2LabsToGo-Eco – Software manual

2LabsToGo-Eco Software execution

Inside the installation folder execute the following command in a Linux terminal:

python3 run.py (or execute the alias ‘go’ if defined)

To access 2LabsToGo-Eco Software open a tab in the browser and enter to either:

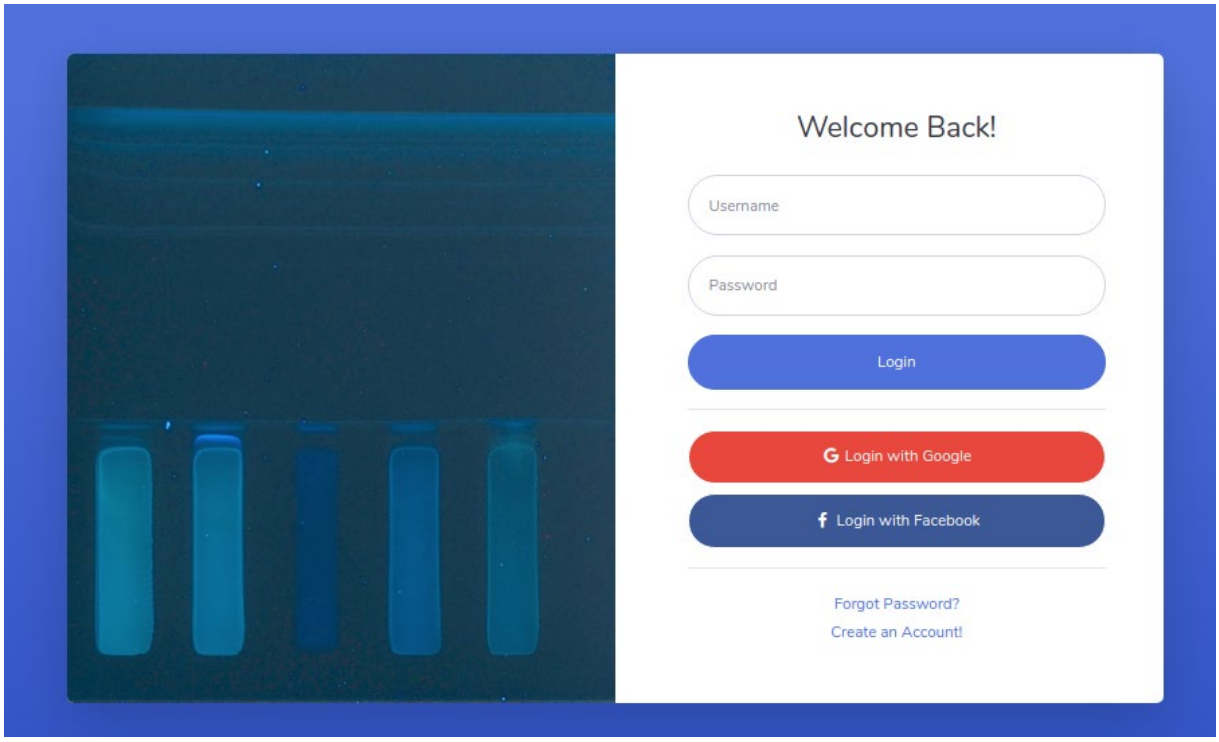
http://127.0.0.1:8000/

http://localhost:8000/

Register

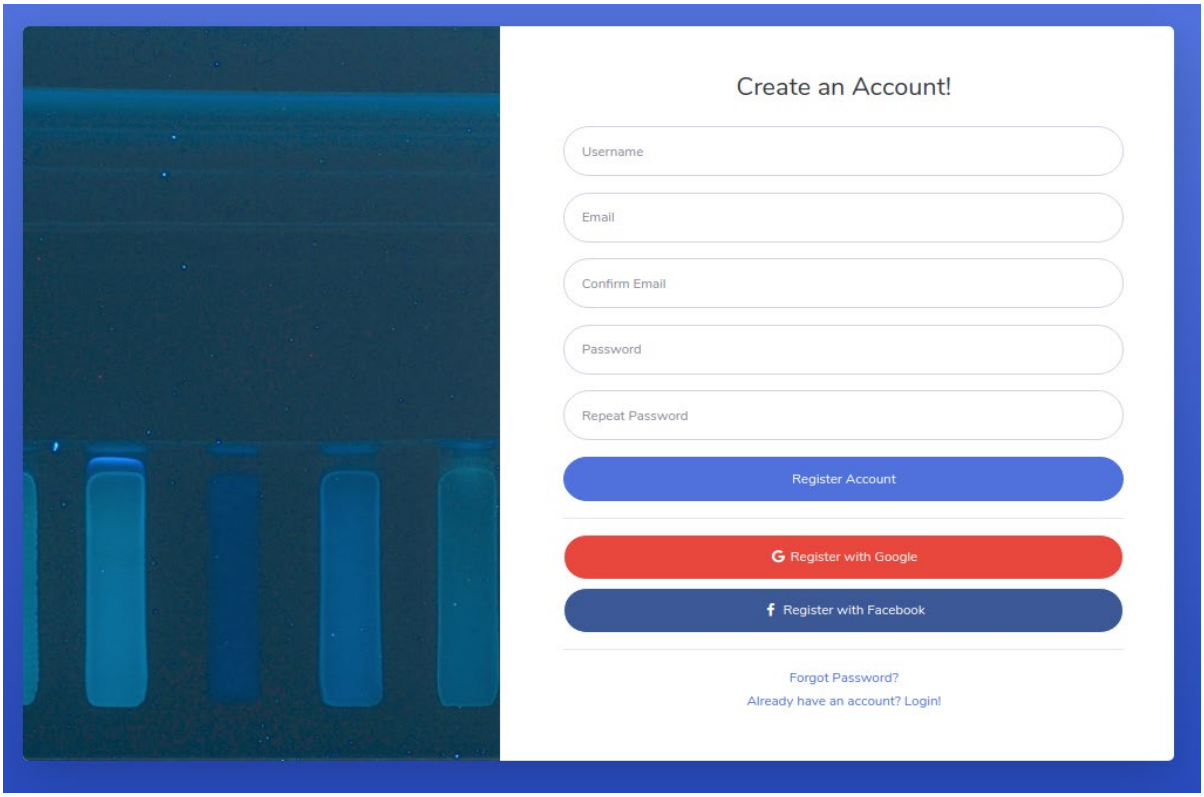
The **login screen** of 2LabsToGo-Eco Software will be displayed.

To create an account, click ‘Create an Account’ on the bottom region of the login screen.



The ***Register screen*** will be shown.

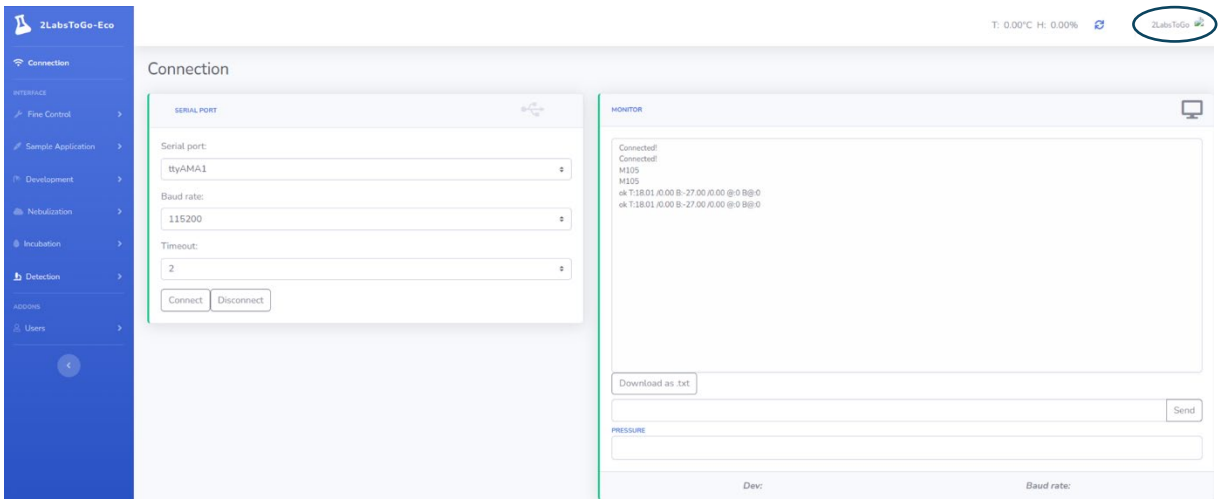
→ Please fill all the fields in order to create a new Account, afterwards press Register Account. If every field was filled with valid data, the ***Connection Screen*** should be visible by now.



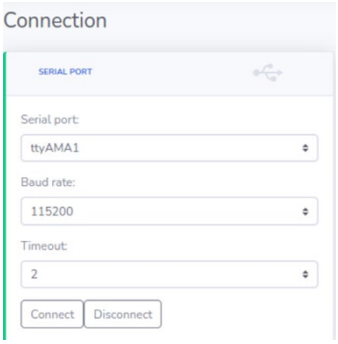
Connection

The connection screen is used to connect to the 2LabsToGo-Eco. The machine will communicate via the Raspberry GPIO with the app. All interactions between the app and 2LabsToGo-Eco will be visible in the Monitor window.

The currently logged in user is displayed here.



The serial port is automatically selected.



The Baud rate is related with the connection speed.

Please leave it in the default option of 115200.

→ A slow baud rate will slow down the speed of reaction of the system.

