Development of an Automated Motor-Based Biomarker for Preclinical Alzheimer's Disease

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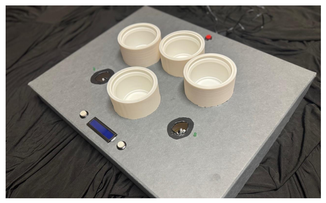
Introduction

Problem Alzheimer's disease is typically diagnosed after significant cognitive decline, limiting treatment effectiveness.

Gap Motor-based assessments can detect early impairments but are often manually administered, introducing variability and limiting scalability.



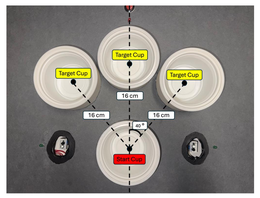
Proposed Solution: Automated motor-based assessment
- Uses sensor-based task initiation
- Provides real-time performance feedback
- Reduces reliance on manual timing and observation
- Improves consistency and reproducibility

Objective Develop and evaluate an automated system to improve reliability and usability.

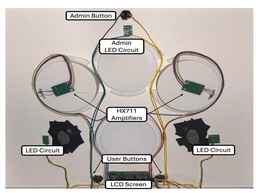
Methods

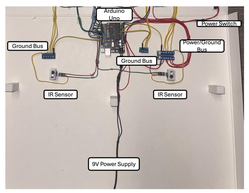
An automated system was developed to administer a motor task, enabling sensor-based timing, real-time feedback, and controlled task flow.

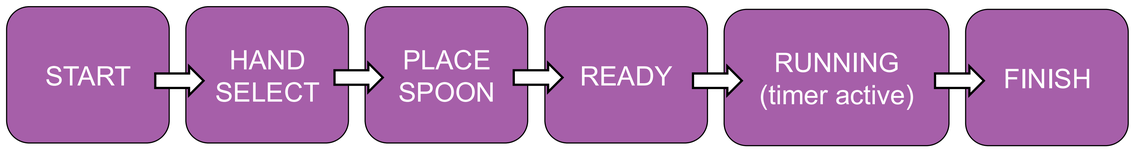
Design Layout



Labeled Electronics







b) System flowchart of task state progression.

Design Iterations:

Load cells were evaluated for automated completion detection

Final system used **Hybrid approach**
- Automated task initiation (IR)
- Manual task termination (Button)

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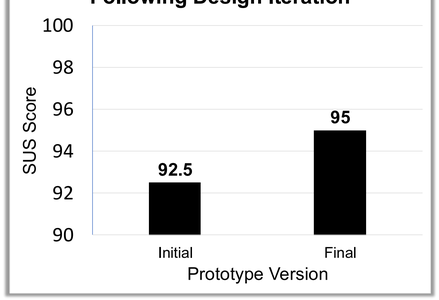
Results

Design Comparison

	Initial Design	Final Design
Task Completion	Load Cells	Manual Button
Reliability	Inconsistent	Consistent
Usability	Lower (SUS 92.5)	Higher (SUS 95)

Fig.1 System Usability Improved Following Design Iteration



Cost and Accessibility:
- Estimated build cost: $100-150 per unit
- Constructed using common components
- Low-cost design supports scalable deployment

Key Findings and Insights:
- Reliable IR-based timer initiation
- SUS Score increased from 92.5 → 95 with iteration
- Hybrid design improved usability

Future Directions

- Reevaluate **automated task completion** using standardized objects
- Reintroduce **load cell-based detection** with more stable and controlled inputs
- Further refine the **encased design** for durability, portability, and ease of use
- Implement **automated data logging** for performance tracking
- Validate system performance across **larger and more diverse populations**

References

[1] Alzheimer's Association, 2025
[2] Hooyman et al., 2025
[3] Li et al. 2024
[4] Schaefer, 2020