Making Mobile Augmented Reality Applications Accessible

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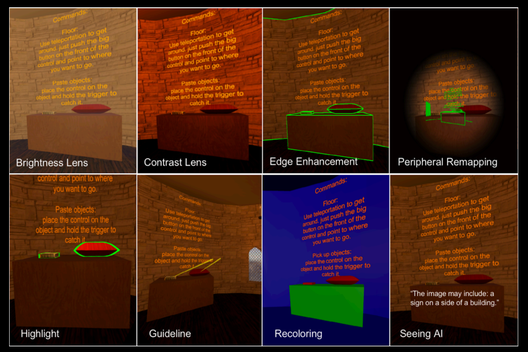
IKEA Place

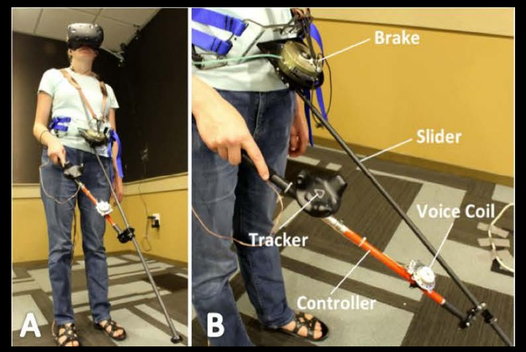
Statue of Liberty

Background

VR Accessibility



SeeingVR
(Zhao et al., CHI 2019)



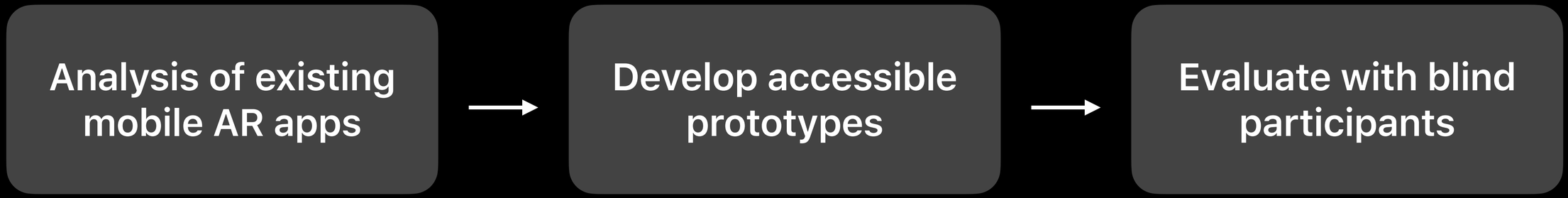
Canetroller
(Zhao et al., CHI 2018)