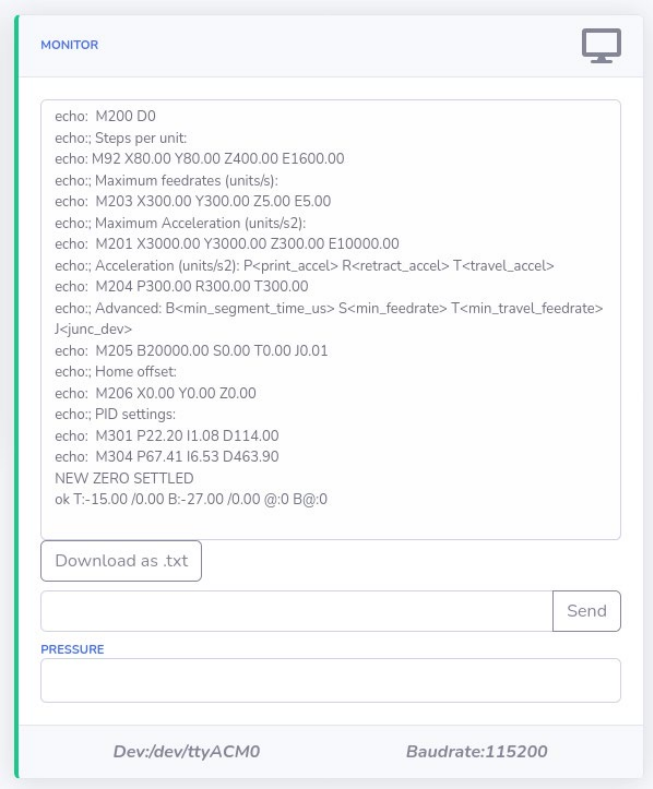
→ If it is set too high, it could produce errors in the messages received and sent.

The Timeout is the maximum time (s) that the app will wait to give a response. Keep the default value.

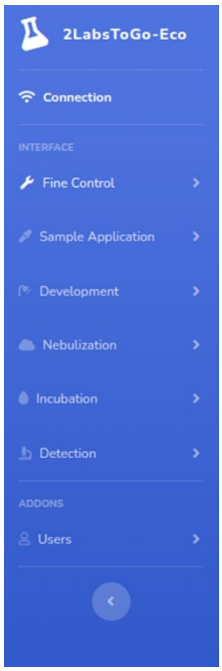
Press the **Connect** button to send a connection request to 2LabsToGo-Eco. The successful established connection is notable because the app will start printing the text sent by the machine on the **Monitor** screen on the right, and the Connection Bar down below the screen will turn to green, and it will display the name of the device to which the app has been connected.

This bar is visible on every tab of the software.

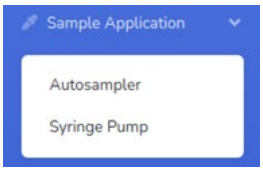
After following the previous steps, the connection should have been established and the machine will be ready to work. Test it by sending **G28** to the machine using the dialog box located in the bottom of the Monitor screen. After the machine receives this command, it should start homing all axes.



Operating the software



On the left side, a blue panel with the different processes of 2LabsToGo-Eco Software is displayed (side bar).



Generally, first left-click on a process, for example, Sample Application, when a sub-selection window is opened.

Right-click on a sub-selection and select “Open link in a new tab”. A new browser tab will be opened to handle the process.

The Connection tab and other software tabs not needed should be closed to avoid an overload of the RAM.

With this arrow the side bar can be hidden.

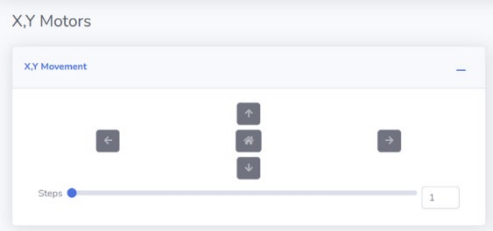
Fine Control

Fine Control provides different tools.

Most of them are self-explanatory like switching on/off case light and the different LEDs for testing.

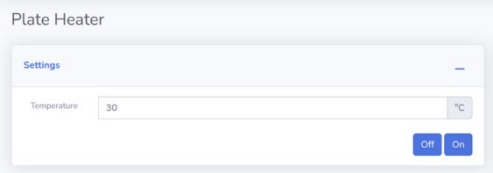
Some others are explained here.

X,Y Motors



Motor control is a simple interface to move the motors a certain amount of mm (Steps) at a certain speed, the motors will move in a specified direction by clicking on the arrows.
The **Home** button between the arrows will move the apparatus into the absolute zero position respective to x and y. This is the position, in which both endstops are triggered.

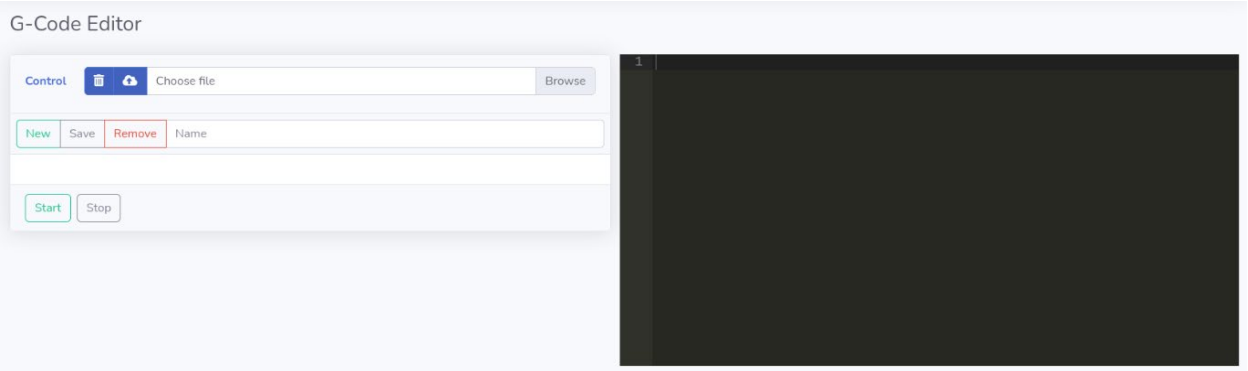
Plate Heater



This window allows the user to heat up the multifunctional plate holder up to 130 °C, for example for plate drying or derivatization reactions. Set the desired temperature in the field and activate the heating by pressing the **On** button. The heating will now be checked every four seconds, displayed in Monitor screen. By pressing the **Off** button the heating can be deactivated.

G-Code Editor

G-code is the language that 2LabsToGo-Eco understands.



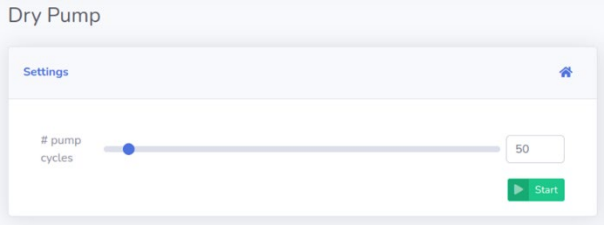
The G-Code editor allows to create new G-code files and to execute them. Files can be created, saved, loaded, removed and uploaded.

Dry Pump

The microfluidic system should not kept wet over night and certainly not for a longer period of time. The valves (elastomers) of the micropump and the 3-way valve may stick preventing proper operations.

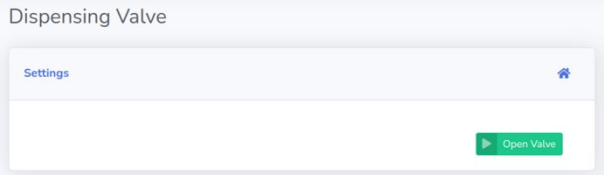
Therefore, rinse the autosampler system with acetone (50 times, see autosampler section), when destilled acetone (free of residues) is strongly recommended. Then remove the tubing from the dispensing valve and connect it to a female 062 MINSTAC-Luer Lock adapter (available at the syringe pump) with a 10-mL gas-tight syringe.

Open **Dry Pump** in a new tab (right click) and **Start** the process (50 times) while applying a slight vacuum with the syringe. Empty the syringe and restart the drying process. Reconnect the tubing to the dispensing valve.

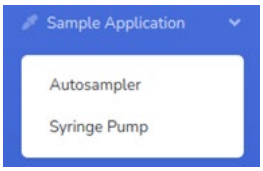


Dispensing Valve

After drying the pump, the tubings from the 3-way valve down to the nozzle should also be dried. Therefore, connect the Luer Lock adapter with the gas-tight syringe to the syringe pump tubing. Open **Dispensing Valve**, click **Open Valve**, and press air with the syringe through the system. Repeat pressing air once again. Note that the valve closes automatically after 30 s.



Sample Application

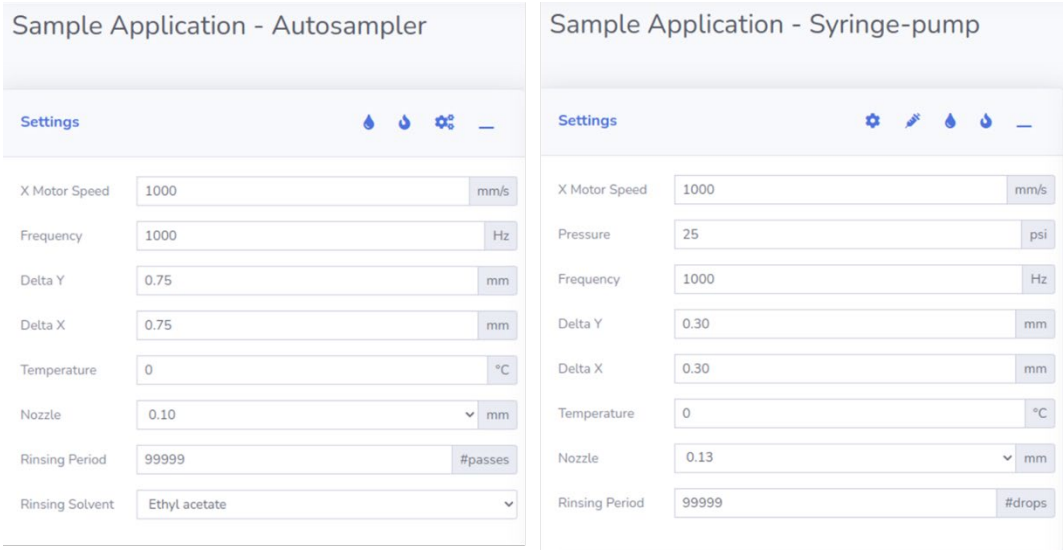


The Sample Application page is used to configure and apply the samples. There are two different ways to apply the samples, displayed in the dropdown list after clicking on **Sample Application** in the sidebar.

The first option is **Autosampler** to proceed with the sample application procedure using the autosampler, *i.e.*, automatically applying up to eight samples. The second option **Syringe Pump** allows to apply sample by sample with the syringe pump (semi-automatic application).

Settings

There are the forms Settings, Parameters, Save and Load and Plate Preview. Note that some forms are different according to the sample application method selected.

