Bee health monitor manufacturing instructions

List of contents

1. Responsibility disclaimer

Building and using of the proposed device is at your own responsibility. We do not take any responsibility of damage caused by building, or using the Bee Health Monitor device. All information, content, and materials available in this project are for general informational purposes only.

2. Introduction

This document describes the assembly of the Bee Health monitor device. Due to the intention of long-term in field measurements, please read this document carefully so you could avoid damaging your device. Basic knowledge in electronics, 3D printing and DYI stuff is needed for the device assembly. Minor deviations from the provided instructions and schemes are possible.

The instructions are valid for the version from summer 2023.

3. Preparation phase

This chapter describes the required steps prior the mechanical and electrical assembly.

3.1. Electronic modules preparations

Prepare the PWM module, DC-DC convertor, rPi camera, rPi4 and the sensor modules as shown in Figure 1. Fill all connectors with electric insulating vaseline (preferably TPFE) and paint the circuit boards with a suitable varnish designed for the use on electronics. This is required to avoid potential damage caused by humidity. Be careful not to paint over camera chip or any contacts.
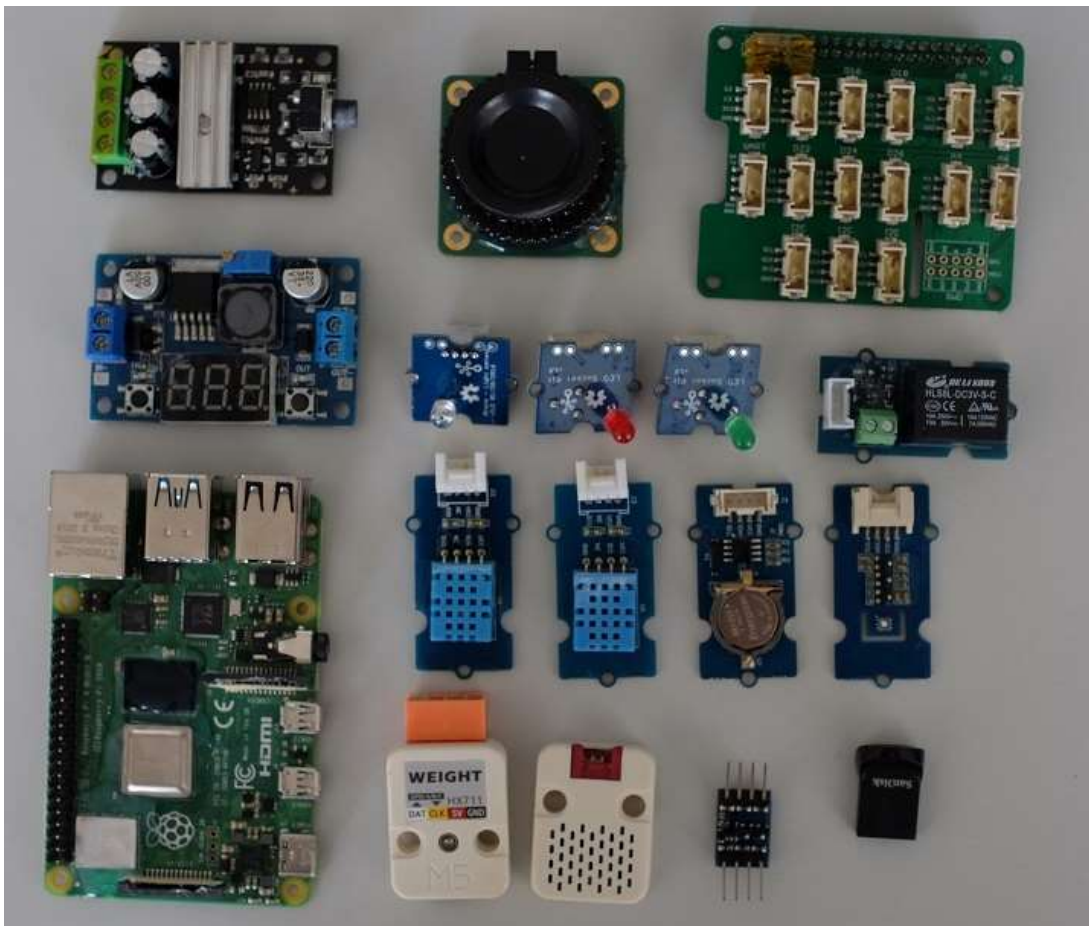

