CSCI 43300
Final Project

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Introduction & Background

Picture this:

- Got a plant from grandma
- She’s visiting next month
- Place it in bright place,
  Water it, and forget about it
- The be before she visits you
  remember
- When you check on it you are
  presented with this:

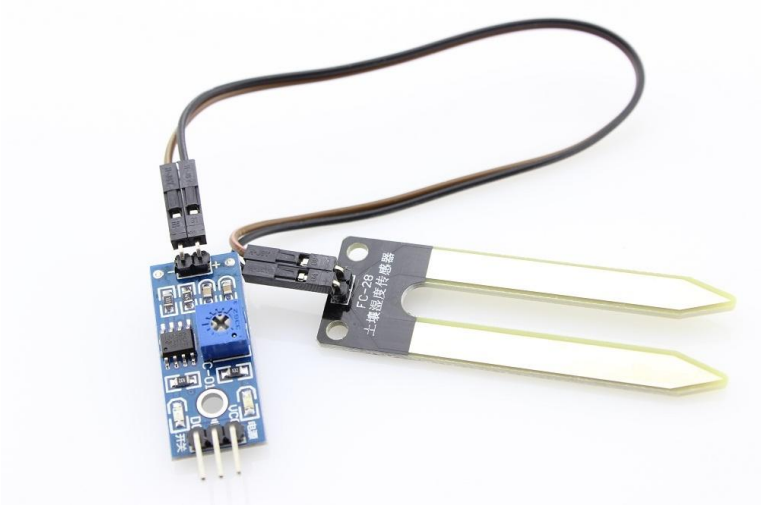
Problem & Solution

- Dead plant = Sad Grandma
- Healthy plant = Happy Grandma
- Should have found a way to keep plant alive
- A solution:

  A device that monitors vital information so the status of the plant can be monitored

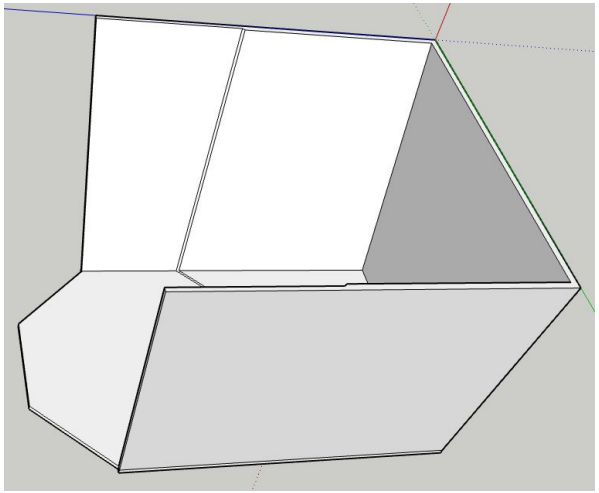
What should be monitored

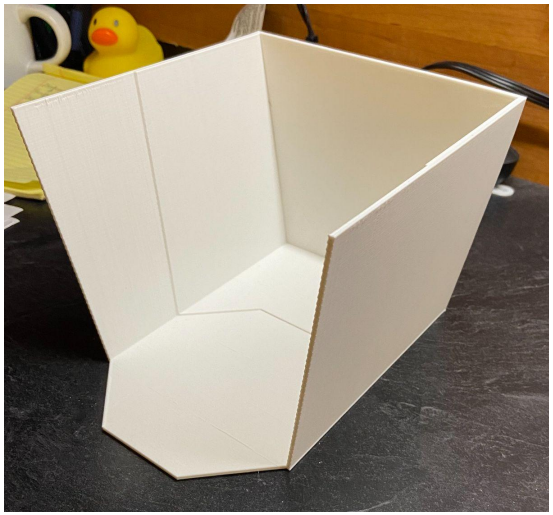
- A plant needs the right environment to stay alive and healthy
- Important statistics to monitor:
  - Soil Moisture
  - Gas/Co2
  - Temperature
  - Light

