

# FlyMeThrough

**Human-AI Collaborative 3D Indoor  
Mapping with Commodity Drones**

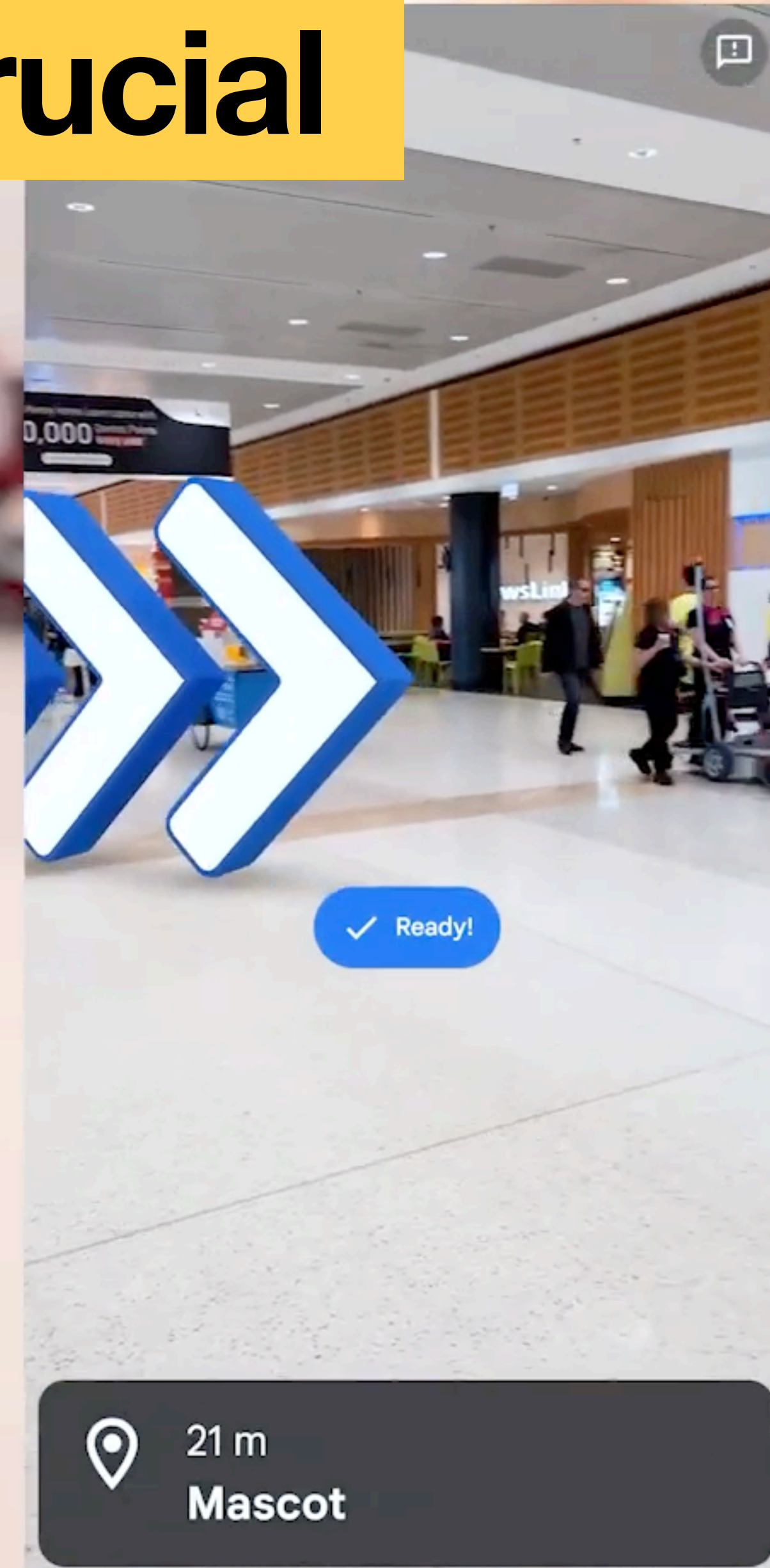
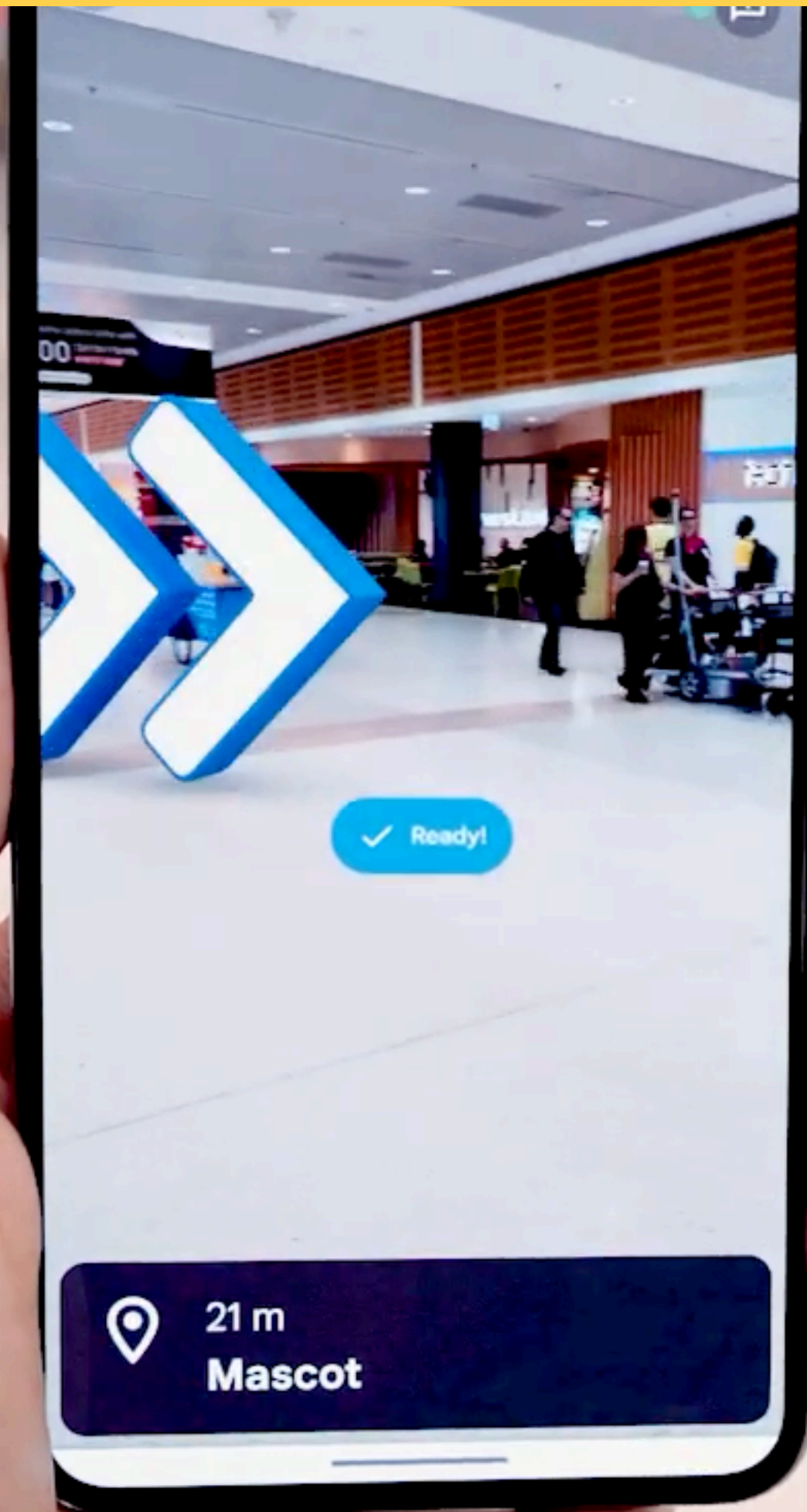


**Xia Su\*, Ruiqi Chen\*, Jingwei Ma, Chu Li, Jon E. Froehlich**





# Indoor mapping data is crucial





# Indoor mapping data is crucial





# However, collection is expensive and slow





# Drone as a special and efficient solution

Large Indoor Space

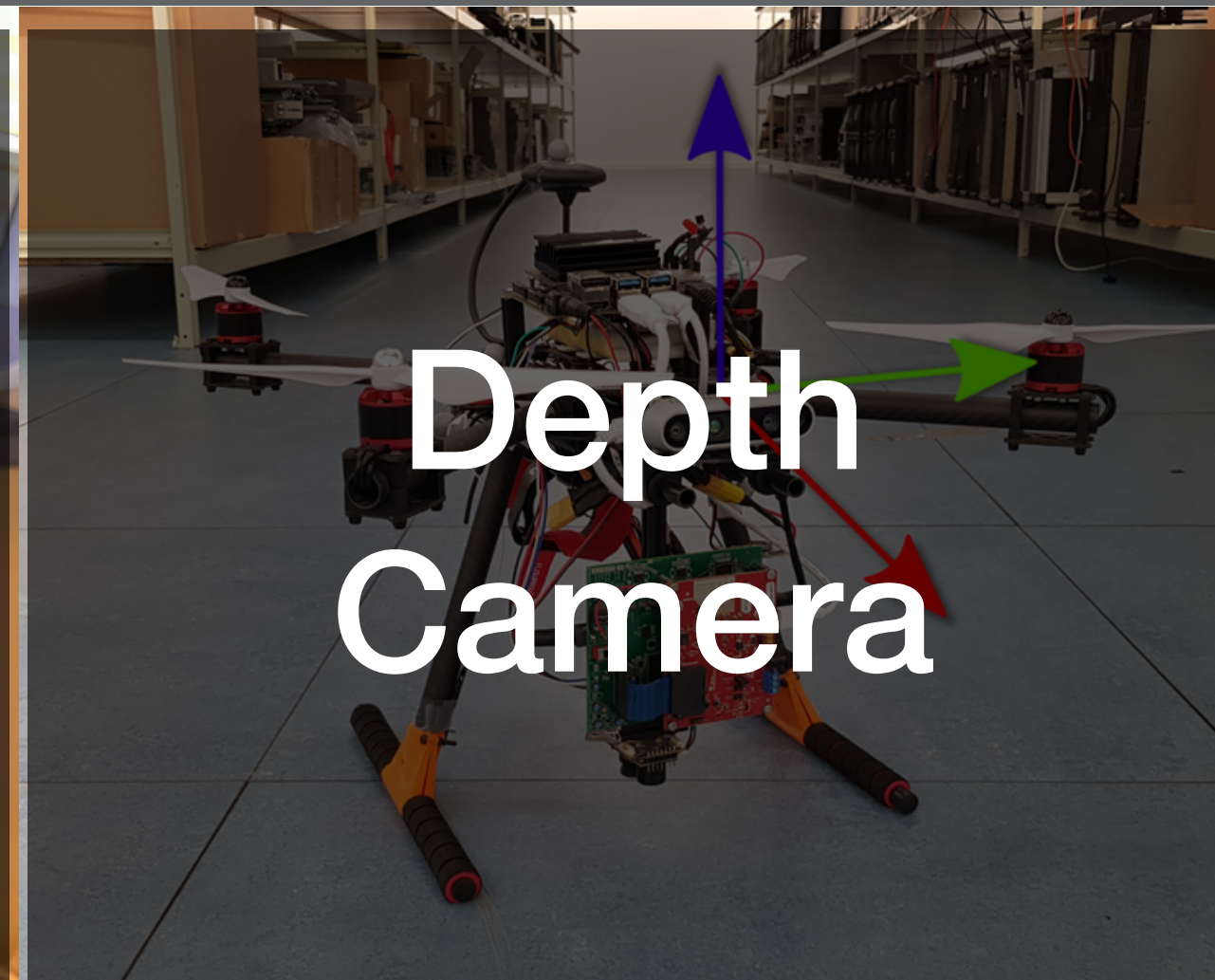
Efficiency

Availability





# Related Works





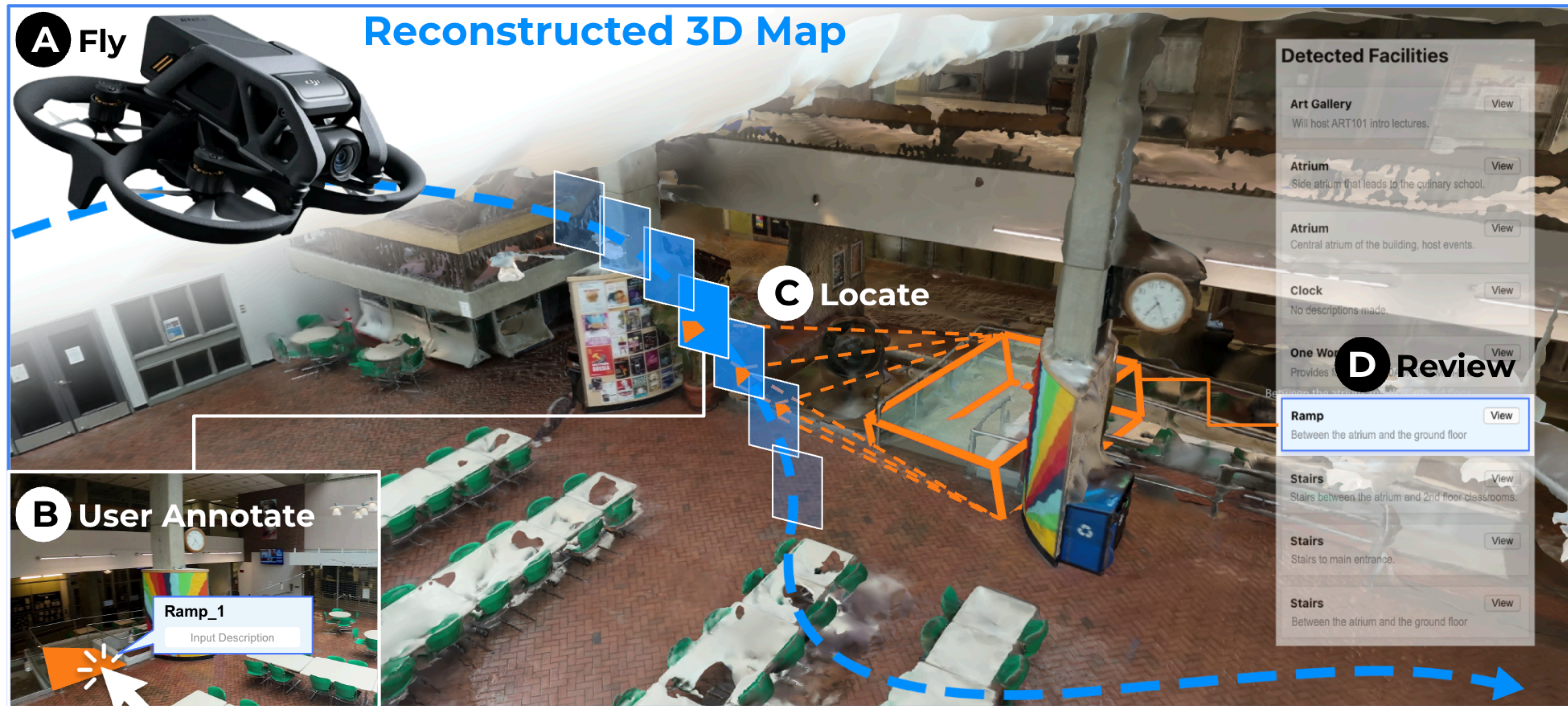
# Research Goal: Lower the Bar

- 1. Explore a hardware-agnostic solution
- 2. Enable non-professionals to incorporate situated knowledge
- 3. Understand opportunities, application scenarios, risk, challenges.