AR as an Assistive Tool

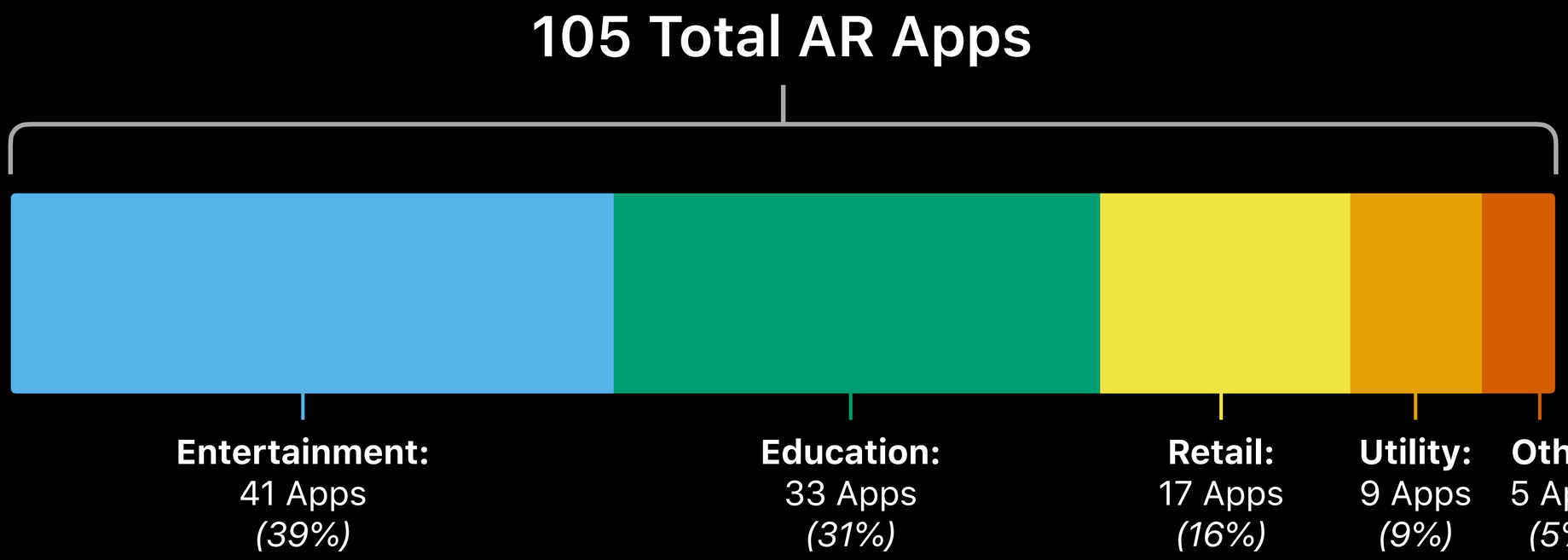
VizLens
(Guo et al., UIST 2016)

NavCog3
(Sato et al., ASSETS 2017)

Making Augmented Reality Apps Accessible

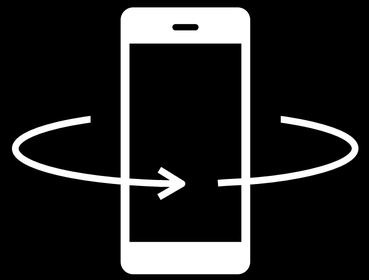


Analysis of Existing iOS Mobile AR Apps



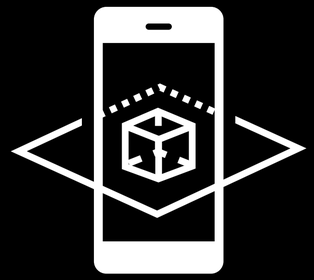
Design Space of AR Interactions

Establishing Physical / Virtual Correspondence



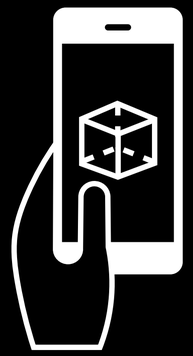
Ex: Scanning the environment to establish tracking

Creating Virtual Content

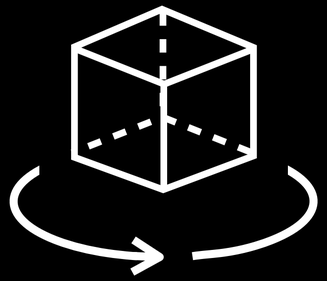


Ex: Placing a virtual object on a physical surface

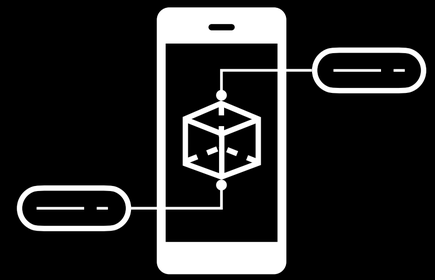
Observing AR Content



Transforming Virtual Content



Activating Virtual Content

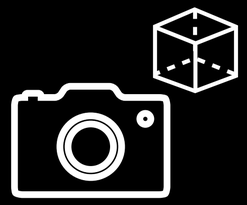


Prototyping Accessible Alternatives

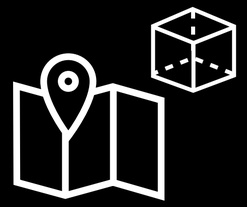
Establishing Physical / Virtual Correspondence

