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Using Virtual Reality to Increase Cyber Situational Awareness

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Discussion Outline

- Project overview & goals
- Background
  - SOC operations & investigation paradigms
  - Situational awareness (SA)
  - Virtual reality
- Theoretical perspective
  - Mapping VR constructs to SA constructs
- Study methodology
  - Experimental approach
  - Datasets
  - VR code
- Current status & next steps

Project Overview & Goals

- Focus:
  - Empirically examine whether VR can improve cyber situational awareness
- Scope:
  - 1 year; $75K (partially funded post-doc)
  - Leverage existing VR code previously developed (Kullman 2018, 2019)
  - Consult with real-world SOCs
  - Experiment with synthetic but realistic datasets

SOC Operations & Investigations

- What do SOCs do?
  - Collect, monitor, aggregate, analyze host and network sensor and log data
  - User behavior analytics
  - Alert analysis & response
  - Playbook implementation
  - Assess, report, integrate threat intel data
  - Investigate intrusions
- What are the challenges?
  - Information overload
  - Lack of 'single pane of glass' solution
  - SOC operator input is still largely textual / 2D graphical

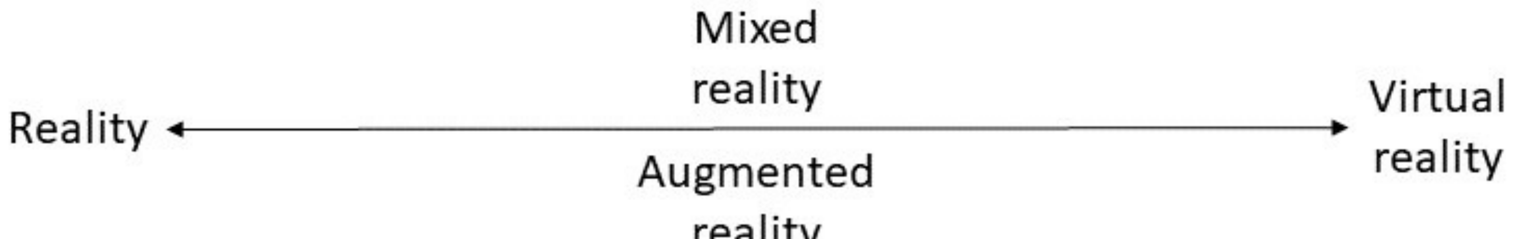
Situational Awareness Overview

- Definition:
  - Ability to perceive and comprehend environmental elements in time and space to the point of being able to project their meaning and state into the future (Endsley 1995)
- Key components
  - Perception: Searching for information
  - Comprehension: Understanding a complex, evolving situation
  - Projection: Ability to apply info to predict near-term
- SA impacts decision making quality and speed when performing dynamic tasks

Cyber Situational Awareness

- SA research has been active in many domains *except cyber operations* (Gutzwiller et al. 2015)
- Fatigue & cognitive overload particularly problematic for cyber operators (Paul & Dykstra 2017)
- Limited cyber SA studies focused on SA improvements from simple data fusion
- Other "SA" studies have focused on benefits of different visualizations (Whitlock 2020)