# FlyMeThrough

## Human-AI Collaborative 3D Indoor Mapping with Commodity Drones



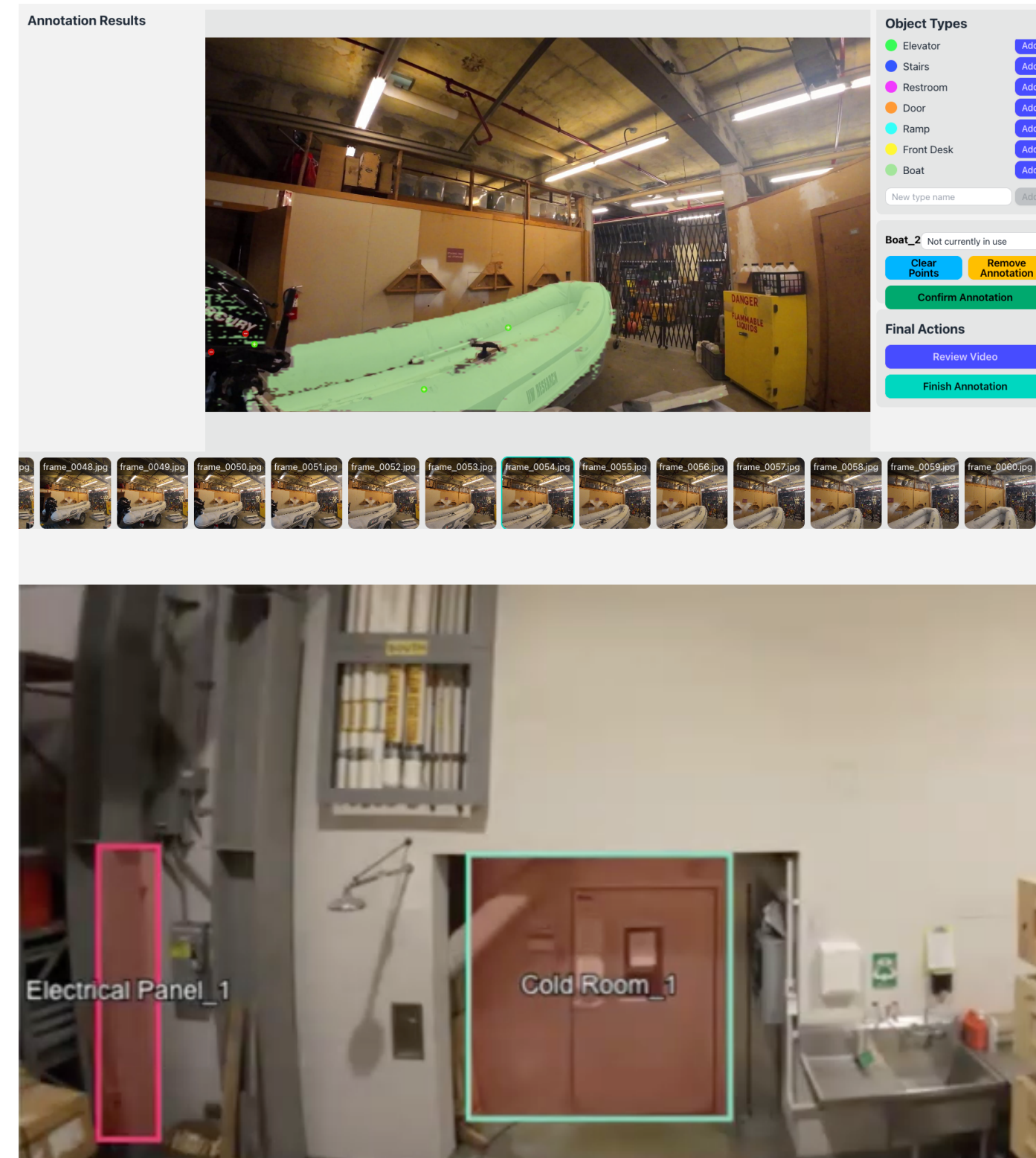
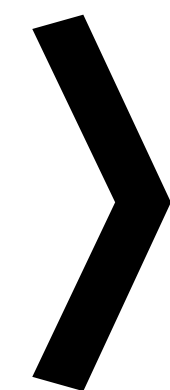


# FlyMeThrough

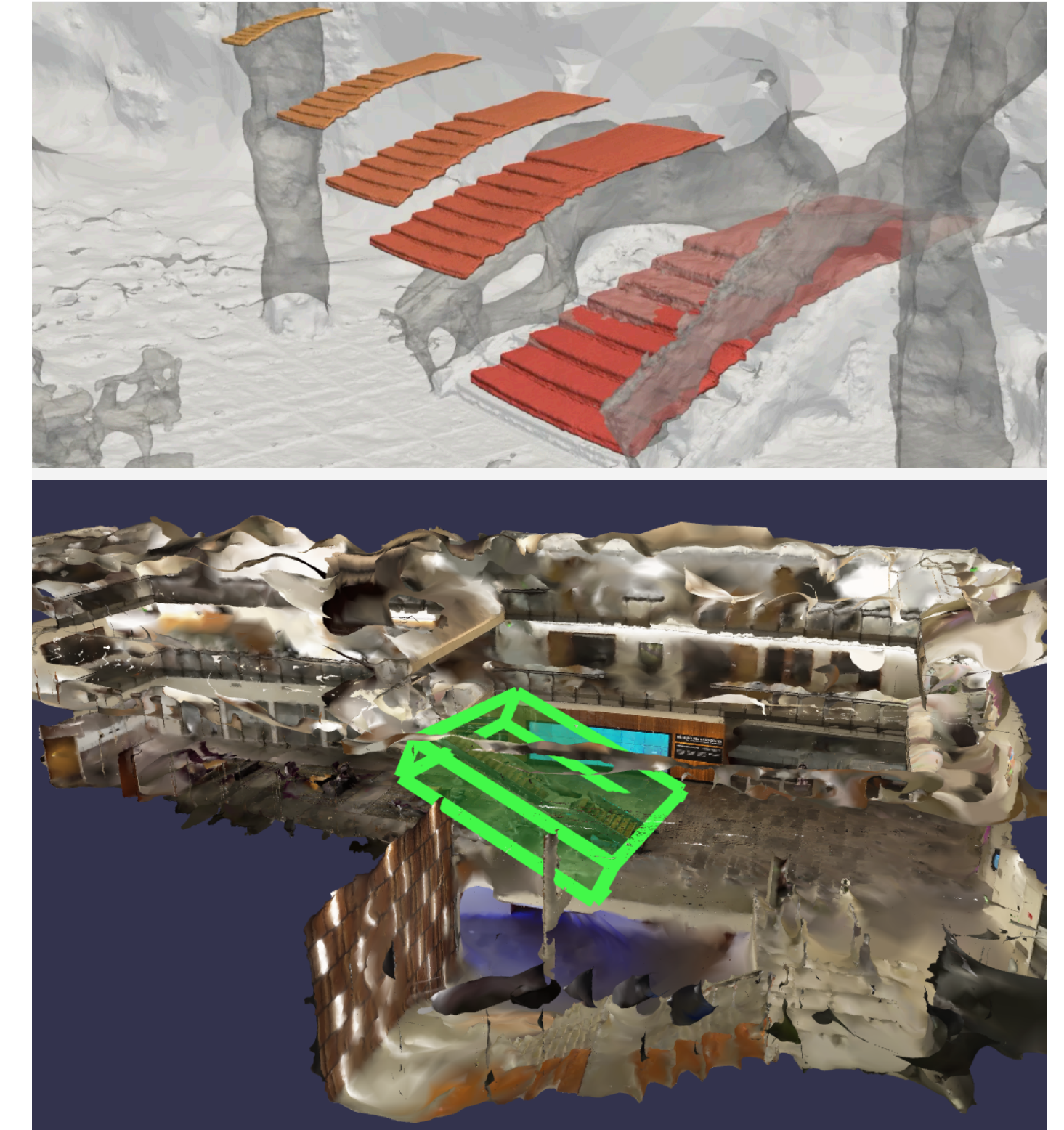
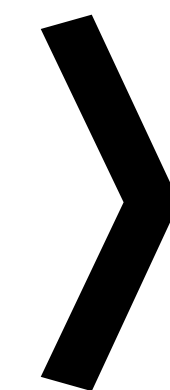
## Human-AI Collaborative 3D Indoor Mapping with Commodity Drones



Structure from Motion  
With Commodity Drone



Annotation  
On Video Frames



POI-infused  
3D Indoor Map



# FlyMeThrough

Structure from Motion  
With Commodity Drone



Annotation  
On Video Frames



POI-infused  
3D Indoor Map

## Results

Check each product page for other buying options.



Sponsored ⓘ  
DJI Neo, Mini Drone with 4K UHD Camera for Adults, 135g Self Flying Drone that Follows You, Palm Takeoff, Subject Tracking,...

★★★★☆ 586  
1K+ bought in past month

\$199.00

FREE delivery Apr 1 - 9

Add to cart



Sponsored ⓘ  
DJI Mini 4K, Drone with 4K UHD Camera for Adults, Under 249 g, 3-Axis Gimbal Stabilization, 10km Video Transmission, Auto Return,...

★★★★☆ 1,571  
1K+ bought in past month

\$99.00

FREE delivery Apr 1 - 9

Add to cart



Sponsored ⓘ  
Holy Stone GPS Drone with 4K UHD Camera for Adults Beginner; HS360S 249g Foldable FPV RC Quadcopter with 10000 Feet Control Range,...


★★★★☆ 2,422  
1K+ bought in past month

\$199.99

prime Same-Day  
FREE delivery Today 5 PM - 10 PM

4 sustainability features

Add to cart



Sponsored ⓘ  
Drones with Camera for Adults 4K, Brushless Motor Drone for Kids Beginners, FPV Foldable RC Quadcopter with 3 Batteries, 45 Mi...


★★★★☆ 543  
4K+ bought in past month

limited time deal  
\$79.98 Typical price \$129.99

Save 5% on 2 select item(s)

prime Same-Day  
FREE delivery Today 5 PM - 10 PM

Add to cart



Sponsored ⓘ  
4K Camera Drone for Kids 8-12 & Adults - Beginner-Friendly Mini Drone with Emergency Stop, 360° Flips, Carrying Case & 2 Batteries,...

★★★★☆ 30  
40+ bought in past month

\$99.99

Save 20% at checkout

prime Overnight  
FREE delivery Overnight 7 AM - 11 AM

Add to cart

## Overall Pick ⓘ



Fly  
RGB images/videos



# FlyMeThrough

Structure from Motion  
With Commodity Drone



Annotation  
On Video Frames



POI-infused  
3D Indoor Map





# FlyMeThrough

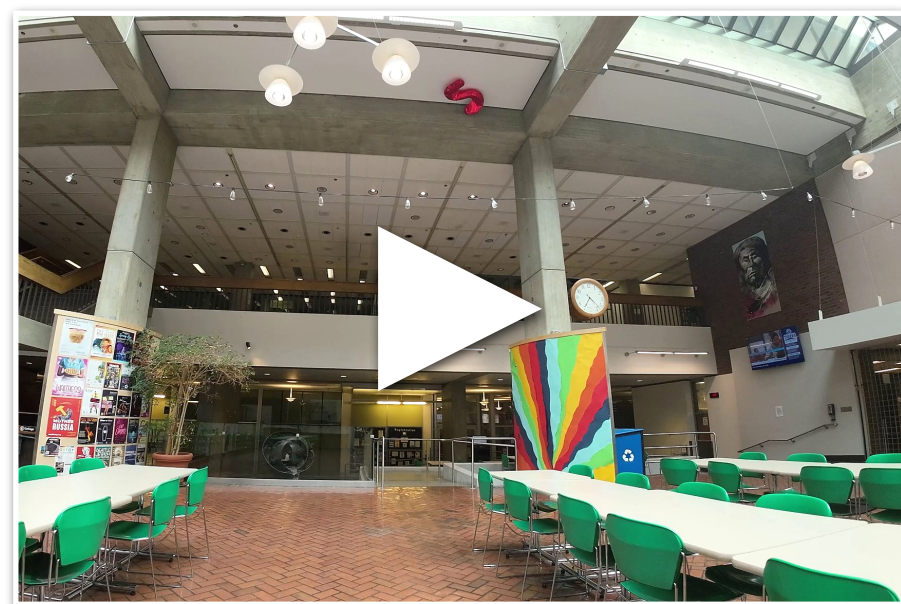
Structure from Motion  
With Commodity Drone



