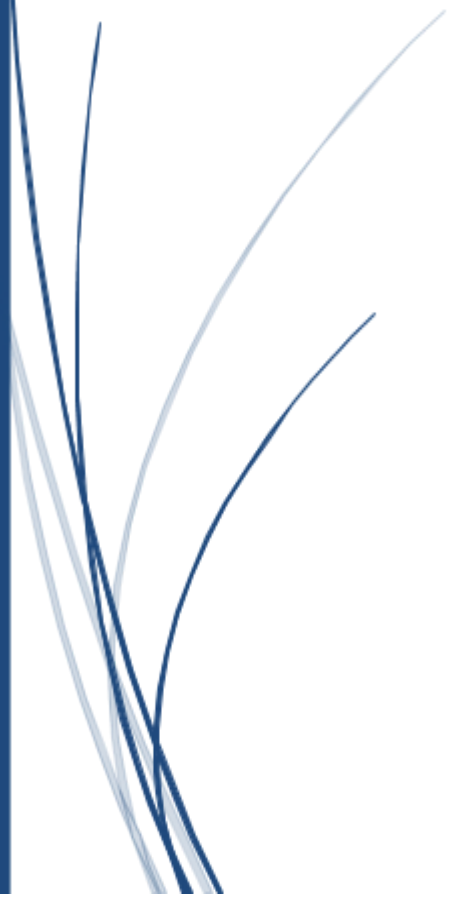
Toby & Boxy

Wifi Plant Watering System

By: Naked Ninja



Contents

The product

If you have soldering experience and are not intimidated by soldering tiny pins in tight spaces, then this build level should be okay for you. Use the proper soldering iron, solder wire, and solder paste for this project. Check the orientation of components before you solder them to the board. **The wrong orientation may damage the components, the board, or your Raspberry Pi!**

We do not take any responsibility and we are not liable for any damage caused through use of products or services from Naked Ninja, be it indirect, special, incidental or consequential damages (including but not limited to damages for loss of business, loss of profits, interruption or the like).

Meet Toby, a plant watering sensor system with a fancy cartoonesque enclosure. Your plant watering sensors need a central hub to receive the messages and notify you when the soil moisture level of a plant is too low.

Toby runs on a Raspberry Pi Zero W and uses Node-Red to process incoming events and drive the display. Toby also has its own website that you can access with your pc, mobile phone, or tablet. On the website, you can configure the network settings and soil moisture notification levels, and manage your plant watering sensors.

Toby uses Text-To-Speech to notify you in a natural voice. This is a unique feature!

Bill of material

We have no affiliation with AliExpress, Banggood, RS-Online, or any other supplier of components. You can use any source you like. If you want to order from another supplier, use the links below as a source for the specifications of the components.

Raspberry Pi Zero W
https://www.raspberrypi.org/products/raspberry-pi-zero-w/
* Note: You'll also need the appropriate equipment to initialize the software for the Raspberry Pi.

8 or 16 GB SD Card
https://www.raspberrypi.org/products/raspberry-pi-zero-w/

5V 2A+ USB Power Adapter
https://nl.aliexpress.com/item/32850255196.html

Micro USB Cable
https://nl.aliexpress.com/item/32391749504.html

Tactile Push Button Switch 6x6x6mm (Through Hole), 4pcs
https://www.aliexpress.com/item/32901668929.html

PCM5102A
https://nl.aliexpress.com/item/32877909874.html

PTV112 Dual 50 kOhm Potentiometer
https://nl.rs-online.com/web/p/potentiometers/1674426/

PAM8403 3W Class D Stereo Amplifier Module (without potentiometer)
https://www.aliexpress.com/item/32392563588.html

Loudspeaker 4R 3W 23mm Round Thickness 7.5mm, 2 pcs
https://www.aliexpress.com/item/32919726105.html

ST7735S 1.8 Inch TFT Display (PAY ATTENTION TO PINOUT!!)
https://nl.aliexpress.com/item/32880822720.html

JST XH2.54 2-Pin Connector Angled, Male, 3 pcs
https://nl.aliexpress.com/item/33008489410.html

JST XH2.54 2-Pin Cable, Female Connector, 3 pcs
https://www.aliexpress.com/item/32980437019.html

Micro USB Breakout Module
https://nl.aliexpress.com/item/4000216515466.html

2X20P Dual Row Female Pin Header
https://nl.aliexpress.com/item/32854215610.html

1x8P Single Row Female Pin Header
https://nl.aliexpress.com/item/32859544578.html

1x4P Single Row Female Pin Header
https://nl.aliexpress.com/item/32859544578.html

1x40P Single Row Male Pin Header, 2pcs
https://nl.aliexpress.com/item/32993182990.html
(To create: 1x11P 1x8P 1x4P 1x3P 2pcs, 1x2P 3ps)

Screw M2.6, Length: 6mm, 5pcs
https://www.aliexpress.com/item/33043885403.html

Naked Ninja Toby PCB
Naked Ninja webshop

PCB Assembly instructions

The following paragraphs will explain how to solder the Toby PCB. Follow each step precisely to ensure everything will work properly.

1. We start with the Tody PCB, see photo 1.

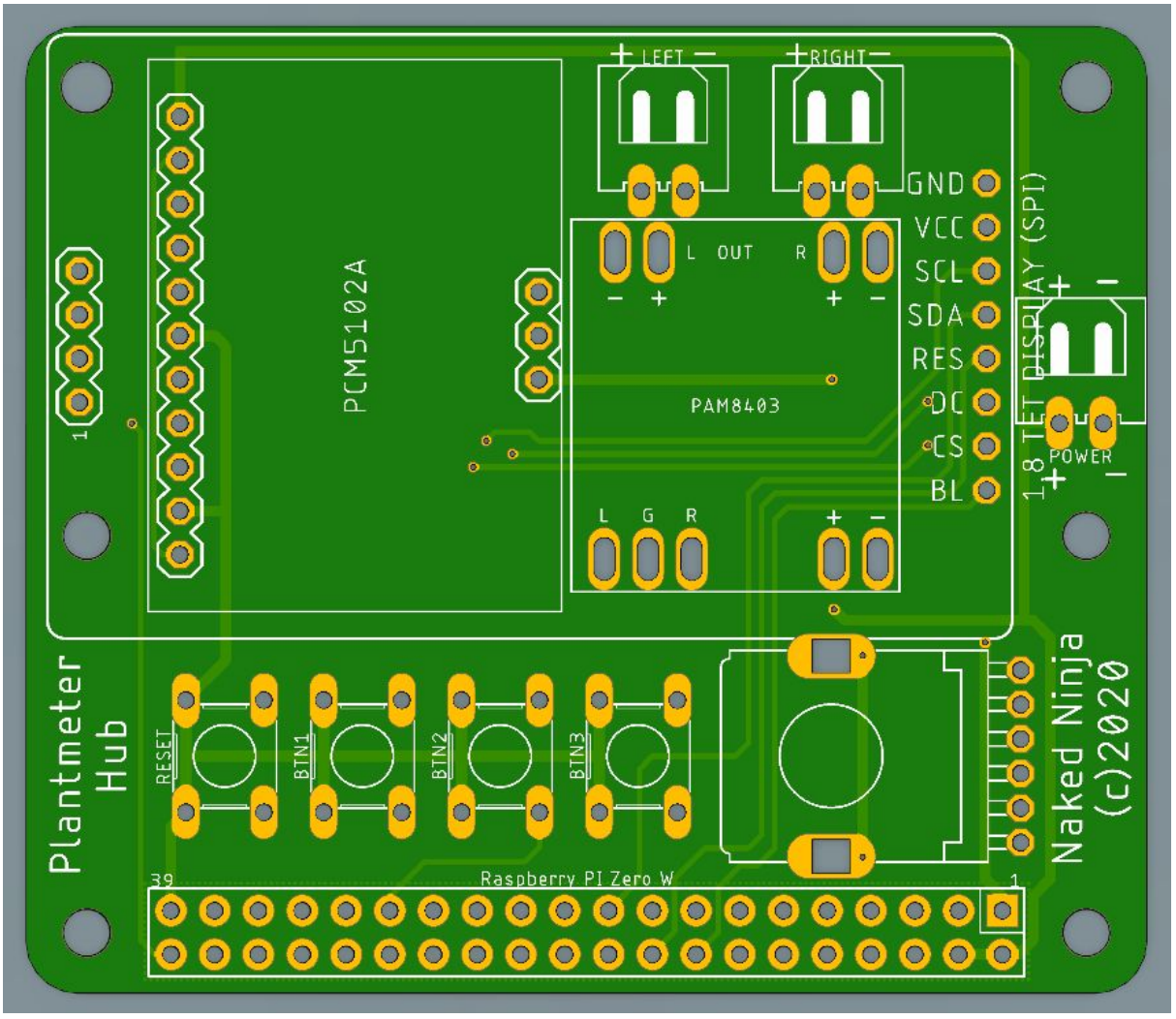


Photo 1: Tody PCB.

2. Solder the PCM5102 and PAM8403 modules to the board using the 1x9P, 1x3P, and 1x2P male headers. See photo 2 and 3

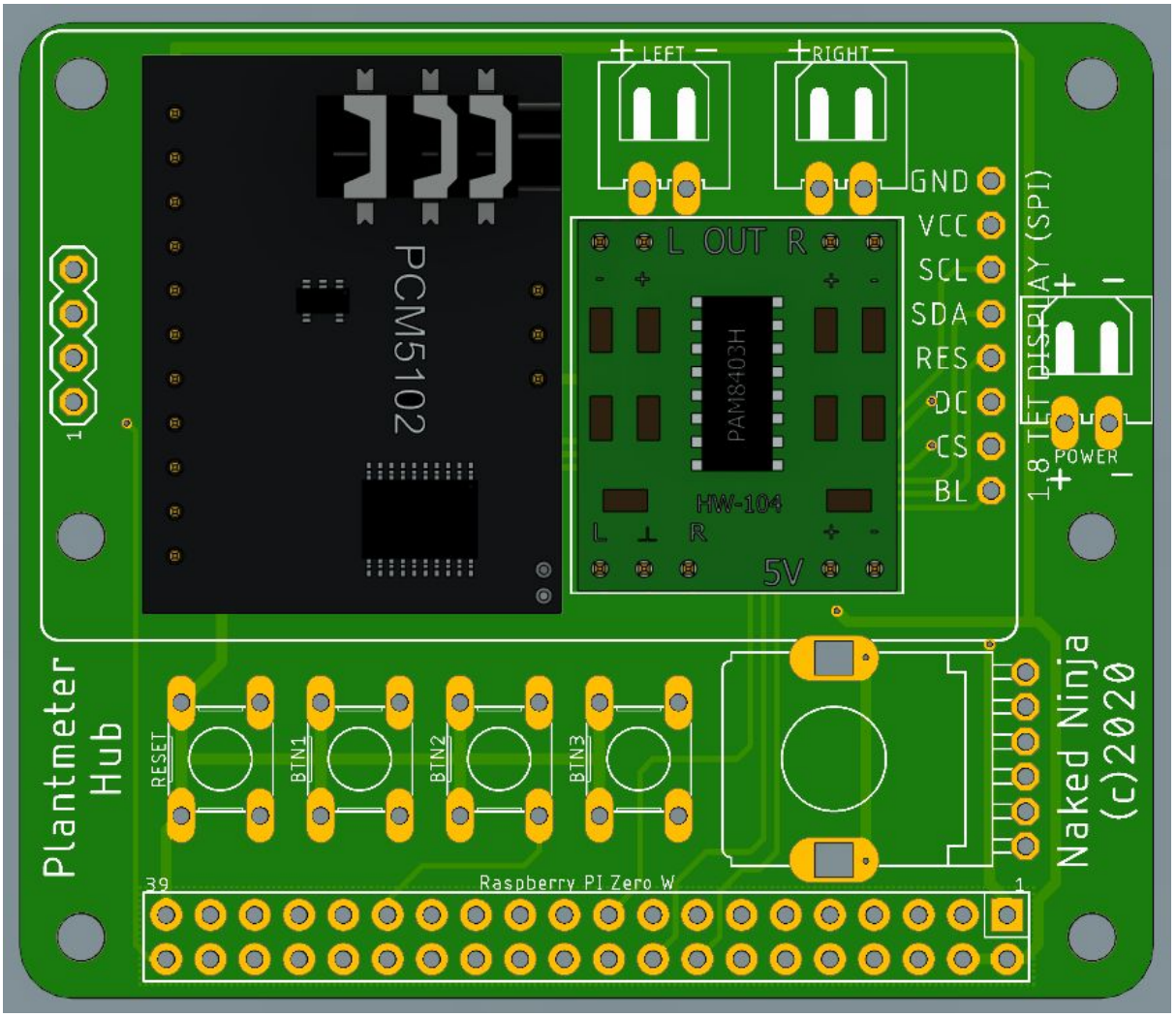


Photo 2: Toby PCB with PCM5102 and PAM8403 soldered, Top view

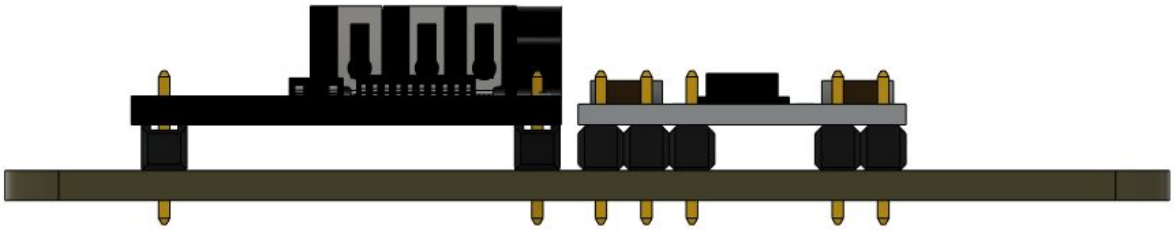


Photo 3: Toby PCB with PCM5102 and PAM8403 soldered. Side view

3. Solder the 3 JST connectors, 4 tactile buttons and 1 potentiometer.

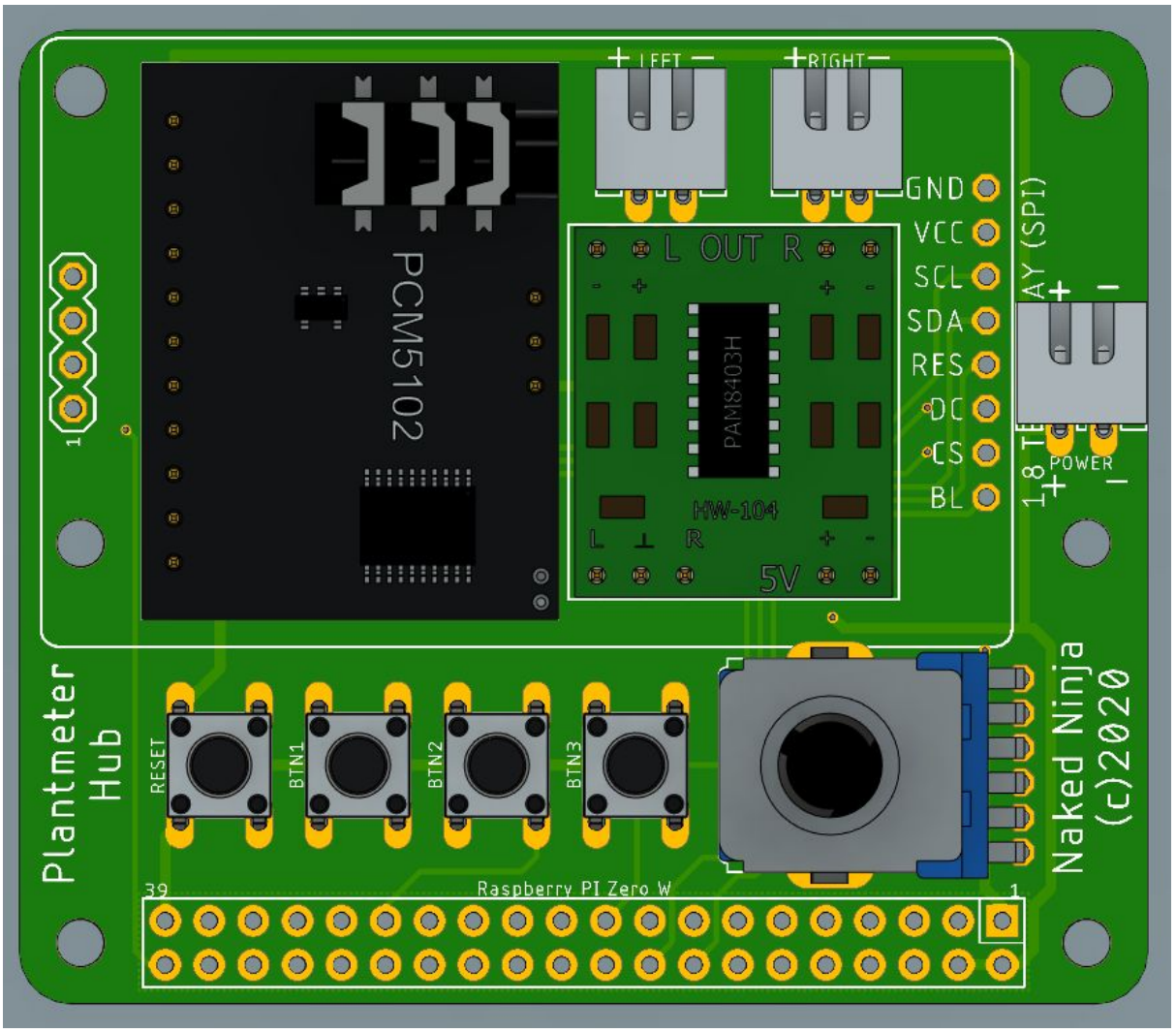


Photo 4: Toby PCB with JST connectors, tactile buttons, and potentiometer added.

4. Solder the 2x20P female header to the bottom of the PCB.

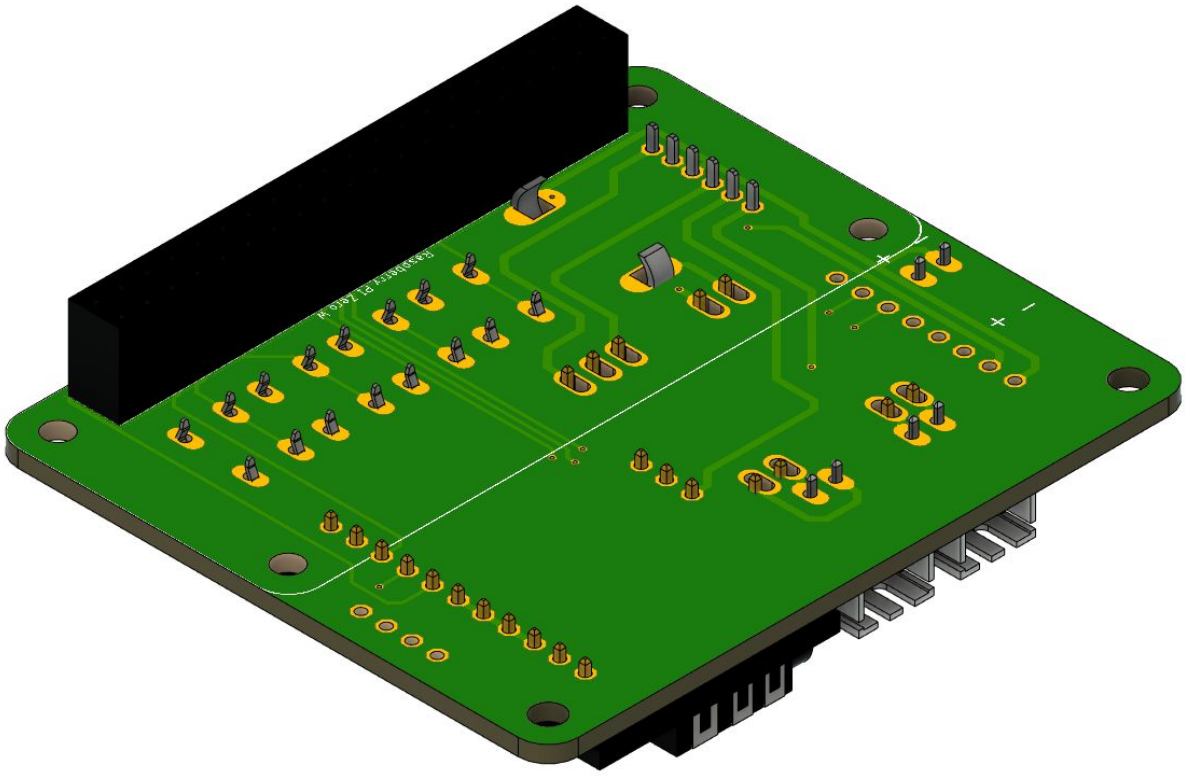


Photo 5: Toby PCB with 2x20Pin female header added.

5. Solder the 1x4 pin male header and 1x8 pin Female header to the PCB

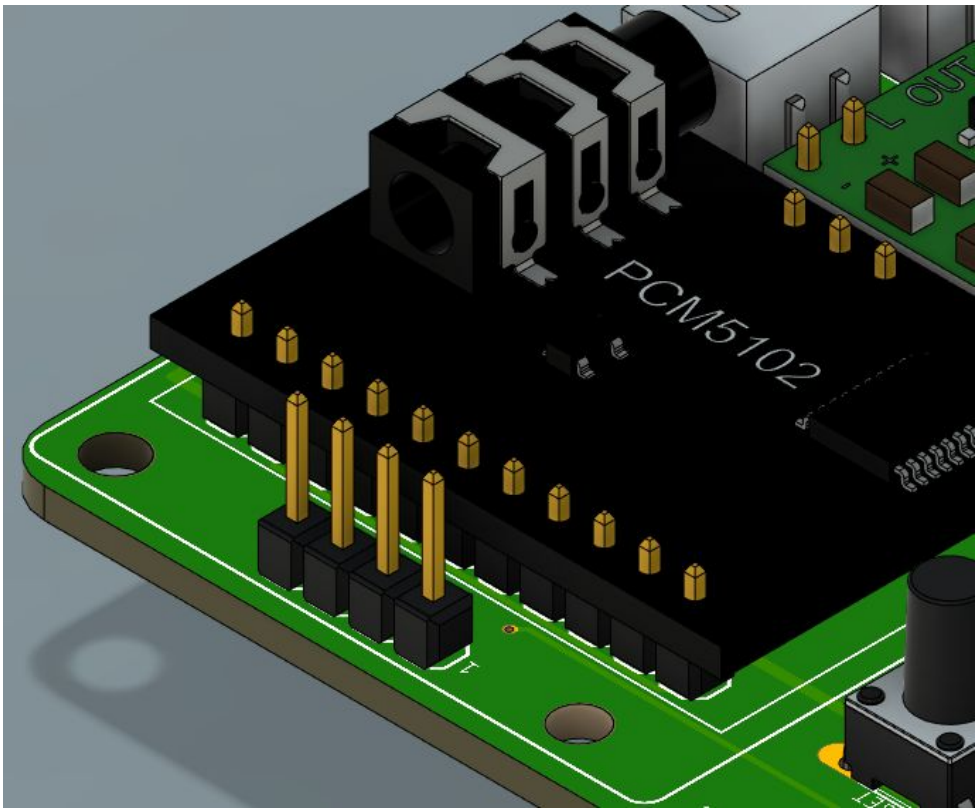


Photo 6: Toby PCB. Angled side view with soldered 1x4 pin male header.

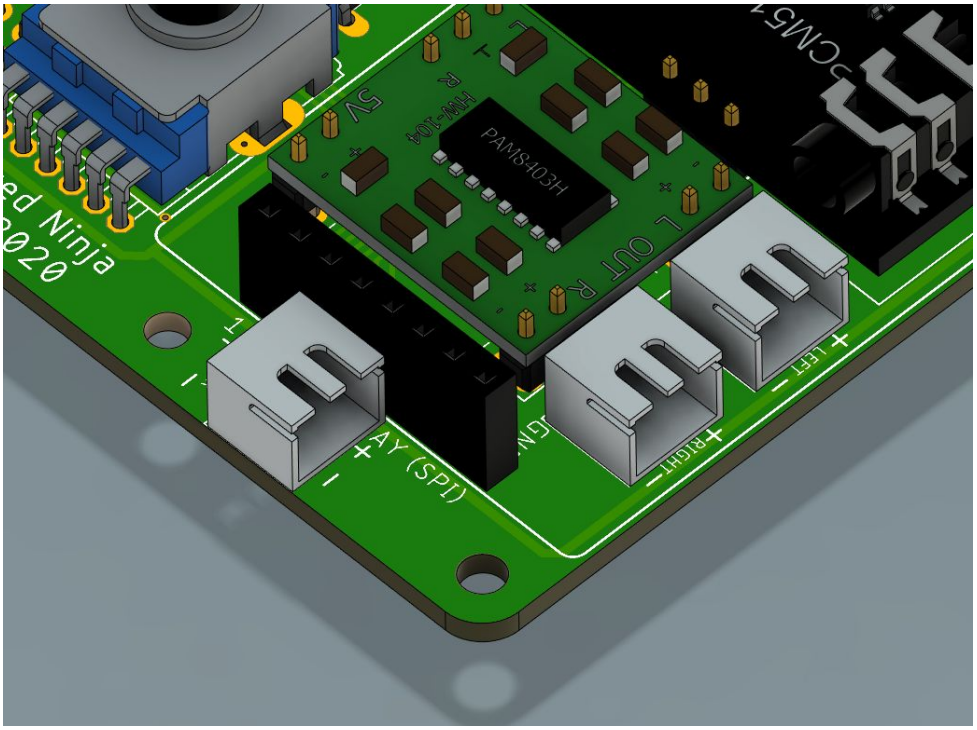


Photo 7: Toby PCB. Angled side view with soldered 1x8 pin female header.

