



Building Projects with Raspberry Pi

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OUTLINE

1. What is Raspberry pi?
2. Comparison of Raspberry Pi with other devices
3. GPIO Programming
4. Interfacing Examples



What is Raspberry Pi?

- **Raspberry Pi** is the name of a series of **single-board computers** made by the **Raspberry Pi Foundation**.
- The **Raspberry Pi** launched in **2012**, and there have been several iterations and variations released since then. The **original Pi** had a **single-core 700MHz CPU** and just **256MB RAM**, and the **latest model** has a **quad-core 1.4GHz CPU** with **1GB RAM**.
- The main price point for **Raspberry Pi** has always been around **Rs. 3000** and all models have been **Rs. 4000** or less.
- The latest version is the Raspberry pi 4 available with 2GB, 4GB, and 8GB RAM size, have a price of Rs. 6500.
- All over the world, people use **Raspberry Pis** to learn **programming skills**, **build hardware projects**, **do home automation**, and even use them in low-scale **industrial applications**.
- The **Raspberry Pi** is a very **cheap** computer based on **Linux**, but it also provides a set of **GPIO** (general purpose input/output) pins that allow you to **control** electronic components for physical computing and provides networking tools to explore the Internet of Things (IoT).

Arduino/NodeMCU v/s Raspberry Pi



Cannot install Programming languages like Python, Java, etc.	Can install any programming language.
Single threaded operation.	Multi-threading is possible.
Does not contain OS.	Contains OS.
Cheaper, Lower Power Consumption, smaller size.	10 times expensive, higher power consumption, slightly larger size.
Contains Analog Pin with inbuilt ADC.	Does not contain Analog Pin. Requires external ADC.

Raspberry Pi v/s Laptop/Desktop



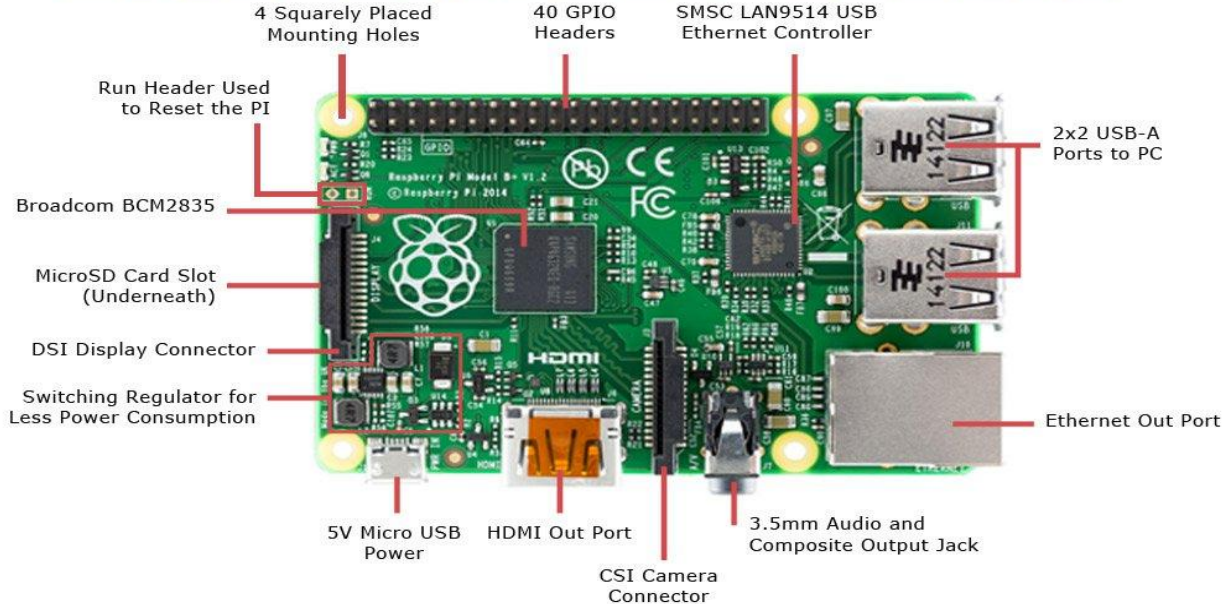
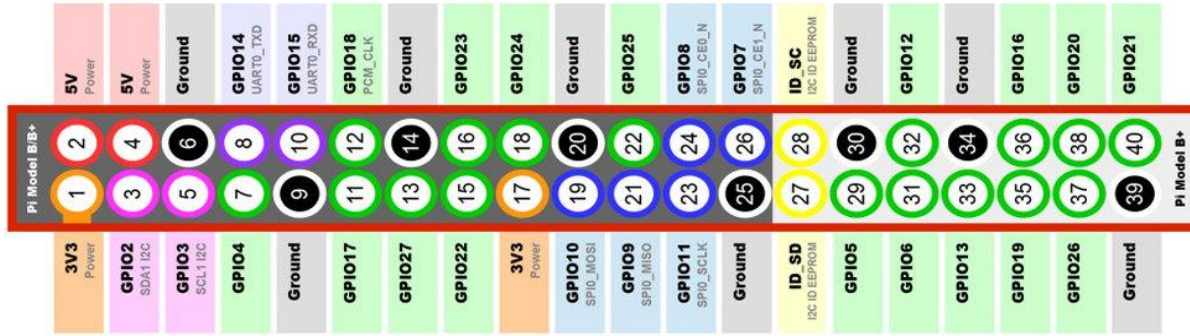
Contains programmable GPIO pins	Does not allow GPIO programming
SD Card is the only hard disk available - upto 512 MB of space available as per SD card specification	Contains upto 512 GB - 2 TB of hard drive
1-2 GB RAM	Usually 4-8 GB RAM and higher
Cheaper, lower power consumption, compact size	Expensive, higher power consumption, bulkier

