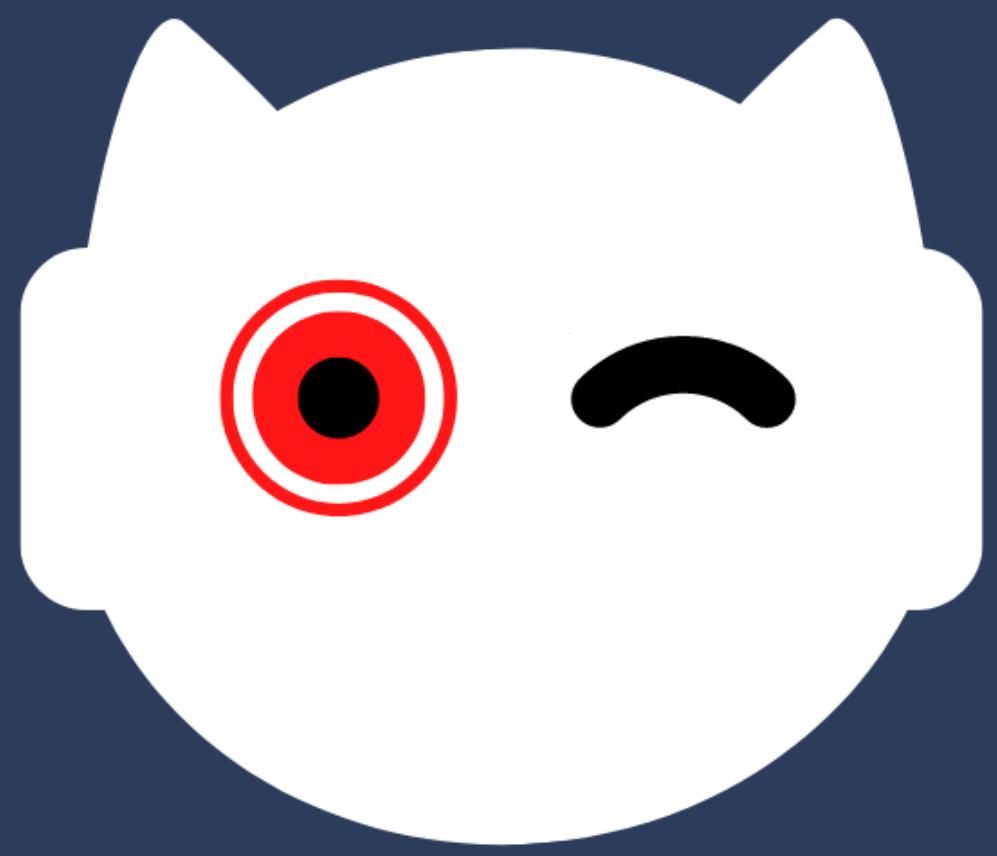


# USER MANUAL

COLLABORATIVE AND LONG RANGE  
INTERCOMMUNICATED MOBILE  
CYBER-PHYSICAL SYSTEM



CYBER-PHYSICAT  
SYSTEMS



Helgen

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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/](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!)

**Desktop image**

The desktop image allows you to try Ubuntu without changing your computer at all, and at your option to install it permanently later. This type of image is what most people will want to use. You will need at least 1024MiB of RAM to install from this image.

[64-bit PC \(AMD64\) desktop image](#)

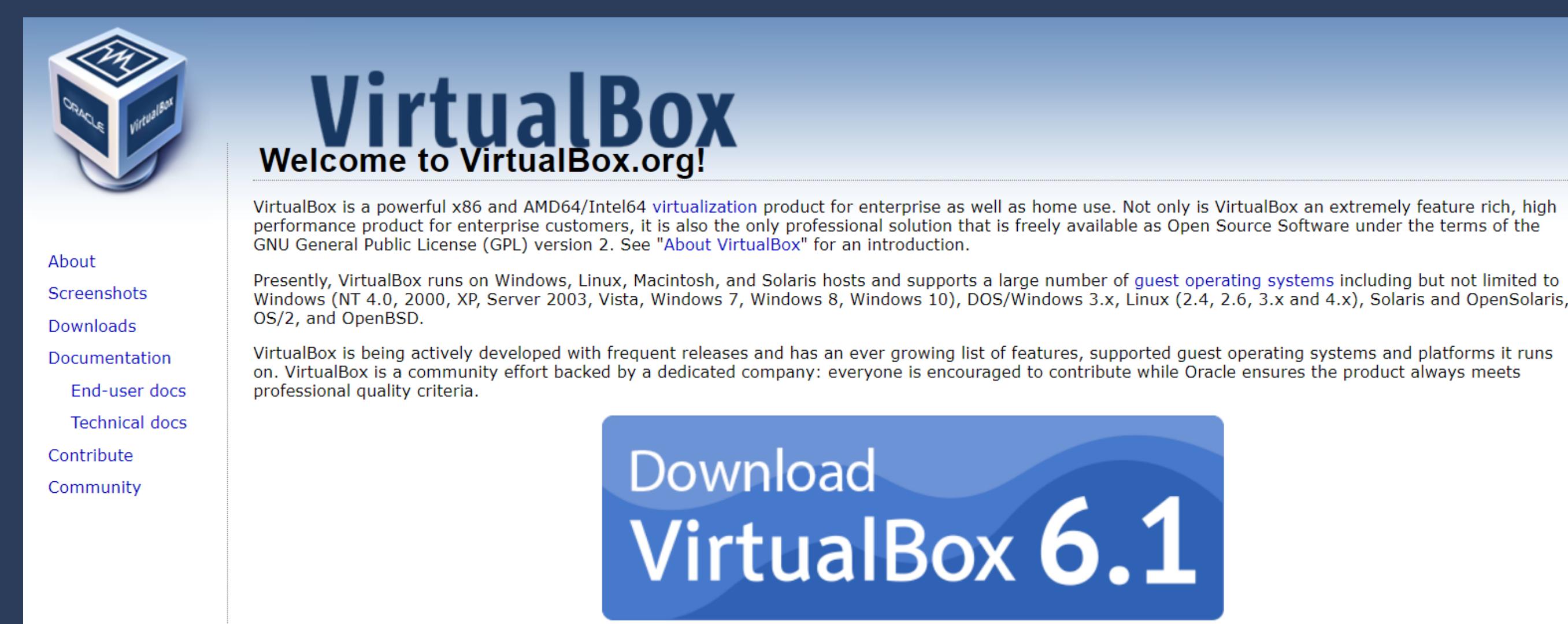
Choose this if you have a computer based on the AMD64 or EM64T architecture (e.g., Athlon64, Opteron, EM64T Xeon, Core 2). Choose this if you are at all unsure.



