

Projeto 01

Teoria

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ENG 1419 – Programação de Microcontroladores

Hardware

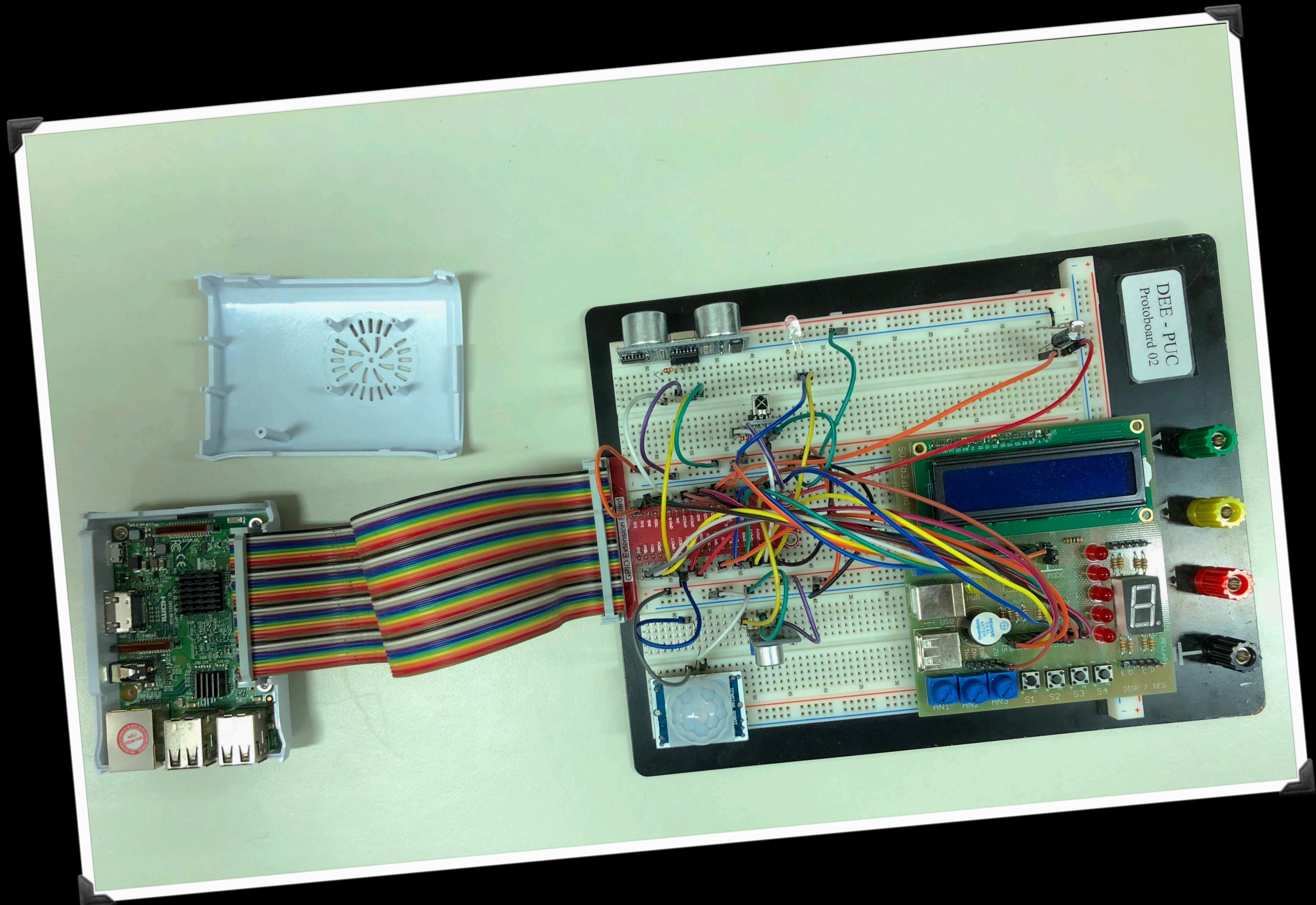
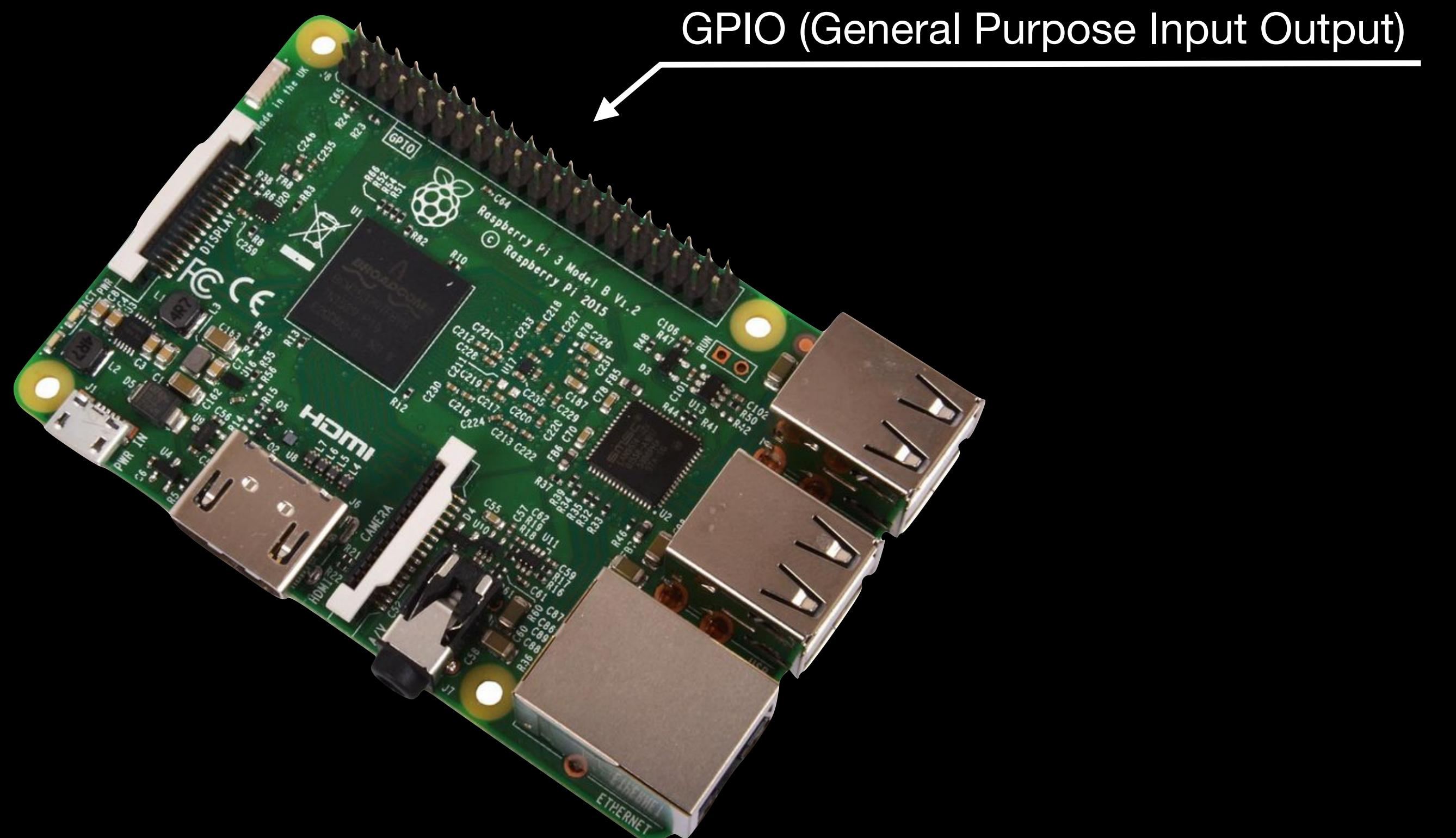
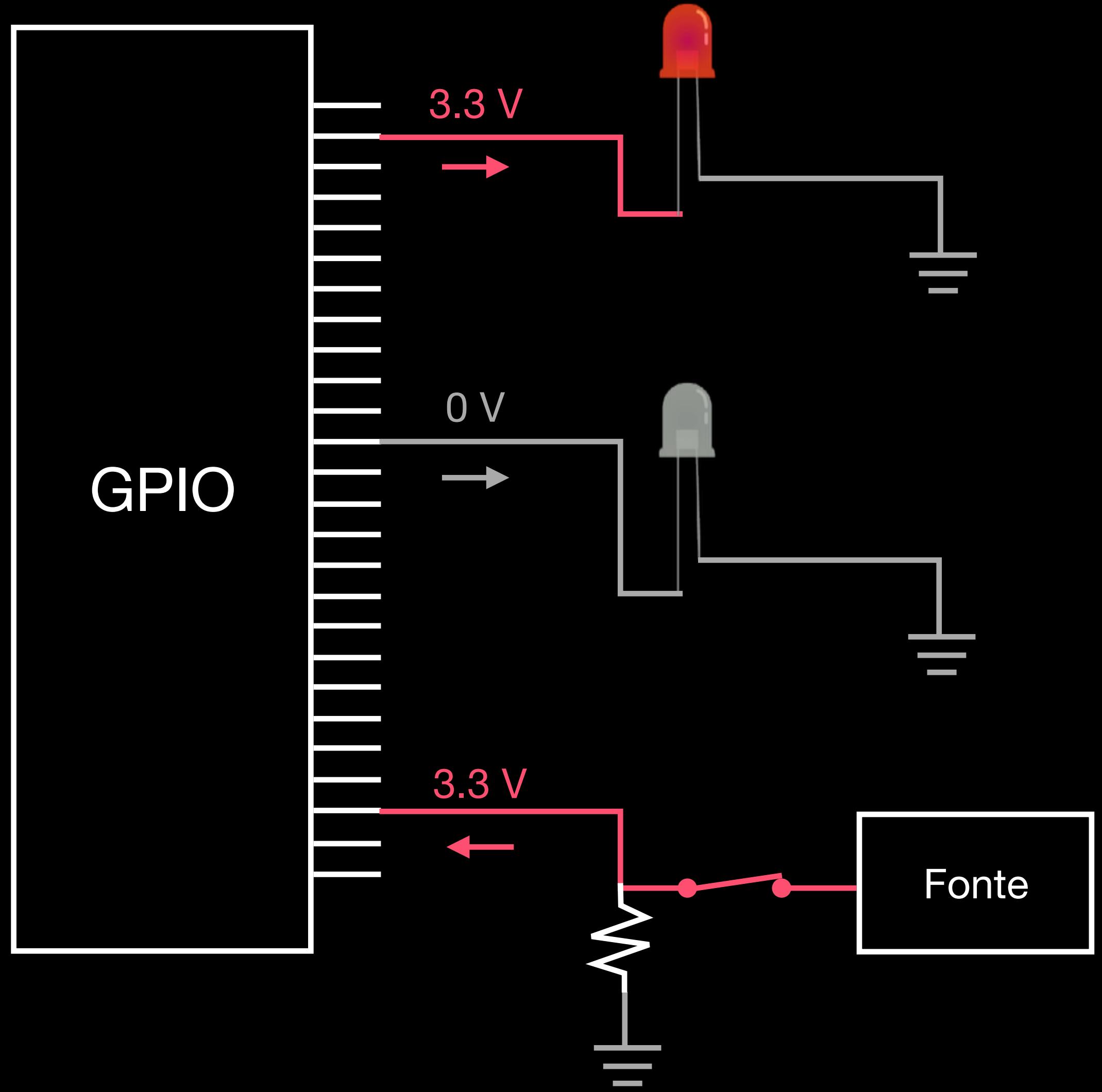


