Connecting Realities for Fluid Computer-Mediated Communication

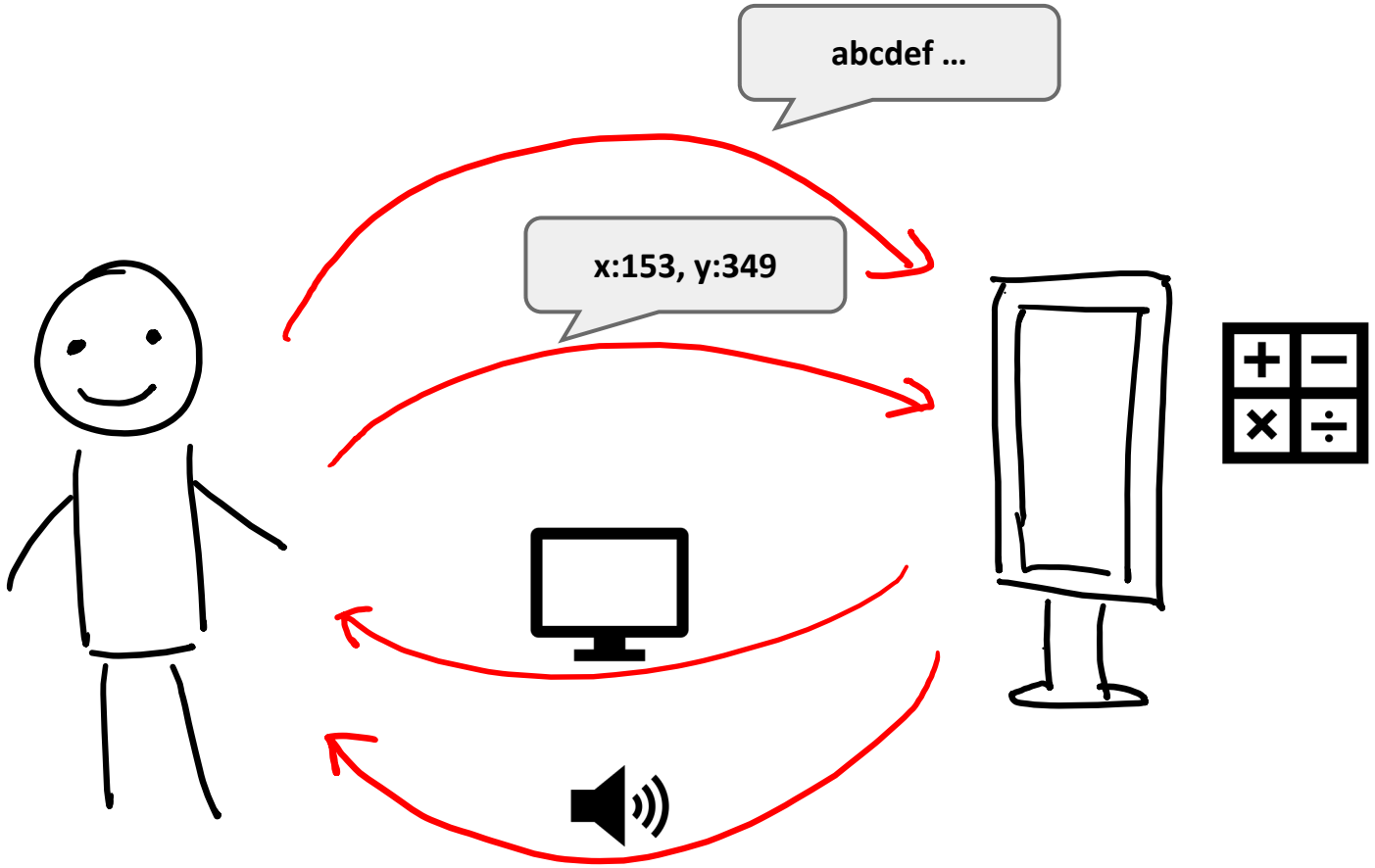
Seongkook Heo

Computer Science Department
University of Virginia

UNIVERSITY of VIRGINIA | SCHOOL of ENGINEERING & APPLIED SCIENCE

Human-Computer Interaction

User Interface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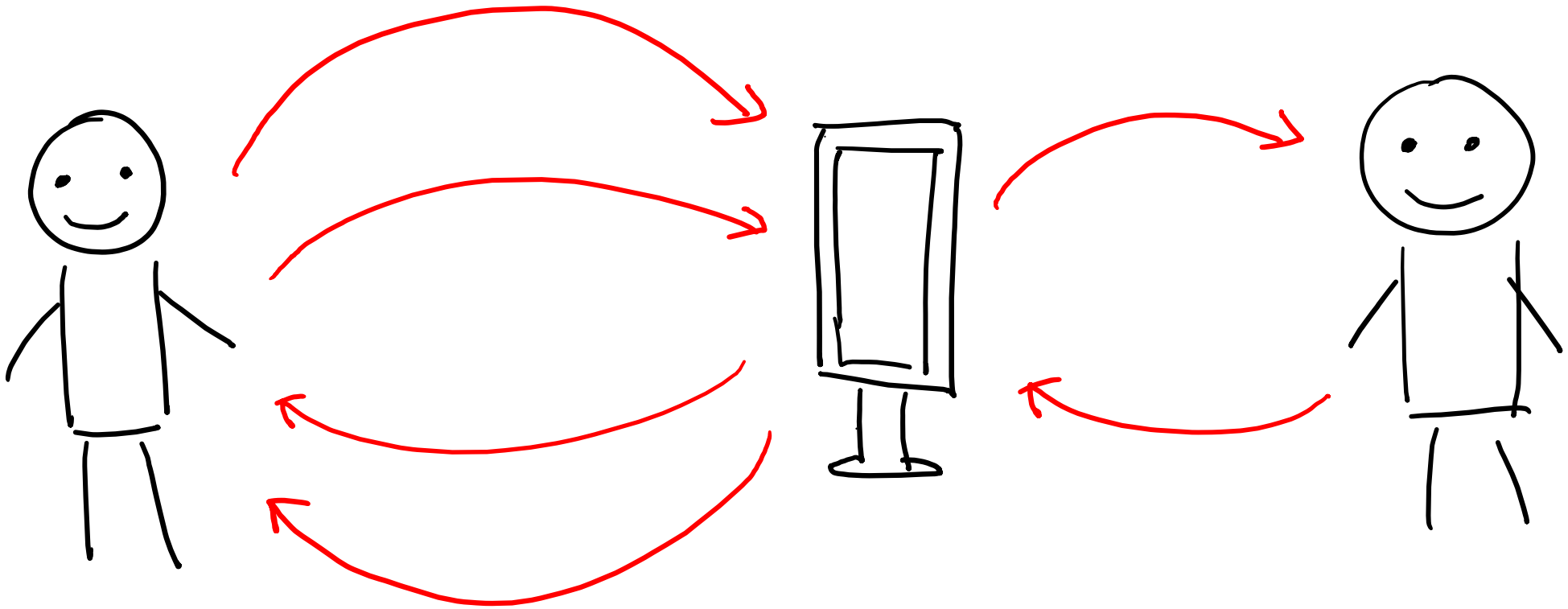
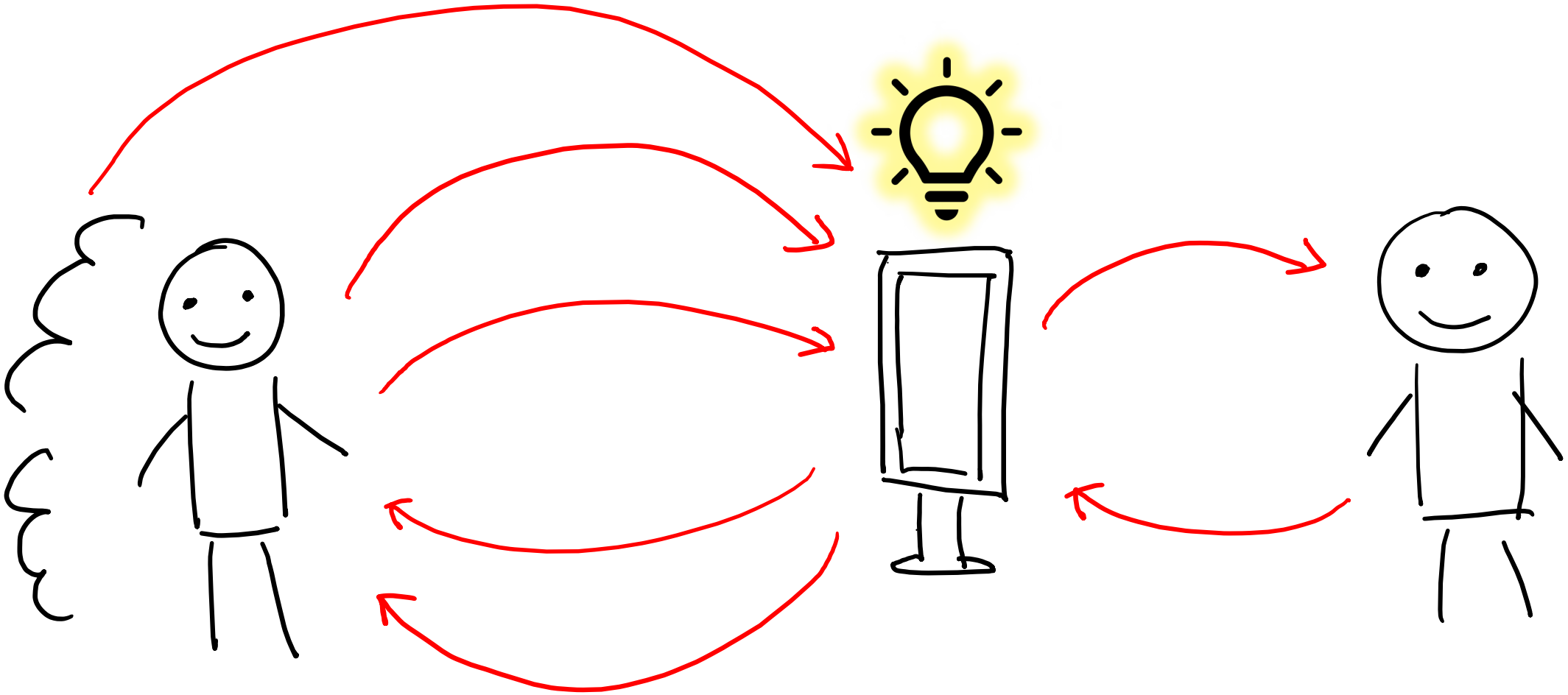
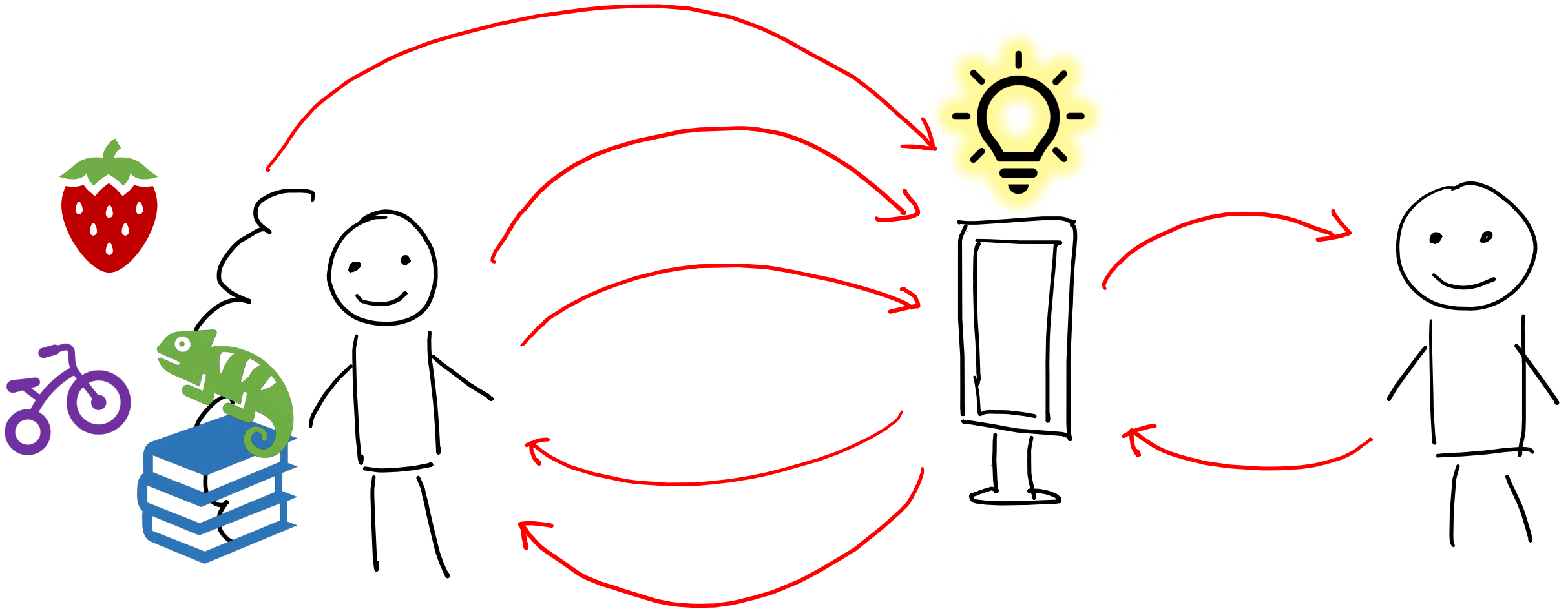
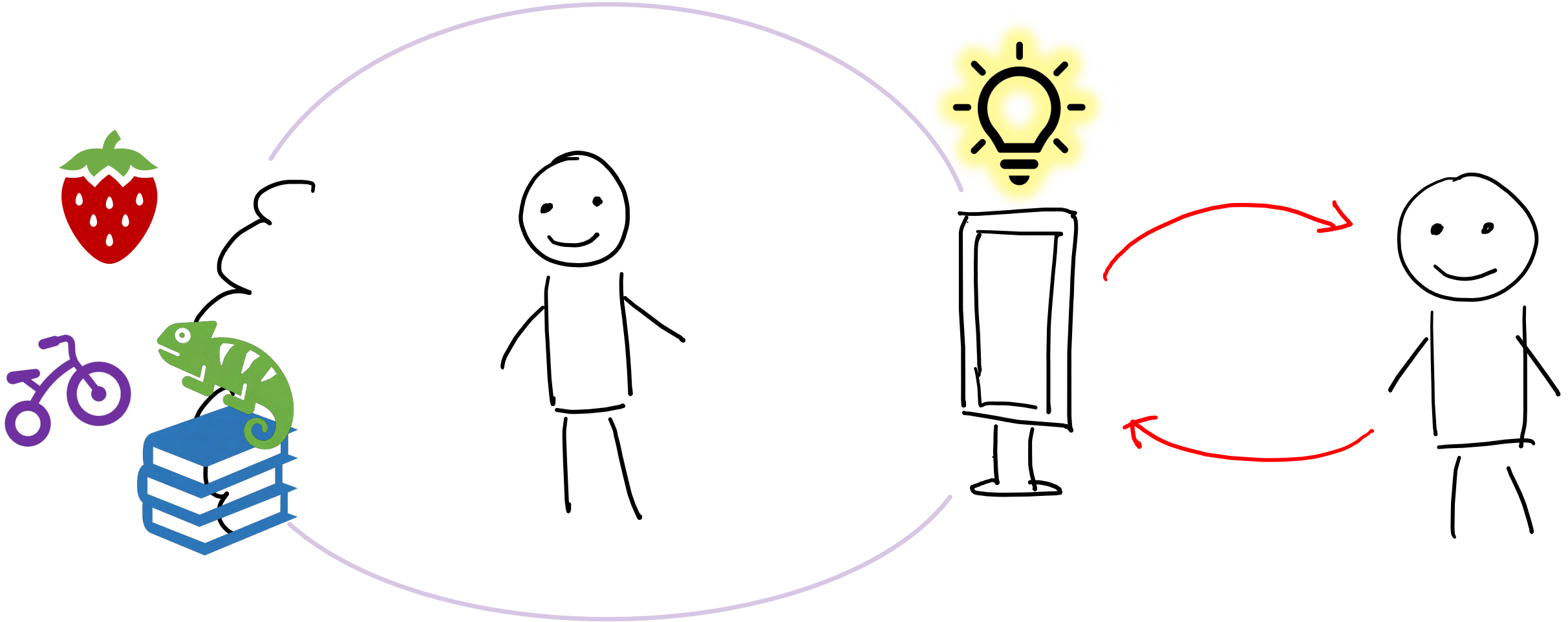