Figure 1 Required HW and electronic modules

As few of the rPi chips and components are BGAs, please seal their surroundings using silicone intended for electronics. Mounting passive cooling is also recommended.

Figure 2 MCU sealings

3.2. Mechanical part preparations

Print all the 3D parts from the *Bee-Health-Monitor/hardware/stls/* directory. Prepare the LED strip on aluminum plate and cut the M3 threads to the plate. Prepare the laser cut plexiglas from the directory *Bee-Health-Monitor/hardware/laser_cut/* and brush the diffusing plate as shown in Figure 3.

Figure 3 Printed 3D parts, laser cuts, LED plate and sealing gasket

The main box and cover should be sprayed with a primer varnish with filler to seal small gaps caused by the 3D printing. The back side of cover plate and the inner side of the box opposite the diffuser plate should be painted with a matt white to improve the illumination conditions (diffuse the light) as shown in Figure 4.

After spraying the exterior of the main box and cover with a primer, use an acrylic varnish of a proper color to improve the protection and place the sealing gasket to the rabbet in the main box.

4. Mechanical assembly

Hold the LED strip with two M3 screws to the electronics mount layer and mount the holding consoles to the sides of the main box. Place the camera on the distant posts as shown in Figure 4.
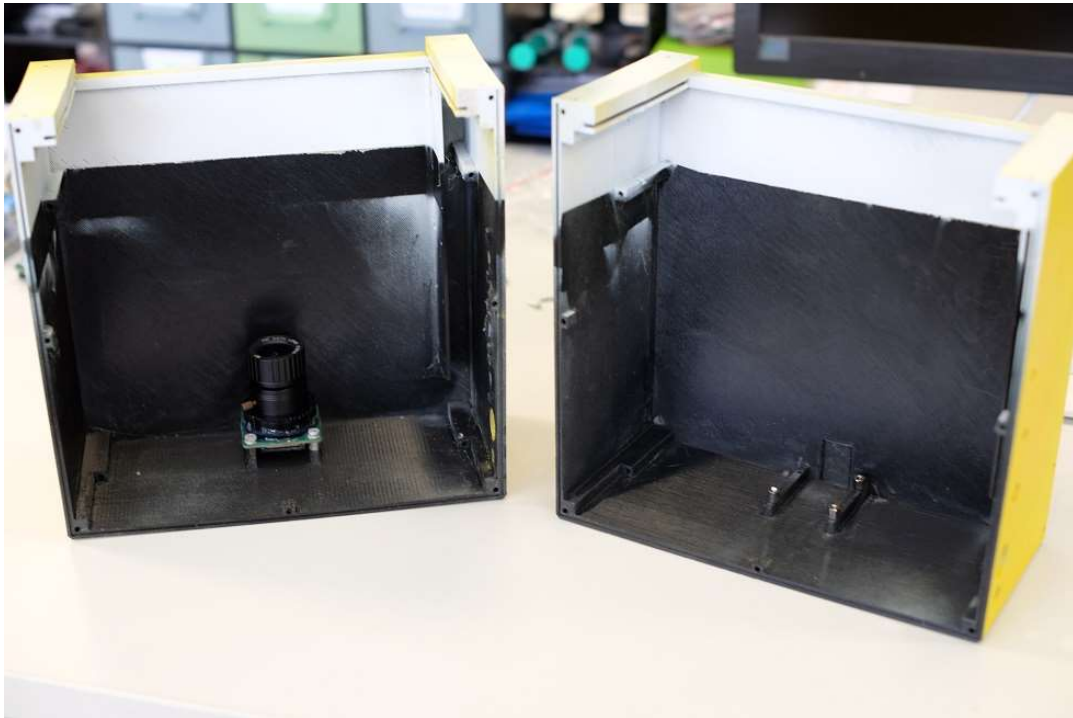