Annotation  
On Video Frames



POI-infused  
3D Indoor Map

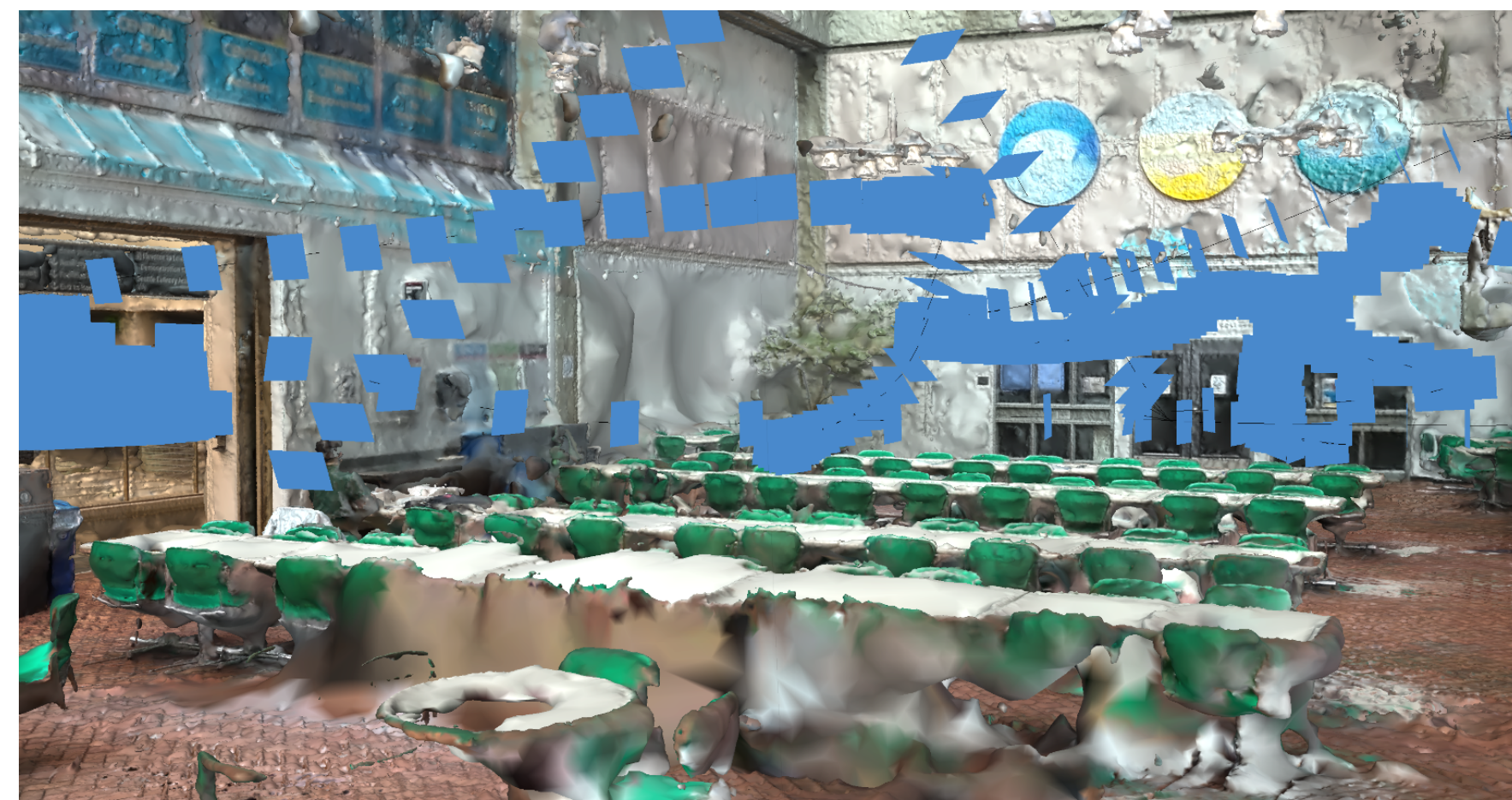


Commodity RGB Drone

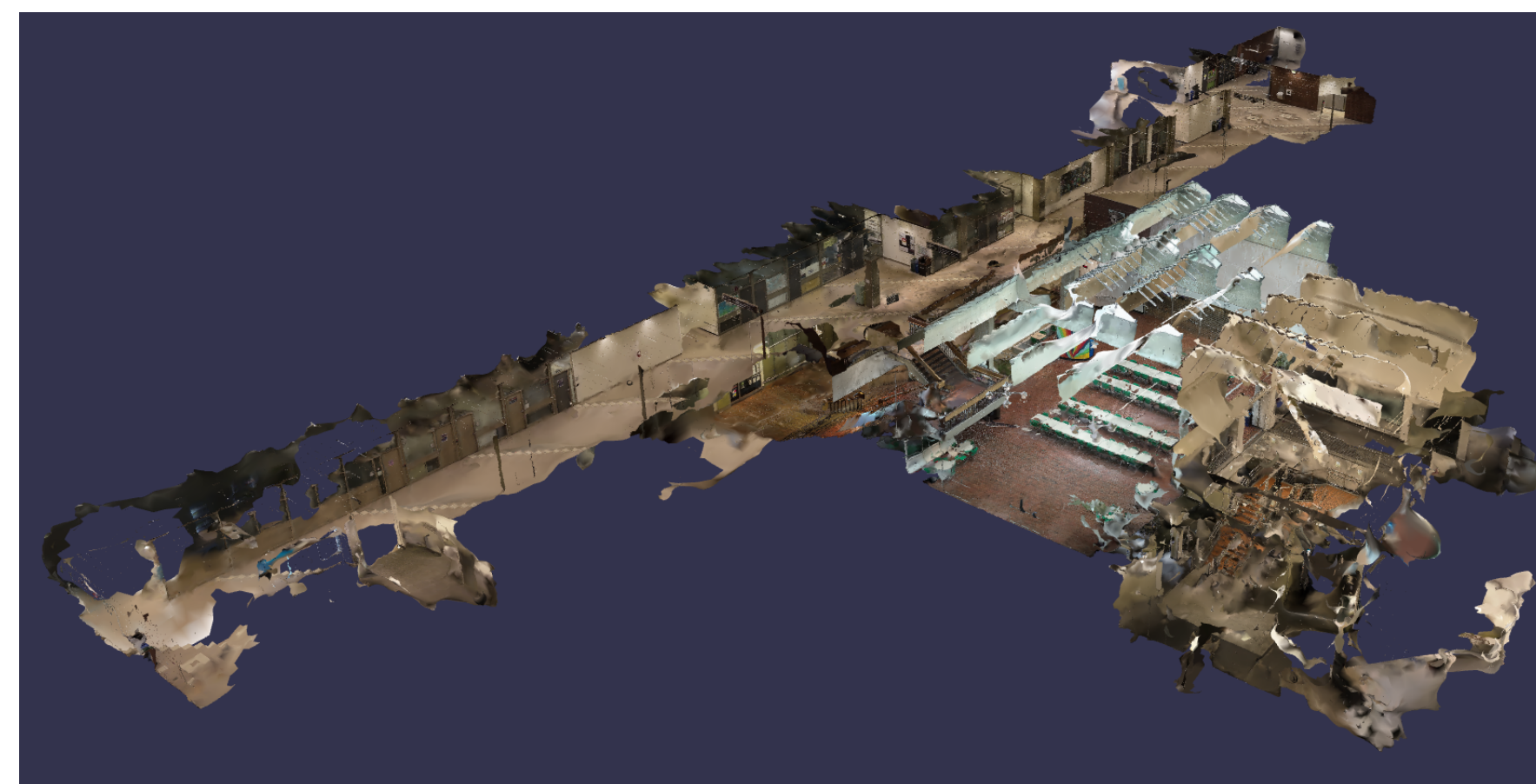
Video



Frames



Camera Extrinsics



3D Reconstruction



# FlyMeThrough

Structure from Motion  
With Commodity Drone

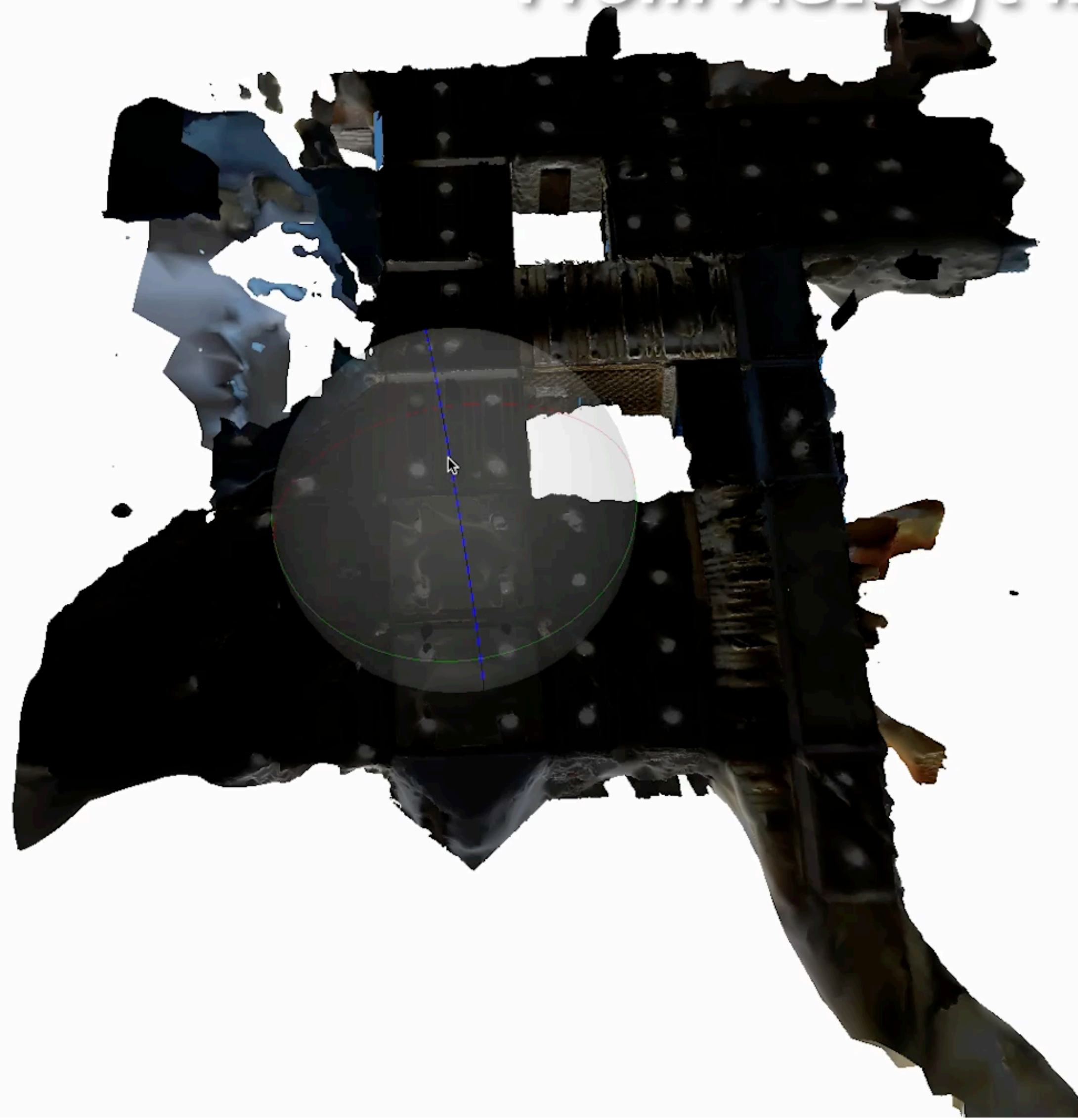


Annotation  
On Video Frames



POI-infused  
3D Indoor Map

*From AGISoft Metashape*





# FlyMeThrough

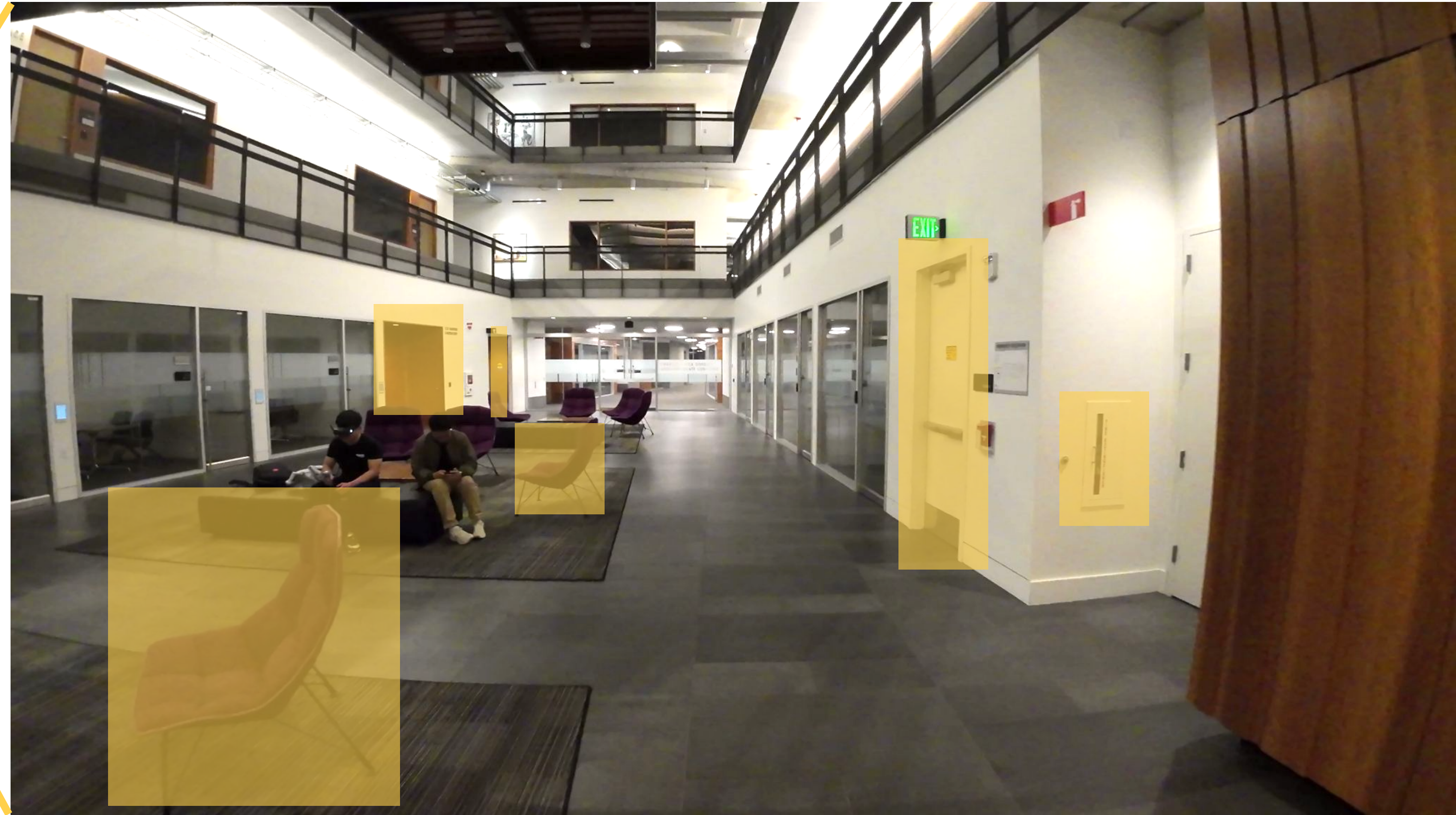
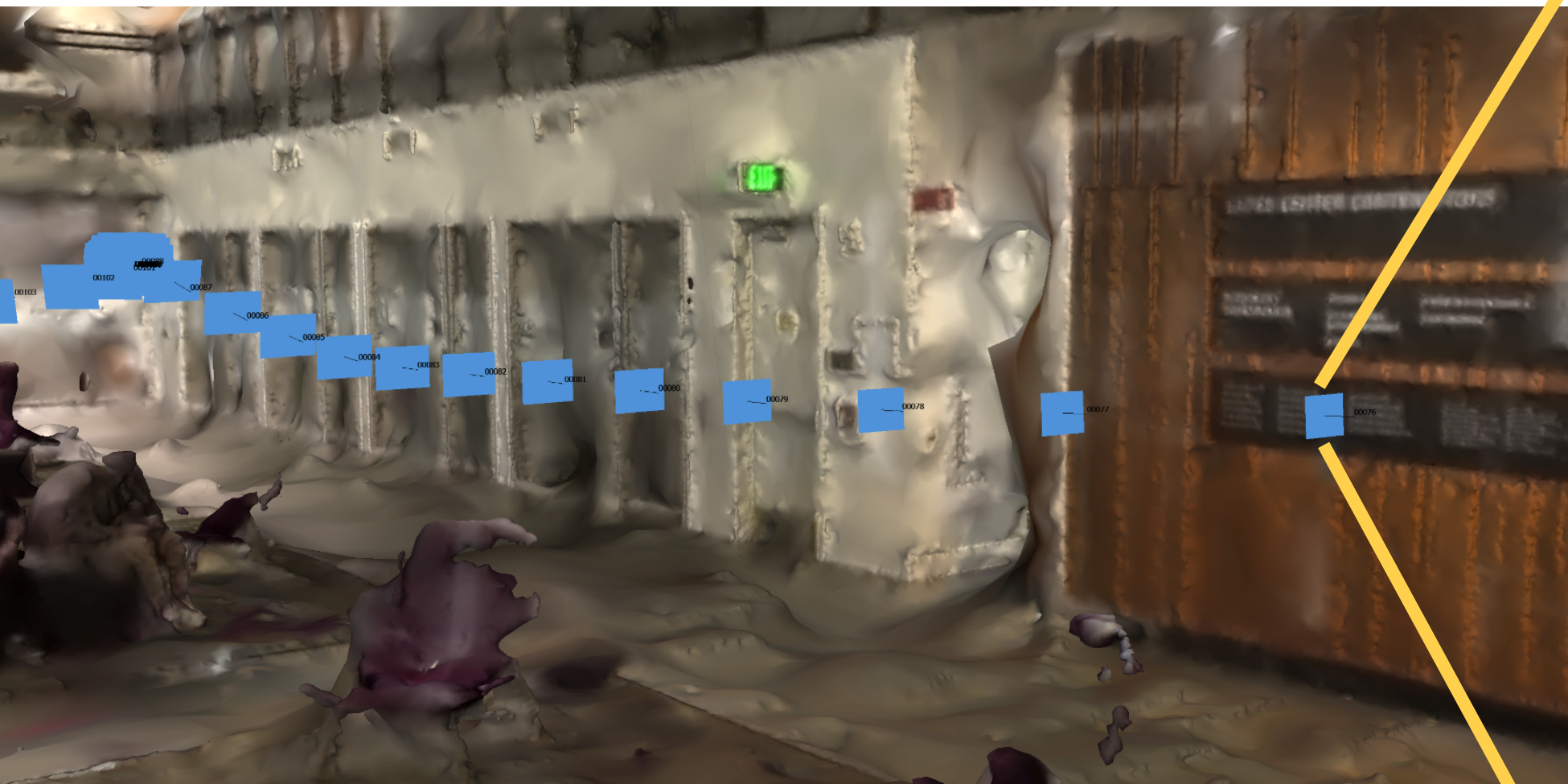
Structure from Motion  
With Commodity Drone



Annotation  
On Video Frames



POI-infused  
3D Indoor Map



Open Vocabulary

Contextual Knowledge

Visually Ambiguous



Annotation Results

<div><div></div>Entrance_2</div> <div>Frame: 4</div> <div>4 boxes</div> <div>View</div>
<div><div></div>Door_1</div> <div>Frame: 4</div> <div>1 boxes</div> <div>View</div>
<div><div></div>Stairs_1</div> <div>Frame: 4</div> <div>8 boxes</div> <div>View</div>
<div><div></div>Front Desk_1</div> <div>Frame: 15</div> <div>4 boxes</div> <div>View</div>
<div><div></div>Door_2</div> <div>Frame: 15</div> <div>6 boxes</div> <div>View</div>
<div><div></div>Elevator_1</div> <div>Frame: 19</div> <div>4 boxes</div> <div>View</div>
<div><div></div>Door_3</div> <div>Frame: 49</div> <div>2 boxes</div> <div>View</div>
<div><div></div>Stairs_2</div> <div>Frame: 139</div> <div>4 boxes</div> <div>View</div>
<div><div></div>Stairs_3</div> <div>Frame: 150</div> <div>10 boxes</div> <div>View</div>
<div><div></div>Elevator_2</div> <div>Frame: 175</div> <div>Processing...</div> <div>View</div>
<div><div></div>Elevator_3</div> <div>Frame: 175</div> <div>1 boxes</div> <div>View</div>
<div><div></div>Door_4</div> <div>Frame: 175</div> <div></div> <div>View</div>



Object Types

- Entrance
- Elevator
- Stairs
- Restroom
- Door
- Ramp
- Front Desk

Add

Add

Add

Add

Add

Add

Add

New type name

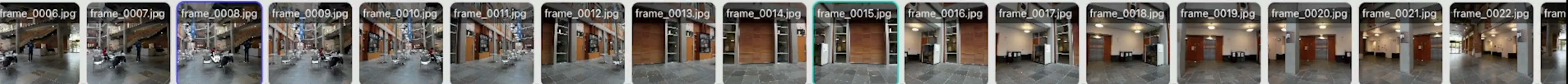
Add

Select an object type to start annotating

Final Actions

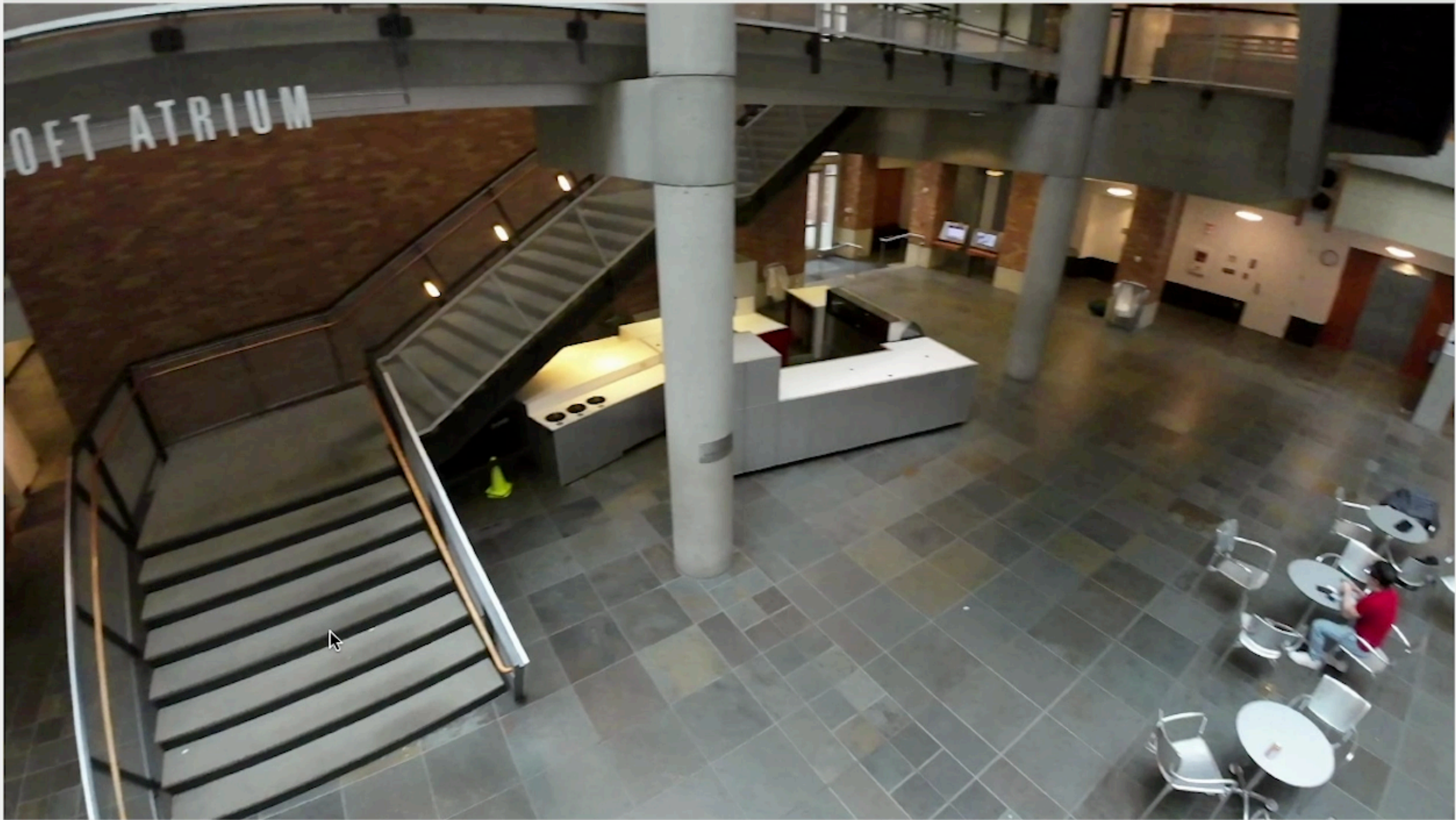
- Review Video

Finish Annotation





Annotation Results



Object Types

- Entrance Add
- Elevator Add
- Stairs Add
- Restroom Add
- Door Add
- Ramp Add
- Front Desk Add