Foto do Equipamento Usado em Sala



GPIO do Raspberry Pi

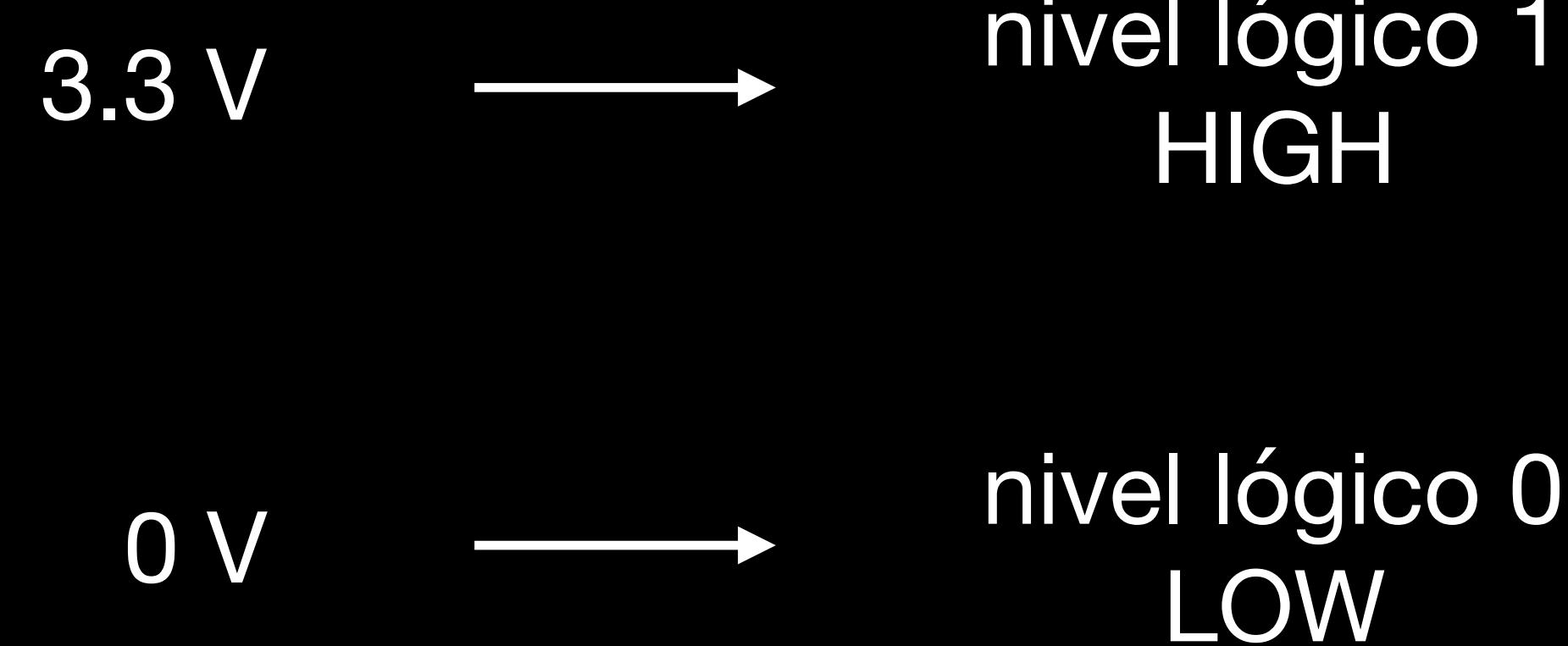
```
>>> ligue a porta 2
```



```
>>> desligue a porta 12
```

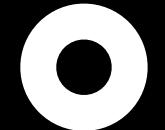
```
>>> leia a porta 25
```

Controle Digital Através da GPIO



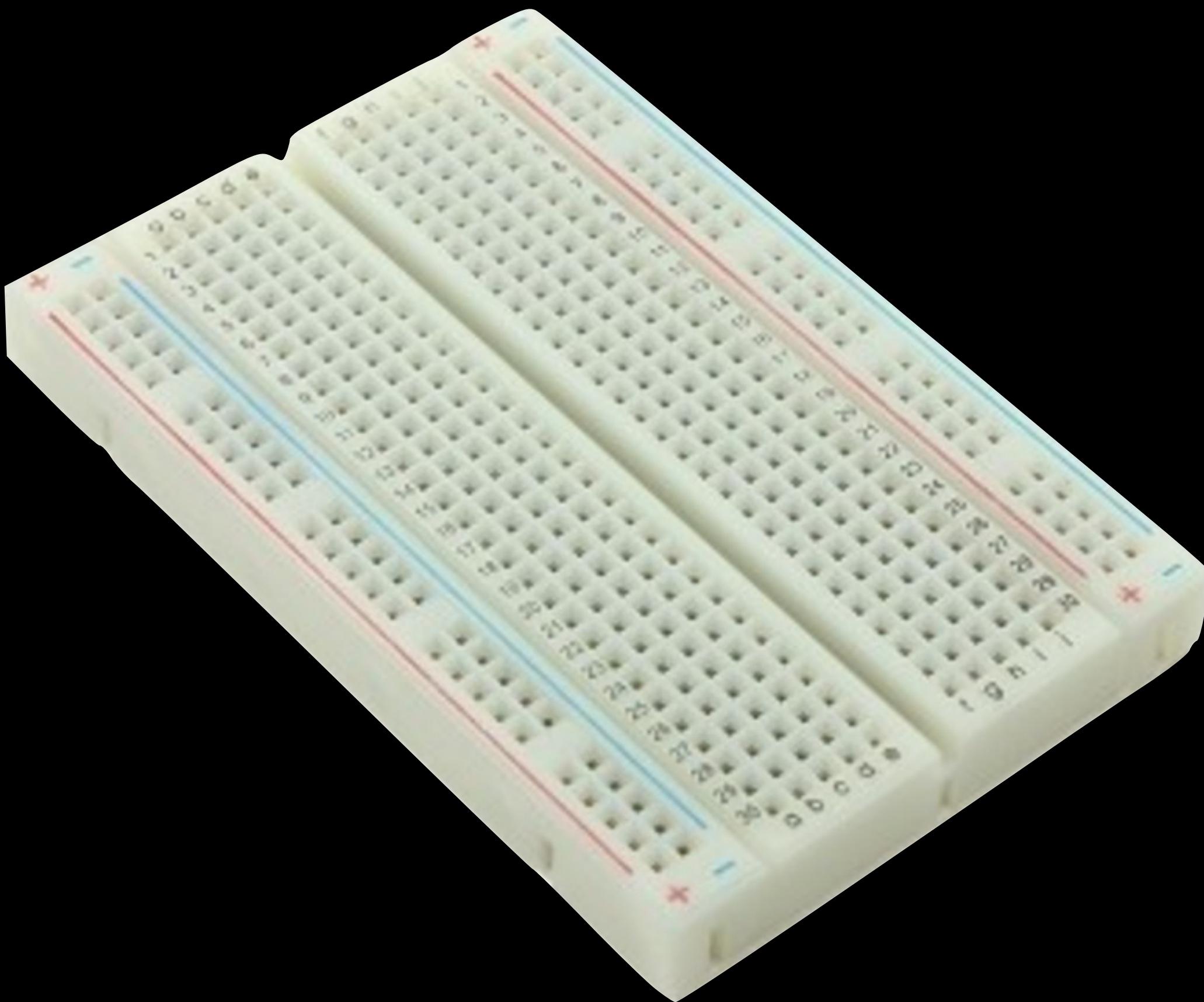
Raspberry Pi 3 GPIO Header

Pin#	NAME	NAME	Pin#
01	3.3v DC Power	DC Power 5v	02
03	GPIO02 (SDA1 , I ² C)	DC Power 5v	04
05	GPIO03 (SCL1 , I ² C)	Ground	06
07	GPIO04 (GPIO_GCLK)	(TXD0) GPIO14	08
09	Ground	(RXD0) GPIO15	10
11	GPIO17 (GPIO_GEN0)	(GPIO_GEN1) GPIO18	12
13	GPIO27 (GPIO_GEN2)	Ground	14
15	GPIO22 (GPIO_GEN3)	(GPIO_GEN4) GPIO23	16
17	3.3v DC Power	(GPIO_GEN5) GPIO24	18
19	GPIO10 (SPI_MOSI)	Ground	20
21	GPIO09 (SPI_MISO)	(GPIO_GEN6) GPIO25	22
23	GPIO11 (SPI_CLK)	(SPI_CE0_N) GPIO08	24
25	Ground	(SPI_CE1_N) GPIO07	26
27	ID_SD (I ² C ID EEPROM)	(I ² C ID EEPROM) ID_SC	28
29	GPIO05	Ground	30
31	GPIO06	GPIO12	32
33	GPIO13	Ground	34
35	GPIO19	GPIO16	36
37	GPIO26	GPIO20	38
39	Ground	GPIO21	40

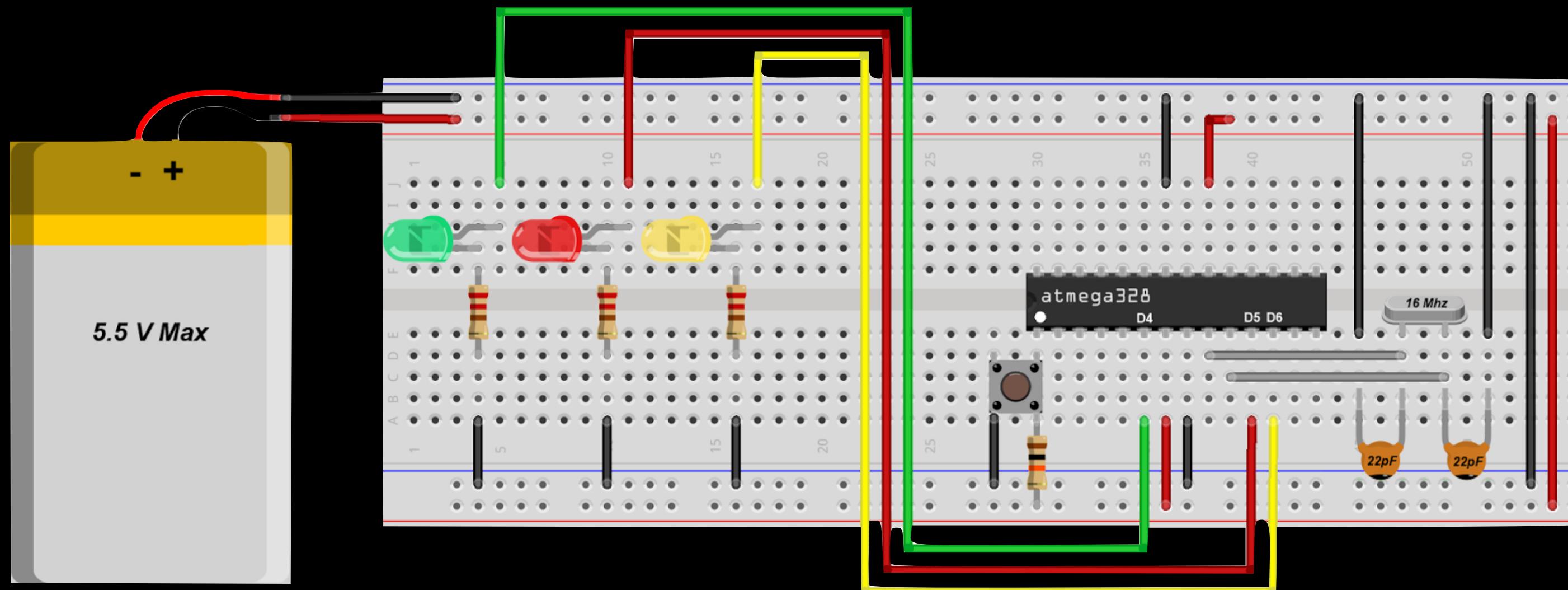
 Porta Reservada (Indisponível)

