a project by
Georgia Institute of Technology's
Public Design Workshop
and Center for Urban Innovation

Fictions of a Smart Atlanta

An Anthology of Smart City Use Cases

FOREWORD

How might we design for the use of the Internet of Things technology in the context of urban environments?

The Participatory Approaches to Researching Sensing Environments (PARSE) project[1] explores this question to advance the understanding what the "smart city" means in Atlanta. The first phase of the project was structured around a series of community engagement workshops that brought together a group of diverse stakeholders to address the opportunities and issues around the deployment of Atlanta's city-wide sensor array. The workshops drew on participatory design practices to gather insights on the current lived experiences within different Atlanta communities and understand how sensing technologies might be used in these contexts.

We hosted three workshops with Old Fourth Ward, Poncey-Highland, English Avenue, Vine City, and Washington Park residents. We used participant insights and ideas gathered from these three workshops to produce a set of use cases, or rather, fictions of what Atlanta might and could look like as a smart city. While we call them fictions, they reflect the very much real lived experiences of these different community members and are grounded in ideas and thoughts that they expressed to us during this project.

In this way, these following use cases are not just the imagination of designers or engineers, but are empirically informed by research with residents, small-business owners, municipal employees and other stakeholders from the very Atlanta neighborhoods slated to be the sites of sensor deployments.

[1]PARSE is a collaboration between the Public Design Workshop and the Center for Urban Innovation at Georgia Tech.

The workshop structure centered around a board game activity we designed to not only understand the community's current lived experience but also surface potential opportunities and concerns around Atlanta's sensor deployment. The board game served as a playful, tangible way for participants to interact with the idea of place and the different conditions that could be sensed in a specific place. The activity helped the participants express ideas around what a smart city might be in their community without having to understand the technical details of sensor technology. We followed the game with a general discussion to further explore ideas that might have surfaced during the group activity.

In this first phase of the project, we hosted three workshops over the span of five months. The first two workshops took place at the Atlanta City Studio at Ponce City Market with a particular focus on one of the sensor deployment sites located at the intersection of North Avenue and Dallas Street. We invited participants from neighborhoods surrounding this site, including Old Fourth Ward and Poncey-Highlands. We scheduled the first workshop in this location in the early afternoon and second workshop in the evening to allow for more opportunities for participants to join. For third and final workshop, we moved to the Westside community, as the sensor array ends at North Avenue and Northside Drive. We hosted an evening workshop at a community coffee shop, Good Kupa Koffie, on Joseph E. Lowery Boulevard.

From these three workshops, we compiled insights from our observations, what participants expressed during and after the activity, and what participants wrote down on the materials. We used this data to construct these smart city fictions. Because the following use cases are by no means comprehensive, we included an appendix with more ideas from community members and some of our group's own ideas around what a smart Atlanta could be.

The Soundscapes of Atlanta

Sensors can help us understand how noise affects our everyday lives and, in turn, help us make more informed decisions.

Key Ideas

i. Sensor data can generate a real-time noise pollution map to help residents make decisions about where to live in Atlanta.

ii. Kiosk display of noise pollution allows BeltLine visitors to avoid busy, loud areas of the trail and gives the homeless a way to find quiet areas to sleep.

iii. Audio and camera data can identify loud noises at night and send notifications via text to residents to assure them of their safety or alert them to any potential dangers.

Key Assumptions

i. Data sets available for real-time access via APIs

ii. Technical support and maintenance of noise pollution map and digital public kiosk

iii. Funding for the development, support, and maintenance of the map and kiosk services

THE SOUNDSCAPES OF ATLANTA

The MARTA train rattles down the track, cars rush down the highway, construction sites rumble and clang — these sounds contribute to the rhythm of our lives in Atlanta, sometimes so integrated into our everyday that we might overlook how they influence our lives. However, Atlanta's new sensor array might just change the ways in which citizens currently consider and navigate the city. With the City of Atlanta's noise map, residents can actually see noise levels in their communities on a map. The map pulls real-time audio data from microphones on sensors installed along major corridors in Atlanta and provides visual overlays of noise pollution intensity using accepted standards for harmful decibel levels. Correlated camera and infrared data provides more granular details about what type of sounds contribute to the noise level, including vehicle and air traffic, bars, restaurants, and outdoor events. With this map, residents can compare noise intensity and kind in the moment or over time within their community or across different neighborhoods.

"Where should I live?"

After accepting a job offer in Atlanta, El quickly found herself in the throes of apartment hunting as she planned her move from Indiana. "I lived near a train station for a year and lost a year's worth of good sleep," she said. This experience left her particularly wary of loud neighborhoods. Through her search for a way to look up noise levels in different Atlanta neighborhoods, she stumbled across Atlanta's noise map. She was initially interested in exploring the area around Ponce City Market for the convenience and proximity to the BeltLine trail. By using the Zillow browser plug-in with the map, she was able to select potential apartments in Old Fourth Ward and monitor noise pollution levels. She looked at the data for over a week and noticed that there was relatively high intensity from ongoing construction and both traffic and pedestrian activity around the BeltLine and Ponce City Market. Because the noise levels still seemed fairly high at night, she decided to explore other neighborhoods and instead signed a lease for an apartment in Kirkwood. "I'm sleeping well. No bags!" she said pointing to her eyes. "I'm three blocks from a train, but it's still quieter than Old Fourth Ward." So far, she reports that she enjoys living close to restaurants, bars, and rapid transit while enjoying the quiet at home.

"I want to go on a peaceful walk on the BeltLine."

With the increasing popularity of the BeltLine trail, many residents find it difficult to enjoy a peaceful run, walk, or bike ride. In response to this issue, the Atlanta BeltLine has recently installed a new addition near Ponce City Market at the entrance of the trail. The new kiosk displays trail map overlays with current noise and activity levels. These overlays use real-time audio, infrared, and image data from the sensors installed along the trail. For now, Atlanta BeltLine has installed one kiosk to gather feedback on how useful these displays are to BeltLine users. Some Atlanta residents have already expressed that they have found the kiosk useful in planning a quiet walk on the trail and avoiding busy areas.

The Atlanta BeltLine also reported that they have noticed homeless residents in the area consulting the kiosk in order to find quiet spots along the trail to sleep. In response to any concerns people might have, a BeltLine representative commented that they are happy to see that sensor technology can benefit all Atlanta citizens in the area: "In the end, we all share the same space. Being more aware about our environment is crucial to making more informed decisions about our lives."

"What's that noise?"

It could be a car or maybe fireworks. Or was it a gunshot? Whenever we hear loud noises late at night, these thoughts usually race through our minds, and for some Atlanta residents, contribute to a restless sleep. "Should I be worried? Where did it come from? I'm never able to go back to bed," said Ms. Smith, an English Avenue resident. However, using the same audio and camera data as the City's map and the BeltLine's kiosk, Atlanta residents like Ms. Smith can now receive alerts from their cell phones that identify the source and location of these mysterious noises. "My phone will text me and say it's just a car one street down. Then I can sleep easy." Through a combination of sensors and analytics that are able to assess and categorize sounds, we can begin understanding the sounds of our lives in different ways that lend to an improved quality of life.

Running in the City

Sensors can help runners plan their routes with real-time environmental data to eliminate the stress of city running.

Key Ideas

i. Environmental sensor data can help runners plan their outdoor running routes based on factors like shade, traffic, air quality, and road conditions.

ii. Using real-time data, a running app allows runners the option to either plan their preferred route accordingly or generate an optimized route. Runners can also receive real-time updates during their run with suggested alternate routes.

Key Assumptions

i. Data sets open and available to third-party developers via APIs

ii. Technical support and maintenance of running app

iii. Funding for the development, support, and maintenance of the running app

RUNNING IN THE CITY

Using environmental data from the City of Atlanta's sensor array, RunATL visually maps out real-time running conditions to reduce the stress of planning running routes. Instead of wondering whether there is any shade along North Avenue at 7pm, Atlanta runners can instead open the RunATL app on their phones and press the "Shade" filter to view variations of shade along the street. This feature uses light sensors placed along the routes to detect the presence or absence of shade. Runners can use the map view to explore current environmental conditions along their usual running routes and modify their plans accordingly. Alternatively, runners can allow the app to completely plan their run by generating an optimized route built around their preferred running conditions. Not only does RunATL help runners plan their run, the app uses real-time sensor data to notify runners of changing conditions as they are running. If a remote sound sensor detects road construction ahead, the app will give runners an audio alert with a suggested alternative route. By leveraging the power of sensor data, RunATL eliminates the stressors of city running and gives runners more reasons to step outside...and run.

Atlanta Track Club Member Feature

Will has been a member of the Atlanta Track Club for two years and has recently started using RunATL as part of his daily running routine.

What are your running essentials?

My Mizuno Wave Riders, Bluetooth headphones, and shorts with zipper pockets always. And more recently, the RunATL app.

How do you use RunATL?

I live off of North Avenue, so it really stresses me out running along North when there's too much traffic. Not only do cars speed, there's just a lot of exhaust fumes. I also get overheated pretty easily. But I have a general route, so I use the map view on the app to look at shade, air quality, pollen count, traffic, and road conditions along my route to figure out what areas to avoid. Then I pair my headphones with my phone so I can hear notifications while I'm running, so that's pretty helpful.

What do you like most about RunATL?

I used to have some anxiety around running outside in the city. There's always so many things going on, things to worry about. Since the sensors were installed, I feel like I'm more informed about the area around me and able to make better decisions about my running route. I'm always surprised to see how bad the air quality is on North at certain times of the day, so I also plan my run around that too.

Weathering the Storm

Sensor data allows response teams to efficicently target problem areas in the event of a major weather event.

Key Ideas

i. In extreme weather conditions, like Snowpocalypse, real-time sensor data can inform response teams of problem areas to streamline their process.

ii. Citizens can use sensor data to avoid walking in problem areas (i.e., icy sidewalks or roads in major snow events, flooded areas in the event of heavy rain).

Key Assumptions

i. Data sets available for real-time access via APIs

ii. Sensor data is directly integrated into existing municipal data systems

iii. Technical support and maintenance of app

iv. Funding for the development, support, and maintenance of app

WEATHERING THE STORM

As we approach the four-year anniversary Snowpocalypse, thousands of Atlantans are relieved that Thursday's recent 2-inch snowfall did not cause the same scene of chaos and confusion.Instead of all the abandoned cars strewn all over the interstate and people trudging along the highway in search of shelter, Atlantans successfully made it home from work. This time, the City of Atlanta and its citizens were armed with an effective winter storm strategy—smart data.

The installation of hundreds of sensor nodes across the city has allowed the City of Atlanta to significantly streamline the salting and plowing process on the highway and major roads. Jim Hopper, a member of the street maintenance team, remembers Snowpocalypse well. "It was a disaster. We didn't salt the roads until it was way too late," he says, shaking his head. This year, Jim shares a much more positive experience of the winter storm. Jim and the rest of the maintenance team are using a new mobile app system that uses data from temperature, moisture, and light sensors to estimate ice formation on the streets. Because the app uses the Google Maps API, Jim can quickly look at the map and see red "trouble areas" forming on roads and walkways in real time to navigate to these spots.

Several Atlanta residents have also leveraged sensor data to monitor ice conditions, both on the road and off. Nancy Wheeler, a resident of Ponce City Market, avoided driving during the snowstorm in the name of safety. She spent a lot of time walking around the city, especially via the BeltLine, and used her custom weather app to avoid icy patches on her routes. "I saw that the stairs up to the BeltLine trail were really icy after the first day, so I just took a longer way by cutting through Old Fourth Ward Park. Worth the extra time to avoid a trip to the hospital." Drawing current data from light, temperature, and moisture sensors and using that to predict ice formation, the app shows her areas to avoid on a map view and provides alternative walking directions. Like Jim and Nancy, other Atlantans can ensure that they will never have to experience another Snowpocalypse again. This time, Atlanta has avoided the nation's mockery by becoming "smarter" through sensing technology.

CHAPTER THREE

The Great Crowd Escape

Real-time crowd data allows people to make informed decisions about when and where to go around the city.

Key Ideas

i. General sensor data can be used to approximate crowds and other social conditions.

Key Assumptions

i. Data sets open and available to third-party developers via APIs

ii. Technical support and maintenance of app

iii. Funding for the development, support, and maintenance of app

THE GREAT CROWD ESCAPE

"I really disliked going anywhere on the weekend when it was nice outside. It's so stressful being around so many people," Barb says as she grimaces and shakes her head at the thought. Barb has lived in Atlanta for four years and is acutely aware of the recent influx of people in metro Atlanta. With the increasing crowds, Barb has found CrowdTrack a welcome addition to her toolkit of city living. She uses the app to "make random decisions" throughout her day. A typical example, she describes, looks like this: she is driving to her office at Ponce City Market, notices that she has about 20 minutes before her morning meeting, and wonders if she has enough time to park her car and grab a coffee at Dancing Goats. CrowdTrack eliminates the guesswork for Barb, drawing real-time data from infrared sensors and cameras to determine how many cars are in the parking lot and estimate how many people are in line at Dancing Goats. Using this real-time information and Google Maps APIs, the app provides Barb with the amount of time it takes to park in the closest available space, walk to Dancing Goats, and wait time for coffee. Barb delightedly notes that she usually gets her coffee and makes it to her meetings without breaking a sweat.

The Art of Sensing

Art installations can provide new ways to publicly display data in ways that are engaging and aesthetically pleasing.

Key Ideas

i. Sensor data can be used for artistic displays that both engage the arts community and provide a novel form of community engagement.

ii. Art can provide alternative ways of engaging with data that don't rely on data literacy.

Key Assumptions

i. Data sets open and available to third-party developers via APIs

ii. Means for soliciting and funding public arts works

iii. Technical support for the development and maintenance of digital public arts works

THE ART OF SENSING

Sensors have clearly made their mark in Atlanta. What first started as the inconspicuous deployment of sensor boxes along the North Avenue corridor has shaped into a series of art installations around the city. The idea is simple: sensors are here, and they can share with us everything that they can see.

Visualizing the Invisible

Marisa Kelly recently noticed an unusual installation near the Old Fourth Ward skatepark on her usual bike ride. "I didn't think much of it because the BeltLine has a lot of interesting art. But I noticed something moving so I decided to check it out," said the Poncey-Highland resident. When she stopped to inspect the modern structure, she realized that the objects were actually colorful bubbles moving around on a large kiosk screen. This installation on the BeltLine is the first of its kind. As part of a collaboration between local artists and the City of Atlanta, the installation visualizes air quality as colorful particulate matter drifting across a large screen. The City of Atlanta has commissioned several local Atlanta artists to create and design these kinds of data visualizations to install in different neighborhoods. Susan Lin is responsible for the artistic vision behind this particular kiosk.

The colors of the particles change in response to the real-time air quality data pulled from the North Avenue sensor array. The installation uses this pollutant data to calculate the air quality index (AQI) and represents this as either green (good), yellow (medium), or orange (poor) particles on the screen. The installation also allows Atlantans to view air quality data from other Atlanta neighborhoods as well. "When I clicked on Poncey-Highlands on the map, the air quality was good, so the particles turned green. That was pretty neat," Marisa said. "Looks like I chose the right neighborhood to live in."

While the installation presents itself as an interactive art piece, it also seeks to raise awareness around the air quality in specific Atlanta communities. Atlantans can playfully "pop" the particles to understand the collective impact of their everyday actions on the air quality index. While Marisa found the revelation sobering, she also felt inspired. "I popped about 10 particles before they changed from yellow to green. The screen told me I had reduced the air quality index to 30, and for that to actually happen in real life, there needed to be 50 less cars on the road today. Now I'm definitely going to make an effort to bike more often."

Though the Old Fourth Ward kiosk is currently the only existing installation, Atlanta residents can also access the same air quality visualization and information online. "It was important to include different means of accessing this information," project director, Hema Kondur, said. "The entire point of this project was to make this data actionable for everyone, and art provides a way to understand data even if you aren't an expert with data. But if you like reading numbers, we also have that data available as well. We also wanted to make sure citizens can use the data without having to physically go to the installations. That way, people with health problems can know to avoid going outside when the air quality is particularly harmful, or people looking to move can use the data to track where the healthiest neighborhoods are." Over the next few months, Atlantans should expect to see three more art installations near Freedom Parkway, Westside Atlanta, and Georgia Tech. By the end of next year, the City of Atlanta has anticipated a total of eighteen installed kiosks to correlate with the number of sensor boxes that are part of the North Avenue sensor array. Whether these next installations will display information other than air quality data is to be determined.

Data Displays

By understanding how we might publicly display sensor data in transparent, interactive ways, we can encourage more citizen agency around what they want to do with this data.

Key Ideas

i. Public data displays become digital hubs for gathering, not unlike water fountains.

Key Assumptions

i. Data sets open and available to city departments, corporations, and third-party developers via APIs

ii. Technical support and maintenance of data displays and public Wifi networks

iii. Funding for the development, support, and maintenance of the data displays and public Wifi networks

DATA DISPLAYS

It's 89 degrees outside today, which calls for an iced coffee from Dancing Goats Coffee Bar! Located near Ponce City Market on 650 North Avenue NE.

The cheery message emblazoned across the screen features two dancing goats against a turquoise backdrop. When the Dancing Goat's advertisement for iced coffee fades, another message promptly materializes in its place ("Headed to the BeltLine? The trail is very crowded right now"). These kinds of pithy messages can be found flashing across information screens at select MARTA train stations and bus stops around Atlanta, signaling the advent of the city's connected technological future. But these displays are not just digital billboards that can direct you to the closest coffee shop. "They're more than that," said Jennifer Wright, MARTA's director of marketing. "So if there's a message about the popularity of the BeltLine, you can actually click to open up a map and explore different areas of the trail for a more granular view of pedestrian and bike congestion based on real-time information."

