USER MANUAL

COLLABORATIVE AND LONG RANGE
INTERCOMMUNICATED MOBILE
CYBER-PHYSICAL SYSTEM

CYBER-PHYSICAT
SYSTEMS

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PURPOSE

THE PURPOSE OF THIS MANUAL IS TO DEMONSTRATE HOW TO PROPERLY INSTALL, OPERATE, AND MANAGE THE LONG-RANGE INTERCOMMUNICATED MOBILE IN ORDER

AUDIENCE

ADDRESSED TO USERS WHO RECENTLY ACQUIRED THE " COLLABORATIVE AND LONG RANGE INTERCOMMUNICATED MOBILE" AND WISH TO OPERATE IT FOR THEIR DESIRED USE.

REQUIREMENTS

THE DEVICE MUST MEET THE FOLLOWING MINIMUM REQUIREMENTS FOR THE SYSTEM TO FUNCTION OPTIMALLY:

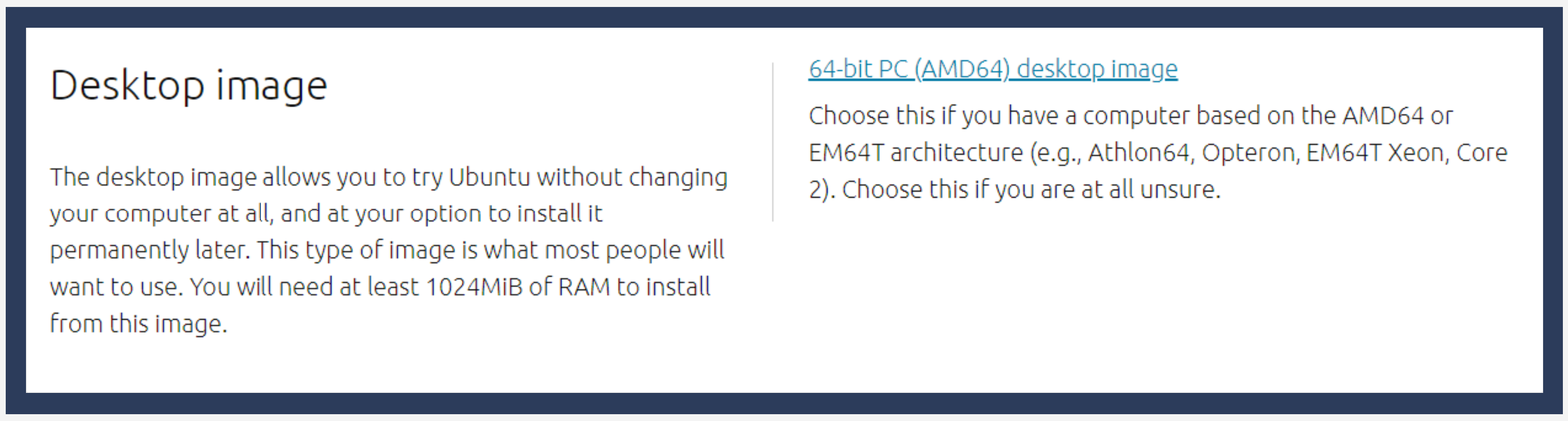
- PROCESSOR: INTEL® CORE I5 1.8 GHZ, RYZEN 5 5600X OR EQUIVALENT
- RAM: 8 GB
- HDD OR SSD: 30 GB AVAILABLE

GETTING STARTED

SOFTWARE DOWNLOAD, INSTALATION AND SETUP (FOR THE BROKER)

UBUNTU 20.04.5 LTS (FOCAL FOSSA) DESKTOP IMAGE

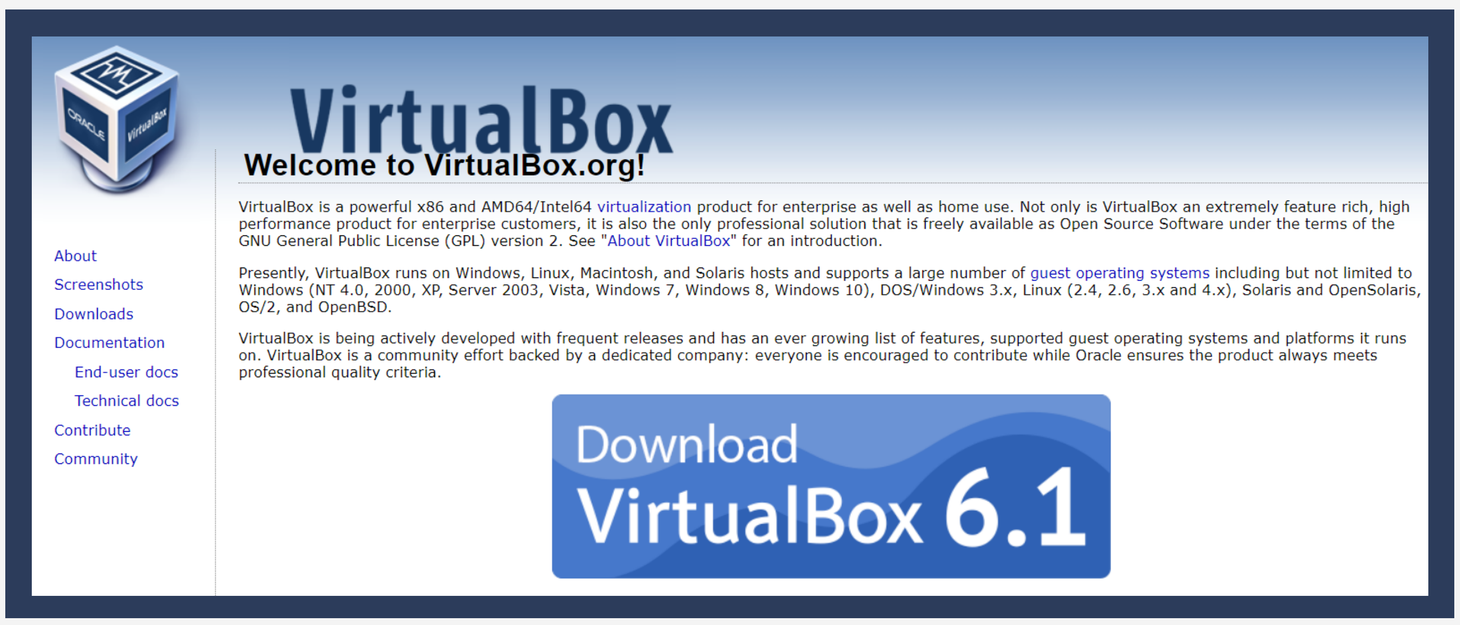
OPEN A BROWSER AND ENTER IN HTTPS://RELEASES.UBUNTU.COM/FOCAL/ AND DOWNLOAD THE 64-BIT PC (AMD64) DESKTOP IMAGE. (MAKE SURE TO SAVE YOUR FILE IN AN EASILY ACCESSIBLE FOLDER!)



VIRTUAL MACHINE (ORACLE VM VIRTUALBOX)

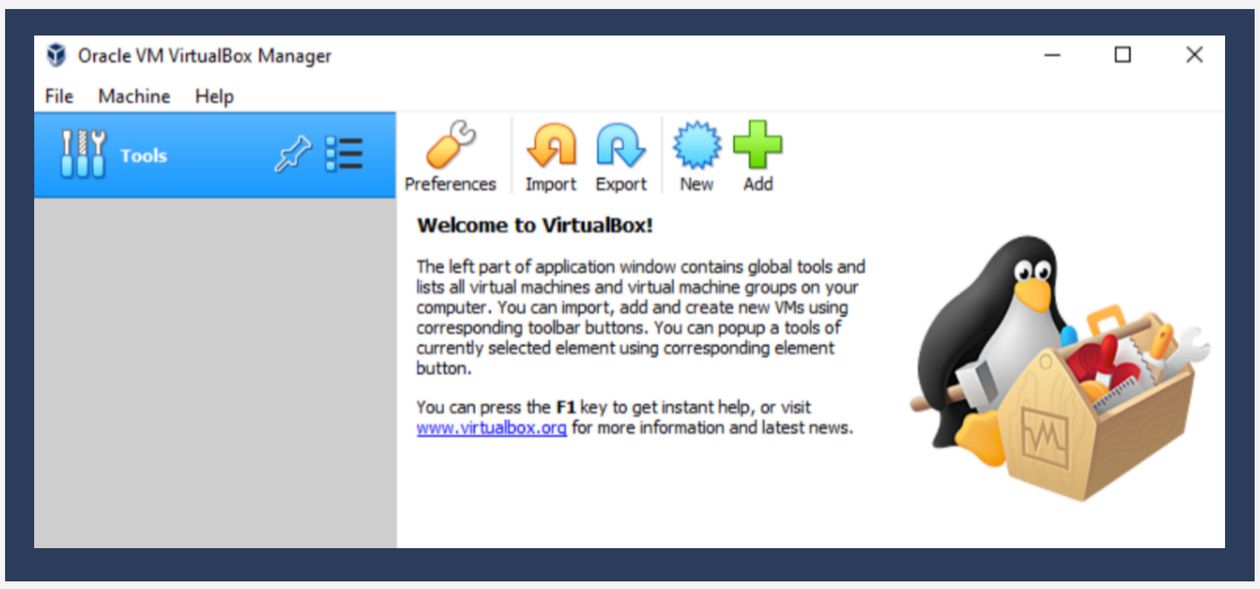
THE SYSTEM OPERATES IN A VIRTUAL MACHINE ENVIRONMENT WITH THE **UBUNTU 20.04** VOPERATING SYSTEM. A VIRTUAL MACHINE IS USED FOR THE PURPOSE OF EXPANDING COMPATIBILITY WITH THE MAIN OPERATING SYSTEM OF VARIOUS DEVICES. (NOTE: IN CASE OF USING UBUNTU 20.04 AS THE NATIVE OPERATING SYSTEM, THIS INSTALLATION IS NOT REQUIRED)