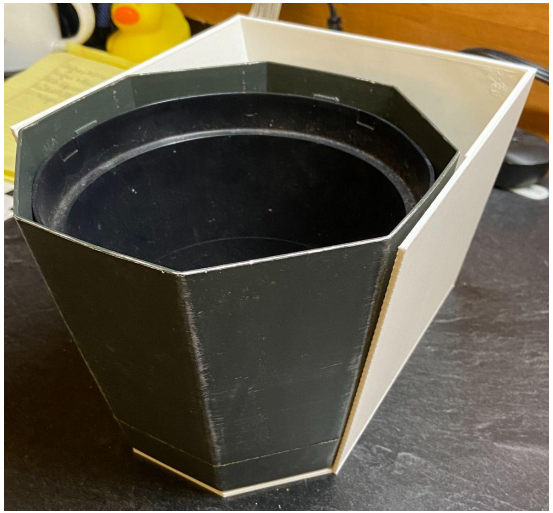


- Each of which will be monitored respectively by
  - HW-080 Soil Hygrometer
  - CCS811 Gas Sensor
  - DHT11 Temp/Humid Sensor
  - Photoresistor

Physical Construction

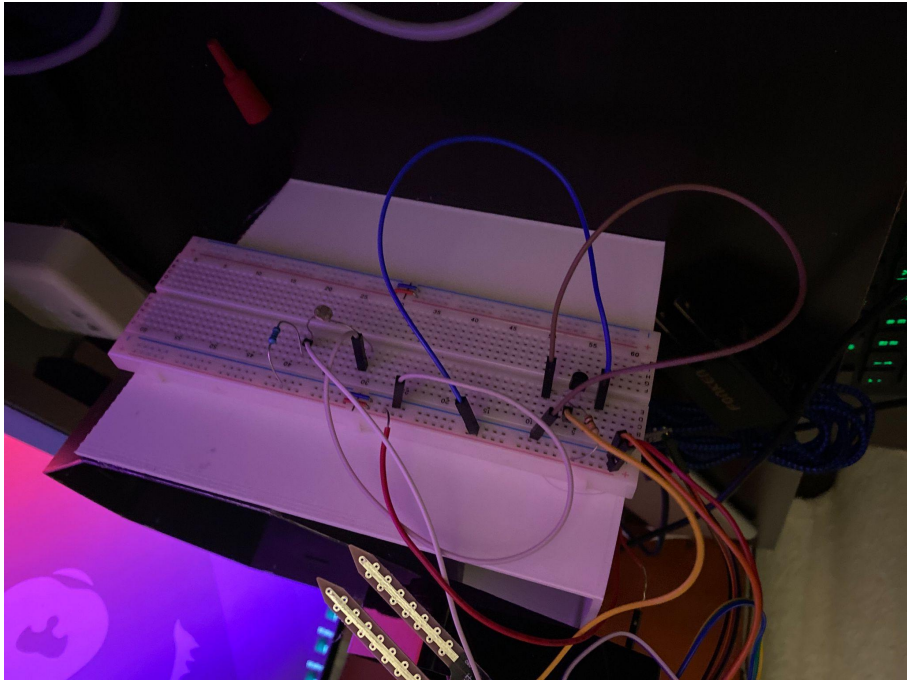


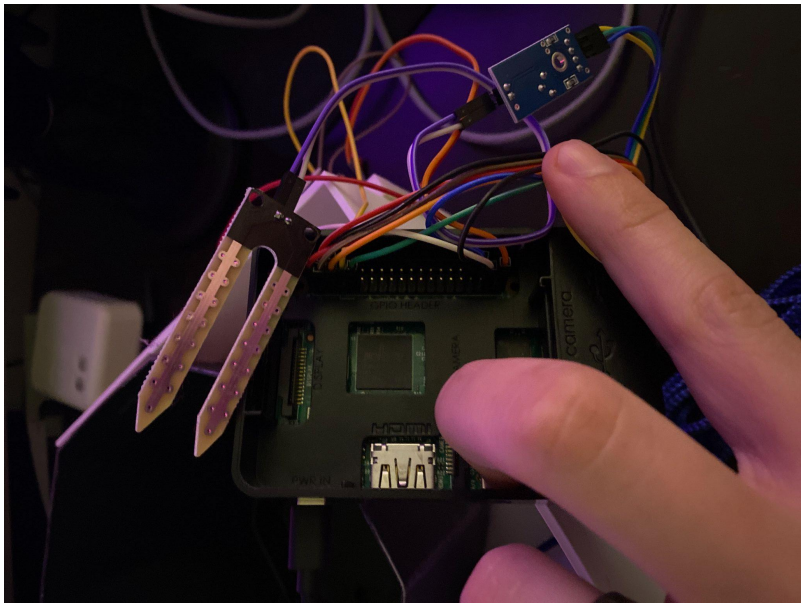


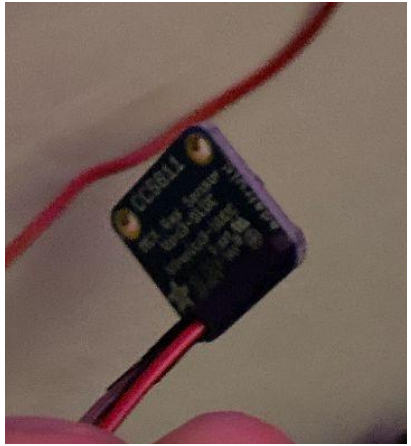


- 3D model created to house electronics
- Print was done by another student
- Pot slots into 3d print
- Pot is secured with waterproof epoxy

Images







Sensor Code

Gas Sensor

```
import time
import board
import adafruit_ccs811

i2c = board.I2C()  # uses board.SCL and board.SDA
ccs811 = adafruit_ccs811.CCS811(i2c)

print("initializing co2 monitor")
# Wait for the sensor to be ready
while not ccs811.data_ready:
    pass
print("done")

def get_co2():
    return "{}".format(ccs811.eco2)
def get_tvoc():
    return "{}".format(ccs811.tvoc)
```

Temperature Sensor

```
import glob
import time

base_dir = '/sys/bus/w1/devices/'
device_folder = glob.glob(base_dir + '28*')[0]
device_file = device_folder + '/w1_slave'

def read_temp_raw():
    f = open(device_file, 'r')
    lines = f.readlines()
    f.close()
    return lines

def read_temp():
    lines = read_temp_raw()
    while lines[0].strip()[-3:] != 'YES':
        time.sleep(0.2)
        lines = read_temp_raw()
    equals_pos = lines[1].find('t=')
    if equals_pos != -1:
        temp_string = lines[1][equals_pos+2:]
        temp_c = float(temp_string) / 1000.0
        temp_f = temp_c * 9.0 / 5.0 + 32.0