## 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/](https://www.virtualbox.org/)

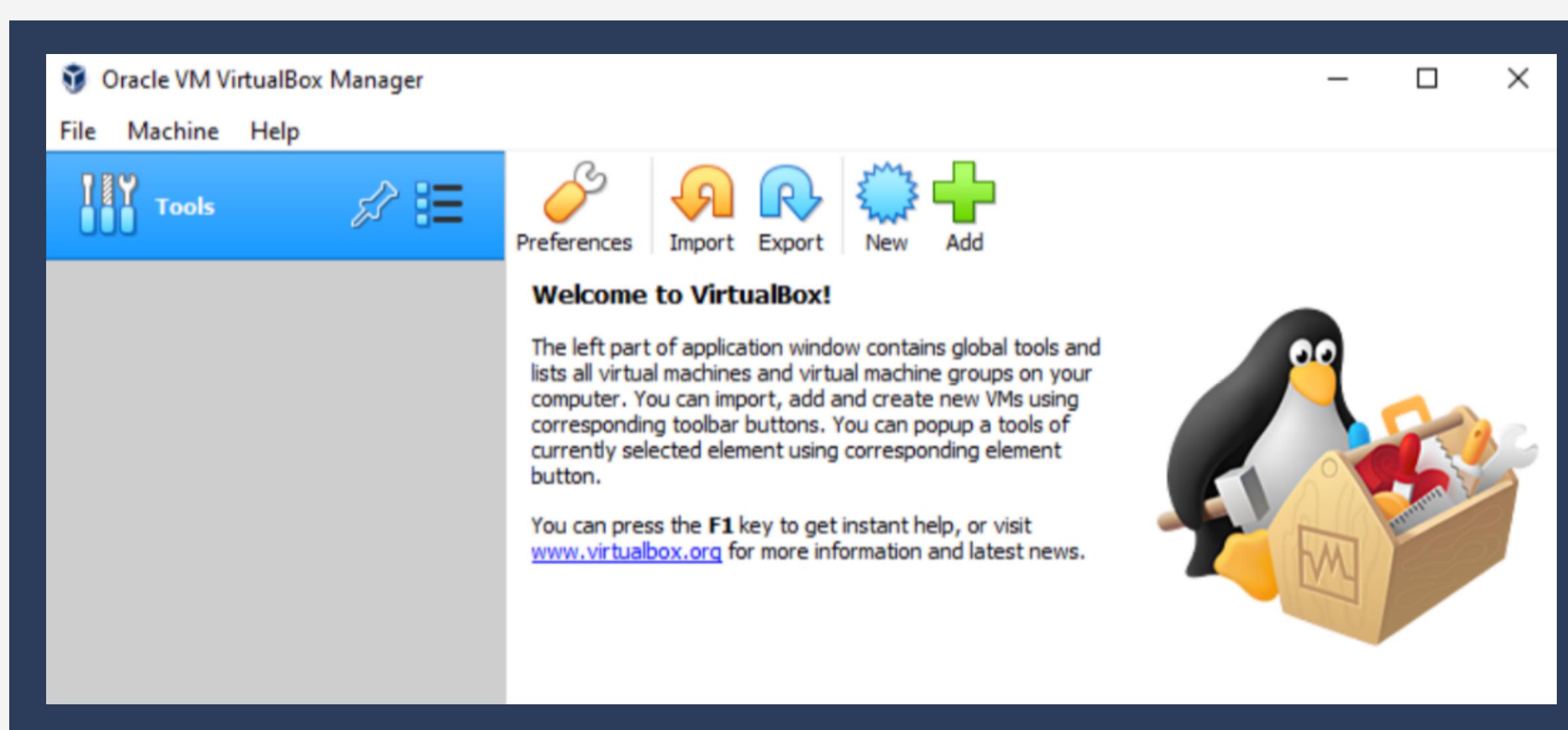


The screenshot shows the official VirtualBox website. At the top left is the VirtualBox logo. To its right, the text "Welcome to VirtualBox.org!" is displayed. Below this, there is a brief description of the product: "VirtualBox is a powerful x86 and AMD64/Intel64 virtualization product for enterprise as well as home use. Not only is VirtualBox an extremely feature rich, high performance product for enterprise customers, it is also the only professional solution that is freely available as Open Source Software under the terms of the GNU General Public License (GPL) version 2. See "About VirtualBox" for an introduction." Further down, another description states: "Presently, VirtualBox runs on Windows, Linux, Macintosh, and Solaris hosts and supports a large number of guest operating systems including but not limited to Windows (NT 4.0, 2000, XP, Server 2003, Vista, Windows 7, Windows 8, Windows 10), DOS/Windows 3.x, Linux (2.4, 2.6, 3.x and 4.x), Solaris and OpenSolaris, OS/2, and OpenBSD." At the bottom right of the main content area, there is a large blue button with the text "Download VirtualBox 6.1". On the left side of the page, there is a sidebar with links: "About", "Screenshots", "Downloads", "Documentation", "End-user docs", "Technical docs", "Contribute", and "Community".

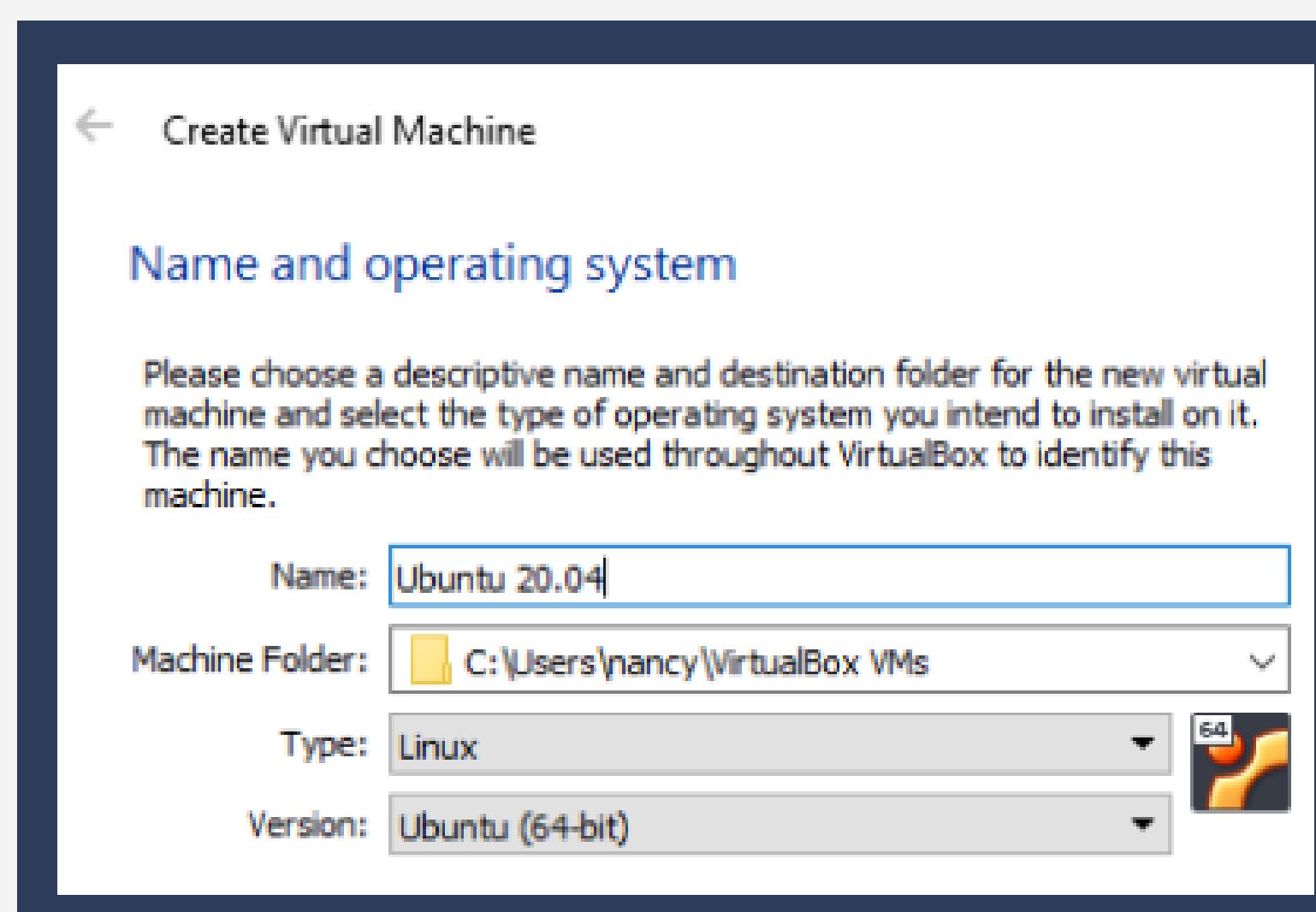
SELECT THE LATEST VERSION FOR OUR MAIN OPERATING SYSTEM AND EXECUTE THE FILE .EXE AS ADMINISTRATOR FOR GETTING ALL THE PERMISSIONS REQUIRED.



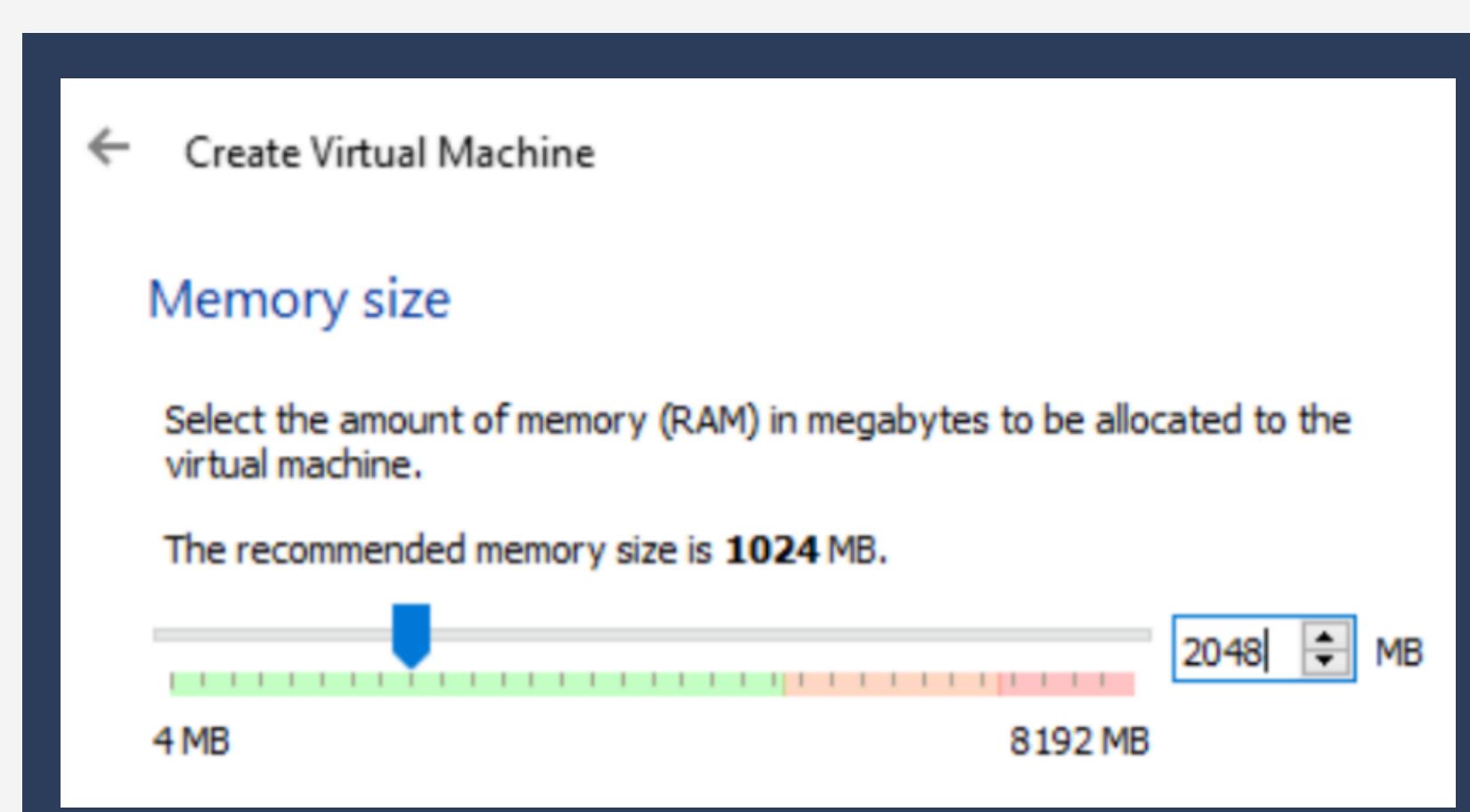
SELECT THE LATEST VERSION FOR OUR MAIN OPERATING SYSTEM AND EXECUTE THE FILE .EXE AS ADMINISTRATOR FOR GETTING ALL THE PERMISSIONS REQUIRED. WHEN INSTALLATION IS FINISHED OPEN THE SOFTWARE