Add

Stairs\_1

Clear Points Remove Annotation

Confirm Annotation

Final Actions

Review Video

Finish Annotation





# FlyMeThrough

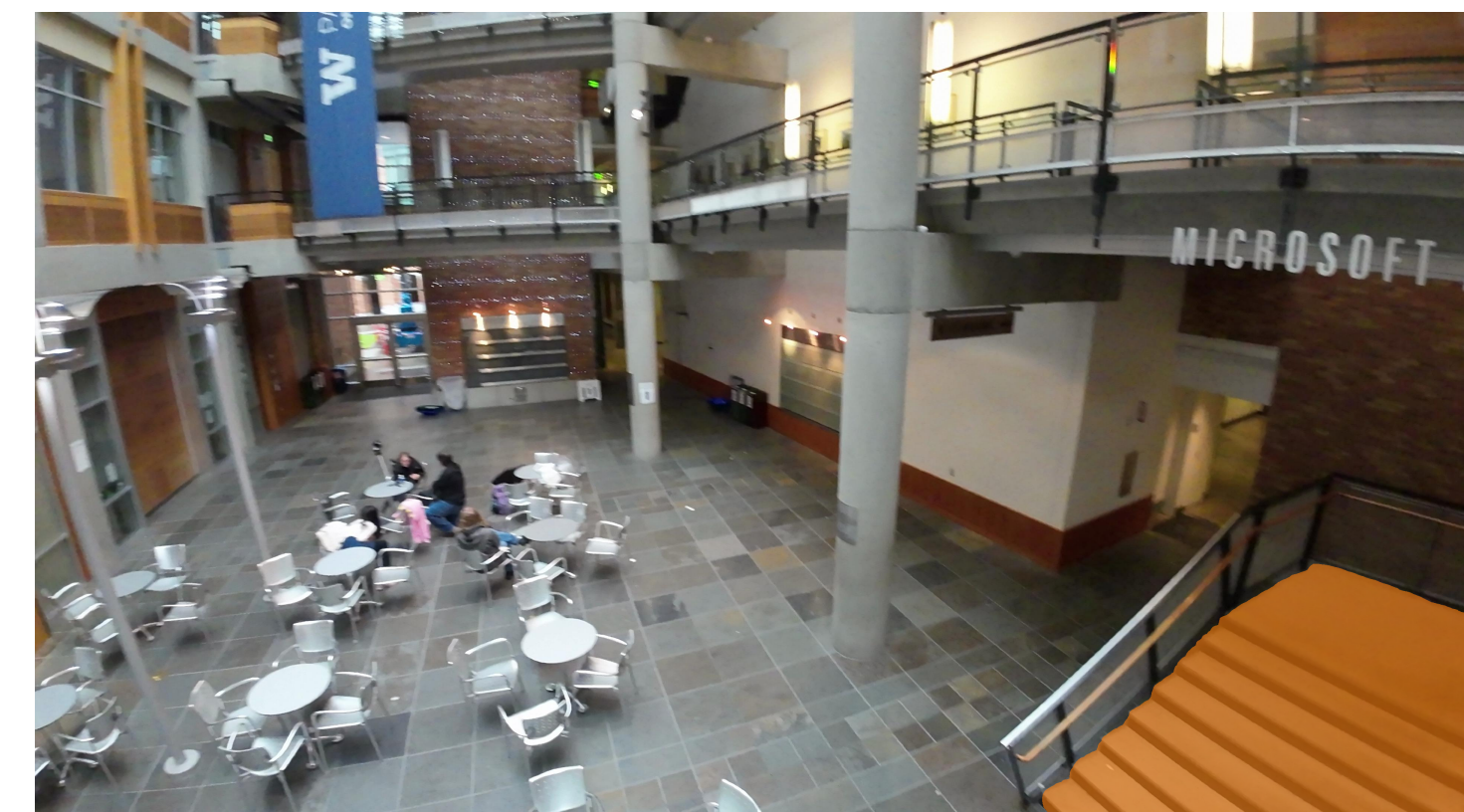
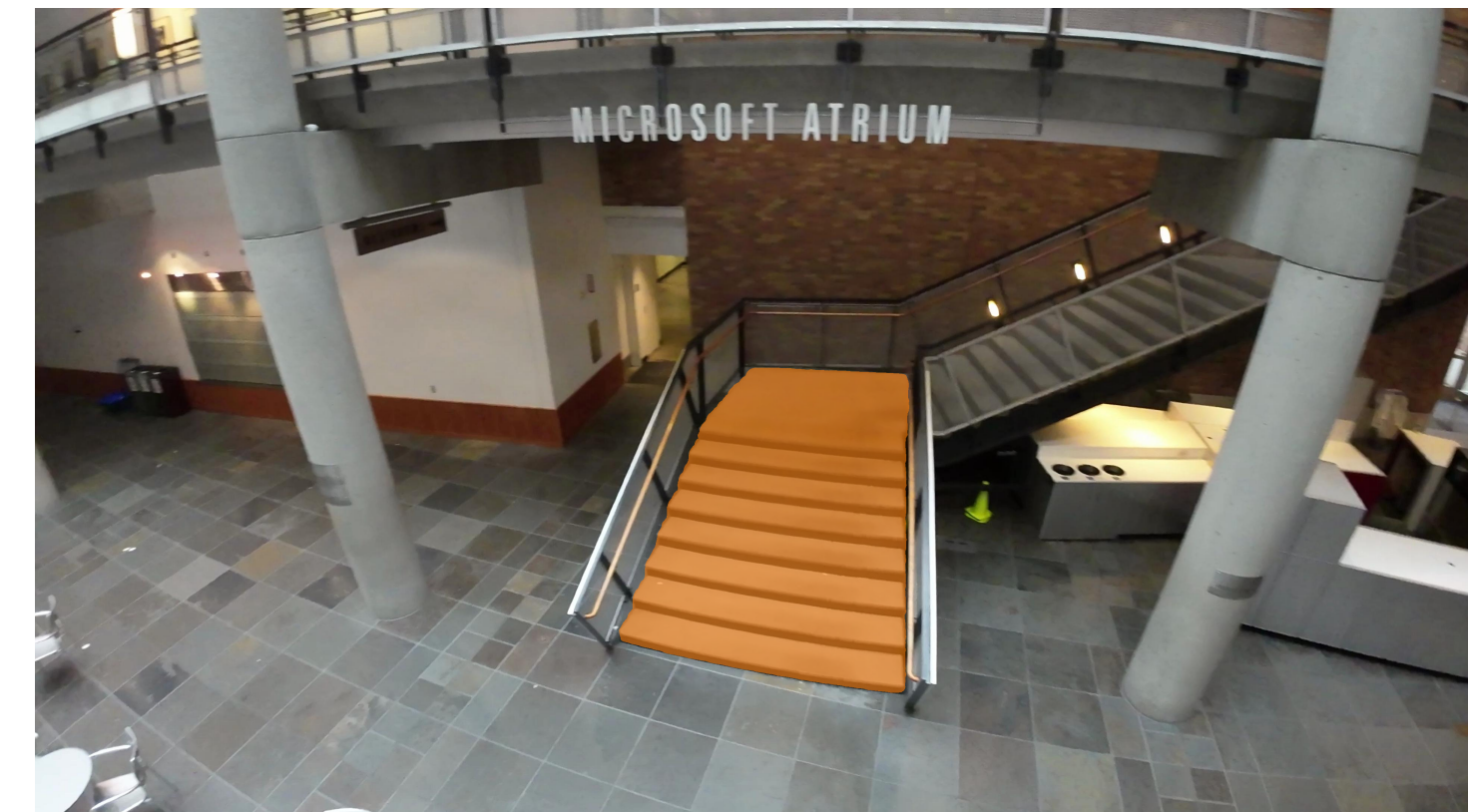
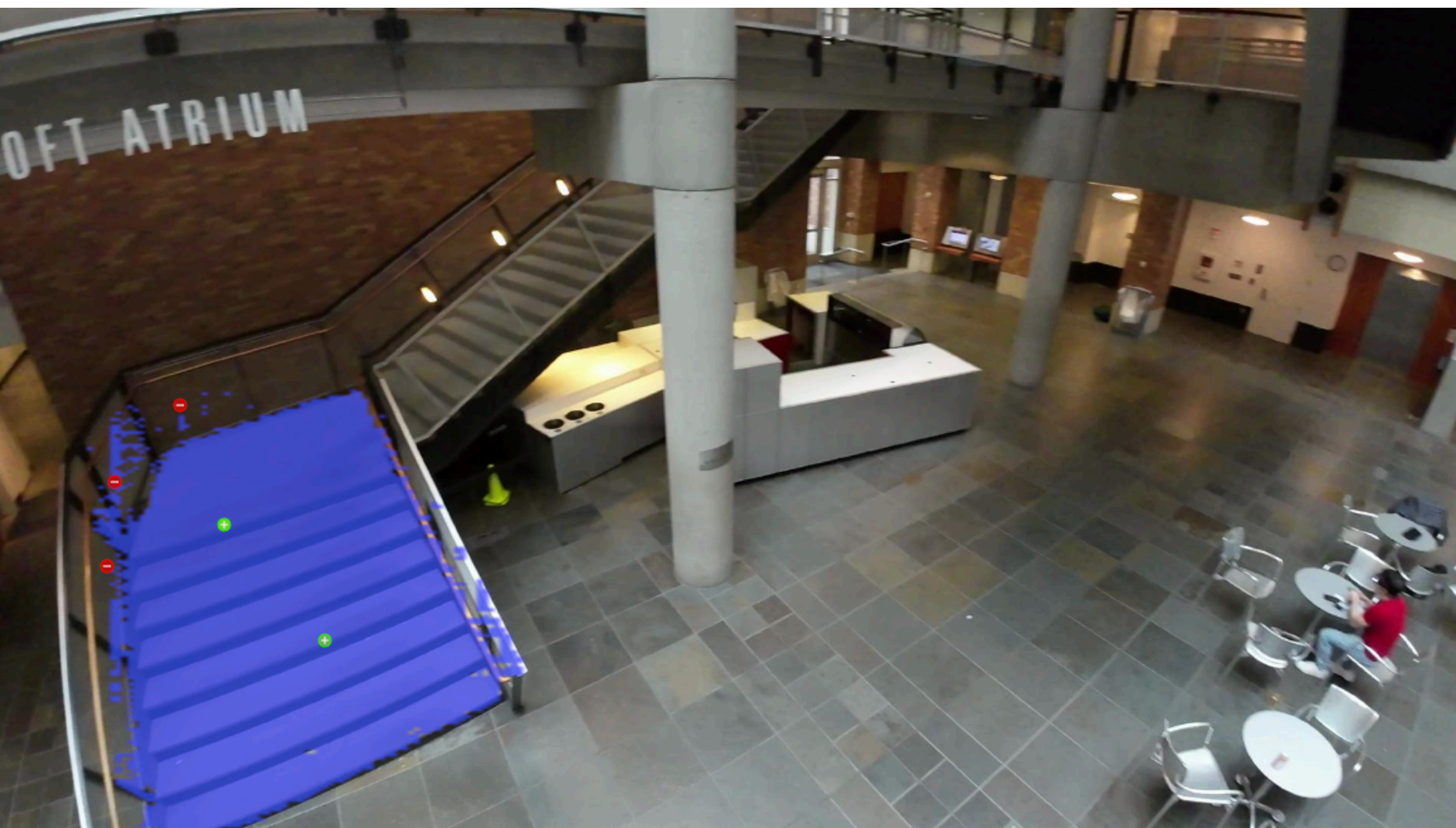
Structure from Motion  
With Commodity Drone



Annotation  
On Video Frames



POI-infused  
3D Indoor Map





# FlyMeThrough

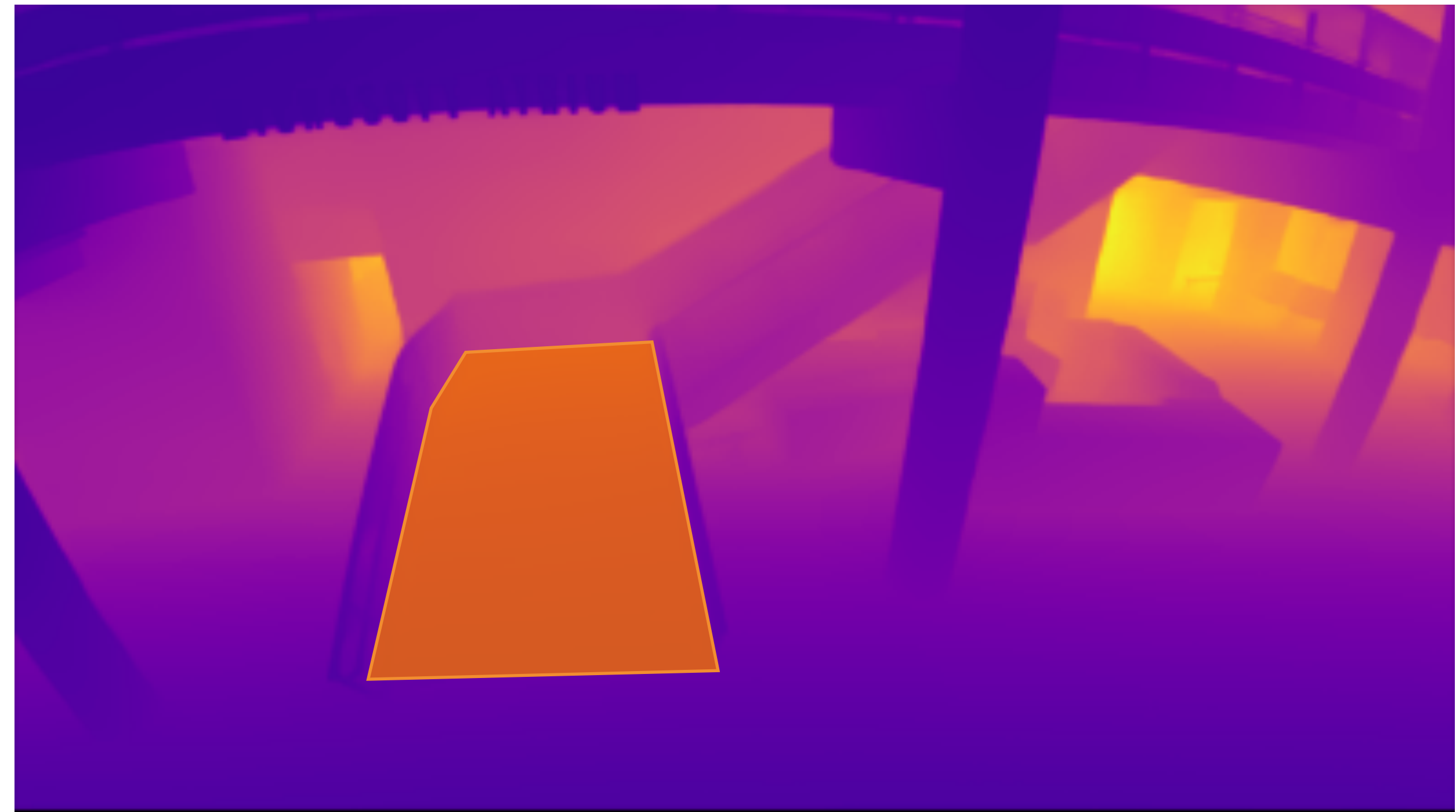
Structure from Motion  
With Commodity Drone