OPEN A BROWSER AND ENTER IN HTTPS://WWW.VIRTUALBOX.ORG/

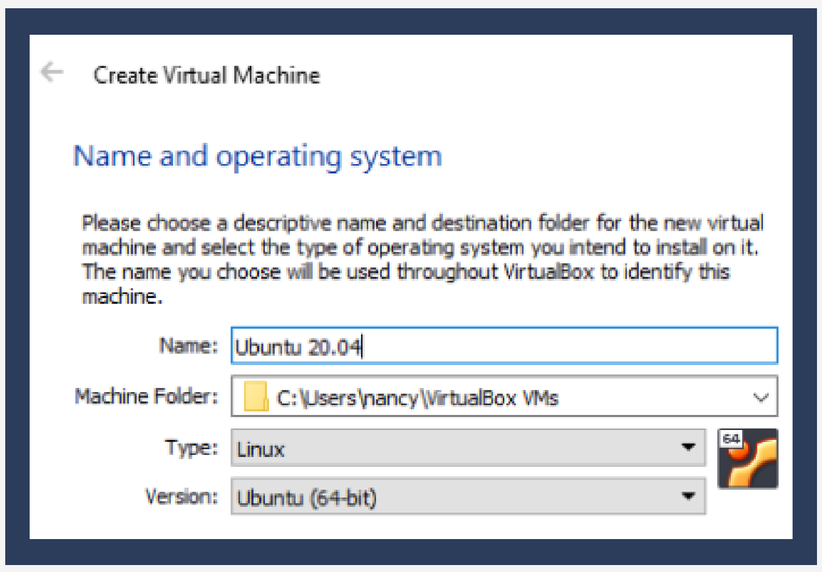


SELECT THE LATEST VERSION FOR OUR MAIN OPERATING SYSTEM AND EXECUTE THE FILE .EXE AS ADMINISTRATOR FOR GETTING ALL THE PERMISSIONS REQUIRED.

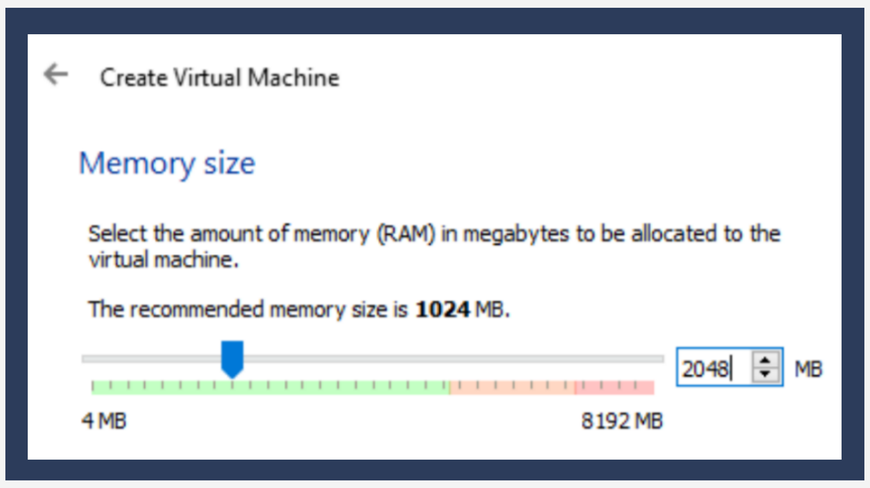
SELECT THE LATEST VERSION FOR OUR MAIN OPERATING SYSTEM AND EXECUTE THE FILE .EXE AS ADMINISTRATOR FOR GETTING ALL THE PERMISSIONS REQUIRED. WHEN INSTALLATION IS FINISHED OPEN THE SOFTWARE



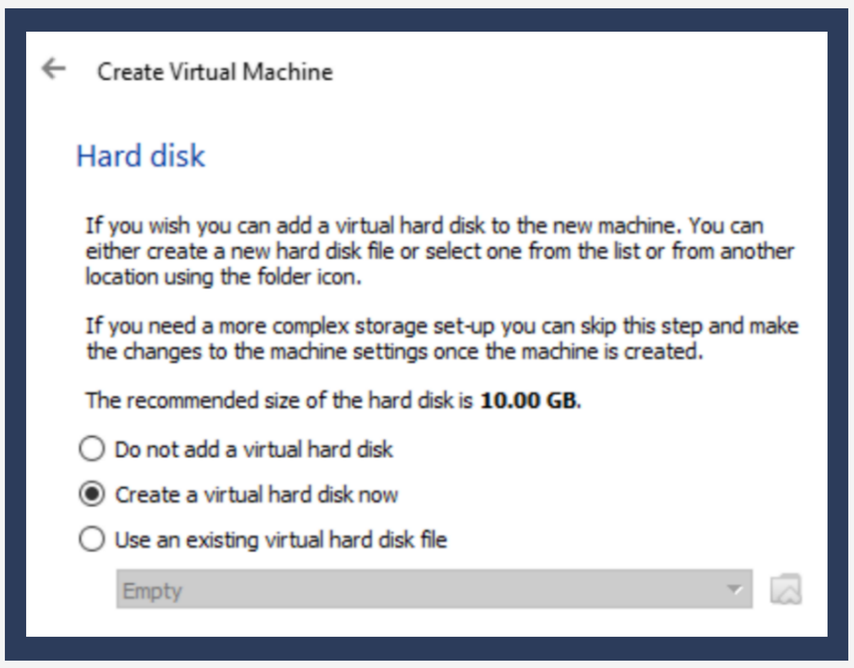
CREATE A NEW VIRTUAL MACHINE. SELECT THE NAME, TYPE AND VERSION OF THE NEW OPERATING SYSTEM. CLICK NEXT



SELECT THE AMOUNT OF RANDOM ACCESS MEMORY (RAM) THAT THE VIRTUAL MACHINE IS ALLOWED TO USE. (NOTE: FOR THE SAFETY OF THE DEVICE WE DO NOT RECOMMEND USING MORE THAN HALF OF THE RAM CONTAINED IN THE DEVICE.) CLICK NEXT.



