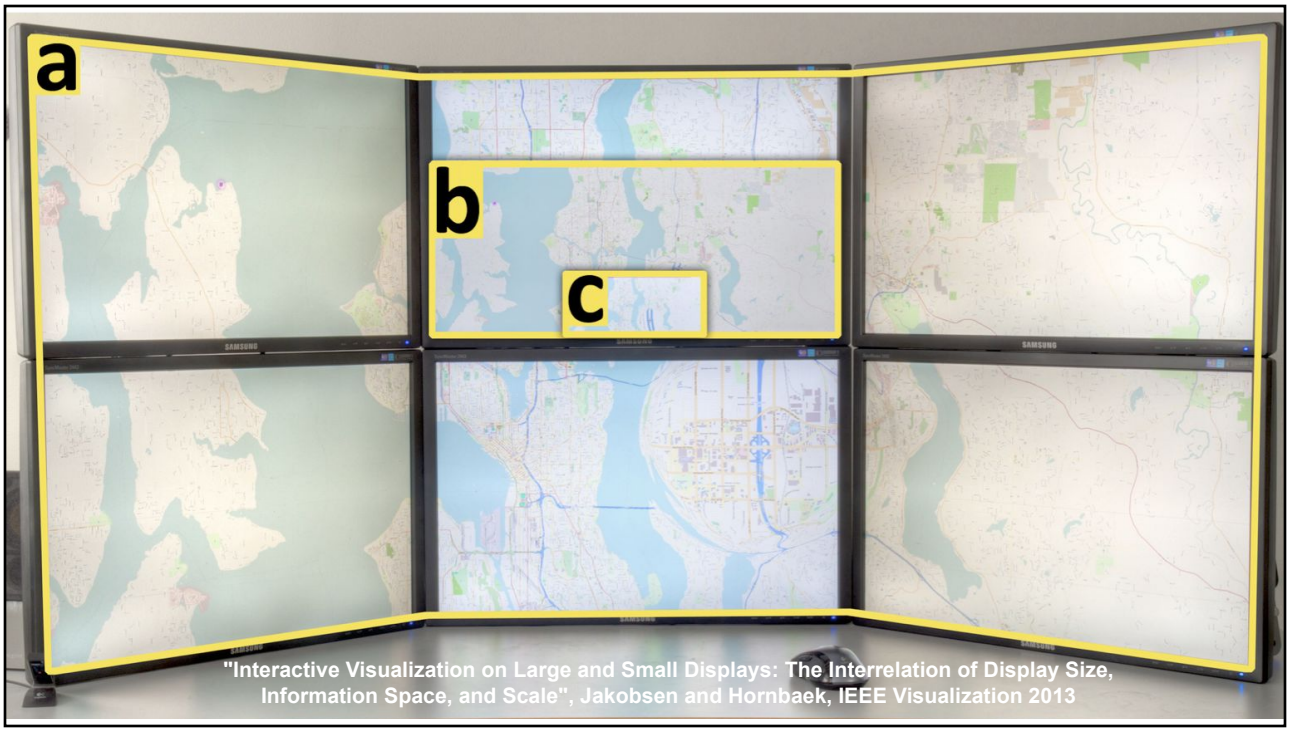
CSCI 4550/6550 Interactive Visualization

https://www.cs.rpi.edu/~cutler/classes/visualization/S24/

Lecture 17: Display Technologies



"Interactive Visualization on Large and Small Displays: The Interrelation of Display Size, Information Space, and Scale", Jakobsen and Hornbaek, IEEE Visualization 2013

Today

- Focus + Context
- Interactive Immersive Environments
- Readings for Today
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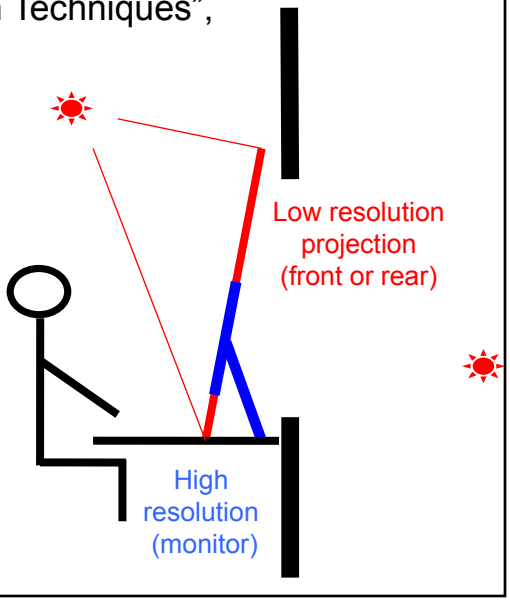
  - “Immersive Collaborative Analysis of Network Connectivity: CAVE-style or Head-Mounted Display?”
  - "Walking > Walking-in-Place > Flying, in Virtual Environments"
- Readings for Friday

