

Umreženi embeded sistemi

Laboratorijske vežbe

Osnovne informacije

Kontakt:

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Materijal za vežbe:

- <https://www.elektronika.ftn.uns.ac.rs/umrezeni-embeded-sistemi/specifikacija/specifikacija-predmeta/>
- <https://github.com/AnjaTanovic/Umrezeni-embeded-sistemi>

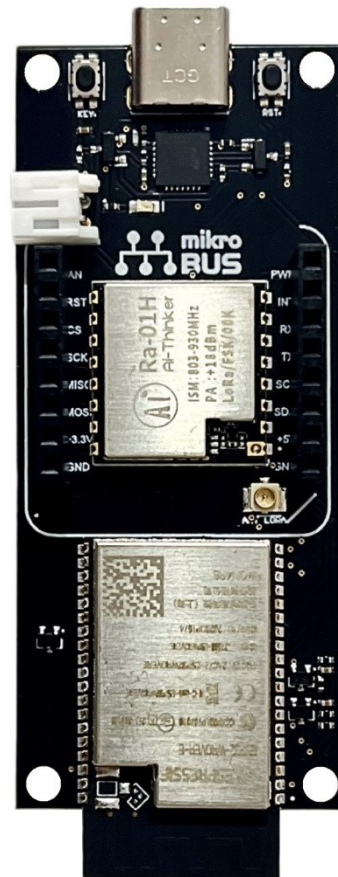
Polaganje vežbi:

- Projekat – 50 poena

Plan laboratorijskih vežbi

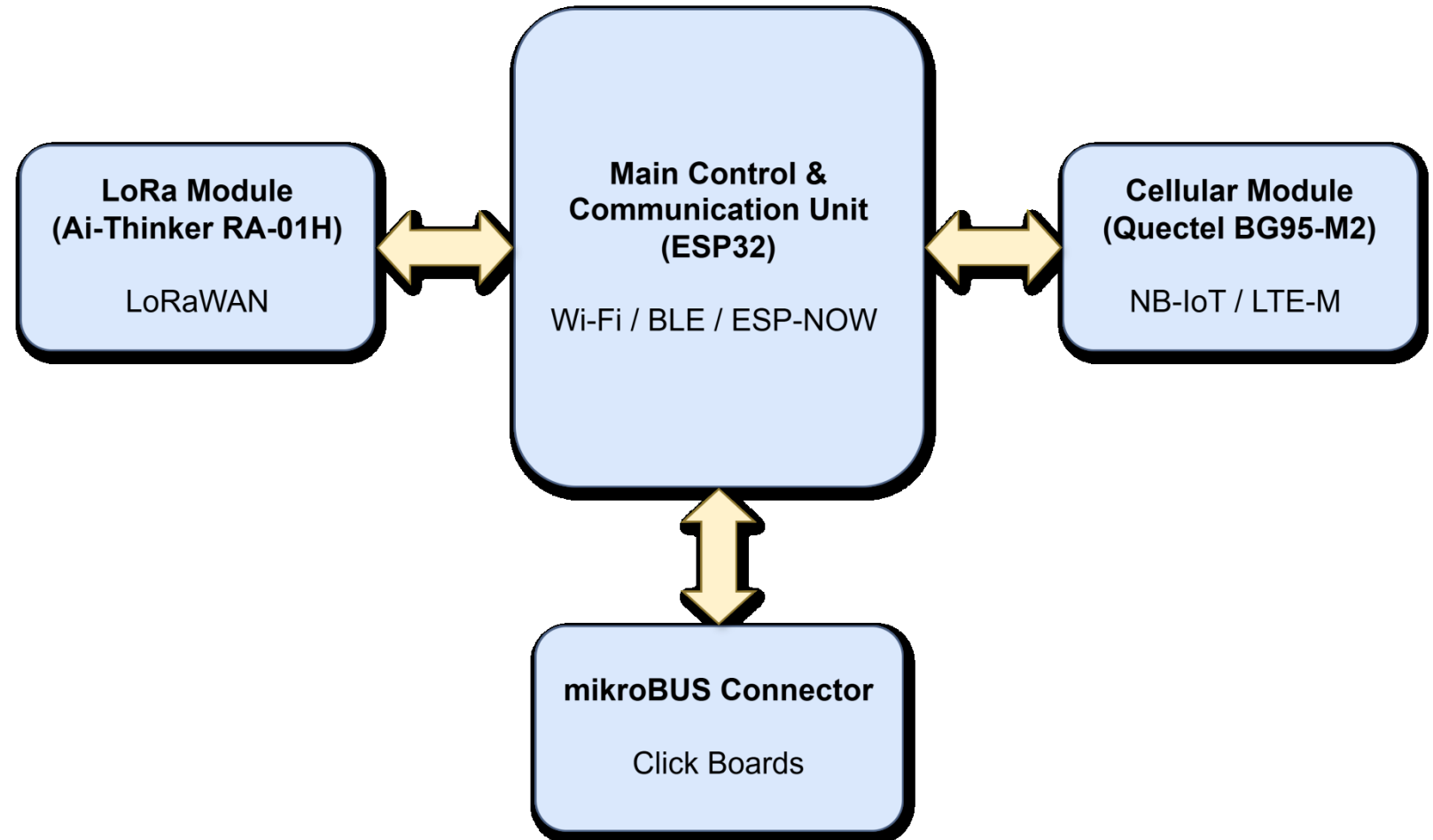
- V1 – WiBLEN razvojna ploča
- V2 – Low Power režimi i RTC
- V3 – ESP32 kao web server
- V4 – ESP32 kao web klijent: HTTP GET metoda i REST API
- V5 – ESP32 kao web klijent: prosleđivanje podataka cloud aplikaciji
- V6 – Node-RED i MQTT protokol
- V7 – Front end
- V8 – Back end i baze podataka
- V9 – LoRaWAN
- V10 – NB-IoT

