

# Becoming the Data: Final Report

## Mobile and Ubiquitous Computing - CS-7470-A/CS-4605-A

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## ABSTRACT

We have opened an exhibition in the 1,300 square foot gallery space at the Price Gilbert Library in April 2024. The exhibition, called the Dataseum, features 5-6 interactive exhibits displaying publicly available datasets around the topic of sustainability (Fig. 1). The Dataseum is intended to provide an opportunity for members of the campus community and the public to engage with datasets they might not otherwise seek out, and it will also serve as a research space for learning sciences and visualization studies on how people learn and how they interact with data and visualizations in informal learning spaces. Because the data represented in the exhibits will be from the Atlanta area, visitors are likely to be represented in those data in some way. To emphasize this connection, we created and deployed a system capturing movements of visitors within the gallery space and displayed the movements back to them as a dataset to highlight their own positionality within research data.

participants can take to make an impact on local sustainability, further grounding the data into measurable and accessible action items. In order to accomplish this, the Becoming the Data team designed and built a web application where, after exploring each individual data exhibit, participants can scan a QR code and navigate to a page with interactive questions or games that allow them to reflect on the themes of said data exhibit. At the end of the experience, they are then presented with a summarized data profile that allows them to reflect even further about their mindset on sustainability and ground in their physical environment by assigning their data profile to a location that is meaningful to them on a map. By providing participants with a way to realize the impact that they have on making our cities more sustainable, we hope to empower them to use that agency to make changes in their own everyday lives.

## 2. BACKGROUND

As Atlanta continues to grow, the city has increased efforts in environmentalism and sustainability. From public transportation to clean energy, Atlanta's efforts to develop a sustainable city has been rooted in helping make the city a better place to live. Additionally, the city of Atlanta has partnered with university programs, such as Georgia Tech Sustainable Cities Studios and Emory Office of Sustainability Initiatives, to improve sustainability initiatives. As of 2019, Atlanta ranks 48th in Sustainable Development among US Cities, making it one of the fastest growing sustainable cities in the United States [1]. Efforts in sustainability have been pushed forward by Chandra Farley, the City of Atlanta's new chief sustainability officer, who plans on converting Atlanta to 100% clean energy by the year 2035 [2].

Like sustainability, data collection has also been an important topic over the past couple of years. As we move further into the age of information, data has been collected from almost every person, from social media interactions to CCTV footage. However, lack of transparency around data collection has caused a lot of controversy. Companies such as Meta (formally Facebook) and X (formally Twitter) have admitted to collecting and selling user data [3]. Recently, internal Meta documents estimate the value of a teen user at “roughly \$270 per teenager”, referencing the amount of revenue a teenage user can generate Meta by selling their information without their consent [4].

Although we seem to be living in a dark age of data, there have also been positive impacts of data collection. Data can help improve a user's experience on social media, tailoring their experience to their unique interests. Additionally, data collection has also led to users being more aware and conscious of their

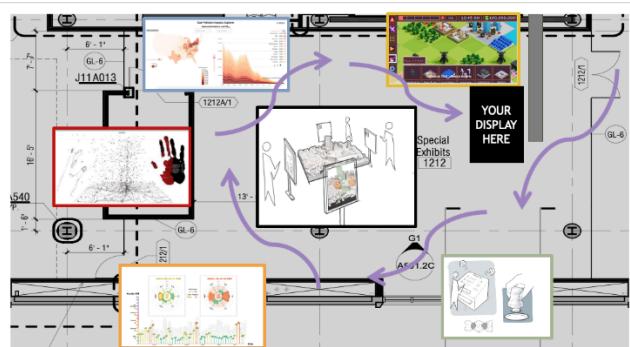


Figure 1. As visitors move throughout the space, they will engage with research data while becoming data themselves as we study how people interact with and learn from the exhibits. How can we A) track visitor movements and B) represent these movements back to the visitor through one or more displays?

## 1. INTRODUCTION

Becoming the Data is an auxiliary experience to the Dataseum, a gallery that introduces participants to sustainability data in their community. Oftentimes when interacting with large complex data sets and displays, it is very difficult to conceptualize the context in which this data resides, and more specifically how we relate to it. Whether it's data about weather or food waste systems, individual human experiences play a large role in how these environmental elements are sustained. Using mobile technologies, our goal was to guide individuals in realizing that impact and connection that they have to data. A central goal here was to focus on actions that

interactions, both online and in the real world. Political, social, and environmental activists have all used data to spread information about their cause and raise awareness about these issues.

Shifting perspectives on our own connection to the data that we provide just by living our lives is vital to self-determination and regaining control over our data in this age of information. Specifically, by orienting participants who are a part of the Georgia Tech community around Georgia data, centers the personification of data that they are interacting with. Personification as a design strategy to bring information that might feel distant, closer to the viewer [5].

