Design and Evaluation of a Behaviorally-Grounded, Caregiver-Governed AI Companion for Individuals With Memory Impairment

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Individuals with early-stage dementia often experience confusion or distress when interacting with standard conversational AI, which may challenge memory, argue, or reinforce inaccuracies. This project developed a room-based AI companion that enforces dementia-safe conversational behavior, ensuring interactions remain predictable, safe, and aligned with caregiver guidance. Prototyping followed a staged approach to isolate behavioral and technical failures. The initial system used scripted utterances without live AI, enabling deterministic evaluation. Early testing revealed excessive responses increased cognitive load and agitation, leading to silence being elevated from a fallback to an explicit system action. Later versions introduced always-on input with context-aware suppression to prevent unintended activation. Memory handling initially repeated inaccuracies, prompting a two-tier memory model requiring caregiver verification. Hardware refinements, including enclosure and microphone/speaker placement, improved reliability and reduced feedback. Final testing used twelve scripted scenarios (memory gaps, false statements, agitation, neutral interaction), each run ten times under control and experimental conditions (240 trials). Results showed caregiver verification triggered for all memory prompts, misinformation was blocked, and agitation was safely de-escalated, while neutral interactions remained natural. The system met all engineering requirements without redesign. Results support the feasibility of deterministic, caregiver-verified AI for safe dementia interactions, though real-world validation is still needed.

Awards Won: