Smart Uptown

Enabling Resiliency and Sustainability through Academic Research and Public Sector Collaboration

Columbus Consolidated Government

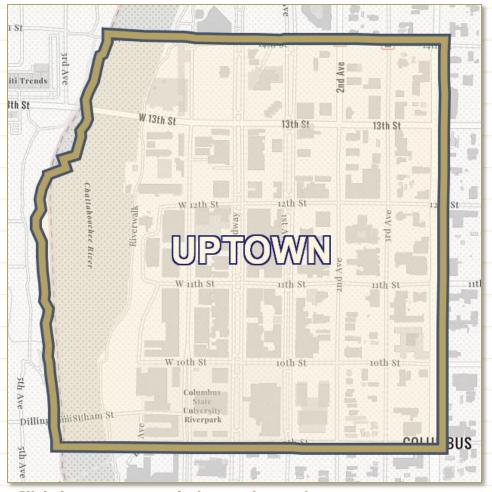
2019-2020 Class Final Report September 10th, 2020





Project Introduction

- Create value for Uptown Columbus by using state of the art technologies and analytical methods
- Communicate the vision with local leaders
- Implement backbone infrastructure to better serve the citizens of Columbus and its workers
- Create new, long-lasting partnerships between public and private entities



Click the map to open the interactive version



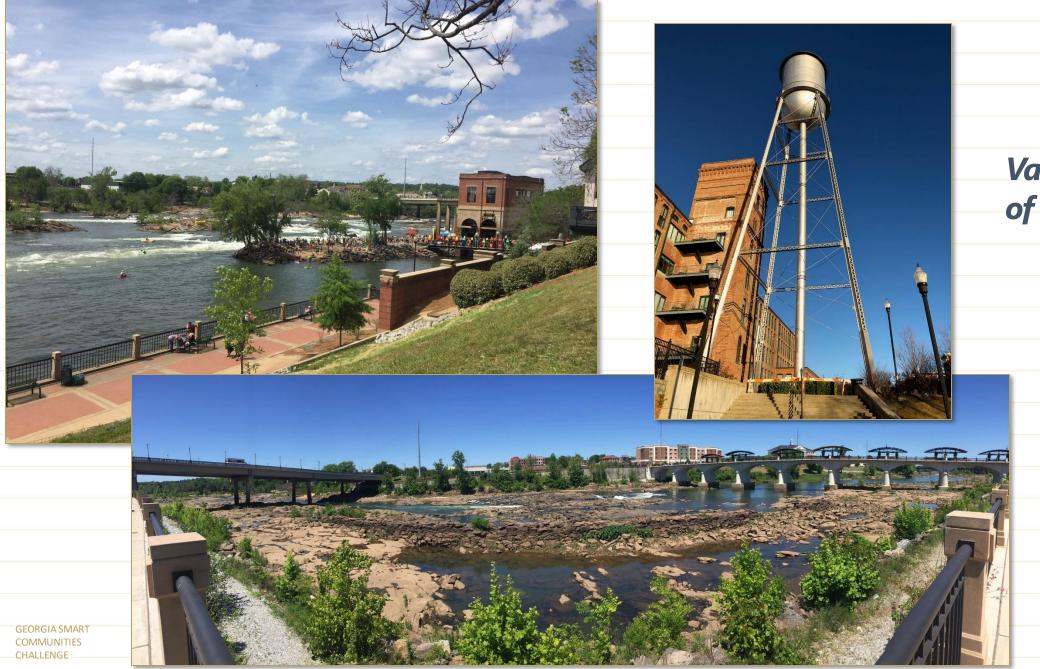
Project Motivation

- A general desire to create an even better Columbus
- Uptown has undergone many changes
 - Revitalization of the area
 - Increase in investment to generate tourism for Columbus
- Support from the executive staff level
 - Mayor & City Manager encouraged applying
- This project will serve as a catalyst for other projects
 - Fostering public/private partnerships;
 sparking other similar projects









Various views of Uptown...

Georgia Tech





Various views of Uptown...

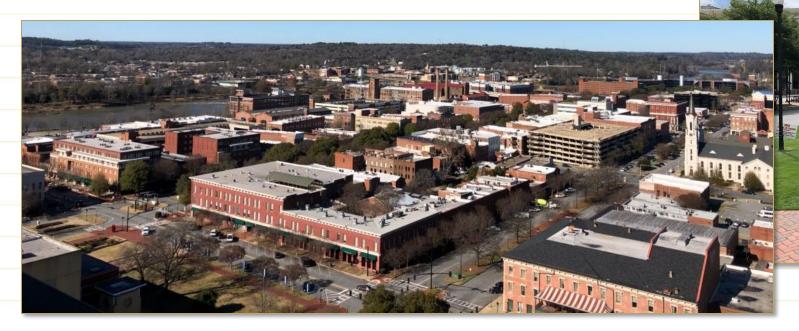


GEORGIA SMART COMMUNITIES CHALLENGE





Various views of Uptown...





Project Overview

- 1. Communicate the vision with local leaders in order to receive community involvement.
- 2. Establish a team based on input from city leaders and the consultant to support the efforts of the grant and future "smart" projects.
- 3. Work with the local planning, engineering and uptown organizations to devise an infrastructure implementation plan.
- 4. Define the necessary data sets/samples that shall benefit economic development, public safety, community engagement and livability decisions.
- 5. Identify the assets and IoT devices and locations that will perform the data metric measurements.
- 6. Deploy no less than two IoT devices capable of gathering and relaying data.
- 7. Construct no less than two data models describing captured data.



Project Goals



CONNECTIVITY INFRASTRUCTURE



ECONOMIC DEVELOPMENT

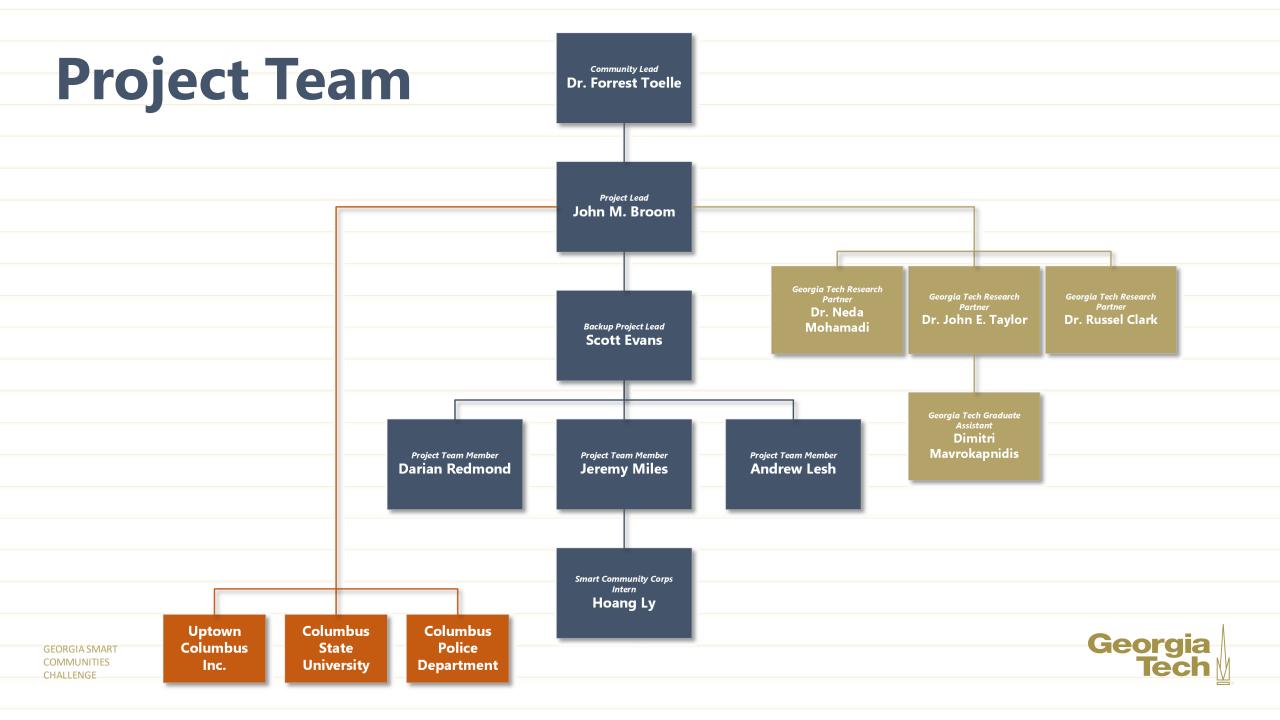


INCREASED SAFETY

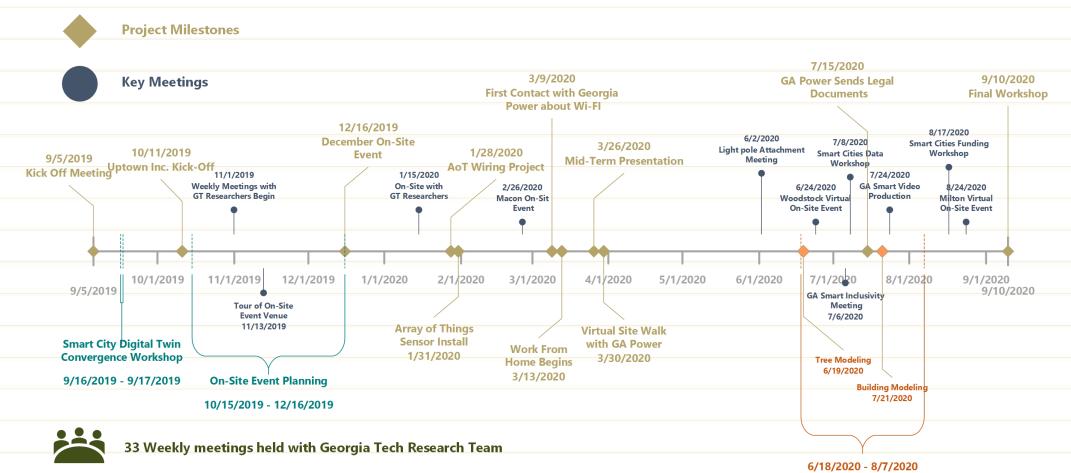


PARTNERSHIPS
BETWEEN PUBLIC AND
PRIVATE ENTITIES





Project Timeline





15 Meetings with our intern Hoang Ly

Smart Community Corps Internship Hoang Ly



Fall Activity - Project Planning

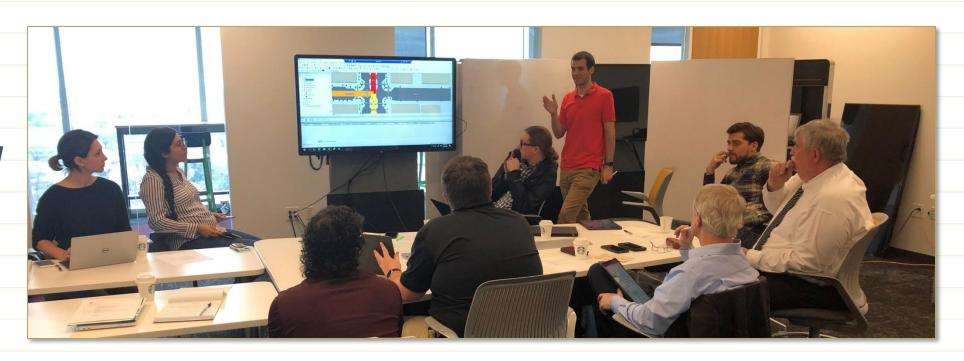
- September through early January timeframe
- Many discussions to determine where we wanted to go with this project
- Decision to tackle this project in a phased approach (3 phases total)
- Planning for the onsite event





Meeting at the CODA building

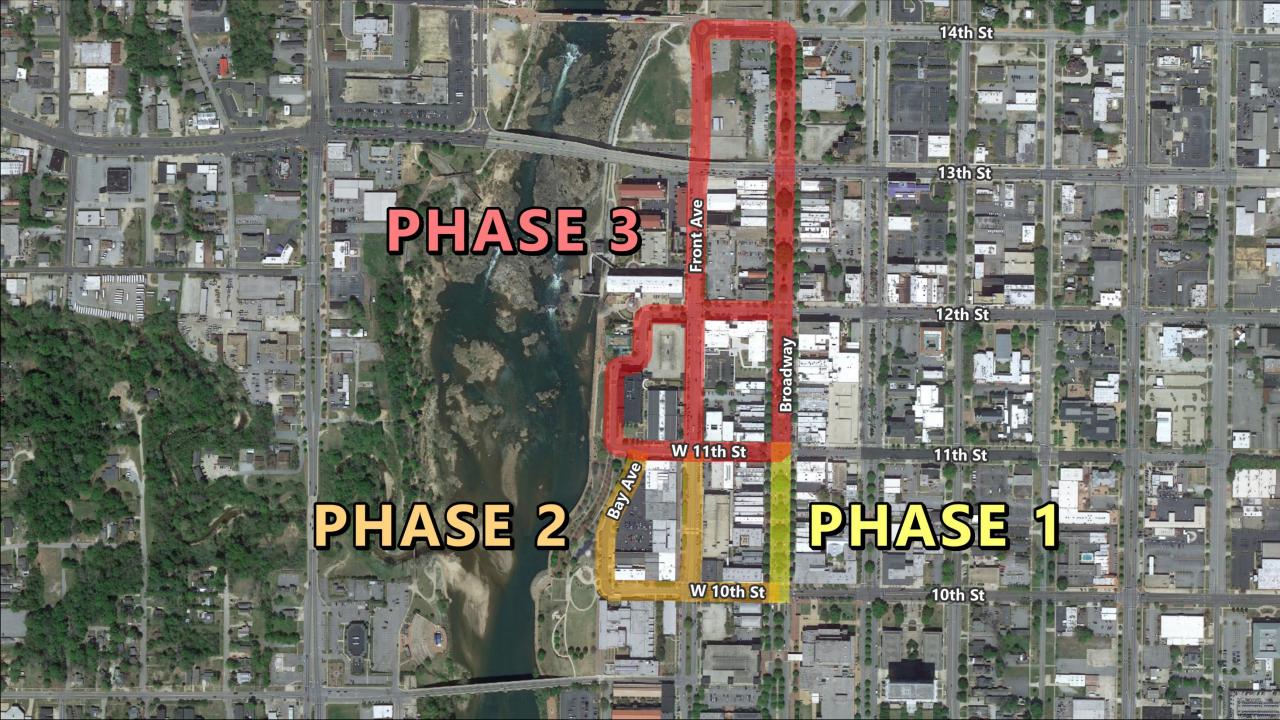
coda













Fall Activity - Onsite Event

- December 16, 2019: 10am 4pm
- Community/city leaders, business owners,
 Columbus State University and K-12 leadership
- Event provided important feedback
- Guided project in more specific direction





Event venue: Pop UPtown



Inside the event venue



Fall Activity - Onsite Event



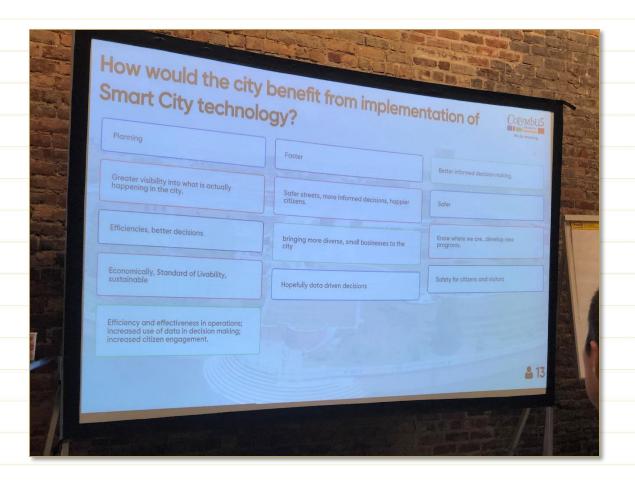
Event attendees touring Uptown

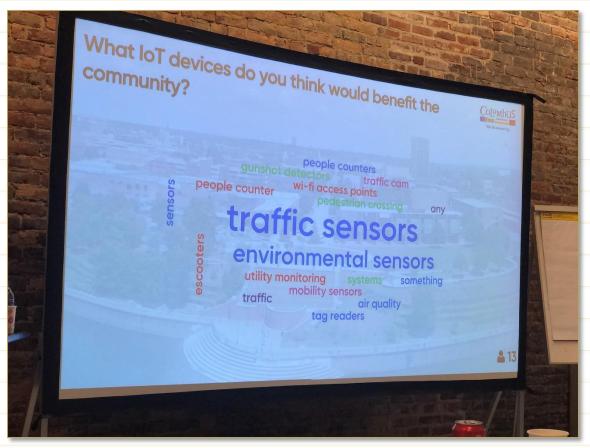


Group photo of onsite event attendees



Fall Activity - Onsite Event







Project Breakdown

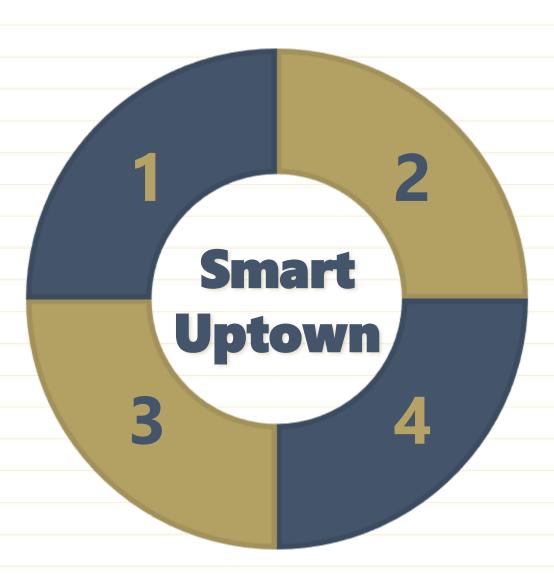
Digital Twin

Development of digital twin that includes 2D to 3D GIS data modeling 0000

Integration

AoT, digital twin, and video data





AoT

Deployment of Array of Things (AoT) units and data dashboard development 0000

Wi-Fi

Deployment of Wi-Fi access point units for public consumption

0000



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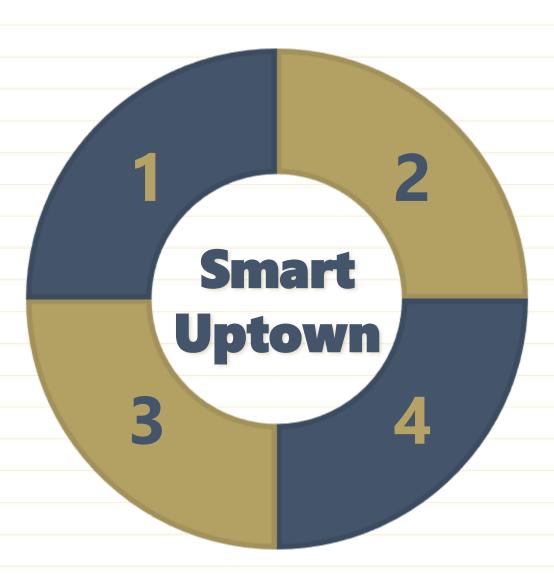
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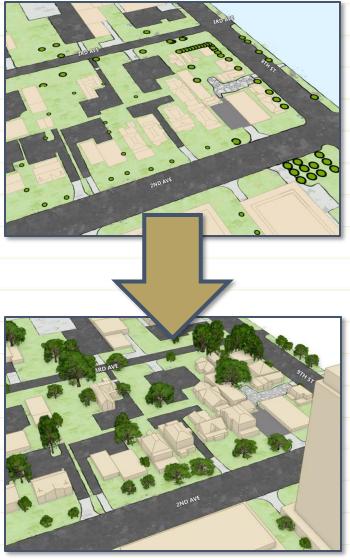
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Digital Twin Development

- GIS-centric data development process to create 3D models
- Some existing data ... but lots of new/refined data
- Data refinement was combination of automated and manual processes and workflows
- Smart Community Corps intern played a crucial role
 - Hoang Ly digitized and refined many features

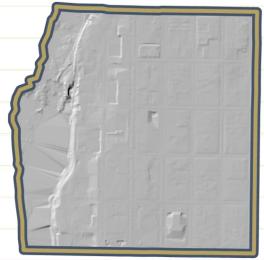




... to this!