Annotation  
On Video Frames

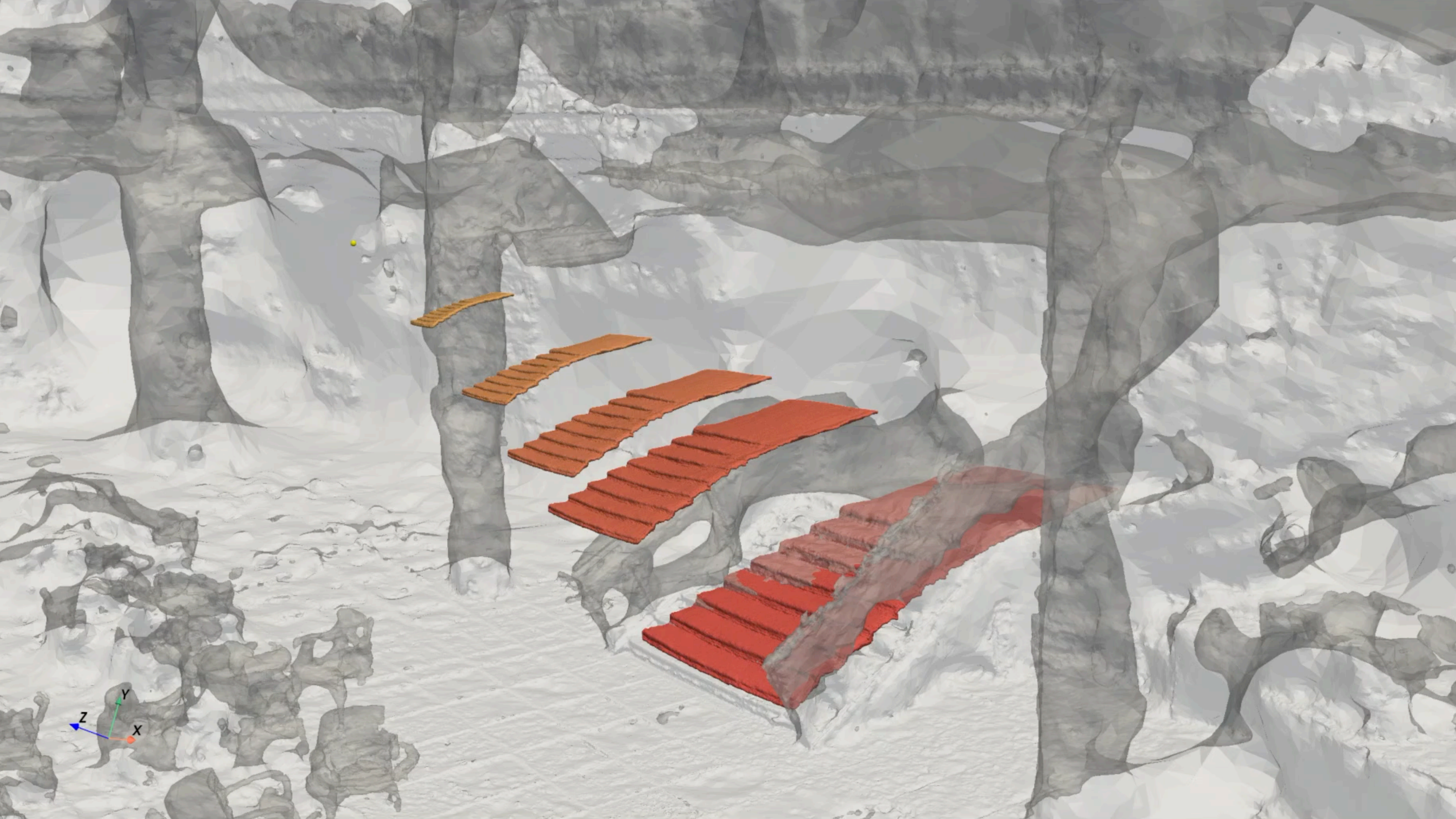


POI-infused  
3D Indoor Map



Depth-guided Ray-casting







# FlyMeThrough

Structure from Motion  
With Commodity Drone



Annotation  
On Video Frames



POI-infused  
3D Indoor Map

participa

.gitF File Loader Plugin | Bab

DepthScapeBackend/VisualC

[UIST2025] DepthScape: Aut

Google Scholar

[CHI2025 Rejected] DepthSc

Text to Speech | ElevenLabs

[UIST2025] FlyMeThrough - C

React App

React App

Blur effect in Premiere

+

Finish update

Detected Facilities

elevator1

No description available

View

Elevator

No description available

View

door1

No description available

View

frontdesk1

No description available

View

stair1

No description available

View

Return to Bird's Eye View



# FlyMeThrough

Structure from Motion  
With Commodity Drone



Annotation  
On Video Frames



POI-infused  
3D Indoor Map

## Spaces



OceanSciencesBuildingShop



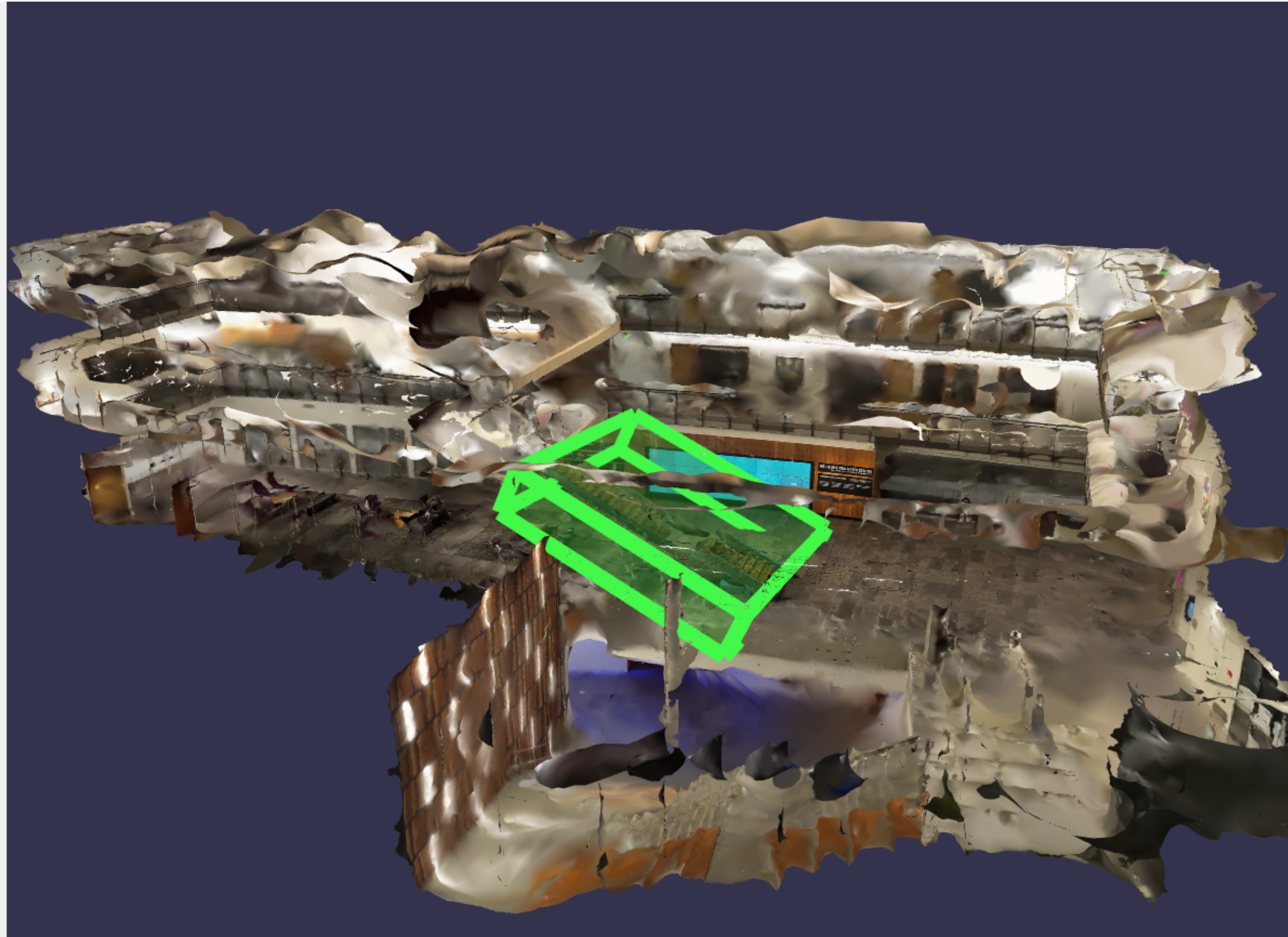
OceanResearchBuilding



MedTeachBuilding



MarineSciencesBuildingShop



## Detected Facilities

Stairs [View](#)

No description available

Stairs [View](#)

No description available

Stairs [View](#)

No description available

Stairs [View](#)

No description available

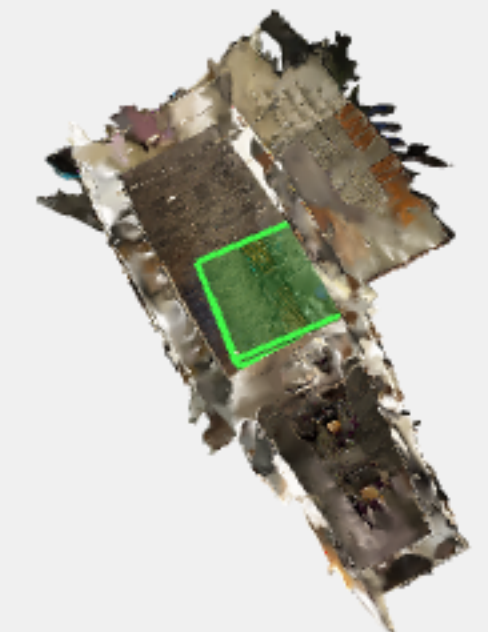
Stairs [View](#)

No description available

Stairs [View](#)

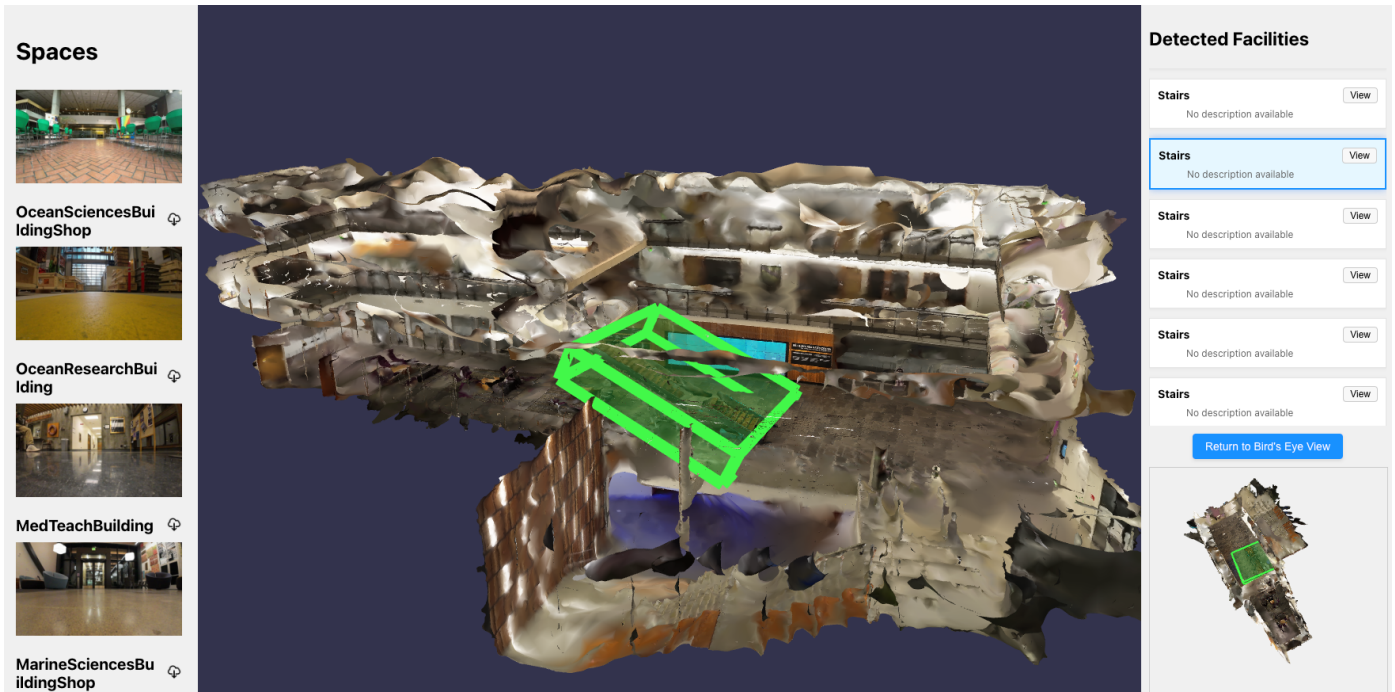
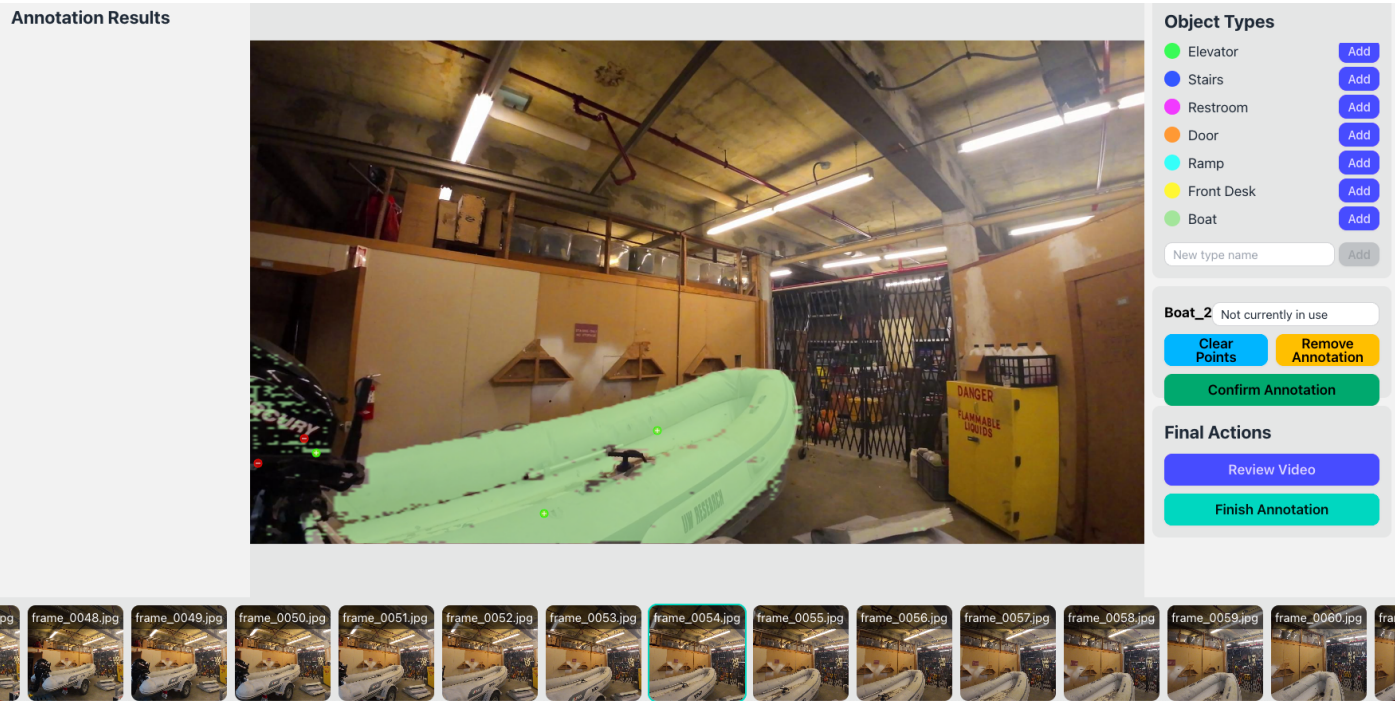
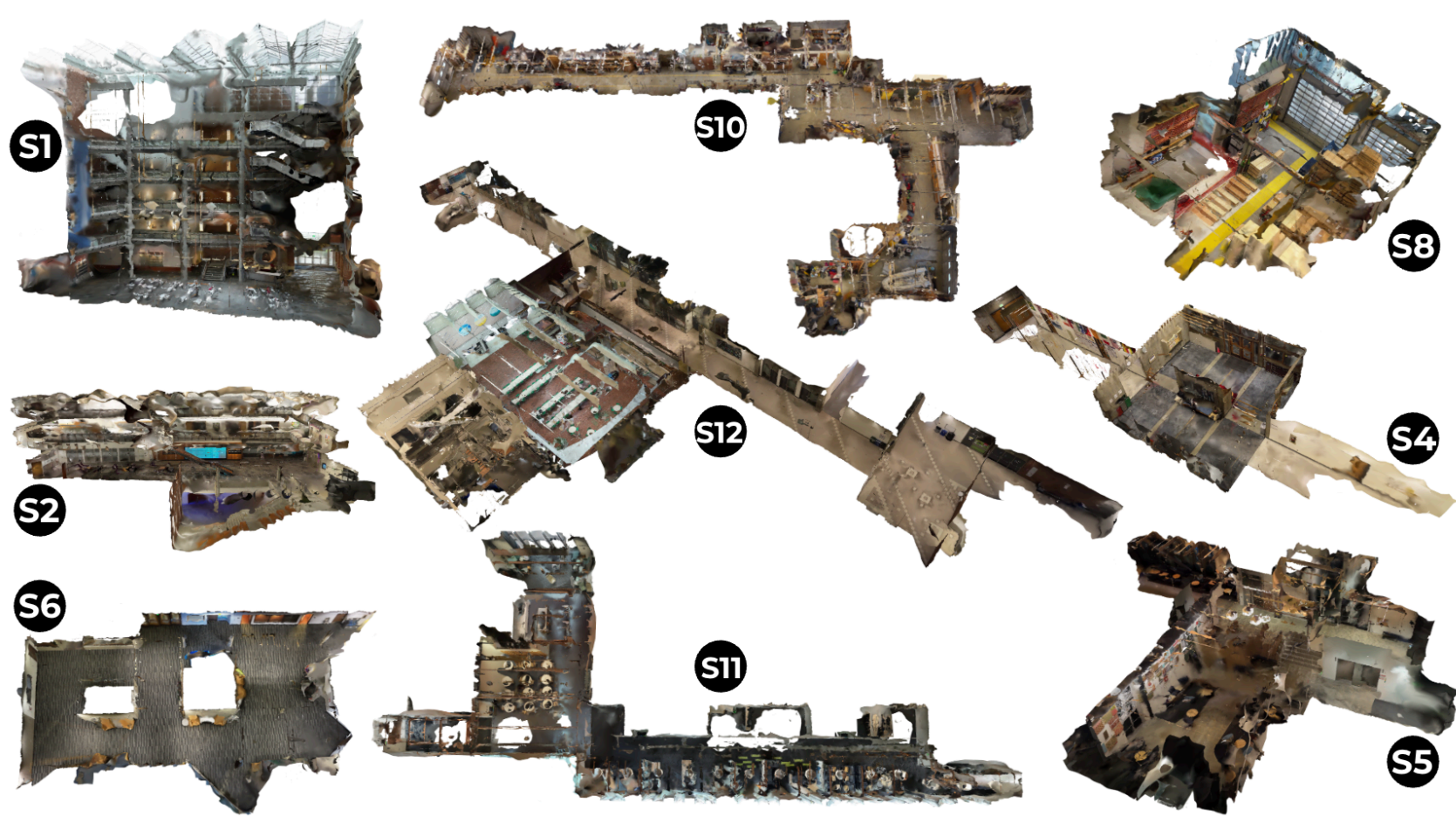
No description available

