BirdyBird

A PROJECT BY
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Prof. Anthony Vanky
Urban Informatics II, Spring 2019
Columbia GSAPP Urban Planning

Final prototype of BirdyBird

About Bhele & Le

Suprima Bhele is a second year graduate student at Columbia GSAPP in Urban Planning. Her concentration in in Urban Analytics. Prior to this stint, Supri obtained her Bachelor's in Mathematics and Statistics (along with Studio Arts) from Hollins University, VA. With a background in design and data, and extreme enthusiasm for urban tech, she hopes to incorporate all her interests in future practices.

https://medium.com/@sb4042

Ri Le (pronounced ARE-ee) is a Columbia GSAPP MS Urban Planning student from California who is interested in the intersections between urbanism, technology, and design. Ri installed their first Linux distribution in the fifth grade on an old Dell hand-me-down from 1999, and combines various disciplines and media such as media arts, photography, and graphic design to create things that inform, provoke, delight, and sometimes confuse. Ri graduated from Vassar College in Poughkeepsie, NY as an urban studies major and hopes to work in the fields of technology, design and urbanism in the very near future.

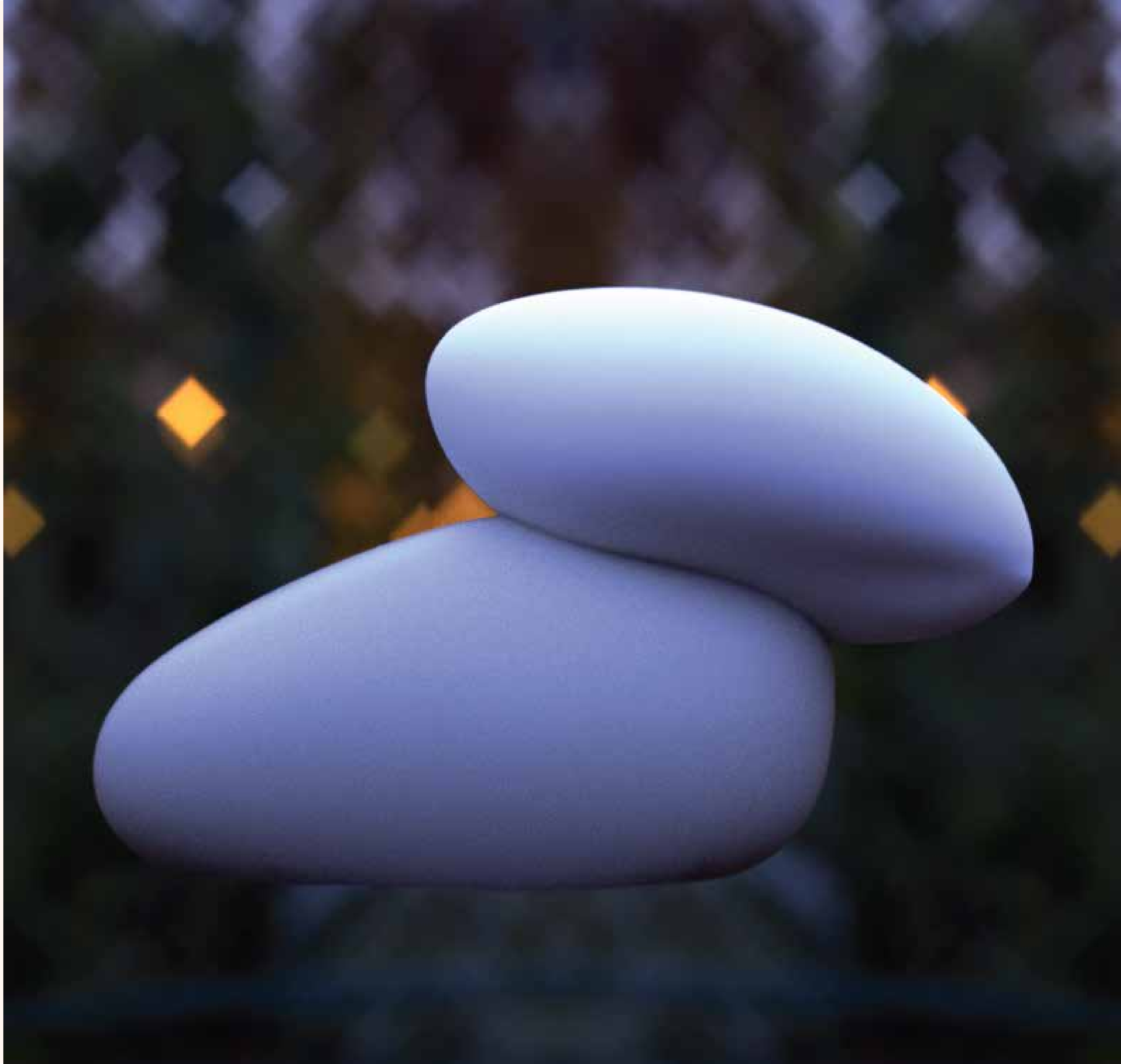
https://rile.digital

Executive Summary

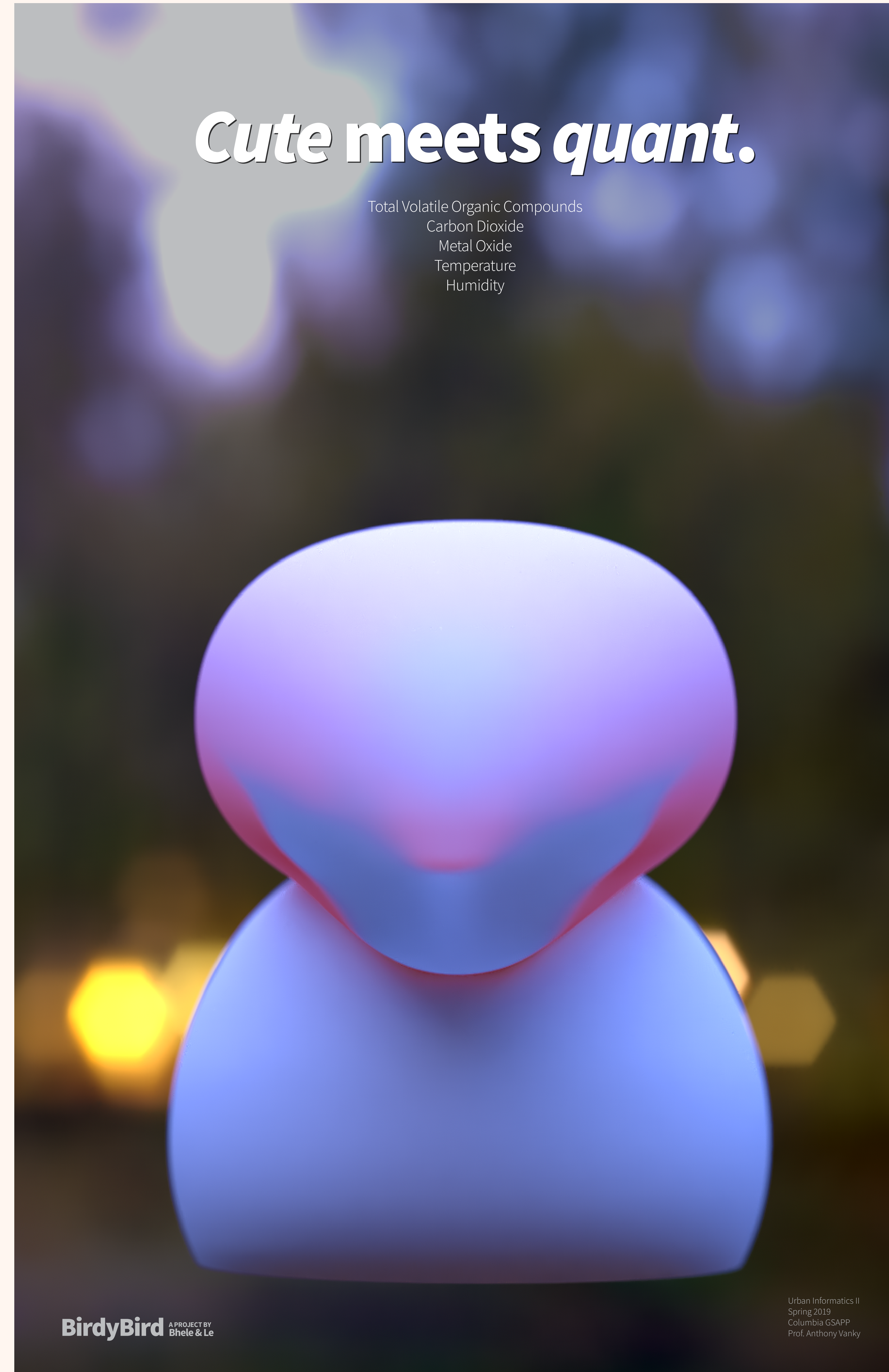
BirdyBird is a cute robot bird that beckons humans to become emotionally invested in improving environmental quality.

BirdyBird is a project that brings into conversation DIY sensing, design, and the emergent field of urban informatics to raise awareness about the daily experience of air quality. BirdyBird takes on the abstract form of an installation which actively collects and stores air quality data. BirdyBird emits a warm, red glow that amplifies in intensity to mimic the pace of one's breath. A faster breath implies difficulty breathing as a result of heightened detected quantities of Total Volatile Organic Compounds (TVOC) and Carbon Dioxide (CO2).

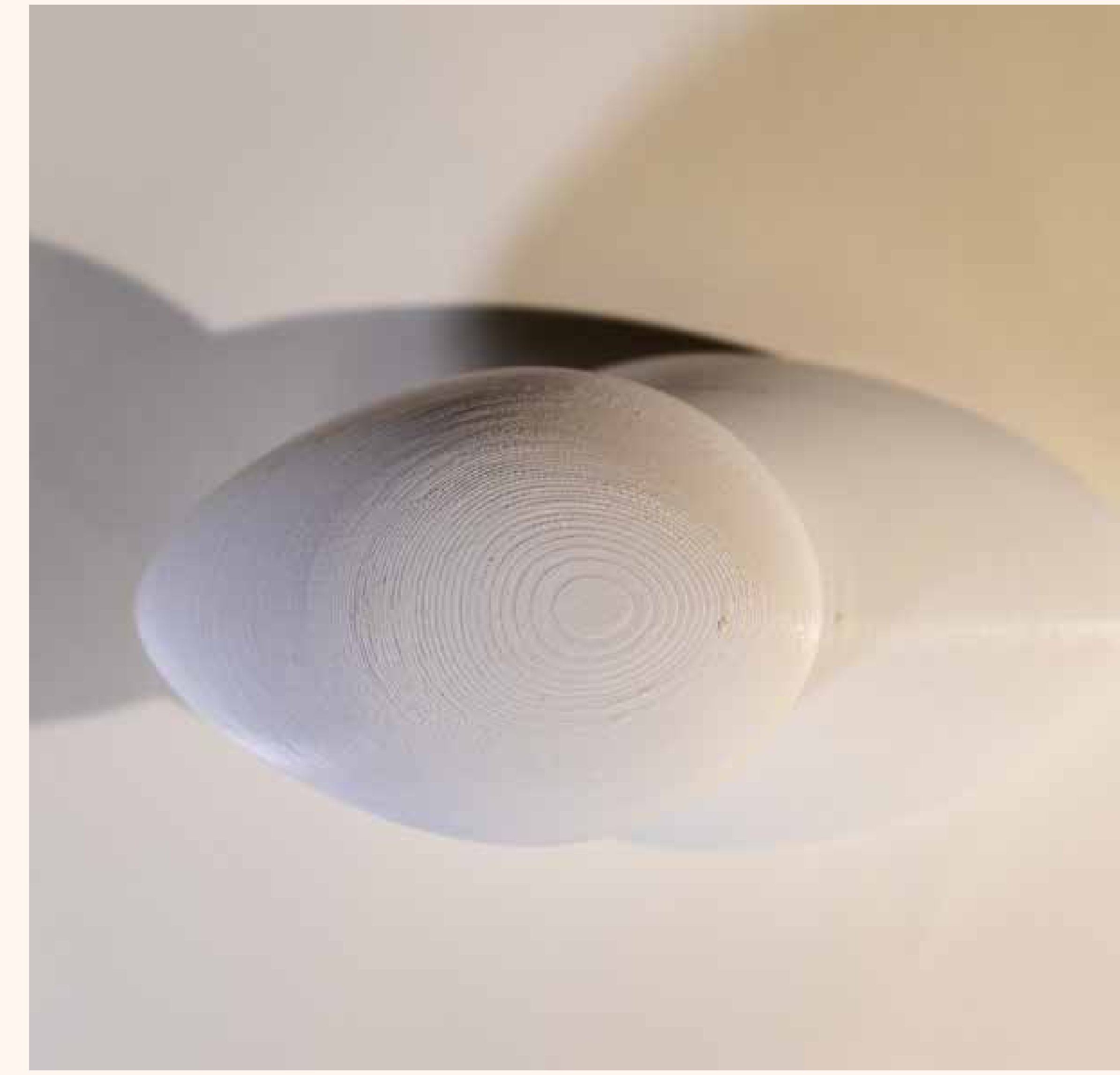
Anecdotal folk knowledge suggests that dogs, birds, bats and other animals of even larger sizes can sense earthquakes hours or even days before they strike. Before humans could employ electronic sensors to safely and continuously monitor and conceive invisible environmental conditions, they relied on the senses and expressions of animals to discern equilibrium flux in the environment. Humans have exploited this quality throughout history; Canary birds were such a sentinel species, used in the mining industry to detect the buildup of toxic gases such as carbon monoxide.



11” by 17” posters








When the air quality is unhealthy, BirdyBird pulses, or breathes, at an increasingly faster rate— a homage to her birdy brethren who perished in the coal mines of the Industrial Revolution. BirdyBird is a cute, cuddly, and keen animatronic bird that produces environmental quality data and makes this information legible through her affective interface paradigms. She is our bird friend that becomes increasingly distressed when she senses unhealthy air quality.

BirdyBird seeks to fill the void between "quant" and cute— making abstract environmental data accessible through applied affective computing techniques. BirdyBird is not merely a data collection device that can produce and contribute to localized environmental datasets, but also an educational tool whose ultimate mission is to raise questions and provoke discussion on the invisible characteristics of our environment such as air quality.

The ethos behind BirdyBird came from a simple prompt from our professor Anthony Vanky, who remarked of the abstract nature of climate change,

"If you asked the average person on the street to describe climate change… they would probably just say something like, 'Oh, I think the weather is warmer where I live, I guess?' But the problem is, how do you communicate the urgency and essence of something large and difficult to see like climate change?"

Local Interactions

Following the example of Mark Weiser and John Seely Brown's "calm technology." BirdyBird seeks to impose minimally on humans. The sense of urgency we wish to convey regarding air quality dictates BirdyBird's level of activity. "Better" air quality—ideally, a default behavior—is represented by the default pattern of a soft, slow pulsing that resembles that of a human breath. As the air diminishes in quality, the pulsing becomes rapid and increasingly urgent. We felt that this was an appropriate affective response worthy of calling the most attention capable for our device.

AT THE 1 METER SCALE, BirdyBird can suit in any location. Her aesthetically pleasing design is fitting for any environment, whether in concert with modern settings or contrast with vernacular, folk, classical, or natural settings. BirdyBird's warm glow can be comforting at the lowest intensity or stimulating and rapid at higher ones.

AT THE 10 METER SCALE, BirdyBird backgrounds itself as effortlessly as the buzz of cicadas, the glow of fireflies, or the chirping of birds. A "flock" of BirdyBirds could be deployed across a small area such as a park, all glowing in concert. The urban public nature of BirdyBird would quickly become apparent at 10-meter scales since BirdyBird units all respond to the same air quality measures and would glow in a spatially clustered manner.