Virtual Reality Overview

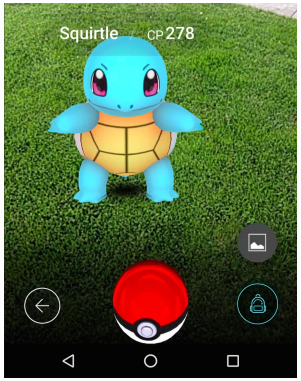


Mixed reality

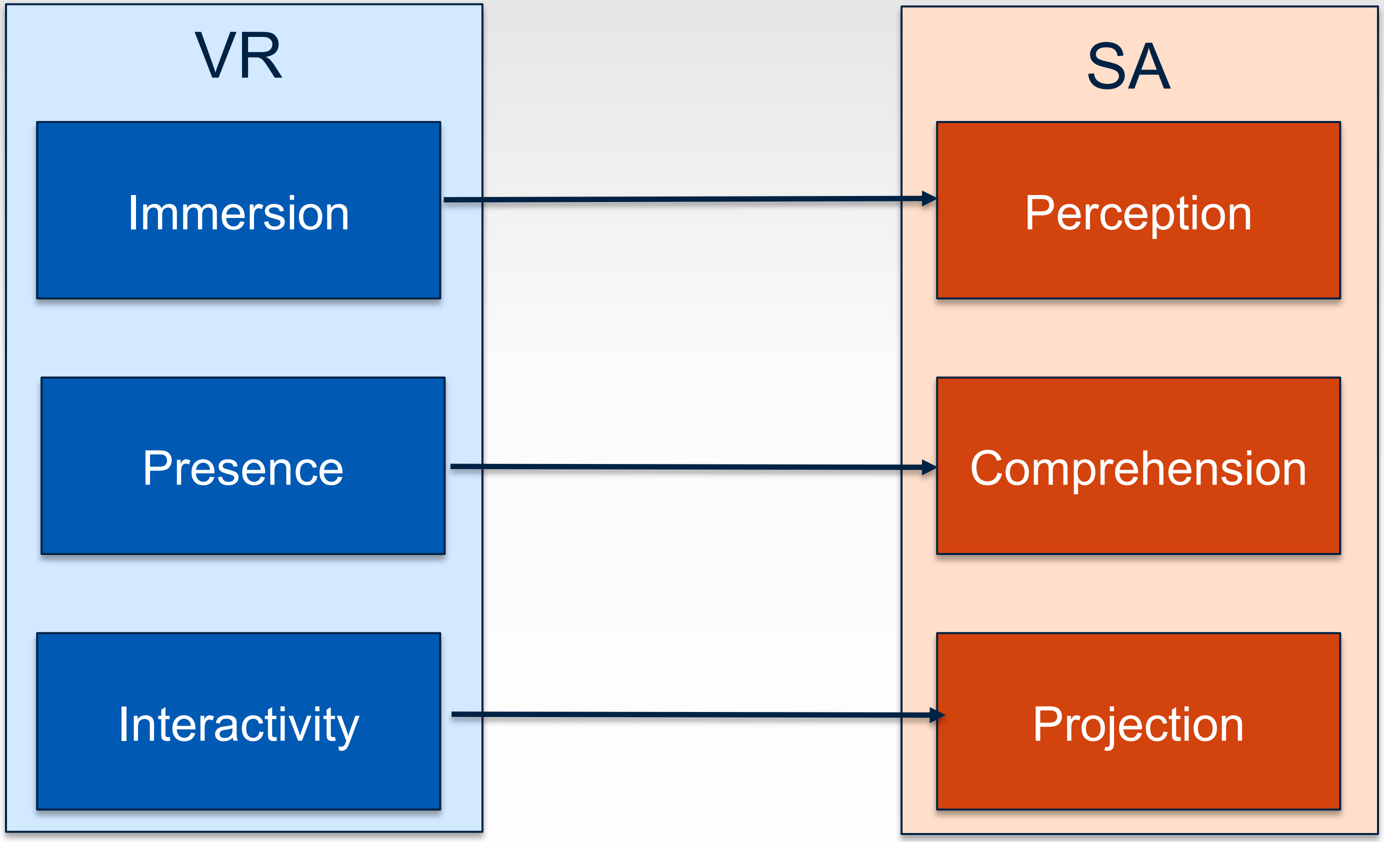
Reality

Virtual reality

