Project - Web server publishing ESP32-CAM pictures and sensor data readings from a MQTT server:

1 - Project Modules and Required Parts:

1.1 - The three modules of the project:

- 1 - Module using the 'NodeMCU V1.0' board with SoC ESP12-E (with ESP8266 microcontroller).
  - Reads the temperature (in ºC) and air pressure (in hPa) from the BMP280 module and the ADC value from the Light Dependent Resistor (LDR).
  - The data read from the sensors are sent to the MQTT server.
  - The NodeMCU is power-supplied by a 18650 battery.
  - The 18650 battery is charged by a TP4056 module and four solar panels.
- 2 - ESP32-CAM Module:
  - Take a picture every five minutes. It just stores the last picture taken, in the SPIFFS memory of the ESP32-CAM.
  - This module hosts the web server HTML page which shows the last picture taken and the sensor data.
  - The HTML code of the wep page is generated in a function of the sketch of this module.
  - The template of the web page is hosted in the header file 'PAG_WEB.h'
- 3 - PC executing **Moquitto MQTT** and Ngrok.
  - Here, I used a Raspberry Pi with the necessary software installed.
  - But its not a requisite to use a Raspberry Pi here. Any computer with windows will do the same thing. It just needs the required software.
  - **Mosquitto MQTT**: Its the MQTT server program. It receives the published data from the NodeMCU ESP8266 and sends the published data to the ESP32-CAM (the subscriber).
  - **Ngrok**: Its the internet server which redirects the ESP32-CAM web server to the internet.
    - It requires an account in the Ngrok site.
    - It offers some free services, like the one shown here. But the site has some paid services too.
    - I'm using here only its free services.

1.2 - Parts used in each module of the project:

- 1 - **NodeMCU (ESP12-E) with the sensors**:
  - 1x NodeMCU 1.0 module (SoC ESP12-E, with the ESP8266 microcontroller).
  - 1x BMP280 sensor module (temperature and air pressure)
  - 1x light dependent resistor (LDR).
  - 1x 4.7K resistor.