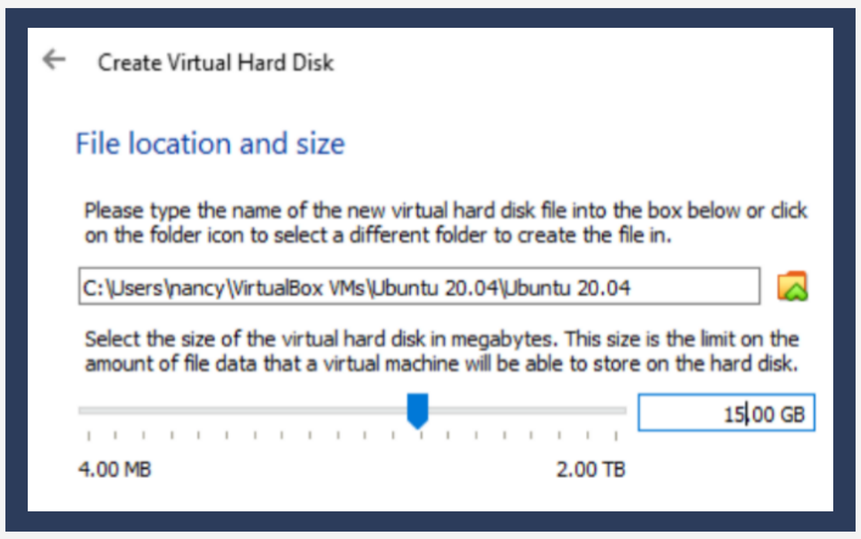
CREATE A NEW VIRTUAL DISK. CLICK CREATE



SELECT THE TYPE OF FILE FOR CREATE THE VIRTUAL HARD DISK. AS WE KNOW, IN THE PREVIOUS SECTION WE DOWNLOADED A DESKTOP IMAGE FILE WITH UBUNTU 20.04. CLICK NEXT

SELECT HOW THE STORAGE WILL BE USED. (WE RECOMMEND USING THE FIXED SIZE HARD DISK TO AVOID OVERSTORAGE.) CLICK NEXT

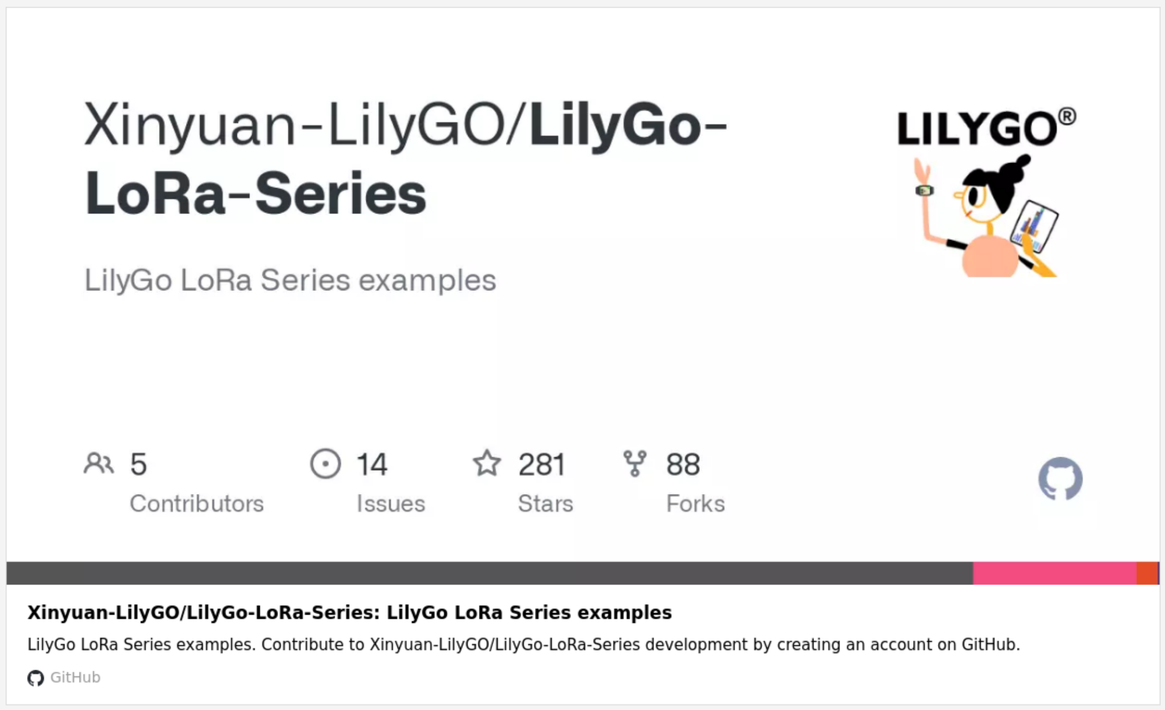
CLICK ON THE 📁 ICON AND BROWSE THE DESKTOP IMAGE PREVIOUSLY DOWNLOADED. CLICK STARR AND THEN CLICK CREATE



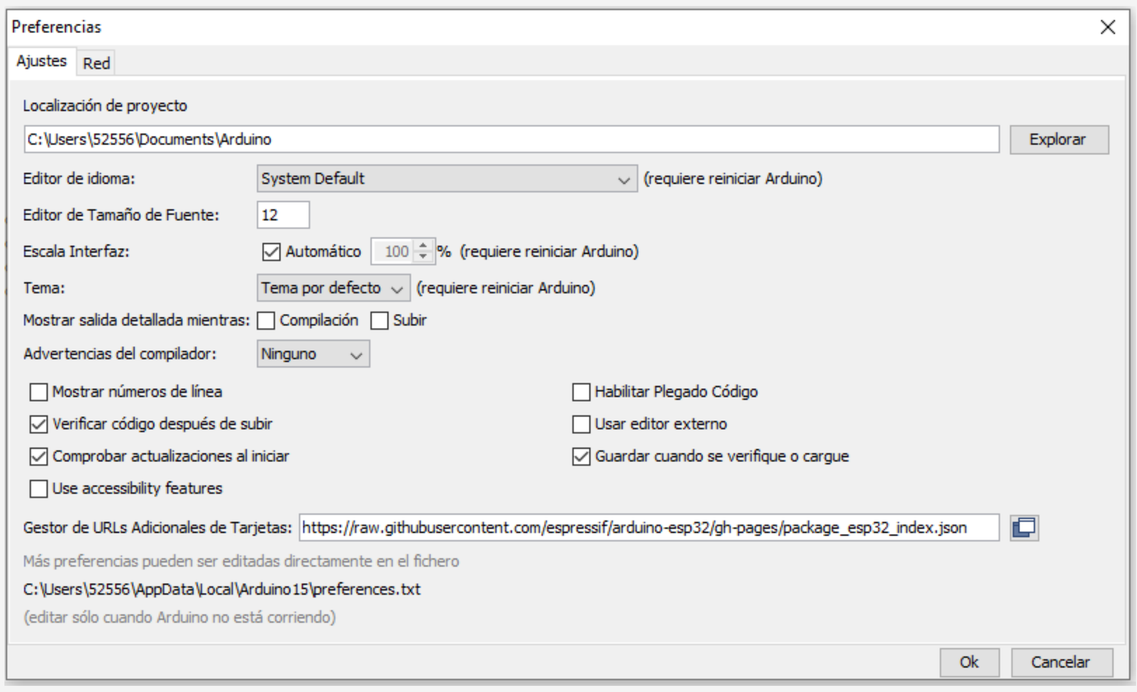
FOR THE HARDWARE SETUP

REQUIRED: 2 MODULES **T-BEAM V1.1 ESP32 (868 MHZ) CON MÓDULO WIFI, BLUETOOTH, GPS, LORA.**

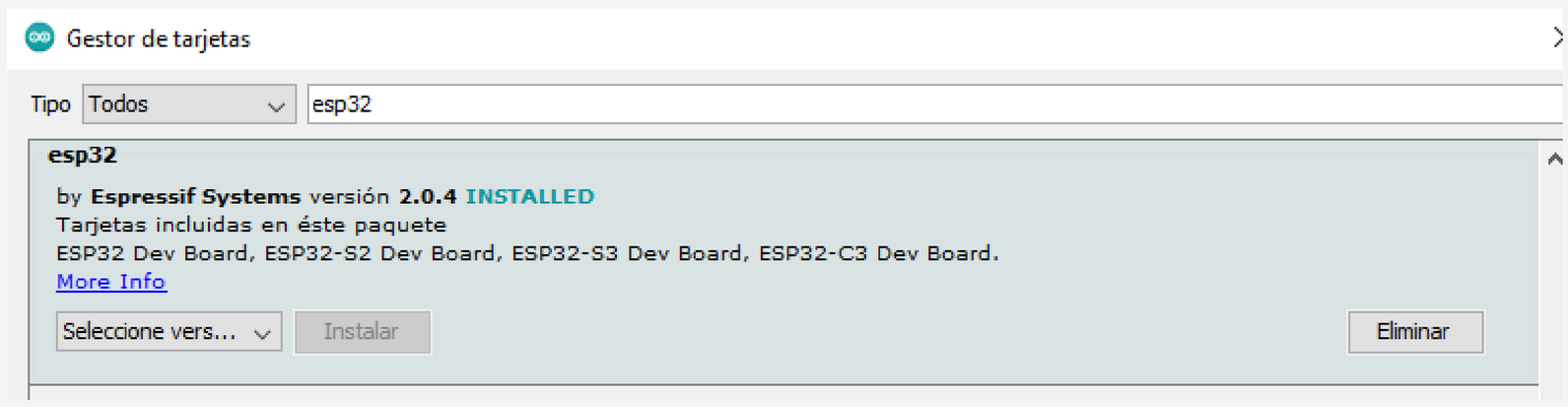
1. USING THE FOLLOWING LINK INSTALL THE CURRENT ARDUINO IDE: HTTPS://WWW.ARDUINO.CC/EN/SOFTWARE
2. DOWNLOAD THE LIBRARY OF THE BOARD *LILYGO® TTGO T-BEAM V1.1 LORA ESP32* IN .ZIP FORMAT: HTTPS://GITHUB.COM/XINYUAN-LILYGO/LILYGO-LORA-SERIES



