



Particle Flower

Identifying urban pockets of bad air

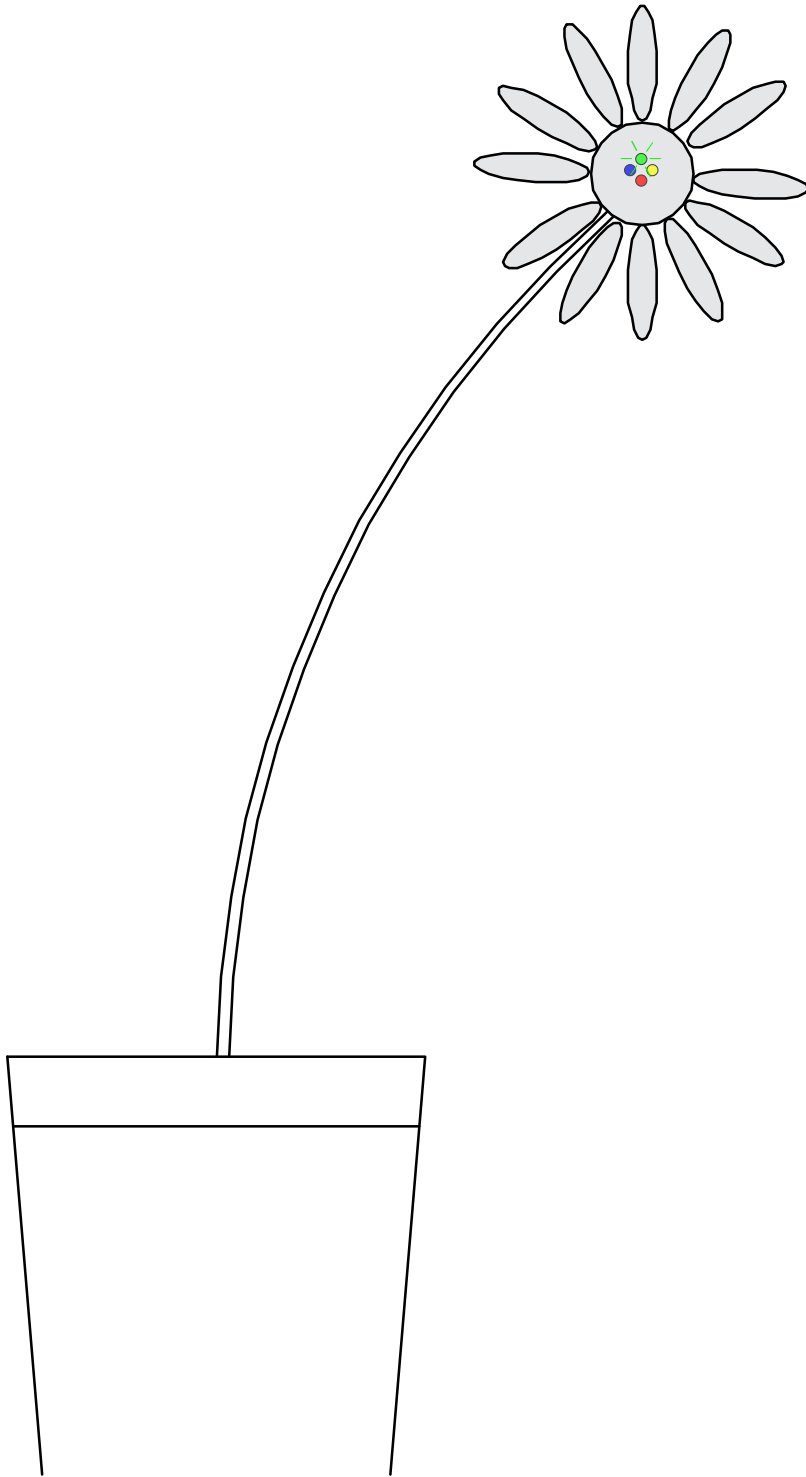
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Executive Summary

Particle plant is an at-home air quality sensor that passively but continuously monitors the air quality outside your window. The small device is designed to be located on the average apartment windowsill and provide real-time information in the form of an LED indicator light on the PM2.5 level. The intent of this project

is to provide a detailed view of the differences in air quality from street to street and neighborhood to neighborhood to start a conversation on who is breathing better or worse air. This data would then be streamed to an online platform that will show, in real time, where in the city air quality is lacking.



Starlight Park

The inspiration before the quarantine pivot

Access to clean air is no doubt a problem across the Bronx. With the location of Starlight Park directly adjacent to a major roadway, the larger air quality issues of the borough apply directly to the park especially given its role as a location for active recreation in the local community.

In the past year, a major rework of the Sheridan Expressway into its current form of Sheridan Boulevard has consisted in lowering the speed of the roadway as well as adding pedestrian crossings

with traffic signals. One of these signalized pedestrian crossings occurs next to the expansive playground and athletic field of the park.

While this pedestrian crossing undoubtedly provides better access to the park from the neighborhood across the roadway, it raises questions about localized air quality. Large trucks using the roadway as an access point to the nearby Hunts Point Market, along with other traffic, frequently come to a complete stop at this signal. When given

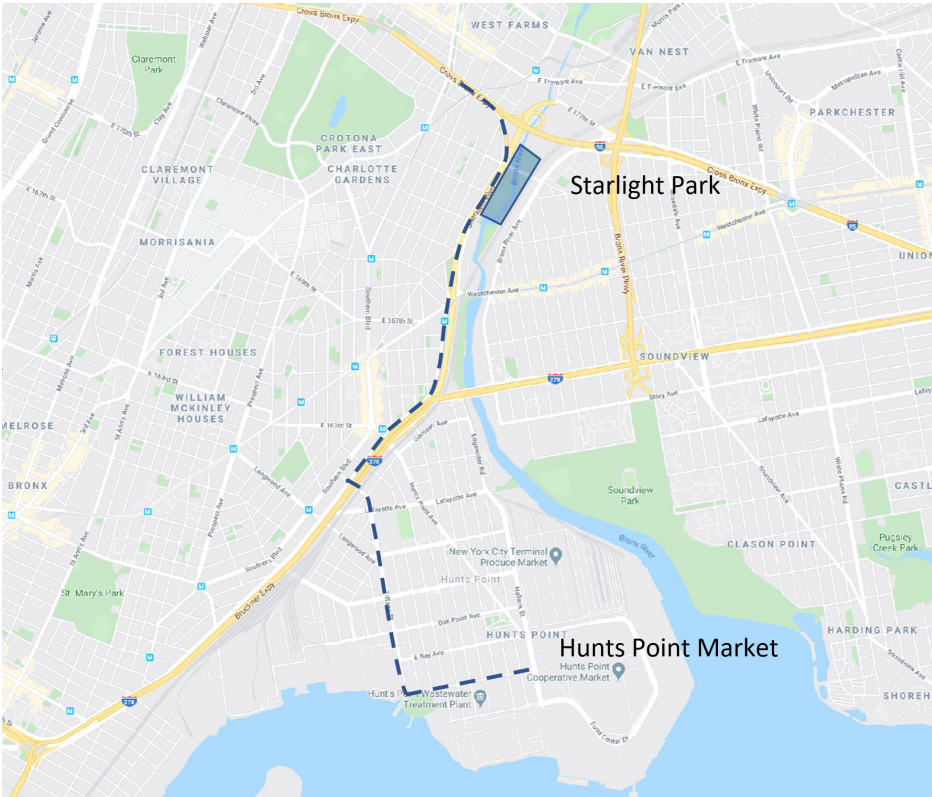
a green light, these vehicles release an immense amount of exhaust, often times visible as plumes of smoke, as they accelerate back to highway speeds.

Is there a measurable deterioration of air quality in the park when the adjacent traffic signal turns green?

I hoped to answer these questions by placing air quality sensors at various locations within the park to see how far the pollution from acceleration at the traffic signal travels into the park.



Starlight Park, The Bronx



Is there a measurable deterioration of air quality in the park when the adjacent traffic signal turns green?

Starlight Park and the truck route to Hunts Point Market



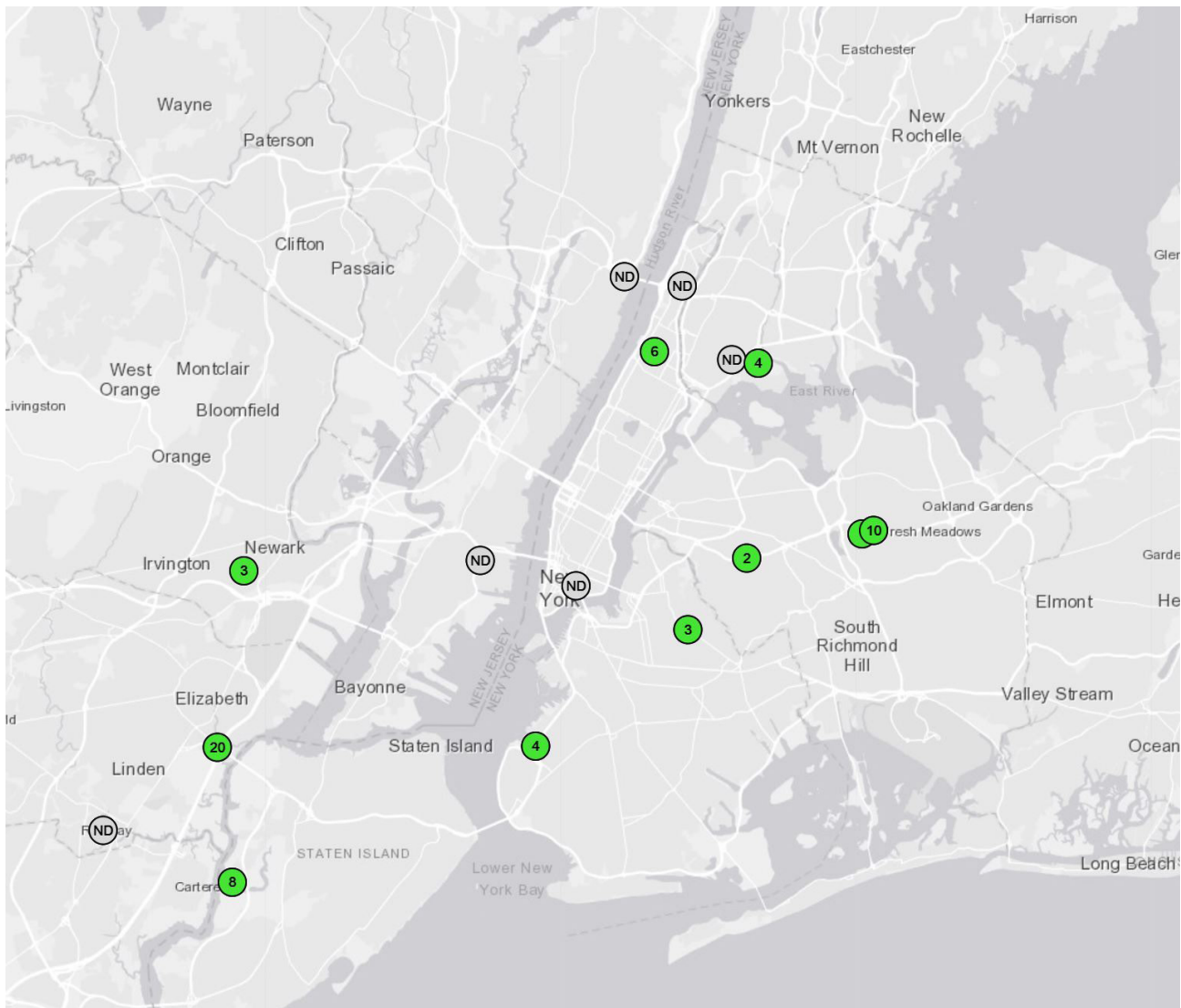
Sheridan Boulevard with new traffic signals and Starlight Park to the right. Photo Courtesy: NY Governor's Office

Introduction

Many cities and regions have air quality sensors that record air quality data for a wider region. While this is certainly useful, it is not nearly specific enough especially for a city like New York where the air one breathes at home can potentially vary widely depending upon which street one lives on. In an urban context, where sources of pollution can be much closer to residences, sometimes even right outside the window, a regional air quality reading is less relevant.

By attempting to get a localized view of the air quality around us, this project aims to show planners and decision-makers not just the neighborhoods in need of air quality intervention, but the specific streets and intersections. The hope is to start a wider conversation on how the street in which one lives has a large impact on the air that one breathes.

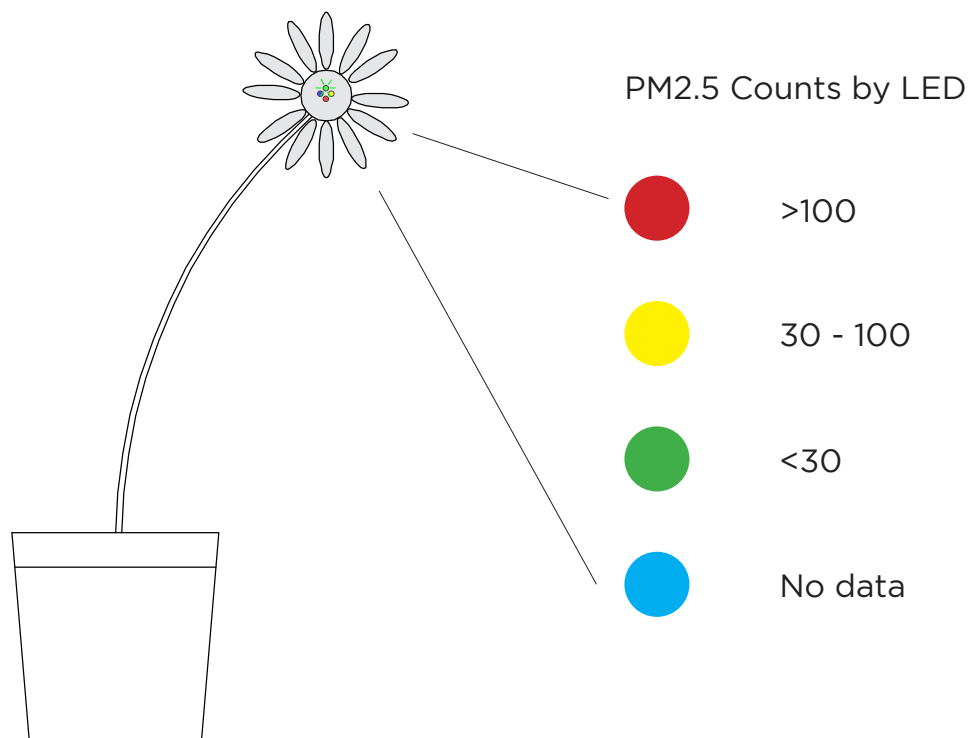
Is there a major difference in air quality between adjacent streets?

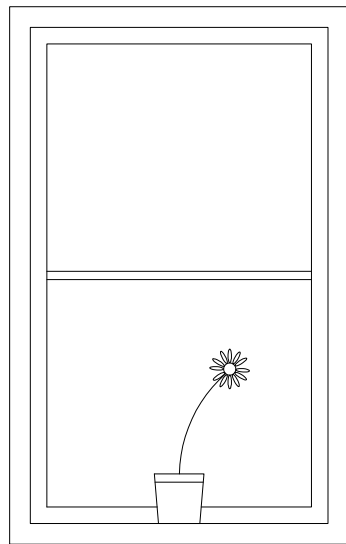
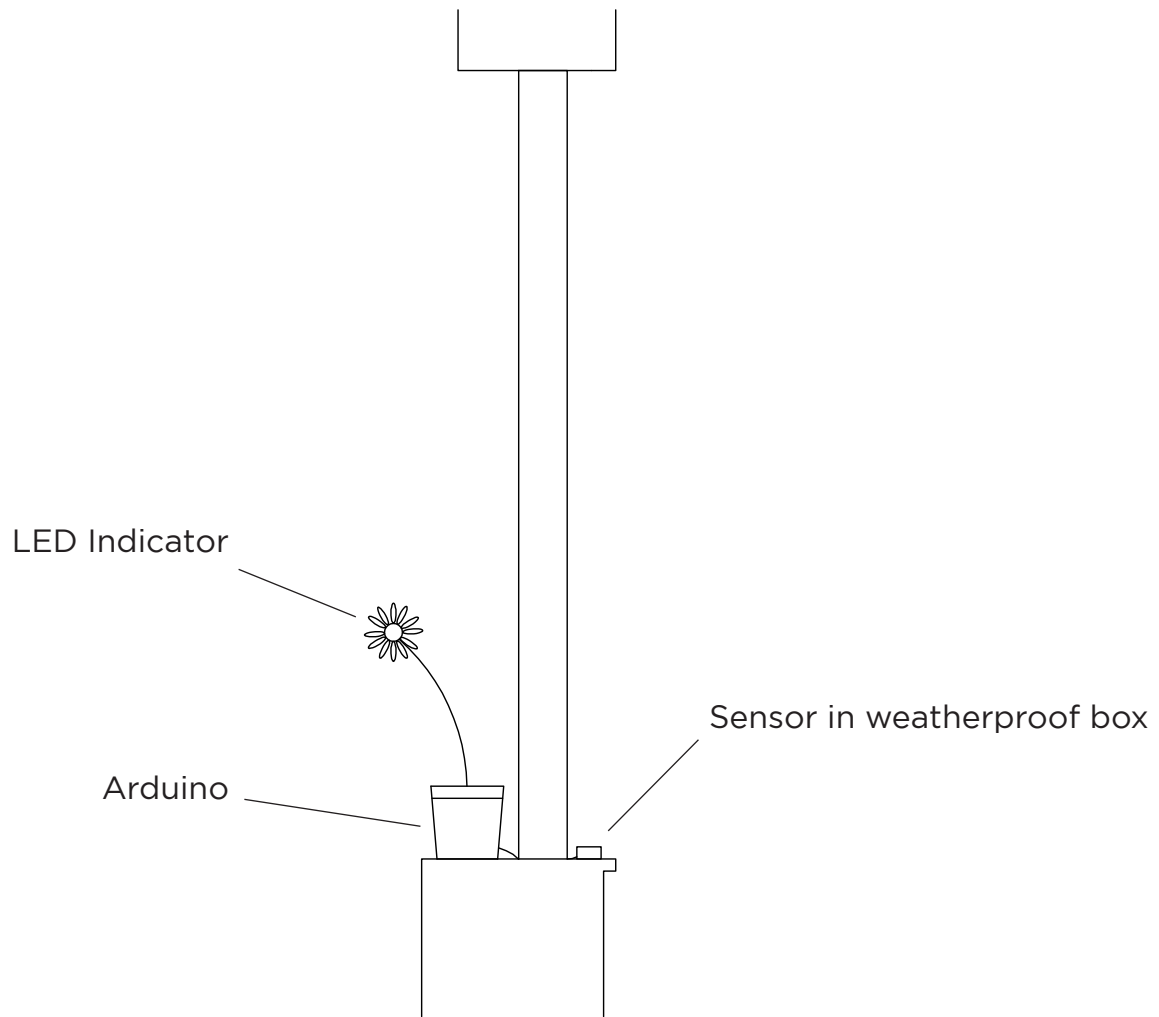


The EPA's Air Now tool only has a few sensors for a sprawling metropolitan region with only one working sensor in Manhattan

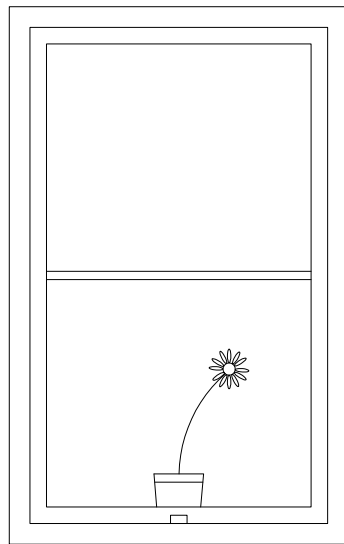
Local Interactions

The device resembles a simple potted flower meant to blend in with any windowsill. At the center of the flower are four colored LEDs which give a reading of the current air quality to whomever may be watching. This device provides a very personal interaction with the air quality readings only visible to the occupant of the room where the device is located.





Inside view



Outside view

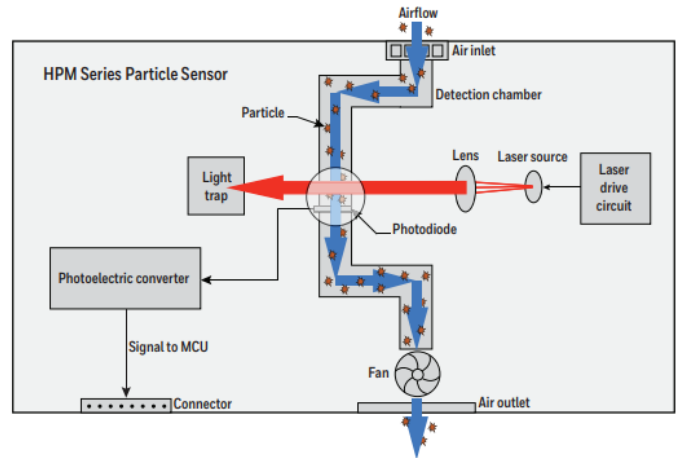
Technologies Used

One measure of air quality is the PM2.5 count in the air. PM2.5 consists of very small particles in the air that are usually found in sources of pollution such as car exhaust and smoke. Consistent exposure to PM2.5 can have detrimental effects to one's health.

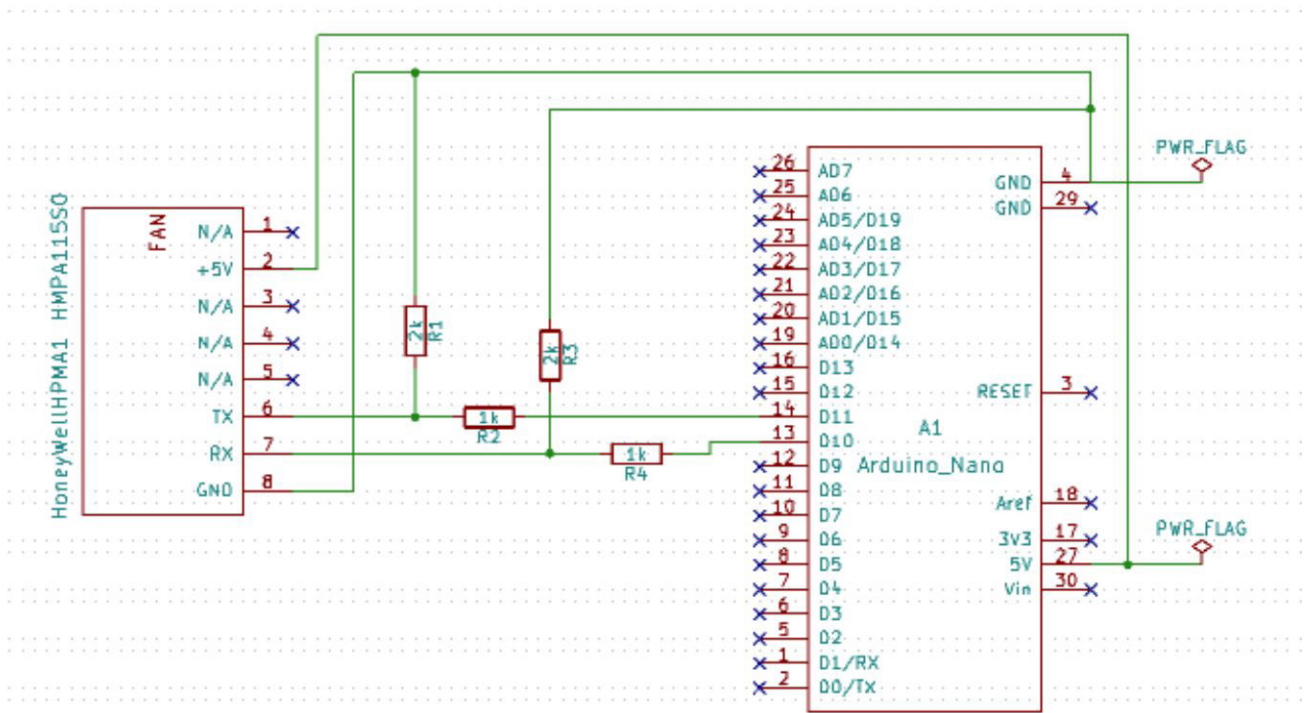
PM2.5 levels were measured with the Honeywell HPM particle sensor. This device uses a fan to create airflow and shines a laser across the flowing air. This laser scatters when it encounters particles in the air. The more particles, the more the laser scatters. The sensor then measures the amount the laser scatters and sends that information back to the Arduino. Four basic LEDs of varying colors were then plugged into various pins in the Arduino to display the PM2.5 level.



Honeywell HPM Particle Sensor



How the sensor works



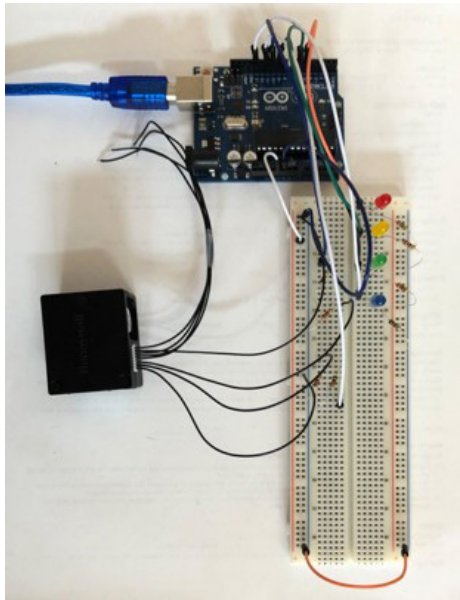
Wiring the sensor to an arduino

Testing

The sensor was tested to establish a baseline and identify its sensitivity to controlled events. This was done through two main scenarios.

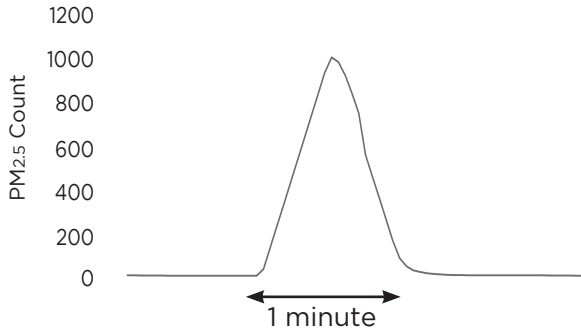
The first test was to see how the sensor responded to the extinguishing of a candle.

The second test was more nuanced and involved multiple steps. In this test, the sensor was brought into a smoky room. Moments later, the room was allowed to ventilate to fresh air outside, decreasing the amount of smoke in the room. After, the sensor was then brought from the room directly to outside. The idea was to test how quickly and accurately the sensor responded to a quickly changing environment.



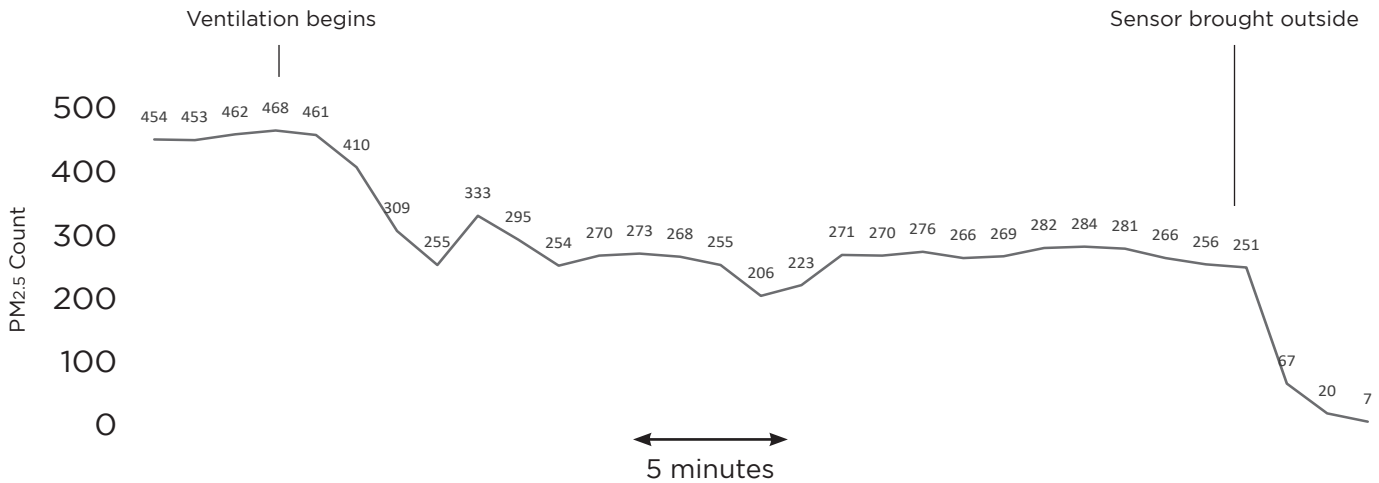
The sensor connected to an arduino

Test 1



The extinguishing of a candle leads to a spike in PM 2.5 levels.

