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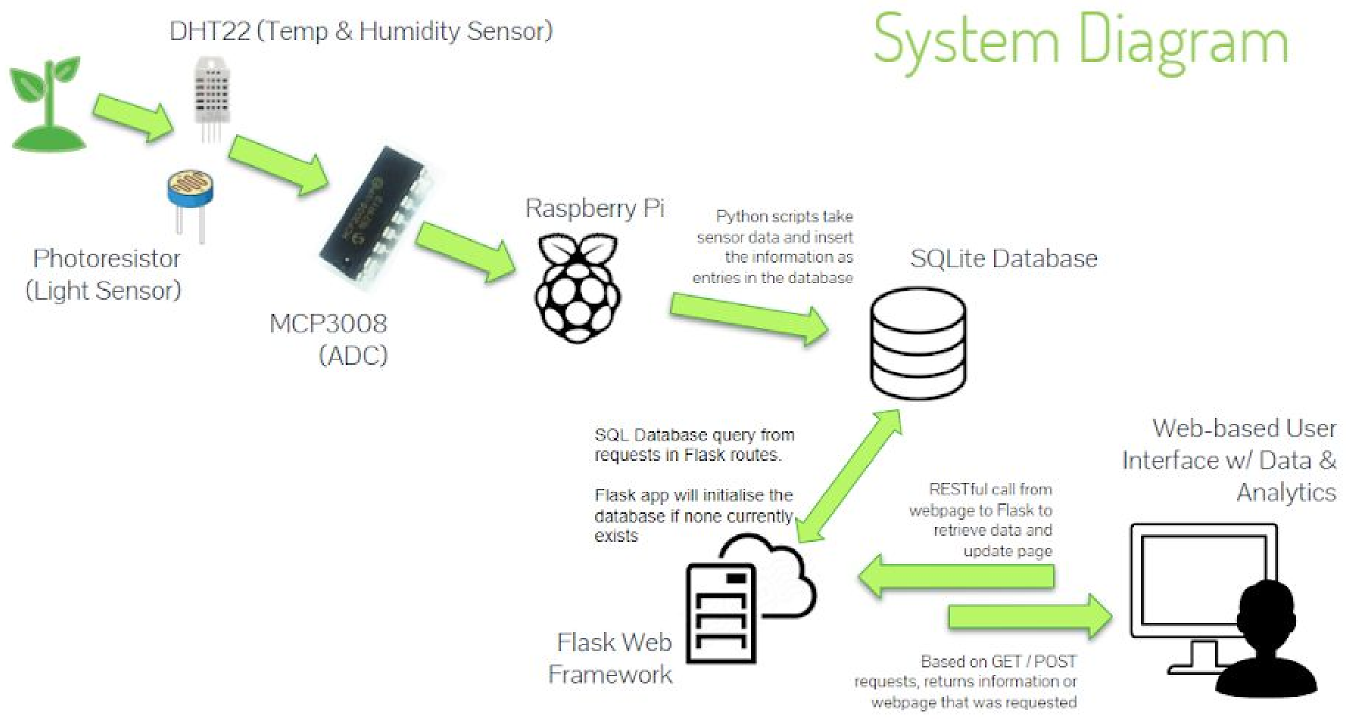
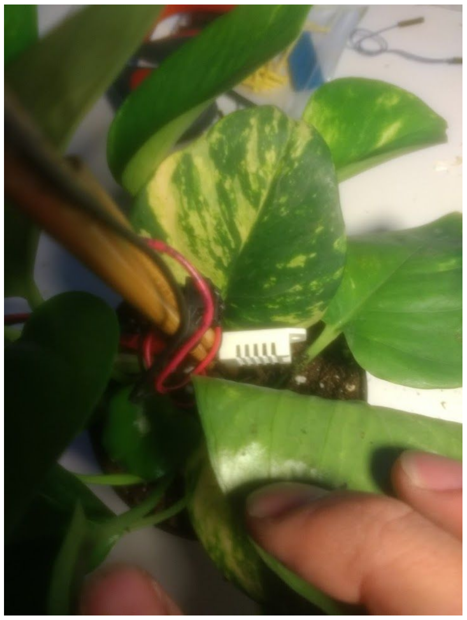
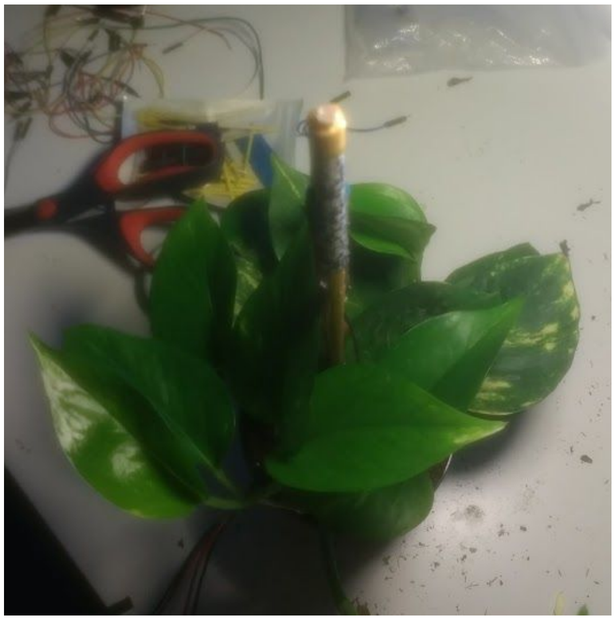
ECE 140A Lab 5 Write-Up

Systems Diagram


System Diagram
DHT22 (Temp & Humidity Sensor)
Photoresistor (Light Sensor)
MCP3008 (ADC)
Raspberry Pi
Python scripts take sensor data and insert the information as entries in the database
SQLite Database
SQL Database query from requests in Flask routes.
Flask app will initialise the database if none currently exists
Flask Web Framework
RESTful call from webpage to Flask to retrieve data and update page
Based on GET / POST requests, returns information or webpage that was requested
Web-based User Interface w/ Data & Analytics



<u>Final Potted Plant</u>
The placement of the sensors was made with usability and functionality in mind. DHT22 humidity and temperature sensor was placed right above the soil but not so close that water would get into it while watering. The center chopstick stand consists of two chopsticks tied with zip ties, tight enough that it would hold in place but adjustable in length by pushing or pulling on the top part. The chopstick sitting on the top has the photosensor mounted on it. A small hole was drilled vertically along the chopstick to make room for the sensor leads to fit into, then a horizontal hole was made so that the wires can come out of the hole and connect to the pi.

<u>Hardware Components</u>

Raspberry Pi

We used Raspberry Pi and the python script to collect sensor data and insert the information as entries in the database. The GPIO pins enable the taking of the sensor data.

Photoresistor

Photoresistor is used to get how much light is falling on the sensor. Photoresistor becomes less in resistance as more light shines on it. This is why it's used as a part of a voltage divider. With more light shining on it, reduced resistance yields higher analog voltage value. Photoresistor in the system serves as a indicator of sufficiency of light for the plant. Too much light and too little light can be determined from the photosensor. To make it more precise, the sensor can be calibrated with another device or use the information datasheet to interpret the analog voltage to precisely know how much luminance is present.

DHT22

DHT22 is a sensor module that feeds both temperature and humidity data to pi. The module is essential component of the system because humidity and temperature matters for optimal plant growth. The data that the module sends is not an analog signal, so the module can be connected straight to the GPIO Pin 4 of Pi.

MCP3008

Because Raspberry Pi cannot take analog input, analog to digital converter was used to take in the photoresistor voltage divider analog values were converted into digital values in 10 bit resolution.

Software Components

Python Scripts on the Pi

Our Python scripts use the wrapper libraries that we wrote to perform data sampling from the sensors configured on our Raspberry Pi. Our wrapper libraries are used for individual sensor sampling, while our scripts control the way we sample, such as sampling frequency, which sensors to sample from, and the output format of our raw data. Our scripts only interact with the Raspberry Pi itself to get the raw data from the sensors and populates our SQLite database with this data.

Vagrant

Vagrant is the tool we used for working in our virtual environment. This was important because it allowed all our teammates to view and collaborate on hosting the server portion of our our web application despite having different network and computer configurations.

SQLite Database

We used the SQLite Database as the database portion of our lab to store all the raw sensor data. The setup of our schema is three tables - one per sensor. This database was used in lab 4 to query from for populating our web application, and used in lab 5 to interact with our RESTful layer for GET and POST requests.

Flask Framework

We used Flask as a framework to host the “server” for our application. Since it is a micro web framework, we were able to use its built-in functionalities and RESTful dispatching to host the server side of Little Leaf. Our sensor_dash.py file is the python file that contains our Flask set-up and routes, and is where we implemented our core RESTful functionalities.

HTML / CSS Pages

Our HTML/CSS pages in our templates folder contain the front-end design layouts of our website. This includes the tables displaying our data and the analytics portion that the user interacts with.

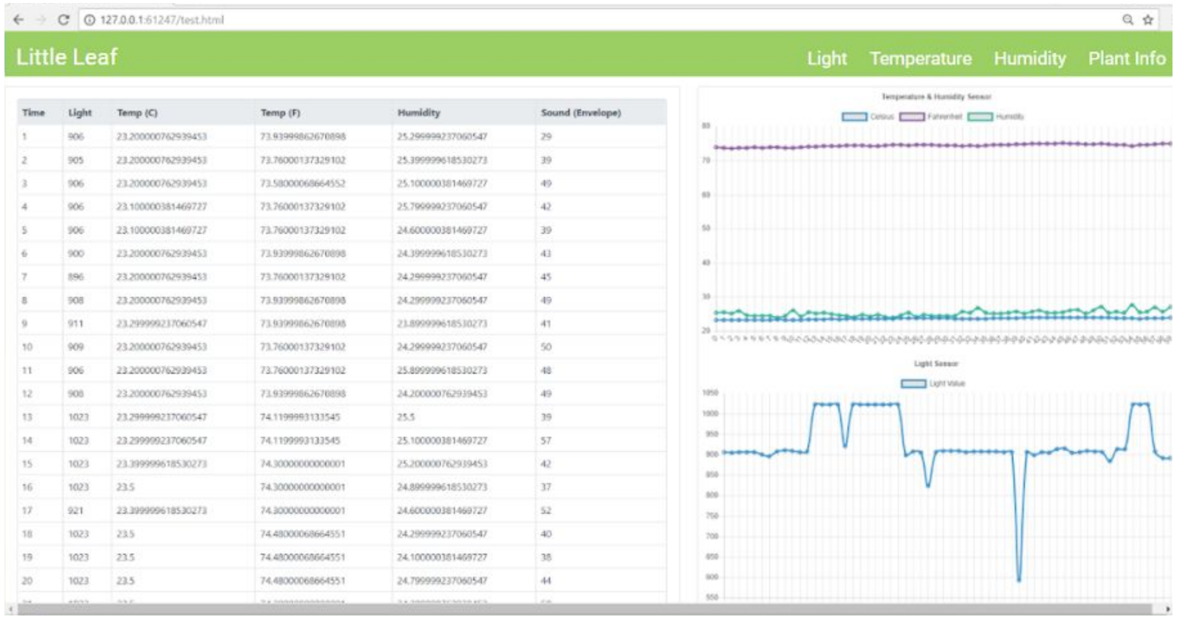
Javascript

Our Javascript is in our static folder, and contains the functionalities that interact with our RESTful layer (fetches the JSON data on button clicks) to modify and re-populate the front-end website according to user interaction. We have a Javascript function which routes to our RESTful call within our sensor_dash.py Flask python file. This call returns the queried database values in JSON format to pass to our front-end web application by updating the HTML.

<u>Screenshots of App</u>

(Include screenshots of every page in the app and explain UI/UX considerations for each page)