Interfacing with Raspberry Pi

What do you need to know?

- Pin-out diagram of Raspberry Pi GPIOs
- Python GPIO Library

GPIO Pinout Diagram



GPIO Summary

- **3.3V supply pins** - 2
- **5V supply pins** - 2
- **Ground pins** - 8
- A **GPIO pin** designated as an **output pin** can be set to **high (3V3)** or **low (0V)**.
- Pins **GPIO2** and **GPIO3** have **fixed pull-up resistors**, but for other pins this can be configured in software.
- **PWM (pulse-width modulation)**
 - **Software PWM** available on **all pins**.
 - **Hardware PWM** available on **GPIO12, GPIO13, GPIO18, GPIO19**
- **SPI**
 - **SPI0:** MOSI (GPIO10); MISO (GPIO9); SCLK (GPIO11); CE0 (GPIO8), CE1 (GPIO7)
 - **SPI1:** MOSI (GPIO20); MISO (GPIO19); SCLK (GPIO21); CE0 (GPIO18);
 - **CE1** (GPIO17); CE2 (GPIO16)
- **I2C**
 - **Data:** (GPIO2); Clock (GPIO3)
 - **EEPROM Data:** (GPIO0); EEPROM Clock (GPIO1)
- **Serial**
 - **TX** (GPIO14); **RX** (GPIO15)

Python GPIO Library

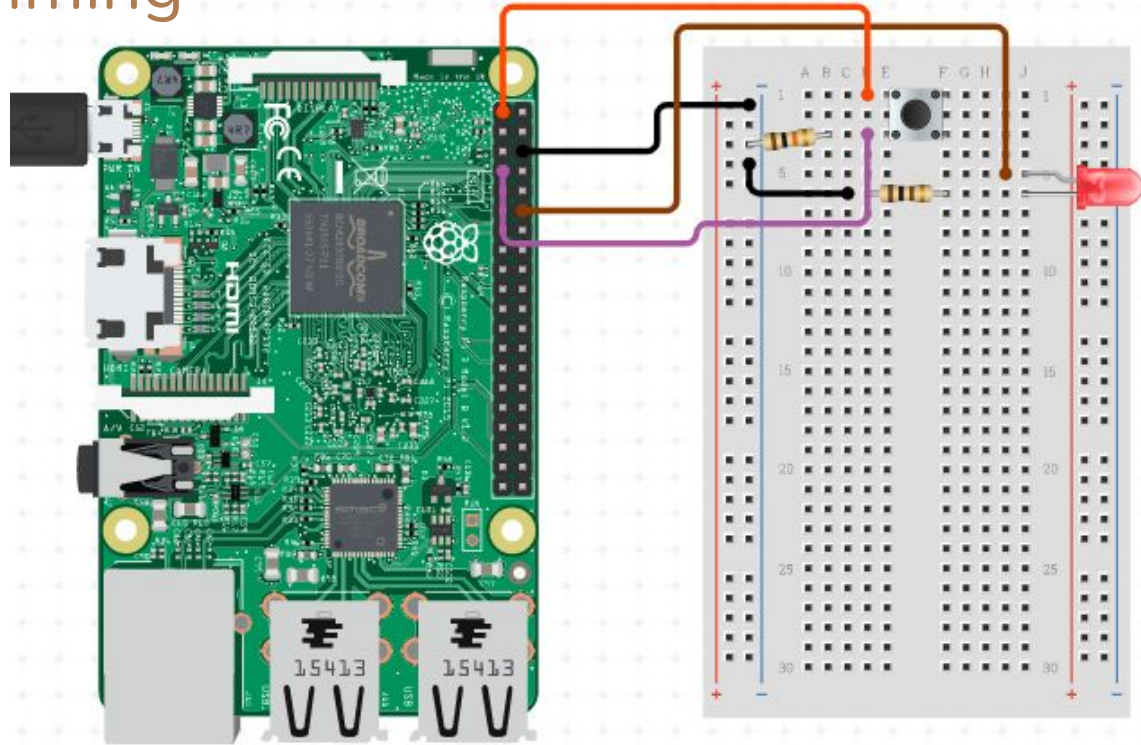
- Installation: `pip3 install RPi.GPIO`
- Import: `import RPi.GPIO as GPIO`