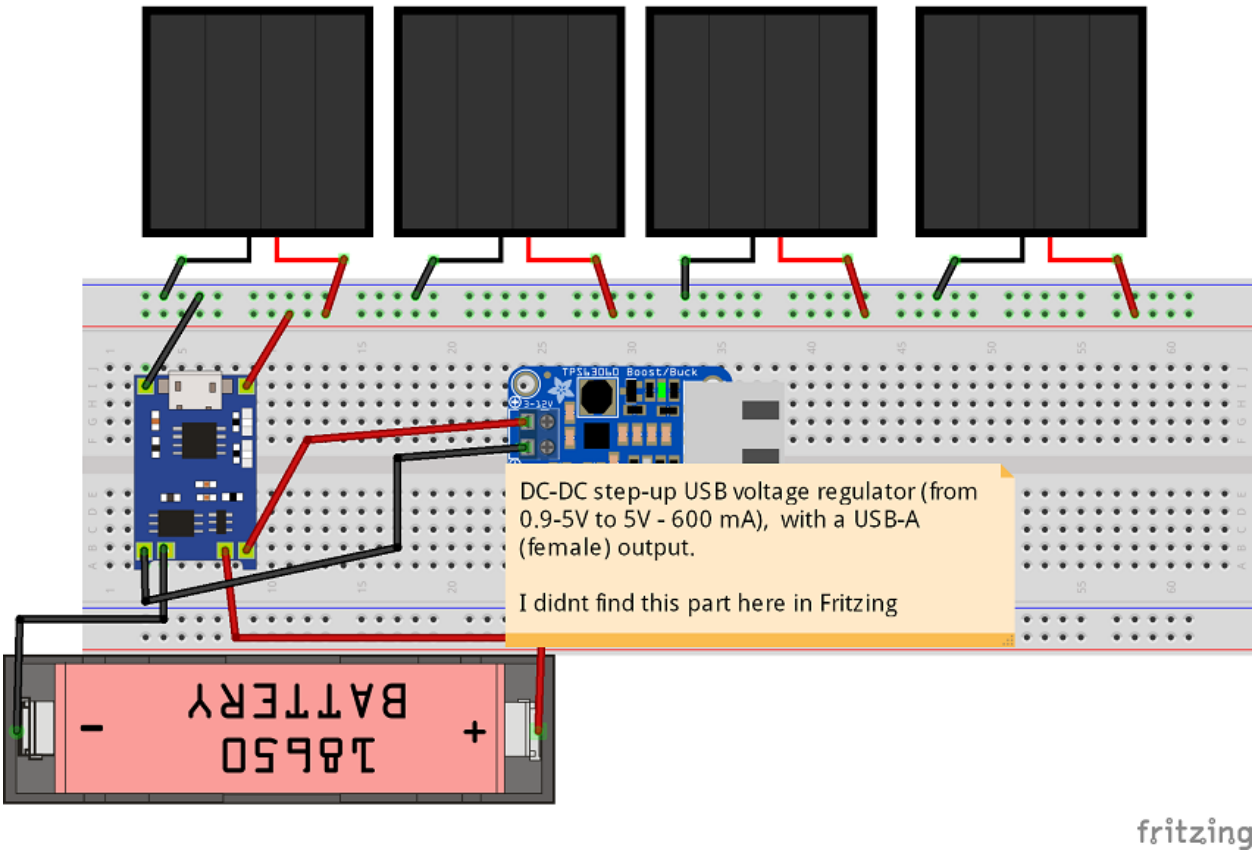


Figure 1: Img_01

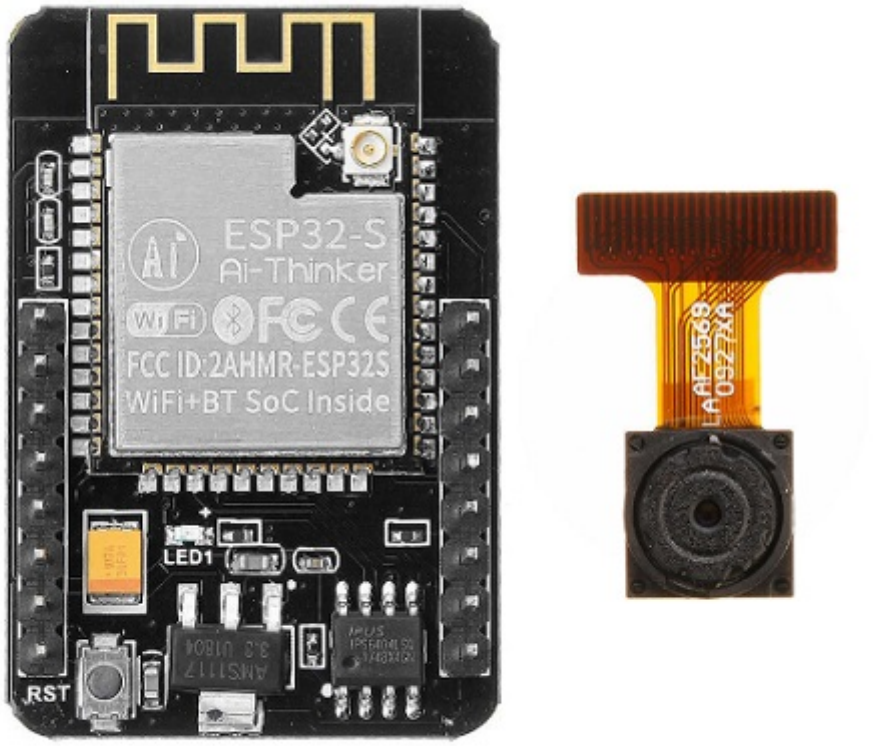


Figure 2: Img_02

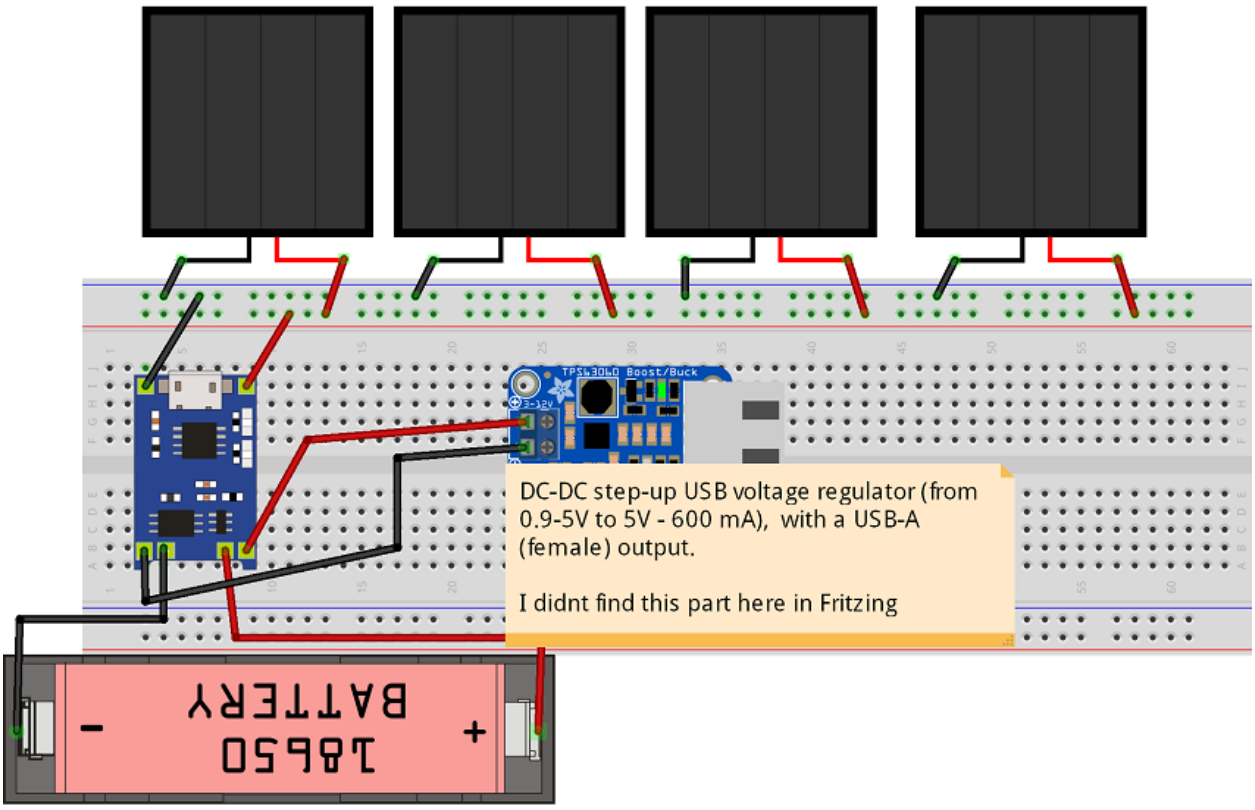
  - 1x DC-DC step-up USB voltage regulator (from 0.9-5V to 5V - 600 mA - with a USB-A output).
  - 1x 18650 battery (4.2V, 9800mAh).
  - 1x Li-ion battery charger module **TP4056**, **WITH PROTECTION**.
  - 4x 1W 6V solar panels (the specifications told that they were 6V panels, but my measurements showed 5V-2.15V).
  - 2x USB cables, with a USB-A and a USB Micro-B terminals. **A charging-only cable does this service very well**.

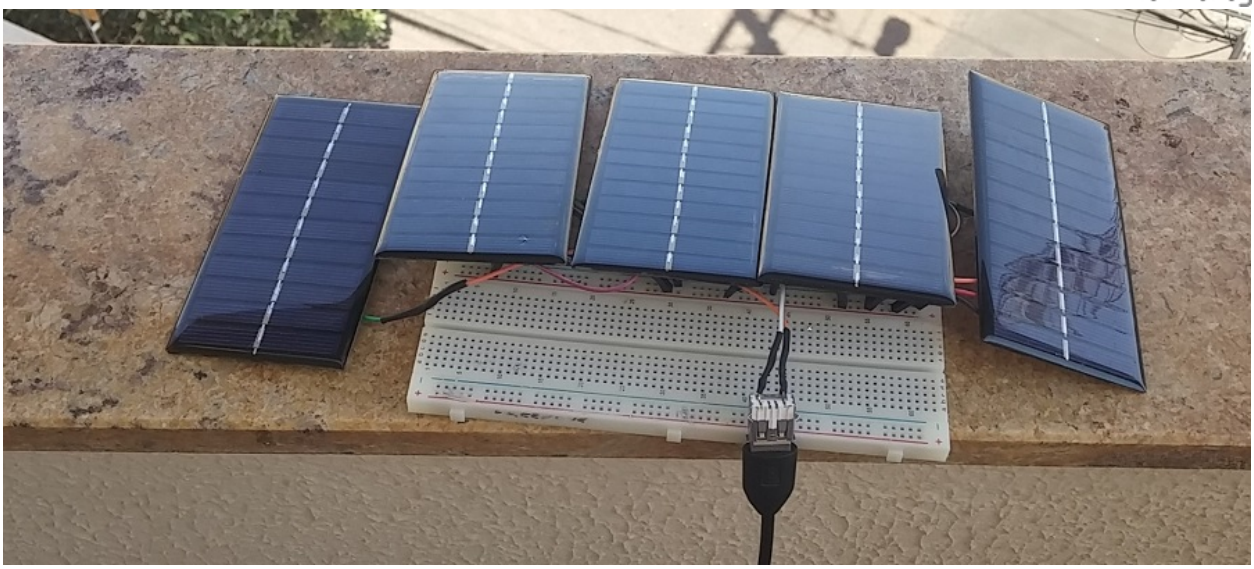
- 2 - **Módulo ESP32-CAM with the web server**:
  - 1x ESP32-CAM module
  - 1x **FT232R FTDI** programmer (the ESP32-CAM doesn't contain a CP2101 chip to transfer the sketches to it).
  - 1x 5V DC power supply.