6. Add support to the display by removing the pins from the 1x4 pin female header, as shown in Photo 8, and place it on the 1x4 pin male header as shown in photo 9.

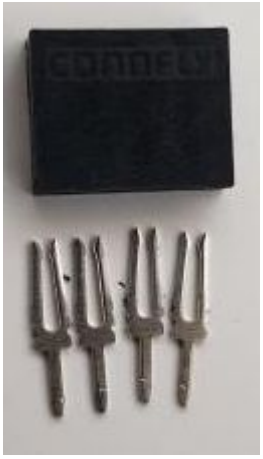


Photo 8: 1x4 pin female header with pins removed.

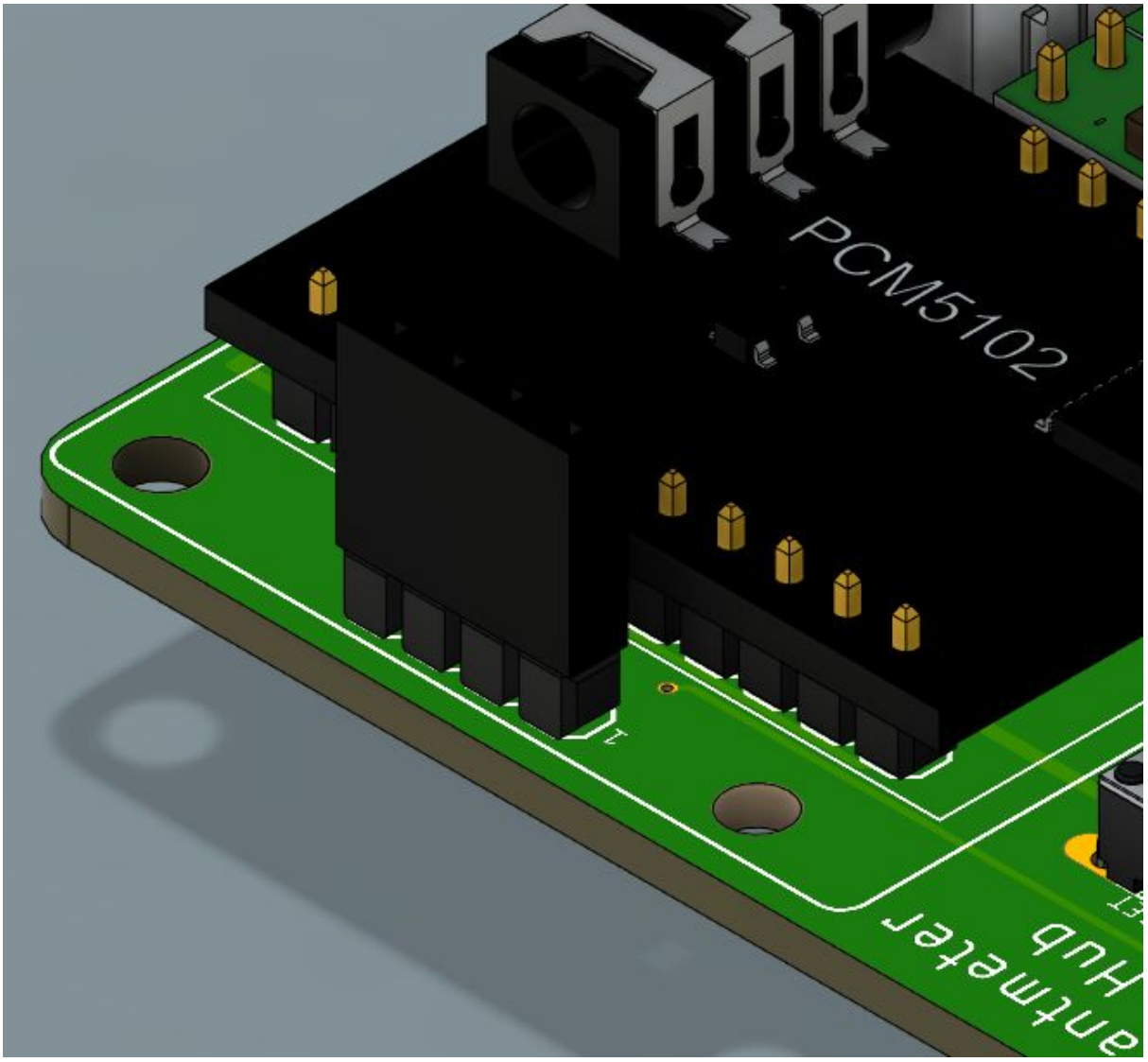


Photo 9: Toby PCB. Angled side view with a 1x4 pin female header placed on a 1x4 pin male header

7. Connect the display to the PCB as shown in photos 10, 11, 12, and 13.

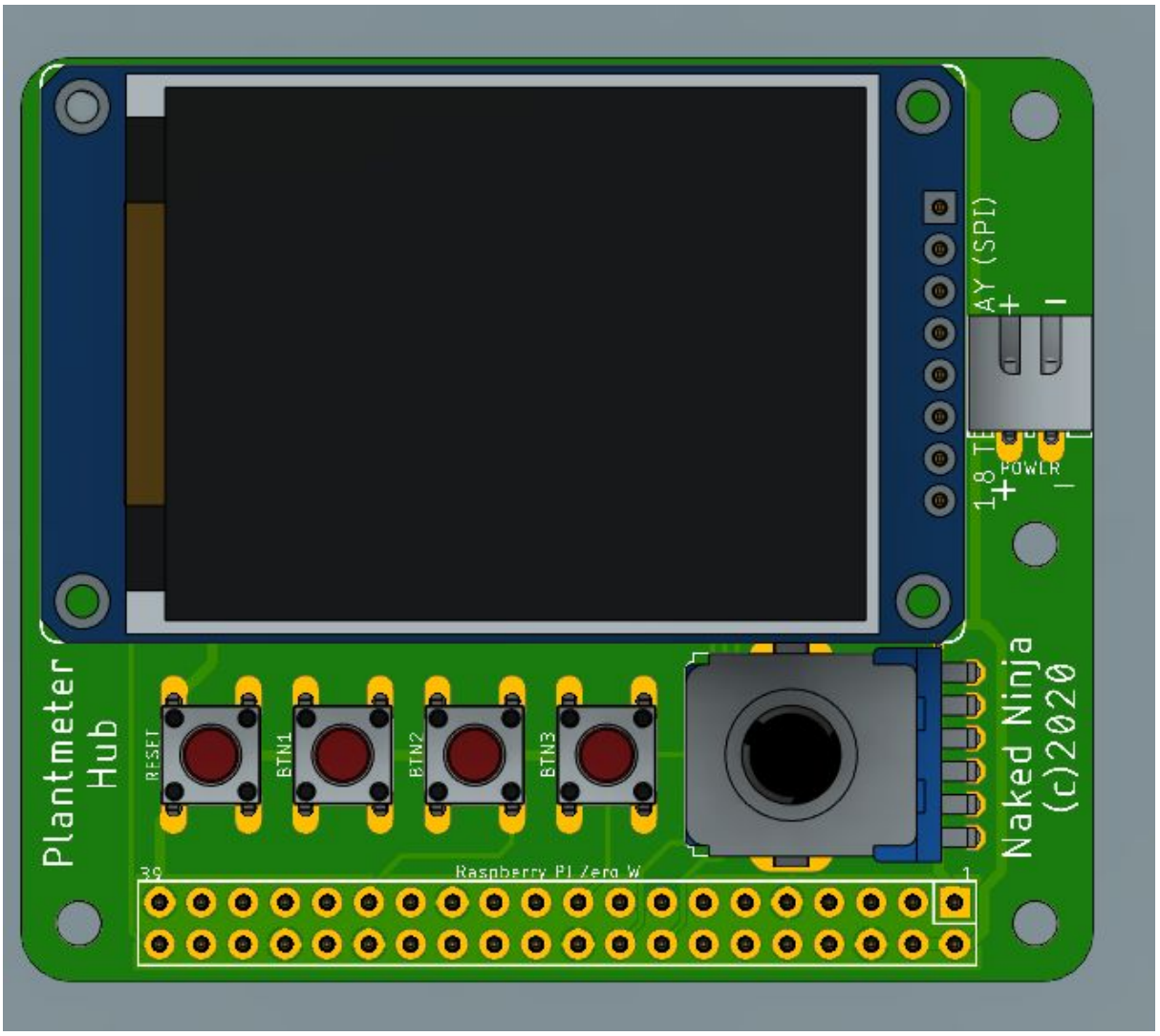


Photo 10: Toby PCB. Top view for display assembly step.

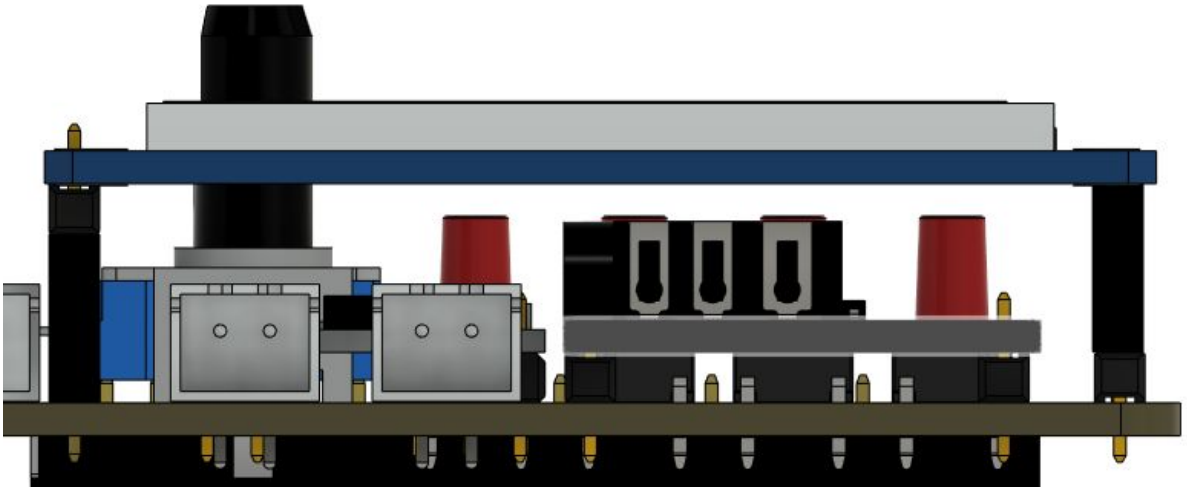
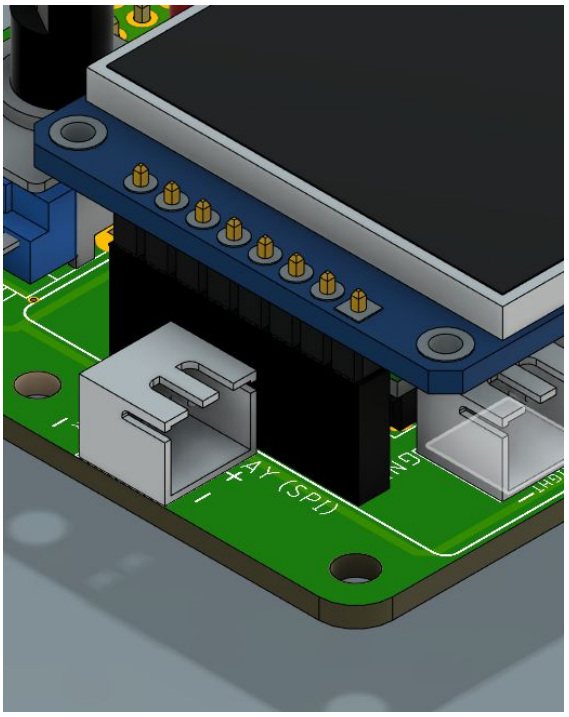
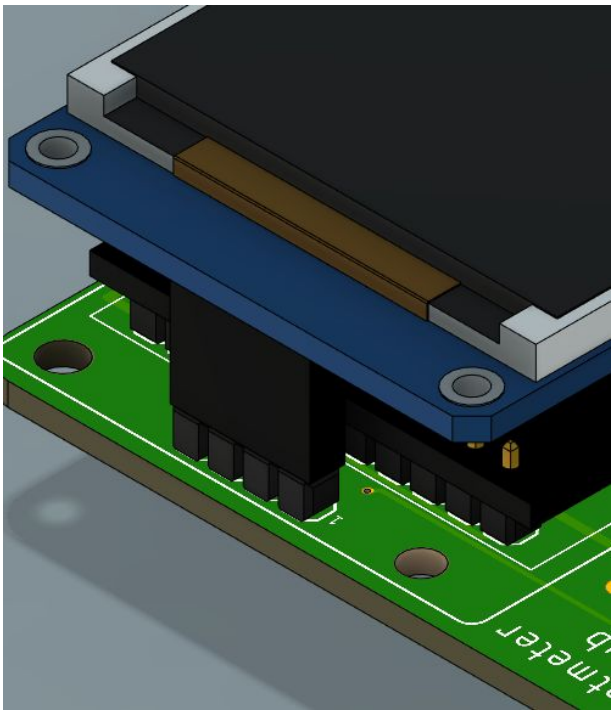


Photo 11: Toby PCB. Side view for display assembly step.





Photos 12 and 13: Toby PCB. Angled view for display assembly step.

8. Insert the Raspberry Pi into the 2x20P female header on the bottom.

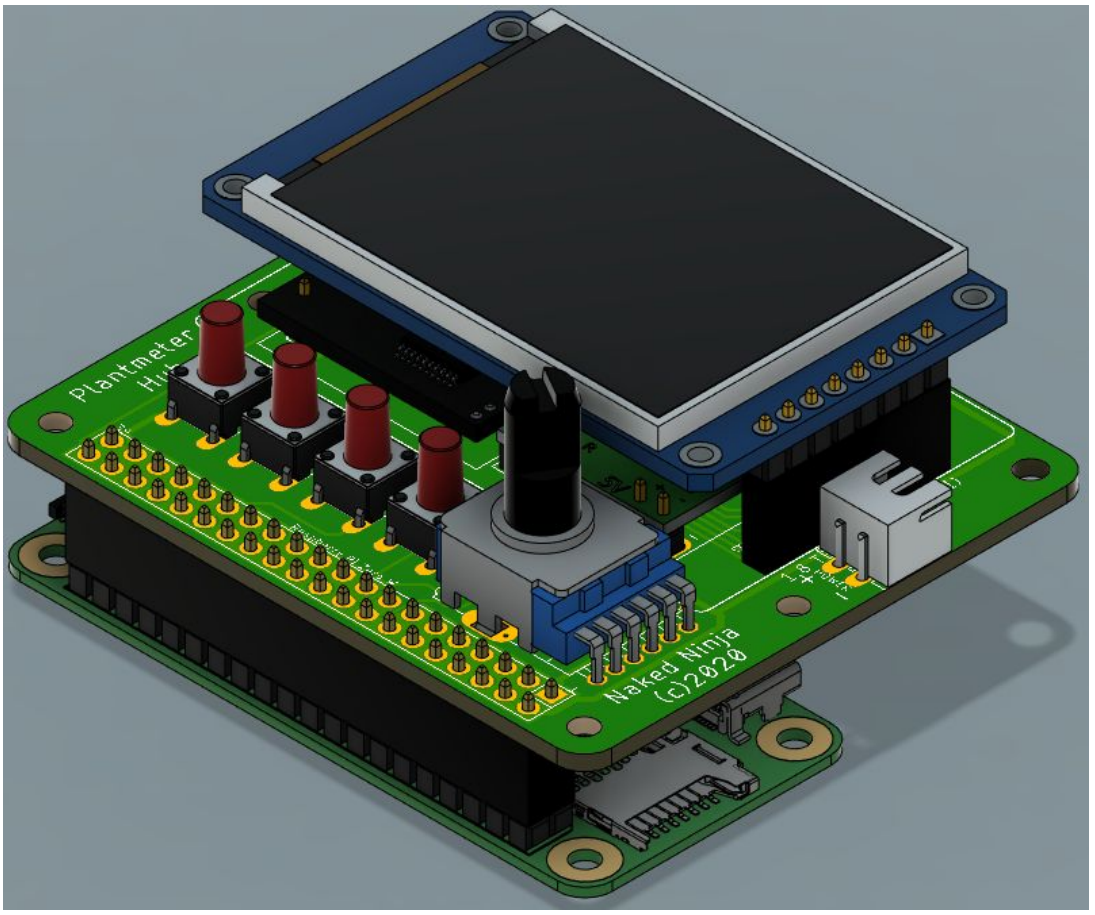


Photo 14: Assembled Toby PCB.

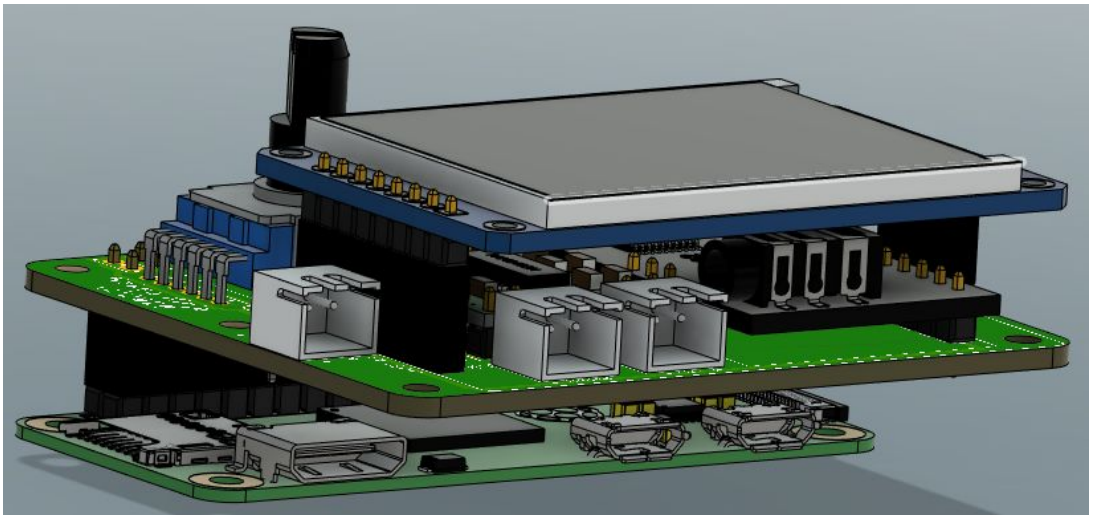


Photo 15: Assembled Toby PCB.

Software Assembly instructions

The following paragraphs will explain how to program Toby.

* Note that you will need to have followed the "PCB Assembly instructions" first before continuing.

You'll need the following equipment in order to install the software for this product:

- A PC/Laptop
- A device that can connect to a Wifi network.
- A micro SD card slot on the PC/laptop or a micro SD to USB converter.
- A mini HMDI to HDMI Converter
- A micro USB to USB converter
- A keyboard

After gathering these items, follow the steps below to install the software:

1. Download the Linux Raspberry Pi image from the Naked Ninja site in the product description of Toby.
2. Download and install the Raspberry Pi Imager program from https://www.raspberrypi.org/downloads/
3. Insert the micro SD card into the PC/laptop.
4. Open the Raspberry Pi Imager

Photo 16: Raspberry PI Imager Program

5. Format the SD card.
   - Select the **ERASE** option for Operating System

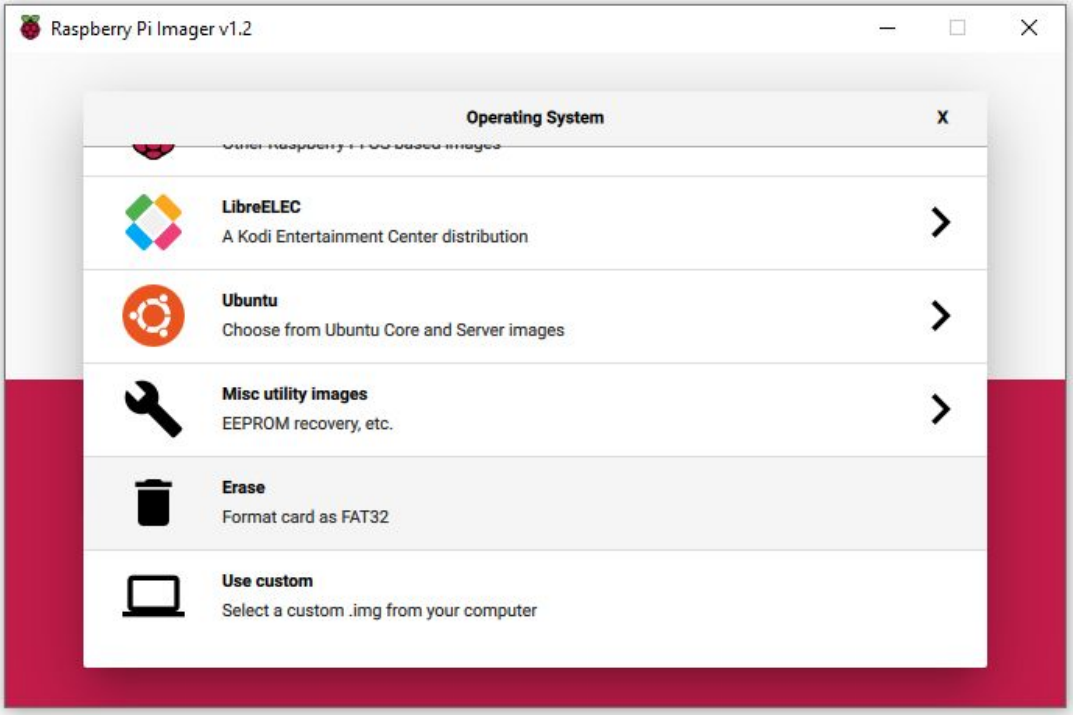


Photo 17: Raspberry PI Imager Program, Operating System selection menu.

   - Select the inserted SD card for the SD Card

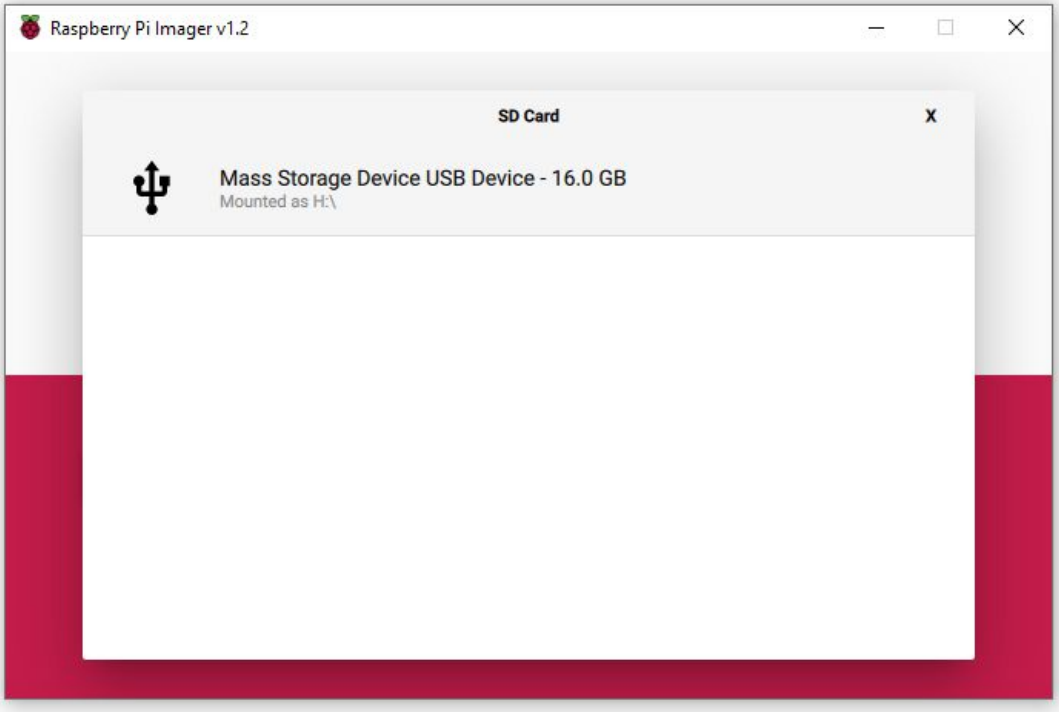


Photo 18: Raspberry PI Imager Program, SD Card selection menu.

