Projeto 09

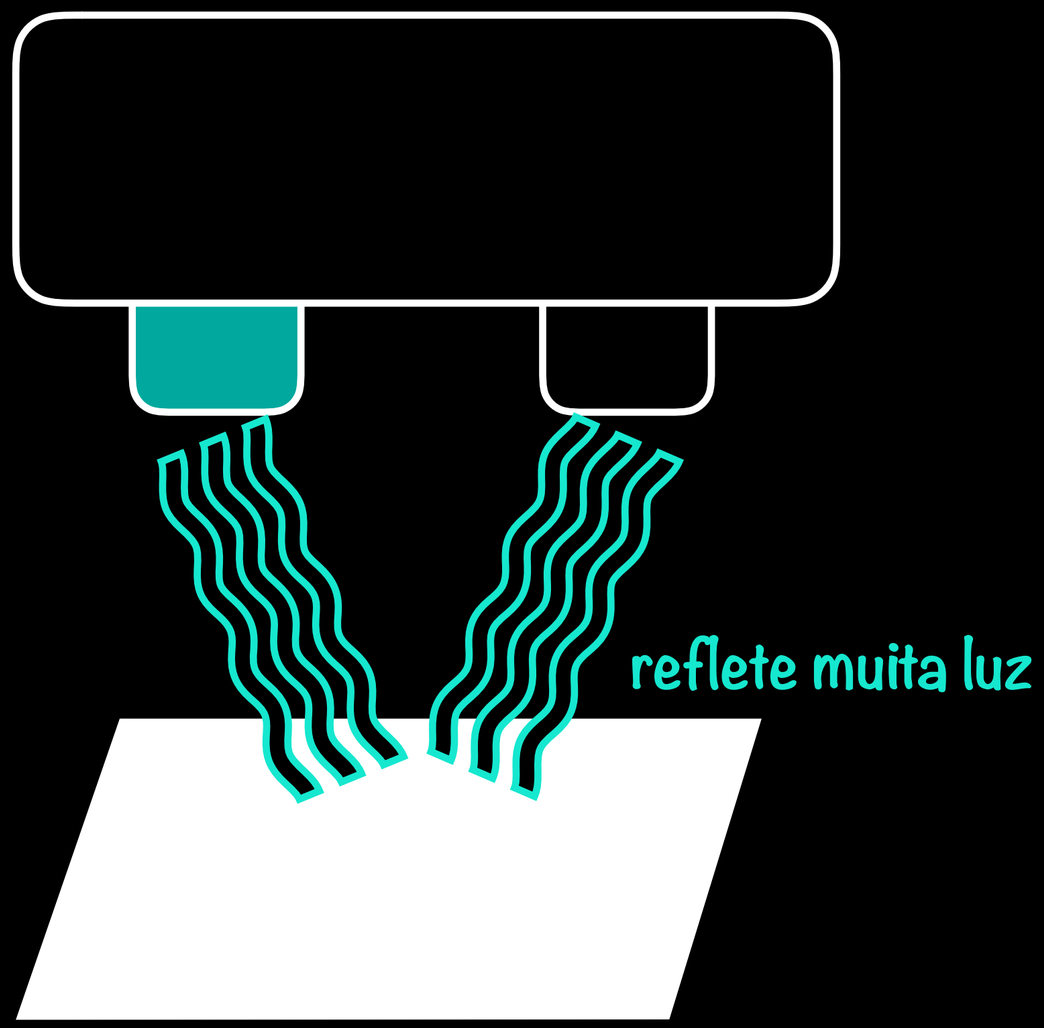
Controle Serial – Teoria

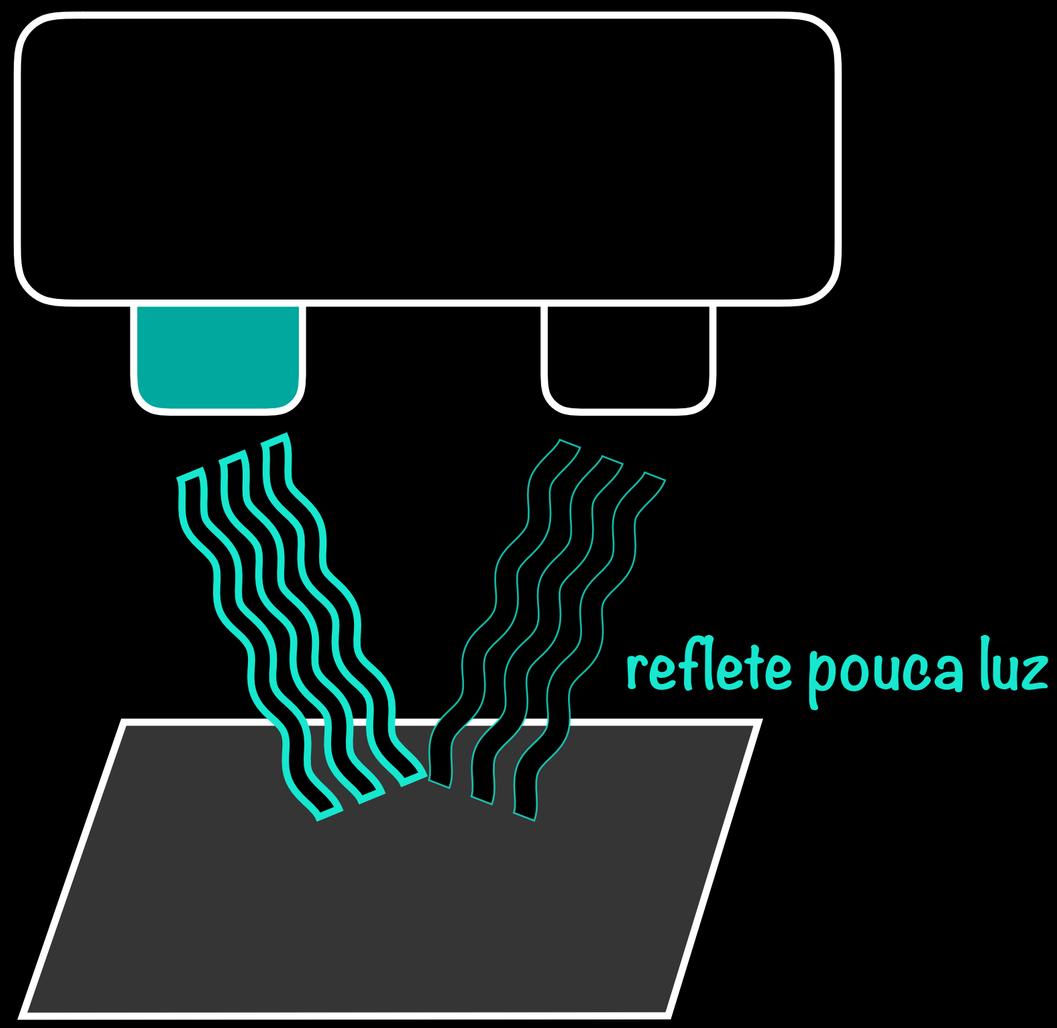
Jan K. S. – janks@puc-rio.br

ENG1419 – Programação de Microcontroladores

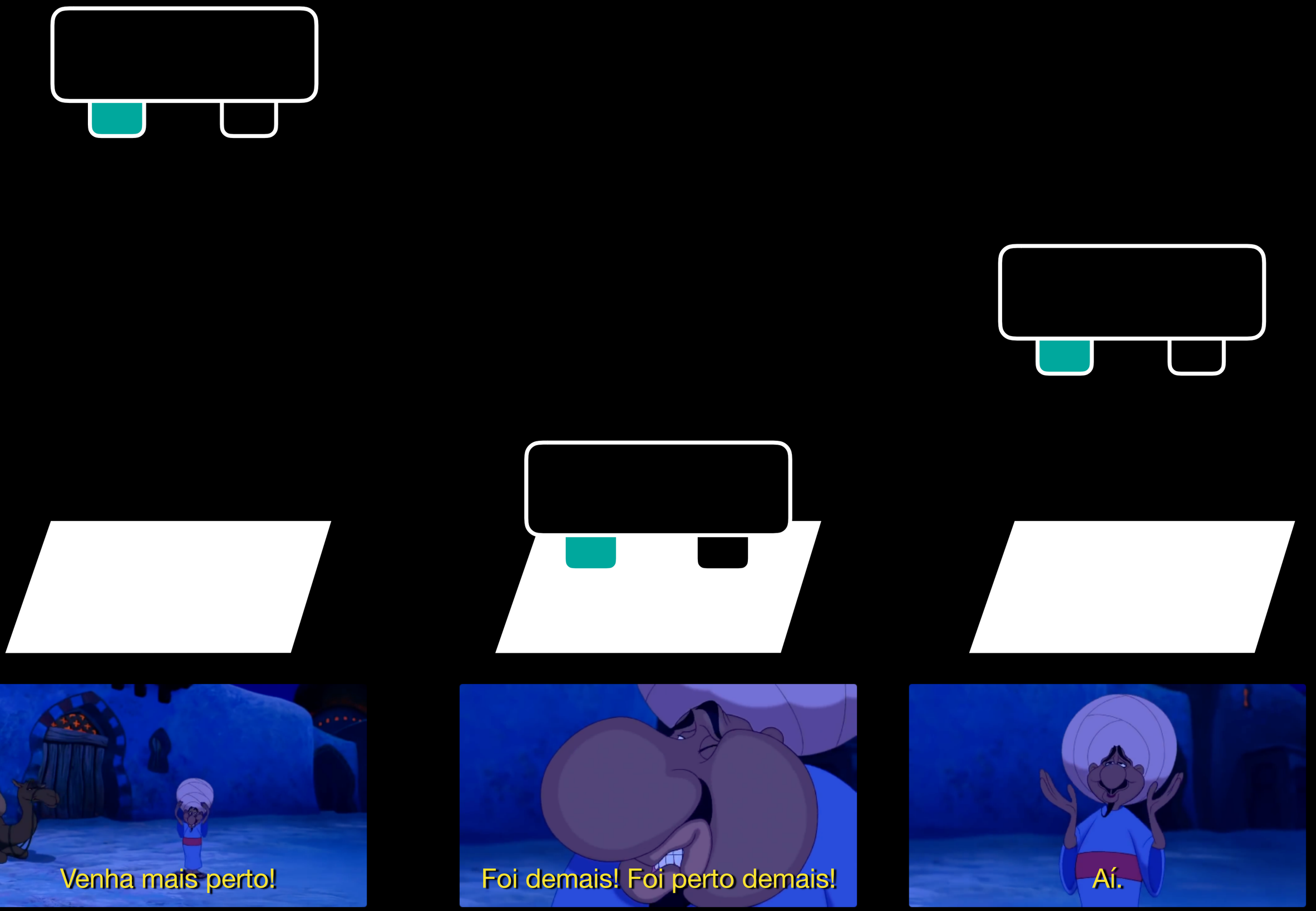
Hardware

Sensor Ótico (TCRT5000)