2 - Diagrams and photos:

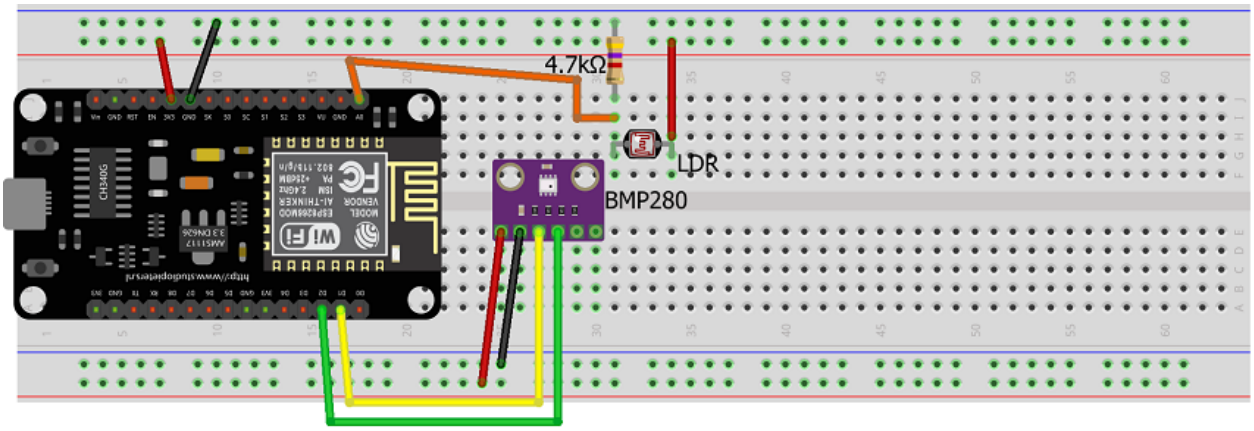
2.1 - Part 1 - ESP8266 and sensors

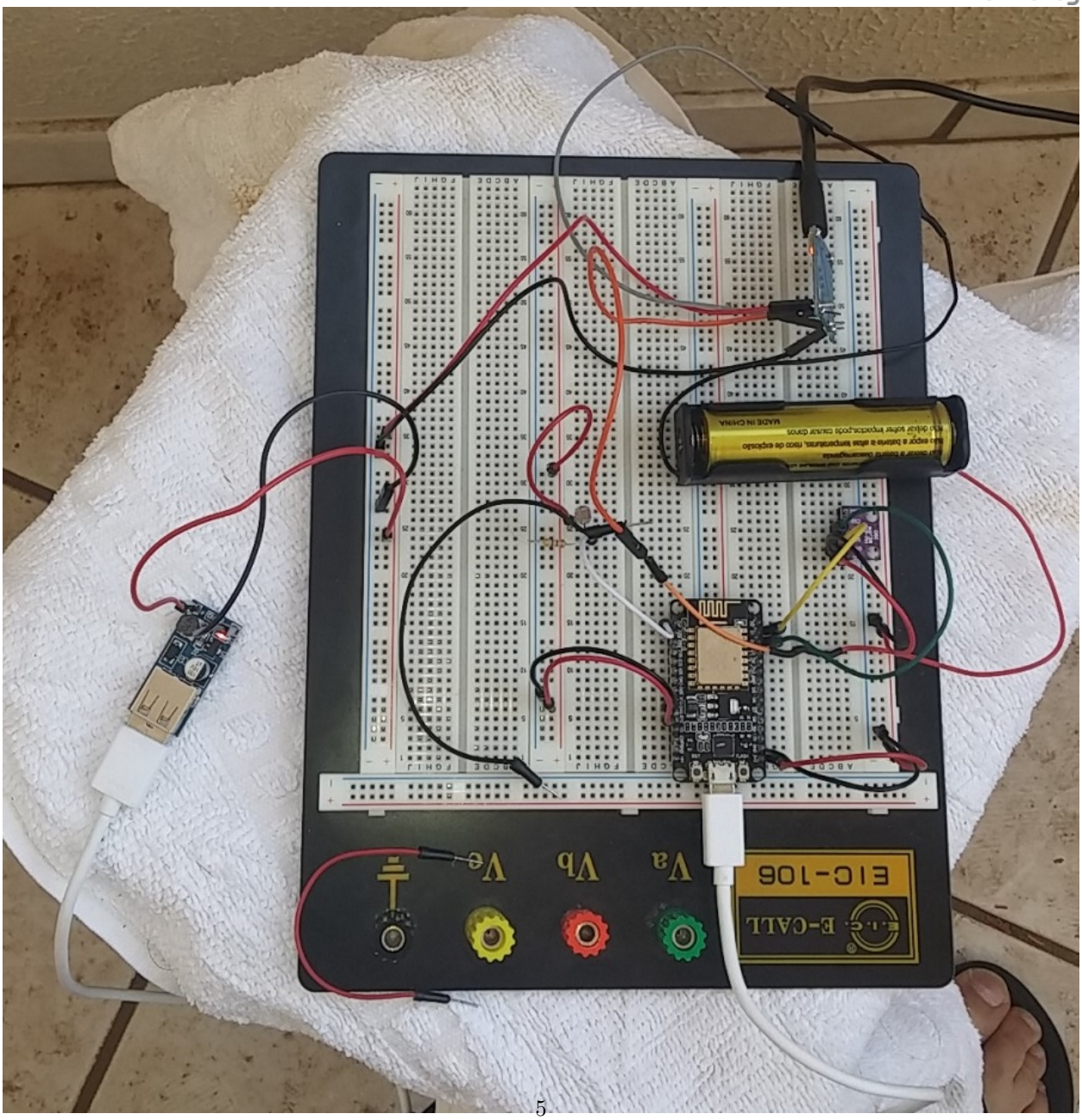
2.1.1 - Power Supply (solar panels and battery charger)