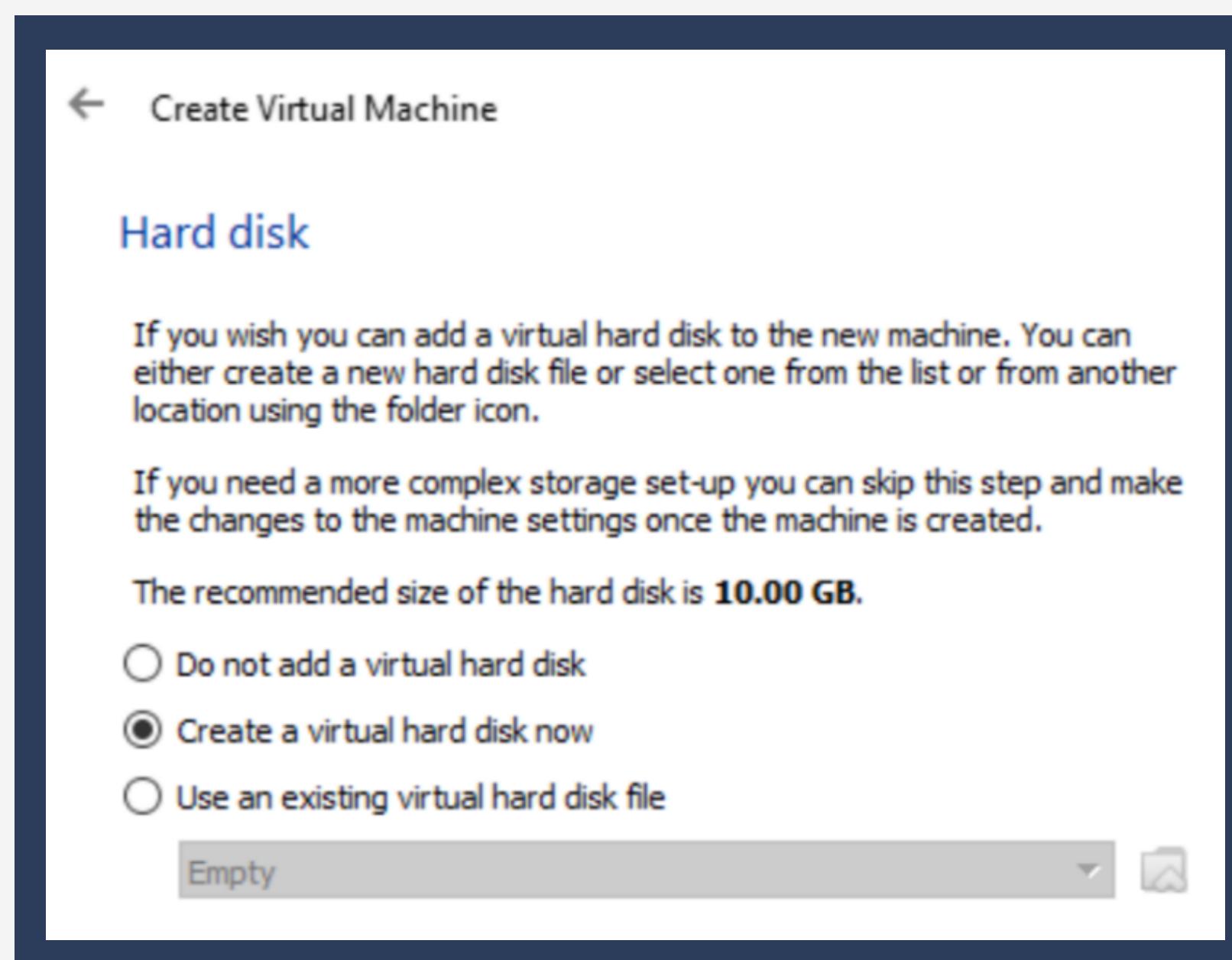
CREATE A NEW VIRTUAL MACHINE. SELECT THE NAME, TYPE AND VERSION OF THE NEW OPERATING SYSTEM. CLICK NEXT



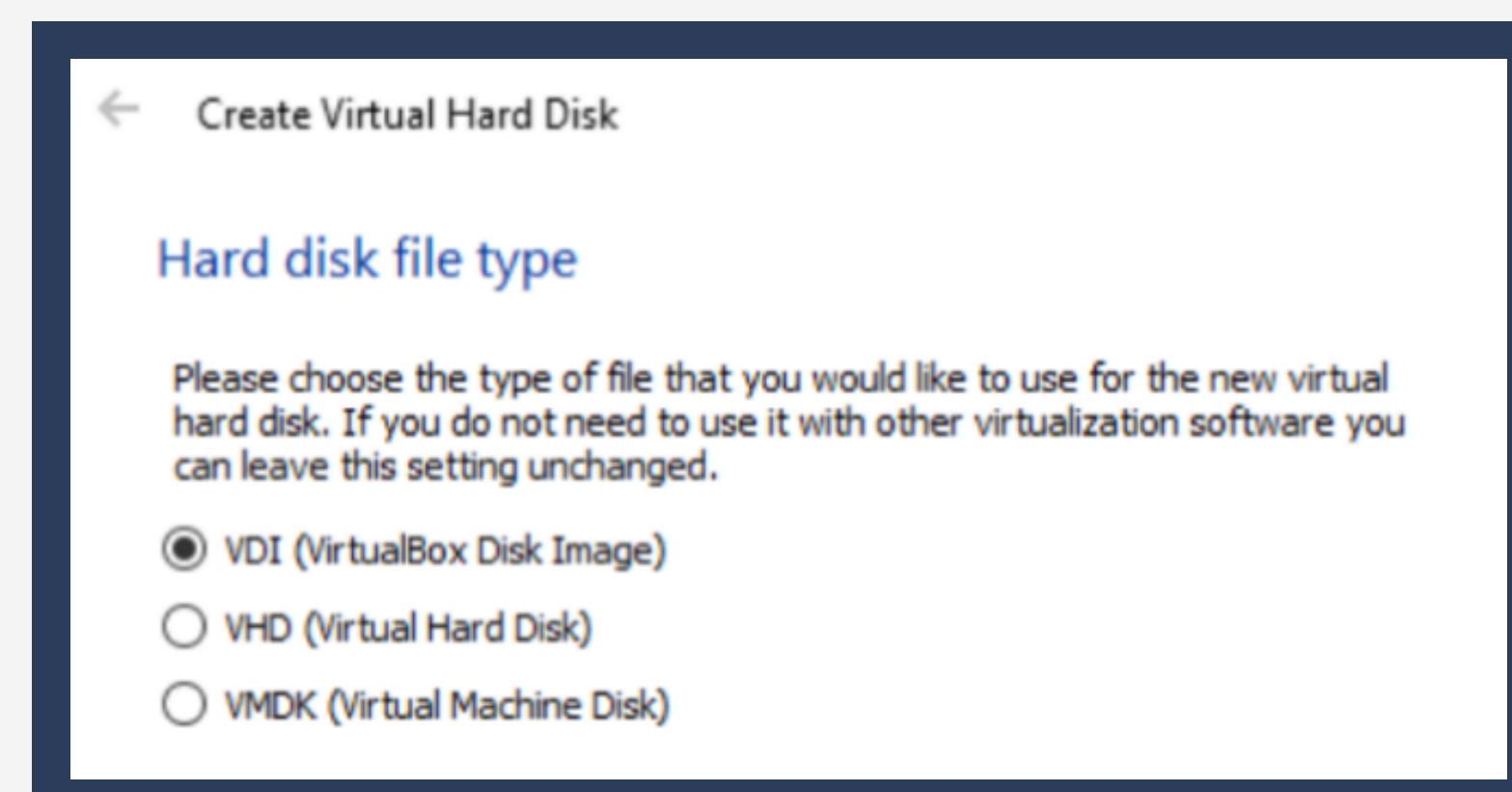
SELECT THE AMOUNT OF RANDOM ACCESS MEMORY (RAM) THAT THE VIRTUAL MACHINE IS ALLOWED TO USE. (NOTE: FOR THE SAFETY OF THE DEVICE WE DO NOT RECOMMEND USING MORE THAN HALF OF THE RAM CONTAINED IN THE DEVICE.) CLICK NEXT.



