Don’t Block My Stuff: Fostering Personal Object Awareness in Multi-user Mixed Reality Environments

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David Lindlbauer

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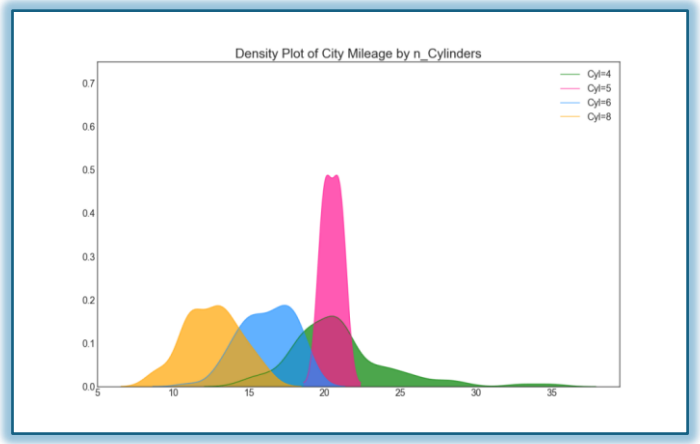
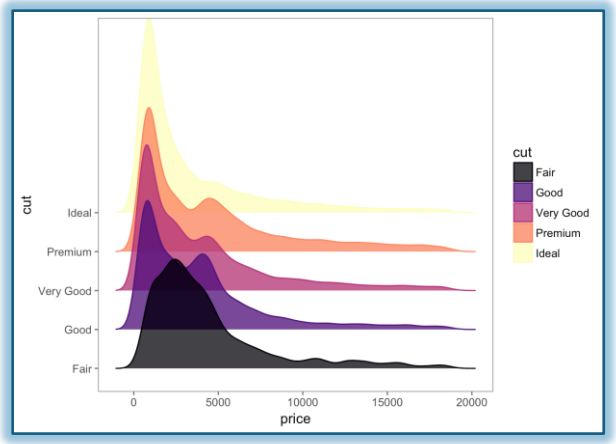
cut
Fair
Good
Very Good
Premium
Ideal
price
0
5000
10000
15000
20000