1. COPY THE FOLDERS FROM "LIBDEPS" TO \DOCUMENTS\ARDUINO\LIBRARIES
2. START ARDUINO AND OPEN PREFERENCES WINDOW. IN FILE > PREFERENCES > ADDITIONAL BOARD MANAGER ADD URL: HTTPS://RAW.GITHUBUSERCONTENT.COM/ESPRESSIF/ARDUINO-ESP32/GH-PAGES/PACKAGE_ESP32_INDEX.JSON

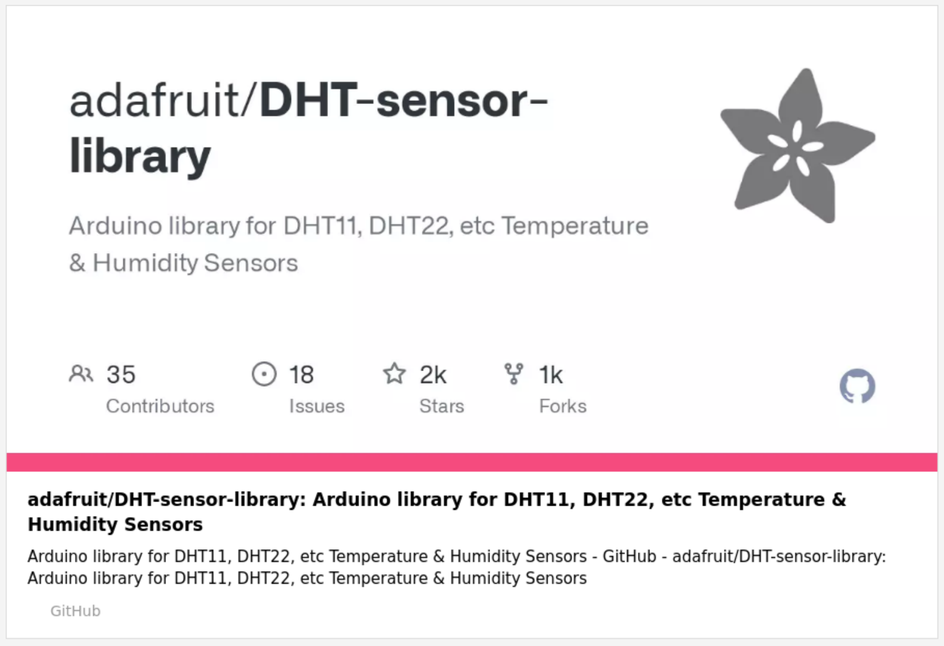


1. IN THE ARDUINO APPLICATION, NAVIGATE TO THE BOARD MANAGER MENU TOOLS > BOARD > BOARD MANAGER SEARCH FOR ESP32

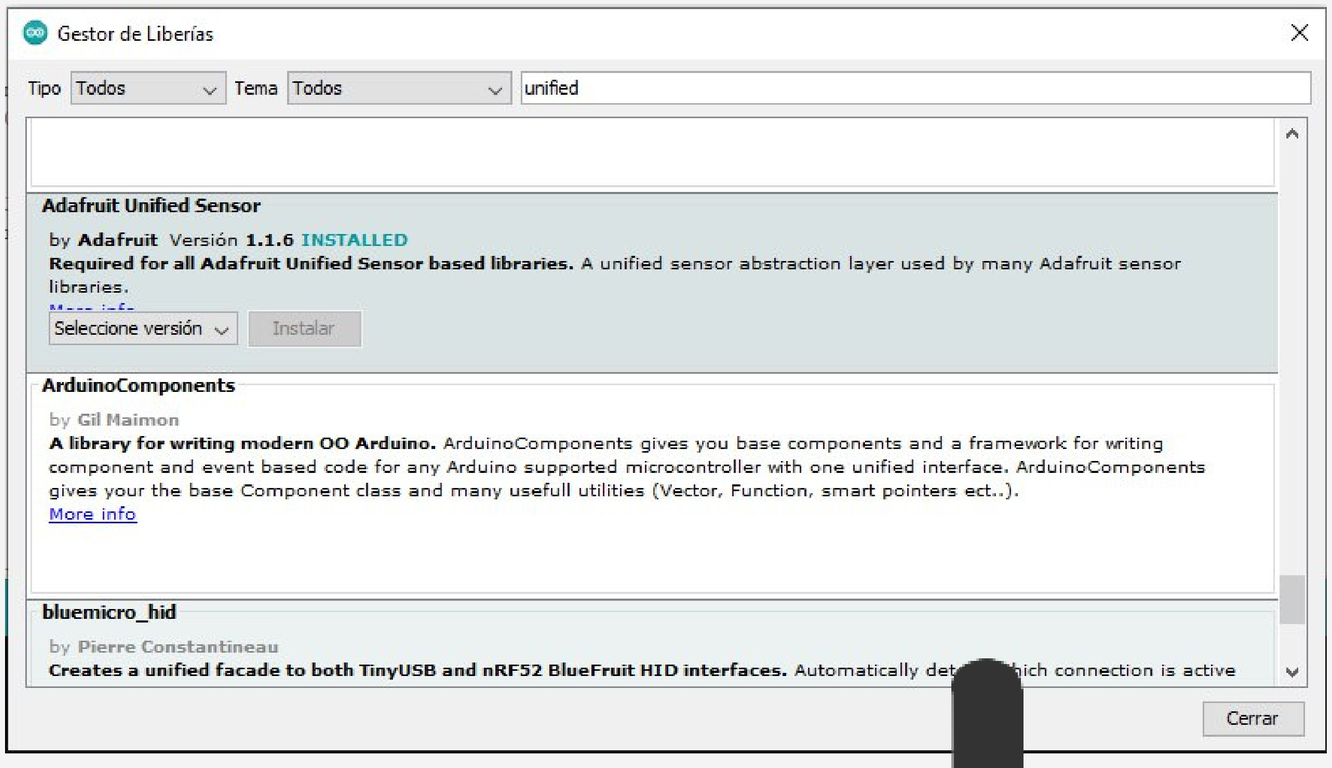


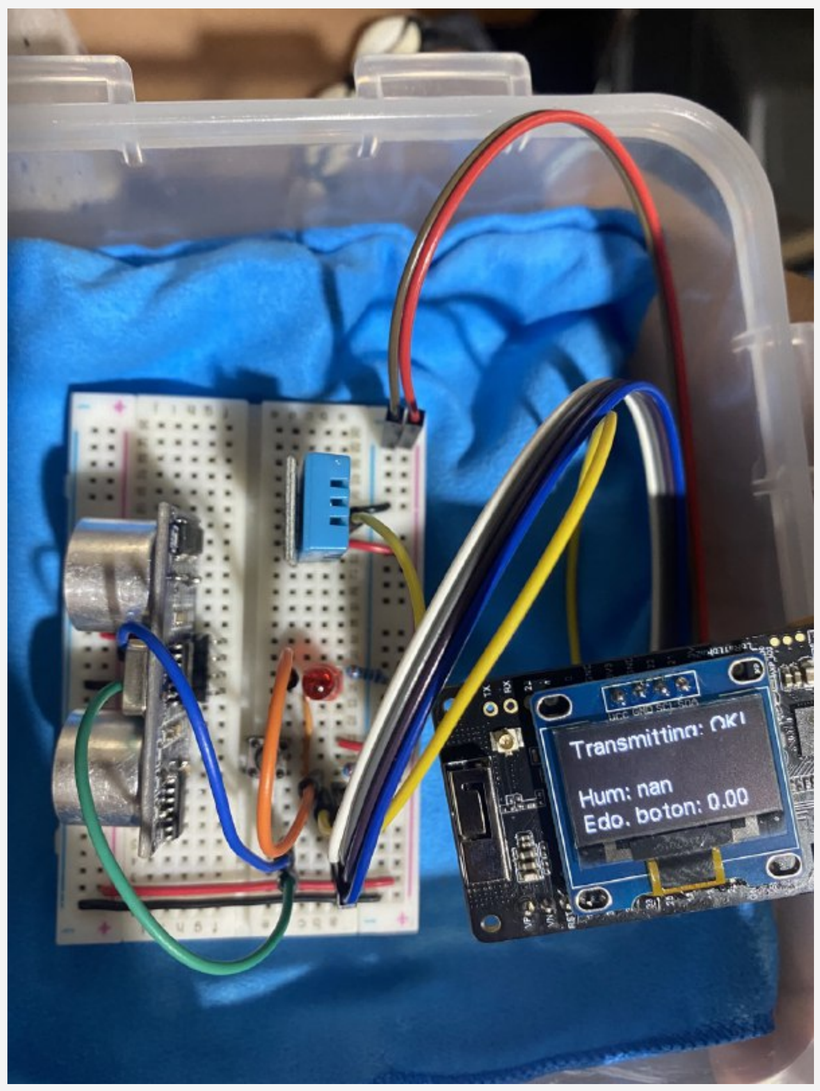
OTHER NEEDED LIBRARIES FOR THE SIMULATION SENSORS