Funcionamento do Sensor Ótico



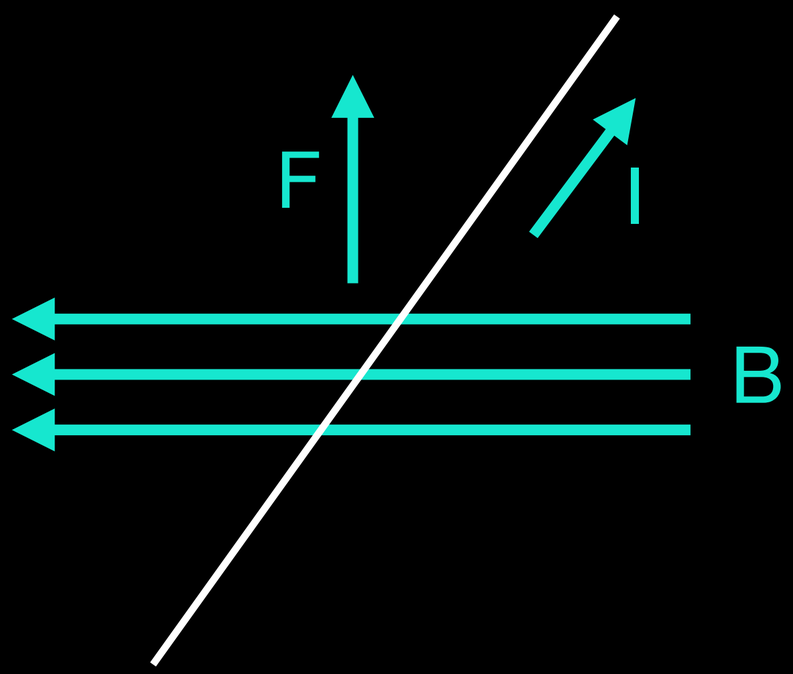
Limitação de Distância do Sensor Ótico

```
int sensorOtico = A11;
void setup () {
    pinMode(sensorOtico, INPUT);
    Serial.begin(9600);
}

void loop () {
    int valorAnalogico = analogRead(sensorOtico);
    Serial.println(valorAnalogico);
    int valorDigital = digitalRead(sensorOtico);
    if (valorDigital == LOW) {
        Serial.println("Superfície clara");
    }
    else {
        Serial.println("Superfície escura");
    }
    delay(200);
}
```

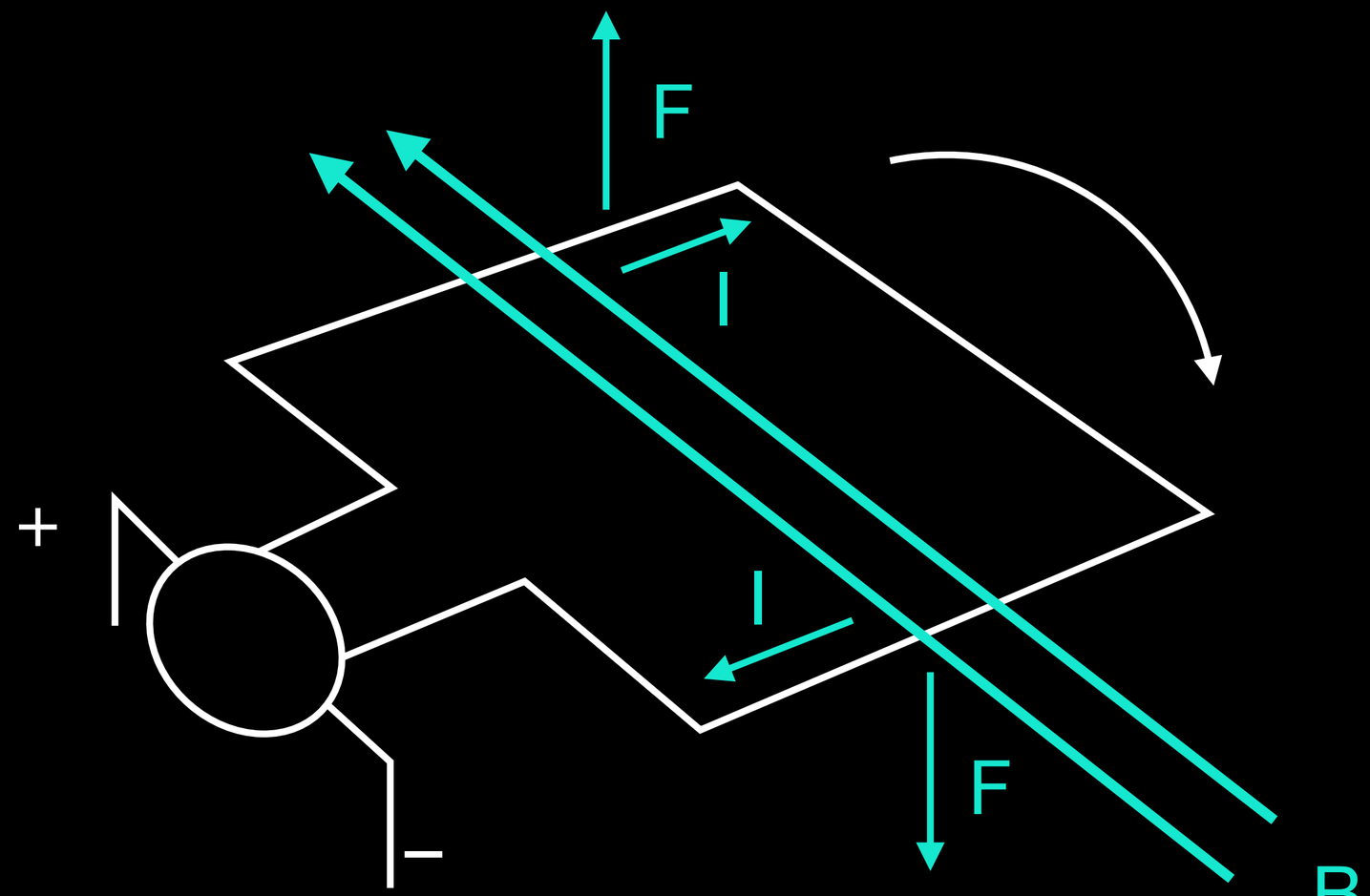
Leitura Analógica e Digital do Sensor Ótico

Motor DC (Motor de Corrente Contínua)

