Requirements :

For Raspberry pi

- Raspberry Pi OS Lite (64-bit)
- Python 3.10
- Python Libraries :
    - numpy 1.22.2
    - pandas 1.4.1
    - feather-format 0.4.1

For Windows (optional)

- Python 3.10
- Python Libraries :
    - numpy 1.22.2
    - pandas 1.4.1
    - feather-format 0.4.1
    - matplotlib 3.5.2

RaspberryPi recommendation :

- RaspberryPi type : RaspberryPi-4
- RaspberryPi name : raspberrypi-projetMOON
- piUser : projetMOON

Useful command :

For windows with powershell :

- Connect to raspberryPi with SSH :
  ```
  ssh piUser@piName
  ```
- Send file to raspberryPi :
  ```
  scp dataToSend piUser@piName:/home/piUser/folderPath
  ```
- Retrieve file from raspberryPi :
  ```
  scp piUser@piName:/home/piUser/FilePath localFilePath
  ```
  if you are already in localFilePath, replace localFilePath by ".\"

For raspberry-pi terminal :

- View file in directory :
  ```
  ls
  ```
- change directory :
  ```
  cd directoryName
  ```
  if you want to go in parent folder change directoryName by ..
- remove file :
  ```
  rm fileName
  ```
- read file :
  ```
  cat fileToRead
  ```
- start pyhton script
  ```
  python script.py
  ```
- start experience script
  ```
  nohup python experience.py ftrFile.ftr
  ```
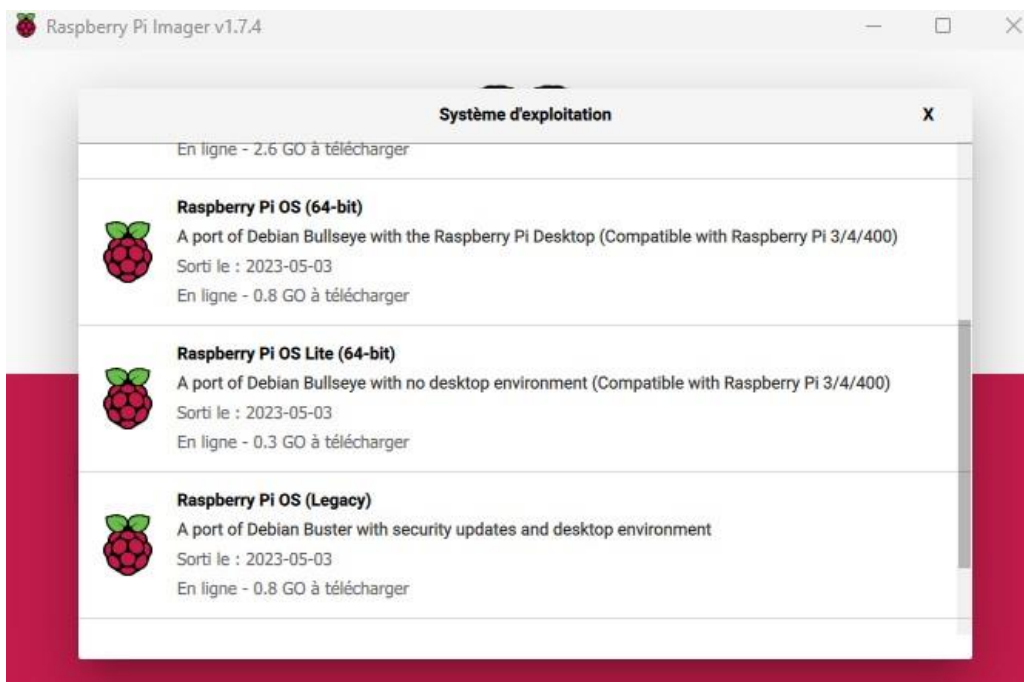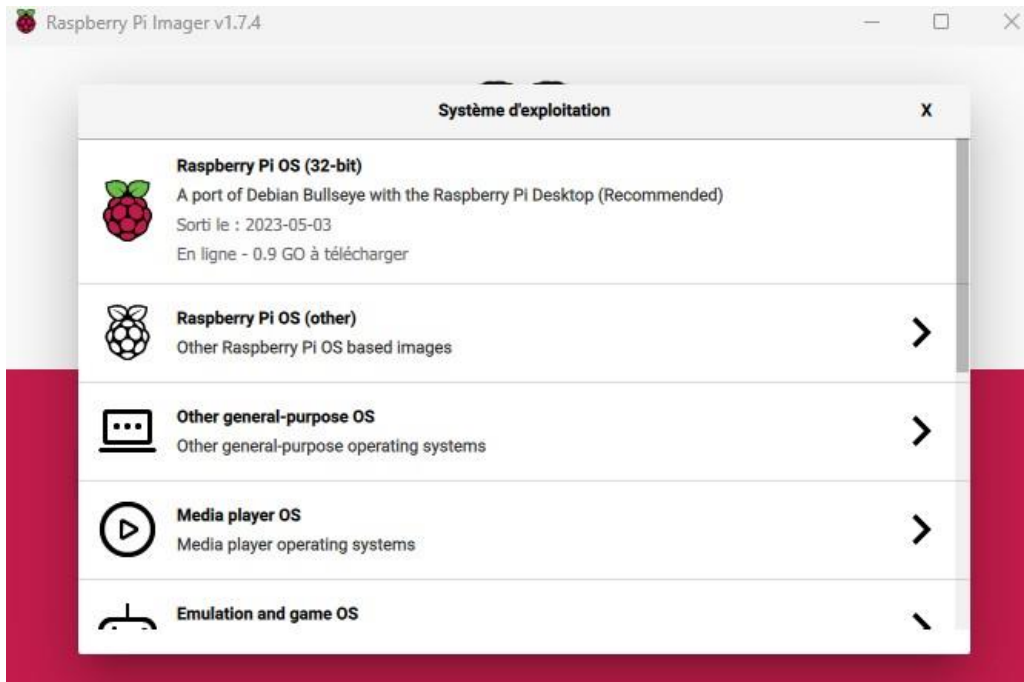
How to setup your raspberry-pi :