        return temp_c, temp_f
```

Sensor Code

Light (Photoresistor)

```
import RPi.GPIO as GPIO
from time import sleep

GPIO.setwarnings(False)
GPIO.setmode(GPIO.BCM)

Button = 26

GPIO.setup(Button, GPIO.IN, pull_up_down=GPIO.PUD_UP)

def get_light():
    button_state = GPIO.input(Button)
    if button_state == 0:
        return "Light".encode("UTF-8")
    else:
        return "Dark".encode("UTF-8")
```

Moisture Sensor

```
import RPi.GPIO as GPIO
import time

#GPIO SETUP
channel = 16
GPIO.setmode(GPIO.BCM)
GPIO.setup(channel, GPIO.IN)


def get_watered(channel):
    if GPIO.input(channel):
        watered = False
    else:
        watered = True


watered = get_watered(channel)
def coap():
    return "Thirsty!".encode("UTF-8")
    if not watered else "Satiated!".encode("UTF-8")

# let us know when the pin goes HIGH or LOW
GPIO.add_event_detect(channel, GPIO.BOTH, bouncetime=300)
# assign function to GPIO PIN, Run function on change
GPIO.add_event_callback(channel, get_watered)
```

Sensor Code

CoAP

```python
#!/usr/bin/env python3

import datetime
import logging

import asyncio

import aiocoap.resource as resource
import aiocoap

import temp
import co2
import soil
import light

class TemperatureResource(resource.Resource):
    def __init__(self):
        super().__init__()

    def get_temp(self):
        return bytes(str(temp.read_temp()[1]).encode('UTF-8'))

    async def render_get(self, request):
        return aiocoap.Message(payload=self.get_temp())

