

# Cyber Affordance Visualization in Augmented Reality (CAVIAR)

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# Problem

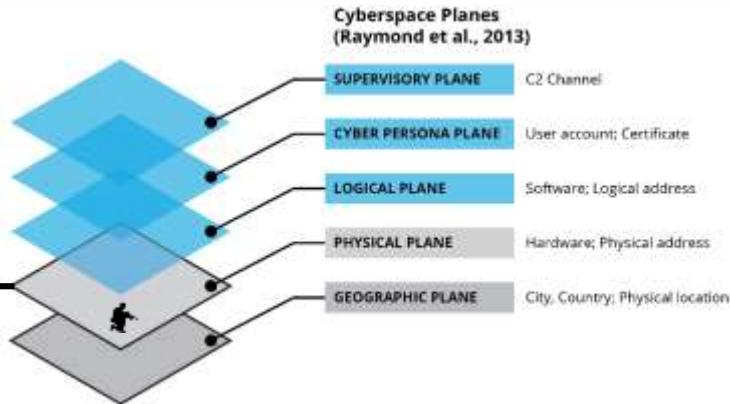
- Cyberspace is intertwined with the physical warfighting domains
- How can we enable soldiers to consider cyber effects in their tactical decisions?



# Approach



Head-worn display



Natural view



View with Cyber Affordances



## Natural View

Soldiers navigate through an urban area in search of a person of interest. However, they are unaware of the cyber terrain in their vicinity.

## View with Cyber Affordances

Cyber affordances make the soldiers aware of the cyber terrain in their immediate surroundings and of the potential cyber effects that can be deployed. The cyber affordances show that the person of interest is located in one of the buildings and that there is a power substation nearby.

## Call For Cyber Effects

The soldiers call in a cyber effect against the power substation to disable lighting in the area so that they can enter the building under the cover of darkness.

# Solution: Initial Prototype



Dynamically visualize cyber terrain within one's immediate surroundings

- Microsoft HoloLens
- Unity Application

## Initial Findings

- HoloLens intended for indoor use
- Limited computing resources
  - 2 GB RAM
  - 64 GB Storage
  - 1.04 GHz CPU

# Solution: Advanced Prototype



**Microsoft HoloLens**  
Augmented Reality Display

**Inertial Measurement Unit (IMU)**  
Provides ground-truth orientation for user's head

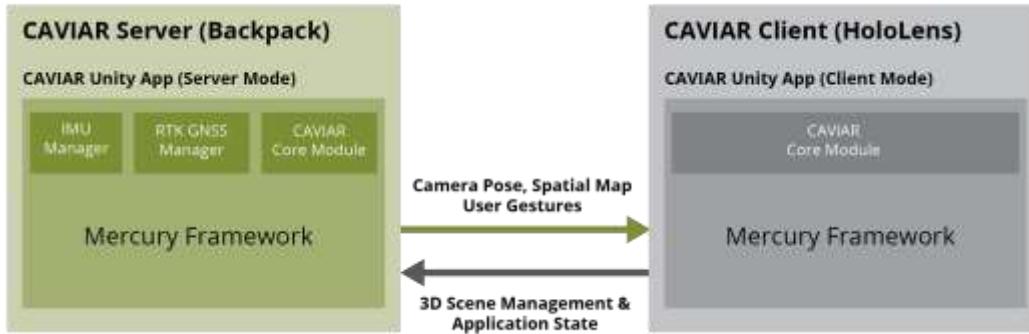
**MSI Gaming Backpack**  
Fuses tracking data from  
IMU, GNSS, HoloLens  
Hosts Unity 3D Scene  
Hosts CAVIAR Server

**Piksi Multi RTK GNSS**  
Adds centimeter-accurate  
GNSS to HoloLens

Partnered with Dr. Steve Feiner at  
Columbia University's Computer Graphics  
and User Interfaces Lab

- Real-Time Kinematic GNSS for outdoor use
- Add more compute resources
  - server – MSI Gaming Backpack
  - client – HoloLens
- Additional IMU needed for server

# Artifacts



## CAVIAR Application & Software Architecture

- Server
  - Fuse tracking data from GNSS, IMU
  - Prepare Scenes
- Client
  - Displays scenes prepared by server

# Findings



## Army 782<sup>nd</sup> MI BN Demo & Focus Group

- More near-term use for support vs. maneuver forces
- Far-field visualizations
- RF/EM visualization—display signal strength
- Remote assistance—guide forces to cyber targets
- Helmet mount vs. visor
- Incorporate non-cyber uses (navigation, battle command, fires, targeting, etc.)

# Future Work



- Eliminate the need for extra equipment
  - Gaming backpack
  - External IMU
- Dealing with GNSS signal loss
- Mobile display for other uses
- Address data ingestion

# Contact Information

## Presenter / Point(s) of Contact

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## Contributors

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