OFICINA DE INTERNET DAS COISAS

DBSERVER

DBLAB

A OFICINA

IMERSÃO NO **COTIDIANO** DO LAB

TECNOLOGIAS PARA INTERNET DAS COISAS

PROGRAMAÇÃO DE SISTEMAS EMBARCADOS

MONTAGEM DE **PROTÓTIPOS**

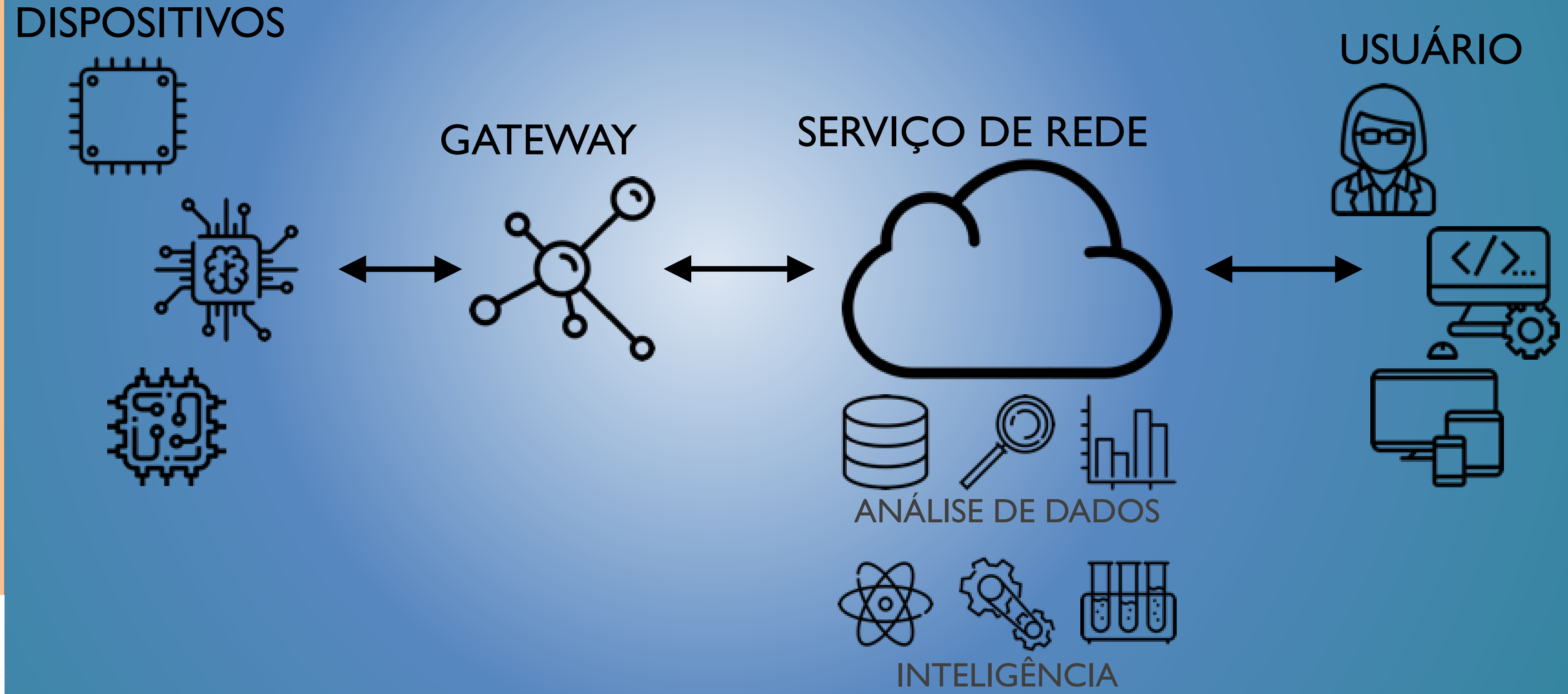
PALESTRA

UBILAB

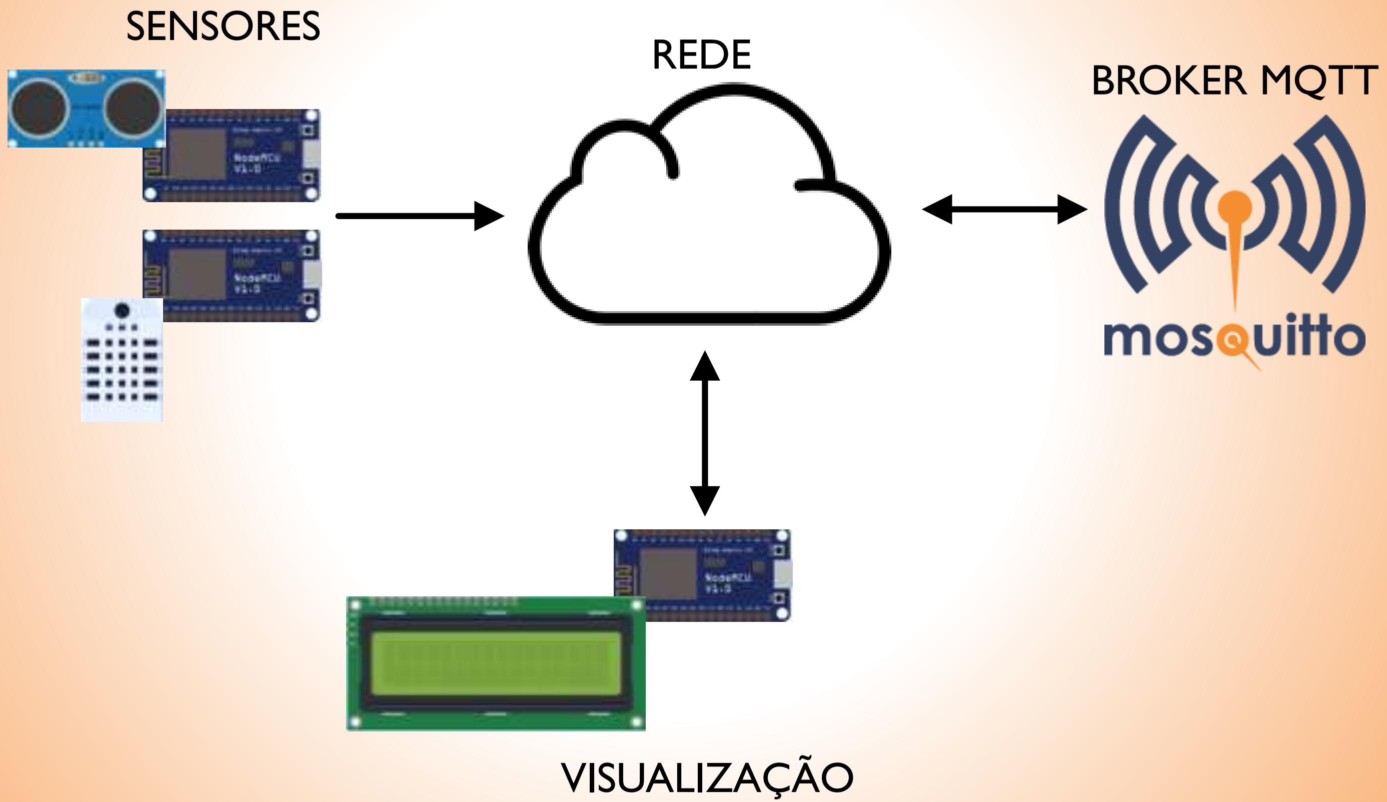
Prof. Eduardo Pellanda:

“Cidade que sente”

ARQUITETURA PARA IOT

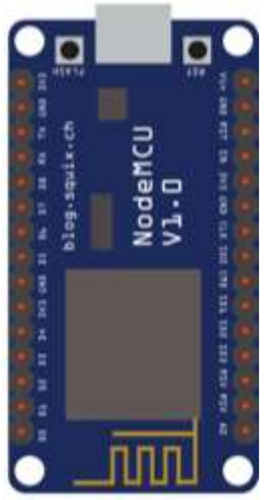


A OFICINA

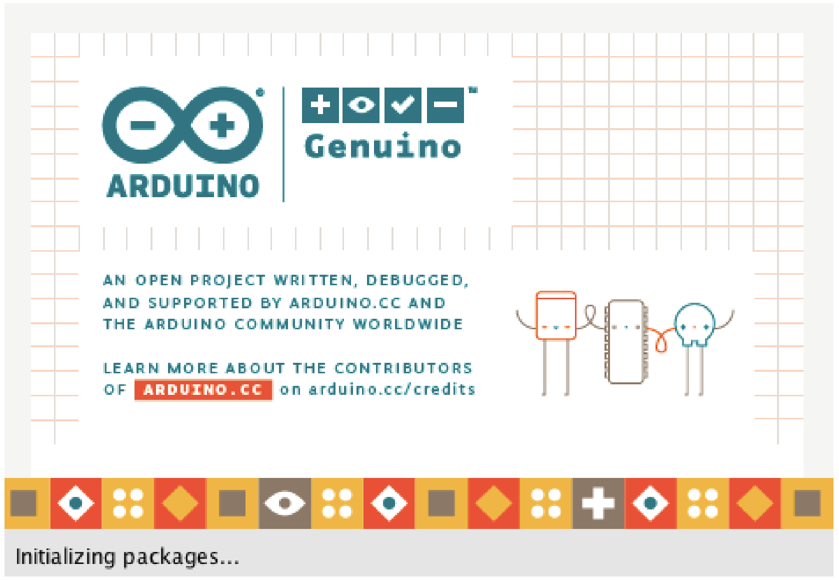


A OFICINA

PLATAFORMAS PARA DESENVOLVIMENTO DE PROTÓTIPOS



ESP8266
WI-FI



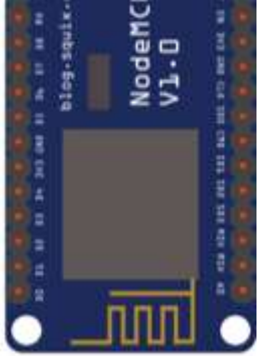
AN OPEN PROJECT WRITTEN, DEBUGGED, AND SUPPORTED BY ARDUINO.CC AND THE ARDUINO COMMUNITY WORLDWIDE

LEARN MORE ABOUT THE CONTRIBUTORS OF ARDUINO.CC on arduino.cc/credits

Initializing packages...

AMBIENTE ARDUINO

A OFICINA



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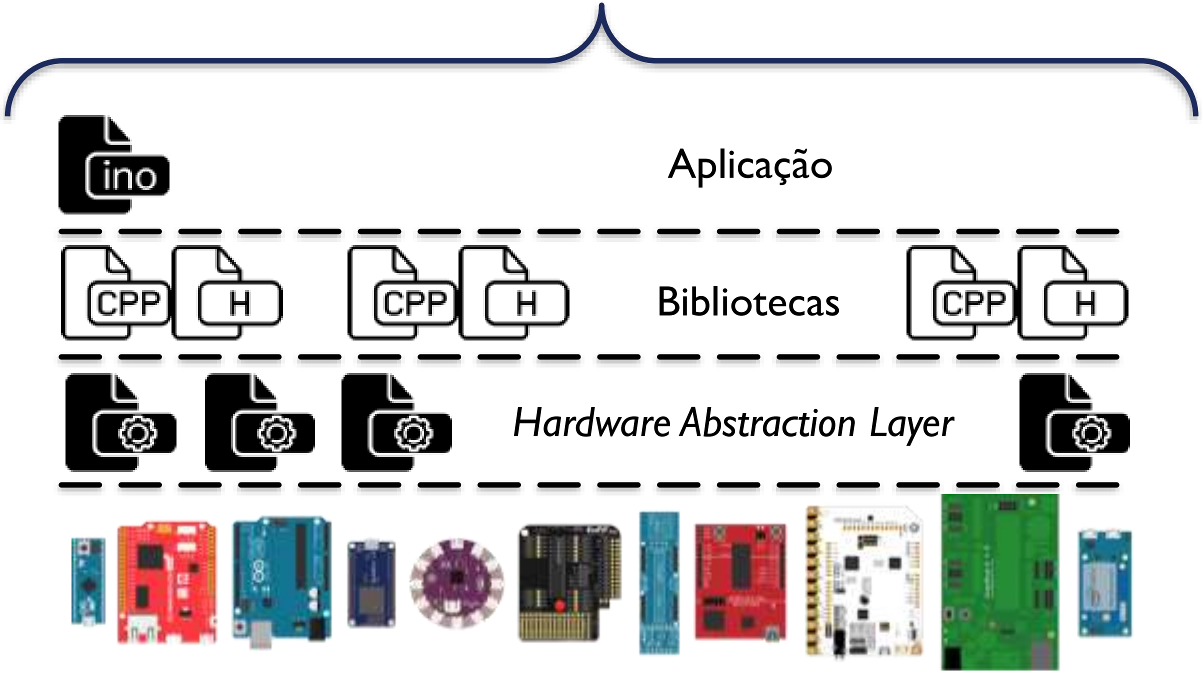
Initializing packages...