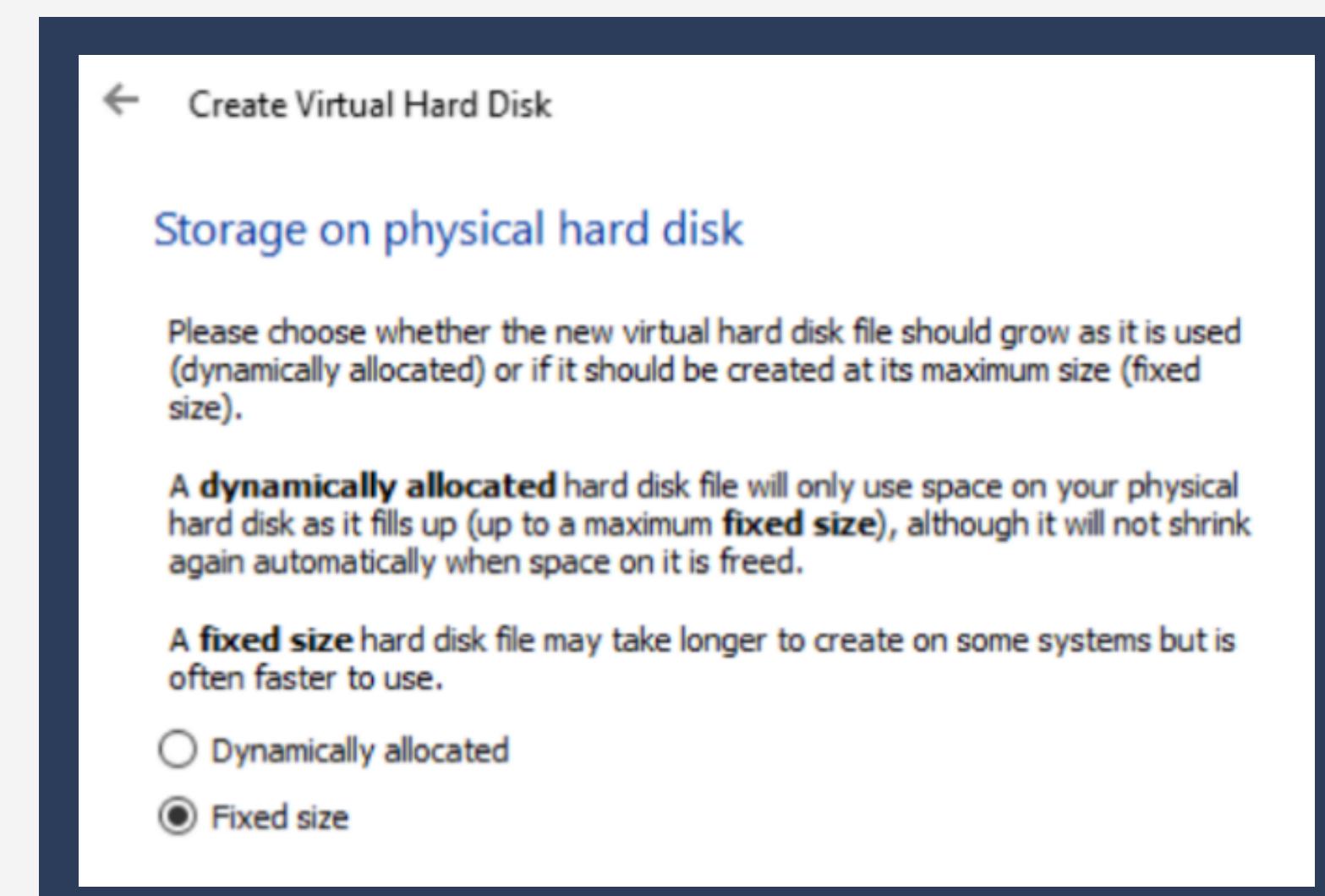
## CREATE A NEW VIRTUAL DISK. CLICK CREATE



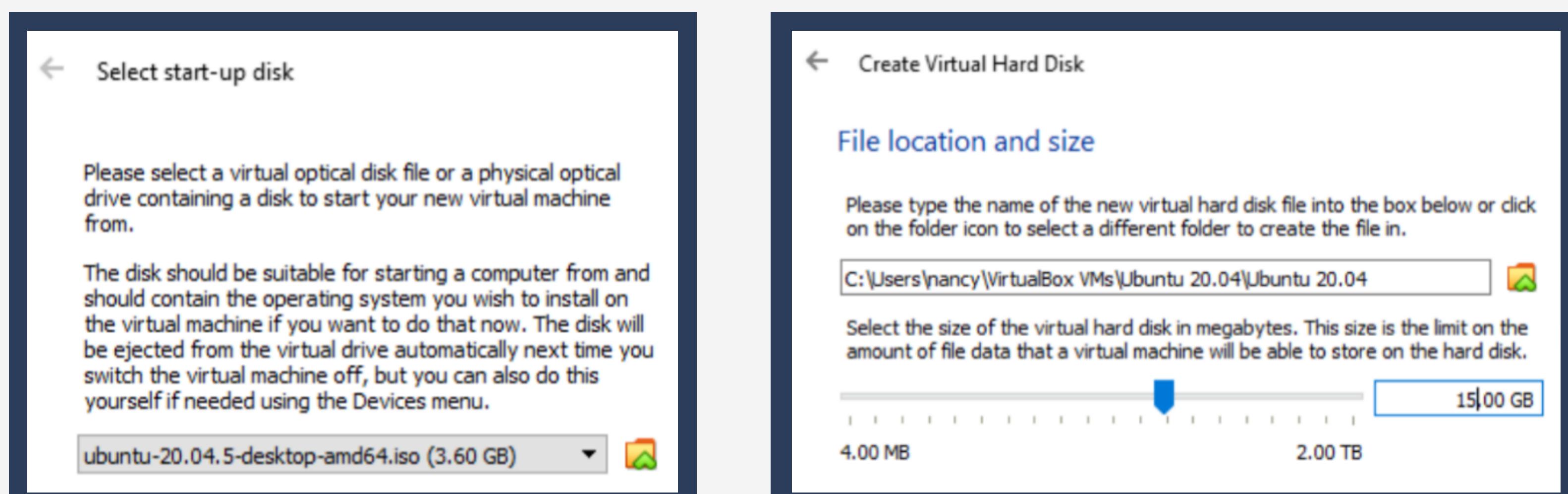
SELECT THE TYPE OF FILE FOR CREATE THE VIRTUAL HARD DISK. AS WE KNOW, IN THE PREVIOUS SECTION WE DOWNLOADED A DESKTOP IMAGE FILE WITH UBUNTU 20.04. CLICK NEXT