Digital Twin Data Layers



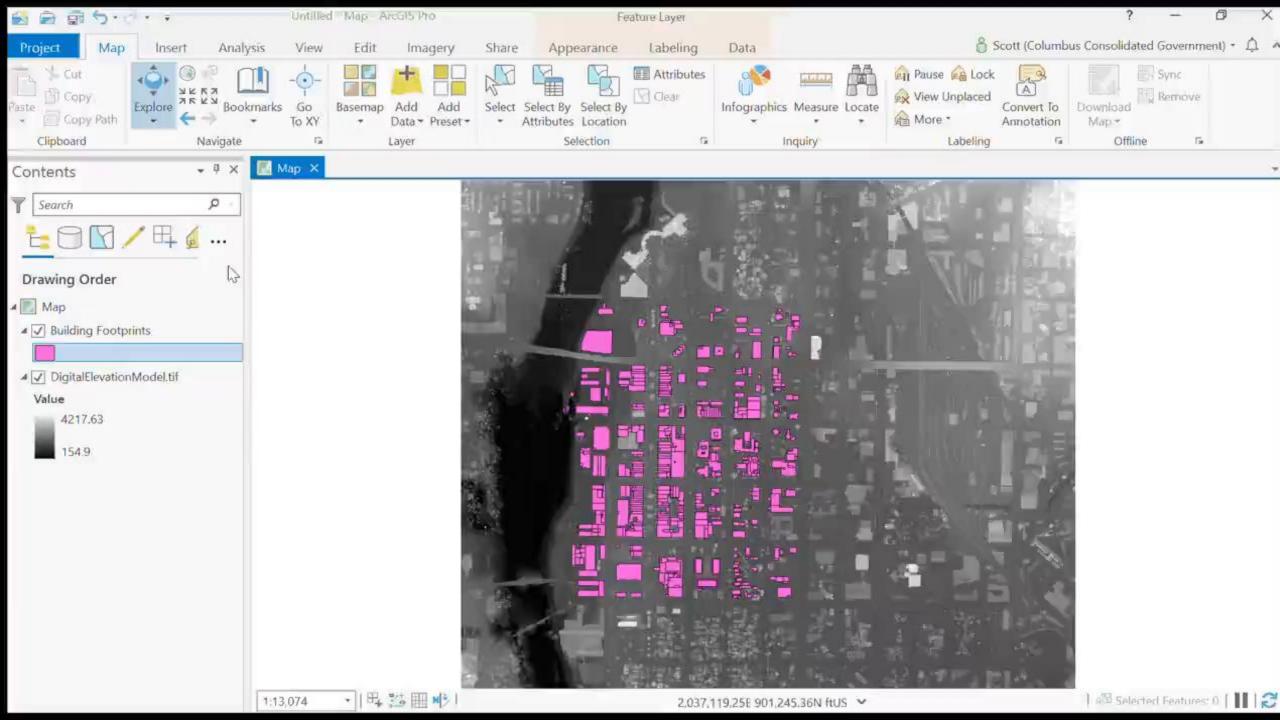












From 2D to 3D



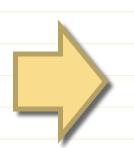




Created and edited 2D in **ArcGIS Pro**



Imported 2D and terrain data into **CityEngine**



Converted data to 3D in **CityEngine**



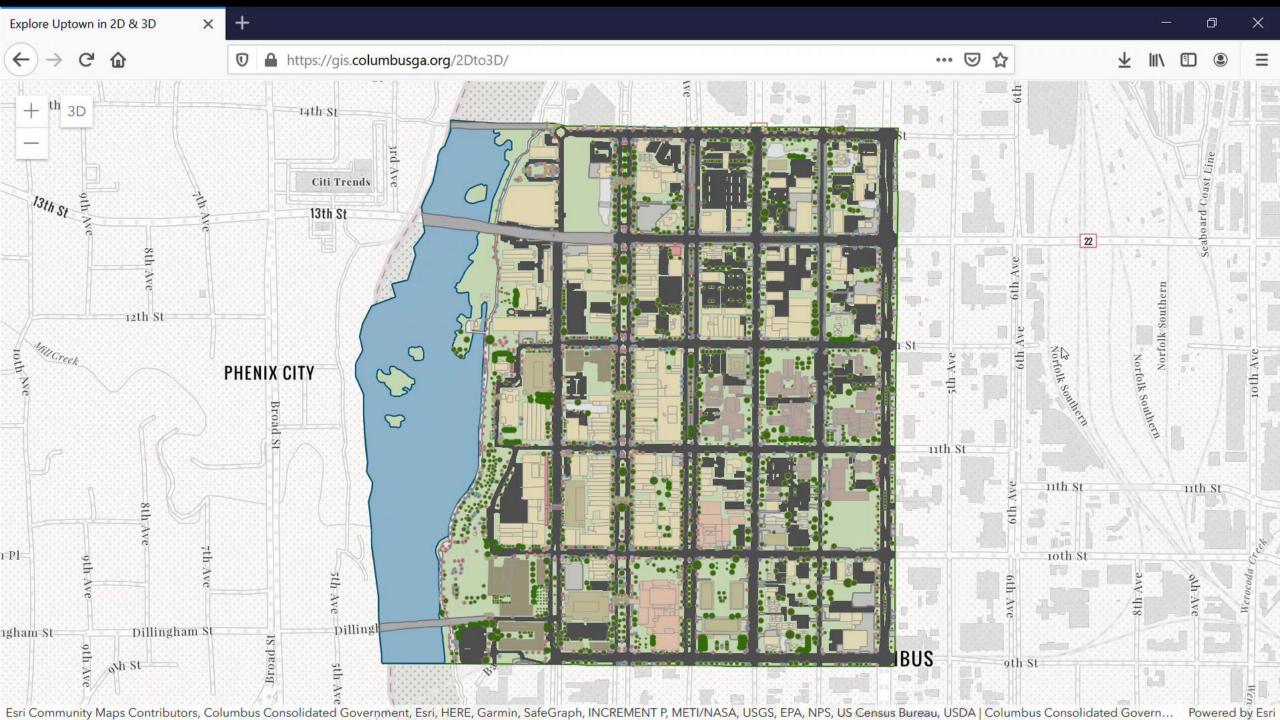
Exported from **CityEngine** to FBX files



Imported FBX files into Unity

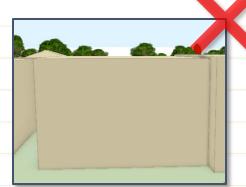


GEORGIA SMAR **COMMUNITIES**



Future 3D Data Development

- https://gis.columbusga.org/2Dto3D
- Continue refining the 3D Uptown model (eg. building facades, sidewalk polygons)
- Deploying 3D GIS techniques, design, and strategies city-wide
 - Enterprise GIS structure
 - Departments contain goldmines of data
 - Telling a story with data





Before



Visualizing property value data in 3D



Project Breakdown

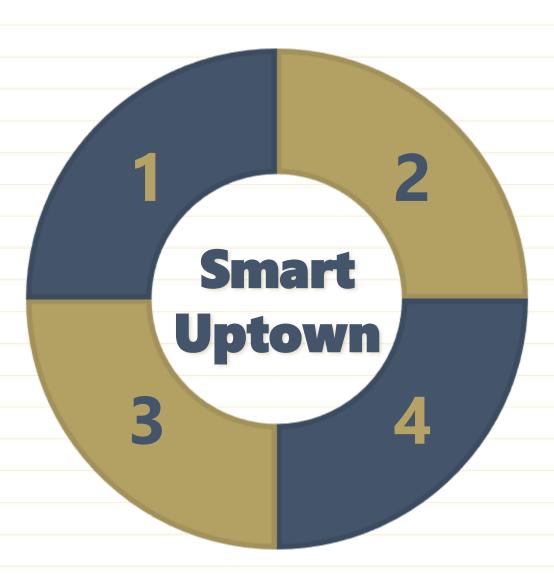
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Array of Things (AoT)

- "modular nodes...to collect real-time data...for academic/public use"
- Tracking impact of environmental and infrastructure changes on activity in key locations
- Denizen privacy is priority with data collected
- Quick access API
- Bulk download available for larger datasets