 Porta Disponível

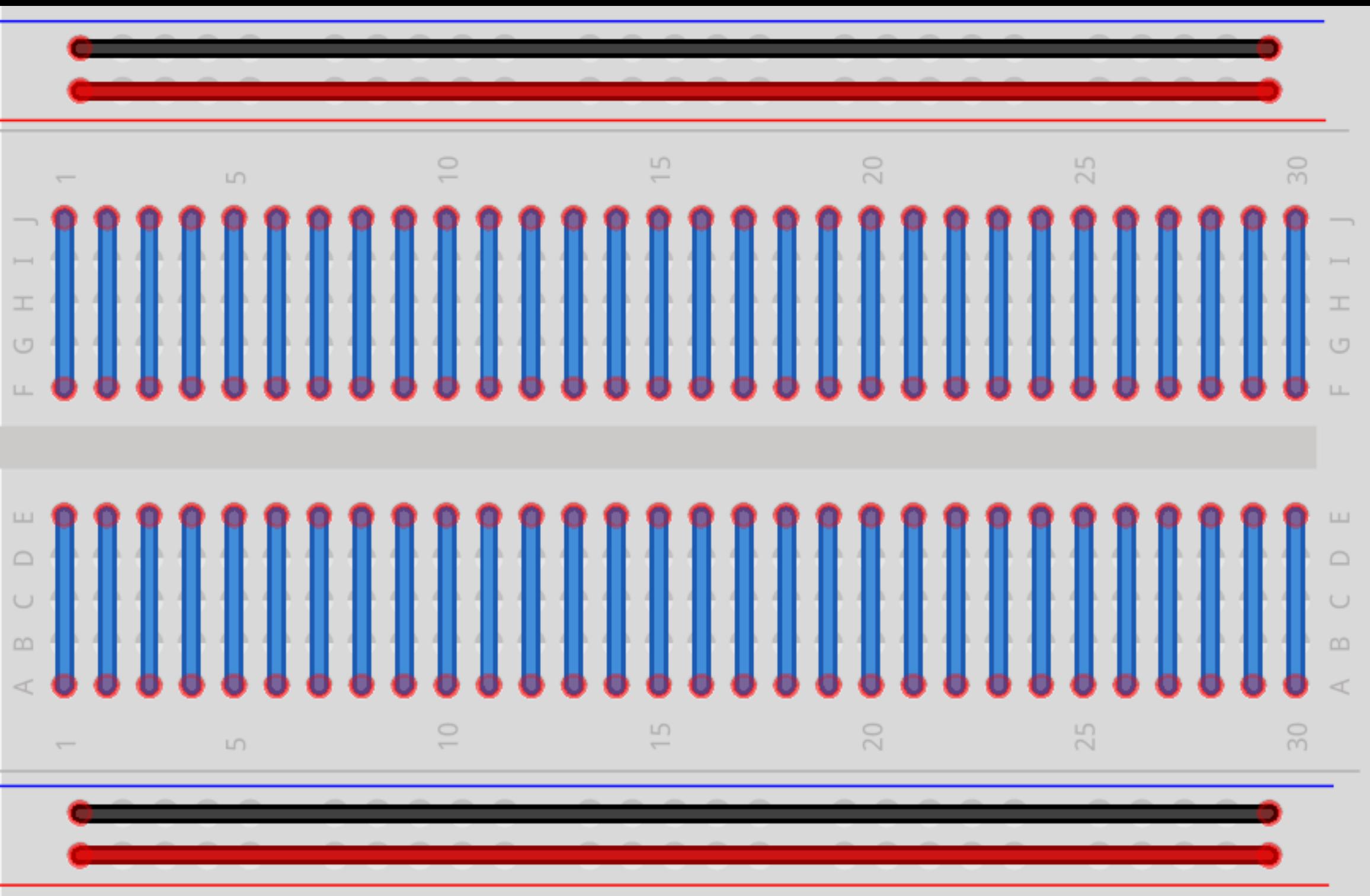
 Porta Disponível com Propriedades Extras



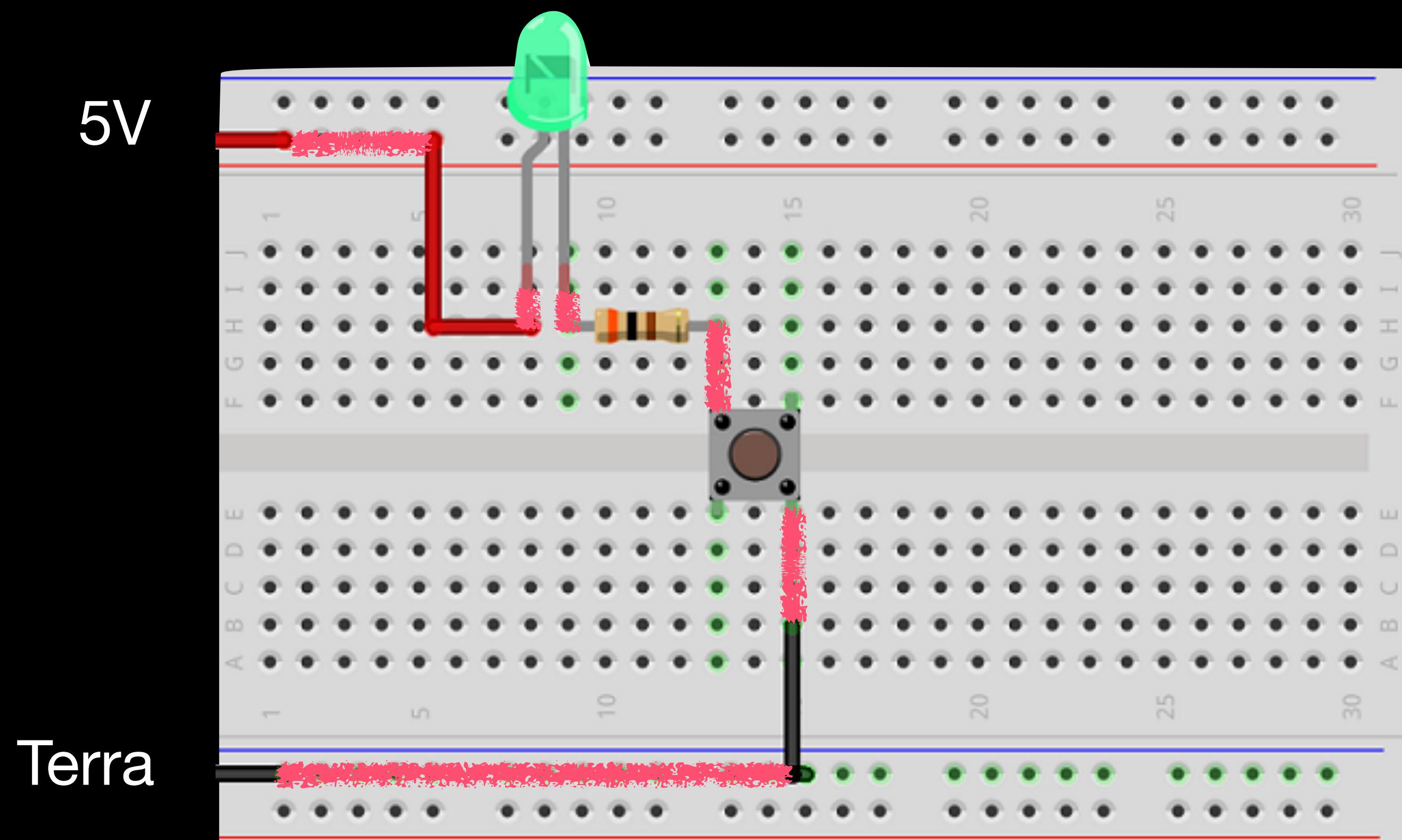
Protopboard



Componentes Eletrônicos em uma Protoboard



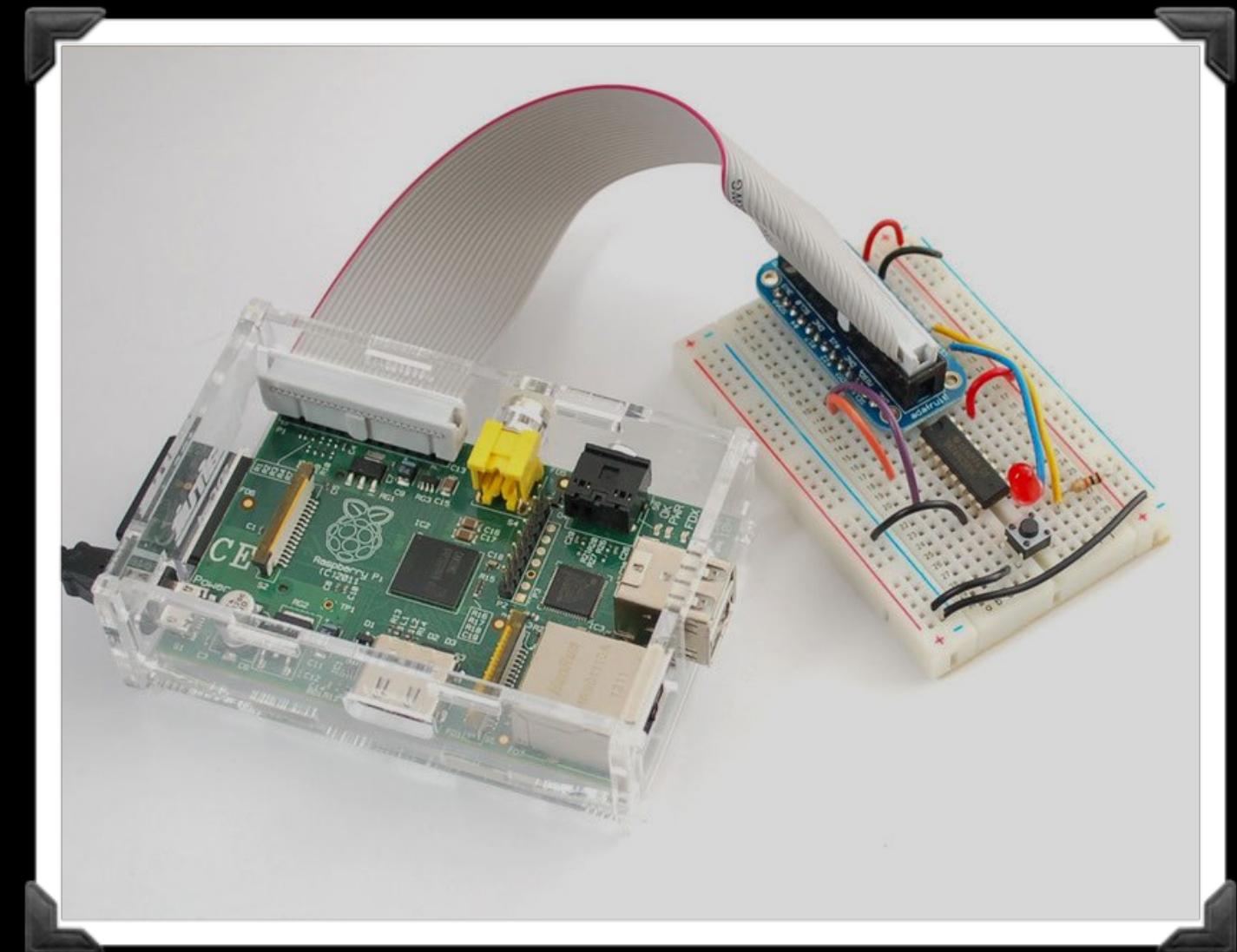
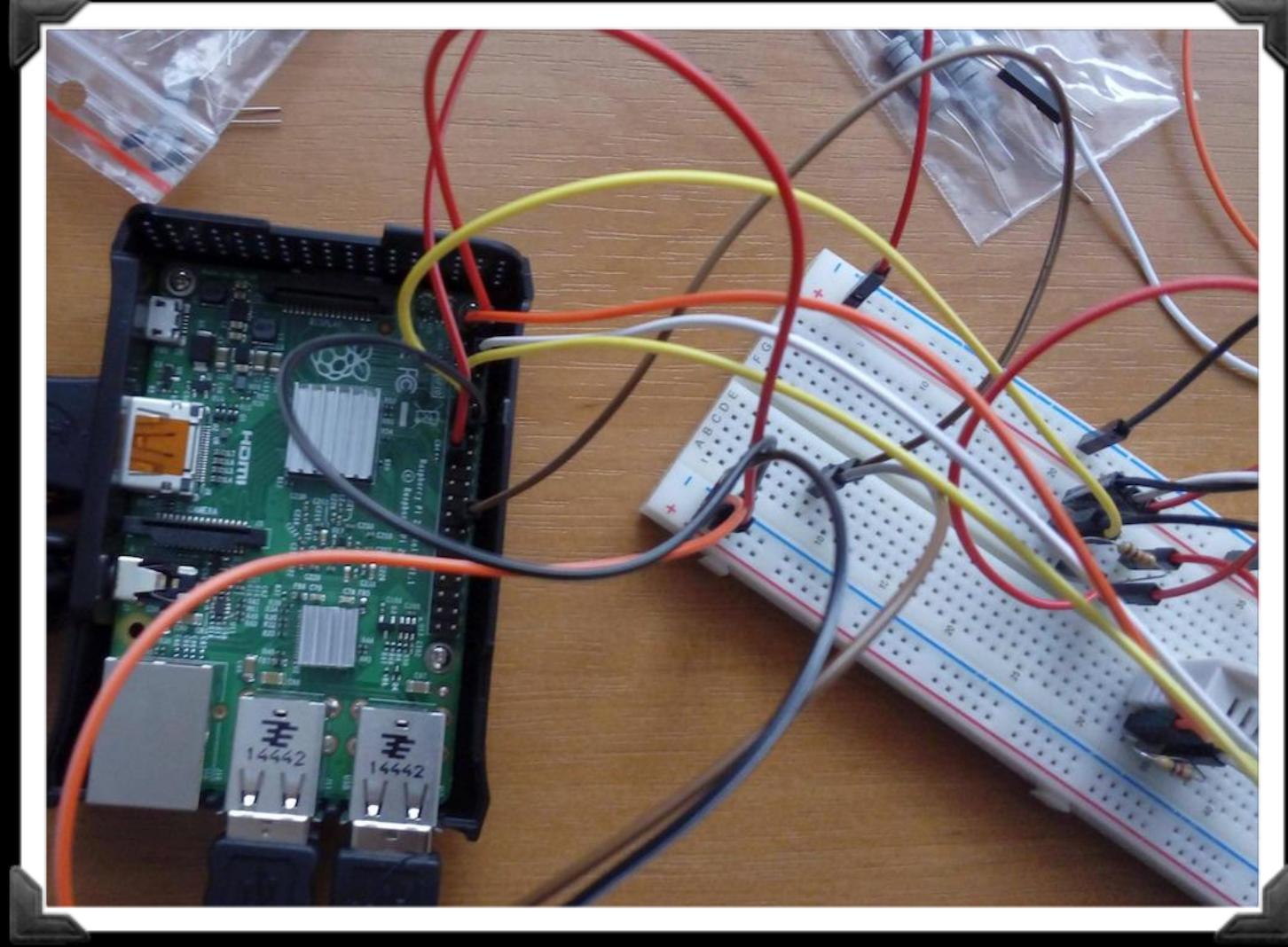
Conexões Internas da Protoboard