“Focus Plus Context Screens: Combining Display Technology with Visualization Techniques”, Baudisch, Good, & Stewart, UIST 2001



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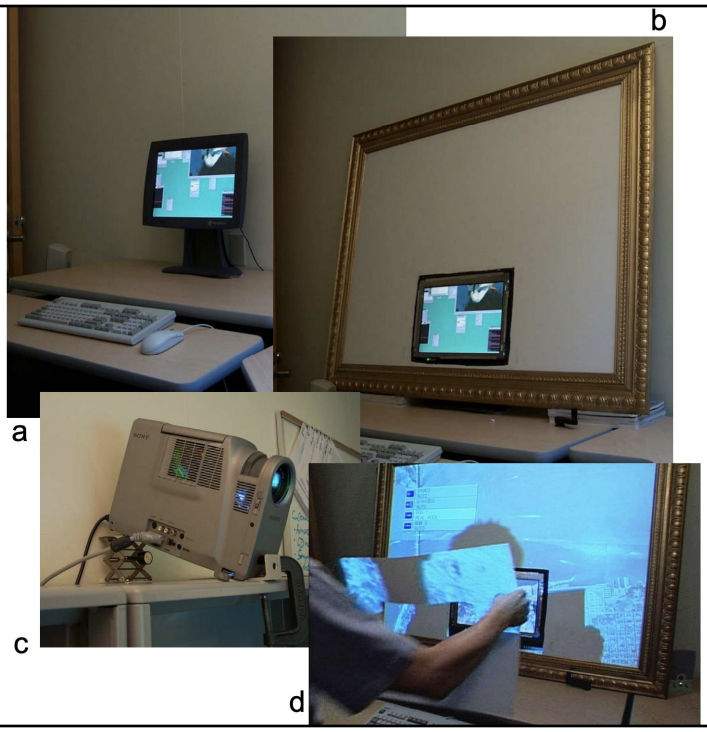
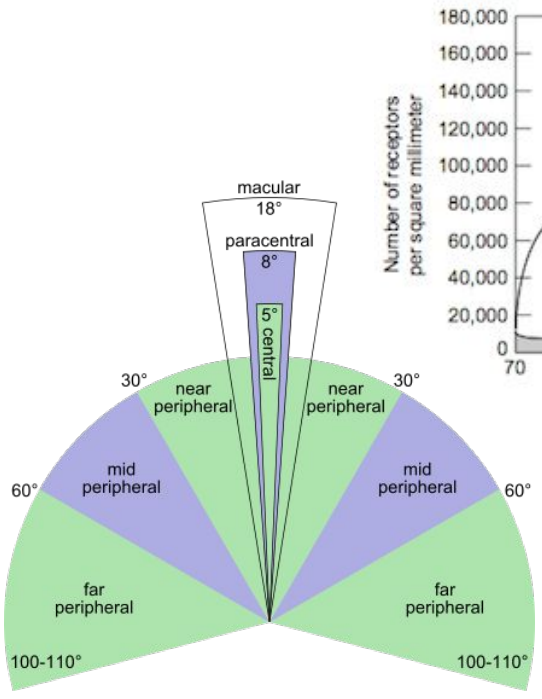
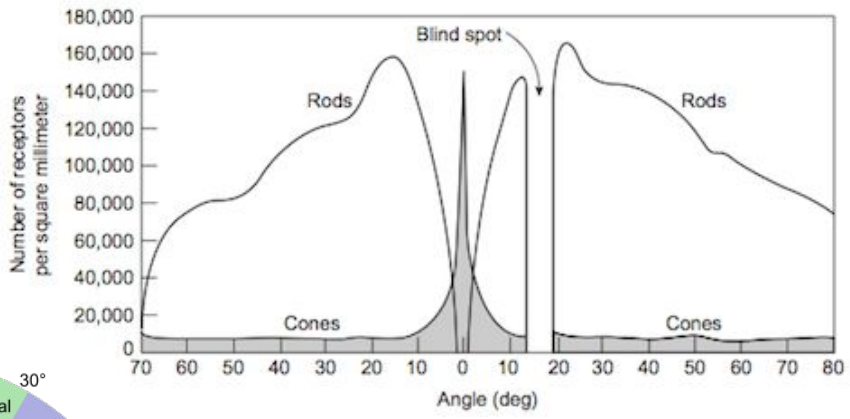