Personal and Shared Interfaces

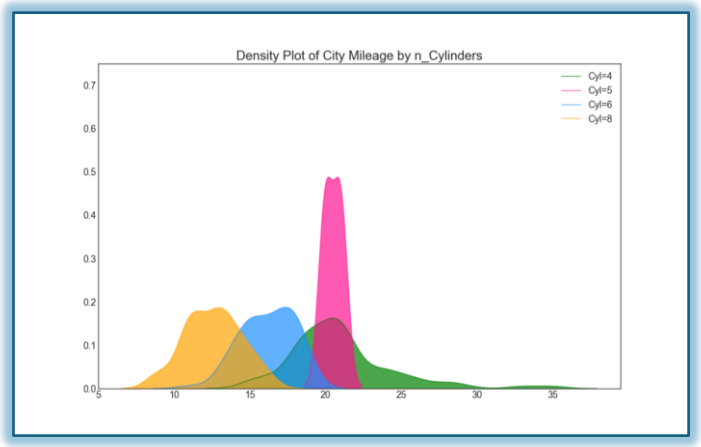
Shared interfaces

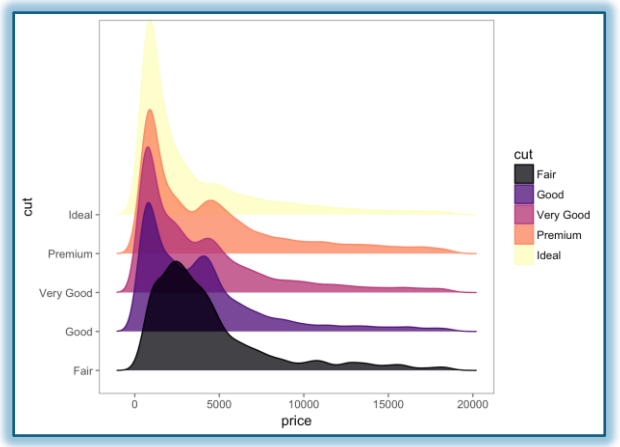




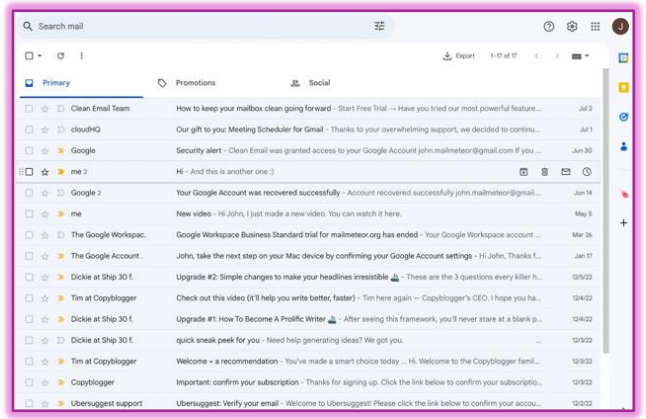
Personal and Shared Interfaces

Shared interfaces





Personal interfaces

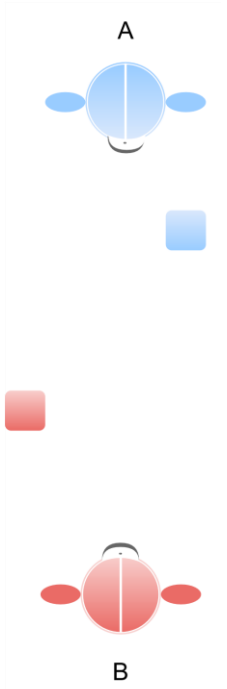


Calendar

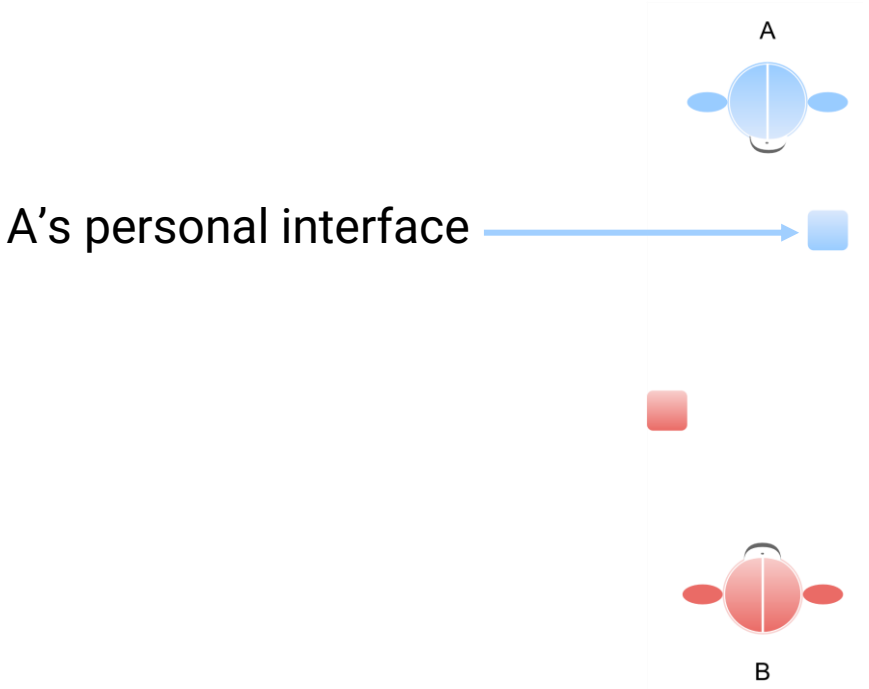
Email

Social Media

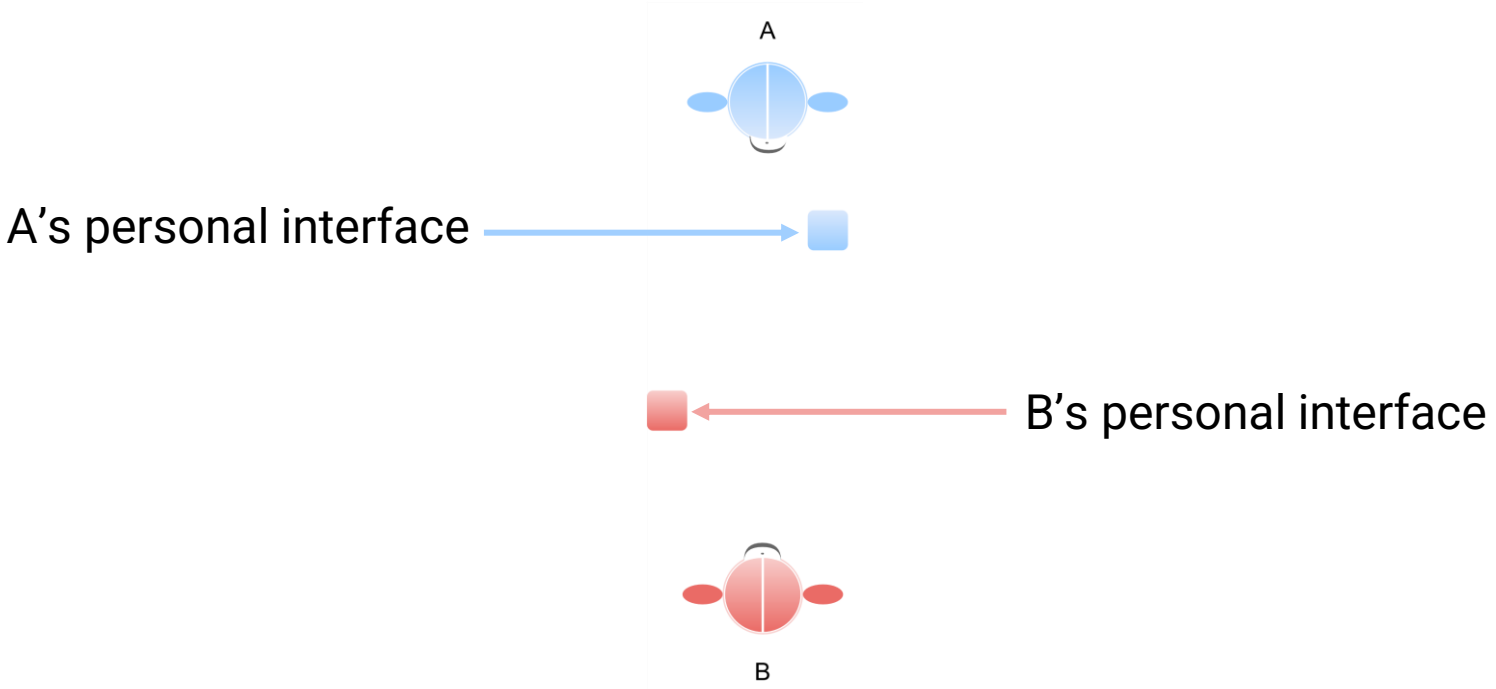
Virtual-Virtual Conflicts



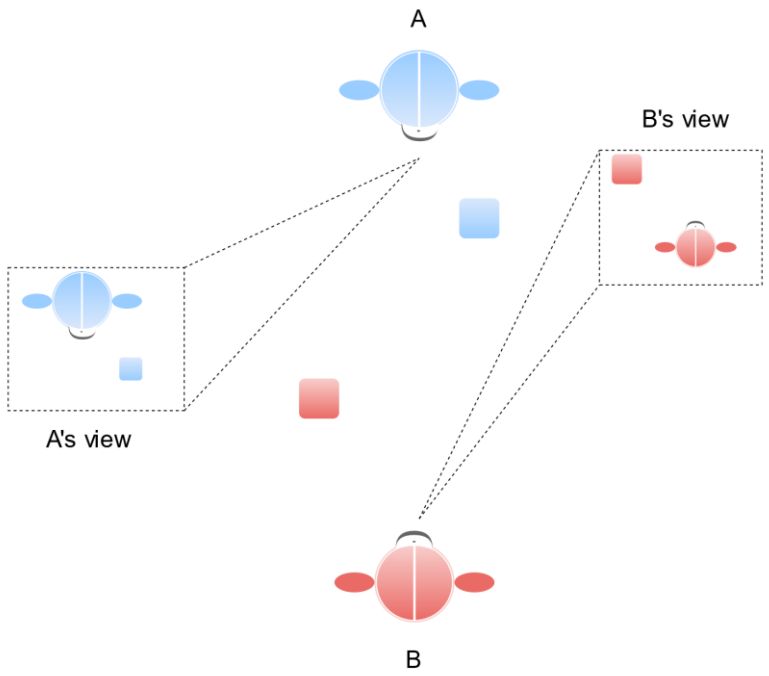
Virtual-Virtual Conflicts



Virtual-Virtual Conflicts



Virtual-Virtual Conflicts



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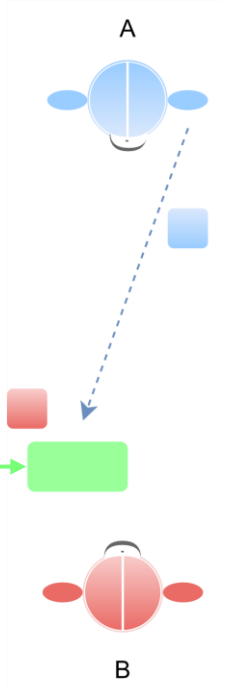
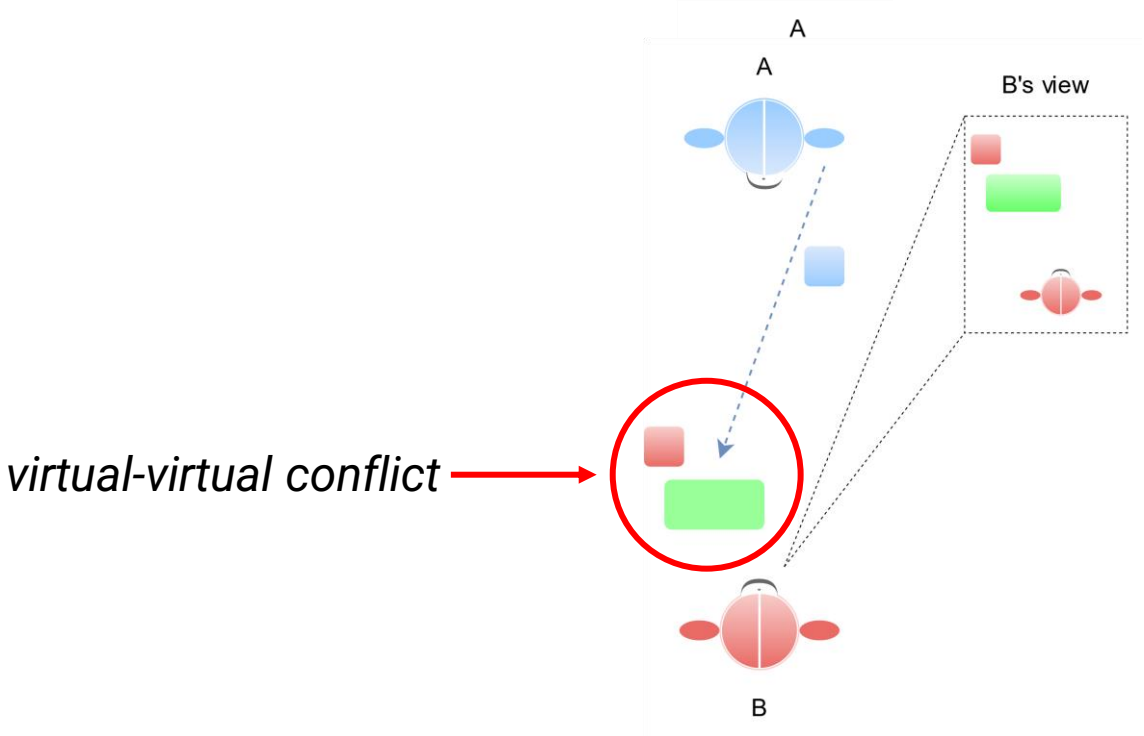
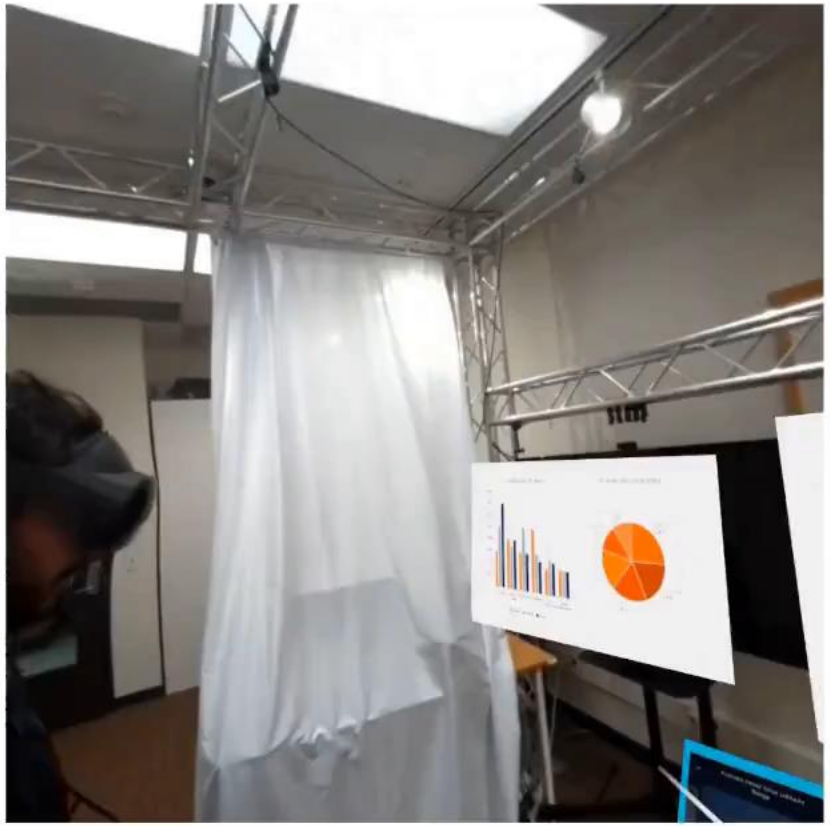