[Return to Bird's Eye View](#)





# Evaluation



Common spaces would be [appropriate to scan]. Like we could do the hallways and large atria.

maybe it's best to blur people's faces before annotation

Performance  
Across Spaces

Interface  
Usability

Opportunities &  
Challenges



# Evaluation

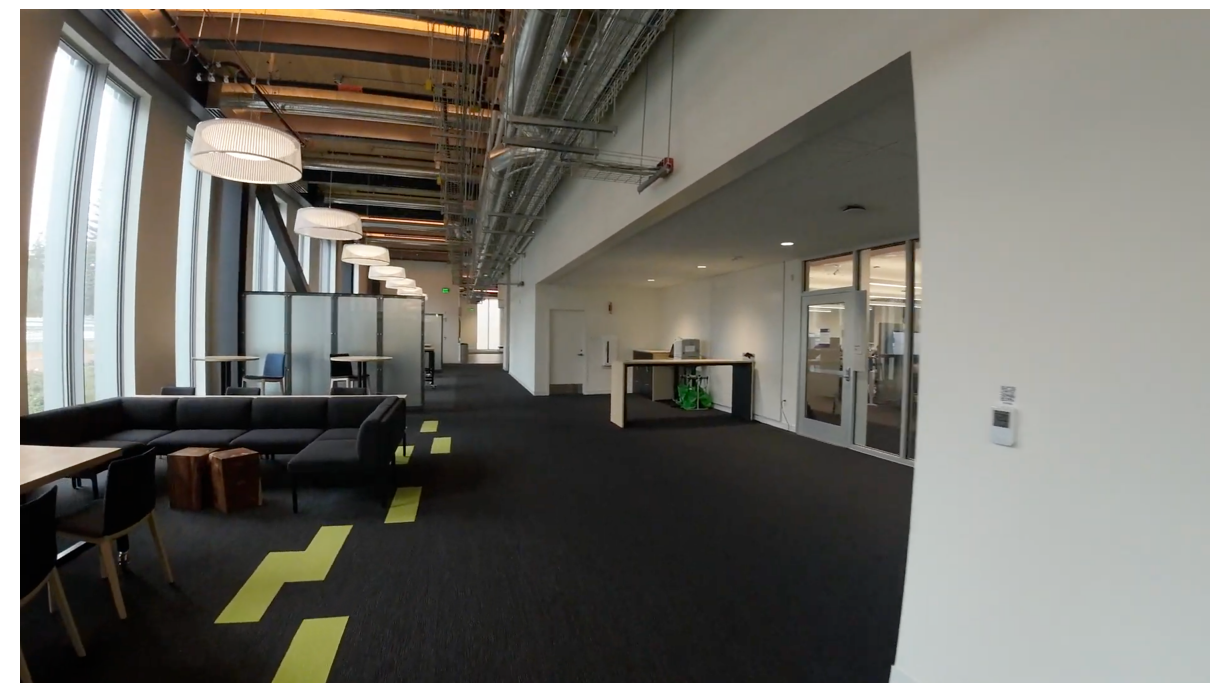
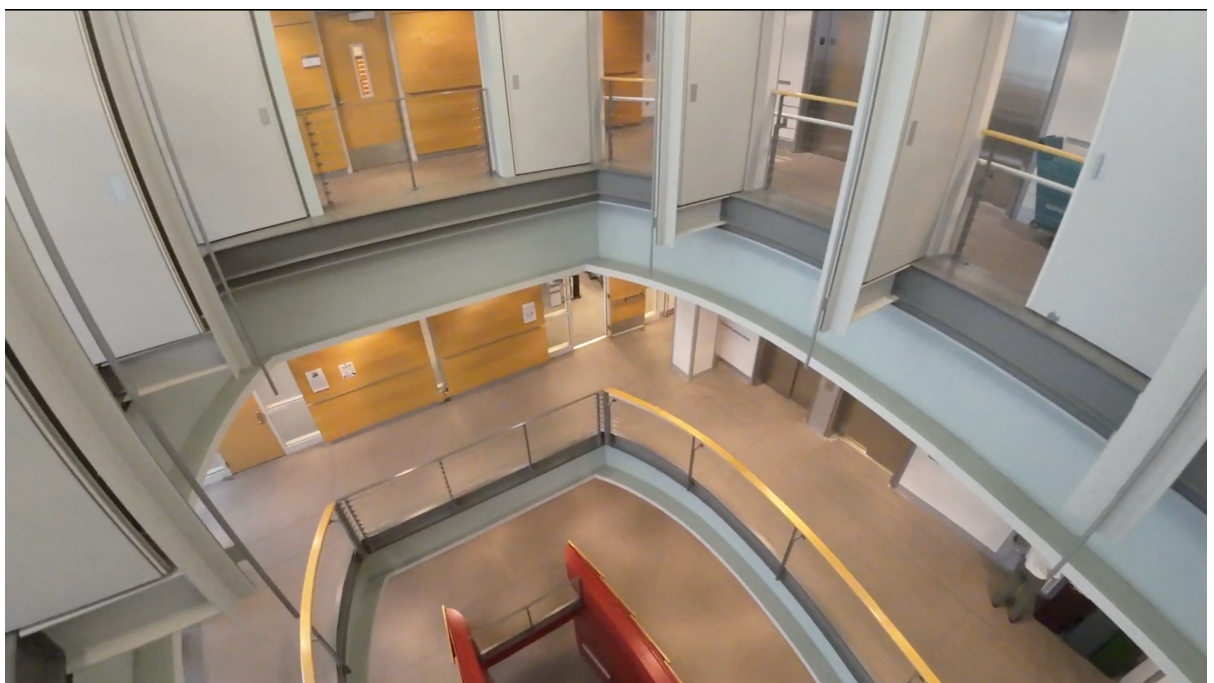
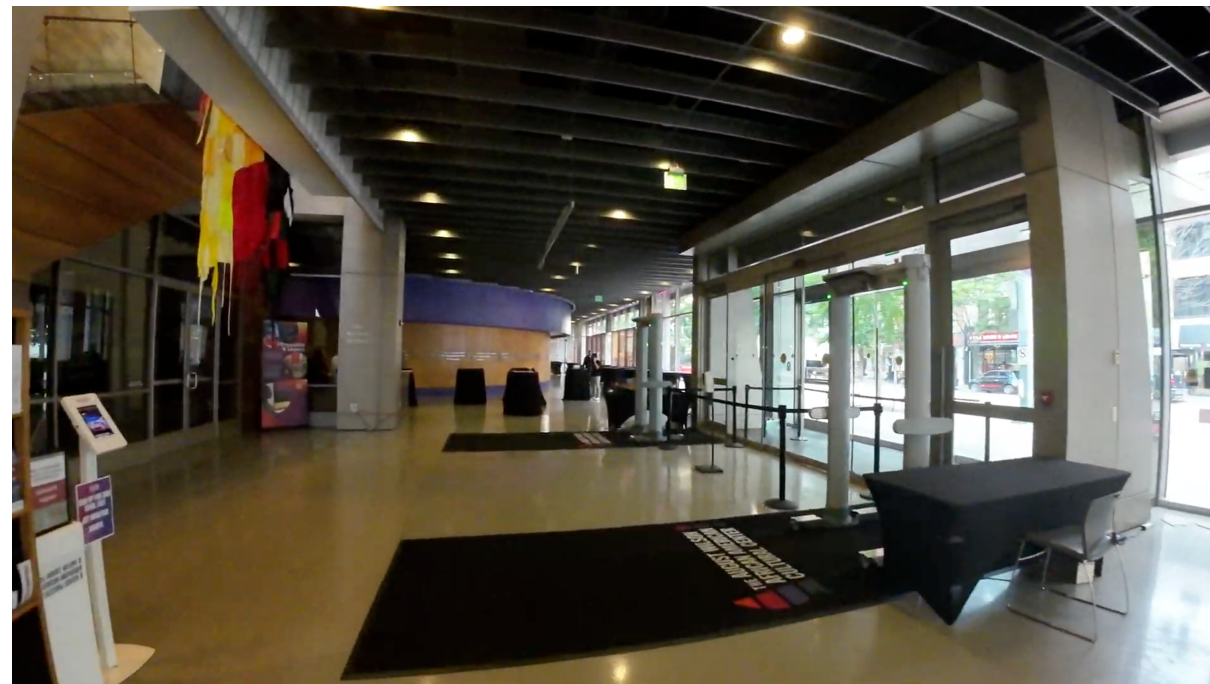
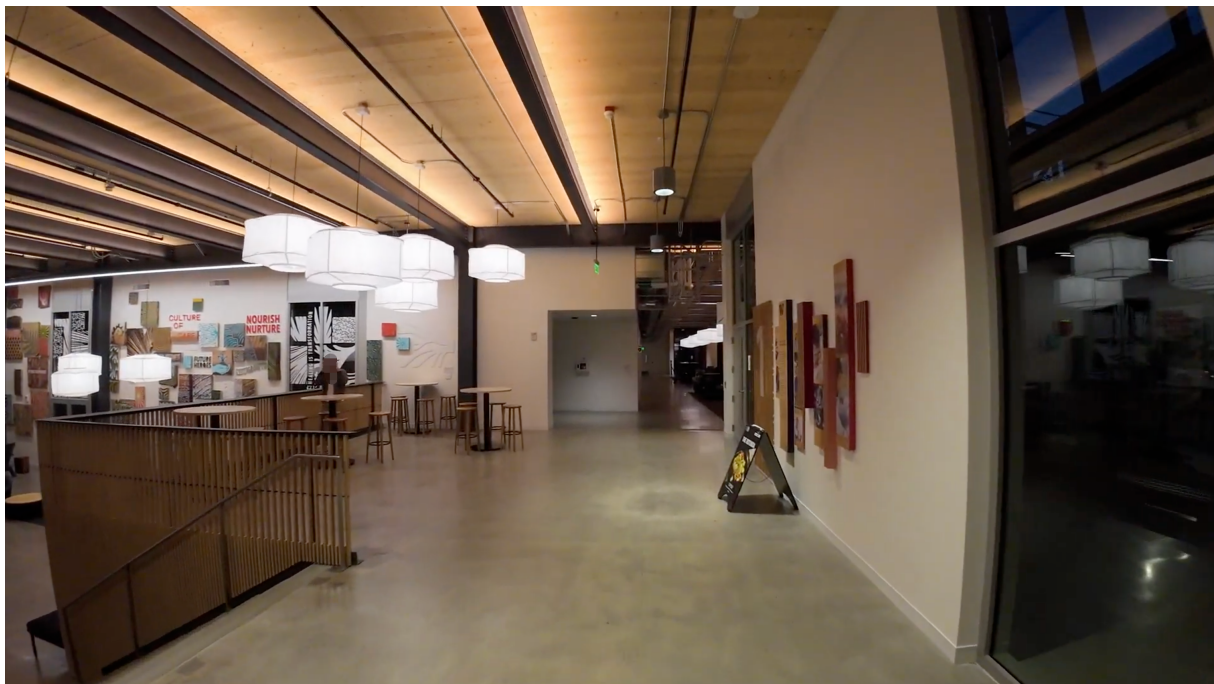
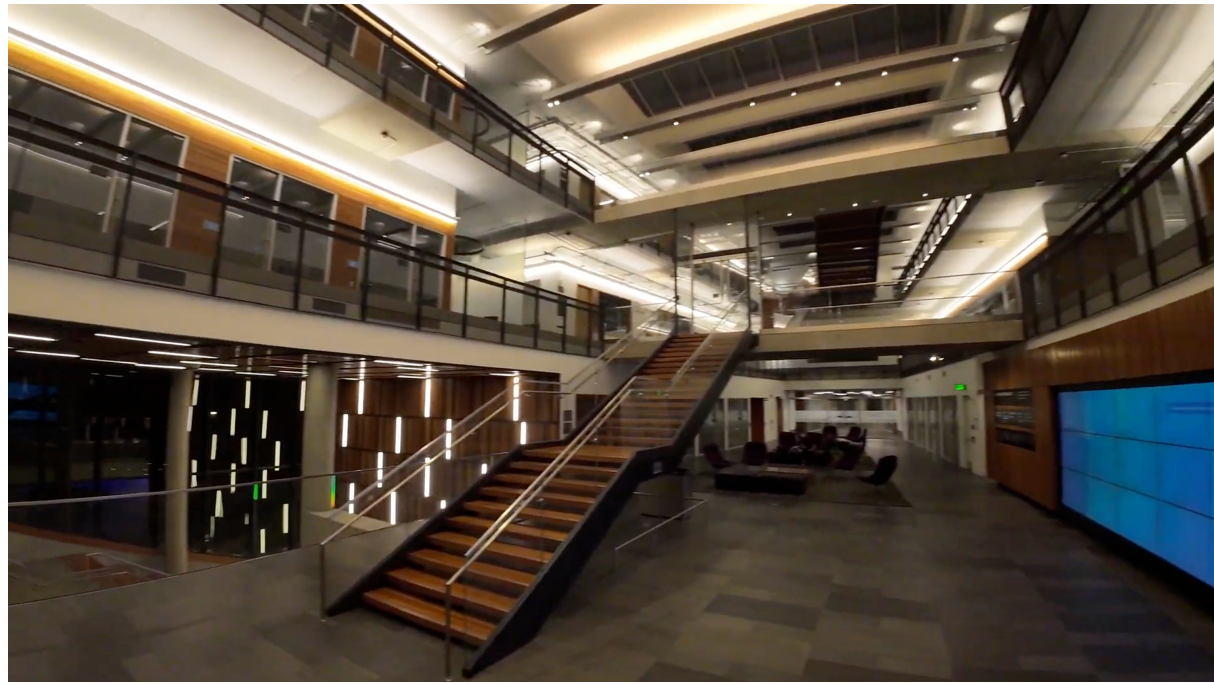
Performance  
Across Spaces