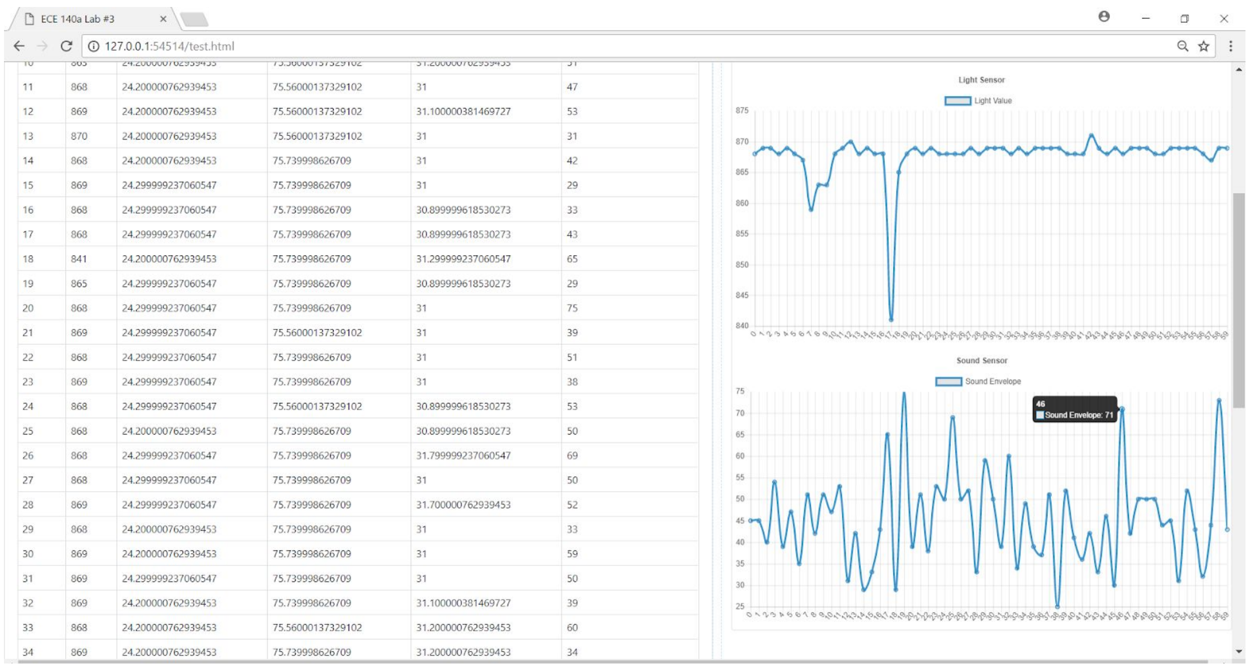
Main Page / Dashboard:



Time	Light	Temp (C)	Temp (F)	Humidity	Sound (Envelope)
1	906	23.200000762939453	73.93999862670898	25.299999237060547	29
2	905	23.200000762939453	73.76000137329102	25.399999618530273	39
3	906	23.200000762939453	73.58000068664552	25.100000381469727	49
4	906	23.100000381469727	73.76000137329102	25.799999237060547	42
5	906	23.100000381469727	73.76000137329102	24.600000381469727	39
6	900	23.200000762939453	73.93999862670898	24.399999618530273	43
7	896	23.200000762939453	73.76000137329102	24.299999237060547	45
8	908	23.200000762939453	73.93999862670898	24.299999237060547	49
9	911	23.299999237060547	73.93999862670898	23.899999618530273	41
10	909	23.200000762939453	73.76000137329102	24.299999237060547	50
11	906	23.200000762939453	73.76000137329102	25.899999618530273	48
12	908	23.200000762939453	73.93999862670898	24.200000762939453	49
13	1023	23.299999237060547	74.1199993133545	25.5	39
14	1023	23.299999237060547	74.1199993133545	25.100000381469727	57
15	1023	23.399999618530273	74.30000000000001	25.200000762939453	42
16	1023	23.5	74.30000000000001	24.899999618530273	37
17	921	23.399999618530273	74.30000000000001	24.600000381469727	52
18	1023	23.5	74.48000068664551	24.299999237060547	40
19	1023	23.5	74.48000068664551	24.100000381469727	38
20	1023	23.5	74.48000068664551	24.799999237060547	44

The layout for our dashboard contains the raw data from our plant readings, as well as a chart that represents the information graphically. Due to time constraints, we were unable to make the front-end part of our website as informative as we had originally wanted it; however, it is still helpful to include general trends of the plant's environment as a part of its analytics.

