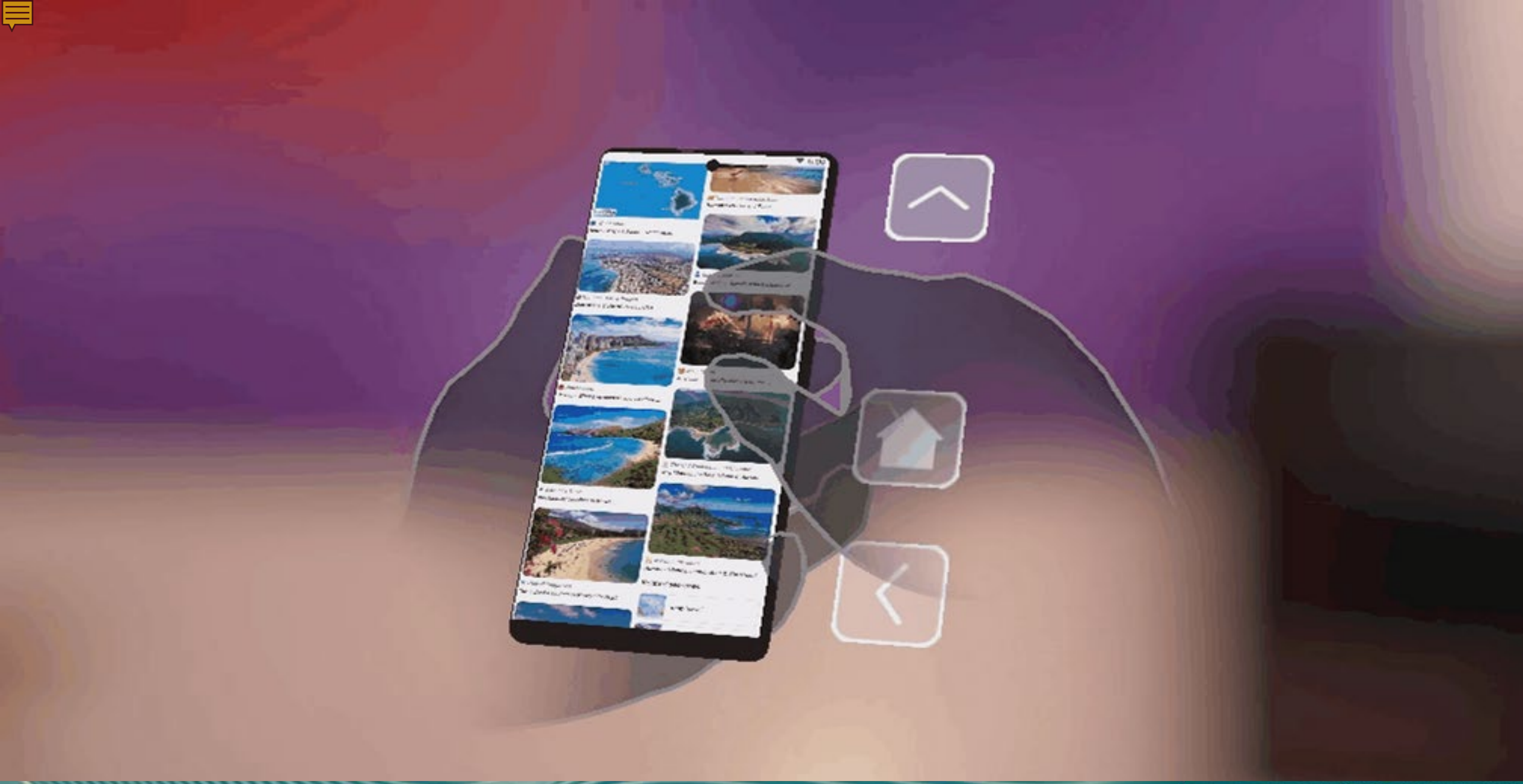
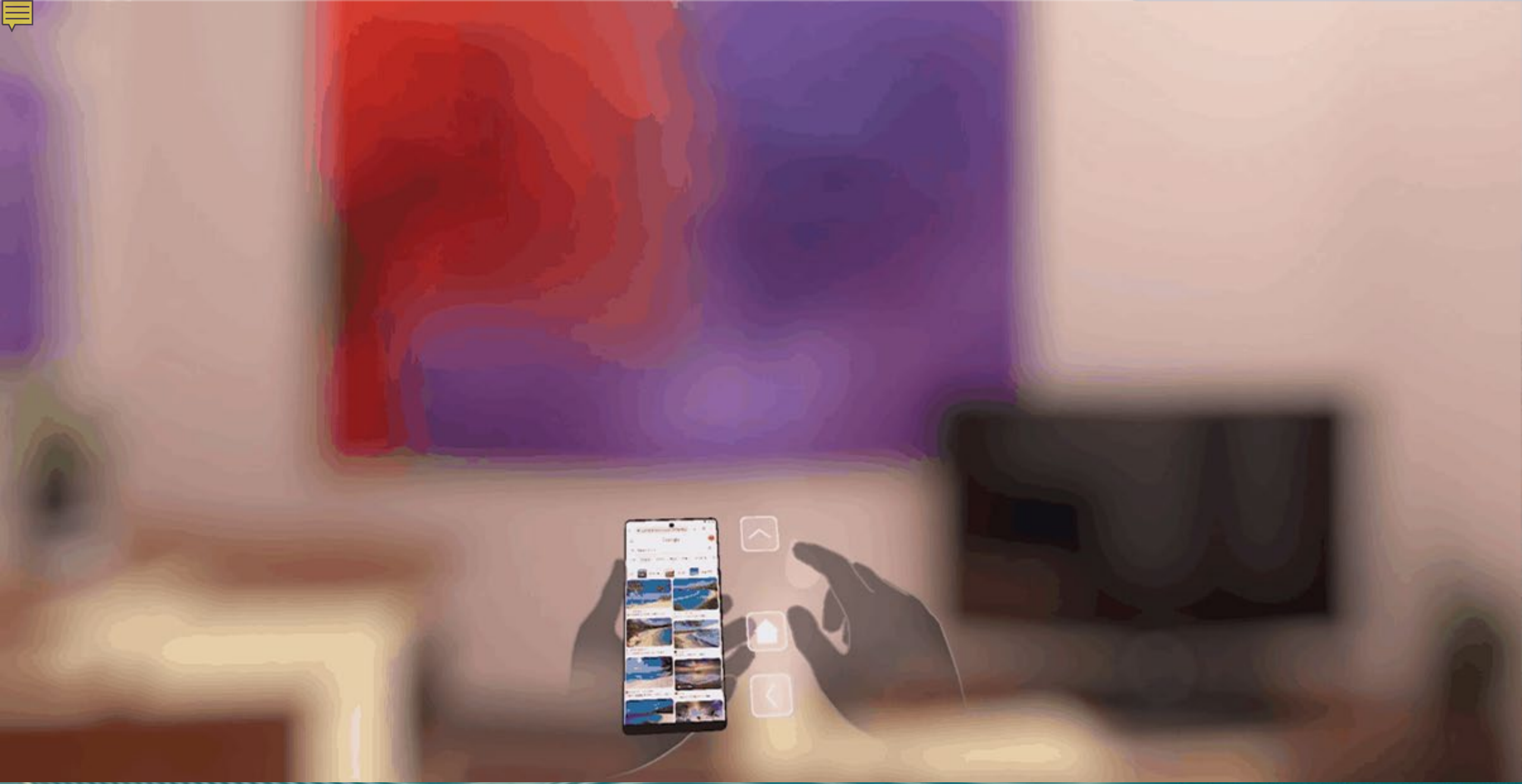
Beyond the Phone

Exploring Phone-XR Integration through Multi-View Transitions for Real-World Applications

Fengyuan Zhu, Xun Qian, Daniel Kalmar, Mahdi Tayarani, Eric J. Gonzalez, Mar Gonzalez-Franco, David Kim, Ruofei Du

