

Perception-Action Coupling in Active Telepresence



Wearable System

I). HTC VIVE Headset x 1

II). Backpack with Laptop

III). Camera x 5 :

Eye-in-body {
Head Camera
Left-Hand Camera
Right-Hand Camera
Tethered Camera

Eye-to-hand ← Workspace Camera

IV). Tracker x 8 :

Elbow x 2 (left / right)

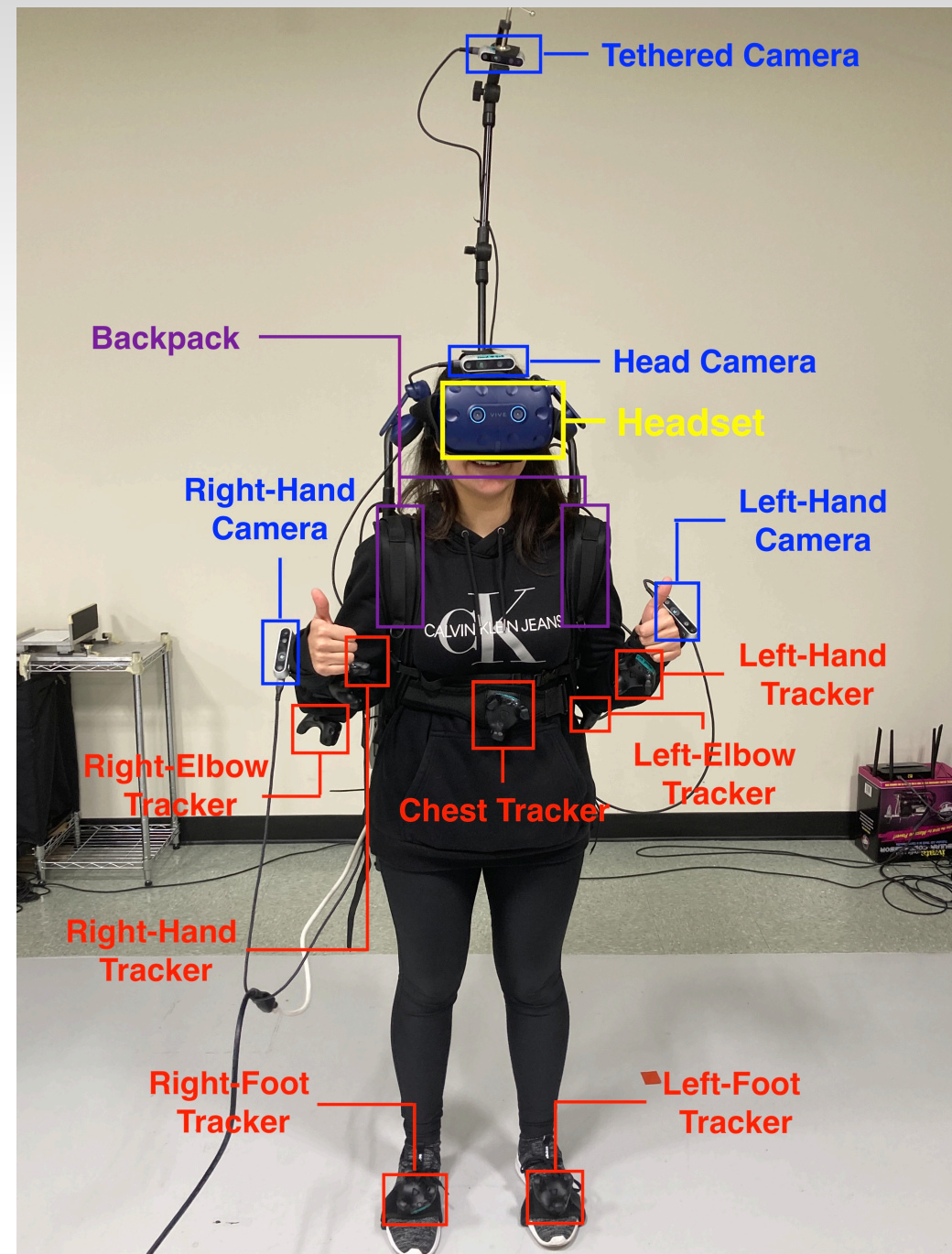
Hand x 2 (left / right)