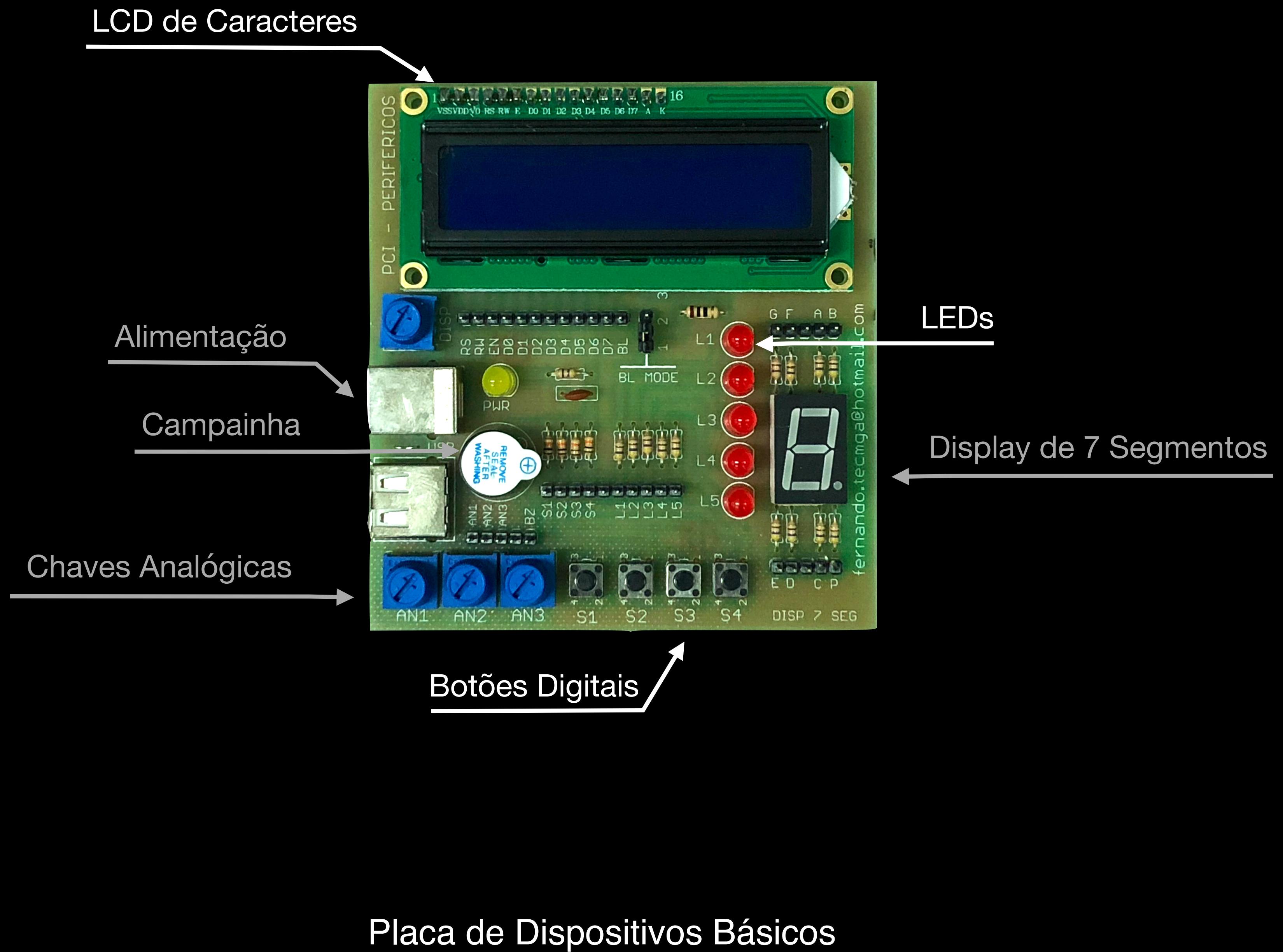
Componentes Conectados Internamente



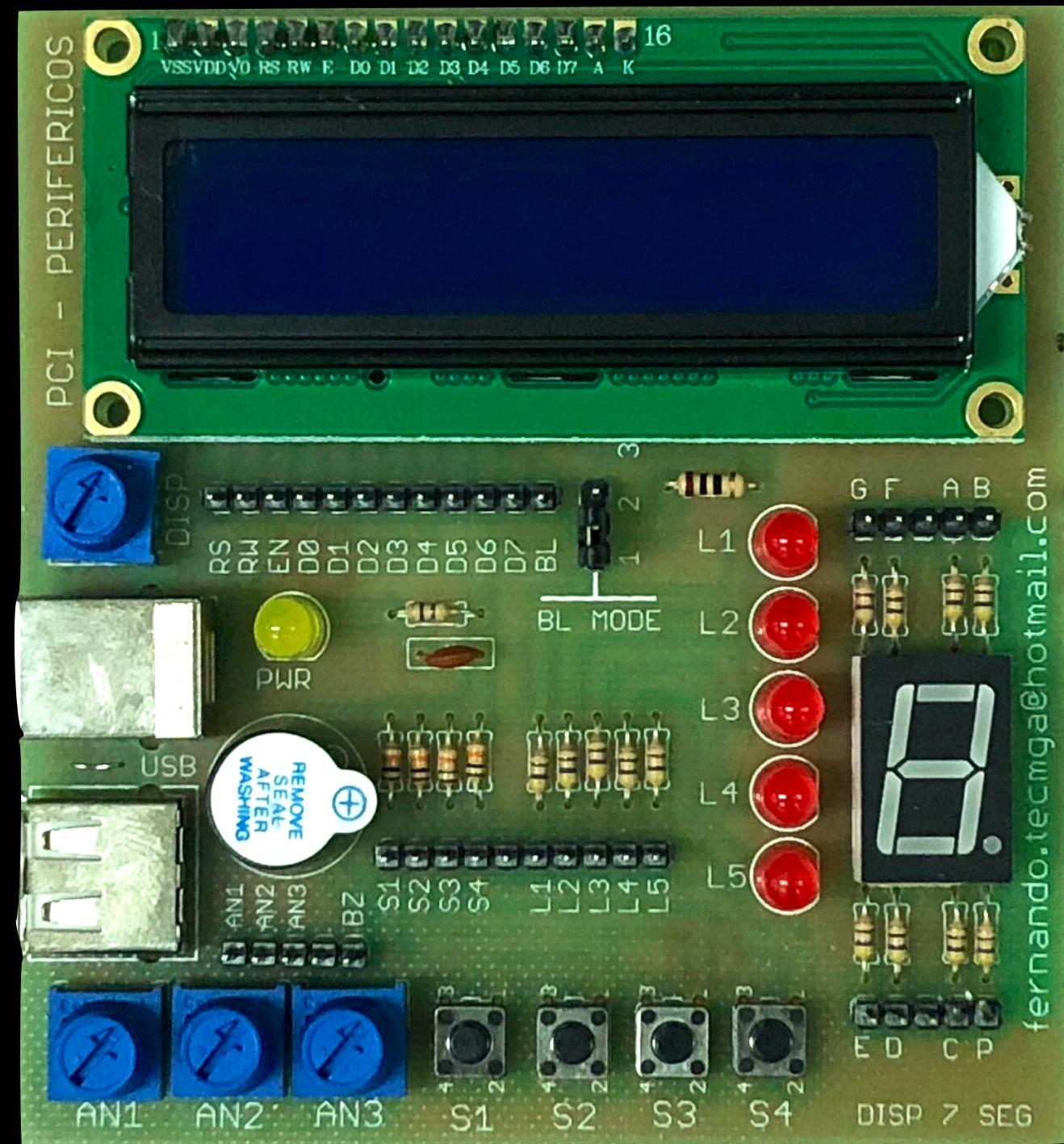
Cabo "Flat" com Identificação



Separação entre Microcontrolador e Circuito



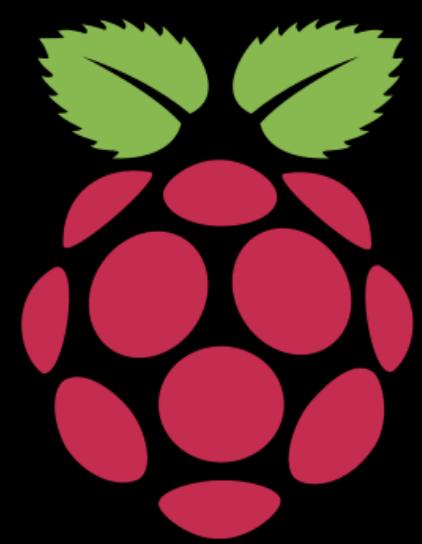
GPIO 2, 3, 4, 5, 6, 7



GPIO 21
GPIO 22
GPIO 23
GPIO 24
GPIO 25

GPIO 11, 12, 13, 14

Conexões dos Botões, LEDs e LCD de Caracters com as Portas da GPIO

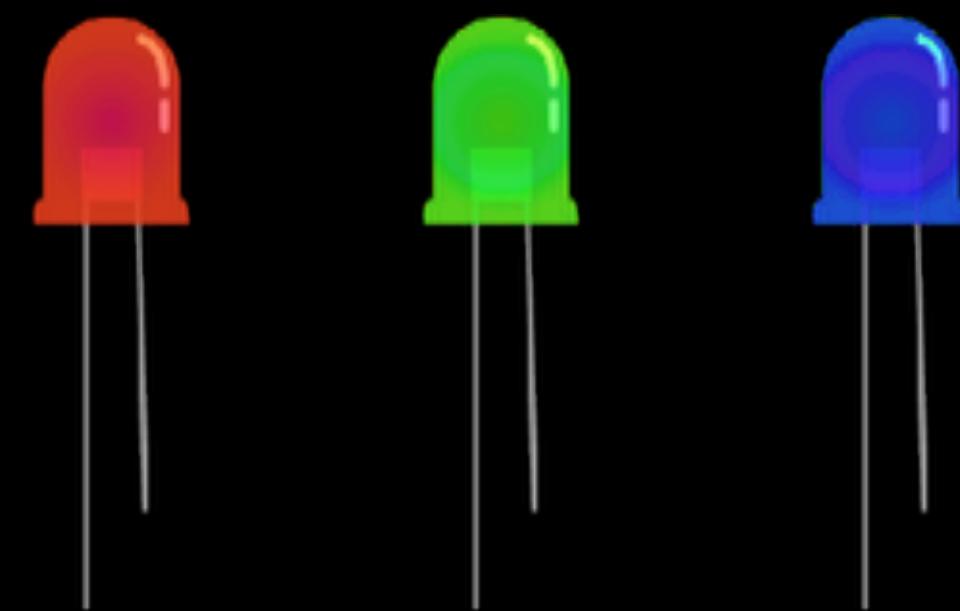


gpiozero

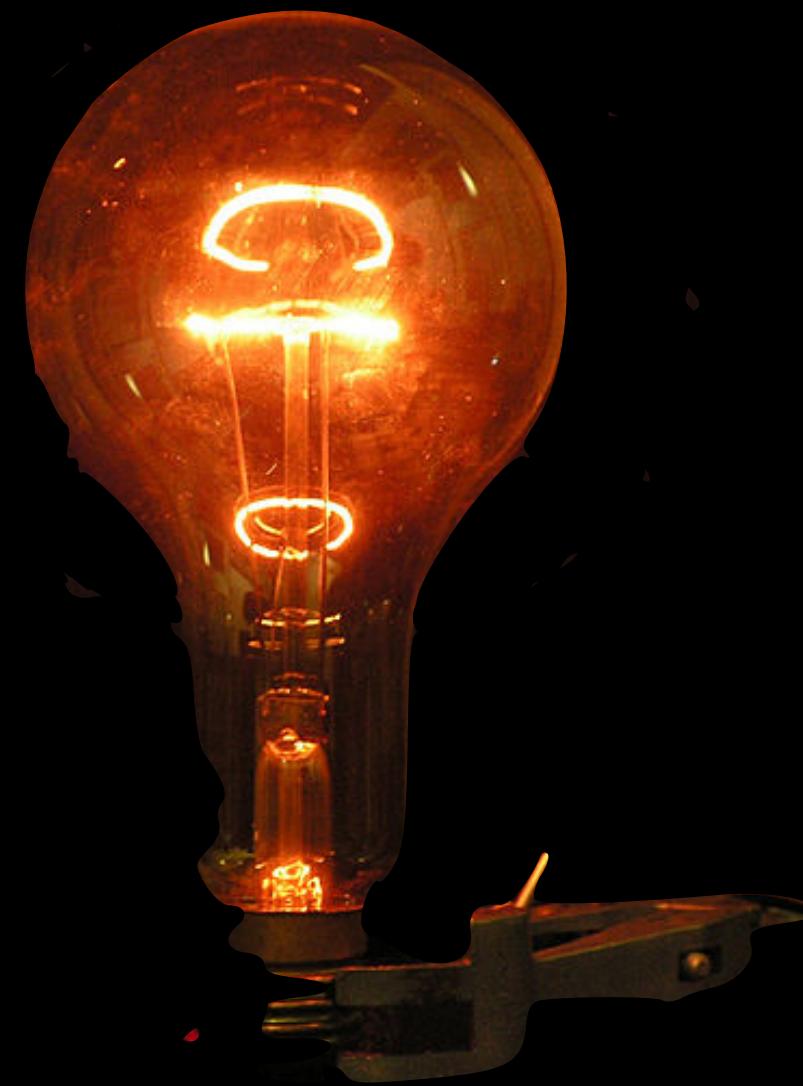


Adafruit_Python_CharLCD

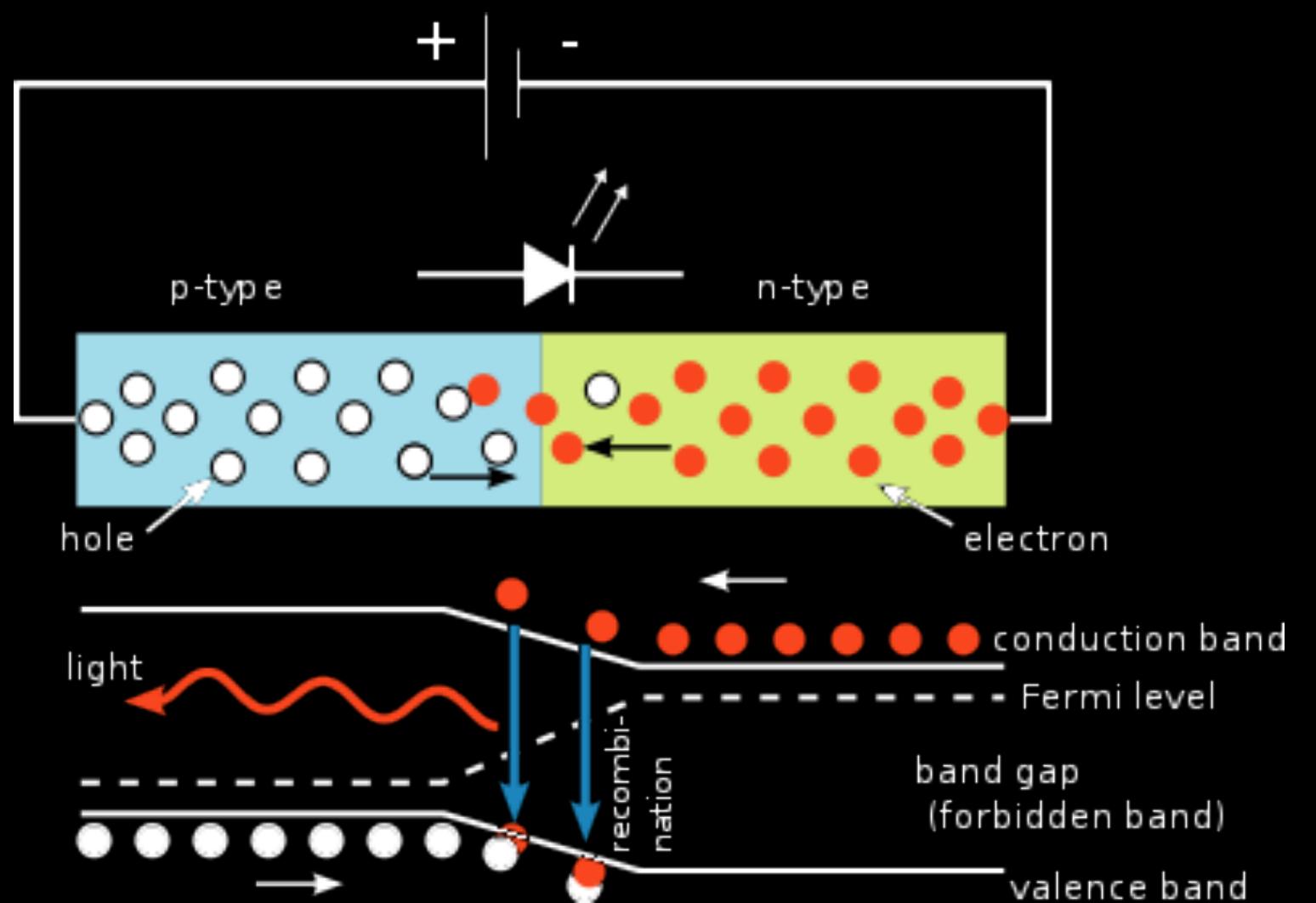
Bibliotecas para Manipular Dispositivos Básicos



LEDs



luz emitida pelo calor



luz emitida por elétrons no silício

Lâmpadas Incandescentes vs LEDs

```
>>> from gpiozero import LED  
>>> led = LED(21) # configura porta 21 da GPIO como LED  
>>> led.on() # acende o LED  
>>> led.is_lit # está aceso?  