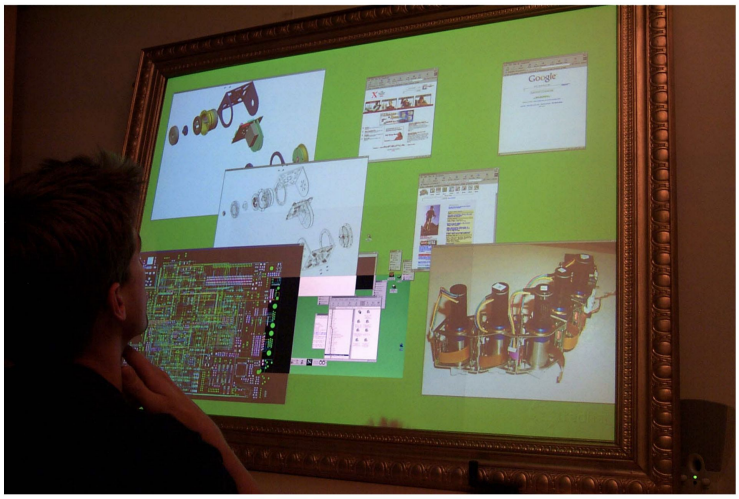


http://www.uxmatters.com/mt/archives/2010/07/updating-our-understanding-of-perception-and-cognition-part-i.php

https://en.wikipedia.org/wiki/Peripheral_vision

Focus + Context Demos / Examples

- City street maps
- Building blueprints
- Circuit diagram
- Computer desktop window manager
- Biological data
- Weather maps
- Art



"Focus Plus Context Screens: Combining Display Technology with Visualization Techniques", Baudisch, Good, & Stewart, UIST 2001

Focus + Context Applications

- Video conferencing / Tele-teaching
- Editing print products (print resolution >> screen resolution)
- Route finding
- Simulation Games

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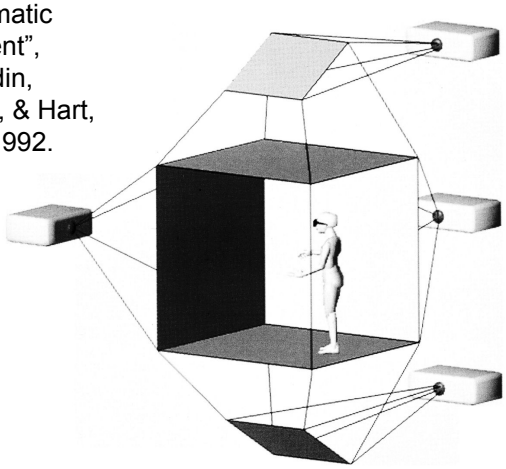
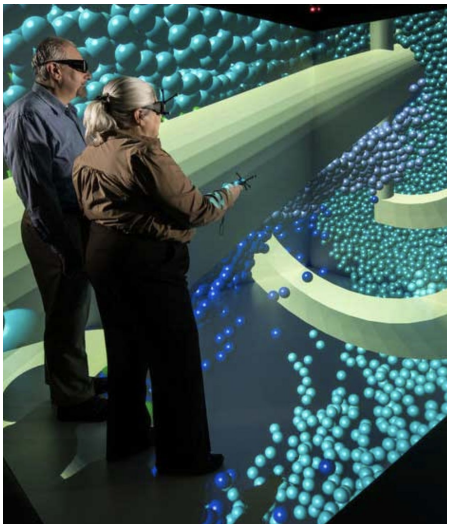
CAVE: Cave Automatic Virtual Environment

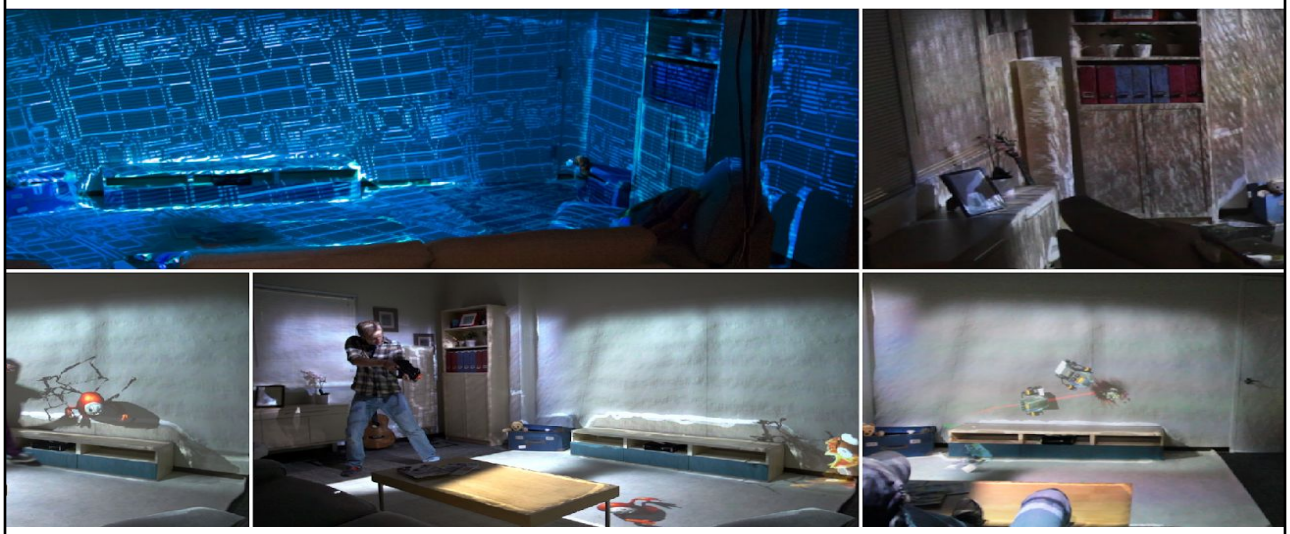
“The CAVE: audio visual experience automatic virtual environment”, Cruz-Neira, Sandin, DeFanti, Kenyon, & Hart, Comm. of ACM 1992.