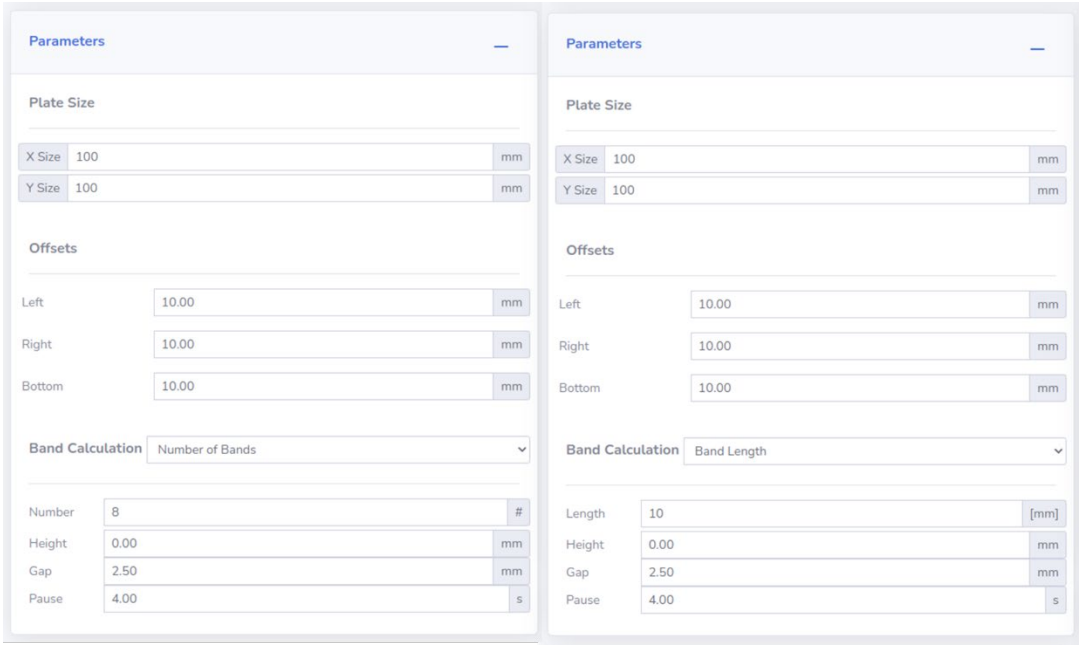


The Settings window configures the basic parameters for the sample application, both for the autosampler and the syringe pump. The differences between the two windows are the functionalities presented by the small icons at the top of the windows, the selection field for the rinsing solvent (autosampler), and the pressure field for the syringe pump.

The following parameters can be selected.

Motor Speed	Sets the movement speed of the x-motor.
Initial Pressure	Sets the pressure to be reached for the syringe-pump system before opening the dispensing valve.
Frequency	Sets the time the valve is opened while applying. The frequency is $\frac{1}{Time_{valveOpen}}$.
Delta Y	Sets the minimum movement between drops in the Y direction.
Delta X	Sets the minimum movement between drops in the X direction.
Temperature	If it differs from 0, the heating is turned on. The machine will wait until it reaches the settled plate temperature before starting. The temperature is held during the sample application.
Nozzle	Select the used nozzle. It will affect the volume calculations.
Rinsing Period	Defines the number of band passes for the autosampler, whereafter a brief rinsing is inserted to prevent a hanging drop, with '1' after each pass, with '2' after two passes, and so on. With the default value of 99999, no rinsing is performed. For the syringe pump, rinsing period defines the number of drops, whereafter a brief rinsing is inserted to prevent a hanging drop. However, the cause of hanging drops is usually a dispensing valve that does not close properly (particles).
Rinsing Solvent	Select the solvent of the rinsing vial (vial rack) to properly rinse the microfluidic system before each sample application and to prevent carry over.

Parameters



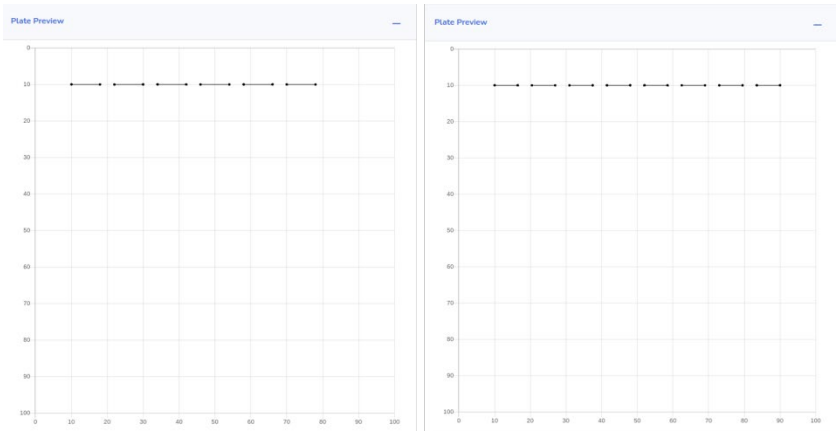
The Parameters define settings related to the plate and band sizes.

It is important to note that the different parameters listed below are limited to each other. For example, it can not be applied on a plate with an X Size parameter of 100 mm if the offset is set to Left 50 mm and Right 50 mm because there will be no space for the bands.

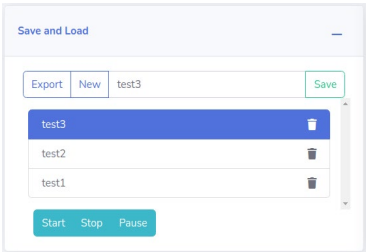
Generally, start with settings the Offsets before selecting the Number of Bands/Band Length to prevent running the software into errors, because the band pattern cannot be realized.

Plate Size	Sets the sizes of the plate (X, Y).
Offsets	Sets a margin on the plate for all sides (Left, Right, Bottom).
Band Calculation	Number of bands creates as many bands as specified in the ***Band Calculation*** field. The bands' length will be adjusted regarding the space between left and right offsets, and the selected gap between the bands.
	Band Length will create as many bands as possible with the set ***Band Length*** regarding the space between left and right offsets, and the selected gap between the bands
Height	Sets the height of the bands, taking steps of the already configured ***Delta Y***, 0 will apply a band, values >0 will apply an area.
Gap	Sets the distance between the bands. This may be decreased/increased to achieve the desired number of bands.
Pause	Setting a waiting time in seconds between the application passes to allow the band to dry.

The resulting bands' design is shown in the Plate Preview.

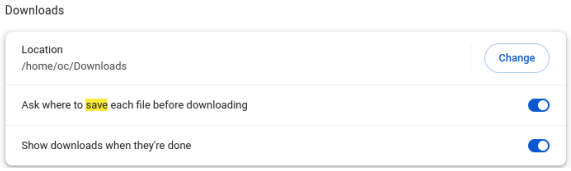


Save and Load

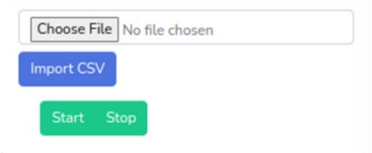


The sample application settings can be saved and loaded to and from the database.

In the text entry field in the Save and Load window, the application settings can get a method name. **After all settings have been performed**, click on ***New***, type a name, and click on ***Save***. If the settings are changed thereafter, click ***Save*** again or create a new method with the changed settings.
Clicking the **Export** button will export all settings as csv file.
Check the browser's setting for downloads and activate "Ask where to save …".



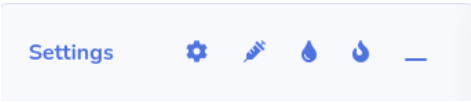
Otherwise the file will automatically saved as output.csv in the Download folder.
To load a method, click on one of the already saved methods and all settings will automatically be reloaded.
To import a sample application method, choose a file and click on ***Import CSV***.



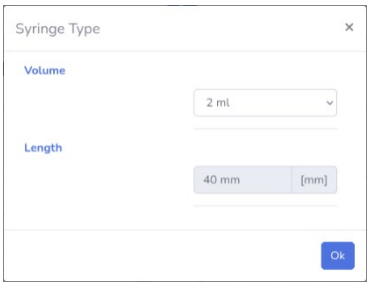
Clicking on **Start** will start the application process. It also can be stopped with **Stop**, if something went wrong. It is important to note that the application process will not be finished immediately, but only after the already sent Gcode commands are processed. For example, plate heating will be finished, before the application is fully stopped.

Syringe-pump

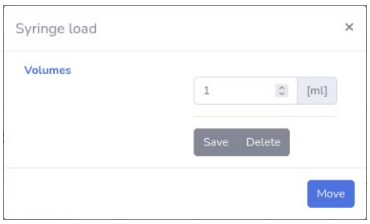
By selecting this application method, some G-codes will automatically be sent to set the movement parameters for the syringe pump motor and to switch the 3-way valve, indicated by the LED's *SP* and *3WV* in front of the electronic box. Some features are also available once clicked on Syringe Pump, displayed in the upper right corner of the Settings form, like in the image below. There also is a mouse-over information.



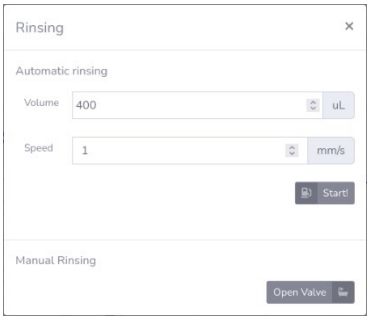
With the **Gear** icon, the syringe size must be selected: 2 mL, 5 mL or 10 mL. According to this selection, the movement calculations are carried out. In the pop-up window it is possible to see how the Length value changes, but the user cannot modify this value here. By clicking ***Ok***, the values are saved and the syringe piston movement can be calculated correctly.



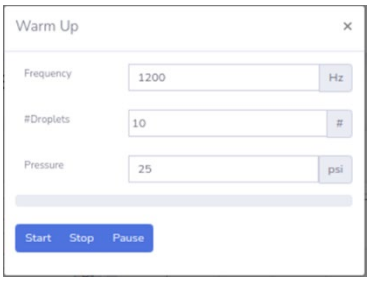
The **Syringe** icon stands for Syringe Load, and it refers to how much volume (in mL) was loaded into the syringe. Once selected and clicking ***Move***, the syringe pump pusher will move to a position that the syringe can be inserted. If the syringe does not fit exactly, increase or decrease the set volume slightly (use the arrows) and click **Move** again. The volumes can also be saved and will be presented in a table on the left side of this window, to rapidly be re-selected.



