Cyber Affordance Visualization in Augmented Reality (CAVIAR)

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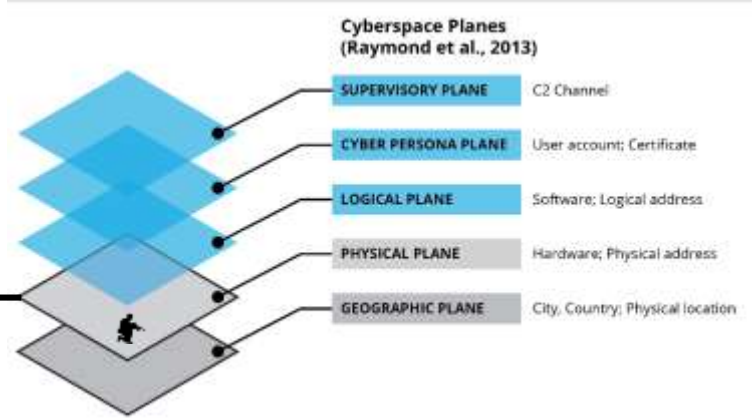
Problem

- 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



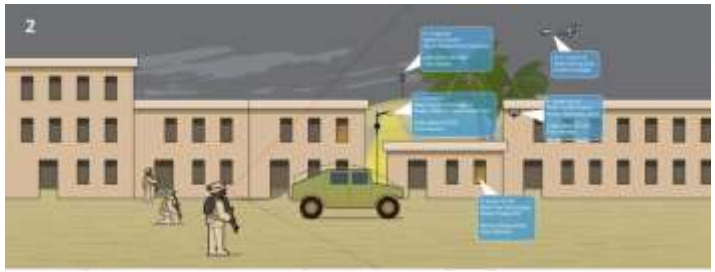
- Create *cyber affordances* to visualize intersections of cyber and physical domains
- Present using Augmented Reality

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

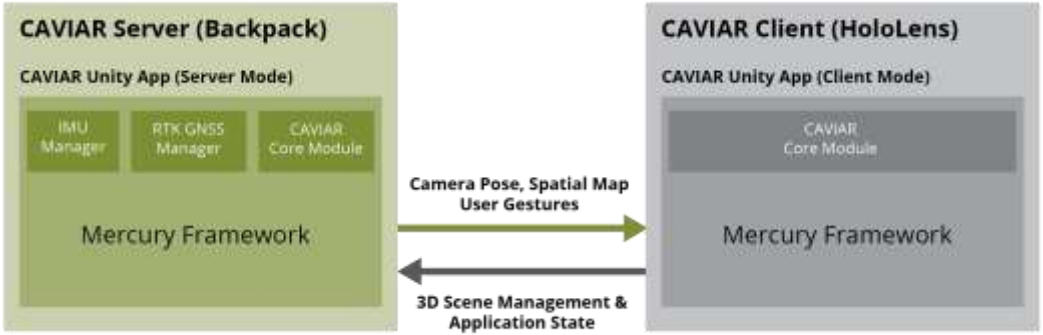
MSI Gaming Backpack
Fuses tracking data from IMU, GNSS, HoloLens
Hosts Unity 3D Scene
Hosts CAVIAR Server

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 782nd 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

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