https://www.mechdyne.com/av-vr-solutions/immersive-virtual-augmented-reality/cave/

Jones, B., Sodhi, R., Murdock, M., Mehra, R., Benko, H., Wilson, A. D., Ofek, E., MacIntyre, B., Shapira, L. RoomAlive: Magical Experiences Enabled by Scalable, Adaptive Projector-Camera Units. ACM UIST, 2014.

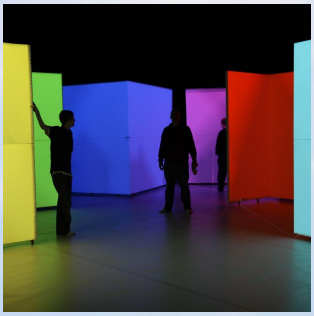


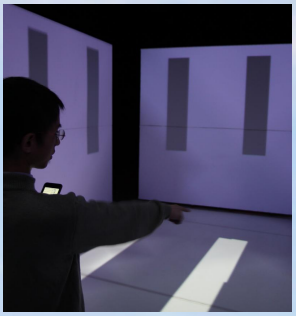
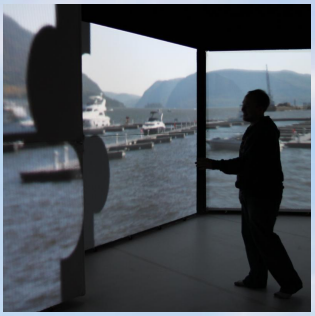
http://projection-mapping.org/roomalive-uist/
https://www.youtube.com/watch?v=ILb5ExBzHqw

Interaction Technology Applications?
Implementation Challenges?

- Color compensation? Non white surfaces?
- Can't move furniture after calibration
- Windows, sunlight, & different artificial lighting?
- How accurate is the touch?
- How adaptable to odd shaped rooms, partial rooms?
- Audio – is surround sound necessary, will it add something, make more immersive, what if target audience member is moving, multiple people
- Seems expensive, requires lots of power, not for home use, but rather permanent installation, charge admission
- Interactive puzzle experience, groups, solve riddles (escape room), adding augmented reality would be interesting
- How does perspective work for multiple viewers for synthetic 3D objects?

Dynamic Projection Surfaces for Immersive Visualization



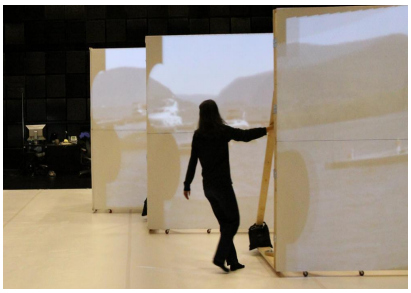
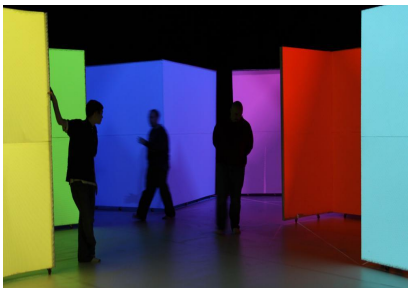
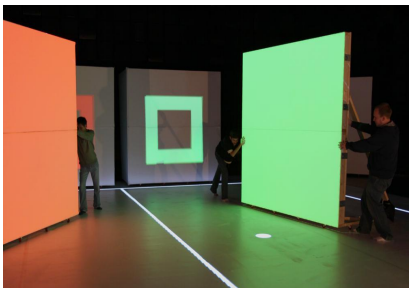



Theodore C. Yapo, Yu Sheng, Joshua Nasman,
Andrew Dolce, Eric Li, and Barbara Cutler