### 3. CREATING THE INTEGRATED DATASEUM EXPERIENCE

We've created a web application that each visitor will load in a browser on their device of choice (mobile phone, tablet, laptop) that acts as a guide through the museum exhibits. An in-app QR scanner is included that uses the device's cameras to scan QR codes placed around the museum. Each QR code links to a corresponding page on the web app that will collect various relevant data points from the user through interactive surveys and mini-games.

The museum experience starts at the Accessible Oceans exhibit. Our web application survey includes a prompt to "build-a-fish", where you draw and name a fish friend. The next exhibit is for Air Quality Index Data Literacy where our system asks them to guess the current AQI and then identify a personal AQI limit (How high the AQI would need to be for them to change their behavior for their own health). After that is the Social Sustainability exhibit where we ask the visitor to identify the "secret to social sustainability" from some multiple choice options. This is displayed as black/white cards mimicking those seen in the party game Cards Against Humanity. We then have a survey centered around acid rain where we have the visitor complete an acid rain word-grouping challenge similar to that of The New York Times Connections. The next exhibit focused on the electrical grid has a corresponding survey in our app that asks the user how much they value power grid reliability and to identify how much extra they'd add to their electricity bill to ensure less power outages (\$0 - \$200). Finally the user wraps up with the central map of Atlanta, where our app asks some final survey questions regarding their personal feelings on sustainability and the related data after experiencing the museum..

The visitor's inputs are used to build a personalized data profile, and upon completing the experience (visiting all other exhibits and then the Becoming The Data station) each visitor can view a summary of this personal Dataseum profile. Visitors are assigned one of 8 sustainability-related "personality" types (i.e. Geologist, Florist, Marine Scientist, etc.) and their survey responses are displayed to them alongside relevant sustainability facts and suggestions. For example, if they struggled on the acid rain mini-game their data profile will label them as an "acid rain student" suggesting there's room for improvement in that area.

The Becoming The Data station in the museum includes a live touchscreen map of Atlanta. Through our web app each Dataseum visitor is given the opportunity to add a "data dot" to the live map. They can customize the color and location of this dot and it lives

permanently on the map for other visitors to view. The user's personality type and some survey responses are displayed here so that the visitor can identify themselves while their data remains anonymous (no info that can directly identify the user is ever collected or shown).

The web application was created using Node JS, an open-source JavaScript runtime environment allowing easy communication between our frontend and backend. On the frontend we use fully custom HTML, CSS, and JavaScript code to ensure user interaction was as smooth and responsive as we originally designed them to be. Two outside libraries were used in the frontend: Leaflet [7] (used for map display and control) and Html5-QRCode [6] (used to build our QR code scanner). On the backend we use the Express JS framework to help in handling page routing, session variables, sending/storing data, and various other functions that we want to be hidden from the user.

Data is stored and controlled using Google's Firebase app development platform, backed by their Google Cloud services. This platform allows us to store visitor and dot info to a cloud data collection (via their Cloud Firestore service) that can be pulled from any authorized location. This provides a secure and easy way to store data for the Becoming The Data experience; All processes that interact with the data collections are completely hidden/inaccessible to the visitors and web page users. Firebase is also used to host the web application to the internet enabling worldwide access, even including a personalized secure URL: (<https://becoming-the-data.web.app>). This service is free of charge up until certain usage limits, but we've found that our use case keeps us well under these limits (\$0.07 of charges caused by usage above the limit, only due to high usage on the opening day of the museum).

### 4. RESULTS

The "Becoming the Data" Dataseum experience is accessed via a Node JS web application connected to Firebase. Using QR codes distributed throughout the physical space, visitors are able to navigate through the reflective experiences via the web app.



**Figure 2.** The "Becoming the Data" Dataseum experience. The web application can be accessed by museum visitors by scanning a QR code when they first enter the museum space. Then, visitors will use the web app to go around the museum and interact with different exhibits.

Initially, when first tasked with the goal of helping participants “Become the Data” using reflective questions, we found ourselves limited by our minimal understanding of the data being presented and what we thought that participants might be interested in. Due to our limited experience with the other exhibits and sustainability data in general, we had trouble brainstorming an experience that felt in line with what future participants would be going through. While initially we were able to do some preliminary brainstorming, we wanted to be very intentional with our desire to make the creation of the reflective experience collaborative with the other teams of the Dataseum. This meant organizing an ideation workshop with our project mentor so that we could involve the entire Dataseum community in this creative process. The workshop was held on March 29th and all six exhibit teams as well as library staff supporters came together to present on their progress for their respective exhibits. Even in their in-progress states, the session allowed us to get a really good idea of the experience of each respective exhibit as well as what each team wanted participants to get out of the experience. After each team presented, we engaged in a discussion on what we found the key takeaways of each exhibit to be. In order to document these findings, we also sent out a Google form for teams to submit their questions for us to use in our final experience design.