2.1.2 - NodeMCU and Sensores





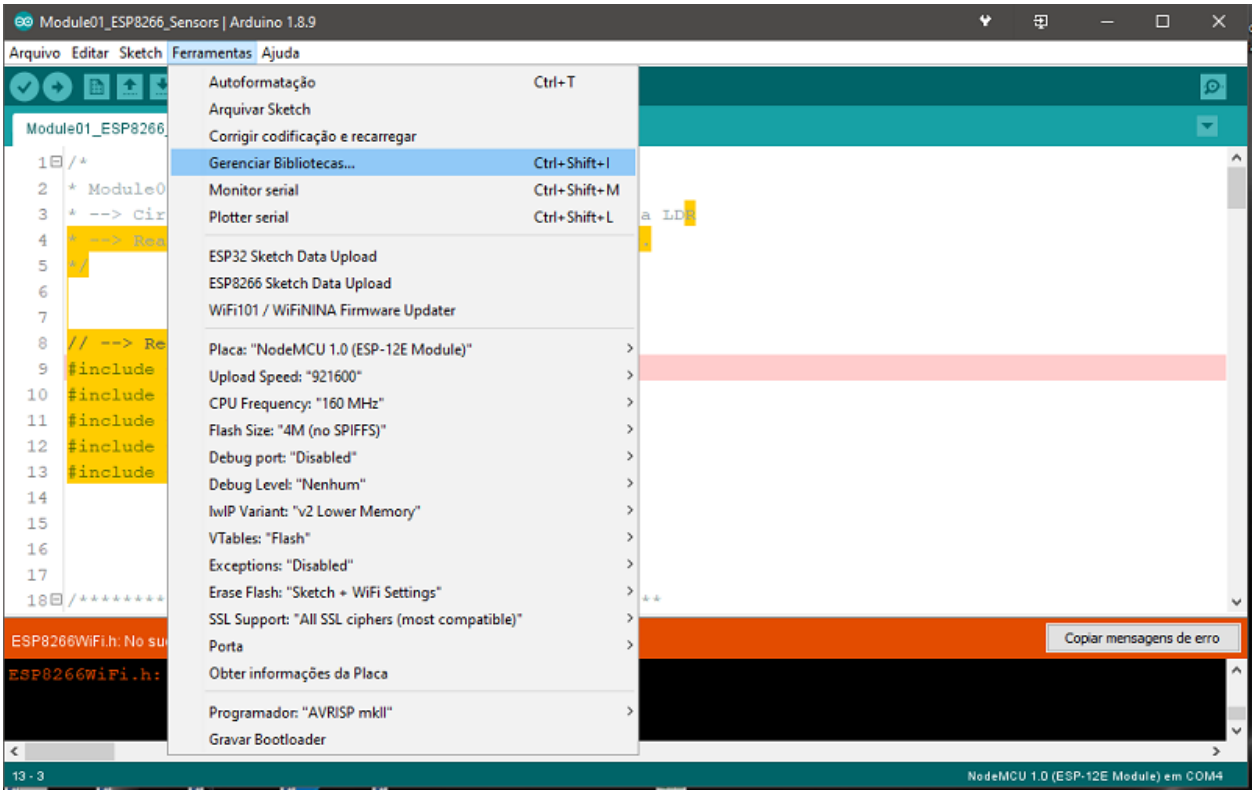


Figure 3: Selecting the NodeMCU board in Arduino IDE

2.1.3 - Selecting the NodeMCU board in Arduino IDE

2.1.4 - MQTT Server:

- The sensor readings are published in the MQTT Server running on Raspberry Pi.
- The MQTT server program used here is the **Moquito MQTT Broker**.
- The picture above shows the result of a subscription to the topic **`sensors/temp`**.
- Alternativelly, you can subscribe for a MQTT with the **MyMQTT** App (Android).
- The image above shows the result on the MyMQTT App, after connecting to my MQTT server in Raspberry Pi and subscribint to the following topics:
  - **`sensors/temp`**.
  - **`sensors/pressure`**.
  - **`sensors/adc_ldr`**.