WiBLEN razvojna ploča



WiBLEN - karakteristike

- **Wi** – WiFi
- **B** – BLE
- **L** – LoRa
- **E** – ESP-NOW
- **N** – NB-IoT

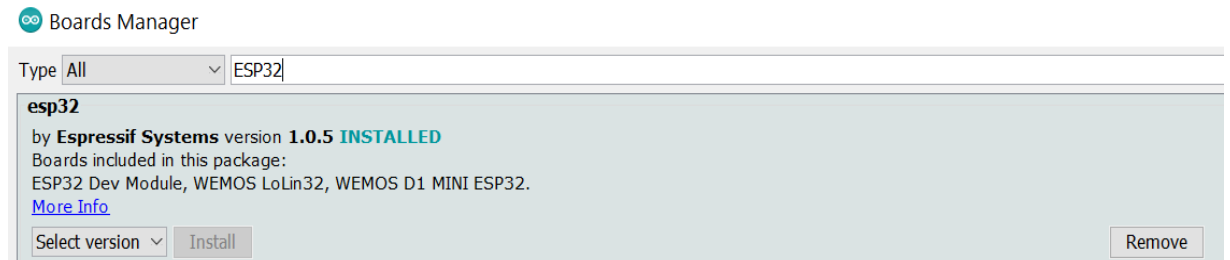
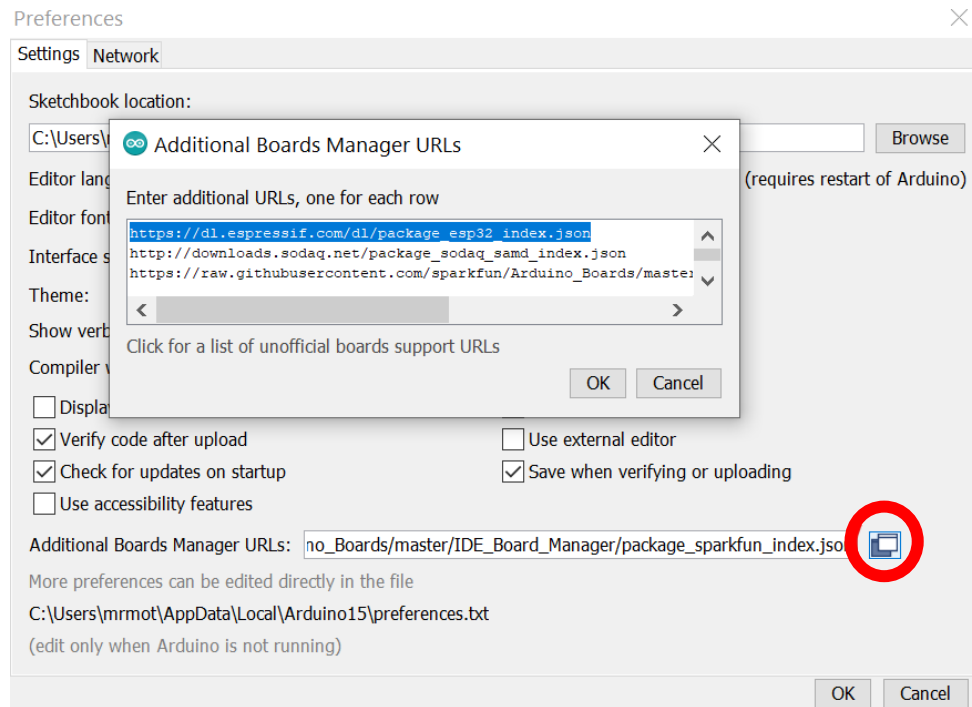