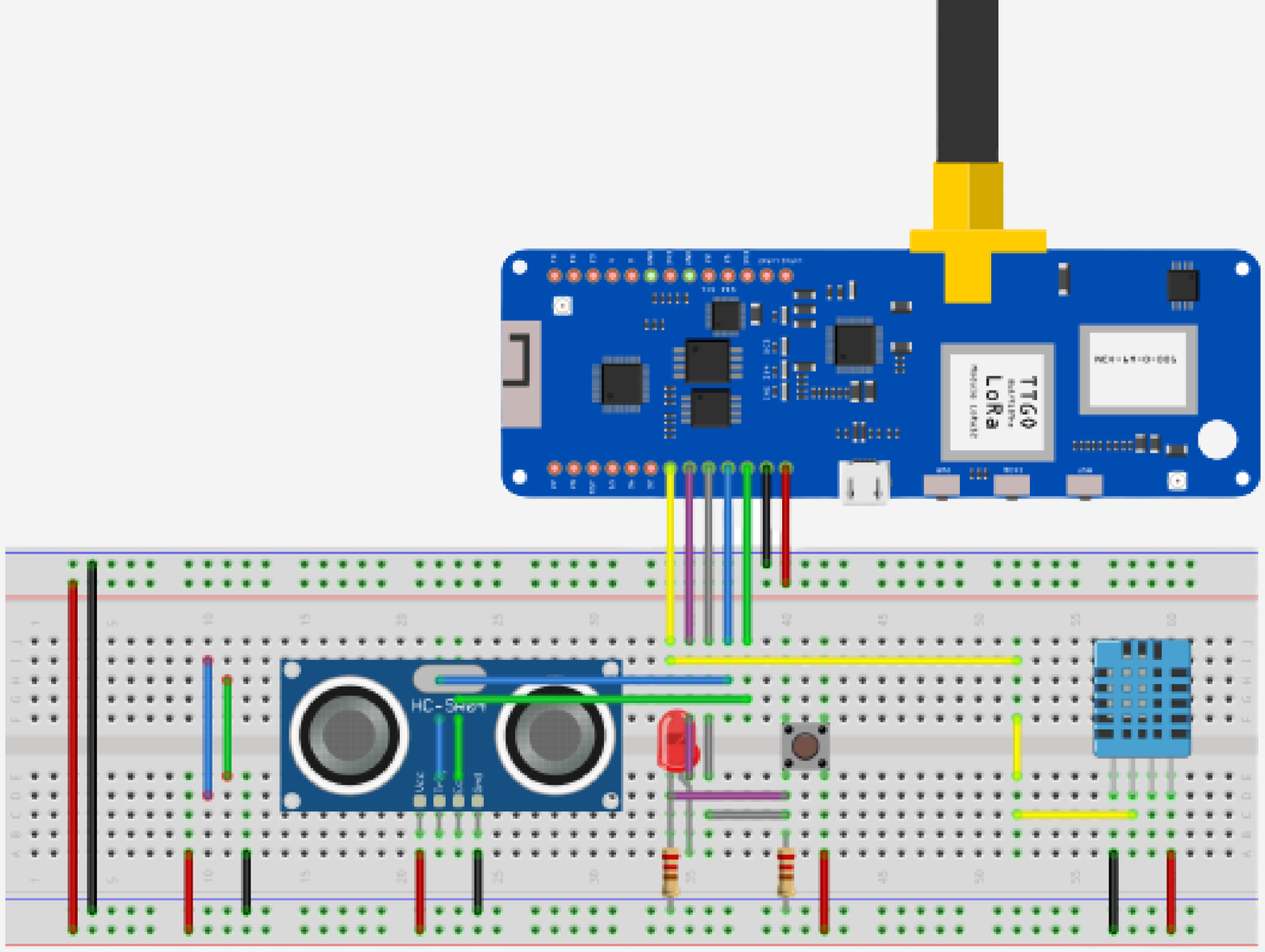
TEMPERATURE AND HIMIDITY SENSOR



ADA-FRUIT UNIFIED SENSOR





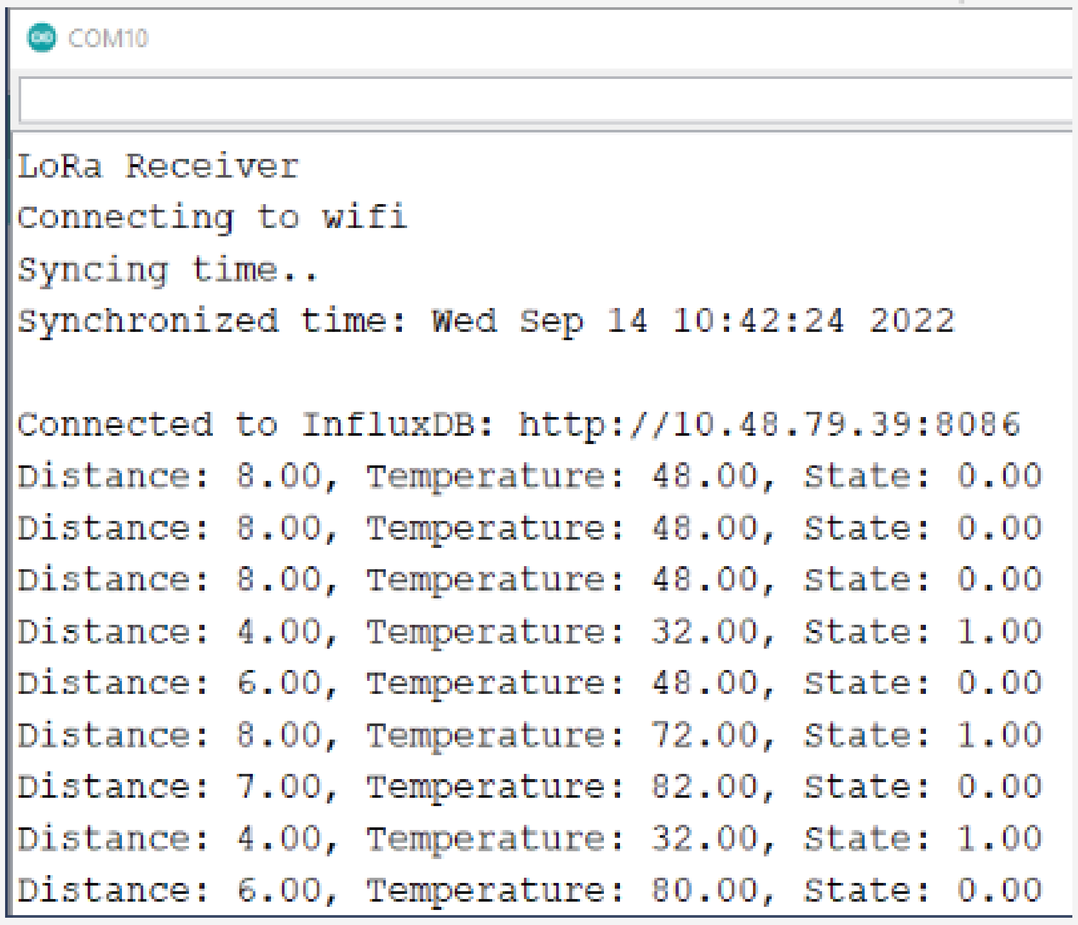


USING THE SENSORS, IT IS POSSIBLE TO SEND VIA LONG RANGE INFORMATION ABOUT

- HUMIDITY
- TEMPERATURE
- DISTANCE FROM AN OBJECT
- AN ALARM (IF THE BUTTON IS PRESSED, THE LED TURNS ON)

THE BOARDS CAN BE IN DIFERENT PLACES WITH OUT LOOSING CONNECTION, DEPPENDING ON SOME FACTORS AS WEATHER, MATERIAL OF THE WALLS, ETC.