Scanning

Creating Virtual Content

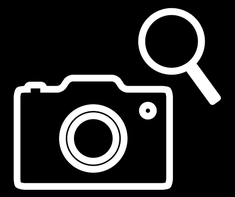


Camera-based Placement



Guided Placement

Observing AR Content



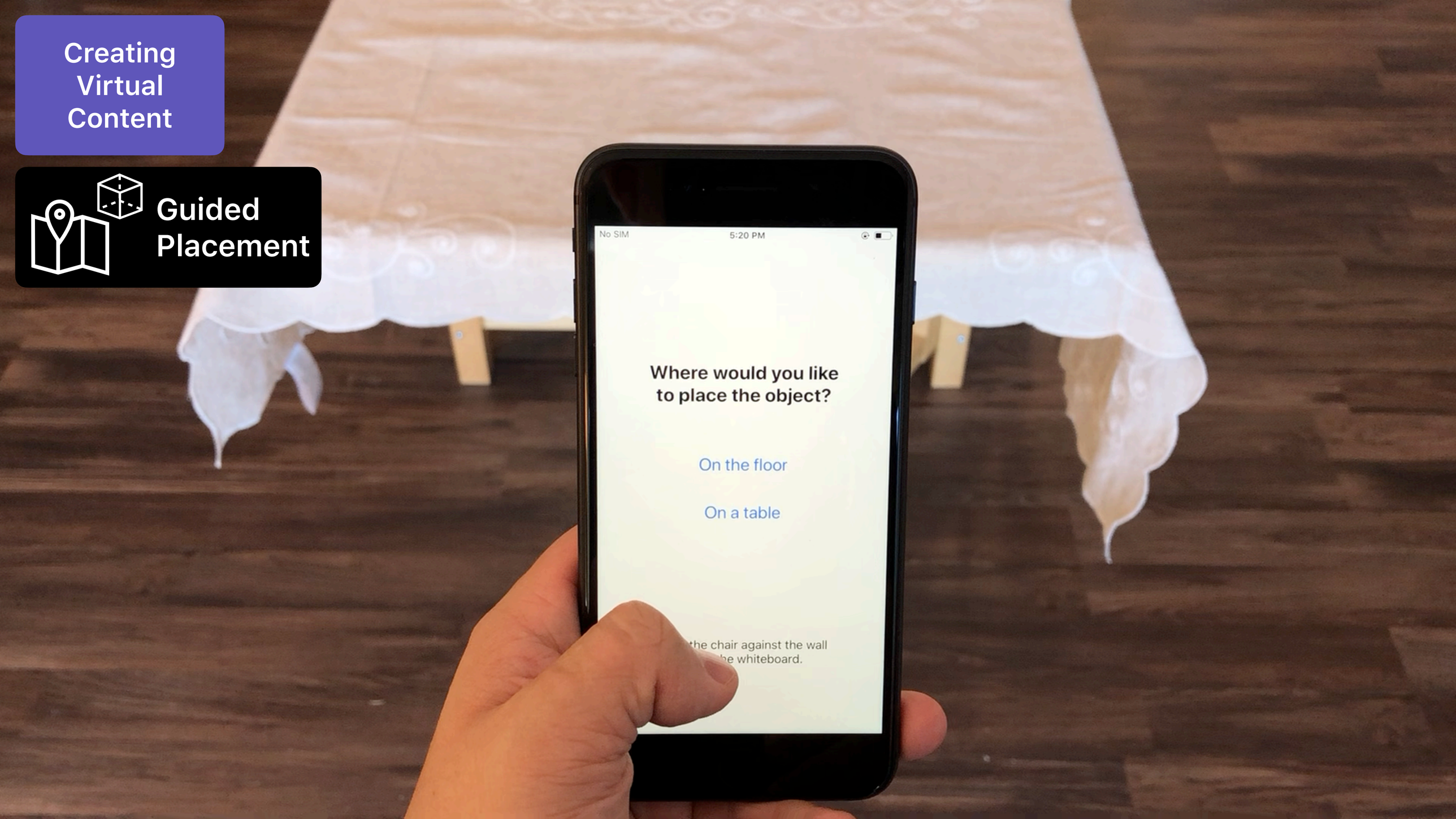
Camera-based Search

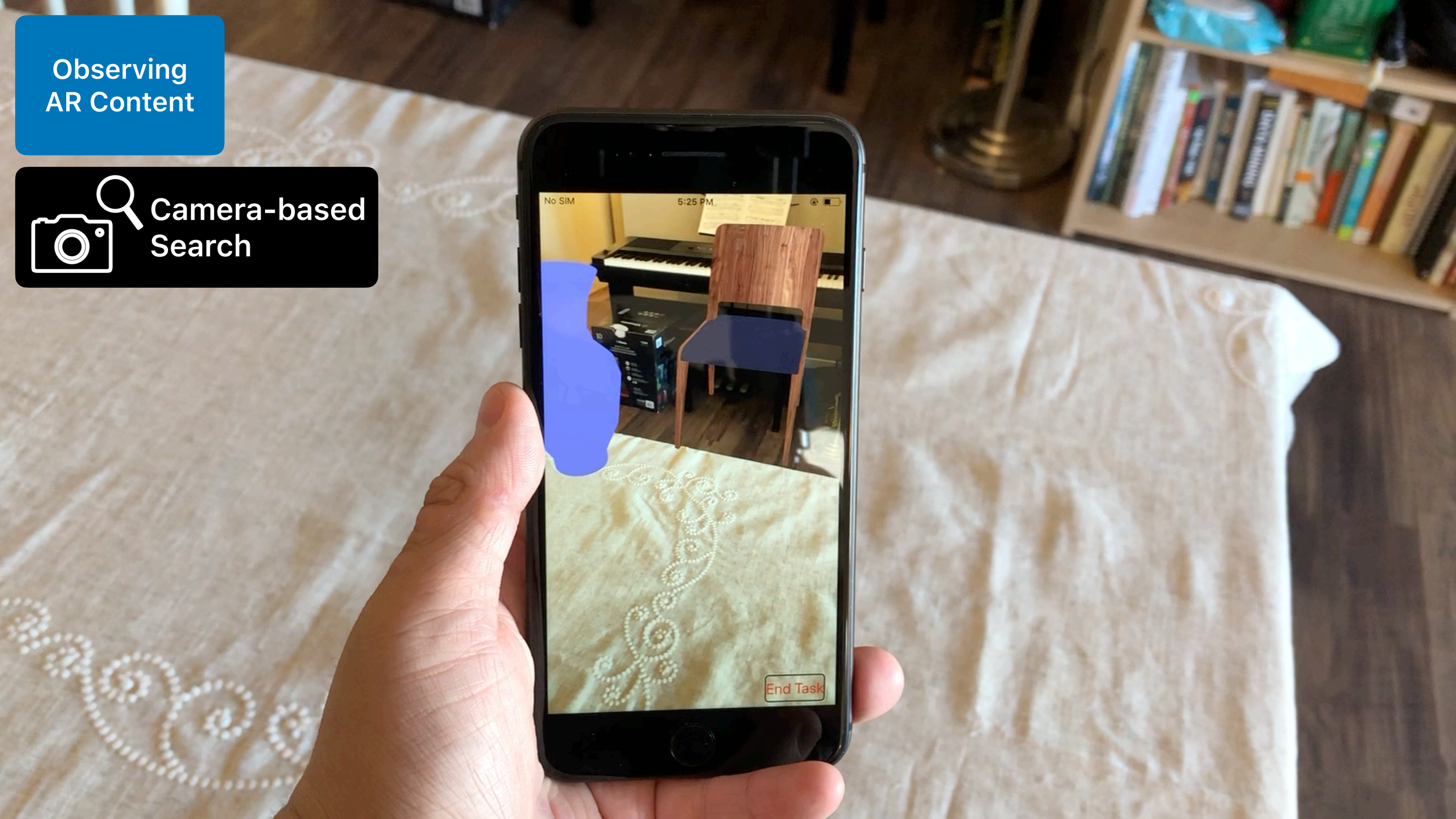
Guided Search

Establishing Physical / Virtual Correspondence