Foot x 2 (left / right)

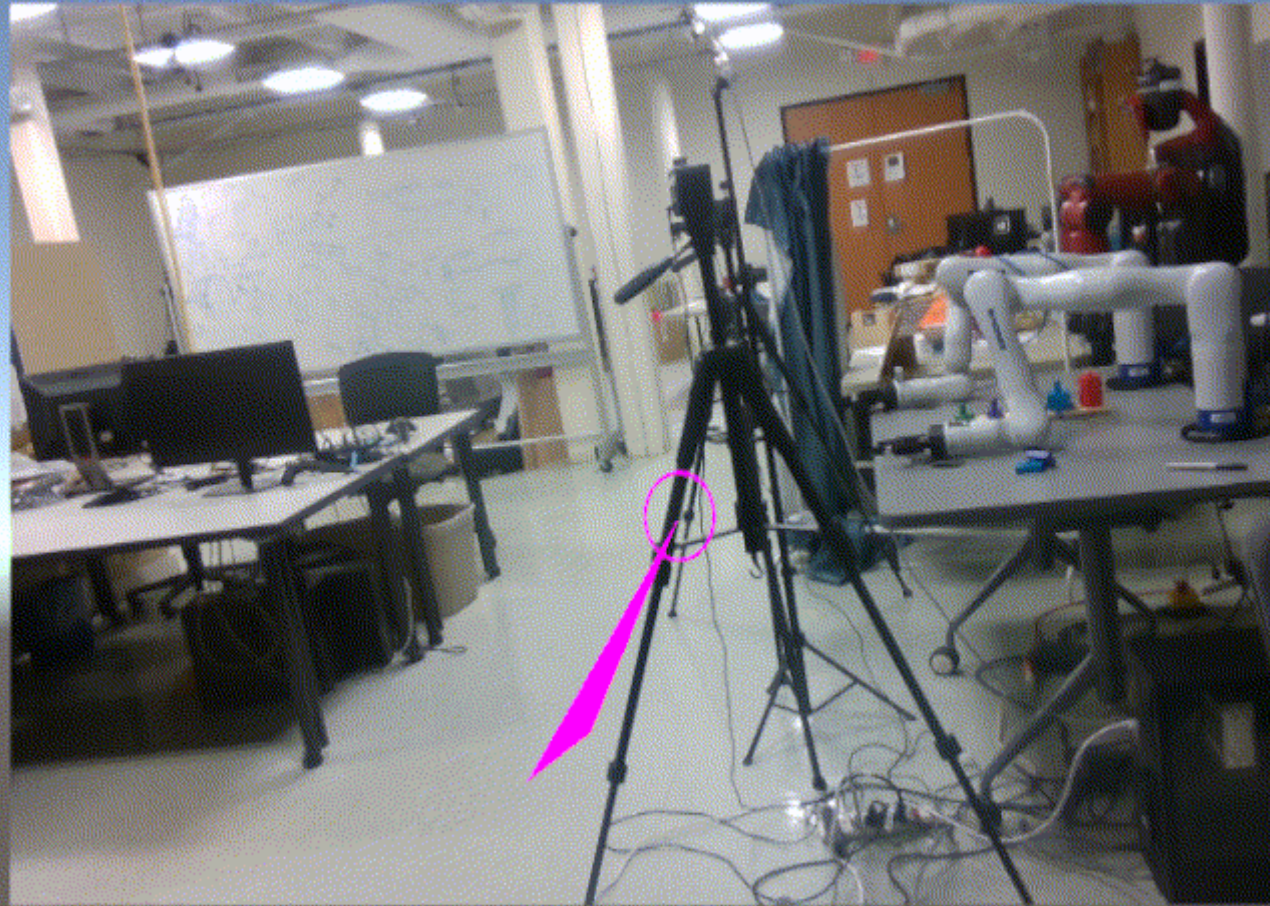
Head (Headset built-in)