A's **shared** interface

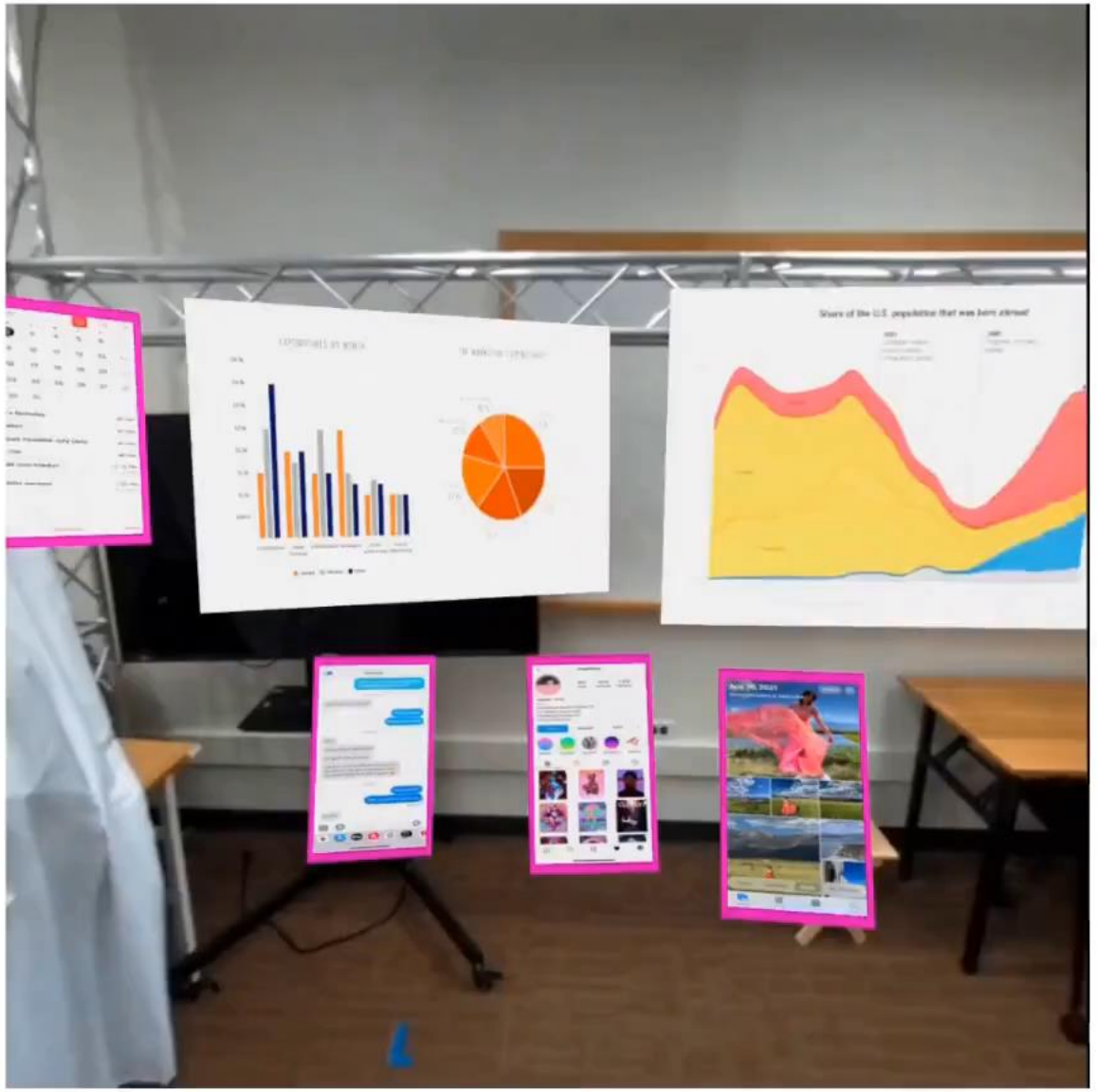
Virtual-Virtual Conflicts



User A’s view



User B’s view



Proposed Solution

Use **visualizations** to **foster awareness** and **mitigate conflicts**

Visualizations

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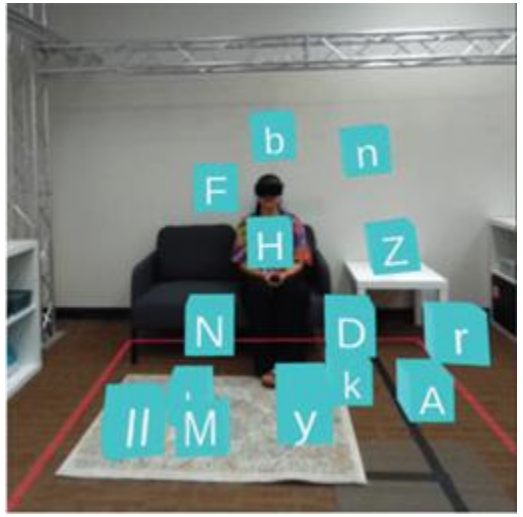
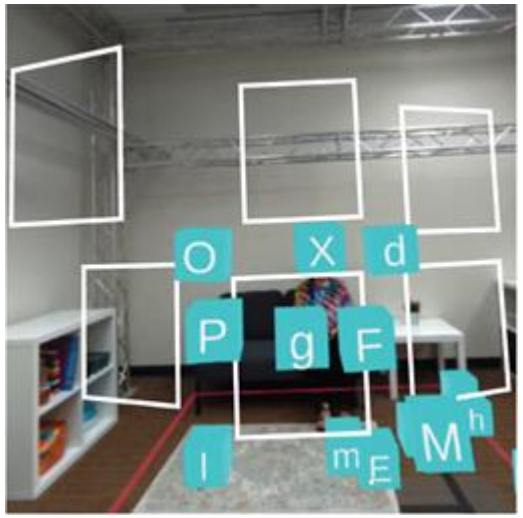


None

Reveals **nothing**

Gems

Reveals **position**



Wireframes

Reveals **position, shape,** and **size**

Ghosts

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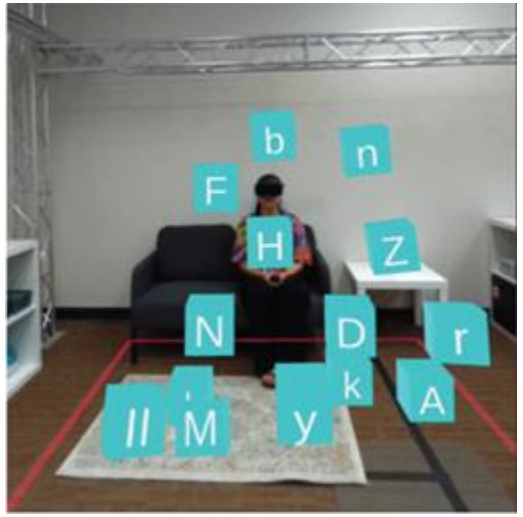
Visualizations

- Use **visualizations** to **foster awareness** and **mitigate conflicts**



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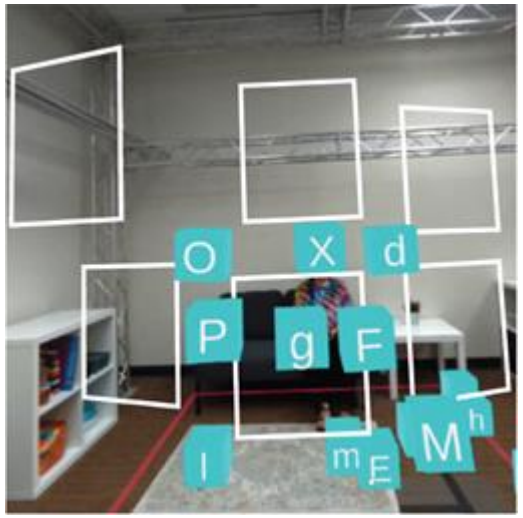

Wireframes

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Ghosts

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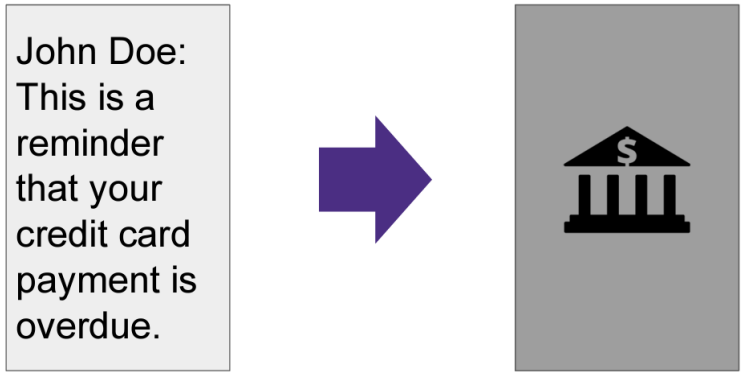
Low information

High information

Prior Work

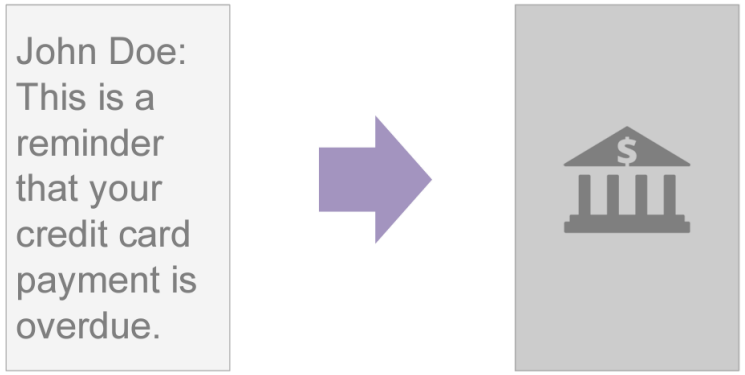
Prior Work on Visualizations



Ghosts: Privacy-preserving sharing

Ruth et. al (USENIX Security '19)

Prior Work on Visualizations



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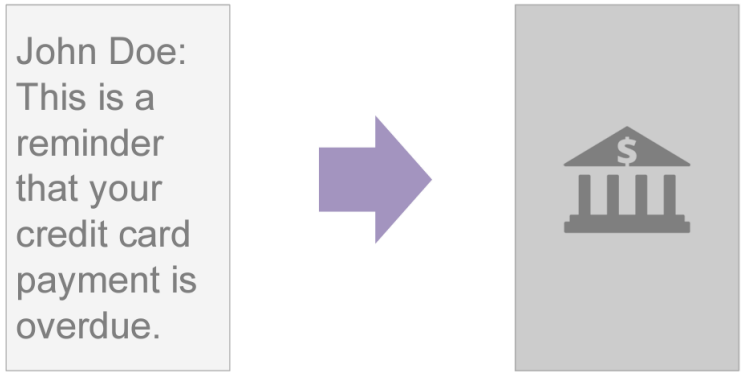
Diminished Reality to reduce clutter

Cheng et. al (CHI '22)

Prior Work on Visualizations



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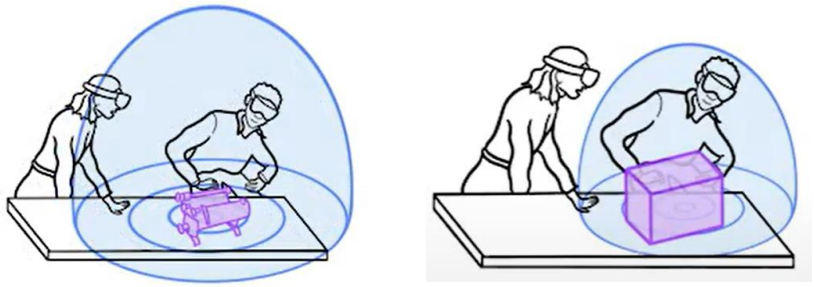

Coarse-grained representations

Rajaram et. al (CHI '23)

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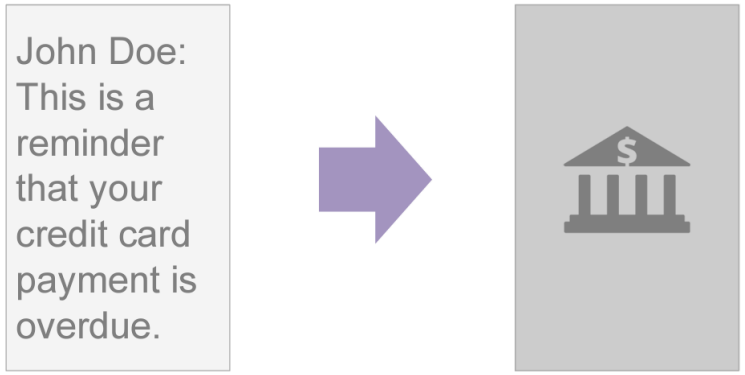

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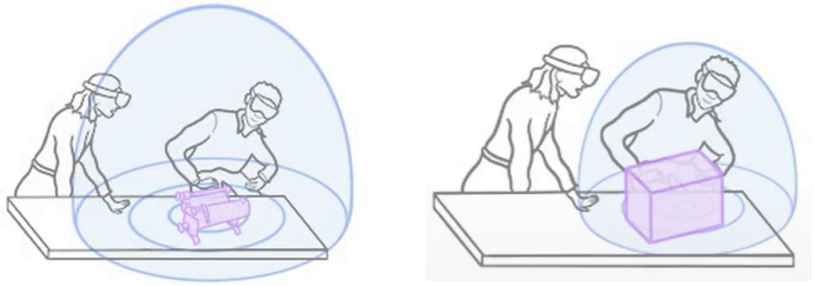

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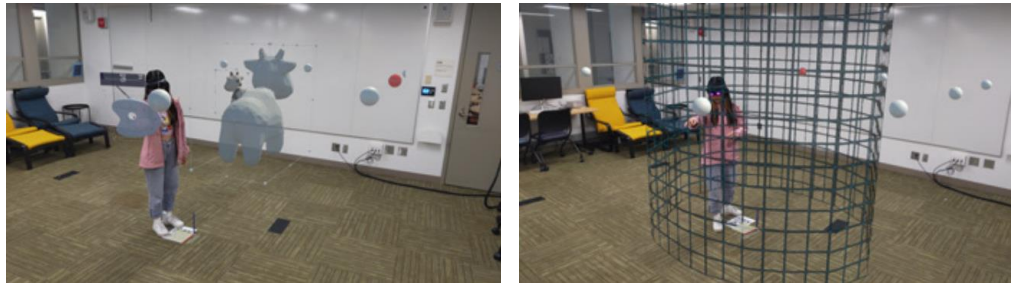