6. Click the **WRITE** button and wait till the SD card formatting is done.

Photo 19: Raspberry PI Imager Program with selected options

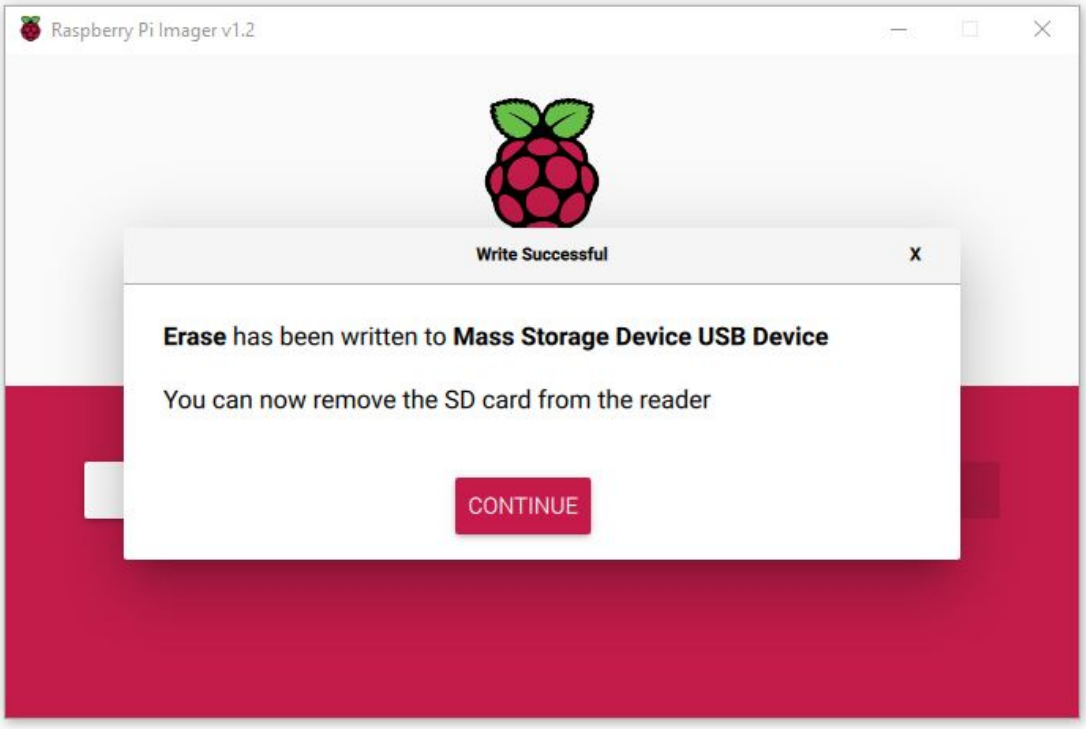


Photo 20: Raspberry PI Imager Program, SD Card selection menu

7. Flash the SD card with the image downloaded from the Naked Ninja site.
   - Select "**Use Custom**" in the Operating System menu

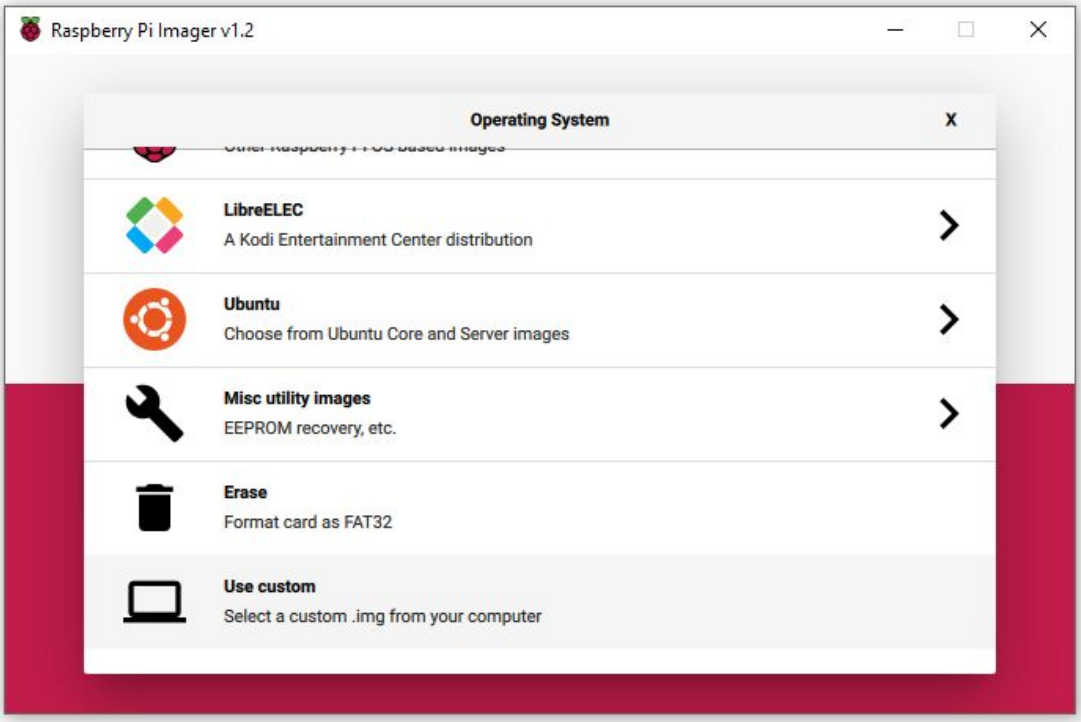


Photo 21: Raspberry PI Imager Program, Operating System selection menu.

- Navigate to and select the Toby image.

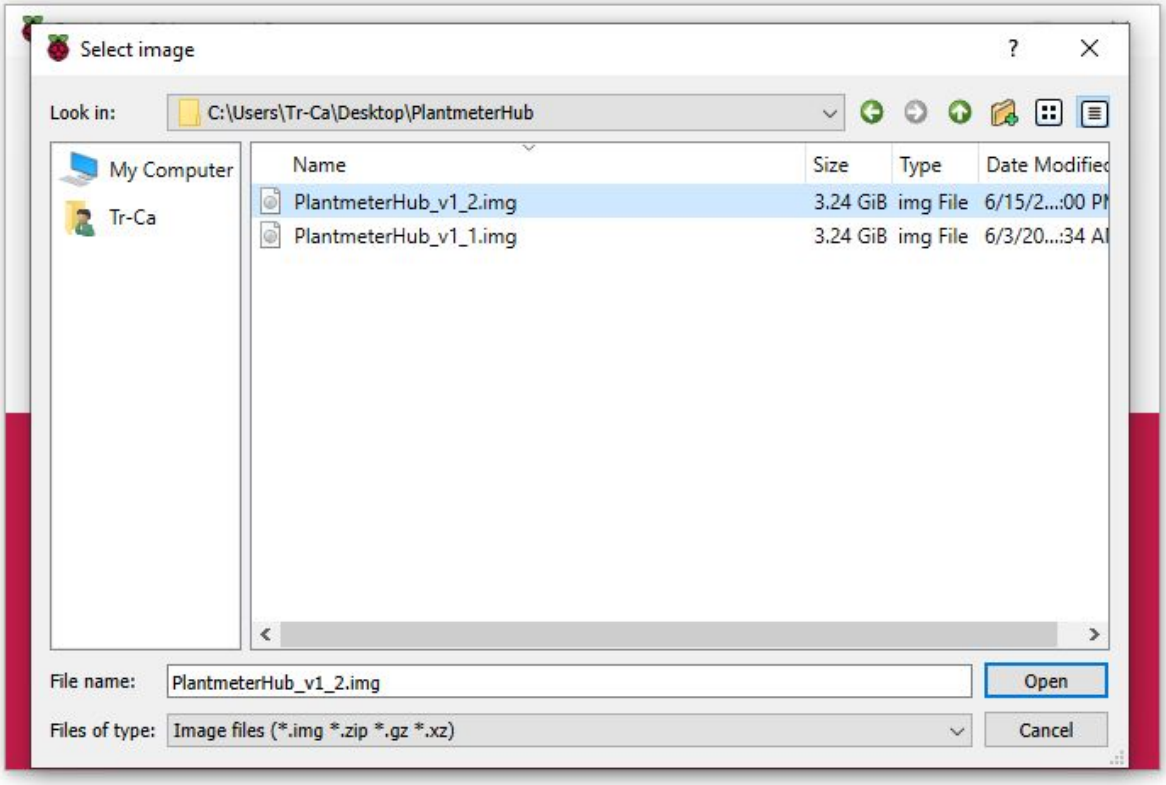


Photo 22: Raspberry PI Imager Program, Toby image selection

- Select the inserted SD card for the SD Card

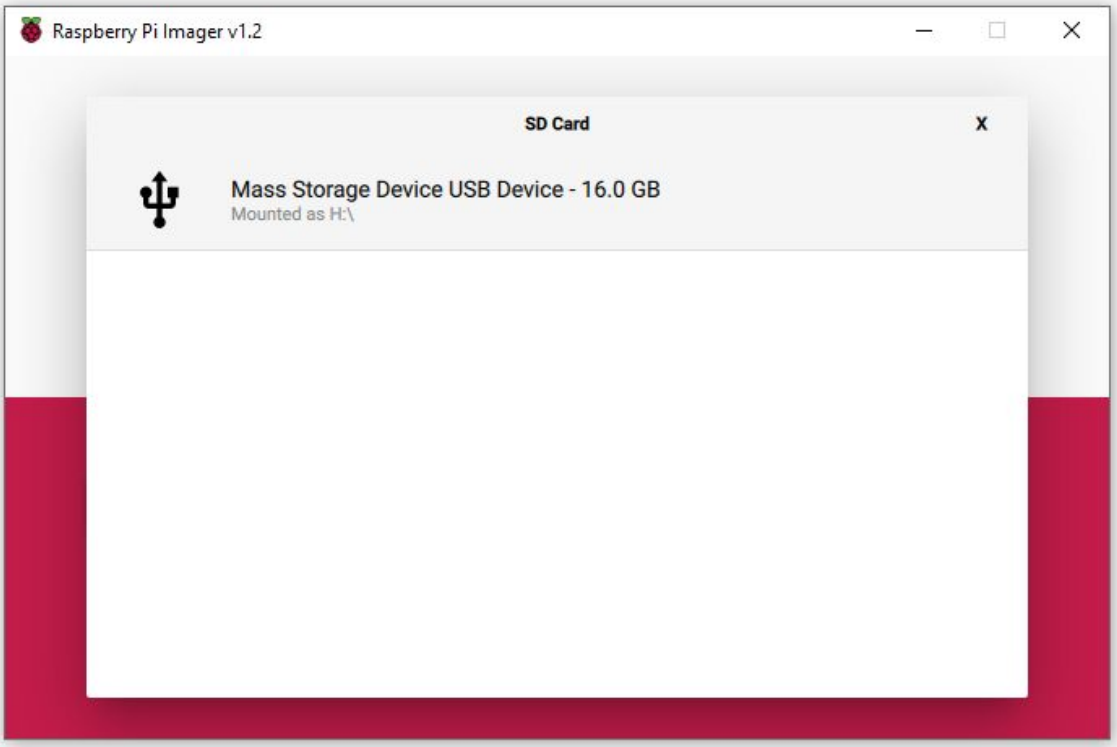


Photo 23: Raspberry PI Imager Program, SD Card selection menu.

- Click the "**WRITE**" button and wait till the SD card is flashed with the selected image.

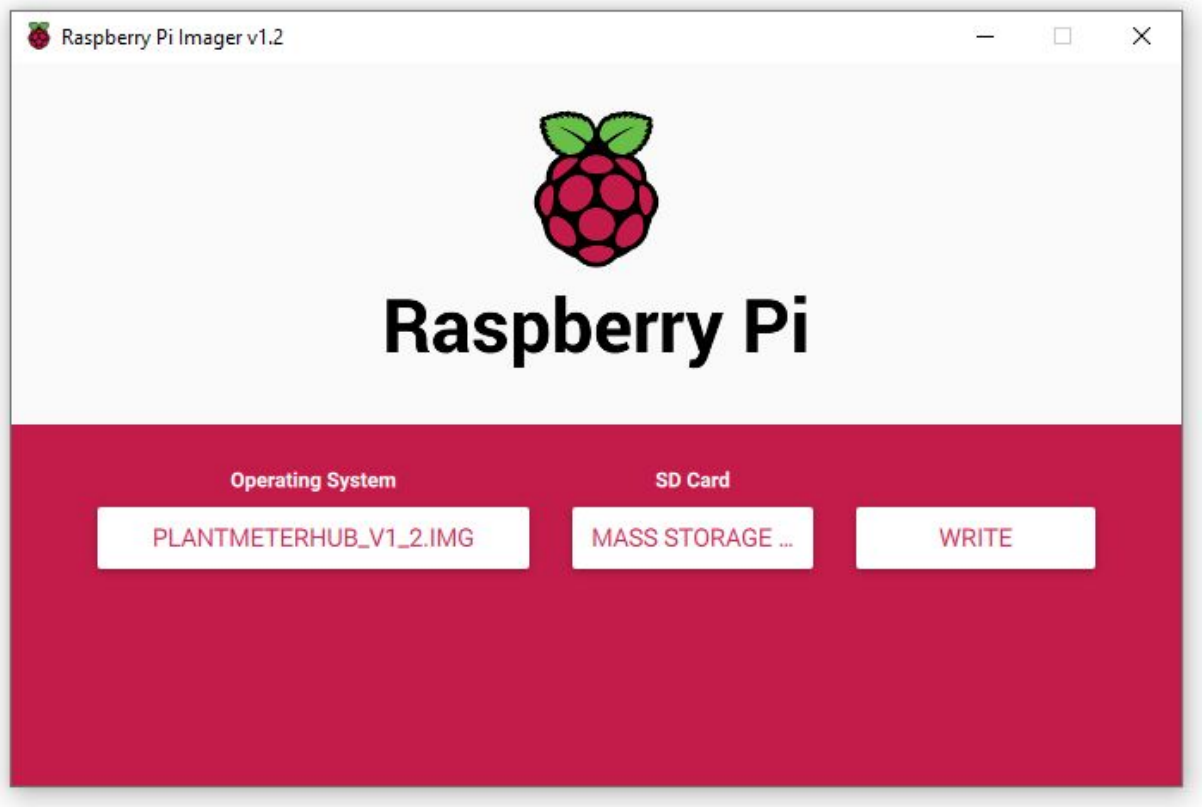


Photo 24: Raspberry PI Imager Program with selected options

Photo 25: Raspberry PI Imager Program writing image file to SD card

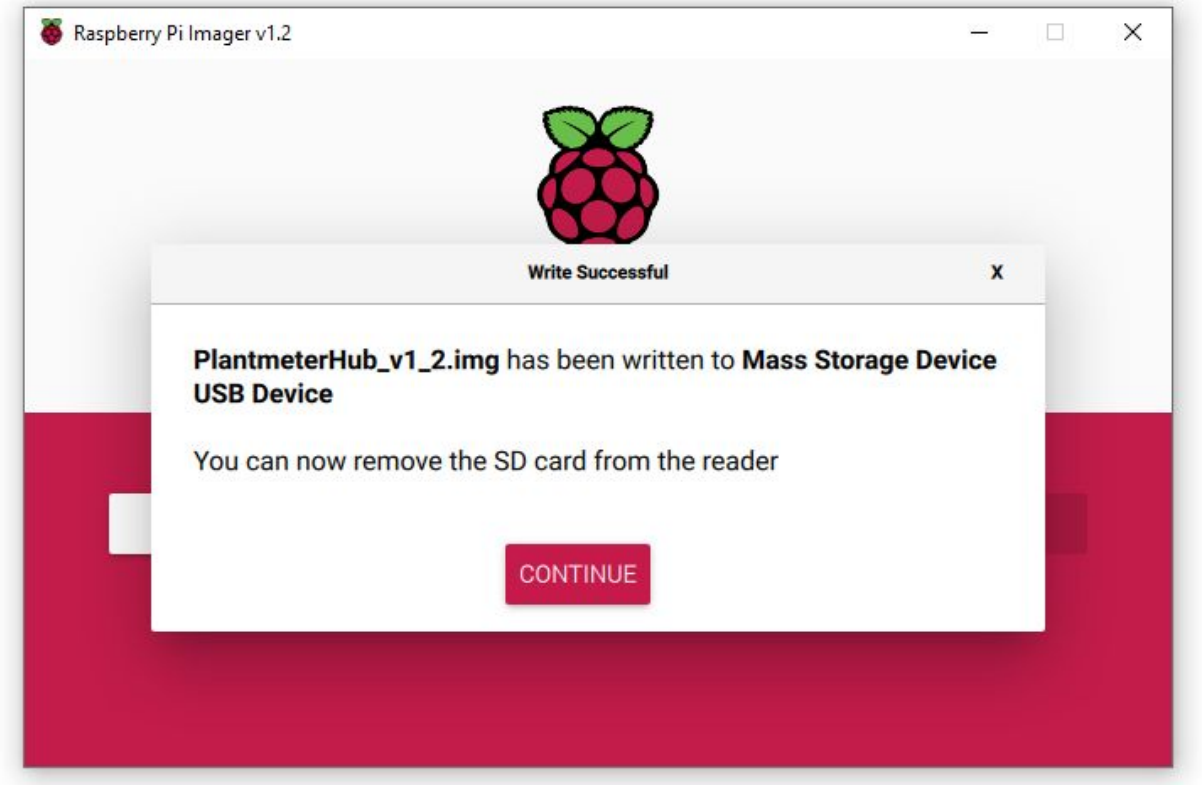


Photo 25: Raspberry PI Imager Program image writing completed message

8. Insert the SD card into the Raspberry Pi

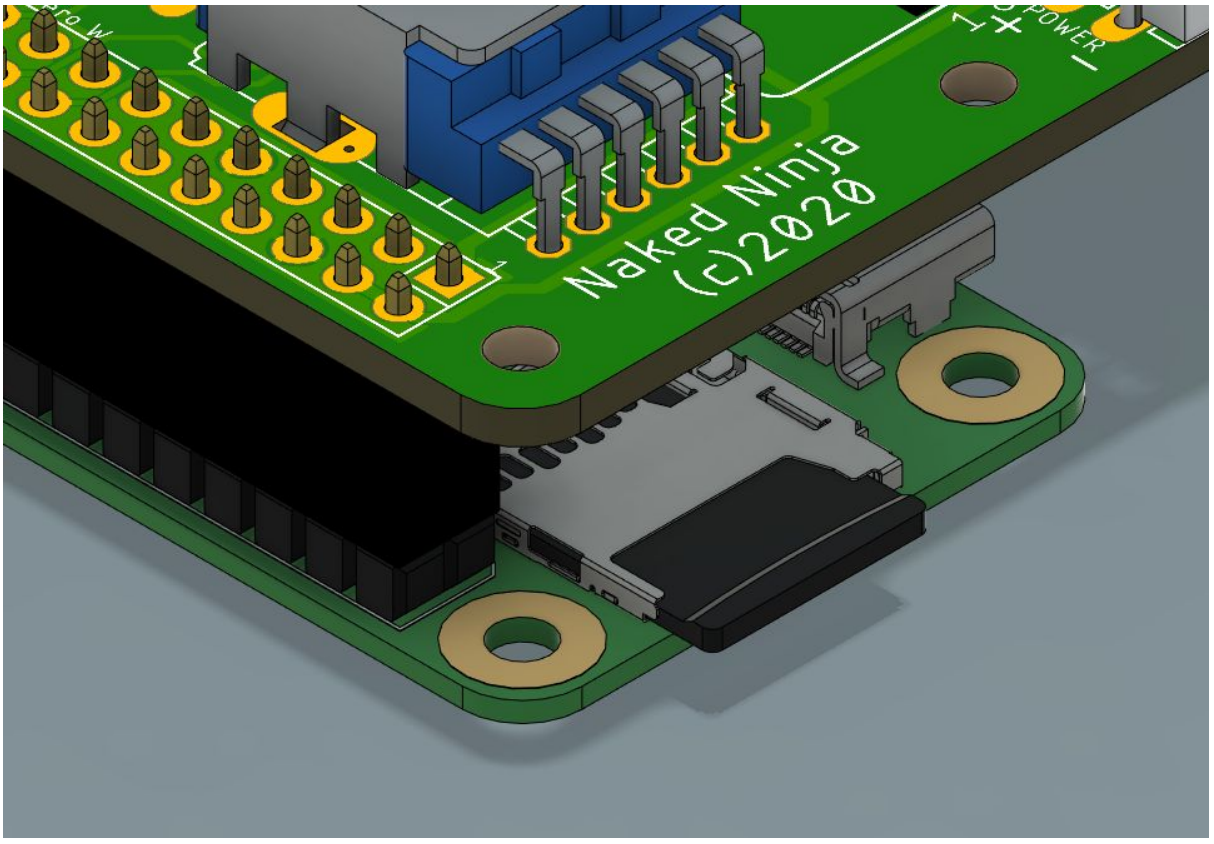


Photo 26: Raspberry PI with SD card inserted

9. Connect power to the product.
   - Hook up power to the assembled PCB.

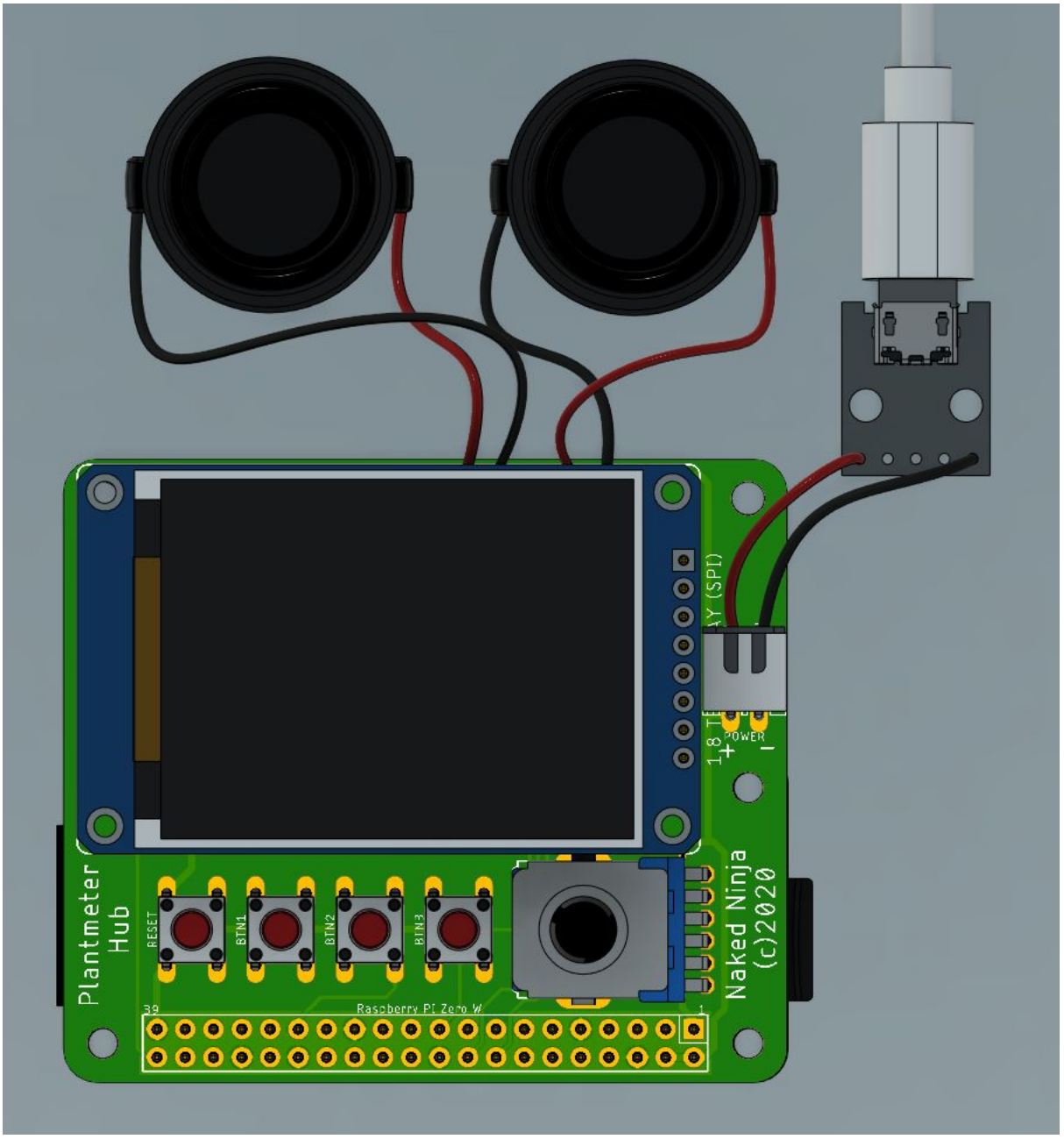


Photo 27: Toby PCB with connected speakers and power

- Wait until Toby has finished starting up.

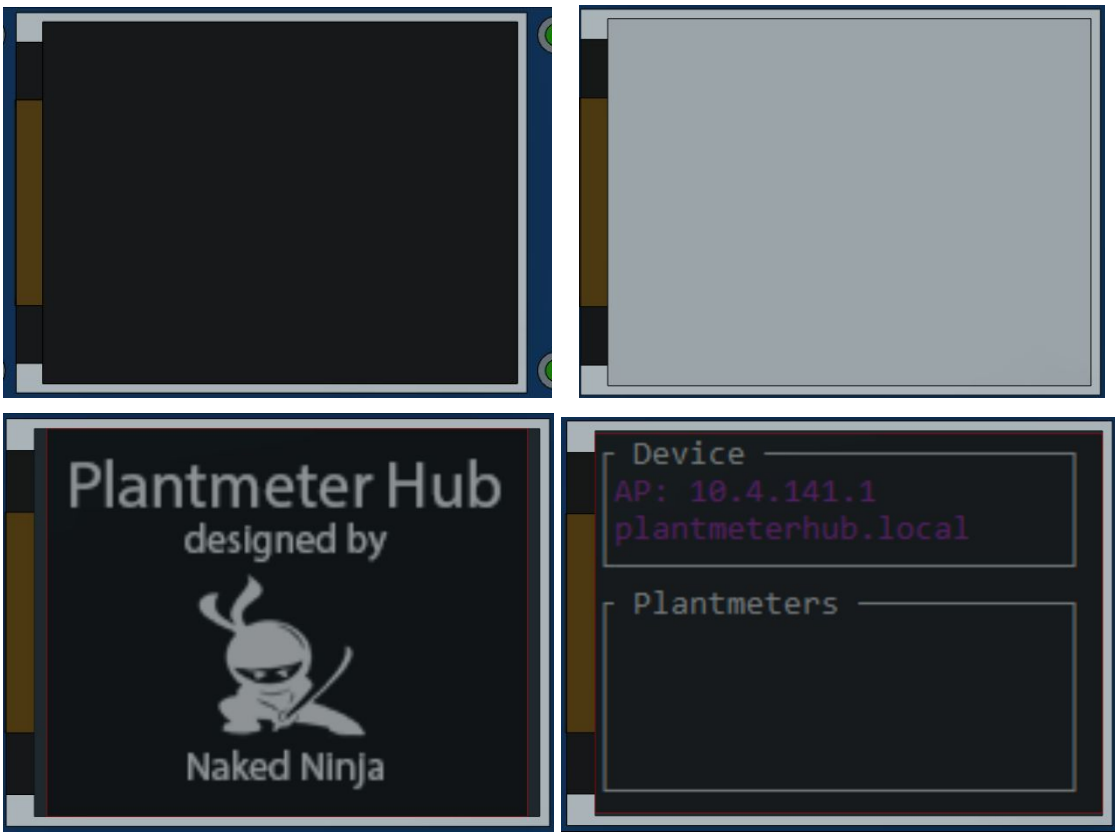


Photo 28: Toby display startup sequence

10. Connect to the hosted Wifi network called “plantmeterhub” with the password “12345678” with your device and set up a Wifi connection.

***Note: The following example is done on a smartphone.**

- Select the “plantmeterhub” to connect too.

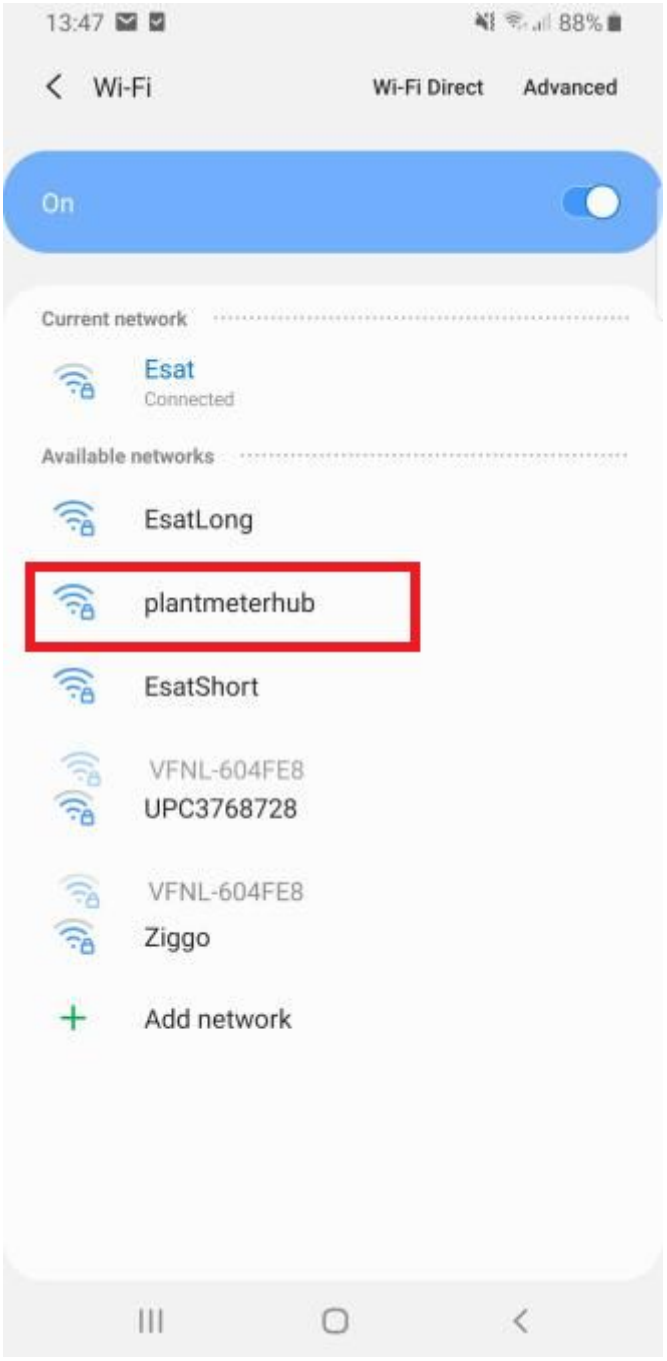


Photo 29: Wifi connection screen with the Toby Wifi access point.

- Enter password to connect to “plantmeterhub”.

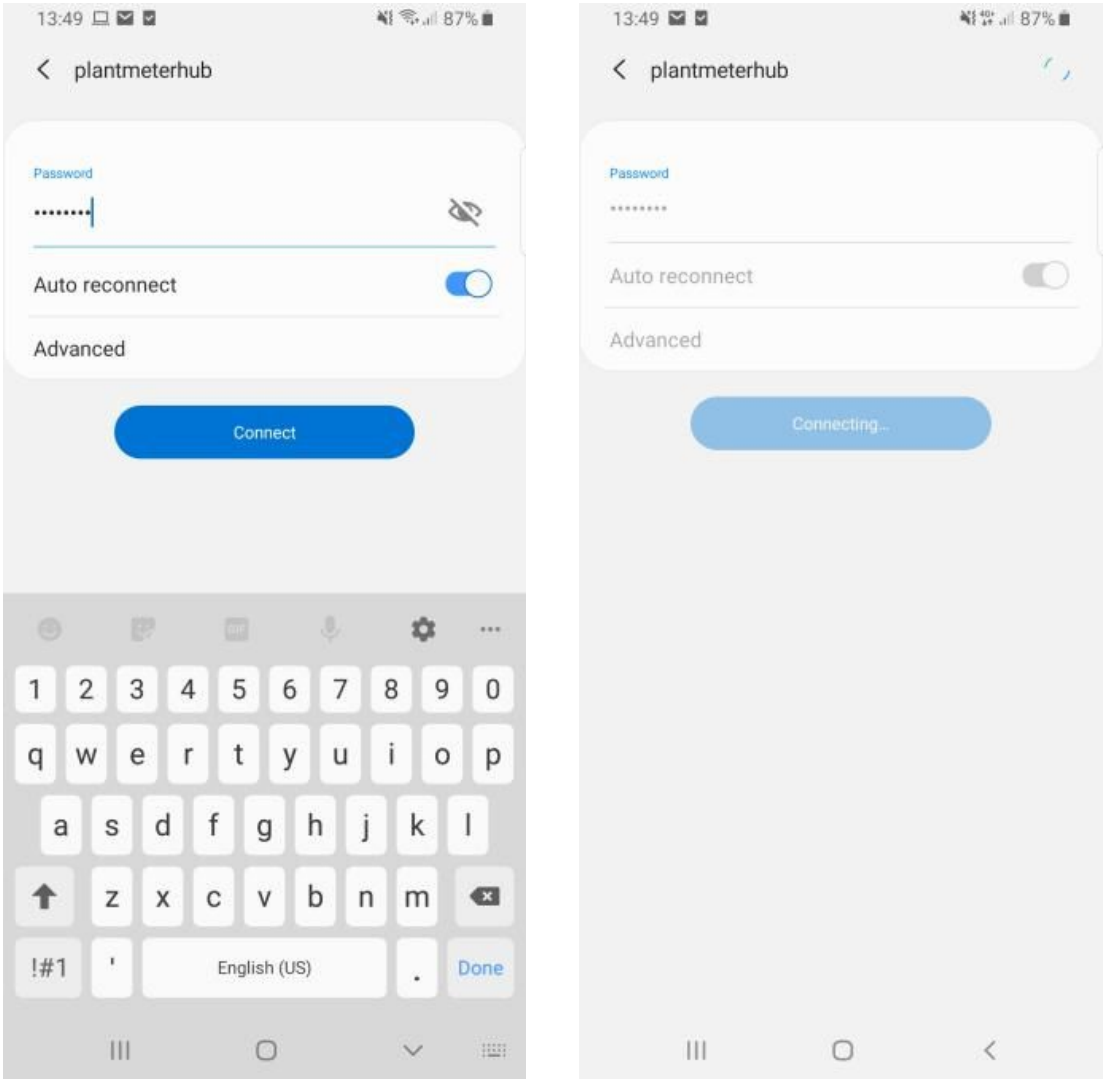


Photo 30: Phone/Device connecting to Toby Wifi access point

- Once connected, click on plantmeterhub and then click on “manage router”

***Note: Some devices may automatically do this after the connection is established.**

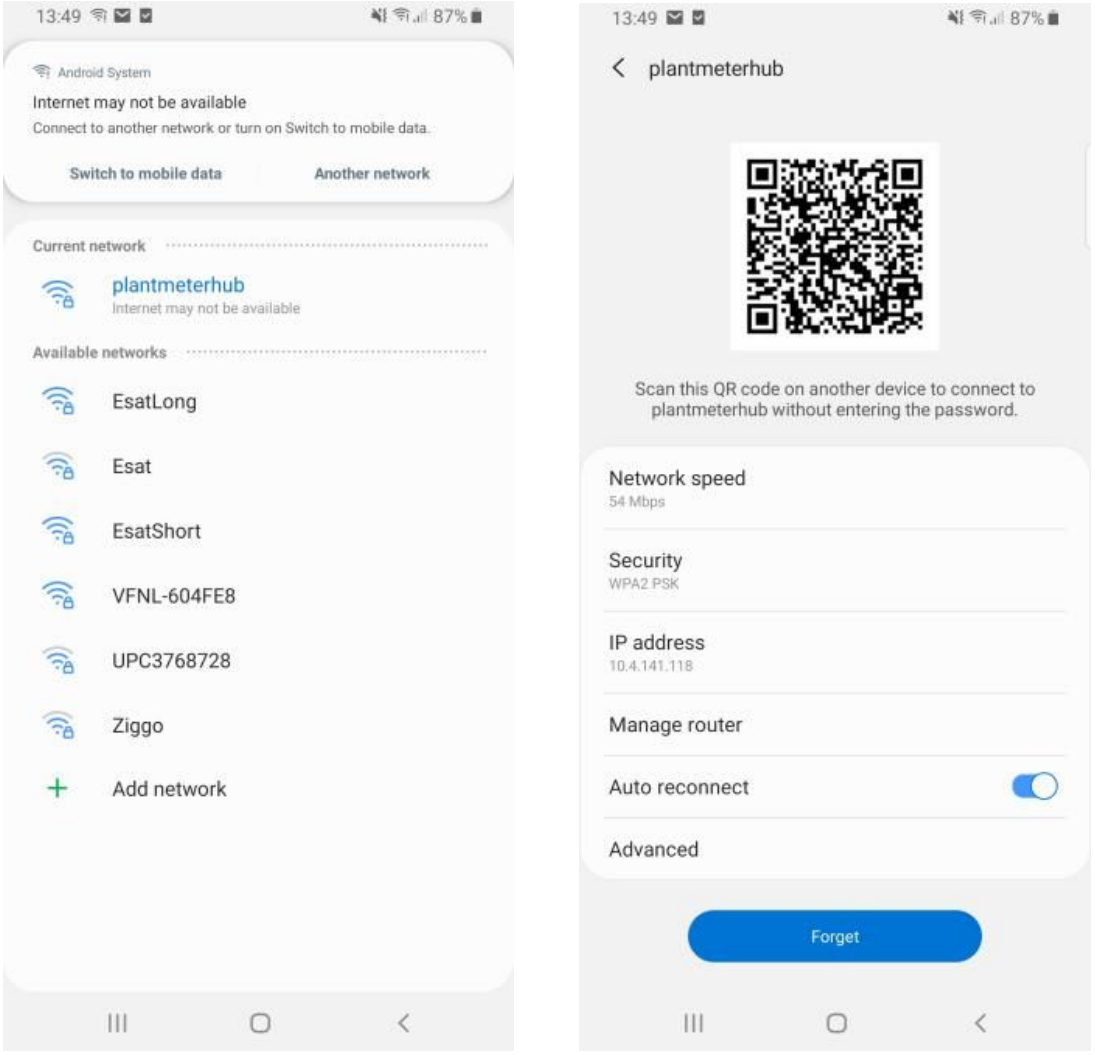


Photo 31: Phone/Device connected to the Toby Wifi access point & access point settings

- Log in to the page using the default username and password:

Username: user

Password: user

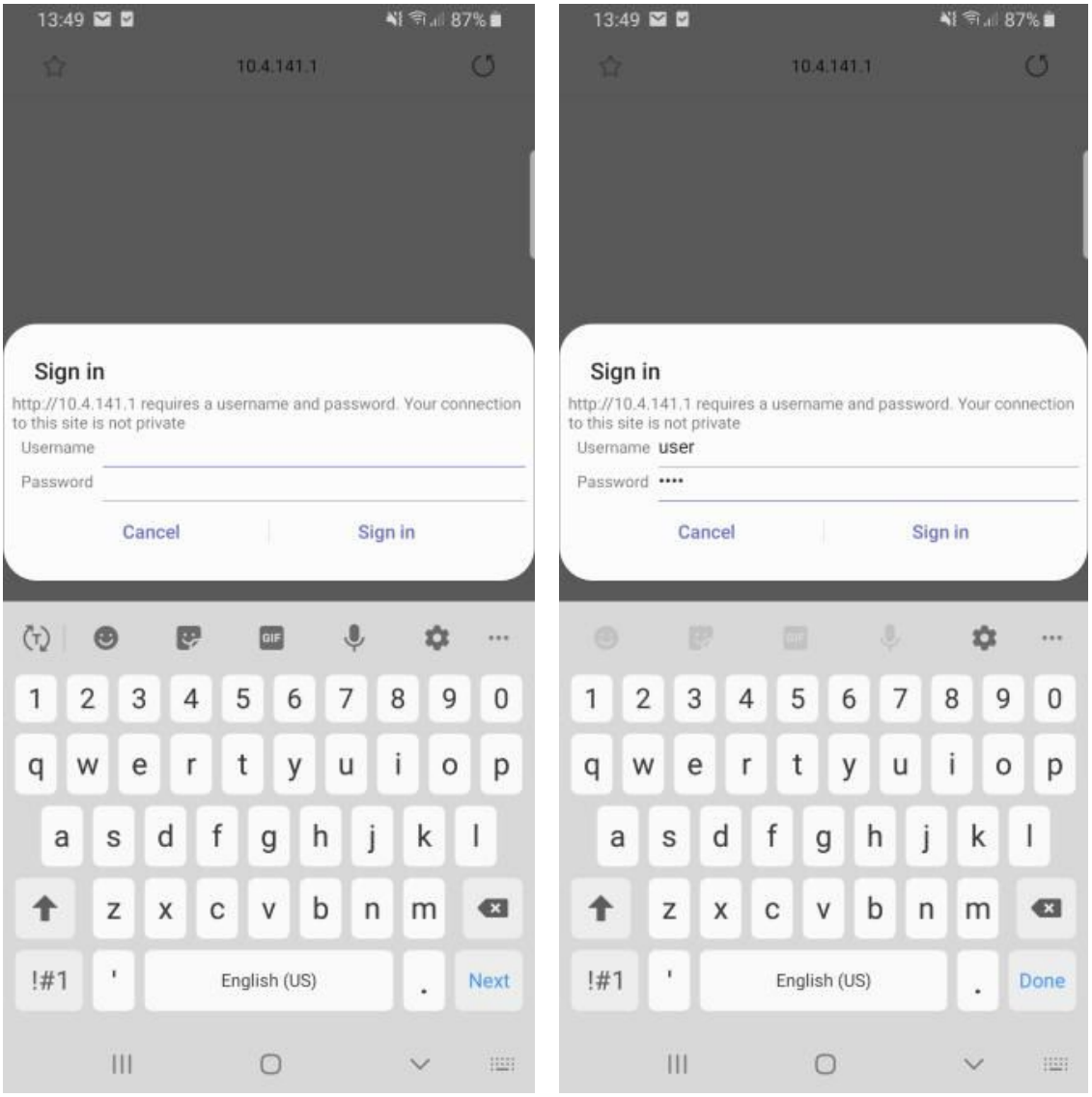


Photo 32: Toby login screen

- Once logged in, click on the options button top left (☰) and navigate to “Setup”

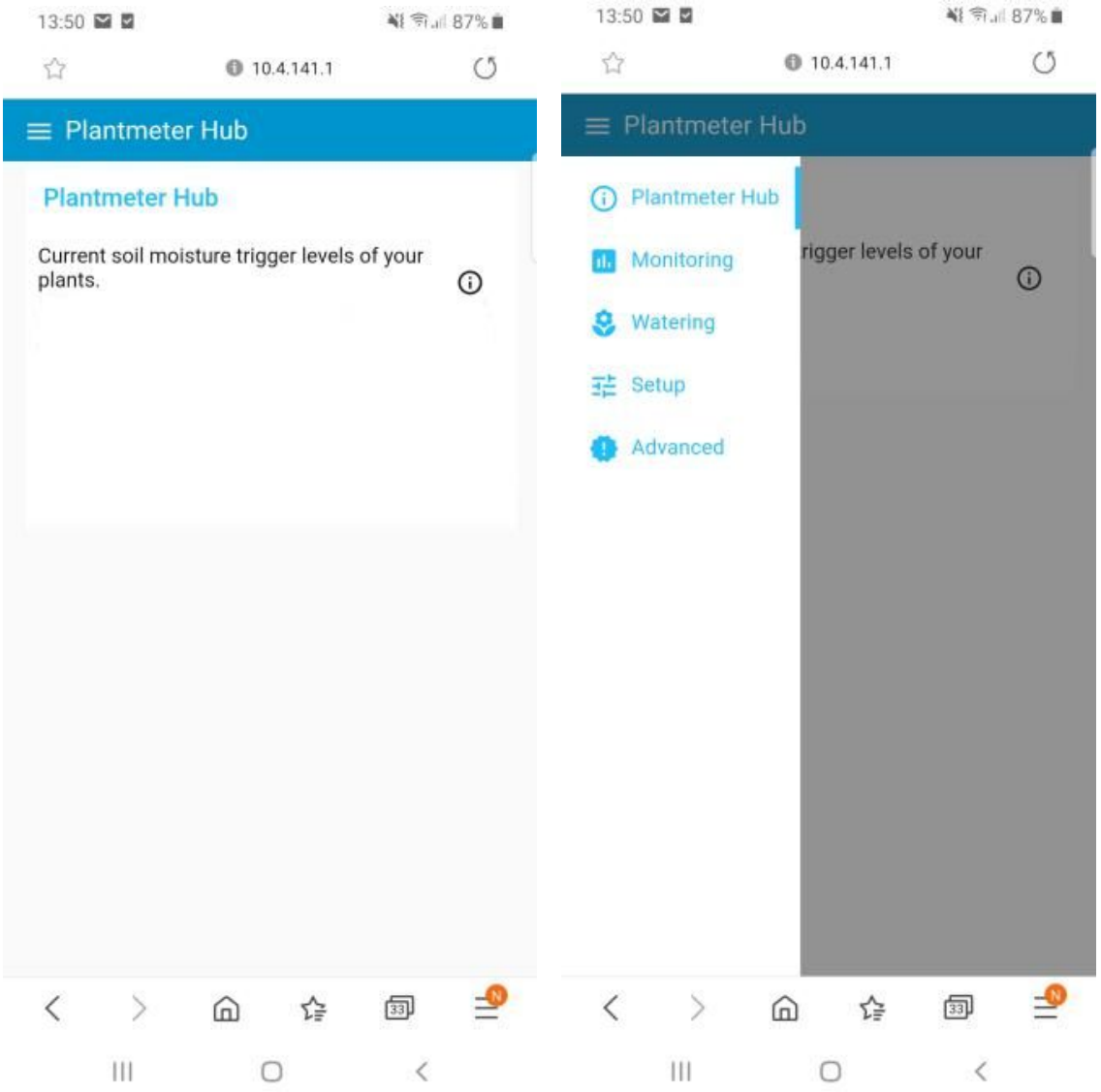


Photo 33: Toby Home screen & Dropdown menu

- Select the Wifi network you want Toby to connect to.

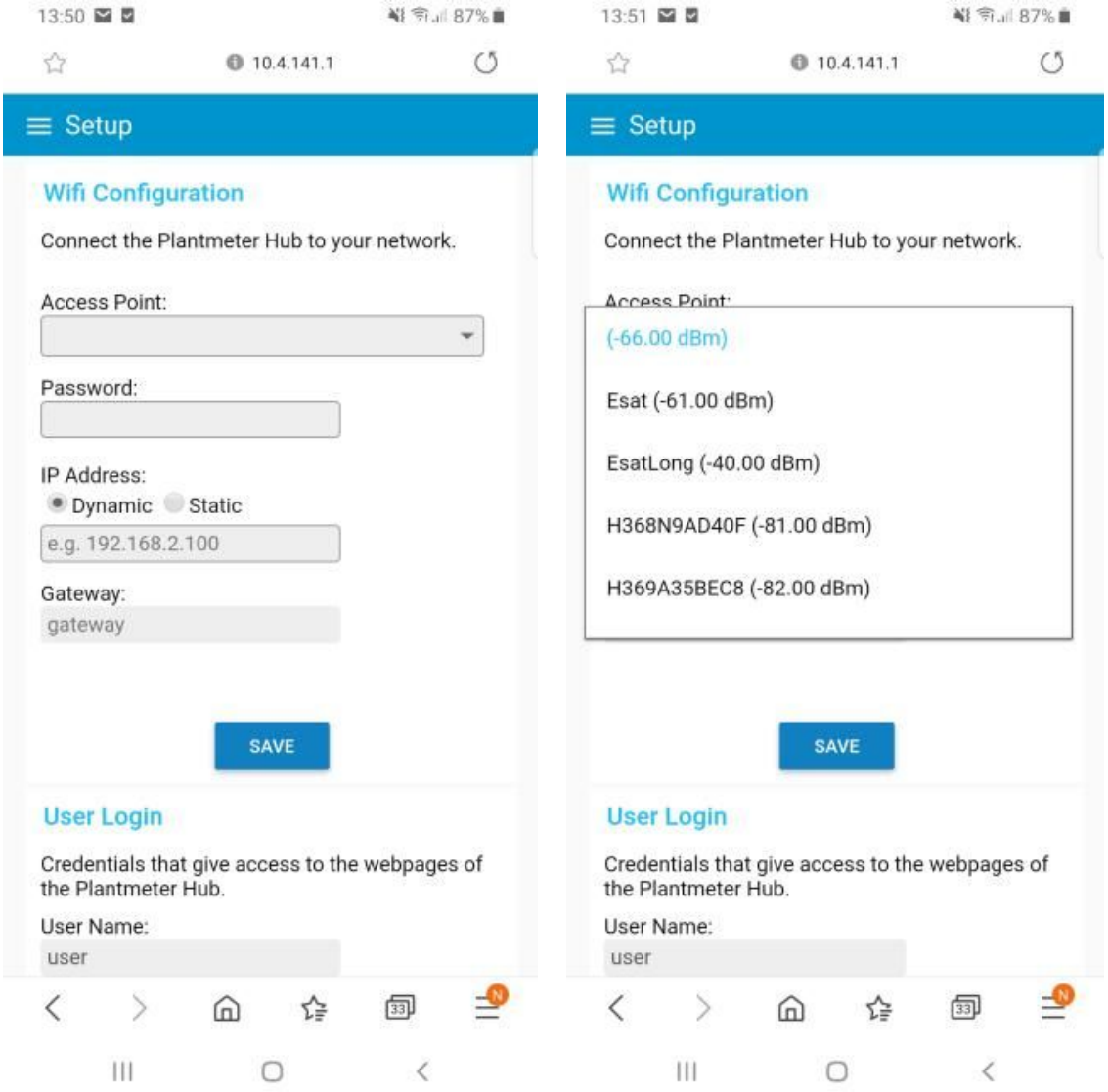


Photo 33: Toby Setup screen & Wifi dropdown menu

- Enter the password for the Wifi network, select “Dynamic” under the IP Address menu, and click save.

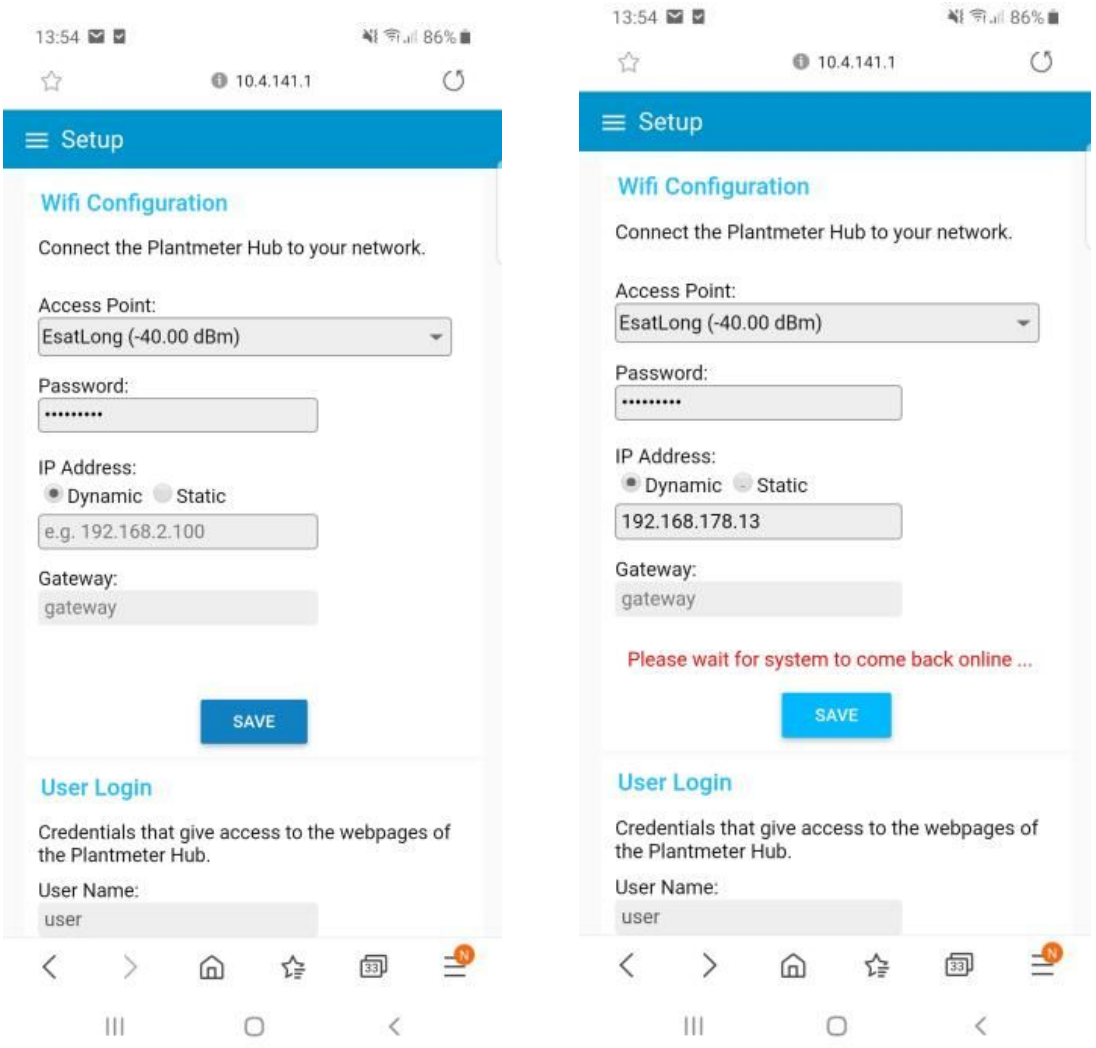


Photo 34: Toby Setup screen with configured dynamic Wifi network

- Device will now restart.
- Wait until the device is restarted and Toby is back online.

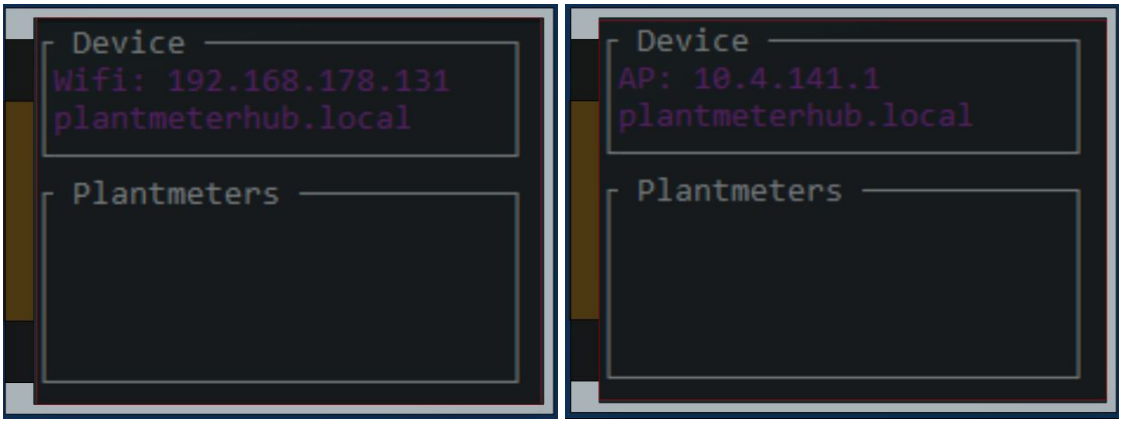


Photo 35: Toby Display with new Wifi IP address and access Point IP address

11. **OPTIONAL:** Setup static IP for Wifi network

NOTE: YOU NEED TO HAVE DONE THE DYNAMIC WIFI SETUP FIRST!

- Open your web browser program on your PC/laptop or phone that is on the same network connection you just configured and go to the Wifi IP address given on the display.

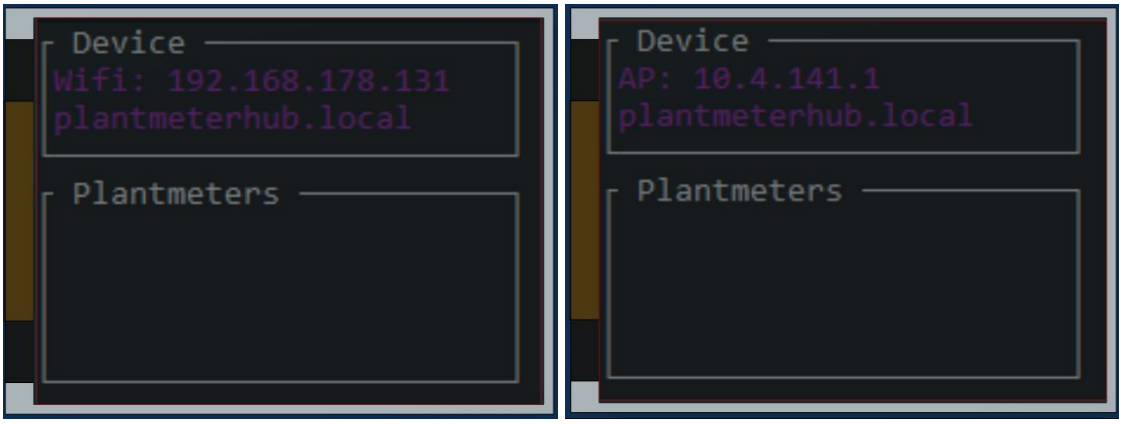


Photo 36: Toby Display with dynamic Wifi IP address and access point IP address

- Log in to the page user the default username and password:

Username: user

Password: user

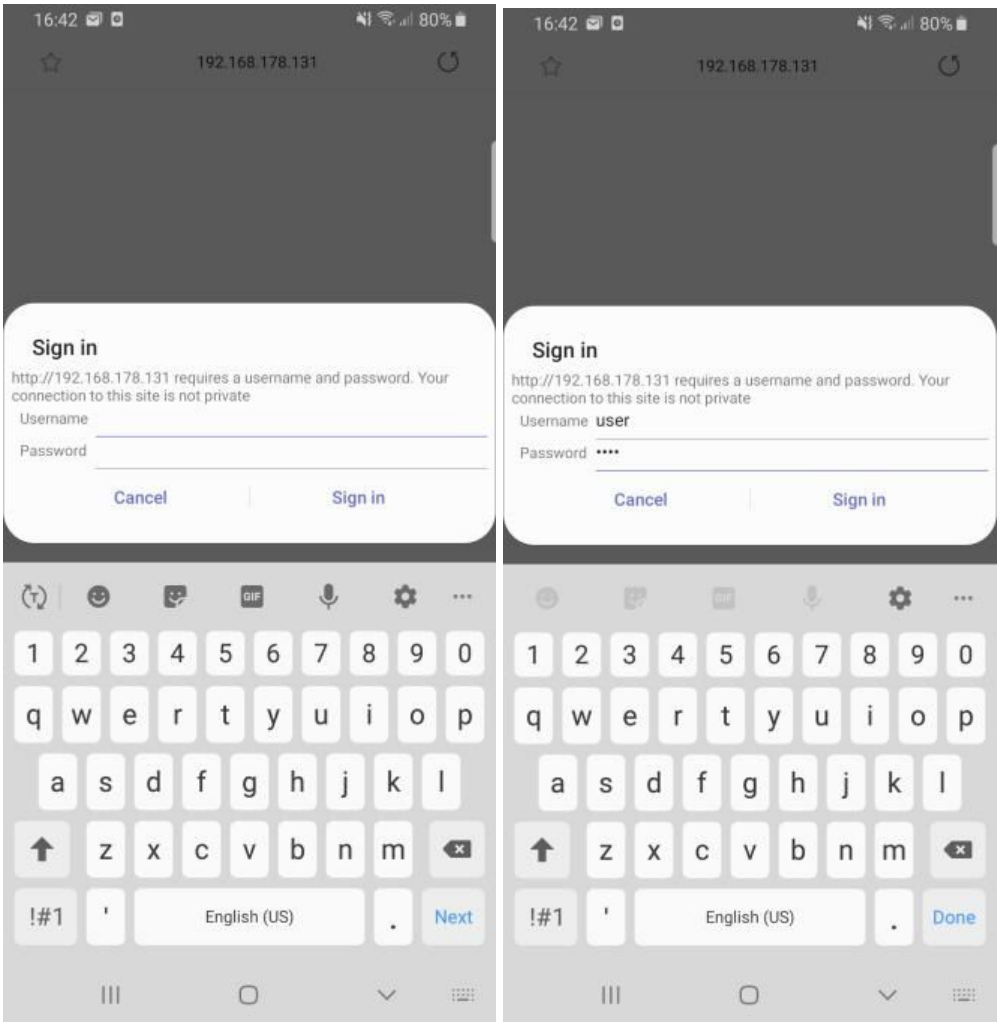


Photo 37: Toby login screen

- Once logged in, click on the menu button top left (☰) and navigate to “Setup”

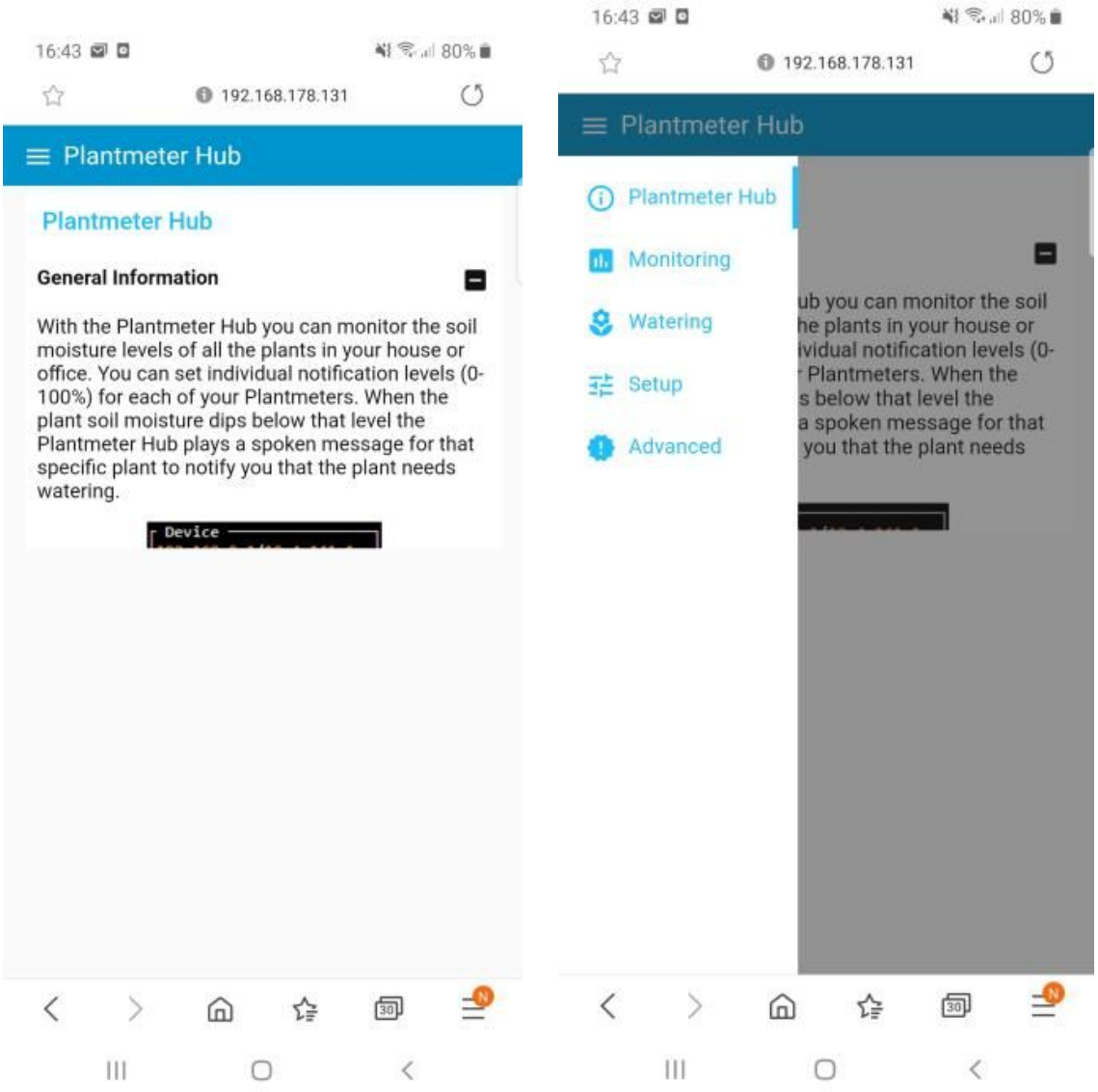


Photo 38: Toby Home screen & Dropdown menu

- The page will load with the configured Wifi network and IP address. Select the “Static” option.

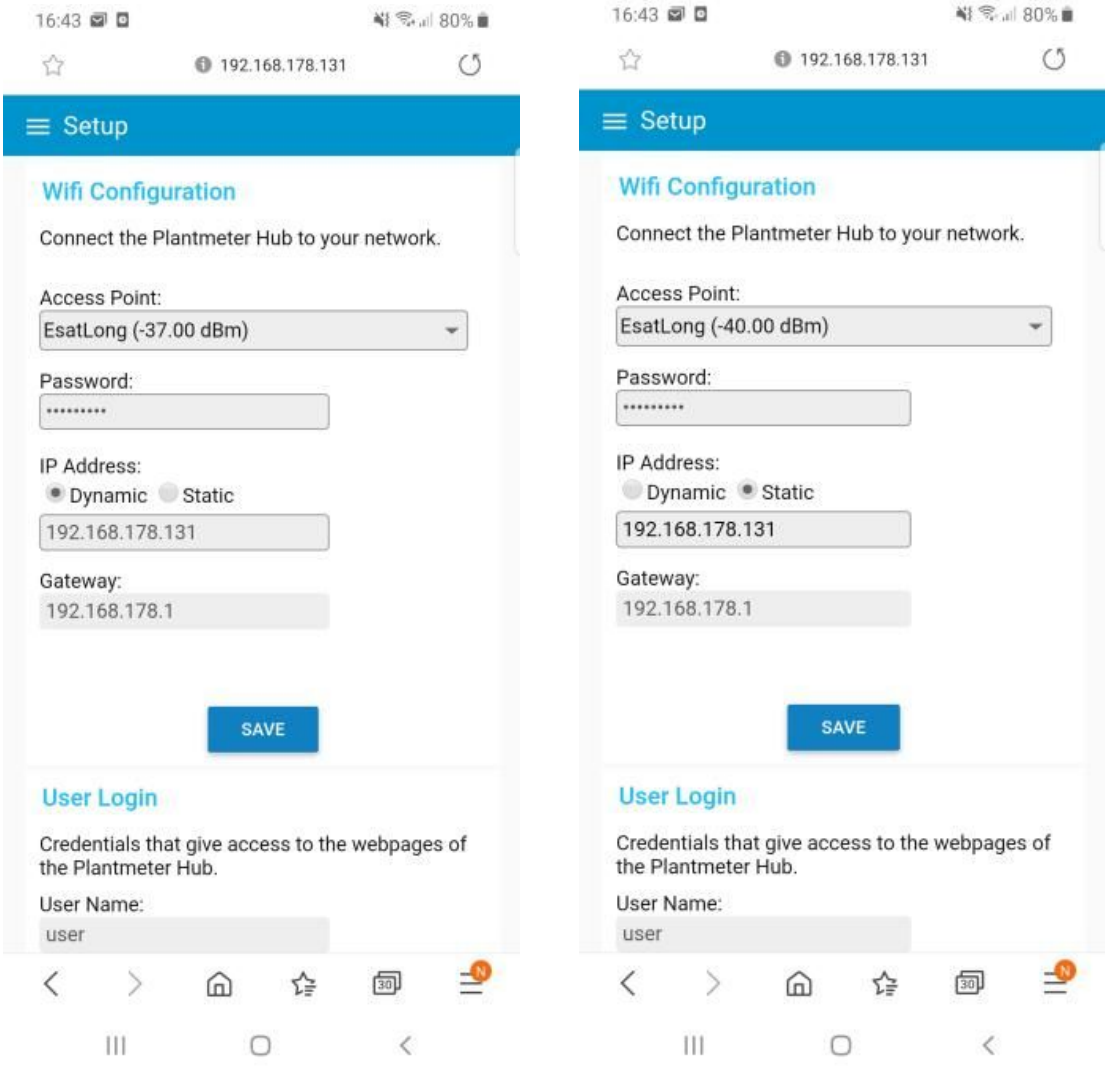


Photo 39: Toby Setup screen with dynamic and static Wifi network

- Change the IP address to the address you want and press the “Save” button.

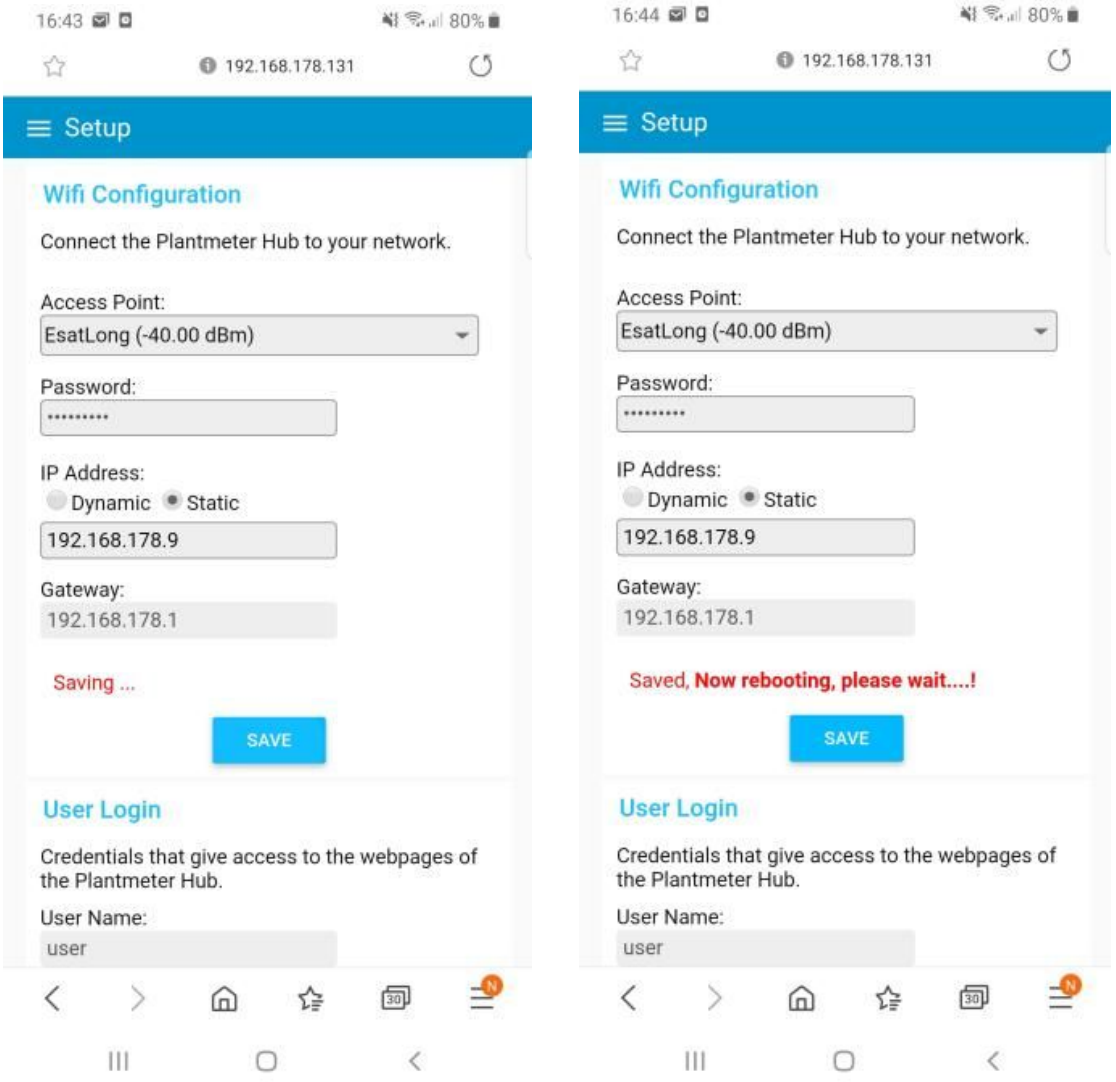


Photo 40: Toby Setup screen with configured static Wifi network

- The device will now restart.
- Wait until the device is restarted and Toby is back online. You’ll then see the set IP address appear on the display.