Figure 4 Mounting the camera and surface preparations

Mount the modules with the light sensor and indication LEDs, fuse mount and main switch as shown in Figure 5. Seal the gaps between the modules and main box with a silicone sealant.
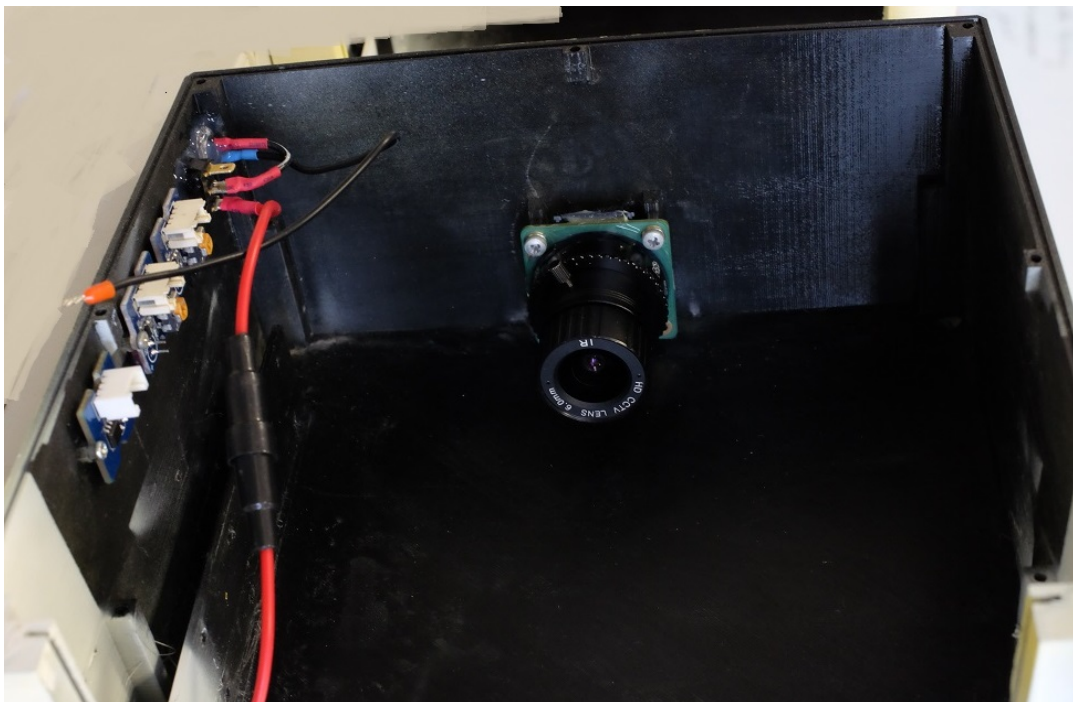