Workspace Guardian
Jackson et. al (TVCG '24)

Our Work

We study the impact of **visualizations** of personal interfaces in a collaborative MR setting

Our Work

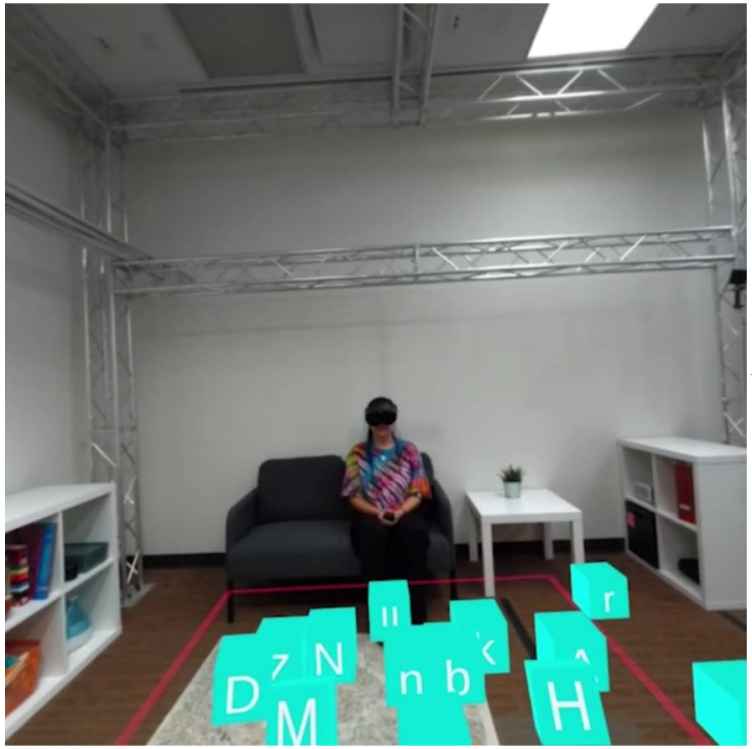
We study the impact of **visualizations** of personal interfaces in a collaborative MR setting