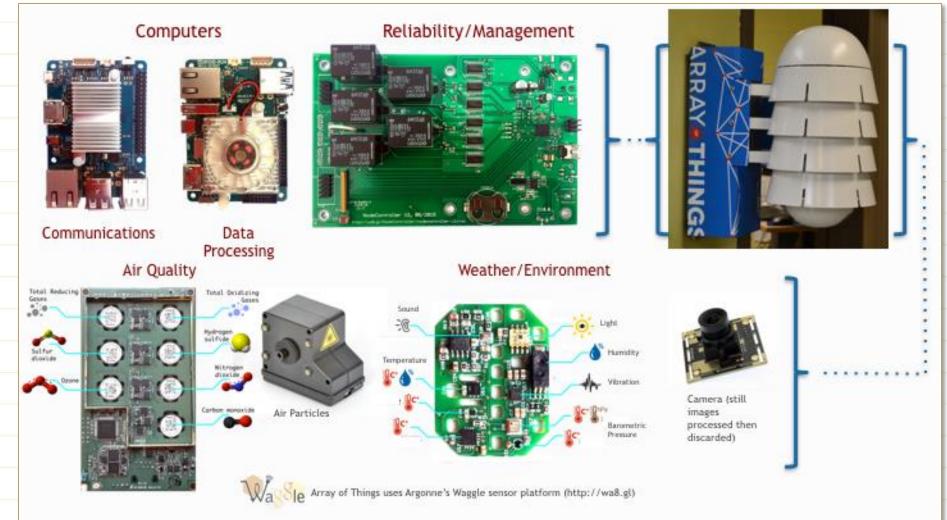
https://arrayofthings.github.io/

https://api.arrayofthings.org/



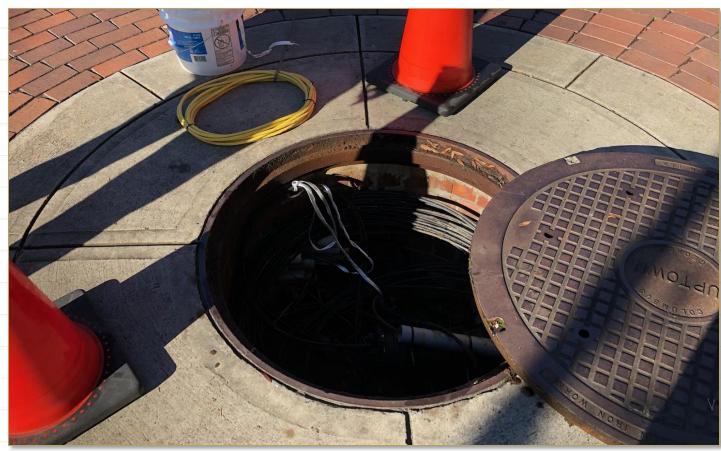


Array of Things (AoT)



Georgia Tech

AoT Installation



Opening the manhole cover reveals the path for running the device wire



Running wire from a 'traffic box'



AoT Installation





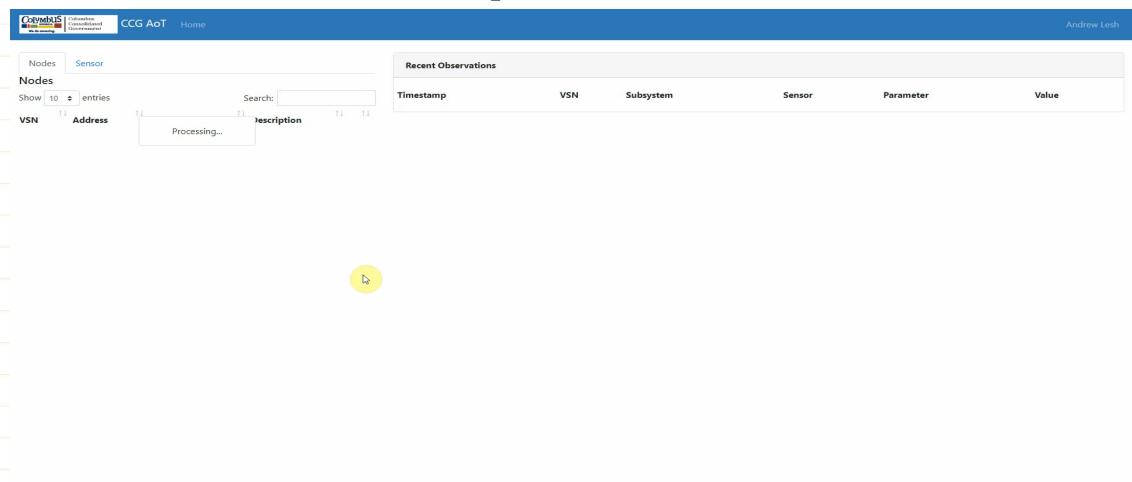
Preparing to mount the AoTunit "OAD"



Wrapping up the final wiring for the AoT Unit "OC1"



Dashboard Development





Project Breakdown

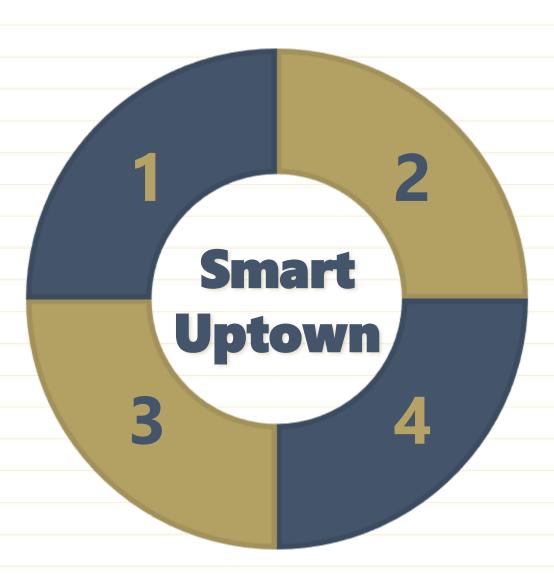
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Integration Case Study: Smart Uptown Digital Twin