Syntax:

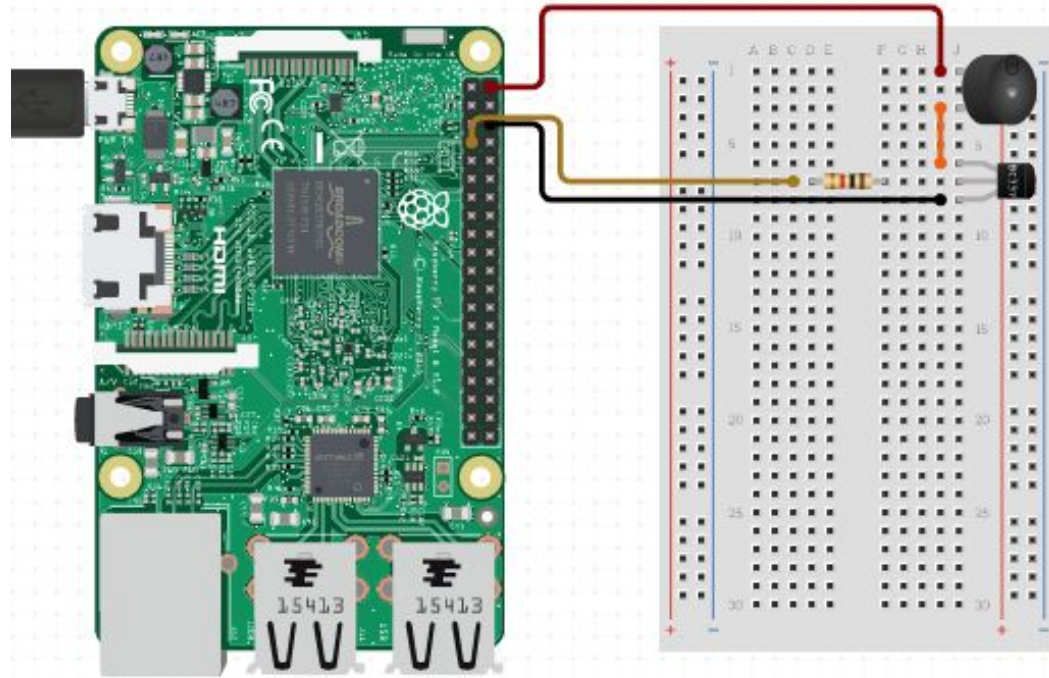
- | | |
|--|--|
| - <code>GPIO.setmode(GPIO.BCM)</code> | # choose BCM or BOARD |
| - <code>GPIO.setup(port_or_pin, GPIO.IN)</code> | # set a port/pin as an input |
| - <code>GPIO.setup(port_or_pin, GPIO.OUT)</code> | # set a port/pin as an output |
| - <code>GPIO.output(port_or_pin, 1)</code> | # set an output port/pin value to 1/HIGH/True |
| - <code>GPIO.output(port_or_pin, 0)</code> | # set an output port/pin value to 0/LOW/False |
| - <code>i = GPIO.input(port_or_pin)</code> | # read status of pin/port and assign to variable i |
| - <code>GPIO.cleanup()</code> | # clean up |