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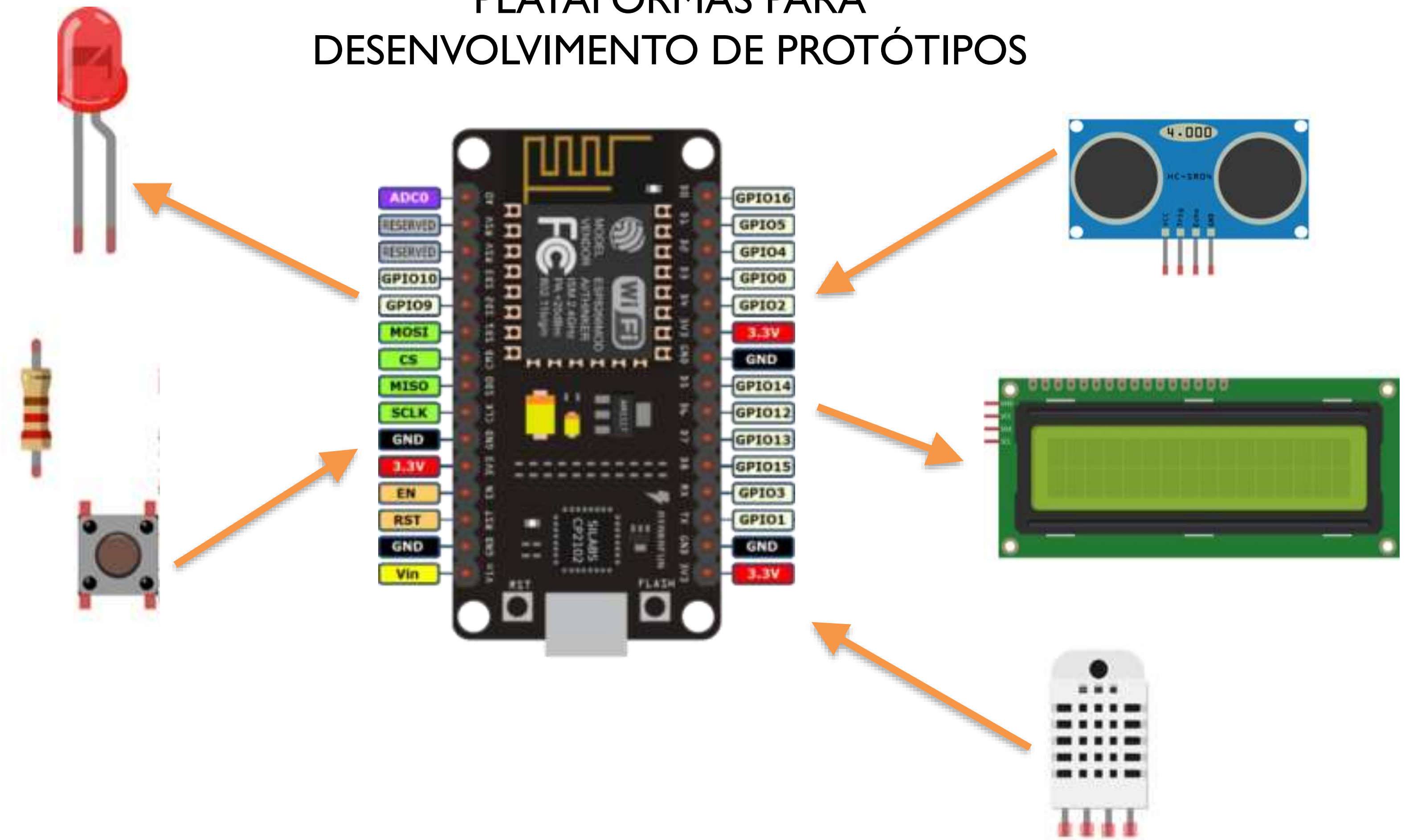
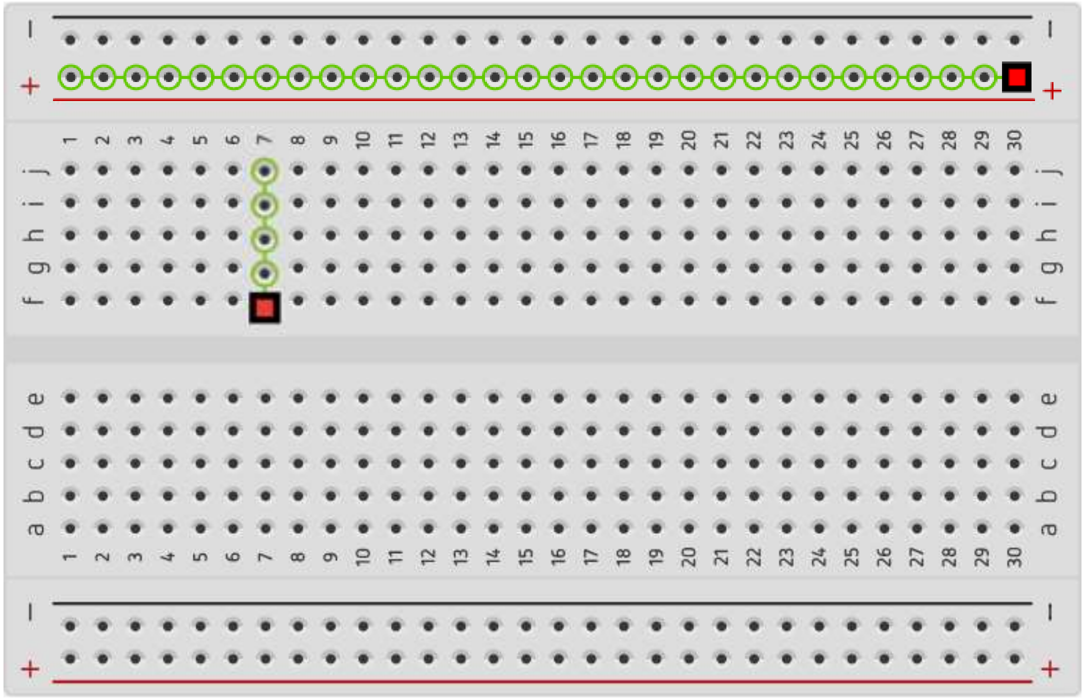
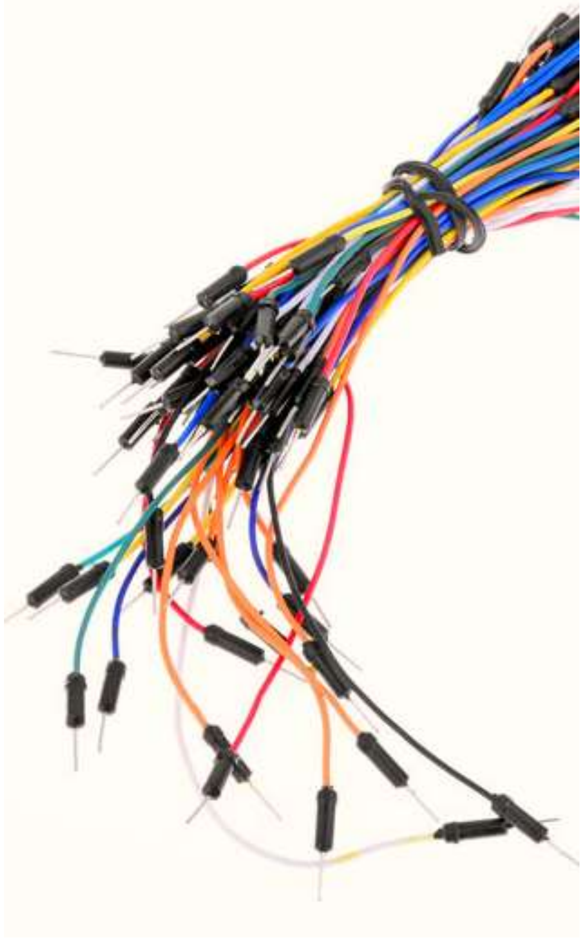
PLATAFORMAS PARA DESENVOLVIMENTO DE PROTÓTIPOS