Test 2



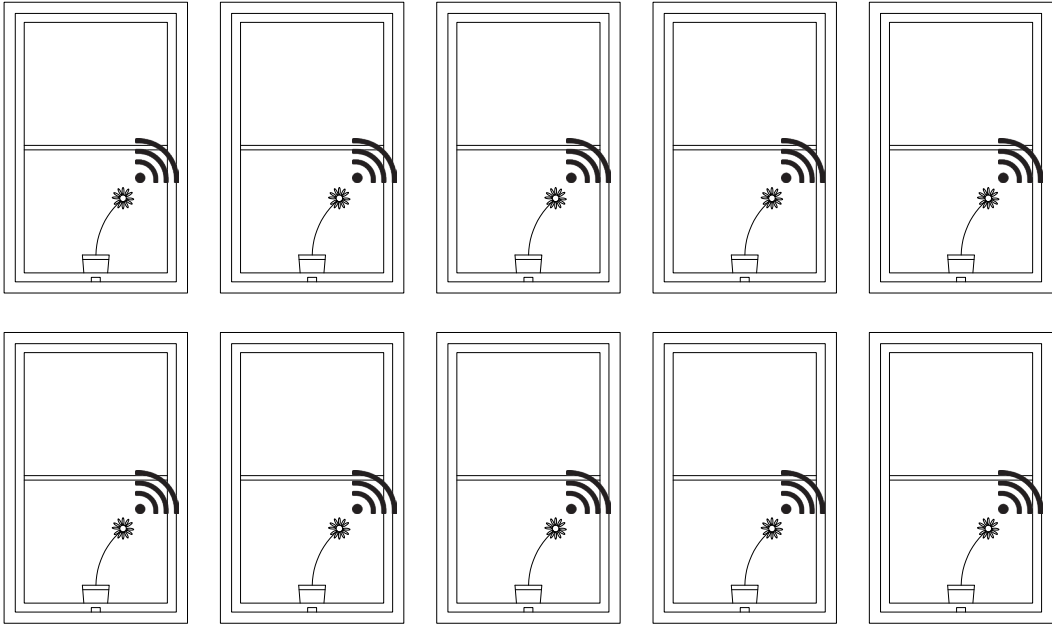
The sensor started in a smoky room which was then ventilated with fresh air. The sensor was then brought outside. The outside PM_{2.5} count at the time was measured to be 7, showing the accuracy of the sensor.

Urban Interactions

Particle Plant was envisioned to be deployed in windowsills across an urban environment to give a detailed view of the varying air quality levels across different streets. By having many Particle Plants on many different streets and in many different neighborhoods, data could start to be collected that gives the general public as well as policymakers a better idea of who is breathing bad air. To have this detailed view in a place like Manhattan, hundreds of Particle Plants would have to be deployed to different windowsills. This data could then be compared to regional air quality readings to see who lives near a localized area of bad air. In addition, mapping this air quality information allows for overlaying it with other information to establish trends. PM2.5 levels could be compared to data such as traffic flows to see if busy streets are significant sources of PM2.5 emissions and how far from that busy street the pollution extends.



An online platform could collect data from scattered Particle Flowers



Conclusion

Particle Plant is a small potted flower that constantly collects the PM2.5 level from a windowsill. The idea is to provide real time air quality information on a large scale to show how air quality is affected by various events such as rush hour, late night trash pickup, or even what happens to air quality on a weekend. This type of information will expose potential inequities in air quality and pinpoint exactly where interventions may be needed. While there are obvious limitations to using low cost air quality sensors such as the one used in Particle Plant, this type of sensor is more than enough to show general neighborhood trends and to compare the data to the regional air quality level. Hopefully, with Particle Plant deployed to hundreds of windowsills across a city, people will be equipped to speak about the deficiencies in the air they breathe.