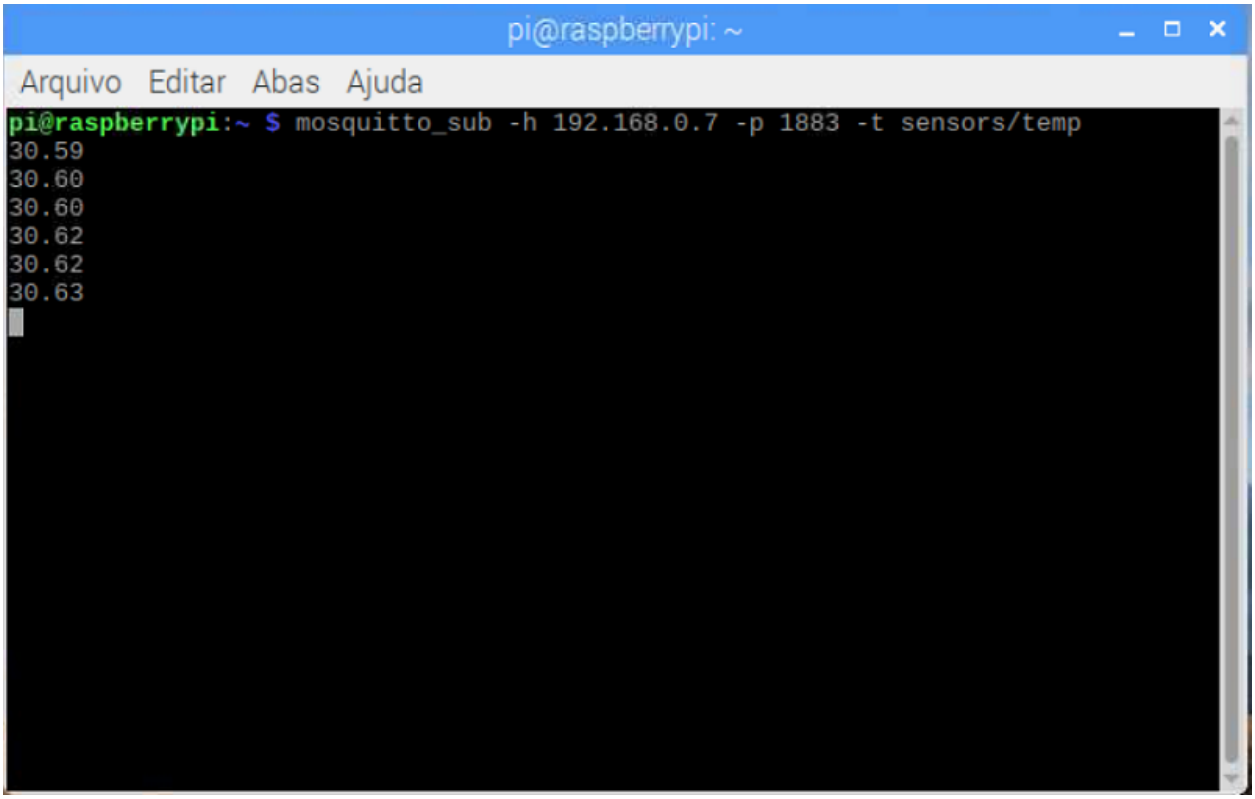
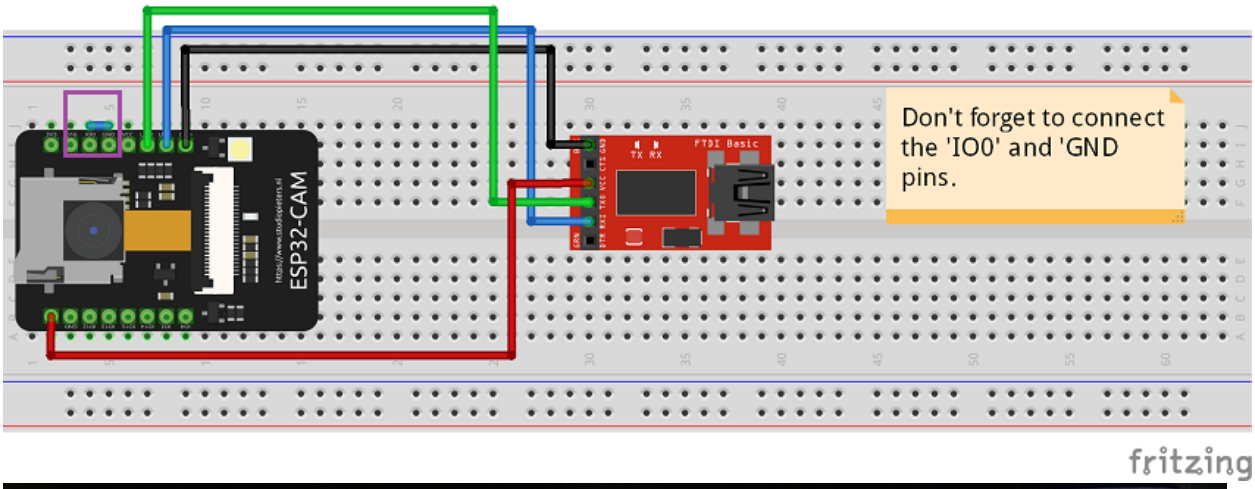
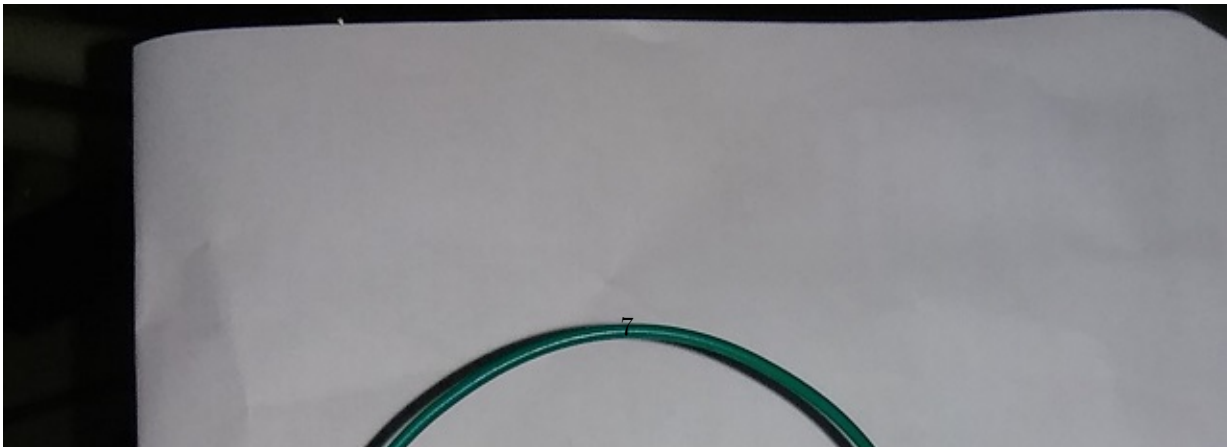