Hardverske karakteristike

Resource	Parameter
Master Chip	ESP32 (240 MHz Xtensa dual-core 32-bit LX6 microprocessor, with ULP coprocessor)
Internal RAM	520 KB SRAM
External RAM	External PSRAM (8 MB)
Flash Memory	External SPI Flash (4 MB)
Wireless Communication	Wi-Fi (IEEE 802.11 b/g/n), Bluetooth (Bluetooth V4.2 BR/EDR and Bluetooth LE specification), ESP-NOW
Cellular Communication	NB-IoT / LTE-M cellular module (Quectel BG95-M2)
NB-IoT Frequency Bands	LTE Cat-NB2 (Band 3, 8, 20) / LTE Cat-M1 (Band 3, 8, 20), region-dependent frequency bands for Europe
LoRa Communication	LoRa transceiver module (Ai-Thinker RA-01H)
LoRa Frequency Bands	Sub-GHz ISM bands (868 MHz EU / 915 MHz US)
Interfaces	USB Interface, mikroBUS-compatible expansion interface
mikroBUS Supported Interfaces	SPI, I ² C, UART, GPIO, PWM
Power Supply	USB and battery-powered operation
Antenna Interfaces	External antennas for LoRa, NB-IoT/LTE-M and GNSS

Instalacija potrebnog softvera

- **Arduino IDE** -> <https://www.arduino.cc/en/software/>
- Dodavanje nove ploče u Arduino IDE: File -> Preferences -> Additional Boards Manager URLs -> https://dl.espressif.com/dl/package_esp32_index.json
- Instaliranje nove ploče: Tools -> Board -> Boards Manager -> **esp32**