Figure 5 Side modules mount

Mount the cooling fan, PWM module, LED strip and DC-DC converter. Prepare the 12 V power bus using a proper terminal box as shown in Figure 6.
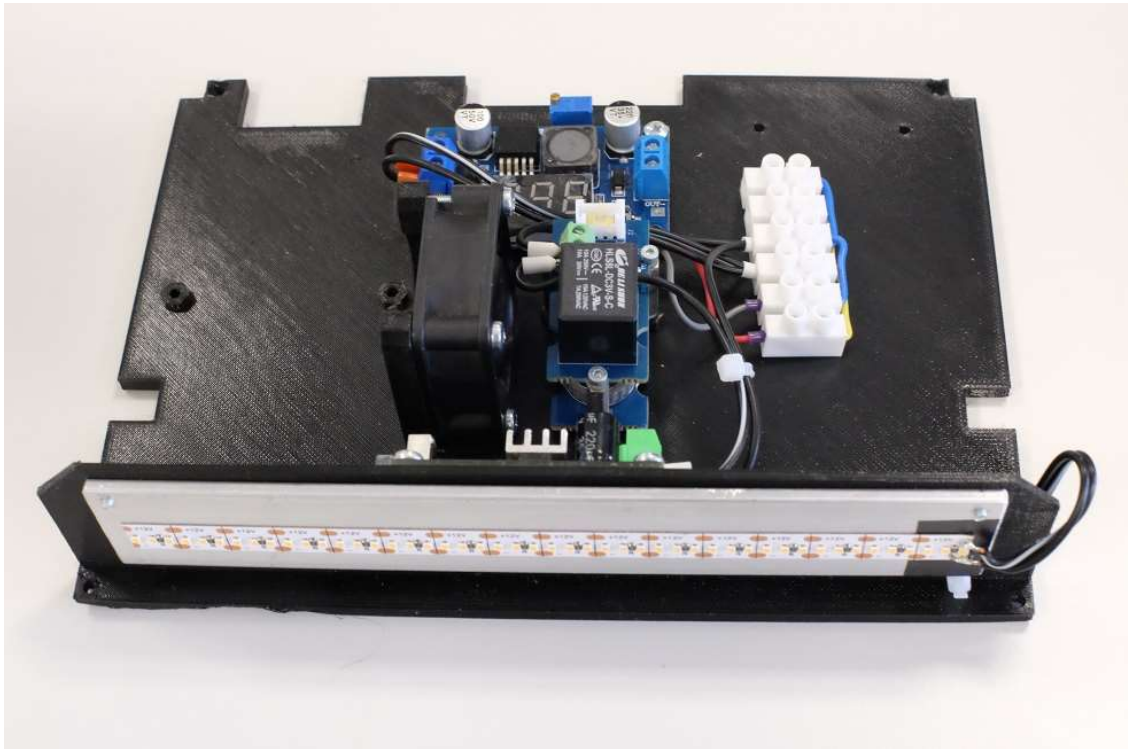

Figure 6 Mount of the cooling fan, LED strip and DC-DC converter

Prepare the rPi power bundle and RTC adapter as shown in Figure 7. The used RTC module has to work on 5 V power bus, which is not compatible with the 3V3 used on the other Grove modules. An overall view of the mounted modules is shown in Figure 8.
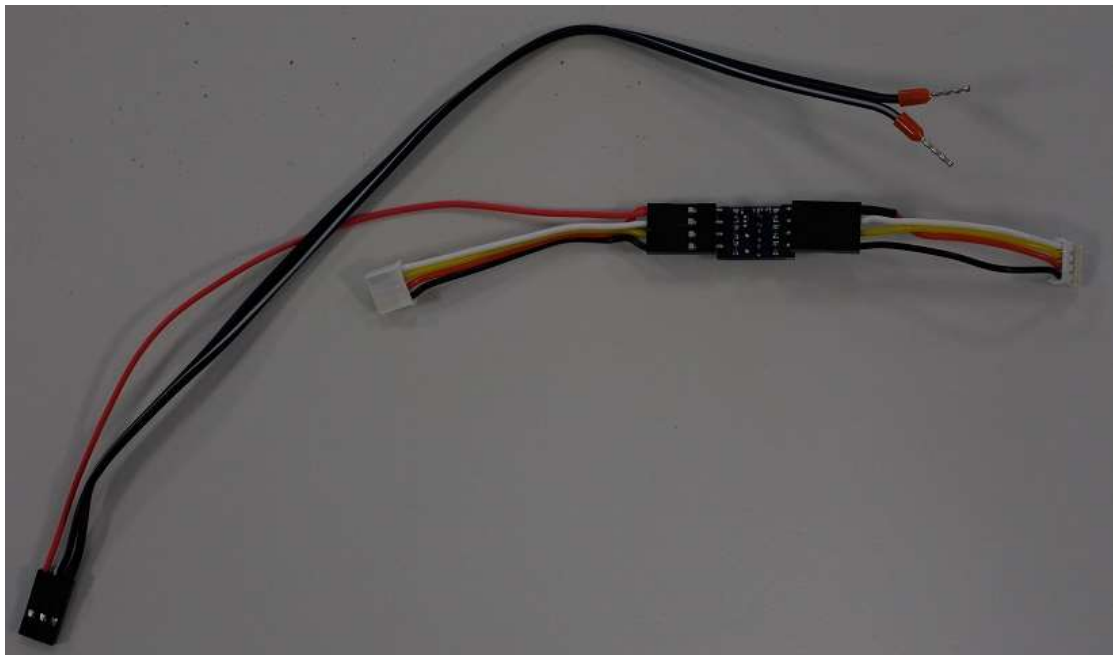