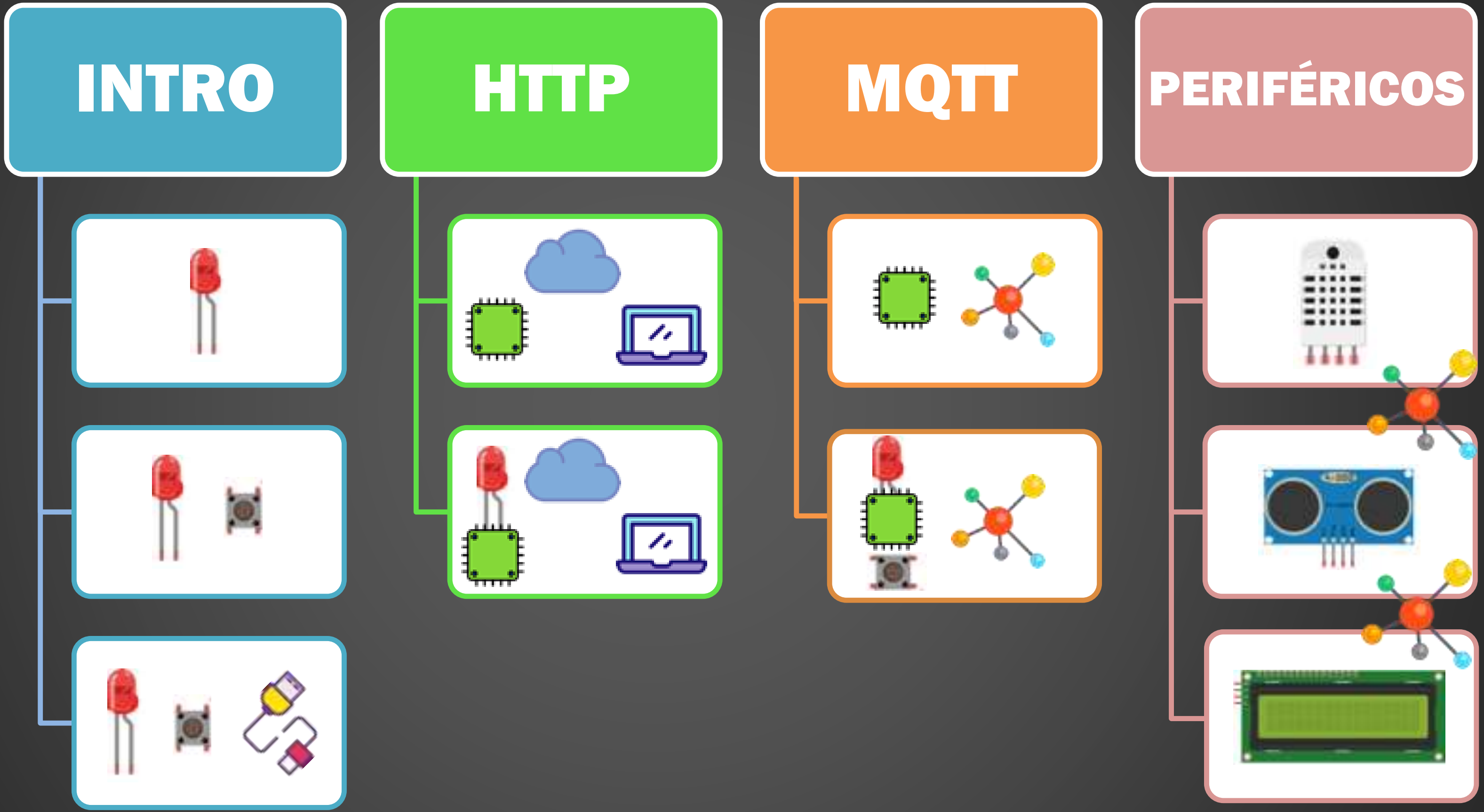
A OFICINA

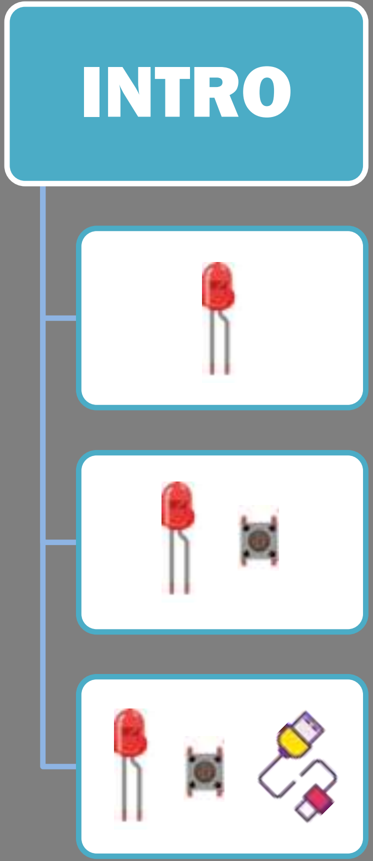
PROTOBOARD





VAMOS COMEÇAR!



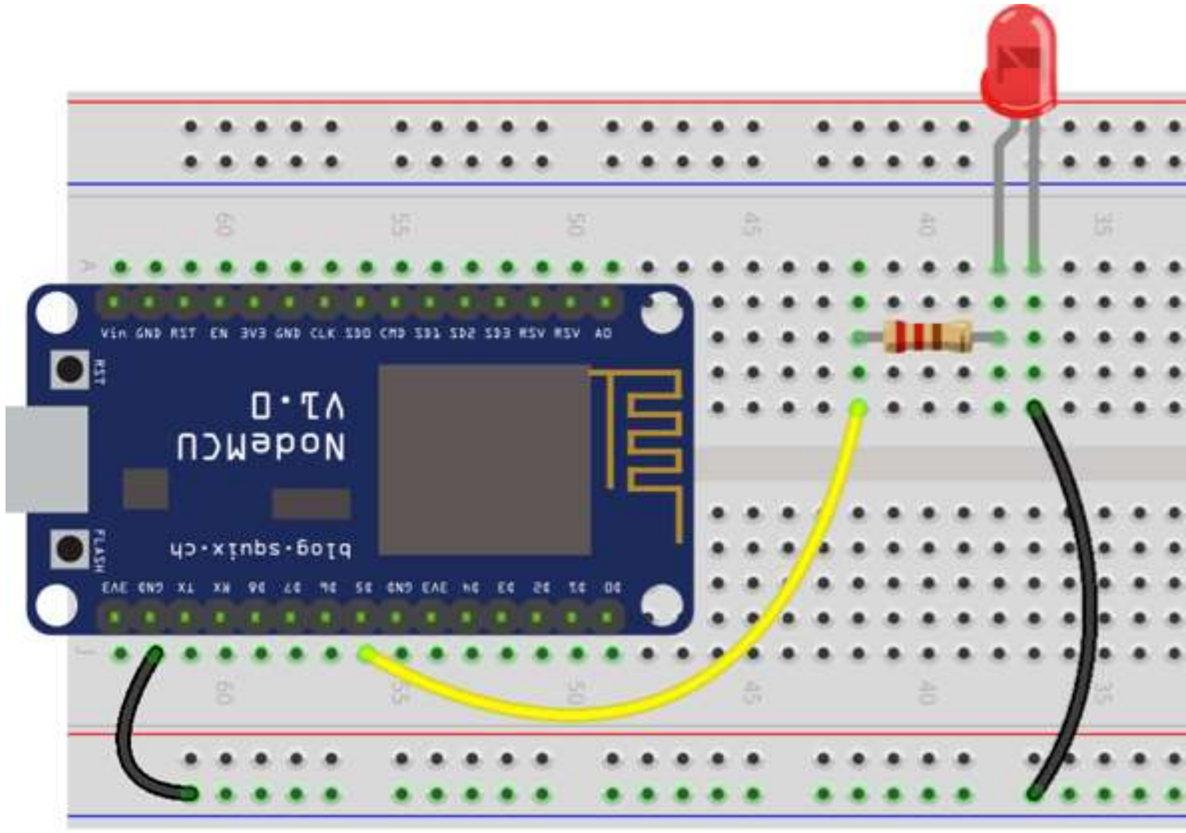


- Introdução à plataforma de desenvolvimento
- Componentes básicos
- Funções básicas

LED

INTRO

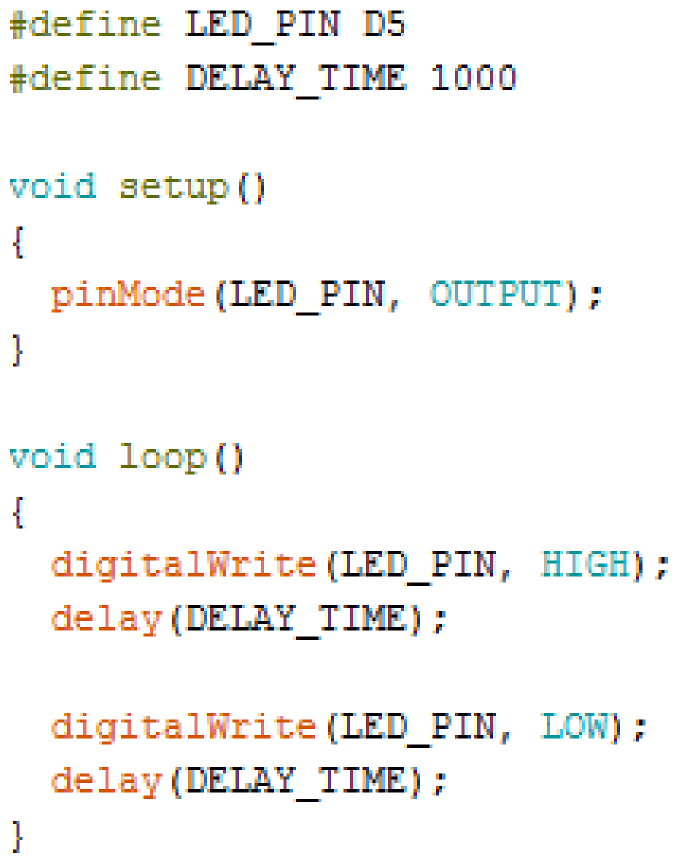
Acionamento de um LED pela placa


Vin GND RST EN 3V3 GND CLK SDO CMD SD1 SD2 SD3 RSV RSV A0
V1.0
NodeMCU
blog.squix.ch
3V3 GND TX RX D8 D7 D6 D5 GND 3V3 D4 D3 D2 D1 D0
RST
FLASH

LED

INTRO

Acionamento de um LED pela placa

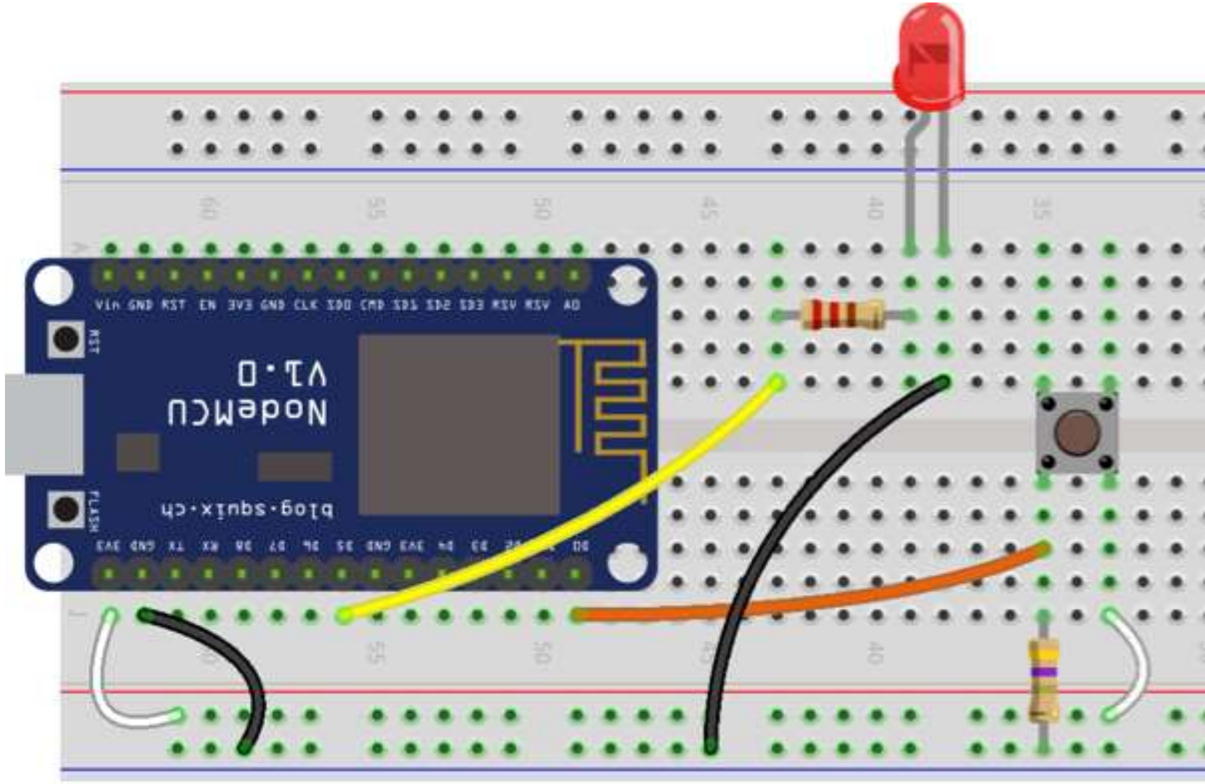


```
#define LED_PIN D5
#define DELAY_TIME 1000

void setup()
{
  pinMode(LED_PIN, OUTPUT);
}

void loop()
{
  digitalWrite(LED_PIN, HIGH);
  delay(DELAY_TIME);

  digitalWrite(LED_PIN, LOW);
  delay(DELAY_TIME);
}
```

LED E BOTÃO

INTRO

Botão para acionar o LED



Vin GND RST EN 3V3 GND CLK SDO CMD SD1 SD2 SD3 RSV RSV A0
RST
V1.0
NodeMCU
blog.squix.ch
FLASH
3V3 GND TX RX D8 D7 D6 D5 GND 3V3 D4 D3 D2 D1 D0

INTRO

Botão para acionar o LED

```
#define LED_PIN D5
#define BUTTON_PIN D0

void setup()
{
  pinMode(LED_PIN, OUTPUT);

  /* TODO: Configure o pino do botão como uma entrada. */
}

void loop()
{
  bool buttonState = digitalRead(BUTTON_PIN);

  digitalWrite(LED_PIN, buttonState);

  delay(10);

}
```