Interface  
Usability



Opportunities &  
Challenges





# Evaluation

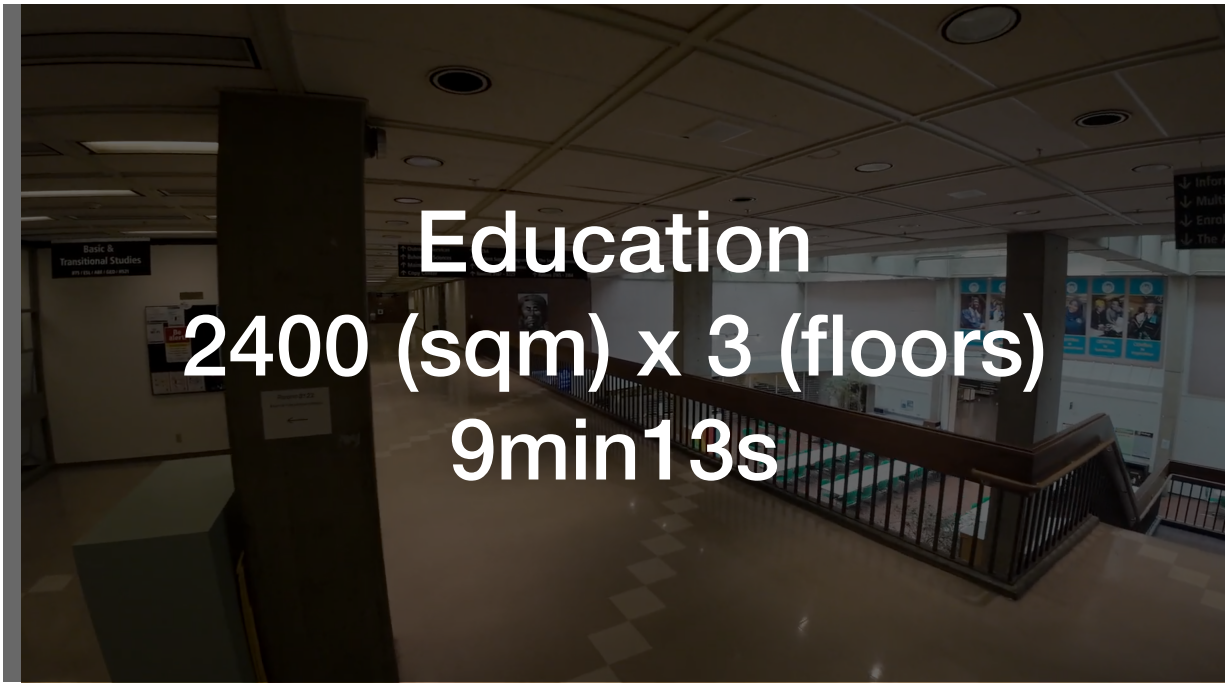
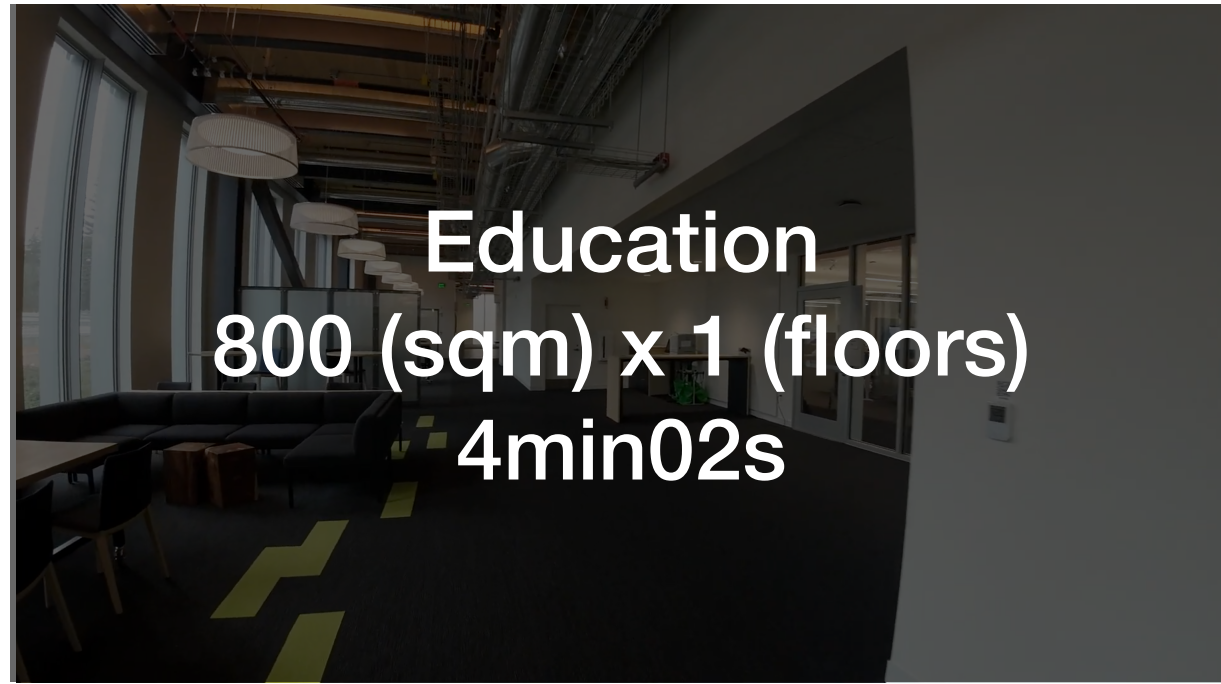
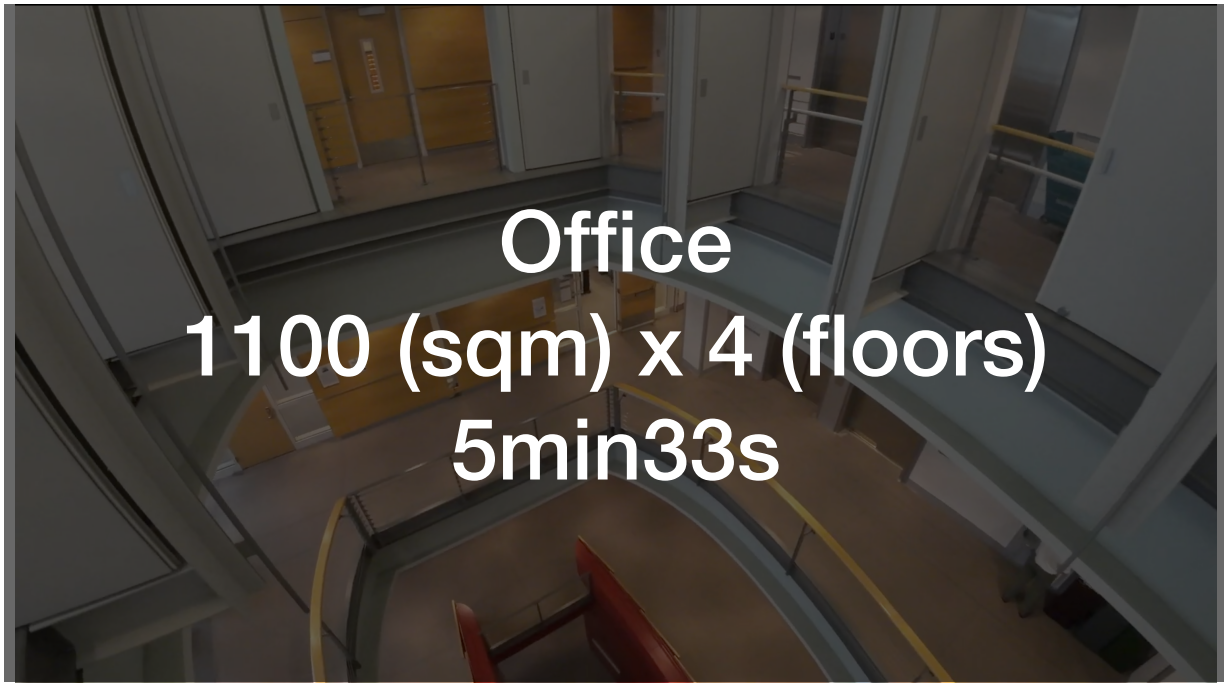
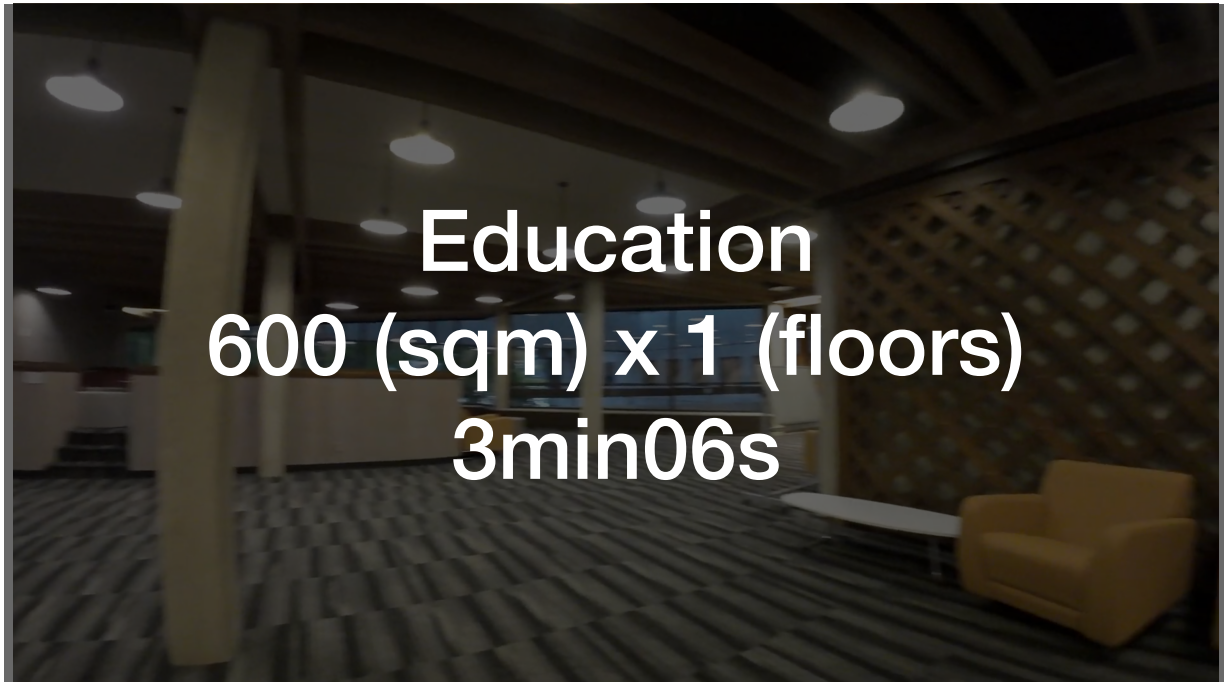
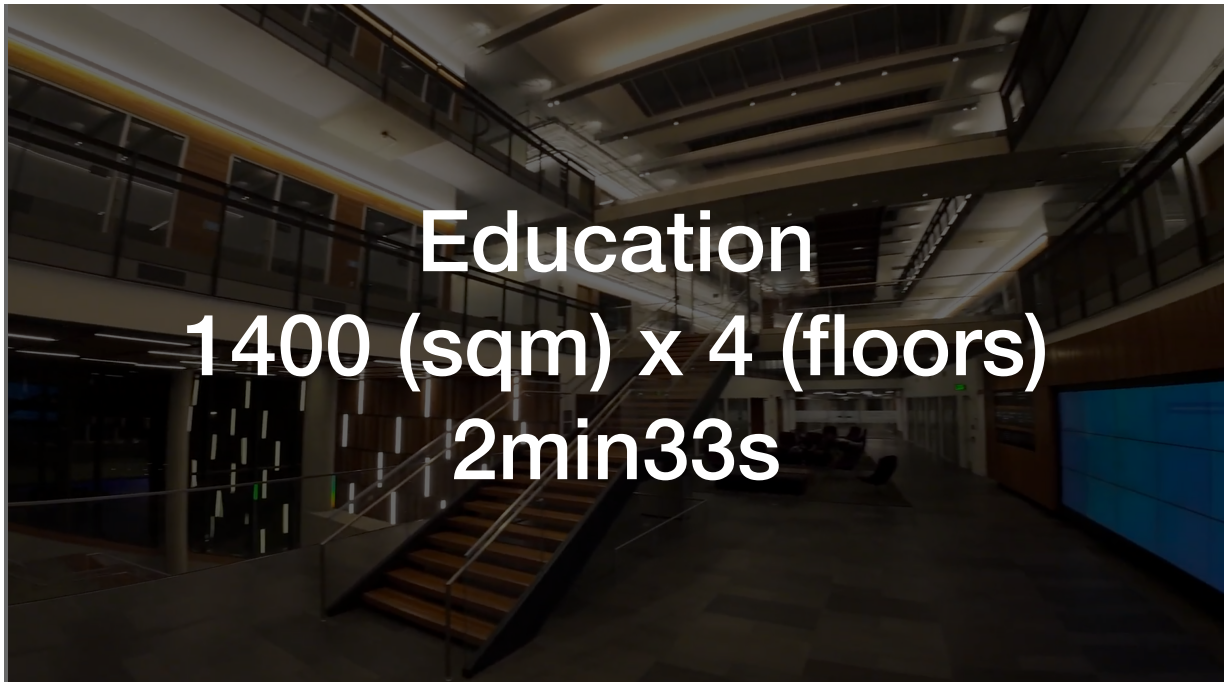
## Performance Across Spaces



## Interface Usability



## Opportunities & Challenges



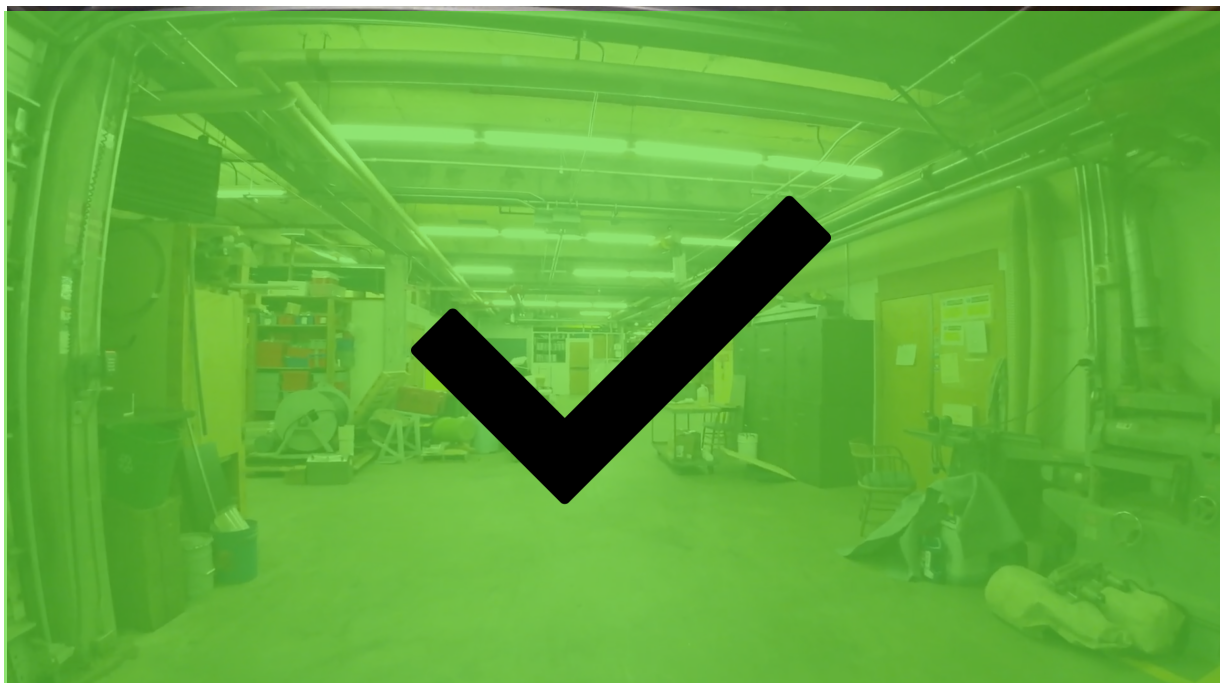


# Evaluation

Performance  
Across Spaces

Interface  
Usability

Opportunities &  
Challenges





# Evaluation

Performance  
Across Spaces



Interface  
Usability



Opportunities &  
Challenges





# Evaluation

Performance  
Across Spaces



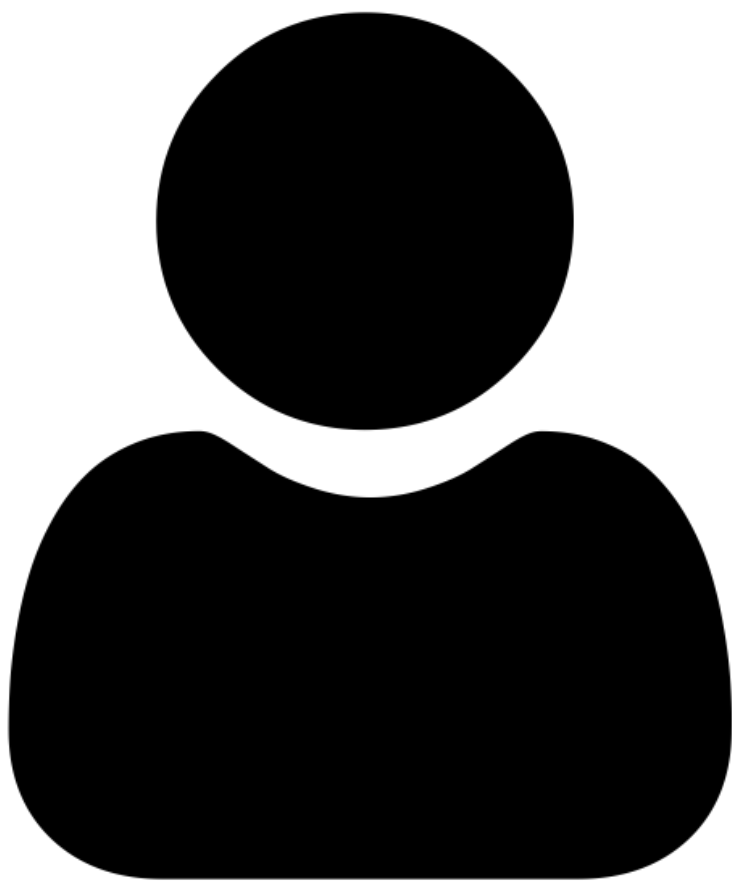
Interface  
Usability



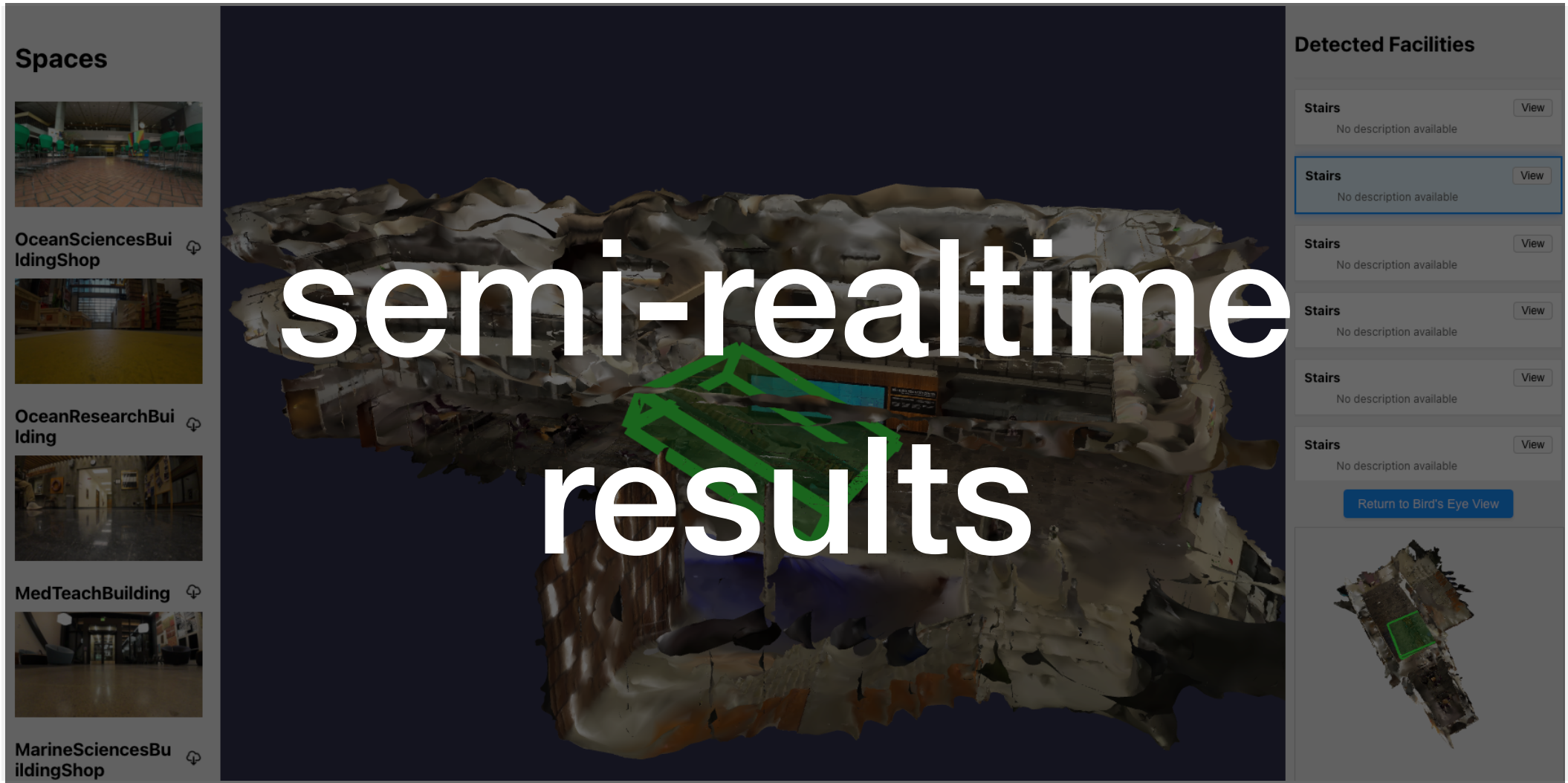
Opportunities &  
Challenges



5 building managers



5 building users





# Evaluation

Performance  
Across Spaces



Interface  
Usability



Opportunities &  
Challenges

- Interfaces are easy to use.