AT THE 100 METER SCALE, BirdyBird is an urban pattern. BirdyBird blends into space, offering real-time feedback and data production on a large scale.

Designing for Affect with Semiotics and Aesthetics

The BirdyBird design process was an intensive exercise in industrial design. We began our design process by researching notions of cuteness and affect, distilling these into visual elements, and taking an inventory of affective representational techniques. Abstraction (a la modernist tradition) was a key design principle that allows us to enable affective agency in the viewer. By using simple geometries and an abstract form, we were able to create a form factor that was ambiguous enough for us to impart meaning into using linguistic and visual branding cues. The structure itself was designed to engulf and obscure the technology powering the device completely; hence, we started the design at dimensions that are larger than the sum volume of our electronics components.

We looked to the work of Jony Ive, Teenage Engineering, Dieter Rams, Maya Lin, Isamu Noguchi, and Constantin Brancusi to find successful examples of both geometric and organic form-making. We were particularly interested in obscuring the technology aspects of our project in the design of the device; thus, we only made compromises in the largely uninterrupted surface of the shell to create necessary ventilation holes to ensure internal air circulation for sensor exposure. We also avoided top-facing holes to maximize weather resistance. We felt that minimizing the technological aspects of our device from the spectator's perspective would allow the foregrounding of the "breathing" pattern and the animal-like form rather than the technical details of the unit.

Our project was initially titled Gaia as a reference to the project's environmentalist origins. However, we learned after short pitch sessions with Arlene Ducao and Anthony Vanky that the name of a project can be a powerful tool in achieving the desired affective qualities. Hence, we reverted to the diminutive, playful, sing-song name of BirdyBird after much deliberation.

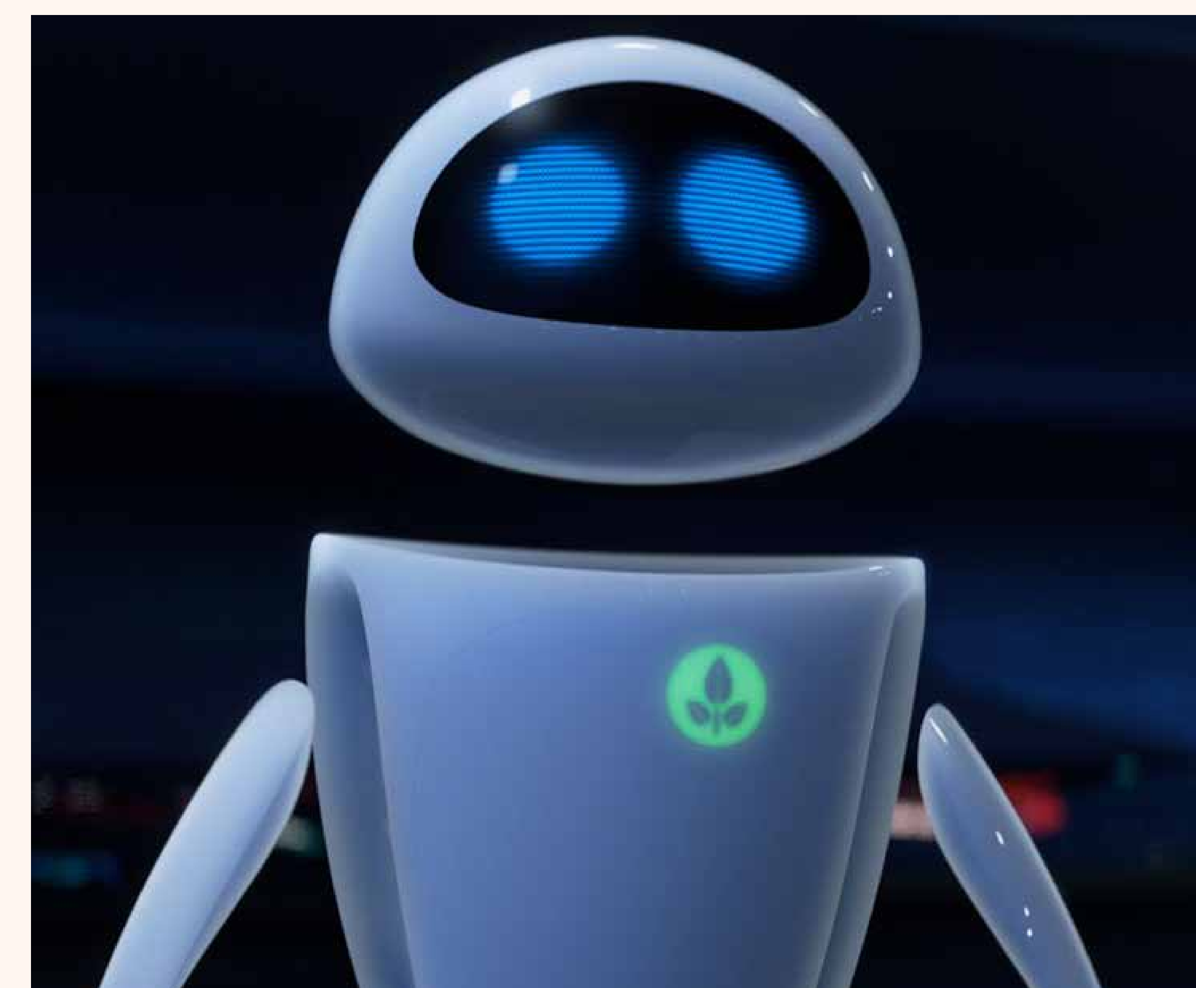
Isamu Noguchi, Water Stone

Maya Lin, Stones

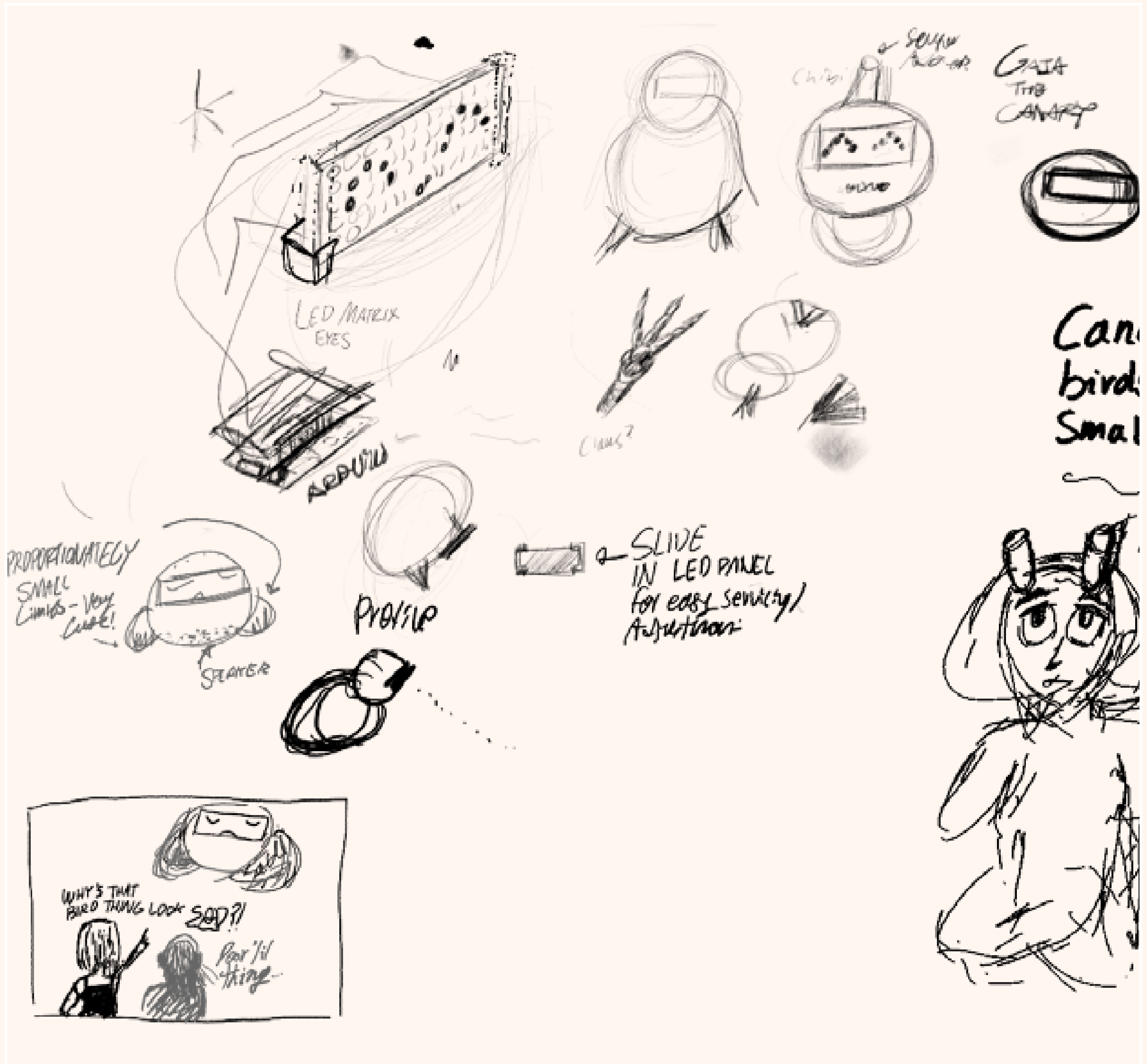
Constantin Brancusi, The Miracle (Seal [I]) (Le miracle)

