

SwitchDoc Labs

The Smart Garden System Version 2 Assembly and Test Manual

July 2020
Version 1.4



**SmartGarden
System**

Table of Contents

Cautions when building and using The Smart Garden System.....	1
Errata.....	1
What is The Smart Garden System?.....	2
Preparing and Learning your Raspberry Pi.....	3
What is in the The Smart Garden System Box?	5
Parts Not Included	8
Step by Step Assembly.....	9
What are we doing here?	9
Assembling the Smart Garden System Wireless Extender.....	9
Assembling the Raspberry Pi.....	21
Testing your Smart Garden Setup	25
Installing the The Smart Garden System Software and Initial Testing on the Raspberry Pi.....	25
SGS Wireless Extender Board Setup	27
Final Testing Your SGS System on the Raspberry Pi.....	32
Disclaimer	34

Cautions when building and using The Smart Garden System

- 1) **Keep all water away from the electronics and power supply at all times!**
- 2) **The Smart Garden System is designed for indoor use only and should be placed in a dry environment where no water or rain can reach to avoid short circuiting the electronics**
- 3) **Insert the moisture sensor into the CENTER of the flower pot, and keep it near the center of the plant and away from the water coming out of the holes cut in the watering pipe.**
- 4) **This is not a toy! Keep it out of reach of young children and pets.**
- 5) **SwitchDoc Labs assumes no liabilities in the use of this kit, beyond the refund of the purchase price.**

Errata

What is The Smart Garden System?

Did you ever want to build your own remote monitoring and management system for your indoor or outdoor garden? Do you want to share your garden and the weather world wide? This project is for you. You can learn the Raspberry Pi and how to connect to the real world through this easy to build **no-soldering** kit. You can measure soil moisture and then use that as feedback to provide your plant or garden just the right amount of water.

Highly expandable! You can have your Raspberry Pi Base Unit inside your house and have multiple wireless control units in your outdoor garden, greenhouse or in the upstairs bedroom. Up to 250 wireless control units can be connected up to one Raspberry Pi base unit. This allows you to control your truly MASSIVE garden. Or your small one. Either way!

This is a perfect highly expandable project kit for kids with some help from the adults and for adults trying to learn some new things. We have done this before with our successful OurWeather KickStarter so we know what we are talking about. People all over the world have built the OurWeather weather station with great success. This project has **no soldering** involved and uses Grove connectors to wire everything up! You can't reverse them and blow things up. [Here is our tutorial on the Grove system.](#)

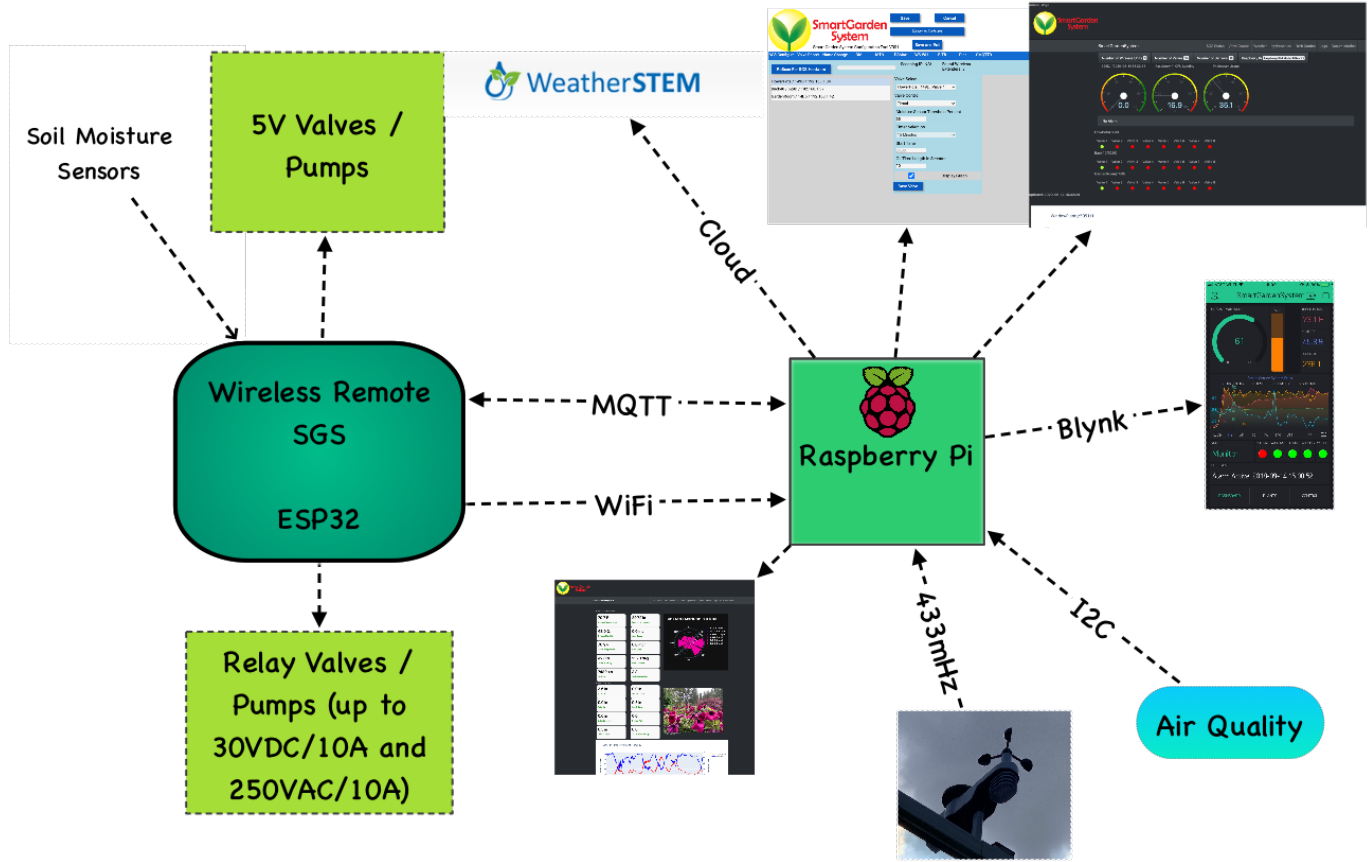
The Smart Garden System Features

- Control Valves, Pumps and Lights
- Measure your Soil Moisture
- Measure your Sunlight
- Measure your Air Quality
- Measure your Weather
- Show your results on the Internet and your Phone

Easy to build. Easy to learn about the IOT (Internet Of Things) and the Raspberry Pi.

Plants

Smart Garden System Block Diagram



SwitchDoc Labs

Preparing and Learning your Raspberry Pi

The Smart Garden System requires a working Raspberry Pi. You can use virtually any Raspberry Pi (3B+, 4B+, ZeroW, etc.) but you do need to set it up before starting the process of building The Smart Garden System.

Initial setup of your Raspberry Pi and connecting to it on your network is well beyond the scope of this manual. There are just too many variables in how you might set up your Raspberry Pi. Consider visiting the Raspberry Pi Foundation for suggestions.

If you have the Weather Station Smart Garden System Add-on you will need to use a Raspberry PI 3B+ or Raspberry Pi 4B.

SwitchDoc Labs provides an SD Card that has the Raspberry Pi operating system, version Stretch, and all the Smart Garden System software installed. <https://shop.switchdoc.com/products/16gb-sd-card-with-stretch-smart-garden-system-grovetweatherpi>

Once you have your Raspberry Pi setup up, running and can access a command line window (terminal) then you are ready to go with this manual.

This is the reason that we consider The Smart Garden System and advanced beginners kit, rather than a beginners kit (like the OurWeather Weather Station).

Here are some resources to get you set up and running as quickly as possible.

Helpful Getting Started Videos:

<https://www.raspberrypi.org/help/videos/>

Helpful Getting Started Written Tutorial:

<https://www.raspberrypi.org/wp-content/uploads/2012/12/quick-start-guide-v1.1.pdf>

If you want to set up a headless (no monitor, keyboard, mouse) Raspberry Pi, it is more complicated. Here are some links to tutorials for that process.

<http://www.circuitbasics.com/raspberry-pi-basics-setup-without-monitor-keyboard-headless-mode/>

<http://blog.self.li/post/63281257339/raspberry-pi-part-1-basic-setup-without-cables>

Many, many more tutorials are available on the web.

Once you have it set up, take a brief tutorial about using the terminal window and the very powerful Raspberry Pi Command Line.

<https://www.raspberrypi.org/blog/learning-the-command-line/>

<https://www.raspberrypi.org/blog/learn-to-love-the-command-line-with-the-magpi/>

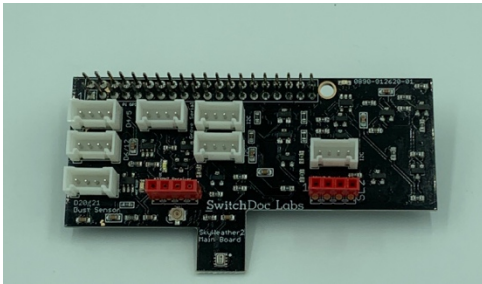
You don't need to know a lot about the command line to enjoy building and running The Smart Garden System, but you do need a bit of knowledge.

What is in the Smart Garden System Box?

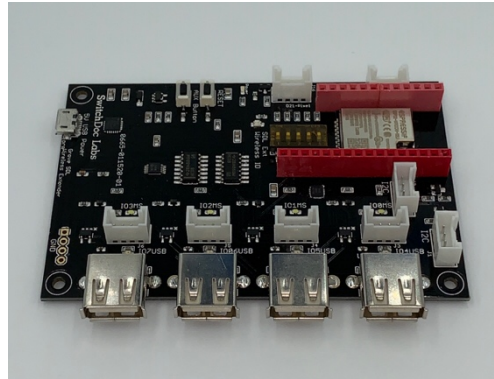
Note: You will need to add two additional things to finish your Smart Garden System Project

- A Raspberry Pi is NOT included and must be purchased separately. Any Raspberry Pi with a 40 pin GPIO connector will work (such as the Raspberry Pi 2, 3 or Zero).
- A box of M2 Plastic Screws, standoffs and nuts (such as: <https://shop.switchdoc.com/products/140pcs-box-m2-nylon-hex-thread-assortment-kit>)

Part A – SGS Board (AKA SkyWeather2)



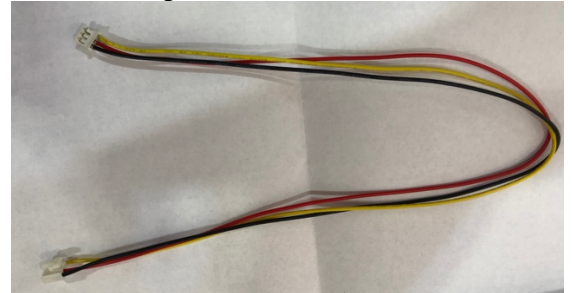
Part B – Wireless Extender Board



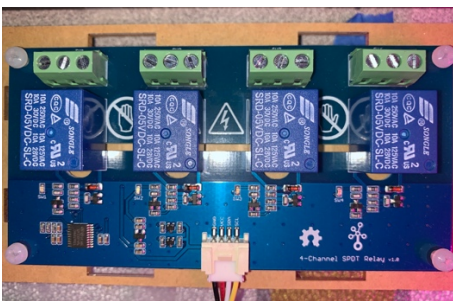
Part C – Grove Capacitive Moisture Sensor



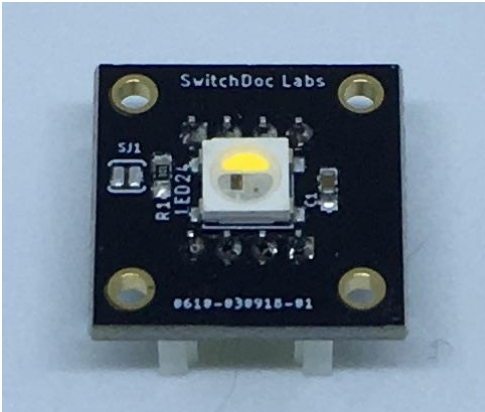
Part D - Grove to Capacitive Moisture Sensor Cable



Part E – I2C Grove 4 Relay Board



Part F – Single Pixel RGBW LED



Part G – USB Light Stick



Part H – WiFi Antenna



Part I – OLED Board



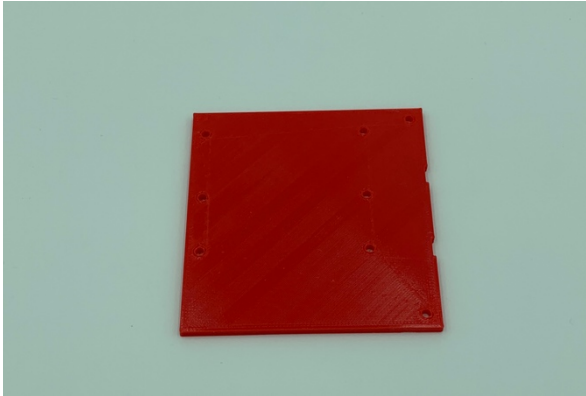
Part K – USB Submersible Pump



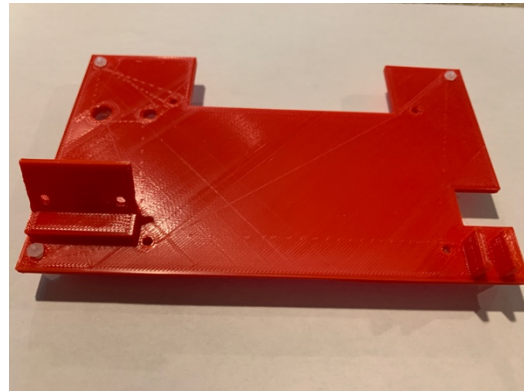
Part M –20cm Grove Cables (3)



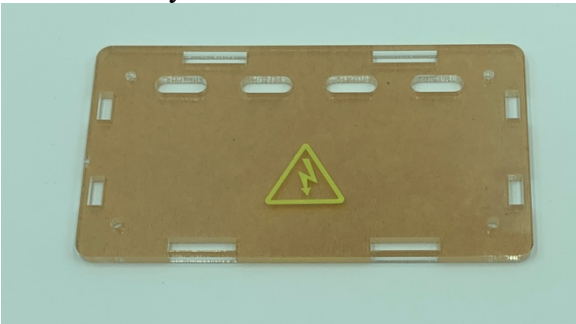
Part N – 3D Printed Raspberry Pi Stand



Part O – 3D Printed Wireless Extender Stand



Part P – Relay Base



Part Q – SDCard for Pi (Optional)



Part R – Micro USB Power Supply (The part included may vary from this picture)



Parts Not Included

You will need a box of M2 Nylon spacers, screws and nuts such as this (on Amazon or shop.switchdoc.com):
<https://shop.switchdoc.com/products/140pcs-box-m2-nylon-hex-thread-assortment-kit>



You will also need 1/4" OD 1/8" ID irrigation plastic pipe for the included USB pump. Available at any major hardware store.

On Amazon: <https://amzn.to/2Cubk4e>



Step by Step Assembly

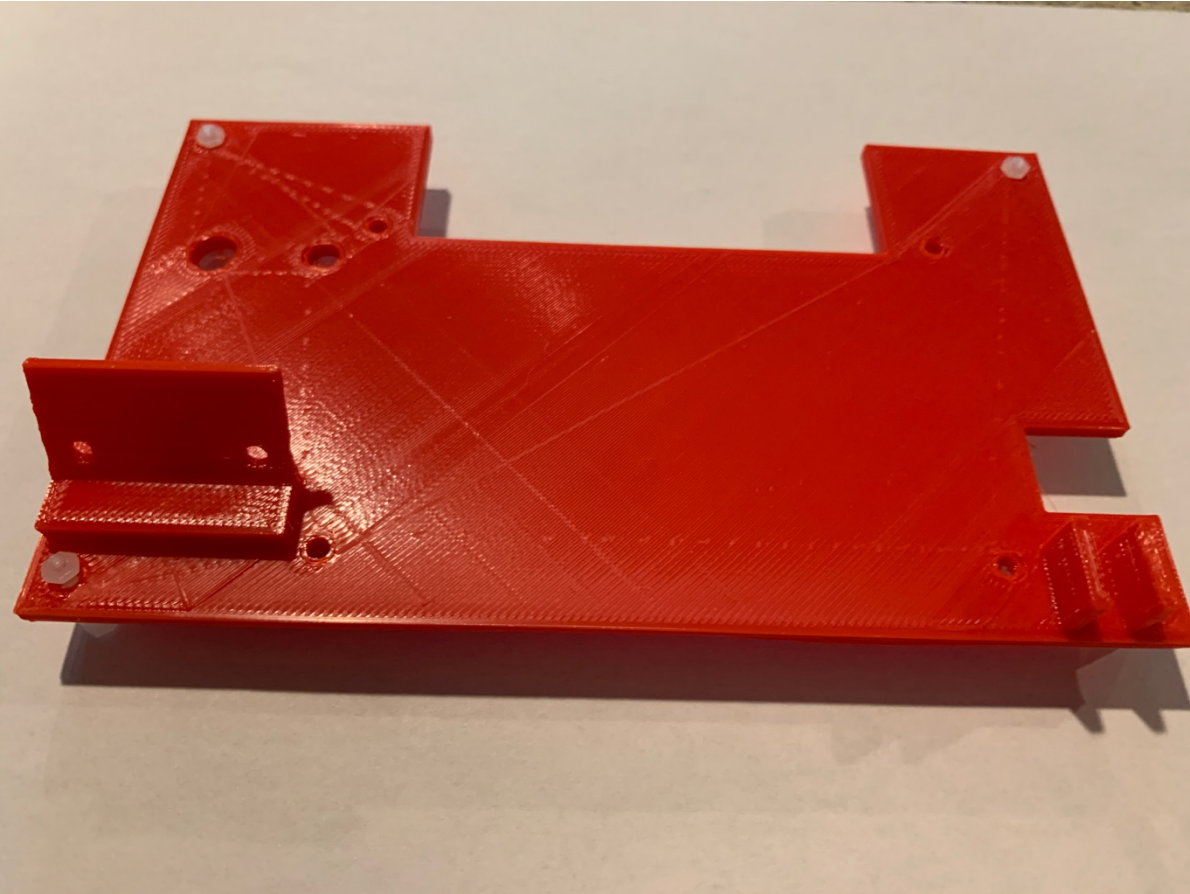
Cautions: Keep your static charge to a minimum during your assembly and operation. Touch metal before handling parts. Avoid shuffling your feet. Before starting assembly, layout all the parts above and familiarize yourself with the various parts.

What are we doing here?

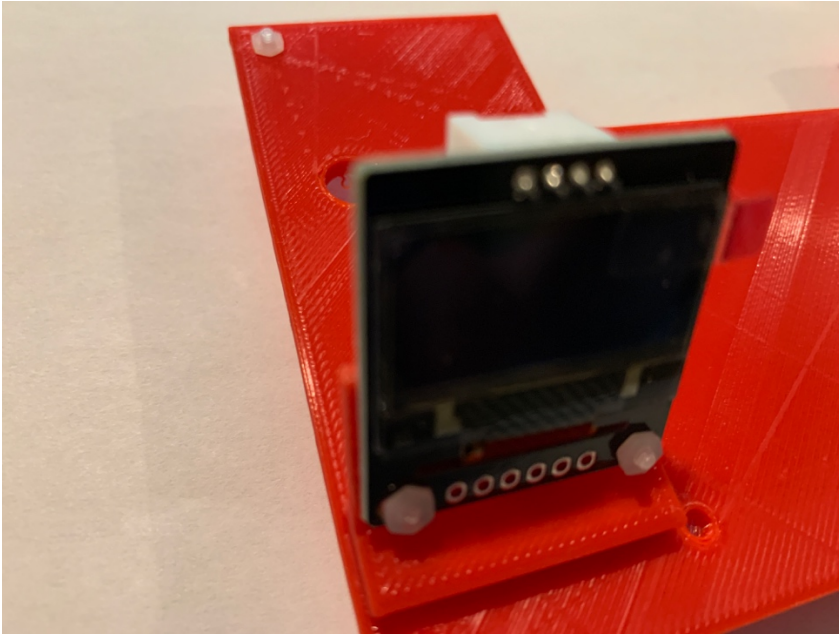
We are assembling the Smart Garden System on the supplied bases to show you how it goes together and to do system testing on the resulting product to find any problems or assembly errors. If you have the 3D Printed SGS Wireless Extender, you will take apart the Wireless Extender and rebuild it inside the 3D Enclosure as a final step.

Assembling the Smart Garden System Wireless Extender

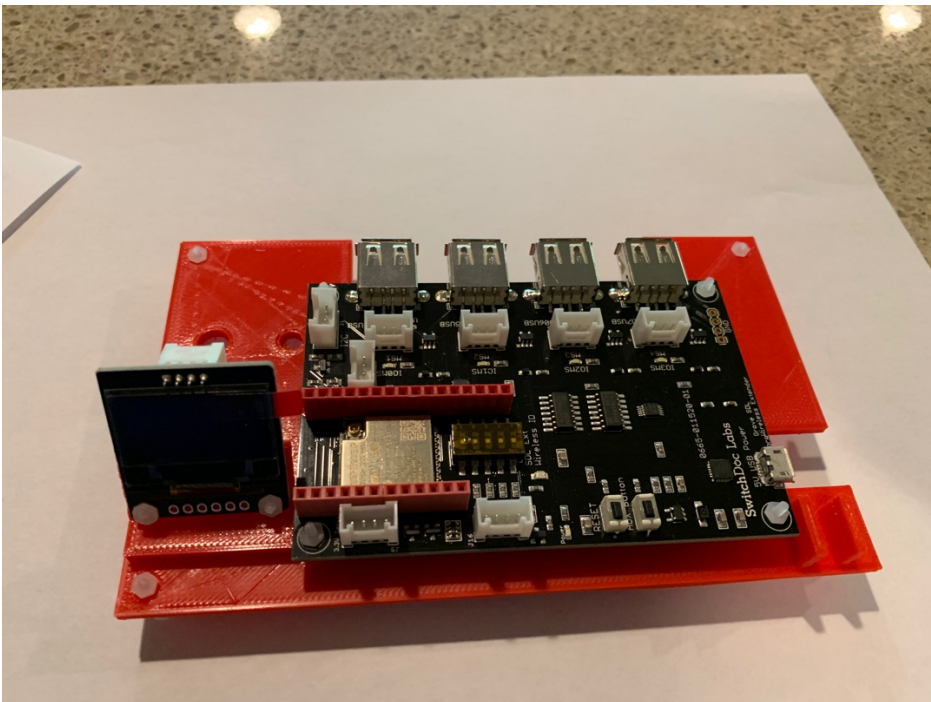
Step 1) Take the 3D Printed Top (Part O) and lay it on a flat surface. Place a standoff in each corner (total of 4).



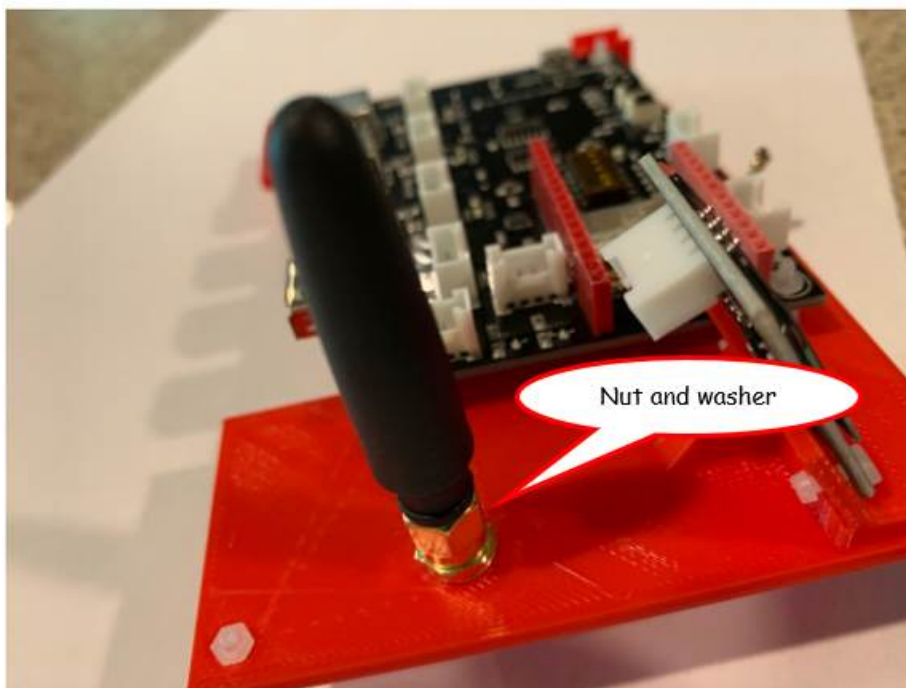
Step 2) Take the OLED Board (Part I) and attach it to the wireless stand (Part O) with two M2 screws and nuts.



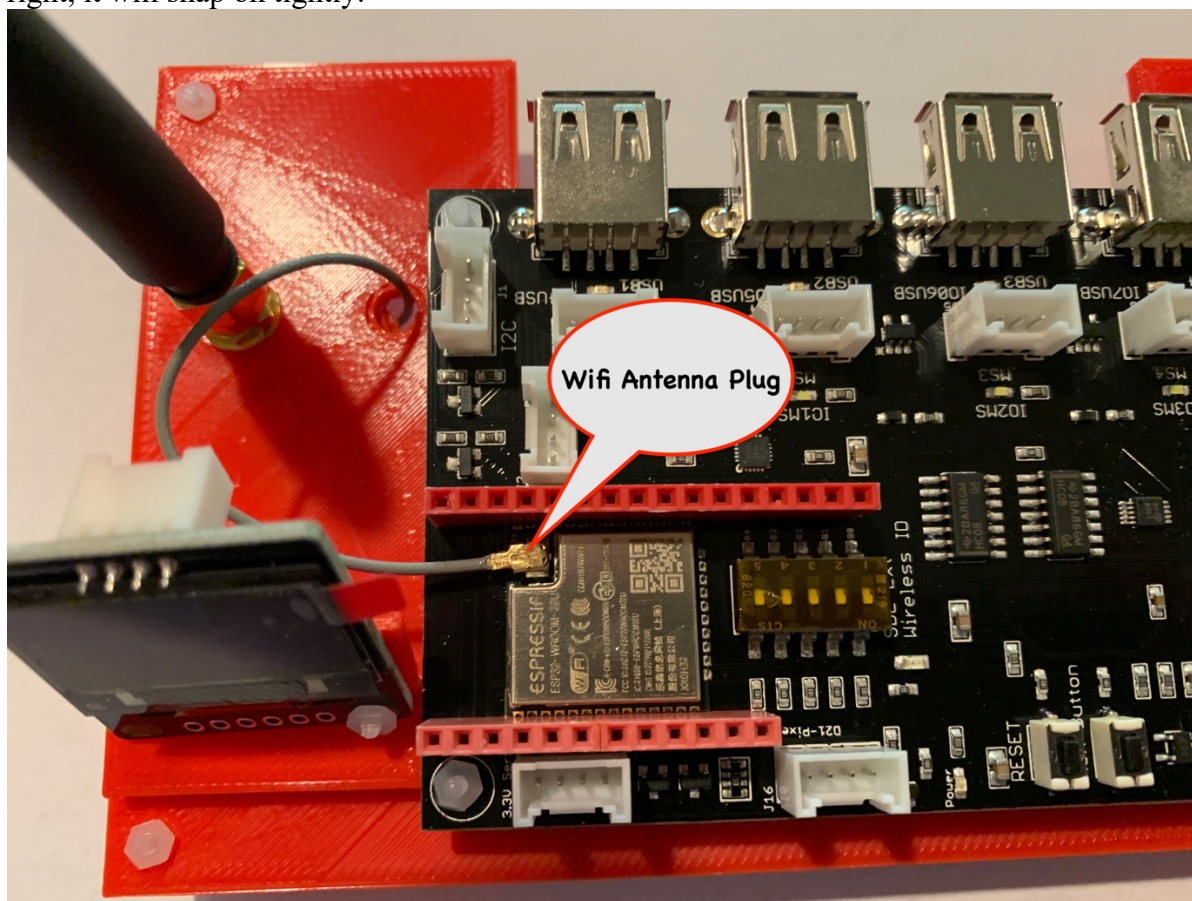
Step 3) Using M2 Nylon standoffs, attach the Wireless Extender Board (Part B) to the wireless stand (Part O)



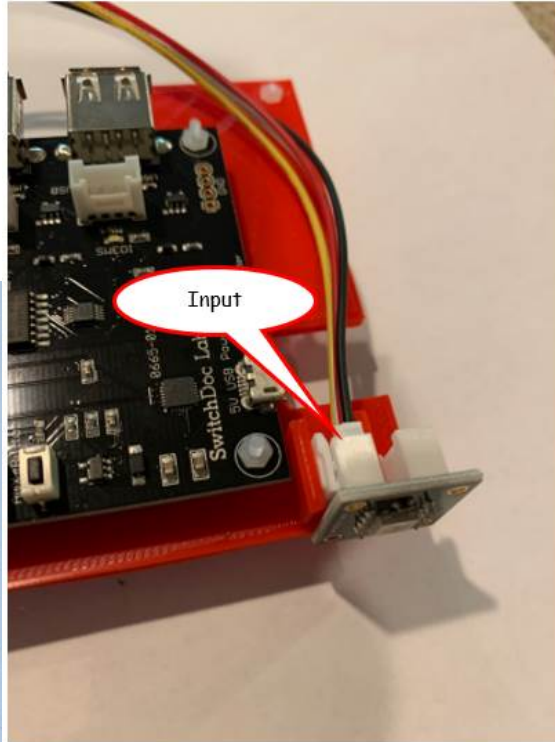
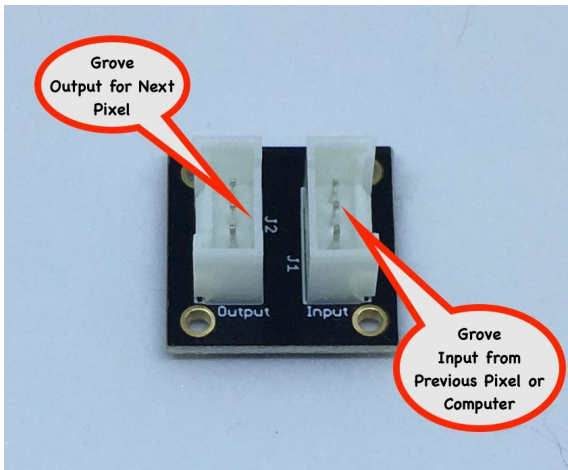
Step 4) Take the Wifi Antenna and Cable (Part H) and push the cable with the larger connector up through the antenna hole in the wireless extender stand (Part O) and attach the cable using the supplied brass nut and washer. Screw the Antenna on the cable jack attached to the top of the stand.