These information displays pull data from various sensors to provide Atlanta citizens with detailed snapshots of happenings around the city. Drawing from GPS data transmitted from MARTA buses, the displays eliminate the unpredictability of the bus schedule by providing riders the ability to track their bus in real time. The displays also broadcast data from the North Avenue sensor network in an interspersed mix of advertisements for local businesses and messages relating to real-time information about air quality, bike, car, and pedestrian traffic, and street noise. The content of these messages depends on the data pulled from the sensor array. However, small businesses and community groups can also tap into this open and accessible data stream to customize and add relevant data themselves. And similarly to the kiosks in New York, these information displays also provide free Wifi and charging stations to riders as they wait for their bus or train. But in many ways, these displays use sensor data to capture the varying moods of different communities (with sound data: "Sounds like a party is happening in Old Fourth Ward park, just 2 blocks away").

"The best part about these displays is that they are interactive. People are not just passively taking in this information," Anne Torres, the City of Atlanta's director of communications, said. "Yes, the messages will automatically cycle through if no one chooses to interact with the screen. But you can actually walk up to these information displays and interact with them to figure out your MARTA schedule, find out about different events in the area, look at things like street noise, traffic, and air quality on a map. Not only that, people can Tweet at the displays or allow the displays to pull from their geotagged Instagram pictures or Tweets. This is information that not only citizens can use to influence and inform their day-to-day decisions but also just understand what is happening around their community."

Data Transparency

Generally, the installation of sensor boxes along North Avenue sparked a varying mixture of excitement, uncertainty, and distrust from many citizens. "What are the boxes really doing?" was a resounding question. And understandably, it was difficult to discern what motivations hid behind the inscrutable white boxes affixed to poles several feet in the air. In a move to alleviate these concerns, the City of Atlanta has worked for the last few months to increase transparency and promote citizen agency around sensor data to largely positive feedback. "I did wonder...are these sensors intended to be something that just fade in the background to watch us?" Old Fourth Ward resident, Ali Kim, said. "So it's great to actually see the information in a public forum in a way that we can interact with it. It shakes off that Big Brother feeling for me. And it's really quite fun to see."

The Commuter's Public Enemy

Sensor data can identify road hazards to help Atlanta drivers avoid them and automatically alert and assign tasks to the Department of Public Works.

Key Ideas

i. Using a combination of sensor data to identify road hazards, an app can alert and redirect drivers around hazardous streets.

ii. The same data is directly integrated with City 311 and with software that can assign tasks to the Department of Public Works.

Key Assumptions

i. Data sets open and available via APIs

ii. Technical support and maintenance of app

iii. Funding for the development, support, and maintenance of app

iv. Sensor data directly integrated into existing municipal data systems

v. Software used to automatically assign municipal response to sensed conditions

THE COMMUTER'S PUBLIC ENEMY

More often than not, sharing a common enemy facilitates collaboration and bonding. There is something to be said about commiserating over a shared hatred for something, which is why most, if not all, commuters can agree to rally around the issue of potholes. The telltale "thud" either renders drivers into an expletive-ridden rage or leaves them anxiously fearing for the state of their tires. Either way, nobody likes a pothole. More recently, the City of Atlanta has presented Atlanta commuters with a new weapon to combat the notorious pothole.

The BumpFinder app tracks and monitors road conditions along major corridors, identifying and mapping road hazards for drivers to avoid. Not only does the app divert drivers around potholes but also warns commuters of ongoing road work and other road hazards. The app draws camera, accelerometer, and noise data from a network of sensors to visually identify potholes and other road hazards and detect any vibrations and noise from vehicle impact. BumpFinder also features a crowdsourcing feature, drawing both from the internal accelerometers in smartphones and citizen reports to detect any unidentified road hazards. "While the sensor data has helped us identify many road hazards automatically, we still realize that some might not be detected through this method and wanted to leave that option for citizens to report easily. We're hoping that we can move to 100% automation soon to eliminate that need," said BumpFinder's lead developer, Amir Ahmadi. "Another option we considered was thinking about how cars might be able to automatically contribute data. So for example, a car bumps a pothole, takes a picture with its rear view camera, and sends that to the City database."

While the public-facing BumpFinder app guides commuters away from potholes, the City version of the app leads worker crews to the potholes. Prior to the installation of Atlanta's sensor array, the Department of Public Works relied on 311 reports, typically leading to a backlog of repair requests. With a more efficient, automated process, crews can now access a list of identified road hazards and use the app to map a streamlined route, enabling them to move from pothole to pothole easily. By using a "smart" approach to road maintenance, Atlanta's municipal government has not only assuaged the ire of many citizens but certainly gained utmost respect in this stand against a long-standing enemy of the commuter.

The Smarter Festival

Sensors can support a larger ecosystem of products and services, including streamlining local festivals.

Key Ideas

i. Sensors can support an open ecosystem of products and services; a festival wristband can draw from and communicate with the City's sensor network to streamline the usually chaotic festival experience.

Key Assumptions

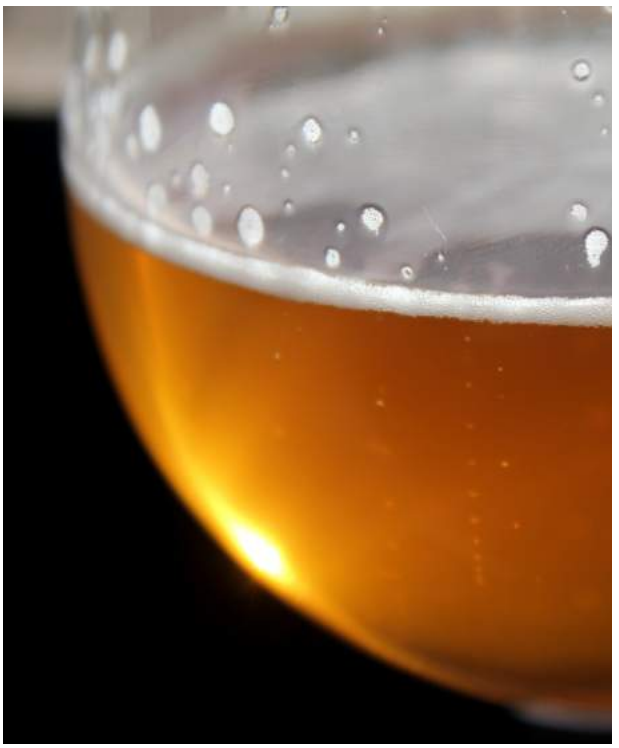
i. Data sets open and available to third-party developers via APIs

ii. Technical support and maintenance for festival service

iii. Funding for the development, support, and maintenance for festival service

THE SMARTER FESTIVAL

People have argued that beer is the cornerstone of civilization. Once we learned how to brew the libation from grain, we gave up our nomadic lifestyle to build settlements and developed technology. From this perspective, it is only fitting to devote festivals to the beverage. And though the festival-goers of the Atlanta Summer Beer Fest might not realize the drink's significance, they still love beer, especially in the thick of a blistering Georgia summer. Though this year's 105-degree weather should've made the experience miserable for festival-goers, excited chatter about the new wristbands dissipated any complaints of the heat. And truly, it would've been hard to overlook this year's arguably sleeker-looking rubber wristbands, and even more difficult to deny the surprisingly streamlined experience of an event that otherwise draws together alcohol and crowds for a chaotic effect.