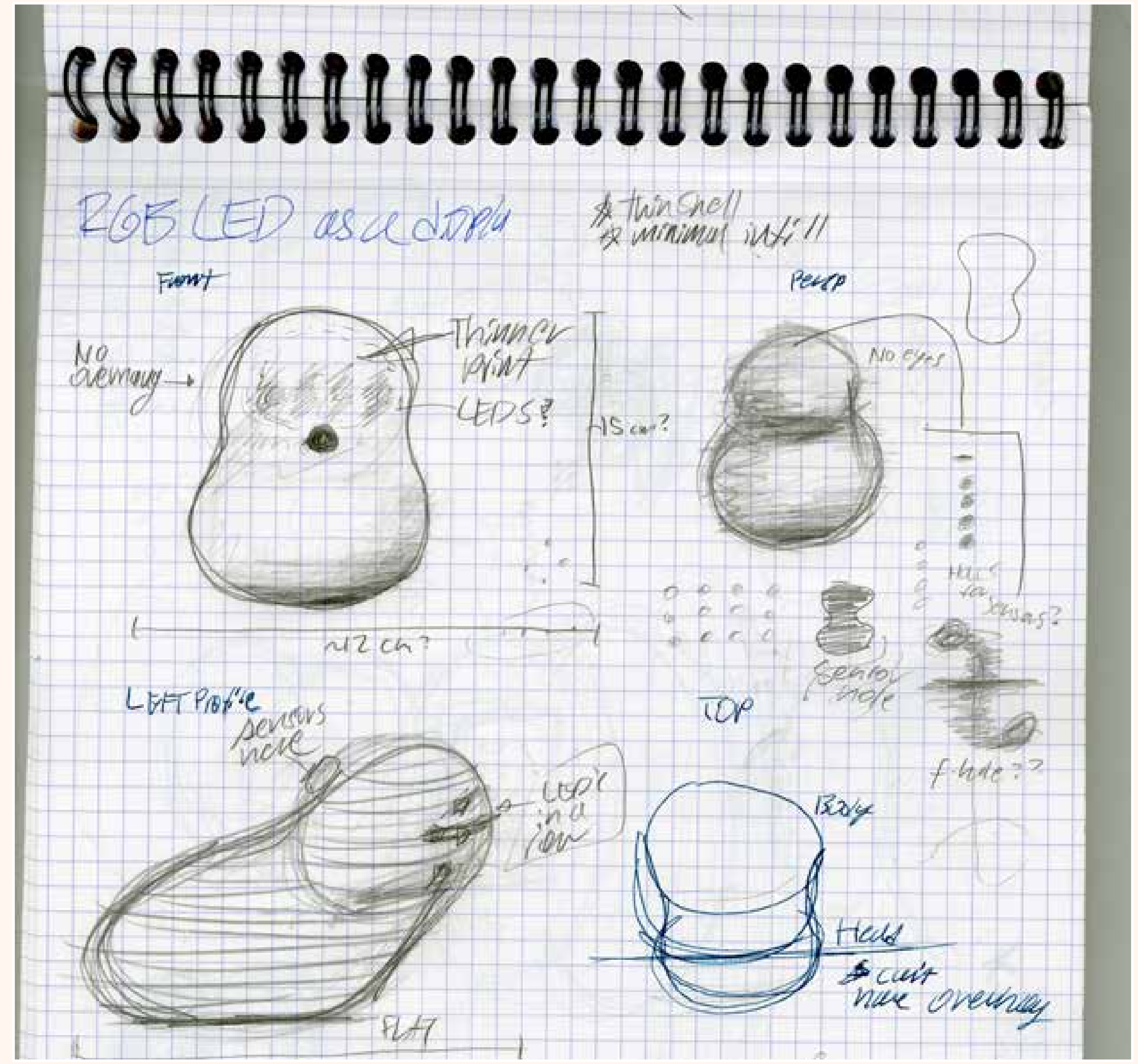
Apple Homepod

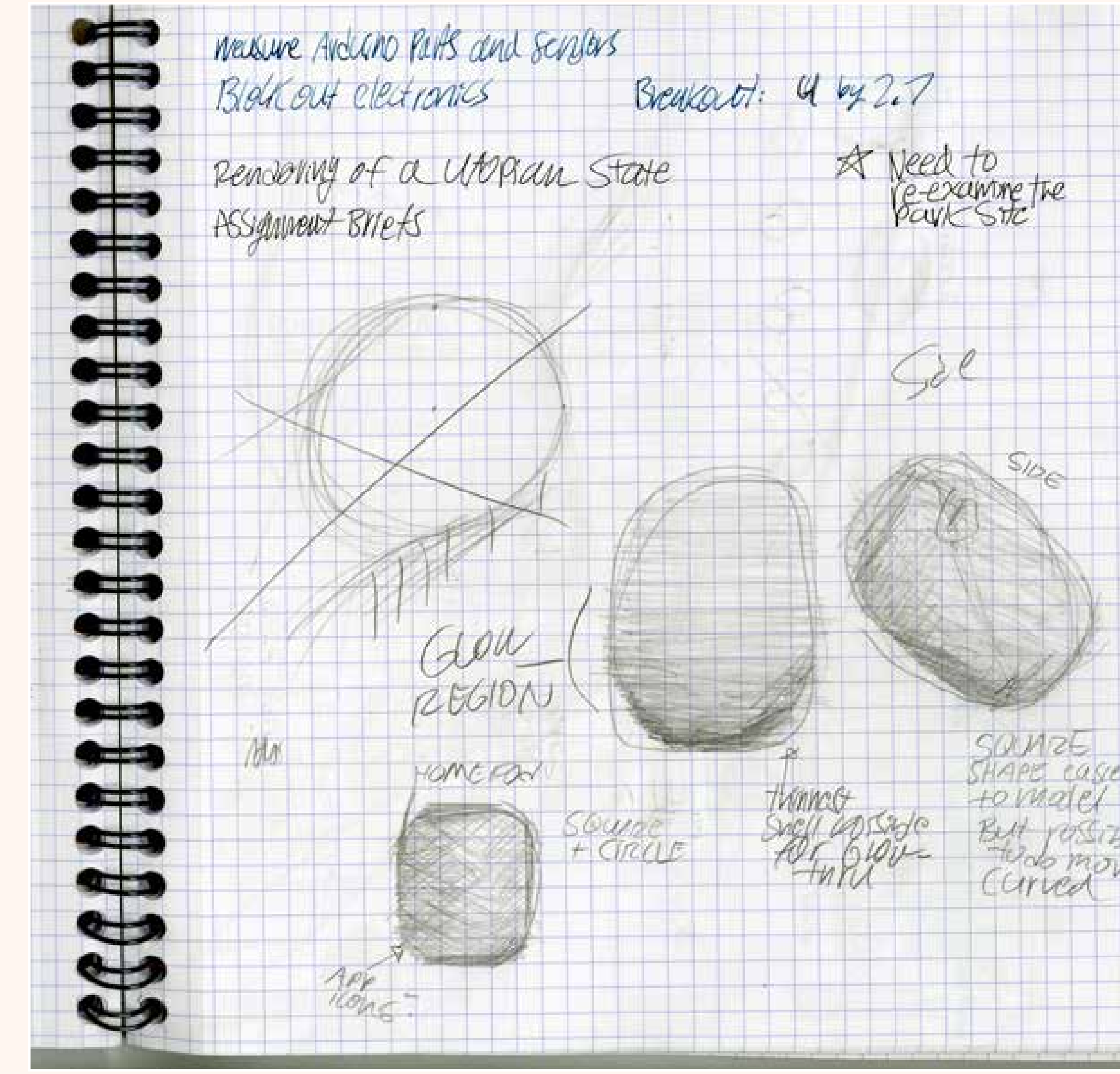
Teenage Engineering, Raven

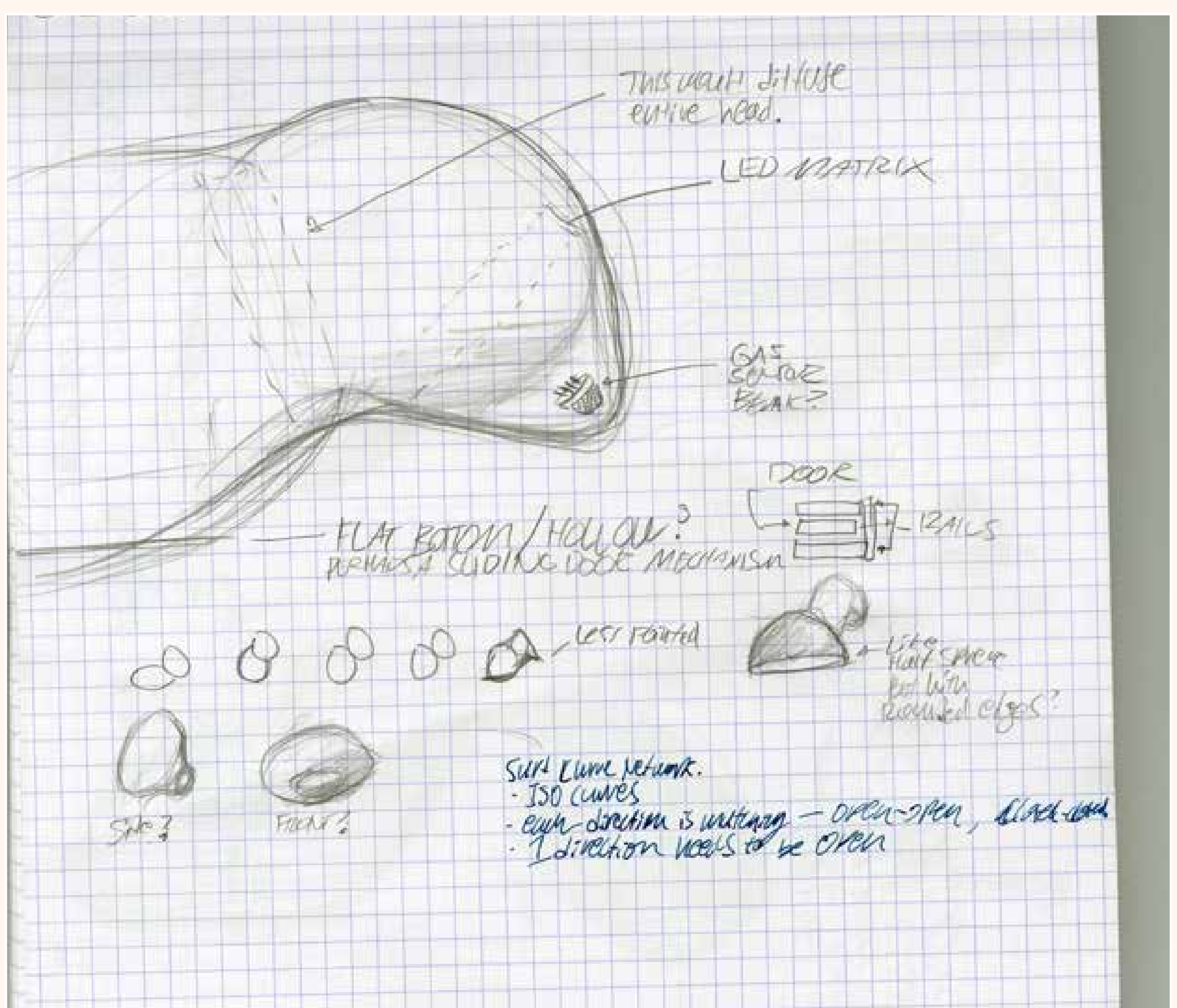


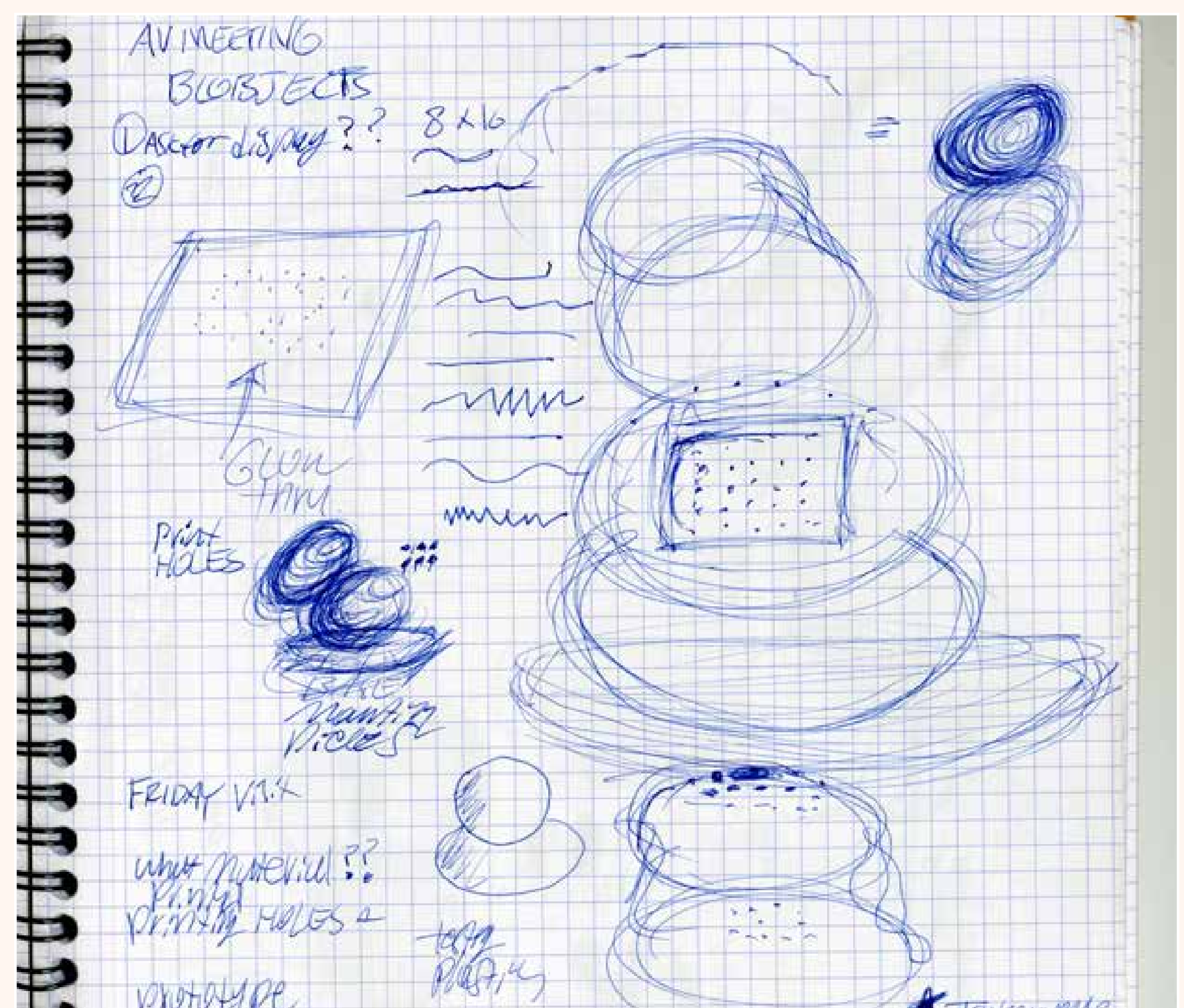
Pixar, EVE from Wall-E


LED MATRIX EYES
ARDUINO
PROPORTIONATELY SMALL
SPEAKER
PROFILE
SLIDE IN LED PANEL for easy sensitivity/ Adjustment
WHY'S THAT BIRD THING LOOK SAD?!


RGB LED as a display
Front
No overhang
Thinner print
LEDS?
Left Profile
Sensors here
TOP
Head
FLAT

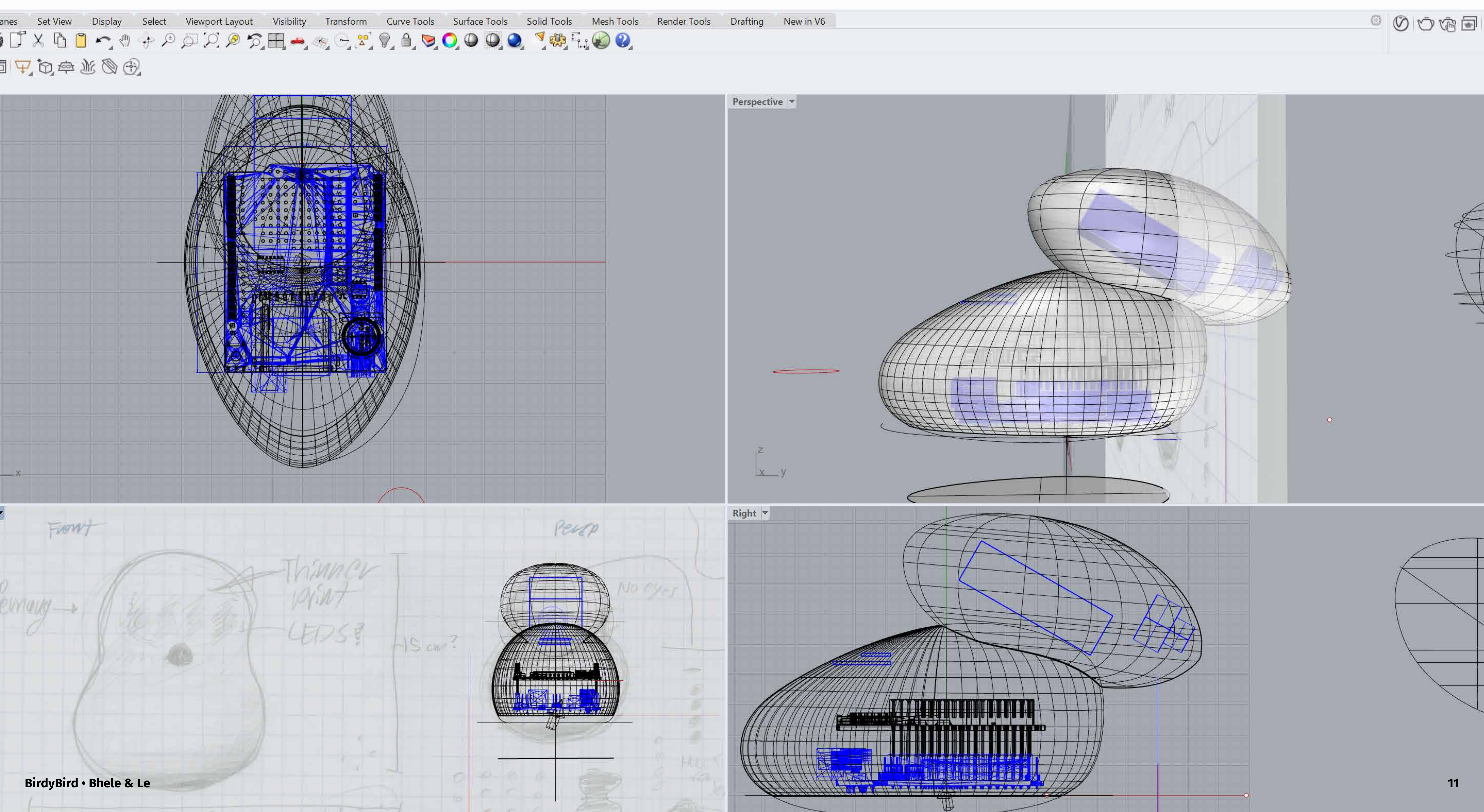

Measure Arduino Parts and Sensors
Breakout electronics
Breakout: 4 by 2.7
Rendering of a Utopian State
Assignment Briefs
Need to re-examine the park site
Side
GLOW REGION
SQUARE + CIRCLE
SQUARE SHAPE easier to model


This would diffuse entire head.
LED MATRIX
GAS SENSOR BEAK?
DOOR
FLAT BOTTOM / HOLLOW?
PERHAPS A SLIDING DOOR MECHANISM
RAILS
Side?
Front?


AV MEETING
BLOBJECTS
8 x 16
Glow thru
PRINT HOLES
FRIDAY
What material?
prototype


BIRDYBIRD IS PART PUBLIC ART, PART AMBIENT INFO DISPLAY.
BIRDYBIRD'S PRESENCE IS MINIMAL — FOREGROUNDED WHEN CONDITIONS NECESSITATE.

The form of BirdyBird was accomplished using a complex curve network.
The form was also dictated by the physical requirements of the hardware inside.



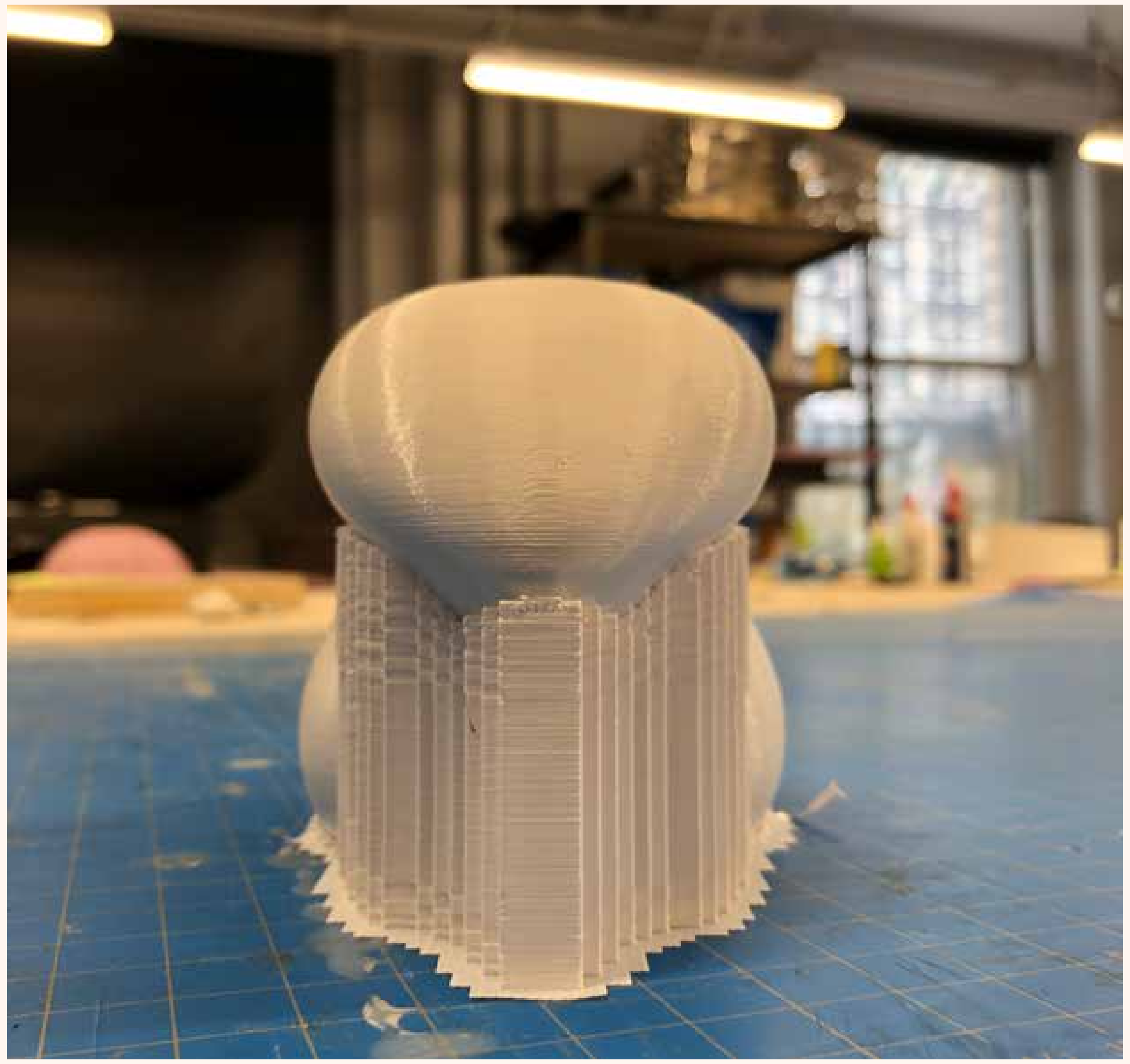
Hardware and Software Prototyping

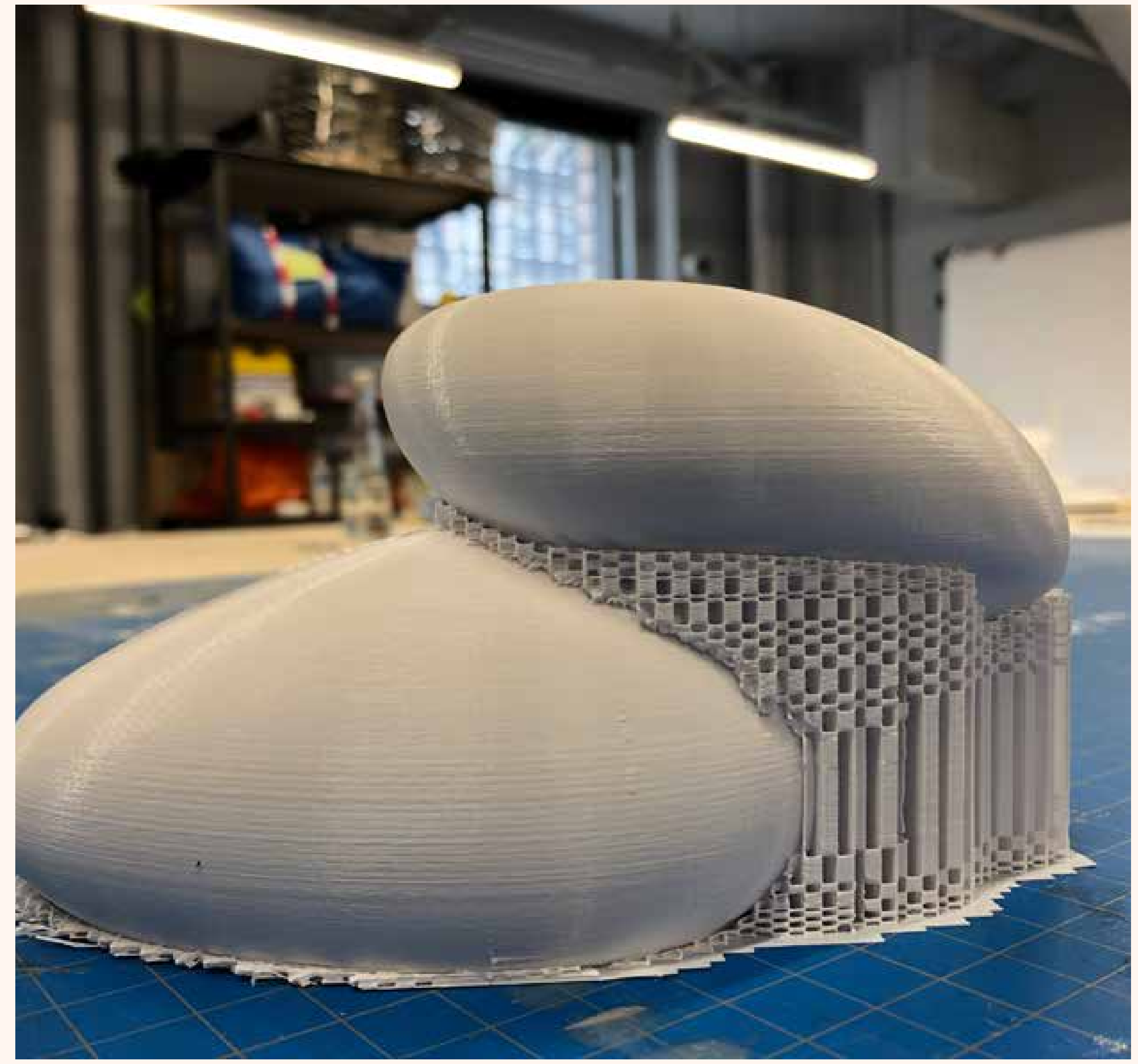
Three models were created with white PLA plastic to preview the form factor of the device. We "tested" the aesthetics of our models by showing them to our peers and eliciting informal feedback. An overwhelming majority of our peers described the form as "very cute." A few observers were, at the very least, intrigued by the mysterious form and function of the unit. We considered both of these to be appropriate and desired and deemed these iterations successful and worthy of further prototyping.

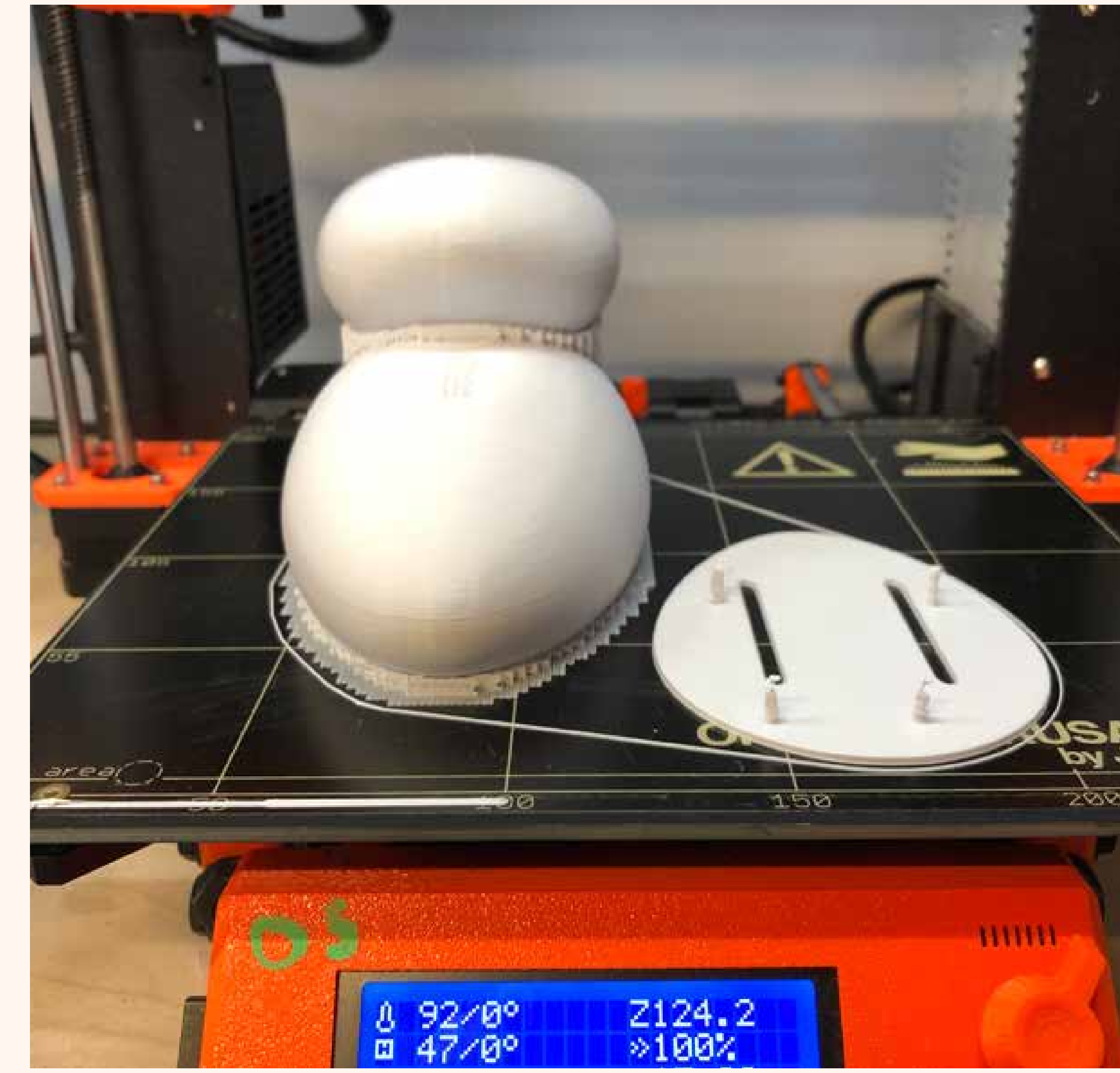
In terms of software engineering, our project was particularly challenging in its software design. The programming of our device operates from a simple logic: initialize the hardware, take measurements and write them to the storage, collapse the CO2 and TVOC measurements to a "stress index," and animate the LED matrix in accordance to this index value.

However, the software engineering aspect of our project was particularly challenging with the interplay between hardware and software. When a hardware component is misconfigured, the software behaves erratically and in unexpected ways. For example, we had mistakenly assigned two different modules to the same input pin on our Arduino board, causing both the LED display and the data logger to behave erratically. Also, the LED matrix proved particularly challenging to program, as the examples provided were not well documented. As a reflection on the practices of software development, it would have been beneficial for library developers to take a more proactive approach in designing user-friendly libraries. For instance, a general overview of the event flow and set-up process of the LED matrix animation process would have significantly benefited our implementation.

