

Function Discoverability and Perceptual Accessibility in Interfaces for Adults Aged 60+: Task-Based UX Study

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Abstract— Ageing populations increasingly rely on digital services, yet older adults often face usability and accessibility barriers, especially when interfaces depend on hidden actions, icon-only controls, and visually demanding layouts. This study assessed whether four different application prototypes (Shopping List, Messenger, Login/Registration, Shop) and alternative User Interface (UI) and Cascading Style Sheets (CSS) variants support function discoverability and perceptual accessibility for adults aged 60+. Overall task difficulty was moderate (mean $M = 2.22$, median $Me = 2$, standard deviation $SD = 1.09$), but only 48.3% of task attempts were completed without moderator help. Messenger was the most challenging module ($M = 2.73$; 29.7% independent), with “add member to group” performing worst ($M = 3.12$; 16.2% independent). Shop was the easiest ($M = 1.82$; 64.0% independent). Participants aged 60+ were less independent and slower than those < 60 ($p < 0.001$). Barriers clustered around discoverability, navigation, icon semantics, form feedback, contrast, and target size. Design improvements should prioritise explicitly labelled actions, stronger feedback, higher contrast, and larger interactive targets; visual styling alone was insufficient without structural interaction changes.

Keywords— usability testing; function discoverability; web accessibility; user interface design.

I. INTRODUCTION

In the context of ongoing population ageing and the continued migration of services to digital channels, the accessibility and usability of interfaces for adults aged 60+ has become an issue of growing social and economic relevance [1]. From the perspective of older users, the central challenge is not merely “access to technology” but also the cost of interaction: increased cognitive effort, uncertainty about the consequences of actions, heightened risk of error, and frustration, which may ultimately result in disengagement from online services [2]. Research on technology acceptance in this group emphasises that sustained use of digital solutions depends largely on a sense of control and ease of use rather than on the system’s

objective functionality alone [3]. Against this background, the present study addressed a practical question: to what extent the designed application modules and User Interface (UI) and Cascading Style Sheets (CSS) variants are comprehensible, discoverable, and executable independently by older adults, who often experience functional limitations.

Cognitive mechanisms help explain why identical interface solutions may operate differently for younger and older users. Processing-speed theory indicates that with age the cost of operations requiring rapid attentional switching and the maintenance of multiple elements in working memory increases, thereby elevating susceptibility to pauses and errors in sequential tasks [4]. In parallel, age-related changes in the visual system (including reduced contrast sensitivity and poorer performance under low luminance) directly affect typographic legibility and the recognisability of elements with weak visual separation [5].

Within these constraints, the literature identifies recurring challenges in interface design for older adults: limited discoverability of functions, navigational disorientation, ambiguity of icons, difficulties with forms (login/registration), and visual and ergonomic barriers associated with small clickable targets. Empirical studies show that age significantly differentiates both perceived website usability and task performance, and that these differences intensify as information architectures become more complex and the number of potential action paths increases [6]. Importantly, older adults rely more heavily on structural cues and layout consistency, and, as informational queries grow more complex, they more frequently commit errors attributable to the costs of search strategies (e.g., goal loss and ineffective exploration) [7]. From a navigation perspective, solutions such as vertical menus have been shown to support effectiveness and user preference in tasks of increasing complexity, reinforcing the importance of explicit and predictable option presentation [8]. Moreover, research on navigation style indicates that the organisation of transitions and the manner of presenting options exert a measurable influence on older adults’ efficiency in web-based environments [9].

Studies have demonstrated that, in older adults, icon comprehension in navigation tasks depends on the semantic distance between a symbol and its intended meaning, as well as on the presence of a textual label; labelling reduces interpretive uncertainty and may limit selection errors [10]. Related work on mobile-device icons suggests that age-related differences are particularly pronounced during initial use, before users acquire interface conventions [11]. Practically, this supports recommendations for selective redundancy (e.g., icon plus label) in task-critical locations, while avoiding unnecessary stimulus density in secondary areas. Research on redundancy further indicates that such solutions can improve performance and confidence among older users, even if younger users sometimes perceive them as superfluous [12]. In communication modules (e.g., a messenger), this body of evidence justifies efforts to minimise unlabeled icons and to increase the clarity of control intent.

Another major category includes forms, particularly login and registration, which combine security requirements with memory demands and error risk. Evidence suggests that older adults more often encounter barriers in authentication, and that the critical factors become unambiguous error messages, support for account recovery, and mechanisms that prevent mistakes (e.g., the ability to reveal a password during entry) [13]. Accordingly, form design for older adults should prioritise clarity, proximity of feedback to the relevant field, reduction of unnecessary steps, and minimisation of the need to infer system rules.