```

```python
class AQResource(resource.Resource):
    def __init__(self):
        super().__init__()

    async def render_get(self, request):
        return aiocoap.Message(payload=co2.get_co2().encode('UTF-8'))

class TVOCResource(resource.Resource):
    async def render_get(self, request):
        return aiocoap.Message(payload=co2.get_tvoc().encode('UTF-8'))

class SoilResource(resource.Resource):
    async def render_get(self, request):
        return aiocoap.Message(payload=soil.coap())

class LightResource(resource.Resource):
    async def render_get(self, request):
        return aiocoap.Message(payload=light.get_light())

class BlockResource(resource.Resource):
    """Example resource which supports the GET and PUT methods. It sends large
    responses, which trigger blockwise transfer."""

    def __init__(self):
        super().__init__()
        self.set_content(b"This is the resource's default content. It is padded "
                         b"with numbers to be large enough to trigger blockwise "
                         b"transfer.\n")

    def set_content(self, content):
        self.content = content
        while len(self.content) <= 1024:
            self.content = self.content + b"0123456789\n"

    async def render_get(self, request):
        return aiocoap.Message(payload=self.content)

    async def render_put(self, request):
        print('PUT payload: %s' % request.payload)
        self.set_content(request.payload)
        return aiocoap.Message(code=aiocoap.CHANGED, payload=self.content)
```

Sensor Code

CoAP cont.

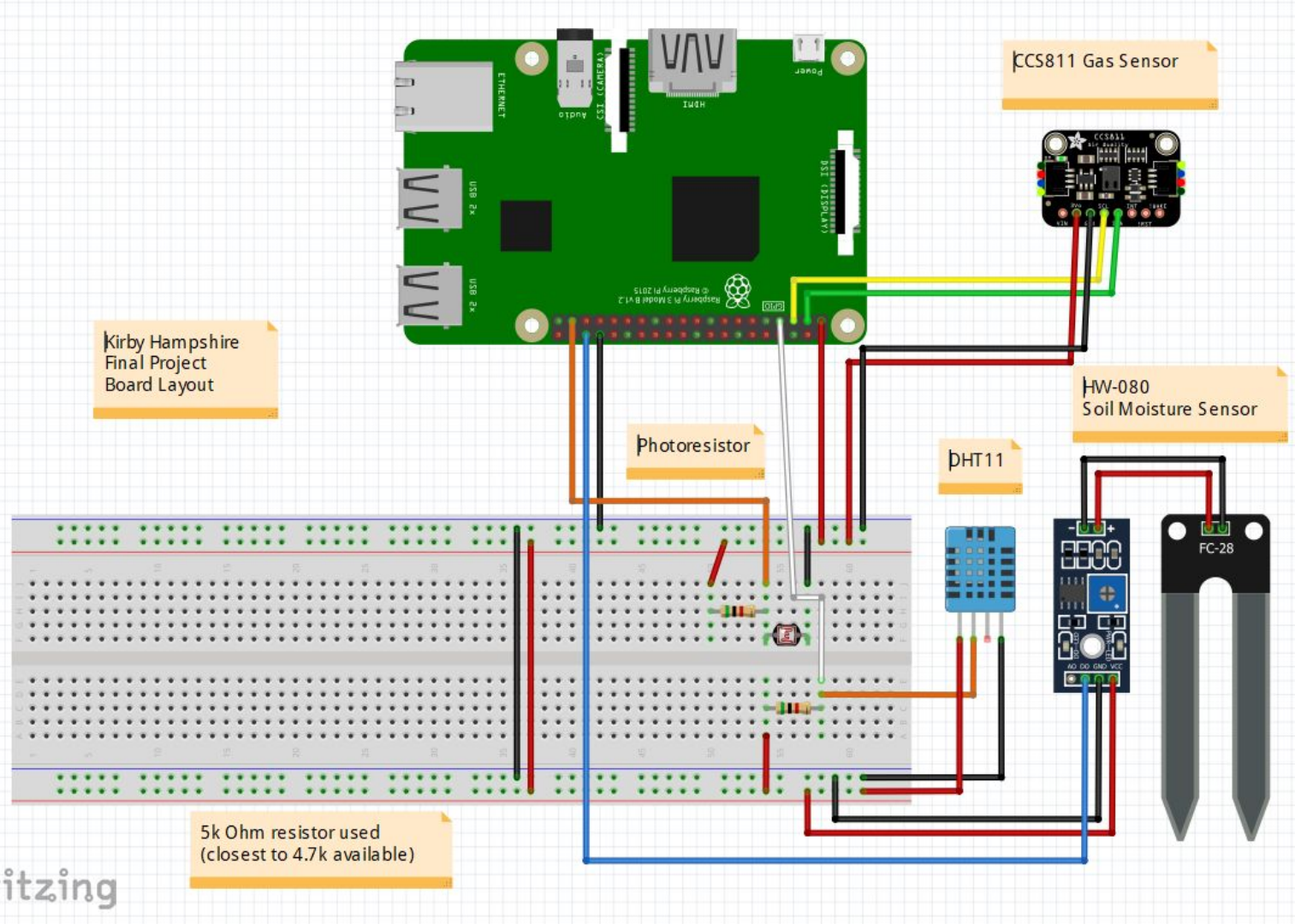
```
class SeparateLargeResource(resource.Resource):