Visting Tinkersphere in lower Manhattan to purchase parts

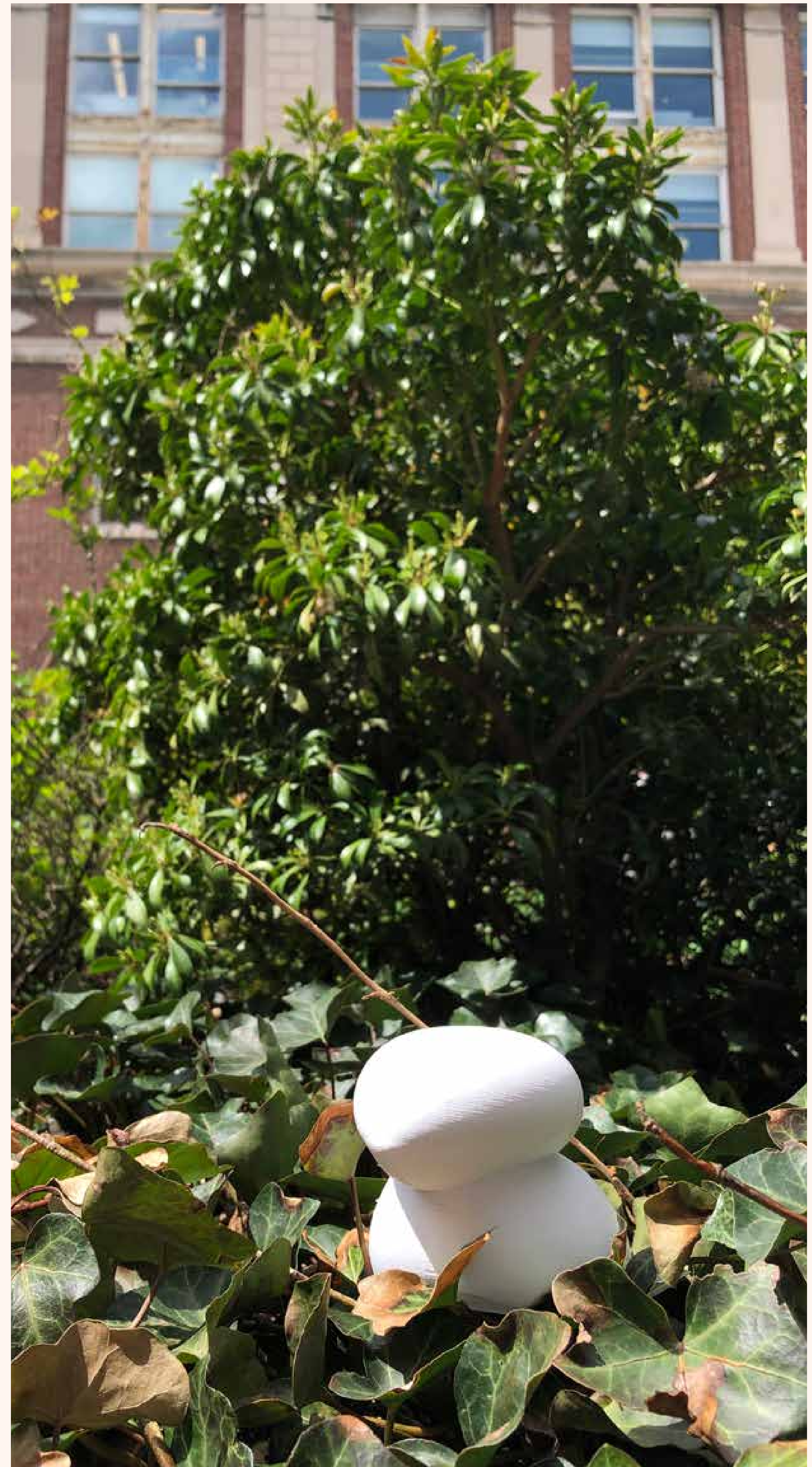





92/0°
Z124.2
47/0°
»100%





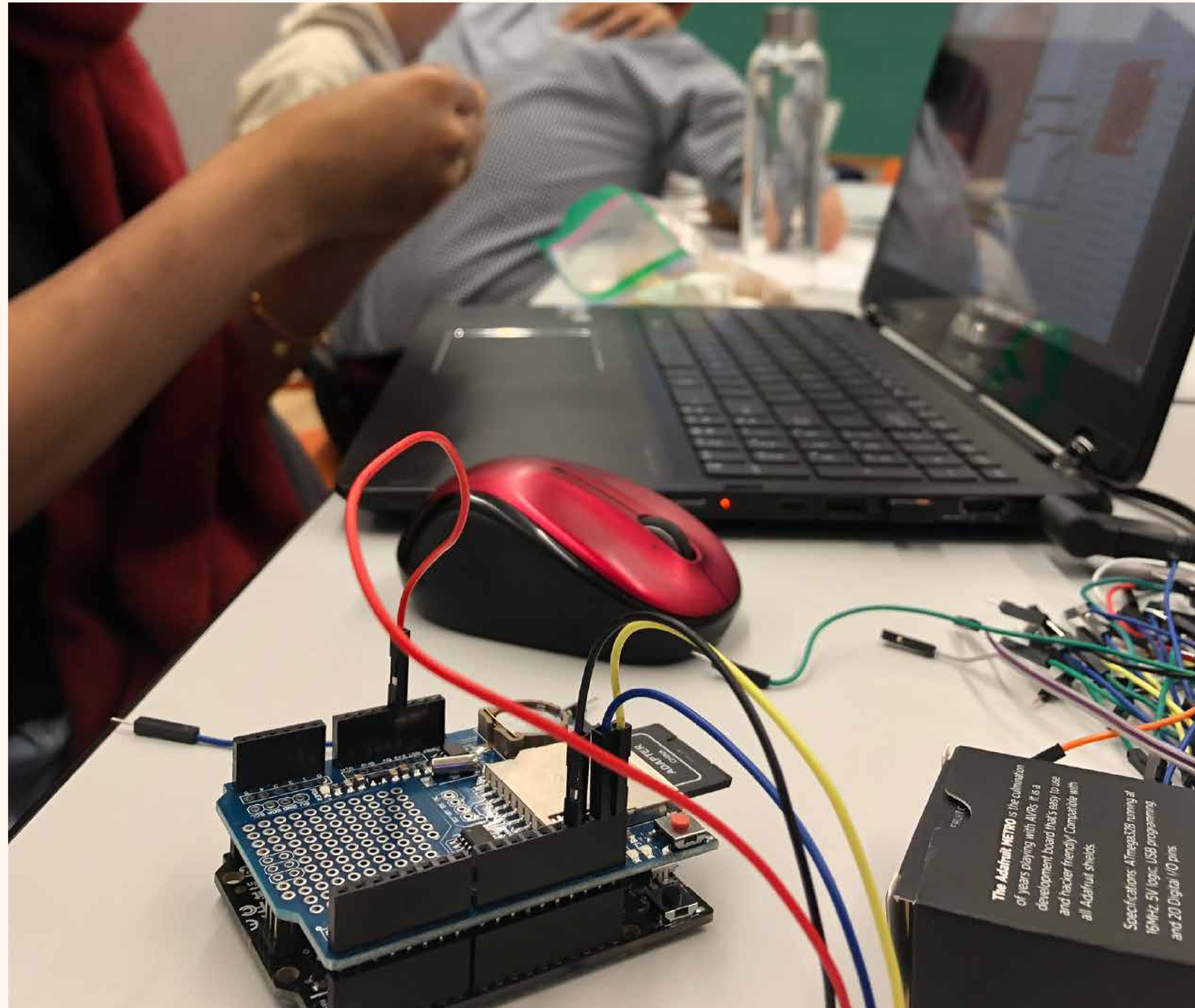



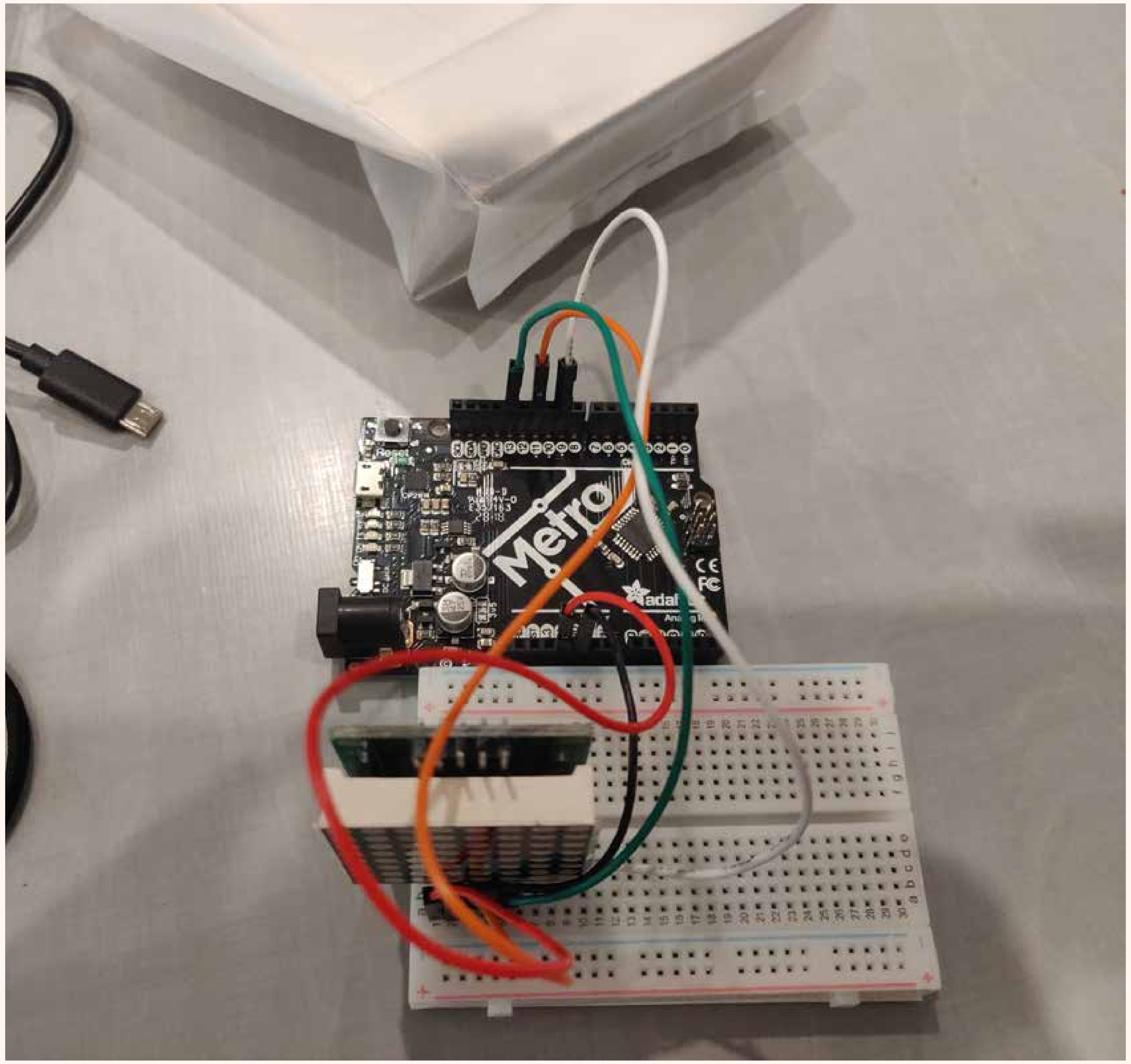
Hardware and Prototyping and Sensing Technologies

Air quality is more than just visibly clean or unclean air. It is easier to address “bad air” that is visible in the form of haze or smoke. For instance, construction sites, industrial facilities, and large automobiles emit highly visible and offensive gas and smoke. However, there are other compounds/pollutants in the atmosphere that causes harm to living beings, which are not noticeable to naked eyes.

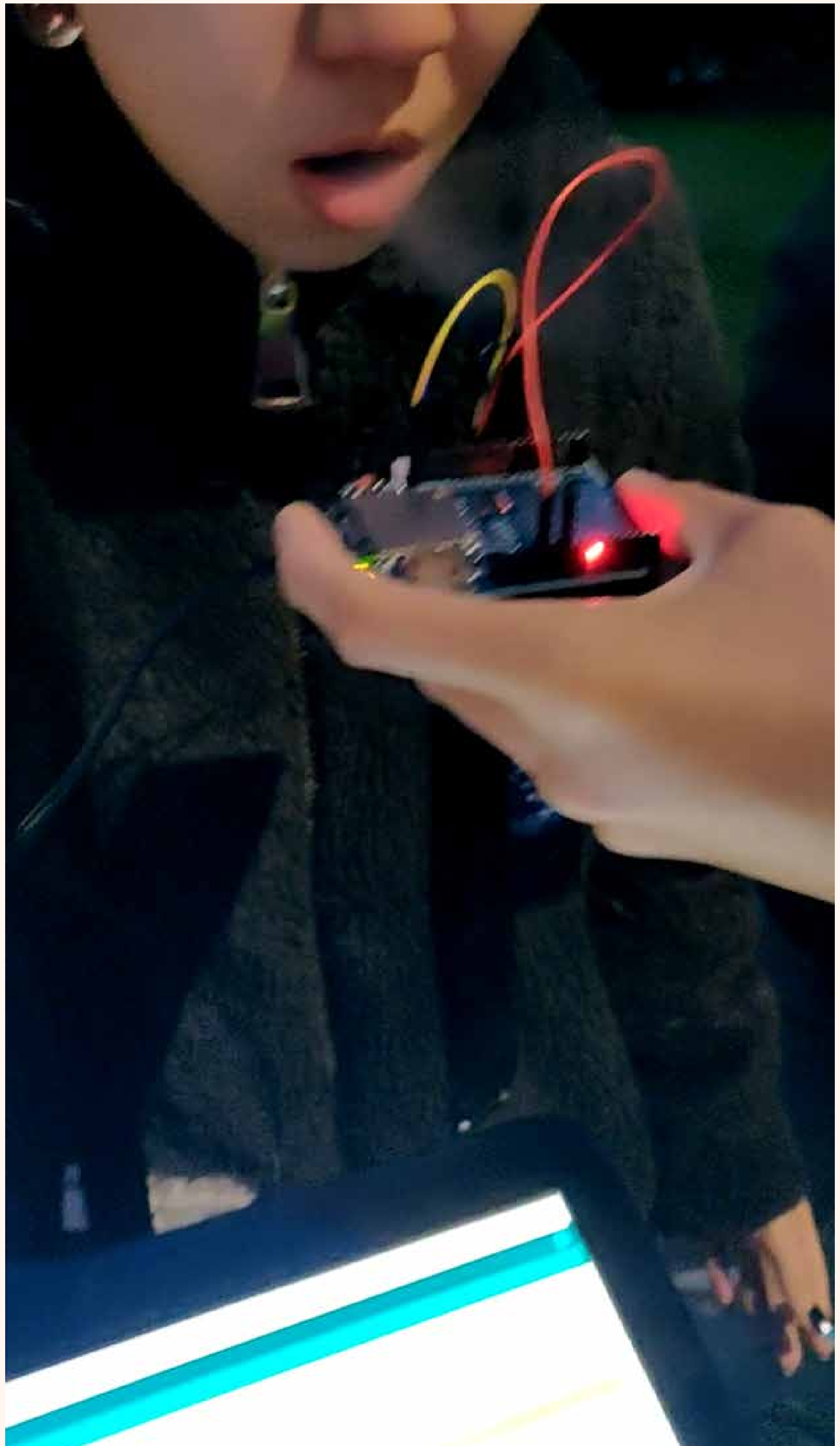
Total Volatile Organic Compounds, or TVOCs, are emitted from solvents, paints, gasoline, and alcohol, and are associated with smog and adverse health conditions. High levels of carbon dioxide, or CO2, are associated with adverse health conditions such as drowsiness, increased heart rate, loss of attention, and slight nausea.

Our device uses the Arduino hardware prototyping platform. We used an Arduino Uno board with the Datalogger shield to facilitate timekeeping and data logging. BirdyBird primarily utilizes the Sparkfun CCS811 Air Quality Breakout, which detects both of these measures. Finally, BirdyBird uses the TinkerSphere 8x8 Red LED Matrix module to achieve the glowing effect.