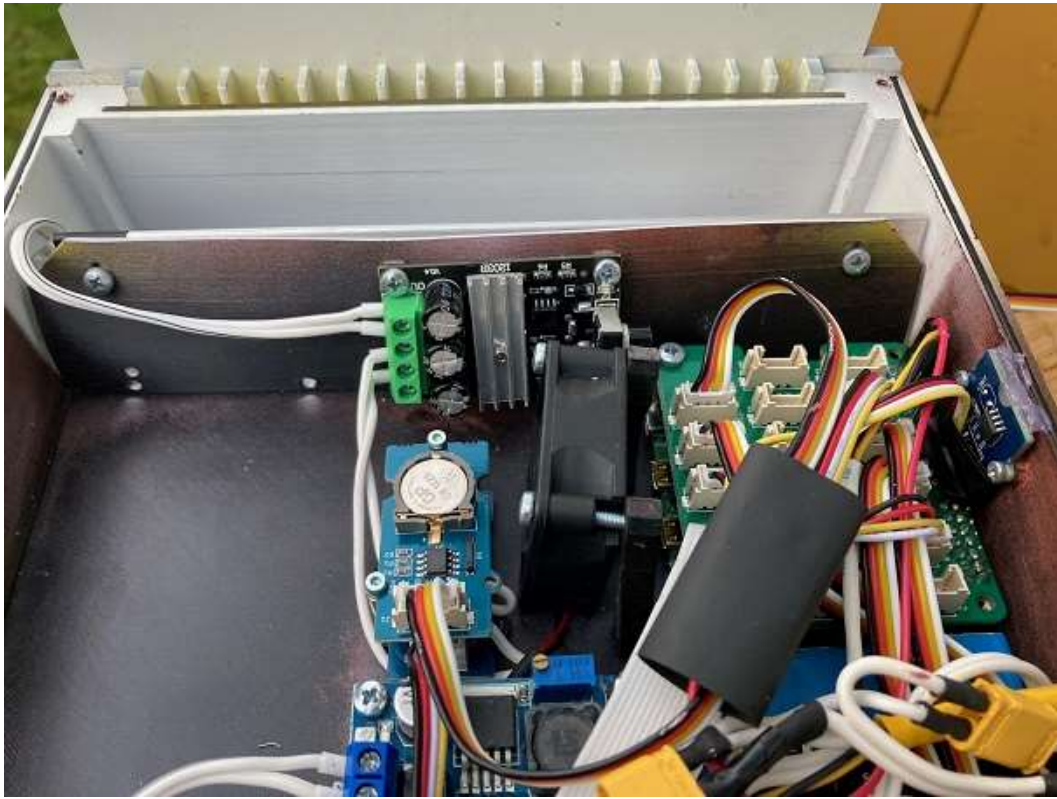*Figure 7 rPi power cable bundle and RTC adapter*