Augmented reality



Linking VR to SA Theoretically



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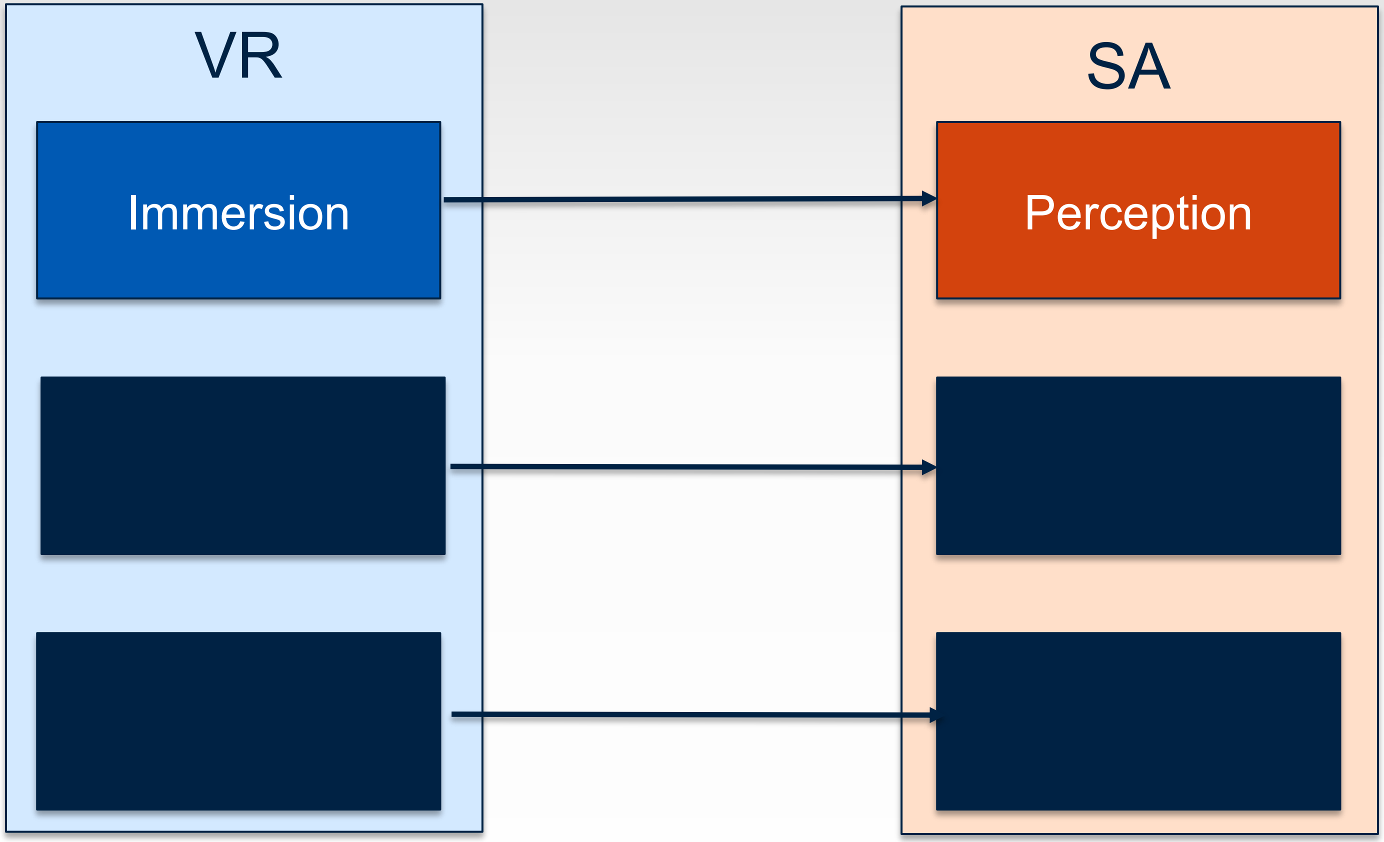