CHAPTER EIGHT

Arianna Vazquez noticed a difference before she even left her house. A veteran of music and beer festivals, she headed to the Atlanta Summer Beer Fest this year with nothing but her phone and her wristband. She simply walked up to the festival entrance at Old Fourth Ward Park and scanned her wrist for entry with little fanfare. "What was the best part of my experience? I think it was just so easy and stress-free," she said. Because the wristband was linked to her credit card already, she simply had to scan her wristband throughout the day for all her transactions from ordering beer samples to buying a branded t-shirt. But it was not the unencumbered purchasing system that she attributed to her positive experience but rather the navigational features embedded in the wristband itself. Many other festival attendees agreed with her, citing this particular function as the main reason for the overall seamless experience. Instead of providing paper maps of the festival layout, the festival went entirely digital this year, where the wristband guided festival-goers to and from their favorite beer tents, restrooms, and food carts. Not only did the wristbands navigate people to points of interests but they did so in a way that significantly reduced wait times, effortlessly guiding attendees around the park.

"How did they do that?" asked another festival goer attendee, Brenda Khor, in wonder. The only clue lies in the embedded touch screens that alludes to some mysterious underpinnings of technology at work. When festival attendees registered for the event, their credit card information along with their individual "itineraries" were uploaded into their wristbands. As part of the registration process, attendees selected their favorite breweries and beer types. Drawing from this personal data and real-time crowd data, the wristband crunched out the most optimal route to different points of interest, based on wait time and location proximity. As soon as any attendee scanned her wristband to enter the park, the wristband automatically buzzed to draw her attention to the navigational arrows that had materialized on the small screen, guiding her to her first destination. Though the wristbands provided almost complete navigation automation, they also allowed for user flexibility and choice. Festival-goers were able to add in a "stop" to the bathrooms, food tents, other beer tents, and water fountains using the simple selection interface; the wristband would account for this new stop and reroute. "I was at another event in this park before, and it was pretty hot like it is now. I just had to leave because I had no idea where the water fountains were," said attendee John Kim. He tapped on his wristband. "Now I know."

The "how" of these experiences rest in the City of Atlanta's network of sensors communicating and coordinating with each other, pulling from facility and festival data (beer tents, bathroom, and water fountain locations) and infrared, sound, and camera data from the sensor network. But for the attendees, the intricacies of the technology remain neatly packaged in an attractive wristband. And most, if not all, attendees also remained largely unaware of their role in producing and sending data back to the installed sensor array along the North Avenue corridor. This data informed Atlanta citizens outside the park about real-time crowd density in and around it. As festival-goers enjoyed festivities in the park, commuters knew to avoid that stretch of North Avenue, and parents made decisions about whether it was too busy to take their children to the park. Though specific to the event, the wristband played a role in the larger "smart" ecosystem by drawing data from the City sensor network and sending data back. As Atlanta moves closer to becoming a "Smart-lanta", future anthropologists might trace back its beginnings to this beer festival, further supporting the claims that beer is the foundation of all technological revolutions.

The Good Samaritan Sensor

Sensor data detect emergency events and automatically contact and assign municipal response quickly.

Key Ideas

i. Sound sensor data and analytics that assesses sound type is used to detect and confirm vehicular accidents and automatically assign emergency response.

ii. Social workers can use sensor data to stay in touch with the homeless in emergency situations to deploy social services as needed.

Key Assumptions

i. Data sets open and available to city departments and third-party developers via APIs

ii. Software is used to automatically assign municipal response to sensed conditions

iii. Sensor data is directly integrated into existing municipal systems

iv. Technical support and maintenance of services

v. Funding for the development, support, and maintenance of services

THE GOOD SAMARITAN SENSOR

Atlanta's "smart" sensor array acts as the silent, unwavering witness to every unfolding event around the city, continuously processing and crunching out data in unrelentless streams. While many citizens could find this omnipresence unsettling in nature, sensors could play a huge role as reliable witnesses in emergency events. What if Atlanta's sensor boxes could not only see these events unfold but contact the appropriate authorities for an immediate response?

"It was late. I was driving home from work, and this car ran the red light as I was crossing the intersection," Atlanta native Chris Perez said. The accident unfolded quickly, leaving Chris stunned and severely bruised. Within minutes, the police and emergency vehicles arrived, taking down Chris' information and shuttling him quickly to the hospital. It wasn't until a day after the accident did he wonder at how quickly emergency vehicles had arrived. "I realized there weren't any witnesses around. I didn't call. I wasn't sure if the other person just called really quickly." The mystery reporter? A sensor box at the corner of North Avenue and Glen Iris that had "witnessed" the entire accident.

How does this work?

The noise sensor within the box detected the loud crashing sounds and correlated the noise data with processed camera data to confirm the car accident within seconds. Once verified, emergency response teams were notified and dispatched within a minute after the accident. In the last year, response teams received about 60 accident notifications within seconds of occurrence, significantly decreasing response time. "We've been really pleased with the way it has worked. Before it took us at least 10 to 15 minutes to make it over to accident sites, but now we are probably there within five minutes. Haven't had any false calls from the boxes yet," said Atlanta's police chief, Erika Shields.