Figure 8 Overall assembly of interval electronics

5. Electrical assembly

Connect the modules and sensors as shown in Figure 9. Seal the sensor grommet to avoid entrance of the bees to the device. Charger module and internal battery is not used in the version 2.1 anymore. Load the SW and test the whole assembly using a monitor, keyboard and mouse. If everything works, focus the camera and mount the front cover to the device.
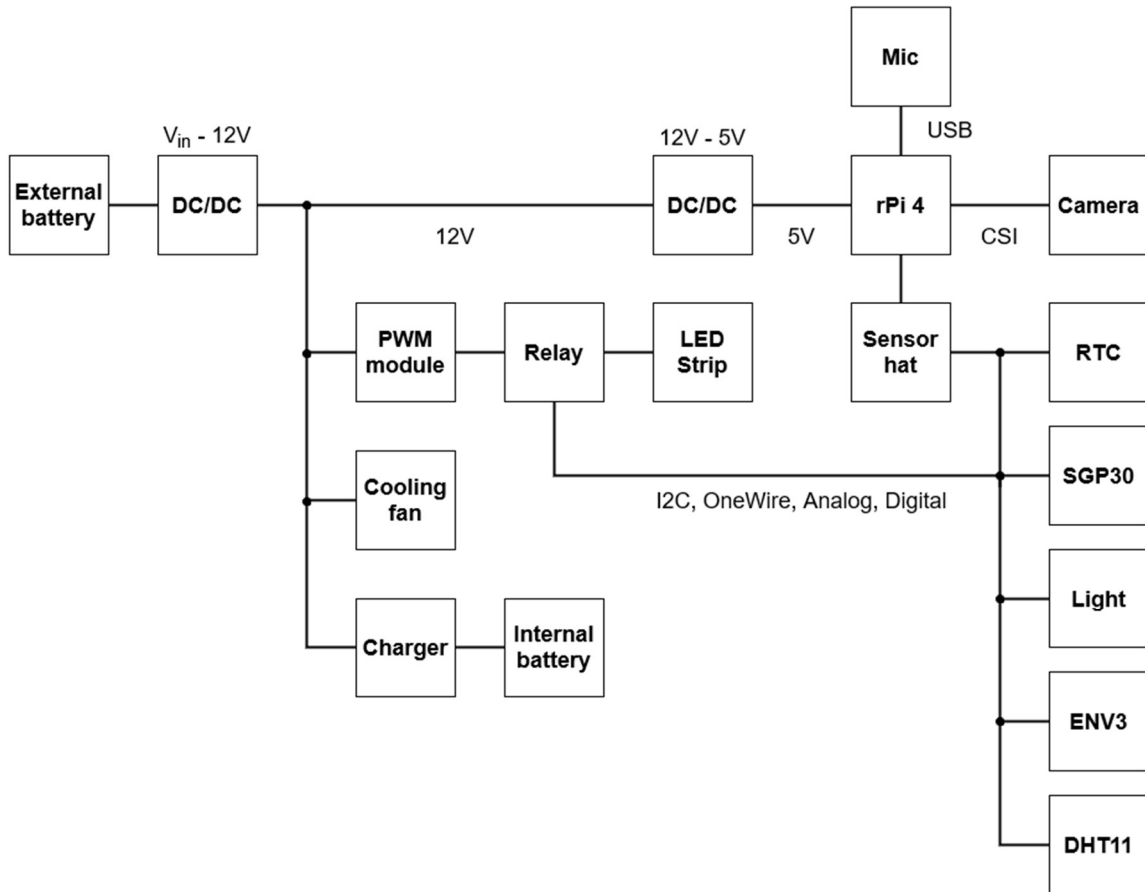

Figure 9 Block scheme of the electrical assembly

6. Mounting the device to the hive

Mount the device to the beehive as shown in Figure 10. If you provide the power supply with the power adapter and the electrical grid, keep the safety regulations for powering the device in the outdoor conditions to avoid a risk of an injury.

1.

Figure 10 Bee health monitor in front of the hive