



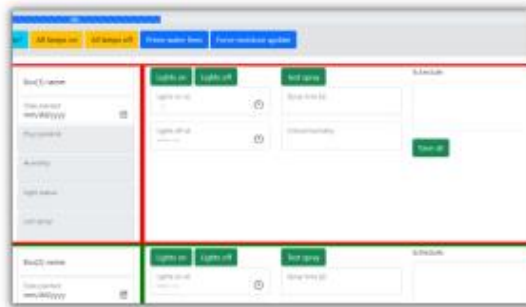
# HERBALIFE

Automatic watering



Schedule precise times  
to water your plants

Interactive UI



Control every aspect like timing  
for watering and lighting  
through a simple web interface

Tank water level sensor



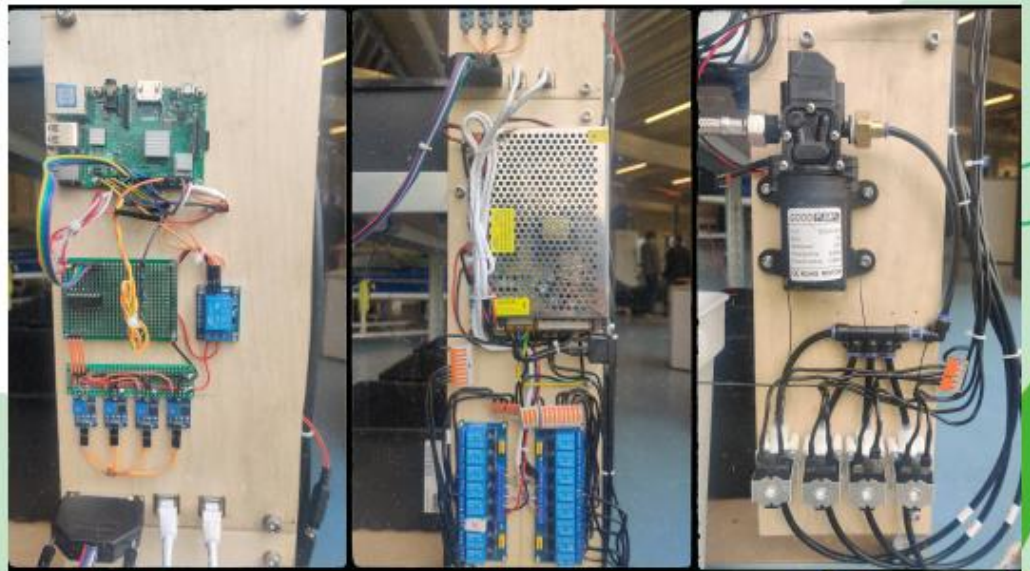
Know how much water is left at  
any time

Measures soil moisture



Automatically detects  
dry soil and waters  
the plants

Electronic intelligent control



Computes and sends electrical signals from a Raspberry Pi to  
components like the water pump, WiFi for remote control and soil  
moisture sensors through AC/DC converters and relays.

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# Herbalife: User manual

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## 1. Set up

### a. Hardware set up

The set-up was not yet designed to be used by everyone; some technical knowledge is required. This could be made easier, but that was not the focus of this project.

1. Use your phone to create a hotspot with SSID "wififorpi" and password "wififorpi"
2. Plug in the power cord.
3. Wait for the lamps to turn on (Level 2 or level 3)
4. The pi automatically connects to the hotspot.

### b. Software set up

1. Connect to the same network as the raspberry pi (your own hotspot).
2. Find the Pi's local network address using a network scanner
3. Using a command line, SSH into the using username "pi" and password "raspberry"