True  
  
>>> led.off()  
  
>>> led.is_lit  
False  
  
>>> led.toggle() # alterna entre aceso e apagado  
  
>>> led.is_lit  
True  
  
>>> led.toggle()  
  
>>> led.is_lit  
False
```

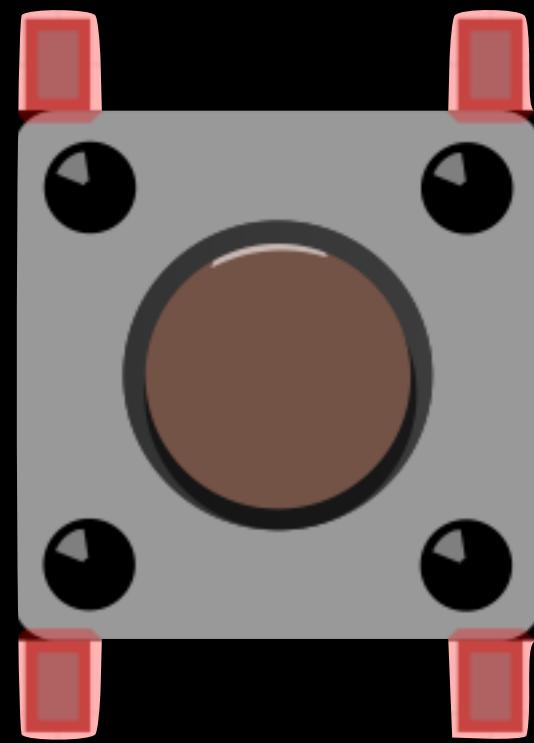
```
>>> from gpiozero import LED  
>>> from time import sleep  
>>> led = LED(21)  
>>> for i in range(0, 4):  
...     led.on()  
...     sleep(1)  
...     led.off()  
...     sleep(1)
```

Deste jeito, o programa
fica travado enquanto
o LED pisca!



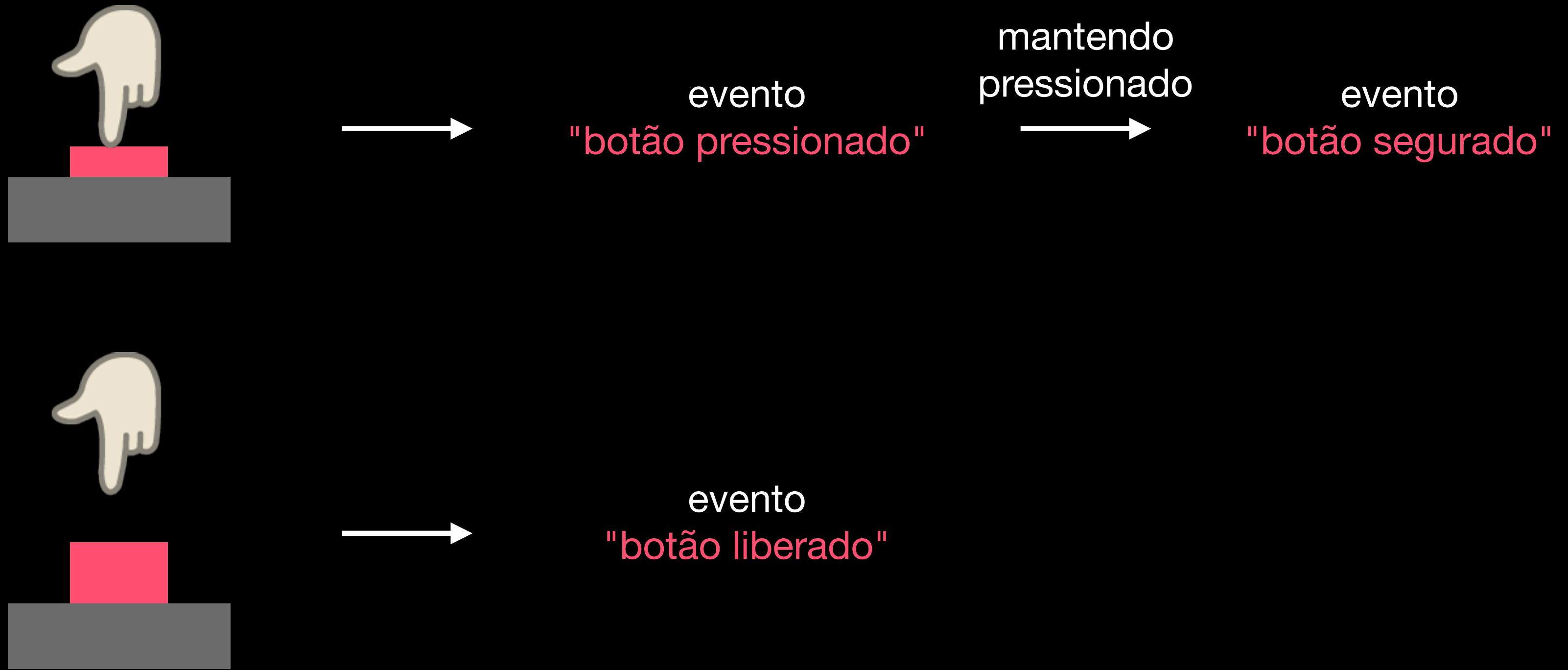
```
>>> from gpiozero import LED  
>>> led = LED(21)  
  
# pisque continuamente  
>>> led.blink()  
  
# LED continua piscando, mesmo rodando outros comandos  
>>> x = 1000 / 57  
  
# defina o tempo aceso e o tempo apagado  
>>> led.blink(on_time=0.5, off_time=2.0)  
  
# pisque 3 vezes  
>>> led.blink(n=3)
```