The **Drop** icon stands for Rinsing, thus flushing the tubings and the nozzle. In the pop-up, there are two options, one is automatic rinsing, and the other is manual rinsing. For Automatic Rinsing, it is possible to select a volume in µL to rinse and a speed in mm/s, then just click the ***Start*** button. In the case of manual rinsing, there is only the **Open Valve** button, which means that the valve will open, and the rinsing process is performed by manually pressing the syringe piston. The valve will automatically be closed after 30 s!

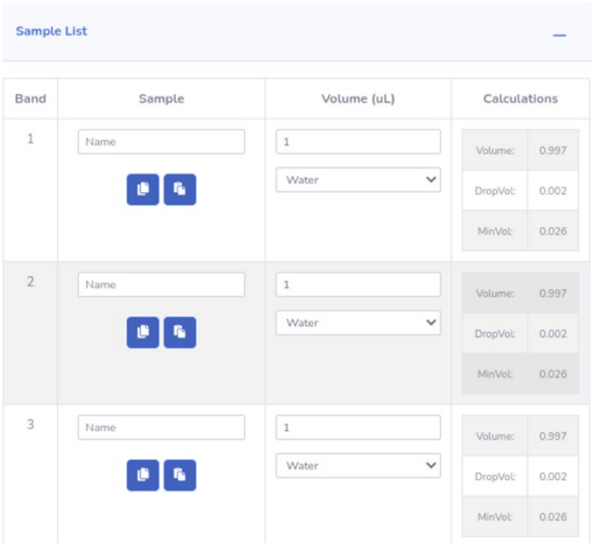


The **Fire** icon refers to Warm Up. Here, the dispensing valve frequency, number of drops and the pressure that must be reached before starting the warm up, are selected. Then it is possible to **Start**, **Stop** and **Pause** this process.



After filling in the above settings, the Sample List section will display a table with as many rows as bands have been selected, to be applied with the same sample in the syringe. In the table, the properties related with each band can be set.

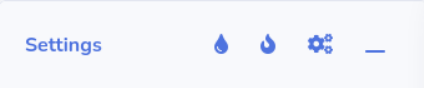
Sample List



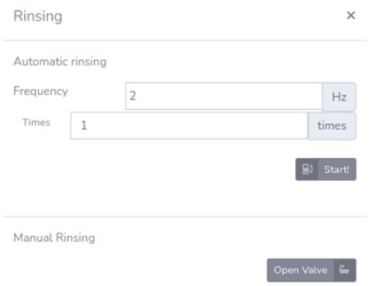
Band	Displays the band number to which the row refers.
Sample	A text box to write a comment or a name to identify the sample. It can be copied and pasted.
Volume	The desired volume in µL to be applied. The type of solvent it is also used to calculate the drop volume; therefore, it must be set (acetone, water, methanol, …). If it is not listed, consult the appendix at the end of this manual.
Calculations	The ***minVol*** (minimum volume to be applied) and the ***DropVol*** (volume of a single drop, depending on the nozzle type, pressure, and solvent type) are shown. The calculated ***Volume*** is a multiple of the ***DropVol***, why it generally cannot match the desired volume exactly. The ***minVol*** is the minimum volume to be applied as a band regarding the band setting.

Autosampler

In the case of the autosampler, some forms are similar to those in the Syringe pump view. The different forms including functionalities are explained here.

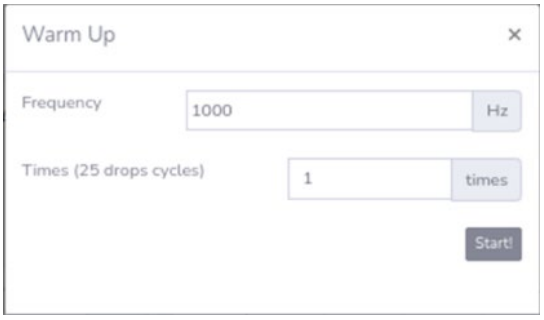


The **Drop** icon refers to Rinsing (as for Syringe Pump), but the way it rinses is different for the autosampler micropump. In this window, as before, automatic rinsing or manual rinsing can be selected. In the case of automatic rinsing, a number of **Times** can be selected, *i.e.*, the number of pump strokes. Although the micropump has a stroke volume of 50 µL, the ejected volume per stroke strongly depends upon the nozzle type, the solvent, and the dispensing valve frequency. For a frequence of 2, for example, it ranges from only 6 to 25 µL for the solvents that can be used with the autosampler. The dead volume of the microfluidic system is 490 µL, thus **Times** must be selected properly for the rinsing process to fill all tubings with solvents, free of air bubbles. Setting **Frequency** to 1, will about double the ejected volume and *vice versa*. Clicking the **Start** button starts the rinsing process. Check and repeat if necessary! The rinsing processes during sample application are calculated by the software regarding the selected nozzle, frequency, and solvent type. The rinsing processes are calculated in the software that way that 1.5 mL and 1.0 mL of the rinsing solvent and the sample, respectively, are consumed.

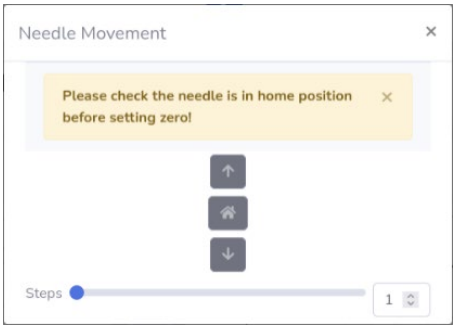


For manual rinse, there is only the **Open Valve** button to open the dispensing valve. This option allows to rinse the tubings, the 3-way valve, the dispensing valve, and the nozzle with any solvent not suitable for the micropump (Instruction S5 – Solvent compatibility). Therefore, disconnect the tubing from the OUT port of the micropump, connect it to a syringe (with the Luer-Lock adapter) filled with solvent, and manually press the syringe piston, while the valve is open. Note that the valve will automatically be closed after 30 s. If needed, click **Close Valve** and **Open Valve** to continue with rinsing.

The **Fire** icon refers to Warm Up. In this pop-up window it is possible to eject a number of drops, where the value **Times** means 25 drops cycles, thus, Times 2 means 50 drops, and **Frequency** sets the desired frequency of the dispensing valve to eject the drops.

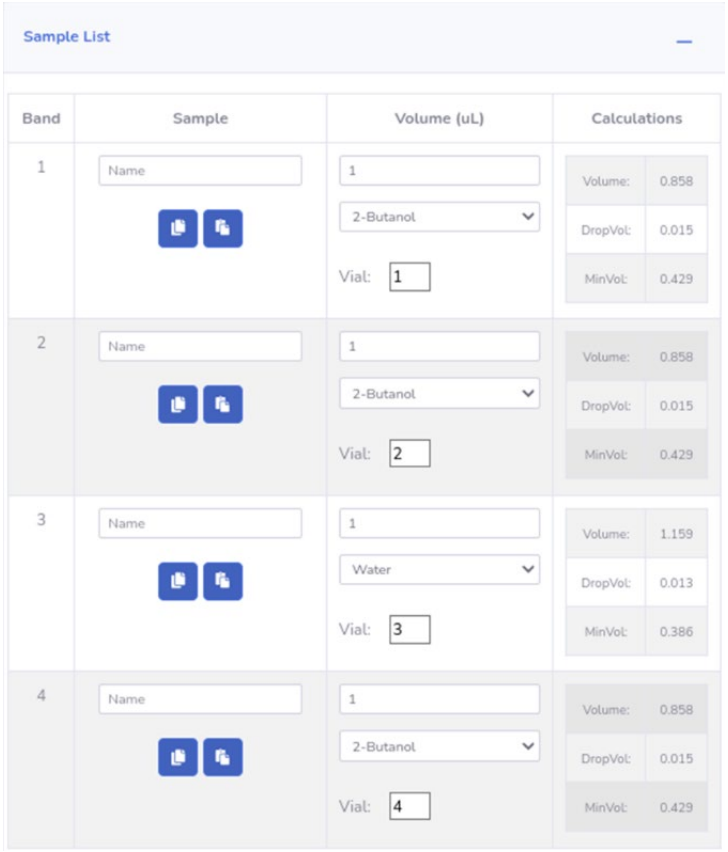


The **Gear** icon refers to Needle Movement. It is possible to move the needle up or down, to be able to place it correctly in the initial position if it is not. It should be noted that the movement is relative (moves the selected steps from the current position). Once the needle is at home height, this position can be set to zero by clicking the **Home** button.



The needle position is once set during the LabsToGo-Eco assembly (Assembly Instruction) and automatically read if the instrument is powered. If, however, a power failure occurred while the needle was down, this position will be read as zero (home), why the needle home position must be set again.

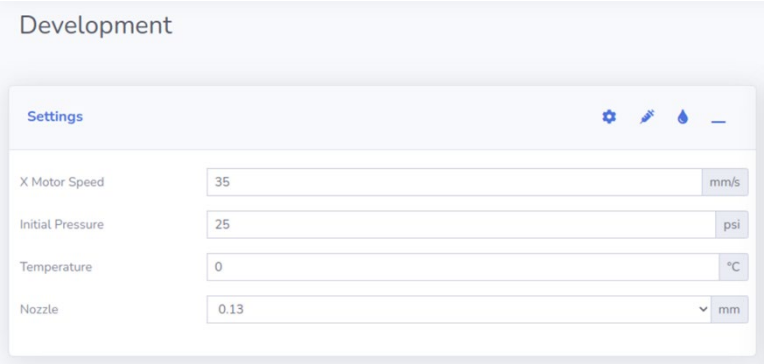
The autosampler Sample List form differs slightly from the Syringe Pump Sample List. Besides the sample name, sample volume and sample solvent, the vial number (up to eight samples) can be selected for each band. To apply a solvent blank from the rinsing vial, type vial number 9.