- How do these visualizations impact:
  1. Occlusion
  2. User perceptions

Experiment

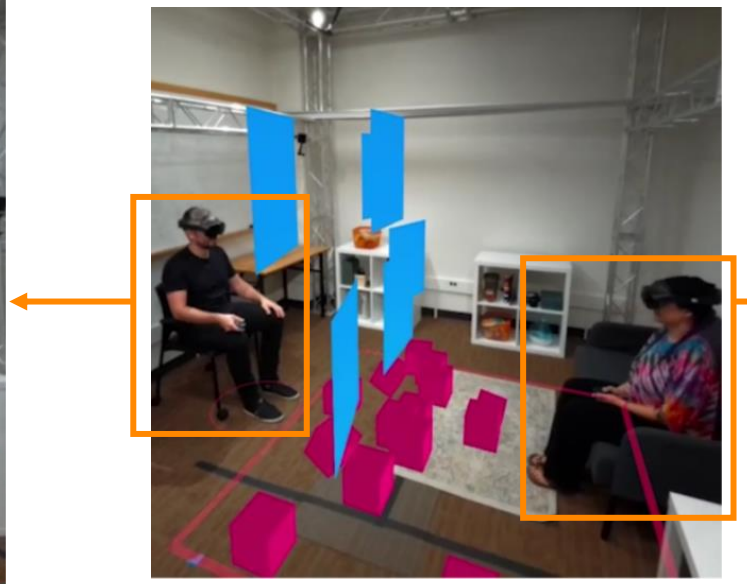
Experimental Task

Sorter's View

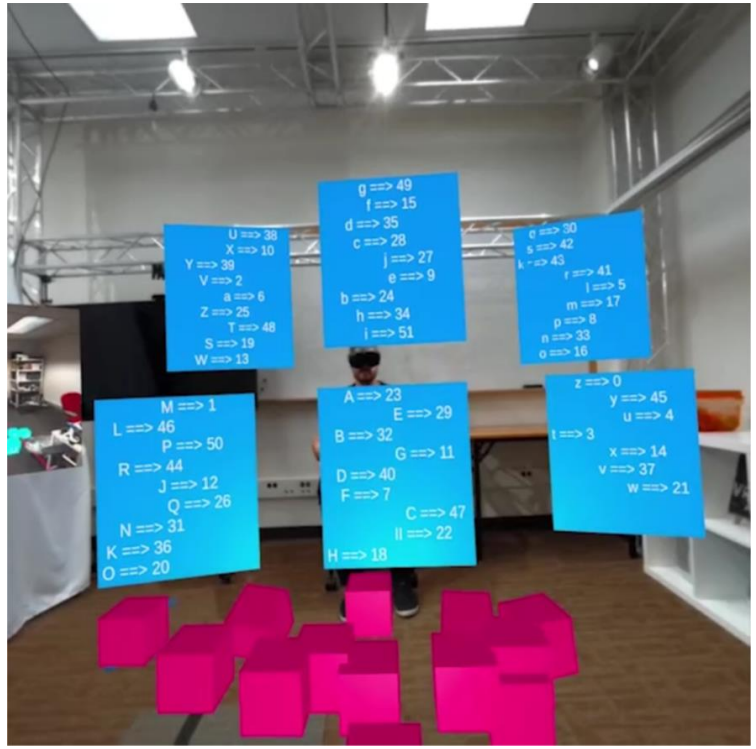


arranges the cubes

cubes represent **shared** interfaces



Searcher's View



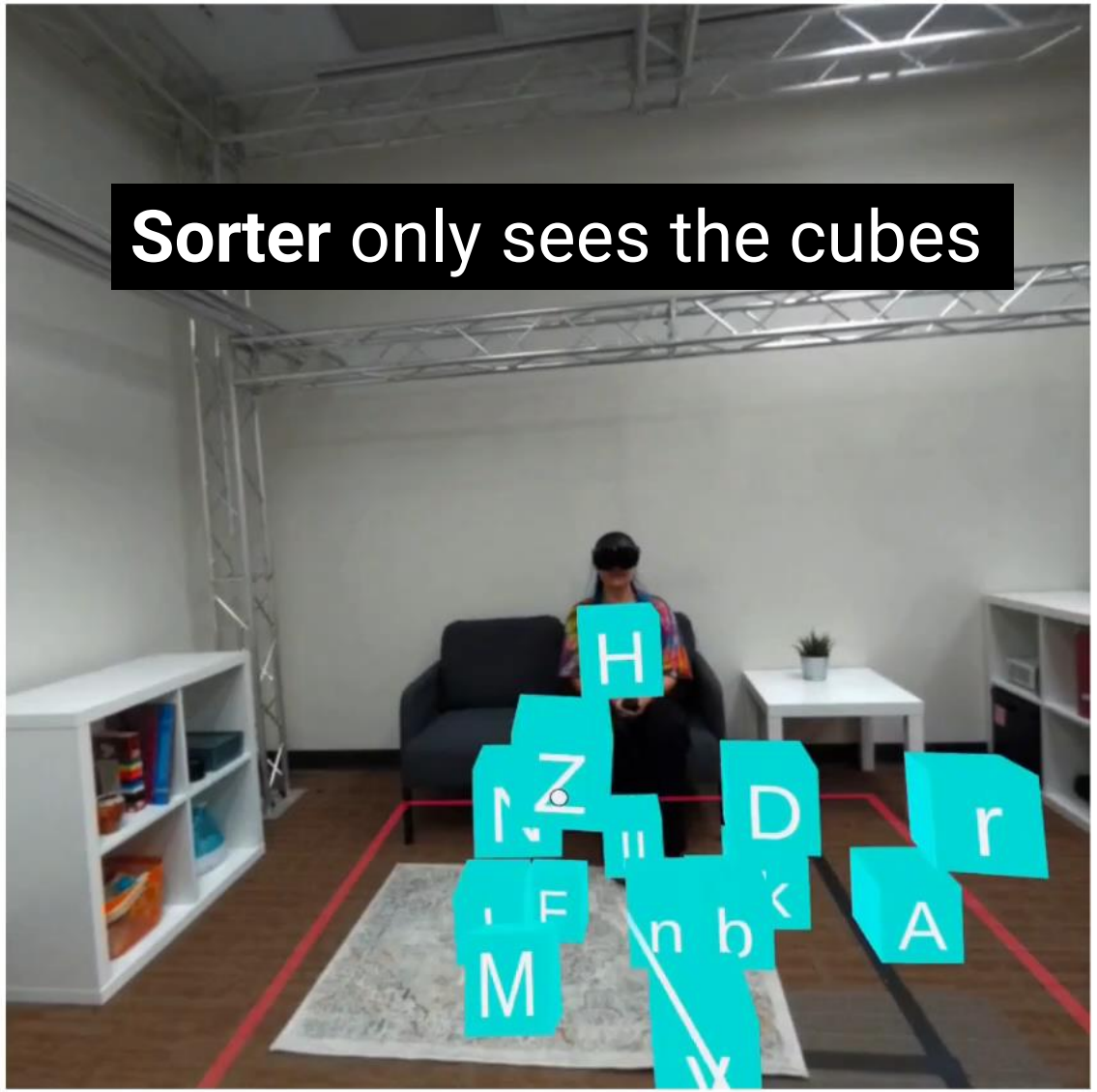
provides order of cubes to **sorter**

panels represent **personal** interfaces

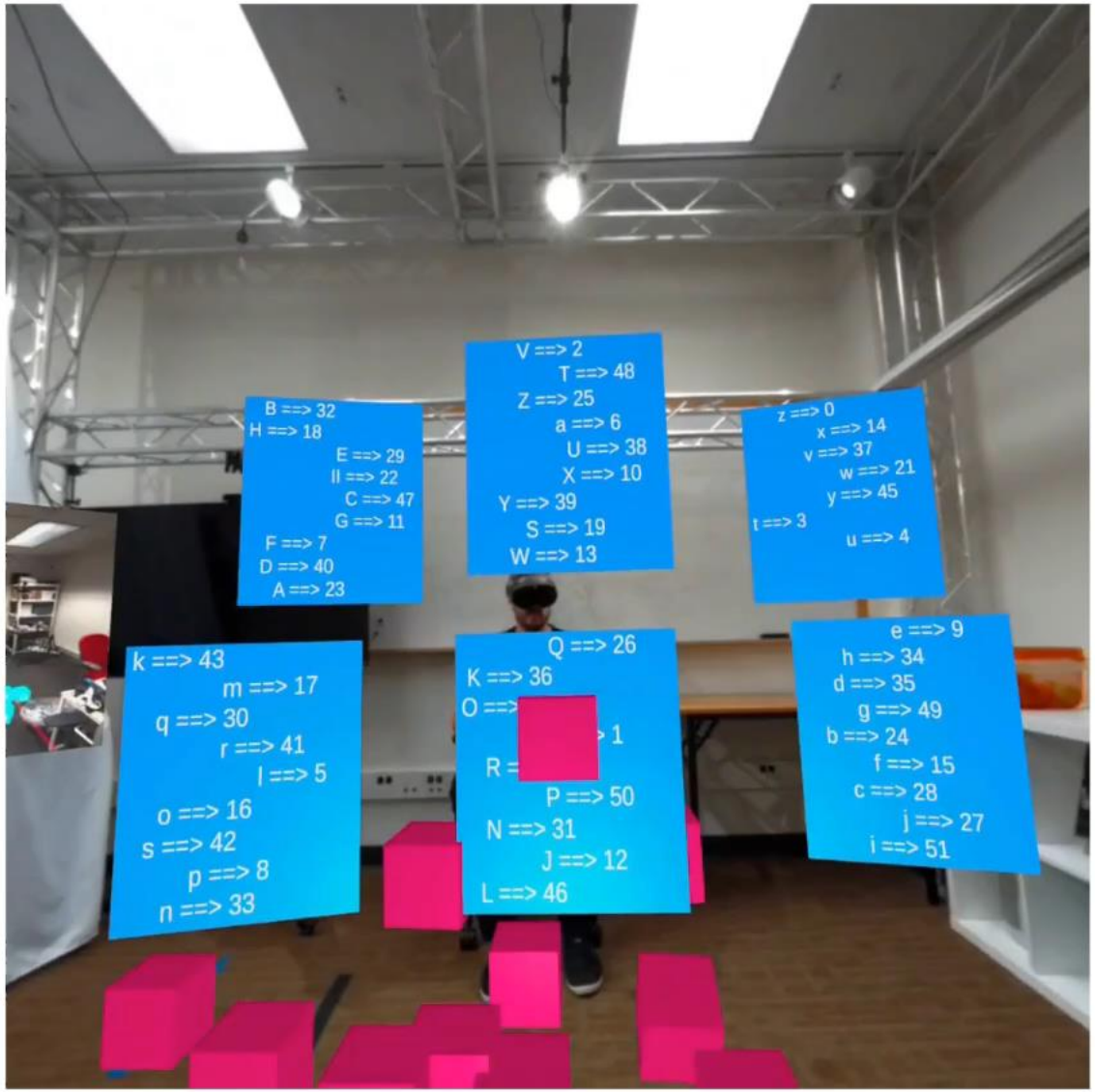
(1) **None**:

Personal interfaces of **searcher** are **not** displayed to **sorter**

Sorter



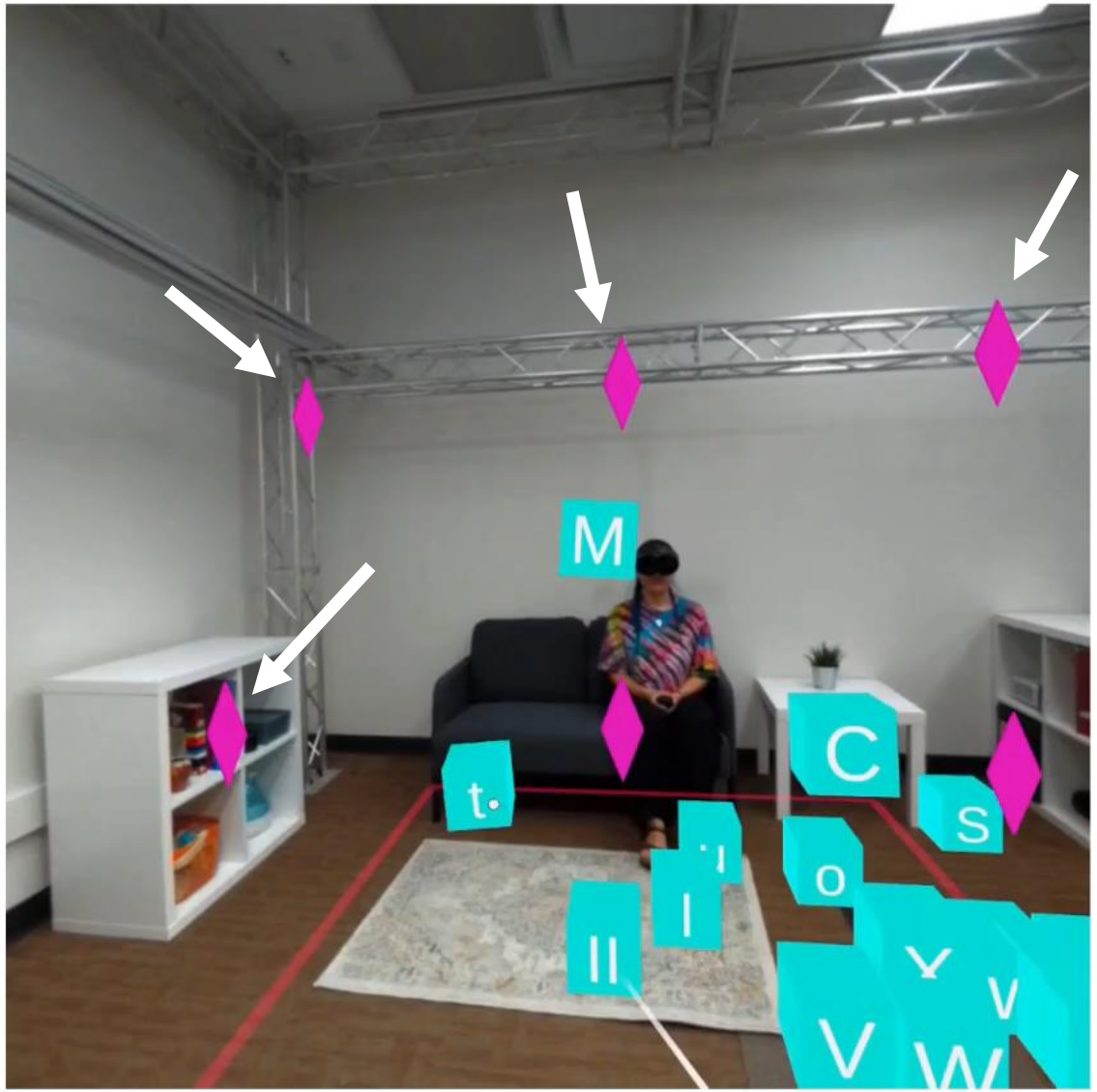
Searcher



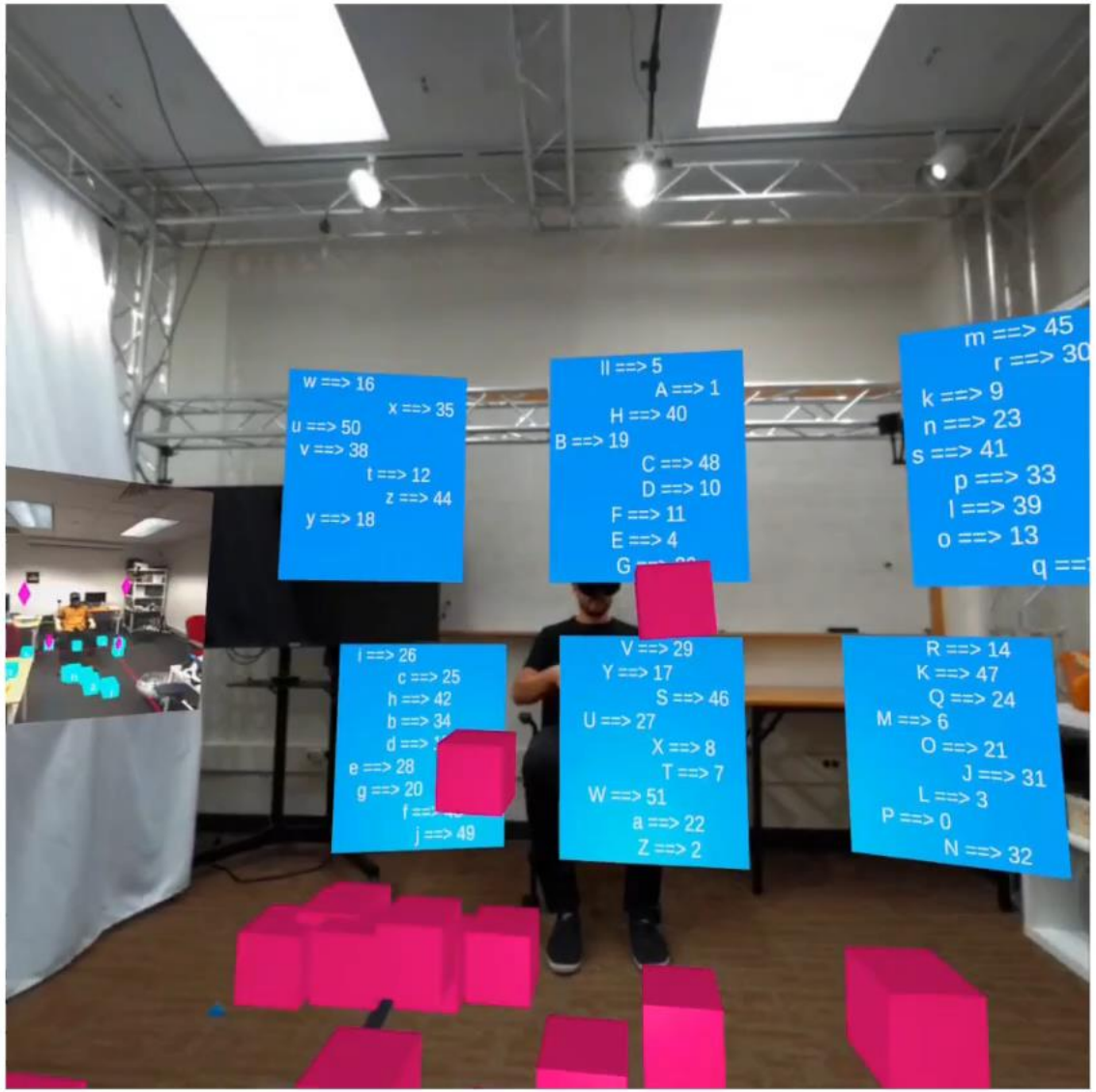
(2) **Gems**:

Personal interfaces of **searcher** are displayed to **sorter** as **gems**

Sorter



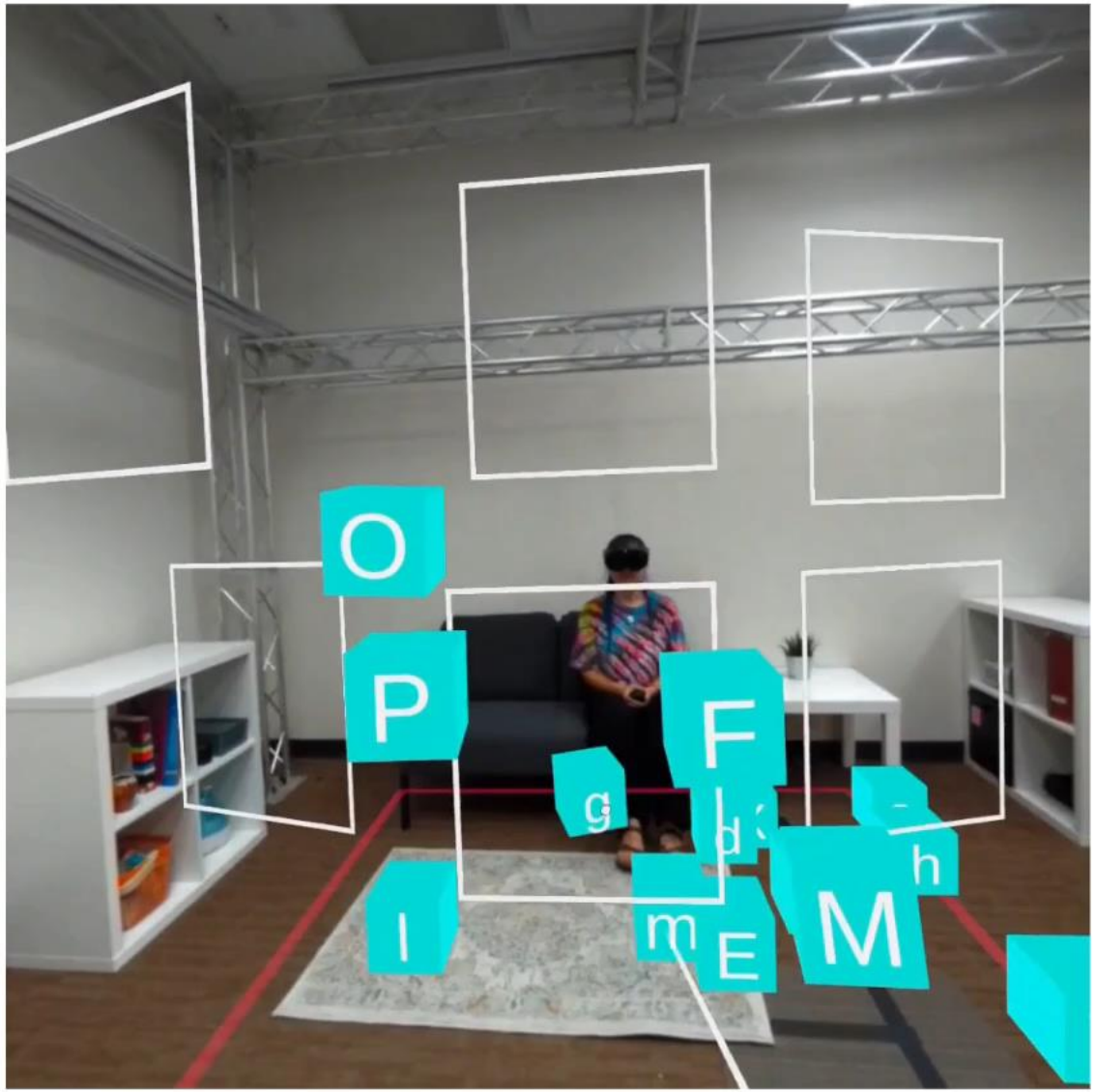
Searcher



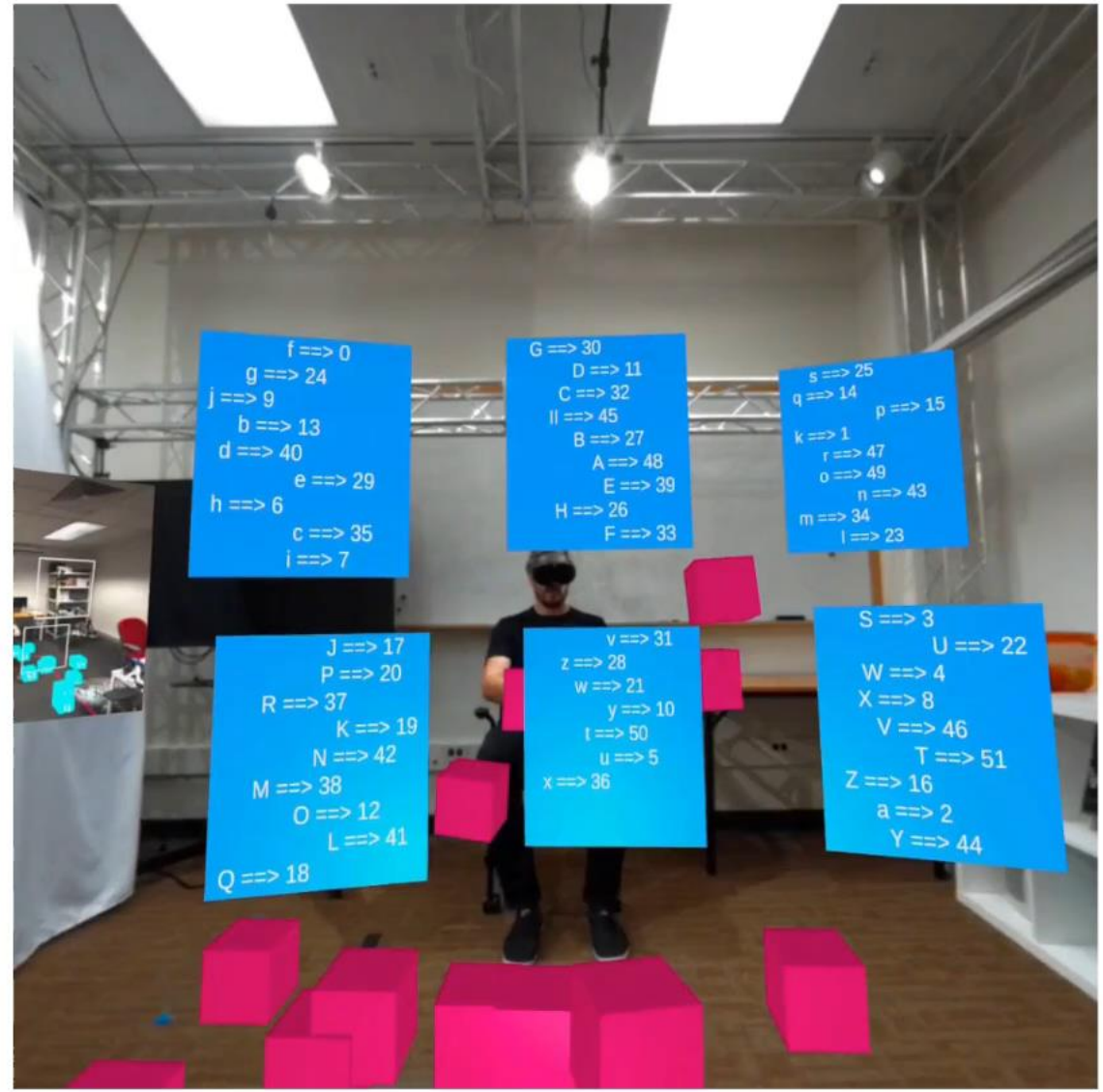
(3) **Wireframes**:

Personal interfaces of **searcher** are displayed to **sorter** as **outlines**

Sorter



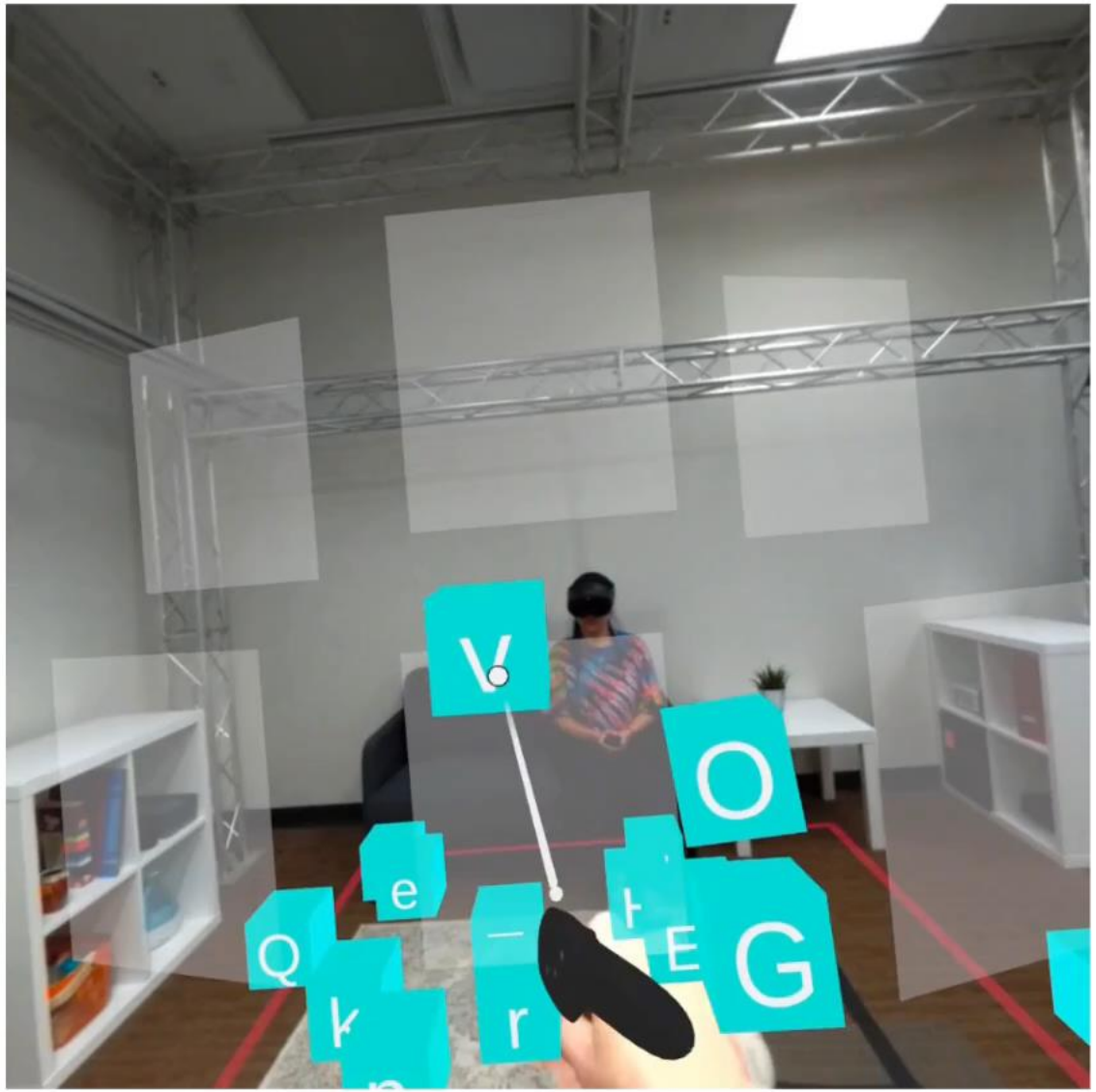
Searcher



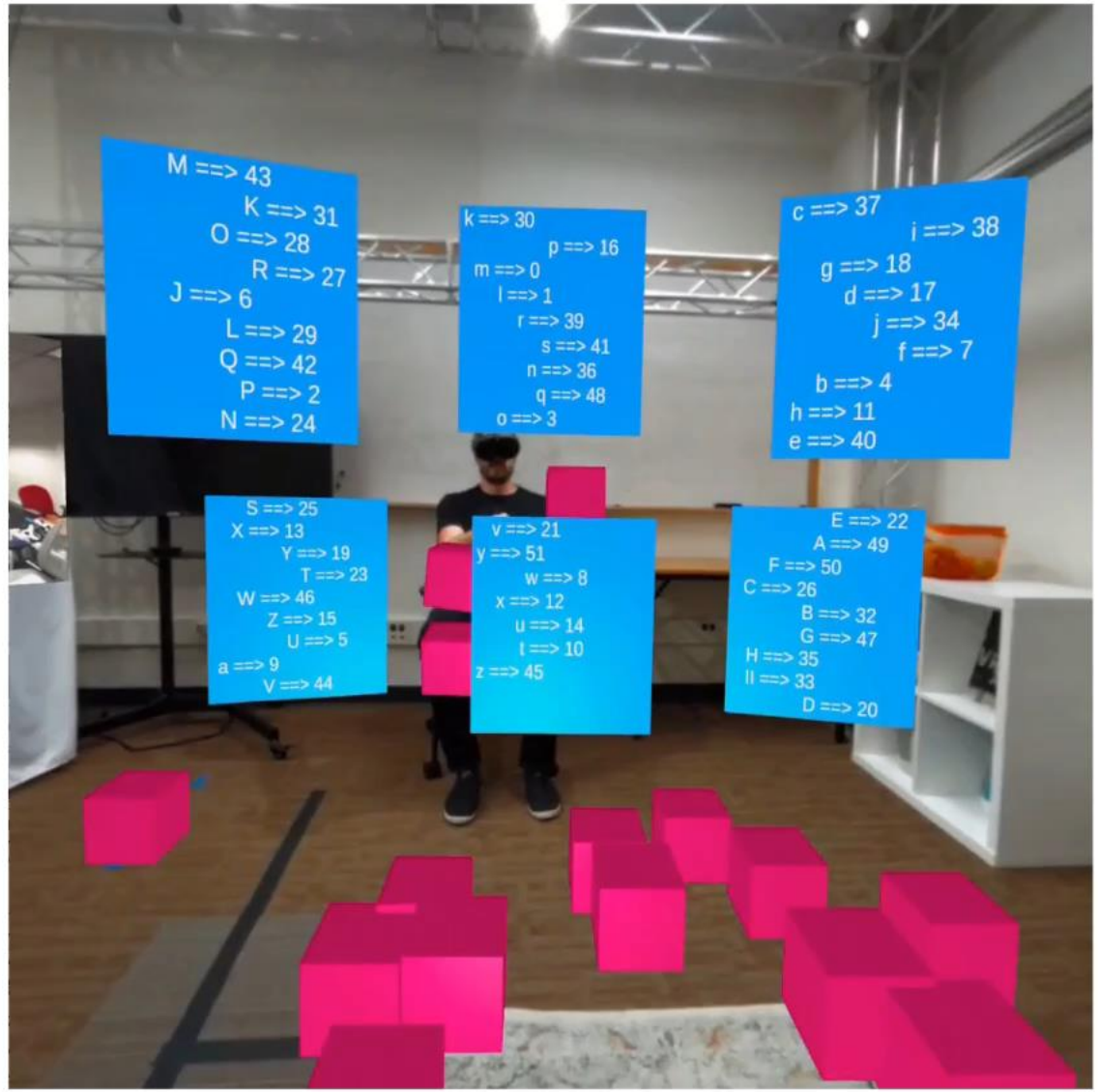
(4) **Ghosts**:

Personal interfaces of **searcher** are displayed to **sorter** as **semi-transparent** objects

Sorter



Searcher



User Study

- N = 32 (16 dyads, 21 male, 11 female)

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- Within-subjects, but fixed order

User Study

- N = 32 (16 dyads, 21 male, 11 female)
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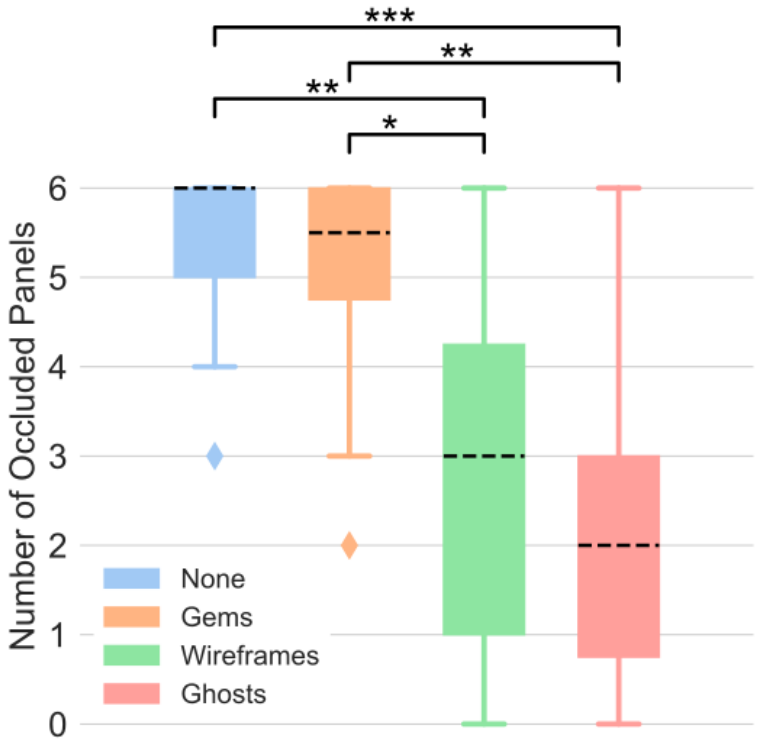
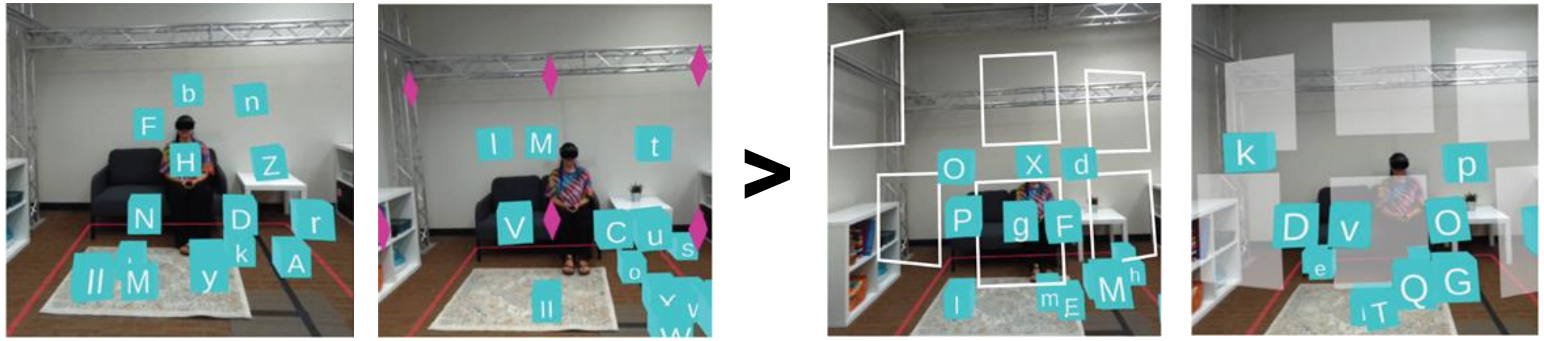
- Metrics:
  1. Occlusion
  2. User perceptions

Results

Occlusion - Objective Measures

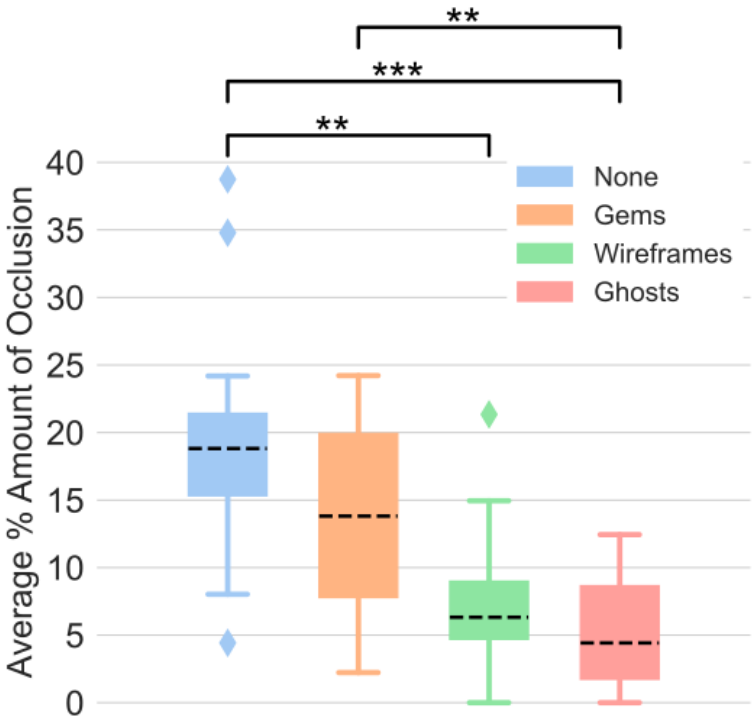


Wireframes and Ghosts had fewer number of panels occluded

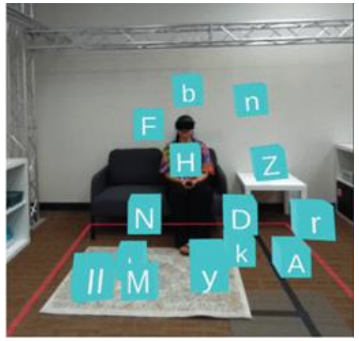


None *Gems* > *Wireframes* *Ghosts*

Occlusion - Objective Measures



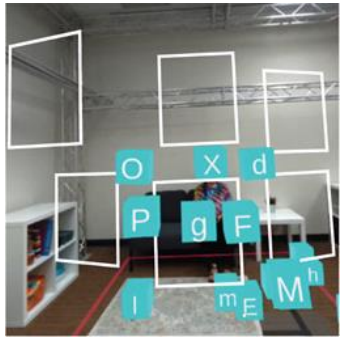
Wireframes and Ghosts had less amount of occlusion