The uses for this kind of sensor technology extend beyond car accidents for other kinds of emergency events. Social workers have now used the open API to build an app that helps them stay in touch with the homeless during extreme weather emergencies. The app uses infrared capabilities of the cameras to look for heat signatures that are not moving, and if it detects them, deploys social services. "During weather emergencies, we worry that there might be people out there without adequate resources, but there was no great way for us to make sure. Now there is," said shelter volunteer Michael Scott.

City Lights

Sensor data can detect and identify areas with light outages, areas in need of street lights, and potential areas for solar panel installations.

Key Ideas

i. Real-time light data can alert the Department of Public Works to dark areas that need street light maintenance or the installation of new street lights.

ii. Sensor data can identify areas with a large amount of light for solar panel installations.

Key Assumptions

i. Data sets open and available via APIs

ii. Software is used to automatically assign municipal response to sensed conditions

iii. Sensor data is directly integrated into existing municipal systems

iv. Technical support and maintenance of services

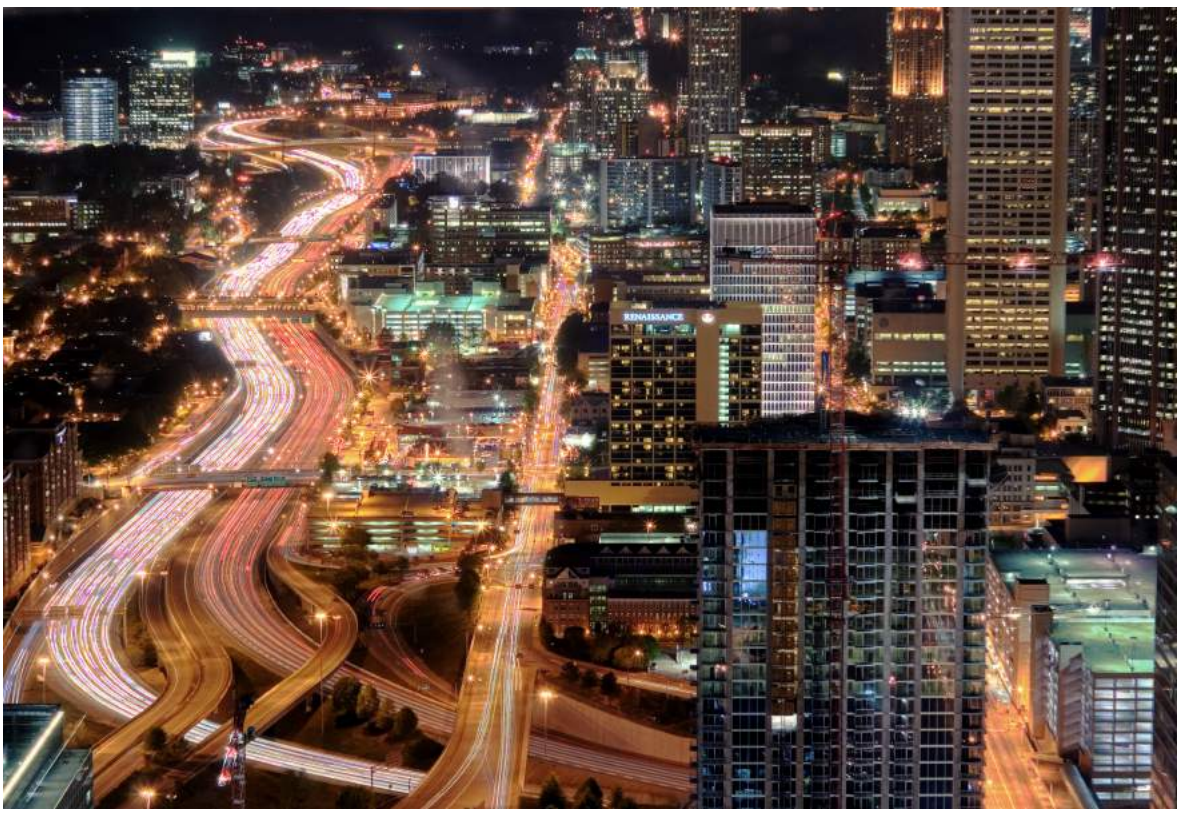
v. Funding for the development, support, and maintenance of services

CITY LIGHTS

Sam Park used to diligently call Atlanta Public Works whenever he noticed a street light outage on his walk home from work. However, more recently, he has noticed not only less outages but more installed street lights along his usual route. "It's definitely needed. I never felt unsafe, but there were parts of North Avenue that were very dark, especially in the winter," Sam said.

Since the deployment of Atlanta's sensor array, Public Works no longer relies on Sam and other Atlanta citizens to report outages. "Now we receive automatic alerts when an area becomes unusually dark," says Jude Dodson from Public Works. Using real-time information from light sensors, Jude and his team can quickly identify light outages on a map and dispatch workers to fix them. Beyond maintenance, Public Works has also used the same data to determine areas in need of street lights. "We've looked at areas that are dark consistently over time based on the data, and we've strategically started installing street lights to remedy that," Jude said. One of these particular areas of focus included Sam's walking route along North Avenue.

Using the same data set, the City of Atlanta is currently observing light levels in different communities over time to identify potential areas for solar panel installations. "Atlanta is dedicated to literally becoming a smarter, energy-efficient city. And this is a move toward that," said Jude of this recent initiative.


RENAISSANCE

Game Day Parking

Community groups can use open and accessible sensor data sets to develop business opportunities for their neighborhood.

Key Ideas

i. Sensor data can be used by both parking companies and community residents to provide smart parking services for game day goers.