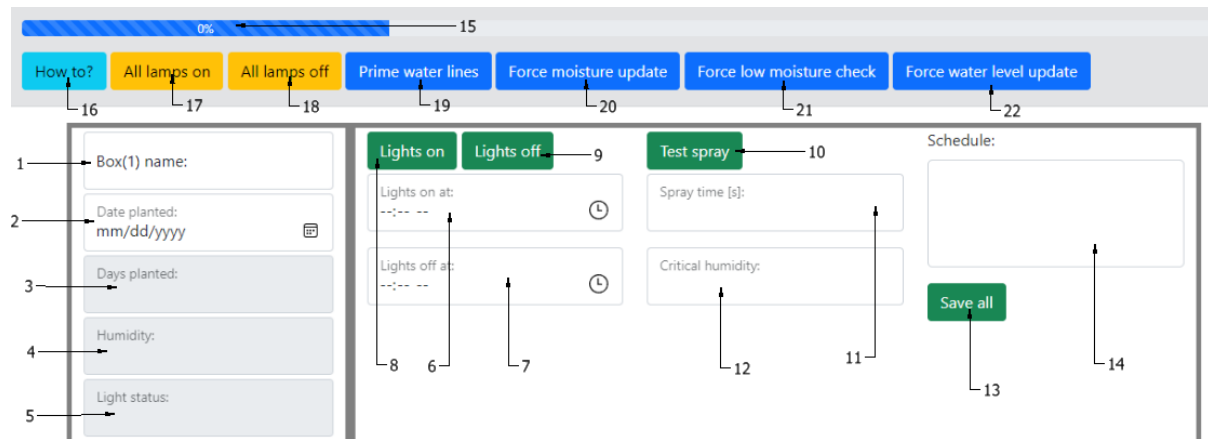
Example: ssh [pi@192.168.0.225](#)

4. Now that you are in the pi, run these commands:  
>>cd /rpi  
>>python -m uvicorn --host "insert pi ip" main:app
5. Browse to the Pi's local network address with port 8000.

Example 192.168.0.225:8000

## 2. General usage

### a. Web interface overview



Everything from number 1 to number 14 is repeated 4 times across the web interface. All these controls/Text fields are level specific. Level 1 is the shelf at the top and level 4 is the shelf at the bottom.

Everything from number 15 to number 22 is not level specific. These are general controls and stay at the top of the web interface even when scrolling down.

#### 1. Box name

The name of the box/level, the user can change this at any time.

#### 2. Date planted

The date the user planted their plants, this can be changed at any time

#### 3. Days planted

The number of days since the “date planted” this gets calculated and changed automatically a couple of seconds after changing “date planted”

#### 4. Moisture level

A number between 0 and 1 where 1 is the most humid state of the soil used and 0 the driest. This can be calibrated (Read “calibration”)

#### 5. Light status

Displays the light status

#### 6. Lights on time

The lights turn on at this time, the user can edit this at any time. (Read “Scheduling water”)

#### 7. Lights off time

The lights turn on at this time, the user can edit this at any time. (Read “Scheduling water”)

#### 8. “Lights on” button

Turns the lights on

#### 9. “Lights off” button

Turns the lights off

#### 10. “Test spray” button

Sprays water for a time equal to “Spray time”(11)

11. Spray time

Used to set the amount of seconds a test spray(10) or scheduled spray(14) will spray

12. Critical moisture

If the moisture level drops below this value, the level will automatically be sprayed for a "spray time"(11) amount of seconds. This value has to be between 0 and 1

13. "Save all" button

This button saves every change made, it is very important. It will not work when one of the fields is empty or contains unfitting information for example: "Spray time = q". The save button will not work because the character "q" is not a whole number. This button will only save the data from the specific level where the button is pressed.

14. Schedule field

This field is used to schedule the automatic watering. (Read "Scheduling water")

15. Water level indicator

This bar indicates the water level as a percentage between 0 and 100 AND as a progress bar.

16. "How to?" button

This button shows this manual.

17. "All lamps on" button

Turn on ALL the lights

18. "All lamps off" button

Turn off ALL the lights

19. "Prime water lines button"

This fills the lines with water. All the valves will be opened when this button is pressed, so if the lines are filled with water, there will be coming water out of most of the nozzles (Not all of them because the pump head is too low to do that).

20. "Force moisture update" button

This button is for debug/presentation purposes, it overrides the timer and measures the moisture level.

21. "Force low moisture check" button

This button is for debug/presentation purposes, it overrides the timer and checks if the measured moisture level is under the critical moisture(12) value given by the user.

22. "Force water level update" button

This button is for debug/presentation purposes, it overrides the timer and measures the water level.



### c. Scheduling water

To schedule automatic watering, add times to the “schedule field”(14). The times need to be in a specific format for the program to register them. If they are in the wrong format, You will be able to save, but the watering won't be scheduled. The correct format is:

HH:MM.

For example: 01:00, 21:02, 19:35.

To add more then 1 scheduled watering moment, just press enter after the first inserted time, and type a new time on the new line. For example:

01:00  
21:02

To set how long you want each watering event to be, edit the “spray time”(11) value  
**Don't forget to press “save all”(13) after setting the schedule.**

### d. Scheduling light

To schedule automatic light control, add times to the “Lights on time”(6) and “Lights of time”(7) fields. The times need to be in a specific format for the program to register them. If they are in the wrong format, You will be able to save, but the watering won't be scheduled. The correct format is:

HH:MM.

For example: 01:00, 21:02, 19:35.

**Don't forget to press “save all”(13) after setting the times.**

### f. Timings

- Data refresh rate: determines how often the web interface gets data from the Pi (standard = 5 s)
- Water level refresh rate: determines how often the pi measures the water level (standard = 20 s)
- Moisture refresh rate: determines how often the pi measures the moisture level (standard = 10 minutes)
- Critical moisture refresh rate: determines how often the pi calculates if the moisture level is too low. (standard = 30 m)

All these values can be edited in /index.html at line 486-489

### g. Calibration

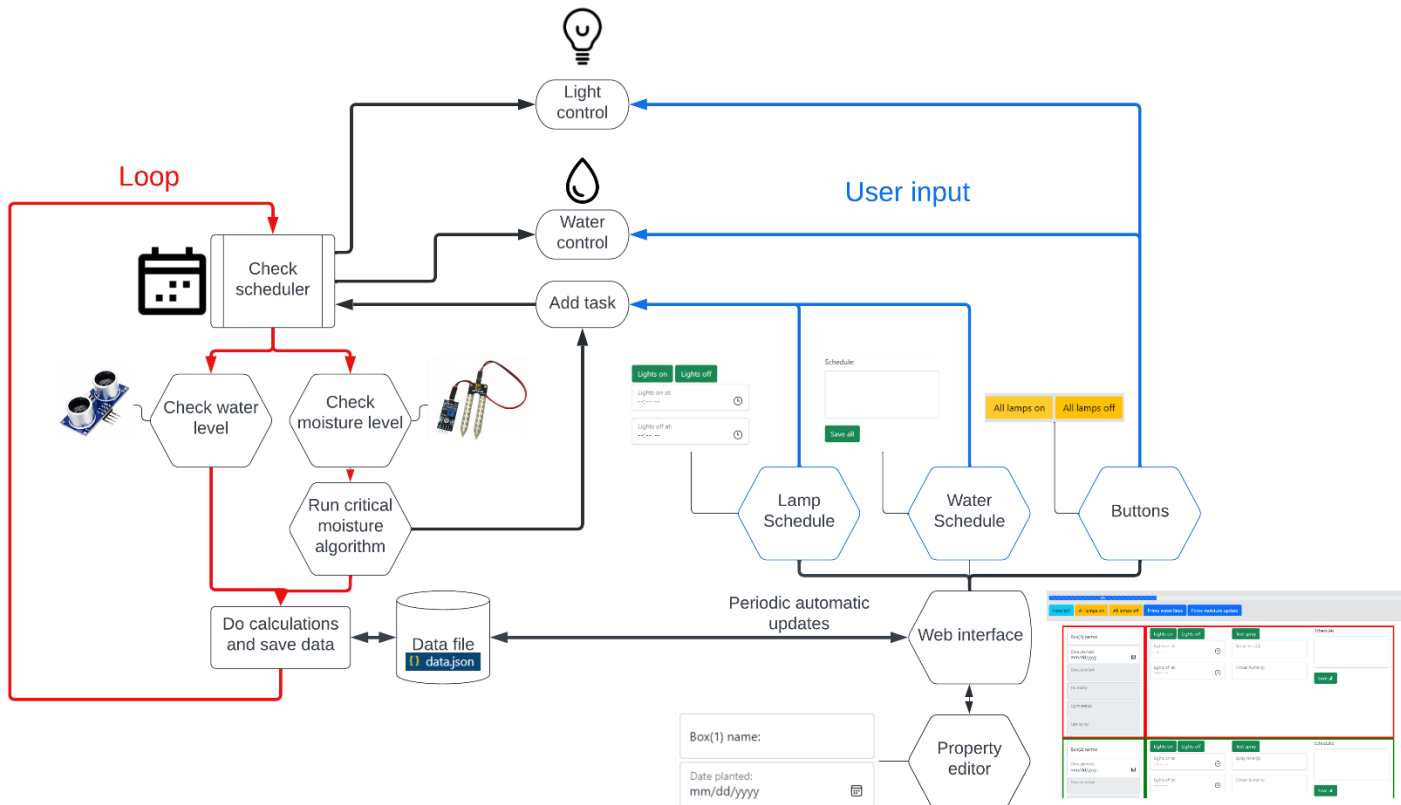
- To calibrate the moisture sensors or the water level sensor, edit the values on line 56-59 in runner.py
- To edit the pins used by the raspberry pi, edit the values on line 31-46 in runner.py
- To edit various pump settings, edit the values on line 54-55 in runner.py

