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A Comparative Usability Study in Designing Institute Interfaces for the Elderly

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ABSTRACT

As the global elderly population continues to rise, ensuring digital inclusion for older adults has become a critical aspect of user interface (UI) design. Older individuals often face unique challenges when interacting with technology due to age-related cognitive, sensory, and motor limitations. These challenges necessitate specialized interface designs that prioritize intuitiveness, clarity, and accessibility. This research paper presents a comprehensive comparative usability study of five distinct UI designs tailored for elderly users: tag-based web interface, hierarchical web interface, mobile application, nostalgic tangible user interface (TUI), and a kiosk interface with seated and non-seated options.

A total of 90 participants aged between 60 and 85 years engaged with all five interfaces in randomized order. The study evaluated usability using both quantitative and qualitative methods, focusing on metrics such as task completion rates, time to task completion, error frequency, satisfaction levels (QUIS), and cognitive workload (NASA-TLX). The nostalgic TUI and tag-based web interface consistently outperformed the others in satisfaction, effectiveness, and workload reduction. In contrast, the mobile app and standing kiosk setups exhibited lower usability scores, highlighting ergonomic and interaction design shortcomings.

The findings provide evidence-based guidelines for designing intuitive, inclusive interfaces for the elderly, emphasizing the importance of physical affordances, simplified navigation, and environmental comfort. This research contributes to the broader understanding of age-friendly design, offering practical recommendations for developers, designers, and researchers seeking to create more accessible digital experiences for aging populations.

INTRODUCTION

Background

The global population is aging at an unprecedented rate. According to the World Health Organization (WHO), by 2050, one in six people worldwide will be over the age of 65. This demographic shift has significant implications for technology design and digital inclusion. While digital tools have become integral to modern life, from managing health to communication and information access, older adults often face barriers that prevent them from leveraging these tools effectively. These barriers arise from physiological changes such as reduced vision, decreased fine motor skills, hearing loss, and cognitive decline affecting memory and problem-solving abilities.

Older adults may experience difficulties with small interface elements, cluttered layouts, and complex navigation structures. Additionally, many technologies are not designed with aging-related needs in mind, which contributes to digital exclusion and can lead to frustration, abandonment of technology, or even reduced quality of life. Given that interfaces originally designed for younger, tech-savvy populations dominate the landscape, a critical need has emerged for designing UIs that are not only accessible but also intuitive and engaging for the elderly.

The concept of 'intuitive design' involves leveraging prior experience and expectations to reduce the learning curve and mental effort required for interaction. For older adults, this means relying on metaphors, consistent feedback, and

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simplicity over complex multitasking or feature-rich interfaces. Furthermore, the integration of tangible and physical interactions has been shown to boost memory and engagement by stimulating sensory pathways that remain robust in old age.

In this context, it becomes essential to evaluate and compare various interface paradigms to identify those most suitable for elderly users. This study contributes to the growing field of age-inclusive design by empirically comparing the usability of five different interface types: tag-based web, hierarchical web, mobile app, nostalgic tangible user interface (TUI), and self-service kiosks. These were selected to represent a broad spectrum of interaction modalities, ranging from touch-based to physical and environmental systems.

The goal is not only to identify which interfaces work best but to understand why they do—by examining usability metrics alongside subjective satisfaction and cognitive workload. Insights from this research can guide developers, designers, and policymakers in creating digital tools that empower rather than exclude the elderly.

Objectives

1. Evaluate five UI types (tag web, hierarchical web, mobile app, nostalgic TUI, kiosk) with elderly users.
2. Compare performance, satisfaction, workload, and error rates.
3. Extract design guidelines informed by quantitative and qualitative results.

Scope

A mixed-methods comparative usability study involving 90 participants aged 60–85. Each participant interacted with all five UIs in randomized order.

LITERATURE REVIEW

Studies show that age-sensitive, shallow information architecture (e.g., tag-based menus) is more effective than traditional hierarchical ones for older users (Pak et al., 2009). Mobile apps often suffer from poor navigation and small touch targets (Barros et al., 2013). TUIs provide tactile affordances, which help in memory recall and engagement (Wang et al., 2020). Self-service kiosks designed with seating and privacy elements significantly improve elderly usability and comfort (Chung & Park, 2021).