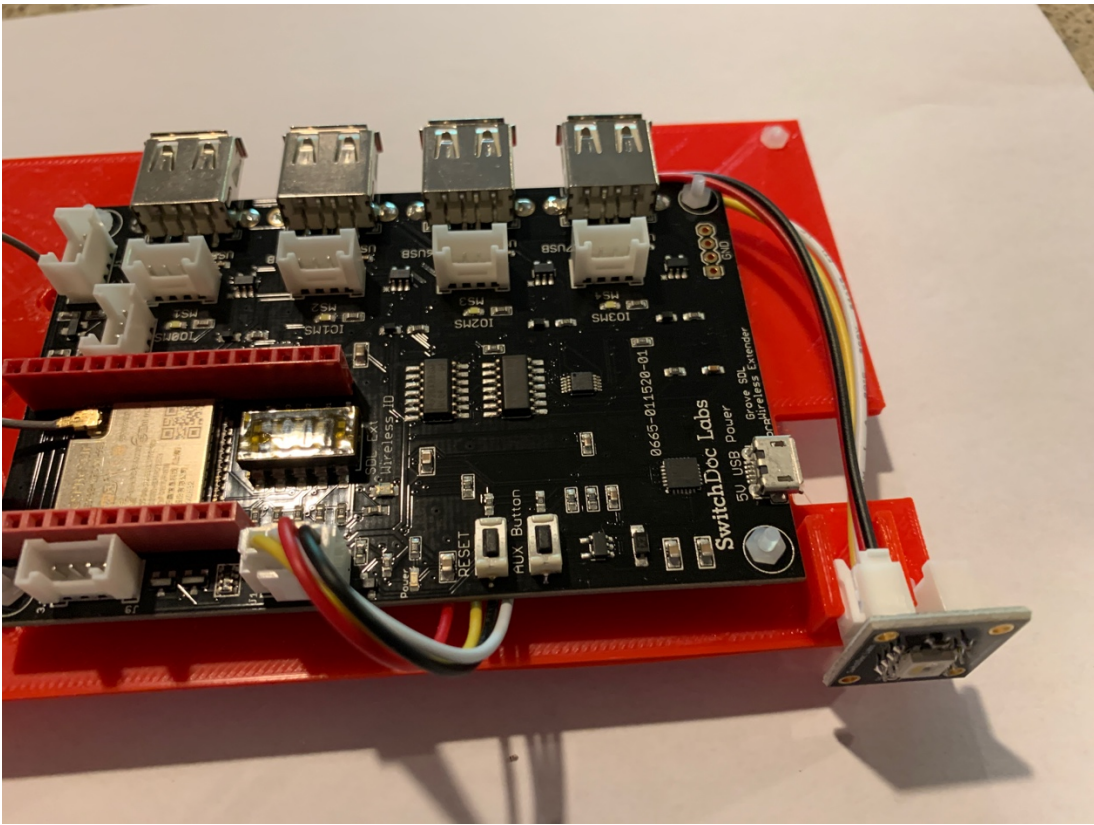


Step 5) Route the antenna cable through the adjacent hole and using a small flat blade screwdriver gently snap the end of the cable onto the antenna connector on the wireless extender board(Part B). If you align it just right, it will snap on tightly.

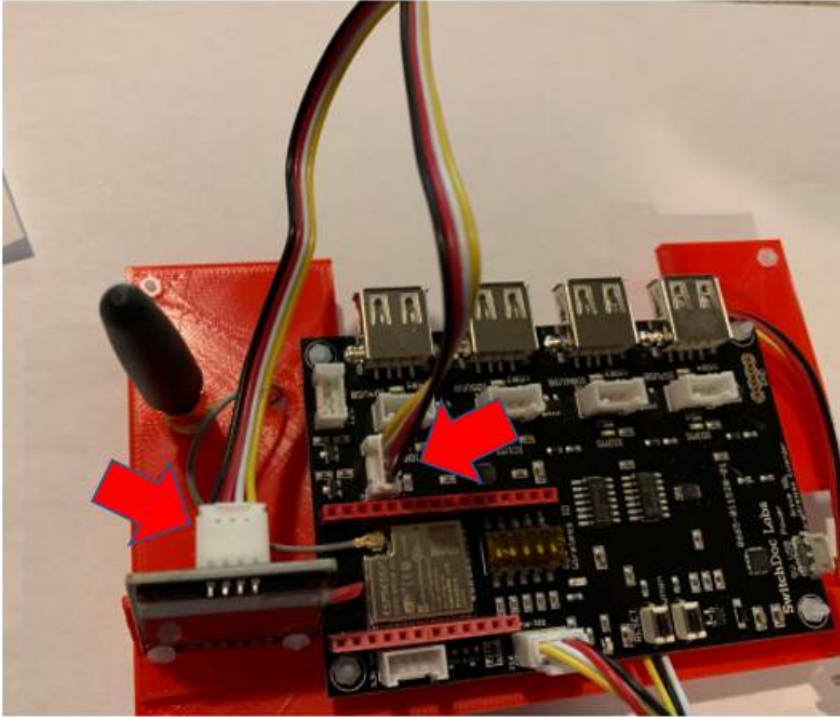


Step 6) Take one of your 20cm Grove cables (Part M) and plug one end of the cable into your Pixel RGBW LED (Part F) in the connector on the back of the LED (Part F) marked INPUT. Get this right! You won't blow up anything if you put it in the wrong connector, but it won't work. Use one of the cables with a buckle on the connector. Grove cables are keyed and can not be put in backwards. This is a happy thing! Note one of the cables will be in the Relay board (Part E) packaging. Place the LED (Part F) into the slot on the wireless base (Part O) to the right of the board. Use some masking tape around the connector if it doesn't fit snug enough. Route the Grove cable under the extender board (Part B) and plug the other end of the cable into the extender board (Part B) into the Grove connector marked Pixel-D21.

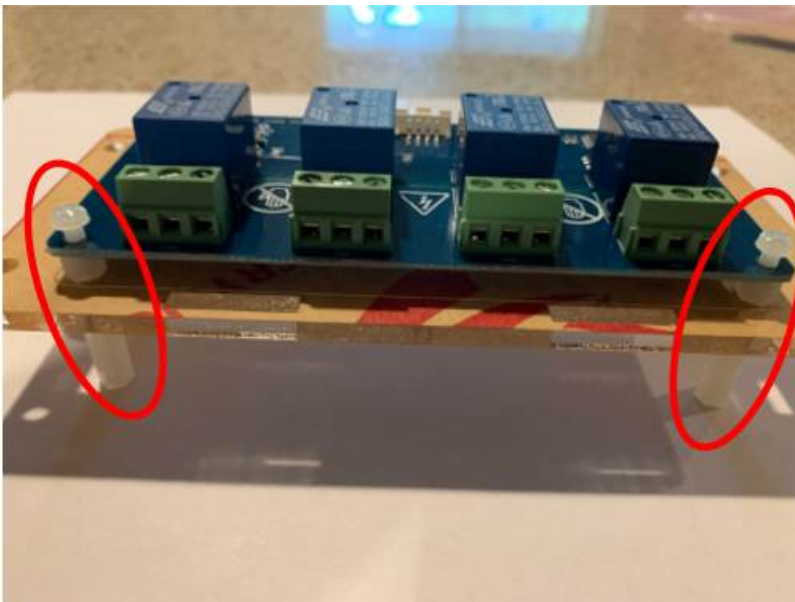




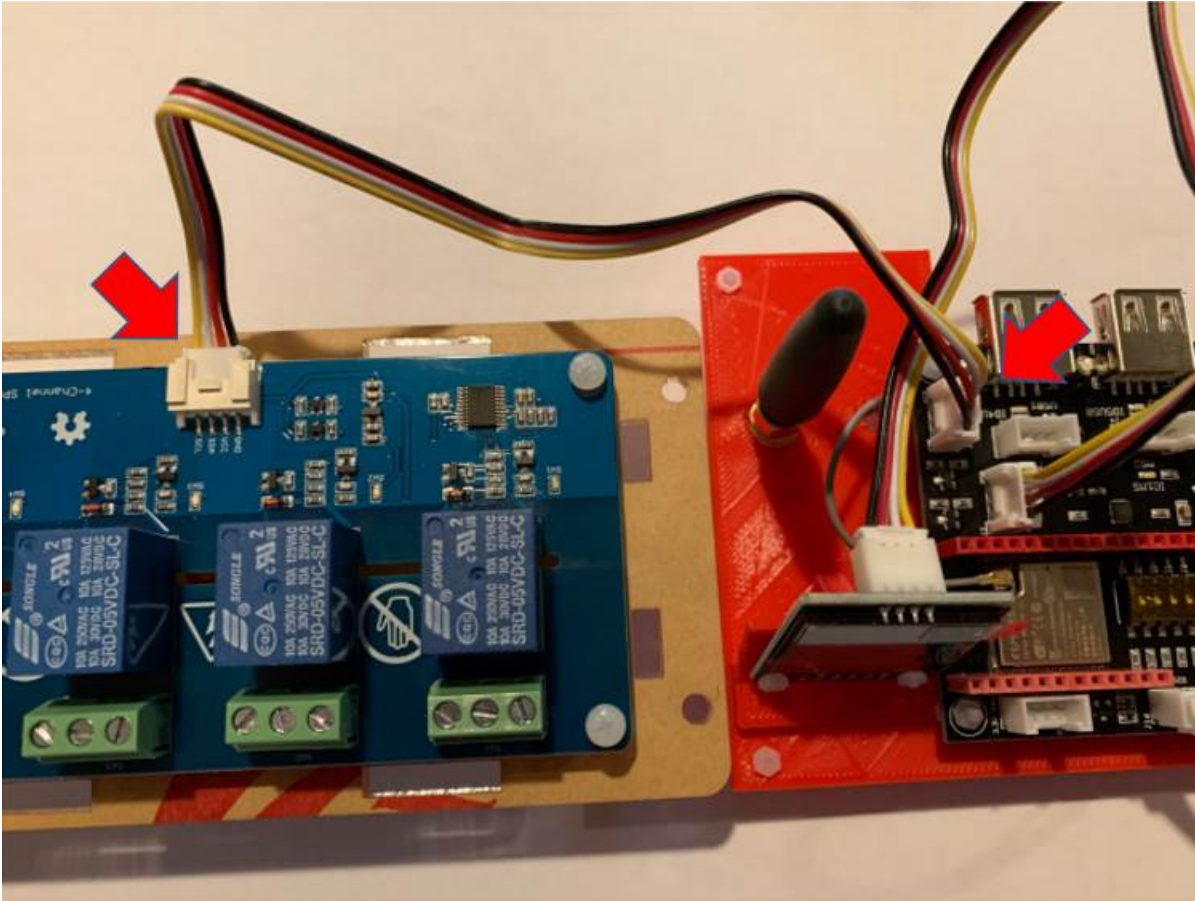
Step 7) Take a 20cm Grove Cable (Part M) and plug it in the back of the OLED display (Part I) attached to the wireless extender base (Part O) and plug the other end into the Grove connector on the extender board (Part B) marked J2 I2C.