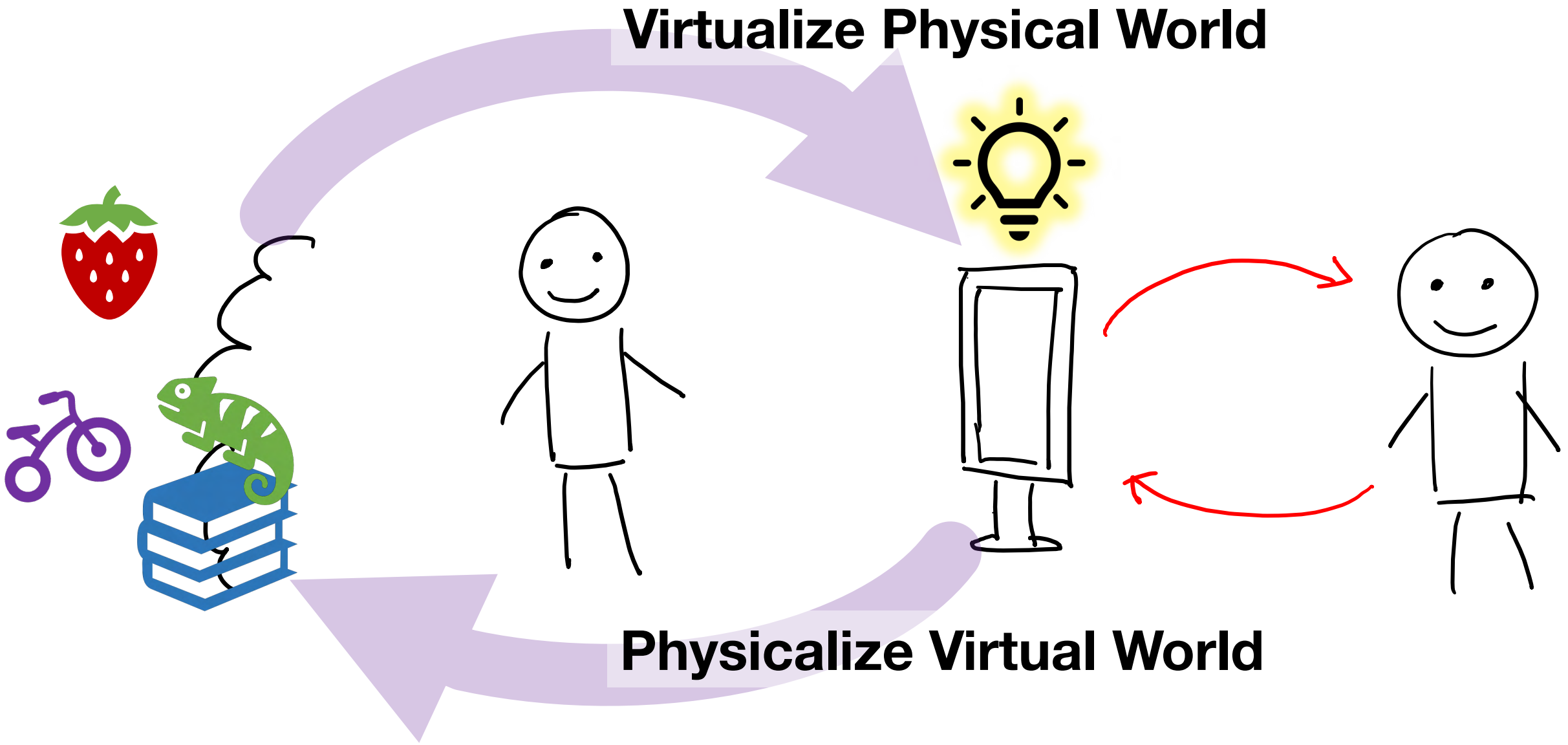


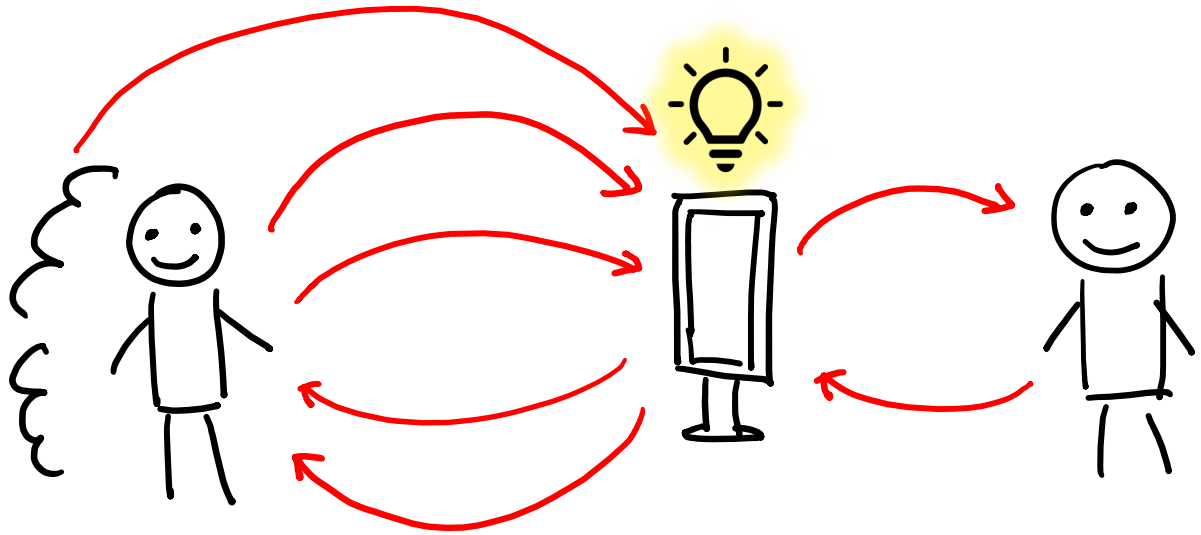
ChatGPT

The image shows a playful kitten lying on its back, with its legs stretched outwards, resting on a person's lap. The person is wearing blue shorts and is seated, with their legs forming a triangle shape on which the kitten is comfortably sprawled. The kitten has a grey coat with darker grey spots and stripes, typical of a tabby pattern, and is looking directly at the camera with a relaxed yet alert expression. The background suggests a home environment, with a red cushion and blue fabric, possibly part of a sofa or chair, complementing the casual and cozy setting.






Virtualize Physical World
Physicalize Virtual World



Virtualizing Physical World for Fluid Remote Communication

ThingShare: Ad-Hoc Digital Copies of Physical Objects for Sharing Things in Video Meetings

Erzhen Hu[1], Jens Emil Grønbæk[2], Wen Ying[1],
Ruofei Du[3], Seongkook Heo[1]
University of Virginia[1], Aarhus University[2], Google Research[3]

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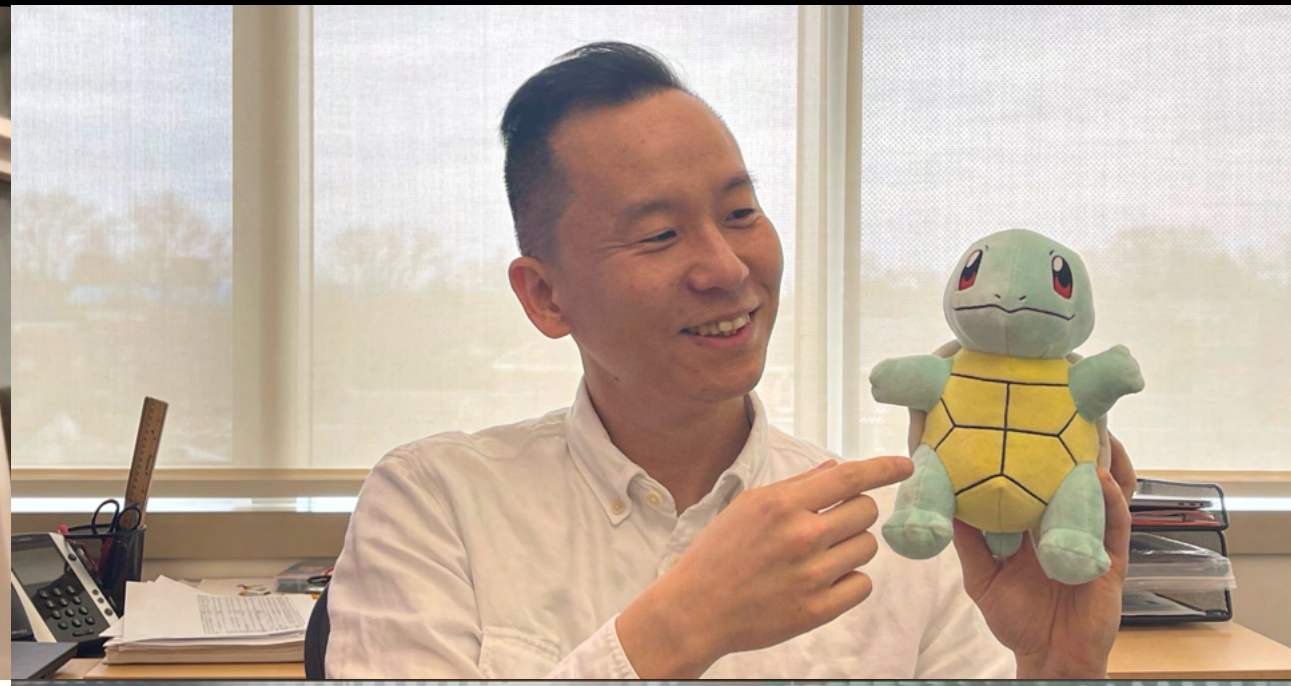
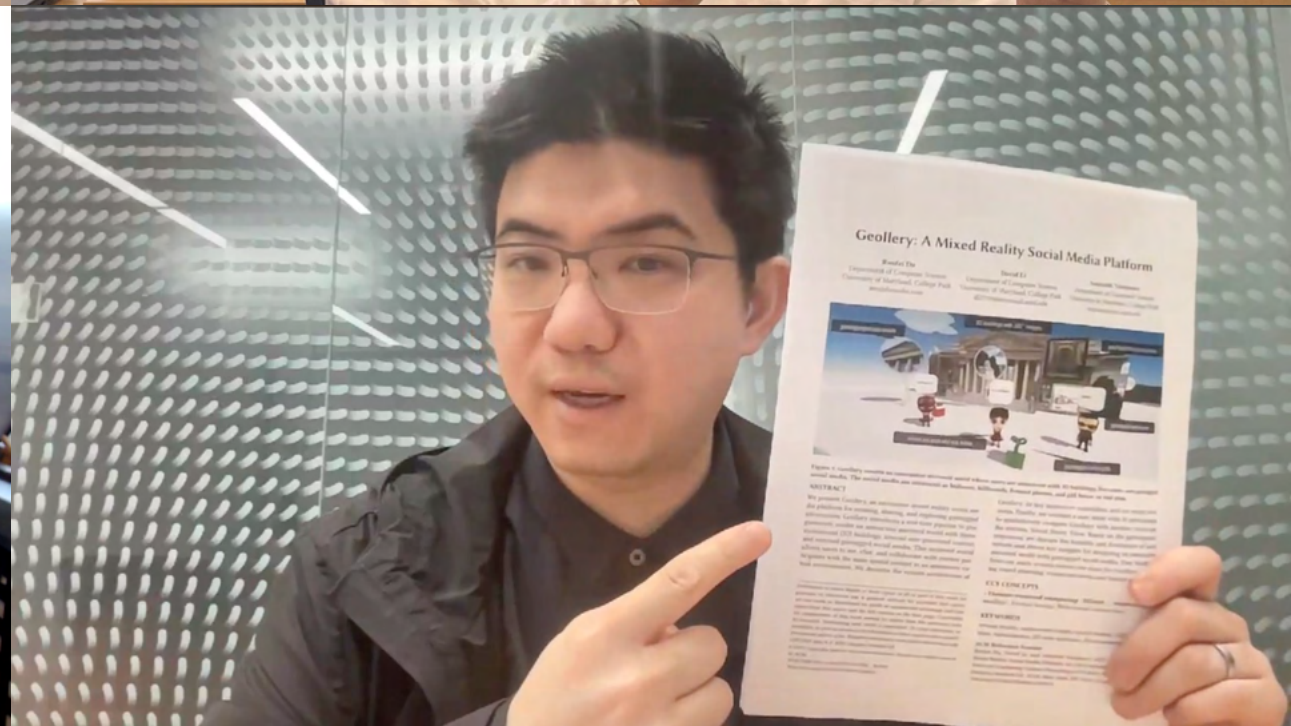
CHI23
Hamburg, Germany | Hybrid
April 23-28, 2023
reCHInnecting

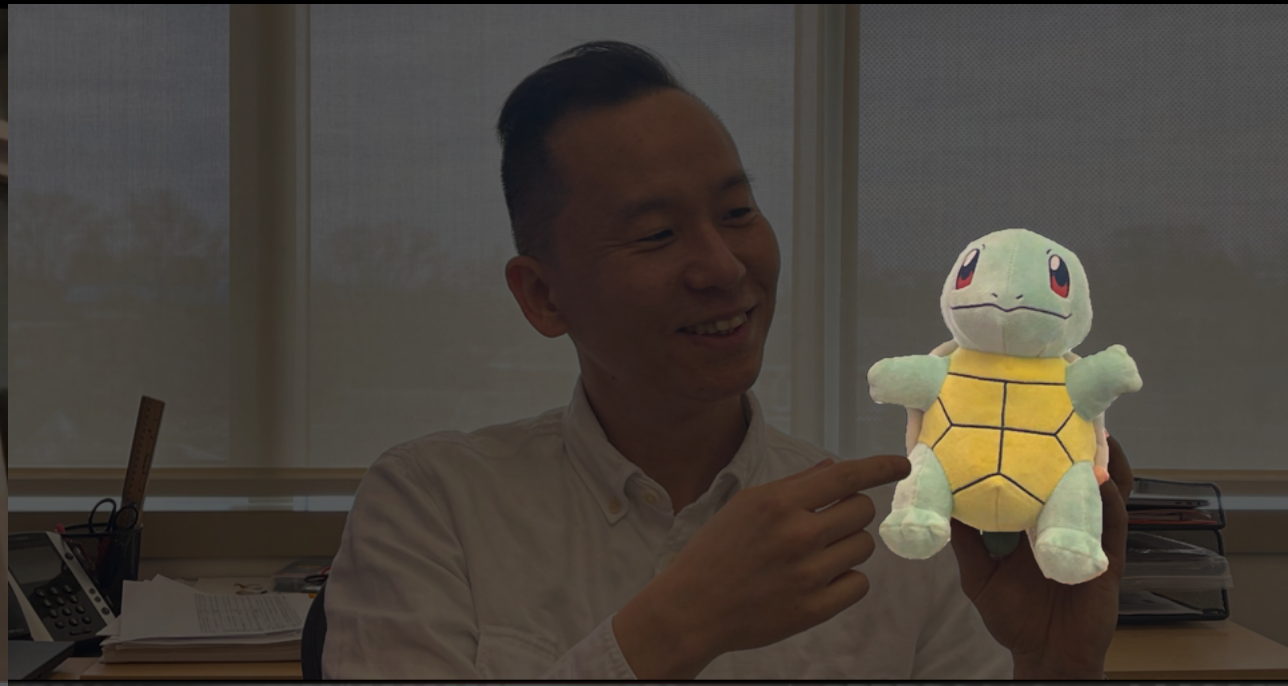
AARHUS UNIVERSITY

Google Research

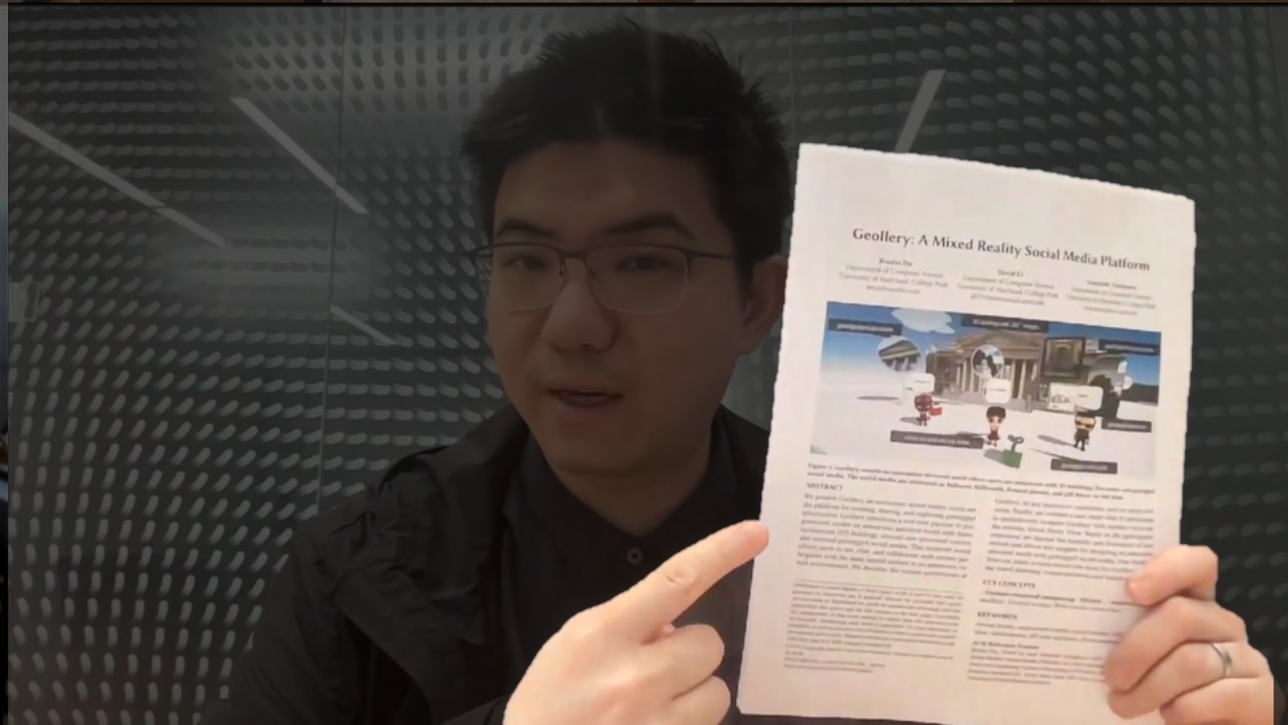


Text


Geollery: A Mixed Reality Social Media Platform



Text
Chat


Geollery: A Mixed Reality Social Media Platform

How to point?