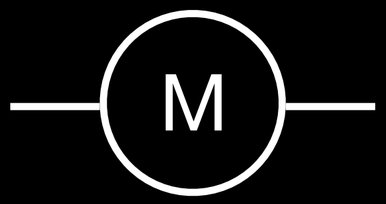


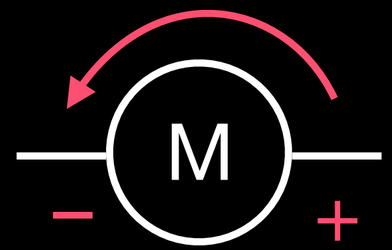
$$F = I \int dl \times B$$

Força de Lorentz: Força Aplicada em uma Corrente num Campo Magnético



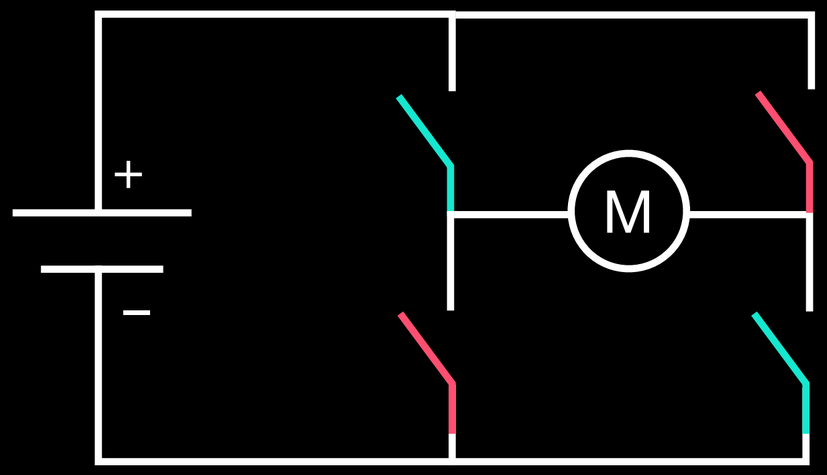
Princípio Básico de um Motor DC

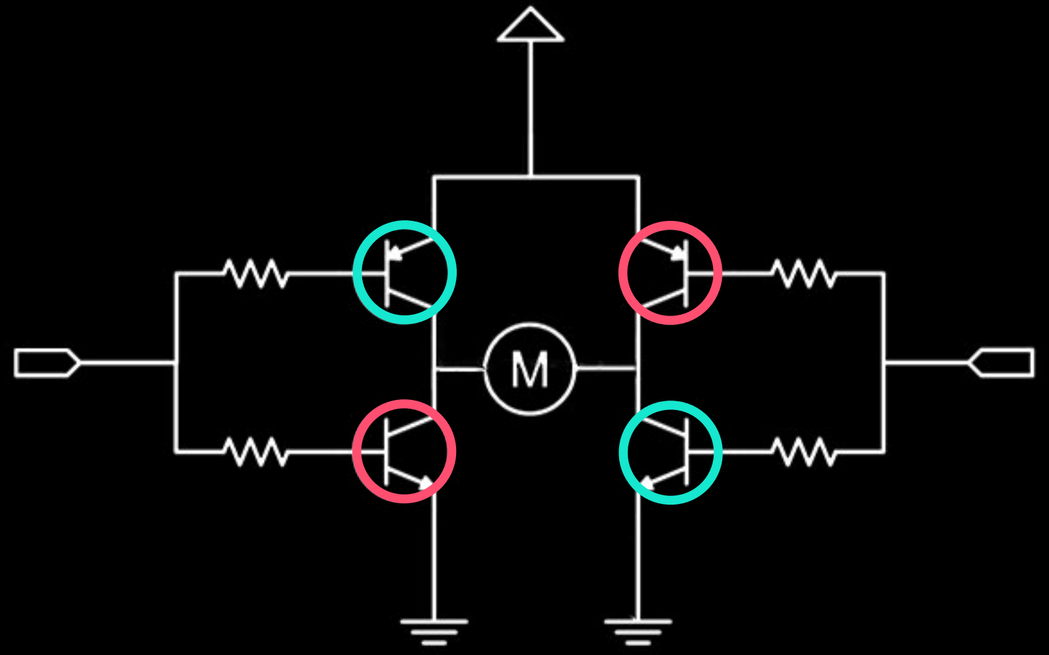




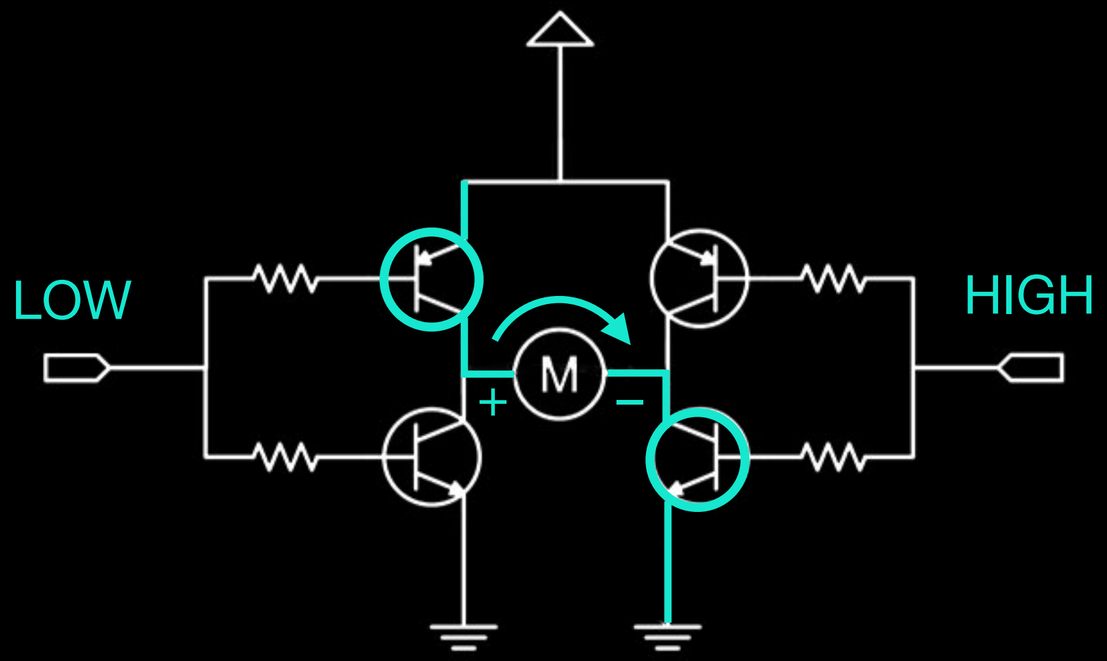
ponte H com chaves

ponte H com transistores

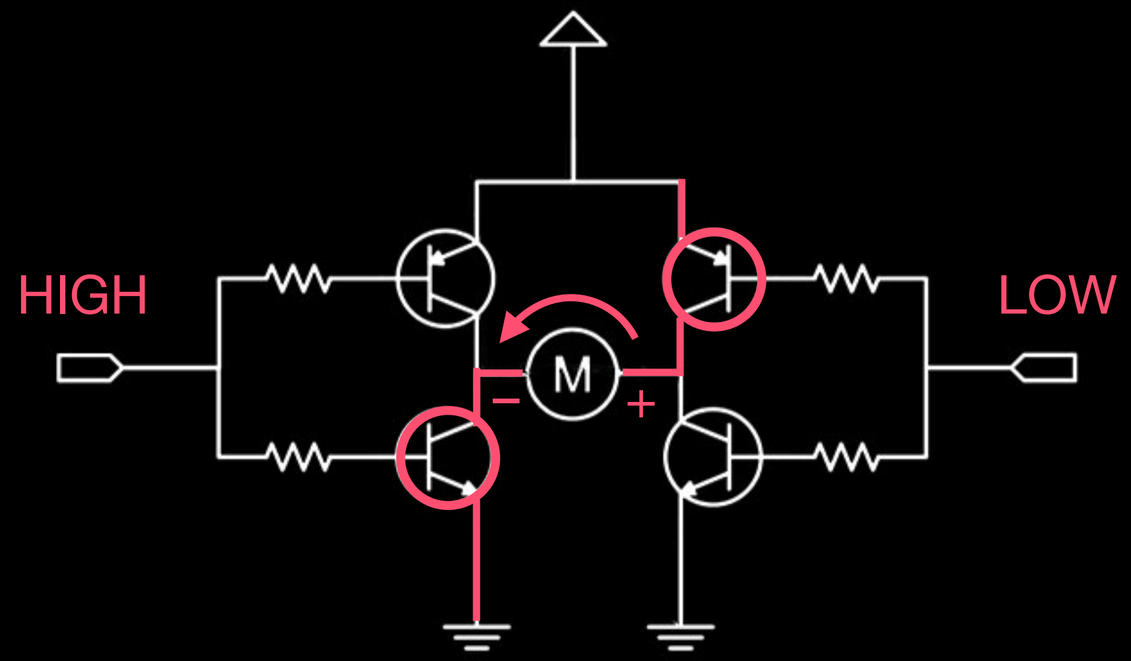




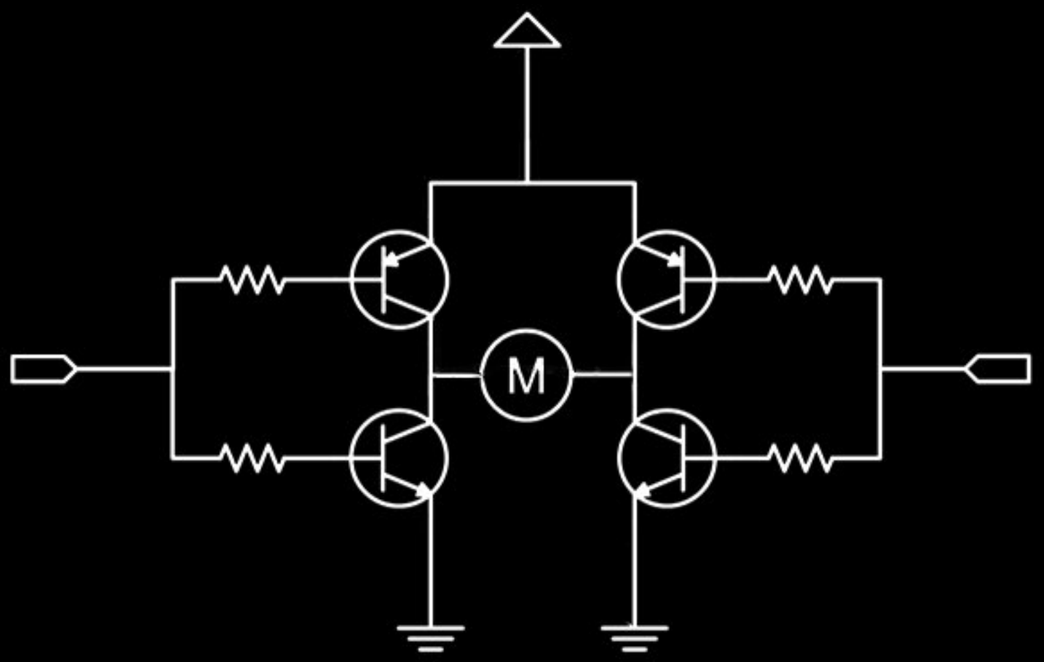
Controle do Sentido de Giro com Ponte H



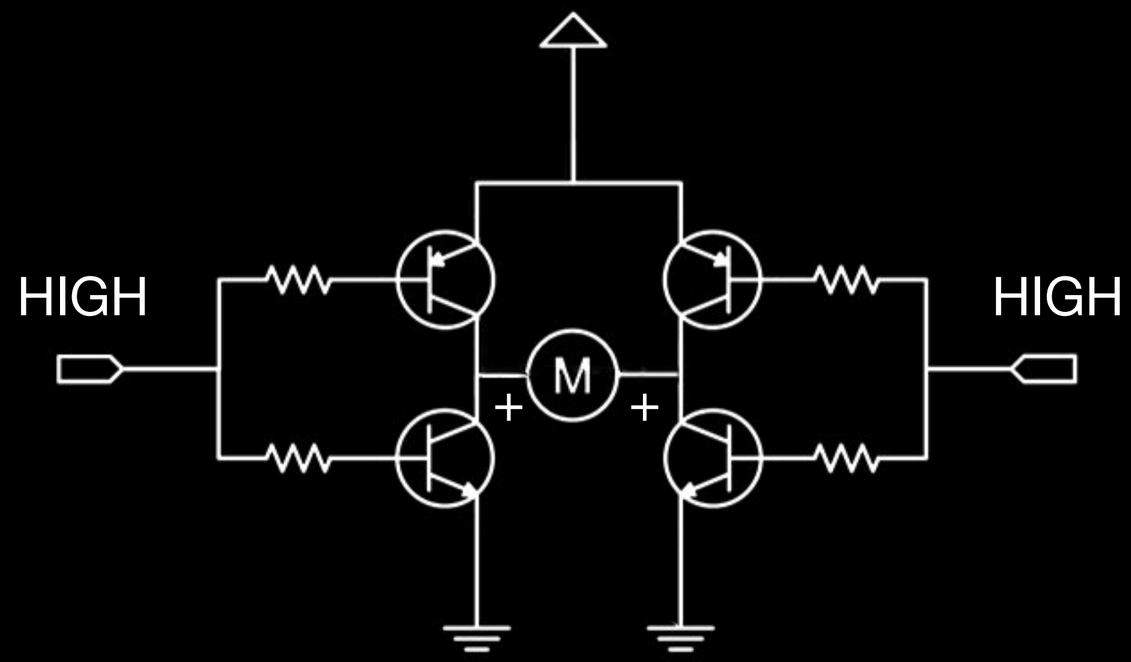
giro (horário)



giro (anti-horário)