PROCAMS 2010 IEEE International Workshop on Projector-Camera Systems, June 2010

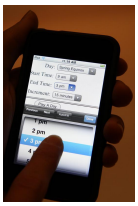
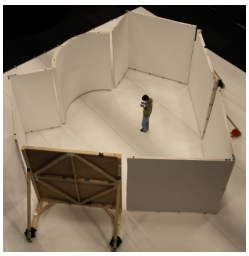
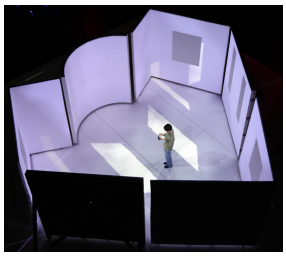
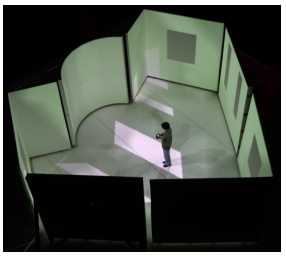
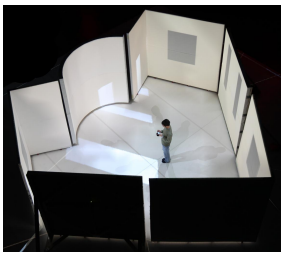
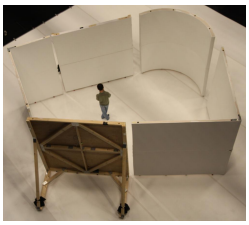
Our System Goals/Requirements

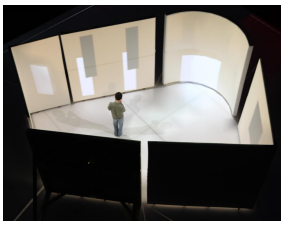
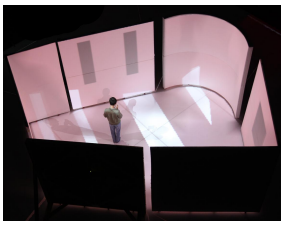
- Large, human-scale projection environment
- People move freely within the space
- Projection surfaces can be moved interactively
- Varying illumination conditions
- Robust & real-time tracking and display

Architectural Daylighting Design

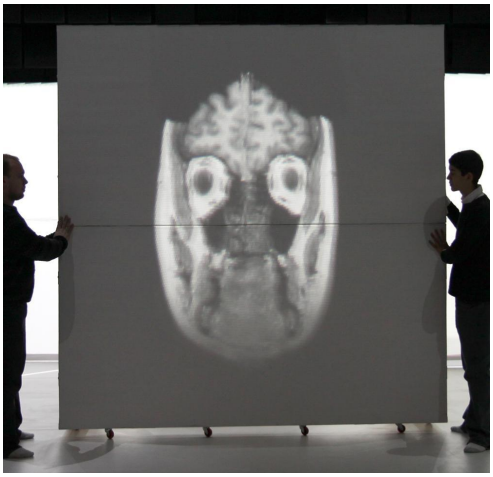
- Windows, wall colors, & time of day controlled through iTouch interface