You need to use the Raspberry Pi Imager software available here
: https://www.raspberrypi.com/software/

Step 1 : Choose OS

You need to choose the Raspberry Pi OS Lite(64-bit). Don't use 32-bit OS because some library needs a 64-bit OS.
You can find it in Raspberry Pi OS (other) menu.

Step 2 : Chose storage

Select the SD card you will use for the raspberry pi.

Step 3 : Setup advance parameter

You need to change multiple parameter before writing the OS in the SD card :
You can find the parameter in the gear.

- Chose for all sessions in Image customization options
- Change the raspberry pi name
- Activate SSH :
  use authentification by password
- Define username and password
- Configurate the wifi

Raspberry Pi Imager v1.7.4 — □ ×

Réglages avancés   X

Image customization options   pour toutes les sessions   ▼

☑ **Nom d'hôte**   rrypi-zero-MOON .local

☑ **Activer SSH**

    ◉ Utiliser un mot de passe pour l'authentification

    ○ Authentification via clef publique

       Définir authorized_keys pour 'projetMOON' :

☑ Définir nom d'utilisateur et mot de passe

ENREGISTRER

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Réglages avancés   X

☑ **Définir nom d'utilisateur et mot de passe**

    Nom d'utilisateur :   projetMOON

    Mot de passe :   ●●●●●●●●●●●●●●●●●●●●●

☑ **Configurer le Wi-Fi**

    SSID :   Wololo

    ☐ SSID caché

    Mot de passe :   ●●●●●●●●●●●●●●●●●●●●●

ENREGISTRER

Step 4 : Write on SD card

You can write the OS in the SD card and your OS it's ready !

Step 5 : Install dependencies and Setup directory

You need to install dependencies.

- Connect to your raspberry pi via SSH :
  ```
  ssh piUser@piName
  ```
  use the piUser and piName you have setup in step 3.
- Install OS update :
  ```
  sudo apt update
  sudo apt upgrade
  ```
- Install python :
  ```
  sudo apt install python3.10
  ```
- Install python library :
  ```
  pip install numpy
  pip install pandas
  pip install feather-format
  ```
- Create directory :
  ```
  mkdir data
  mkdir userData
  ```

All the dependencies are installed you can close the SSH connection by closing the terminal.