Figure 4: Subscribing to a Topic in Mosquitto

2.2 - Part 2 - ESP32-CAM

2.2.1 - Programming the ESP32-CAM with the FT232R FTDI





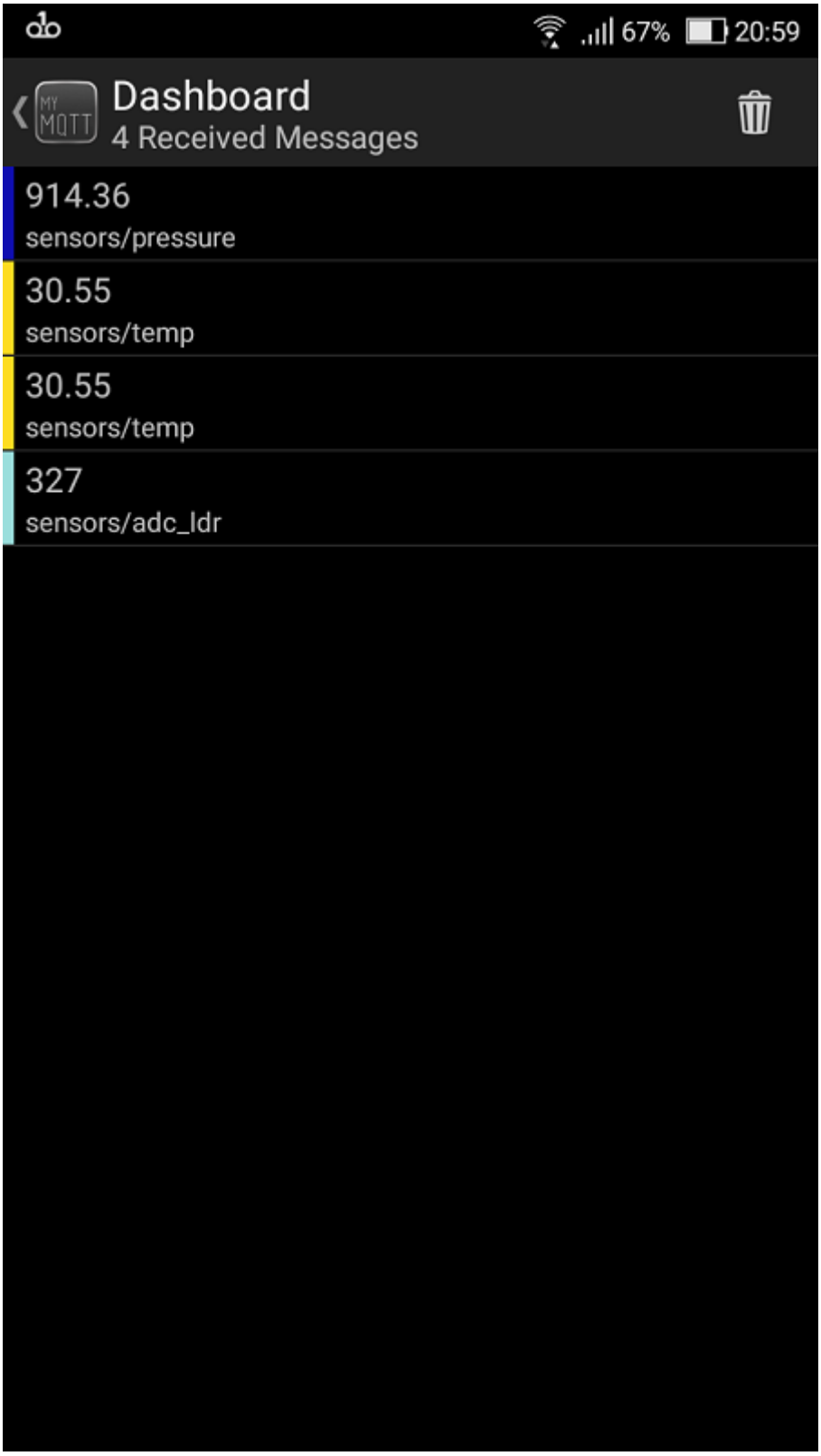


Figure 5: MyMQTT (Android) Screenshot

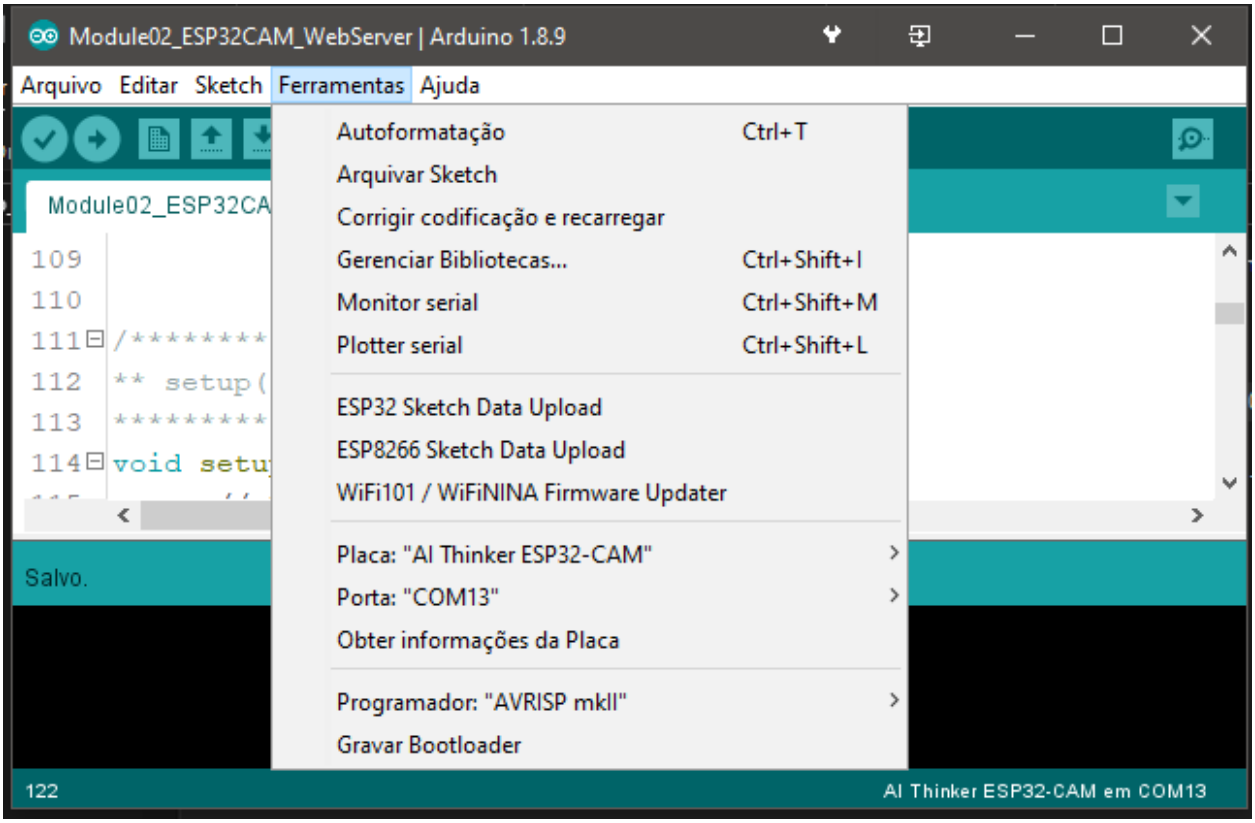
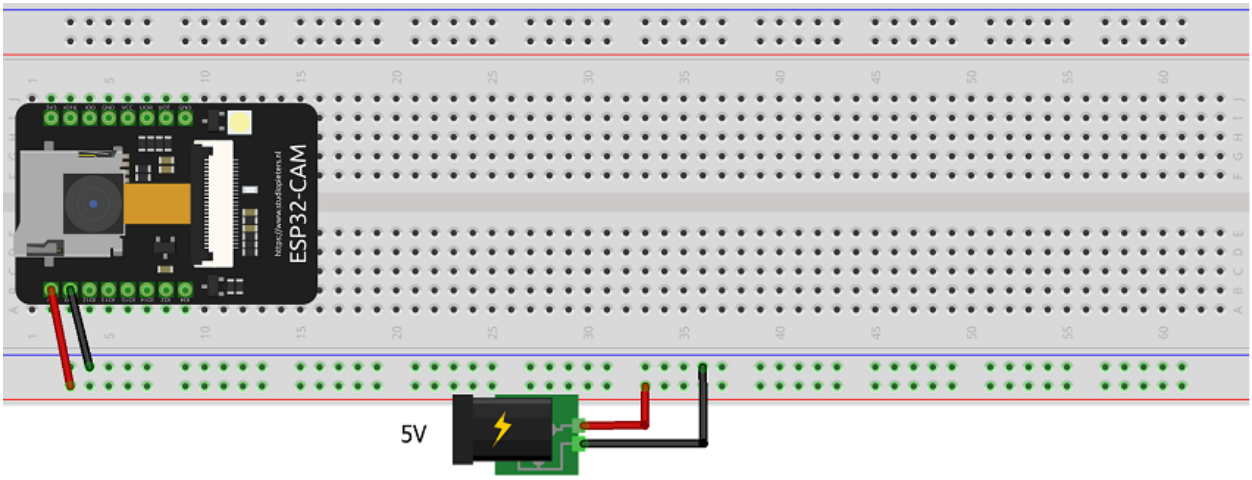