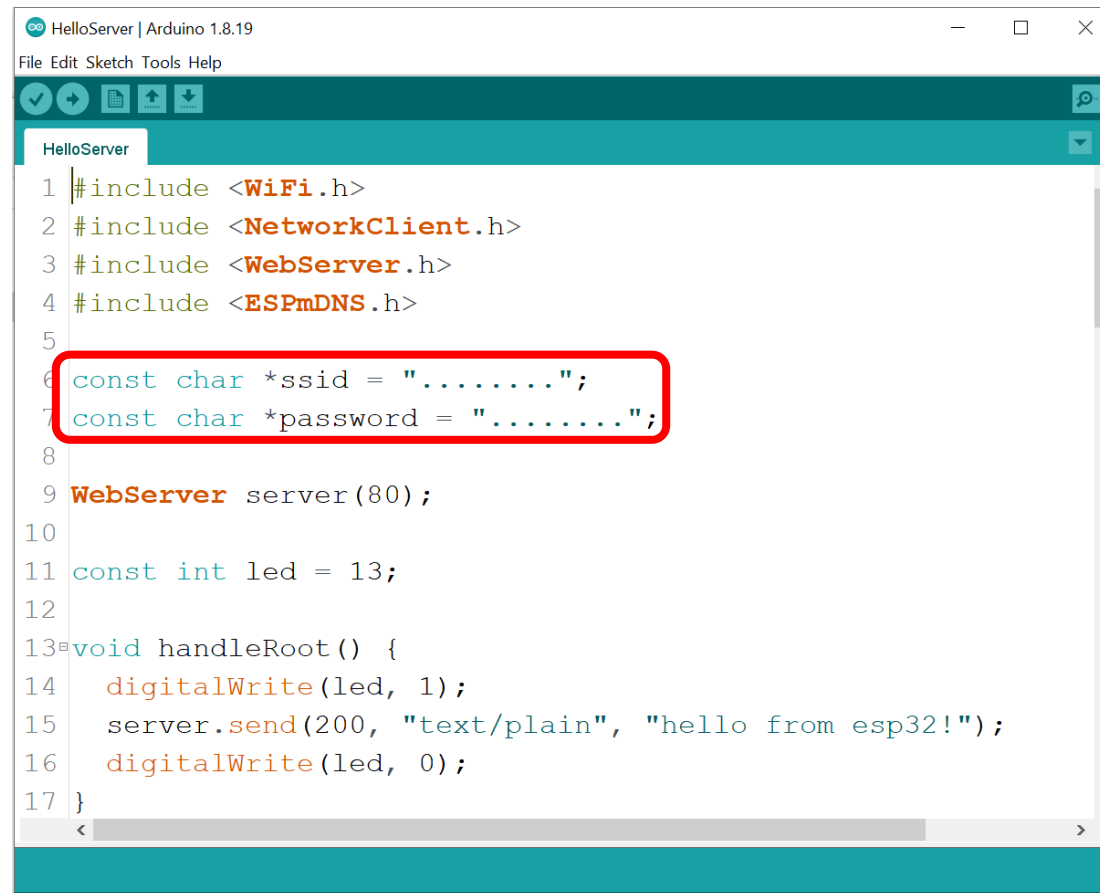


Arduino IDE – konfiguracija

- Izbor ploče: Tools -> Board -> ESP32 Arduino -> **ESP32 Dev Module**
- Izbor porta: Tools -> Port -> **COMx**
- Device Manager - provera porta COMx