Função para Piscar o LED



Botão

```
>>> from gpiozero import Button  
  
# configura porta 11 da GPIO como um botão  
>>> botao = Button(11)  
  
# está pressionado?  
>>> botao.is_pressed  
False  
  
# pausa o programa até que o botão seja pressionado  
>>> botao.wait_for_press()
```



Eventos de um Botão

```
botao.tipo_de_evento = minha_funcao
```

chame a minha função quando o tipo de evento acontecer

```
>>> from gpiozero import Button, LED  
>>> led = LED(21)  
>>> def acender_led():  
...     led.on()  
  
...  
>>> botao = Button(11)  
>>> botao.when_pressed = acender_led
```



não coloque parênteses no final!

```
>>> from gpiozero import Button, LED  
>>> led = LED(21)  
>>> led2 = LED(22)  
>>> def acender_led():  
...     led.on()  
...  
>>> def piscar_led2():  
...     led2.blink(n=2)  
...  
>>> def apagar_led():  
...     led.off()  
...  
>>> botao = Button(11)  
>>> botao.when_pressed = acender_led  
>>> botao.when_held = piscar_led2  
>>> botao.when_released = apagar_led
```

não coloque parênteses no final!

```
>>> from gpiozero import Button, LED  
>>> led = LED(21)  
>>> led2 = LED(22)  
>>> def acender_led():  
...     led2.blink(n=2)  
  
...  
>>> botao = Button(11)           chame diretamente a função "on" do LED  
>>> botao.when_pressed = led.on  
>>> botao.when_held = piscar_led2  
>>> botao.when_released = led.off
```

...

```
>>> bota01.when_pressed = minha_funcao1
```

```
>>> bota02.when_pressed = minha_funcao2
```

```
>>> bota03.when_pressed = minha_funcao3
```

...

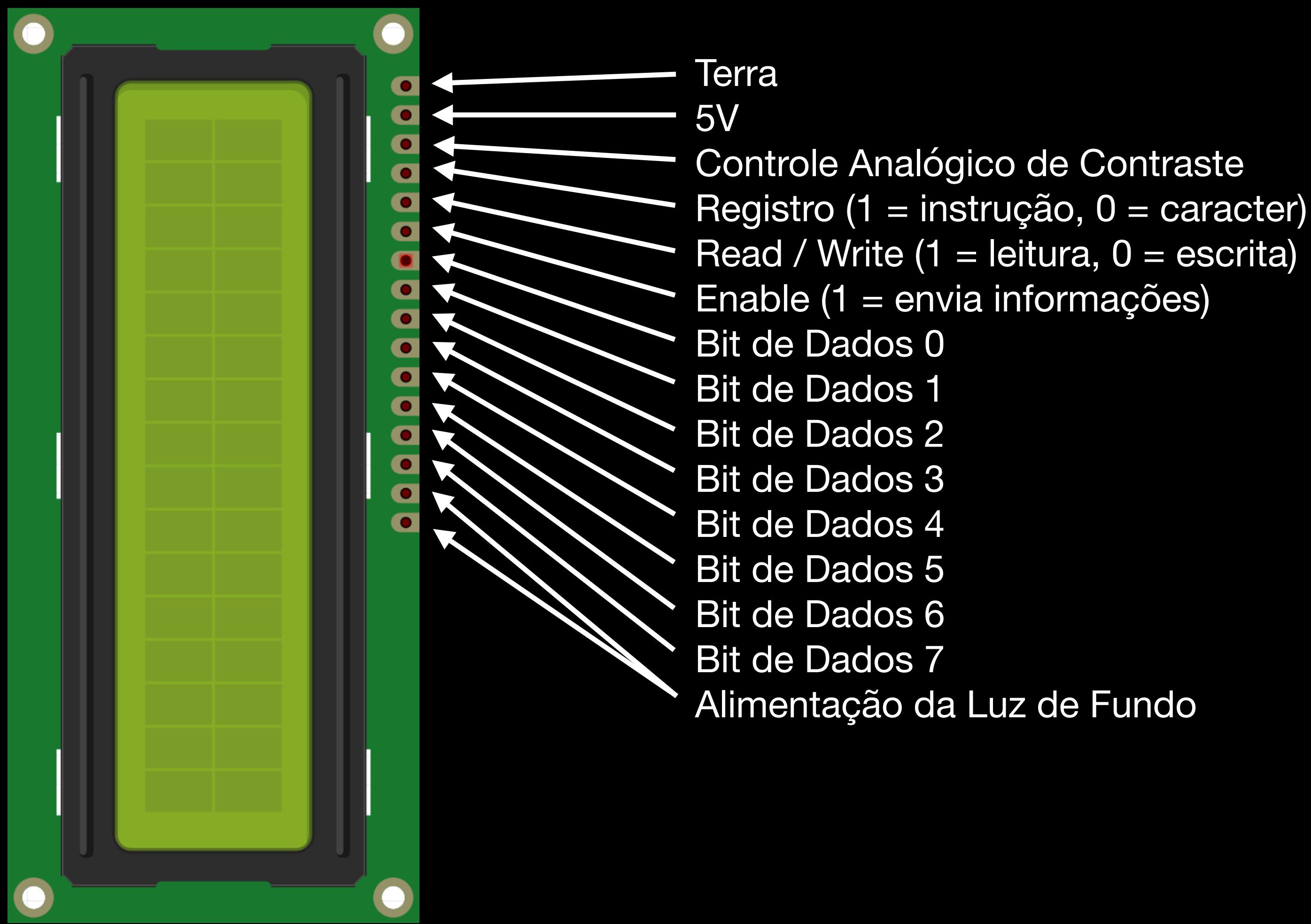
Uso Mais Comum: Apenas Evento de Botão Pressionado



LCD de Caracteres



Vídeo sobre o Display LCD 16 x 2 no YouTube



Pinos do LCD de Caracteres

Instruction	Instruction code											Description	Execution time (fosc=270KHz)
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0			
Clear Display	0	0	0	0	0	0	0	0	0	1		Clears entire display and sets DDRAM address to 00H.	1.53ms
Return Home	0	0	0	0	0	0	0	0	1	-		Sets DDRAM address to 00H in AC and returns shifted display to its original position. The contents of DDRAM remain unchanged.	1.53ms
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	SH		Sets cursor move direction and enable the shift of entire display. These operations are performed during data write and read.	39 μ s
Display ON/OFF Control	0	0	0	0	0	0	1	D	C	B		Set ON/OFF of entire display (D), cursor ON/OFF(C), and blinking of cursor position character(B).	39 μ s
Cursor or Display Shift	0	0	0	0	0	1	S/C	R/L	-	-		Moves cursor and shifts display without changing DDRAM contents.	39 μ s
Function Set	0	0	0	0	1	DL	N	F	-	-		Sets interface data length (DL: 8-bit/4-bit), numbers of display line (N: 2-line/1-line), and display font type (F: 5x11dots/5x8dots)	39 μ s
Set CGRAM Address	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0		Set CGRAM address in address counter.	39 μ s
Set DDRAM Address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0		Set DDRAM address in address Counter.	39 μ s
Read Busy Flag and Address	0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0		Reads busy flag (BF) indicating internal operation is being performed and reads address counter contents.	0 μ s
Write data to CG or DD RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0		Write data into internal RAM (DDRAM/CGRAM).	43us
Read data from CG or DD RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0		Read data from internal RAM (DDRAM/CGRAM).	43us

Upper Lower 4 bits 4 bits	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
CG RAM (1)	0000	CG	P	P												
CG RAM (2)	0001	CG	1	A	Q	a	q									
CG RAM (3)	0010	CG	2	B	R	b	r									
CG RAM (4)	0011	CG	3	C	S	c	s									
CG RAM (5)	0100	CG	4	D	T	d	t									
CG RAM (6)	0101	CG	5	E	U	e	u									
CG RAM (7)	0110	CG	6	F	V	f	v									
CG RAM (8)	0111	CG	7	G	W	g	w									
CG RAM (1)	1000	CG	8	H	X	h	x									
CG RAM (2)	1001	CG	9	I	Y	i	y									
CG RAM (3)	1010	CG	J	Z	j	z										
CG RAM (4)	1011	CG	K	K	k	{										
CG RAM (5)	1100	CG	L	Y	l	}										
CG RAM (6)	1101	CG	M	M	m	}										
CG RAM (7)	1110	CG	N	n	n											
CG RAM (8)	1111	CG	O	O	o											

