# Raspberry Pi Behavioral Setup

A key component of multiple Ethopy behavioral systems is the Raspberry Pi (link), a small, affordable, single-board computer. It includes ports for HDMI, USB, Ethernet, audio, camera interface (CSI), display interface (DSI), and General Purpose Input/Output (GPIO) pins. It primarily runs on a Linux-based OS called Raspberry Pi OS, and also supports other operating systems. Below, we analytically describe the steps to implement a Raspberry Pi-based behavioral setup.

## Hardware parts list

### Electronics

| # | Item | Qty | Part # | Vendor | Ind. Price | Notes |
|---|---|---|---|---|---|---|
| 1 | Raspberry Pi 4 Model B/4GB | 1 | SC0192-3 | https://www.raspberrypi.com/products/raspberry-pi-4-model-b/ | 55€ | |
| 2 | Official Raspberry Pi 7 Touch Screen Display with 10 Finger Capacitive Touch | 1 | 2473872 | https://www.raspberrypi.com/products/raspberry-pi-touch-display/ | 75€ | |
| 3 | Premium High Speed microSD Card – MICROSDHC/XC V30 UHS-I U3 | 1 | INMSDH32G-100/70V30 | Integral | 6.73€ | |
| 4 | EthoPy Controller Board | 1 | Designed in the lab | Custom | | |
| 5 | Lick Ports | 2 or 3 | Designed in the lab | Custom | | 2 to detect licks and deliver water, 1 can be used as a proximity indicator (center port) |

| | | | | | | |
|---|---|---|---|---|---|---|
| 6 | Beam Photoelectric Sensor - Infrared Rotation Count Sensor Module for Arduino | 1 | HR0172 | https://grobotronics.com/infrared-photoelectric-encoder-sensor.html?gad_source=1&gad_campaignid=20999016384&gbraid=0AAAADpI6QoH9W856tbaWuxd2AiKQAmbh&gclid=CjwKCAjw3_PCBhA2EiwAkH_j4p0yAANfuS8QBCiWeAw2R4YwHmmT_q-WtRFtR7XScU17NU2EudBH0RoCm9EQAvD_BwE | 2€ | Can be used as a proximity indicator (center port) |
| 7 | Solenoid valves | 2 | LHDA0533415H | LEE SLR | | |
| 8 | Ultrasound Speakers 40kHz | 2 | UT-1640K-TT-2-R | Mouser Electronics | 3.20€ | For auditory experiments |

## Other Hardware

| # | Item | Qty | Part # | Vendor | Ind. Price | Notes |
|---|---|---|---|---|---|---|
| 1 | M3 screws | 6 | M3X12/D7985 | Grobotronics | 1.80€ | For mounting the screen to the base |
| 2 | Raspberry Pi 4 Heatsink (40x30x5mm) | 1 | 49-00012076 | Grobotronics https://grobotronics.com/raspberry-pi-4-heatsink-blue.html | 1.80€ | |

## 3D printed parts

You will find the blueprints for the items you should 3D print here.

| # | Item | Qty | Filename | Notes |
|---|---|---|---|---|
| 1 | Base | 1 | base.stl | Includes the lick port holders |
| 2 | Screen holder | 2 | screen_holder.stl | |
| 3 | Center port holder | 1 | center_port.stl | |
| 4 | Center port and speaker holder | 1 | center_port_with_speakers.stl | Includes the speaker holders |
| 5 | Pins | 1 | pin.stl | For mounting the center port holder |