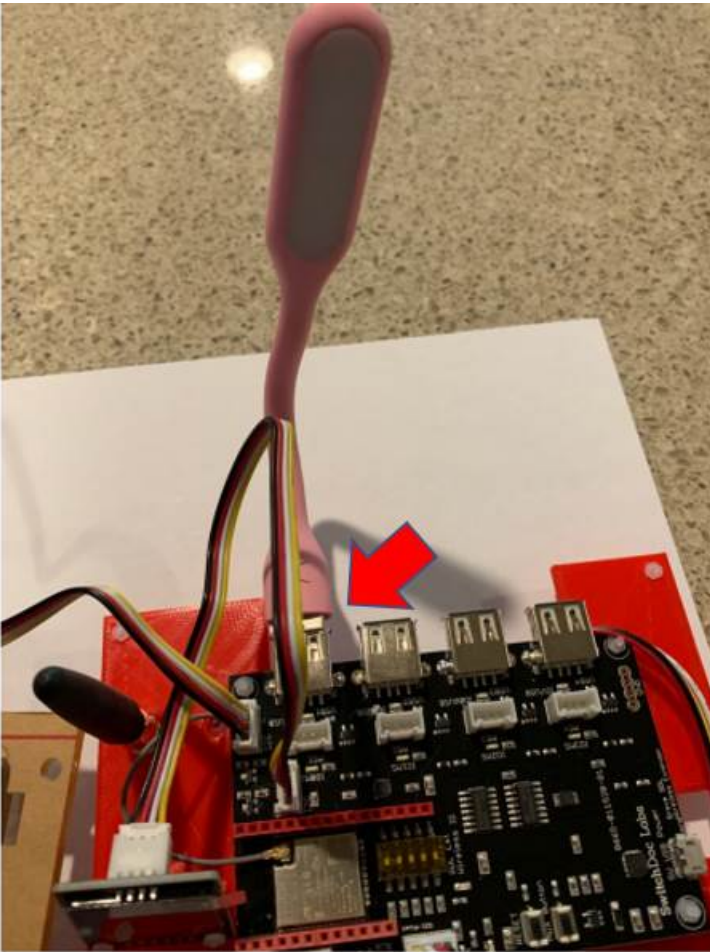
Step 8) Open the Relay Box and remove the Grove Cable (Part B), one of the Relay Bases (Part P) and the I2C Relay Board (Part E). Using the M3 spacers, screws and nuts in the Relay Board, attach the Relay Board (Part E) to the Relay Base (Part P). Yes, you will have a lot of parts left over!



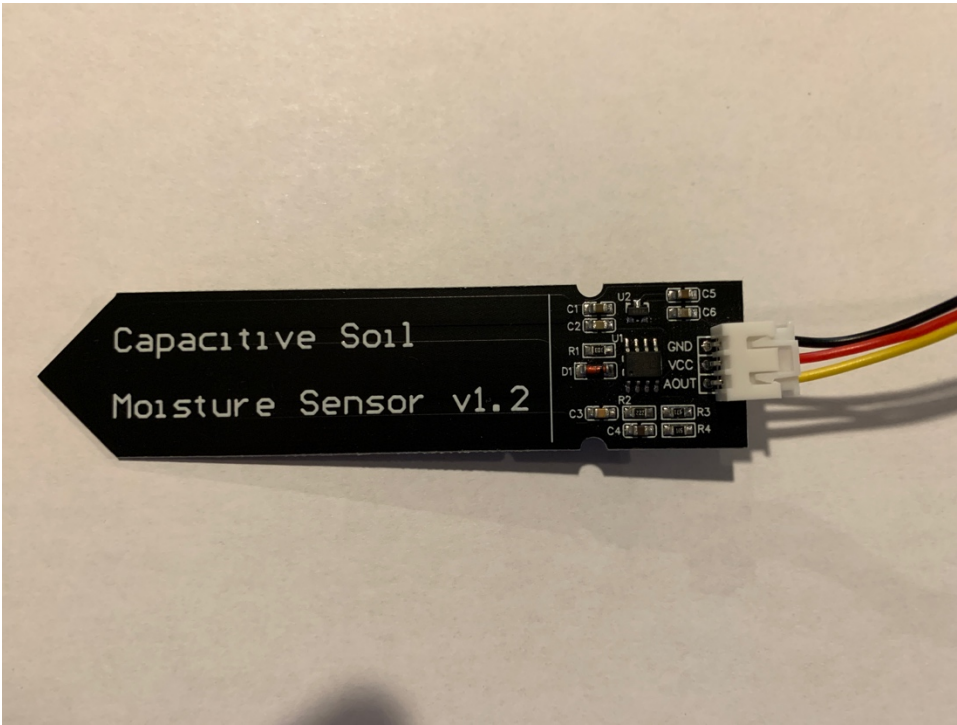
Step 9) Using your remaining 20cm Grove Cable (Part M) plug it into the Grove connector on the relay board (Part E) and plug the other end of the cable into the Grove connector marked J1 I2C on the Wireless Extender board (Part B).



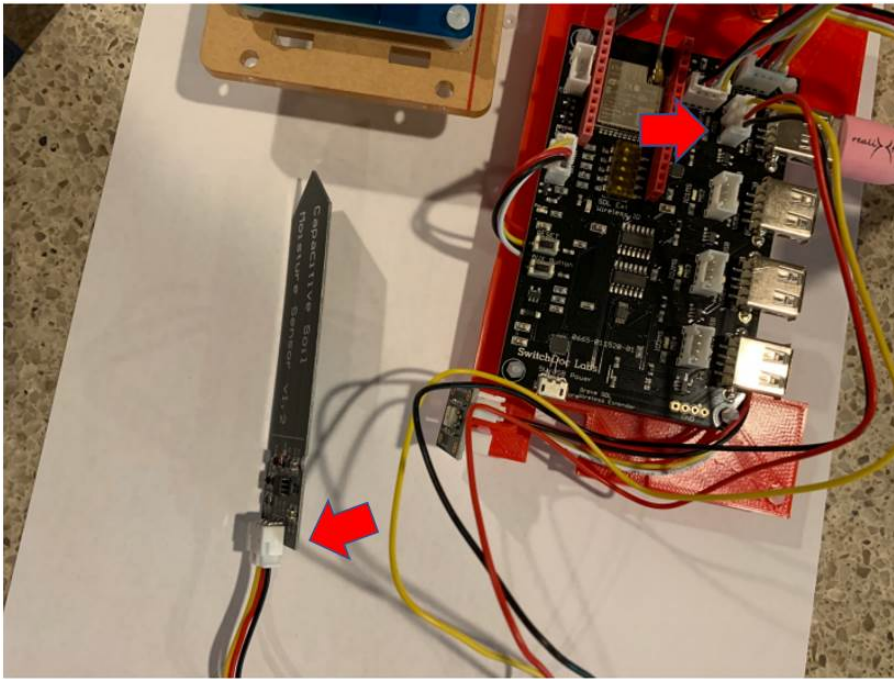
Step 10) Take the USB Light Stick (Part G) and plug it into USB Port 1 on the Wireless Extender Board (Part B).

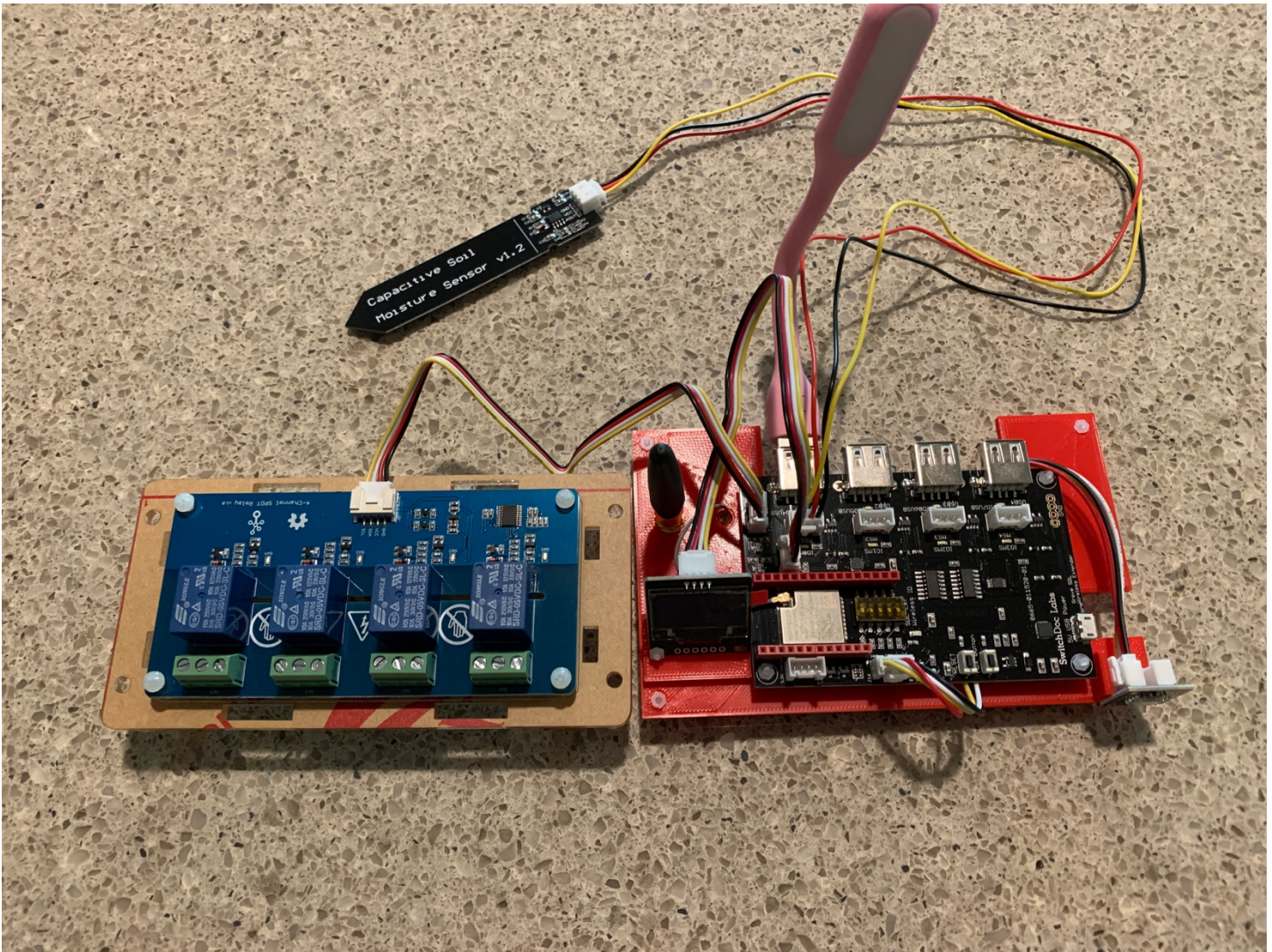


Step 11) Take your Grove Capacitive Moisture Sensor (Part C) and plug in the three pin end of the Grove to Capacitive Moisture Sensor Cable (Part D).