Visual accessibility is likewise an area in which seemingly minor design choices can substantially increase interaction costs for older adults. Research in the context of medical devices indicates that font size and button position influence task execution in older users, underscoring the importance of information hierarchy and the placement of primary actions [14]. Systematic reviews focusing on typography for older adults emphasise that legibility parameters (size, typeface, line spacing) should be considered in relation to task type (reading versus scanning) and users' perceptual conditions [15].

Interaction ergonomics (e.g., the size and spacing of touch targets) constitutes another central axis of design for older adults, particularly given reduced motor precision. Empirical work has shown that button size and spacing affect touch characteristics in older adults, translating into error rates and user comfort [16]. Similar conclusions have been reported for smartphone pointing performance, where older users exhibited poorer outcomes with small targets and dense layouts [17].

Existing studies synthesising design recommendations indicate that effective support for older adults typically requires a coherent set of interventions rather than a single change. For example, heuristic accessibility checklists for smartphone interfaces have been proposed, addressing legibility, consistency, visibility of system status, and the reduction of cognitive load [18]. Case studies of redesign for older adults demonstrate that usability improvements usually result from bundles of changes: simplifying information architecture, reducing visual clutter, and increasing the

explicitness of controls [19]. Systematic reviews of mobile-app guidelines for older adults highlight recurrent recommendations, including large interactive elements, consistent navigation, predictable flows, and redundant information coding in critical locations [20]. Relatedly, calls for consolidating standards for the "ageing web" reinforce the need to connect design practice with accessibility requirements and established guidelines [21].

More recent empirical work on interface element characteristics suggests that specific design decisions can influence task performance in older adults, encouraging task-based prototyping and evaluation rather than reliance on design intuition alone [22]. In parallel, a strand of research has advanced in-action user support (e.g., real-time interactive guides), which may enhance older adults' web accessibility and reduce reliance on external assistance [23]. The present study therefore evaluated User Experience (UX) and the perception of key User Interface (UI) elements in an older adult cohort, with particular attention to how typographic legibility, contrast, colour scheme, and clickable-target size shape the completion of typical tasks in web applications. An additional objective was to identify interaction barriers and formulate design recommendations supporting inclusive solutions for older users.

The rest of this paper is organized as follows. Section II describes the methodology of the study. Section III presents the results. Section IV discusses the findings. Section V concludes the paper and outlines directions for future work.

II. METHODS AND METHODOLOGY

A mixed-methods design was employed, integrating quantitative and qualitative components. The quantitative component comprised (i) participants' subjective ratings of task difficulty on a five-point scale (1-5), (ii) a dichotomous record of whether moderator assistance was required (Yes/No), and (iii) dichotomous (Yes/No) evaluations of the legibility of key user interface elements. The qualitative component was based on participants' open-ended statements concerning experienced difficulties, accompanying feelings and emotions, and suggestions for interface improvements. Sampling was non-probabilistic: the core sample consisted of older adults (60+), complemented by a small group of younger participants included as a comparative reference in selected analyses. Data collection was conducted between 16 July 2025 and 3 February 2026.

A. Procedure

The procedure was structured and consisted of four stages. All sessions were conducted individually in the presence of a moderator, who observed task performance, recorded difficulty ratings and completion status, and provided clarification only when necessary. This moderated setting ensured consistent task administration across participants. First, participants completed an introductory questionnaire including demographic items as well as questions regarding technology use and physical health. Second, a task-based usability test was conducted across four modules/prototypes, described in detail in Section F (*Prototypes and tasks*); after each task, the moderator

recorded the perceived difficulty rating (1-5), whether assistance or clarification was necessary, and the task completion time, based on the recorded end-time stamp, enabling subsequent analysis of task efficiency. Third, after completing each module, participants filled in a post-module evaluation including Yes/No questions on font legibility, perceived colour scheme, and button size, supplemented with open-ended questions about difficulties and emotions. Finally, a closing questionnaire was administered, in which participants provided, among other responses, a subjective assessment of workload (e.g., tiring/demanding) and indicated the elements they perceived as easiest and most difficult.

B. Variables and measures

The study included a set of variables and measures capturing both task outcomes and subjective experience. The primary outcome was task independence, operationalised as task completion without assistance versus completion with moderator support. Additional measures comprised subjective task difficulty (1-5) and task duration, derived from recorded task end-time stamps. Perceptual evaluation of the interface (font legibility, colour scheme, and button size) was captured in a Yes/No format and enriched with participant comments. A separate category included qualitative data, i.e., the content of open-ended responses describing usability barriers and design recommendations.