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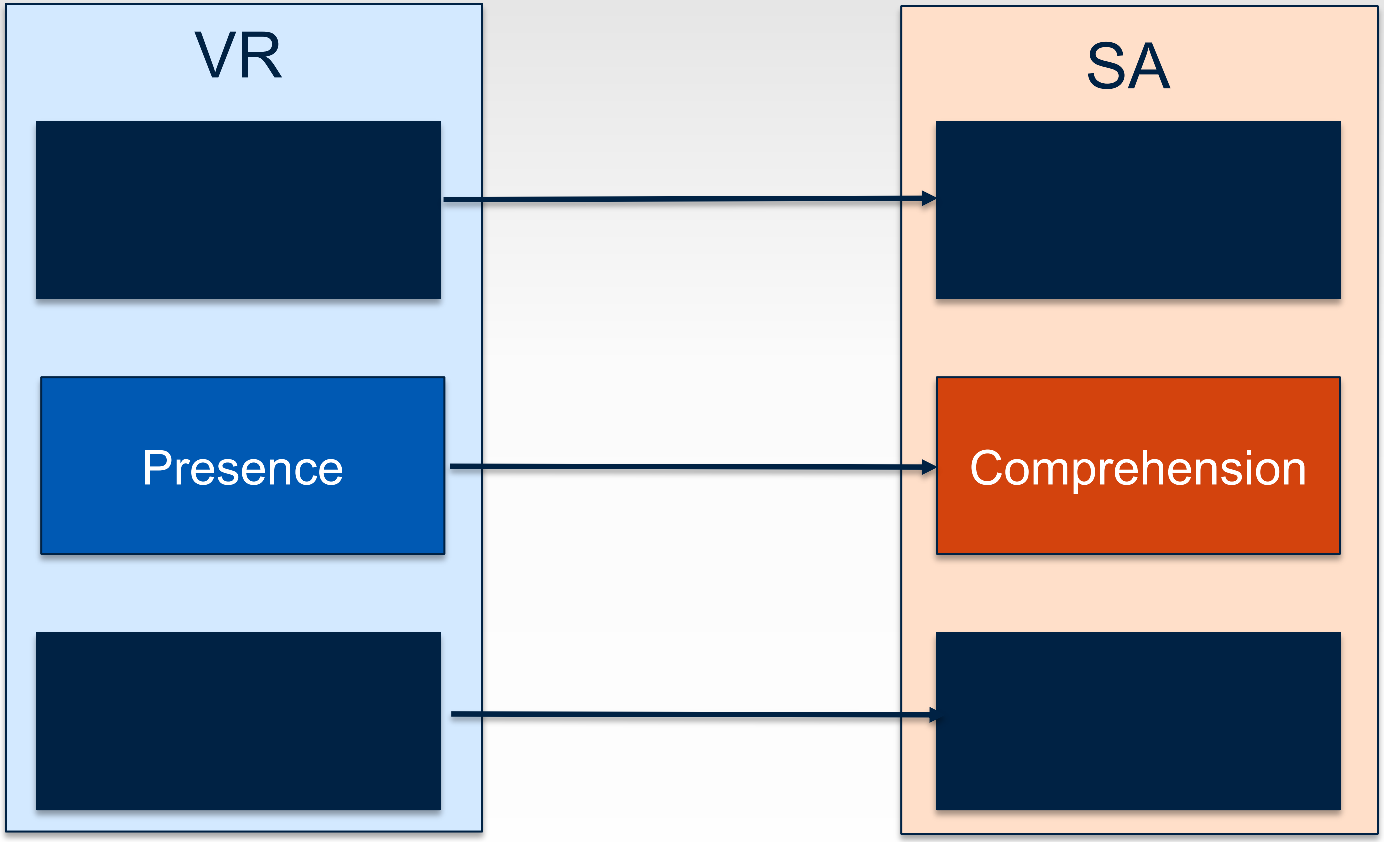
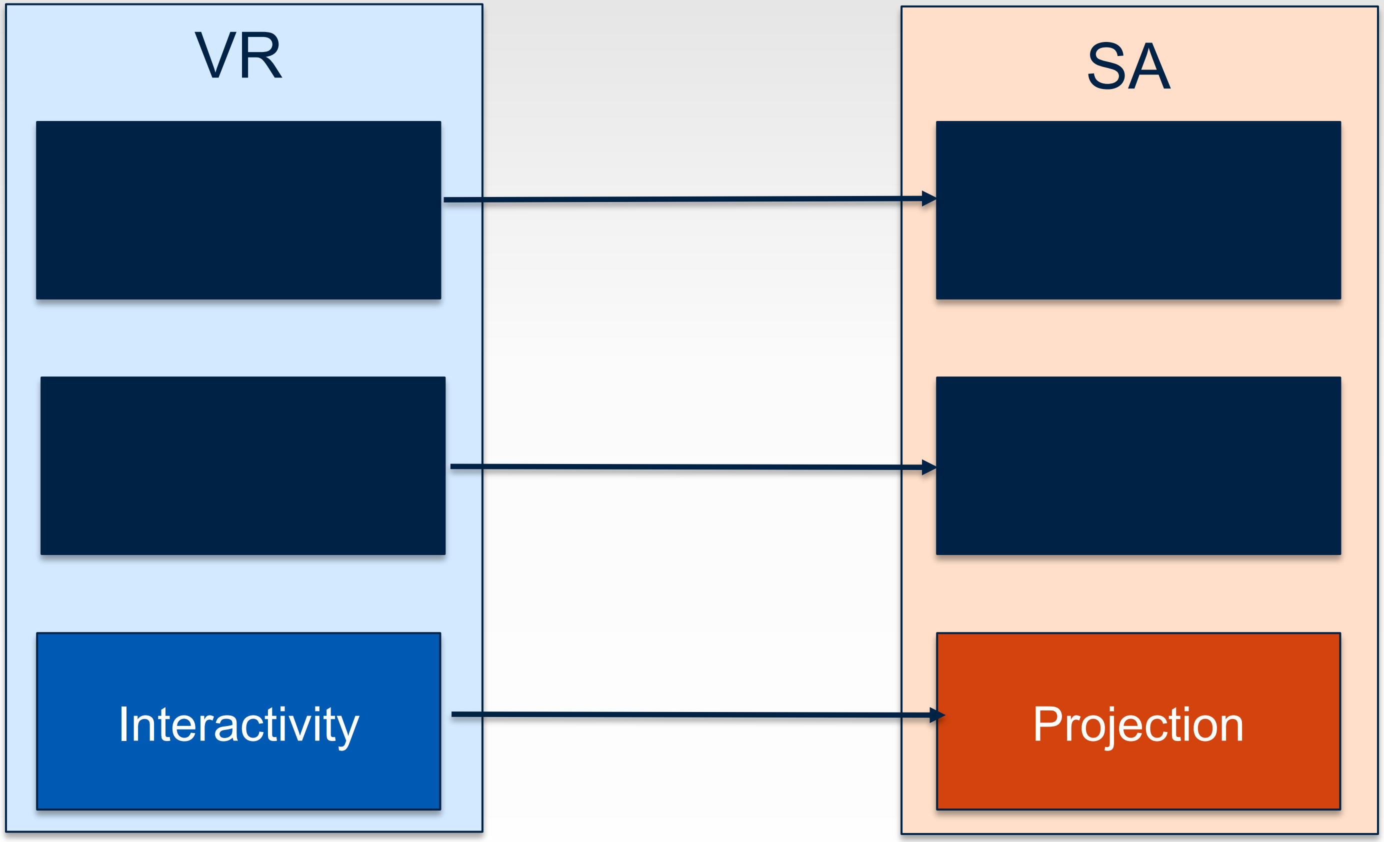