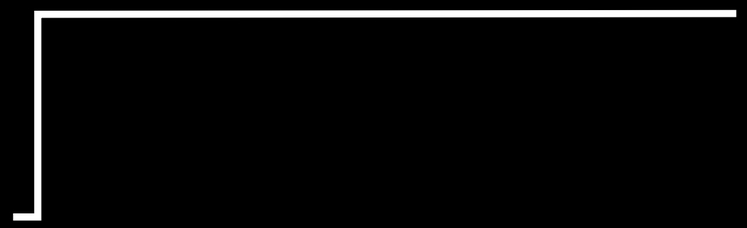
repouso

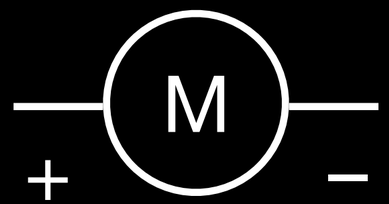


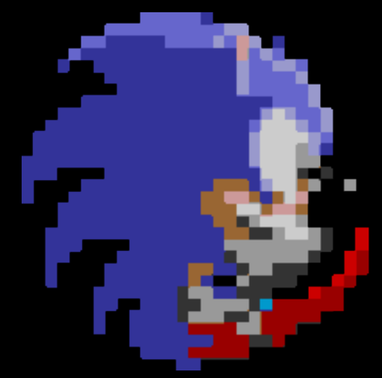
travado

Controle do Sentido de Giro com Ponte H

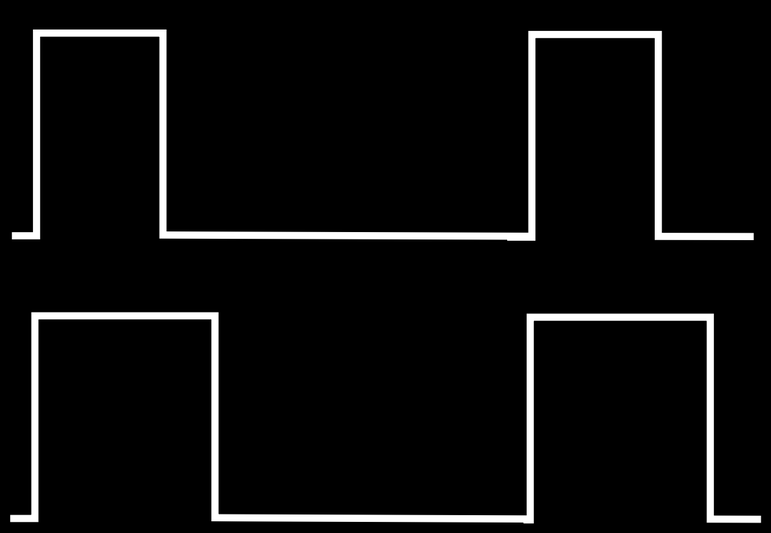
velocidade total



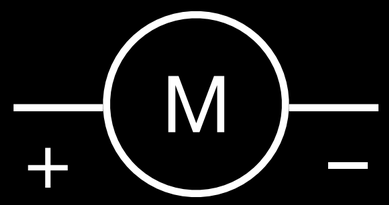


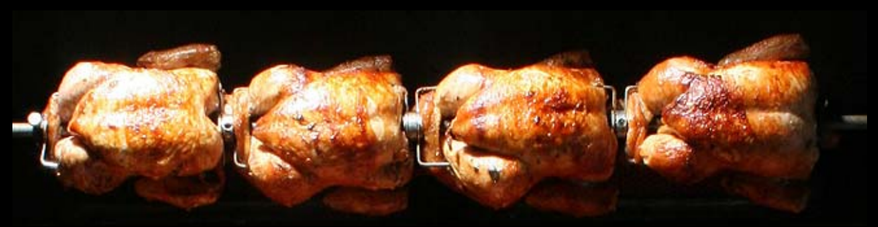


velocidade parcial

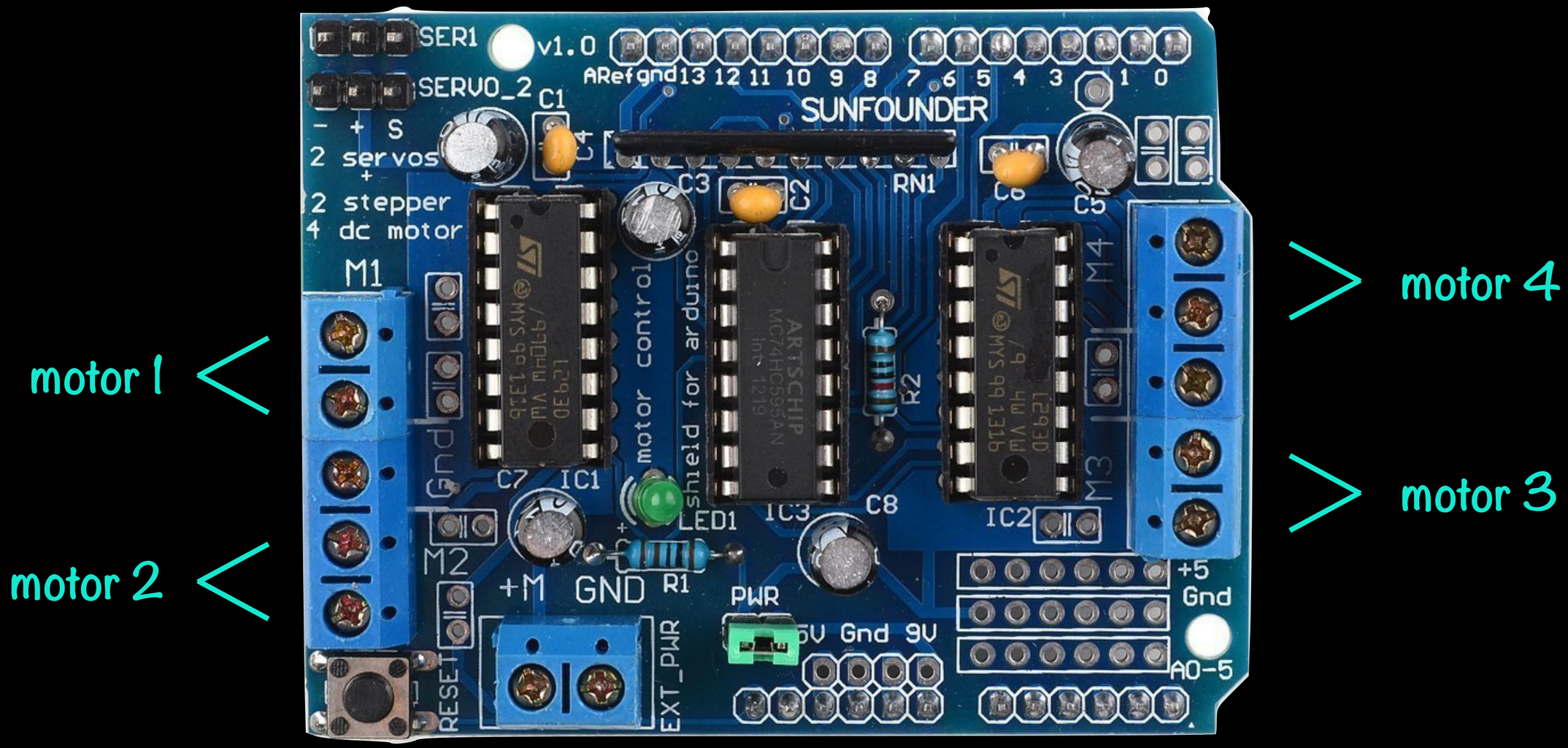


PWM

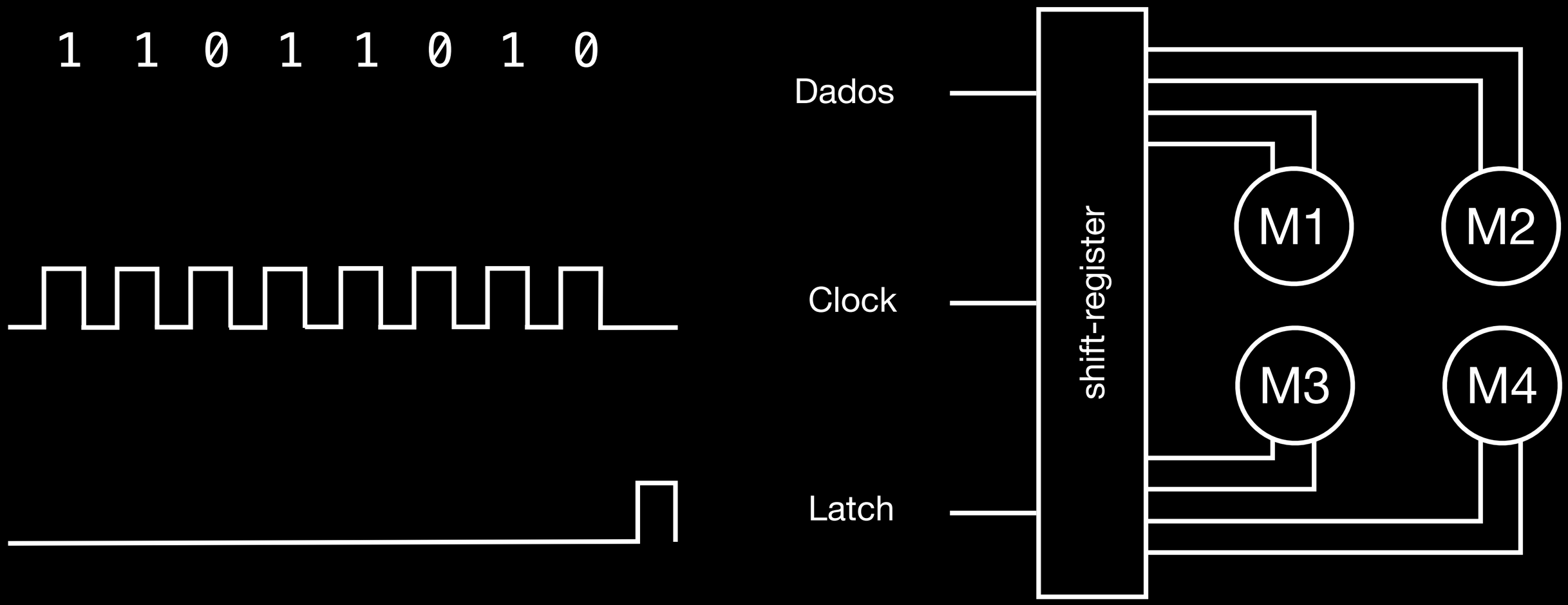




Controle de Velocidade com PWM



Shield para Motores



Controle dos 4 Motores via Shift Register

GitHub, Inc. github.com/adafruit/Adafruit-Motor-Shield-

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adafruit / **Adafruit-Motor-Shield-library**

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Adafruit Motor shield V1 firmware with basic Microstepping support. Works with all Arduinos and the Mega
http://www.ladyada.net/make/mshield

24 commits **1** branch **1** release **6** contributors