Key Assumptions

i. Data sets open and available to city departments, corporations, and third-party developers via APIs

ii. Technical support and maintenance of parking apps

iii. Funding for the development, support, and maintenance of parking apps

GAME DAY PARKING

For most Falcons fans, the game day scene is a welcome sight — a general display of pride and camaraderie featuring black and red gear and the smoky scent of grilled meats. Though tents and grills seem to magically appear around the stadium the morning of kickoff, most game goers can attest to the significant amount of preparation required to enjoy the festivities at the Dome. From the grocery store expeditions to the tailgate setup, Falcons fans spend an average of days tackling even the most seemingly minute details. One of these easily overlooked details but arguably the most crucial is parking. While season ticket holders receive parking as part of their package, fans attending single games need to either reserve parking online or search for parking spaces the day of the game. While tailgaters are limited to specific lots due to various rules, other game goers can choose between the Georgia Dome lots or private parking lots. A plethora of parking websites and apps, including ParkingPanda and ParkingWhiz, help customers reserve their desired parking spaces ahead of time. However, for those who forget or want to simply pay for day-of parking, parking companies, including LAZ Parking and Lanier Parking, offer a "smarter" solution. Instead of driving around the stadium and suffering through game day traffic to search for available parking, these companies offer customers efficiency packaged into an app. Now customers can simply open the EventPark app, search for available parking near the stadium based on proximity and price range, and follow the GPS directions to a parking spot. These directions update based on real-time data from the City's sensor network, redirecting customers as needed when available spots become occupied.

A New Kind of Parking Service

However, these parking companies are not the only ones utilizing this particular data. A new parking service has emerged as a result of the City's open APIs. English Avenue resident, Rich Hines, created ParkingLawn as a counter to game day festivities. In stark contrast to game goers and tailgaters, residents of English Avenue, Vine City, and Washington Park dread game days. "Most folks set themselves up to stay at home all day," Rich said. "It is a nightmare for us." This nightmare looks like this — trash from tailgates blows into the neighborhood, people drive through the neighborhood and park their cars "wherever", impatient drivers nearly run into pedestrians crossing the street. If residents accidentally find themselves in game day traffic, they spend nearly an hour trying to turn back around.

Westside residents understand that football games and the problems that accompany them will be permanent fixtures in their lives for a few months out of the year. However, while they can't exactly change their situation, they can be creative in the ways in which they tackle these longstanding issues by adopting the motto: if you can't beat them, join them. If people are going to come into the neighborhood to park anyway, why not just charge them? Many residents already had been allowing game goers to park on their lawns for a fee, but Rich decided to transform these informal transactions into an actual service with the ParkingLawn app. "I was talking to my neighbor who lets people park on his lawn, and I asked him how he advertises that. He said he just makes signs and goes out to Northside to get people's attention," Rich said. "So I thought to myself - how can we make that process easier for the community? It all clicked together one morning. I have some coding skills. Other parking apps are using the data from the sensors around the city. It's open data, so the community should be able to use it too."

With ParkingLawn, residents can sign up for accounts and "list" their driveways and lawns through the app or the website. Similarly to the other parking apps, users can reserve a spot prior to game day at a discounted price. While residents can personally set their prices, the app suggests an average price based on other lot prices and proximity to the stadium. However, for day-of parking, ParkingLawn allows residents to use real-time data to dynamically adjust parking prices as other parking lots become full. "Say the Dome lots are packed, and the other ones around the stadium are filling up. Well, Ms. Bernice's house is way closer to the stadium than those other lots. People are going to pay more for that convenience," Rich said.

Despite ParkingLawn's adoption by many residents and customers, Rich acknowledges that people will still park in residential areas without paying — but not without repercussions. "Those sensors are everywhere. We didn't really want them here, but now that they are, how can find opportunities to use that data? So now, the community is working with the City to ensure that we can use sensor data to identify cars that don't belong to residents and visitors and ticket them. So yes, we're trying our best to adapt to this new technology." By no means does ParkingLawn solve the many problems that these residents face. Most residents need a permanent job to pay their steadily rising rent and property taxes that part-time jobs at the stadium and this parking service can't provide. However, it still generates some extra money to pay the bills. But to Rich, ParkingLawn is more than a business service: "It showcases the beauty of this community. We always work with what comes our way, and I think that makes us just as smart, or smarter, than those sensors."

Sensor Maintenance

As part of deploying a civic sensor array, we need to consider different strategies of maintenance and support in the event of network failure or sensor malfunction.

Key Ideas

i. The city can hire community members to check on specific sensors in their neighborhood that seem to be producing faulty data or malfunctioning.

ii. In moments of network breakdown, resident local knowledge can potentially be leveraged to fill in the gaps in sensor data.

Key Assumptions

i. Means of soliciting and funding community members

ii. Provided resources for community members to use to check on sensor boxes and report back to the city i. Means of soliciting and funding community members

ii. Provided resources for community members to use to check on sensor boxes and report back to the city

SENSOR MAINTENANCE

Atlanta has a sensor problem.

Following the deployment of the citywide sensor network, the City of Atlanta found itself facing the inevitable challenges that generally manifest themselves after the introduction of new technology. Despite all the opportunities that these new Internet of Things (IoT) technologies bring, the actual implementation usually requires some fine tuning. In Atlanta's case, several sensor boxes were producing erratic data readings that city employees could not quite explain. A quick look at the data portal for that week reveals rather dramatic fluctuations in readings from some sensor boxes, indicating that some inexplicable major event was occurring every minute or, more likely, something was wrong with the sensor boxes.

Instead of dispatching workers to go out and inspect these boxes, the City of Atlanta decided to outsource the work to community members. "We have been thinking about how we can get more community members who aren't necessarily in the technology sector involved with the smart city initiative. It made sense because the sensors are in these communities and belong to residents just as much as they belong to the city," Kurt Garin, a SmartATL employee, said. "So we reached out at NPU meetings, passed out flyers, Tweeted, asking for help." Because community members were simply checking the poles to give the City a better idea of what might be going on with the sensors, no technical skills were necessary for the job. "We had residents take pictures of the poles, the area around the pole, and the box itself. We also asked them to write down notes."

Surprisingly, a large number of community residents were eager to provide information; most of the notes consisted of the accumulation of daily observations around the area, not particularly contained to just notes about the sensor boxes. In fact, it was one of these stray observations that helped the City figure out what was going on with some of these sensor boxes. "It was something like, 'People have been digging up the street for the last few weeks'. So we looked into it," Kurt said. The SmartATL office eventually correlated the anomalous data to an excavation snafu that happened around the same time, where a landscaping contractor accidentally hit some fiber and communication lines and presumably affected part of the sensor network.