Sample List
Band
Sample
Volume (uL)
Calculations
1
Name
1
2-Butanol
Vial: 1
Volume: 0.858
DropVol: 0.015
MinVol: 0.429
2
Name
1
2-Butanol
Vial: 2
Volume: 0.858
DropVol: 0.015
MinVol: 0.429
3
Name
1
Water
Vial: 3
Volume: 1.159
DropVol: 0.013
MinVol: 0.386
4
Name
1
2-Butanol
Vial: 4
Volume: 0.858
DropVol: 0.015
MinVol: 0.429

Development

First place the **Cover Development** on top of the plate holder to built the development chamber.

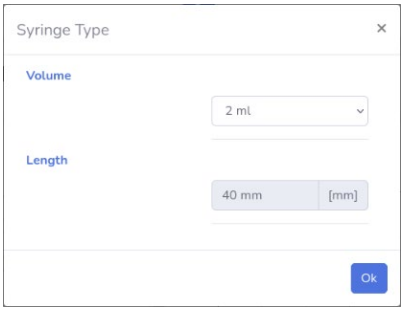
Settings



X Motor Speed	Sets the speed of the x-axis motor.
Initial Pressure	The minimum pressure to be reached before the valve is opened.
Temperature	Sets the temperature of the plate during the development (option). It may delay the start of the process.
Nozzle	Only for documentation of the nozzle used.

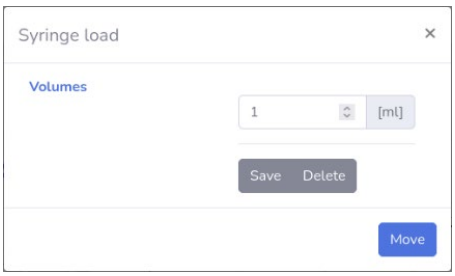
Syringe type

With the **Gear** icon it is possible to select the Syringe Type: 2 mL, 5 mL or 10 mL. According to this selection, the movement calculations are carried out. In the pop-up window it is possible to see how the Length value changes, but the user cannot modify this value. By clicking **Ok**, the values are saved, and the syringe load can be calculated correctly. This is the first setting that the user should modify.



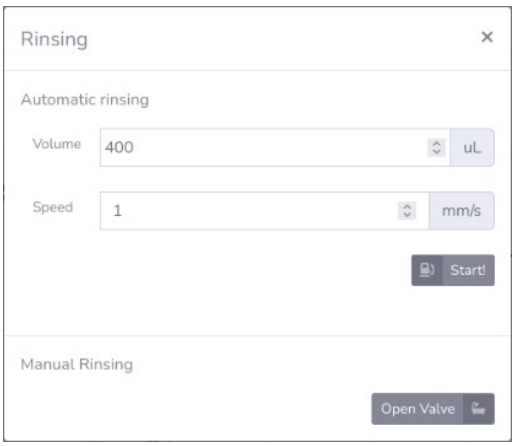
Syringe load

After click on the **Syringe** icon located in the top-right corner, the **Syringe load** screen will open. It refers to how much volume (in mL) of mobile phase was loaded into the syringe. Once selected and clicking **Move**, the axis of the syringe pump will move and the syringe can be inserted. If the syringe does not fit exactly, increase or decrease the set volume slightly via the arrows and click **Move** again.



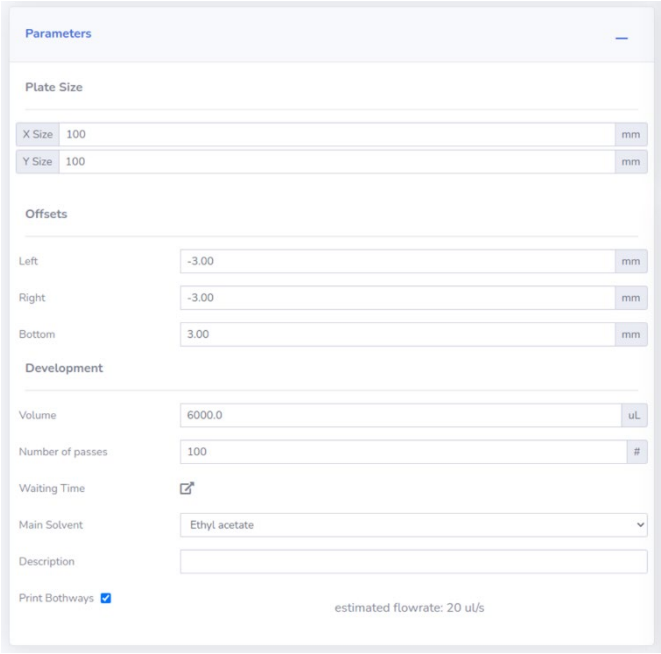
Rinsing

After click on the **Drop** icon located in the top-right corner, the **Rinsing** screen will open. Rinsing is a quick way especially to exchange the solvent and to remove air bubbles from the microfluidic system. Rinsing can be done automatically with a set volume by pressing **Start** or manually by clicking **Open Valve** and pressing the syringe manually.

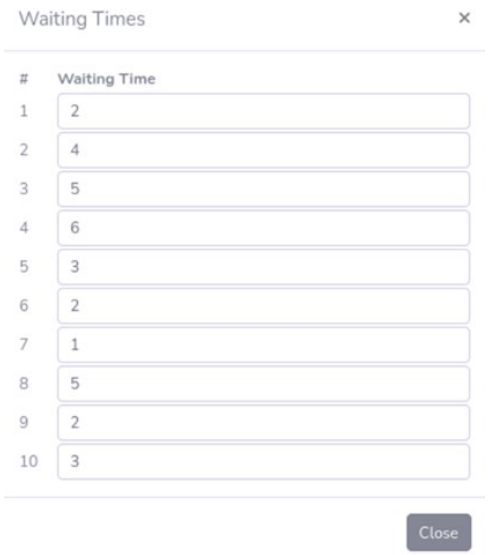


Development Parameters

Detailed information on plate sizes and offsets can be found under the analogous parameters used for Sample Application.

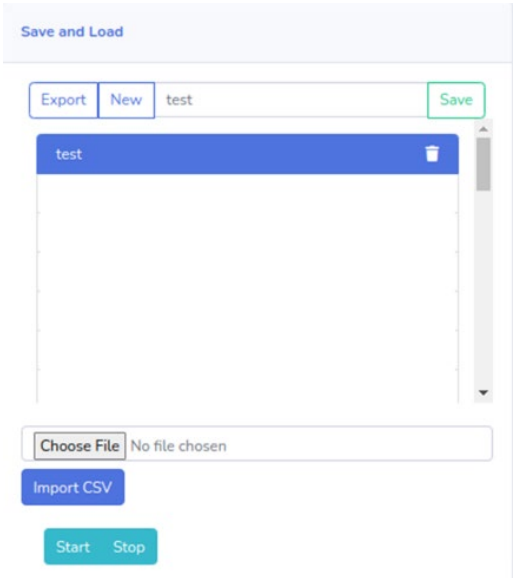


Volume	Total amount of mobile phase volume ejected in the development process.
Number of Passes	The number of passes in which the total volume will be applied. Change it to result in an estimated flow rate of about 20 µL/s.
Waiting Time	Sets the waiting time between each pass not to overload the plate, depending on the migration speed. Available in a new window (see below).
Main Solvent	Only for documentation of the main solvent of the mobile phase.
Print Bothways	If this option is checked, the solvent will be ejected on the way back also.



Save and Load

As for the the Sample Application, in the text entry field in the **Save and Load** window, the development settings can get a method name to be saved in the database.



After performing all settings, click on **New**, type a name, and click on **Save**. After changing the parameters, click **Save** again or create a new method with the changed settings.

Clicking the **Export** button will export all settings as csv file.

To load a development method, click on one of the already saved methods in the list and all settings will automatically be reloaded.
A csv file can also be imported. Therefore, choose a file and click on **Import CSV**.

Nebulization

Mini-Incubation

Software operation of the Nebulizer and Mini-Incubator is self-explanatory (Instruction S1).

Concerning the bioassay lab devices, cultivation with the Mini-Shaker is not integrated in software.

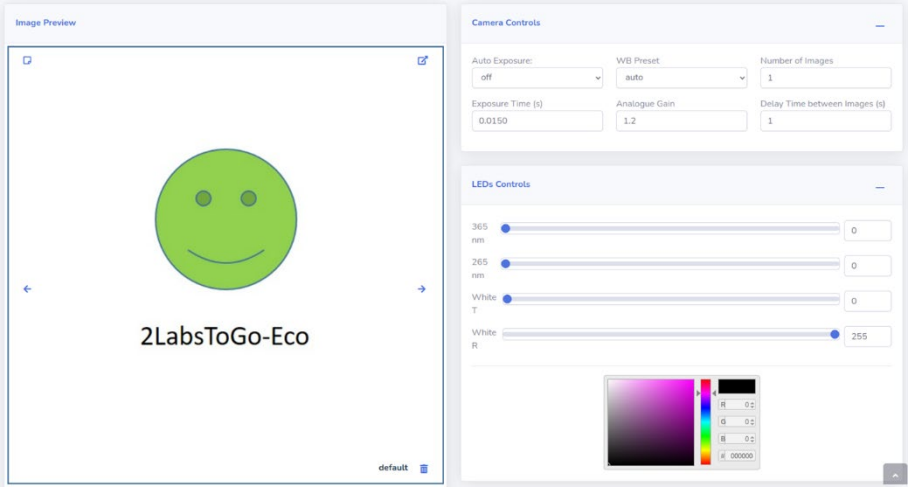
Detection

In the side bar menu, Detection offers **Capture Image** and **Process Image**. Right-click on Capture Image opens the Detection tab to capture plate images and to save them.

After setting User Controls, Camera Controls and LED Controls, the images to be captured can get a method name in the text entry field in Plate Preview window. Click on **New**, type a name, and click on **Save**. After changing the parameters, click **Save** again or create a new method with the changed setting. It is a good idea to have different methods different illuminations, for example, green tea 265 nm, green tea 365 nm, and so on.

Clicking the **Export** button will export all settings as csv file. A csv file with all image settings can also be imported. Therefore, choose a file and click on **Import CSV**.