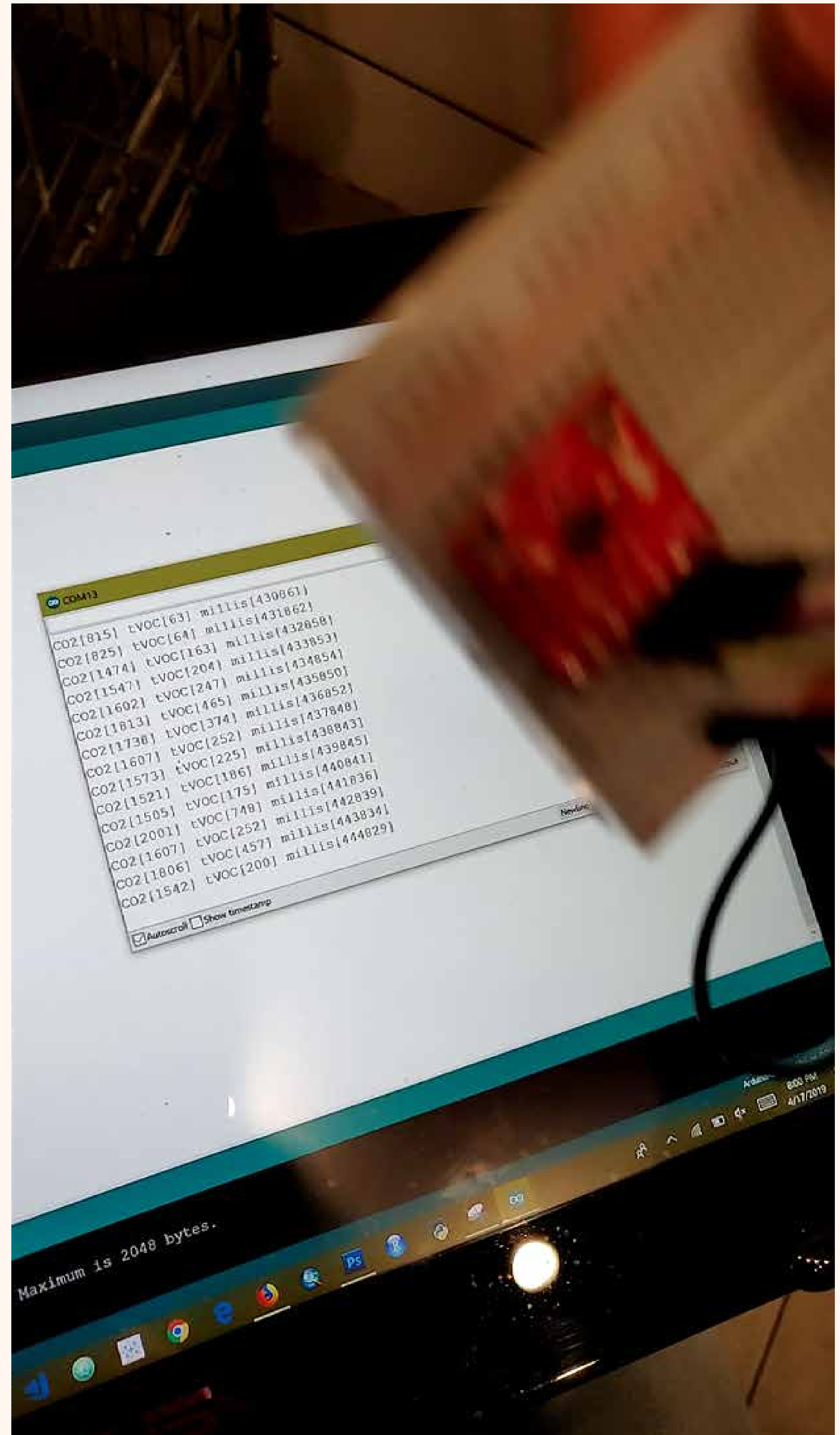



Metro

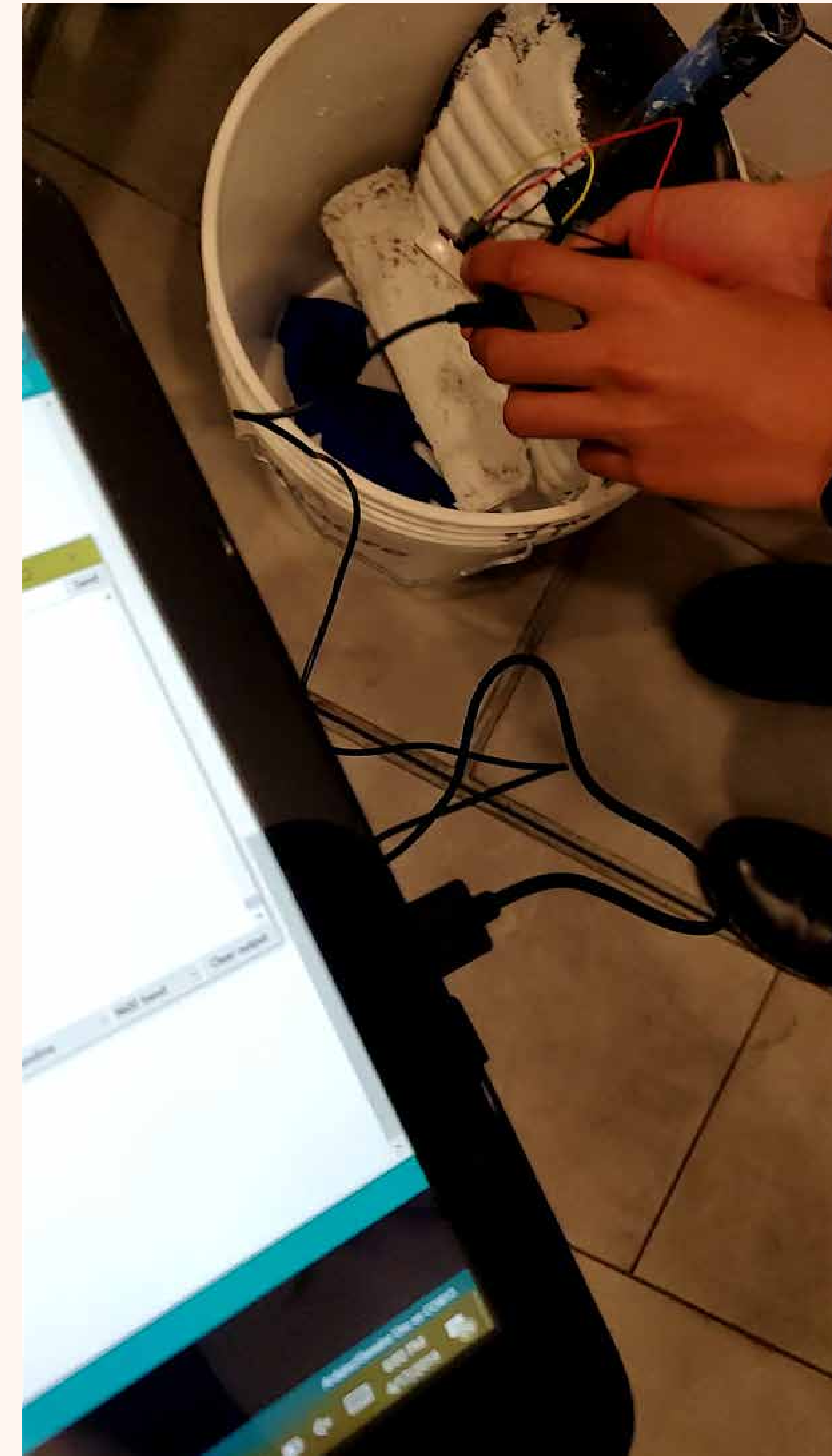

TINKERSPHERE
ROBOTICS & HOBBY ELECTRONICS
TINKERSPHERE
ROBOTICS & HOBBY ELECTRONICS
POWERTRON BATTERIES
CR1220
3V



Asking an anonymous volunteer to blow smoke
into the air quality sensor



Air quality sensor tests...



Placing sensor near a paint bucket increased TVOC readings

The BirdyBird Pilot Project

In collaboration with NYC Parks, Professor Anthony Vanky assigned our project to Starlight Park in the Bronx, a few minutes south of the Bronx Zoo. Starlight Park is located on the Bronx River and is a well-utilized park with many families and younger attendees enjoying the various basketball courts and playgrounds in the park.

On May 4th, we traveled to Starlight Park to deploy BirdyBird...

We deployed BirdyBird alongside our classmates, Cloud Team...






In addition to placing BirdyBird on a tree, we also carried BirdyBird around the park in order to look for variation in readings.

Analysis and Visualization

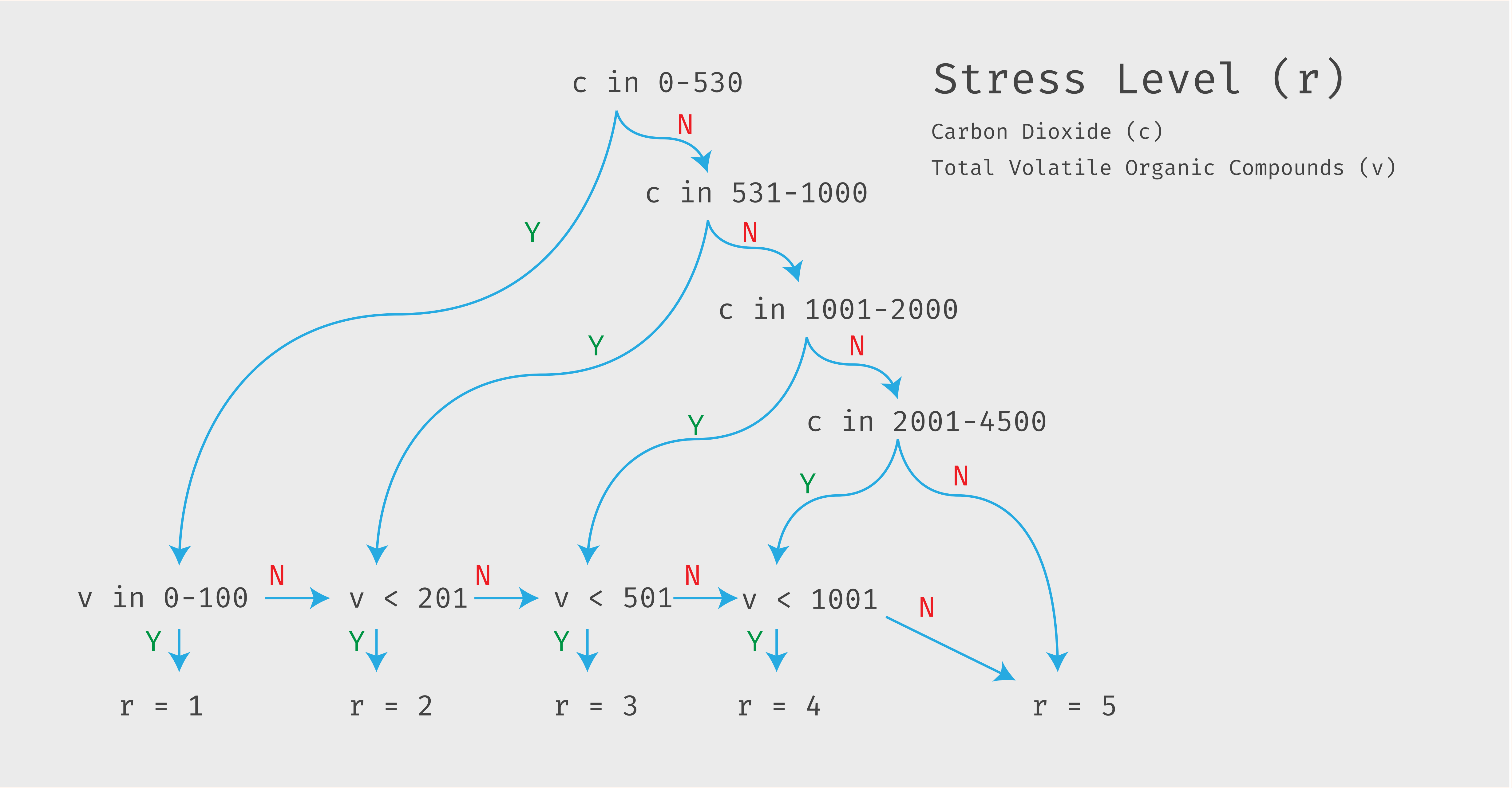
Stress Level Calculation

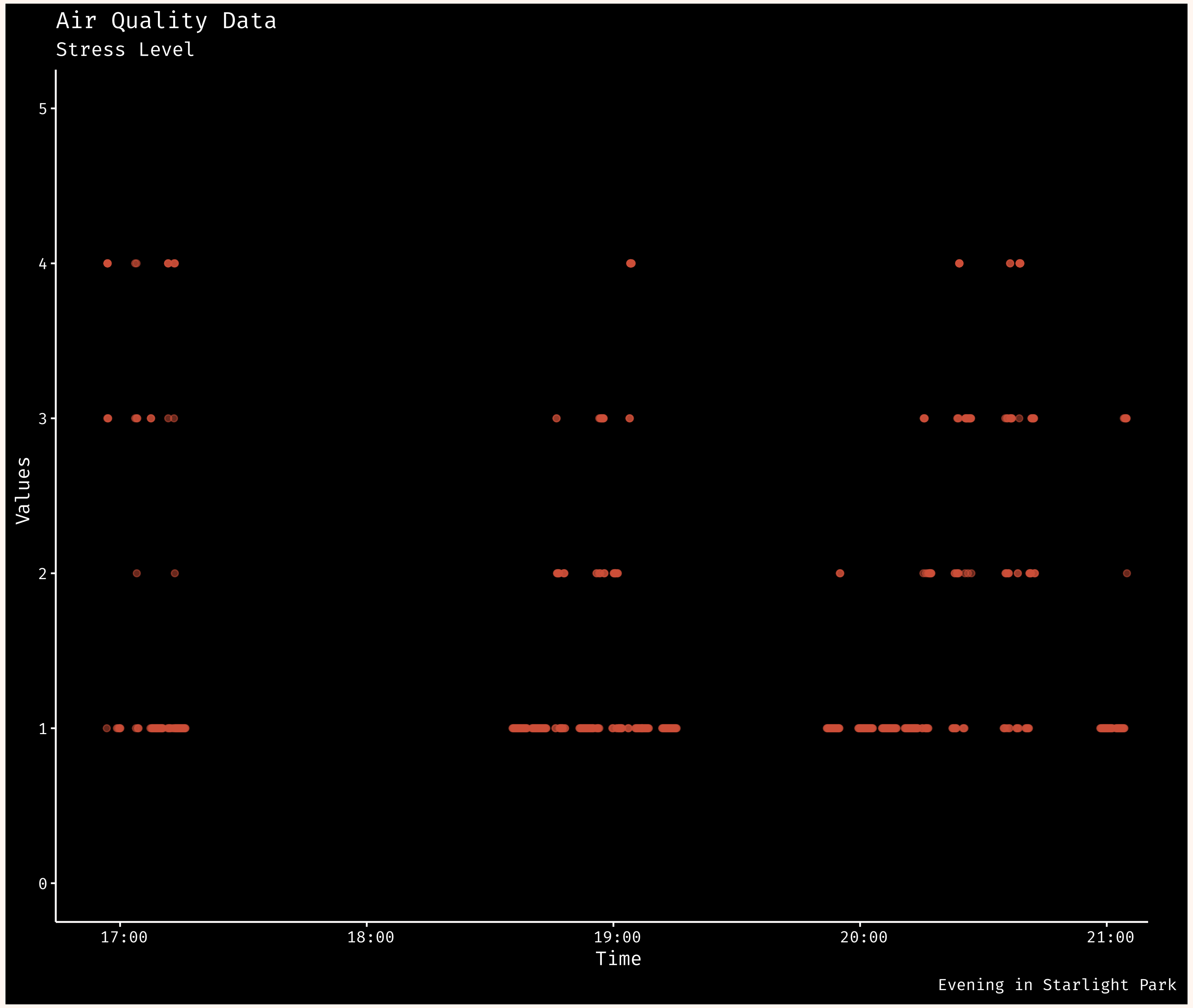
Consideration for CO2 and TVOC levels:
The units used by the sensor for CO2 and TVOC measurements are ppm and ppb. Source: ("What are safe levels of CO and CO2 in rooms?,". Kane International.)

Using the above data as as guide, CO2 measurements were divided into five bins.

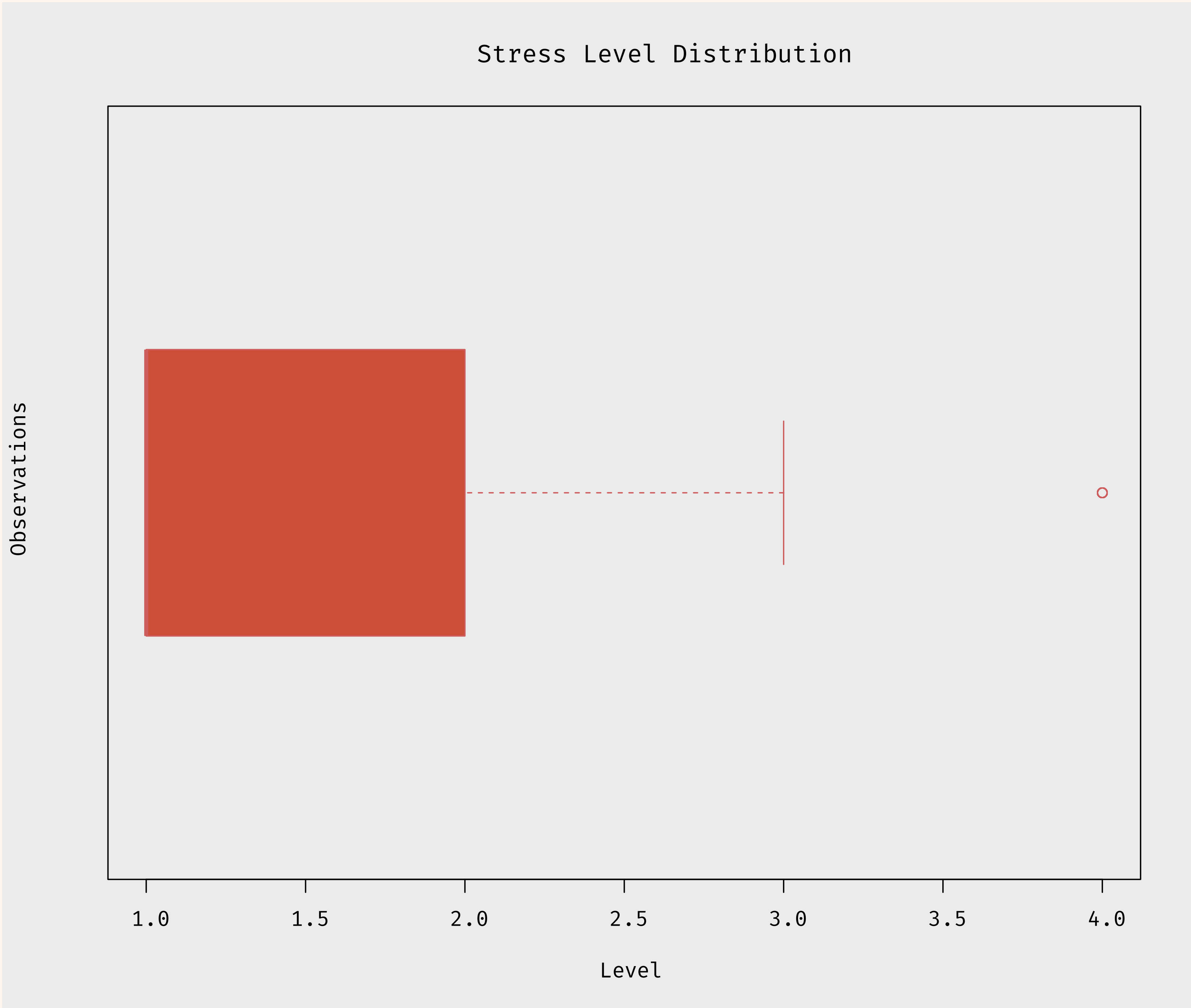
For TVOC, no relative danger guides were found during our process. VOCs are mostly present indoors than outdoors. We used our own intuition through sensor observations to create TVOC bins.