LED E BOTÃO

INTRO

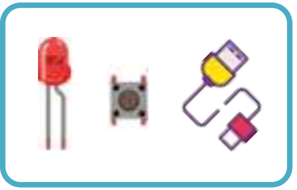
Botão para acionar o LED

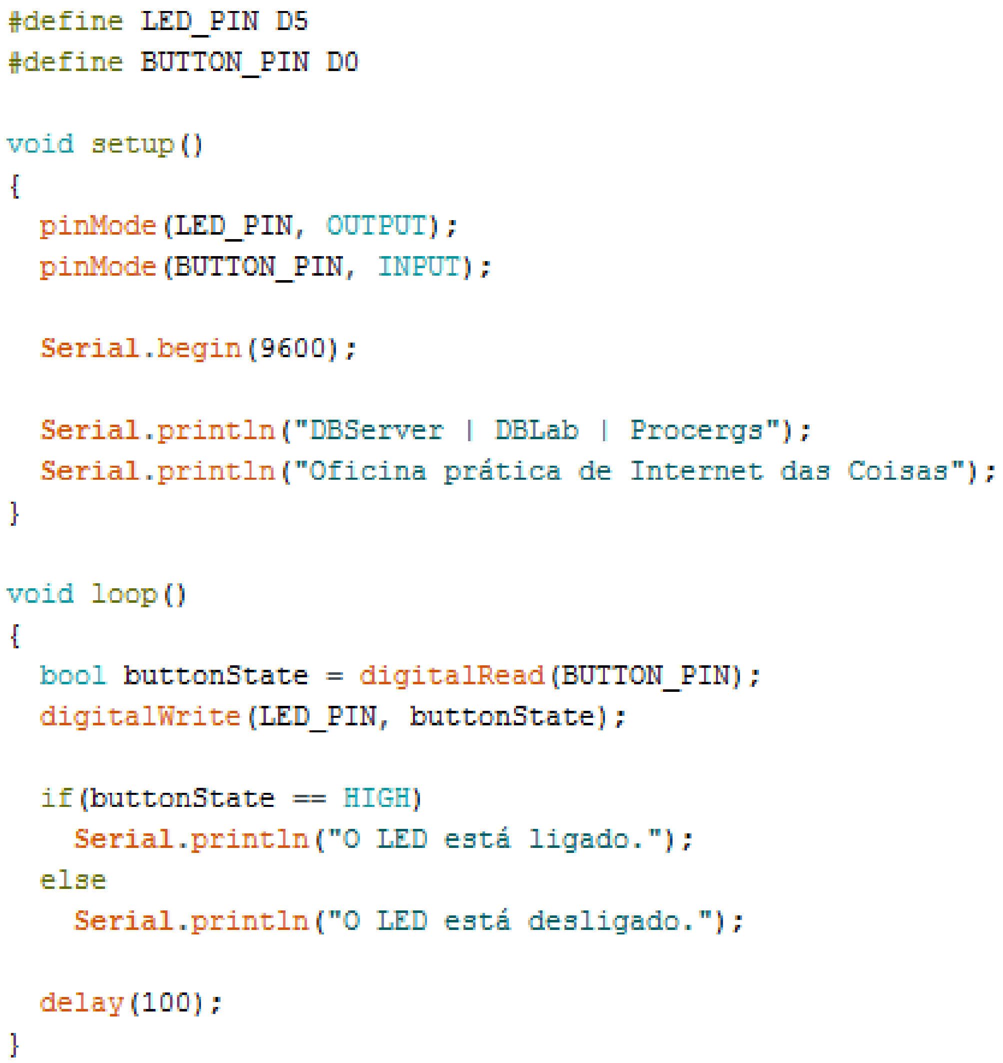
```
#define LED_PIN D5
#define BUTTON_PIN D0

void setup()
{
  pinMode(LED_PIN, OUTPUT);

  pinMode(BUTTON_PIN, INPUT);
}

void loop()
{
  bool buttonState = digitalRead(BUTTON_PIN);

  digitalWrite(LED_PIN, buttonState);

  delay(10);
}
```

PORTA SERIAL

INTRO

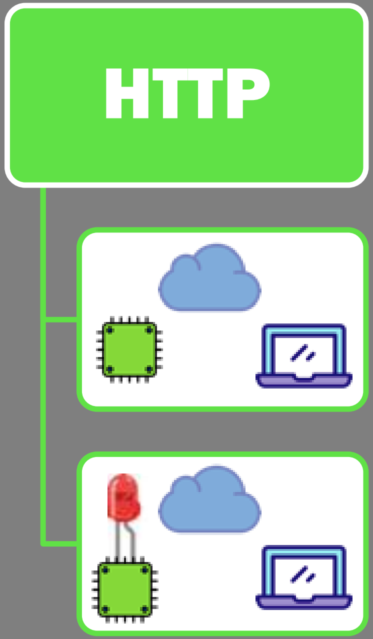
Comunicação serial com o PC





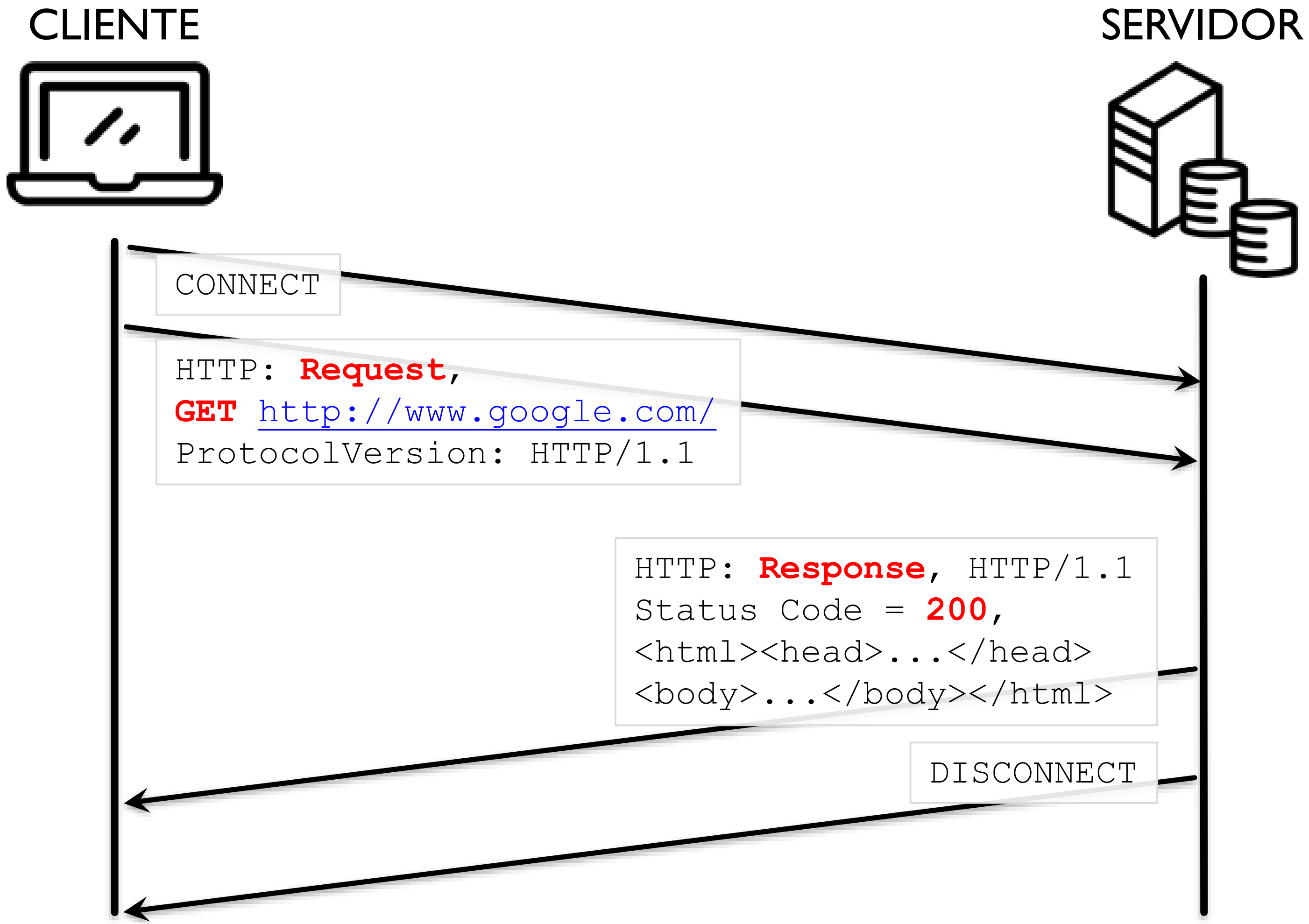
```
#define LED_PIN D5
#define BUTTON_PIN D0

void setup()
{
  pinMode(LED_PIN, OUTPUT);
  pinMode(BUTTON_PIN, INPUT);

  Serial.begin(9600);

  Serial.println("DBServer | DBLab | Procergs");
  Serial.println("Oficina prática de Internet das Coisas");
}

void loop()
{
  bool buttonState = digitalRead(BUTTON_PIN);
  digitalWrite(LED_PIN, buttonState);

  if(buttonState == HIGH)
    Serial.println("O LED está ligado.");
  else
    Serial.println("O LED está desligado.");

  delay(100);
}
```

COMUNICAÇÃO HTTP



- Serviço HTTP
- Conectividade Wi-Fi
- Controle de um LED pela Internet

COMUNICAÇÃO HTTP

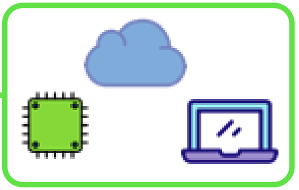


```
HTTP: Request,
GET http://www.google.com/
ProtocolVersion: HTTP/1.1
```

```
HTTP: Response, HTTP/1.1
Status Code = 200,
<html><head>...</head>
<body>...</body></html>
```

CLIENTE WI-FI

HTTP

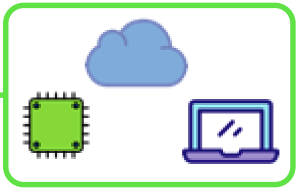


Serviço HTTP via Wi-Fi

```
#include <ESP8266WebServer.h>
#include "wifi.h"

ESP8266WebServer server(80);

WFclass wifi;

void setup(void)
{
  Serial.begin(9600);

  wifi.setup();

  server.on("/", handleRoot);

  server.begin();
}

void loop(void)
{
  server.handleClient();
}

void handleRoot()
{
  server.send(200, "text/plain", "Ola Procergs! ;)");
}
```

CLIENTE WI-FI

HTTP

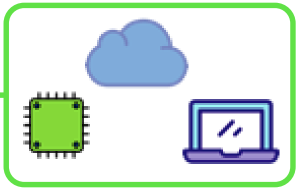


Serviço HTTP via Wi-Fi

```
#include <ESP8266WiFi.h>
#include <WiFiClient.h>

class WFclass
{
    public:
      WFclass();
      void setup();

    private:
      /* TODO: Informe aqui o nome e senha da rede
       *   Wi-Fi disponivel. */
      const char* c_ssid = "";
      const char* c_pass = "";

      int status;
};
```