THE 32nd IEEE CONFERENCE ON VIRTUAL REALITY AND 3D USER INTERFACES



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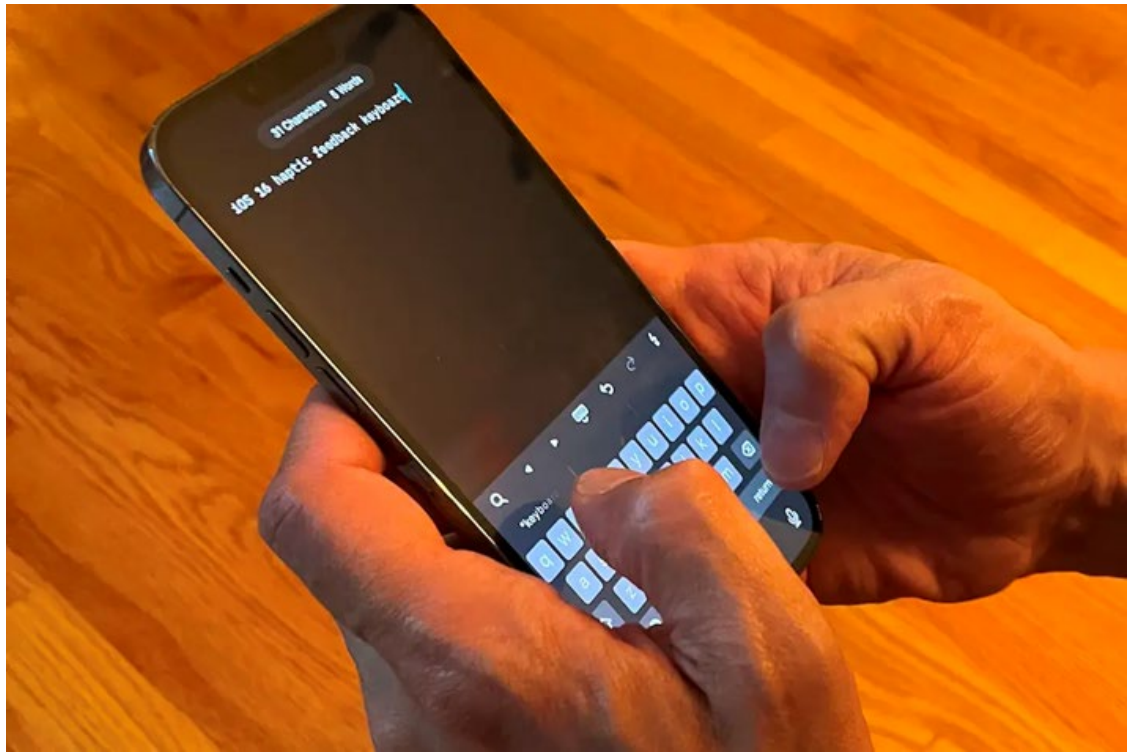
Motivation

The Integration of Personal Devices and XR

Smartphone Advantages

External electronic organ

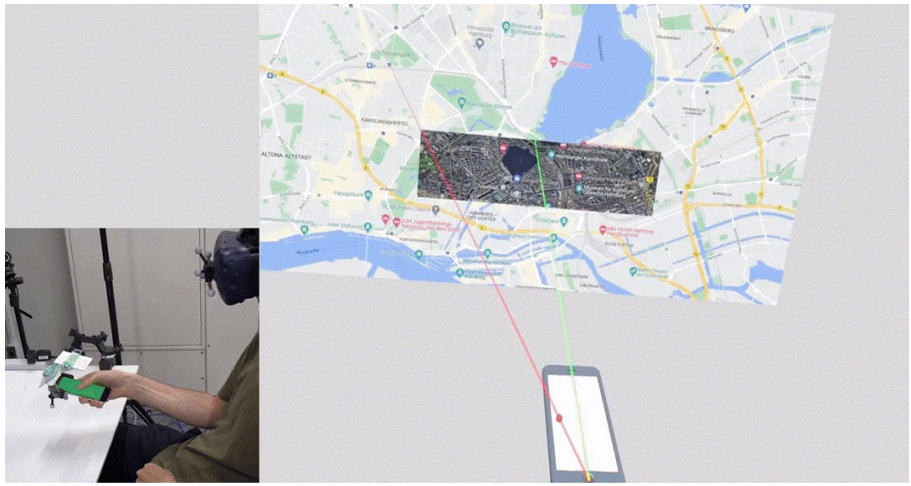
Haptic & precise input



Related works

PhoneTroller CHI 2021

AboveScreen CHI 2024



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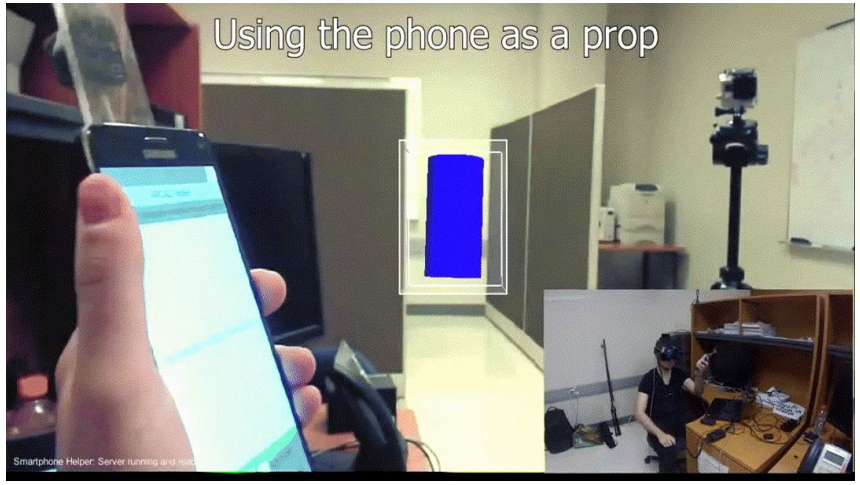

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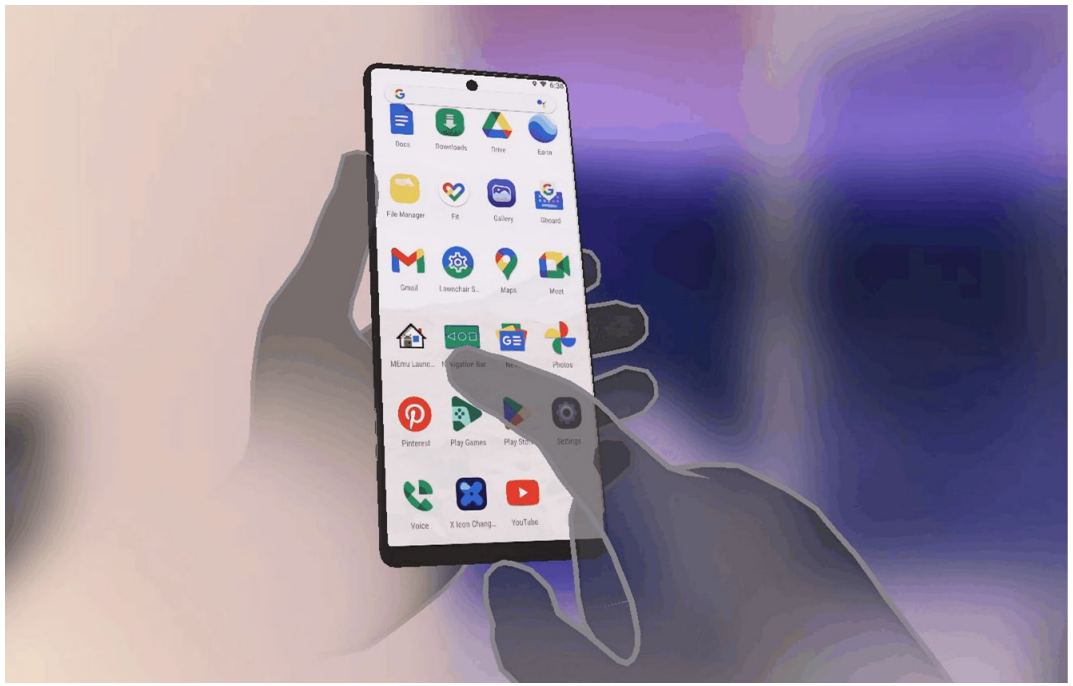
Common Strategies for Phone-XR Integration

Video See-Through (VST)

Phone Mirroring



Issues of Smartphones in XR:

1. Usability issue
2. Unclear setups
3. Mock-up vs real-world applications

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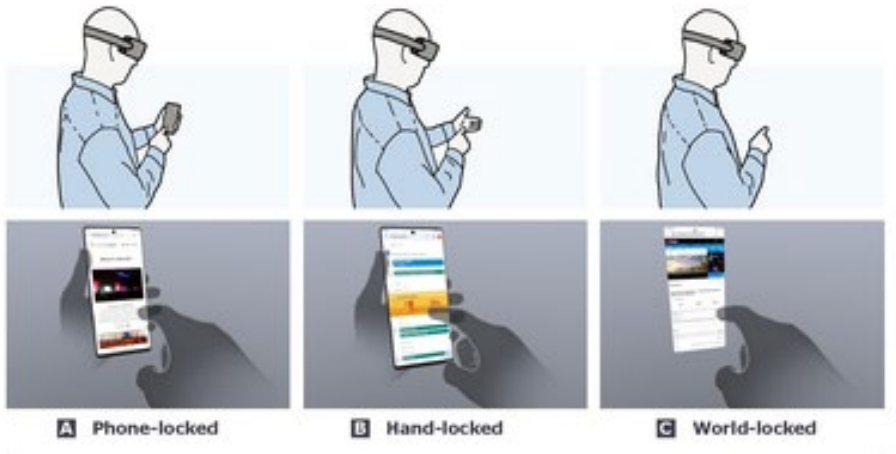

PhoneInVR CHI 2024

Issues of Smartphones in XR:

1. Usability issue
2. Unclear setups
3. Mock-ups vs real-world applications

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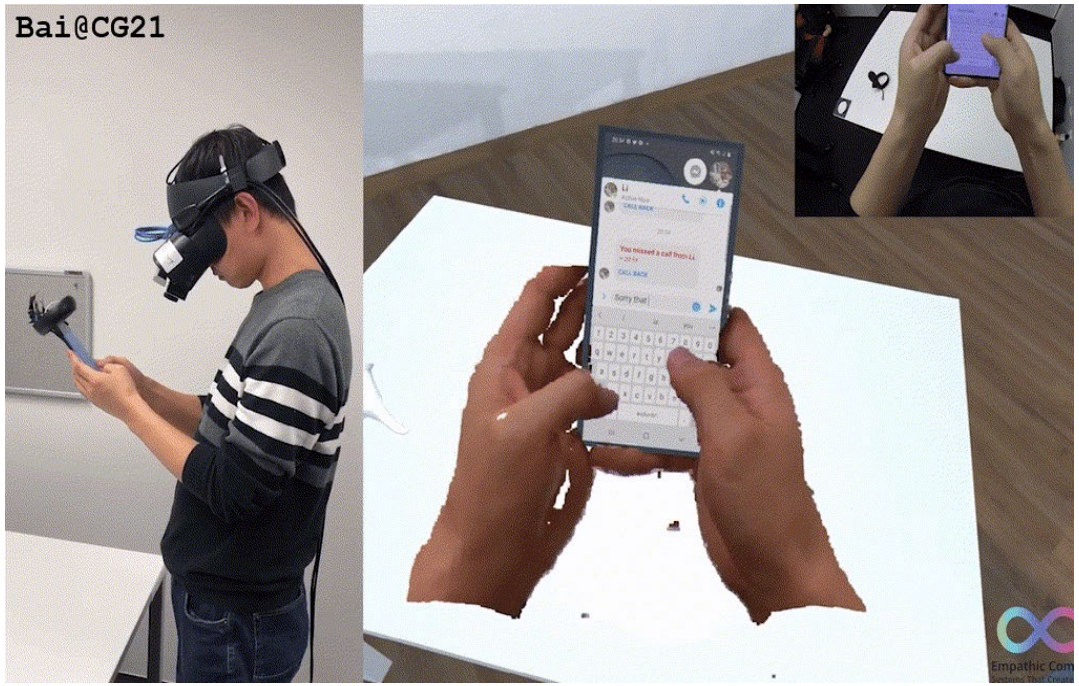
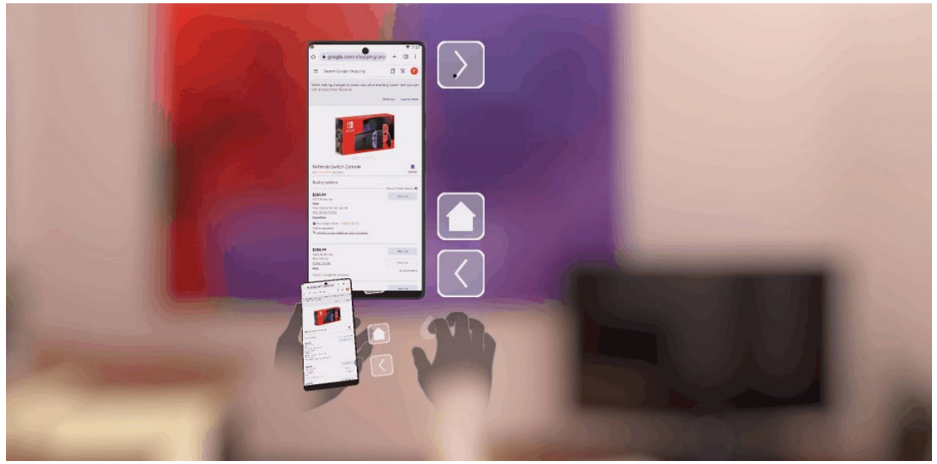
It’s time to reshape the Phone + XR

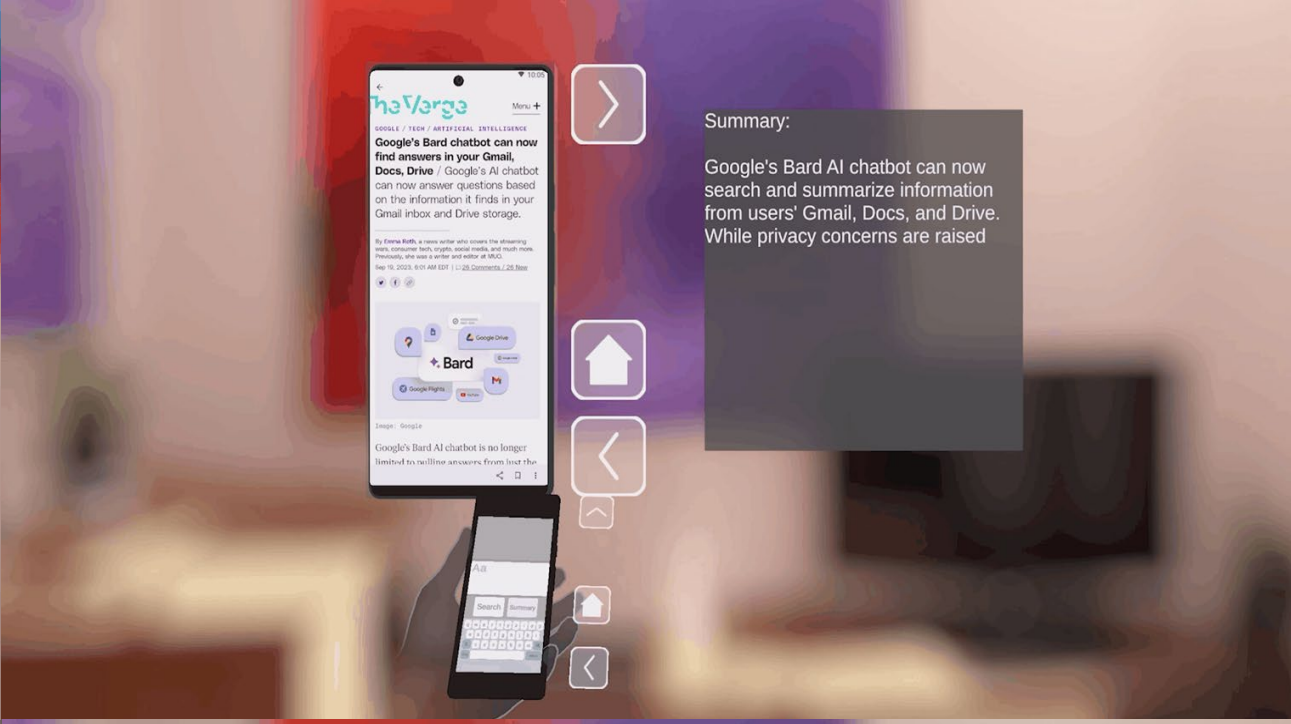
- How can we enhance usability and readability with proper view setups