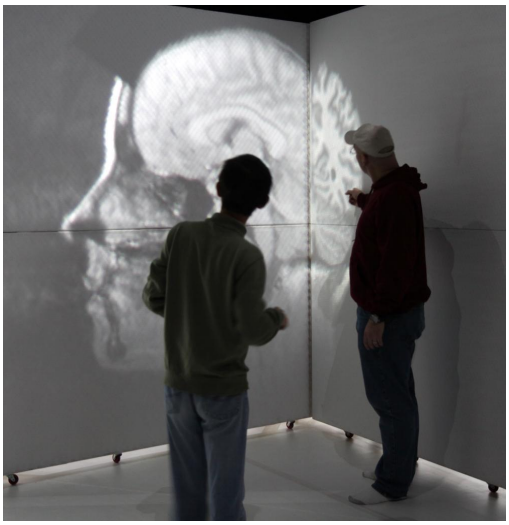







Volumetric Visualization

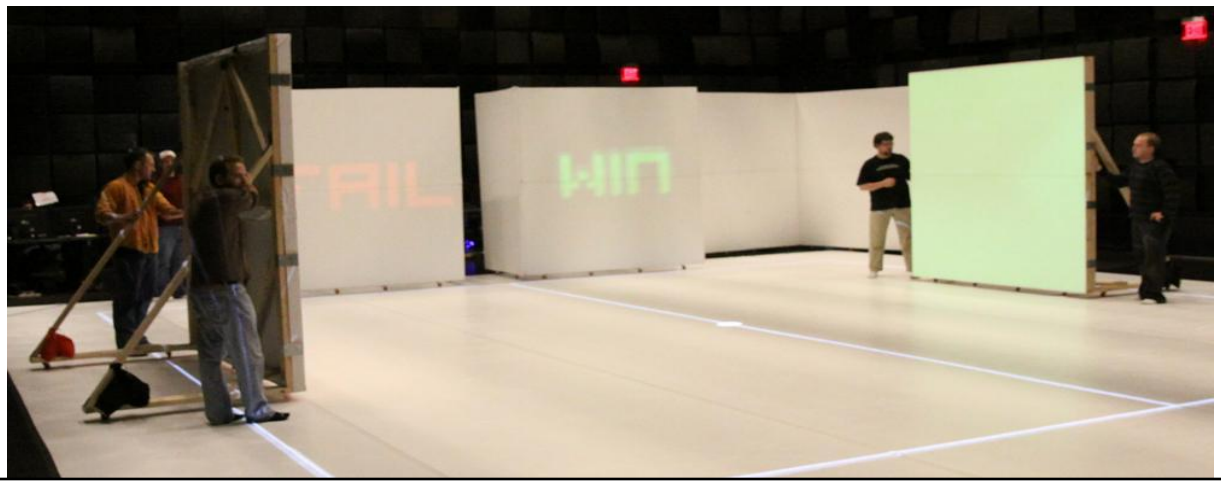
- Cross sections of a 3D medical dataset virtually placed within the projection volume

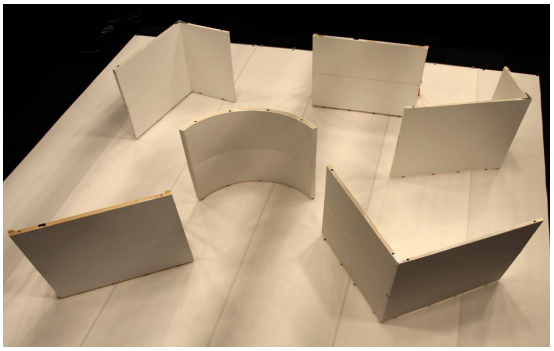


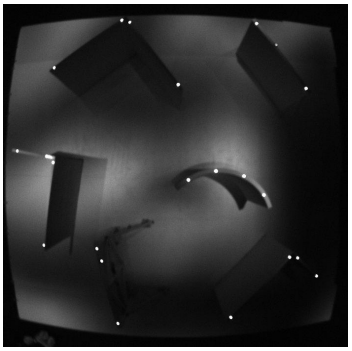


General User Interface Elements

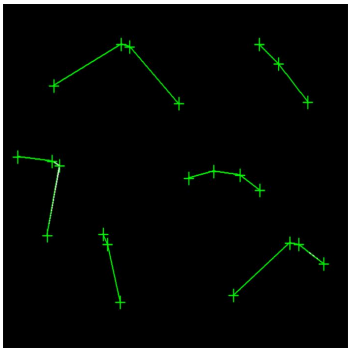
- Projection surfaces as input devices
- No instruction necessary to play the game!

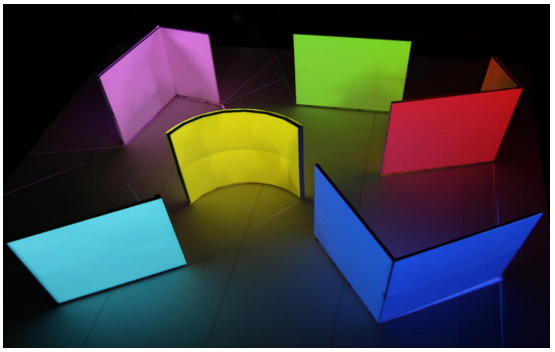






https://www.cs.rpi.edu/graphics/procams2010/





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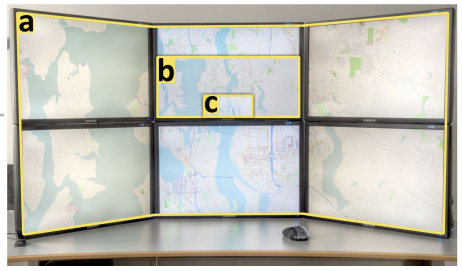

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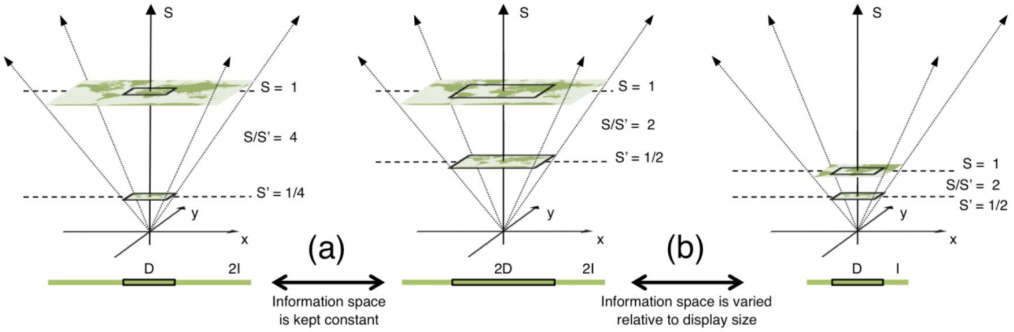