GPIO Programming

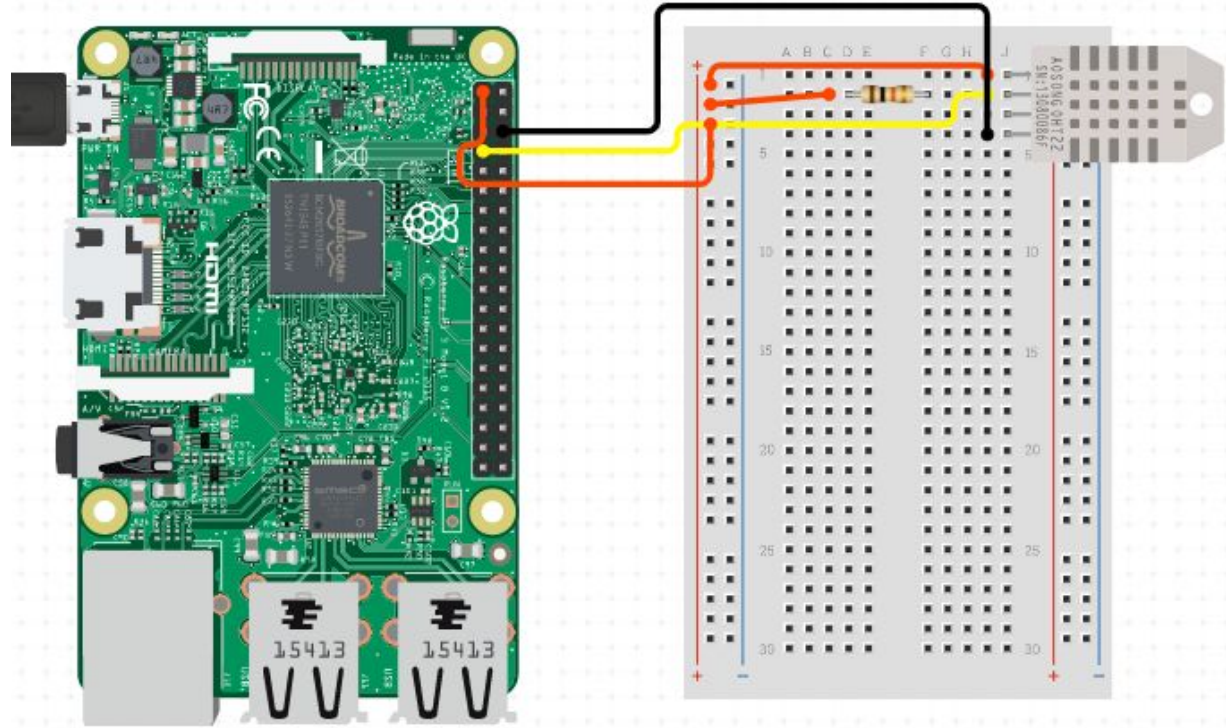
- LED
- Push button



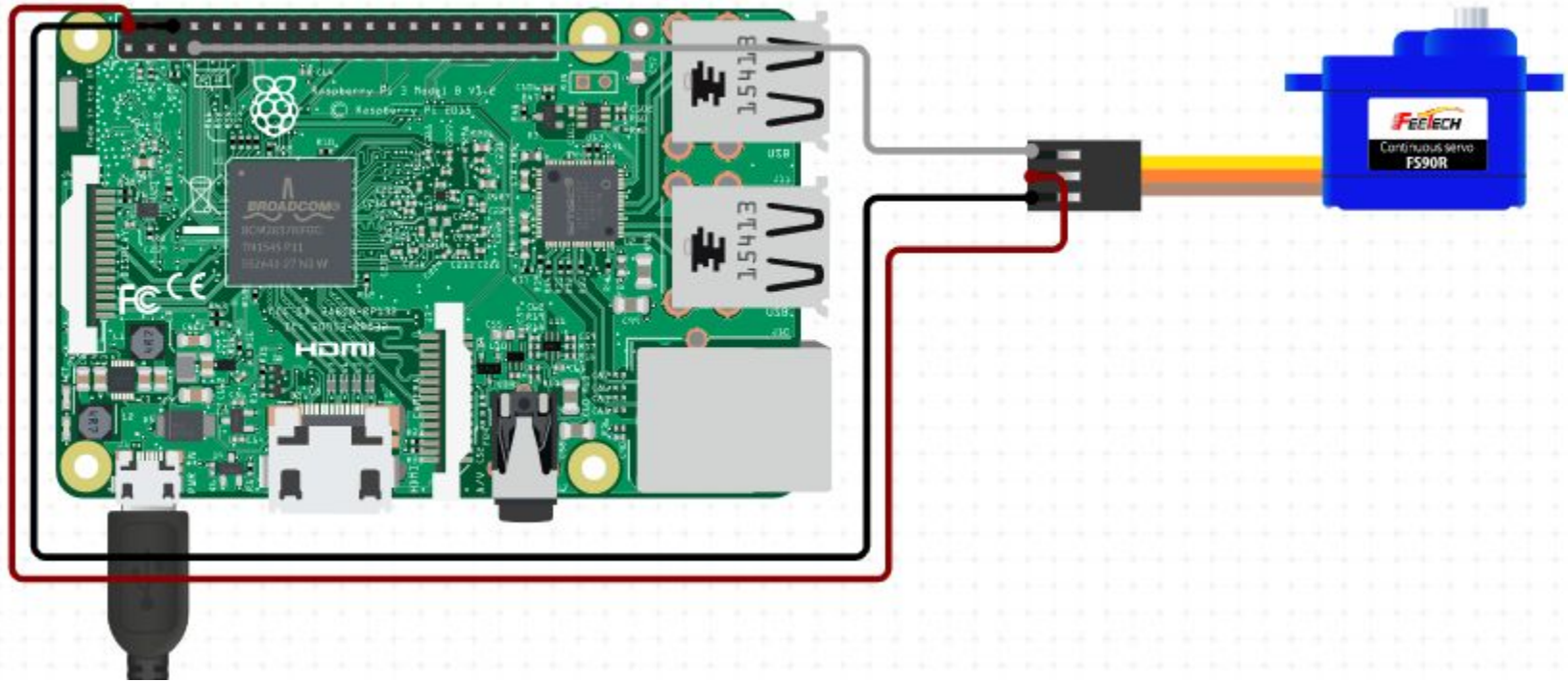
Buzzer



DHT11 Humidity Sensor



Servo Motor



7 - segment Display

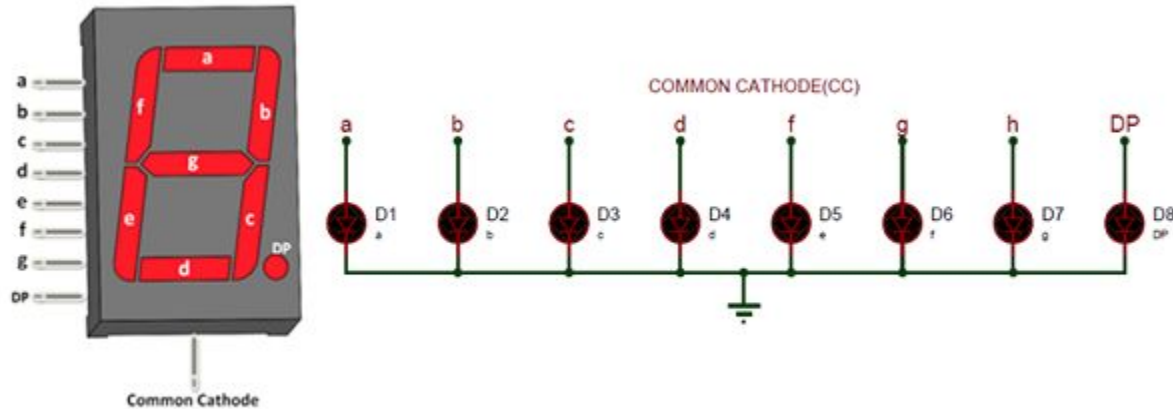
- Available in two modes Common Cathode (CC) and Common Anode (CA)
- Available in many different sizes like 9.14mm,14.20mm,20.40mm,38.10mm,57.0mm and 100mm (Commonly used/available size is 14.20mm)
- Available colours: White, Blue, Red, Yellow and Green (Res is commonly used)
- Low current operation
- Better, brighter and larger display than conventional LCD displays.
- Current consumption : 30mA / segment
- Peak current : 70mA