It’s time to reshape the Phone + XR

- Framework for real world applications
  - Generalizable and adaptable, won’t reinventing the wheel for each app
  - Intermediate states for transition
  - Between mirroring and XR alternative
  - Controller mode should not overwrite the real app interface





Summary:

Google's Bard AI chatbot can now search and summarize information from users' Gmail, Docs, and Drive. While privacy concerns are raised

Design Process

Expert Workshop

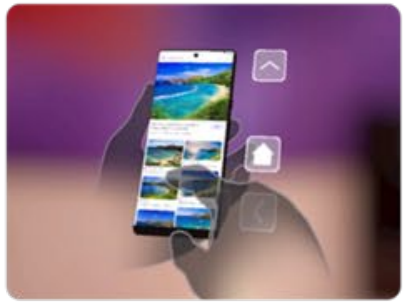
Picking representative applications

1. Exploring potential enhancements could be applied and interactions

2. Considering interfaces and transitions between different states

Application	Example	Pain Points on Phones	Content Visualization	Phone Interaction
Web Browsing	Wikipedia	• Text readability • Screen size	• Expanded displays • Focused reading and summarization modes	• Touchpad (tap & multitouch) • Context dependent menus
Collaborative Work	Google Docs	• Inconsistent layouts • Editing challenges	• Multiple panels for drafting, editing, revising, etc.	• Keyboard (typing) • Touchscreen for markups
Photo Browsing	Google Photos	• Screen size	• Immersive gallery • Panoramic views	• Spatial (raycast) • Editing palette
Video Watching	YouTube	• Screen size • Environment distractions	• Immersive cinema view • Extended device screen	• Intuitive video scrubbing
Shopping	Amazon	• Lack of 3D and in-situ visualizations	• 3D in-home gallery view • Color/style palette	• Spatial (placement & manipulation)
Communication	FaceTime	• Limited embodiment • Transcription & augmentation	• 3D avatar views • Summarization views	• Keyboard (typing)
Navigation	Google Maps	• Lack of 3D visualization • Screen size	• 3D Overlays • Earth view	• Touchpad (tap & multitouch) • Context dependent menus
Social Media	Twitter	• Text readability • Screen size	• Embodied content • Immersive videos	• Keyboard (typing)