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



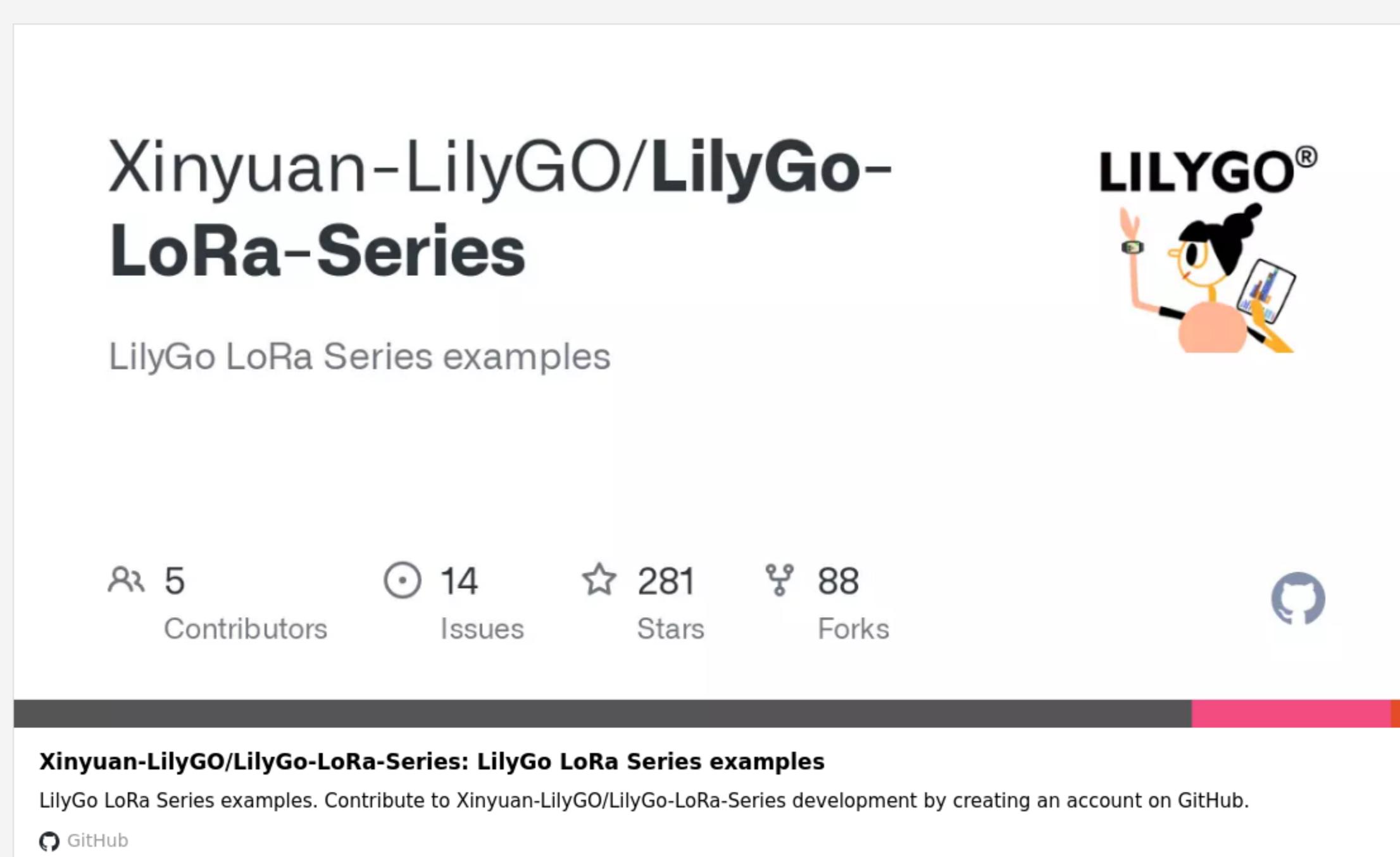
# FOR THE HARDWARE SETUP

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:

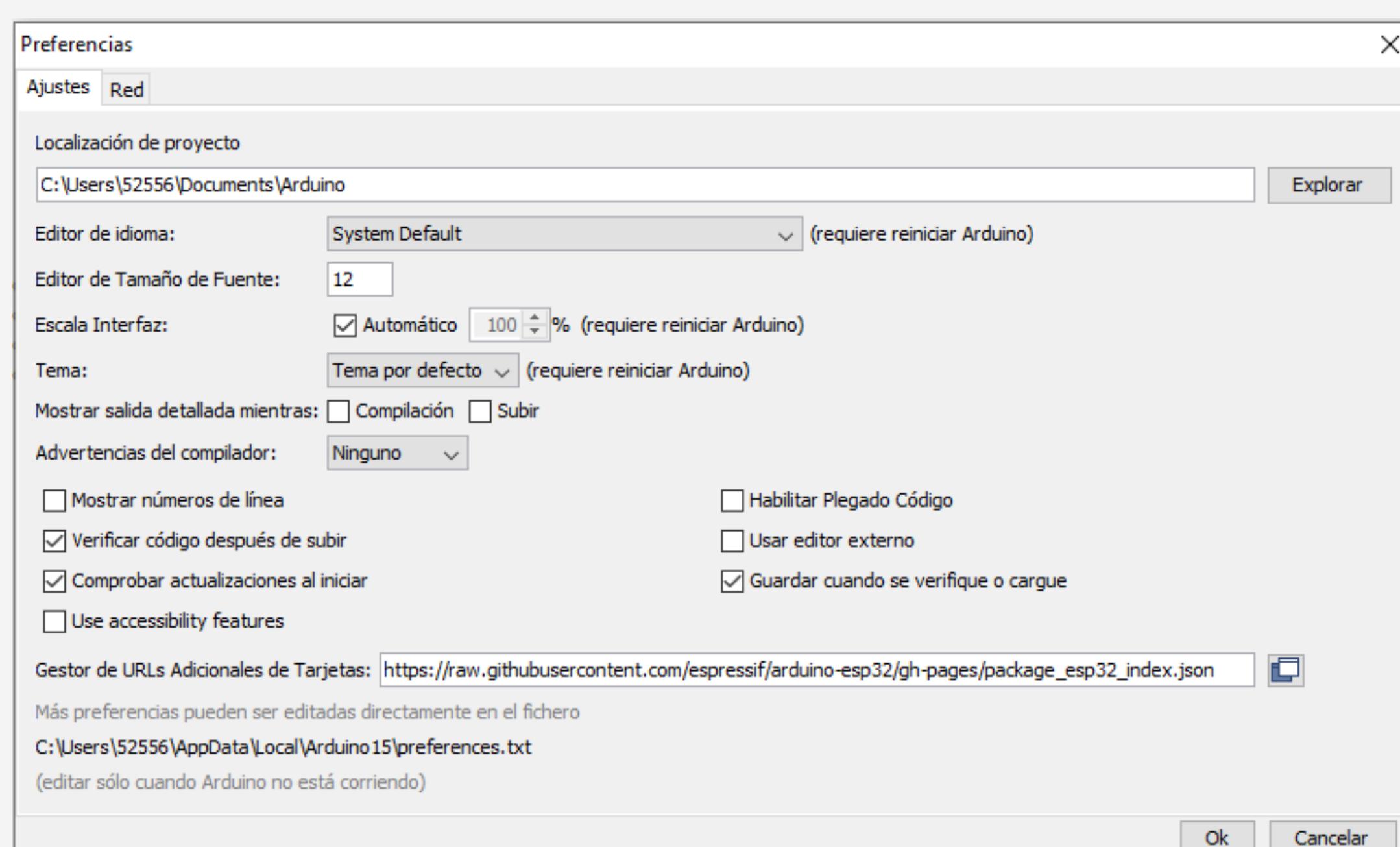
[HTTPS://WWW.ARDUINO.CC/EN/SOFTWARE](https://www.arduino.cc/en/software)

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](https://github.com/XINYUAN-LILYGO/LILYGO-LORA-SERIES)

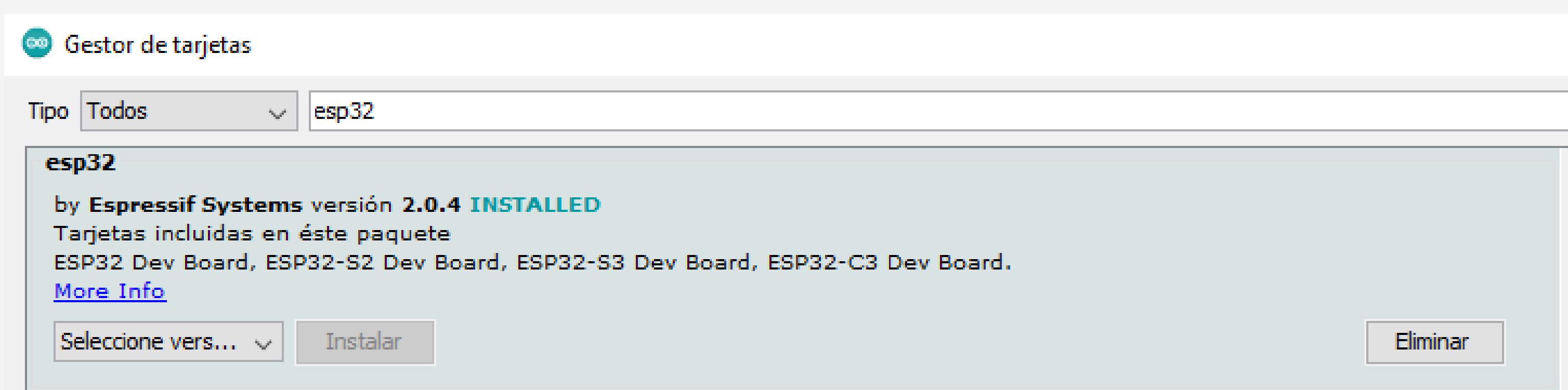


1. COPY THE FOLDERS FROM "LIBDEPS" TO \DOCUMENTS\ARDUINO\LIBRARIES

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](https://raw.githubusercontent.com/espressif/arduino-esp32/gh-pages/package_esp32_index.json)