Branch: master New pull request Create new file Upload files Find file Clone or download

ladyada Update README.txt Latest commit 99381df on 17 Oct 2016

.github	Add GitHub issue template	2 years ago
examples	Fixed to use built in Servo library	7 years ago
AFMotor.cpp	Added support for cipKIT/MPIDE (PIC32 architecture) boards. Please se...	6 years ago
AFMotor.h	Update AFMotor.h	4 years ago
README.txt	Update README.txt	2 years ago
keywords.txt	The latest version	8 years ago

Biblioteca da Adafruit para o Shield de Motor

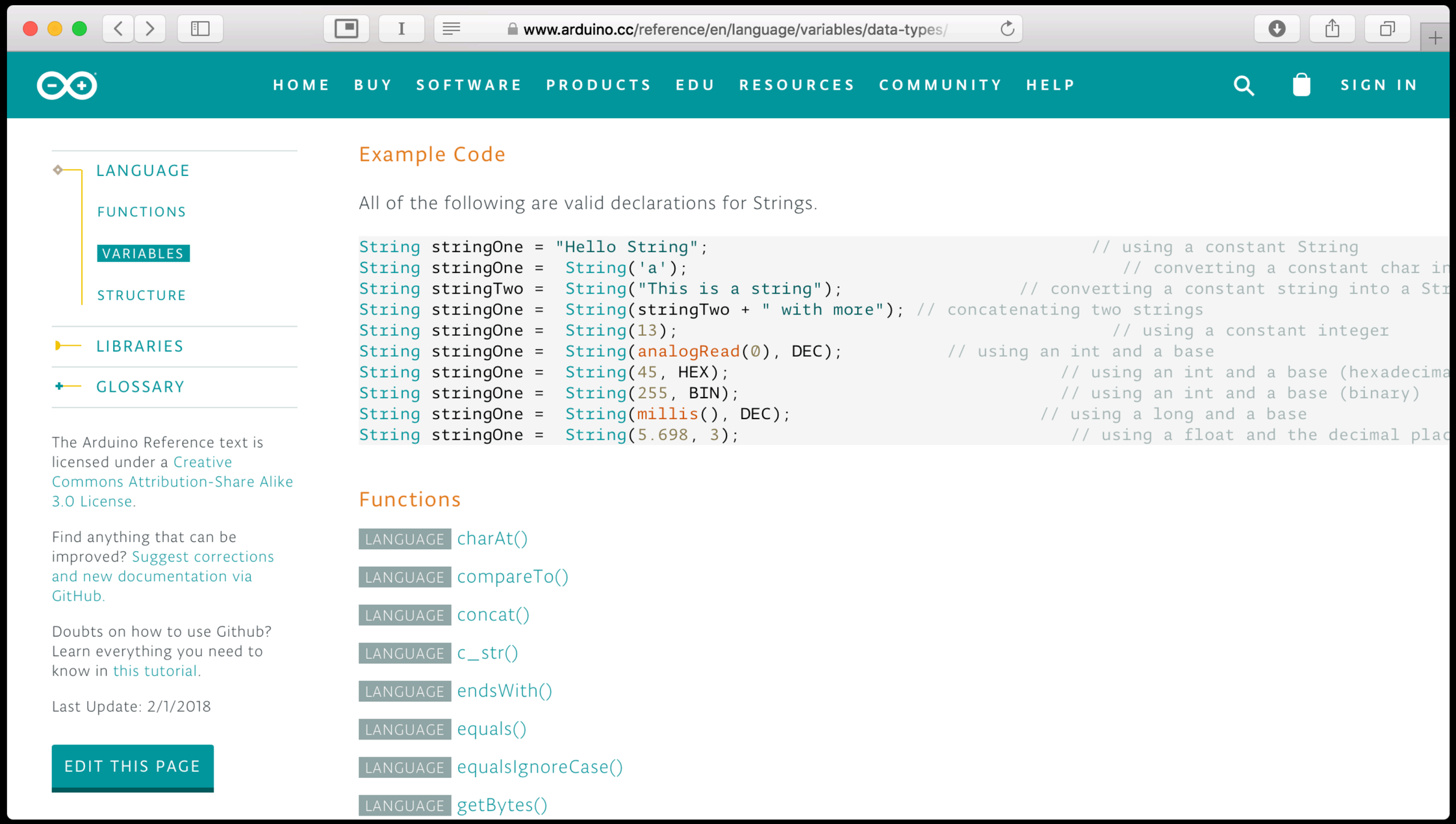
```
#include <AFMotor.h>

AF_DCMotor motorA(1);
AF_DCMotor motorB(2);
void setup () {
    motorA.setSpeed(255); // valor entre 0 e 255
    motorB.setSpeed(128);
}

void loop () {
    motorA.run(FORWARD);
    motorB.run(BACKWARD);
    delay(1000);

    motorA.run(RELEASE);
    motorB.run(BRAKE);
    delay(1000);
}
```

A opção de freio não foi implementada direito, por algum motivo...