Display Enhancements



Mirrored View

Magnified View

Augmented Views

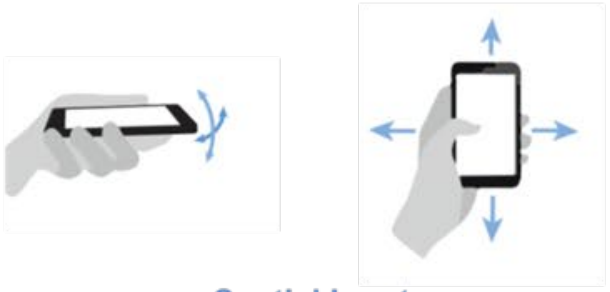
Phone Interfaces

Mirrored Interface

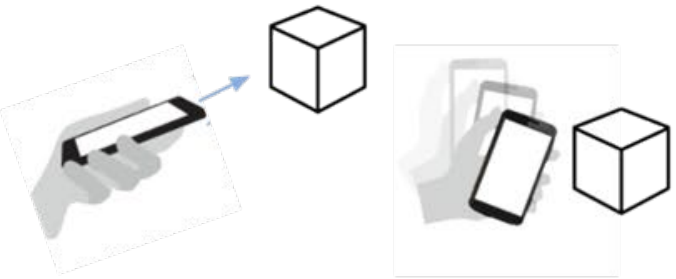
Tailored Interface

Interactions

Touch Input

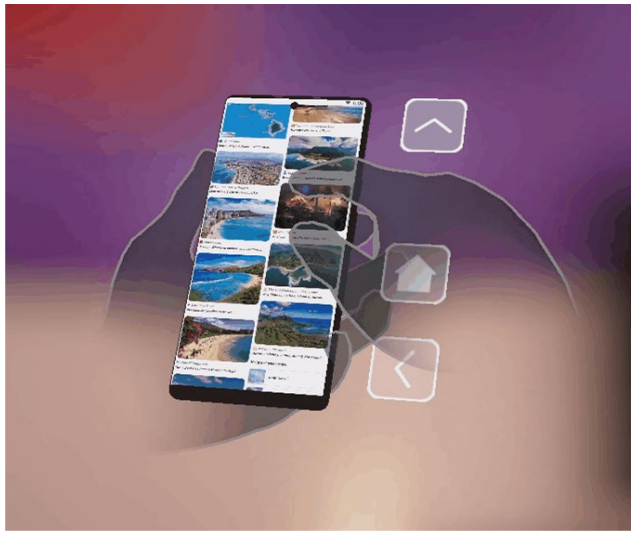


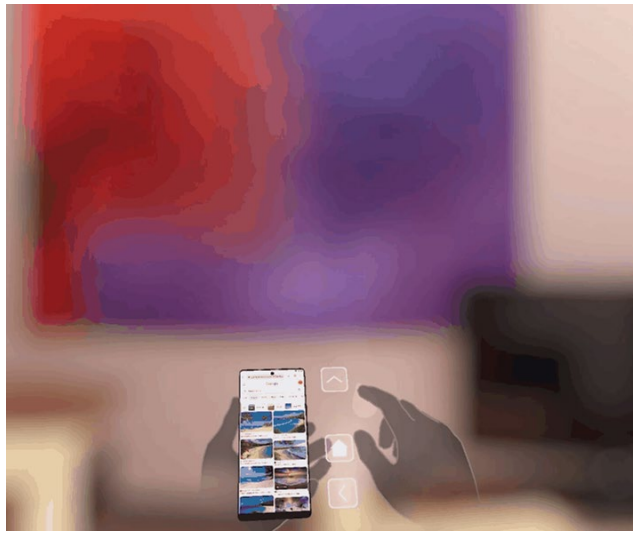
Spatial Input

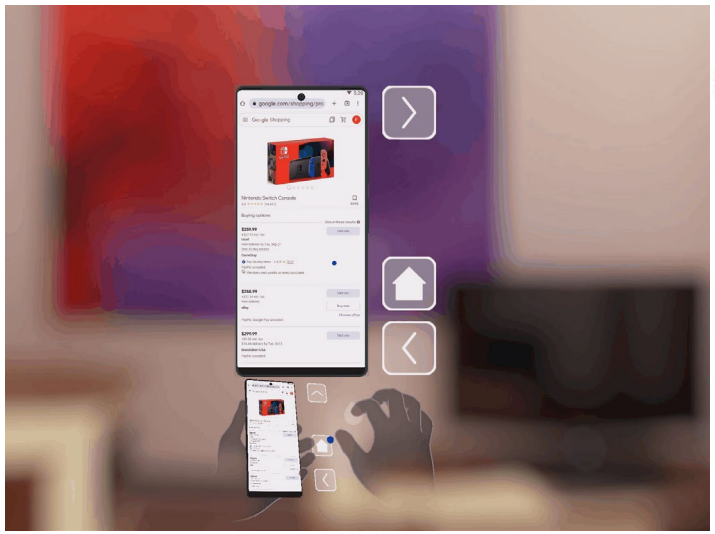


Spatial Relations

Display Enhancements

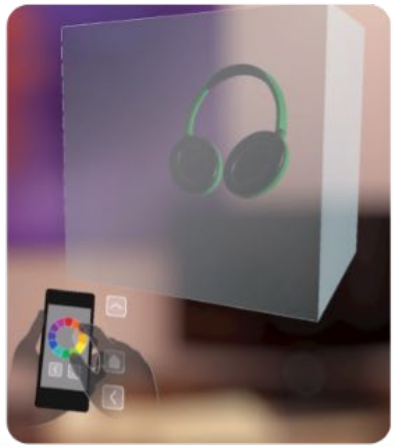




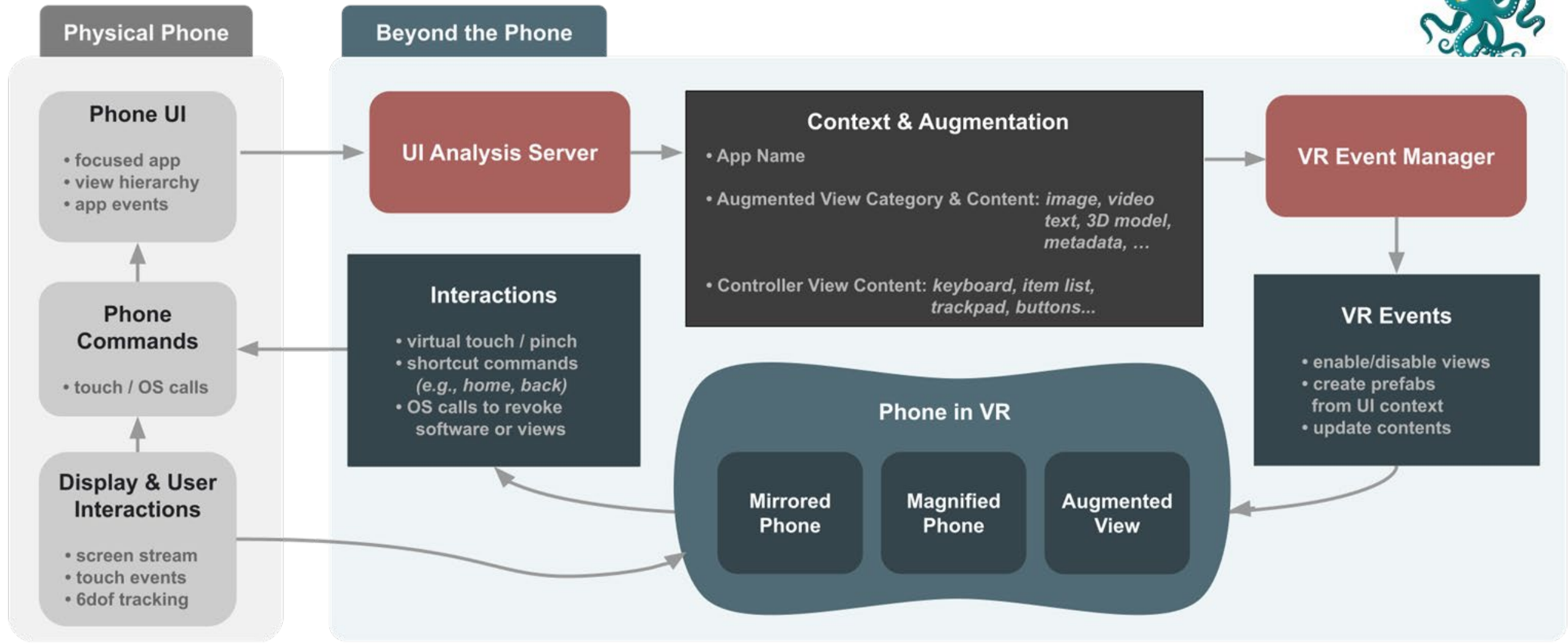


Augmented Views

Phone Interfaces



Implementations


Physical Phone
Beyond the Phone
Phone UI
• focused app
• view hierarchy
• app events
Phone Commands
• touch / OS calls
Display & User Interactions
• screen stream
• touch events
• 6dof tracking
UI Analysis Server
Context & Augmentation
• App Name
• Augmented View Category & Content: image, video text, 3D model, metadata, …
• Controller View Content: keyboard, item list, trackpad, buttons...
VR Event Manager
Interactions
• virtual touch / pinch
• shortcut commands (e.g., home, back)
• OS calls to revoke software or views
VR Events
• enable/disable views
• create prefabs from UI context
• update contents
Phone in VR
Mirrored Phone
Magnified Phone
Augmented View

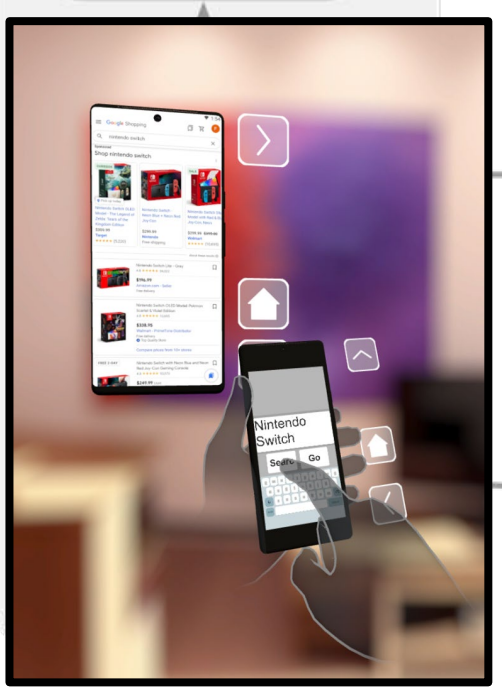
App Name: Google Shopping
Augmented View: 3D Model → Nintendo Switch
Controller View: item list (product name, price, etc)

Physical Phone

Beyond the Phone

Phone UI

- focused app
- view hierarchy
- app events



UI Analysis Server

Interactions

- virtual touch / pinch
- shortcut commands *(e.g., home, back)*
- OS calls to revoke software or views

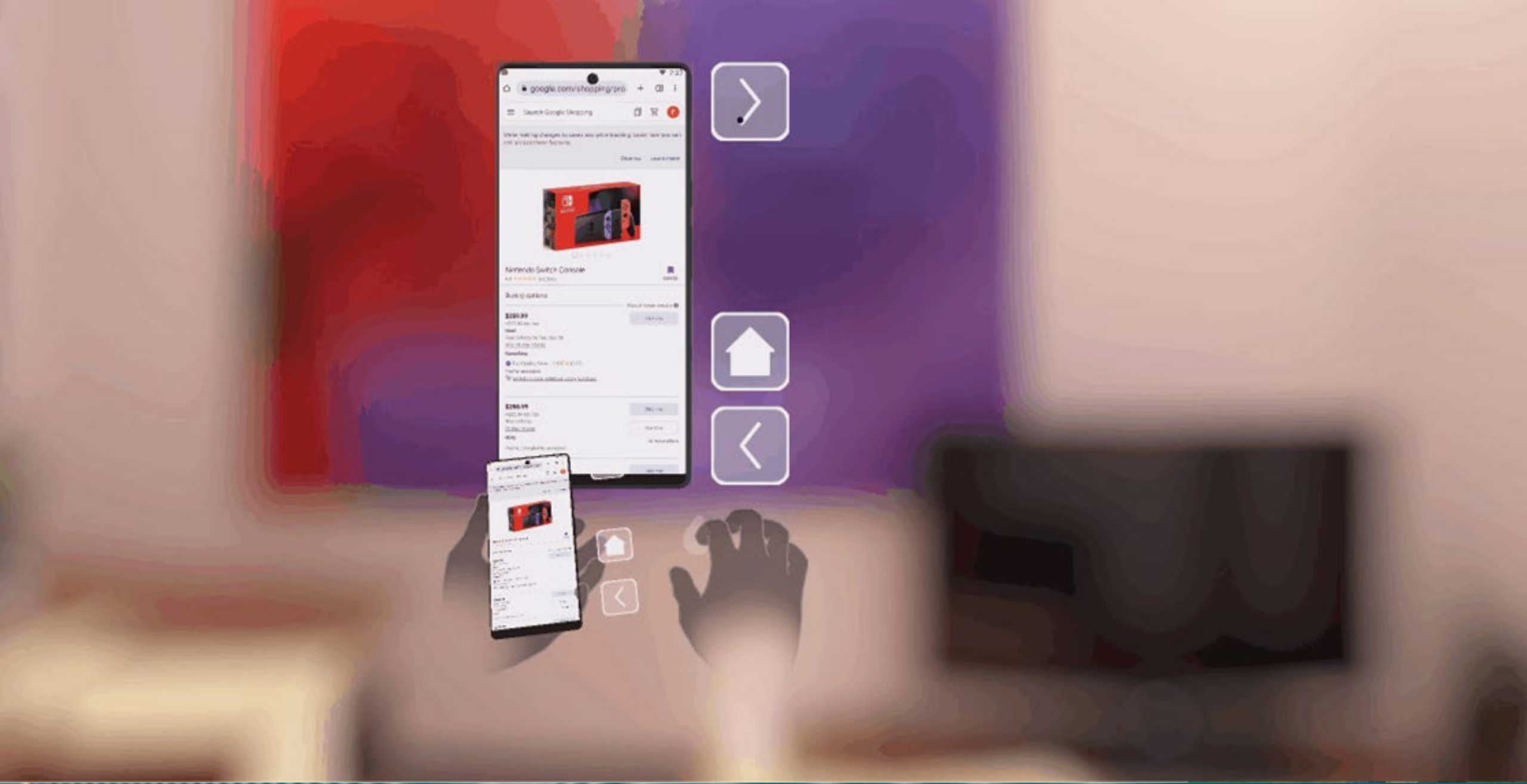
Context & Augmentation

- App Name
- Augmented View Category & Content: *image, video text, 3D model, metadata, …*
- Controller View Content: *keyboard, item list, trackpad, buttons…*

