Immersive XR-based Behavioral Analytics IntegratingVisual Strategy and Game Design for Early Detection of Mild Cognitive Impairment in Older Adults

Skema Penelitian Q1/Q2

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Abstract

Garden Organizer turns indoor gardening into a WebXR task for behavioral measurement. Thirty older adults sorted virtual plants, followed by interviews and comparison with independently administered MoCA-Ina scores.

The system records timing, placement accuracy, movement smoothness and errors. Results support feasibility and an initial association between XR performance and cognitive screening scores.

Keywords: WebXR, interaction design, behavioral measurement, older adults

Introduction

Everyday XR tasks can extend conventional screening by recording how people act over time, including delays, movement and errors [1,2].

This study examines how familiar activity design can support approachable interaction and interpretable behavioral data.

Design rationale

Recognizable plant shapes and redundant color cues guide sorting. Clear instructions, recoverable errors and untimed practice support task understanding.



Figure 1. Participant testing with Meta Quest 2 and hand controllers.

Participants: 24 women and 6 men, aged 55–78 years (mean 65.67 ± 7.35). A researcher remained nearby during testing.

Selected references

[1] Nasreddine et al. (2005). J Am Geriatr Soc, 53, 695–699.

[2] Parsons (2015). Front Hum Neurosci, 9, 660.

Research Method

Study design. Empirical evaluation in Malang, Indonesia (N = 30), supported by two expert reviews.

Task. Sort 12 pots across four categories (tomato, sunflower, cactus and strawberry) into matching zones. Each action follows an inspect, grasp, move and release loop.



Figure 2. Garden Organizer sorting area and virtual garden environment.

Behavioral Deviation Index (BDI)

BDI v1 averages six standardized features: log completion time, log reaction time, reversed placement accuracy, reversed smoothness, selection errors and plant/zone mismatch errors.

Higher BDI indicates less efficient interaction. Reference parameters remain fixed from rows 1–20. BDI has no clinical diagnostic cutoff.



Figure 3. Desktop telemetry and CSV/JSON export. Screen values are illustrative session values.

Discussion & Results

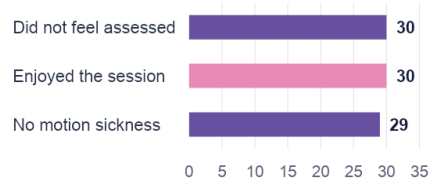
Empirical task performance (N = 30). Values below are cohort medians.

Telemetry measure	Median
Completion time	161.20 s
Reaction time	1.87 s
Placement accuracy	69%
Movement smoothness	92%

86.7%

26/30 participants completed within 5 minutes. The 300 s threshold classifies timing only.

Post-session experience



Counts out of 30. One participant reported mild motion sickness. Interviews do not establish safety.

BDI and cognitive screening

ρ = −0.371

Spearman correlation with MoCA-Ina. Adjusted for age and education: ρ = −0.317. Higher BDI co-occurred with lower MoCA-Ina scores.

Conclusion

Garden Organizer links familiar activity design to continuous behavioral logging. The findings support feasibility and further task validation.

The cross-sectional sample is small. Replication, test–retest studies and longitudinal clinical comparisons are needed before diagnostic use.