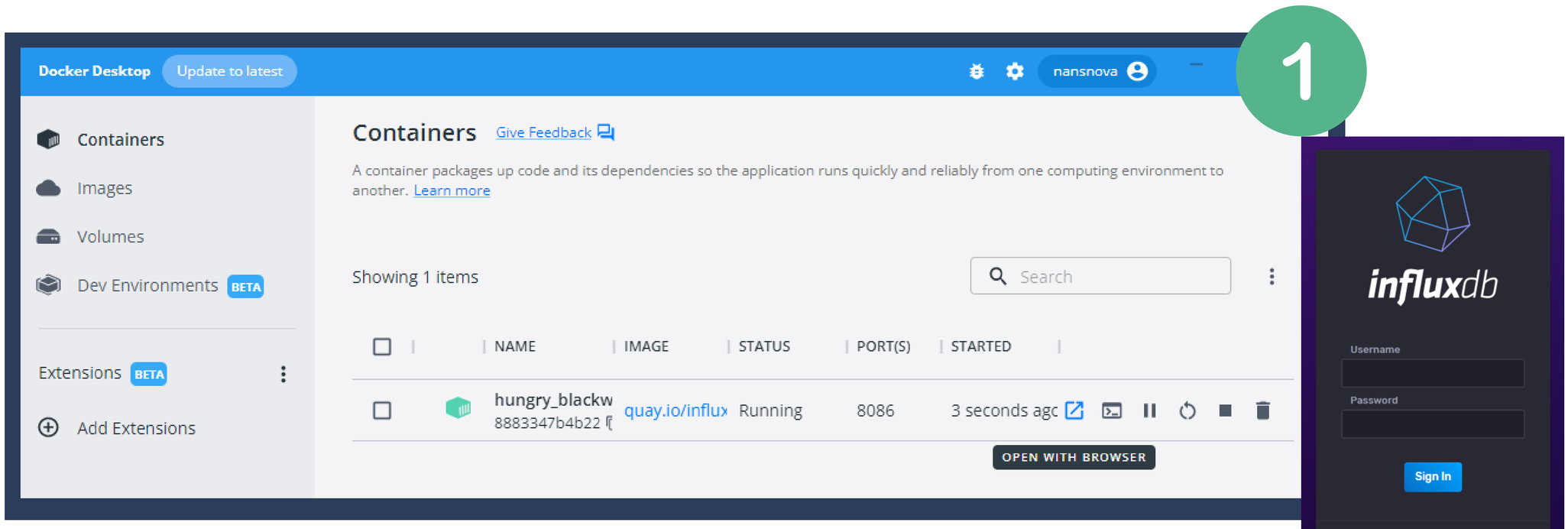
WIFI CONNECTION IS NEEDED FOR THE VISUALIZATION OF THE DATA IN A DASHBOARD, SINCE IT IS IN A WEB BROWSER.