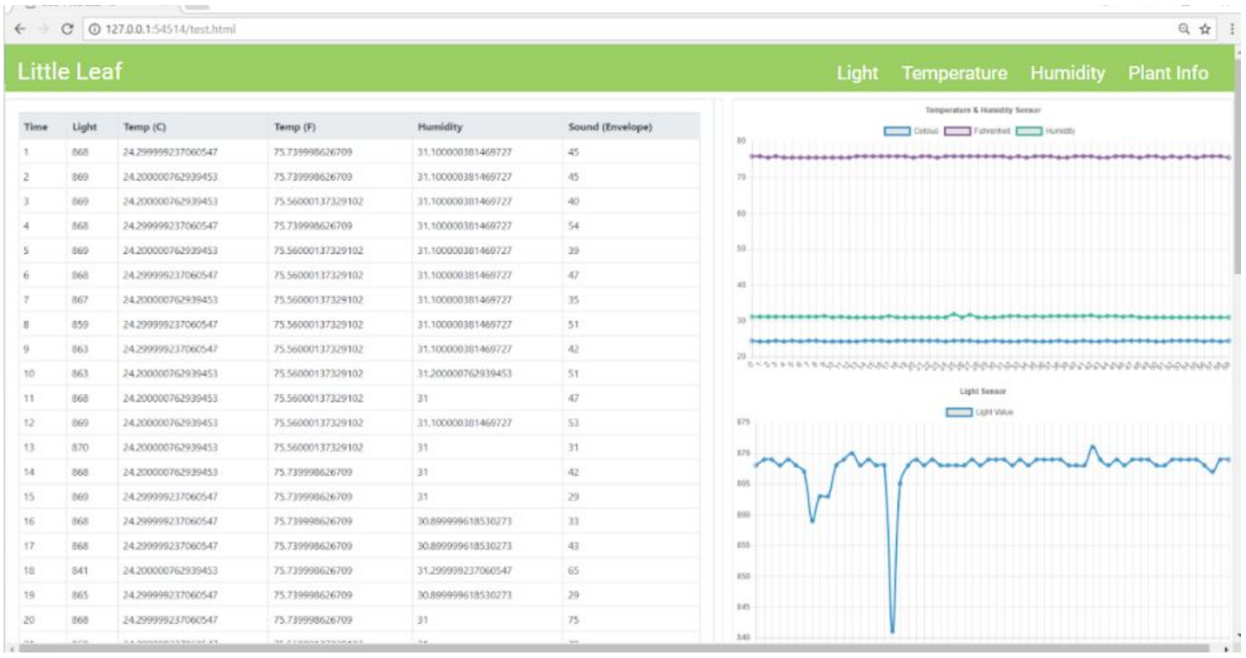
Light Sensor Page:



11	868	24.200000762939453	75.56000137329102	31	47
12	869	24.200000762939453	75.56000137329102	31.100000381469727	53
13	870	24.200000762939453	75.56000137329102	31	31
14	868	24.200000762939453	75.739998626709	31	42
15	869	24.299999237060547	75.739998626709	31	29
16	868	24.299999237060547	75.739998626709	30.899999618530273	33
17	868	24.299999237060547	75.739998626709	30.899999618530273	43
18	841	24.200000762939453	75.739998626709	31.299999237060547	65
19	865	24.299999237060547	75.739998626709	30.899999618530273	29
20	868	24.299999237060547	75.739998626709	31	75
21	869	24.299999237060547	75.56000137329102	31	39
22	868	24.299999237060547	75.739998626709	31	51
23	869	24.299999237060547	75.739998626709	31	38
24	868	24.299999237060547	75.56000137329102	30.899999618530273	53
25	868	24.200000762939453	75.739998626709	30.899999618530273	50
26	868	24.299999237060547	75.739998626709	31.799999237060547	69
27	868	24.299999237060547	75.739998626709	31	50
28	869	24.299999237060547	75.739998626709	31.700000762939453	52
29	868	24.200000762939453	75.739998626709	31	33
30	869	24.200000762939453	75.739998626709	31	59
31	869	24.299999237060547	75.739998626709	31	50
32	869	24.200000762939453	75.739998626709	31.100000381469727	39
33	868	24.200000762939453	75.56000137329102	31.200000762939453	60
34	869	24.200000762939453	75.739998626709	31.200000762939453	34

The page for our light sensor is similar to our dashboard, but specific to the light sensor readings.