Introduction:

- The seven segments displays are the oldest yet one of the efficient types of display used in embedded applications.
- This display has nothing more than 8 LED inside it.
- These 8 LEDs are separated into each segments which can be named as a,b,c,d,e,f,g,DP as shown in the picture above.
- These entire 8 segment LEDs have one end of their pins pulled out of the module as shown above and the other ends are connected together and pulled out as the Common pin.
- So to make an LED of a particular segment glow we just have to power common pin along with the segment pin.
- This way we can power more than one segment at a time to represent the numeric number 0-9 and also few Alphabets as shown on the graphic image below.
- We also have an option to show a decimal point using the DP pin.

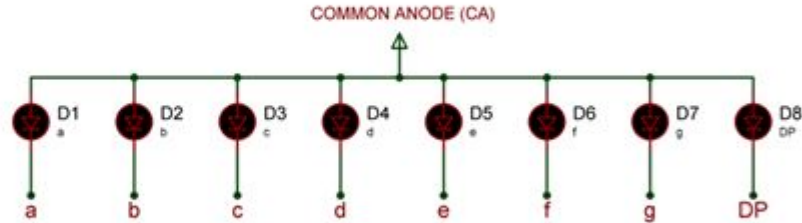
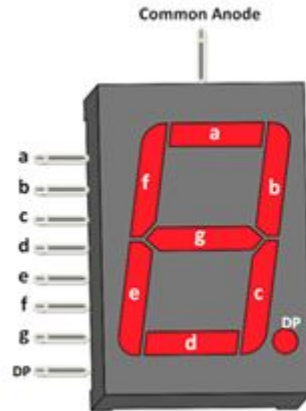
Common Cathode (CC)

The common cathode display is commonly called CC display. In this type the common pin on the 7-segment display is connected to all the eight Cathode pins of the LEDs. So In order to make this type of seven segment display to work we should connect the Com pin to the Ground pin and power the other pins with Vcc (+5V typically).



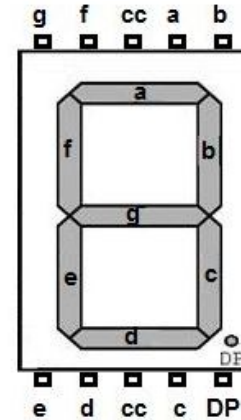
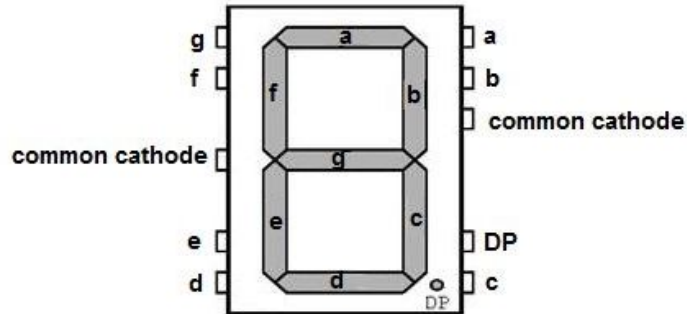
Common Anode (CA)