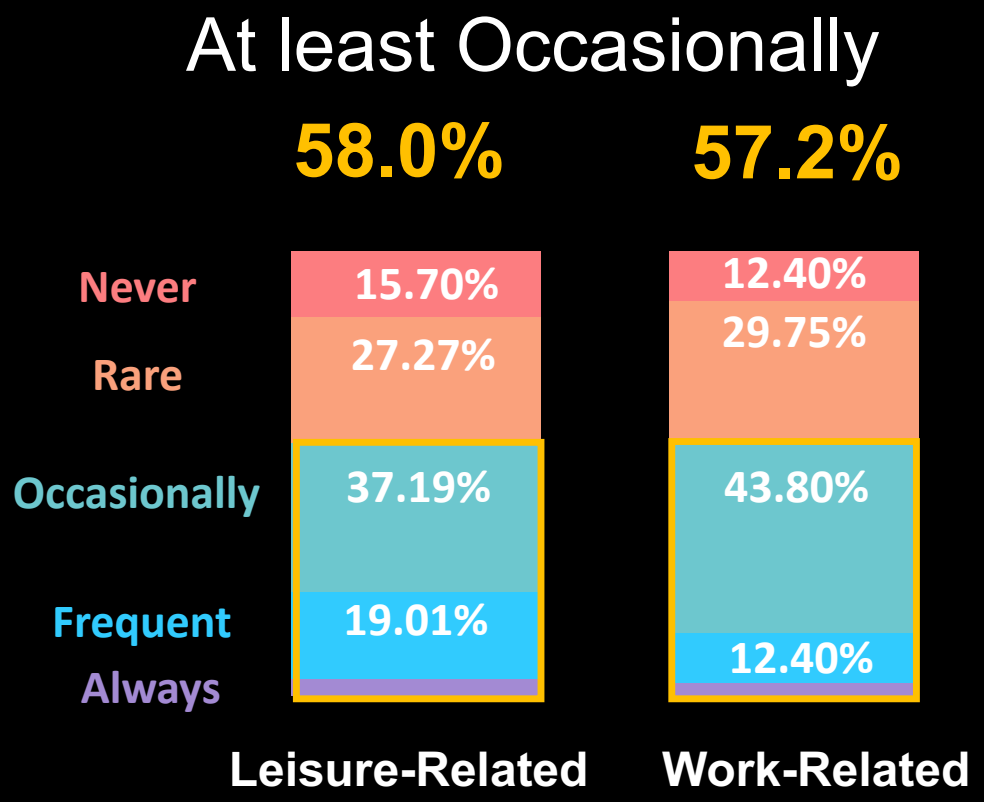
Stop Video | Mute | Virtual Background | Show Object | Focus Share

Objects Blurred
By background!
Erzhen Hu

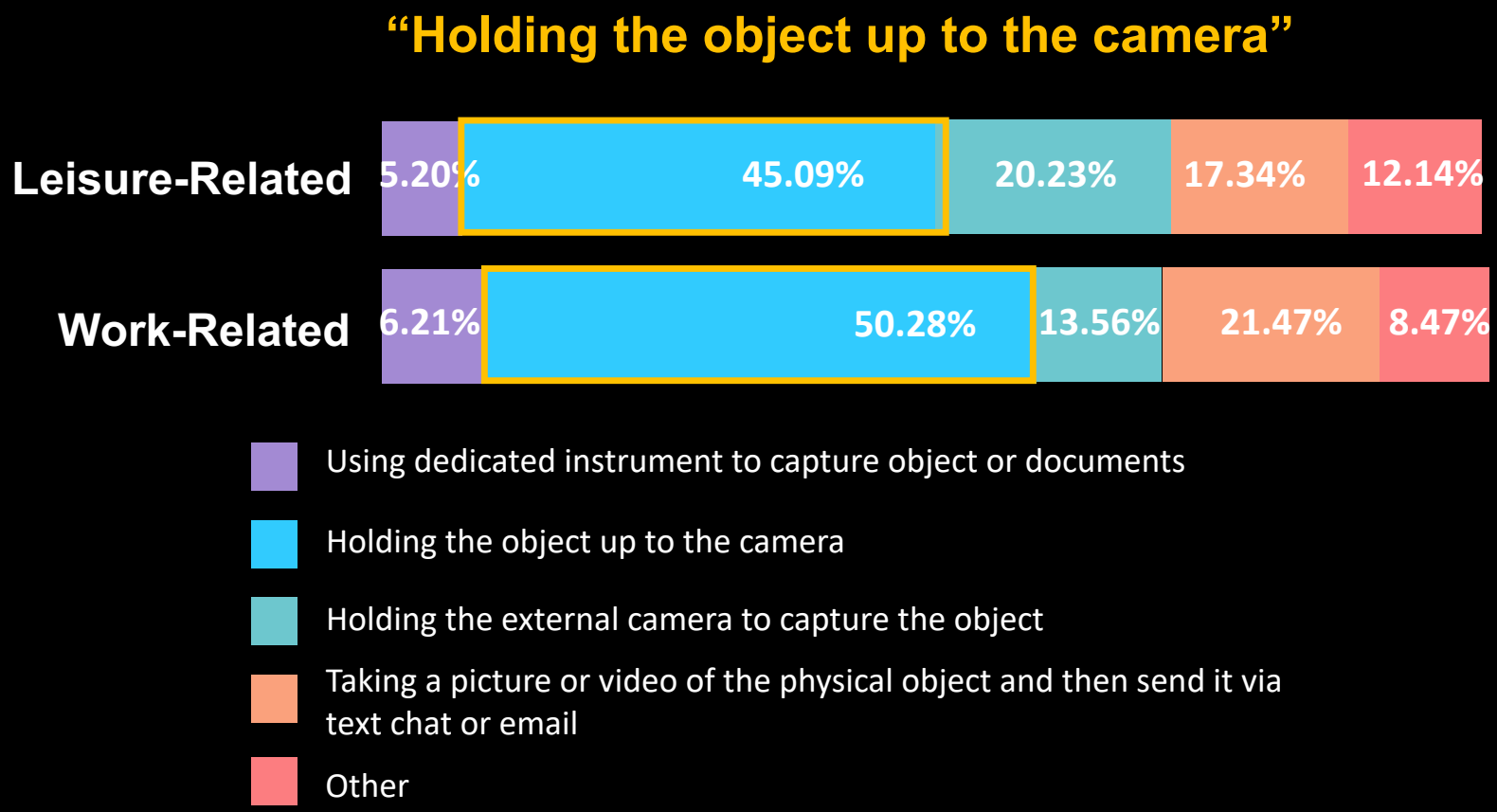
Formative Study

Survey with 124 Mturk users

How often do you show physical objects in video meetings?



How do you show objects?



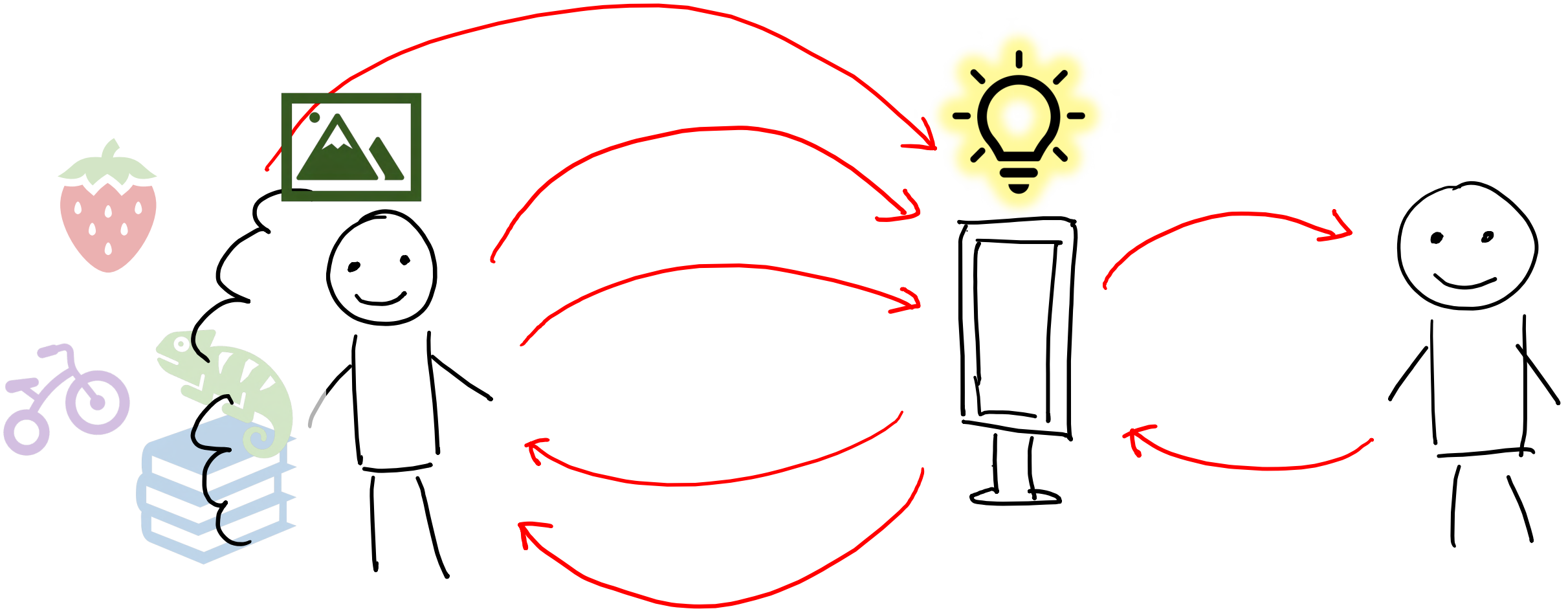
Challenges of Showing Physical Objects

- **Details:** Difficult to show the fine detail of an object.
- **Perspectives:** Unable to show multiple pages of a document or different perspectives.
- **Remote Referencing:** Limited view to reference and understand remote user's attention.
- **Framing:** Laborious to repeatedly frame, coordinate, and adjust the position and angle.
- **Privacy:** Virtual background obscures the object.

Challenges of Showing Physical Objects

- Details
- Perspectives
- Remote Referencing
- Framing
- Privacy

Not Difficult
for Virtual Objects

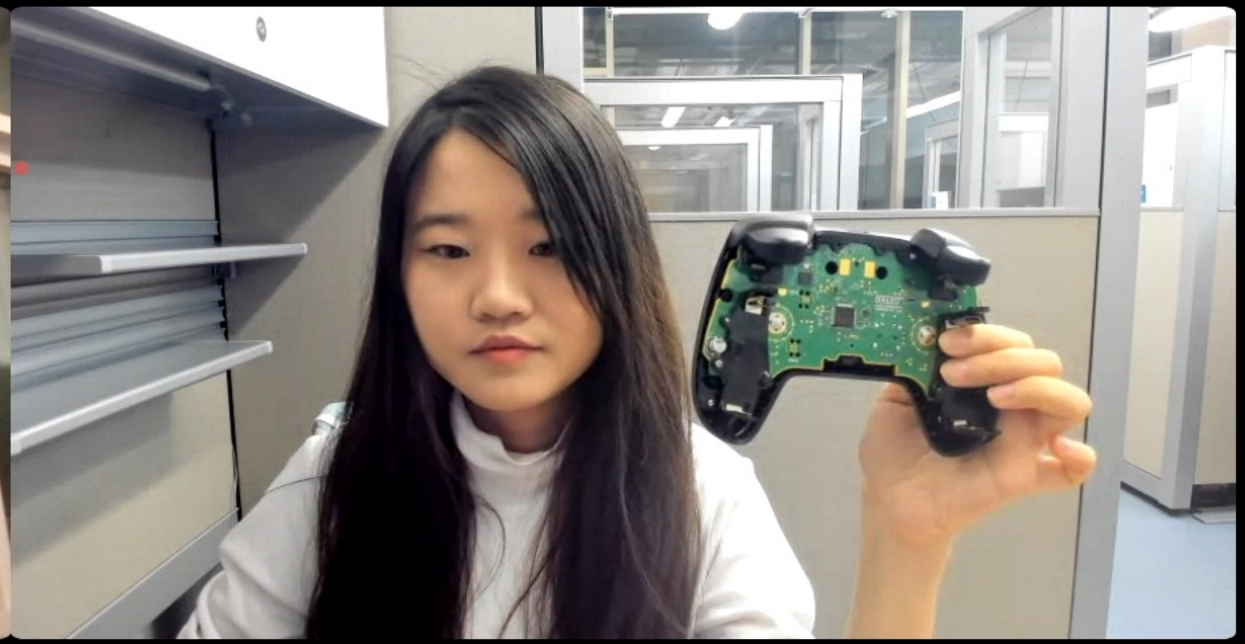


ThingShare

Local User

Remote User

Stop Video | Mute | Virtual Background | Stop Showing Object | Focus Share

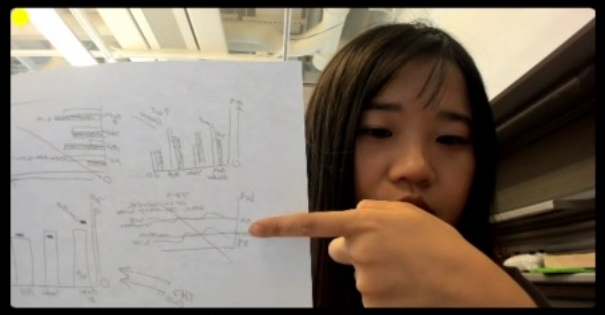


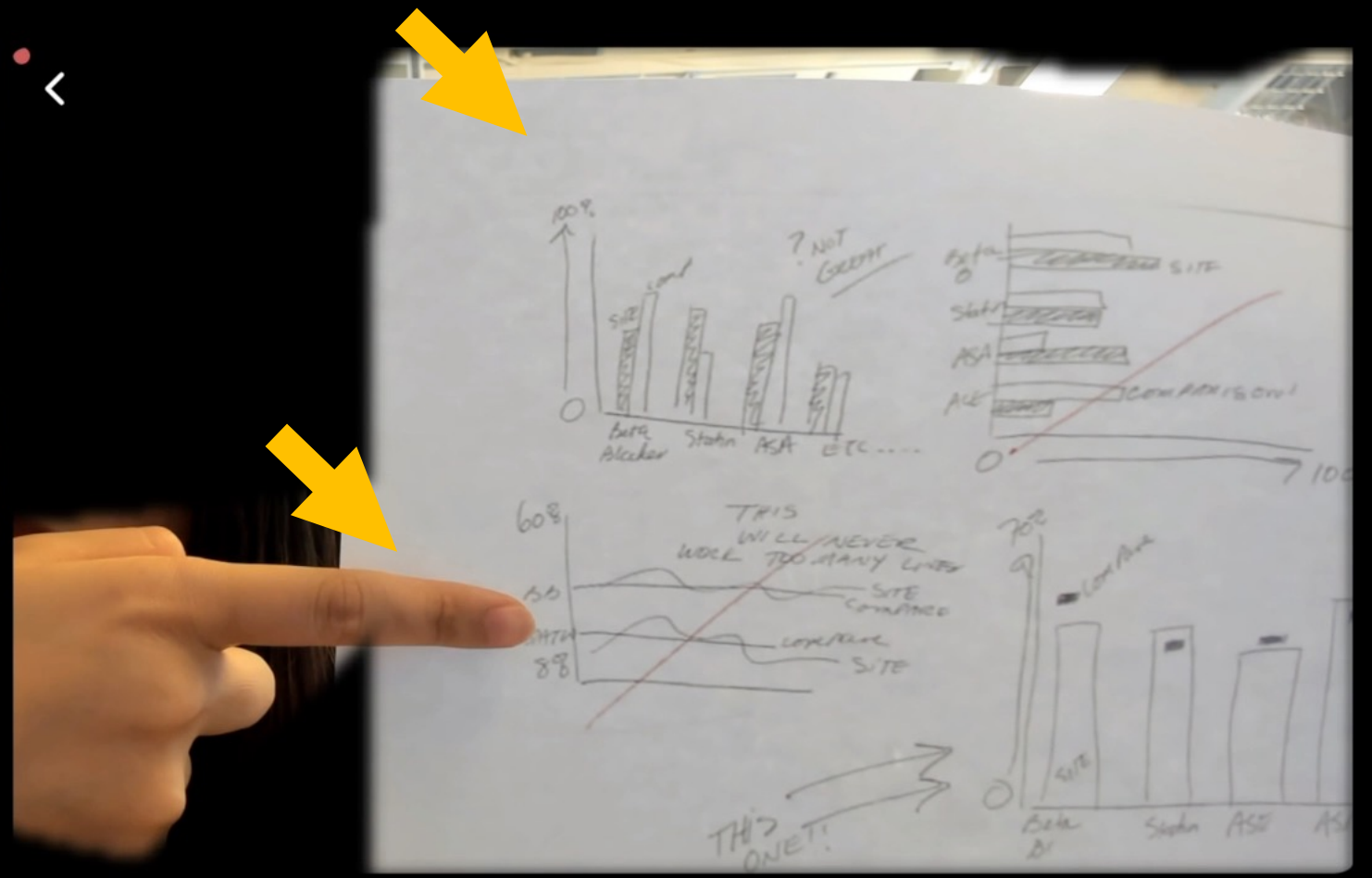
Snapshots Snapshots Snapshots Snapshots

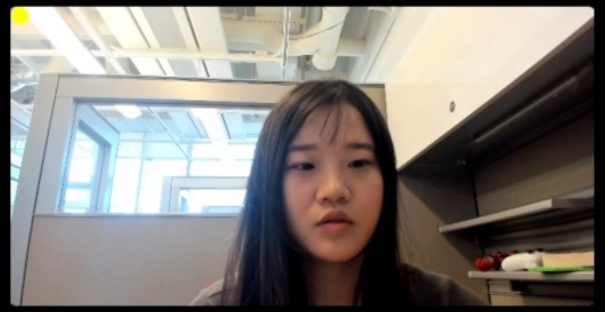
Stop Video | Mute | Virtual Background | Show Object | Focus Share

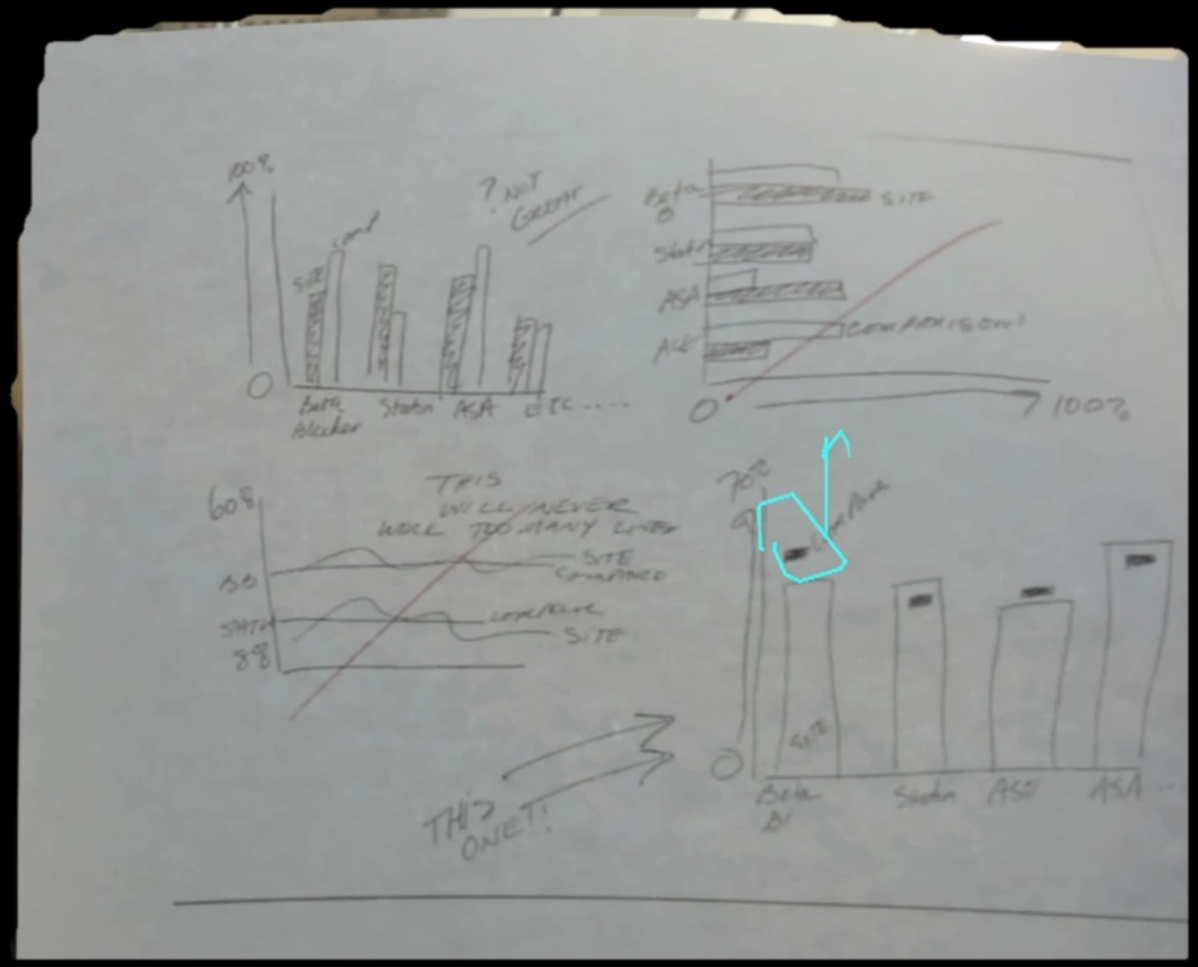
Peet's
COFFEE

Objects
Disjointed
Hands




100%
? NOT GREAT
Beta Blocker
Statin
ACA
etc....
SITE
60%
THIS WILL NEVER WORK TOO MANY LINES
SITE
LOW RISK
SITE
THIS ONE!