Step 12) Plug the other end of the Grove to Capacitive Moisture Sensor Cable (Part D) into the Grove Connector marked MS1 on the Wireless Extender Board (Part B).

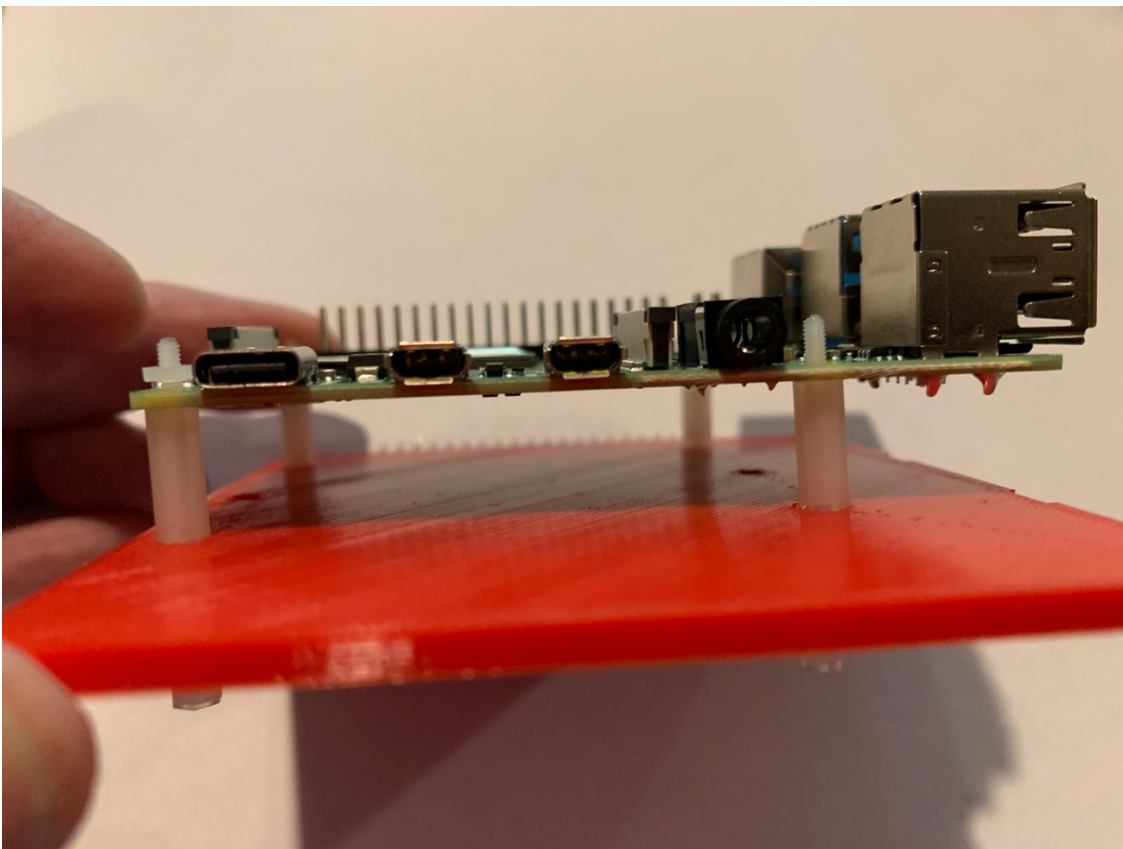
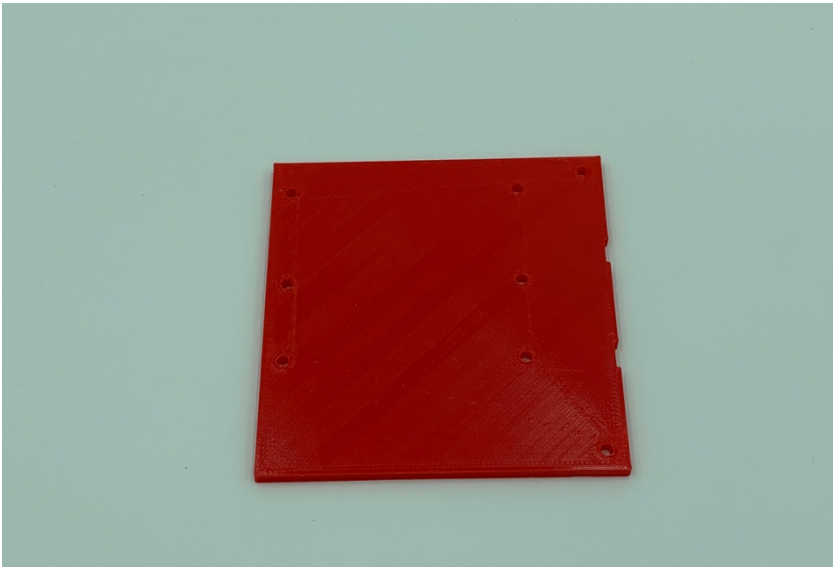




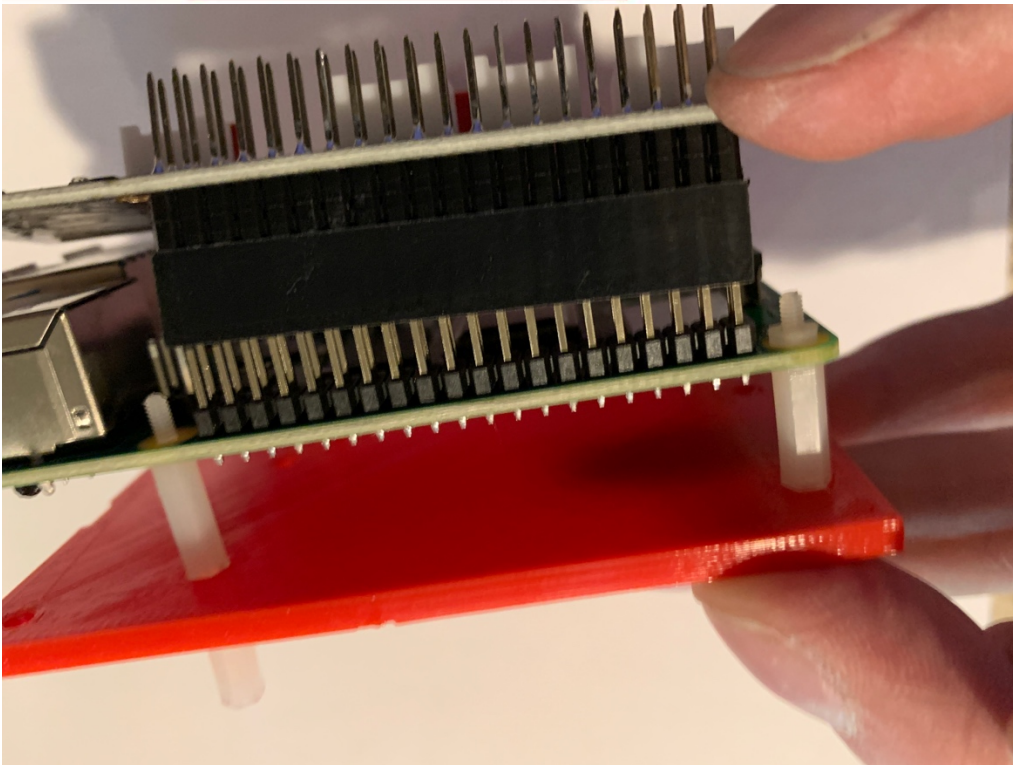
Congratulations! You have now completed the assembly of the Smart Garden System Extender Board. Set this assembly aside for now.

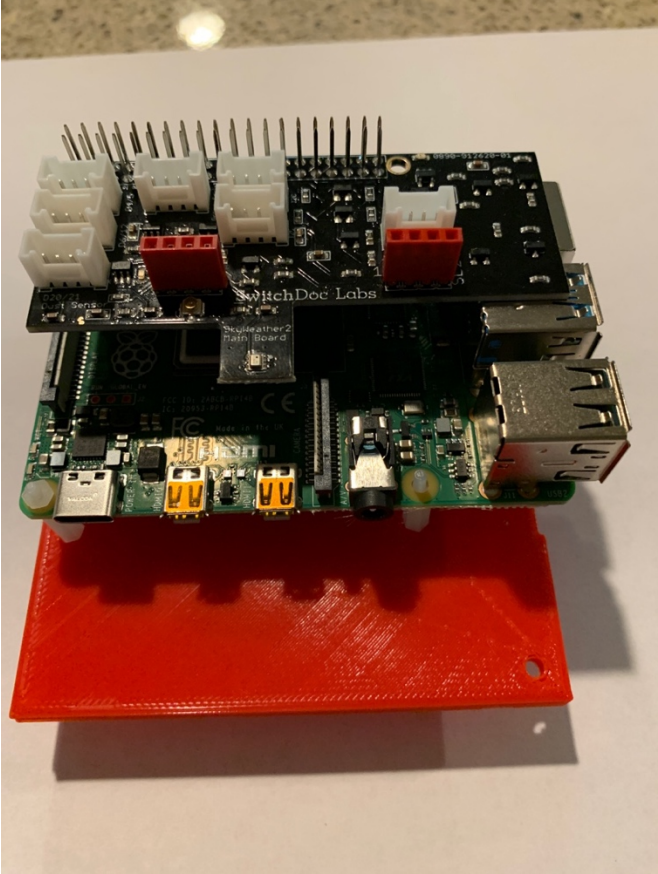
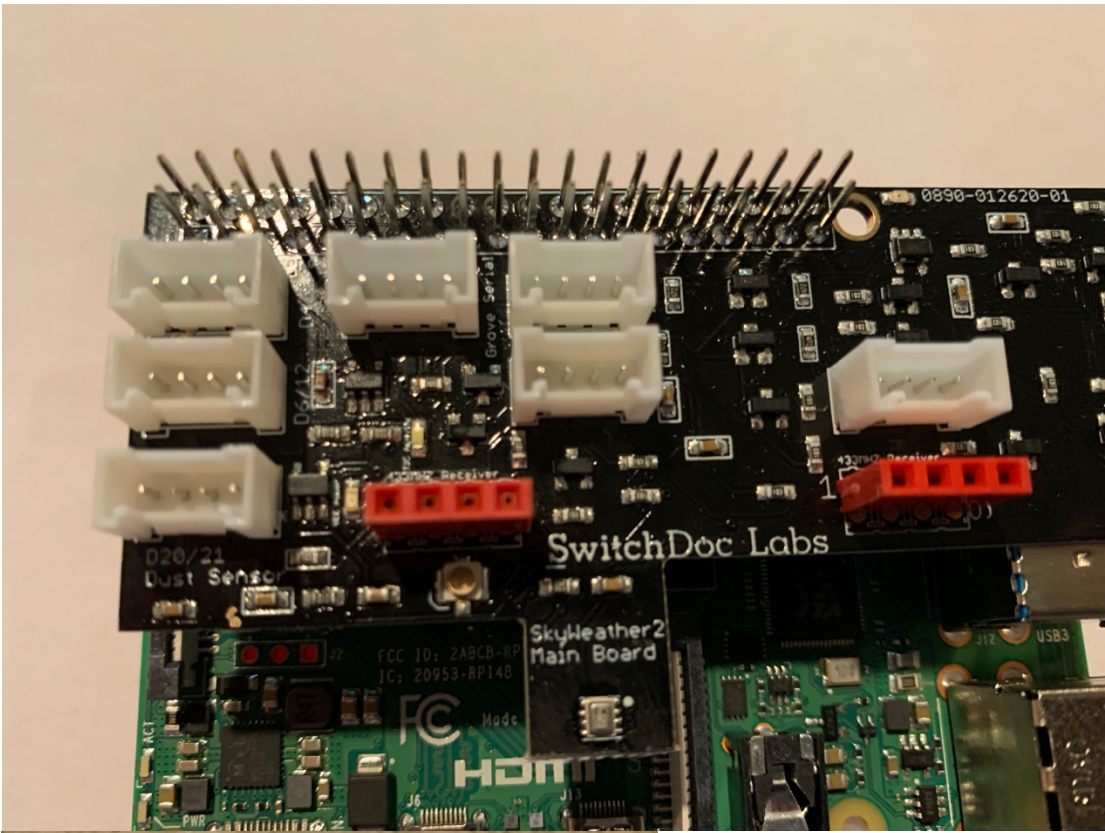
Assembling the Raspberry Pi