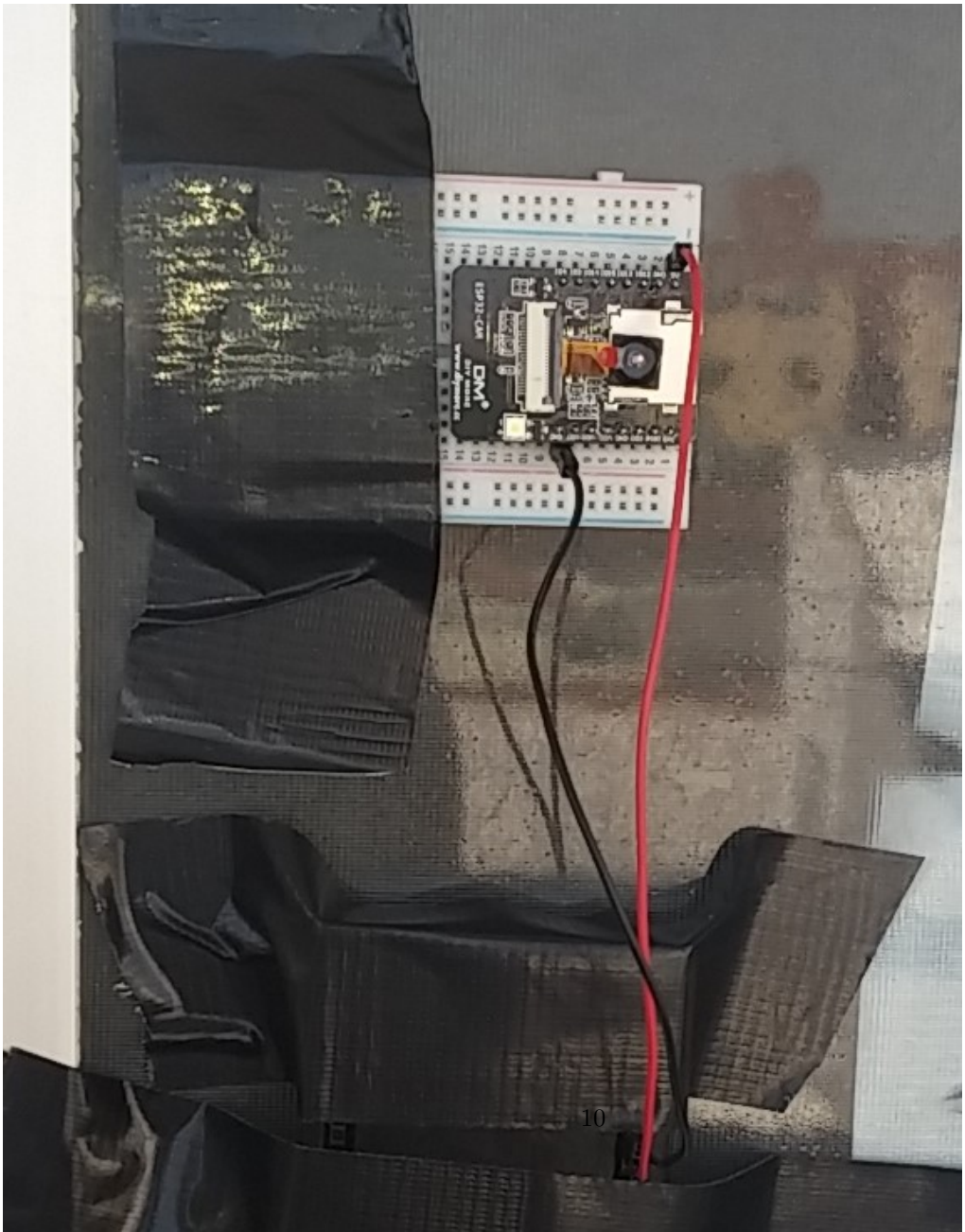
Figure 6: Img_09

- The image above shows hw to connect the ESP32-CAM to the FT232R FTDI programmer.
- The `IO0` pin of the ESP32-CAM must be connected to the `GND` pin of the ESP32-CAM.

2.2.2 - Selecting the ESP32-CAM in Arduino IDE:

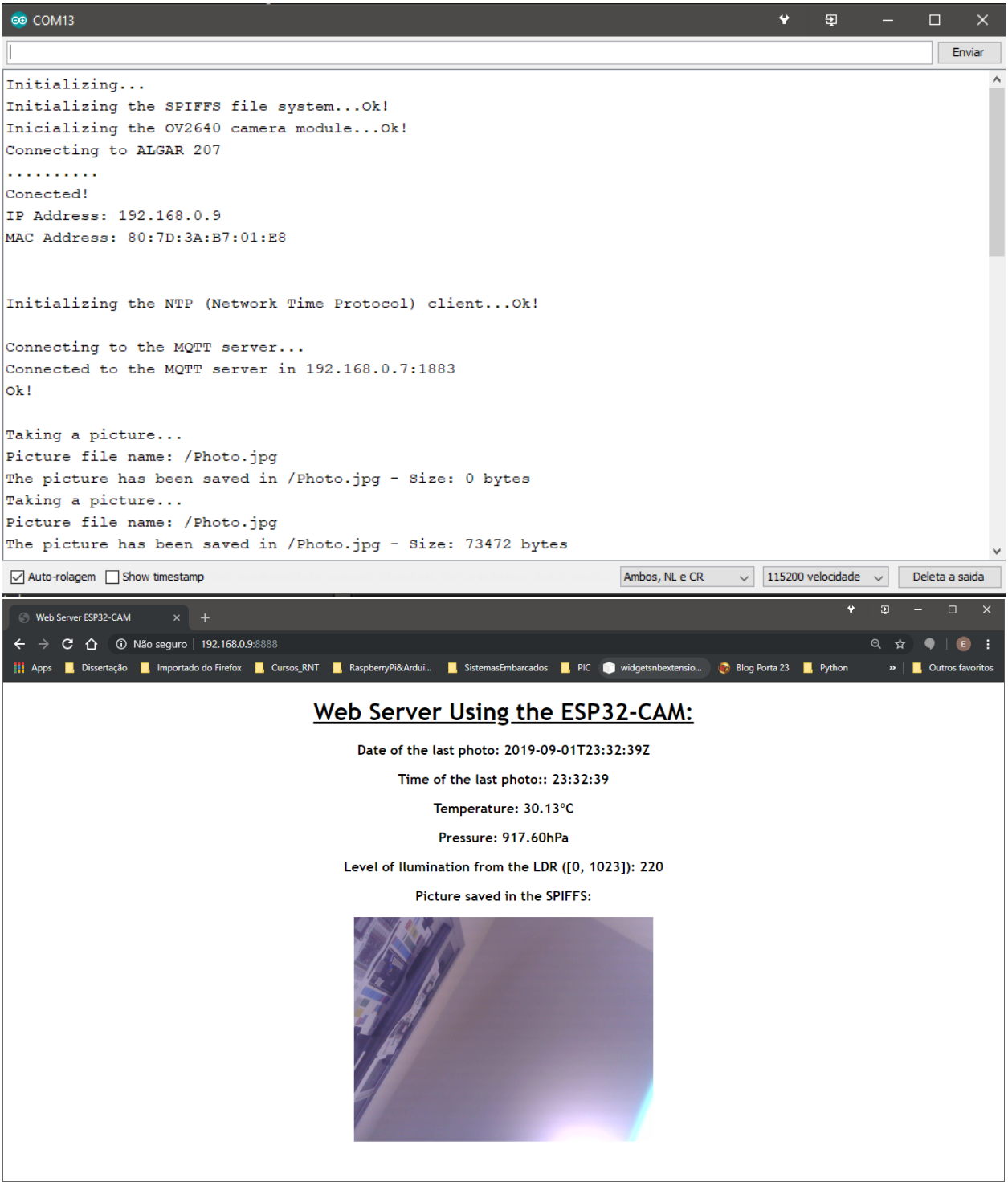
2.2.3 - Running the sketch





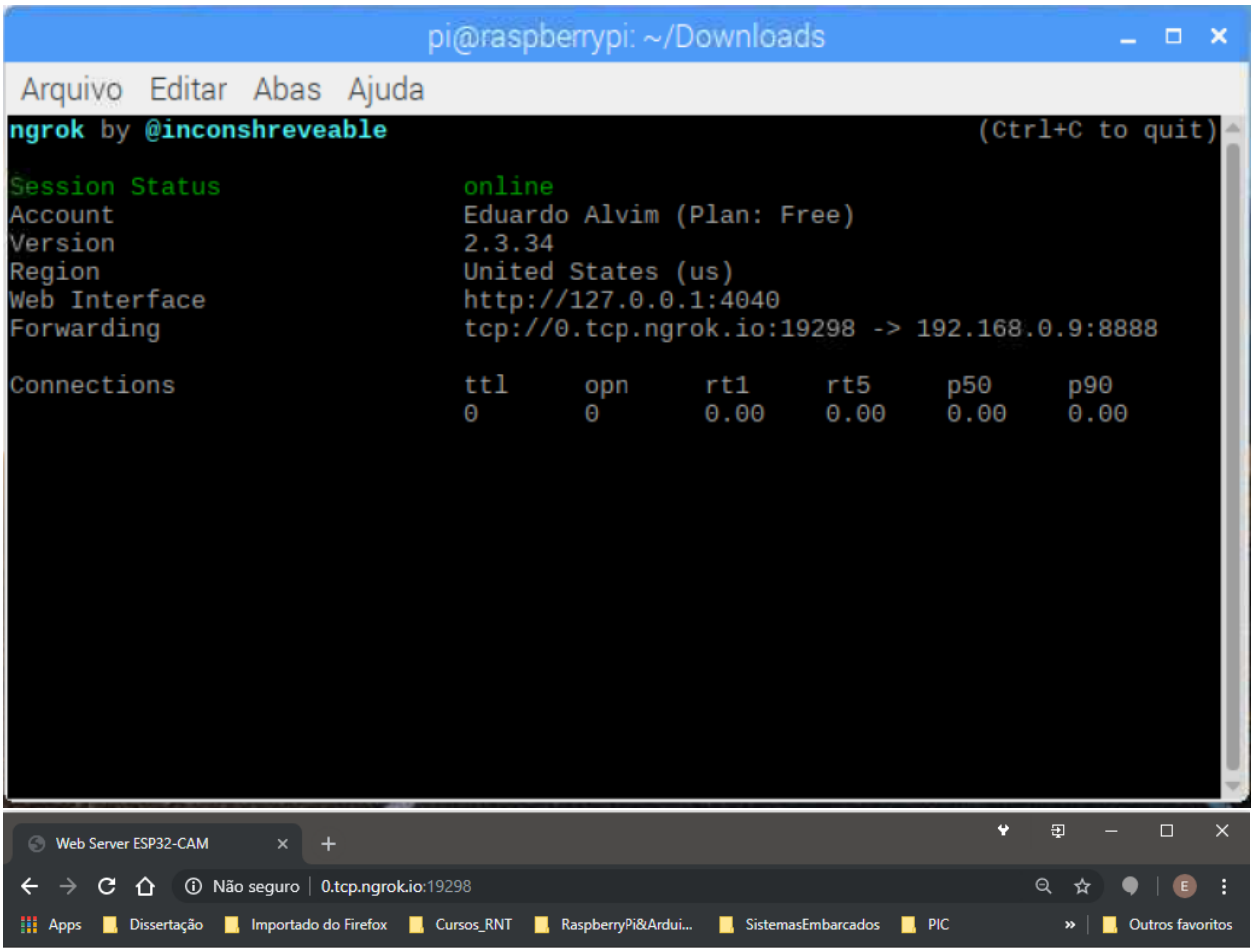
- I Used here an broken Arduino UNO, whose power-supply pins were the only pins working.
- But any 5V DC power-supply will do the same.
- Don't forget to remove the wire connecting the pins `IO0` and `GND`.

2.2.4 - The ESP32-CAM Web server:



- The first image above shows the output in Monitor Serial of the Arduino IDE.
- The ESP32-CAM IP address in my Wi-Fi network is **192.168.0.9**.
- To access the web server (second image above), just type in your internet browser the IP address of the ESP32-CAM and the port number (in my case, `192.168.0.9:8888`).

2.2.5 - The Ngrok redirection service:



- After install and configure the Ngrok program in your Raspberry Pi or PC, and with the web server of the ESP32-CAM running, you can execute the Ngrok to make the web server available in the internet.

- In Raspberry Pi:
  - Go to the folder where the Ngrok program is installed: `cd /home/pi/Downloads` (Or the folder

which you installed it).

  - Execute Ngrok:
    * **Raspberry Pi**: `./ngrok tcp 192.168.0.9:8888`

    * **Windows Power Shell**: `ngrok tcp 192.168.0.9:8888`

- The ouput shown in the first image above shows that my web server is available in the address `http://0.tcp.ngrok.io:19298/`

- To access your web server outside your Wi-Fi network, just type this address (`http://0.tcp.ngrok.io:19298/`) in any internet browseer.