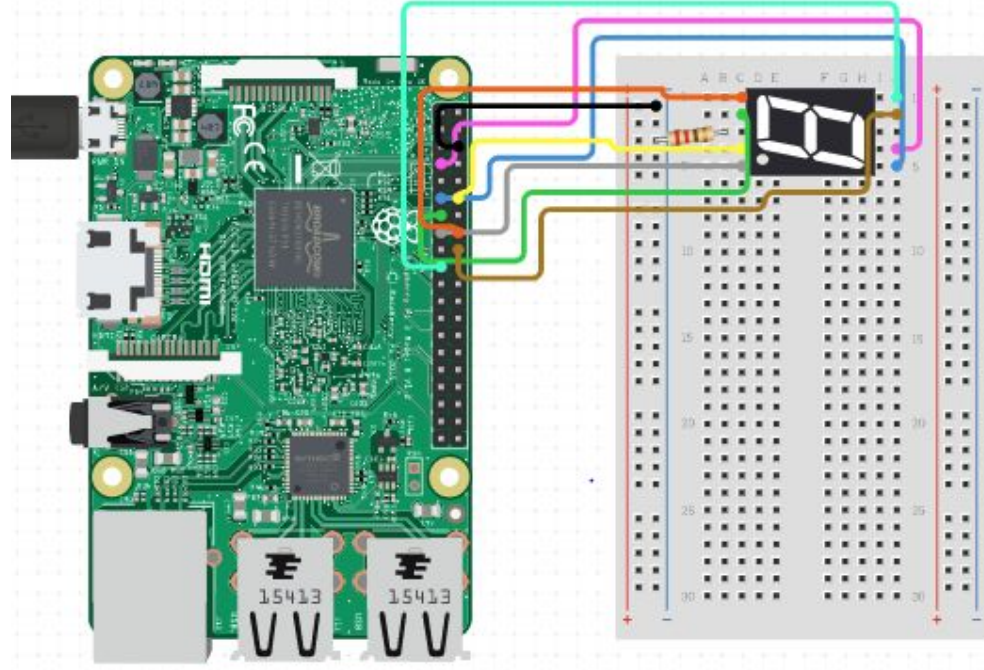
The common anode display is commonly called CA display. In this type the common pin on the 7-segment display is connected to all the eight Anode pins of the LEDs. So In order to make this type of seven segment display to work we should connect he Com pin to the Vcc (+5V typically) and ground the required segment pin to turn it on.



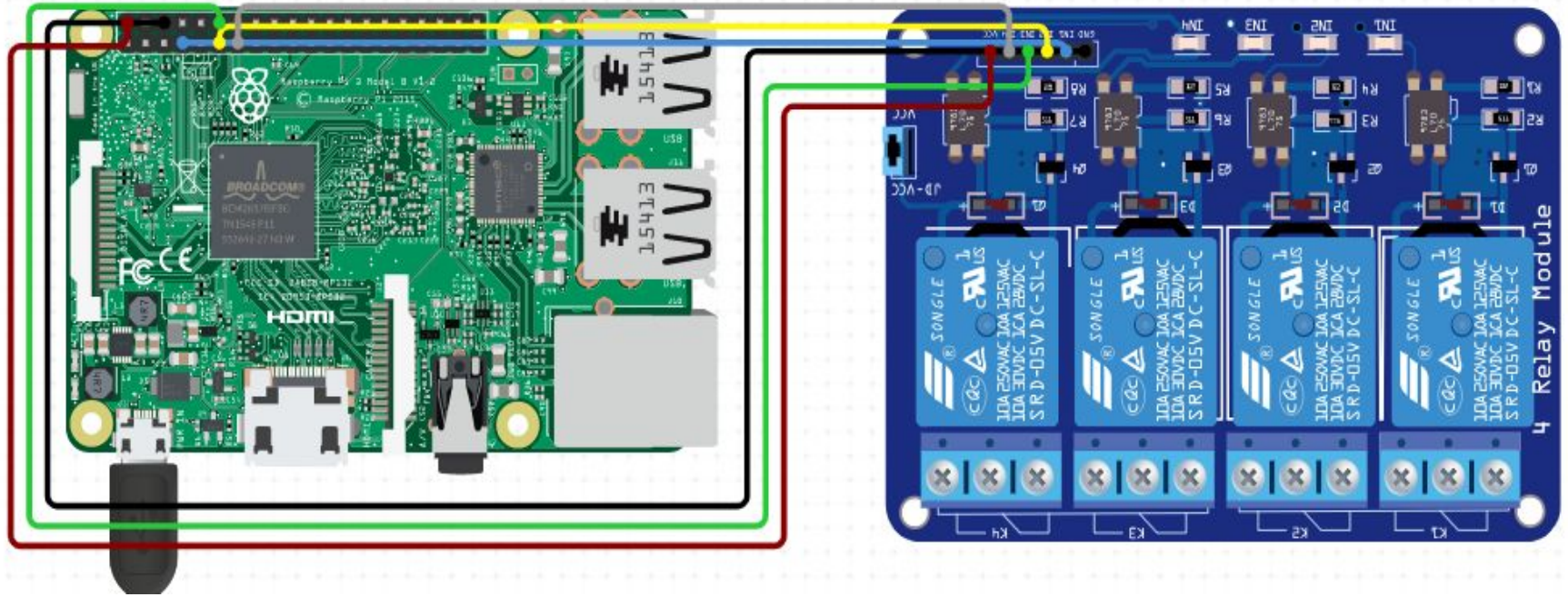
Application & Pinout of CC display

- Used in applications where font size is required to be bigger
- Microcontroller Independent, hence used in small circuit projects
- Used in combination with four segments to display measurement/sensor value with four characters
- Has bright illumination, hence used where display are required to work in low light or dark conditions