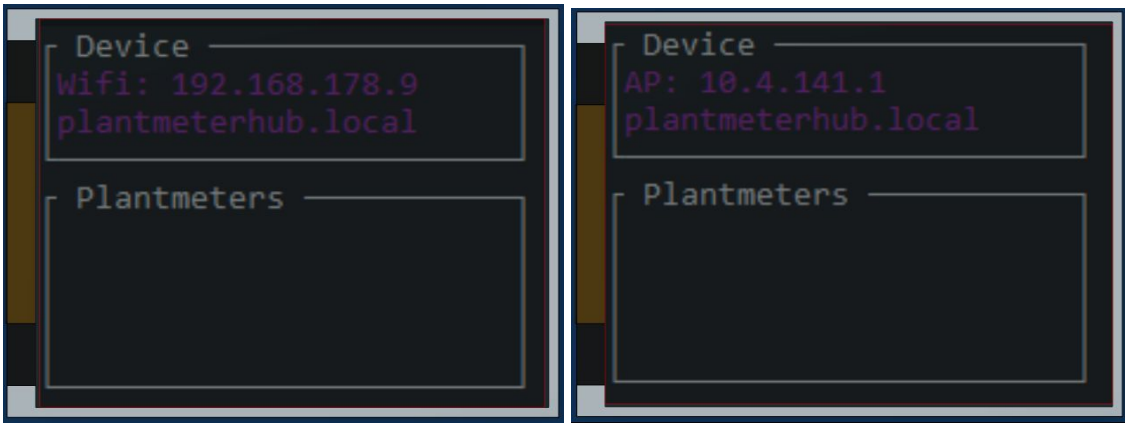


Photo 41: Toby Display with static Wifi IP address and access point IP address

Adding a Plantmeter device

The following paragraphs will show you how to add a Plantmeter device to Toby.

* Note that you will need to have followed the “PCB Assembly instructions” and “Software Assembly instructions” first before continuing.

Make sure the plantmeter device has power (battery or micro USB adapter)

Press the small button on the side of the plantmeter.

Pressing the button will activate an access point and webserver on the plantmeter itself for 5 minutes. During that time you can log in and configure the plantmeter.

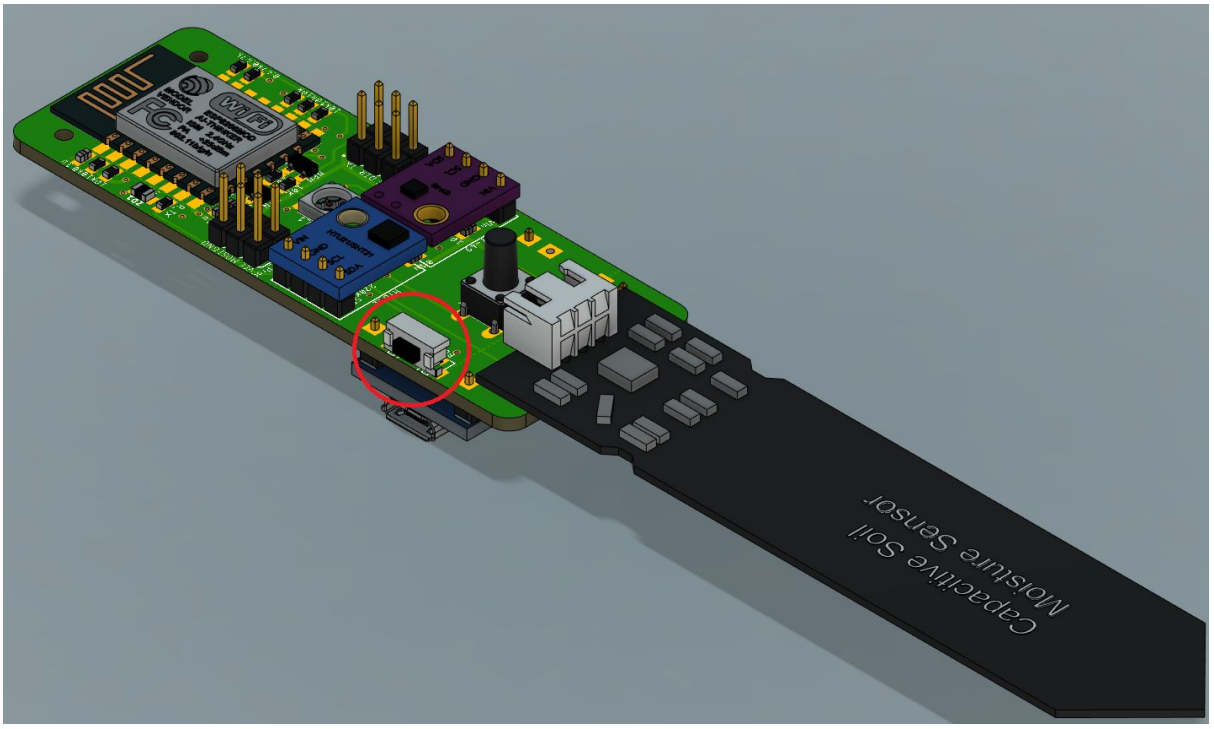


Photo 42: Plantmeter Device

- Connect to the access point that is hosted on the plantmeter with a mobile phone, tablet, or PC/laptop.
The access point is called “Plantmeter1”

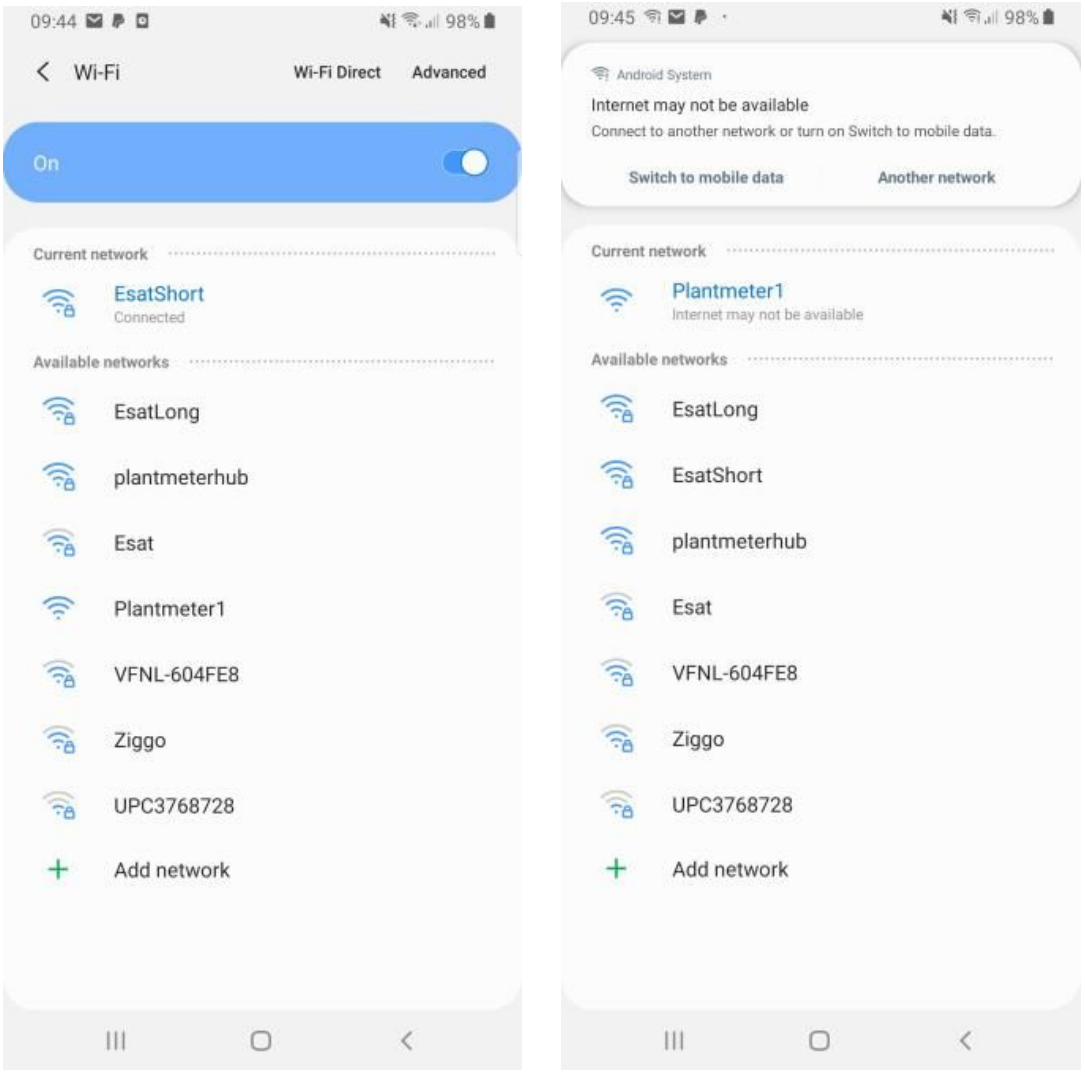


Photo 43: Wifi connection screen on a mobile device with the Plantmeter Device access point, “Plantmeter1”.

- Either open the Wifi network and press on the “Manage router” button or go to the IP address “192.168.4.1” in your web browser app.
- Press the “Configure Wifi” button.

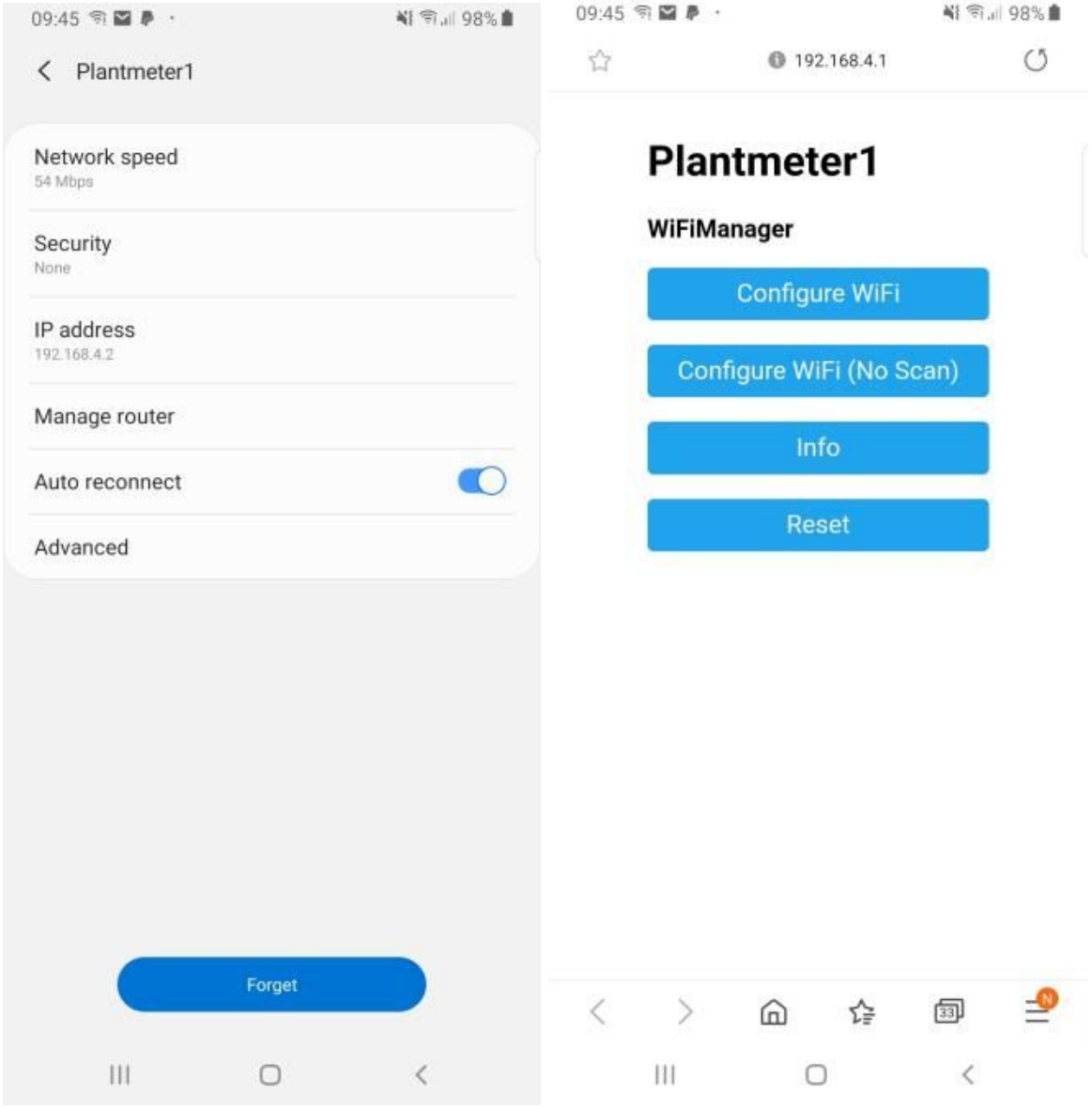


Photo 43: “Plantmeter1” Wifi connection settings screen and Plantmeter device configuration screen.

- Select the “plantmeterhub” wifi network and enter the password “12345678”

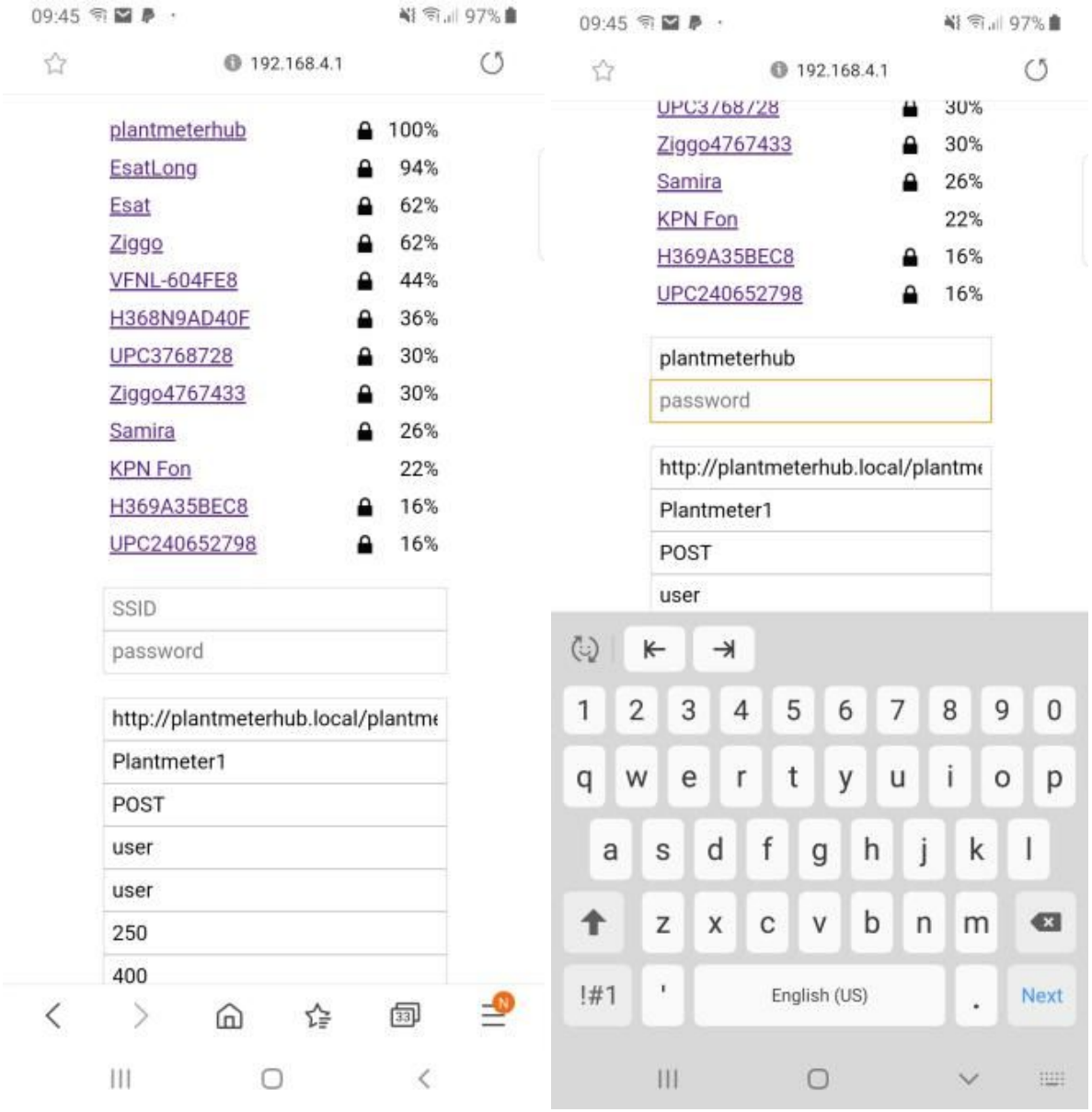


Photo 44: Plantmeter device Wifi Configuration screen wifi configuration example.

- Change the name “Plantmeter1” to any name you want. Advice: name it after the plant that you want to monitor, for example: “Rose”

*Note that the Access point network that will be hosted by the Plantmeter device will also change to this name entered.

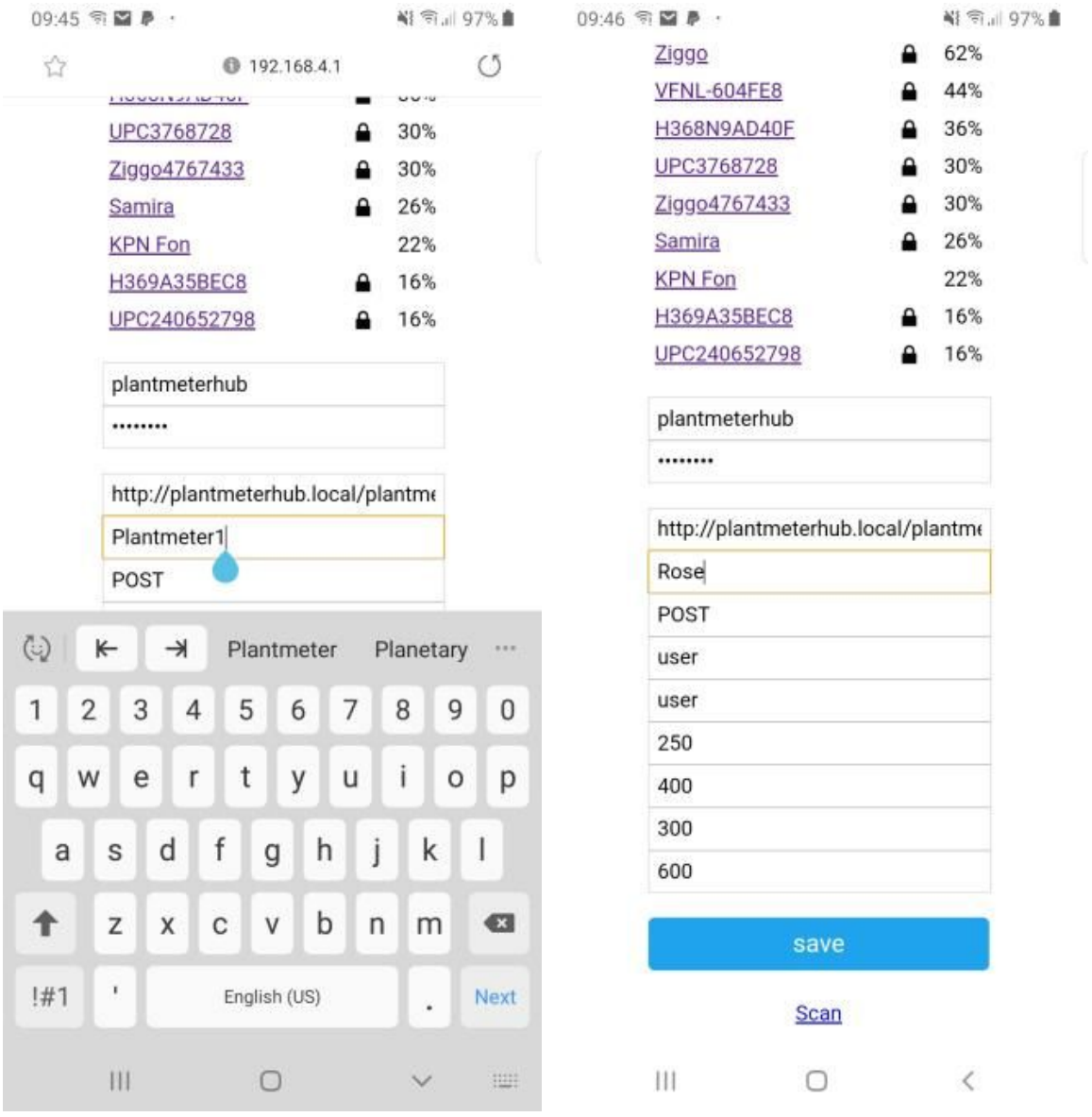


Photo 45: Plantmeter device Wifi Configuration screen name change example.

- Press the “save” button and wait for 15 seconds.

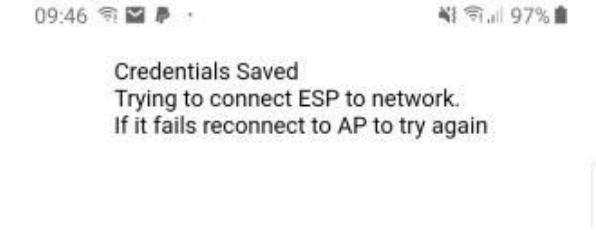


Photo 46: Plantmeter device exit screen after pressing “save”.

- Press the main button on the Plantmeter device and wait for the RGB LED to blink.

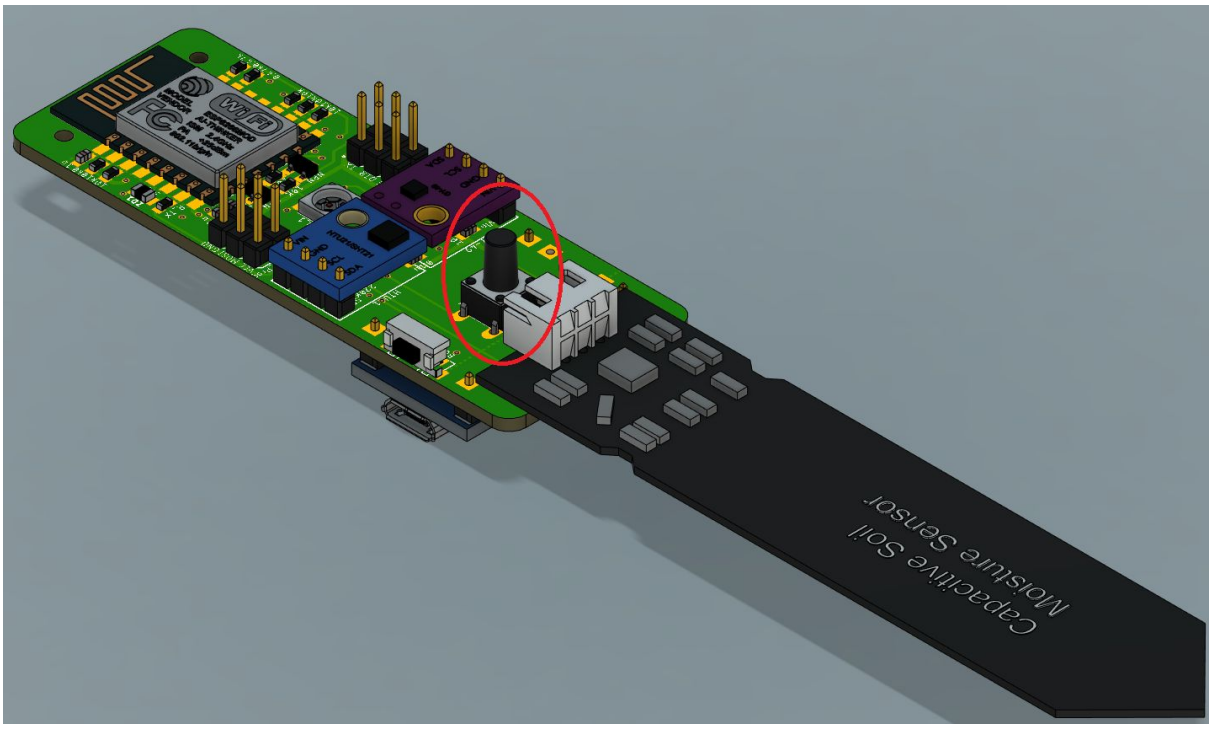


Photo 47: Plantmeter Device.

