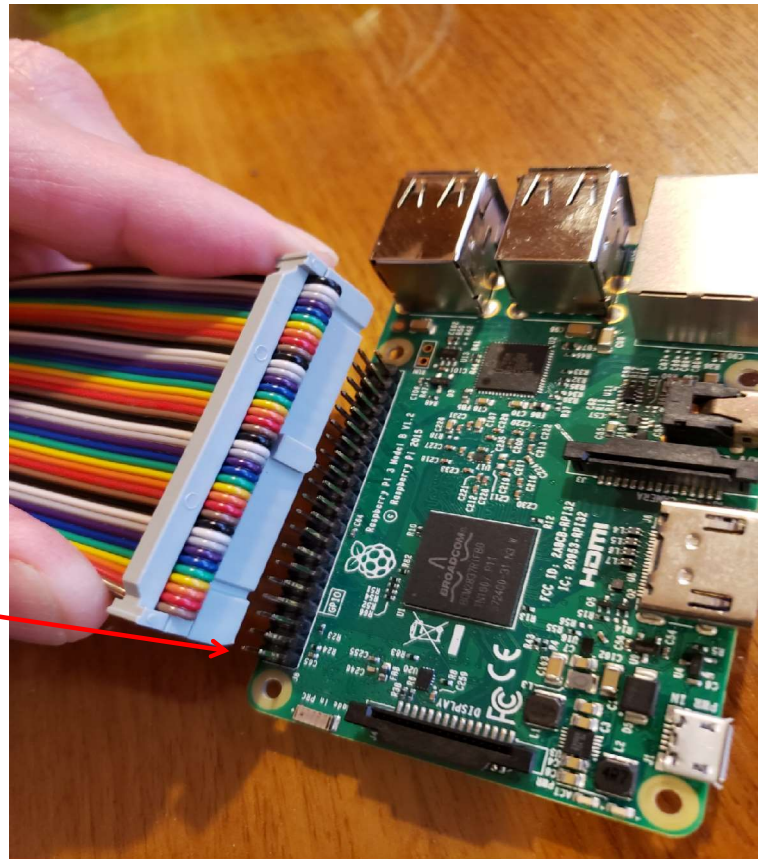
Properly Attaching the Ribbon Cable between the Raspberry Pi and the T-Cobbler



Align the notch on the ribbon cable with the t-cobbler

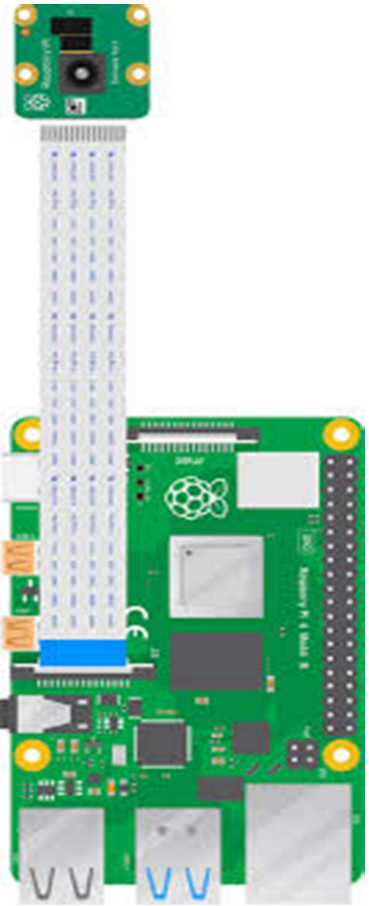
Connect the ribbon cable so it does not cross over the Raspberry Pi (as illustrated)

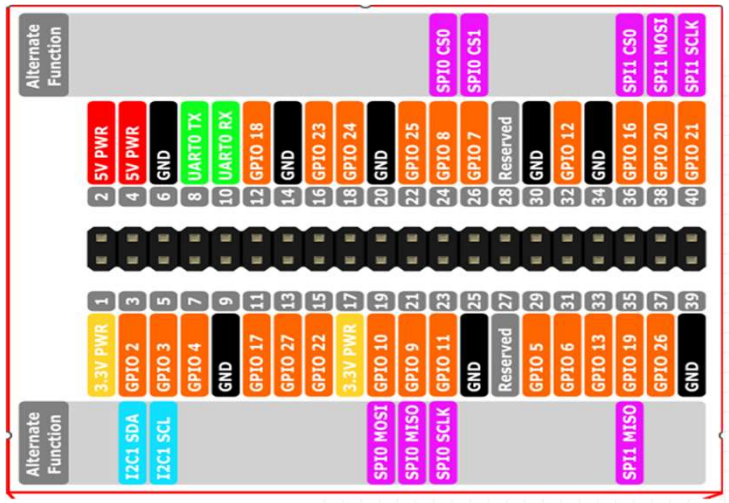
* Carefully align the ribbon cable to connect all 40 pins of the GPIO header.