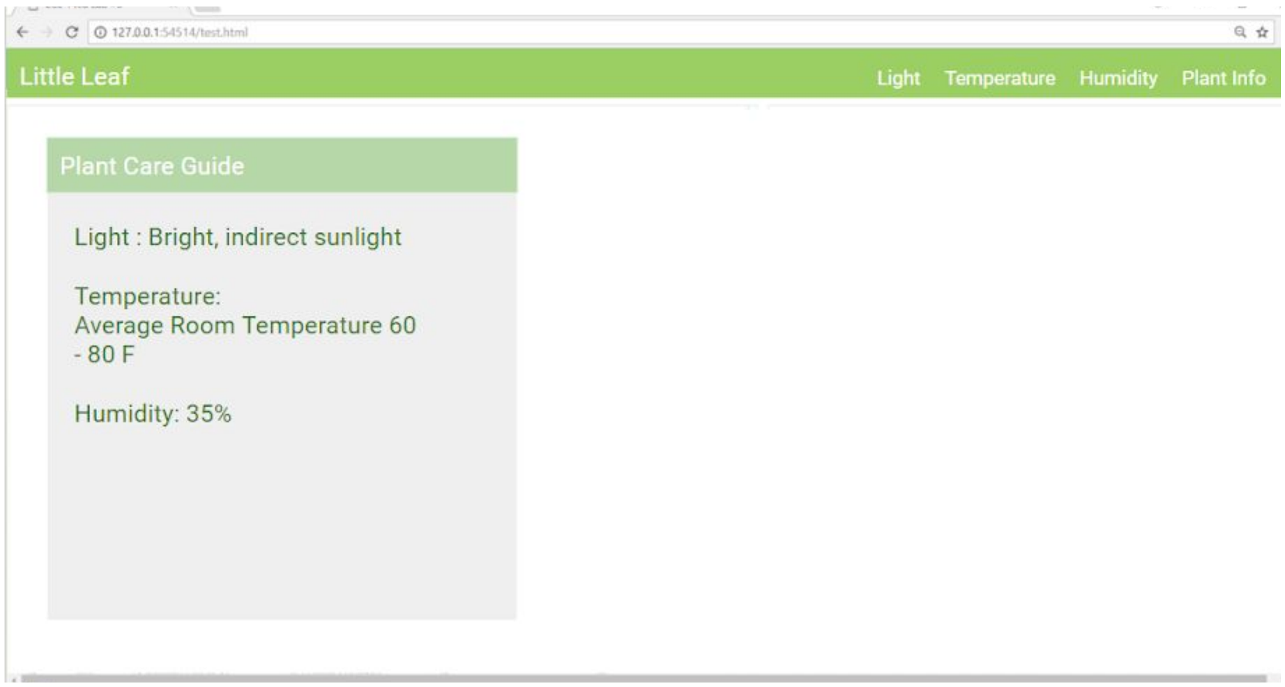
Temperature Page:



Time	Light	Temp (C)	Temp (F)	Humidity	Sound (Envelope)
1	868	24.299999237060547	75.739998626709	31.100000381469727	45
2	869	24.200000762939453	75.739998626709	31.100000381469727	45
3	869	24.200000762939453	75.56000137329102	31.100000381469727	40
4	868	24.299999237060547	75.739998626709	31.100000381469727	54
5	869	24.200000762939453	75.56000137329102	31.100000381469727	39
6	868	24.299999237060547	75.56000137329102	31.100000381469727	47
7	867	24.200000762939453	75.56000137329102	31.100000381469727	35
8	859	24.299999237060547	75.56000137329102	31.100000381469727	51
9	863	24.299999237060547	75.56000137329102	31.100000381469727	42
10	863	24.200000762939453	75.56000137329102	31.200000762939453	51
11	868	24.200000762939453	75.56000137329102	31	47
12	869	24.200000762939453	75.56000137329102	31.100000381469727	53
13	870	24.200000762939453	75.56000137329102	31	31
14	868	24.200000762939453	75.739998626709	31	42
15	869	24.299999237060547	75.739998626709	31	29
16	868	24.299999237060547	75.739998626709	30.899999618530273	33
17	868	24.299999237060547	75.739998626709	30.899999618530273	43
18	841	24.200000762939453	75.739998626709	31.299999237060547	65
19	865	24.299999237060547	75.739998626709	30.899999618530273	29
20	868	24.299999237060547	75.739998626709	31	75

The page for our temperature and humidity sensor is similar to our dashboard, but specific to the temperature and humidity sensor readings.

Plant Information Page:


127.0.0.1:54514/test.html

Little Leaf

Light Temperature Humidity Plant Info

Plant Care Guide

Light : Bright, indirect sunlight

Temperature:
Average Room Temperature 60 - 80 F

Humidity: 35%

This is our page containing specific information about our plant. Although we would have liked to incorporate this information into our analytics and provide the user with more specific ways to care for the plant, we wanted to still include the information somewhere on our app to make the information accessible in some way.