1	Team Name	Project Title	Project Description	Potential Questions and input types. (ex: “What is your zip code?” input type: text field)
2				what are the common driver pollutant of Atlanta (Multiple choice) how is AQI being calculated (Text input)
AQI	Decoding AQI			how do you describe the trend of AQI in Atlanta (Text input) Did you find the date that has the worst AQI during 2023? (date input)
3	Dataseum Central Exhibit	Dataseum Central Exhibit	Central exhibit made up of data windows, ipads with AR data, and a central exhibit board	1) Do you feel empowered to talk about sustainability in Atlanta? input type: multiple choice, yes/no with option to elaborate. 2) Do you think this data might be biased? Why or why not? input type: text 3) How do you think this exhibition change the way you think about data? Why or why not? input type: text *How much, on a scale of 1-10, do you value reliability of your power grid? input type: number 1. How much more would you pay on top of your current electricity bill to ensure that there will be less outages caused by wildfires? sliders between 0 to 100 percent, when the user moves the slider more fire emojis will fall from the top of the screen when they get closer to 100 percent and more fire emojis will fall from the top of the screen when they are sliding it closer to 0 percent.
4	Gaming for Electric Power Grids	Current Crisis	A video game teaching players about the power grid and its resiliency.	2. What do you believe are some of the most concerning threats to the integrity of the power grid in addition to wildfires? - Flock of pigeons - Physical attacks - Cybersecurity How would you feel if your power was cut off for a few hours because of a fire risk warning? Also, I have the quilt designs for our team; please email me at <a href="mailto:pyadav60@gatech.edu">pyadav60@gatech.edu</a>
5	Gaming for Electric Power Grids	Current Crisis	Simulation Style game to aid in the development of resilient and safer power grid systems	
6	Gaming For Electric Power Grids VIP	Current Crisis		

**Figure 3. Screenshot of the “Becoming the Data- Checkpoint Questions” form responses from creators of each of the other Dataseum exhibits documenting types of potential questions to ask participants that would garner some type of reflection on the data.**

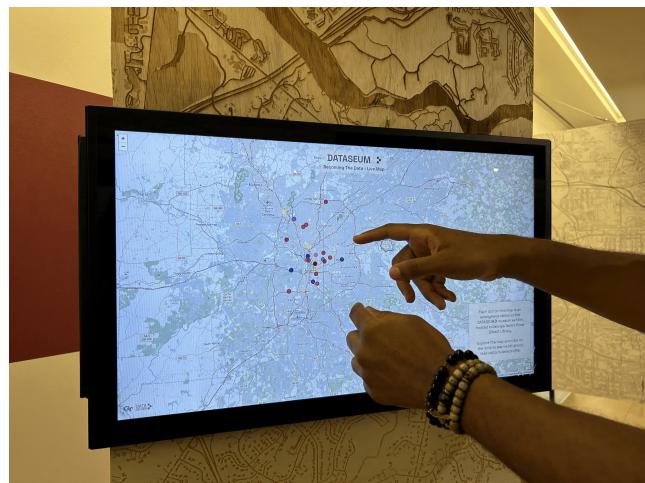
The culmination of our work on the Becoming the Data project was presented during the end of semester Dataseum Opening Reception on April 18th, 2024. During this reception, library visitors were able to come in and experience the Dataseum in its entirety, navigating through each of the data entry points then reflecting on the data through our integrated web app experience. Based on our Dataseum visitor data summary, over the course of “Became the Data” using our experience. It was exciting to see participants navigate through the exhibits learning about AQI, crime data, electrical grids, etc, as well as pulling their phones out to contextualize the data within their own lives and values.

DATASEUM X					
Visitor Data					
SessionID	Group	Active	Start Time	ExhibitInfo	
lulqmhuryu0yj0	5	true	4/4/2024, 9:17:05 PM	AC: completed= errors, AQI: quiz; , map: [     ], game: [ \$ ], fish: [ ], social: [ ]	
lulqn3jmnzrwe	7	false	4/4/2024, 9:17:58 PM	AC: completed= errors, AQI: quiz; , map: [     ], game: [ \$ ], fish: [ ], social: [ ]	
lulqnjokuto1e	5	true	4/4/2024, 9:18:14 PM	AC: completed= errors, AQI: quiz; , map: [     ], game: [ \$ ], fish: [ ], social: [ ]	
luls3qdx4a2bk	7	true	4/4/2024, 9:18:23 PM	AC: completed= errors, AQI: quiz; , map: [     ], game: [ \$ ], fish: [ ], social: [ ]	
luls3uvoyog3mu	4	true	4/4/2024, 9:18:35 PM	AC: completed= errors, AQI: quiz; , map: [     ], game: [ \$ ], fish: [ ], social: [ ]	
luls3ve9yk6qB	8	false	4/4/2024, 9:18:35 PM	AC: completed= errors, AQI: quiz; , map: [     ], game: [ \$ ], fish: [ ], social: [ ]	
lulg484fv6g6hh	3	true	4/4/2024, 9:18:52 PM	AC: completed= errors, AQI: quiz; , map: [     ], game: [ \$ ], fish: [ ], social: [ ]	