### 3. Troubleshooting

Type	Nr	Problem	Possible cause	Solution
Hardware	1	Water doesn't pump	Intake pulls air instead of water	Seal intake port and intake tube of the pump
	2		Water tank empty	Fill water tank
	3	Water does not reach correct level	Valves are connected in the wrong order	Connect valves in correct order
	4	Water leaks while pump is working	The pump is on but the (wrong) valve remains closed	Order of relay switching by using the lights on the relay board The valve should always open before the pump start
	5	Sensors give no/inaccurate results	Visible oxidation on moisture sensor: sensor degradation	Replace sensor
	6		Sensor cable is not plugged in	Plug in the sensor cable
	7	Lights or valves don't turn on	Relay cables not plugged in or switched	Connect the cables and check labels on connector head
	8			
	9	Wrong lights/valves turn on	Pins are placed incorrectly on Raspberry pi	Check pin placement on Raspberry Pi
Software	10		Code contains the wrong variable	Check pin variables in runner.py
	11	Moisture levels is not correct	Wrong pin is assigned in code or badly calibrated	Change moisture pin variables in runner.py
	12	Water level is not correct	Wrong pin is assigned in code or badly calibrated	Change water level variables in runner.py

## 4. Software

### a. Schematic



The red loop runs automatically which gets and processes sensor data. It also checks the schedule, if there is a task in the schedule, then it will be executed (watering plants or turning on/off the lights). The blue part is the user input.

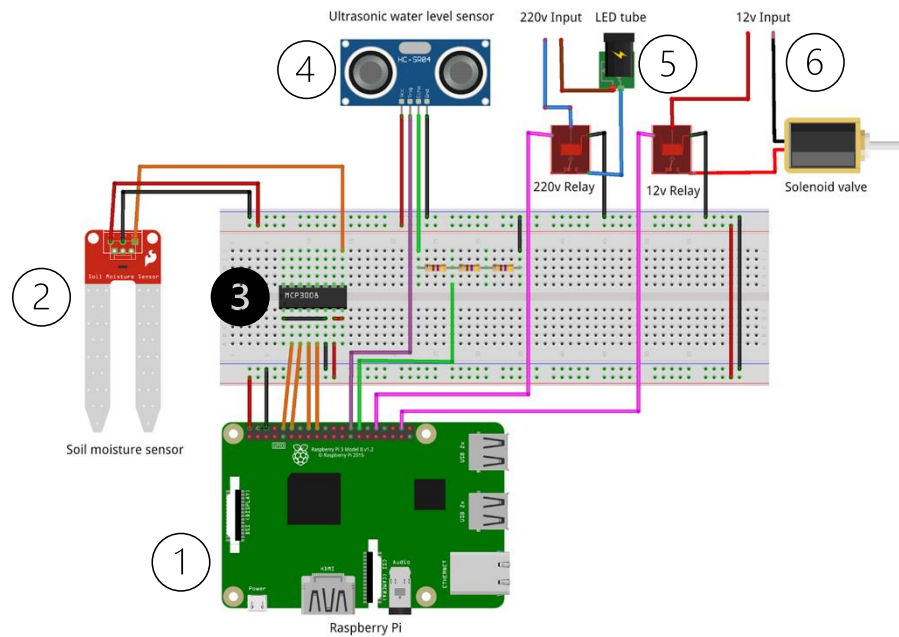


## 5. Electrical system

### a. Schematic

Each level contains the same components.