"Software"

```c
// textos no estilo C
char texto[] = "Olá!";

// textos no estilo C++
string texto = "Olá!";

// textos no estilo Arduino
String texto = "Olá!";
```

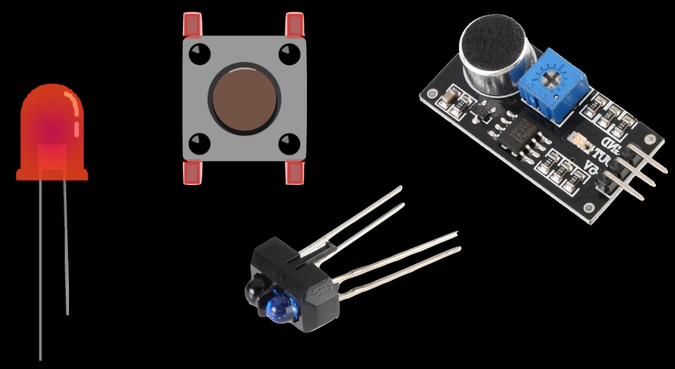
Variações do Tipo Texto

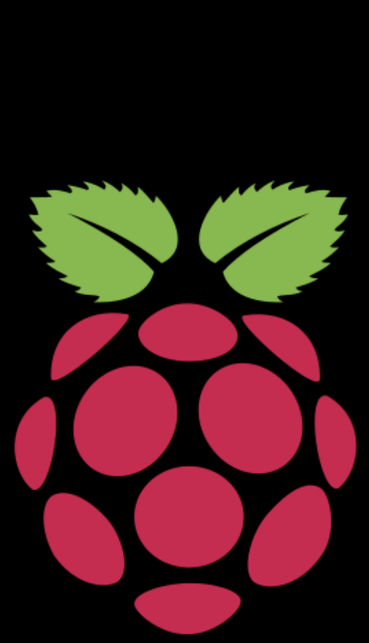


Manipulação de Strings no Arduino

```
String texto1 = "Olá, mundo!";

int numero = 100 * 2;
String texto2 = String(numero);                 // "200"
int numero2 = texto2.toInt() + 2;               // 202

String texto3 = "aaa" + texto2;                 // "aaa200"

bool ehIgual = texto2 == texto3;                    // false
bool comecaComOla = texto1.startsWith("Olá"); // true

String trecho = texto1.substring(0, 3);   // "Olá"
String trechoFinal = texto1.substring(5); // "mundo!"

String texto4 = "  abc abc  \n";
texto4.trim();                                  // "abc abc"
texto4.replace("ab", "AB");                     // "ABc ABc"
```