XR Event Manager

XR Events

- enable/disable views
- create prefabs from UI context
- update contents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Search Google Shopping
Nintendo Switch Console

Separate Haptic and Phone UI

Prototype purposes

- Physical phone for touching and tracking
- The phone UI in XR is re-rendered

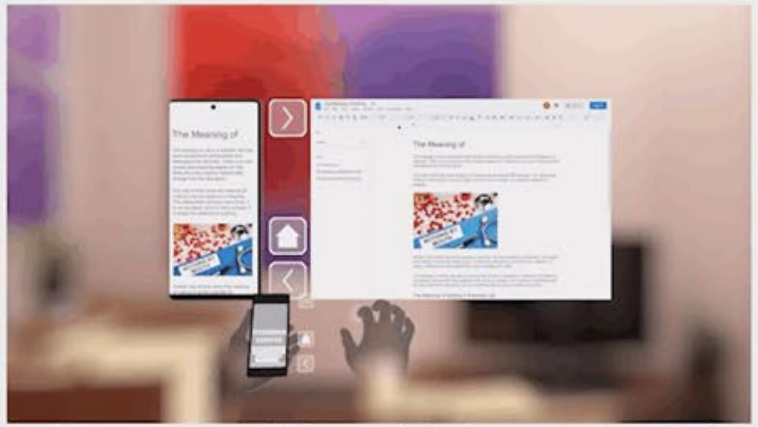
Applications

(a) web browsing with desktop views

(b) news reading with summarization

(c) reviewing photos with immersive views

(d) video watching with media controls



(e) document editing with format controls

(f) shopping with color palette & 3D views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Videos
Honolulu
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Honolulu, on the island of Oahu's south shore, is capital of Hawaii and gateway to the U.S. island chain. The Waikiki neighborhood is its center for dining, nightlife and shopping, famed for its iconic crescent beach backed by palms and...
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Honolulu
Honolulu is Hawaii's main gateway to the world. It is also a major hub for business, finance, hospitality, and military defense in both the state and Oceania.
Honolulu County, Hawaii · Timeline of Honolulu · Chinatown, Honolulu · Skyline
About
Honolulu, on the island of Oahu's south shore, is capital of Hawaii and gateway to the U.S. island chain. The Waikiki neighborhood is its center for dining, nightlife and shopping, famed for its iconic crescent beach backed by palms and high-rise hotels, with volcanic Diamond Head crater looming in the distance. Sites relating to the World War II attack on Pearl Harbor include the USS Arizona Memorial. — Google
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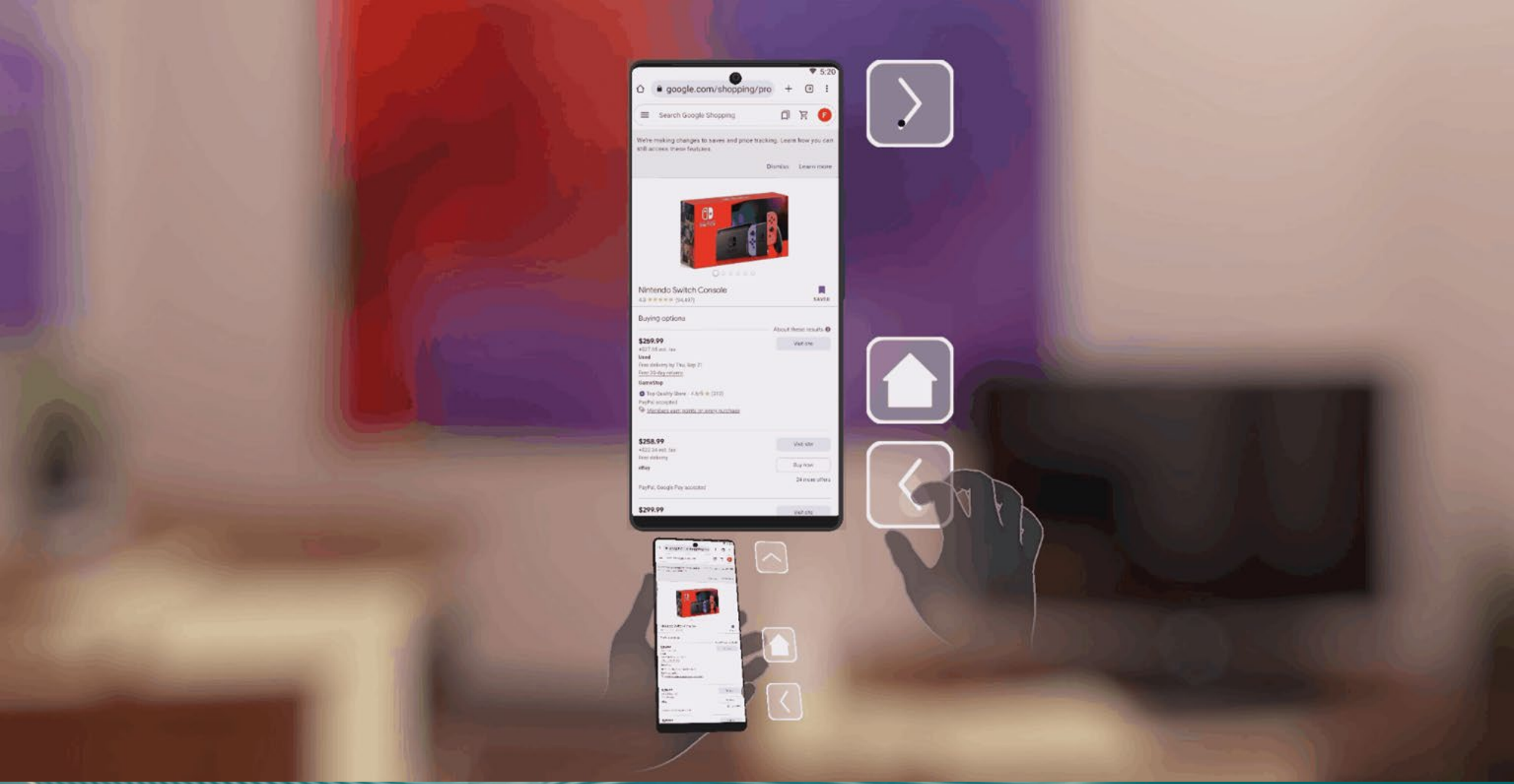
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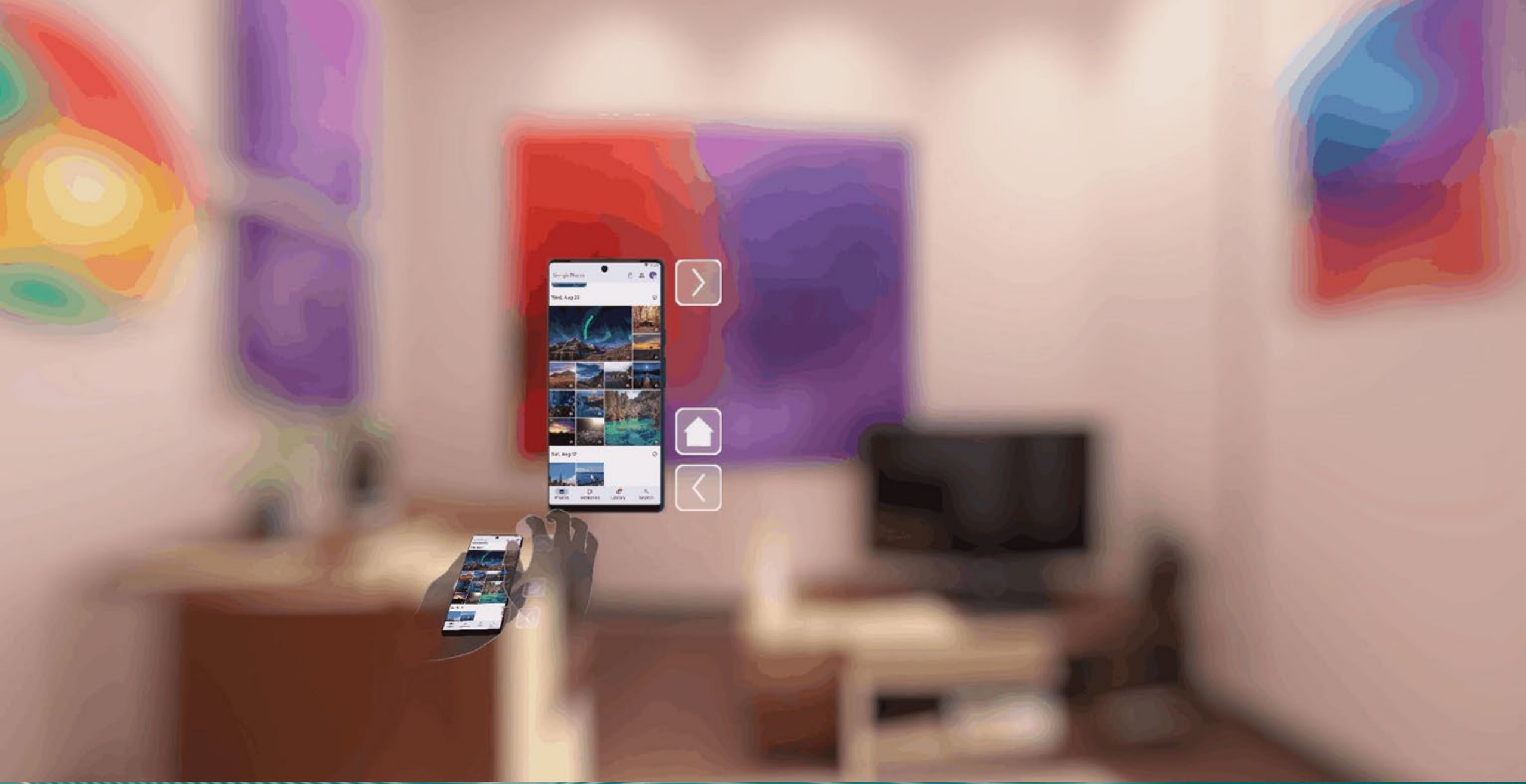