In many ways, this kind of community collaboration epitomizes an unlikely cornerstone of the smart city, where sensor networks and local knowledge meet. "You know, we often think about connectivity and networks in technology terms, and it's these moments of breakdown that we actually see that there is a different kind of network that already exists in these communities. These residents know their neighborhood in distinctly different ways than sensor data can ever tell us. It'd be worth figuring out how we can better incorporate the two in the future," Kurt said. "We're still learning what it means to be a Smart Atlanta, and that's a good direction to follow."

Data Stewards

In considering what kinds of economic opportunities the smart city brings to people who are not in the technology, data, or government sector, we might think about how we can involve community residents who have local, situated knowledge.

Key Ideas

i. Because residents are the people who know their community best, data stewardship positions in collaboration with the city can augment the data gathered from the civic sensor network.

Key Assumptions

i. Means of soliciting and hiring community members

DATA STEWARDS

Ms. Juanita Brown would be the first to tell people about her initial distrust and skepticism around Atlanta's smart city initiative. "I didn't want sensors in my neighborhood at all," the Washington Park resident said shaking her head. "But look at me now. A community data steward," she added with a wry chuckle.

The idea of community data stewards served as a response to the emerging problems around Atlanta's sensor network. Just a few months ago, the City of Atlanta used community reports to successfully pinpoint the cause of a network outage, sparking increased recognition of local community knowledge from the SmartATL department. More recently, another opportunity surfaced for community collaboration with the Westside neighborhoods. The streets of the English Avenue and Vine City neighborhoods are notoriously prone to flooding following heavy rain; the City of Atlanta already knew this fact prior to the sensor network deployment. "It's great that the sensors can tell us which streets are flooded, but we already knew that from historical data," said SmartATL marketing director, Cristina Perlera. "What the sensors can't tell us is what that water looks like. Is it brown? What is in it?" In response to this particular problem, the City decided to hire a few community members to collect this data.

Ms. Brown was among this group of community data collectors. Despite her criticisms of the smart city sensor network, she appreciated the general acknowledgement from the City. "I signed up for the job because I felt like—by hiring us—they were saying you know this community best. You are the experts, so you tell us what's going on in your neighborhood. And you know, we have had to deal with the flooded streets for some time. I could tell you without those sensors exactly which streets flood, and what that water usually looks like."

These kinds of engagements eventually gave shape to the data stewardship program. "We're starting to understand the limitations of the sensor network, and we think that these kinds of community engagements can address most of those limitations. The program is our way of extending a more permanent collaboration," Cristina said. "These residents know their neighborhoods well, which means they can provide us with more situated and accurate interpretation of the sensor data. Not only that, these stewards are part of this close-knit community, where neighbors are usually happy to share different kinds of information with them."

For the most part, Ms. Brown appreciates these new opportunities for her and her community. "Really, we just need jobs. And if the smart city can bring us more of these opportunities, then that really is a smart city to me."

Summary Insights

For a civic sensor array to be most valuable, data from the sensors should feed directly into municipal systems and should be factored into work assignments. This will require significant process and software development.

For a civic sensor array to be most valuable, data from the sensors should be available to third-party developers, including businesses, advocacy groups, and civic and recreational clubs and organizations.

One value of a civic sensor array is that, if it is open and accessible, it should support an ecology of services. As such, the civic sensor array should be seen as a platform that can be programmed with and upon.

Reflections

After hosting and facilitating three workshops in two different locations, we wanted to share our insights for future considerations moving forward with this project.

Who is included to participate? Who is excluded?

Concerns of who was excluded from these workshops surfaced after the third event in the Westside community. Prior to this last workshop, we had advertised the event through mailing lists and personal connections. For the third workshop, we announced the event at a NPU meeting and left flyers at the community coffee shop. As a community member said during the workshop: "We didn't even know. Nobody got anything in the mail. That requires footwork and face-to-face interactions." Given the small turnout at this event, we should consider different channels of communication to ensure that more stakeholders are included in the future, especially those who might not know to seek out these events. We should also utilize modes of communication that the community currently uses to not only advertise events and meetings but provide other means for community members to provide insights.

Speaking to community interests and needs

While participants from the first two workshops were excited about the proposed sensor array, the workshop with the Westside community surfaced intense concern around the initiative, making it difficult for participants to see any opportunities the sensors might offer. Their community's current concerns are vastly different from that of the Old Fourth Ward and Poncey-Highland communities, highlighting the importance of speaking to these specific interests and needs through our workshop activity.

Follow-up engagements after the workshop

Our engagements with participants ended after the workshop event. Given the time they devoted and insights they shared, we should consider ways of sharing updates and promoting follow-up discussions through the process.

Participant Ideas

While we used empirical data from the workshops to create the use cases, there were still a few participant insights we did not fully develop but are still important to highlight for future work with this civic sensor array and other city services.

1. Use sensors to detect source of trash blowing into the Westside community during game day to charge the trash offenders

2. Use sensors to alert residents when people are in the neighborhood parks late at night

3. Use sensors to detect stray dogs in the neighborhood and alert residents and animal control

4. Use sensors to alert and redirect blind people around hazardous streets (i.e., flooded streets) by using crosswalk audio alerts

5. Use sensors to direct disabled people around the city with ADA-friendly routes

6. Is there a way to opt in or out of the smart city? (i.e., when residents are just having a block party, they don't want to feel like they are being watched). Or are residents able to know who is watching and when?

7. Use data to identify areas with local business opportunities (i.e., grocery stores, farmer's markets, community centers) and provide support for community members to open local businesses

8. Permanent job opportunities for community members in the smart city

9. Use sensor data to alert residents of unsafe areas that they should avoid

10. Use sensors to gather data on community soccer field use to make an argument for Atlanta United team to come out and play on the field

11. Use sensors to determine areas in the city to install wind meters

12. Use sensors to compare "performance measures" across different neighborhoods (i.e., is the air quality better in Old Fourth Ward?)

13. Ability to share sensor data through social media (i.e., a geofilter on Snapchat to show what the air quality looks like in Old Fourth Ward)

14. Open data dumps for third-party developers

15. Smog alerts for people with breathing problems

16. Sensor data to show emergency driver what the house looks like before they arrive

17. Allow residents decide on sensor placement in locations where they want to know certain information (i.e., satellite sensors)

18. Sensors redirect game goers so that they are not driving through neighborhood during game day