Model, Visualize & Simulate

Citizen Hazard Exposure

Integrate AoT and video data streams with Digital Twin model

Apply object detection & tracking using computer vision algorithms

Sense pedestrian and vehicular traffic

Simulate and predict community dynamics

Implement & validate "what-if?" scenarios using forecasting models

Phase 1



Ambient Air Quality

Carbon Monoxide Hydrogen Sulphide Nitrogen Dioxide Ozone, Sulfur Dioxide Air Particles

Sound intensity RMS Sound Level

Street conditions, traffic flow, events
Camera

Detect heavy vehicles, shock to street pole

Magnetic Field
Acceleration and
Orientation
Physical Shock/Vibration

Weather Condition

Barometric Pressure Humidity, Temperature

Cloud cover, sunlight intensity, Infrared Light, Light, Ultraviolet Intensity, Visible Light



Collective Citizen Hazard Exposure

Heat Stress Exposure in Columbus, GA

High exposure to hot, humid temperatures and heat waves, which can lead to heat stroke, heat exhaustion, and heat cramps.









https://www.wtvm.com/2020/07/21/practicing-heat-safety-during-hottest-days-summer/



Assessing Collective Passersby Exposure

Temperature-Humidity Index (THI)

Combines Temperature & Humidity measures at each intersection

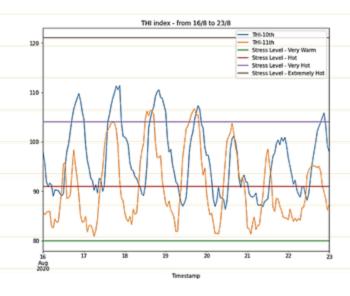
Passersby Detection & Tracking

(Broadway 10th & 11th)

YOLO & DeepSORT algorithms: detect and maintain passersby information.

Weighted THI

Integrates Passersby weight at each intersection



$$THI = t - (0.55 - 0.0055RH)(t - 58)$$

$$PWE_{THI,i} = \frac{1}{P} \sum_{t=1}^{N} THI_{i,t} \cdot P_{i,t}$$







Assessing Collective Passersby Exposure

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Combines Temperature & Humidity measures at each intersection

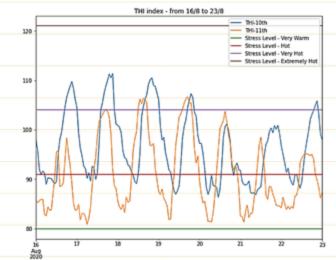
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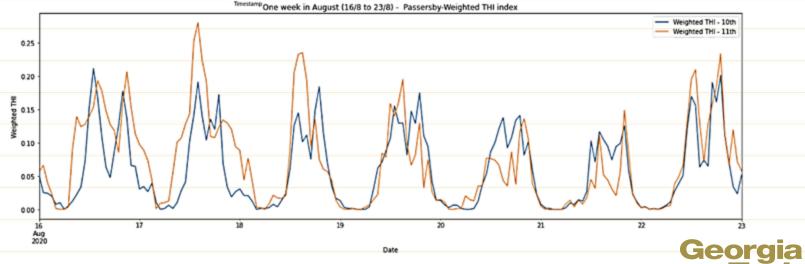
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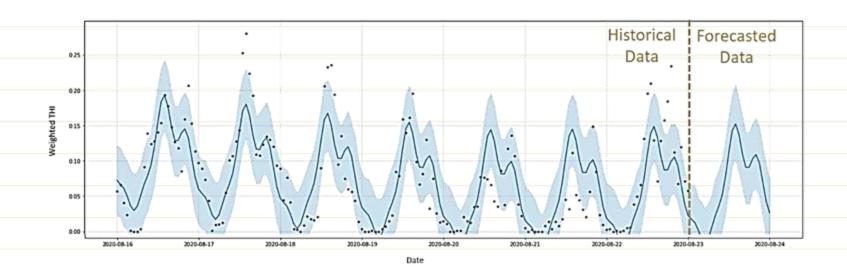




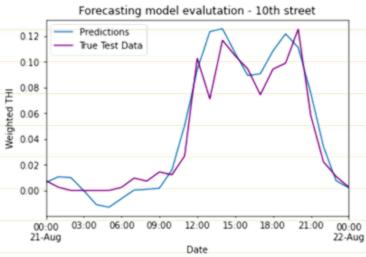
Assessing Collective Passersby Exposure

Monitoring and forecasting Hazard Exposure in the Uptown area

"What-if?" Scenario-based Decision Making & Planning









Project Breakdown

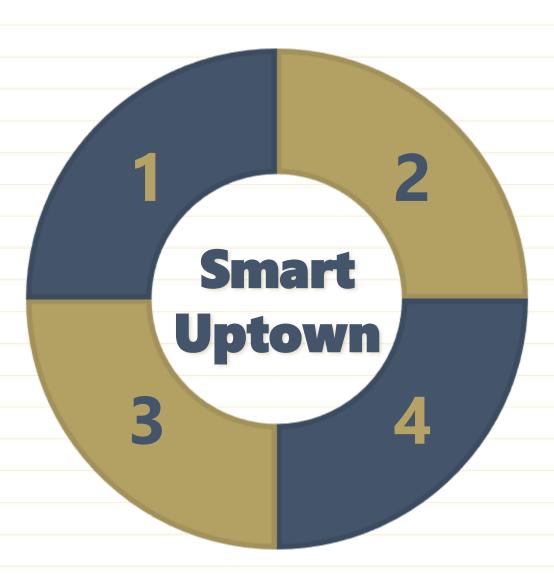
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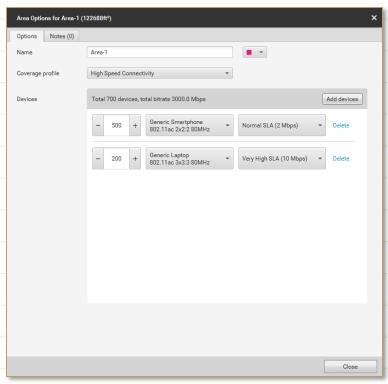
Wi-Fi