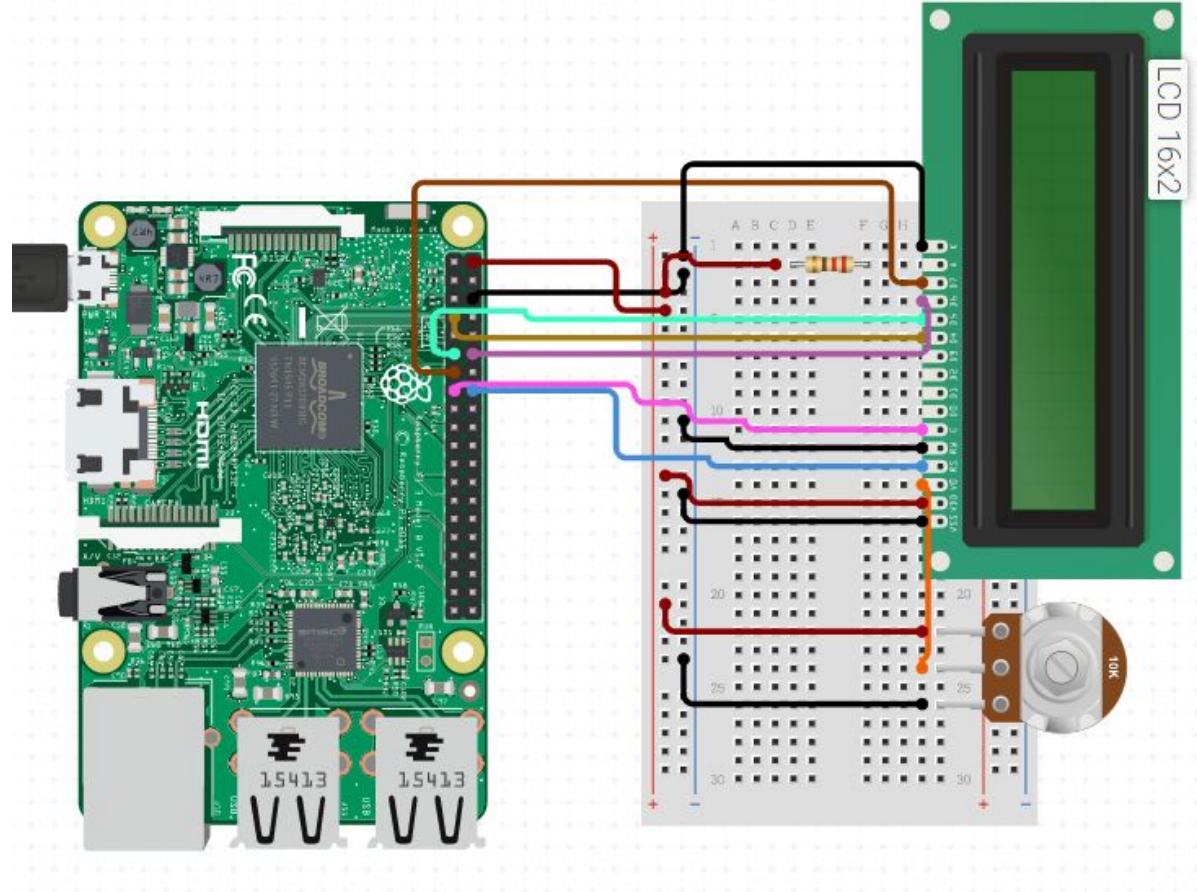




4 Channel Relay



LCD 20*2 Display



Datasheets for different Models of Rpi

Raspberry pi Model 4:

https://www.raspberrypi.org/documentation/hardware/raspberrypi/bcm2711/rpi_DAT_A_2711_1p0_preliminary.pdf

Raspberry pi Model 3b+ :

<https://static.raspberrypi.org/files/product-briefs/Raspberry-Pi-Model-Bplus-Product-Brief.pdf>

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