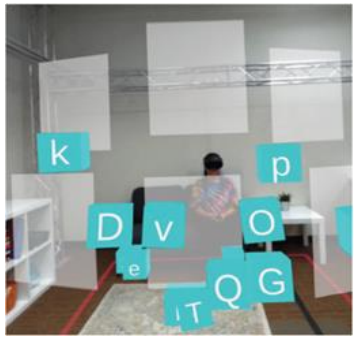
None

Gems

>

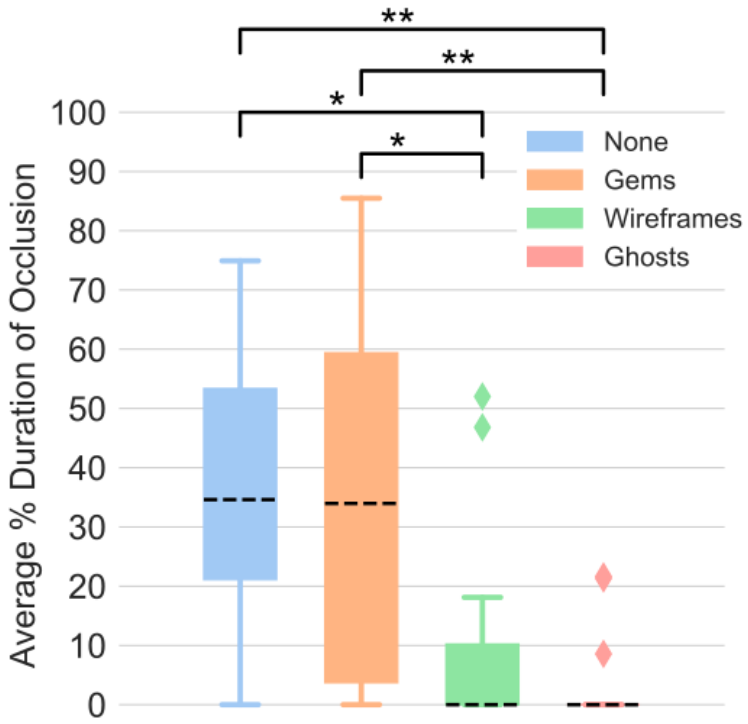


Wireframes

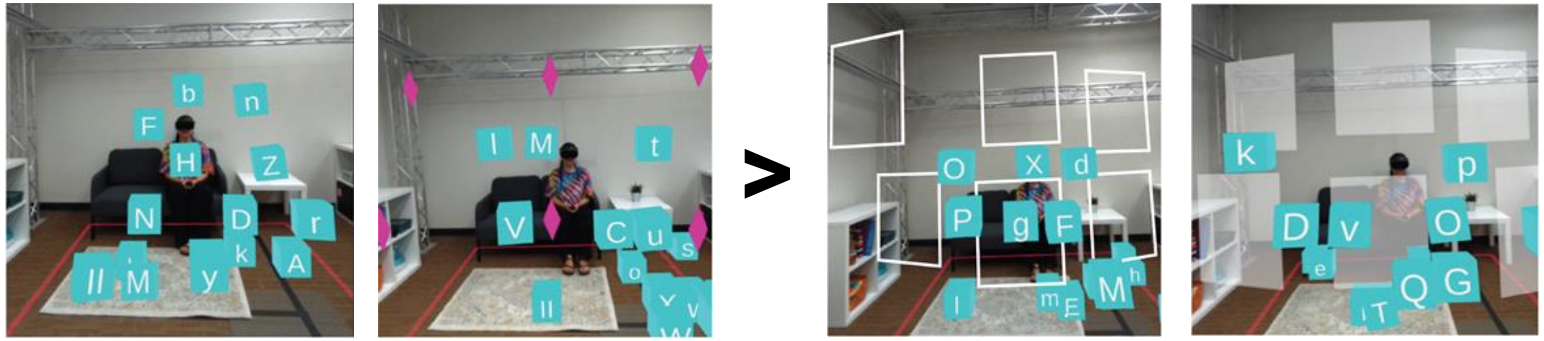


Ghosts

Occlusion - Objective Measures

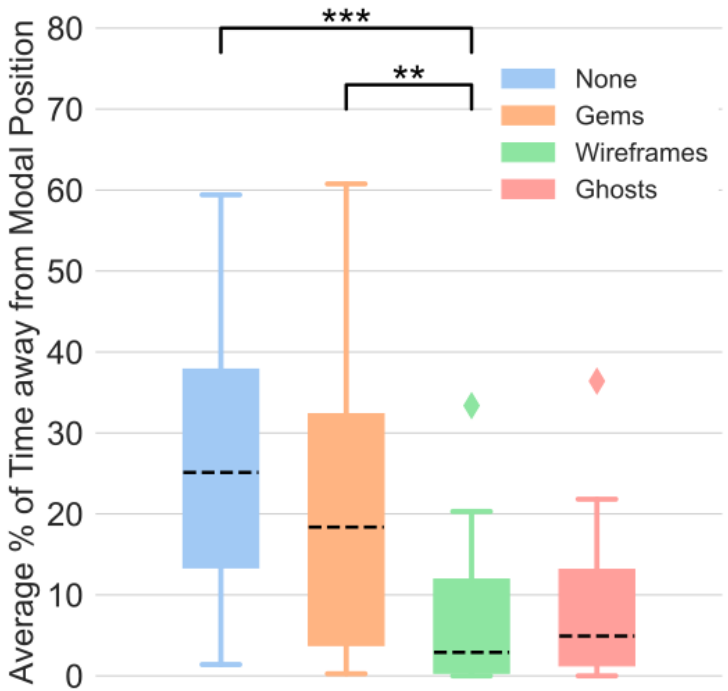


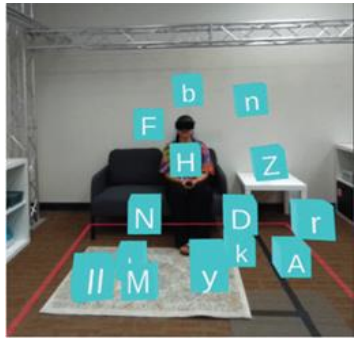
Wireframes and Ghosts had less occlusion time



None *Gems* > *Wireframes* *Ghosts*

Occlusion – Proxy Measures





None

Gems

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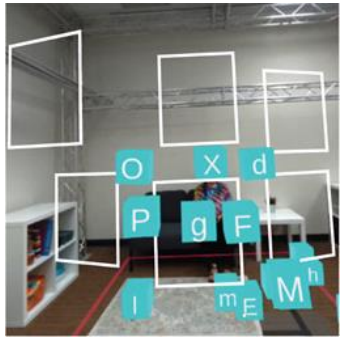
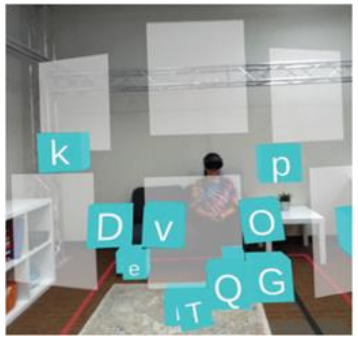


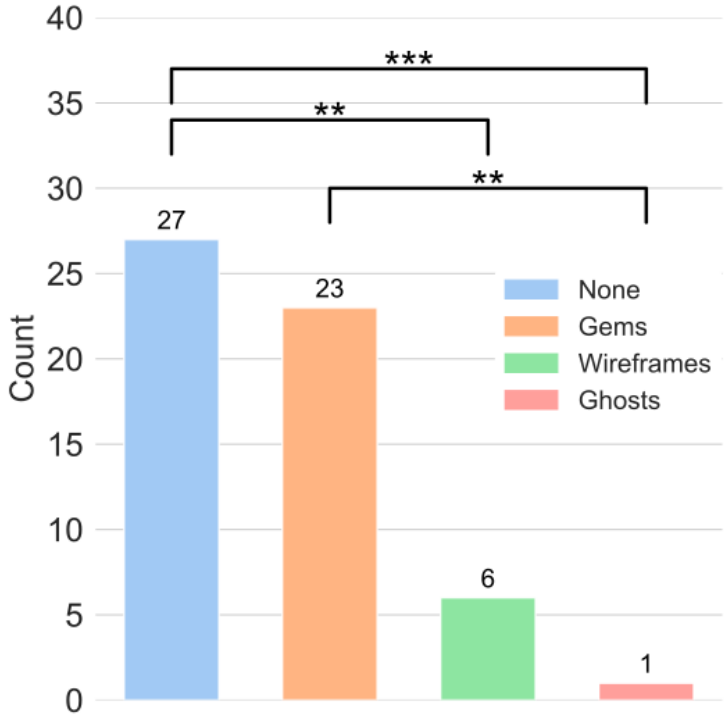
Wireframes

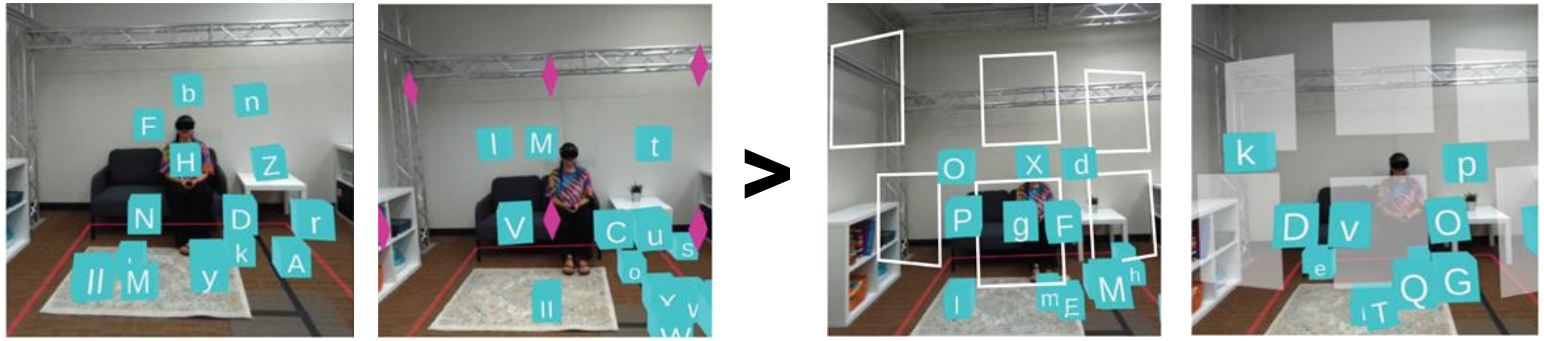


Ghosts

Wireframes result in fewer occlusion-related head movements

Occlusion – Proxy Measures





None *Gems* *Wireframes* *Ghosts*

Wireframes and Ghosts had fewer occlusion related verbal references

Implications & Discussion

Design Implications

- Mere knowledge of existence is not sufficient

  shape and size must be conveyed

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- Perspective Taking

  “he kept putting them [cubes] in front of them [panels] still. Like he couldn’t tell he was pushing too far forward”

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Fostering **awareness of personal interfaces** using visualizations results in **fewer virtual-virtual conflicts** and improved collaboration,
with more holistic visualizations proving to be more effective

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