Here is a schematic for what the connections look like on each level:

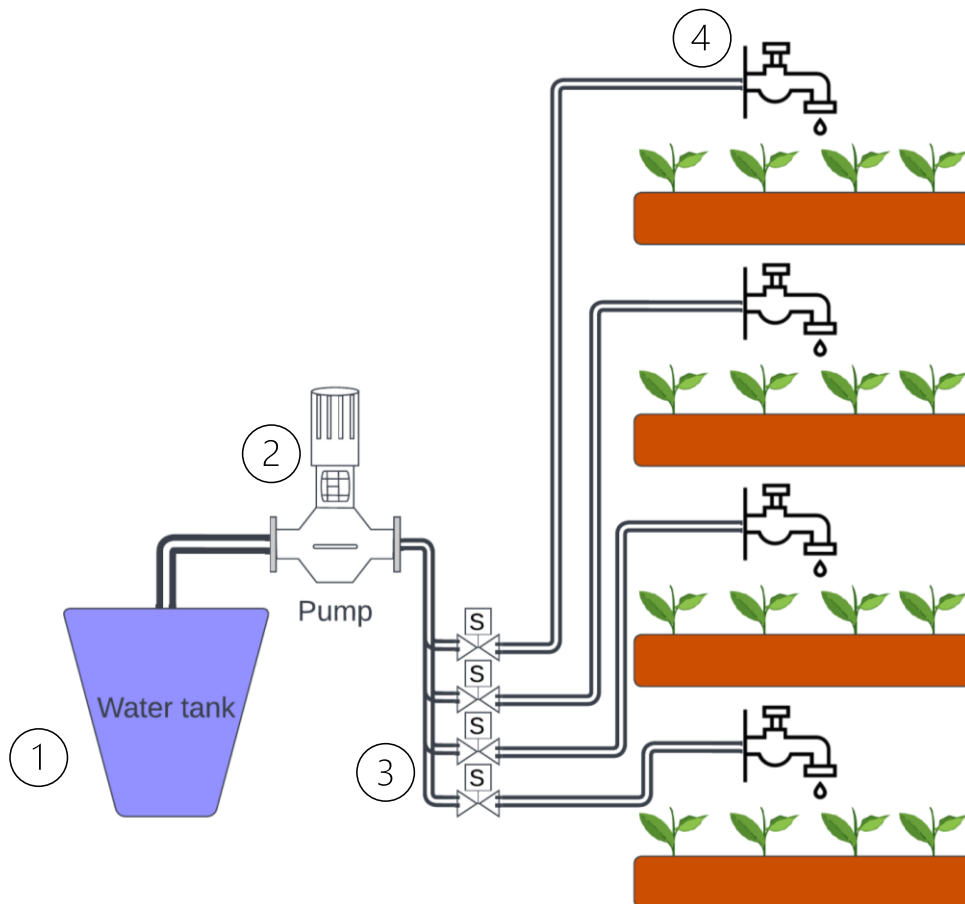


1. Raspberry Pi: it's the brains of the automated grow box and runs Linux Raspbian.
2. Soil moisture sensor: measures the moisture level of soil and sends that data to an MCP3008 (5.a.3).
3. MCP3008: converts and analogue signal to a digital one, so the Raspberry Pi (5.a.1) can interpret that data.
4. Ultrasonic water level sensor: it measures the time for a soundwave to bounce off of the surface of water and back. The RPI (5.a.1) sends a 5v signal to the "Trig" pin, it receives a 5v signal back from the "Echo" pin. These 5v get stepped down with a voltage divider to 3.3v. This way the RPI (5.a.1) can receive it safely.
5. 220v Relay & LED tube: The 220v relays are connected to LED tubes from Phillips that have a T8 connection (often seen used on fluorescent light tubes).
6. 12v Relay & Solenoid valve: The 12v relays are connected to the Solenoid valves, which make sure the correct levels get water.

## 6. Water system

### a. Schematic

This is a simplified overview of how all the water line connections are made.



1. Water tank: it has a capacity of 9L when full and contains one hole for the pump (6.a.2), and another for the Ultrasonic water level sensor (5.a.4).
2. Pump: a 12v pump that draws a maximum of 72W and can create a pressure head of 90 metres (0,9MPa). It is rated for a flowrate of about 6L/min. The pipe fittings on each end are 3/4<sup>th</sup> inch pipe threads. On the intake side the pump also features a water filter at the end of the pipe.
3. Water splitter and Solenoids: the water splitter (1 in; 4 out) divides the water over the four solenoid valves, which operate at 12v and rest in a NC state.
4. Water drip lines: spread water over the whole soil area of that level.