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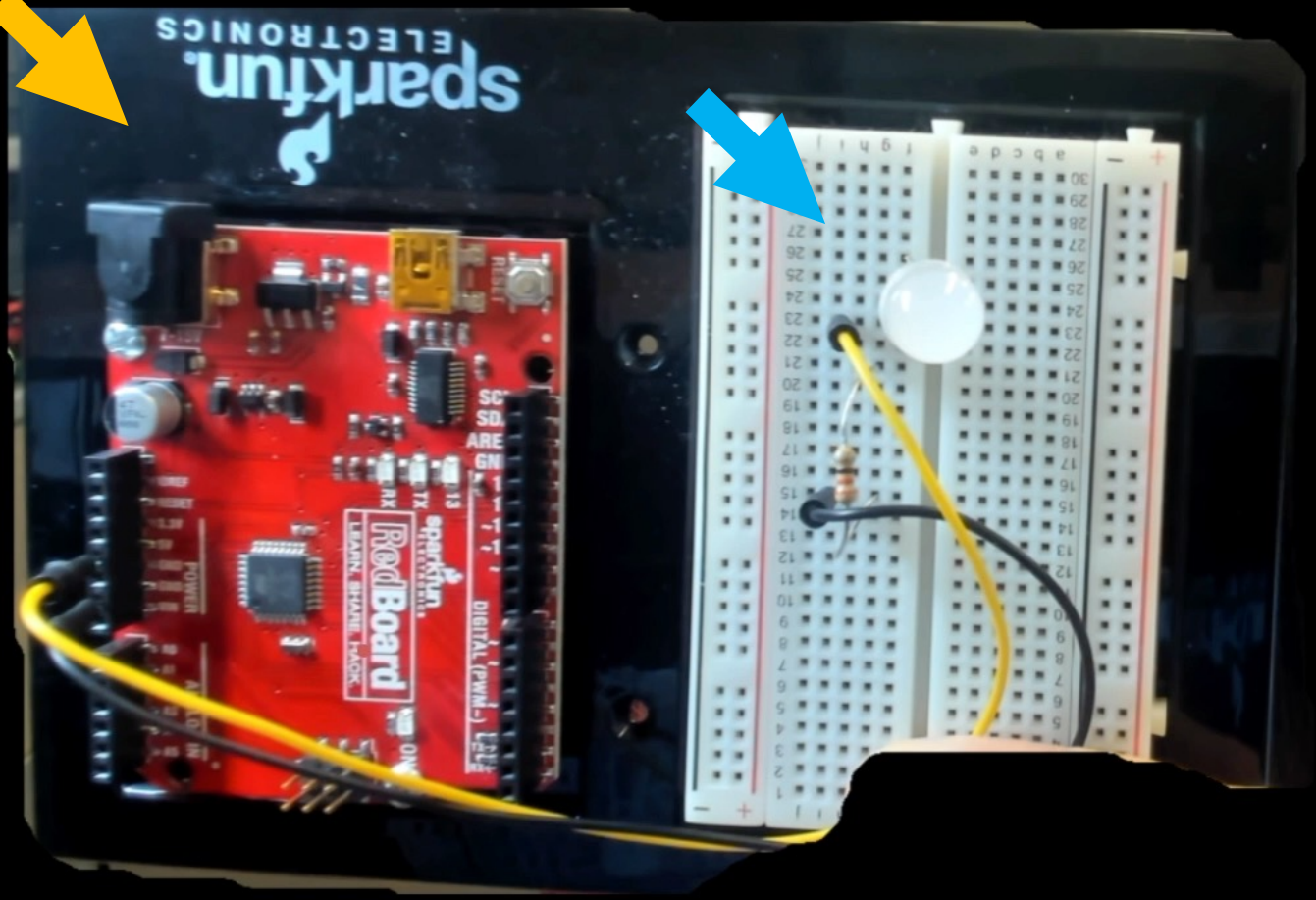
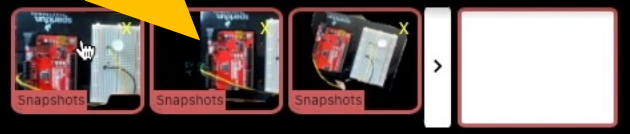
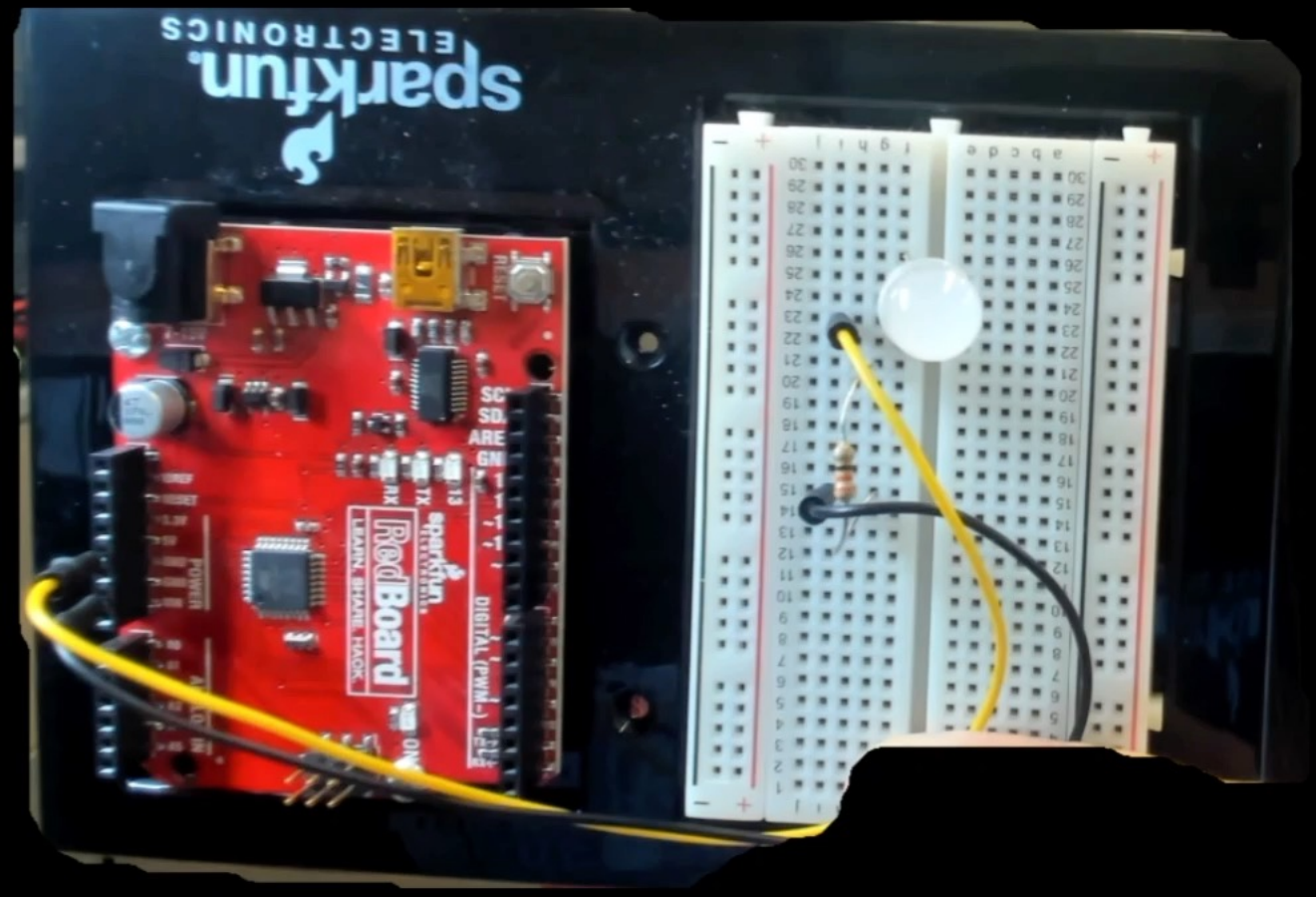
Snapshots

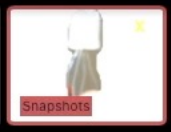
Stop Video | Mute | Virtual Background | Show Object | Focus Share





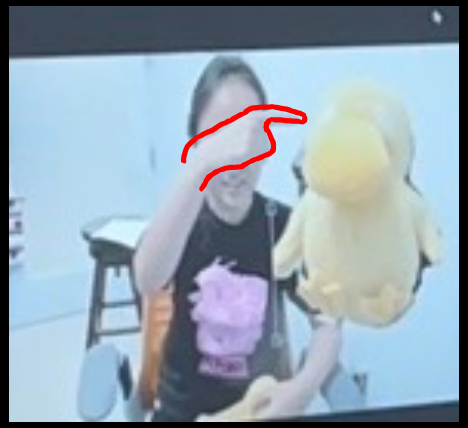
Stop Video | Mute | Virtual Background | Stop Showing Object | Focus Share

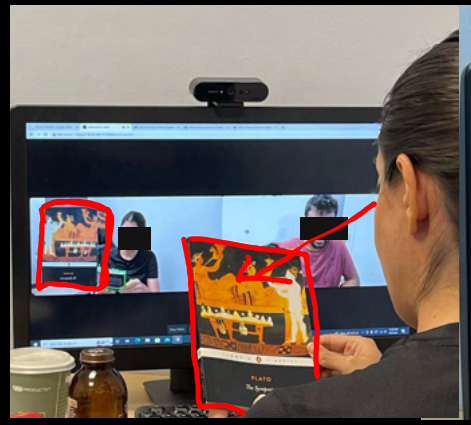


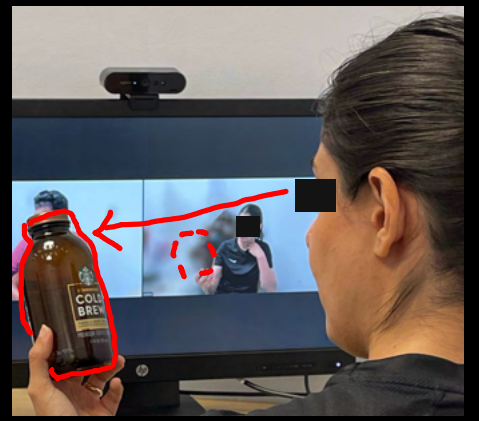


Stop Video | Mute | Virtual Background | Stop Showing Object | Focus Share

Use of Digital Copies

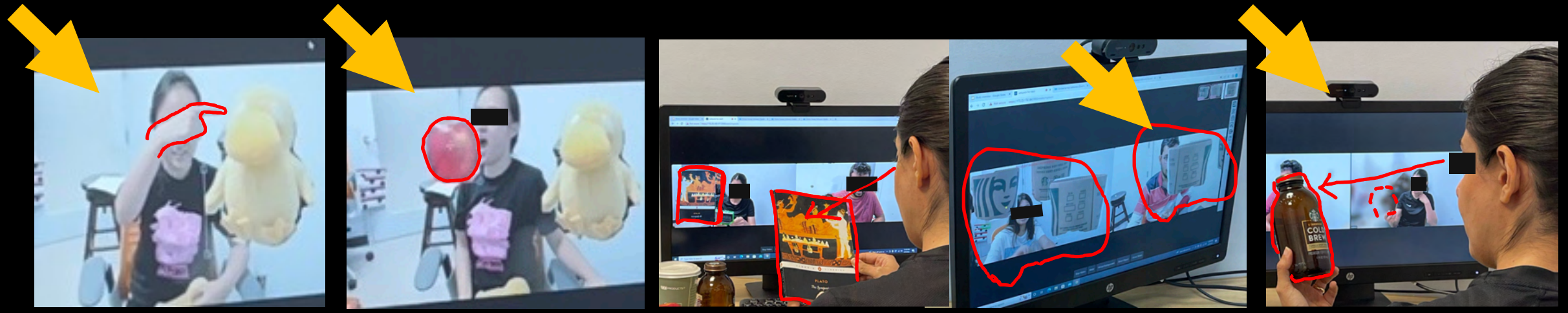






Use of Digital Copies

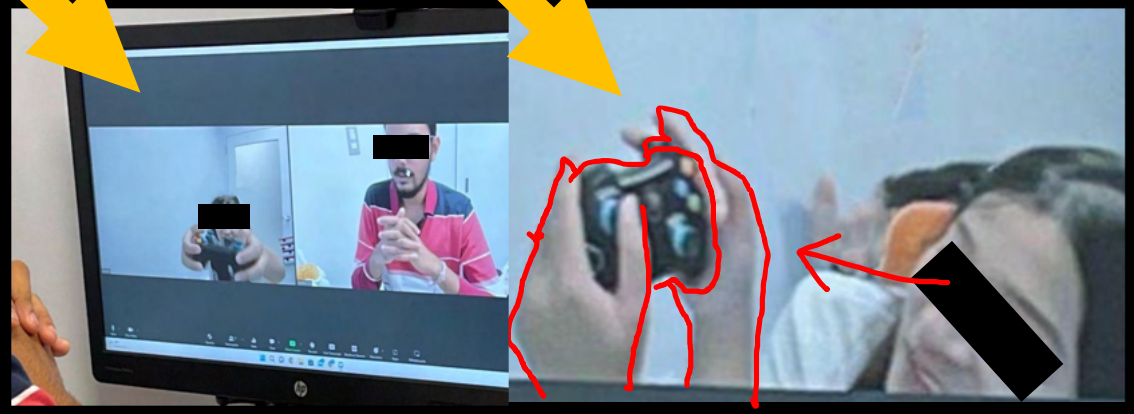
- Blending digital copies and video can support casual and playful conversations
- Remote access to digital copies enables parallel exploration
- Maintaining privacy while sharing physical objects



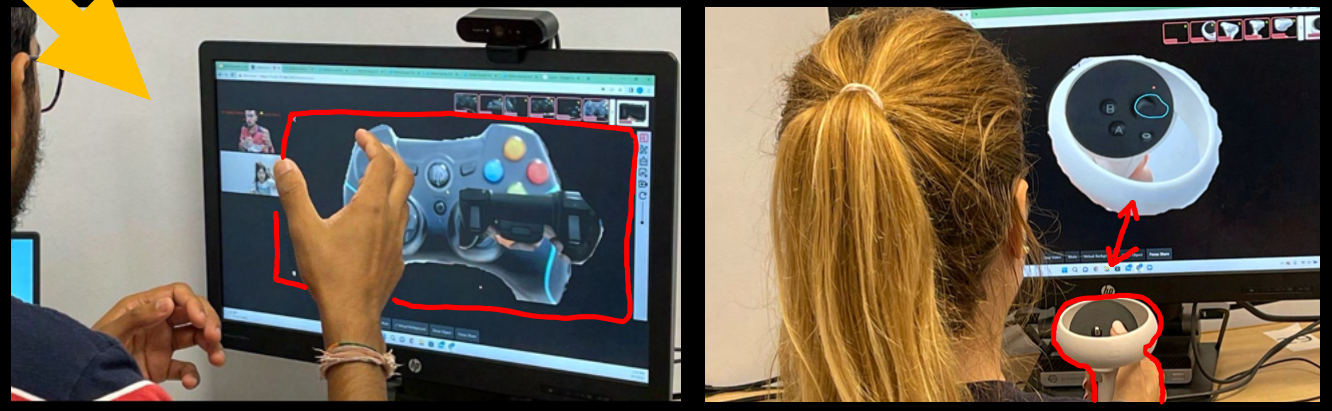
Constructing Shared Perspectives

- For Asymmetric Tasks, digital copies enable a shared perspective.