Linking VR to SA Theoretically



VR

SA

Interactivity

Projection

Study Methodology

- Experimental approach
- Datasets
- VR code

Experimental approach

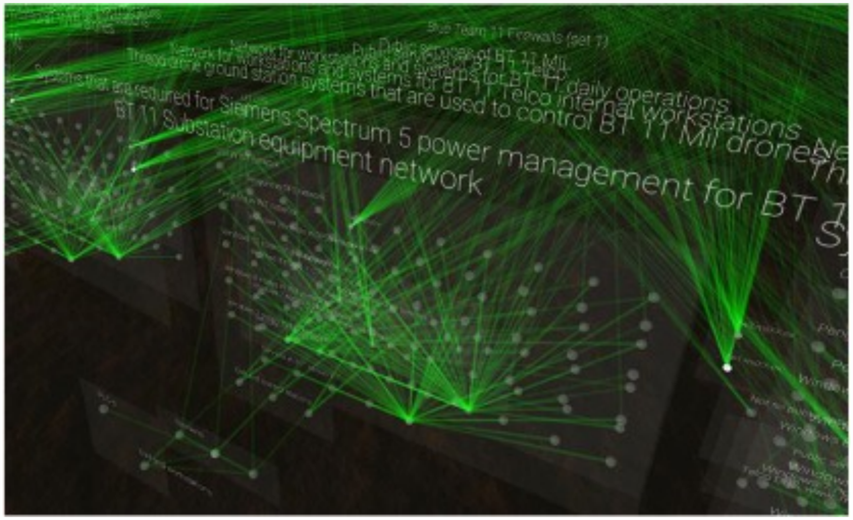
- Adapting the SAGAT (Situation Awareness Global Assessment Technique) approach (Endsley 2000)
  - Pause participant's progress (freeze)
  - Ask questions about their status and thoughts (probe)
- Participants are divided randomly into two groups
  - One group performs threat analysis using standard tools
  - Other group uses standard tools plus VR
- Does the VR group achieve higher SA?

Datasets

- Considered a variety of datasets
- Selected two from UTSA professional education cyber range
  - Contain lateral movement / data transfer
  - Sophisticated but small to enable experiments

VR code

- VDE (Virtual Data Explorer) Kaur Kullman, ARL and now UMBC
- Displays nodes in a network and traffic between them
- User may mark nodes as harmful to track threats


Systems that are used to control BT 11 Mil drones
daily operations
internal workstations
Siemens Spectrum 5 power management for BT 1
BT 11 Substation equipment network

Current Status & Next Steps

- IRB approval acquired
- Code acquired & working
- Datasets collected
- Currently preparing for experiments
- Writing theory & empirical papers
- Next steps:
  - Conduct experiments
  - Finish papers

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QUESTIONS & COMMENTS?