Step 6 : Transfert file on raspberry pi

You need to transfert all necessary file on raspberry pi.
Download following file from the repository :

- armerPompe.py
- controle.csv
- controle.py
- dataPreparation.py
- experience.py
- resetGPIO.py

repeat the following command for each file in the list to transfert to raspberry pi :

- Send file to raspberryPi :
  ```
  scp fileToSend piUser@piName:/home/piUser
  ```

The setup of the raspberry pi is complete.

Plug experience

Motor

Motor n°1

- red wire to Mosfet 1 Drain
- black wire to Mosfet 1 Source

Motor n°2

- red wire to Mosfet 2 Drain
- black wire to Mosfet 2 Source

Motor n°3

- red wire to Mosfet 3 Drain
- black wire to Mosfet 3 Source

Electrovanne

Electrovanne n°1

- wires to Mosfet 4 Drain/Source

Electrovanne n°2

- wires to Mosfet 5 Drain/Source

Electrovanne n°3

- wires to Mosfet 5 Drain/Source

Raspberry pin

Alimentation

- pin 4 (Alimentation 5V) to 5 V
- pin 6 (GND) to GND

Motor

- pin 11 (GPIO 17) to Mosfet 1 Gate
- pin 13 (GPIO 27) to Mosfet 2 Gate
- pin 15 (GPIO 22) to Mosfet 3 Gate

Electrovanne

- pin 29 (GPIO 5) to Mosfet 4 Gate
- pin 31 (GPIO 6) to Mosfet 5 Gate
- pin 33 (GPIO 13) to Mosfet 6 Gate

Run an experience

Step 1 : Prepare your data

The data need to be in csv file. The separator need to be ",".
Your data are presented like this :

time	conc1	conc2
0	1	1
2	6	8
10	2	1
15	4	2

time correspond of time from the start in second.
conc1 and conc2 it's the concentration of element at time t.

If you have download dataPreparation.py on your computer you can convert your data on your computer directly. For convert your data directly on your computer follow the Step 3 before the Step 2.

Step 2 : Transfert your data on raspberry pi

Transfert your data on the raspberry pi in the folder userData.
Open terminal in the folder of your data and use this command :
`scp dataToSend piUser@piName:/home/piUser/userData`
If you have convert your data directly on your computer use this command instead :
`scp dataToSend piUser@piName:/home/piUser/data`

Step 3 : Convert your data

If you have transfert your CSV file on raspberry pi

- Connect to your raspberry pi via SSH :
  `ssh piUser@piName`
- run dataPreparation.py :
  `python dataPreparation.py`
  Indicate the name of your data when ask.

Your data is now converted and placed in data.
The data converted is named by the date of creation like this:
year-moth-day_hourminsec.ftr

you can check the name of the data created in the folder data using :
```
cd data
ls
```
it will show all the data in the folder data.

If you want convert your data on Windows

Before convert your data on Windows make sure you have the optionnal requirement on your computer.
Create 2 folder in directory of dataPreparation.py:

- userData
- data

Put your data to convert in userData folder.
Run dataPrepartion.py and indicate the name of your data when ask.
Your data is now converted and placed in data.
The data converted is named by the date of creation like this:
year-moth-day_hourminsec.ftr
You can check the data created using the script verificationFtr.py
Now you can do Step 2.

Step 4 : Run experience

For start experience connect to raspberry pi if it's not already done :
```
ssh piUser@piName
```
Run experience.py in background with :
```
nohup python experience.py dataToUse.ftr
```
Close the terminal.
The Experience is running Step 5 and 6 will show you how to interact with experience.

Step 5 : Control experience

If you want take sample or make an observation during the experience you need to suspend the process.

- Connect to raspberry pi :
  ```
  ssh piUser@piName
  ```
- run controle.py `python controle.py`

- Choose what you want to do :

    i. Sample
       For take a sample, you need to indicate which quantity you take.
    ii. Observation
       For observe the cells.
    iii. Restart cycle
       When you have finished your sample/observation restart the cycle.
    iv. Log
       For see the last log of the experience.
    v. Stop
       Force stop of the experience if something goes wrong.
    vi. Cancel
       Close controle.py

When you have finished dont forget to restart cycle and you can press cancel for close controle.py

Step 6 : Check log

- Connect to raspberry pi :
  `ssh piUser@piName`
- Open the log:
  `cat output.log`

For debug log use instead :
`cat nohup.out`