Exemplos de Funções para Strings

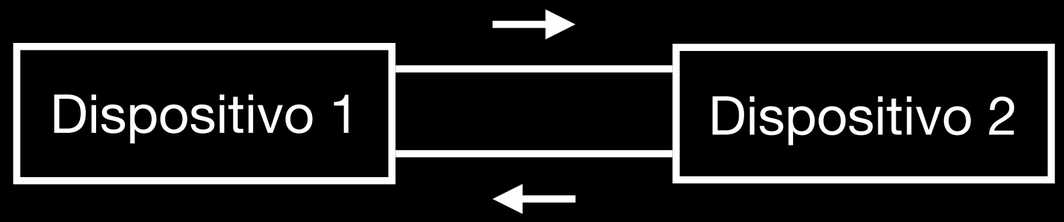




Comunicação Serial

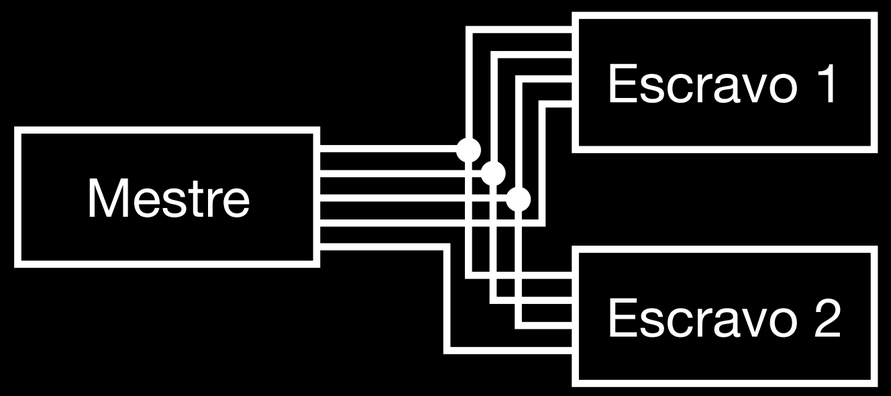
UART

Universal Asynchronous
Receiver/Transmitter



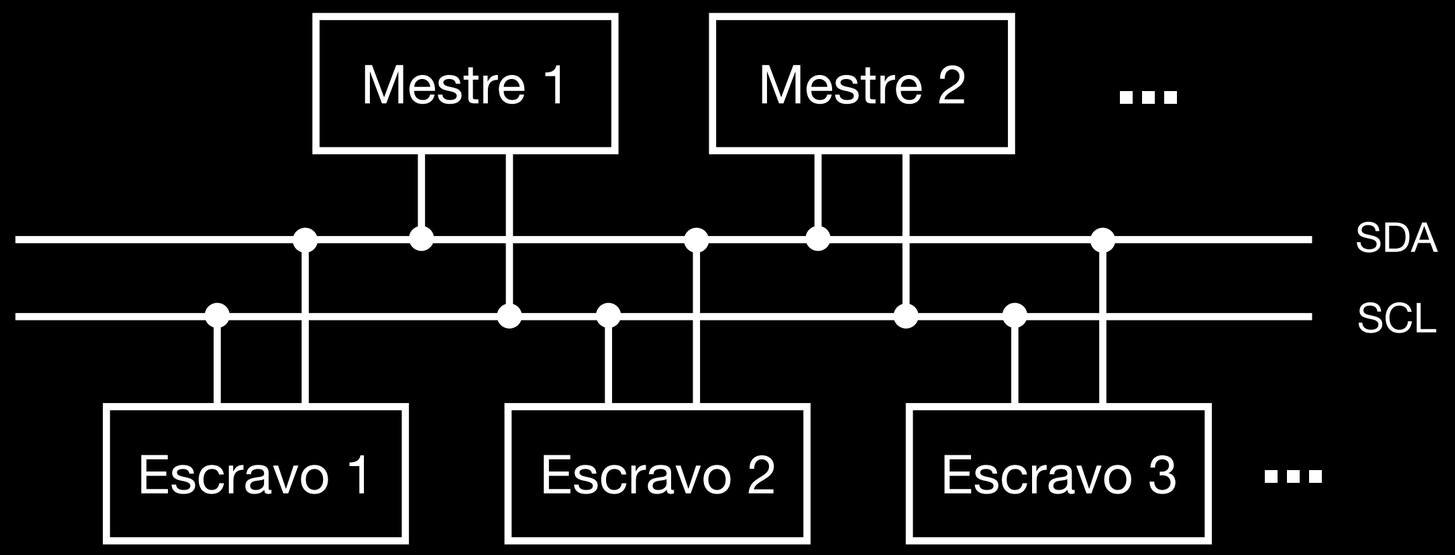
SPI

Serial Peripheral Interface

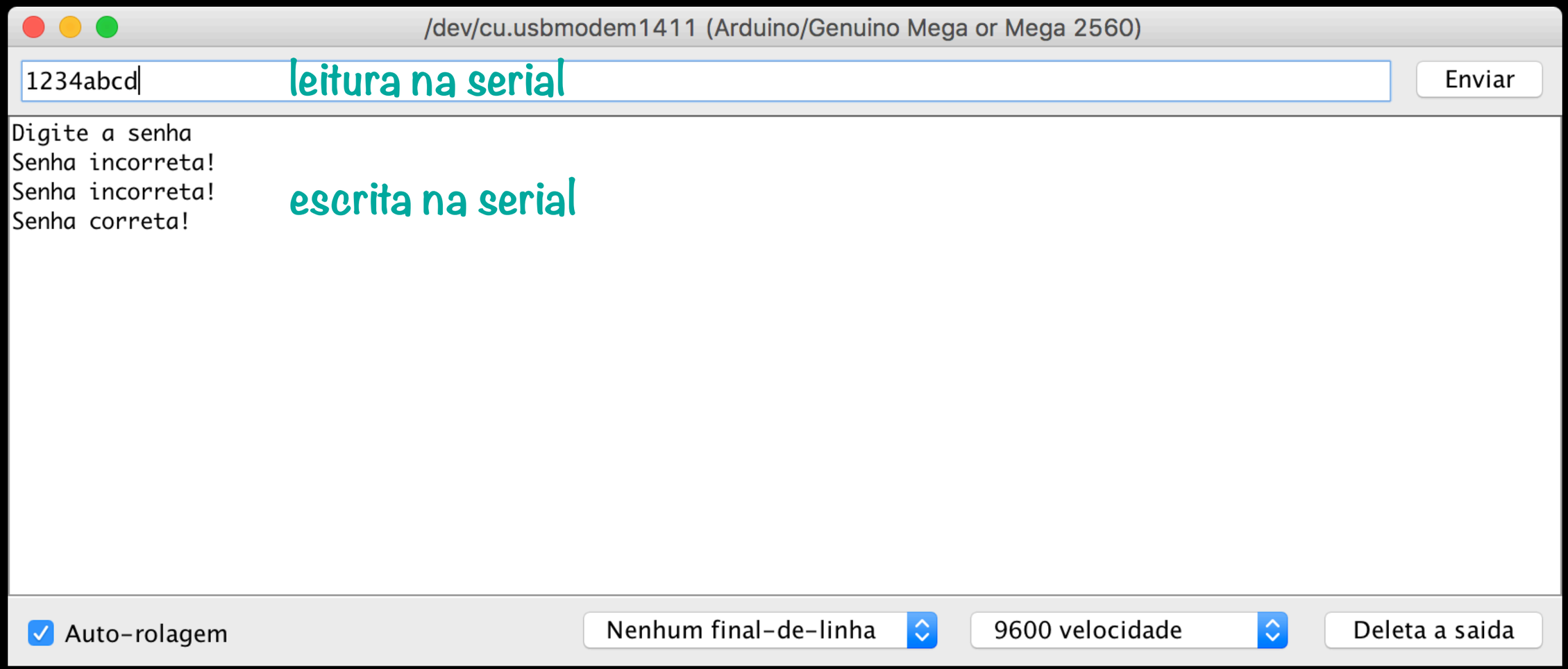


I2C

Inter-Integrated Circuit



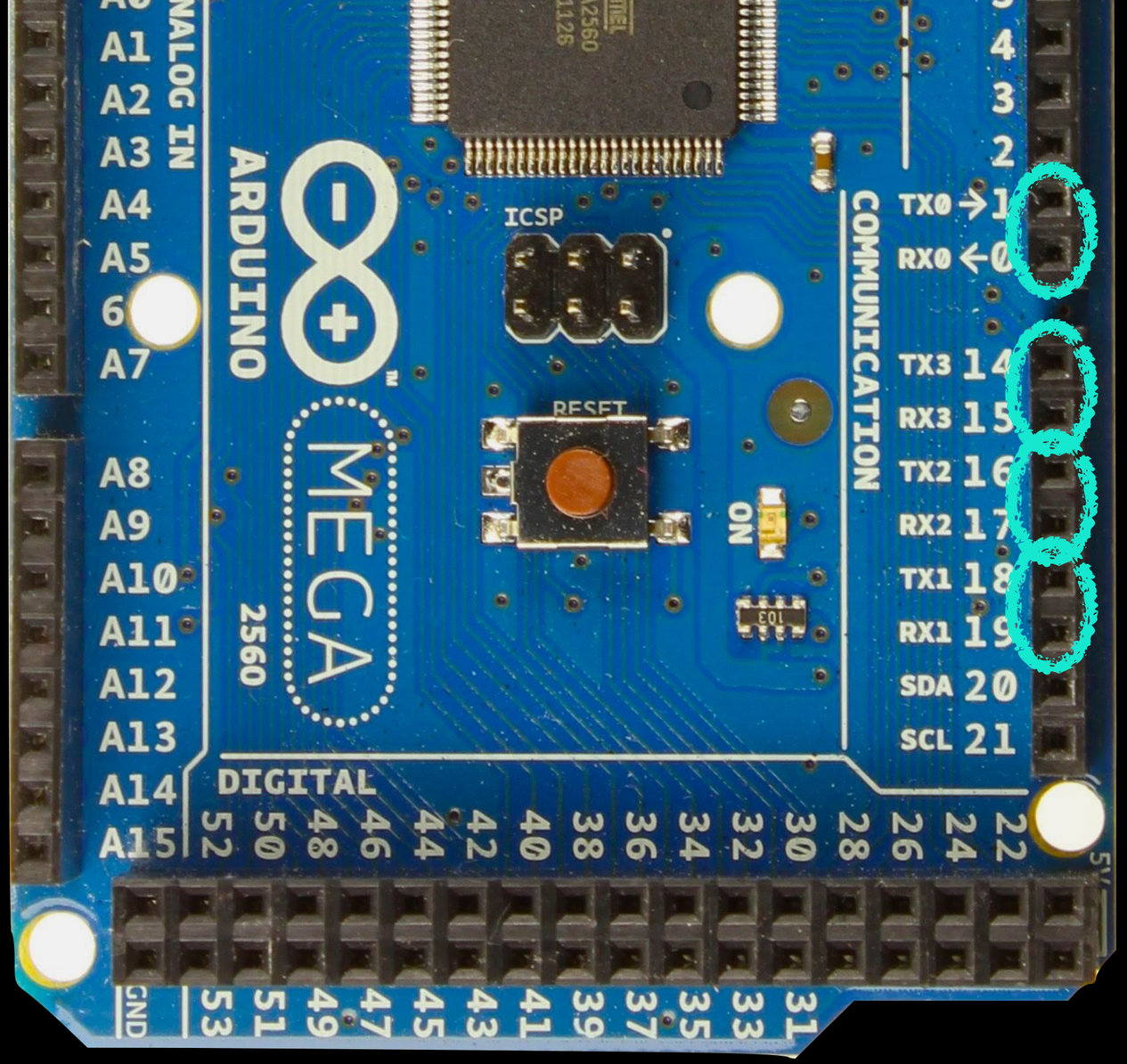
Tipos de Comunicação Serial



Comunicação Serial com o Computador

```ino
void setup () {
    Serial.begin(9600);
    Serial.println("Digite a senha");
    Serial.setTimeout(10); // espera máxima de 10ms na leitura
}

void loop () {
    String texto = Serial.readString();
    texto.trim();              // remove quebra de linha
    if (texto != "") {
        if (texto == "1234abcd") {
            Serial.println("Senha correta!");
        }
        else {
            Serial.println("Senha incorreta!");
        }
    }
}
```

Essa lógica é bem parecida com a leitura do controle remoto do Projeto 02!