CLIENTE WI-FI

HTTP

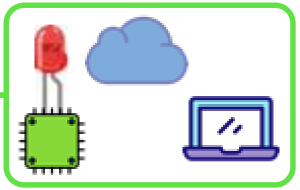


Serviço HTTP via Wi-Fi

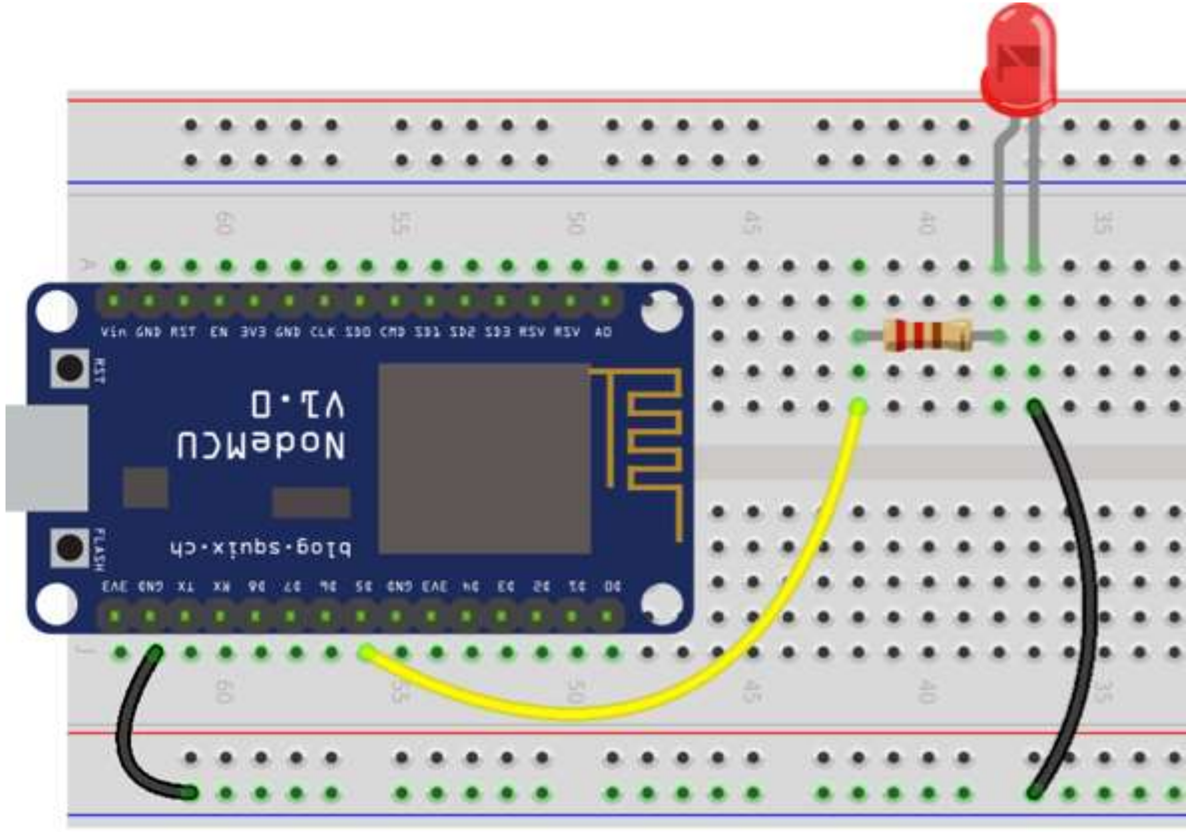
```
#include <ESP8266WiFi.h>
#include <WiFiClient.h>

class WFclass
{
    public:
      WFclass();
      void setup();

    private:
      const char* c_ssid = "DBDevices";
      const char* c_pass = "!mP@db@dM";

      int status;
};
```

WEB SERVER E LED

HTTP

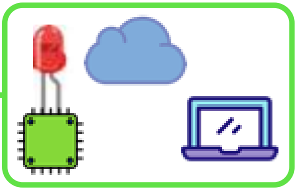


Controle de um LED pela web

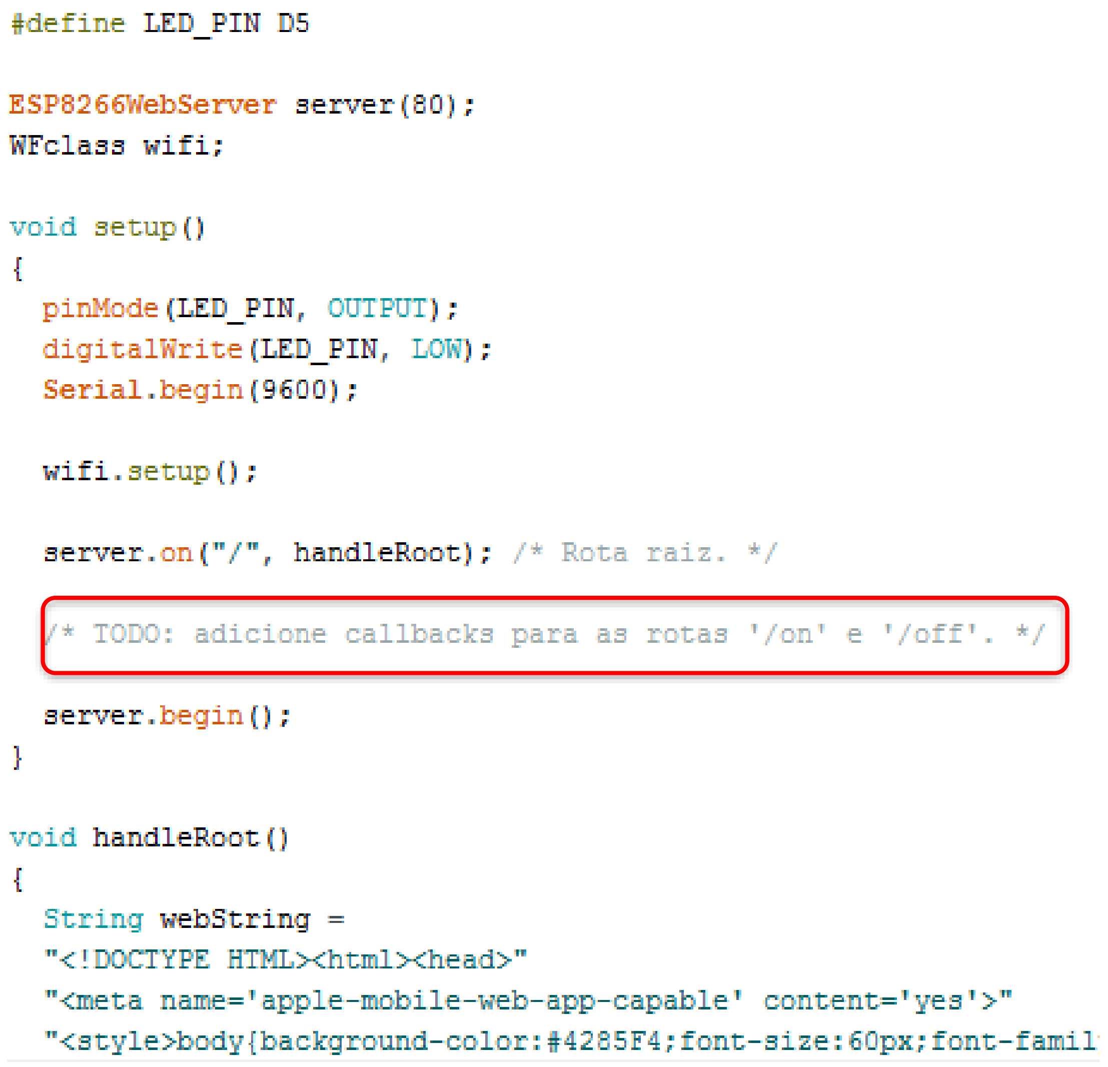

Vin GND RST EN 3V3 GND CLK SDO CMD SD1 SD2 SD3 RSV RSV A0
RST
V1.0
NodeMCU
FLASH
blog.squix.ch
3V3 GND TX RX D8 D7 D6 D5 GND 3V3 D4 D3 D2 D1 D0

WEB SERVER E LED

HTTP



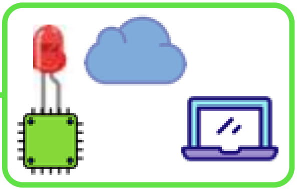
Controle de um LED pela web



```
#define LED_PIN D5

ESP8266WebServer server(80);
WFclass wifi;

void setup()
{
  pinMode(LED_PIN, OUTPUT);
  digitalWrite(LED_PIN, LOW);
  Serial.begin(9600);

  wifi.setup();

  server.on("/", handleRoot); /* Rota raiz. */

  /* TODO: adicione callbacks para as rotas '/on' e '/off'. */

  server.begin();
}

void handleRoot()
{
  String webString =
  "<!DOCTYPE HTML><html><head>"
  "<meta name='apple-mobile-web-app-capable' content='yes'>"
  "<style>body{background-color:#4285F4;font-size:60px;font-famil
```

WEB SERVER E LED

HTTP

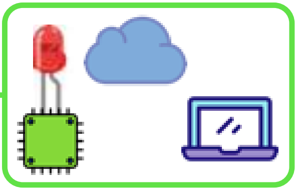


Controle de um LED pela web

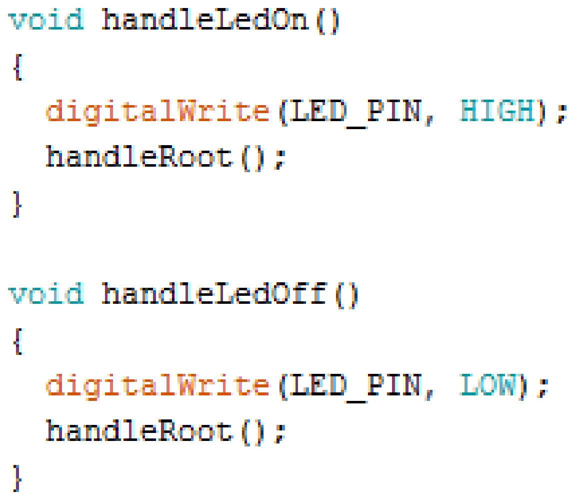
```
#define LED_PIN D5

ESP8266WebServer server(80);
WFclass wifi;

void setup()
{
  pinMode(LED_PIN, OUTPUT);
  digitalWrite(LED_PIN, LOW);
  Serial.begin(9600);

  wifi.setup();

  server.on("/", handleRoot);
  server.on("/on", handleLedOn);
  server.on("/off", handleLedOff);

  server.begin();
  Serial.println("Servidor HTTP rodando...");
}

void handleRoot()
{
  String webString =
  "<!DOCTYPE HTML><html><head>"
  "<meta name='apple-mobile-web-app-capable' content='yes'>"
```

WEB SERVER E LED

HTTP

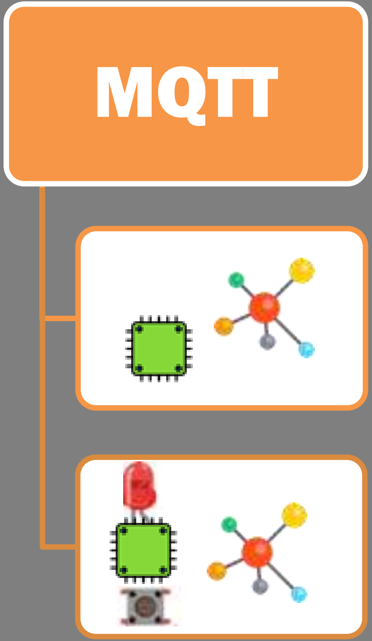


Controle de um LED pela web



```
void handleLedOn()
{
  digitalWrite(LED_PIN, HIGH);
  handleRoot();
}

void handleLedOff()
{
  digitalWrite(LED_PIN, LOW);
  handleRoot();
}
```