Chest

V). Base Station x 4

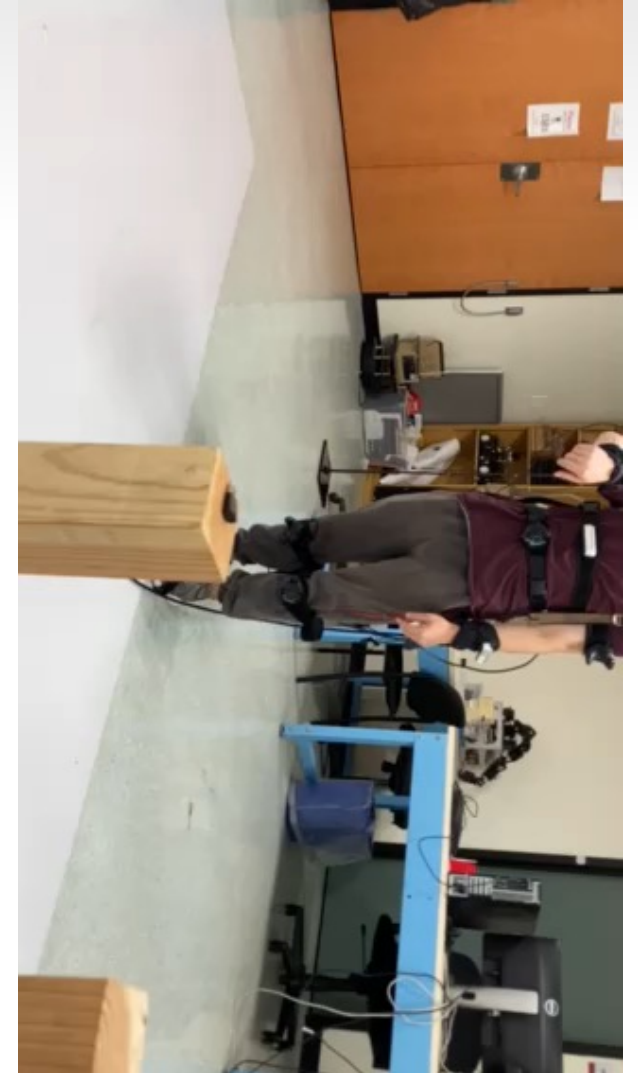
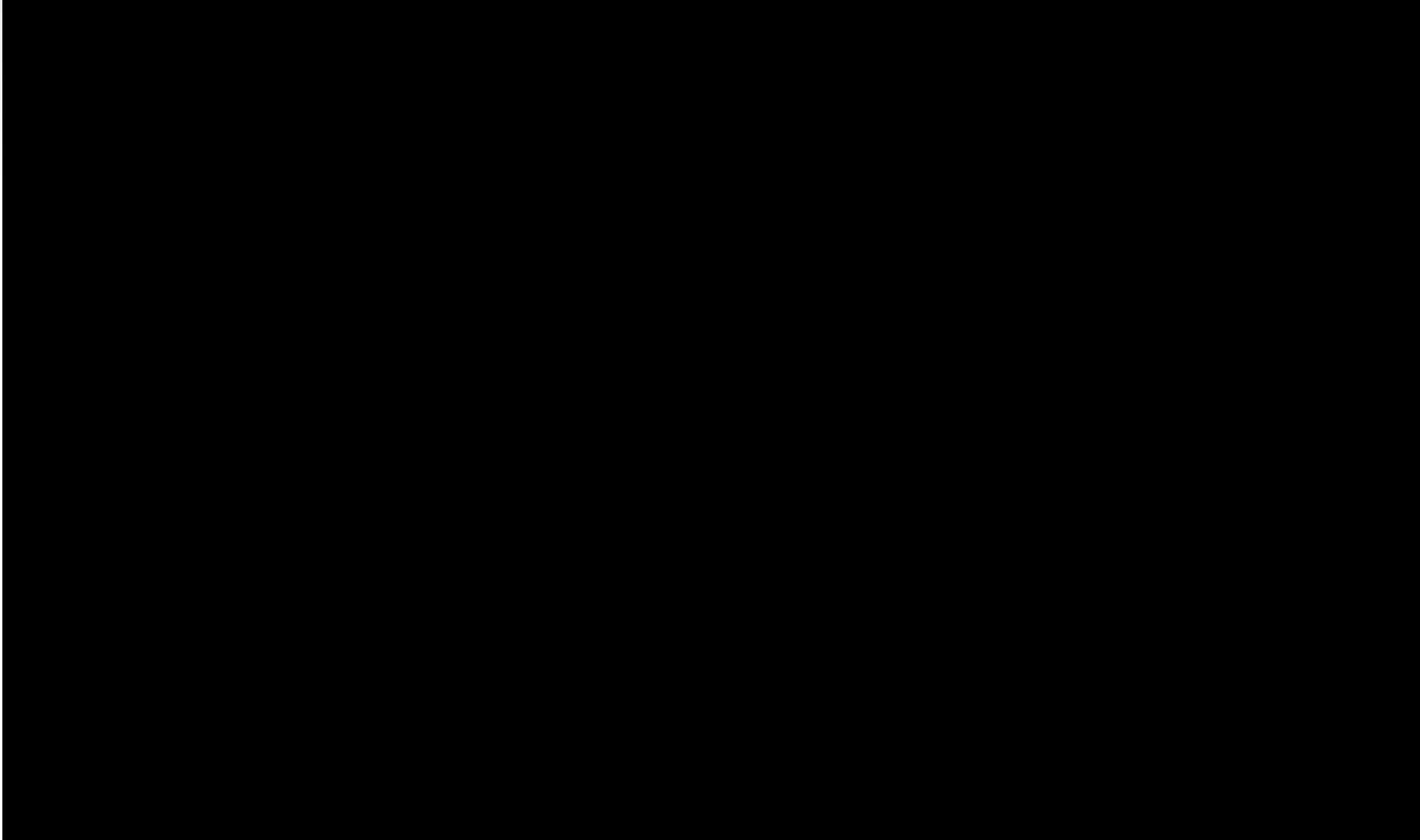


