

# WHEEL2VR: GAZE-CONTROLLED DUAL ROBOTIC ARMS FOR ASSISTIVE WHEELCHAIR INTERACTION IN VIRTUAL REALITY

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## INTRODUCTION

- Individuals with **tetraplegia** require independence for daily grasping tasks.
- However, current wheelchair-mounted robotic arms (WMRAs) rely on inaccessible physical joysticks and typically offer **only single-arm functionality**.
- We developed Wheel2VR, a Unity VR system featuring **two gaze-controlled robotic arms**.

## QUESTIONS

Does **AI-assisted shared control** reduce workload compared to **fully manual control** for dual-arm wheelchair manipulation in VR?

Which gaze input method (**head-tracking vs. eye-tracking**) do users prefer for controlling wheelchair-mounted robotic arms?



## METHODS

### STUDY DESIGN

18 participants tested the system

**Task:** Coordinated two-handed pill bottle opening

**Comparison:** Manual vs. AI-assisted Shared Control.



Fig 1: Gaze-based UI with AI/Manual modes

### METRICS

QUANTITATIVE
<b>NASA-TLX</b> Workload (6 subscales, 21-pt)
<b>SUS</b> System usability (0-100)
<b>Completion Time</b> Task duration in minutes
<b>Button Presses</b> Interaction load count
<b>Input Preference</b> Eye vs. head tracking choice

QUALITATIVE
<b>Prior VR Exp.</b> Self-reported familiarity
<b>Post Interviews</b> Open-ended feedback
<b>Control Feeling</b> Perceived sense of agency
<b>AI Perception</b> Trust & predictability
<b>Suggestions</b> Improvement ideas



Fig 2: Two-handed pill bottle task

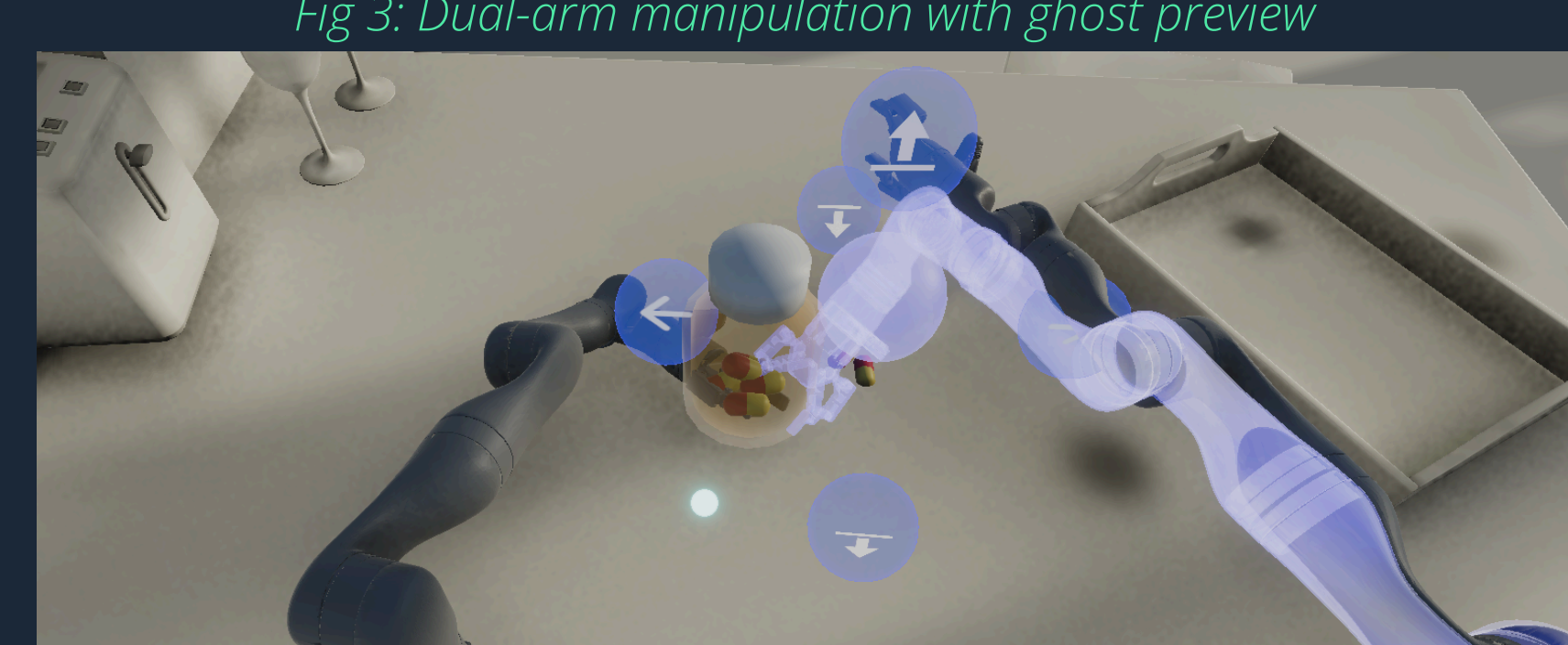
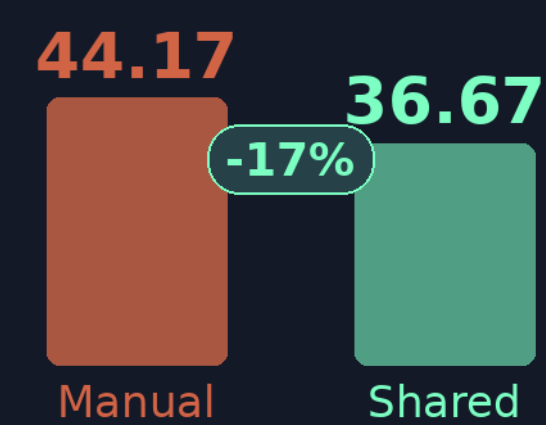