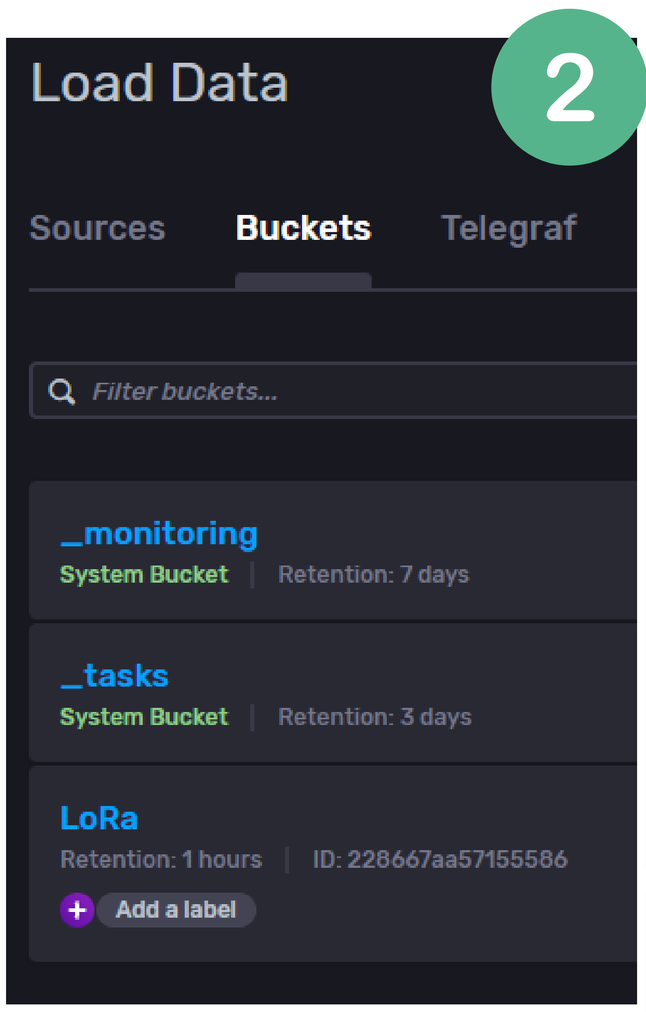


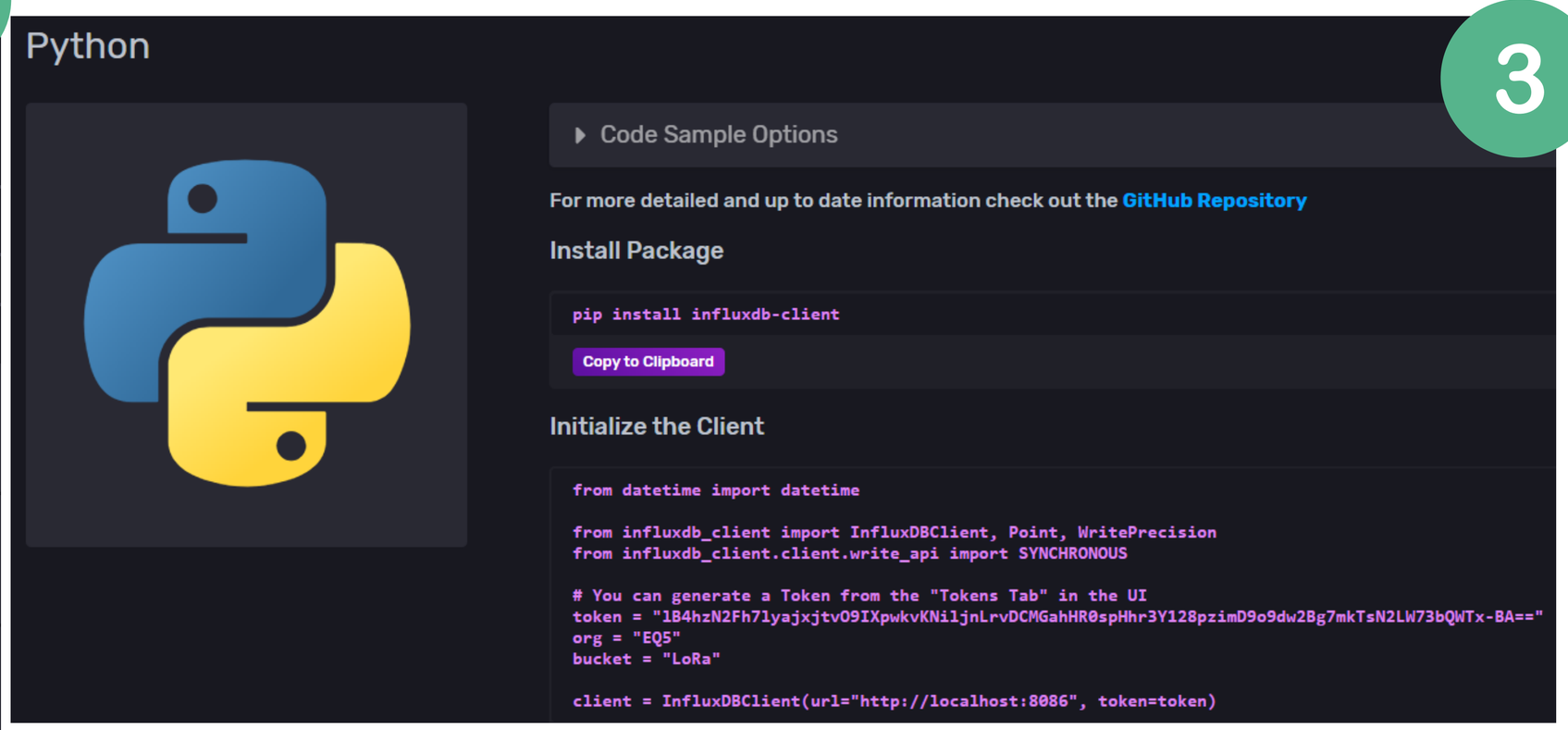
TIME TO INITIALIZE THE CLOUD DB

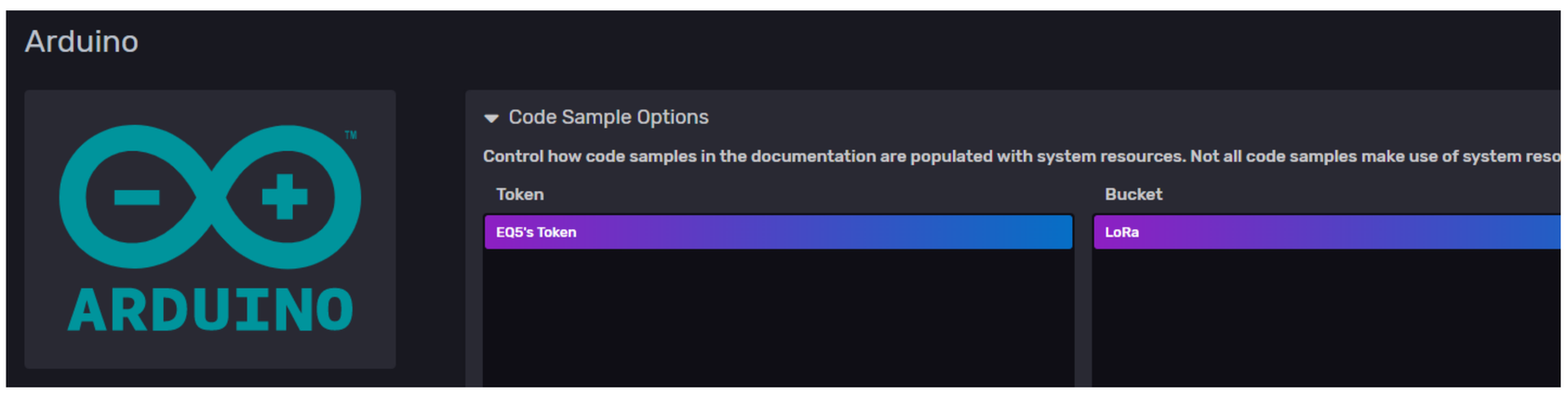
ONE T-BEAM WILL BE USED AS A SERVER CONNECTED TO THE INTERNET (RECEIVER) AND AND THE OTHER WILL BE READING THE SIMULATION SENSORS OR THE DATA IN THE CSV (SENDER).
BOTH WILL USE LONG RANGE COMMUNICATION TO SEND THE DATA BETWEEN THEM.

1. ONCE DOCKER IS INITIALIZED (IN THE CLOUD OR LOCALLY USING UBUNTU), LOGING IN USING A WEB BROWSER
2. CREATE A BUCKET THAT WILL BE USED AS A DATABASE
3. OBTAINING THE CREDENTIALS REQUIRED TO INTERFACE THAT BUCKER WITH INFLUX, ARDUINO AND PYTHON. IN HOME > LOAD DATA > SOURCES > ARDUINO/PYTHON









FOR THE SIMULATION USING REAL SENSORS:

1. VERIFY UTILITIES.H FILE WITH THE 868HZ FRECUENCY AND THE RIGHT #DEFINE THE LILYGO_TBEAM VERSION.
2. SET UP THE LIBRARIES PREVIOUSLY MENTIONED FOR THE SENSORS AND INFLUX.
3. CONNECT THE BUTTON, LED, DHT11 AND ULTRASONIC SENSOR AS IN THE DIAGRAM.
4. RUN THE SENDER CODE, THAT CAN BE FOUND IN THE GITHUB REPOSITORY LORA-COMMUNICATION > RETO > LORASENDERFINAL.INO
5. OBTAINING THE CREDENTIALS REQUIRED TO INTERFACE THAT BUCKER WITH INFLUX, ARDUINO AND PYTHON (TO SEND TO A CSV) AND REPLACE THE FOLLOWIN #DEFINE LINES:
6. RUN THE RECIVER CODE, (IN THE GITHUB REPOSITORY)
   LORA-COMMUNICATION > RETO > LORARECEIVERFINAL.INO

```
26    # Database Specifications
27    bucket = "LoRa"
28    url = "http://192.168.1.70:8086"
29    token = "1B4hzN2Fh7lyajxjtvO9IXpwkvKNiljnL
30    org = "EQ5"
```

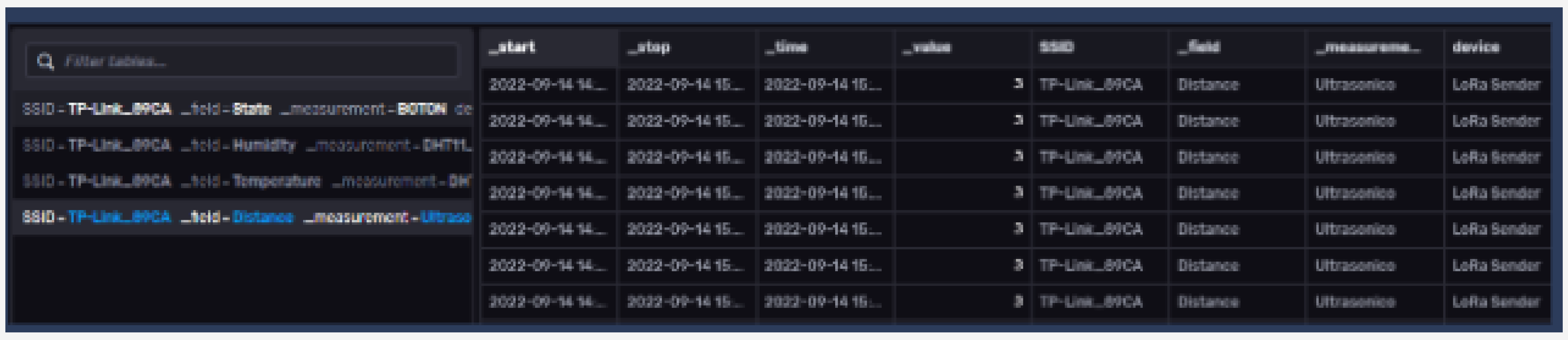
```
#define WIFI_SSID "TP-Link_89CA"
#define WIFI_PASSWORD "47626096"
#define INFLUXDB_URL "http://192.168.1.70:80
#define INFLUXDB_TOKEN "1B4hzN2Fh7lyajxjtvO9
#define INFLUXDB_ORG "EQ5"
#define INFLUXDB_BUCKET "LoRa"
#define TZ_INFO "AEDT+11"
```