Baseline



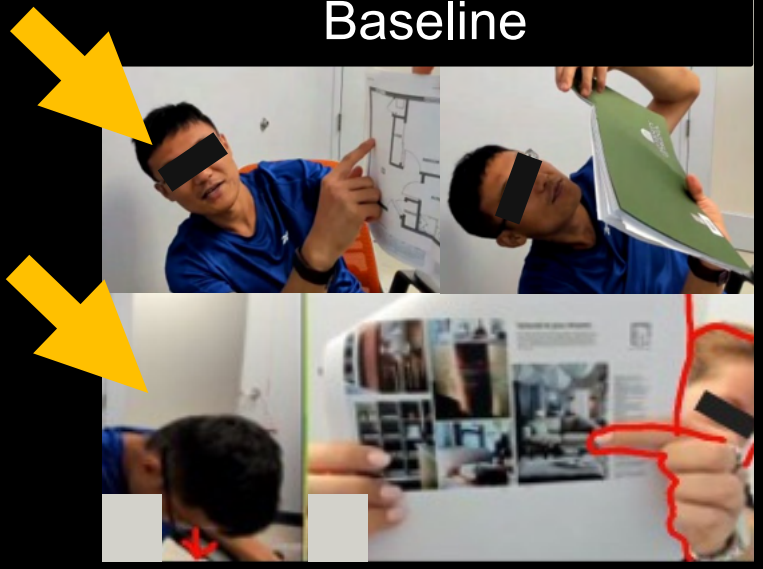
ThingShare



Constructing Shared Perspectives

- For Symmetric Tasks, digital copies help gauge attention.

Baseline



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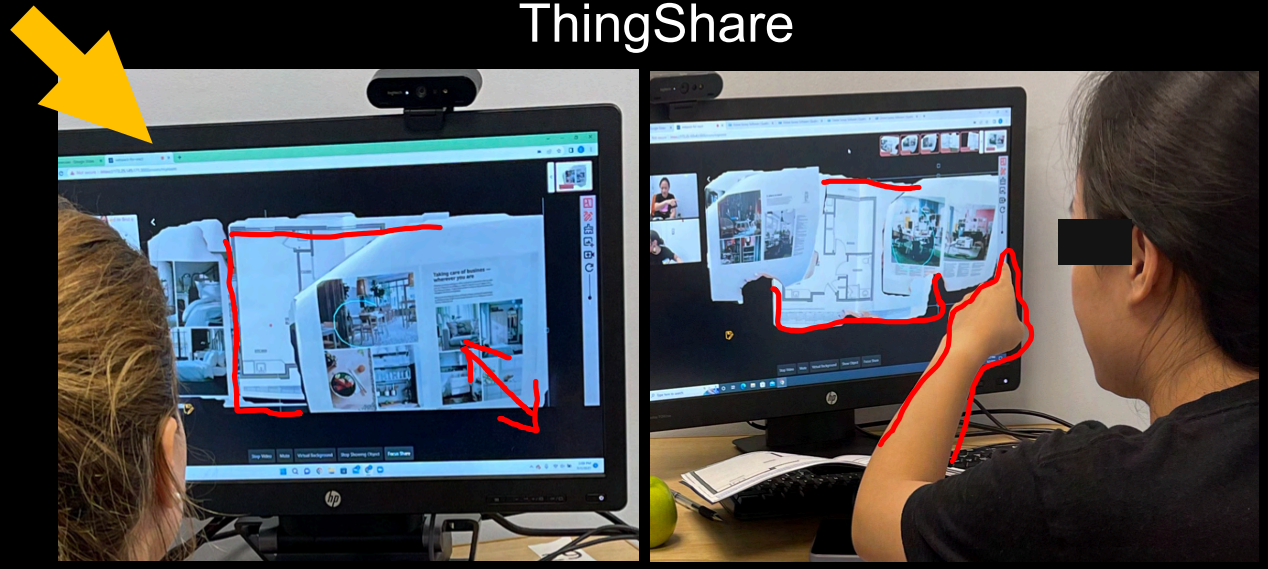
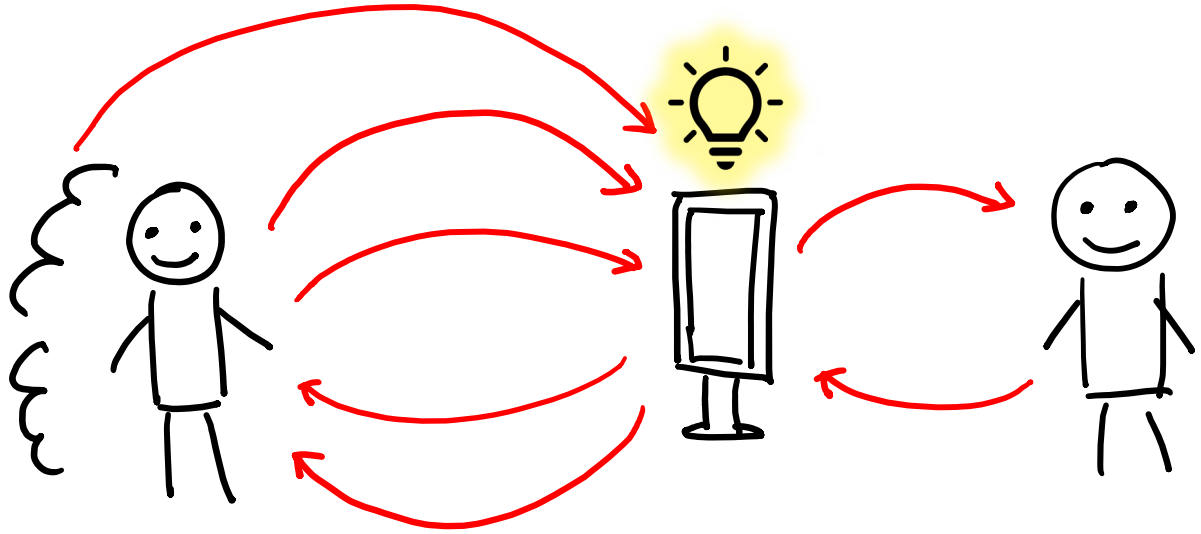
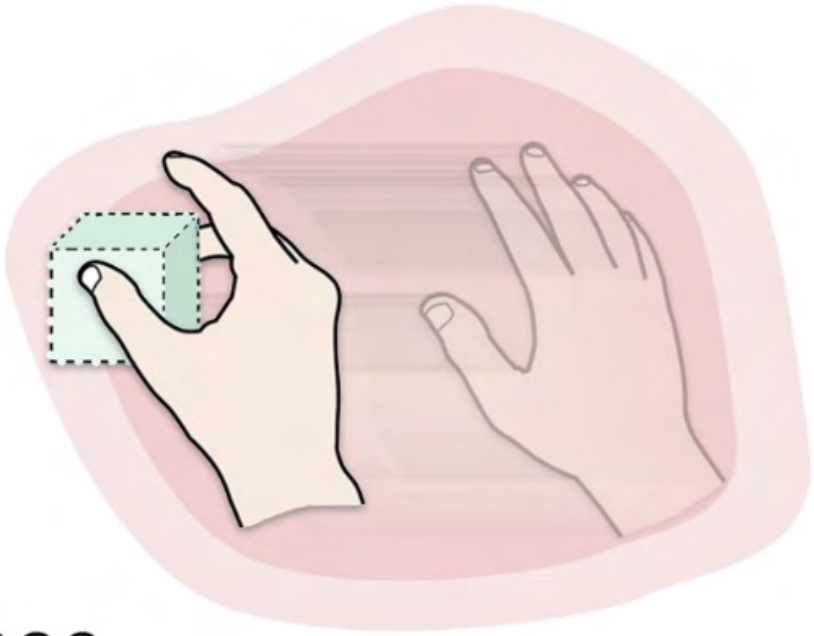




Physicalizing Virtual Interaction for Accessibility



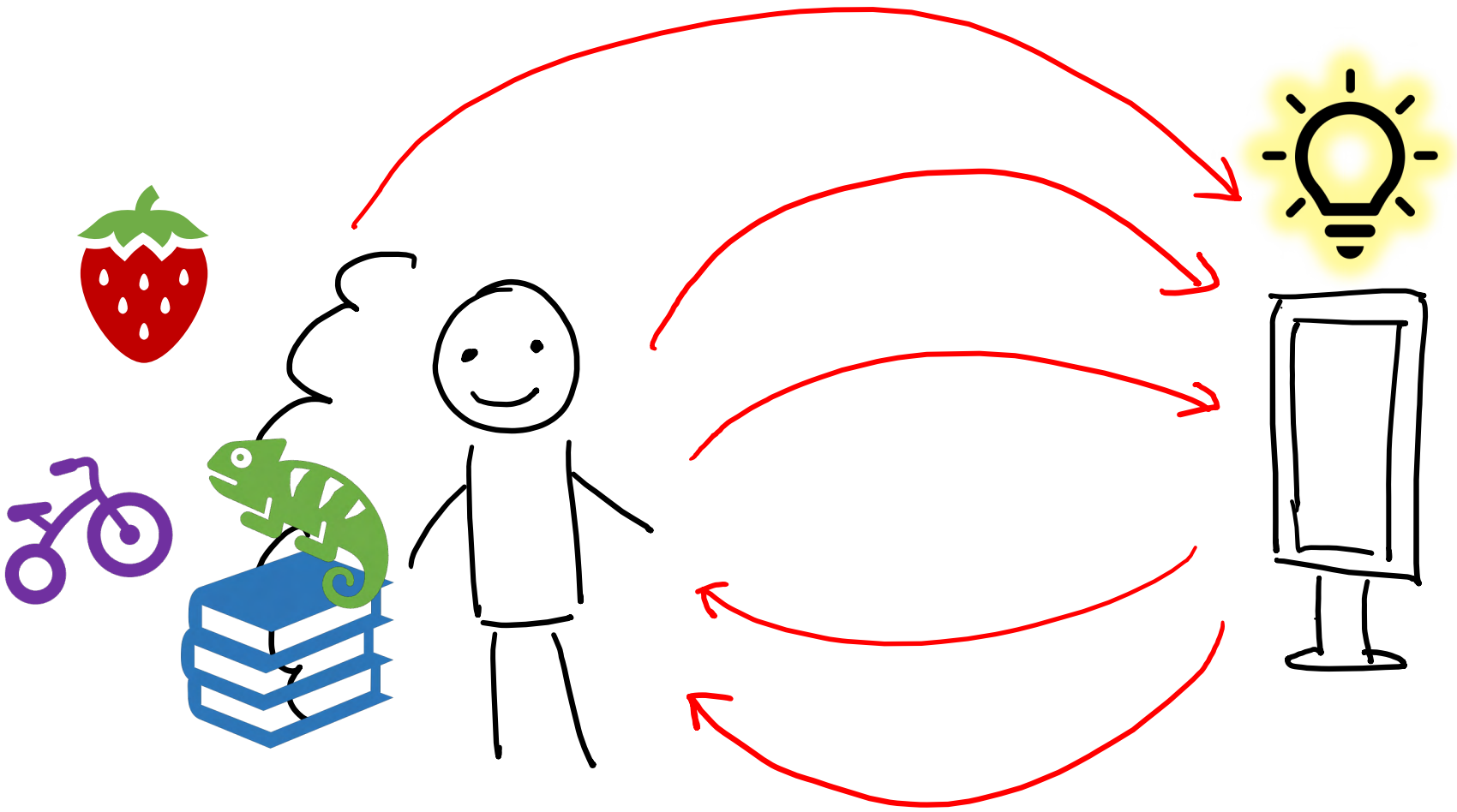
Take My Hand

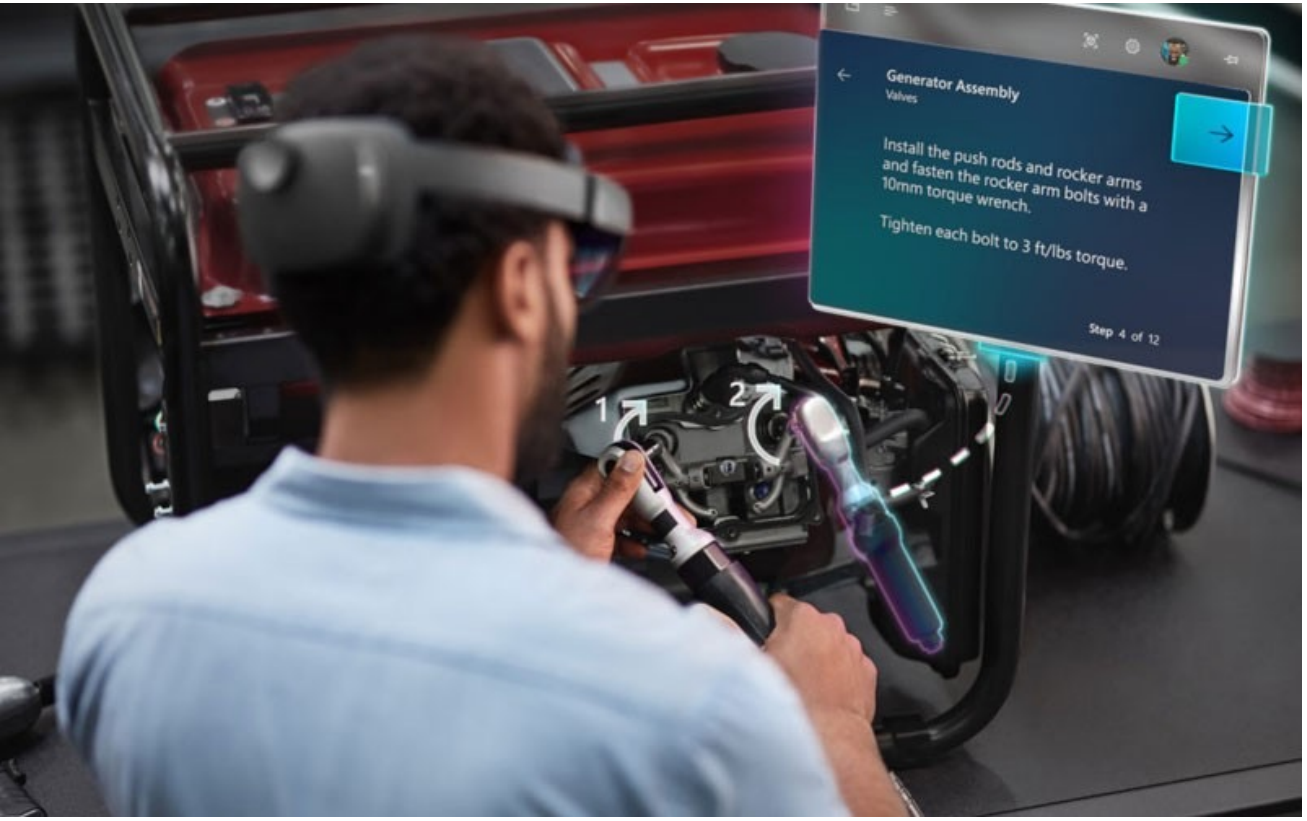
Automated Hand-Based Spatial Guidance for the Visually Impaired

Adil Rahman, Md Aashikur Rahman Azim, and Seongkook Heo
University of Virginia

CHI23
Hamburg, Germany | Hybrid
April 23-28, 2023
reCHInnecting

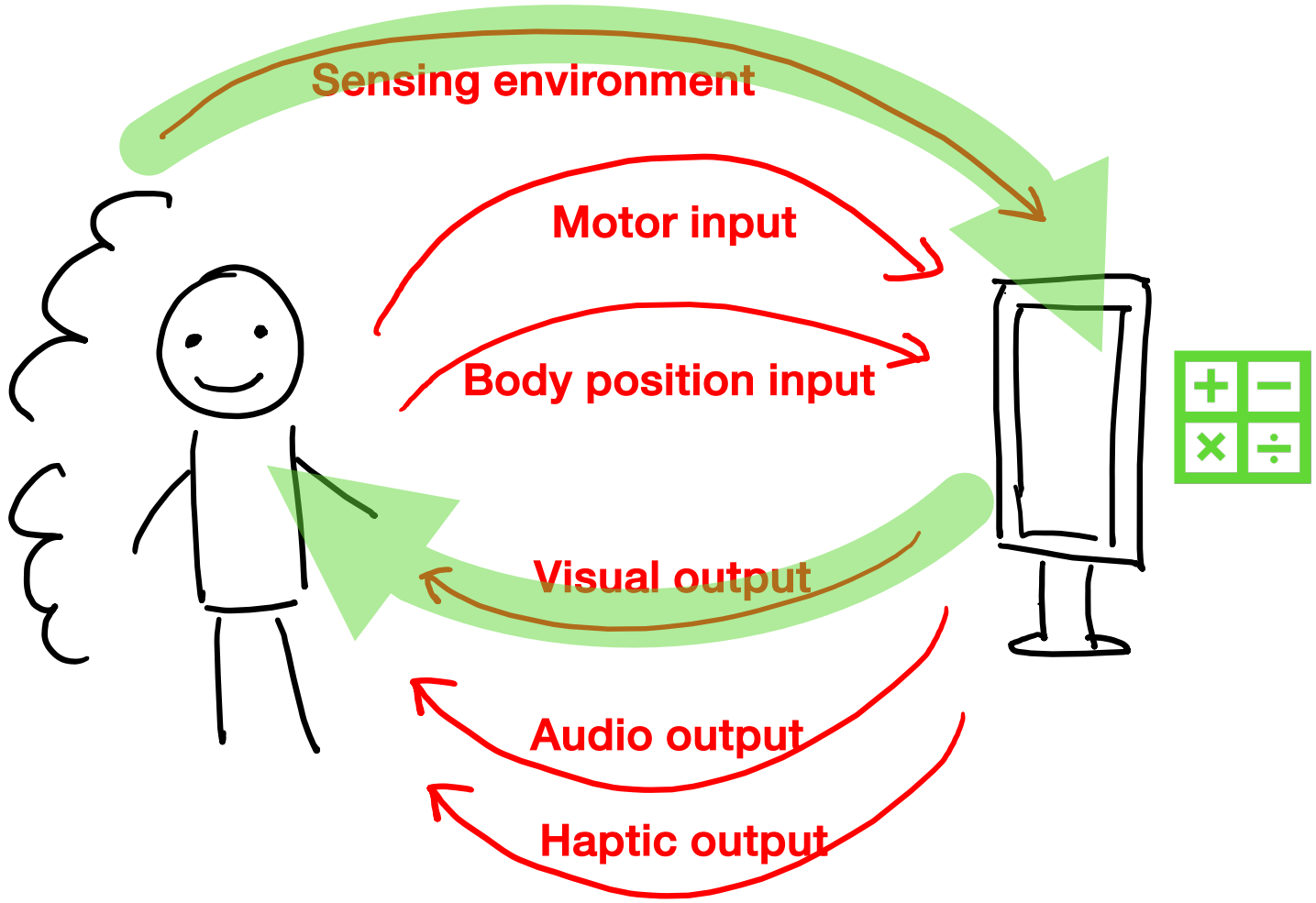
University of Virginia | School of Engineering & Applied Science