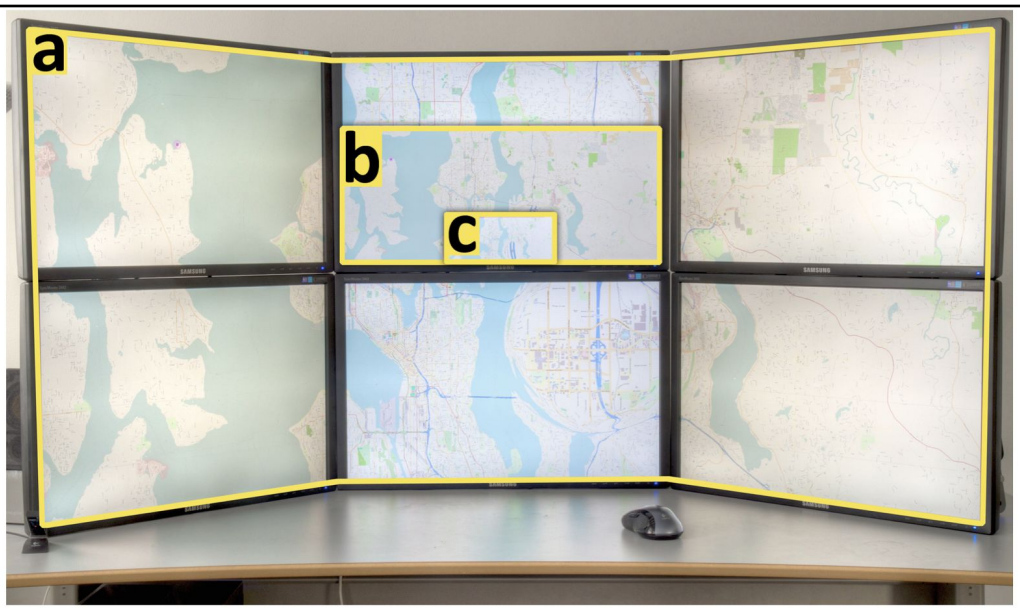

Figure 1: How do visualization techniques perform at different display sizes such as (a) 13.8, (b) 1.5, or (c) 0.17 megapixels?

- "Sizing Up Visualization: Effects of Display Size in Focus+Context, Overview+Detail, and Zooming Interfaces", Jakobsen and Hornbaek, CHI 2011
- Most visualization studies are done on standard size displays
- Large displays allow more information to be shown, and improve task performance & user satisfaction
- Physical navigation is easier on large displays
- Different technologies: focus+context, overview+detail, & zooming
- Research Questions:
  - If a technique works well to improve small scale visualization, will it also improve large scale visualization?
  - Which tasks take best advantage of a large display visualization?

- Display size vs information space vs scale
- Large displays often have low resolution or pixel density
  - Distance from viewer to display
  - Apple's "Retina" displays
- This paper:
  - Fixed-information-space experiment: used maps of the same size for all display sizes, which allows for absolute comparisons of performance measures, but causes scale ratios to vary.
  - Variable-information-space experiment, varied the map size relative to display size so that the scale ratios are constant across display sizes, but does not allow direct comparisons because performance with maps of different sizes is measured.

- This study shows that these visualizations do not benefit from a "large" (multi-monitor) display
  - When targets are visible at all zoom levels
  - When interaction is required
  - When target search time is included
- *Why not ask which technique is best for each display size?*

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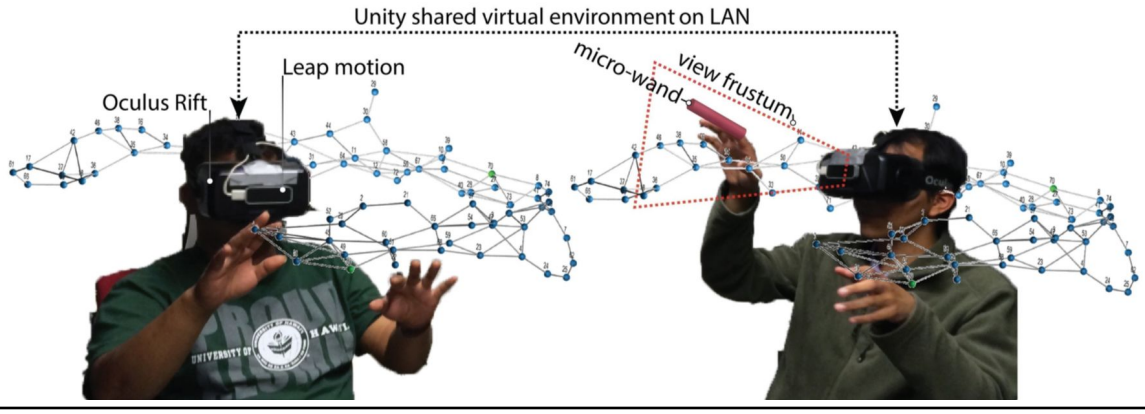
Reading for Today