When fresh wall paints were used around the sensor, TVOCs went upto 546 as the sensor got closer. Relative measurements were also taken with cigarettes and an e-cigarette around the sensor.



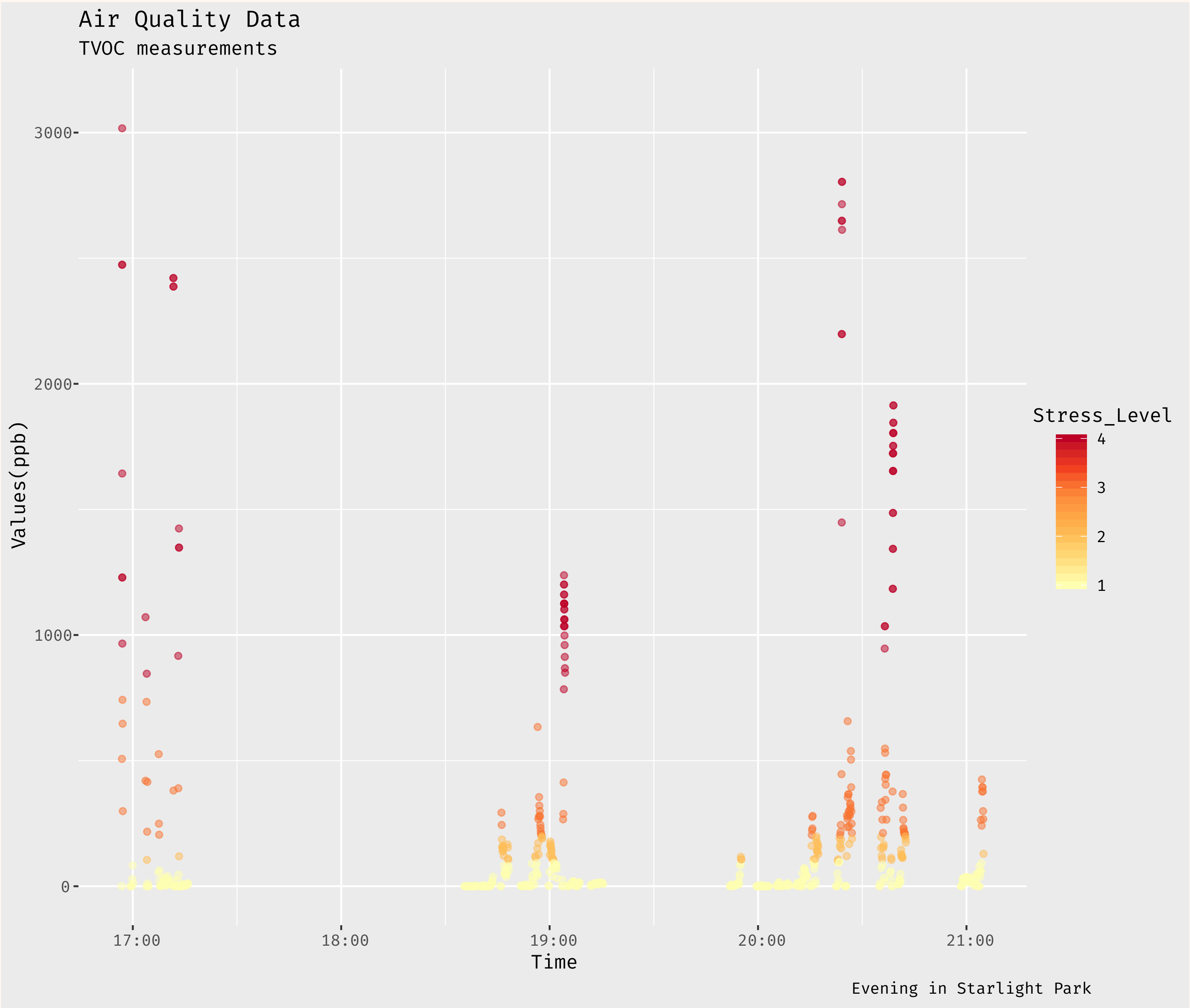


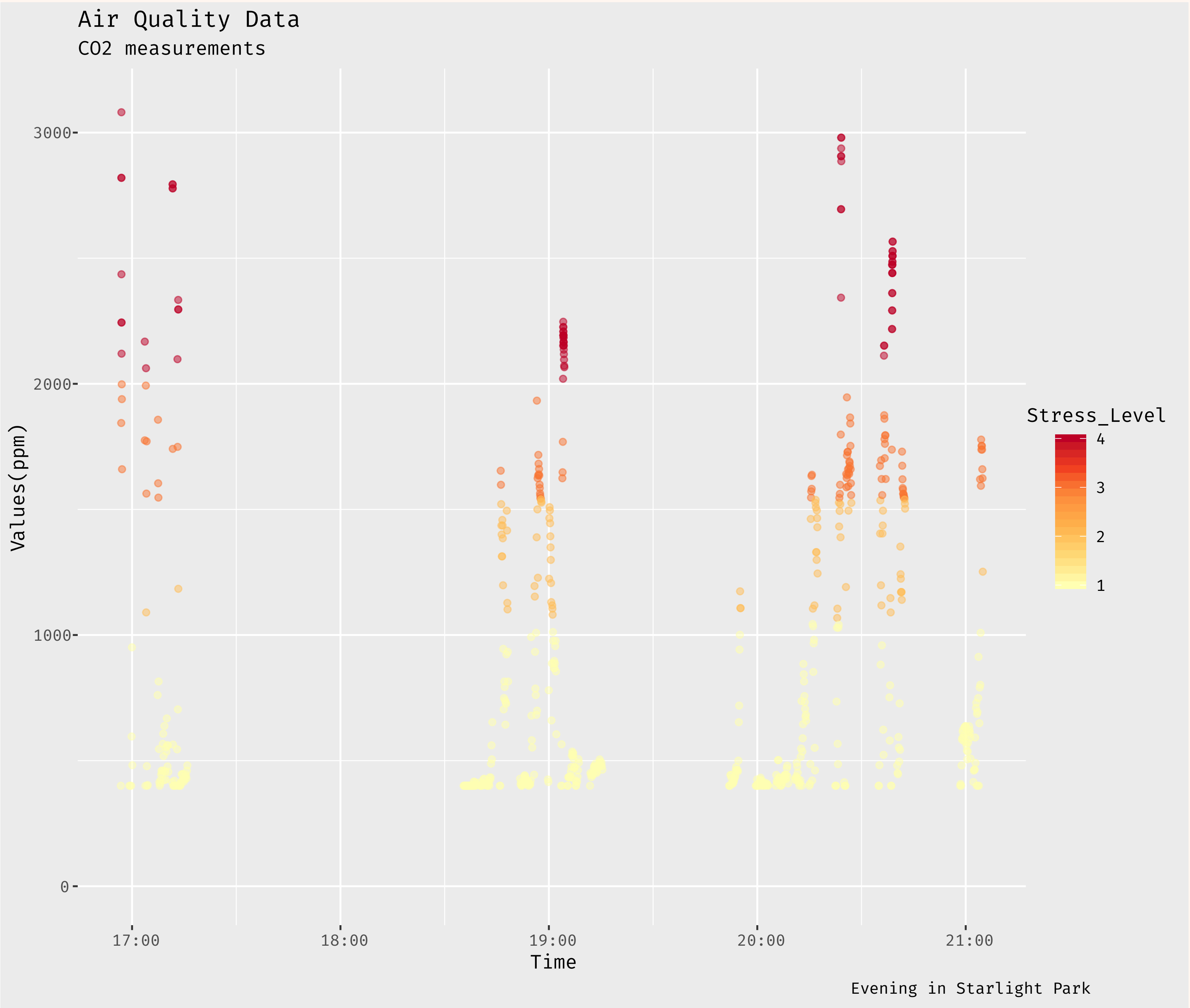
This graph shows a time series of Stress_Level (1 being the least) observed at the site visit. The majority of observations made had low stress levels.

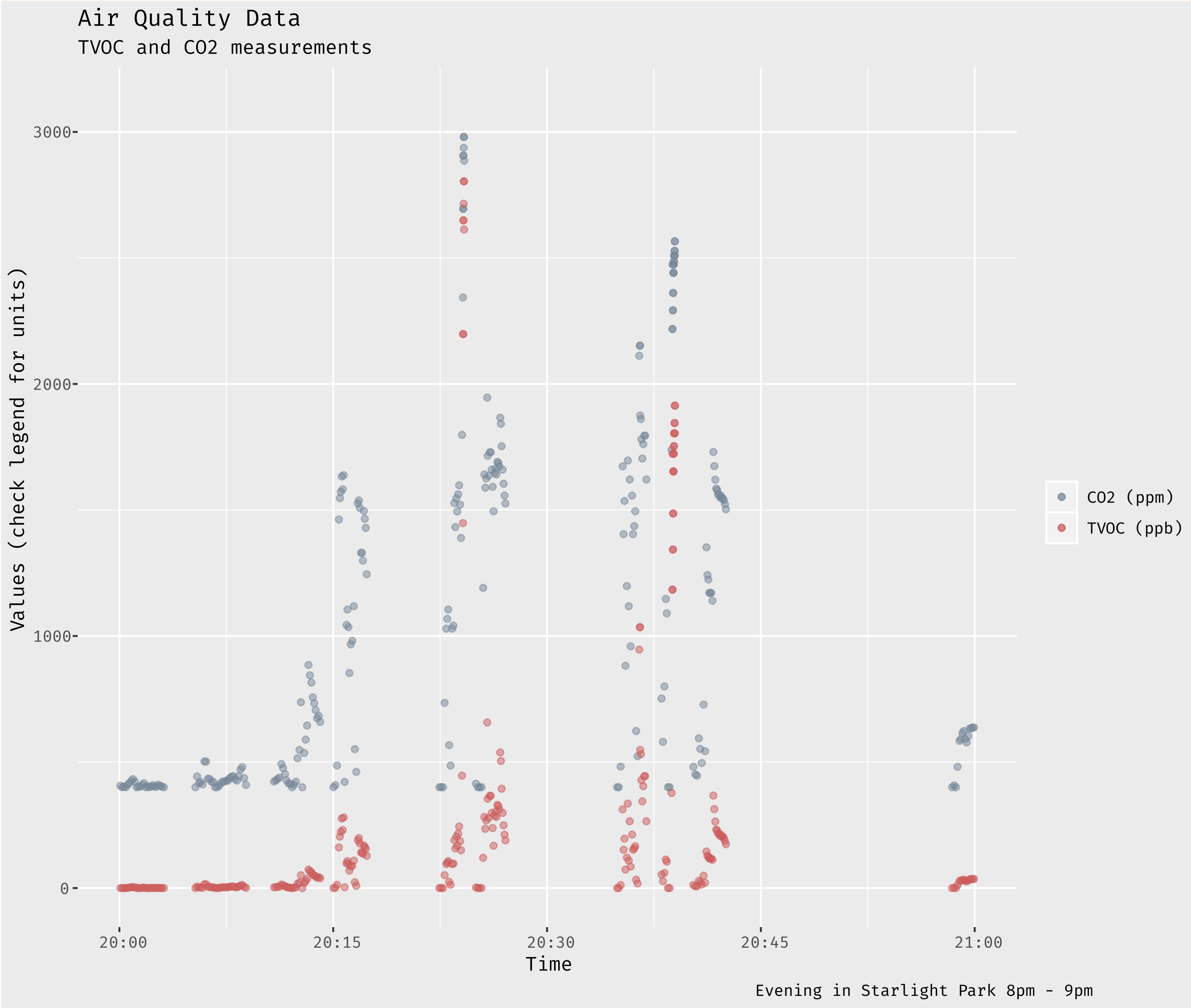


This graph shows a time series of Stress_Level (1 being the least) observed at the site visit. The majority of observations made had low stress levels.

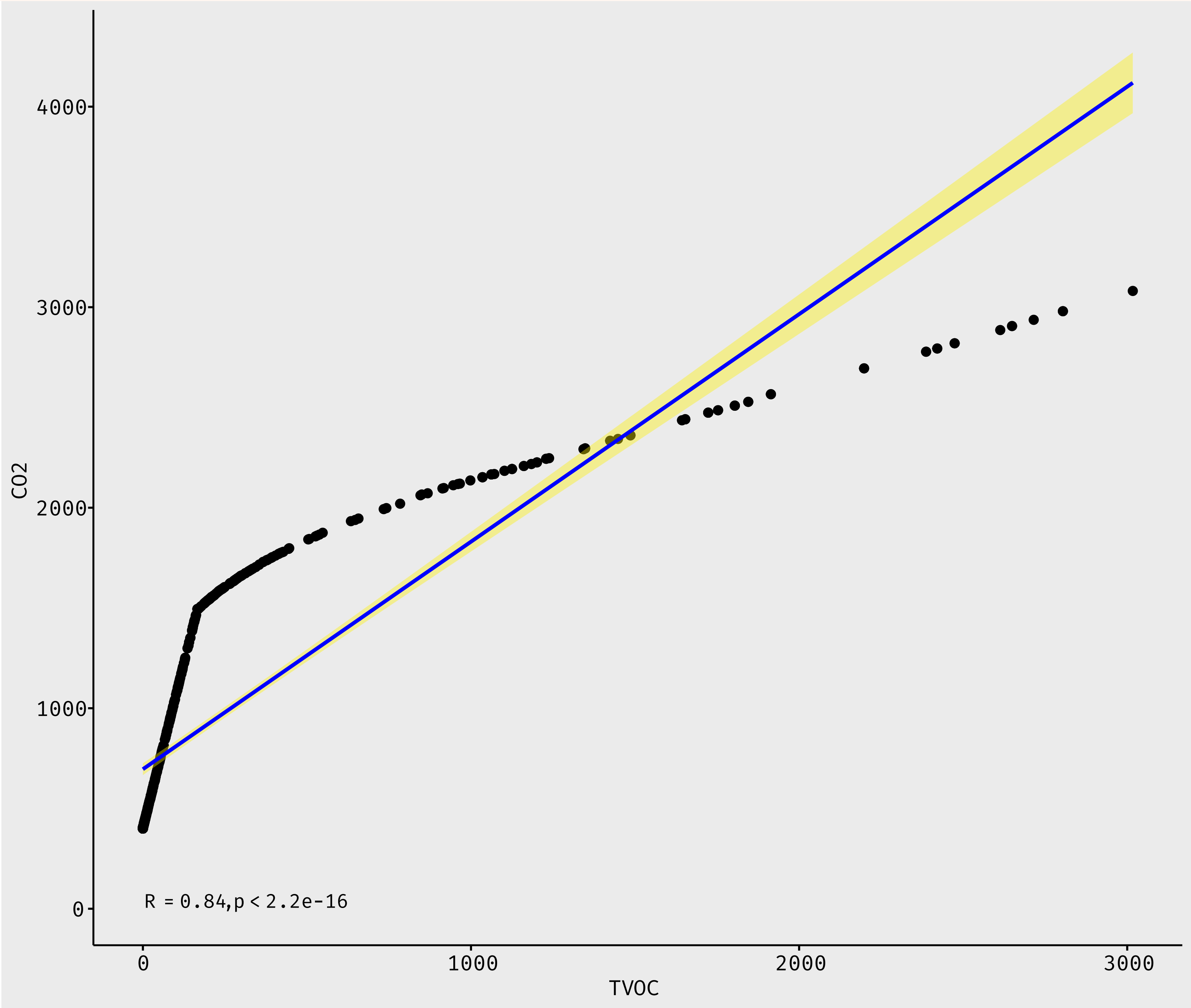
Higher levels of TVOC and CO2 do lead to higher Stress Level. There is no accurate or exact relationship between TVOC and CO2 to be stated. However, both measurements seem to follow similar spike patterns.