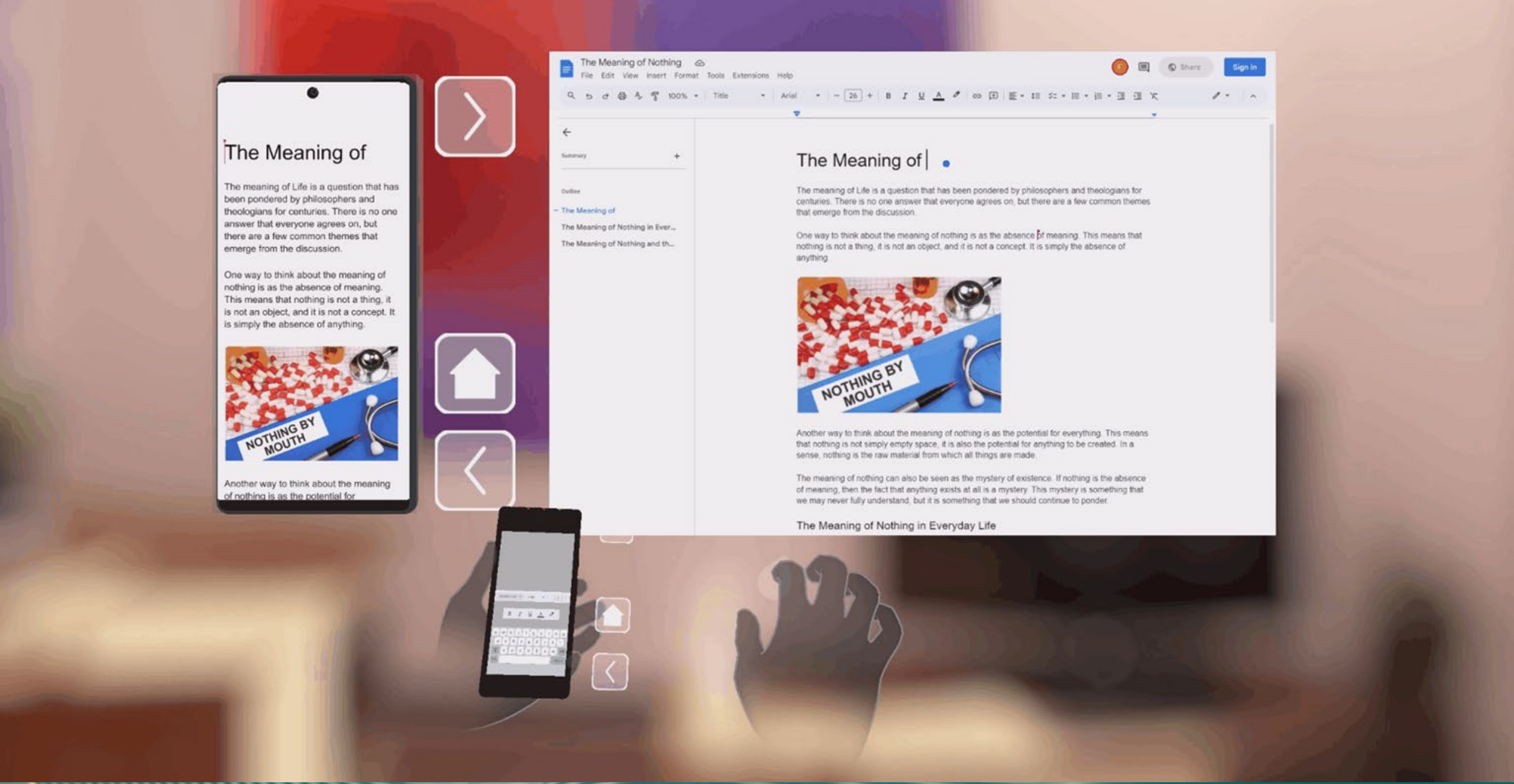
The Meaning of
The meaning of Life is a question that has been pondered by philosophers and theologians for centuries. There is no one answer that everyone agrees on, but there are a few common themes that emerge from the discussion.
One way to think about the meaning of nothing is as the absence of meaning. This means that nothing is not a thing, it is not an object, and it is not a concept. It is simply the absence of anything.
NOTHING BY MOUTH
Another way to think about the meaning of nothing is as the potential for
The Meaning of Nothing
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NOTHING BY MOUTH
Another way to think about the meaning of nothing is as the potential for everything. This means that nothing is not simply empty space, it is also the potential for anything to be created. In a sense, nothing is the raw material from which all things are made.
The meaning of nothing can also be seen as the mystery of existence. If nothing is the absence of meaning, then the fact that anything exists at all is a mystery. This mystery is something that we may never fully understand, but it is something that we should continue to ponder.
The Meaning of Nothing in Everyday Life

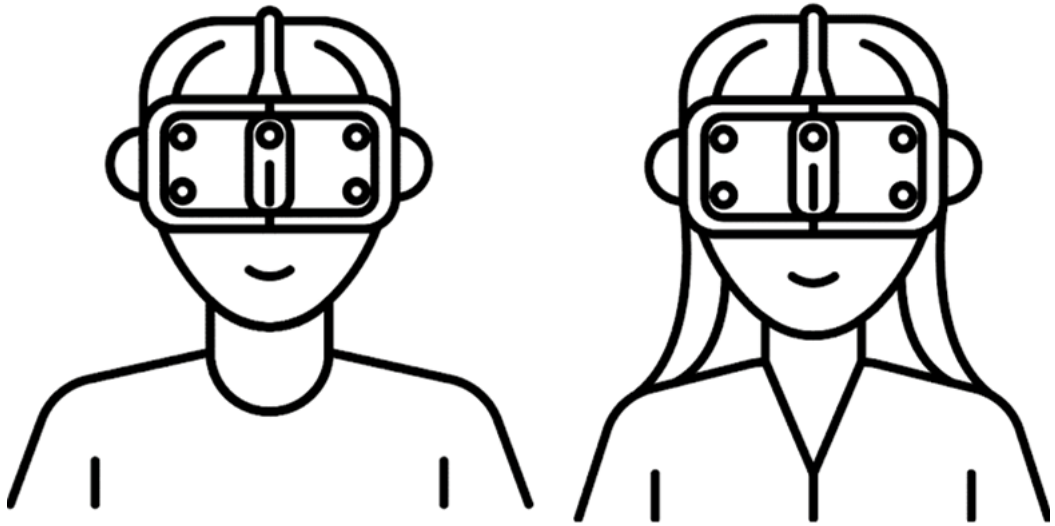
Summary:

Google's Bard AI chatbot can now search and summarize information from users' Gmail, Docs, and Drive. While privacy concerns are raised

Validations

User Study

- Recruit Experts to avoid novice effect
- Evaluate preference and coherence across views
- Evaluate strength and weakness



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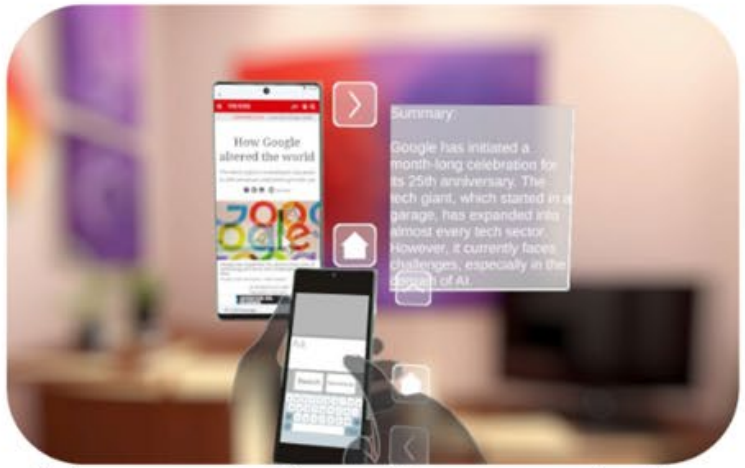

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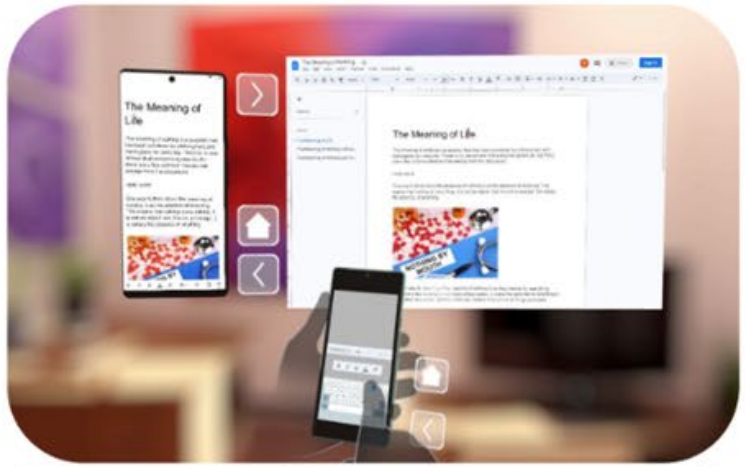
(c) reviewing photos with immersive views

(d) video watching with media controls

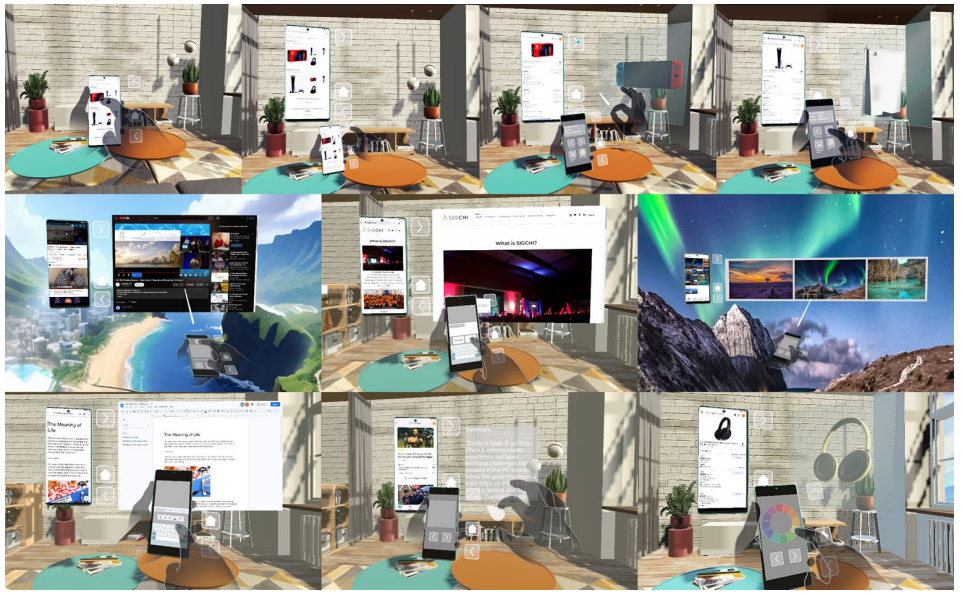


(e) document editing with format controls

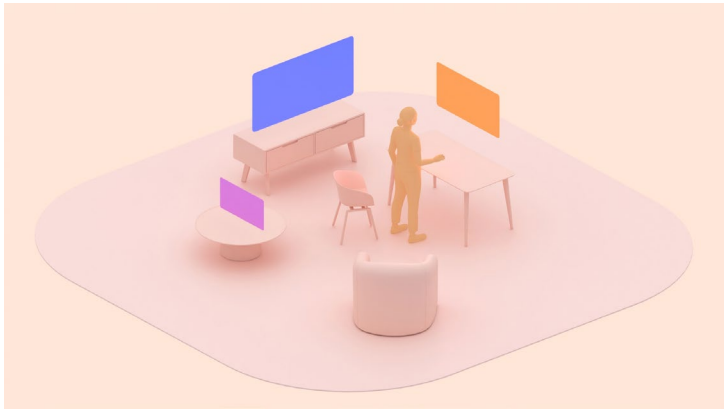
(f) shopping with color palette & 3D views

Findings

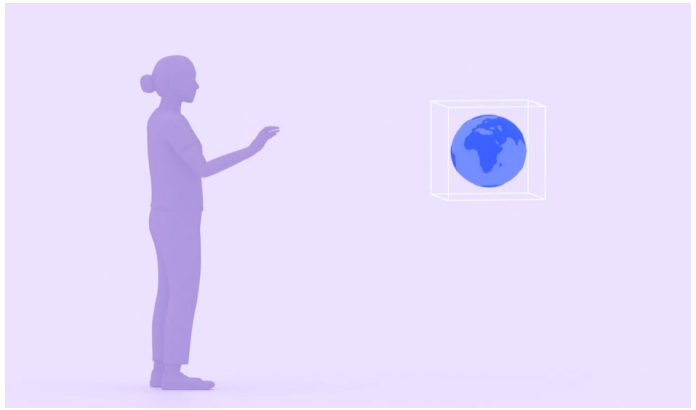
- Preference between magnified and augmented varies
  - 3D & Interaction types
- Interview Results
  - Overarching positive feedback on Immersion, spatially enriched content, legibility and enhanced usability.
  - Challenges with juggling co-existing views
    - Single view
    - Customizable interface
    - Controller interface



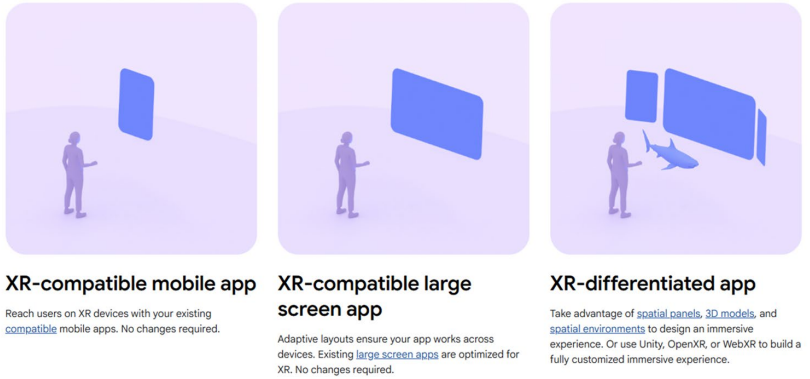
Future Directions



More apps, more states



Real-time generated content



Go beyond phone applications

Thanks!

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