Gaze Tracking



Pixel Coordinates: (1014.21, 465.19)

Wearable System Video Demo

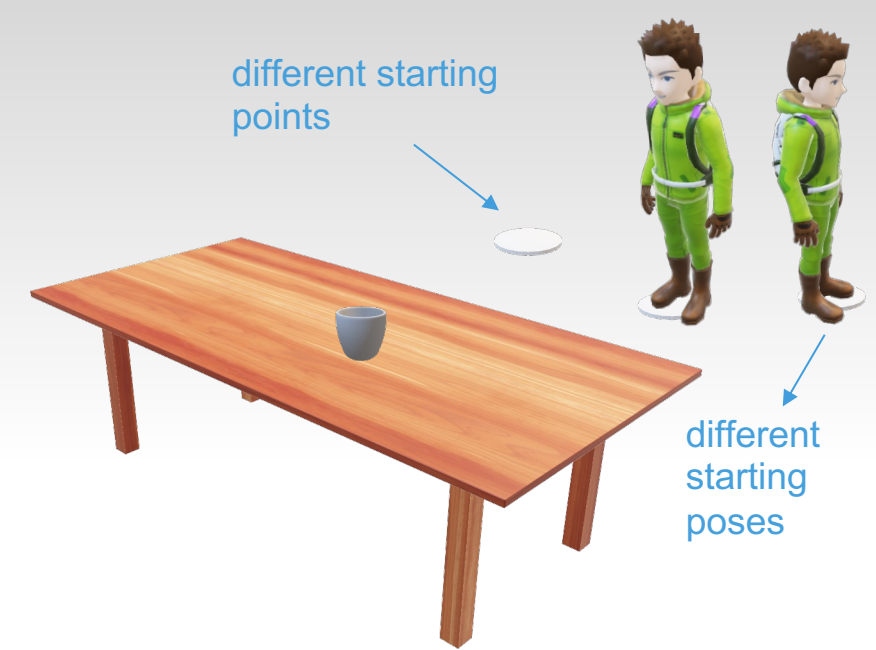


Experiment Design

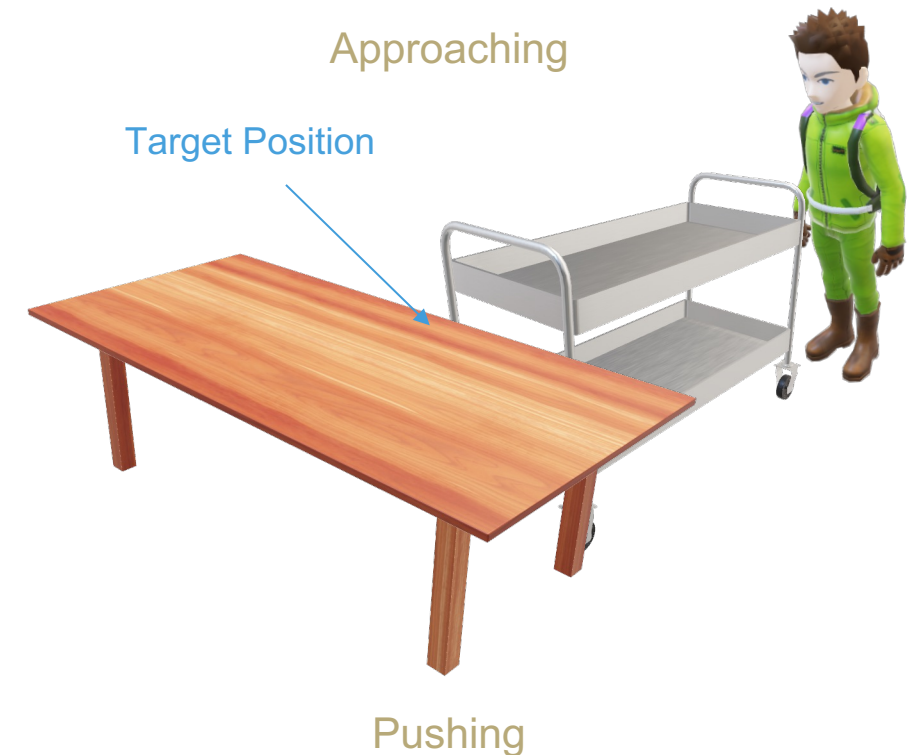
User Study Design

Task: Loco-Manipulation

- **Primitive Action** = Approaching, Pushing
 - **Object Size** = stick (slim), office chair (medium), wheeled workbench (bulky)