Microsoft HoloLens 2

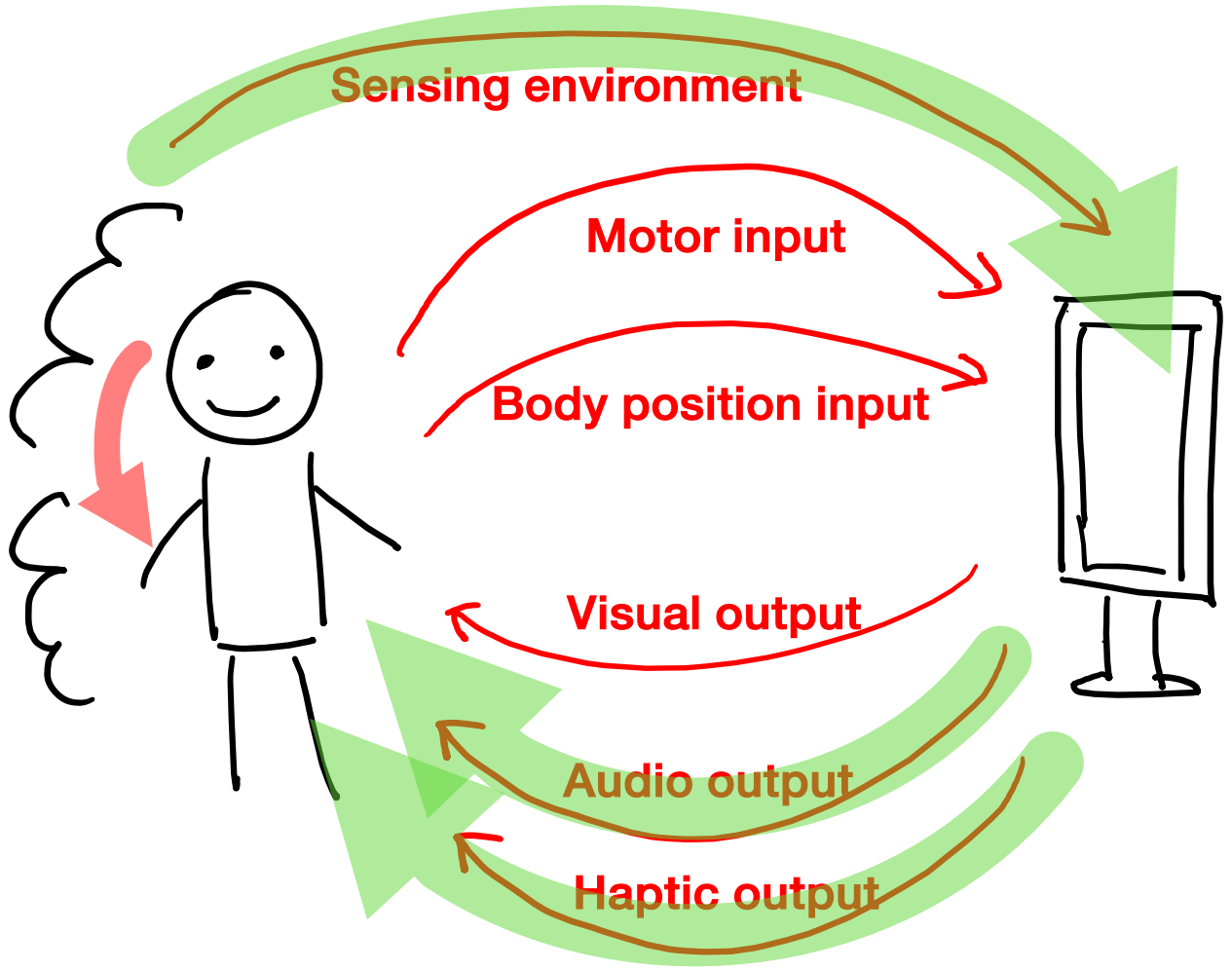
Ruofei Du et al. Opportunistic Interfaces for Augmented Reality: Transforming Everyday Objects into Tangible 6DoF Interfaces Using Ad hoc UI. CHI Demo ‘22


Sensing environment
Motor input
Body position input
Visual output
Audio output
Haptic output

Anhong Guo, Junhan Kong, Michael Rivera, Frank Xu, Jeffrey Bigham. StateLens: A Reverse Engineering Solution for Making Existing Dynamic Touchscreens Accessible. UIST '19

Anhong Guo, Junhan Kong, Michael Rivera, Frank Xu, Jeffrey Bigham
StateLens: A Reverse Engineering Solution for Making Existing Dynamic Touchscreens Accessible, UIST '19

Jonggi Hong, Alisha Pradhan, Jon E. Froehlich, Leah Findlater
Evaluating Wrist-Based Haptic Feedback for Non-Visual Target Finding and Path Tracing on a 2D Surface, ASSETS '07


Sensing environment
Motor input
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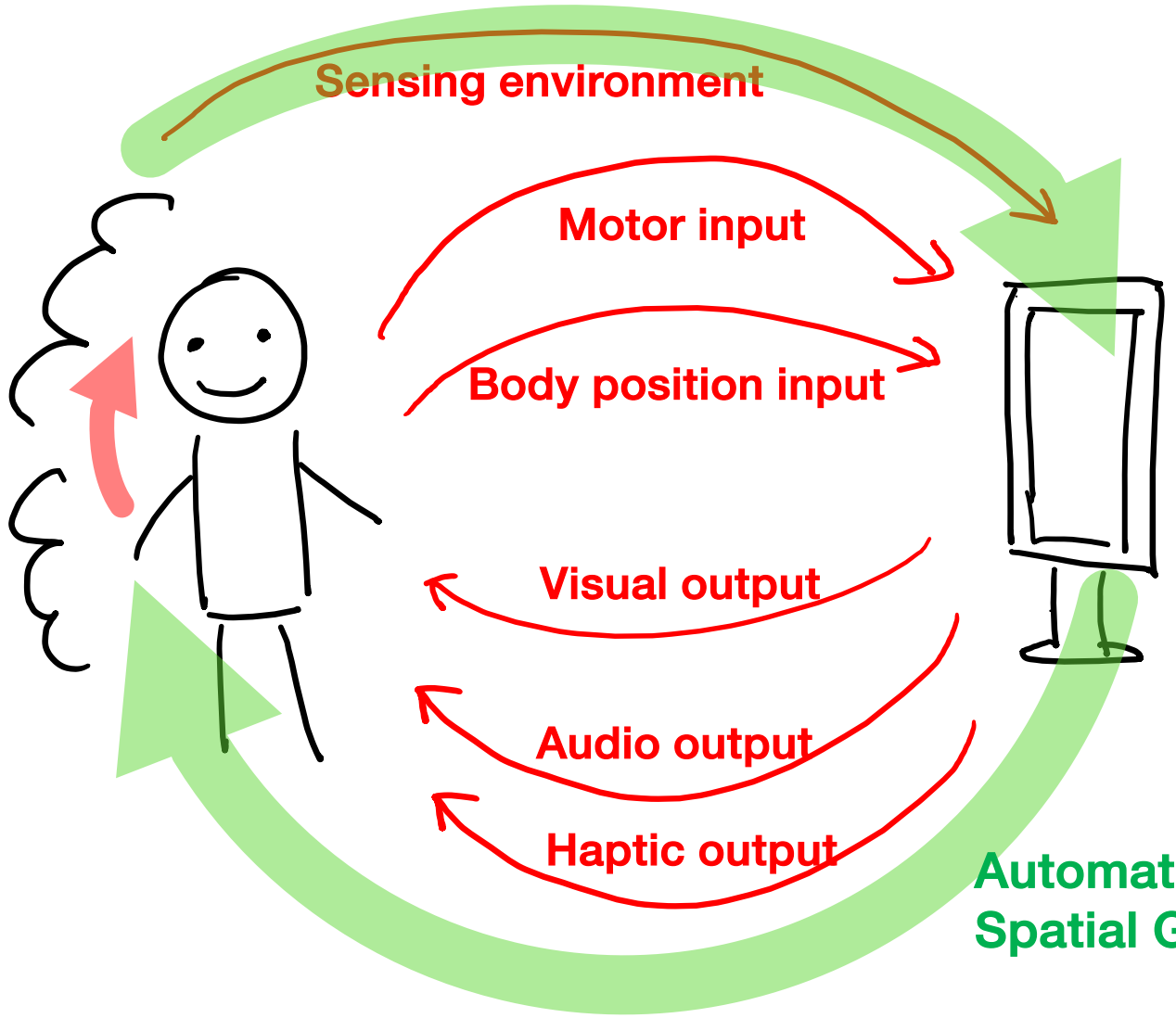
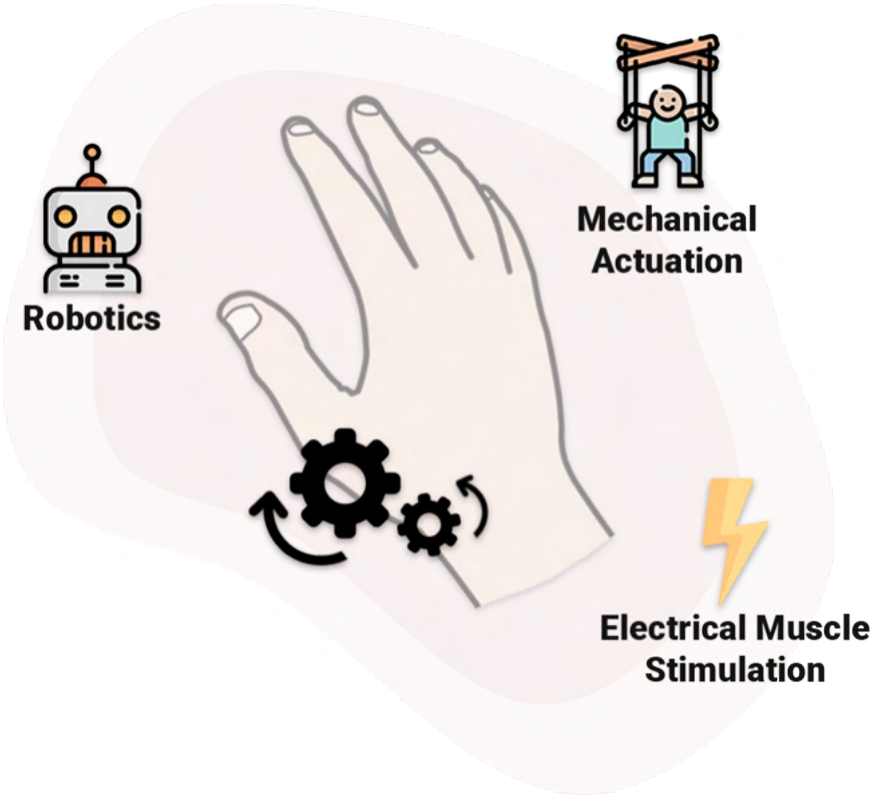
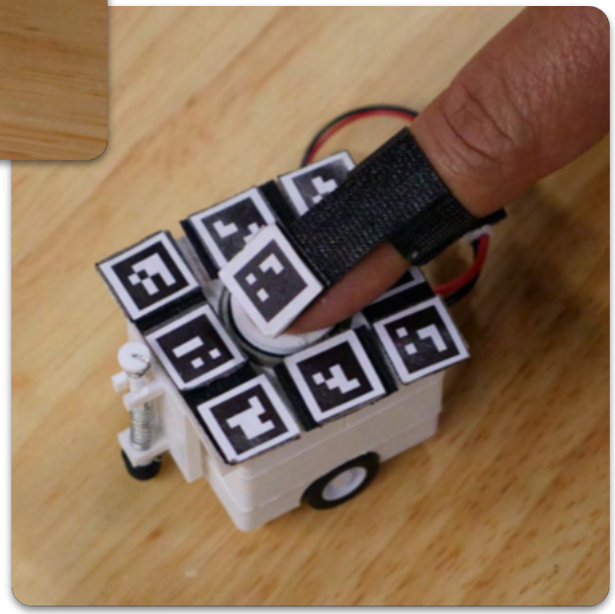


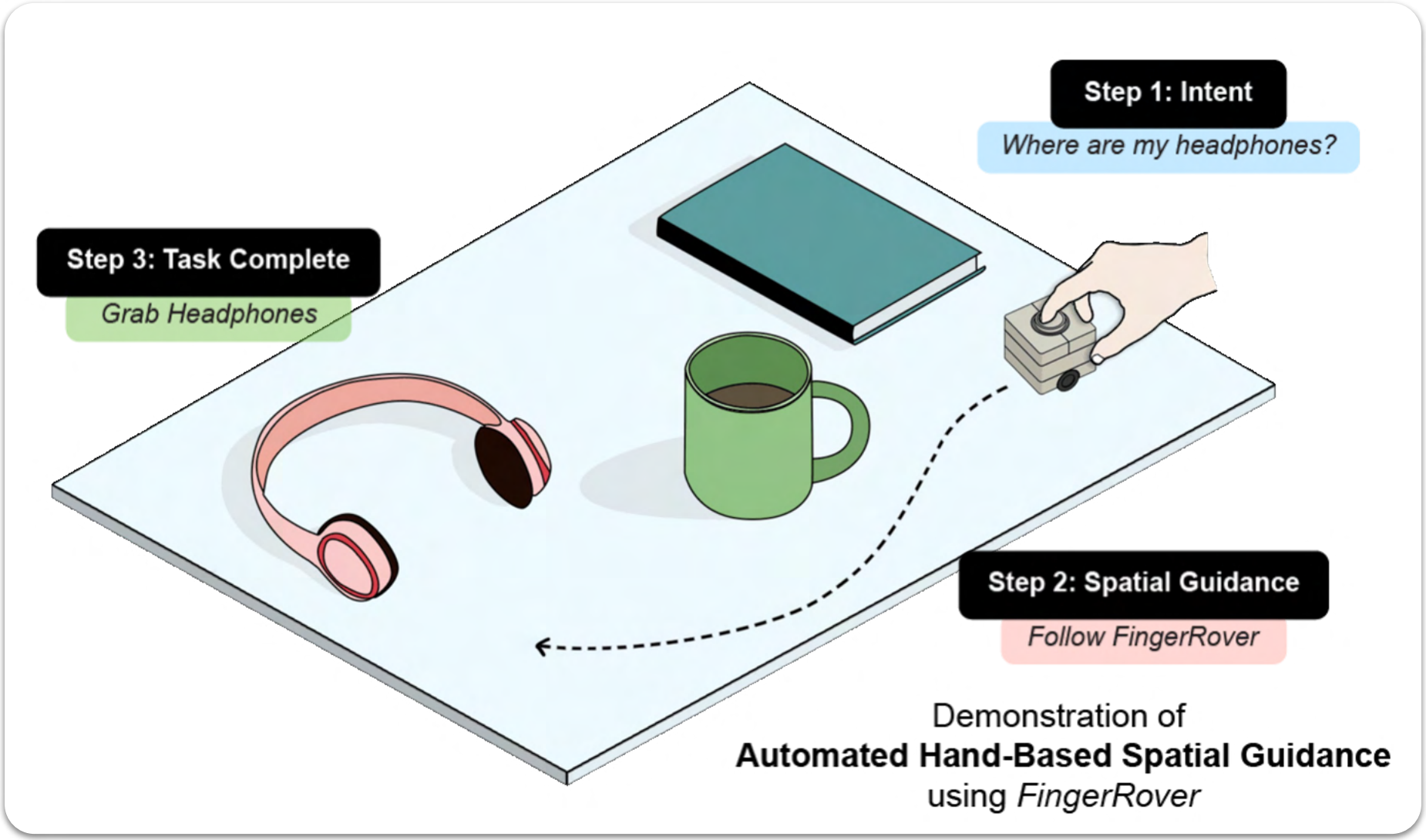
Automated Hand-based
Spatial Guidance



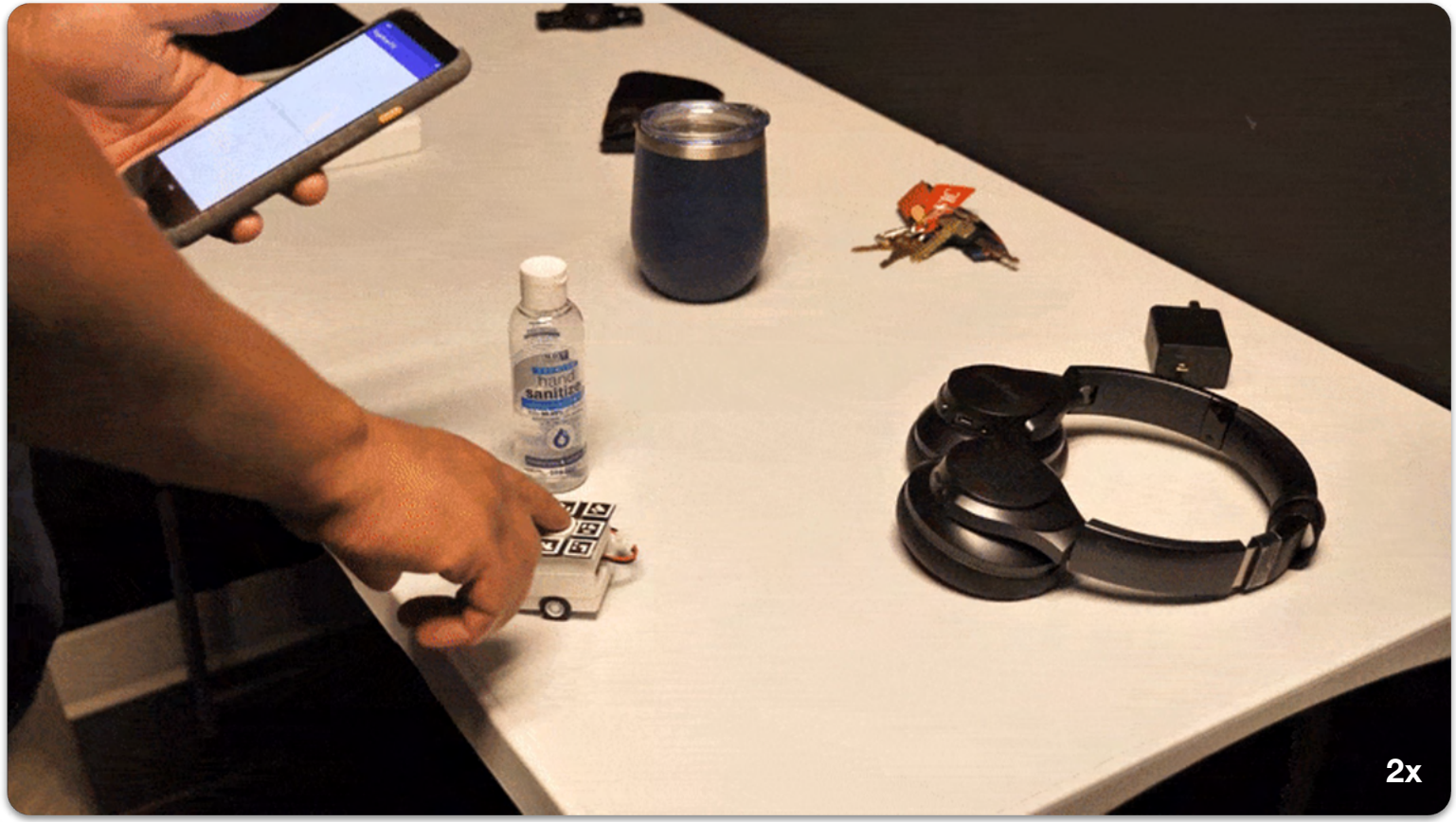
There are several ways of actuating the user’s hand.