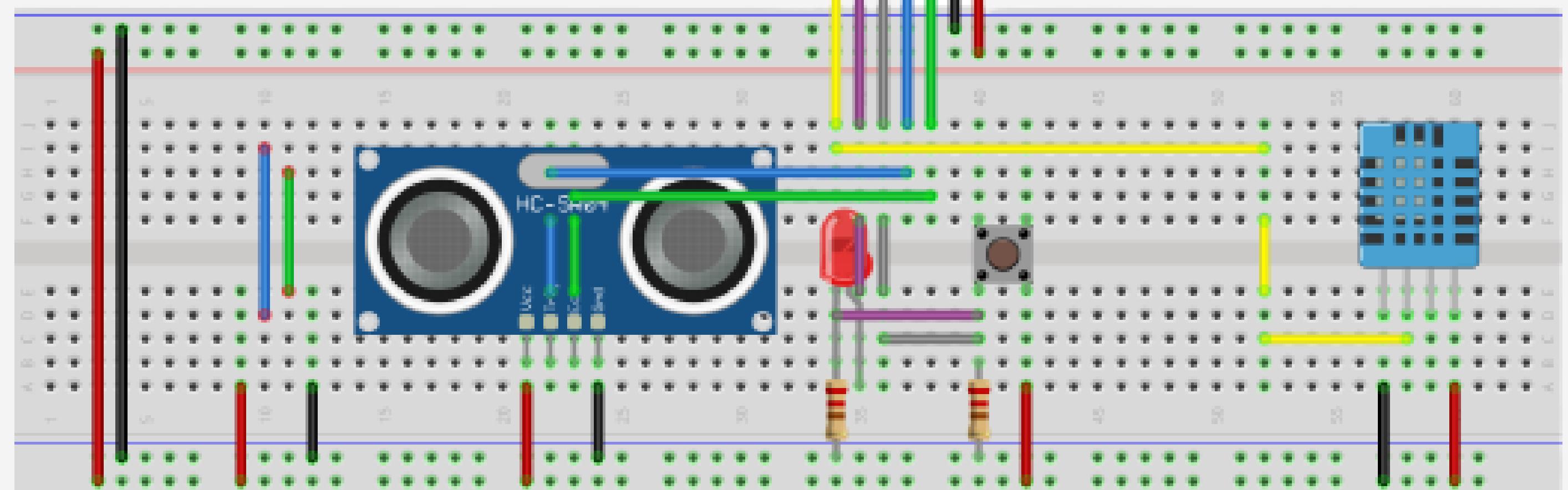
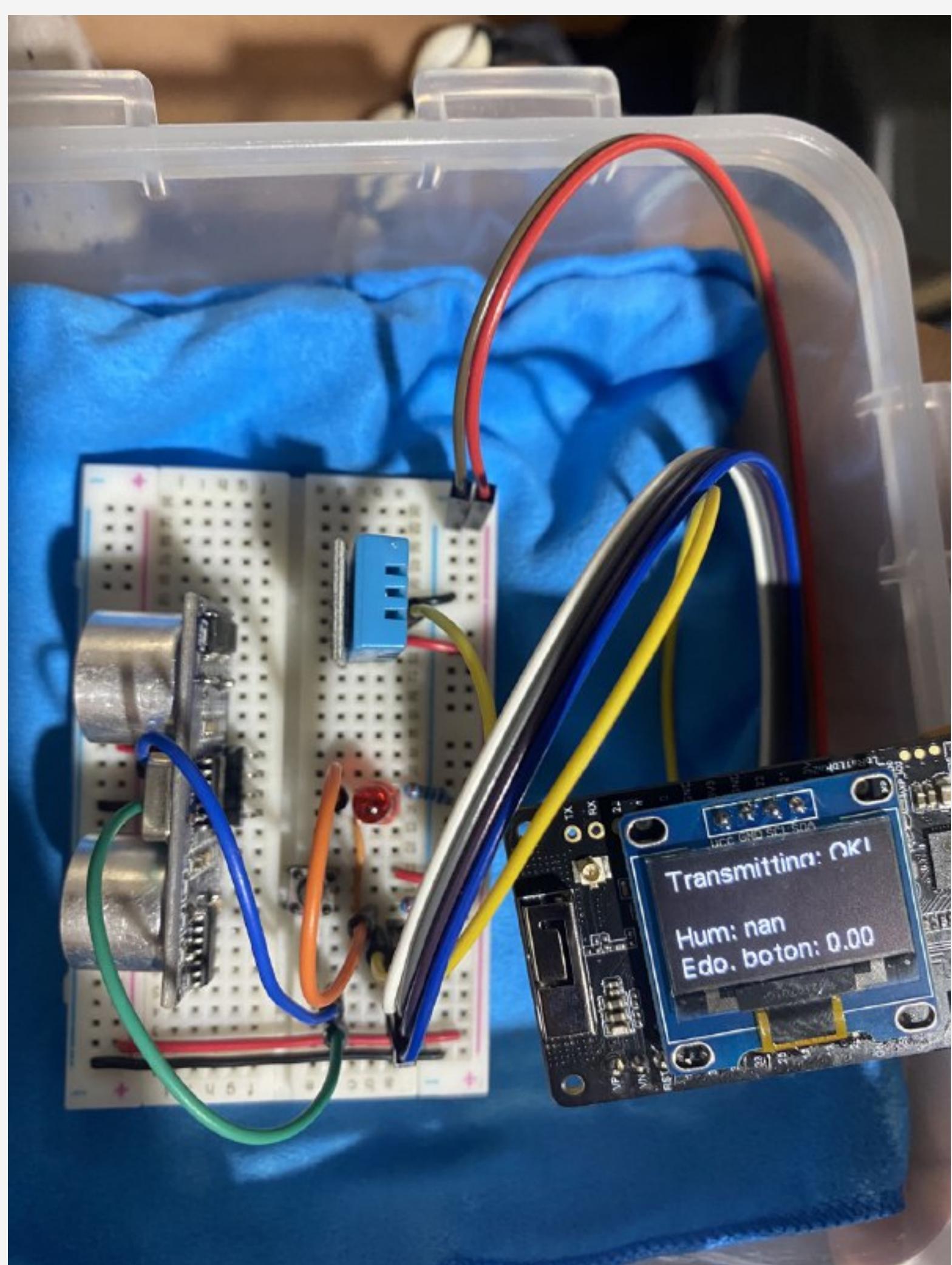
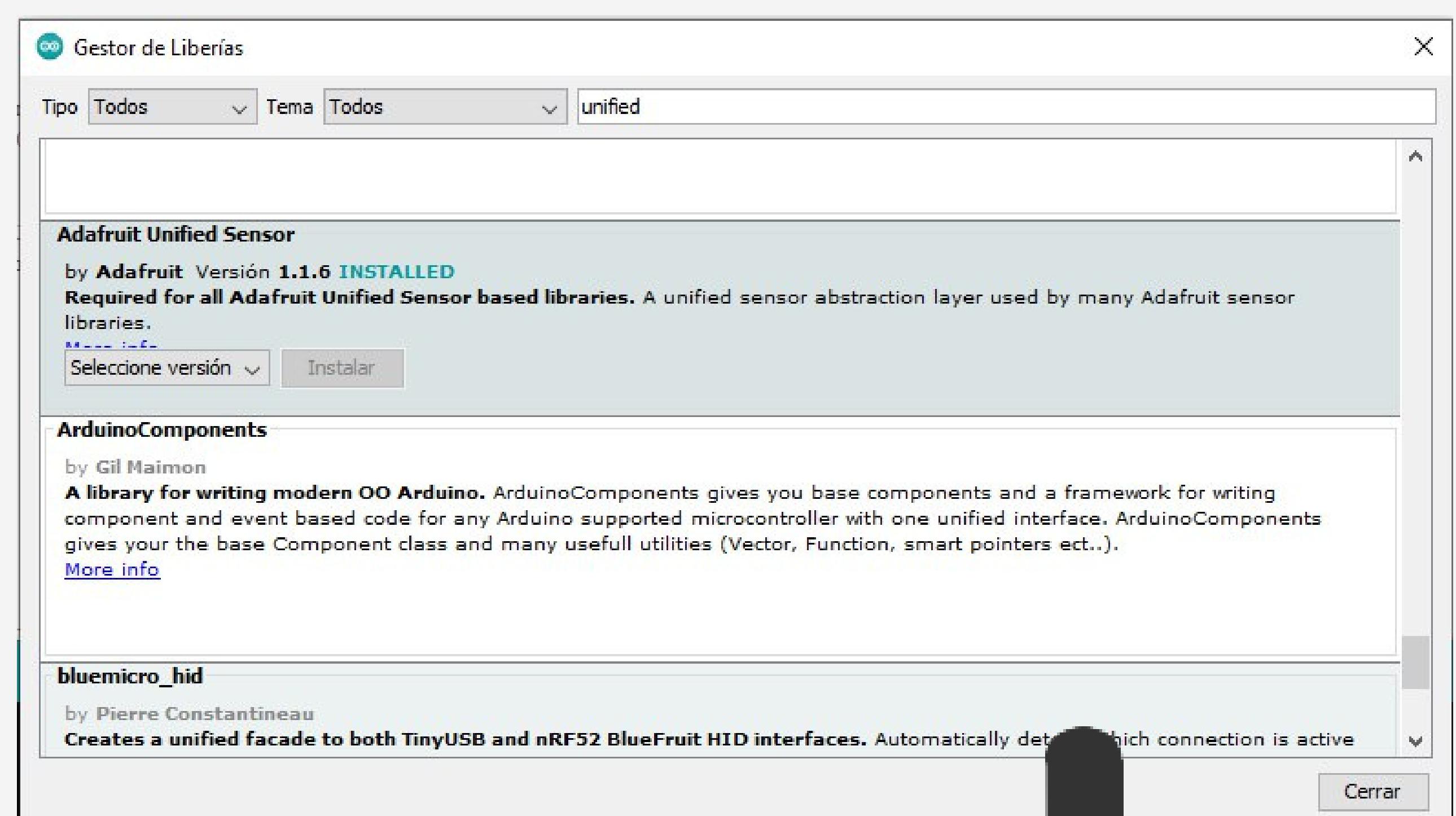
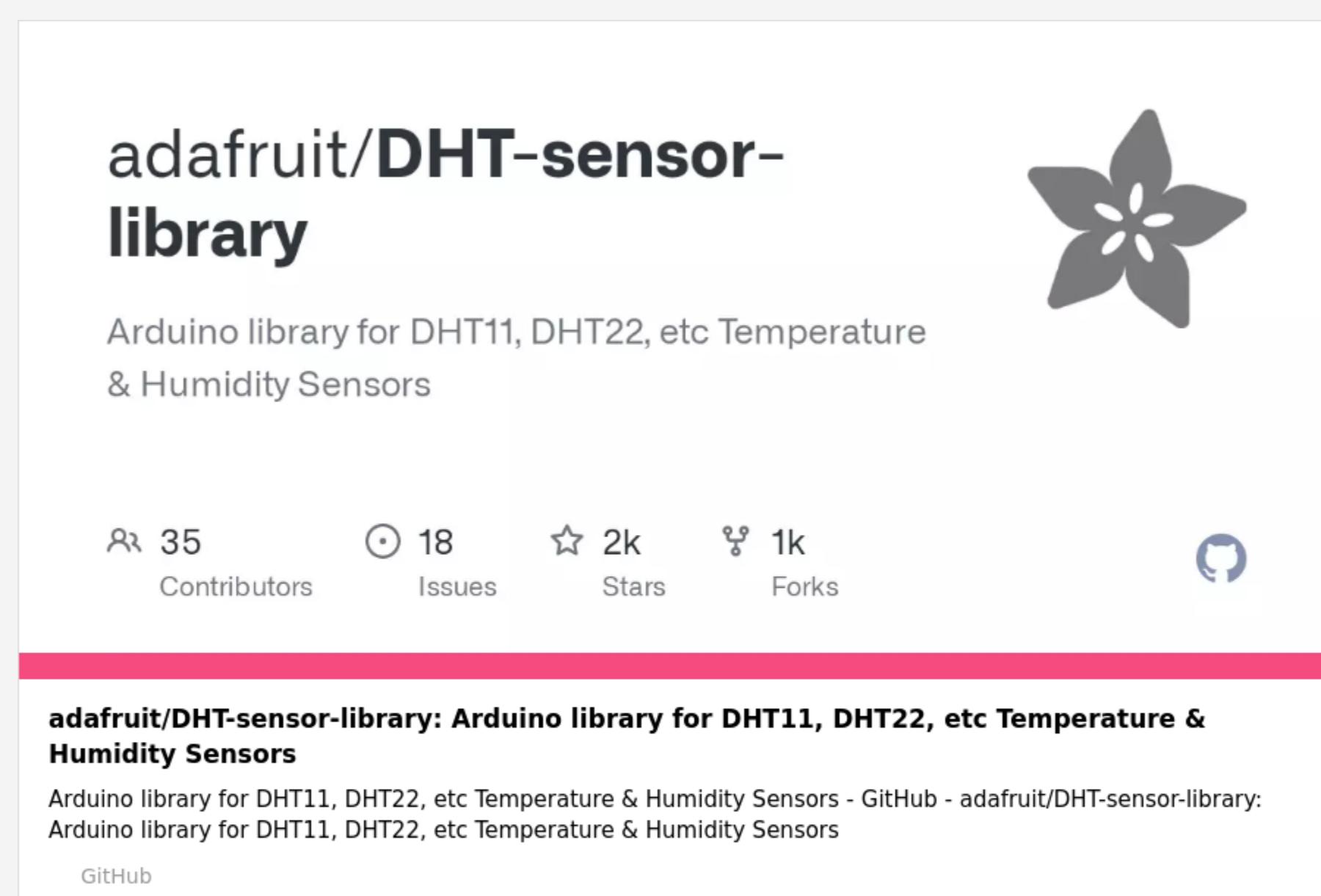