Step 1) Mount your Raspberry Pi on the 3D Printed Plate Part N using 2M nylon spacers, nuts and screws. Attach at least two nuts to the Raspberry Pi.

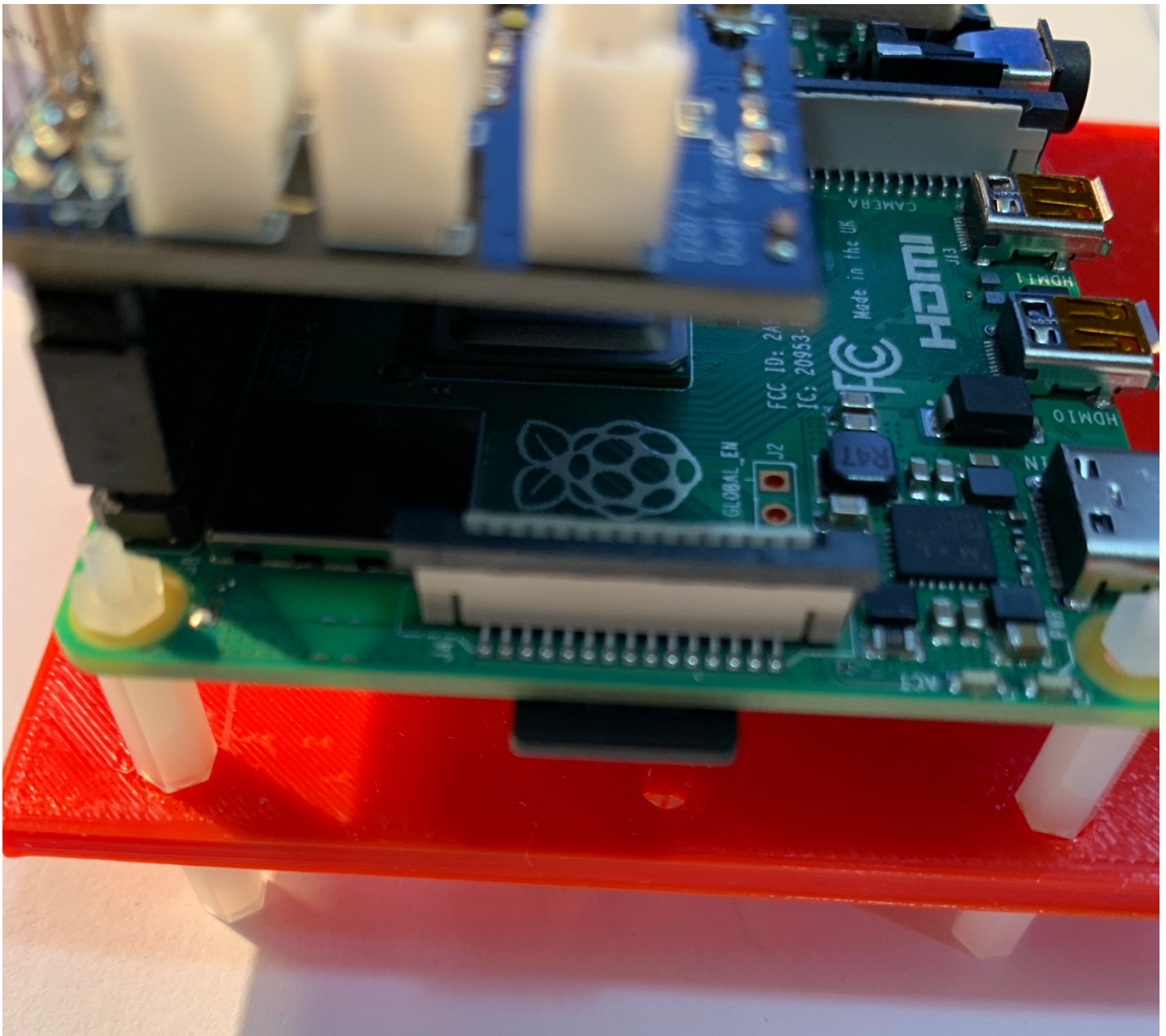


Step 2) Take the SGS Board (AKA SkyWeather2) (Part A) and plug it into the 40 pin GPIO ports on your Raspberry Pi. Start at one end and gently work it onto the GPIO pins making SURE the pins are all aligned and not bent. Inspect the top pins on the SGS Board (Part A) to make sure they also are not bent.





Step 3) Plug the SD Card into your Raspberry Pi (You can buy the SwitchDoc Labs SDCard (PartQ) with all of the necessary code through our Website.).



This completes your assembly of your Raspberry Pi for the Smart Garden System. If you haven't set up your Raspberry Pi yet, refer to the *"Preparing and Learning your Raspberry Pi"* section in the manual above.

You have now completed the initial assembly of The Smart Garden System.

NOTE THAT THERE IS NO WATER ANYWHERE IN THE PROJECT AT THIS TIME!

We will now proceed to initial testing.

Testing your Smart Garden Setup

This section assumes you have your Raspberry Pi up and running with either the SwitchDoc Labs SDCard, or you have installed the Smart Garden System Software yourself. You can get it on GitHub:

https://github.com/switchdoclabs/SDL_Pi_SmartGardenSystem2

Installing the The Smart Garden System Software and Initial Testing on the Raspberry Pi

In order to test The Smart Garden System before installing the water, you must be familiar with the Raspberry Pi and the terminal command line as suggested in the Learning Your Raspberry Pi Chapter. You cannot do this test without understanding how to use your Raspberry Pi. You must have Buster or a newer version of the Raspbian Operating System installed.

To save yourself the trouble of installing the Operating System and all the drivers, SwitchDoc Labs provides an SD Card that has the Raspberry Pi operating system, version Buster, and all the Smart Garden System software installed.

For beginners and people short of time, we strongly recommend getting the SD Card.

<https://shop.switchdoc.com/products/16gb-sd-card-with-stretch-smart-garden-system-groveweatherpi>

If you have this SD Card, you can skip steps 2 – 5 below.

Step 1) Plug in your Raspberry Pi. You should see one blue LEDs turn on the SGS Board. In addition, you will see a red LED on the Raspberry Pi board and an occasionally flashing yellow LED on the Raspberry Pi.

Step 2) Open a terminal window on your Raspberry Pi, either on the Pi Graphical Interface or using ssh from another computer.

Step 3) Run the following commands:

```
sudo apt-get update
```

Next, upgrade all your installed packages to their latest versions with the command:

```
sudo apt-get dist-upgrade
```

This may take quite a while.

Now we are ready to start installing the Smart Garden System software.

Step 3) First install I2C on Raspberry Pi – Follow the directions in this link:

<https://learn.adafruit.com/adafruit-raspberry-pi-lesson-4-gpio-setup/configuring-i2c>

Step 4) Next, Install GPIO and apscheduler

```
sudo apt-get install build-essential python-pip python-dev python-smbus git
```

```
git clone https://github.com/adafruit/Adafruit\_Python\_GPIO.git
```

```
cd Adafruit_Python_GPIO
```

```
sudo python setup.py install
```

```
sudo pip install --upgrade setuptools pip
```

```
sudo pip install setuptools --upgrade
```

```
sudo pip install apscheduler
```

Step 5) Install the The Smart Garden System software

```
sudo git clone https://github.com/switchdoclabs/SDL_Pi_SmartGardenSystem2
```

Check the README.md in this directory for any new installation instructions for the software.

Step 6) I2C Test - Now we can run the first major test.

Type this into a terminal window:

```
sudo i2cdetect -y 1
```

Here is what you should see:

```
pi@SwitchDocLabs:~/SDL_Pi_SmartGardenSystem2 $ sudo i2cdetect -y 1
   0  1  2  3  4  5  6  7  8  9  a  b  c  d  e  f
00:  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --
10:  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --
20:  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --
30:  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --
40:  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --
50:  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --
60:  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --  --
70:  --  --  --  --  --  --  --  77
pi@SwitchDocLabs:~/SDL_Pi_SmartGardenSystem2
```

This shows the Barometer on the SGS Board at I2C address 0x77.

Next we will set up the Wireless Extender Board and then return to the Raspberry Pi for more testing.

SGS Wireless Extender Board Setup

The SGS Wireless Extender Board is based on an ESP32 dual core processor with built-in WiFi. Most setup of the Extender Board is done by the Smart Garden System software on the Raspberry Pi, but we do have to connect up to your local WiFi.