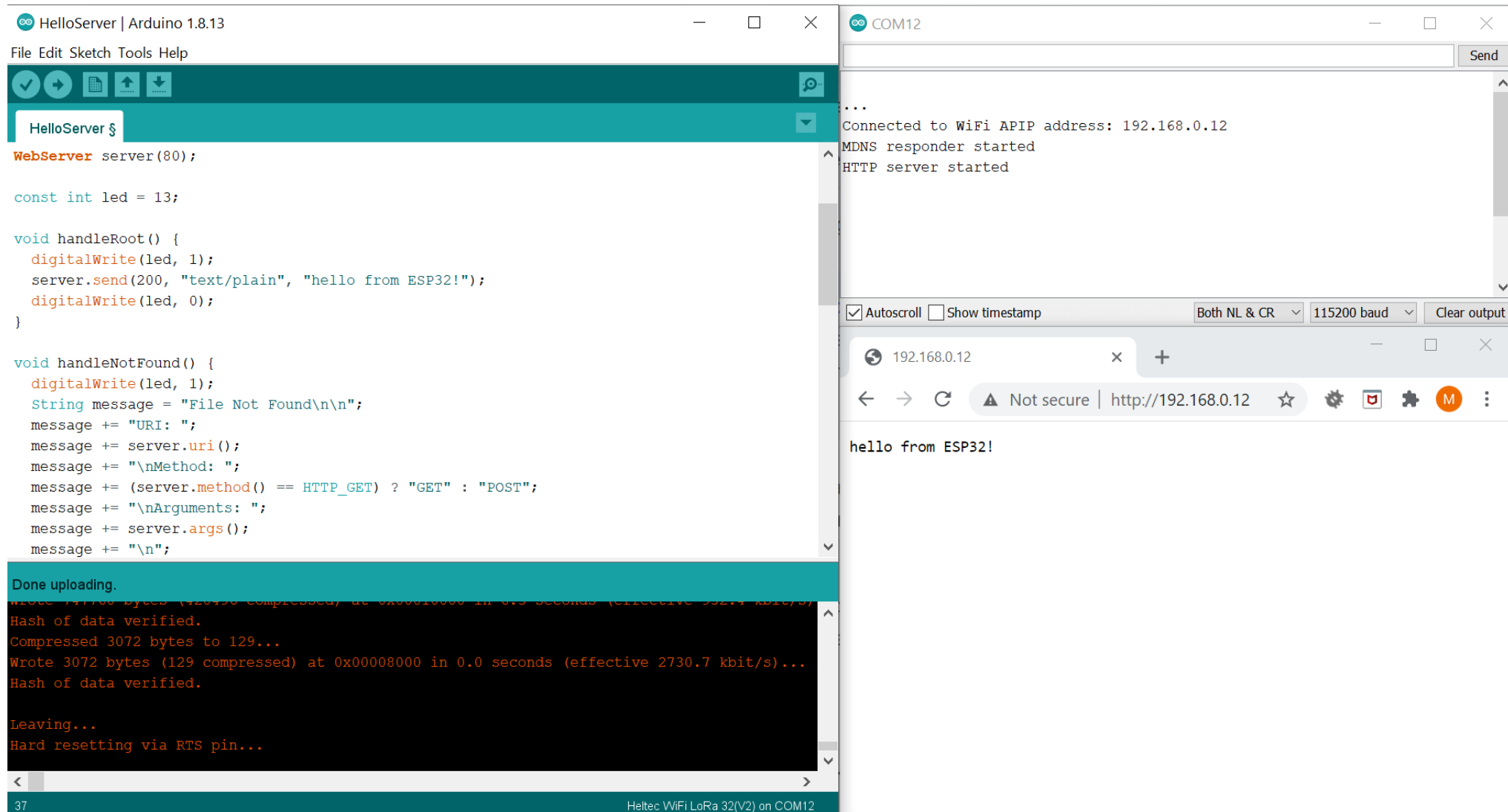
Primer 1: Web server

- Primer: File -> Examples -> Examples for ESP32 Dev Module -> WebServer -> **HelloServer**
- Uneti ssid i password



```
1 #include <WiFi.h>
2 #include <NetworkClient.h>
3 #include <WebServer.h>
4 #include <ESPmDNS.h>
5
6 const char *ssid = ".....";
7 const char *password = ".....";
8
9 WebServer server(80);
10
11 const int led = 13;
12
13 void handleRoot() {
14     digitalWrite(led, 1);
15     server.send(200, "text/plain", "hello from esp32!");
16     digitalWrite(led, 0);
17 }
```

Primer 1: Web server



The image shows two windows from an Arduino IDE. The left window is titled "HelloServer | Arduino 1.8.13" and displays the following code:

```
WebServer server(80);

const int led = 13;

void handleRoot() {
  digitalWrite(led, 1);
  server.send(200, "text/plain", "hello from ESP32!");
  digitalWrite(led, 0);
}

void handleNotFound() {
  digitalWrite(led, 1);
  String message = "File Not Found\n\n";
  message += "URI: ";
  message += server.uri();
  message += "\nMethod: ";
  message += (server.method() == HTTP_GET) ? "GET" : "POST";
  message += "\nArguments: ";
  message += server.args();
  message += "\n";
}
```

Below the code, a status bar indicates "Done uploading." and provides details about the upload process:

```
Wrote 74700 bytes (42610 compressed) at 0x00000000 in 0.3 seconds (effective 392.4 kbit/s)
Hash of data verified.
Compressed 3072 bytes to 129...
Wrote 3072 bytes (129 compressed) at 0x00008000 in 0.0 seconds (effective 2730.7 kbit/s)...
Hash of data verified.

Leaving...
Hard resetting via RTS pin...
```

The right window is titled "COM12" and shows the serial output of the program:

```
...
Connected to WiFi APIP address: 192.168.0.12
MDNS responder started
HTTP server started
```

Below the serial output, there are controls for "Autoscroll" (checked), "Show timestamp" (unchecked), "Both NL & CR" (selected), "115200 baud" (selected), and a "Clear output" button. Below these controls is a browser window showing the URL "http://192.168.0.12" and the response "hello from ESP32!".

At the bottom of the IDE window, the page number "37" is visible on the left, and the hardware information "Heltec WiFi LoRa 32(V2) on COM12" is visible on the right.