Capture Plate Image



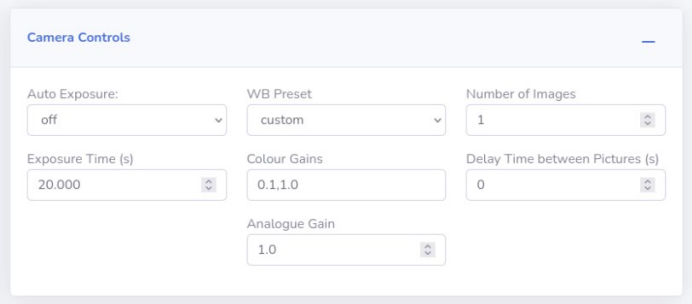
User Controls

The User Controls include a list of settings that will be applied to the image, once it is already taken, so it is post-processing of the image.

Brightness	Adjust the image brightness [-1.0 to 1.0], where 0.0 is the default ‘normal” value, -1.0 is very dark and 1.0 is very bright.

Contrast	Sets the contrast [0.0 to 32.0] of the image, where 0.0 is the default ‘no contrast” value, 1.0 is the default ‘normal’ contrast, and larger values increase the contrast proportionately.
Saturation	Amount of colour saturation [0.0 to 32.0] of the image, where 1.0 is the default ‘normal saturation” value, 0.0 produces greyscale images saturation, and higher values produce more saturated colours.
Sharpness	Sets the image sharpness [0.0 to 16.0], where 1.0 is the default ‘normal” level of sharpening, 0.0 implies no additional sharpening is performed, and larger values apply proportionately stronger sharpening.

Camera Controls



Camera Controls includes a list of configurations that will affect the camera settings.

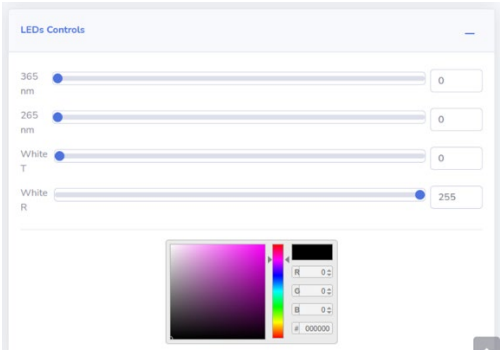
Auto Exposure	on – off
Exposure Time	Time in seconds, only when Auto Exposure is off, range [0.0001 to 200.0000].
WB Preset	Set the White Balance (WB) mode to any of the following: off, auto, tungsten, fluorescent, indoor, daylight, cloudy, or custom.
Colour Gains	Only when WB Preset is Custom, it is possible to set the colour gains [0.0 to 32.0], a pair of numbers where the first is the red gain (the gain applied to red pixels by the WB algorithm) and the second is the blue gain.
Analogue Gain	Proportional to ISO is the analogue gain applied to the sensor, [1.0 to 30.0], where 1.0 is the default value.

In the case a set of consistent plate images is required by a multishot, select the number of images and the delay time. While multi-shooting, the images are consistent each other, there are no settings changed between images, even the camera itself does not autogain between images.

Number of Images	Multishot possibility, from [0 to 200], where 1 is the default value.

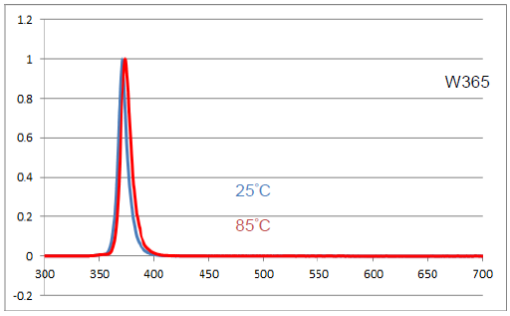
Delay Time between Images	Time in seconds between images in case of multishot [0 to 200], where 0 is the default value.

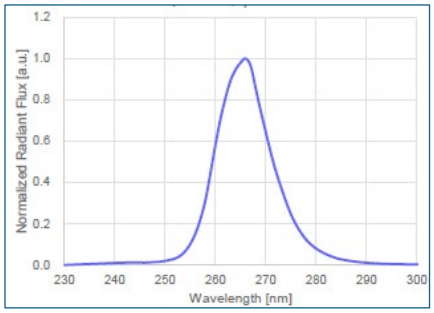
LEDs Control



Allow to illuminate the plate with the UV-light (365 nm and 265 nm) and visible light.
The UV LED power can be settled from 0 (minimum) to 255 (maximum), the same applies in the case of WhiteT (White Transmission) and WhiteR (White Reflection).
The RGB selector allows different combinations of red, green, and blue light intensities.

As compared to 365-nm UV bulbs in other instruments to capture HPTLC plate images, 365-nm UV LEDs used in the 2LabsToGo-Eco provide a comparably small emission peak. To obtain a fluorescent signal, the compound of a separated zone must be able to absorb within the emitted UV light.

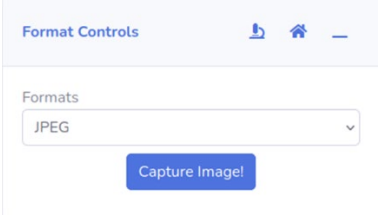




Thus, it is possible not detecting a fluorescent zone with the 2LabsToGo-Eco as it was detected with another instrument including an UV hand lamp.
Although UV 254-nm LEDs are available, they are very expensive, why the 2LabsToGo-Eco uses 265-nm LEDs. In case of F-plates, it makes no difference, because the fluorescence indicator (F_{254}, manganese activated zinc silicate) has a broad absorption with a maximum at 280 nm[1]. In case of fluorescence excitation, however, the same rules apply as for the 365-nm LEDs.

[1] Fred Schade, Wolfgang Schwack, Yetkin Demirbas, Gertrud E. Morlock, Analytica Chimica Acta 1174 (2021) 338702

Format Control



Allows to select a format between JPEG, PNG and BMP, where JPEG is the format by default. The image resolution generally is 2028 x 1520 px and cannot be changed.
Clicking on the **Microscope** icon will start to move the plate under the camera cabinet, while the case light is switched off and the vialrack holder moves a little bit to the back to close the instrument with the front cover.
Clicking on **Take Photo!** will take a photo with the current configurations.
Clicking the **Home** icon will move the plate holder to the front.

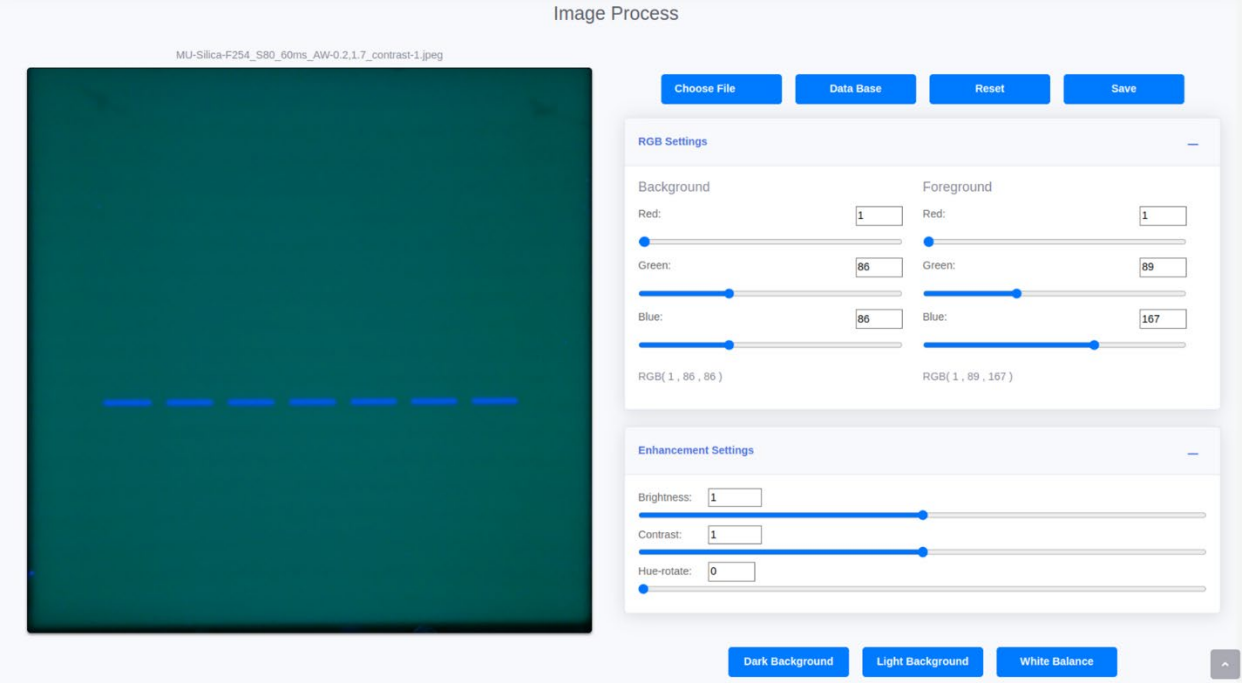
Plate Preview

Creating and saving a new detection method, a default image is presented in the **Plate Preview**.
After capturing a plate image, this will be displayed in the preview. Instead of the insert “default”, the filename (timestamp) of the image is diplayed, so it easily can be located in the media folder (2LabsToGo-Eco-Software/app/media/images) to export it.
The image can be enlarged in a new browser window (click in the upper right corner).
To delete the image click in lower right corner.

For multishots, each image is saved with the same timestamp but a consequtive number is added.
Clicking the arrows to the left or to the right in the previewed image switches between the images of a method while displaying all settings of the particular image taken.

Notes can be added (click upper left corner) to each image to provide some more information than the method name.

Process Image

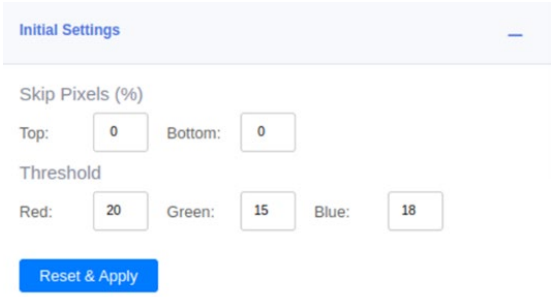


Opening the Process Image tab (under Detection in the main menu), the last captured plate image of the database (timestamp) will be loaded. With the arrows (right and left of the image) it can be toggled between the images in the database.
Alternatively, any plate image can be uploaded from a local storage (**Choose File**).
This image processing tool allows to modify the RGB (Red, Green, Blue) values of both the background and the foreground (zones) to obtain an optimal contrast. Additionally some **Enhencement Settings** can be changed for optimization.