    """Example resource which supports the GET method. It uses asyncio.sleep to
    simulate a long-running operation, and thus forces the protocol to send
    empty ACK first. """

    def get_link_description(self):
        # Publish additional data in .well-known/core
        return dict(**super().get_link_description(), title="A large resource")

    async def render_get(self, request):
        await asyncio.sleep(3)

        payload = "Three rings for the elven kings under the sky, seven rings "\
                  "for dwarven lords in their halls of stone, nine rings for "\
                  "mortal men doomed to die, one ring for the dark lord on his "\
                  "dark throne.".encode('ascii')
        return aiocoap.Message(payload=payload)

class TimeResource(resource.ObservableResource):
    """Example resource that can be observed. The `notify` method keeps
    scheduling itself, and calles `update_state` to trigger sending
    notifications."""

    def __init__(self):
        super().__init__()

        self.handle = None

    def notify(self):
        self.updated_state()
        self.reschedule()

    def reschedule(self):
        self.handle = asyncio.get_event_loop().call_later(5, self.notify)

    def update_observation_count(self, count):
        if count and self.handle is None:
            print("Starting the clock")
            self.reschedule()
        if count == 0 and self.handle:
            print("Stopping the clock")
            self.handle.cancel()
            self.handle = None

    async def render_get(self, request):
        payload = datetime.datetime.now().\
                  strftime("%Y-%m-%d %H:%M").encode('ascii')
        return aiocoap.Message(payload=payload)
```