Fig 3: Dual-arm manipulation with ghost preview

## RESULT AND DISCUSSION

### LOWER WORKLOAD

NASA-TLX Score



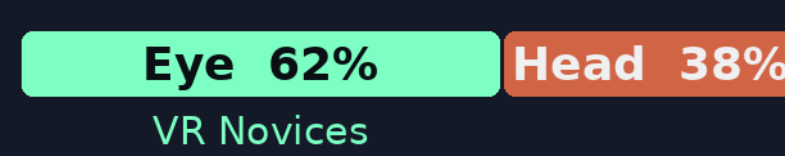
$p = .032$  (Wilcoxon)

### INPUT PREFERENCE

VR Novice Preference

62%

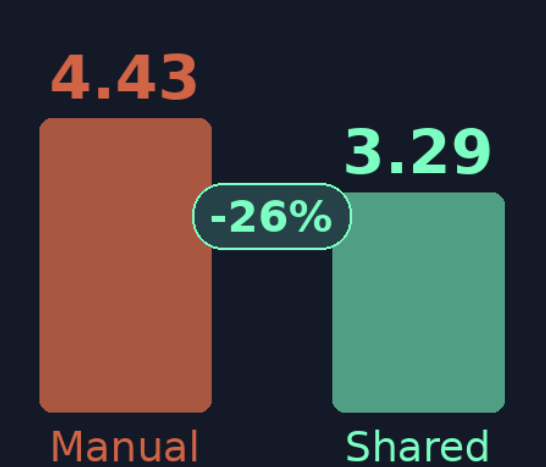
chose Eye-Tracking



$n = 8$  novice participants

### FASTER EXECUTION

Minutes to Complete

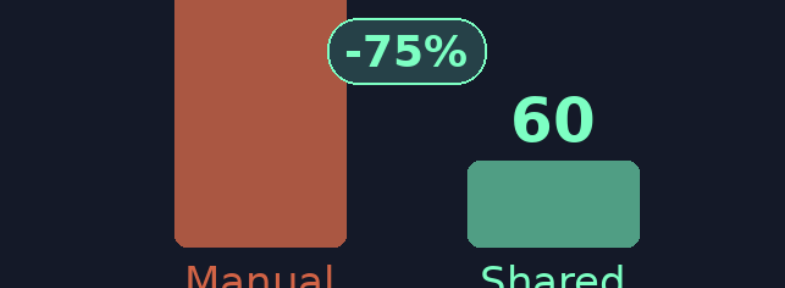


descriptive ( $p = .495$ )

### LESS INTERACTION

Median Button Presses

241



$p = .009$  (Wilcoxon)

Figure 4: Observed interaction load and time by sequence and participant