Scanning
Walk around the room and slowly pan the camera to scan.
End Task

Creating Virtual Content

Camera-based Placement

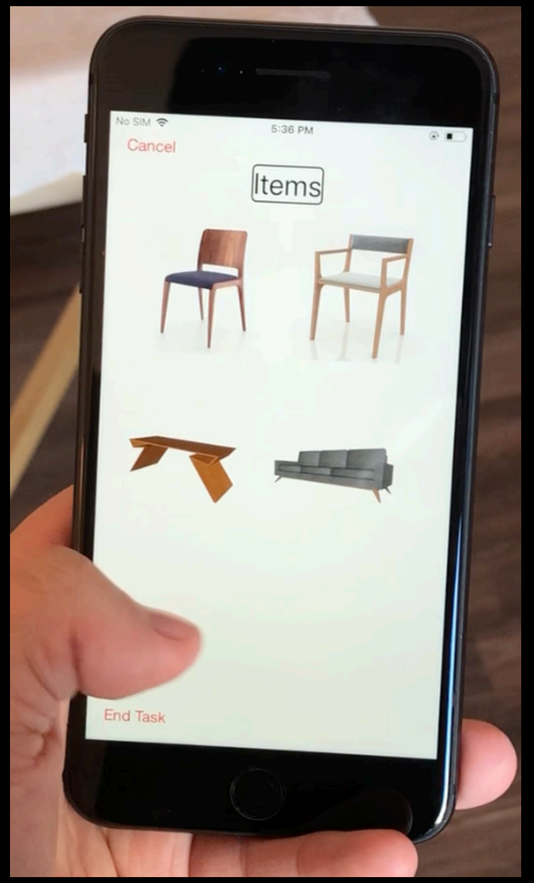

Creating Virtual Content
Guided Placement
No SIM
5:20 PM
Where would you like to place the object?
On the floor
On a table
the chair against the wall
he whiteboard.

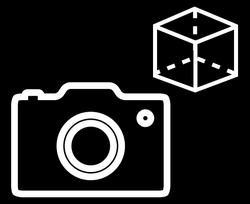

Observing
AR Content
Camera-based
Search
No SIM
5:25 PM
End Task

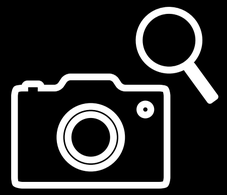
Observing
AR Content
Guided
Search
No SIM
5:27 PM
Objects
Grey chair
Pink vase
Black chair