1. IN THE ARDUINO APPLICATION, NAVIGATE TO THE BOARD MANAGER MENU TOOLS > BOARD > BOARD MANAGER SEARCH FOR ESP32



# OTHER NEEDED LIBRARIES FOR THE SIMULATION SENSORS

## TEMPERATURE AND HUMIDITY 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 DIFFERENT PLACES WITH OUT LOSING CONNECTION, DEPENDING ON SOME FACTORS AS WEATHER, MATERIAL OF THE WALLS, ETC.

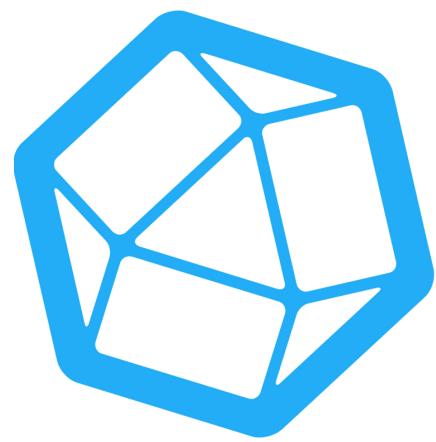
WIFI CONNECTION IS NEEDED FOR THE VISUALIZATION OF THE DATA IN A DASHBOARD, SINCE IT IS IN A WEB BROWSER.

The screenshot shows a terminal window titled "COM10" with the following text output:

```
LoRa Receiver
Connecting to wifi
Syncing time..
Synchronized time: Wed Sep 14 10:42:24 2022

Connected to InfluxDB: http://10.48.79.39:8086
Distance: 8.00, Temperature: 48.00, state: 0.00
Distance: 8.00, Temperature: 48.00, State: 0.00
Distance: 8.00, Temperature: 48.00, state: 0.00
Distance: 4.00, Temperature: 32.00, State: 1.00
Distance: 6.00, Temperature: 48.00, state: 0.00
Distance: 8.00, Temperature: 72.00, State: 1.00
Distance: 7.00, Temperature: 82.00, state: 0.00
Distance: 4.00, Temperature: 32.00, State: 1.00
Distance: 6.00, Temperature: 80.00, state: 0.00
```

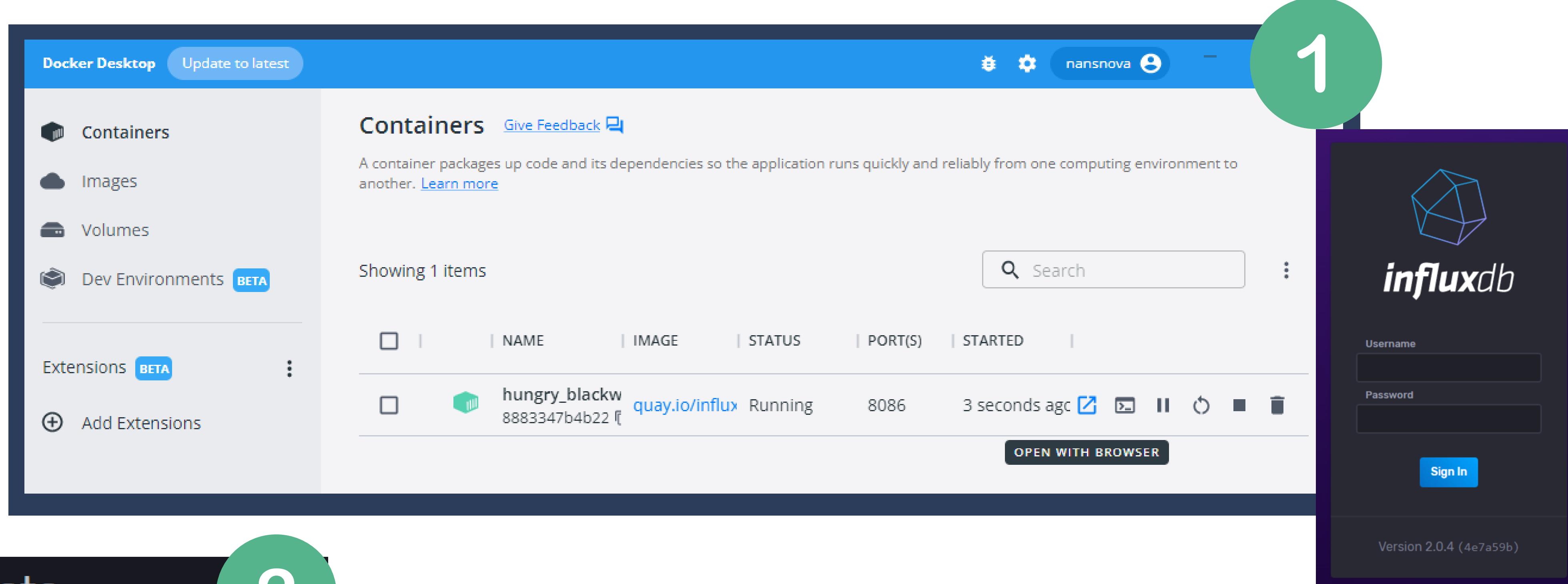
# TIME TO INITIALIZE THE CLOUD DB



ONE T-BEAM WILL BE USED AS A SERVER CONNECTED TO THE INTERNET (RECEIVER) 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 FREQUENCY 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 RECEIVER CODE, (IN THE GITHUB REPOSITORY) LORA-COMMUNICATION > RETO > LORARECEIVERFINAL.INO



```

25
26     # Database Specifications
27     bucket = "LoRa"
28     url = "http://192.168.1.70:8086"
29     token = "1B4hzN2Fh7lyajxjtv09IXpkvKNiljnL"
30     org = "E05"