Sensor Code

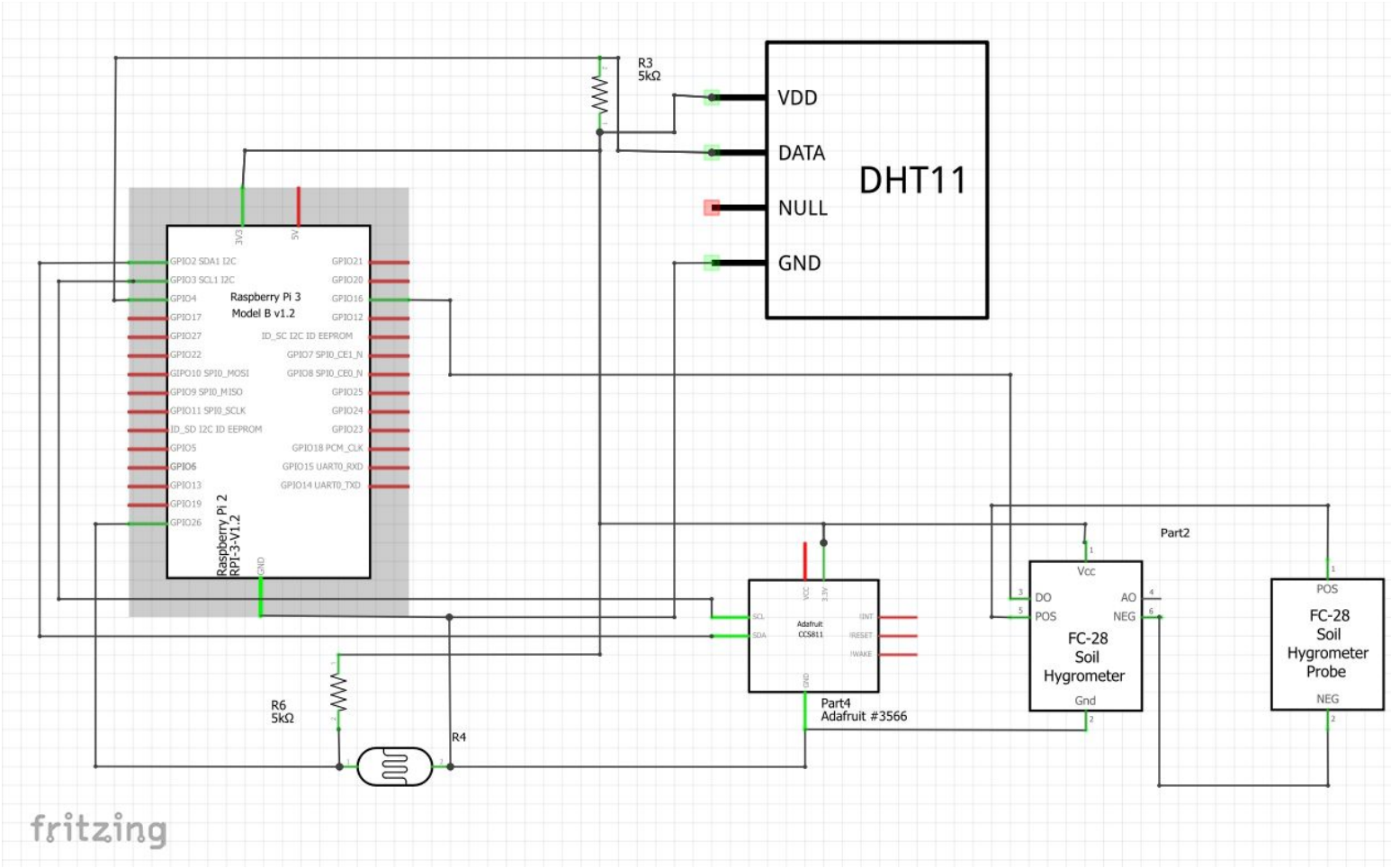
CoAP cont.

```
class WhoAmI(resource.Resource):
    async def render_get(self, request):
        text = ["Used protocol: %s." % request.remote.scheme]

        text.append("Request came from %s." % request.remote.hostinfo)
        text.append("The server address used %s." % request.remote.hostinfo_local)

        claims = list(request.remote.authenticated_claims)
        if claims:
            text.append("Authenticated claims of the client: %s." % ", ".join(repr(c) for c in claims))
        else:
            text.append("No claims authenticated.")

        return aiocoap.Message(content_format=0,
                payload="\n".join(text).encode('utf8'))

# logging setup

logging.basicConfig(level=logging.INFO)
logging.getLogger("coap-server").setLevel(logging.DEBUG)

async def main():
    # Resource tree creation
    root = resource.Site()

    root.add_resource(['.well-known', 'core'],
            resource.WKCResource(root.get_resources_as_linkheader))
    root.add_resource(['time'], TimeResource())
    root.add_resource(['other', 'block'], BlockResource())
    root.add_resource(['other', 'separate'], SeparateLargeResource())
    root.add_resource(['whoami'], WhoAmI())
    root.add_resource(['temp'], TemperatureResource())
    root.add_resource(['co2'], AQResource())
    root.add_resource(['tvoc'], TVOCResource())
    root.add_resource(['soil'], SoilResource())
    root.add_resource(['light'], LightResource())


    await aiocoap.Context.create_server_context(root)

    # Run forever
    await asyncio.get_running_loop().create_future()

if __name__ == "__main__":
    asyncio.run(main())
```