- “Immersive Collaborative Analysis of Network Connectivity: CAVE-style or Head-Mounted Display?”, Cordeil, Dwyer, Klein, Laha, Marriott, Thomas, IEEE InfoVis 20



- Multi-person spatial immersive displays
- CAVE vs head-mounted display, compare:
  - Ease of use
  - Degree of collaboration
  - Qualitative usability
- Head-tracking is important (reduces disorientation)
  - Only 1 user can be head-tracked in a CAVE
- Focus on features available in both systems

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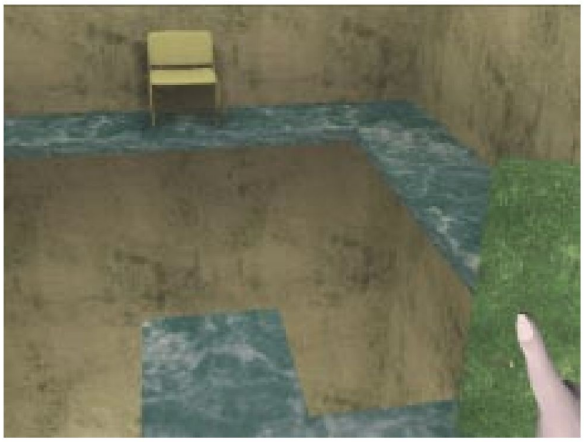
Reading for Today

- “Walking > Walking-in-Place > Flying, in Virtual Environments”, Usoh, Arthur, Whitton, Bastos, Steed, Slater, & Brooks, SIGGRAPH 1999



- Well designed study
- Good to have intuitive expectations confirmed by experiment
- Discussion of nausea / “oculomotor discomfort” in VR
- Cables used to be the biggest problem for VR. But even though we have wireless VR now, it still isn’t popular / widespread.
- Virtual pit room, similar to virtual cliff experiments
- Familiarity with game/VR decreases immersion over time?
- Gender differences noted, are they significant & reproducible?
- Would modern improved VR graphics show the same or more/less of an impact in emotional response to the pit room?
- … amazed that VR existed this early and looked this good in 1999

Figure 5.21
Myers/DeWall, *Psychology in Everyday Life*, 4e,
© 2017 Worth Publishers

https://en.wikipedia.org/wiki/Visual_cliff

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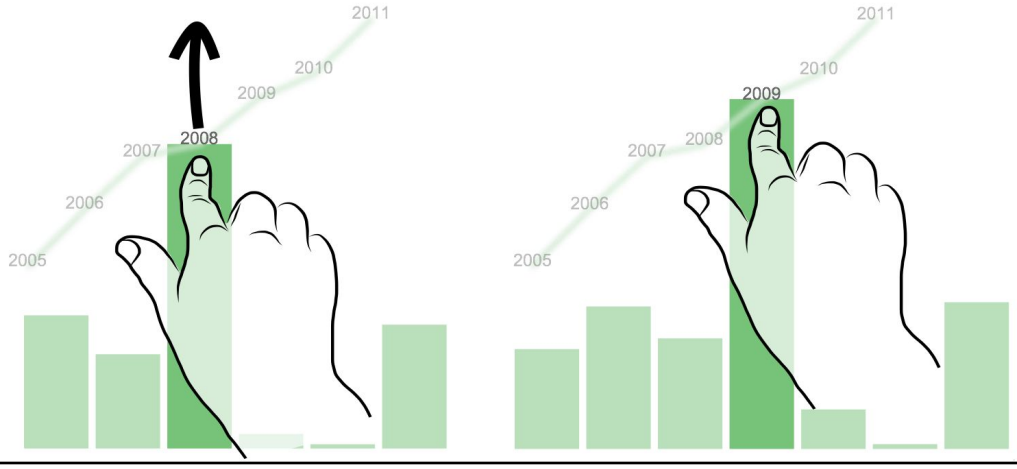
Reading for Tuesday *pick one*

- "DimpVis: Exploring Time-varying Information Visualizations by Direct Manipulation", Kondo and Collins, IEEE Visualization 2014



Reading for Tuesday *pick one*

- "Active Reading of Visualizations", Walny, Huron, Perin, Wun, Pusch, and Carpendale, IEEE InfoVis 2017