Comandos para o LCD

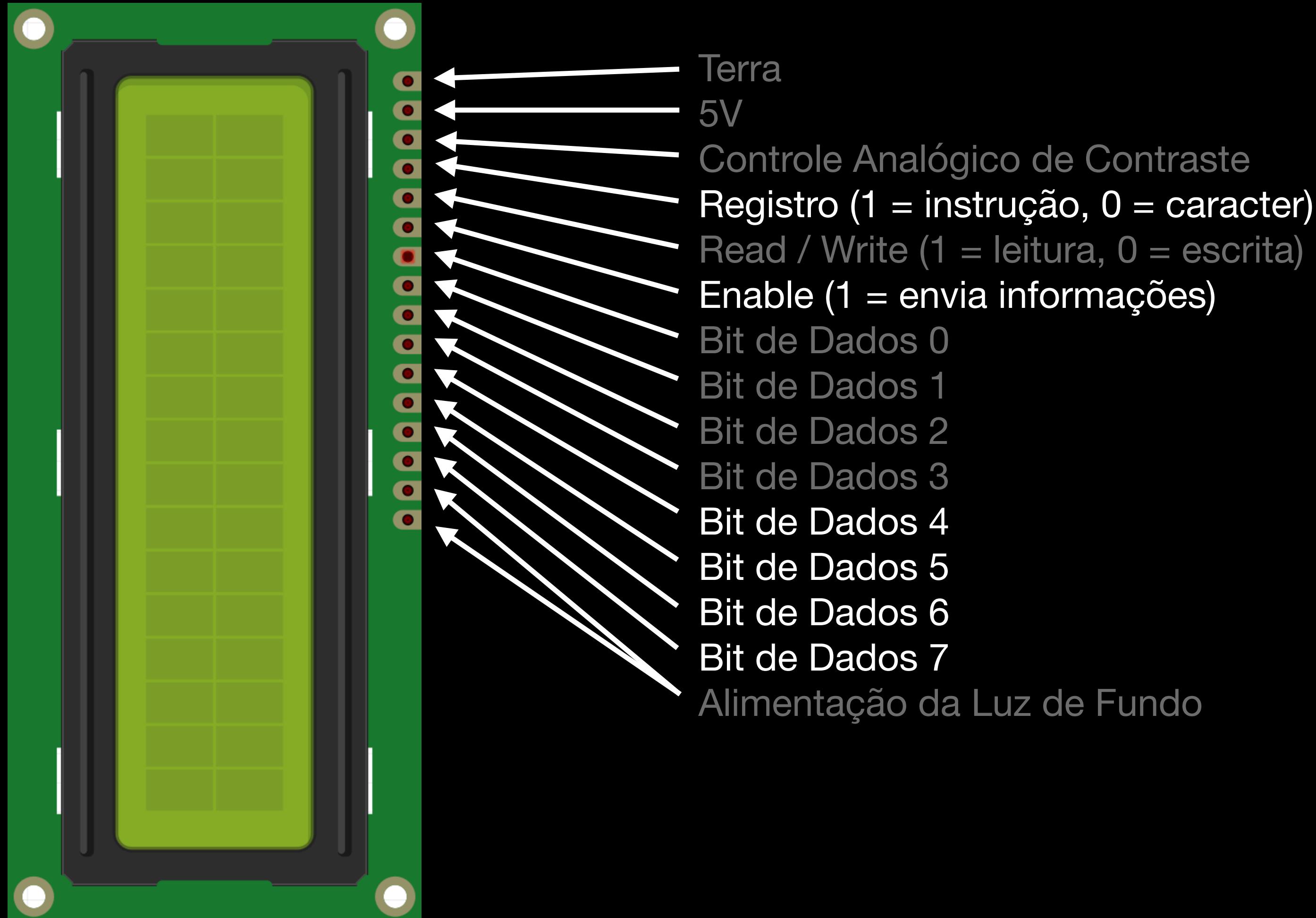


Precisamos implementar
todos esses comandos e
códigos???

Relaxa, a gente já fez tudo
isso para você!



Comandos para o LCD



pinos conectados na GPIO

Adafruit_CharLCD(RS, EN, D4, D5, D6, D7, colunas, linhas)

dimensões do LCD

Pinos Usados pela Biblioteca da Adafruit

```
Adafruit_CharLCD(RS, EN, D4, D5, D6, D7, colunas, linhas)
```



no nosso caso...

```
Adafruit_CharLCD(2, 3, 4, 5, 6, 7, 16, 2)
```

Pinos Usados pela Biblioteca da Adafruit

```
>>> from Adafruit_CharLCD import Adafruit_CharLCD  
>>> lcd = Adafruit_CharLCD(2, 3, 4, 5, 6, 7, 16, 2)  
>>> lcd.message("Teste")  
>>> lcd.message("Teste 2")  
>>> lcd.clear()  
>>> lcd.message("Teste 3")
```



Exibição de Mensagens no LCD de Caracteres

```
>>> from Adafruit_CharLCD import Adafruit_CharLCD  
>>> lcd = Adafruit_CharLCD(2, 3, 4, 5, 6, 7, 16, 2)  
>>> lcd.message("Teste com texto longo")  
>>> lcd.clear()  
>>> lcd.message("Teste com\n texto longo")
```



```
# bibliotecas
from gpiozero import LED, Button
from Adafruit_CharLCD import Adafruit_CharLCD
from time import sleep

# funções
def minha_funcao1():
    ...

def minha_funcao2():
    ...

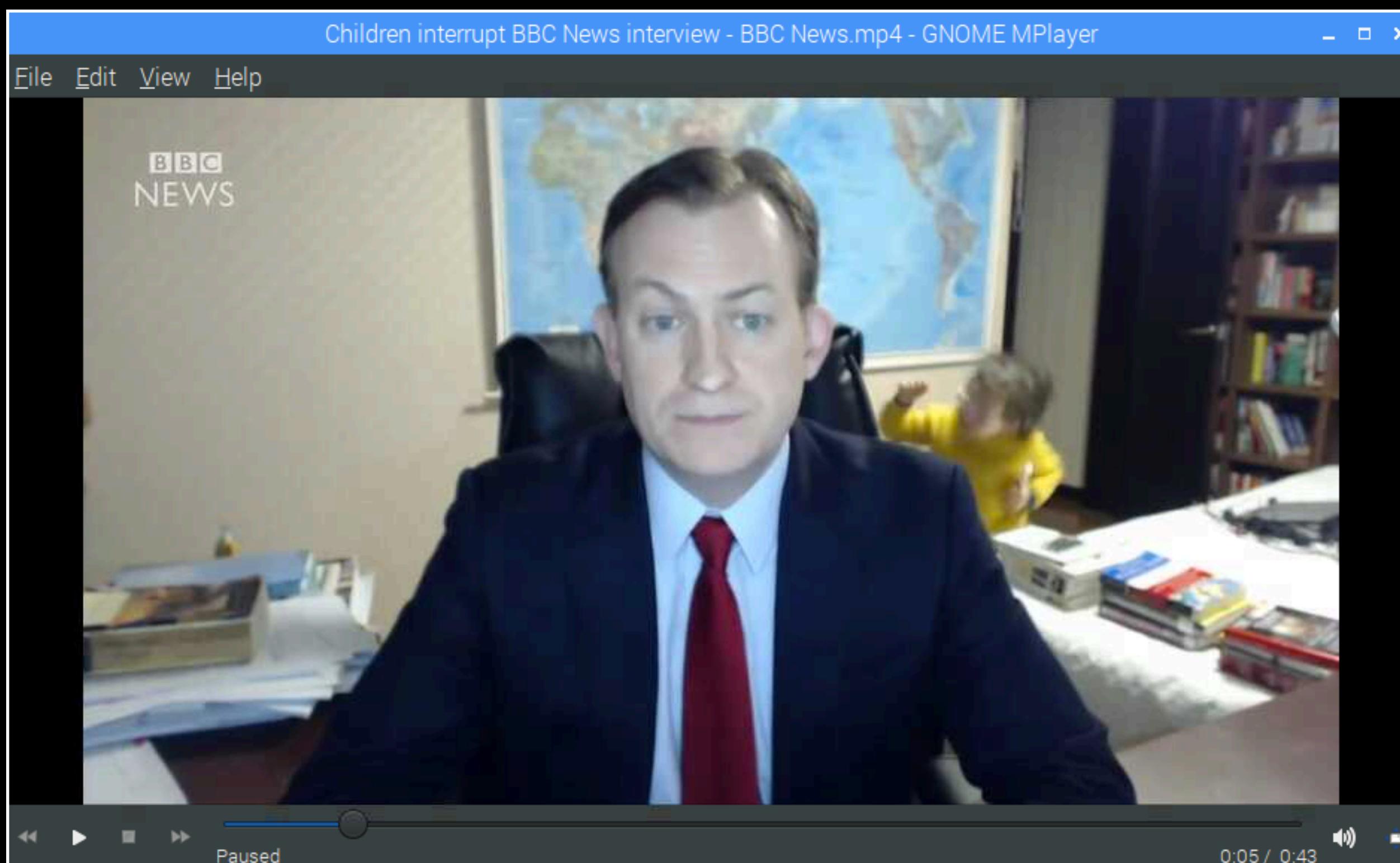
# componentes
led1 = LED(21)
led2 = LED(22)
lcd = Adafruit_CharLCD(2, 3, 4, 5, 6, 7, 16, 2)
botao = Button(11)
botao.when_pressed = minha_funcao1
...

# loop infinito
while True:
    ...
    sleep(0.5)
```