**Figure 4. Screenshot from the Dataseum visitor data summary found at <https://becoming-the-data.web.app/data>**



**Figure 5. Photo from the end of the Dataseum experience where participants scan to receive their data profile summary and place their profile on a map displayed on a touchscreen monitor.**



**Figure 6. Photo from inside the Dataseum as participants point to their personal data profile placed on their location of interest on the interactive map.**



**Figure 7. Photo of the first sign you see as you enter the Dataseum that enters you into the interactive experience upon scanning the QR code.**

## 5. CONCLUSION AND REFLECTION

While we were very happy with the overall outcome of our project, there were a couple of aspects of it that required some pivoting and adjustment due to feedback from other exhibit creators, our faculty mentor, and participants who navigated the physical Dataseum during the reception. While the Dataseum was able to be temporarily opened that day, several of the exhibits are going to be spending the next month or so making adjustments to ensure that this can be an independently running museum starting this summer.

We originally had plans to print a souvenir on receipt paper for visitors based on their responses, but realized that printing a receipt for each individual visitor wouldn't be sustainable. Instead, we created a digital profile report for visitors that they can screenshot to save. By changing the format to digital, visitors are now able to have a longer, more detailed report in addition to not generating any unnecessary waste.

During the actual reception day, we got to observe the way that participants moved through the space and note adjustments that need to be made before the Dataseum officially opens to the general public. One thing we found through participant feedback was that something about the color reception in the iPhone camera made it less likely to be able to detect the QR codes that were lighter colors. Therefore we had to make an adjustment making sure that all of the QR codes for scanning used colors with high

enough contrast to be scanned by participants both on screen and on print. Another bit of feedback received from participants was that due to the placement of QR codes, it wasn't always clear what they needed to scan in order to enter the reflection experience. In order to address this, in the coming weeks we plan to work more closely with the other exhibition creators to better integrate our data entry points in their existing exhibits in order to increase that legibility.

We believe that we have achieved our original goal, which was to provide an interactive experience for Dataseum visitors, making their experience both fun and memorable. At the reception we got several comments from participants stating how effective the addition of the *Becoming the Data* web app was in helping them think more closely about the data in the Dataseum and their relationship with it. We hope that this experience can act as a jump off point for visitors in making efforts to be more sustainable in their everyday lives. We also hope that for future creators of data experiences, this proves as an important reference for how to make data presentations more relevant and personal to their viewers in order to help researchers not only present data, but support people in realizing how they are a part of it.

## 6. REFERENCES

- [1] Barton, E. 2019. Atlanta ranks 48th in Sustainable Development among US Cities. Sustainability Initiatives. Emory University. <https://sustainability.emory.edu/atlanta-ranks-48th-in-sustainable-development-among-us-cities/>
- [2] Hudson, L. 2023. Atlanta's new sustainability officer talks city's goals to achieve 100 % clean energy by 2035. WABE. <https://www.wabe.org/atlantas-new-sustainability-officer-talks-citys-goals-to-achieve-100-clean-energy-by-2035/>
- [3] Rothenburg, E. 2023. Meta collected children's data from Instagram accounts, unsealed court document alleges. CNN. <https://www.cnn.com/2023/11/26/business/meta-collecting-data-children-facebook/index.html>
- [4] Palya, A. 2024. Mark Zuckerberg told he 'has blood on hands' in tense hearing & confronted by kids saying they're 'worth more than \$270'. The Sun. <https://www.the-sun.com/news/10249813/zuckerberg-blood-hands-hearing-kids-worth-more-social-media/>
- [5] The, R. 2010. Face the facts-experimental embodied data visualization. MIT Media Lab. <https://www.media.mit.edu/publications/face-the-facts-experimental-embodied-data-visualization/>
- [6] minhaz a.k.a mebjas. Html5-QRCode. <https://github.com/mebjas/html5-qrcode>
- [7] Agafonkin, Volodymyr. Leaflet JS. <https://leafletjs.com/>