The RGB LED on the device will blink green if the communication to Toby is successful.
The display on Toby will then show the following:

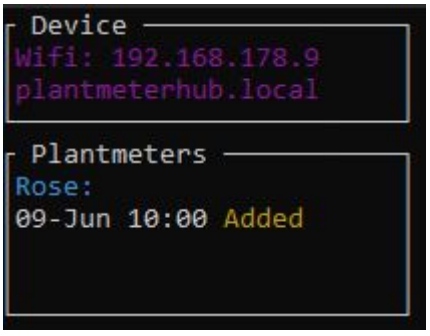


Photo 48: Toby Display, Device added screen

When a new measurement from the Plantmeter device is received it will show the device on the display with one of two messages:

Photo 49: Toby Display, Device message received screen

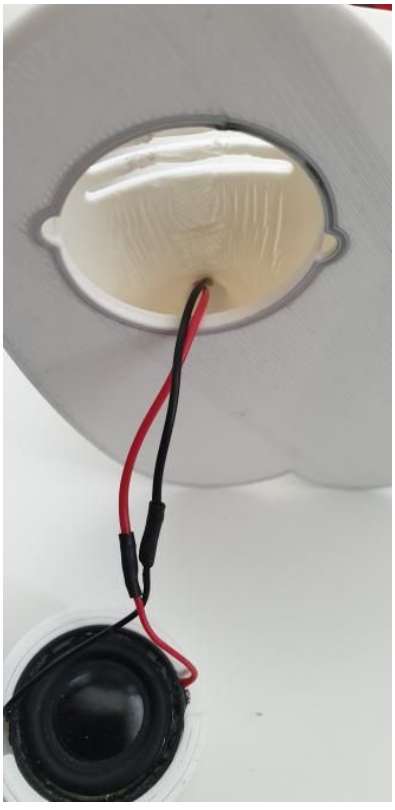
3D Printing & Assembly

The following paragraphs will explain how to assemble Toby into the designed enclosure. You can get the enclosure files to print from the Naked Ninja website under the description of Toby.

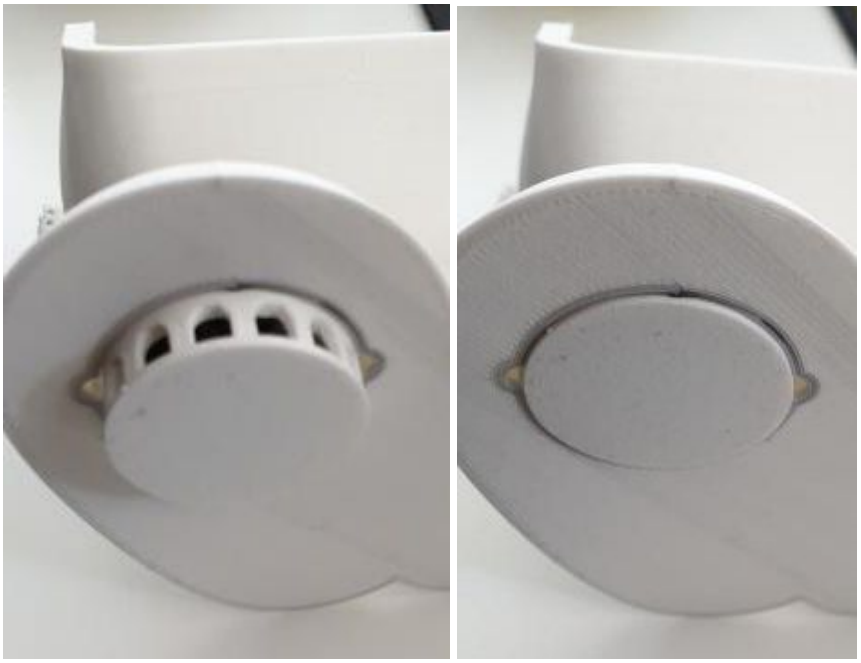
* Note that you will need to have done the “PCB Assembly instructions” and “ Software Assembly instructions before continuing here.

- Insert the speakers into their enclosure.


- Pull the cable of the speakers through the leg of the enclosure.



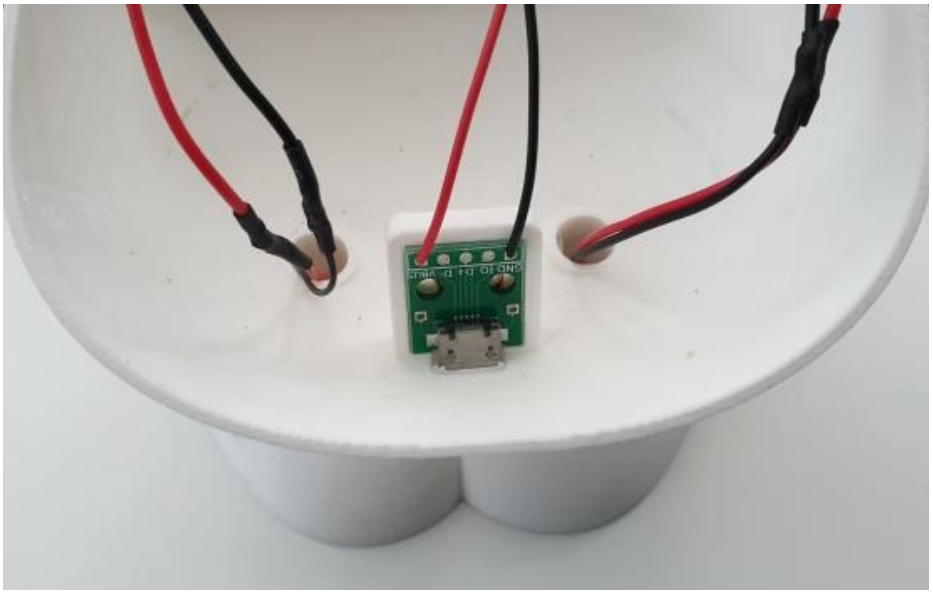

- While pulling the speaker cable from the other side, insert the speaker enclosure into the bottom of the feat



- Place the enclosure of its feet

- Solder the two JST XH2.54 2-Pin cables with a female connector to the speaker cables and isolate the solder joint by either electrical tape or heat shrink tubing.

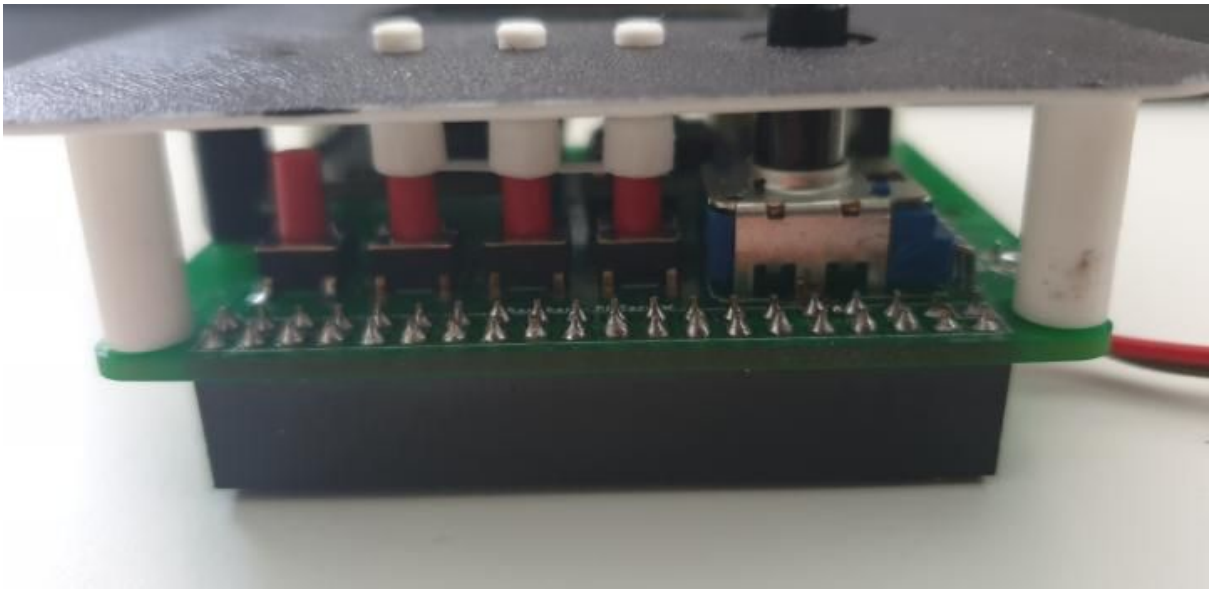
- Solder the JST XH2.54 2-Pin cable with a female connector to the micro USB module and place the module in the created slot.



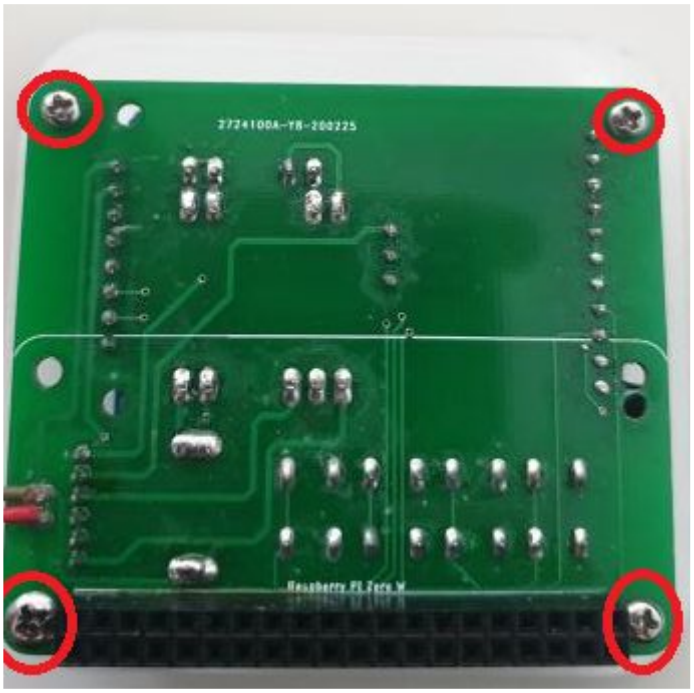
- Screw-in the micro USB module with the M2.6 6mm screw.

- Place the button covers into the front plate of the enclosure

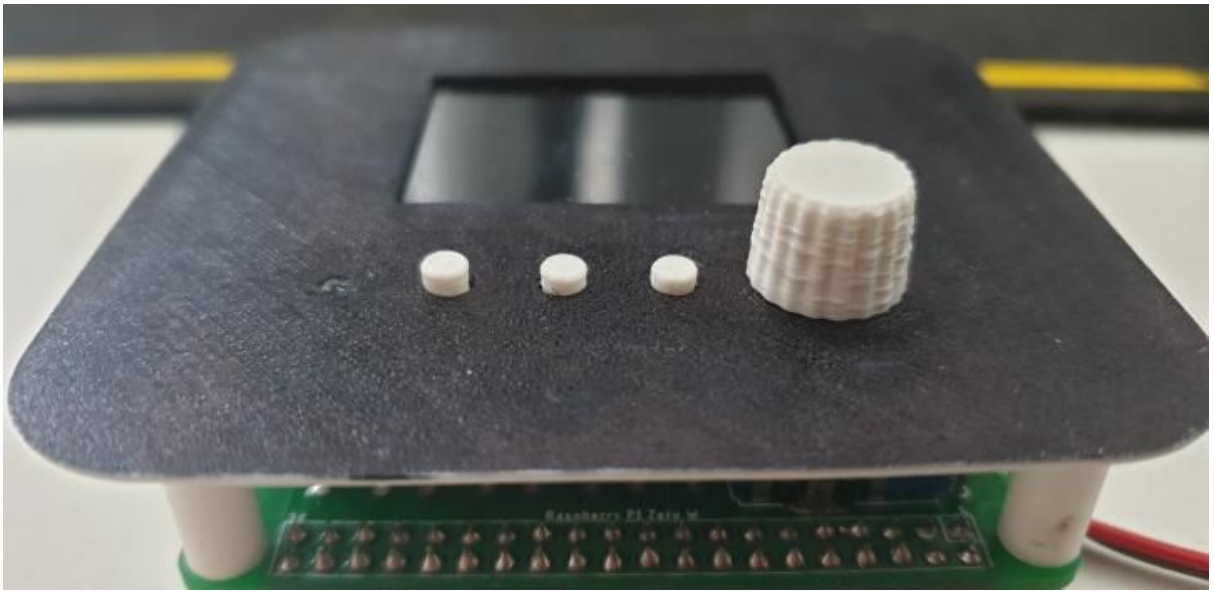
- Place the assembled PCB without the Raspberry Pi Zero W on the front plate



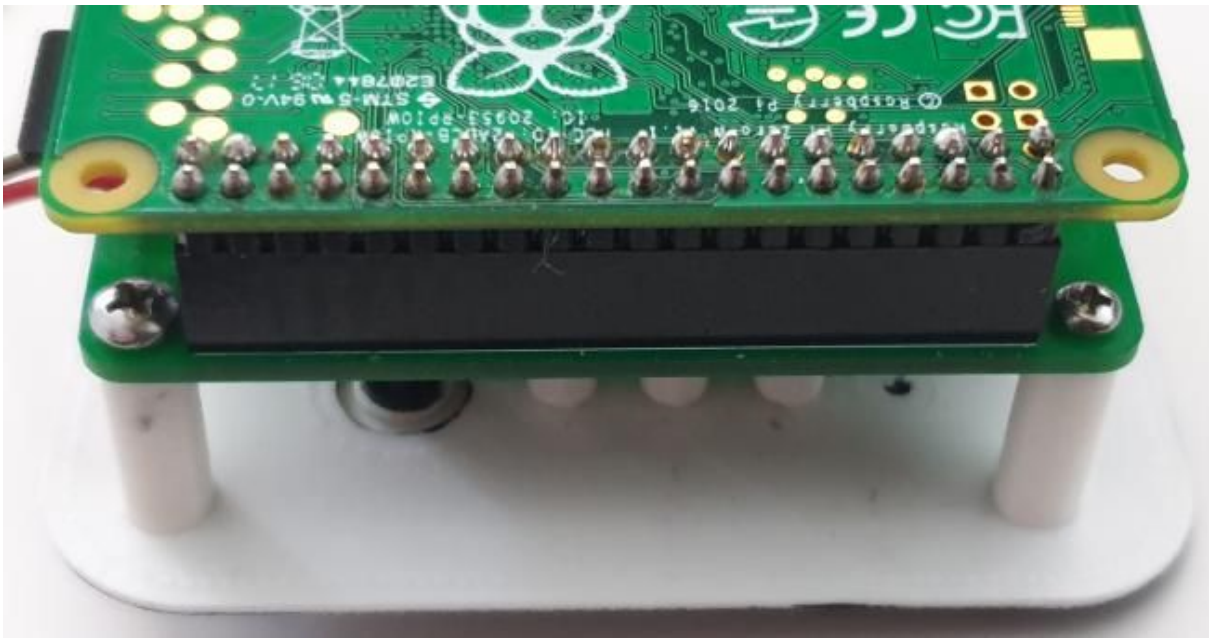
- Screw-in the PCB with the four M2.6 6mm screws



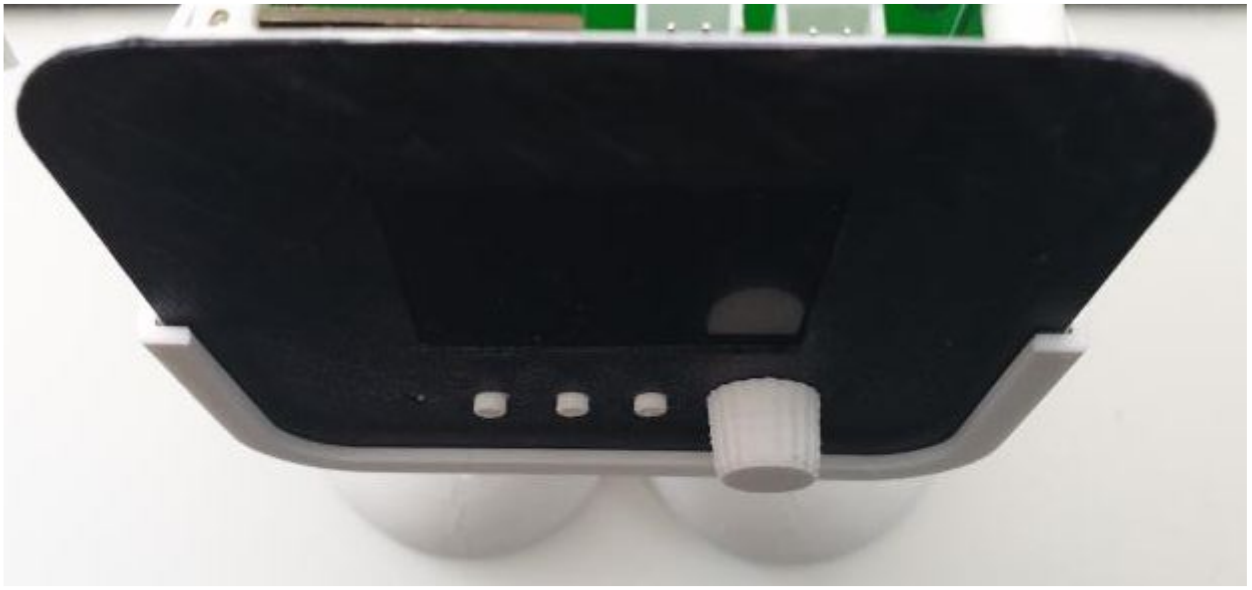
- Place the potentiometer cover on the Potentiometer



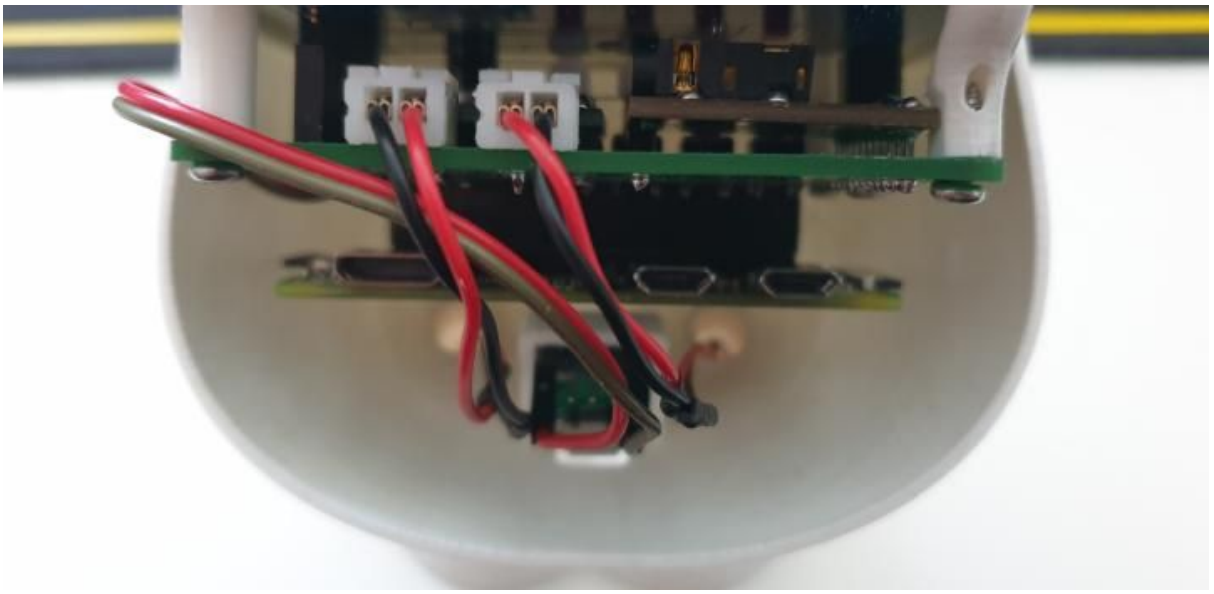
- Connect the Raspberry Pi Zero W to the PCB



- Slide the front plate into the enclosure bottom



- Connect the two speakers and power JST connectors.



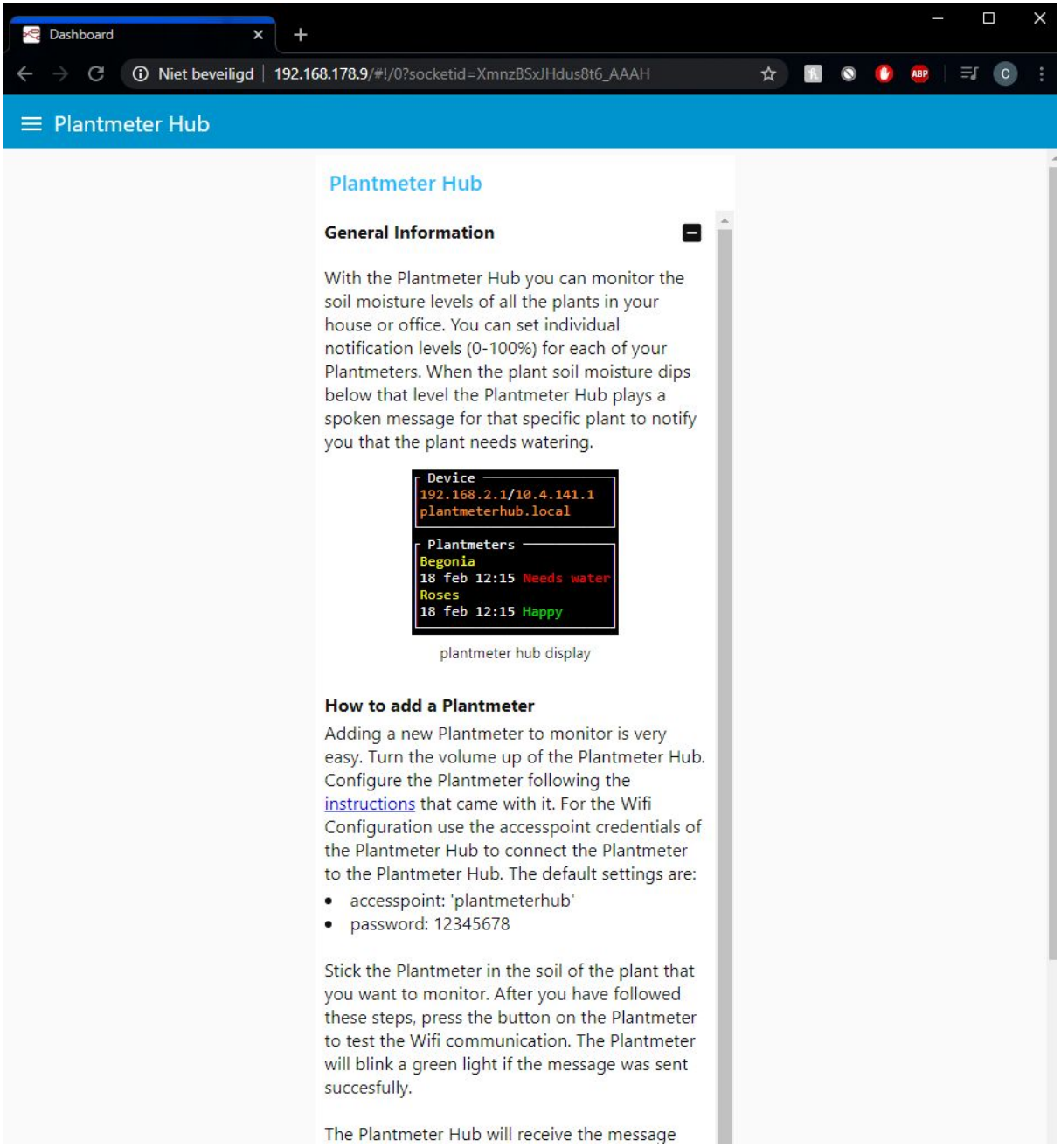
- Close the enclosure by combining the top and bottom enclosure.

User Manual

The following text will explain each webpage in the web interface of Toby.