Accessible AR Experiences

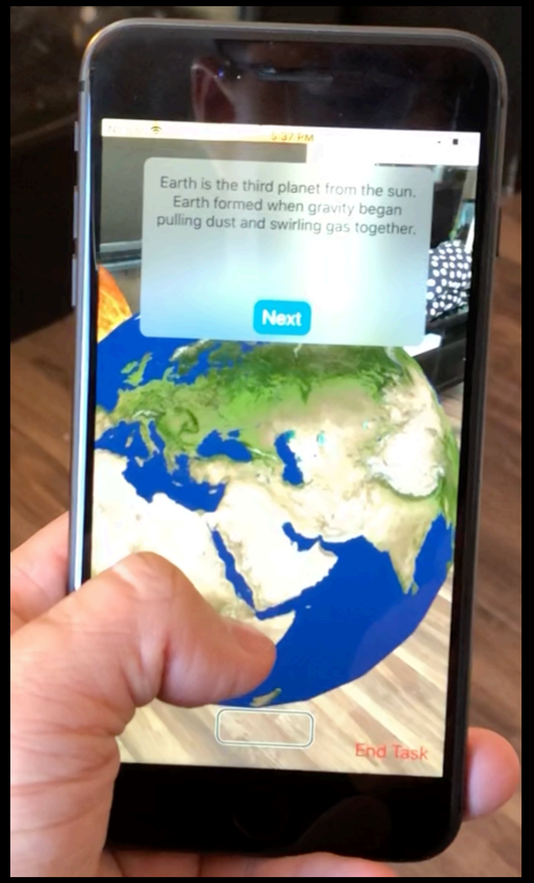
Furniture App

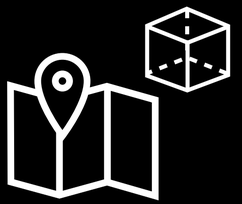


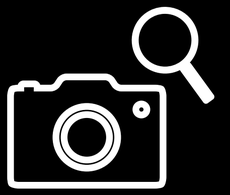




Solar System App







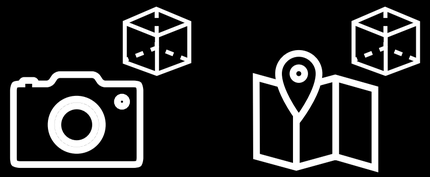
Evaluation

User study with 10 participants (8 completely blind, 2 low vision)

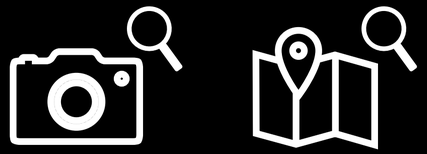
Component Tasks

Scanning Task

Object Placement Task

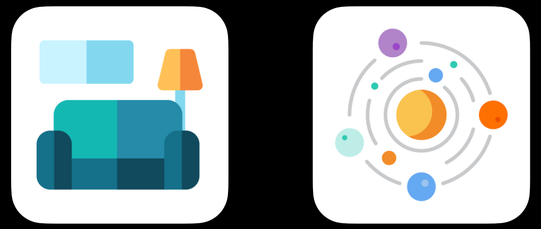


Object Search Task

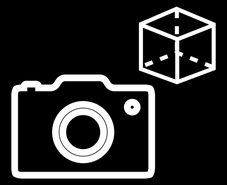


Full Apps

Open-Ended Use



Results



Camera-based Placement

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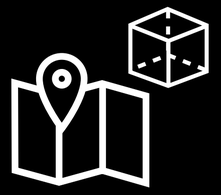

Guided Placement

Camera-based Search

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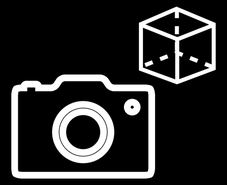
Guided Search

Results



Camera-based Placement

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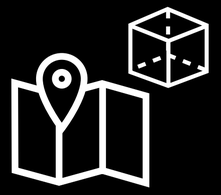

Guided Placement

Camera-based Search

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Guided Search

Results

We need to:

- Provide continuous and meaningful feedback
- Mix virtual and physical descriptions
    - Guidance relative to physical landmarks
    - Safety in navigation
    - Better descriptions of content

Limitations and Future Work

- Involve visually impaired people in the design process
- Other modalities: spatial audio, haptics
- Advance semantic understanding of scene

Key Takeaways

- AR can be made accessible to blind users
- Provide continuous and meaningful feedback
- Mix virtual and physical descriptions

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