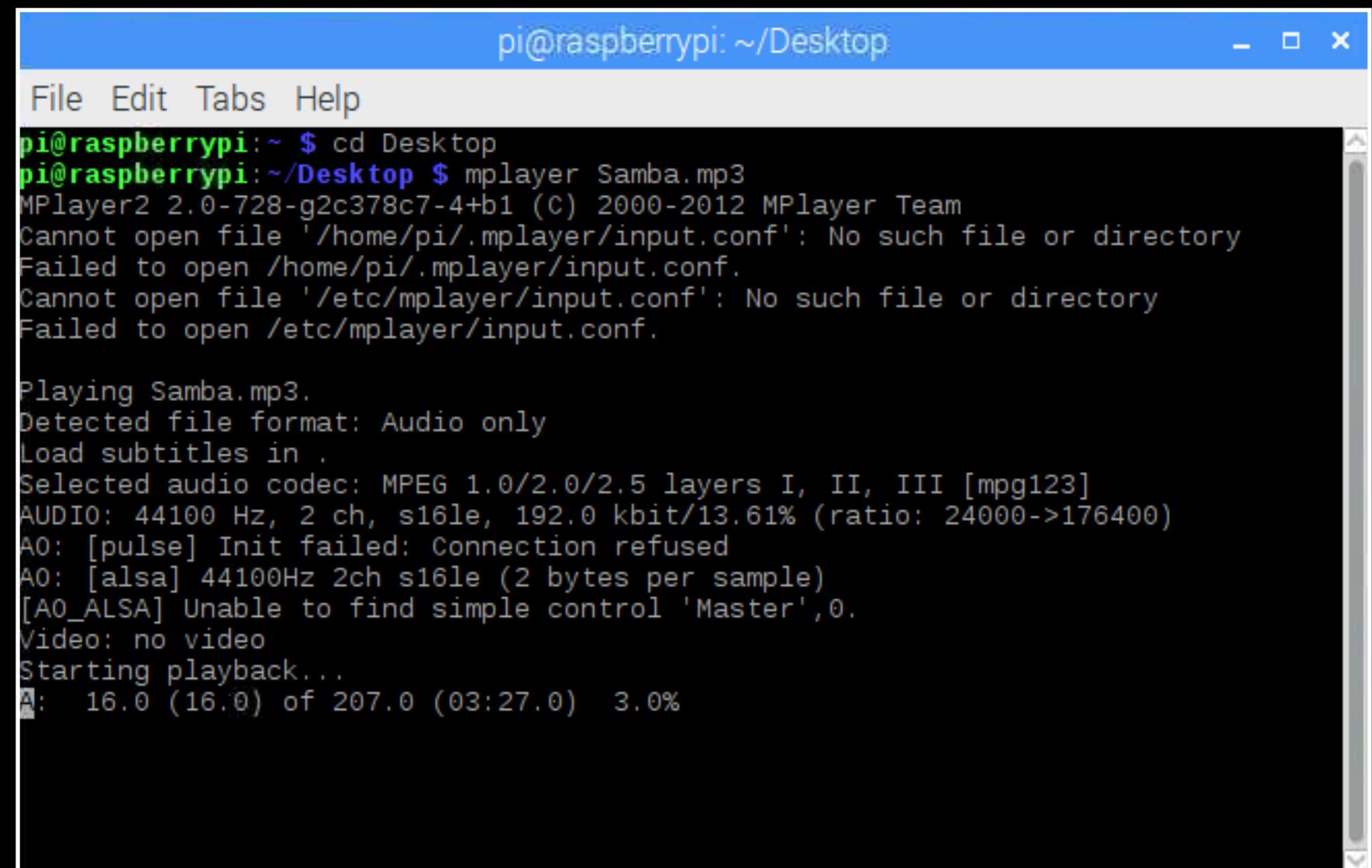
Software



Aplicativo MPlayer



Interface Gráfica do MPlayer

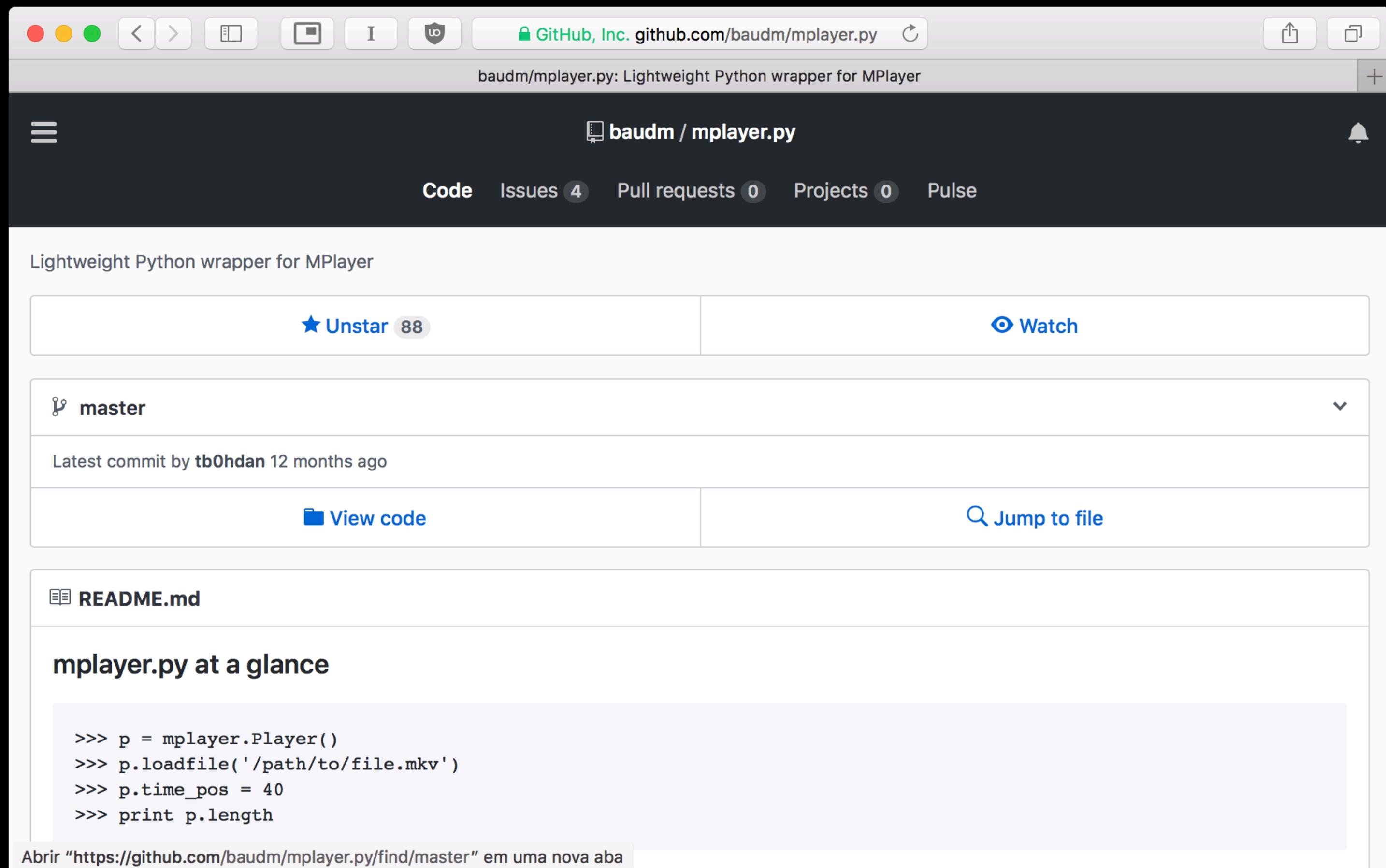


A screenshot of a terminal window titled "pi@raspberrypi: ~/Desktop". The window has a blue header bar with standard window controls. Below the title, there is a menu bar with "File", "Edit", "Tabs", and "Help". The main area of the terminal shows the command-line interface of MPlayer. The user has run the command "mplayer Samba.mp3". The output indicates that MPlayer is unable to find configuration files at "/home/pi/.mplayer/input.conf" and "/etc/mplayer/input.conf", and instead falls back to using pulseaudio and ALSA for audio output. It also mentions that no video is present. The playback status shows 16.0 seconds of a 207.0-second file.

```
pi@raspberrypi:~/Desktop
pi@raspberrypi:~/Desktop $ mplayer Samba.mp3
MPlayer2 2.0-728-g2c378c7-4+b1 (C) 2000-2012 MPlayer Team
Cannot open file '/home/pi/.mplayer/input.conf': No such file or directory
Failed to open /home/pi/.mplayer/input.conf.
Cannot open file '/etc/mplayer/input.conf': No such file or directory
Failed to open /etc/mplayer/input.conf.

Playing Samba.mp3.
Detected file format: Audio only
Load subtitles in .
Selected audio codec: MPEG 1.0/2.0/2.5 layers I, II, III [mpg123]
AUDIO: 44100 Hz, 2 ch, s16le, 192.0 kbit/13.61% (ratio: 24000->176400)
A0: [pulse] Init failed: Connection refused
A0: [alsa] 44100Hz 2ch s16le (2 bytes per sample)
[A0_ALSA] Unable to find simple control 'Master', 0.
Video: no video
Starting playback...
A: 16.0 (16.0) of 207.0 (03:27.0) 3.0%
```

Uso do MPlayer via Terminal



Integração do MPlayer com Python



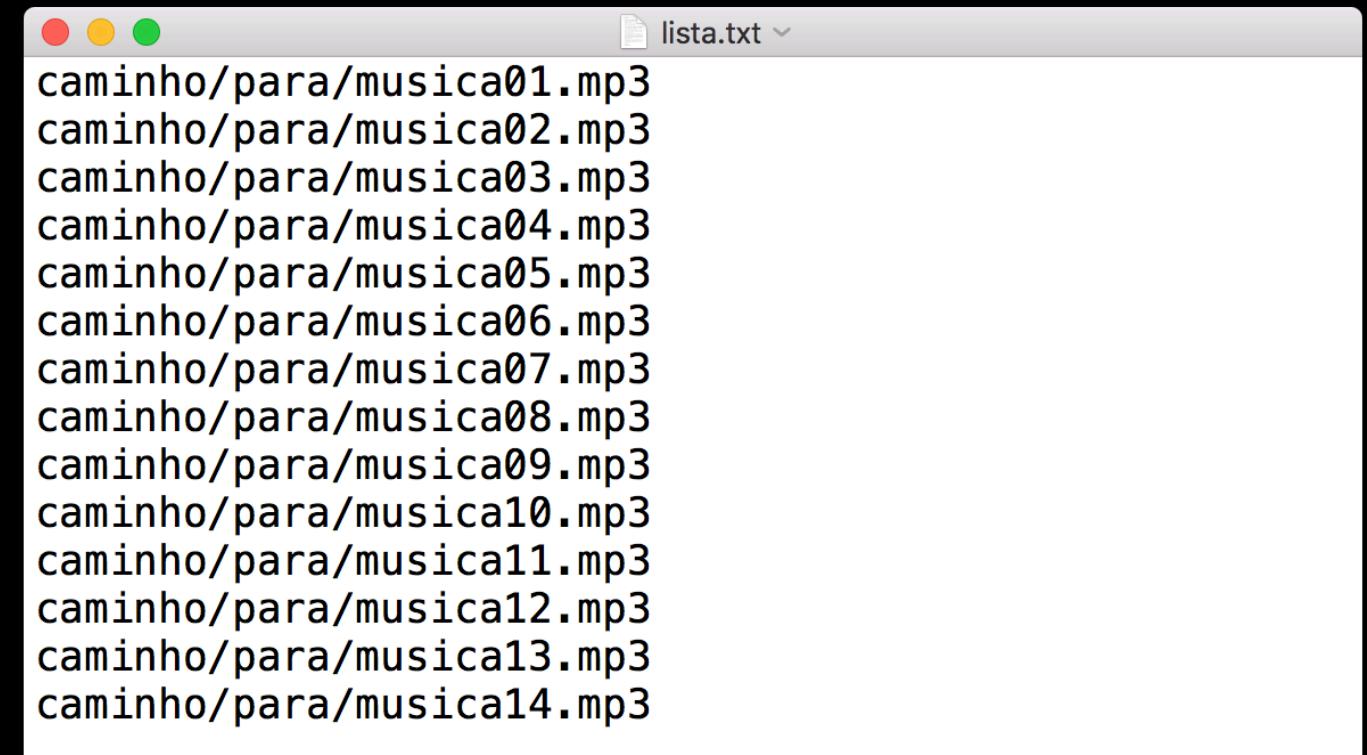
Foco da Aula: Reprodução de Áudio

```
>>> from mplayer import Player  
>>> player = Player() # inicializa o player  
>>> player.loadfile("Musica.mp3")  
>>> player.pause()  
>>> player.paused  
True  
>>> player.pause()      # alterna entre pausa e despausa  
>>> player.paused  
False  
>>> player.stop()  
>>> player.quit()
```

```
>>> from mplayer import Player  
  
>>> player = Player()  
  
>>> player.loadfile("Musica.mp3")  
  
# duração total do áudio em segundos  
>>> player.length  
490.985944  
  
# instante de tempo atual da reprodução de áudio  
>>> player.time_pos  
145.358277  
  
# vá para uma posição de tempo específica  
>>> player.time_pos = 60  
  
# pule 5 segundos  
>>> player.time_pos += 5
```

```
>>> from mplayer import Player  
>>> player = Player()  
>>> player.loadfile("Musica.mp3")  
>>> player.metadata  
{'Title': 'Ixtapa', 'Artist': 'Rodrigo y Gabriela',  
'Album': 'Area 52'}  
>>> player.metadata["Artist"]  
'Rodrigo y Gabriela'  
>>> player.metadata["Genre"] ← chave pode não existir nos  
Traceback (most recent call last):  
  File "<pyshell>", line 1, in <module>  
KeyError: 'Genre'  
>>> "Genre" in player.metadata  
False
```

```
>>> from mplayer import Player  
>>> player = Player()  
>>> player.loadlist("lista.txt")  
>>> player.pt_step(1)      # avance para a próxima faixa  
>>> player.pt_step(2)      # avance 2 faixas  
>>> player.pt_step(-1)     # vá para a faixa anterior
```



```
>>> player.volume # valor entre 0 e 100  
100  
  
>>> player.volume = 70  
  
>>> player.speed = 2 # toque 2 vezes mais rápido  
  
>>> player.speed = -2 # toque 2 vezes mais lento
```

Resumo da Ópera

Funcionalidade

Comandos

LED

[acessar documentação](#)

```
from gpiozero import LED • led = LED(21)
led.on() • led.off() • led.toggle() • led.is_lit
led.blink() • led.blink(n=4, on_time=0.5, off_time=2)
```

Botão

[acessar documentação](#)

```
from gpiozero import Button • botao = Button(11)
botao.is_pressed • led.wait_for_press()
botao.when_pressed = funcao
botao.when_released = funcao
botao.when_held = funcao
```

LCD

[acessar documentação](#)

```
from Adafruit_CharLCD import Adafruit_CharLCD
lcd = Adafruit_CharLCD(2, 3, 4, 5, 6, 7, 16, 2)
lcd.message("Texto 1\nTexto 2")
lcd.clear()
```

MPlayer

```
from mplayer import Player • player = Player()
player.loadfile("Musica.mp3") • player.loadlist("lista.txt")
player.pause() • player.paused • player.quit()
player.time_pos = 2 • player.duration • player.pt_step(-1)
player.metadata["Title"] • player.metadata["Artist"]
player.volume = 70 • player.speed = 2
```

Funcionalidade	Comandos
Entrada / Saída	<pre>x = input("Digite um número: ") • print("Resultado: ", x)</pre>
Listas acessar documentação	<pre>lista = [1, 2, 3] • lista2 = ["texto", [0, 0], 5] lista[0] • total_de_elementos = len(lista) lista.append(novo_elemento) • lista.remove(indice)</pre>
Dicionários acessar documentação	<pre>dicionario = {"chave 1": 42, "chave 2": [1, 2, 3]} dicionario["chave 1"] • dicionario["chave 3"] = "Olá!"</pre>
Textos (Strings) acessar documentação	<pre>texto = "olá!" • len(texto) • caractere = texto[0] texto + "\n" • texto + str(numero) • "x = %.2f" % numero</pre>
Condicionais	<pre>if x != 0: if x not in [1, 2]: y = 4 else: y = 0 elif x >= 0: y = 3 else: y = 0</pre>
Repetições	<pre>for elem in lista: ... for i in range(1, 4): ... while x > 1: ...</pre>
Criação de Funções	<pre>def funcao1(x): return x + 2 def funcao2(x, y, z): ... def funcao3(): global x</pre>