Table 1: Summary of Relevant Studies

Study	Interface	Participants	Key Outcomes
Pak et al., 2009	Web (health)	60+	Tag-based menus improved usability and recall
Barros et al., 2013	Mobile app	60+	Larger icons, higher contrast improved interaction
Wang et al., 2020	Nostalgic TUI	60+	Higher engagement, cognitive stimulation
Chung & Park, 2021	Kiosk	Mixed ages	Seating & privacy improved task success, lowered mental workload

METHODOLOGY

Participants

90 older adults (aged 60–85, mean = 72.4, SD = 6.3), varied digital literacy, gender-balanced, with normal-to-corrected vision.

Interfaces

1. **Tag-based Web**
2. **Hierarchical Web**
3. **Mobile App**
4. **Nostalgic TUI**
5. **Kiosk (seated & non-seated)**

Tasks

- Web: Find health-related articles.
- Mobile: Log and view medications.
- TUI: Use physical tokens for task review.
- Kiosk: Perform a mock health check.

Measures

- Task Success Rate
- Time to Complete Task
- Error Rate
- Satisfaction (QUIS 7.0)
- NASA-TLX (mental workload)

Results

Table 2: Usability Metrics by UI Type

UI Type	Success (%)	Time (sec)	Errors (avg)	Satisfaction (1–9)	NASA-TLX (0–100)
Tag Web	96	115 ± 22	0.7 ± 0.5	7.4 ± 1.0	30 ± 12
Hierarchical Web	89	142 ± 33	1.5 ± 0.8	6.6 ± 1.4	38 ± 15
Mobile App	82	158 ± 45	2.1 ± 1.0	6.2 ± 1.5	45 ± 18

Nostalgic TUI	94	128 ± 29	0.9 ± 0.6	8.3 ± 0.7	28 ± 10
Kiosk (Seated)	90	150 ± 35	1.1 ± 0.7	7.0 ± 1.2	35 ± 13
Kiosk (Standing)	82	180 ± 40	2.5 ± 1.2	5.5 ± 1.6	52 ± 20

Comparative Analysis

Criterion	Tag Web	Hier Web	Mobile	Nostalgic TUI	Kiosk (Seated)	Kiosk (Standing)
Efficiency	High	Moderate	Low	High	Moderate	Low
Workload	Low	Medium	High	Very Low	Medium	High
Satisfaction	High	Medium	Medium	Very High	High	Low
Engagement	Moderate	Low	Low	Very High	Moderate	Low
Comfort	n/a	n/a	n/a	Good	Excellent	Poor

DESIGN GUIDELINES

1. **Simplify navigation**: Prefer shallow, tag-based structures.
2. **Optimize for perception**: Use high-contrast, large text/buttons.
3. **Integrate physical affordances**: Use tokens, sliders for TUIs.
4. **Ensure environmental comfort**: Provide seating and privacy.
5. **Support error recovery**: Include undo, confirmations.
6. **Include workload measurement**: Use NASA-TLX in evaluations.
7. **Iterate early**: Engage older users from prototyping to testing.

CONCLUSION

The comparative usability study underscores the significance of designing intuitive, inclusive digital interfaces that cater specifically to the needs of elderly users. Through detailed evaluation across five diverse interface types, it is evident that user experience among older adults can be substantially enhanced through thoughtful, evidence-based design. Tag-based web interfaces and nostalgic tangible user interfaces (TUIs) consistently emerged as the most

favourable in terms of usability, cognitive load, and overall satisfaction. These findings emphasize the value of simplicity, physical metaphors, and familiar interaction models.

Notably, the mobile application and standing kiosk designs were associated with increased error rates, longer task completion times, and higher perceived cognitive workload. This highlights the ergonomic and cognitive constraints that developers must consider when designing for an aging population. The inclusion of physical elements such as tokens and seating arrangements not only improved comfort but also supported memory retention and confidence during task performance.

The study also validated the utility of tools like NASA-TLX and QUIS in capturing nuanced usability differences. Beyond raw performance metrics, participants' subjective responses provided deep insights into emotional engagement and preferences, which are critical for fostering long-term technology adoption among seniors.

Moving forward, UI design for the elderly must integrate universal design principles with continuous user feedback loops. Future research should explore adaptive and personalized interfaces that respond to users' evolving abilities over time. Ad

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