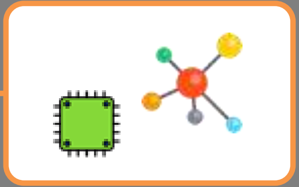
COMUNICAÇÃO MQTT

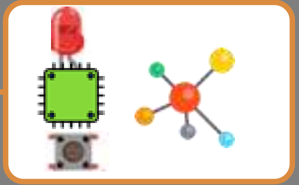


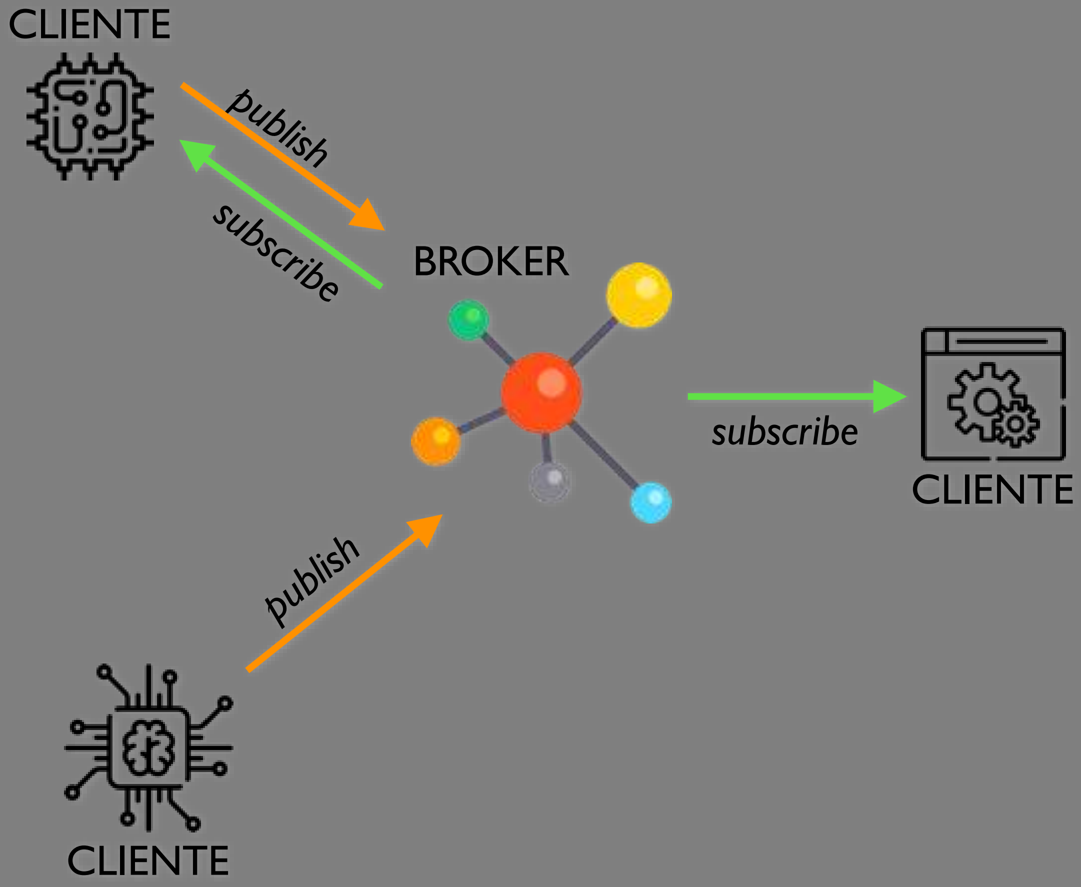
- Arquitetura *publish/subscribe*
- Publicação de mensagens em um *broker* público

COMUNICAÇÃO MQTT

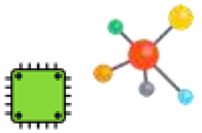
MQTT







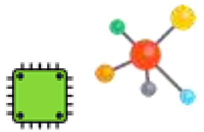
MQTT



Cliente MQTT simples

```
WFclass wifi;
ESP8266PubSubClient mqttClient;
int value = 0;
long lastTimeMsg = 0;

void setup()
{
  Serial.begin(9600);
  wifi.setup();
  mqttClient.setup();
  mqttClient.connect();
}

void loop()
{
  if(!mqttClient.connected()) mqttClient.connect();
  mqttClient.loop();

  long now = millis();
  if (now - lastTimeMsg > 2000) {
    lastTimeMsg = now;
    ++value;
    String message("Hello World! #");
    message += String(value, DEC);
    mqttClient.publish(MQTT_OUT_TOPIC, message.c_str());
    Serial.println("Mensagem publicada: " + message);
  }
}
```

MQTT

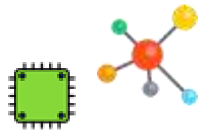


Cliente MQTT simples

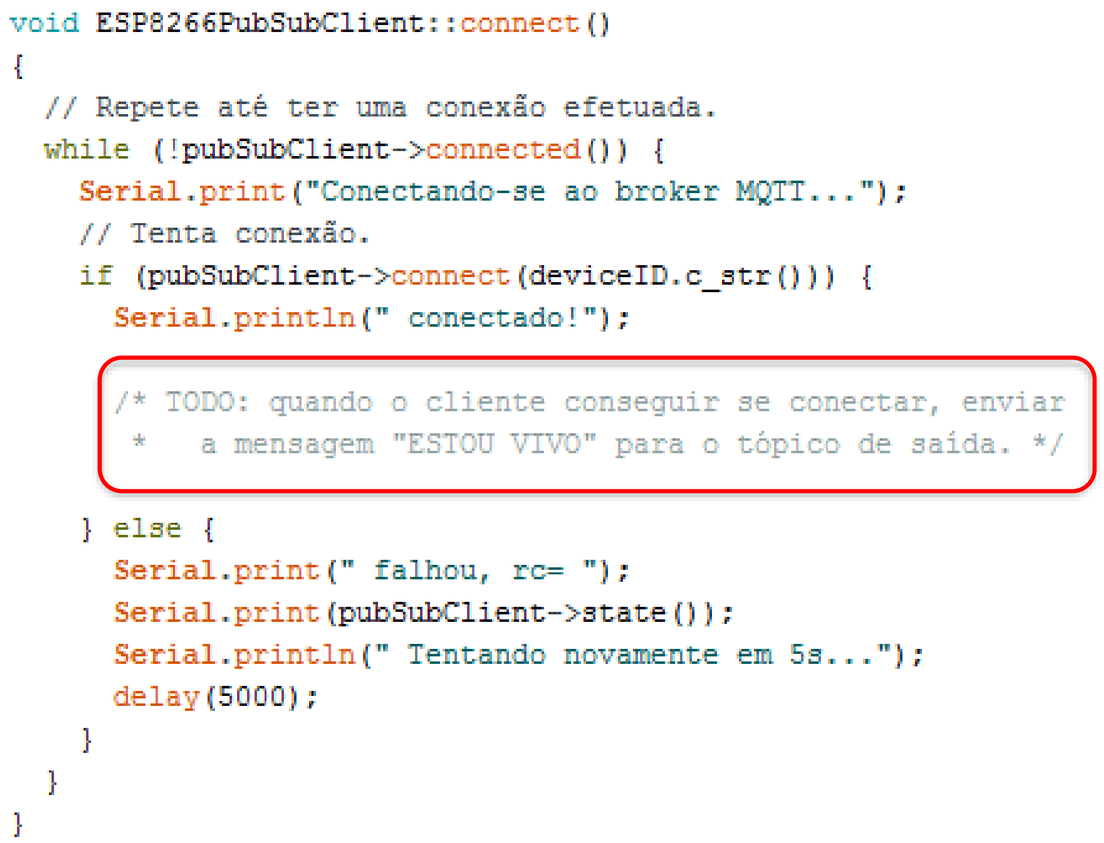
```
ESP8266PubSubClient::ESP8266PubSubClient()
{
  pubSubClient = new PubSubClient(wifiClient);
  byte mac[6];
  WiFi.macAddress(mac);
  deviceID = String(mac[0],HEX)+String(mac[1],HEX)+String(mac[2],HEX)+
             String(mac[3],HEX)+String(mac[4],HEX)+String(mac[5],HEX);
}

void ESP8266PubSubClient::setup()
{
  pubSubClient->setServer(mqtt_server, mqtt_server_port);
}

void ESP8266PubSubClient::setCallback(MQTT_CALLBACK_SIGNATURE)
{
  pubSubClient->setCallback(callback);
}

boolean ESP8266PubSubClient::publish(const char* topic,
                                     const char* payload)
{
  return pubSubClient->publish(topic, payload);
}
```

MQTT

MQTT



Cliente MQTT simples



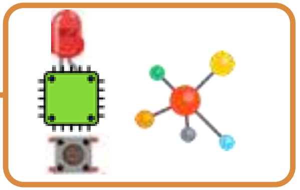
```
void ESP8266PubSubClient::connect()
{
  // Repete até ter uma conexão efetuada.
  while (!pubSubClient->connected()) {
    Serial.print("Conectando-se ao broker MQTT...");
    // Tenta conexão.
    if (pubSubClient->connect(deviceID.c_str())) {
      Serial.println(" conectado!");

      /* TODO: quando o cliente conseguir se conectar, enviar
       *   a mensagem "ESTOU VIVO" para o tópico de saída. */

    } else {
      Serial.print(" falhou, rc= ");
      Serial.print(pubSubClient->state());
      Serial.println(" Tentando novamente em 5s...");
      delay(5000);
    }
  }
}
```

MQTT

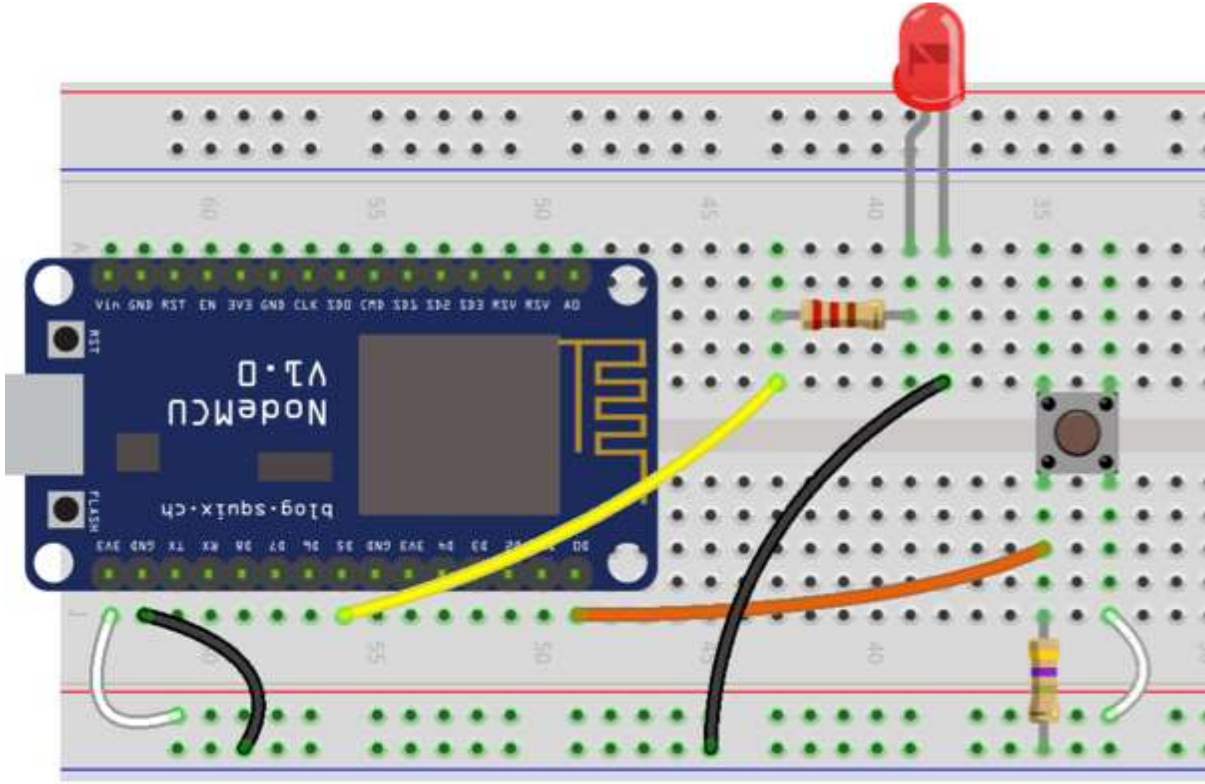
Cliente MQTT simples

```
void ESP8266PubSubClient::connect()
{
  // Repete até ter uma conexão efetuada.
  while (!pubSubClient->connected()) {
    Serial.print("Conectando-se ao broker MQTT...");
    // Tenta conexão.
    if (pubSubClient->connect(deviceID.c_str())) {
      Serial.println(" conectado!");

      pubSubClient->publish(MQTT_OUT_TOPIC, "ESTOU VIVO!");

    } else {
      Serial.print(" falhou, rc= ");
      Serial.print(pubSubClient->state());
      Serial.println(" Tentando novamente em 5s...");
      delay(5000);
    }
  }
}
```