Clicking **Dark Background**, for example, will set the mean of background pixels to black. Here, it is best to exclude image parts not of interest (Skip Pixels (%) in the window **Initial Settings**) below the application (Bottom) and above the solvent front (Top). For a 10 cm x 10 cm plate, the percentage value of Skip Pixels (%) is identical with mm from the bottom and the top. The default value is 0.
The Threshold section controls how the application distinguishes between foreground and background pixels based on their RGB values, in terms of sensitivity.

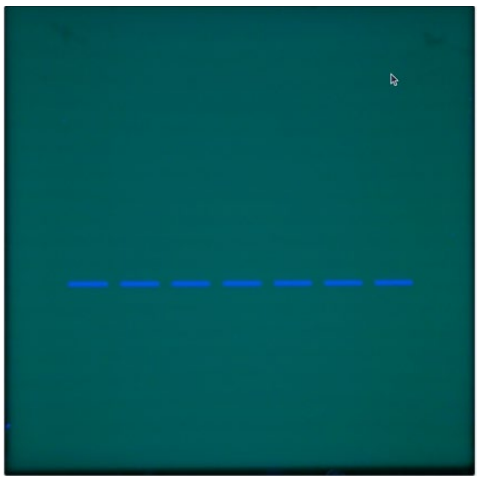
How it works:

- First, the mean RGB value of the entire image is calculated, excluding the parts not of interest.
- Then, for each pixel, the difference between its RGB values and the mean RGB value is calculated.
- If the difference is higher than the specified threshold, the pixel is considered part of the foreground; otherwise, it is considered background.

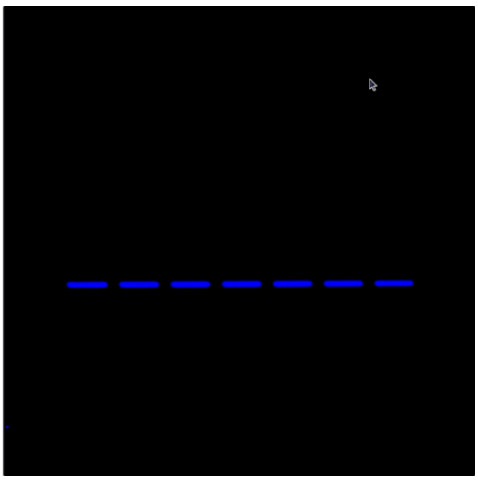


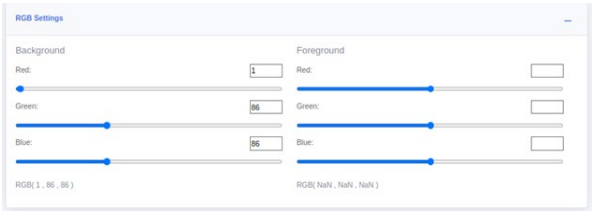
The result can be like this:

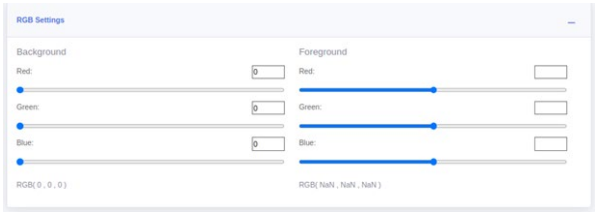
before



after Process Image (Black Background)







Clicking the **Reset and Apply Button** will reset the slider settings and apply the new configurations made in the "Skip Pixels" and "Threshold" sections.

Clicking **Reset** in the main window returns to the original image.
Clicking on **Save** will save the corrected image under a selected name.
Clicking on **Database** returns to the images saved in 2LabsToGo-Eco database.

A simple **White Balance** Tool is also available.

Appendix

Adding solvents

To add a solvent not provided by the 2LabsToGo-Eco Software (here Beer), four files have to be edited.

Density table

2LabsToGo-Eco-Software/app/finecontrol/calculations/flow.py#L16

Insert a new line in the section:

```
class Flow:
….
      density_table = {
         "Beer": {"density": 1, "fluid_correction_factor": 1.0},
…
      }
```

and

```
class FlowAS:
….
      density_table = {
         "Beer": {"density": 1, "fluid_correction_factor": 1.0},
…
      }
```

Development options

2LabsToGo-Eco-Software/app/templates/modules/development/devproperties.html#L50

add a new line:

```
<option value="Beer">Beer</option>
```

SampleApp options

2LabsToGo-Eco/app/templates/modules/sampleapp/table/table.js#L1

```
const OPTIONS = [""Water", "Methanol", "Acetone", "2-Butanol", …, "Beer",….]
```

2LabsToGo-Eco/app/templates/modules/sampleapp/table/tablesp.js#L1

```
const OPTIONS = [""Water", "Methanol", "Acetone", "2-Butanol", …, "Beer"]
```

To load the modified javascript files (js), delete the browser's cache!

Adding nozzles

To add a nozzle not provided by the 2LabsToGo-Eco Software (here 0.25), four files have to be edited.

Development

2LabsToGo-Eco-Software/app/templates/modules/development/settingsform.html#L38

add a line:

```
<option value="0.25">0.25</option>
```

SampleApp

2LabsToGo-Eco-Software/app/templates/modules/sampleapp/dinamicpropertiesform.html#L60

add a line:

```
<option value="0.25">0.25</option>
```

2LabsToGo-Eco-Software/app/templates/modules/sampleappsp/dinamicpropertiesform.html#L60

add a line:

```
<option value="0.25">0.25</option>
```

2LabsToGo-Eco-Software/app/finecontrol/calculations/flow.py#L43-L44

add two lines:

```
if nozzle_diameter == '0.25':
        self.nozzle_lohms = 7500
```

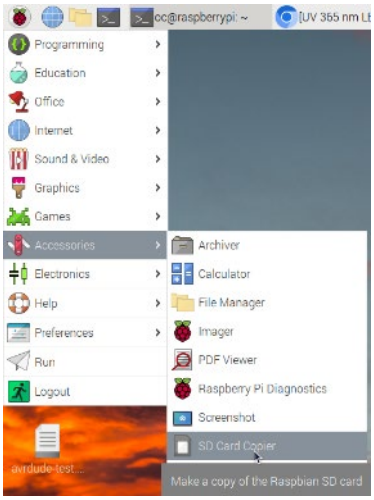
Backup

Manual backup for media folder, database and SD card

At least, regularily save the database (2LabsToGo-Eco-Software/app/db.sqlite3) and the media folder (2LabsToGo-Eco-Software/app/media).
In case a new installation is required, both can be imported.

The SD card of the Raspberry Pi is not as stable as an SSD drive. A power failure, for example, can make the SD card unreadable.
Therefore, it is good to have a full backup of the SD card with all installations, from time to time.

There is an „SD Card Copier“ tool on the Raspberry Pi under „Accessories“.
Connect an USB SD card reader with a fresh SD card (64 GB) to the Raspberry Pi and run the tool.



However, the backup medium is still an unstable SD card (magnetic field, heat).

It is therefore the best to prepare a compressed image file to be saved on a PC or server.
The Linux dd command (disk dump) and pishrink are the used tools.

Insert an NTFS formatted USB stick (128 GB free space) in the Raspberry Pi.
Open a new Linux terminal and type

`df -l` (I like List)

The last line of the output gives the information, under which name the USB stick was mounted, for example:

/media/*username*/AAA4B3EBA4B3B7E1

[“*username*” is the username selected during the Raspberry Pi OS setup.]

Then type the following dd command:

`sudo dd bs=4M if=/dev/mmcblk0 of=/media/username/AAA4B3EBA4B3B7E1/2LabsToGo-Eco.img status=progress` (and press ENTER)

The process takes a while. After finishing, there is a file “2LabsToGo-Eco.img” on the USB stick.

Compressing the file, is the job of pishrink (must have been installed, see Assembly Instruction).

In the terminal type:

```
sudo pishrink.sh -z /media/username/AAA4B3EBA4B3B7E1/2LabsToGo-Eco.img
```

The former img file will be overwritten by a compressed 2LabsToGo-Eco.img.gz file, which also takes a while.

With the Raspberry Pi Imager, this file can simply be flashed on an SD card. Thus, the complete installation on the date of the image file is restored.

There also is a bash script available in the folder “2LabsToGo-Eco/2LabsToGo-Eco-Backup”, running both the dd and pishrink command.

In a Linux terminal change to this folder by typing

```
cd ~/2LabsToGo-Eco/2LabsToGo-Eco-Backup
```

Make the file executable

```
sudo chmod +x dd_pishrink.sh
```

Then type

```
./dd_pishrink.sh
```
(and press ENTER)

The script first asks for the name of the USB stick to be typed (or copied and pasted using the Edit tab). Then the formerly described commands are running automatically ending up in the compressed img file.

Timer-controlled backup for media folder, database and SD card

Concept of regular automated data backups
Terminal commands are greyed.

Placeholders used in the following instruction
mybackupfolder: name of the USB connected hard disk or folder on the Raspberry Pi to mount an external backup server
mybackupserver: name of a USB hard disk or IP address of an external backup server
share_name: name of the shared folder on an external backup server
myusername: username for the external backup server
mypassword: password for the external backup server
my2LabsToGo: name of the 2LabsToGo-Eco system to be saved (freely to select) = stem name of the backup files

Preparations

Select a medium to save the backups (external hard disk USB connected to the Raspberry Pi or server accessible through local network/WiFi, cloud server).

The files operating the backups, are in the folder /home/2LabsToGo-Eco/2LabsToGo-Eco-Backup.