- **Approaching**
- User is to approach and hold objects within different starting points and poses
- **Pushing**
- User is to put cart to reach the target position
 - Camera/Task Order and starting points/poses are randomized
 - 3 trials for each task



Approaching

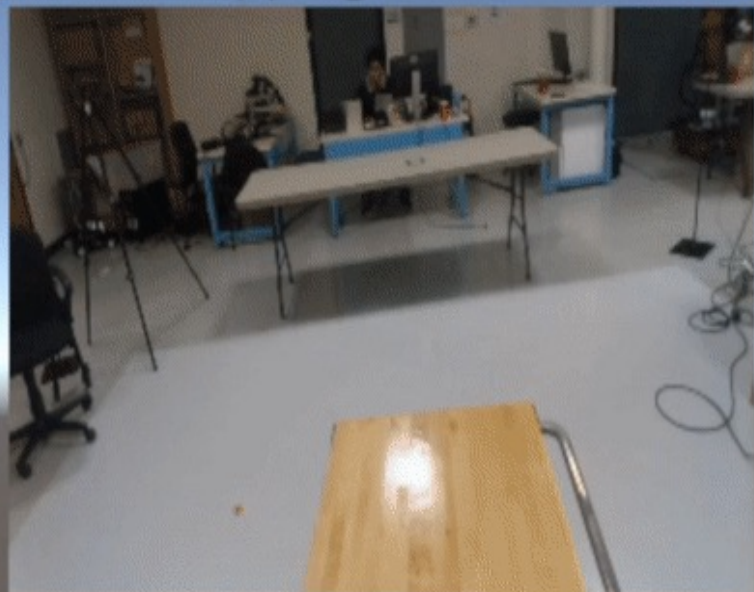


Gaze Stopping Time: 0s



Pixel Coordinates: (803 23 591 25)