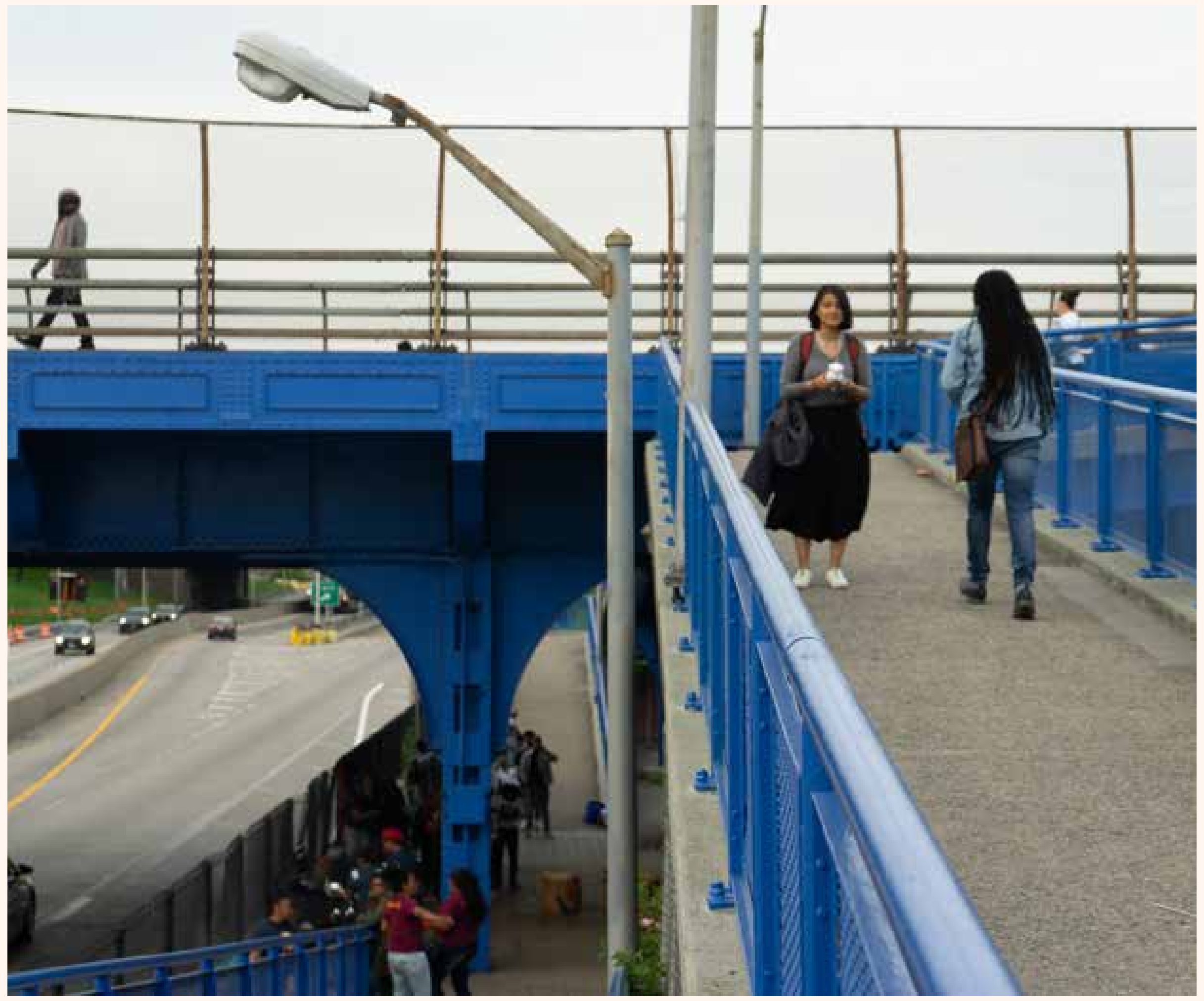


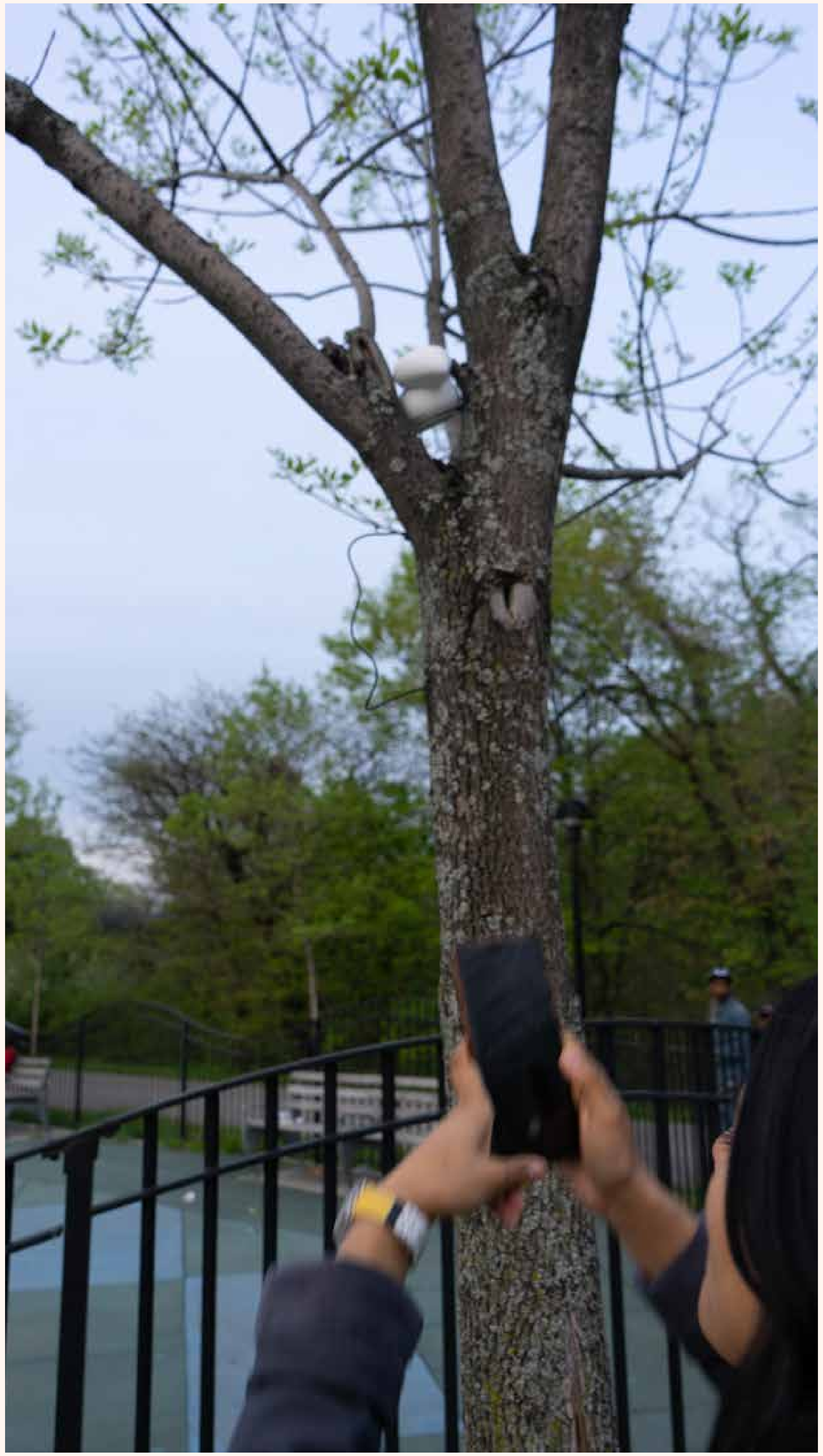
This plot is a zoomed in version of 8pm-9pm data. We left the site at 8pm and carried BirdyBird around with us as we travelled on the road to get to the subway station and inside the subway too. The measurements spiked up as we left the park and stayed relatively high when we were in the subway.

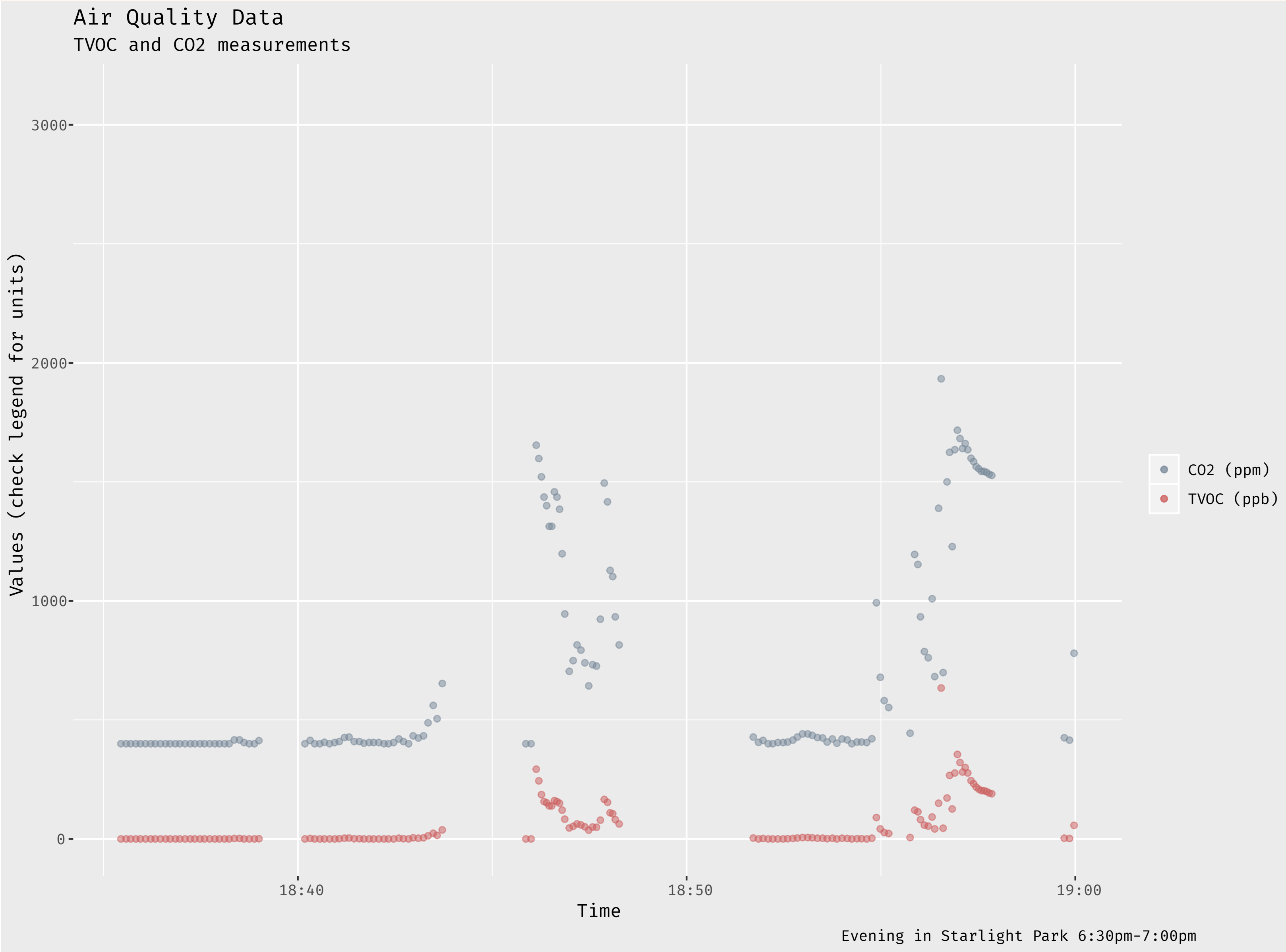


There is a positive correlation between TVOC and CO2. The correlation coefficient is rather high. The very small p-value suggests that the correlation is statistically significant.

The Saturday evening at Starlight was full of community bonds and vibrant urban life.







BirdyBird saw this as a moderate-high stress level scenario because these measurements are the only factors it considers. Hence, we noticed BirdyBird's limitation. Community barbecue was a great event that brought people together, with music, food, and games. We want to encourage and advocate for such events. However, for BirdyBird only the smoke that it produced had mattered. Therefore, it is essential to assess the context behind the measurements.

Urban Interactions

BirdyBird would provide an ambient response that could potentially alter a locality's sense of place according to environmental factors. At such an urban scale, BirdyBird's reaches its biomimicry apex in the ways that plants and animals are able to convey environmental conditions through their activity. In both natural settings and in the built environment, BirdyBird networks would be part of a larger urban sensing infrastructure providing real-time feedback and visualization. Hundreds of BirdyBirds at 100 meter intervals would weave together a dynamic fabric of urban data that is both illuminating in both literal and figurative ways. One could imagine similar projects to BirdyBird that take the animal metaphor further. An abstract fish design could be deployed in water to measure and display water quality information, and so forth.

An urban-scale BirdyBird (or a BirdyBird ensemble cast) could open many opportunities to educate the general public about invisible environmental quality metrics. By providing ways to visualize this information, perhaps in ways that could also be auditory or even tactile, BirdyBird could serve as an educational tool for the general public and give the public both data and a readily visible metric around which to advocate for more sustainable and environmentally-conscious policy and action.

BirdyBird as a contribution to ubiquitous computing

Perhaps BirdyBird's greatest potential at the urban scale would be it's cultural and aesthetic impacts; BirdyBird technology, if deployed on a large enough scale, could contribute to the aesthetic landscapes of "smart urbanism." Can we visualize a "smart" city in which the aesthetics of space are dynamic and ever-changing as a result of the environment? In this way, the saturation of urban space with display technologies could become augmented with the addition of a project such as BirdyBird, which seeks to employ ubiquitous display technologies for the purpose of popular environmental conservation education.

But there are many challenges to these ubiquitous computing approaches. For one, can Weiser and Brown's notion of "calm technology" remain "calm" when it is ubiquitous? How might flocks of BirdyBirds further contribute to urban "attention pollution?" In a not-so-distant world where human attention is as valuable as physical commodities, BirdyBird could potentially compete with other urban display technologies that may have competing agendas. These reflections are crucial for designers and planners considering the design of affective devices that employ the psychogeographic aspects of urban life.

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