Case 1 – external hard disk (256 GB is enough)

To get the name of an USB connected hard disk, type

df -l (l like list)

The output gives the information, under which name the USB stick was mounted, for example:

/media/pi/AAA4B3EBA4B3B7E1 (=mybackupfolder)

Open the file “backup_db_media.sh” (backup of the database and the media folder) with a simple text editor and update the yellow marked placeholders.

```
#!/bin/bash
#mounting backup system
sudo mount mybackupfolder  #name of the hard disk drive, as /media/pi/AAA4B3EBA4B3B7E1
#variables
2LabsToGo_FOLDER="/home/piuser/2LabsToGo-Eco/2LabsToGo-Eco-Software"  #folder of the software
BACKUP_FOLDER="mybackupfolder"  #name of the hard disk drive, as /media/pi/AAA4B3EBA4B3B7E1
BACKUP_NUMBER="5"  #number of the backups to be kept
BACKUP_NAME="my2LabsToGo_DB"   #keep the extension _DB!!
#backup database and media folder
sudo tar -zcvf ${BACKUP_FOLDER}/${BACKUP_NAME}-$(date +%Y%m%d-%H%M).tar.gz
${2LabsToGo_FOLDER}/app/db.sqlite3 ${2LabsToGo_FOLDER}/app/media > /dev/null
#Delete backups > BACKUP_NUMBER
pushd ${BACKUP_FOLDER}; ls -tr ${BACKUP_FOLDER}/${BACKUP_NAME}* | head -n -
${BACKUP_NUMBER} | xargs -r rm; popd
#unmounting backup system
sudo umount mybackupfolder  #name of the hard disk drive, as /media/pi/AAA4B3EBA4B3B7E1
```

Save the file.

Open the file “backup_sd.sh” (backup of the complete SD card) with a simple text editor and update the yellow marked placeholders.

```
#!/bin/bash
#mounting backup system
sudo mount mybackupfolder  #name of the hard disk drive, as /media/pi/AAA4B3EBA4B3B7E1
#variables
BACKUP_FOLDER="mybackupfolder"  #name of the hard disk drive, as /media/pi/AAA4B3EBA4B3B7E1
BACKUP_NUMBER="5"  #number of the backups to be kept
BACKUP_NAME="my2LabsToGo_SD"   #keep the extension _SD!!
#backup SD card
sudo dd if=/dev/mmcblk0 of=${BACKUP_FOLDER}/${BACKUP_NAME}-$(date +%Y%m%d).img bs=1MB
```

```
#pishrink to clean and compress the image
sudo pishrink.sh -z ${BACKUP_FOLDER}/${BACKUP_NAME}-$(date +%Y%m%d).img
#delete backups > BACKUP_NUMBER
pushd ${BACKUP_FOLDER}; ls -tr ${BACKUP_FOLDER}/${BACKUP_NAME}* | head -n -
${BACKUP_NUMBER} | xargs -r rm; popd
#unmounting backup system
sudo umount mybackupfolder  #name of the hard disk drive, as /media/pi/AAA4B3EBA4B3B7E1
```

Save the file.

Possibly change the backup times in both timer files (backup_sd.timer, backup_db.timer):

OnCalendar=*-*-* 23:30:00 (daily at 23:30 for the media folder and the database)

OnCalendar=*-*-01 00:00:00 (first day of the month at midnight for the sd card)

[https://silentlad.com/systemd-timers-oncalendar-(cron)-format-explained]

Make the bash files excutable:

```
cd /home/2LabsToGo-Eco/2LabsToGo-Eco_Backup
sudo chmod +x *.sh
```

Move all files (except fstab and .backupuser, not needed here) to the folder /etc/systemd/system of the Raspberry Pi:

```
sudo mv *.sh *.timer *.service /etc/systemd/system
```

To check the success of backups, type

```
sudo mount /mybackupfolder
ls  (to list the actual content of the USB drive), follwed by
sudo umount /mybackupfolder
```

Case 2 - server accessible through local network/WiFi, cloud server

On the backup server, create a folder for the backups and give it a share name (share_name).

Create a user (with password) accessing the backup folder.

On the Raspberry Pi, create a directory to mount the backup server:

```
sudo mkdir /mnt/mybackupfolder
```

Open the credential file ".backupuser" with a simple text editor and update the yellow marked placeholders:

```
username=myusername  #username for the network drive
password=mypassword  #password for the network drive
```

Open the file "backup_db_media.sh" with a simple text editor and update the yellow marked placeholders.

```
#!/bin/bash
```

```
#mounting backup system
sudo mount mybackupfolder  #name of mount folder on the Raspberry Pi, like /mnt/mybackupfolder
#variables
2LabsToGo_FOLDER="/home/piuser/2LabsToGo-Eco/2LabsToGo-Eco-Software"  #folder of the software
BACKUP_FOLDER="mybackupfolder"  #name of the mount folder on the Raspberry Pi, like /mnt/mybackupfolder
BACKUP_NUMBER="5"  #number of the backups to be kept
BACKUP_NAME="my2LabsToGo_DB"   #keep the extension _DB!!
#backup database and media folder
sudo tar -zcvf ${BACKUP_FOLDER}/${BACKUP_NAME}-$(date +%Y%m%d-%H%M).tar.gz
${2LabsToGo_FOLDER}/app/db.sqlite3 ${2LabsToGo_FOLDER}/app/media > /dev/null
#Delete backups > BACKUP_NUMBER
pushd ${BACKUP_FOLDER}; ls -tr ${BACKUP_FOLDER}/${BACKUP_NAME}* | head -n -
${BACKUP_NUMBER} | xargs -r rm; popd
#unmounting backup system
sudo umount mybackupfolder  #name of the mount folder on the Raspberry Pi, like /mnt/mybackupfolder
```

Open the file “backup_sd.sh” with a simple text editor and update the yellow marked names.

```
#!/bin/bash
#mounting backup system
sudo mount mybackupfolder  #name of the mount folder on the Raspberry Pi, like /mnt/mybackupfolder
#variables
BACKUP_FOLDER="mybackupfolder"  #name of the mount folder on the Raspberry Pi, like /mnt/mybackupfolder
BACKUP_NUMBER="5"   #number of the backups to be kept
BACKUP_NAME="my2LabsToGo_SD"   #keep the extension _SD!!
#backup SD card
sudo dd if=/dev/mmcblk0 of=${BACKUP_FOLDER}/${BACKUP_NAME}-$(date +%Y%m%d).img bs=1MB
#pishrink to clean and compress the image
sudo pishrink.sh -z ${BACKUP_FOLDER}/${BACKUP_NAME}-$(date +%Y%m%d).img
#delete backups > BACKUP_NUMBER
pushd ${BACKUP_FOLDER}; ls -tr ${BACKUP_FOLDER}/${BACKUP_NAME}* | head -n -
${BACKUP_NUMBER} | xargs -r rm; popd
#unmounting backup system
sudo umount mybackupfolder  #name of the mount folder on the Raspberry Pi, like /mnt/mybackupfolder
```

Save the file.

Open the file “fstab” with a simple text editor and update the yellow marked placeholders: [fstab is responsible for mounting an external backup server.]

```
proc            /proc           proc    defaults          0       0
PARTUUID=68d743e8-01  /boot           vfat    defaults          0       2
PARTUUID=68d743e8-02  /               ext4    defaults,noatime  0       1
# a swapfile is not a swap partition, no line here
#   use  dphys-swapfile swap[on|off]  for that
//IP-address/share_name /mnt/mybackupfolder cifs credentials=/etc/systemd/system/.backupuser,rw,vers=1.0 0
0
```

#empty line

Possibly change the backup times in both timer files (backup_sd.timer, backup_db.timer):
OnCalendar=*-*-* 23:30:00 (daily at 23:30 for the media folder and the database)
OnCalendar=*-*-01 00:00:00 (first day of the month at midnight for the sd card)
[https://silentlad.com/systemd-timers-oncalendar-(cron)-format-explained]

Make the bash files executable:

```
cd /home/2LabsToGo-Eco/2LabsToGo-Eco-Backup
sudo chmod +x *.sh
```

Make the credential file ".backupuser" readable

```
sudo chmod 600 .backupuser
```

Move all files (except fstab) to the folder /etc/systemd/system of the Raspberry Pi:

```
sudo mv *.sh *.timer *.service .backupuser /etc/systemd/system
```

The file .backupuser (with username and password) can also be renamed (.mycredentials):

```
sudo mv /etc/systemd/system/.backupuser /etc/systemd/system/.mycredentials
```

[Then also correct it in "fstab"!!]
Move the file fstab to the folder /etc:

```
sudo mv fstab /etc
```

To check the server connection, type

```
sudo mount /mnt/mybackupfolder
```

followed by

```
cd /mnt and cd bus
ls (reports the actual content of the backup folder)
```

Changing the backup files after they have been moved to /etc

Open the files with

```
sudo nano …  (after cd to the respective folder)
```

Otherwise they cannot be saved!

Commands to start the backup service

```
sudo systemctl daemon-reload
sudo systemctl enable backup_sd.timer backup_db.timer
sudo systemctl start backup_sd.timer backup_db.timer
[sudo systemctl restart backup_sd.timer backup_db.timer]
```

To check if the the backup service is working, type

```
systemctl status backup_sd.timer backup_db.timer
```

The output should be like this:

```
● backup_sd.timer - My backup job timer
     Loaded: loaded (/etc/systemd/system/backup_sd.timer; enabled; vendor preset: enabled)
     Active: active (waiting) since Mon 2024-12-16 13:46:46 CET; 17s ago
    Trigger: Wed 2025-01-01 00:00:00 CET; 2 weeks 1 days left
   Triggers: ● backup_sd.service

Dec 16 13:46:45 pi systemd[1]: Stopped My backup job timer.
Dec 16 13:46:45 pi systemd[1]: Stopping My backup job timer.
Dec 16 13:46:46 pi systemd[1]: Started My backup job timer.

● backup_db.timer - My backup job timer
     Loaded: loaded (/etc/systemd/system/backup_db.timer; enabled; vendor preset: enabled)
     Active: active (waiting) since Mon 2024-12-16 13:46:53 CET; 20s ago
    Trigger: Mon 2024-12-16 23:00:00 CET; 9h left
   Triggers: ● backup_db.service

Dec 16 13:46:53 pi systemd[1]: Stopped My backup job timer.
Dec 16 13:46:53 pi systemd[1]: Stopping My backup job timer.
Dec 16 13:46:53 pi systemd[1]: Started My backup job timer.
```

Exit the report with Ctrl+c.

Revovering the backups

In case an SD card was damaged (does not boot anymore) the last image file saved on the backup system (my2LabsToGo_SD-DATE.tar.gz) can be flashed by the Raspberry Pi Imager (www.raspberrypi.com/software/) onto a new SD card (with the complete installation).
The last backup of the media folder and the database db.sqlite3 (extract my2LabsToGo_DB-DATE.tar) can then be copied (overwritten) to the new installation. Thus, the data pool of yesterday was recovered.
Thereafter, the terminal commands to start the backup service must again be executed (see above) to continue the backup services.