MQTT



Cliente MQTT
pub/sub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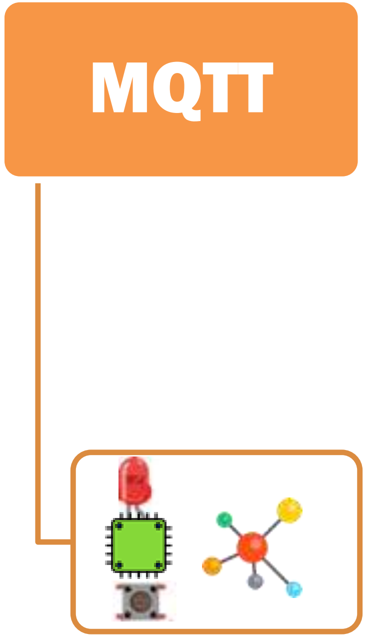
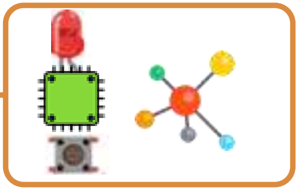
RST
FLASH
NodeMCU
V1.0
blog.squix.ch
3V3 GND TX RX D8 D7 D6 D5 GND 3V3 D4 D3 D2 D1 D0



Cliente MQTT pub/sub

```
#define LED_PIN D5
#define BUTTON_PIN D0

WFclass wifi;
ESP8266PubSubClient mqttClient;

int currentButtonState = LOW;

void setup()
{
  Serial.begin(9600);

  pinMode(BUTTON_PIN, INPUT);
  digitalWrite(BUTTON_PIN, LOW);

  pinMode(LED_PIN, OUTPUT);
  digitalWrite(LED_PIN, LOW);

  wifi.setup();
  mqttClient.setup();
  mqttClient.connect();

  mqttClient.setCallback(callback);
}
```

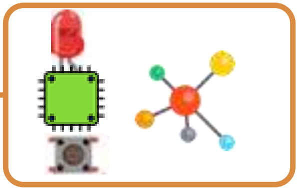
MQTT



Cliente MQTT pub/sub

```
void callback(char *topic, byte *payload, unsigned int length)
{
  char message[length+1];
  memcpy(message, payload, length);
  message[length]=0;

  Serial.print("Mensagem recebida: ");
  Serial.println(message);

  if(!strncmp(message, "on", 2))
  {
    digitalWrite(LED_PIN, HIGH);
    Serial.println("O LED está ligado!");
  }
  else if(!strncmp(message, "off", 3))
  {
    digitalWrite(LED_PIN, LOW);
    Serial.println("O LED está desligado!");
  }
}
```

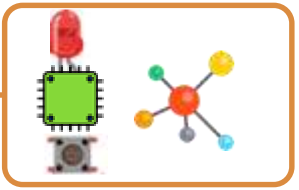
MQTT



Cliente MQTT pub/sub

```
void loop()
{
  if(!mqttClient.connected()) mqttClient.connect();
  mqttClient.loop();

  int buttonState = digitalRead(BUTTON_PIN);
  if(buttonState != currentButtonState) {
    delay(50);
    buttonState = digitalRead(BUTTON_PIN);
    if(buttonState != currentButtonState)
    {
      currentButtonState = buttonState;

      String message("Meu botão está ");
      if(buttonState == LOW)
        message += String("desligado.");
      else
        message += String("ligado.");

      mqttClient.publish(MQTT_OUT_TOPIC, message.c_str());

      /* TODO: publique o estado do botão no tópico de entrada,
       *   com mensagens "on" e "off". */

      Serial.println("Mensagem publicada: " + message);
    }
  }
  delay(10);
}
```

MQTT

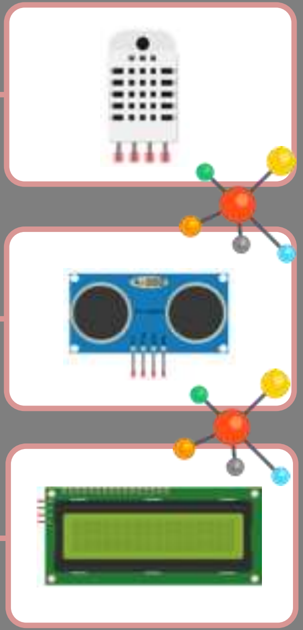


Cliente MQTT pub/sub

```
void loop()
{
  if(!mqttClient.connected()) mqttClient.connect();
  mqttClient.loop();

  int buttonState = digitalRead(BUTTON_PIN);
  if(buttonState != currentButtonState) {
    delay(50);
    buttonState = digitalRead(BUTTON_PIN);
    if(buttonState != currentButtonState)
    {
      currentButtonState = buttonState;

      String message("Meu botão está ");
      if(buttonState == LOW)
        message += String("desligado.");
      else
        message += String("ligado.");

      mqttClient.publish(MQTT_OUT_TOPIC, message.c_str());

      if(buttonState == LOW) mqttClient.publish(MQTT_IN_TOPIC, "off");
      else mqttClient.publish(MQTT_IN_TOPIC, "on");

      Serial.println("Mensagem publicada: " + message);
    }
  }
  delay(10);
}
```

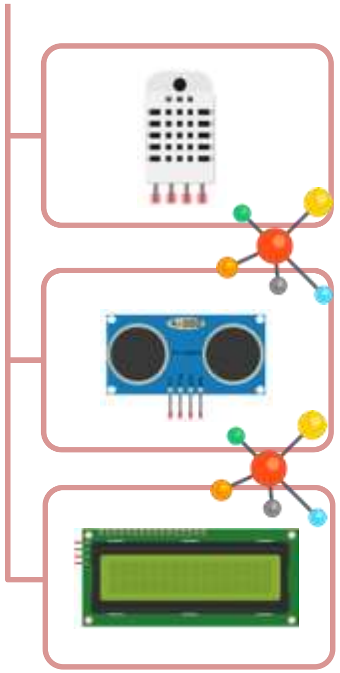
MQTT

PERIFÉRICOS



- Integração com periféricos de entrada e saída
- Comandos e mensagens via MQTT

PERIFÉRICOS



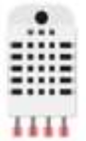
SENSORES:

```
#define MQTT_OUT_TOPIC "dblab/hands-on/mqtt/display"
mqttClient.publish(MQTT_OUT_TOPIC, msg);
```

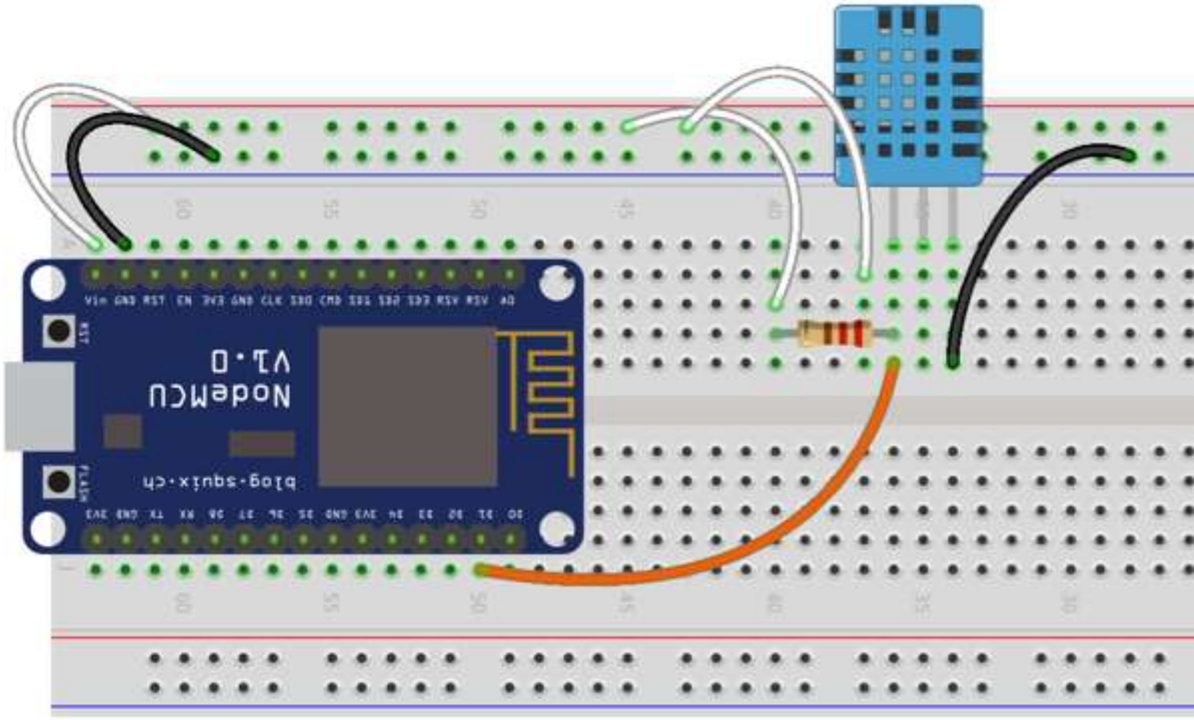
DISPLAY:

```
#define MQTT_IN_TOPIC "dblab/hands-on/mqtt/display"
pubSubClient->subscribe(MQTT_IN_TOPIC);
```

PERIFÉRICOS

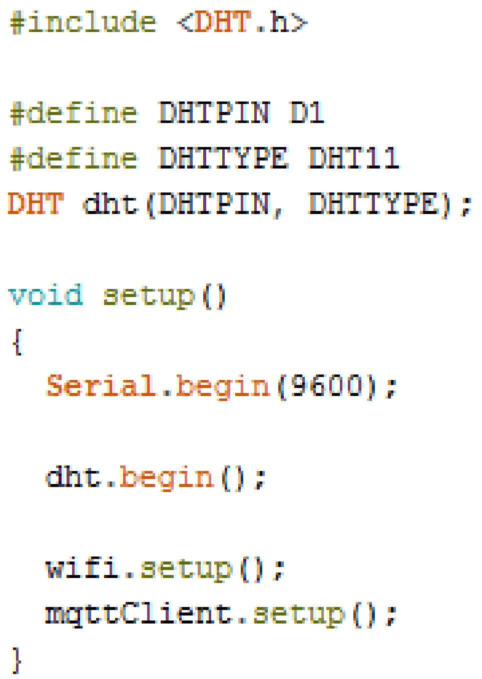


Sensor de temperatura e umidade


Vin GND RST EN 3V3 GND CLK SDO CMD SD1 SD2 SD3 RSV RSV A0
RST
V1.0
NodeMCU
FLASH
blog-squix.ch
3V3 GND TX RX D8 D7 D6 D5 GND 3V3 D4 D3 D2 D1 D0

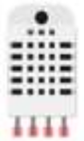
PERIFÉRICOS

Sensor de temperatura e umidade



```
#include <DHT.h>

#define DHTPIN D1
#define DHTTYPE DHT11
DHT dht(DHTPIN, DHTTYPE);

void setup()
{
  Serial.begin(9600);

  dht.begin();

  wifi.setup();
  mqttClient.setup();
}
```