“

Pretty easy to use  
- M2 & O5

”

“

Not complicated at all  
- M5

”

Easy to use:  
6/7

Model quality:  
5/7

91.7% annotation  
Success

71.5% POI  
High quality



# Evaluation

Performance  
Across Spaces

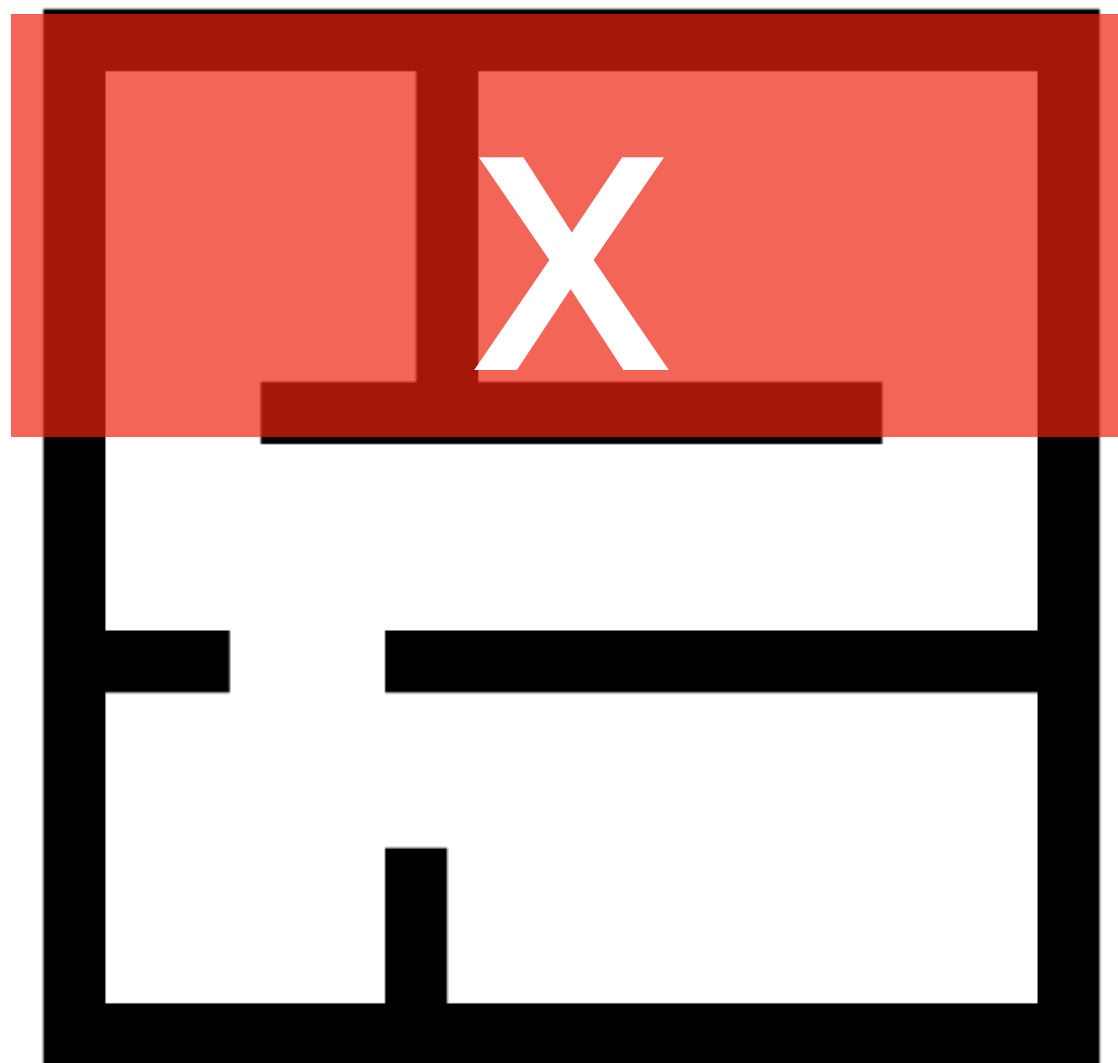


Interface  
Usability

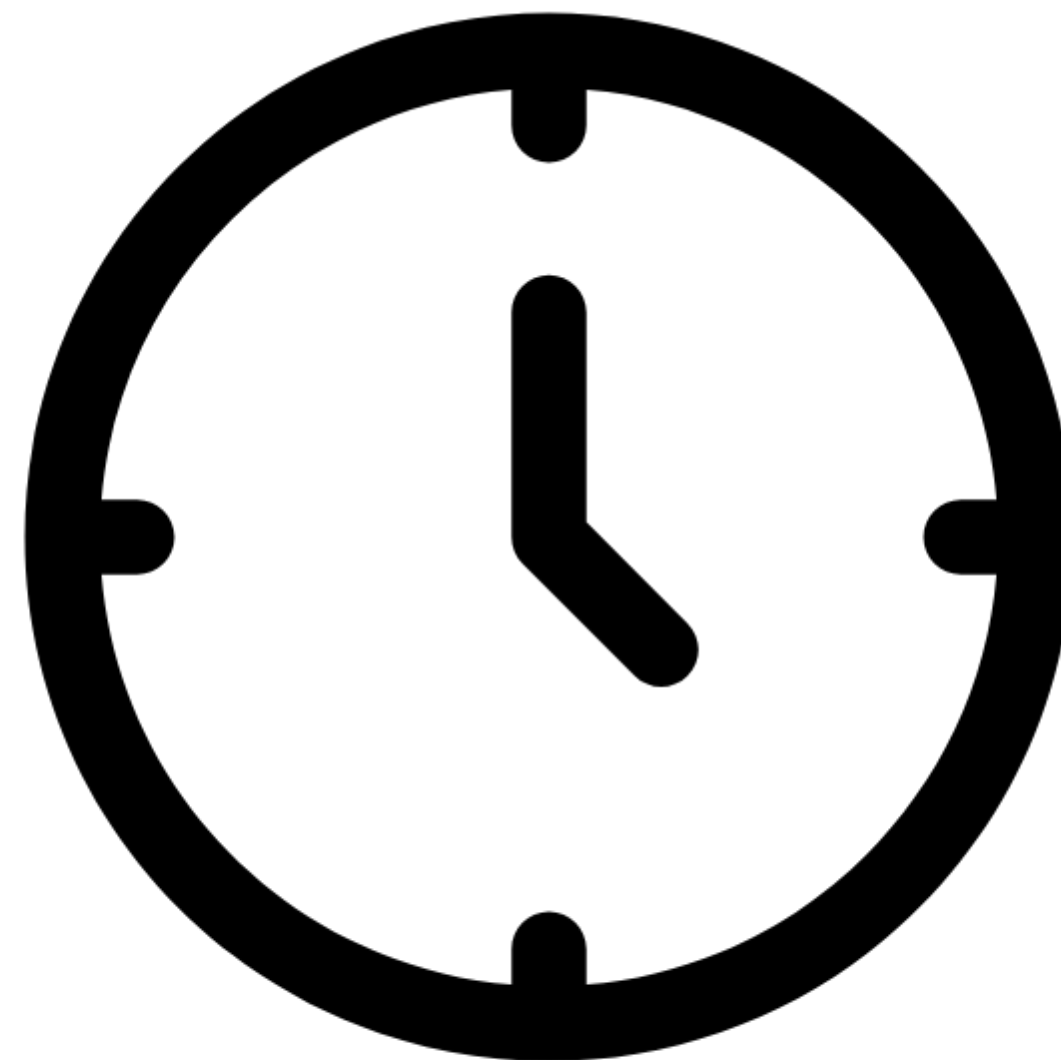


Opportunities &  
Challenges

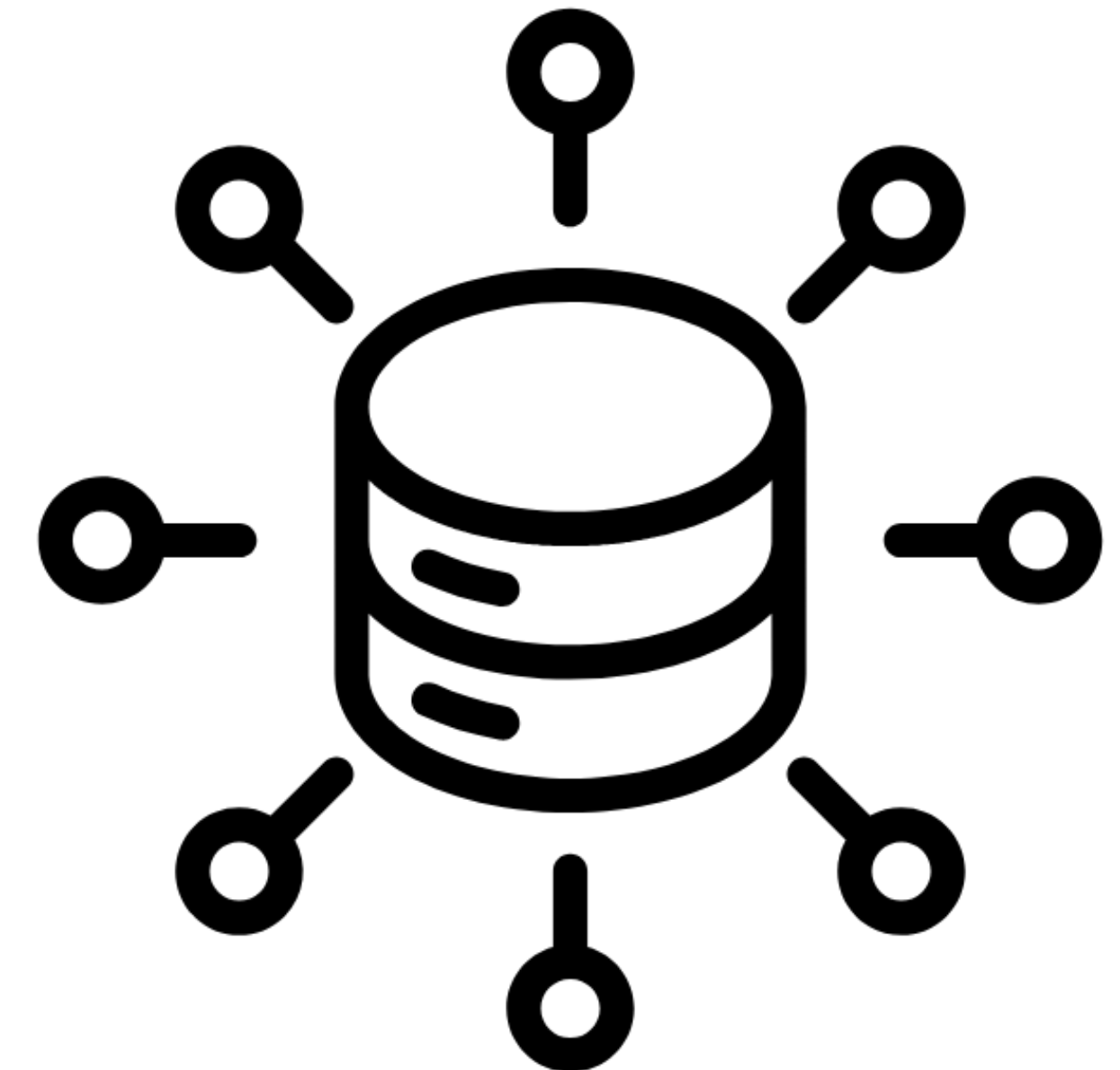
- Participants are **relatively relaxed** about the indoor drone fly.
- **Privacy** emerged as a key concern but can be mitigated by:



Spatial Exclusion



Temporal Minimization



Data Management



# Evaluation

Performance  
Across Spaces



Interface  
Usability



Opportunities &  
Challenges

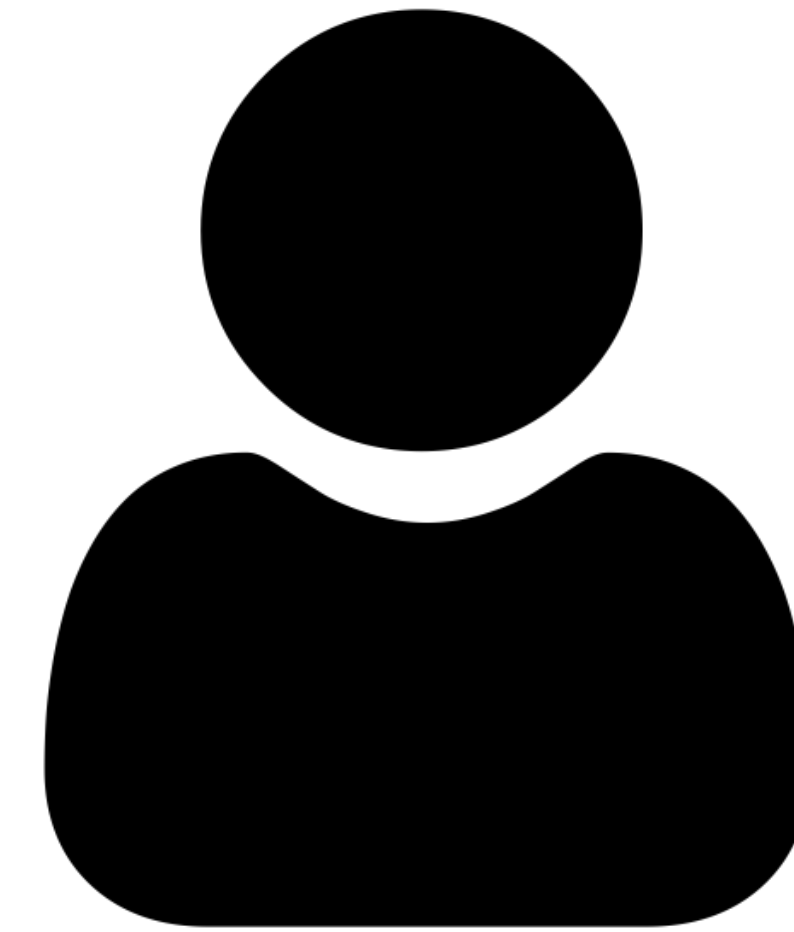


Space Planning

Remote Inspect

Utilization Analysis

Assets Management



Navigation

AI ly Eval

Safety & Util



# Evaluation

Performance  
Across Spaces



Interface  
Usability



Opportunities &  
Challenges

Low-cost

Open vocabulary

Community Driven

Make indoor maps a **common resource**,  
not the privilege of a few.



# FlyMeThrough

## Human-AI Collaborative 3D Indoor Mapping with Commodity Drones

Xia Su\*, Ruiqi Chen\*, Jingwei Ma, Chu Li, Jon E. Froehlich



**Xia Su**, 5th year PhD student, UW CSE

**On job market for industry research positions**

HAI, CST, Multi-modality, Spatial Intelligence

[xiasu@cs.washington.edu](mailto:xiasu@cs.washington.edu)



**Ruiqi Chen**, master student, UW HCDE

**Looking for PhD programs** relevant to

Human-AI systems and AI-assisted tools

[ruiqich@uw.edu](mailto:ruiqich@uw.edu)



**Project Page  
& Code**