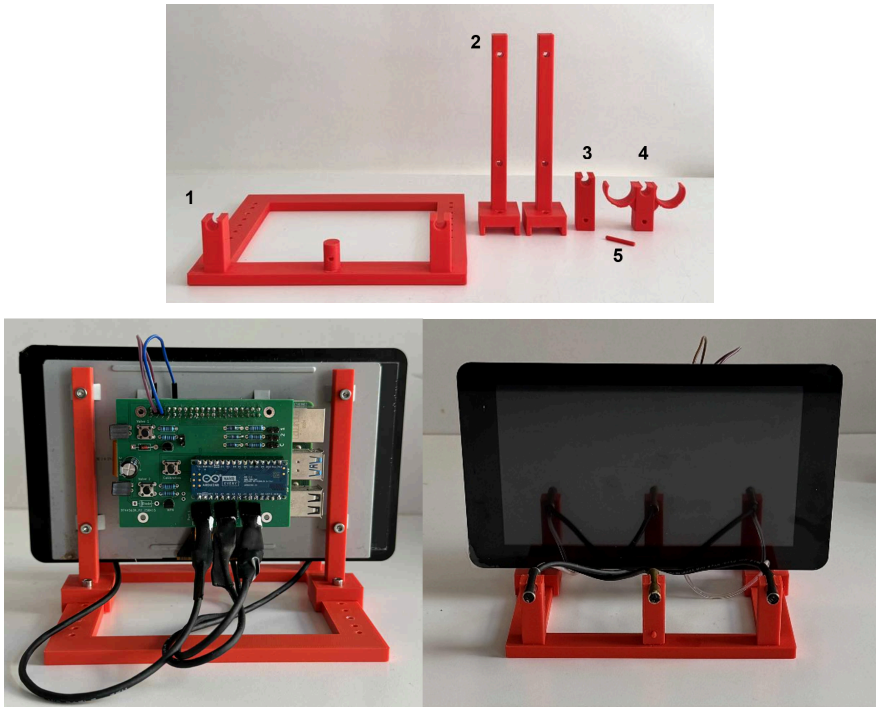


**Figure 1.** *RP setup (top: 3D printed parts of the RP's base, bottom: assembled RP base).*

# Step-by-step assembly instructions

**Step 1**. Install the operating system of the RPi (instructions). In our experiments, we have used the Bullseye Raspberry Pi OS.

**Step 2**. Mount the Raspberry Pi to the Raspberry Pi Touch Display and connect the Flat Flexible Cable and the power of the Touch Display to the Raspberry Pi (instructions).

**Step 3**. Connect the Ethopy Controller Board to the RPi.

**Step 4**. Add a heatsink (Other Hardware parts list, item #2) on the back of the RP to avoid excessive warming.

**Step 5**. Plug in the side and the center (lick or interruptor) ports, and the valves to the EthoPy Controller Board, to the positions indicated on the board.

**Step 6**. Connect the valves to the water supply. Each LEE valve (Electronics parts list, item #7) has 3 pipe-edges (1) to be connected to the lick port tube, (2) to be connected with the water supply tube, and (3) to be connected with the other valve through a tube and 2 pins to be connected to the board (Fig.2 left).

In the RP setup, the upper valve corresponds to the left lick port, and the bottom valve corresponds to the right lick port (Fig.2, right).

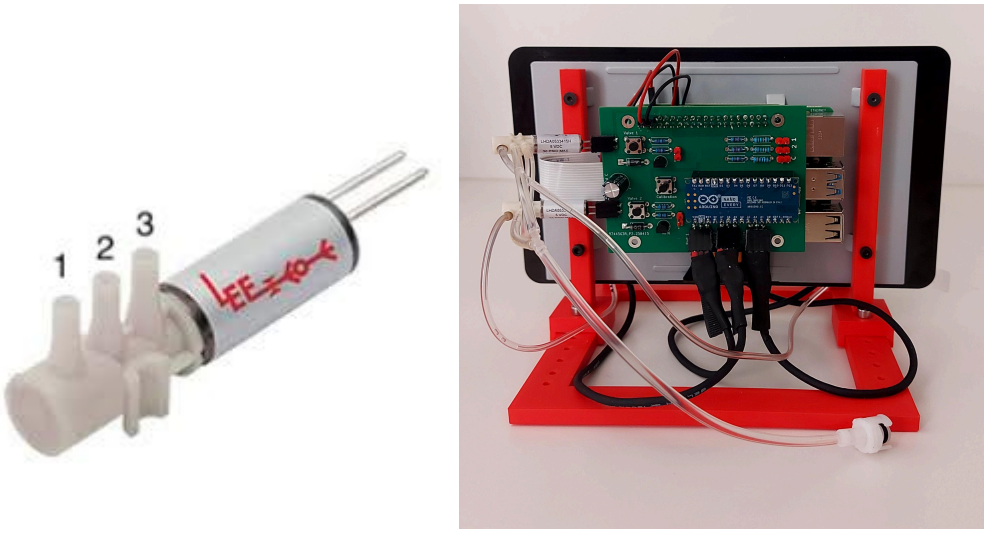


**Figure 2.** *Connections of the solenoid valve (left: positions of the tubes, right: placement of the valves on the RP board).*

**Step 7**. Connect to the RPi and run a test task.

- ssh username@*ip_address*
- Follow the instructions on how to install/run EthoPy

Optional: Rename the RP and set a static IP address

When using multiple RPs, it is best to use unique names that follow a consistent structure and assign static IP addresses to each RP to facilitate identification and management. To do this, connect to the RP and change its default name following the instructions. It is recommended to use a fixed prefix followed by an incremental number for each RP added.