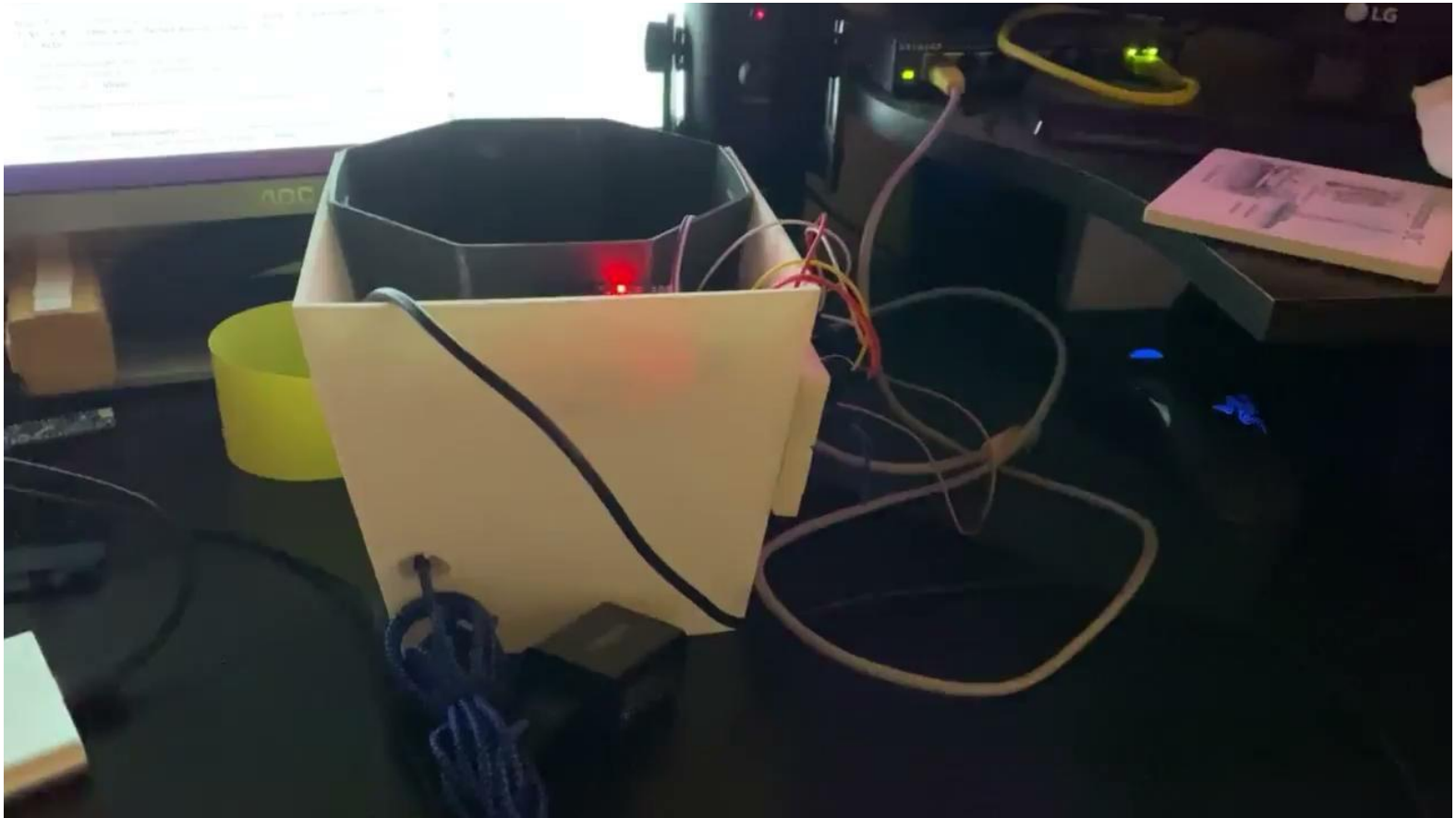
Board Layout



Circuit Diagram



Demo



Tragedy

The test plant was dying… Sago Palms need a lot of sun.

Results and conclusion

- We are able to successfully develop a system that could monitor plant stats by request
- Further steps would be to create a system that would help rectify any stats that were out of line
- A prolonged test over the course of a few months would give results on the effectiveness of the device

References

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Alldatasheet.com. (n.d.). *HW-080080-10-9*. ALLDATASHEET. Retrieved November 15, 2021, from https://pdf1.alldatasheet.com/datasheet-pdf/view/458562/MACOM/HW-080080-10-9.html.