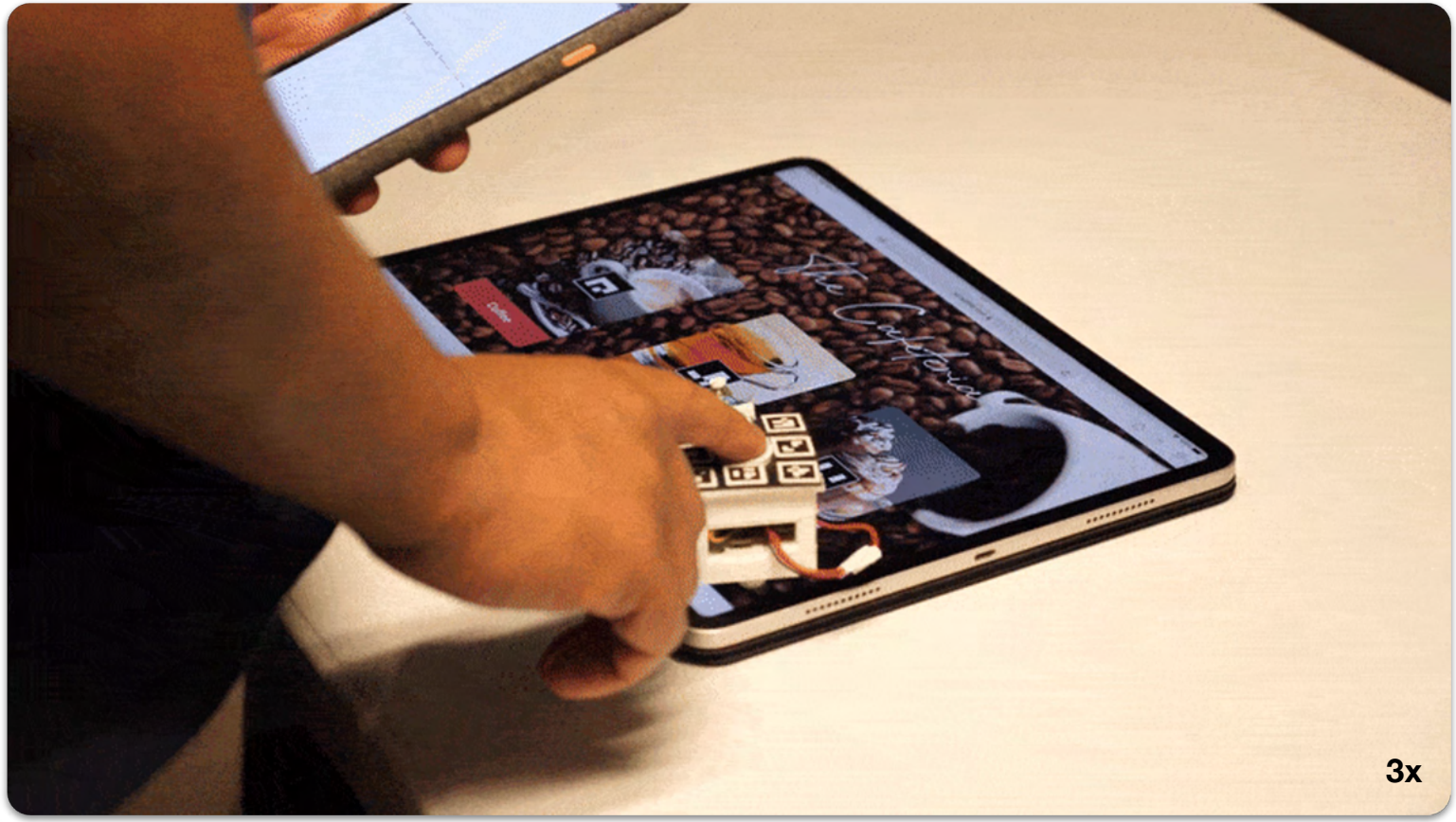
In this work, we achieve this using **FingerRover**, an *on-finger* miniature robot.


Step 1: Intent
Where are my headphones?
Step 3: Task Complete
Grab Headphones
Step 2: Spatial Guidance
Follow FingerRover
Demonstration of
Automated Hand-Based Spatial Guidance
using FingerRover

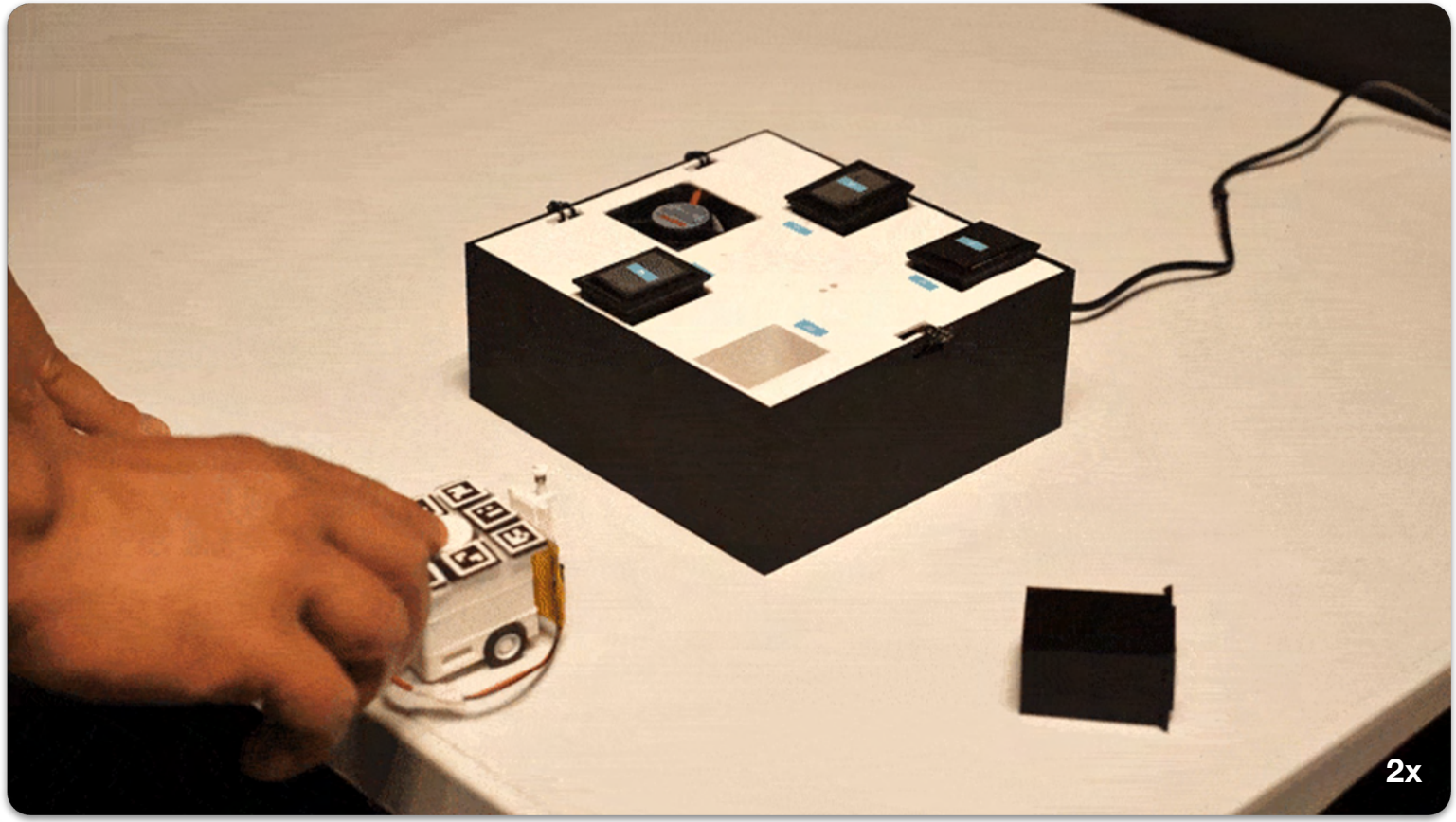
Locating Objects



Operating
Touchscreen



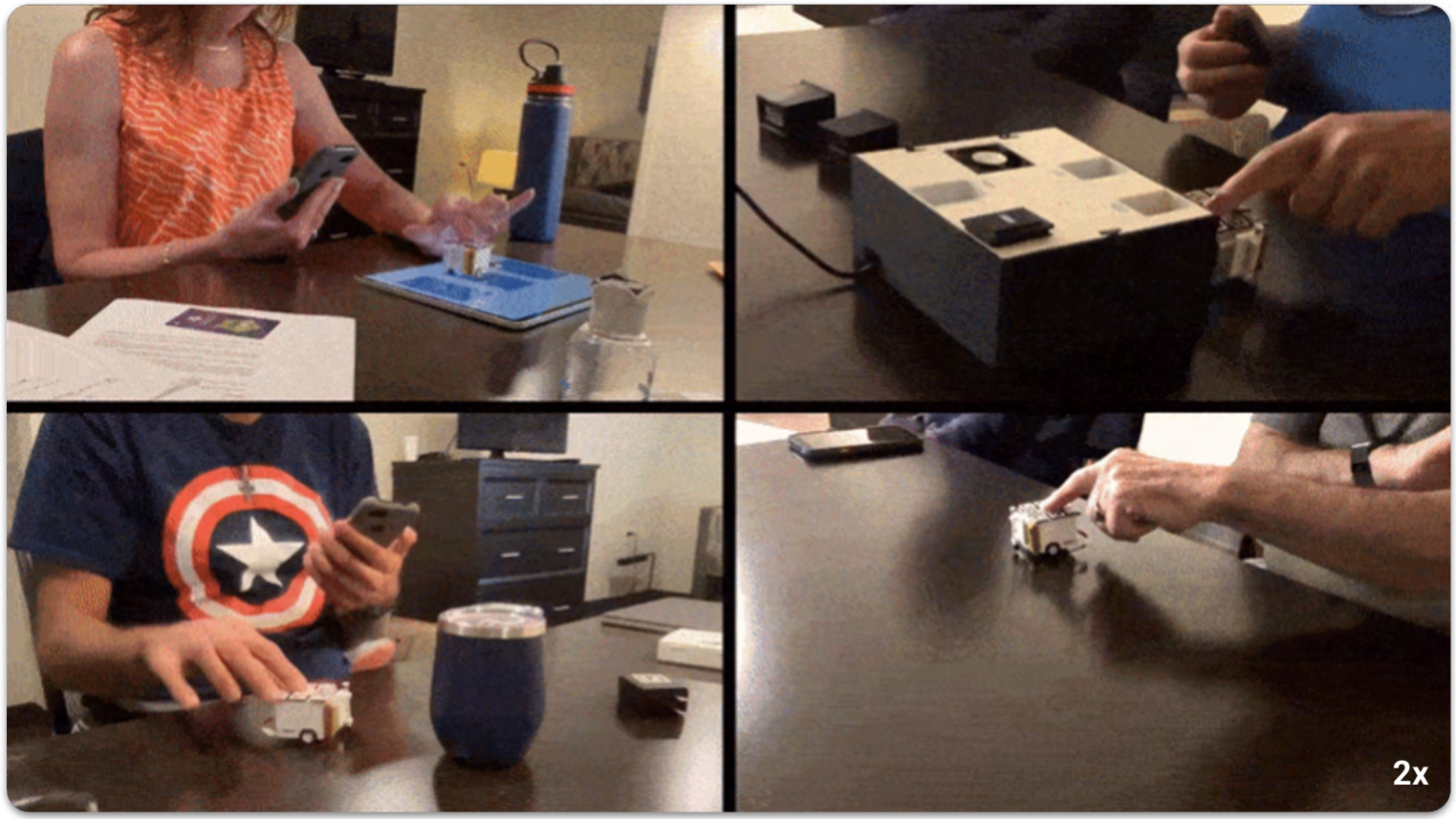
Assembling Objects



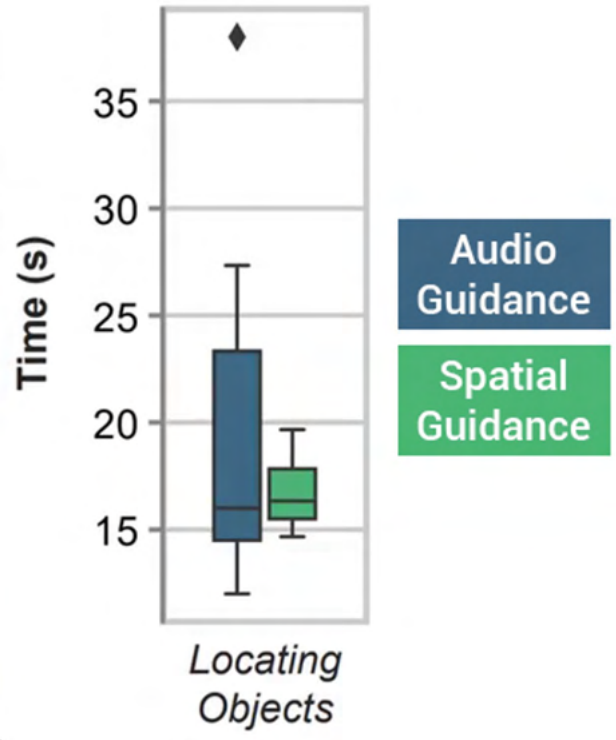
Shape
Sensemaking

We conducted an **exploratory user study** with 7 visually impaired participants to test the effectiveness of automated hand-based spatial guidance in **supporting interactions for BVI individuals**.

Participants were able to easily adapt to spatial guidance, and found it to be effective in guiding their hands.



Task 1: Locating Objects

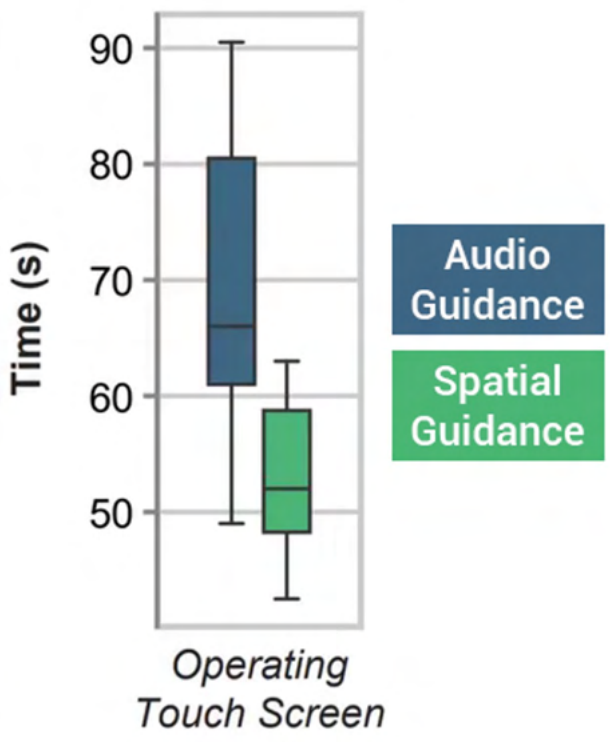


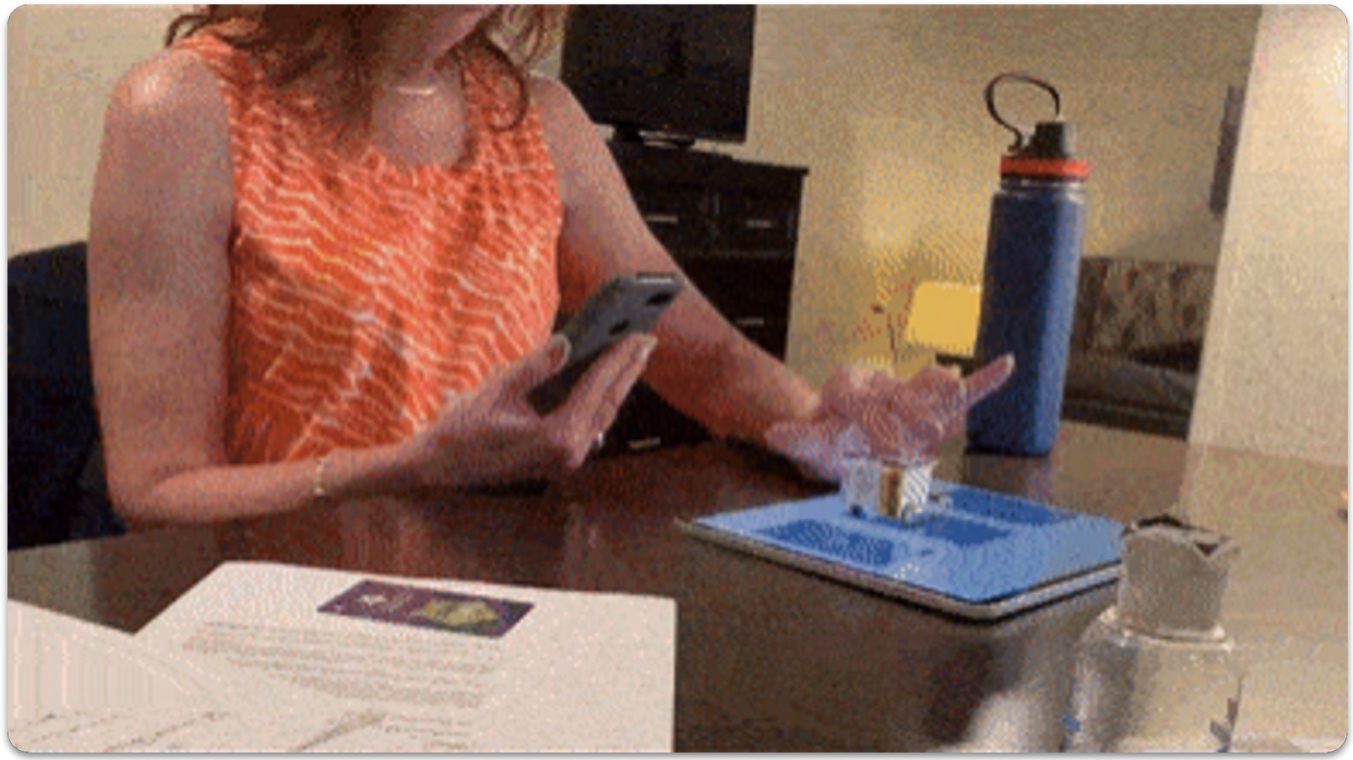
Task 1: Locating Objects

“I feel [the robot] is a little safer because it will navigate around objects, as opposed to just the audio where I could knock something over to get to something else” (P5)