Exercise: Construct the Doorbell Device (30 mins)

Exercise: Construct the “Smart” Doorbell Device

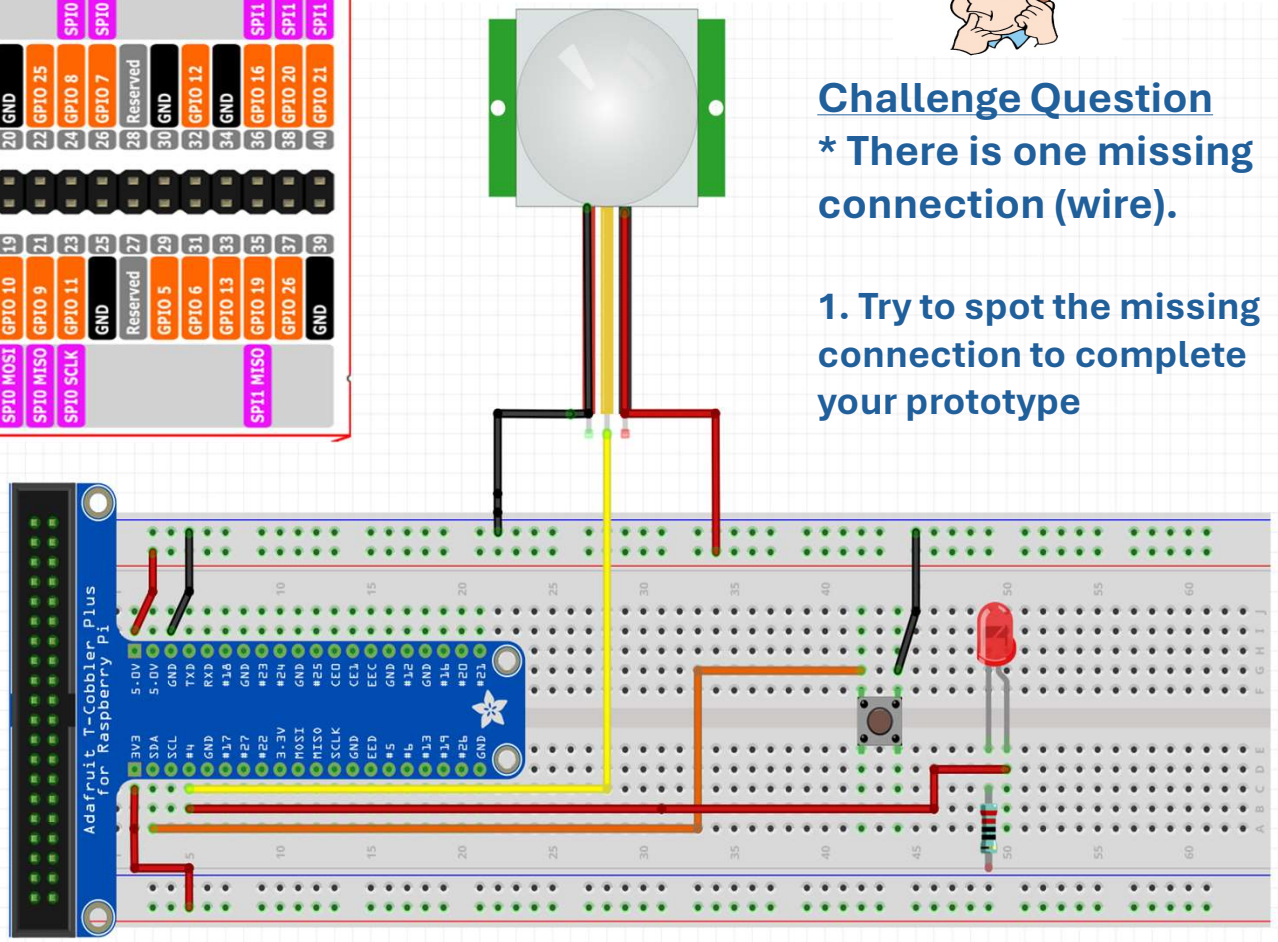




Challenge Question

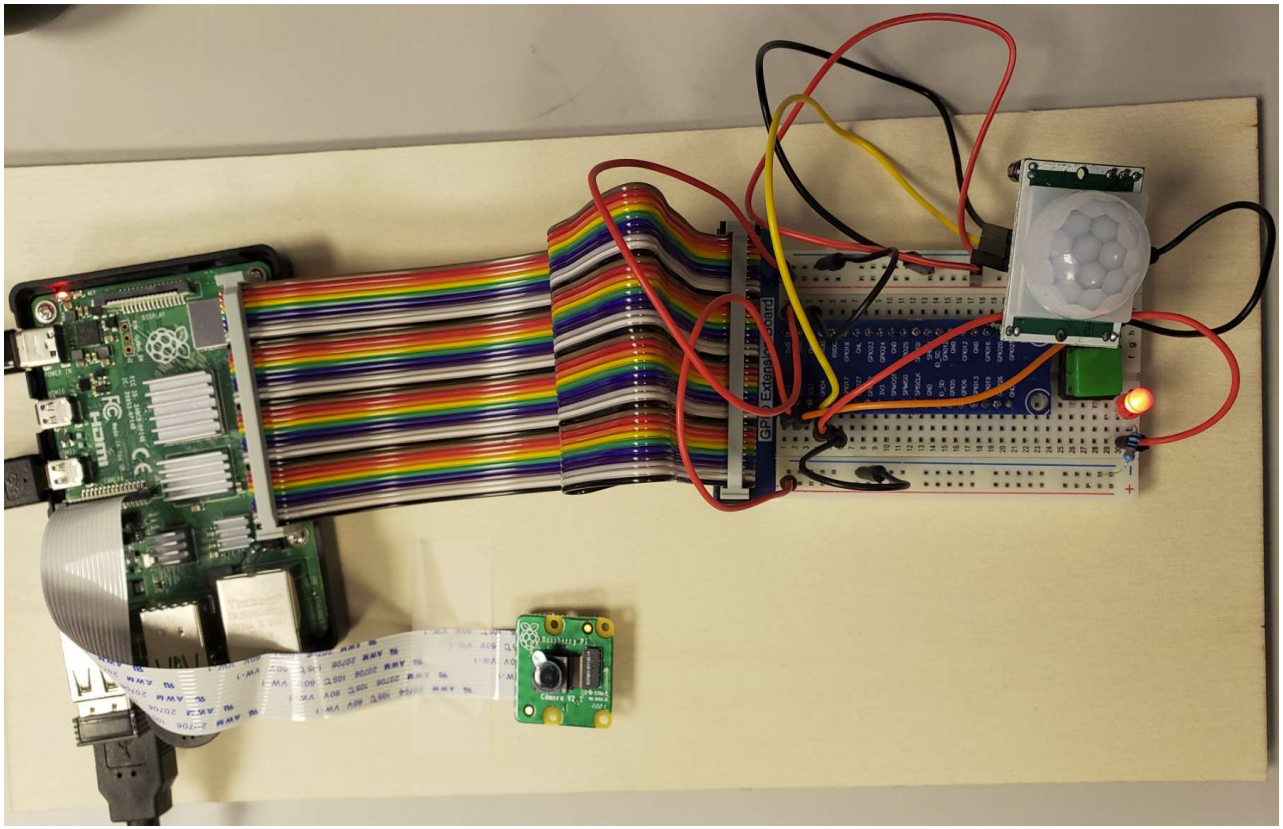
*** There is one missing connection (wire).**

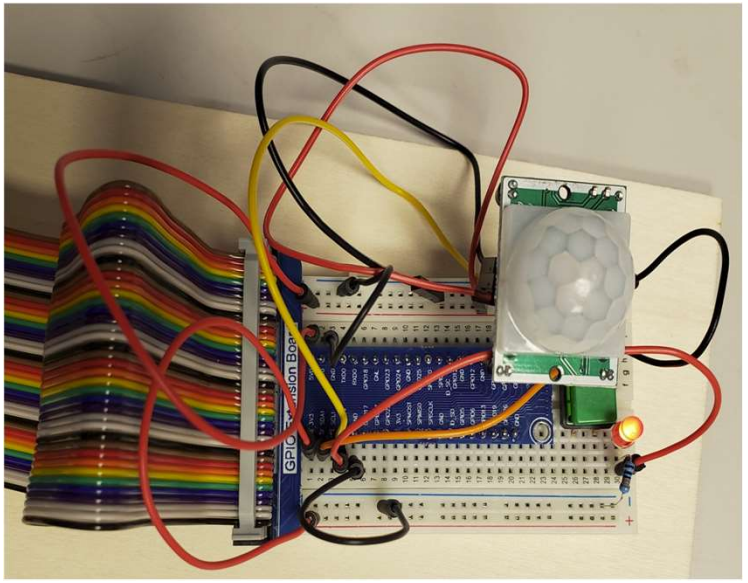
1. Try to spot the missing connection to complete your prototype



* With the power disconnected, attached the camera to raspberry Pi exactly as shown

The Completed “Smart” Doorbell Device





Attach the Device to the Raspberry Pi, and power it on
Note: the LED should illuminate when the PIR sensor detects motion

Test The Camera

- Establish and VNC or SSH session with the Raspberry Pi
- In the terminal, run the command:
  raspistill -t 2000 -o ~/Desktop/testshot.jpg

- If the operation is successful, the command will return and generate a file: testshot.jpg on Desktop (as shown)

- If the command is returns error such as “no camera available”
  1. Make sure the camera is connected properly (with the Raspberry Pi powered off)
  2. Run sudo raspi-config and ensure that Legacy camera is enabled