PERIFÉRICOS

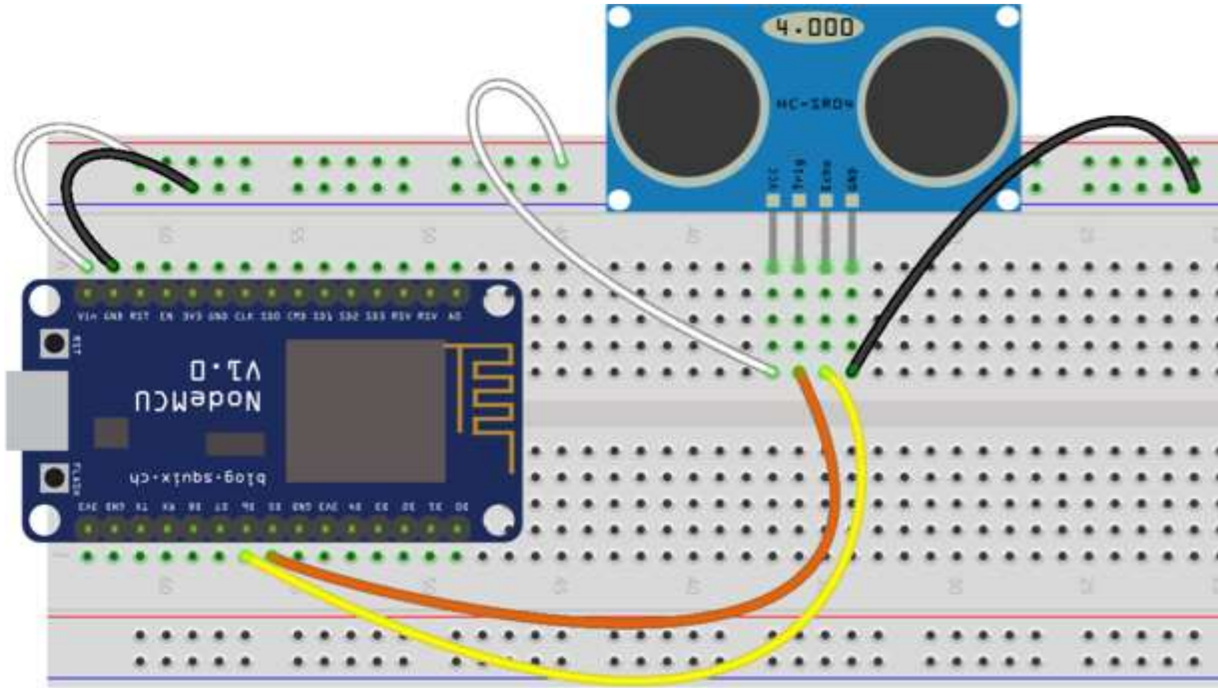


Sensor de temperatura e umidade

```
void loop()
{
  if (!mqttClient.connected()) mqttClient.connect();
  mqttClient.loop();

  float hum = dht.readHumidity();
  float temp = dht.readTemperature();
  Serial.print("Humidity: ");
  Serial.print(hum);
  Serial.print(" %, Temp: ");
  Serial.print(temp);
  Serial.println(" Celsius");

  char humidity[MESSAGE_MAX_SIZE] = "";
  char temperature[MESSAGE_MAX_SIZE] = "";

  snprintf (temperature, MESSAGE_MAX_SIZE, "T: %02dC", (int)temp);
  snprintf (humidity, MESSAGE_MAX_SIZE, "H: %02d%%", (int)hum);

  mqttClient.publish(MQTT_OUT_TOPIC, humidity);
  mqttClient.publish(MQTT_OUT_TOPIC, temperature);
}
```

PERIFÉRICOS

Sensor de distância



PERIFÉRICOS

PERIFÉRICOS

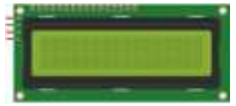
Sensor de distância

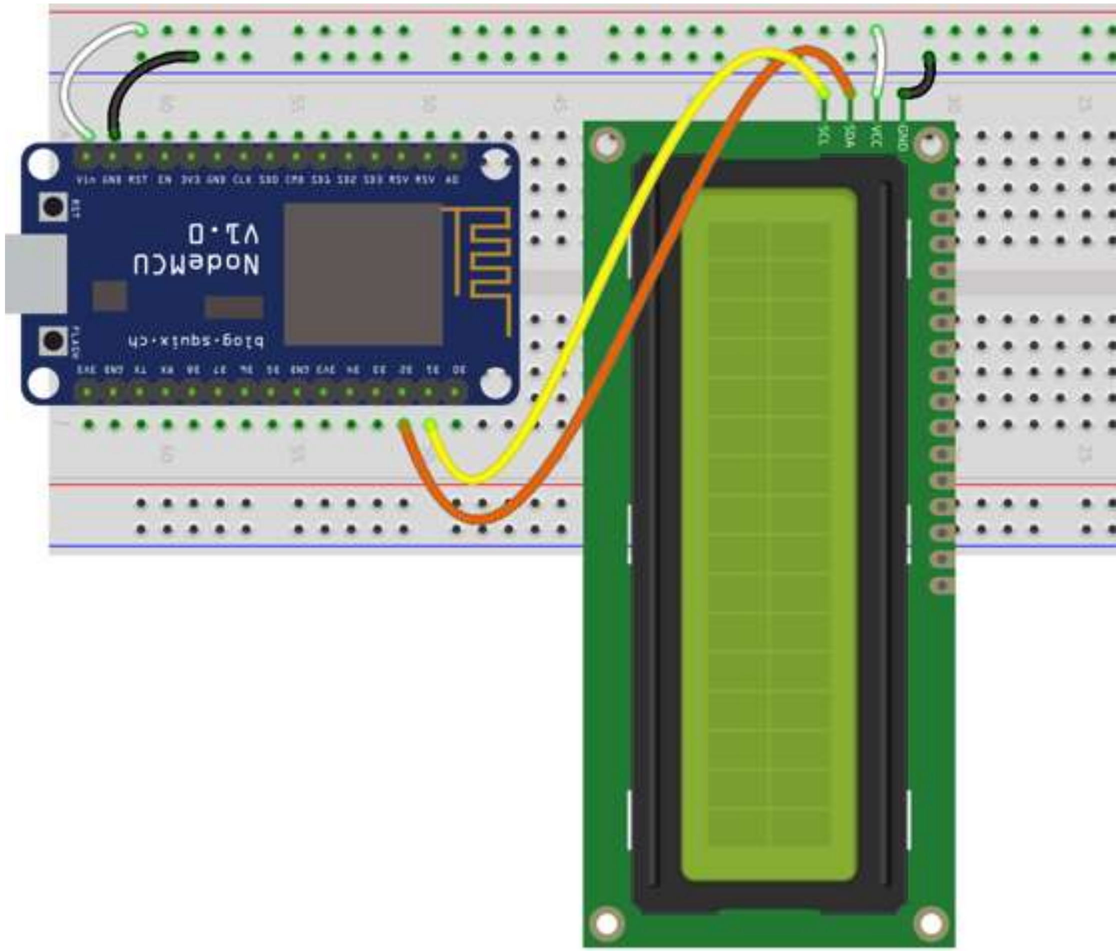
```
#include <hcsr04.h>

#define TRIG_PIN D5
#define ECHO_PIN D6

HCSR04 hcsr04(TRIG_PIN, ECHO_PIN, 20, 4000);

...


void loop()
{
  if (!mqttClient.connected()) mqttClient.connect();
  mqttClient.loop();

  long now = millis();
  if (now - lastTimeMsg > 500)
  {
    lastTimeMsg = now;

    int distance = hcsr04.distanceInMillimeters();
    char msg[MESSAGE_MAX_SIZE] = "";
    snprintf (msg, MESSAGE_MAX_SIZE, "Dist: %ldmm", distance);
    Serial.println(msg);
    mqttClient.publish(MQTT_OUT_TOPIC, msg);
  }
}
```

PERIFÉRICOS

PERIFÉRICOS

Display de cristal líquido

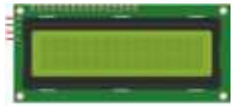




PERIFÉRICOS

PERIFÉRICOS

Display de cristal líquido

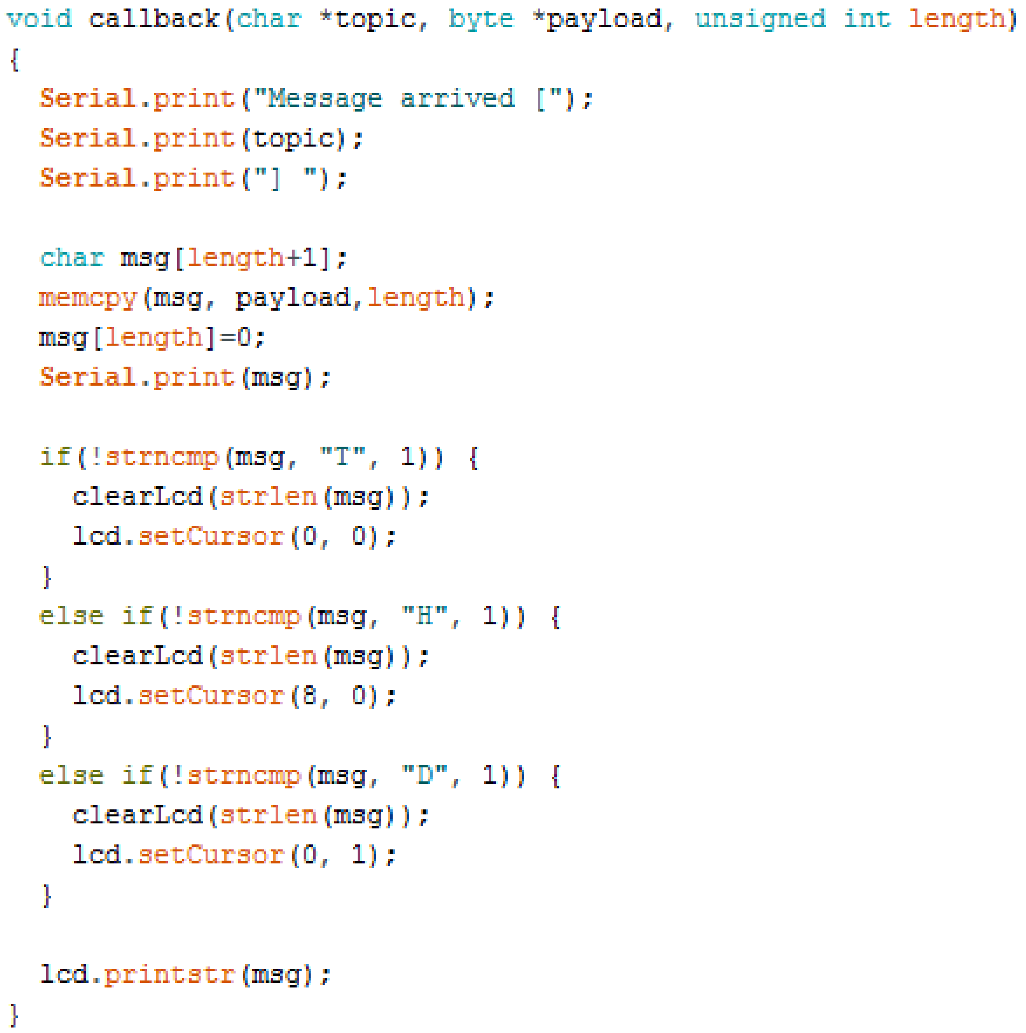


```
#include <Wire.h>
#include <LiquidCrystal_I2C.h>

LiquidCrystal_I2C lcd(0x27, 16, 2);

void setup()
{
  Serial.begin(9600);

  wifi.setup();
  mqttClient.setup();
  mqttClient.connect();

  mqttClient.setCallback(callback);

  lcd.begin();
  lcd.backlight();
  lcd.print("DBLAB HANDS-ON");
}

void loop()
{
  if (!mqttClient.connected()) mqttClient.connect();
  mqttClient.loop();
}
```

PERIFÉRICOS

PERIFÉRICOS

Display de cristal líquido



```
void callback(char *topic, byte *payload, unsigned int length)
{
  Serial.print("Message arrived [");
  Serial.print(topic);
  Serial.print("] ");

  char msg[length+1];
  memcpy(msg, payload,length);
  msg[length]=0;
  Serial.print(msg);

  if(!strncmp(msg, "T", 1)) {
    clearLcd(strlen(msg));
    lcd.setCursor(0, 0);
  }
  else if(!strncmp(msg, "H", 1)) {
    clearLcd(strlen(msg));
    lcd.setCursor(8, 0);
  }
  else if(!strncmp(msg, "D", 1)) {
    clearLcd(strlen(msg));
    lcd.setCursor(0, 1);
  }

  lcd.printstr(msg);
}
```

https://github.com/dbserver/dblab/tree/master/hands-on/iot

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DBLAB

Obrigado!

Medium

dblab@dbserver.com.br

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