“A couple of objects were next to each other, so I could’ve certainly picked up the wrong thing [using audio guidance]. I think the robot was better than the audio. I was able to find everything that you asked me to instantly.
I didn’t pick up the wrong things” (P3)

Task 2: Operating Touchscreen



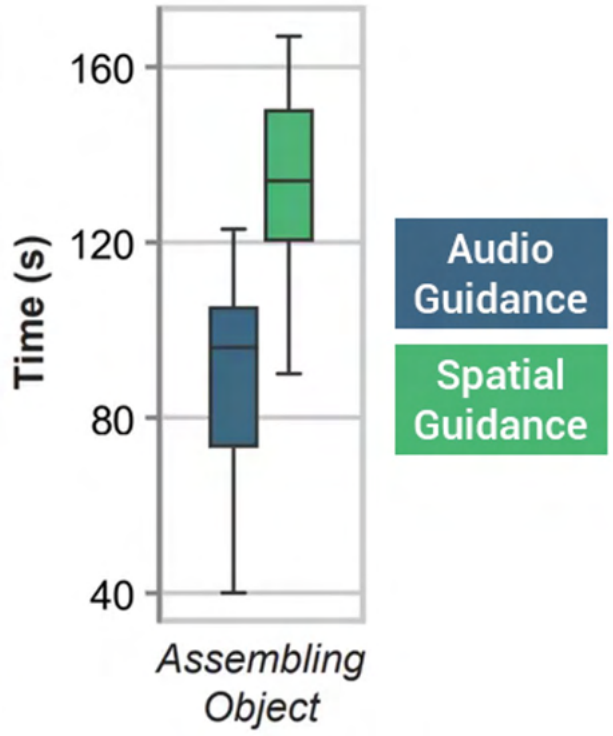


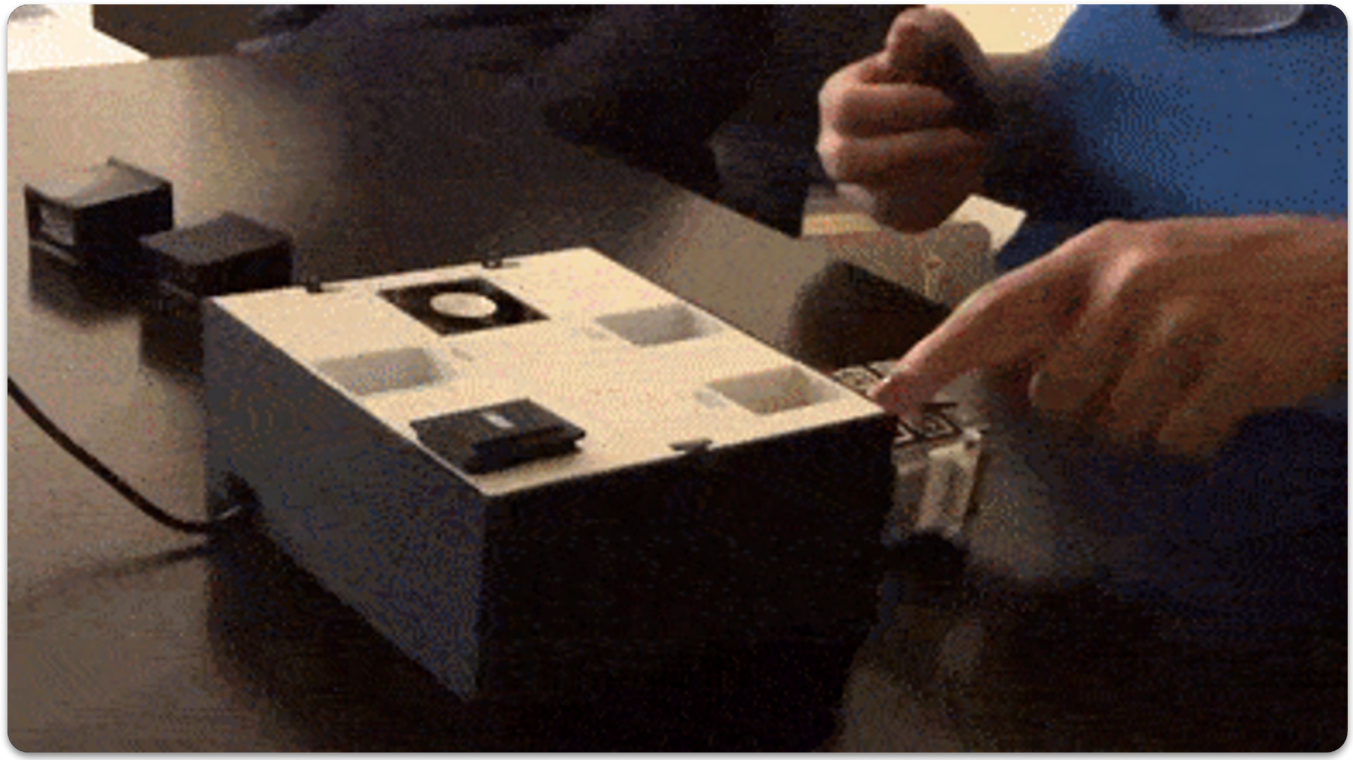
Task 2: Operating Touchscreen

“I liked that the robot gives you haptic and auditory feedback. So you actually have something that you can touch as it moves across the screen” (P2)

“[The interaction] was very simplistic, which is good. There was a natural flow, because the menu can change, but your actions remain the same.” (P6)

Task 3: Assembling Objects





Task 3: Assembling an Object

“It’s easier to pick things up [using the robot] if they’re in a jangled mess.” (P3)

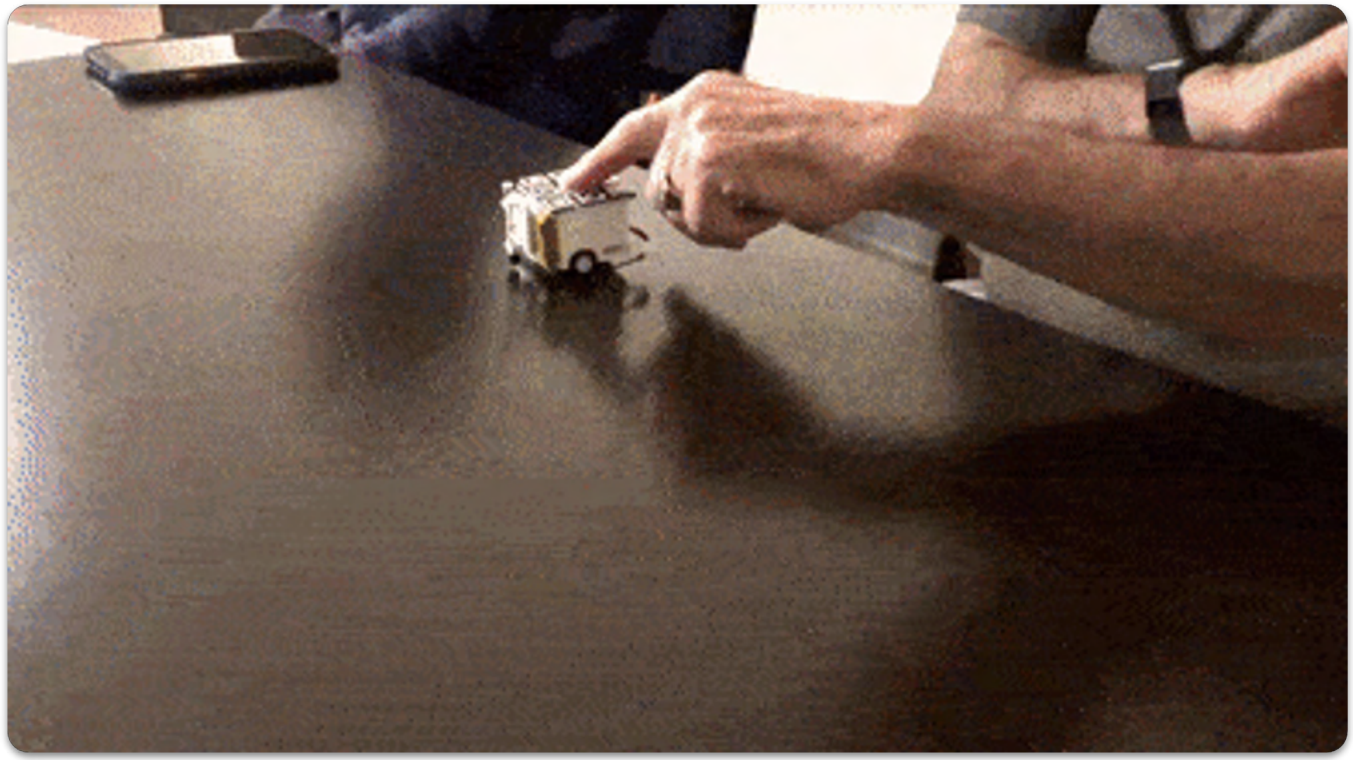
P1 commented that unclear verbal instructions could also lead to potential misunderstandings between the user and the guide, which could be avoided by using the robot, as the guide would have explicit spatial controls.

Task 4: Shape Sensemaking

Shape 1: Triangle (7/7)

Shape 2: Square (5/7)
Trapezoid (1)
Hexagon (1)

Shape 3: Rhombus (0/7)
Off-Angled Square (1)
Square (2)
Parallelogram (1)
Rectangle (3)



User Agency

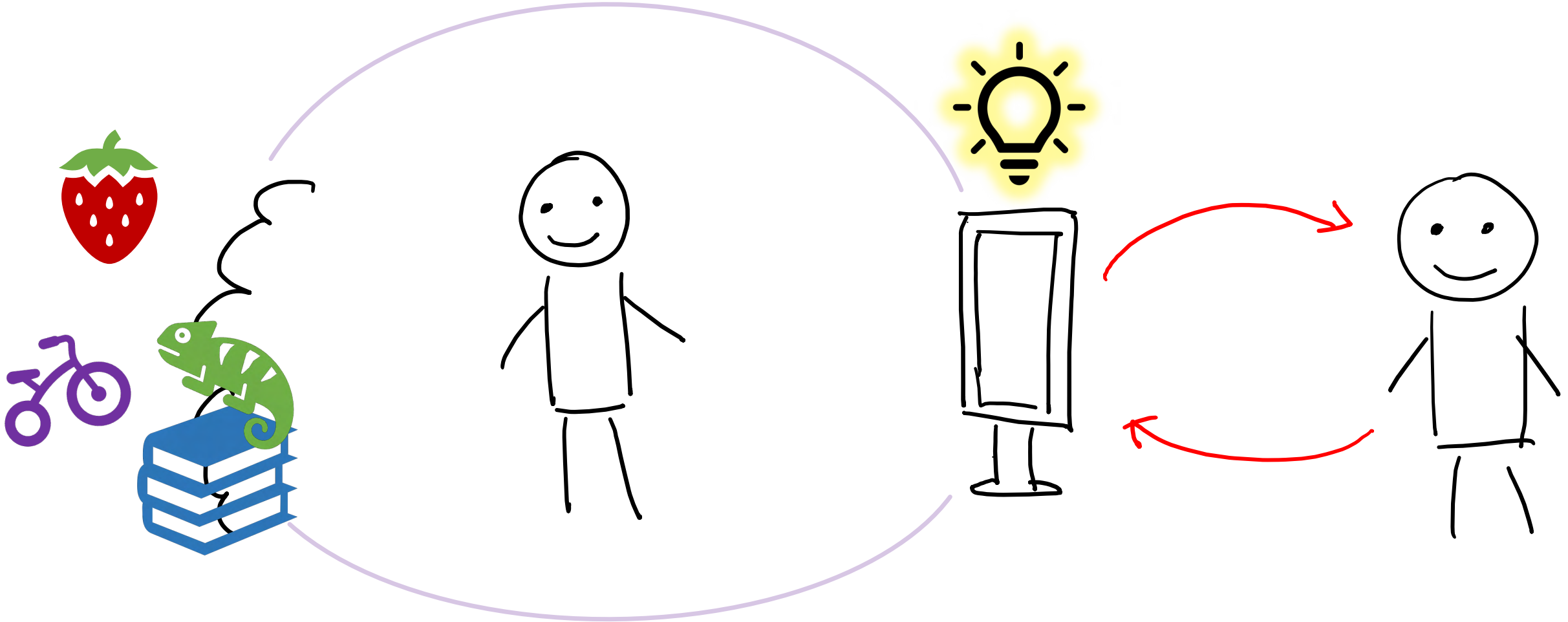
While the idea of automated hand-based spatial guidance may be promising, the **susceptibility** of this technique to **possible risks** *must not be overlooked*.

Since this technique takes the task of controlling the user's hands off the user, **the user may relax their agency**. And this can be **particularly dangerous** if the **system gets compromised**.

Safety *must* be carefully considered when designing automated hand-based spatial guidance systems.

In our study, **users unanimously agreed** that they felt **completely in control over FingerRover**, and that they could stop following the guidance at any point by simply lifting their fingers.

FingerRover, as a device, is **not strong enough to override the user's agency** – it moves **ONLY** if the user wants it to move.



Capabilities and Limitations of the Two Worlds are different

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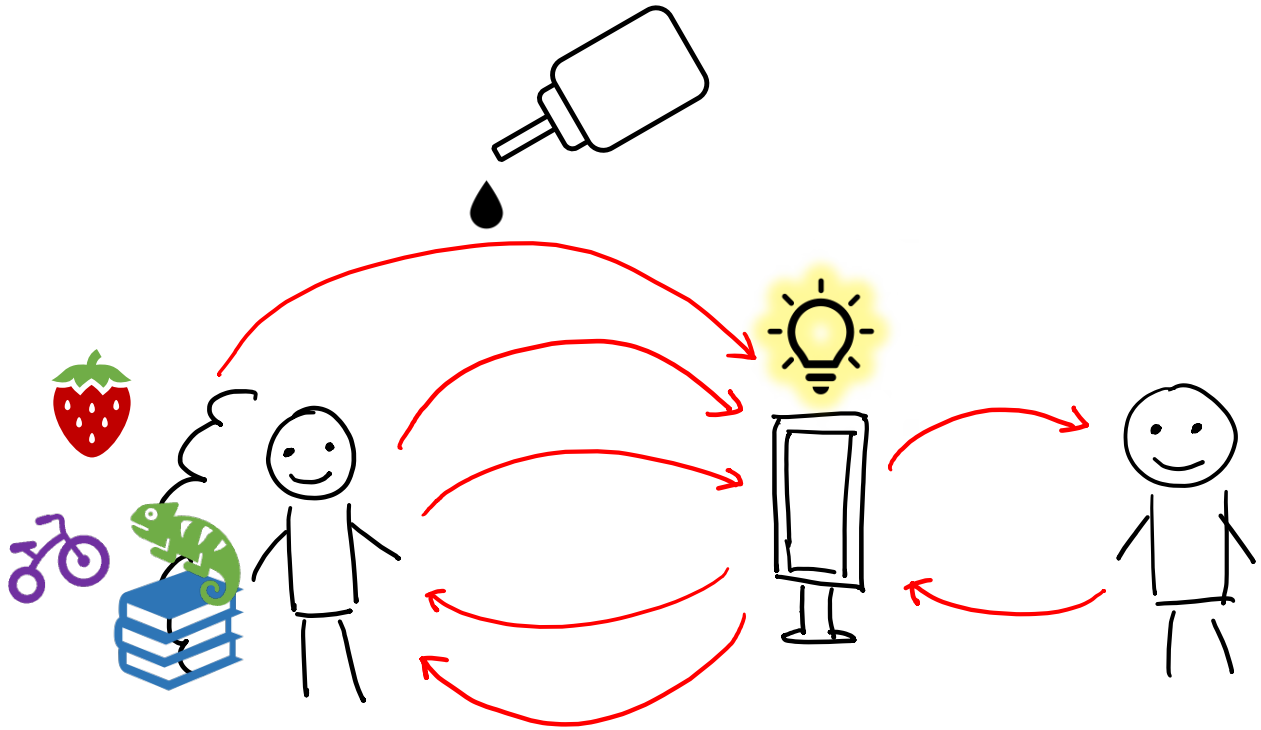

Wen Ying

Erzhen Hu