```

```

#define WIFI_SSID "TP-Link_89CA"
#define WIFI_PASSWORD "47626096"
#define INFLUXDB_URL "http://192.168.1.70:8086"
#define INFLUXDB_TOKEN "1B4hzN2Fh7lyajxjtv09IXpkvKNiljnL"
#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:

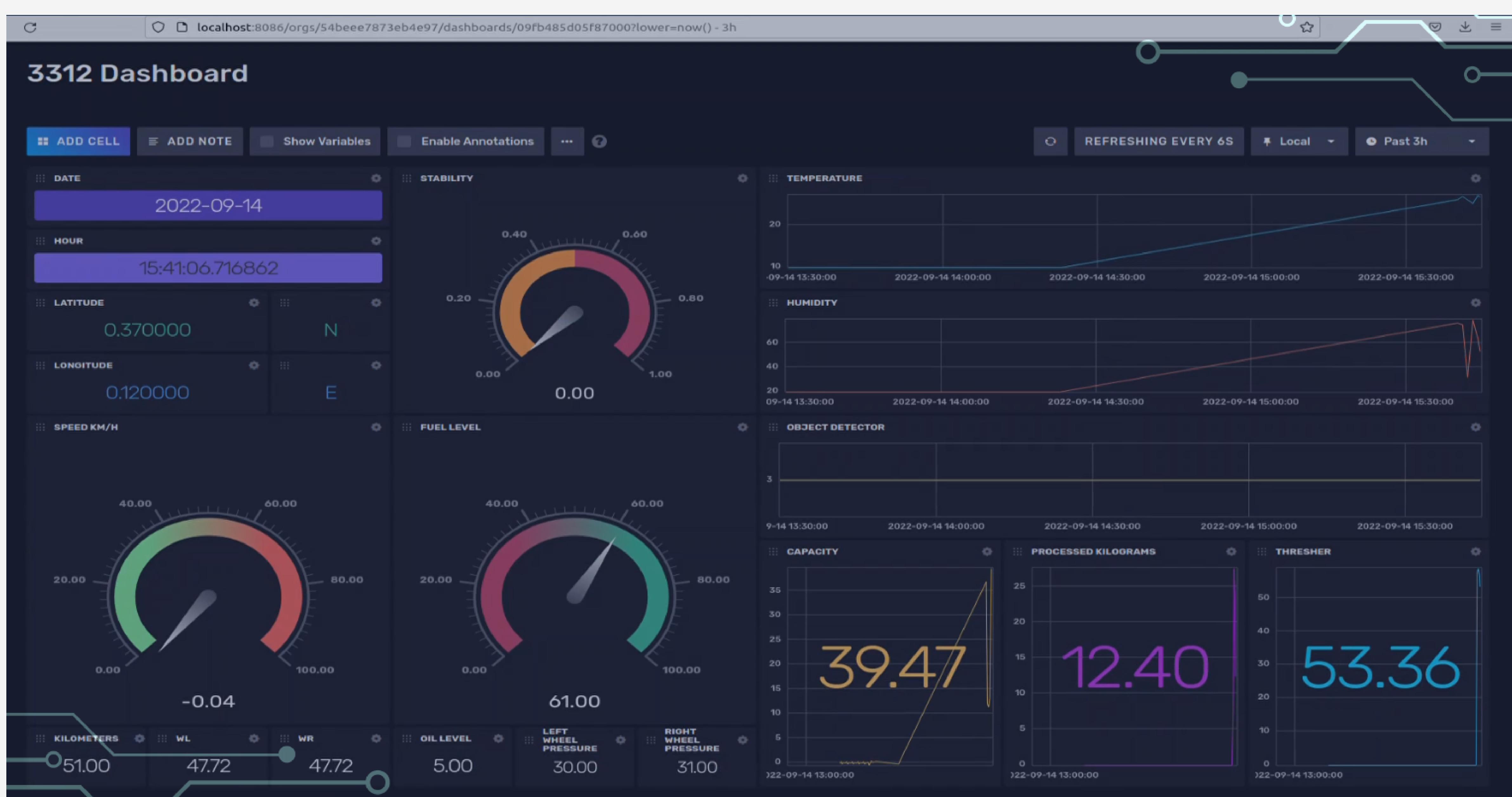
```

>>> 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="00:01:48.441941",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:

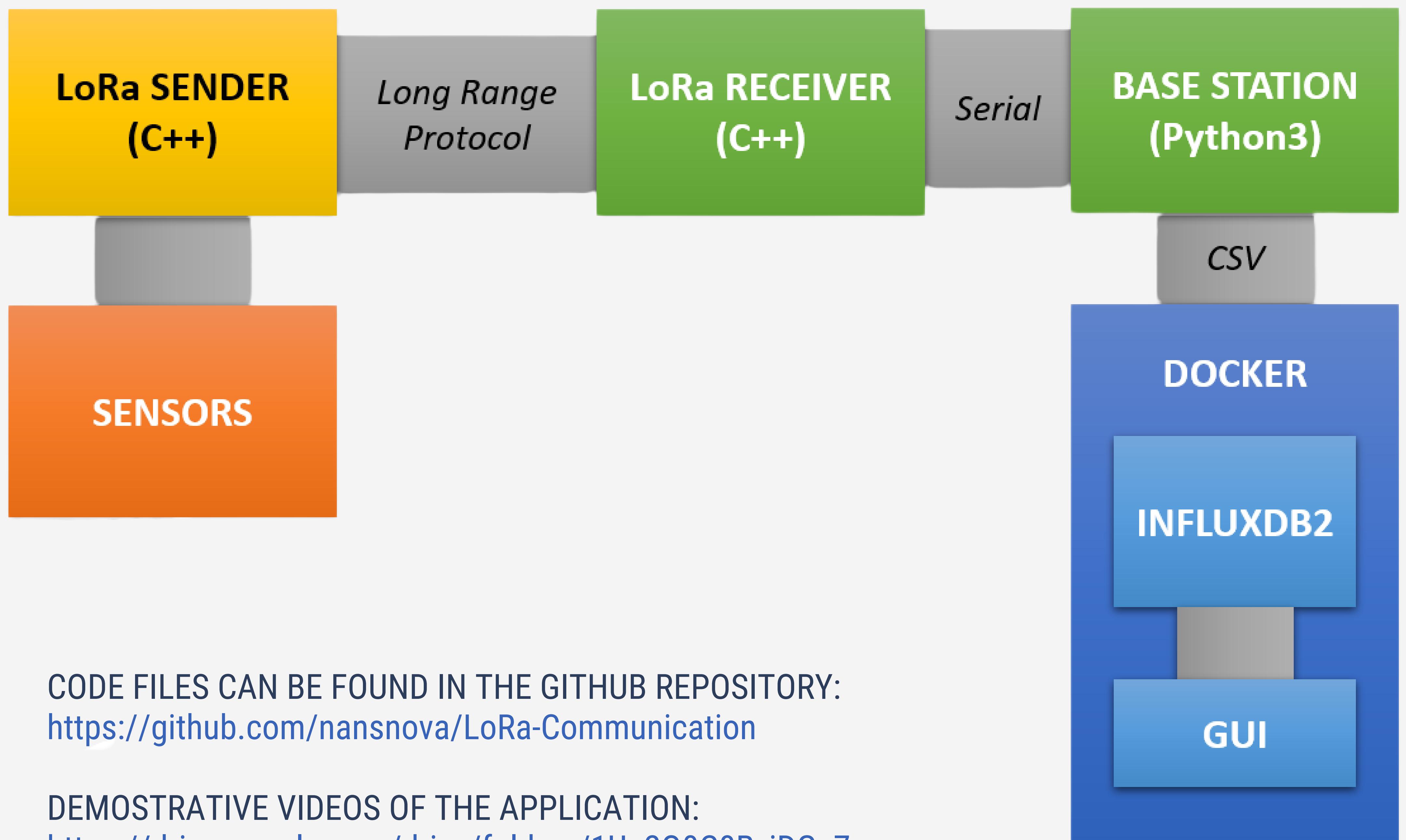
```

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

	_start	_stop	_time	_value	SSID	_field	_measurement	device
SSID - TP-Link_89CA _field - State _measurement - BOTTOM	2022-09-14 14...	2022-09-14 15...	2022-09-14 15...	3	TP-Link_89CA	Distance	Ultrasonic	LoRa Sender
SSID - TP-Link_89CA _field - Humidity _measurement - DHT11	2022-09-14 14...	2022-09-14 15...	2022-09-14 15...	3	TP-Link_89CA	Distance	Ultrasonic	LoRa Sender
SSID - TP-Link_89CA _field - Temperature _measurement - DHT11	2022-09-14 14...	2022-09-14 15...	2022-09-14 15...	3	TP-Link_89CA	Distance	Ultrasonic	LoRa Sender
SSID - TP-Link_89CA _field - Distance _measurement - Ultrasonic	2022-09-14 14...	2022-09-14 15...	2022-09-14 15...	3	TP-Link_89CA	Distance	Ultrasonic	LoRa Sender
	2022-09-14 14...	2022-09-14 15...	2022-09-14 15...	3	TP-Link_89CA	Distance	Ultrasonic	LoRa Sender
	2022-09-14 14...	2022-09-14 15...	2022-09-14 15...	3	TP-Link_89CA	Distance	Ultrasonic	LoRa Sender
	2022-09-14 14...	2022-09-14 15...	2022-09-14 15...	3	TP-Link_89CA	Distance	Ultrasonic	LoRa Sender



## DIAGRAM



## SUPPORT

FOR FURTHER HELP FEEL FREE TO CONTACT US!

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