# BerryBox assembly procedure

The BerryBox is a custom-built, low-cost imaging station designed to support high-throughput, infrared imaging of vertically grown Arabidopsis thaliana seedlings. Below is a detailed guide to assist with the construction and assembly of the BerryBox system. All files are openly available to support reproducibility and modification.

* Build a closed imaging box from wooden planks with the following internal dimensions: (H 70, L 60, W 60 cm). Ensure the front face is open or fitted with a removable panel for access to plates and equipment.
* Download and laser-cut the 3 mm plexiglass sheets using the design files available at: <https://github.com/SRobertGroup/DLhook//tree/main/BerryBox>.
* Assemble the cut pieces into Petri dishes racks using plastic-compatible glue. A 3D schematic is available to help.
* Place the racks to the side wall of the box. Position the holes to allow even alignment for a 3-column × 4-row grid of 12 cameras.
* Drill 12 circular holes through the side panel of the box at the camera rack positions.
* Mount the 12 Raspberry Pi NoIR cameras into the drilled holes from the outside.
* Connect the cameras to three IVPort camera multiplexers, following the manufacturer's guidelines available at: <https://github.com/ivmech/ivport>.
* Link the IVPorts to three Raspberry Pi 3 Model B boards.
* Attach infrared LED strips to the back panel of the box to uniformly illuminate the seedlings during time-lapse imaging. Cut the diffusing paper into three vertical strips sized to span the height and width between racks and light sources. Use 18 metal hooks fixed inside the box walls to hold the paper strips. Secure each strip using paper clips or rubber bands, forming three flat diffusing surfaces between the IR lights and imaging zone.

Supplemental Table 1: BerryBox components

| **Name of the BerryBox components** | **quantity** |
| --- | --- |
| Raspberry PI 3 Model B | 3 |
| SanDisk MicroSD Card (Class 10 A1) | The Pi Hut | 3 |
| Official Raspberry Pi 3 Universal Power Supply (5.1V 2.5A) | 3 |
| Raspberry Pi "NoIR" Infrared Camera Board V2 (8MP,1080p) | 12 |
| Flex Cable for Raspberry Pi Camera or Display - 24" / 610mm | 12 |
| Raspberry Pi 3 Heat Sink Kit | 3 |
| IVPort Raspberry Pi Camera Module Multiplexer | 3 |
| IVPort Dual V2 Raspberry Pi Camera Module V2 Multiplexer | x |
| Enclosed box | 1 |
| SOLAROX® LED Streifen infrarot 940nm IR1-60-940 - 50cm | 4 |
| Universal AC/DC adapter | 1 |
| 3 mm thick plexiglass |  |
| 450 Three Eighth White Diffusion - Filtro gelatina 122x50cm | 1 |
| Metal hooks | 18 |
| bolt and nuts |  |
| RS PRO Packaging Plastic Coated Wire, 50m | 1 |

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| Supplemental Figure 1 |

# Instruction for the BerryBox

The power supply for the system is located on top of the BerryBox.

* Power Units 1 and 2: Press the on/off button.
* Power Unit 3: Must be plugged in manually.

Start with Raspberry Pi #3:

* Connect the monitor, mouse, and keyboard to Rpi n3.
* Then turn on the power supply.

After booting, Rpi n3 will display a red LED, indicating power, followed by a green LED, signaling boot sequence activity.

Insert Petri plates vertically into the rack with the back side of the plates facing the camera.

Each camera row corresponds to one plate, arranged top to bottom.

Use an alignment line inside the box as a visual guide to correctly position the rack.

### How to set up the picture acquisition

Accessing the acquisition Script:

* On the Rpi, open the File Manager.Go to the file manager, Navigate to the folder ivport-v2 and open the file “kinematic.py”

You may modify the following lines in the script to suit your experiment:

| **Parameter** | **Line** | **Notes** |
| --- | --- | --- |
| Number of pictures | L11 | Total timepoints in the time-lapse |
| Output file names | L13,16,19,22 | One for each camera. Use underscores ( \_ ) instead of dashes (-) or special characters to avoid script errors. For example: wt\_mut1\_mut2\_IAA |
| Image frequency | L23 | Defines how often pictures are taken (in seconds or minutes, depending on script config) |

### Acquire pictures

Open the terminal, go into the ivport-v2 folder, Initialize the multiplexer, start the kinematic script

| **cd ivport-v2**  **python init\_ivport.py**  **python kinematic.py** |
| --- |

The pictures will appear in the ivport-v2 folder.

Check that they look good, otherwise close the terminal, adjust the plates and then restart the system. I usually test by setting the kinematic script on 2 pictures every 3 seconds, and if they look good I modify the script again and start the system