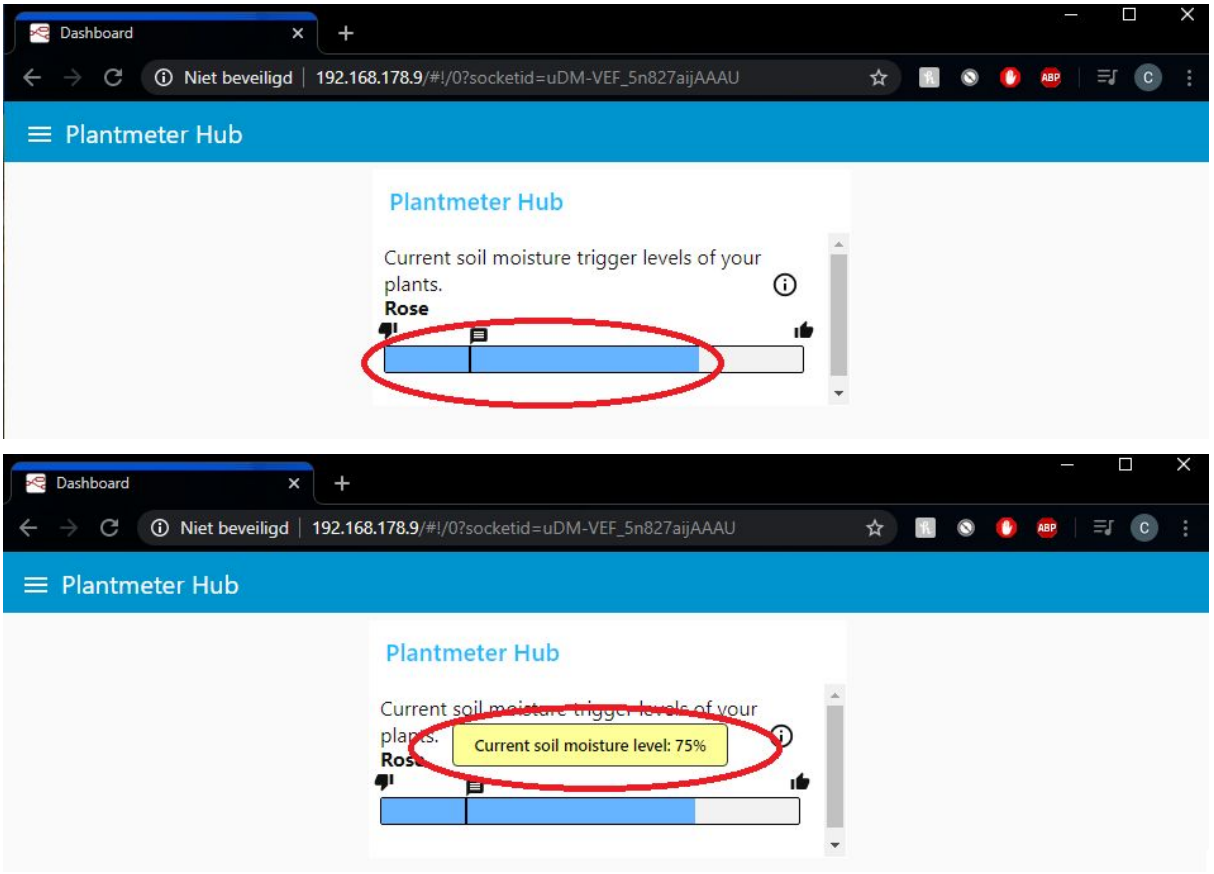
Plantmeter Hub

The “Plantmeter Hub” screen consists of two screens.
The first is an information screen that shows up when no Plantmeter Devices are configured/added. This screen contains general information about Toby, how to add a Plantmeter Device, and some support information.

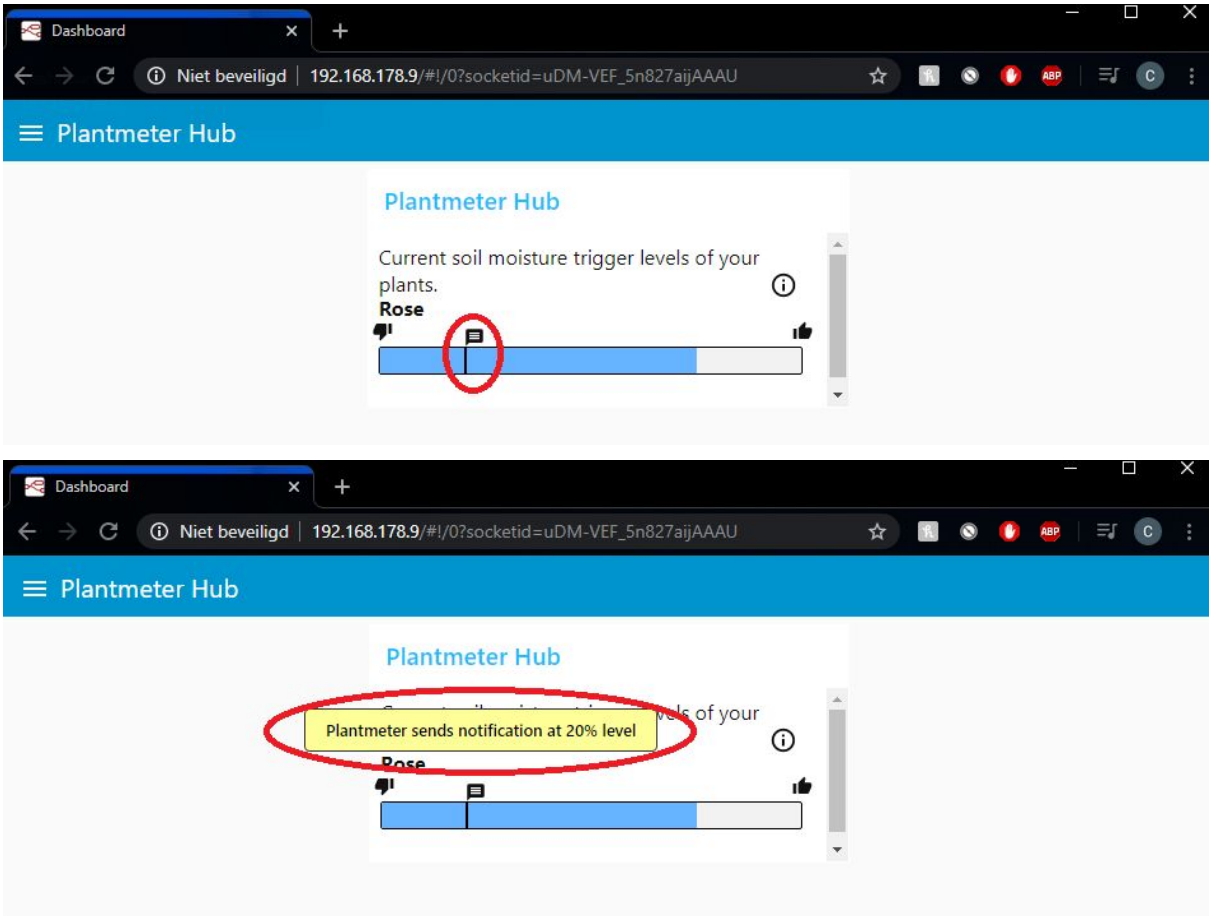


plantmeter hub display

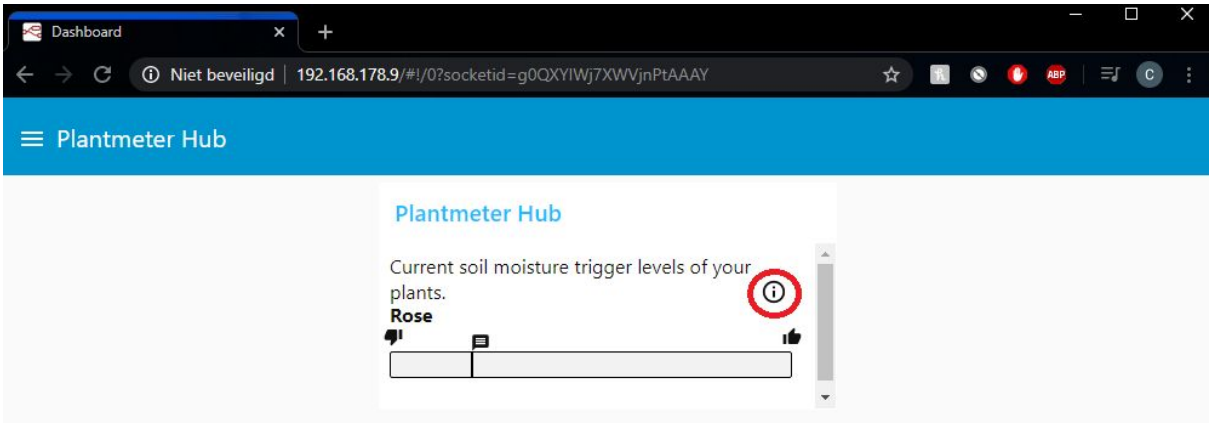
The second screen shows the current water levels of the connected Plantmeter Devices. This screen appears by default after at least one Plantmeter Device is added to Toby. The blue bar underneath the Plantmeter Device's name shows how much percentage of water is measured by the devices. By hovering the mouse over the bar, a popup message will appear with the exact percentage measured.



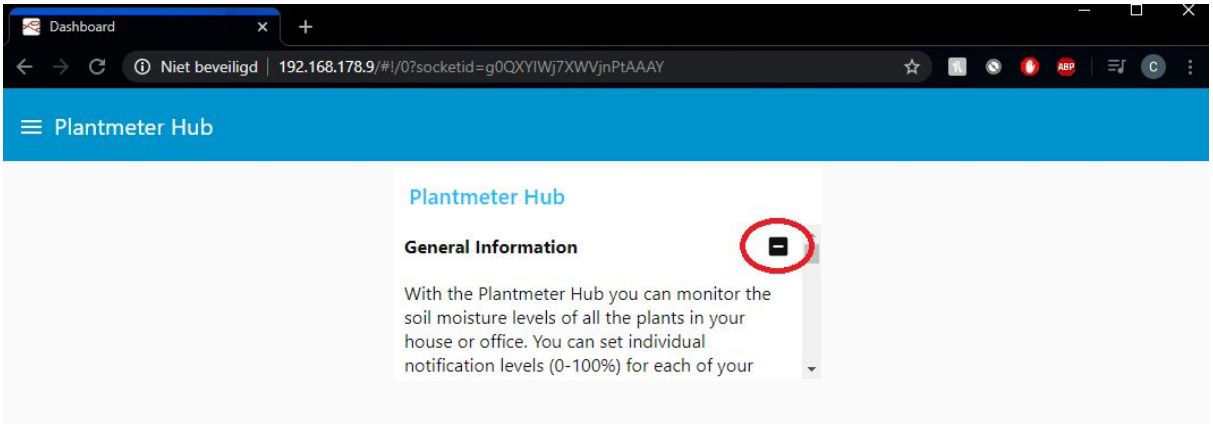
There is also a small black link on the blue bar itself. This line represents the trigger value that is configured for the Plantmeter Device. When hovering over the small black box above the line, a popup message will appear with the exact percentage level at which Toby will send a notification.



To see the information screen again when a Plantmeter Device is added, you can click on the small information icon in the top right corner. By doing this the information screen will appear again.



To go back to the Plantmeter Device water level screen, you can click on the small black button in the top right corner.

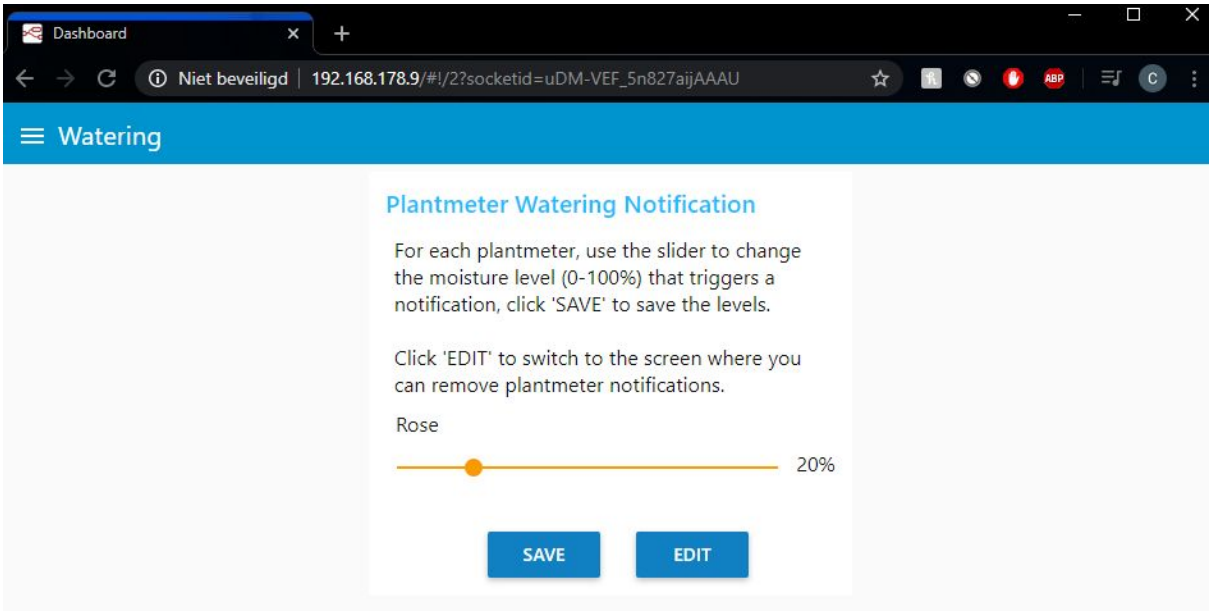


Monitoring

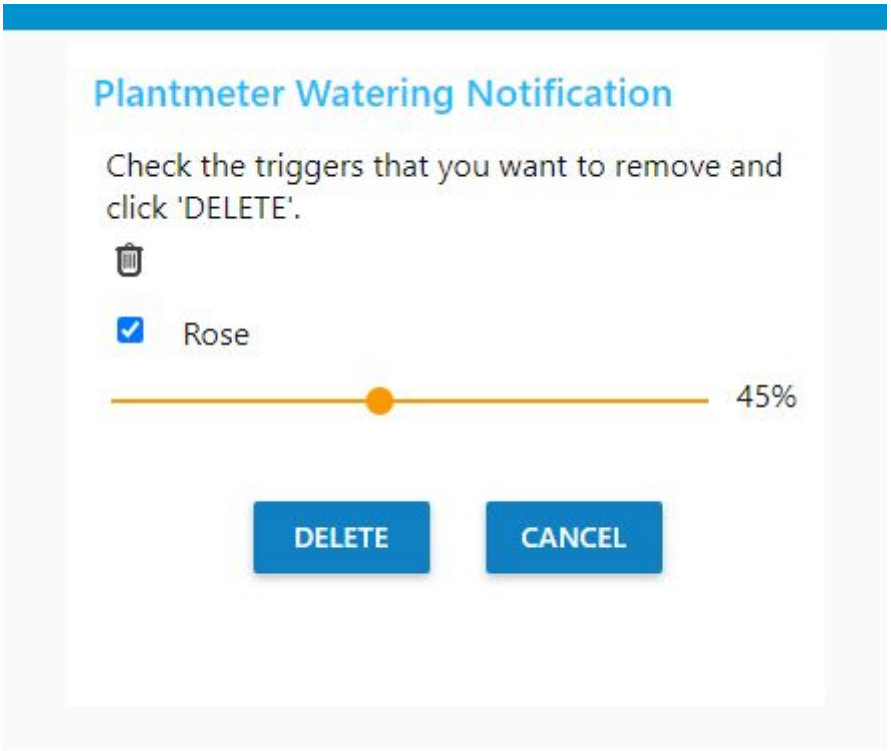
The monitoring page is used to see the measurement data from the selected Plantmeter Device. You can select the Plantmeter Device you want underneath the “Plantmeter” dropdown menu and the date you want to see underneath the “Log file” dropdown menu.
When the two are selected the graphs will be filled with the measurement data.

Watering

In the Watering page, you can set up at what level you want Toby to notify you. The value can be changed for each Plantmeter Device connected and will be saved after pressing the “SAVE” button.

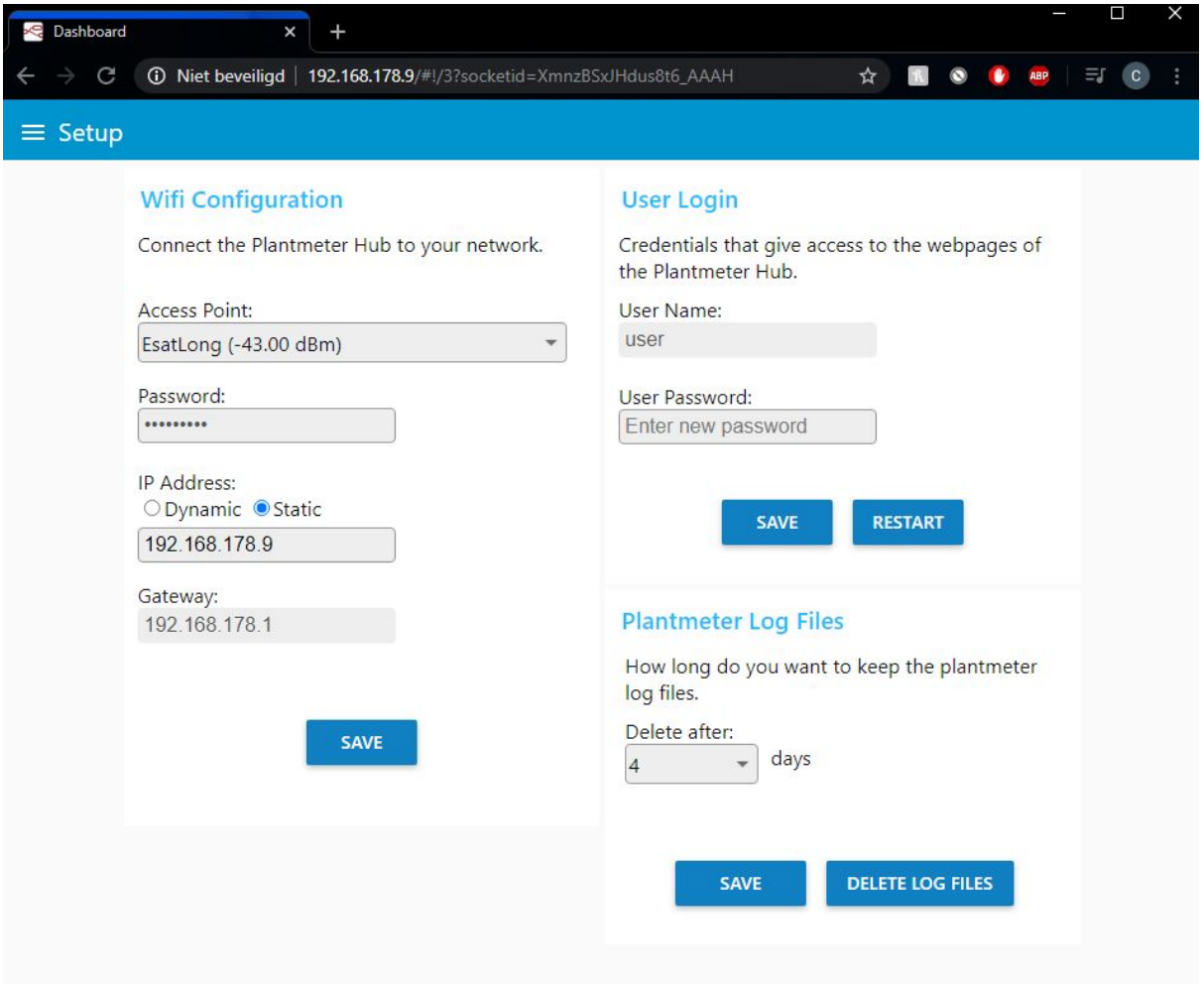


The Plantmeter Devices can also be deleted here by pressing the “EDIT” button, selecting the Plantmeter Devices you want to delete, and pressing the “DELETE” button.
Note that this will also delete all the measurement data that is/was received from these devices.



Setup

In the Setup page, you can configure the basic settings of Toby.



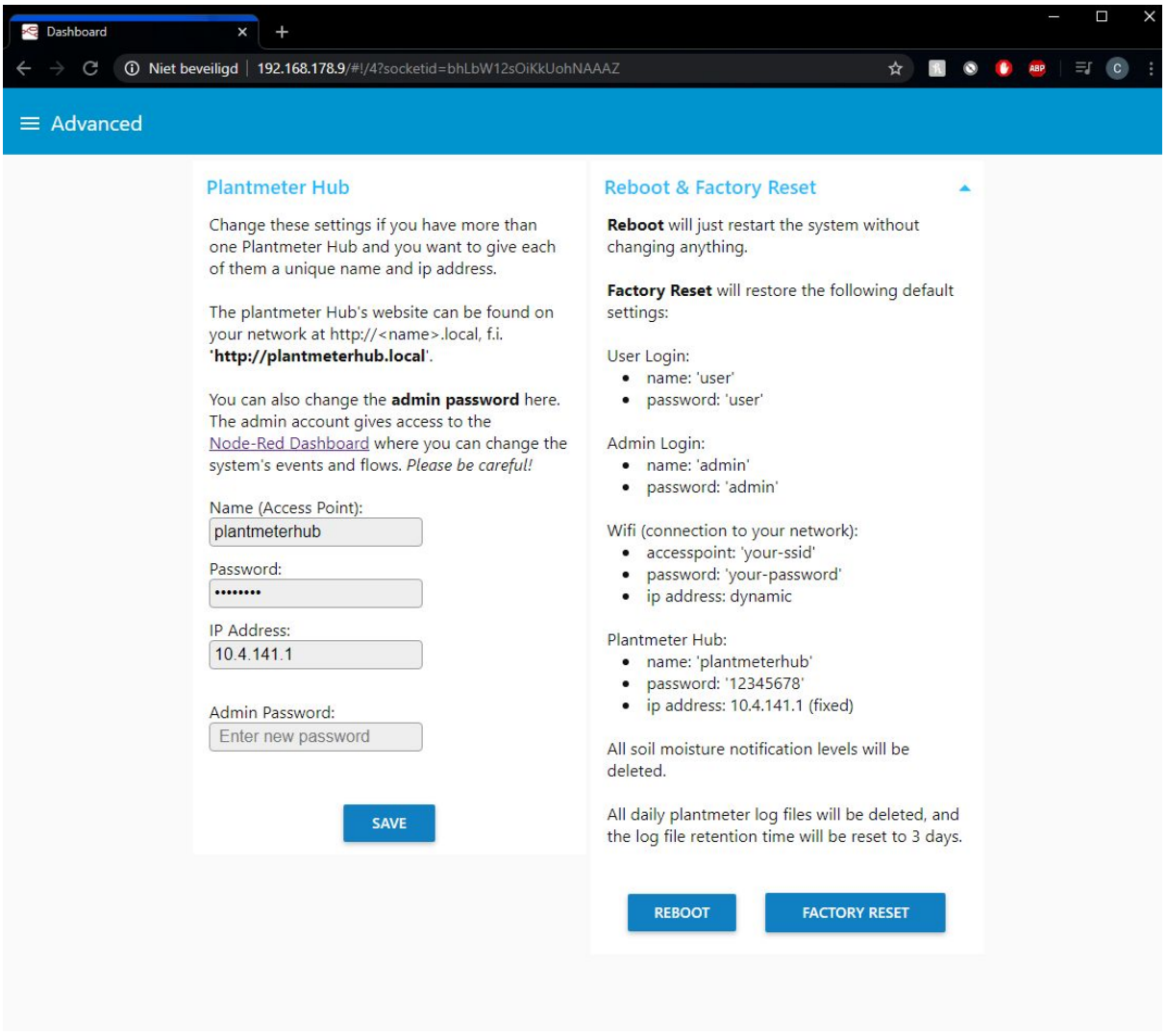
The first is the Wifi configuration, where you can select the Wifi network you want Toby to connect to and where you can select if you want a dynamic or static IP address.

The second is the user login configuration. Here you can change the default password of the Webpage interface to your choosing. It is recommended to change the password to ensure that no unauthorized person can log in to Toby.

Last but not least, you can configure for how many days the log of measurement should be kept. The default for this is set to 4 days.

Advanced

The Advanced page is used to configure the more advanced settings of Toby, reboot the Toby or reset all settings to the factory defaults.



The advanced settings you can configure for Toby are:

- Name (Access Point):
  - The Name is used as the Wifi access point that Toby will host. When this is changed, the Plantmeter Devices will also need to be updated to connect and send the measured data to the correct Wifi network and device.
- Password:
  - The Password is the password that is used to log in to the Wifi access point hosted by Toby.
- IP Address:
  - The IP Address is the default webpage link when connected to the Wifi access point hosted by Toby.
- Admin Password:
  - The Admin Password is the login password of the NodeRed page of Toby.

Customizability

WARNING: Editing/Customizing items here can affect the workings of Toby.
DO THIS AT YOUR OWN RISK. Naked Ninja does not take any responsibility and is not liable for any damage caused.

Toby is fully customizable by going to “10.4.141.1/admin” or “<IP_ADDRESS>/admin”, where <IP_ADDRESS> is the IP address given by the connected Wifi network, and logging in with the username “admin” and password “admin”. Once logged in you can change every aspect of Toby.
*Note: The default password is “admin” and can be changed in the Advanced web page.