Serial

Serial 3

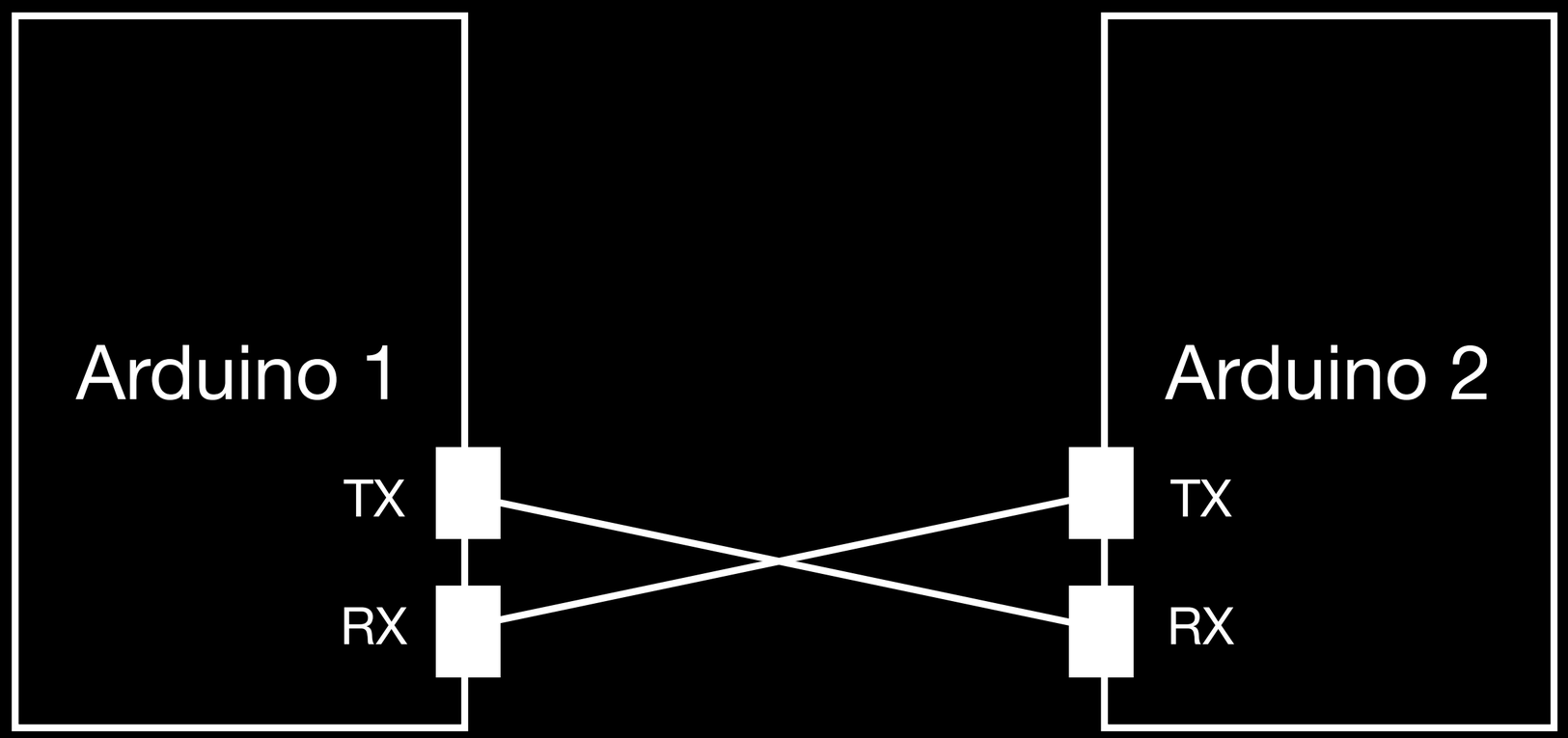
Serial 2

Serial 1

TX = transmissão

RX = recepção

Portas Seriais do Arduino Mega



Comunicação Serial entre Arduinos

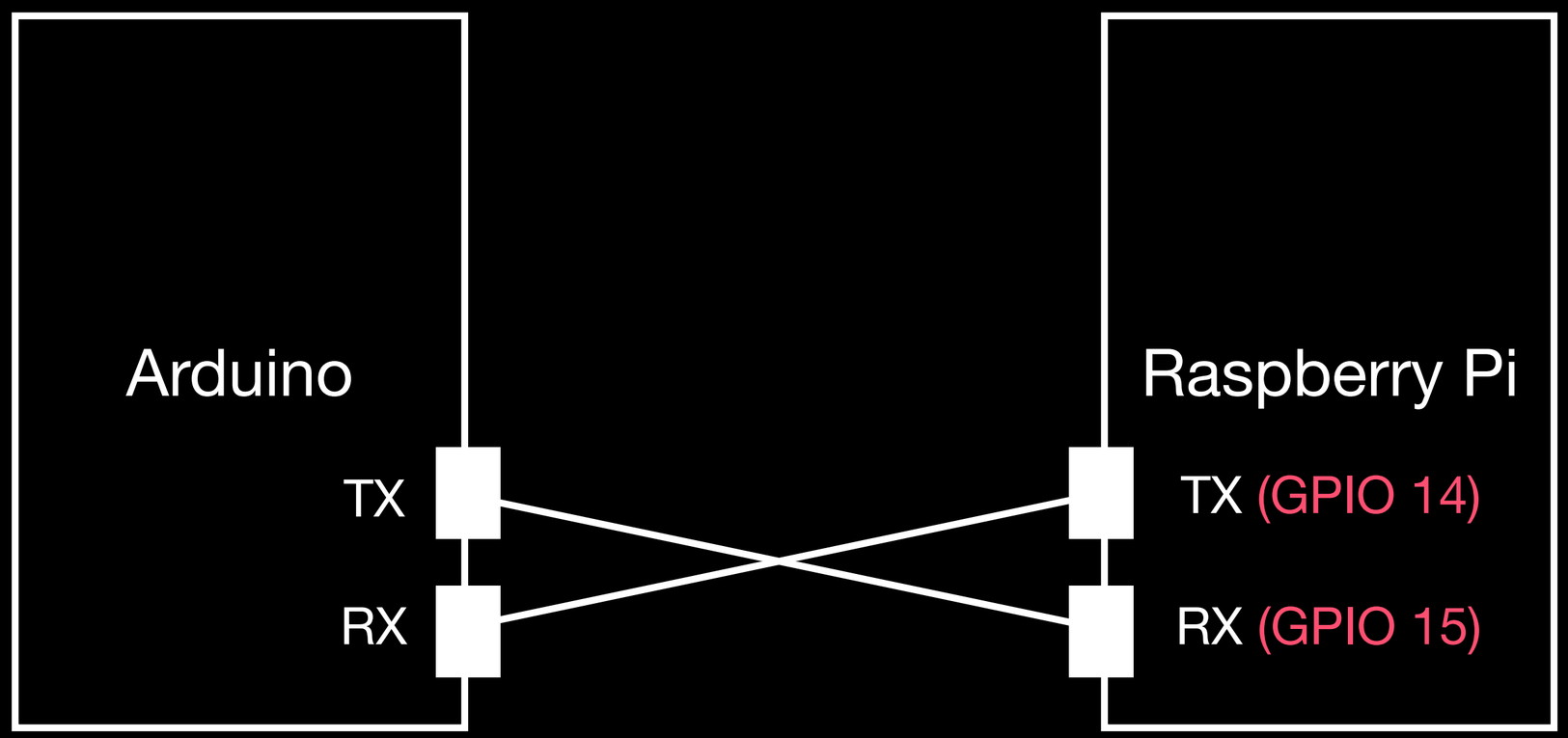
```
void setup () {
    // conexão serial "0" com o computador
    Serial.begin(9600);
    Serial.setTimeout(10);

    // conexão serial "1" com o outro Arduino
    Serial1.begin(9600);
    Serial1.setTimeout(10);
}

void loop () {
    String texto = Serial1.readString();
    texto.trim();
    if (texto != "") {
        if (texto == "1234abcd") {
            Serial1.println("Ok!");
            Serial.println("Texto recebido: " + texto);
        }
    }
}
```

Multiplas Conexões Seriais

Raspberry Pi 3 GPIO Header

Pin#	NAME		NAME	Pin#
01	3.3v DC Power		DC Power 5v	02
03	GPIO02 (SDA1 , I²C)		DC Power 5v	04
05	GPIO03 (SCL1 , I²C)		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 (I²C ID EEPROM)		(I²C 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

Portas Seriais do Raspberry Pi



Comunicação Serial entre Arduino e Raspberry Pi

pythonhosted.org/pyserial/

pySerial 3.0 documentation »

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Enter search terms or a module, class or function name.

Welcome to pySerial's documentation

This module encapsulates the access for the serial port. It provides backends for Python running on Windows, OSX, Linux, BSD (possibly any POSIX compliant system) and IronPython. The module named "serial" automatically selects the appropriate backend.

Other pages (online)

- project page on GitHub
- Download Page with releases
- This page, when viewed online is at https://pyserial.readthedocs.org/en/latest/ or http://pythonhosted.org/pyserial/ .

Contents:

Biblioteca PySerial

```
>> from serial import Serial

>> meu_serial = Serial("/dev/serial0", baudrate=9600,
timeout=0.01)

>> texto = "Olá!" + "\n"
>> meu_serial.write(texto.encode("UTF-8"))
```

```
>> while True:
...     retorno = meu_serial.readline()
...     if retorno != "":
...         texto_recebido = retorno.decode().strip()
...         print(texto_recebido)
```

Código Serial no Raspberry Pi

Resumo da Opera

Funcionalidade	Comandos

Sensor Ótico	`int sensor = A11; pinMode(sensor, INPUT);`
	`digitalRead(sensorOtico) == LOW // superfície é clara?`
	`int valorAnalogico = analogRead(sensorOtico);`

Shield Motor
acessar documentação
	`#include <AFMotor.h>`
	`AF_DCMotor motorA(1); AF_DCMotor motorB(2);`
	`motorA.setSpeed(255); motorB.setSpeed(128);`
	`motorA.run(FORWARD); motorB.run(BACKWARD);`
	`motorA.run(RELEASE);`

Strings
acessar documentação
	`String texto = "Oi!", trecho = texto.substring(0, 3);`
	`String texto1 = String(numero), texto2 = "aaa" + texto2;`
	`int numero2 = texto2.toInt() + 2;`
	`texto2 == texto3; bool comecaCom = texto.startsWith("Olá");`
	`texto.trim(); texto.replace("a", "A");`

Serial no Arduino
acessar documentação
	`Serial.begin(9600); Serial1.begin(9600);`
	`Serial.setTimeout(10);`
	`Serial.print("Olá"); Serial1.println(2);`
	`String texto = Serial.readString().trim();`

PySerial
acessar documentação
	`from serial import Serial`
	`meu_serial = Serial("/dev/serial0", baudrate=9600)`
	`texto = "Olá!" + "\n"`
	`meu_serial.write( texto.encode("UTF-8") )`
	`texto_recebido = meu_serial.readline().decode().strip()`

Resumo para o Projeto 09

Funcionalidade	Comandos

Leitura Analógica
acessar documentação
	`int potenciometro = A10;`
	`pinMode(potenciometro, INPUT);`
	`int valorAnalogico = analogRead(potenciometro);`
	`int valorMapeado = map(valorAnalogico, 0, 1023, min, max);`

Servomotor
acessar documentação
	`#include <Servo.h>`
	`Servo servo;`
	`servo.attach(pino); servo.detach();`
	`servo.write(anguloEmGraus);`

Braço Mecânico
acessar documentação
	`#include <meArm.h>`
	`int base = 12, ombro = 11, cotovelo = 10, garra = 9;`
	`meArm braco(`
	`180, 0, -pi/2, pi/2, // ângulos da base`
	`135, 45, pi/4, 3*pi/4, // ângulos do ombro`
	`180, 90, 0, -pi/2, // ângulos do cotovelo`
	`30, 0, pi/2, 0 // ângulos da garra`
	`);`
	`braco.begin(base, ombro, cotovelo, garra);`
	`braco.goDirectlyTo(x, y, z); braco.gotoPoint(x, y, z);`
	`braco.openGripper(); braco.closeGripper();`
	`braco.getX(); braco.getY(); braco.getZ(); braco.end();`

EEPROM
acessar documentação
	`#include <EEPROM.h>`
	`EEPROM.get(endereco, minhaVariavel);`
	`EEPROM.put(endereco, minhaVariavel);`

Resumo para o Projeto 08

Funcionalidade	Comandos

Campainha Passiva
acessar documentação
	`int campainhaPassiva = 5;`
	`pinMode(campainhaPassiva, OUTPUT);`
	`int frequencia = 220; int duracaoEmMs = 500;`
	`tone(campainhaPassiva, frequencia);`
	`tone(campainhaPassiva, frequencia, duracaoEmMs);`
	`noTone(campainhaPassiva);`

Interrupção
acessar documentação
	`int sensorDeSom = 19;`
	`pinMode(sensorDeSom, INPUT);`
	`int origem = digitalPinToInterrupt(sensorDeSom);`
	`attachInterrupt(origem, minhaFuncao, RISING);`

Contagem de Tempo
acessar documentação
	`unsigned long instanteAnteriorDeDeteccao = 0;`
	
	`if (millis() > instanteAnteriorDeDeteccao + 10) {`
	`  instanteAnteriorDeDeteccao = millis();`
	`}`

Encoder Rotativo
acessar documentação
	`#include <RotaryEncoder.h>`
	`RotaryEncoder encoder(20, 21);`
	`attachInterrupt(digitalPinToInterrupt(20), funcao, CHANGE);`
	`attachInterrupt(digitalPinToInterrupt(21), funcao, CHANGE);`
	`encoder.tick(); int posicao = encoder.getPosition();`

Resumo para o Projeto 07

Funcionalidade	Comandos

Revisão de C++	`int inteiro = 2; float decimal = 4.5; bool booleano = true;`
	`char texto[] = "Olá"; int listaDeInteiros[] = {1, 2, 3, 4};`
	`if (x > 0 && y > 0) { z = 1; }`
	`else if (x < 0 || y < 0) { z = 2; }`
	`for (int i = 0; i < 5; i++) { Serial.println(i); }`
	`float soma (float x) { return x + 2; }`

Print Serial	`Serial.begin(9600); Serial.println("Olá"); Serial.println(2);`

Escrita/Leitura
acessar documentação
	`int led = 13; pinMode(led, OUTPUT); digitalWrite(led, LOW);`
	`int campainha = 3; digitalWrite(campainha, HIGH);`
	`int botao = A1; pinMode(led, INPUT); digitalRead(botao) == LOW`

GFButton
acessar documentação
	`#include <GFButton.h>`
	`GFButton botao(A1); botao.isPressed(); botao.process();`
	`botao.setPressHandler(funcao); botao.setReleaseHandler(funcao);`

ShiftDisplay
acessar documentação
	`#include <ShiftDisplay.h>`
	`ShiftDisplay display(4, 7, 8, COMMON_ANODE, 4, true);`
	`ShiftDisplay display(4, 7, 8, COMMON_CATHODE, 4, true);`
	`display.set(1234); display.set(4.21, 2); display.set("Erro");`
	`display.update(); display.show(1000);`

Timer1 acessar documentação	`#include <TimerOne.h>` `Timer1.initialize(1000000); Timer1.attachInterrupt(funcao);`

Resumo para o Projeto 06