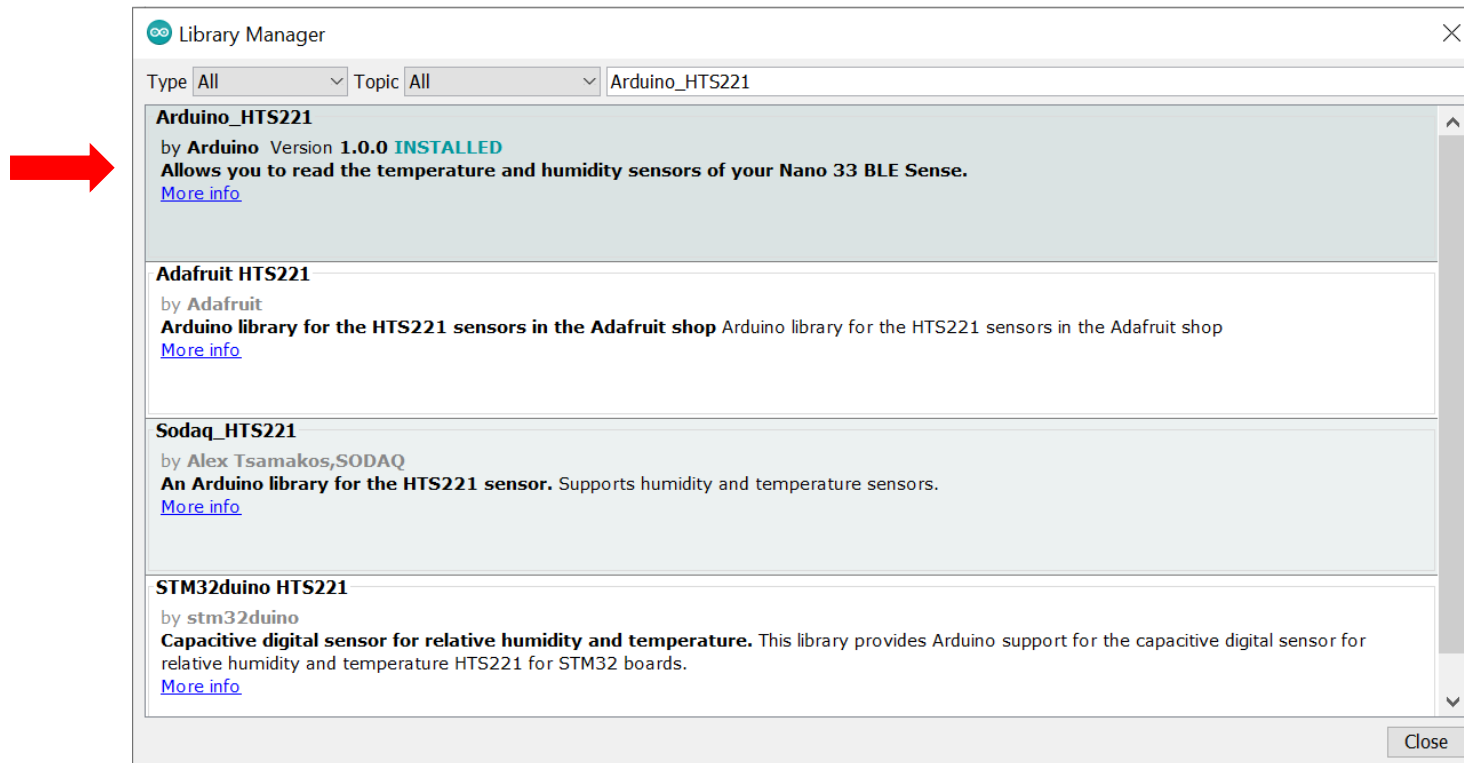
Temp&Hum Click Board

- <https://www.mikroe.com/temp-hum-click>
- Temp&Hum Click koristi HTS221, visoko precizan 16-bitni senzor relativne vlažnosti i temperature
- Temperaturni raspon: 0 °C – 60 °C
- Raspon relativne vlažnosti: 0 % – 100 % RH



Primer 2: Temp&Hum Click

- Instaliranje biblioteke: Sketch -> Include Library -> Manage Libraries -> **Arduino_HTS221**
- Primer: File -> Examples -> Examples for any board -> Arduino_HTS221 -> **ReadSensors**



Primer 2: Temp&Hum Click

```
ReadSensors | Arduino 1.8.19
File Edit Sketch Tools Help
ReadSensors
1 /*
2  HTS221 - Read Sensors
3
4  This example reads data from the on-board HTS221 sensor of the
5  Nano 33 BLE Sense and prints the temperature and humidity sensor
6  values to the Serial Monitor once a second.
7
8  The circuit:
9  - Arduino Nano 33 BLE Sense
10
11  This example code is in the public domain.
12 */
13
14 #include <Arduino_HTS221.h>
15
16 void setup() {
17   Serial.begin(9600);
18   while (!Serial);
19
20   Serial.println("HTS221 - Read Sensors");
21   Serial.println("-----");
22   Serial.println("Temperature = 28.86 °C");
23   Serial.println("Humidity = 41.72 %");
24   Serial.println("-----");
25 }
26
27 void loop() {
28   Serial.println("Temperature = 28.86 °C");
29   Serial.println("Humidity = 41.72 %");
30   Serial.println("-----");
31   delay(1000);
32 }

```

Hard resetting via RTS pin...

```
COM17
Send
Humidity = 41.72 %
Temperature = 28.86 °C
Humidity = 41.48 %
Temperature = 28.85 °C
Humidity = 41.13 %
Temperature = 28.86 °C
Humidity = 40.90 %
Temperature = 28.86 °C
Humidity = 40.73 %
 Autoscroll  Show timestamp No line ending 9600 baud Clear output
```