The Wireless Extender Board comes pre-programmed with the Smart Garden System. The software is open source and you can see it up on github.com:

https://github.com/switchdoclabs/SDL_ESP32_WirelessSmartGardenExtender

You can find more information about the Wireless Extender Board in the Advanced Operations manual for the Smart Garden System.

Step 1) Unplug the SGS Wireless Extender power supply (Part R) if you have it plugged in.

Step 2) Wait 10 seconds

Step 3) Plug the SGS Wireless Extender power supply (Part R) power supply back into the outlet and connect the Micro USB Plug to the Wireless Extender Board (Part B) micro USB input plug.

Step 4) You will see a very similar screen on the OLED as below:

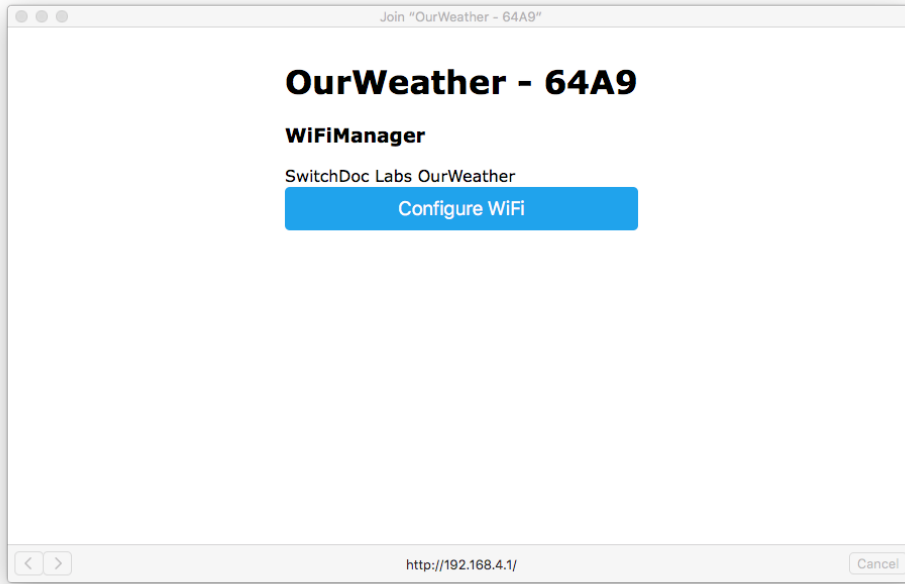


Step 5) Connect your computer or laptop WiFi to the Wireless Access Point name (SGS2WExt-1299 in our example above). Example on a Mac below.

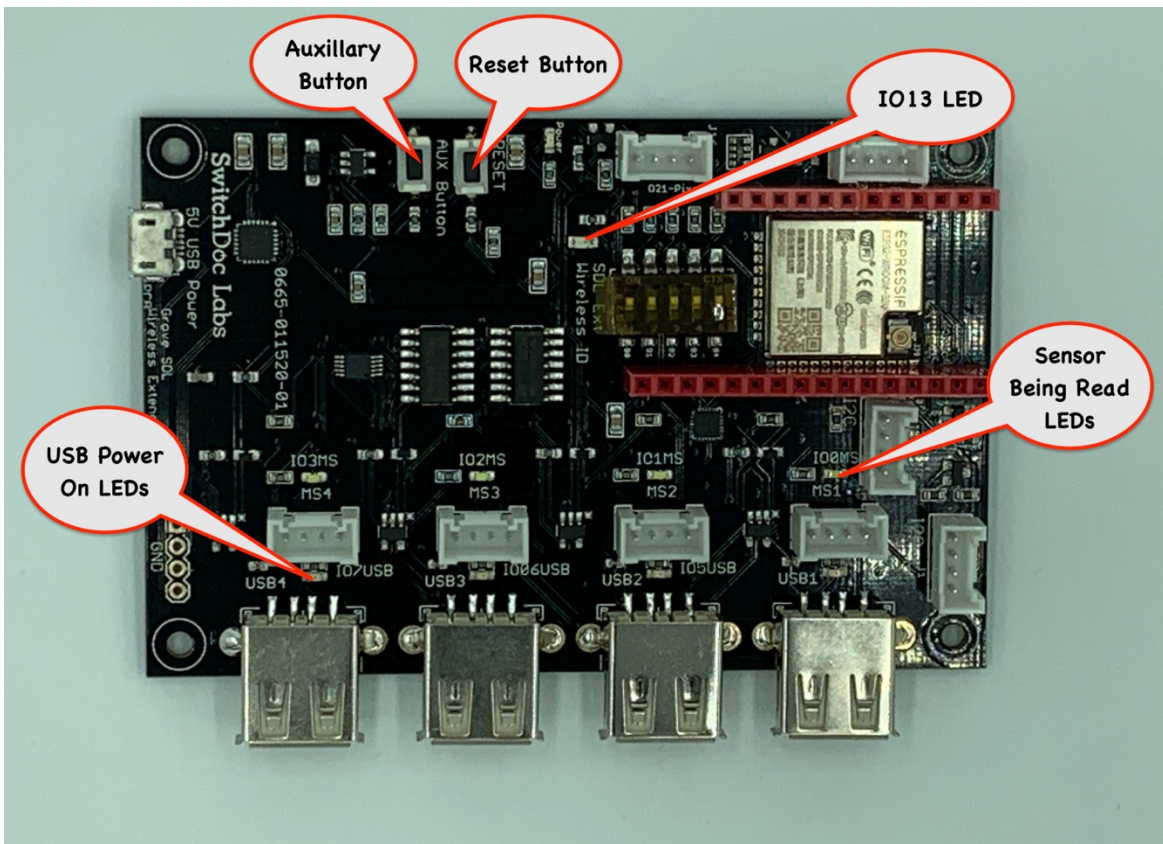


And yes, we are very aware of the Harry Potter reference.

Step 6) Open a web browser (Safari, Chrome preferred - will work with most Internet Explorer versions) and



type in "<http://192.168.4.1>" and shortly you will see a screen as below. Note that you only have 5 minutes to complete the next steps. Otherwise the SGS Wireless Extender will start displaying the system data. If you wish to restart, either repeat Steps 1-3 or push the reset button on the Wireless Extender Board.



Step 7) Click on the Configure WiFi Button on the screen that comes up. It may take a bit before your computer connects. If it doesn't, repeat Step 5 and 6. Rebooting the SGS Wireless Extender computer (by power cycle or using the Reset button) may be required, depending on your network.

Step 8) Fill out the displayed form to set up SGS Wireless Extender WiFi connection.

Each of these fields is described below:

Your Station Name – Optional - The name of your SGS Wireless Extender Station (ex. Howard Flowers)

WiFi Name - The name (SSID) of your local WiFi connection

WiFi Password - The password for your local WiFi connection

An example filled out page follows.

Join "SGS2WExt-1299" 100%

gracie	100%
arnold7	52%
NETGEAR45	30%
gracie_ext	30%
DIRECT-95-HP OfficeJet 4650	22%
HOJACK74	18%
NETGEAR-Guest	12%

your Station Name

Your Station Name

gracie

WiFi Name

yourwifipassword

WiFi Password

save

192.168.4.1 Cancel

Step 9) Hit Save. SGS Wireless Extender will try to connect. If it doesn't connect (for example if you typed a bad password or WiFi name - watch the screen) then it will reset itself back to Step 4 and you can try again.

Step 10) You are now connected to your local WiFi. SGS Wireless Extender will start displaying system information.



Step 11) When you see the screen below (reboot to see the screen again) write down the IP number displayed in the screen (in our example below, the IP Address is 192.168.1.2):



You may have to reboot your SGS Wireless Extender (by turning the power off or the reset button) to get it to connect to your network.

You should notice the OLED screen cycling through system information and the Pixel LED slowly pulsing green.

Now we will return to the Raspberry Pi for the final test of our system.

Final Testing Your SGS System on the Raspberry Pi

Step 1) Return to the terminal window on your Raspberry Pi while leaving your SGS Wireless Extender plugged in and connected to the network.

Step 2) Change to the SDL SGS2 directory

```
cd ~/SDL_Pi_SmartGardenSystem2
```

Step 3) Using your favorite text editor, edit the testSGSSystem.py file and change the SGSEXT_IP variable to the IP address of your SGS Wireless Extender that you copied down in the last section. For example, our test SGS WirelessExtender has an IP address of "192.168.1.2".

We, in our example, changed the line:

```
SGSEXT_IP = ""
```

To:

```
SGSEXT_IP = "192.168.1.2"
```

Step 4) Run the following command:

```
sudo python3 testSGSSystem.py
```

If everything is good, then you should get a result such as this:

```
pi@SwitchDocLabs:~/SDL_Pi_SmartGardenSystem2 $ sudo python3 testSGSSystem.py
#####
Smart Garden System 2 System Test
#####
2020-07-12 17:23:30.644911

Wireless Extender Address = 192.168.1.2
#####
BMP280 Present and working
#####

#####
Starting Wireless Extender Test
#####
sending REST URL = http://192.168.1.2/setSingleValve?params=admin,1,1,20
#####
Wireless Extender: 192.168.1.2
Successfully Responding
#####
{'return_value': 0, 'id': '1299', 'name': '', 'ipaddress': '192.168.1.2', 'hardware': 'esp32',
'return_string': '', 'connected': True}
#####
sending REST URL = http://192.168.1.2/enableMoistureSensors?params=admin,1,1,1,1
sending REST URL = http://192.168.1.2/readMoistureSensors?params=admin
```

Moisture Sensors:

```
{'return_value': 0, 'id': '1299', 'name': '', 'ipaddress': '192.168.1.2', 'hardware': 'esp32',  
'return_string': '1,28.60,1,100.00,1,100.00,1,100.00,C1,C1,C1,C1', 'connected': True}  
#####
```

You will see the following.

- 1) The Green Glowing LED on your SGS Wireless Extender will Blink White (that's the message being received by the Extender)
- 2) You will see your USB Light Stick (plugged into USB1) turn on for 20 seconds and then turn off
- 3) Moisture Sensor #1 will read something less than 100% depending on your exact sensor.

If any of these tests fail, go back and check your wiring on your SGS Wireless Extender and make sure that both your Raspberry Pi and the SGS Wireless Extender are connected to the same WiFi Network.

If you are still having problems, a great place to go for help is forum.switchdoc.com

Once you have this working, move onto the Smart Garden System Operation and Configuration Manual.

Disclaimer

SwitchDoc Labs, LLC takes no responsibility for any physical injuries and possession loss caused by those reasons which are not related to product quality, such as operating without following the operating manual and cautions, natural disasters or force majeure.

SwitchDoc Labs, LLC has compiled and published this manual which covers the latest product description and specification. The contents of this manual are subject to change without notice.