- Goals of the Wi-Fi segment of our grant were:
 - Provide a backbone connection system for city workers
 - Provide a stable internet connection
 - Bridge digital equity divides
 - Develop our methodologies



Connection Backbone

- Currently no substantial wireless infrastructure in Uptown area
- Reliant on cell service
- Plan centered around providing access to our private network for city workers
- Up to 700 devices
- Public and Private network can be toggled on and off at anytime
 - Allows for more devices per SSID in case of an emergency
- Preferred access point is the Meraki MR84



Area coverage settings within Ekahau





Public Wi-Fi

- Initially wanted to provide economic value through more people coming to Uptown and seeing public Wi-Fi as a perk
- Thinking to a post- Covid-19 world; public internet access has become a much larger topic
 - Helps connect those that might not have home connections
 - Keep students engaged in a virtual learning environment
- Smart Project has become a catalyst of research on how CCG will implement Public Wi-Fi- access going forward













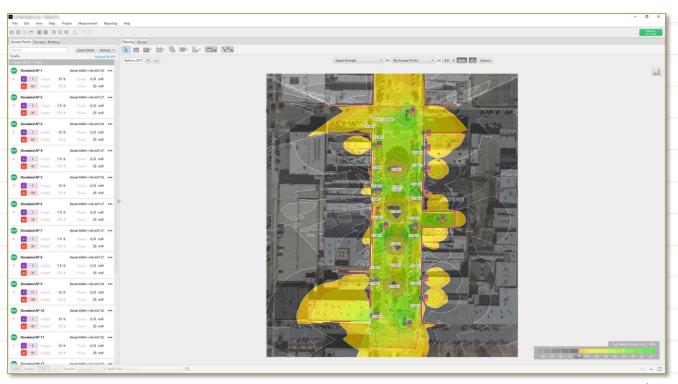


Methodologies

- CCG needed a science backed way to plan Wi-Fi deployment
- Acquired Ekahau software and sidekick hardware
 - Allows for a more analytical planning and monitoring of Wi-Fi deployment
 - Results in less wasted costs on equipment and time
 - Done correctly the first time
 - Provides us with right-sized results for planning Wi-Fi
- Ekahau allowed us to create the Uptown area and its parameters
 - Number of devices
 - Type of APs and antennas
 - SLA for connection speed



Ekahau Sidekick Wi-Fi Analyzer



Finalized Ekahau plan for the Uptown Area, displaying connection speed SLA



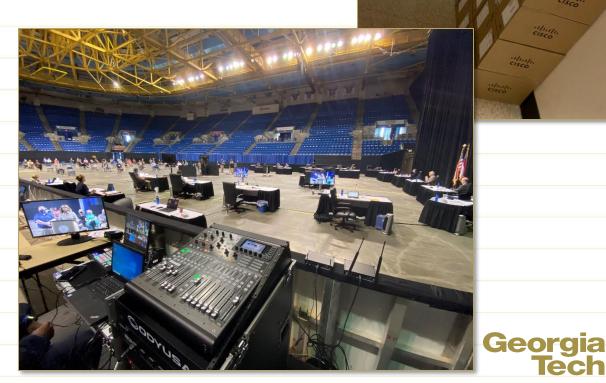
Methodologies (Continued)

- Transitioning from planning to implementing
 - Communications with Georgia Power helps build our partnership and complete project
 - Covid-19 slowed this phase of the Wi-Fi plan
 - Hard to get together all the people needed
 - Unable to do valuable on-site meetings with stakeholders (I.T. itself, Uptown Inc., Georgia Power, etc.)
 - Longer lead times on equipment
 - Plan is to continue to implement as we can get assets on-site
 - Next steps is to work through legal language of contract
 - Work to get testing complete, while still observing all Covid precautions
 - Install APs and go live with the private and public access



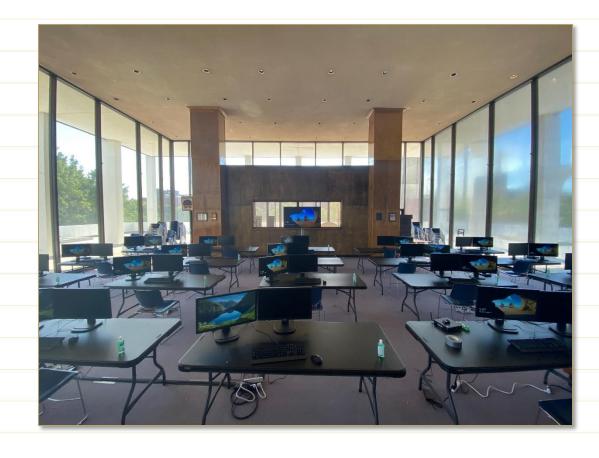
Challenges

- Leadership changes in stakeholders
- Developing new skills and methodologies in fields not normally pursued (eg. 3D modeling and Ekahau)
- Covid-19/Pandemic situation
 - City Council
 - Training for other City projects
- Balancing daily duties with the time needed for the project (aka time!)





Challenges







Future Plans

- Building out Wi-Fi in other public locations
- Expand upon our 3D GIS infrastructure
- Work on Phases 2 & 3



Phase 2



Phase 3

- Funding opportunities
 - National Science Foundation (NSF)
 <u>Civic Innovation Challenge Grant</u>
 - Knight Foundation
 - Local partners (eg. Uptown Columbus and other local businesses)





Project Team Contact Information

Community Lead:

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- Dimitri Mavrokapnidis, Graduate Assistant, <u>dimavrok@gatech.edu</u>