Gaze Stopping Time: 0.261s

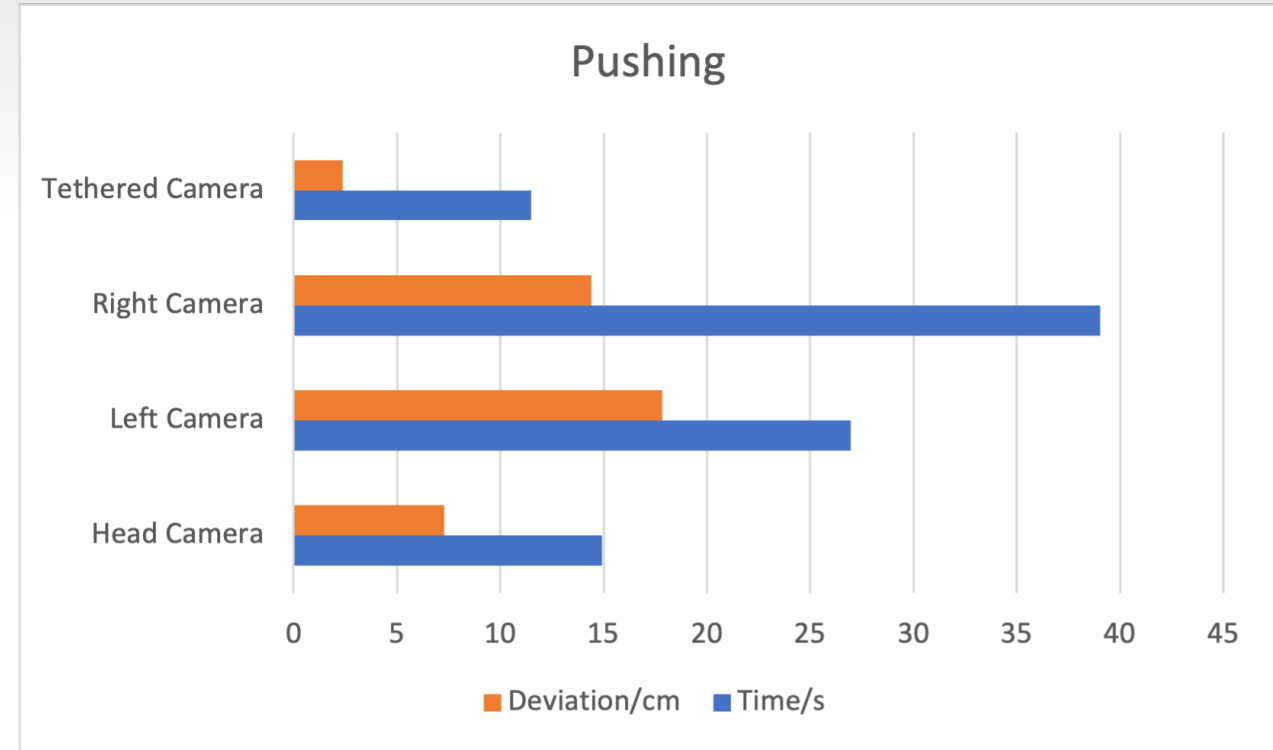


Pixel Coordinates: (1242 46 313 16)



Pushing a wheeled workbench

- **Head Camera**
 - The way as normal, but not most efficient
- **Right-Hand Camera**
 - **Problem** = Used as dominate hand for both pushing the cart and navigation
 - ☐ **Consequence** = Most time to perform task
- **Left-Hand Camera**
 - **Problem** = Jerk and FOV tendency
 - ☐ **Consequence** = Most deviation distance
- **Tethered Camera** = Most preferred
 - **Problem (Subject)** = It would be extremely hard for the subjects to judge if the front finishing line has been reached while pushing (Limited Perception Affordance problem)
 - ☐ **Suggestion** = Need other sensory feedback (e.g. attach sensor in the front of cart)



Data Analysis

Mobility Tasks Design

- **Navigation** =
 - Passibility = passing corridor, turning around corner, passing a door;
 - Long-distance = goal-directed navigation, way-point navigation;
 - Approaching = human, counter workspace;
- **Loco-manipulation** = moving IV stand (slim), office chair (medium), wheeled workbench (bulky)
- **Perception** =
 - Search = Searching for a target in a room;
 - Coverage = Explore entire workspace, e.g., showing a tour through telepresence, taking picture of landmarks?
- **Condition** =
 - Environment = with/out obstacles; wide vs narrow;
 - Speed = comfort pace vs time-pressure;
 - Social = with/out human pedestrians;

Metrics

Objective = 1). Task Performance Time, 2). Errors made (e.g. times of running into obstacle collisions),

Subjective = 1). NASA-TLX, 2). SUS, 3). User Interview (Usability, Workload, Cybersickness)