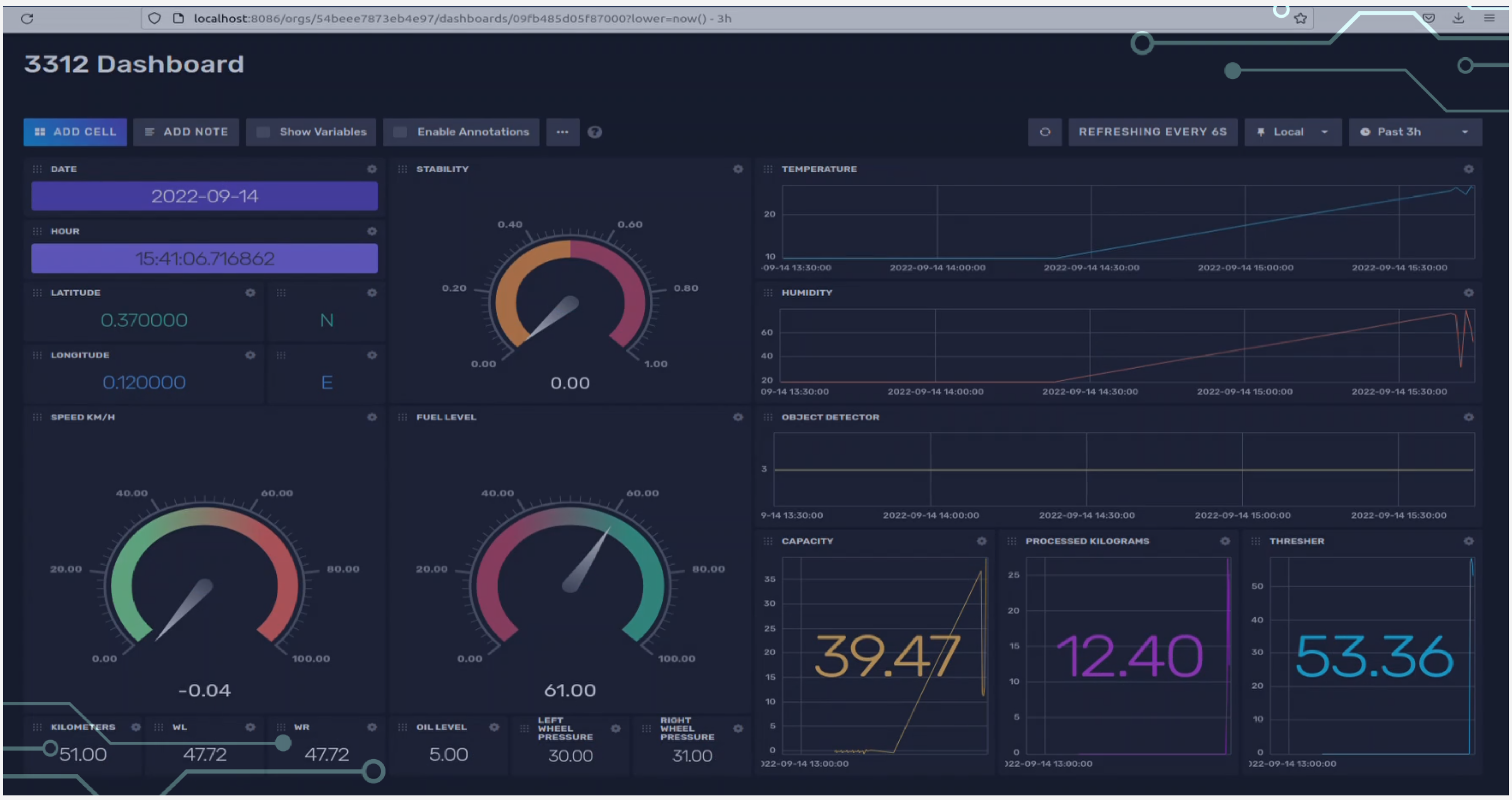
FOR THE CSV READ:

1. REPLACE LINES 27-30 OF THE LOAD_CSV.PY FILE WITH THE RIGHT CREDENTIALS
2. RUN THE SERIAL_READ.PY CODE FOR READING THE SERIAL MONITOR
3. RUN THE FILL_CSV.PY CODE TO CREATE THE CSV WITH THE SYNTHETIC DATA
4. RUN THE LOAD_CSV.PY CODE FILE TO EXPORT ALL THE DATA TO INFLUX
5. IF THE REQUEST IS SUCCESFUL, THE FINAL MESSAGE SHOULD LOOK LIKE THIS:

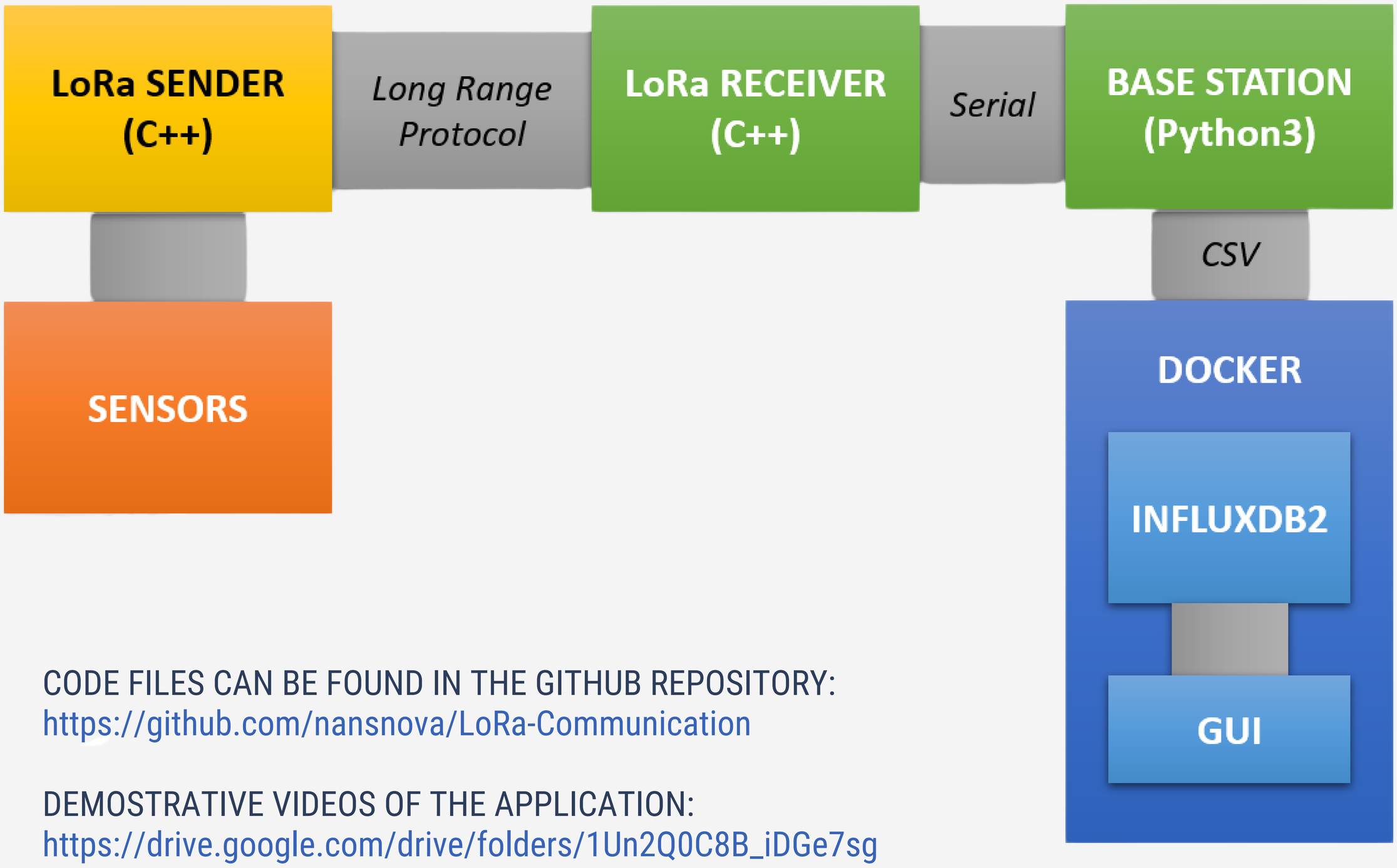
```
>>> Request: 'POST http://192.168.1.70:8086/api/v2/write?org=EQ5&bucket=LoRa&precision=ns'
>>> Content-Encoding: identity
>>> Content-Type: text/plain
>>> Accept: application/json
>>> Authorization: ***
>>> User-Agent: influxdb-client-python/1.32.0
>>> Body: b'Tractor\\ 3312 ALERT=0,CH_FUEL=98i,CH_KM=14i,CH_LWP=31i,CH_OIL=5i,CH_RWP=31i,CS_FILL=22.49,CS_KGP=
14.46,CS_VEL_TH=52.07,DIST=3.35,GPS_COOR_LAT="S",GPS_COOR_LONG="E",GPS_DATE="2022-09-17",GPS_H="00:01:48.44194
1",GPS_LAT=52.74,GPS_LONG=8.1,GPS_ORI=0.22,GPS_VALID="A",GPS_VEL=-0.07,HUM=42.36,IMU_AX=0.07,IMU_AY=-0.12,IMU_
AZ=0.47,IMU_GX=0.06,IMU_GY=-0.12,IMU_GZ=-0.19,TEMP=22.18,WL=47.86,WR=47.86'
<<< Response: 204
<<< Date: Sat, 17 Sep 2022 05:06:53 GMT
<<< Body:
```

FINALLY, ACCESS THE ADDRESS OF THE DASHBOARD TO VISUALIZE THE REAL-TIME DATA





DIAGRAM



CODE FILES CAN BE FOUND IN THE GITHUB REPOSITORY:
https://github.com/nansnova/LoRa-Communication

DEMOSTRATIVE VIDEOS OF THE APPLICATION:
https://drive.google.com/drive/folders/1Un2Q0C8B_iDGe7sgJGnMggByVuSU9KQ2?usp=sharing

SUPPORT

FOR FURTHER HELP FEEL FREE TO CONTACT US!

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