C. Characteristics of cohorts

A total of 74 individuals participated in the study (N = 74), enabling a description of the sample in terms of basic demographic and social characteristics. The gender distribution indicated a predominance of women: 53 female participants (71.6%) and 21 male participants (28.4%). The age structure was dominated by older adults aged 60+ (65 participants; 87.8%), with the largest subgroup comprising participants aged 70-79 years (31 participants; 41.9%). Participants younger than 60 years constituted 9 individuals (12.2%) and served as a comparison group in the analyses. With respect to educational attainment, higher education was reported most frequently (38 participants; 51.4%), followed by secondary education (26 participants; 35.1%), indicating a relatively high level of educational capital in the study group.

Residence was characterised along two territorial dimensions: settlement size and participants' self-reported location descriptors. The sample structure indicated a predominance of urban residents, particularly from large urban centres, which should be taken into account when interpreting the results and generalising them to older populations with different territorial characteristics. Consequently, while the collected material supported inferences about typical barriers to interaction and interface perception among older adults, the scope of generalisation should consider potential differences arising from everyday-life context, the availability of digital services, and place-related variation in technological competence.

D. Technology experience and functional limitations

Most participants reported regular contact with technology: 64 individuals (86.5%) used technology daily. The most frequently reported device was a smartphone (55 participants; 74.3%), alongside a small group of non-users (4 participants; 5.4%). For interpretation, the high prevalence of self-reported health-related limitations was also salient: 50 participants (67.6%) indicated conditions or disabilities that could affect interaction with the user interface. Notably, visual difficulties predominated among the declared limitations (46 participants; 62.2% of the total sample). As limitation categories could overlap (e.g., concurrent visual impairment and motor difficulties), percentages do not sum to 100%.

E. Tools

The questionnaire and data-recording protocol were implemented using Google Forms. The research materials comprised: (1) the introductory questionnaire, (2) task scenarios for the four prototypes, (3) post-module evaluation questions, and (4) the closing questionnaire.

F. Prototypes and tasks

The test covered four web-application prototypes reflecting typical user activities:

1. Shopping list/form (4 tasks): adding, deleting, marking as purchased and filtering, and editing an item.

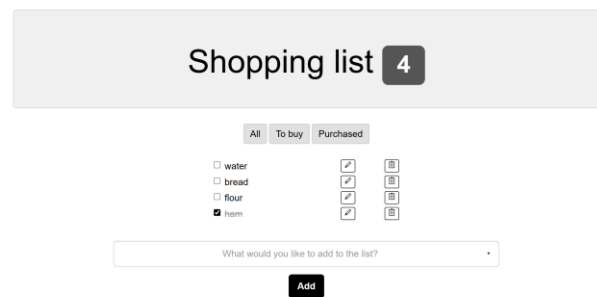


Figure 1. Shopping list interface.

2. Messenger (3 tasks): sending a message, adding a user to a group, and sending a photo with a caption and an emoji.

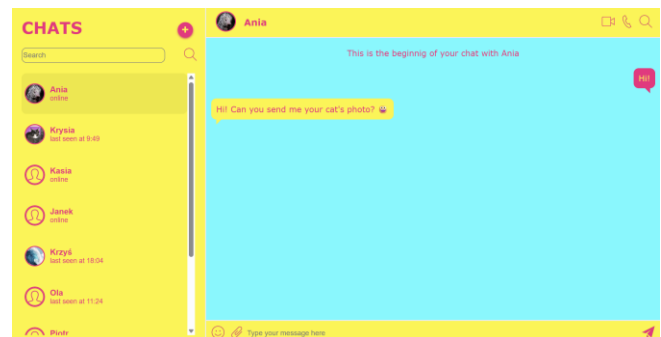


Figure 2. Messenger interface.

3. Login/password recovery/registration (3 tasks): logging in, password recovery via a code-based procedure, and account registration.

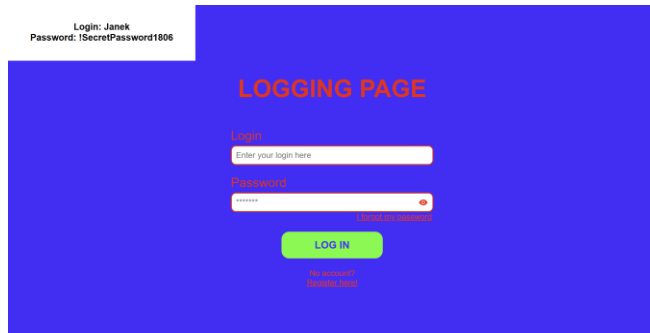


Figure 3. Login page interface.

4. Online shop (3 tasks): searching for a product, selecting a variant and adding it to the cart, and completing the purchase flow (delivery and payment).

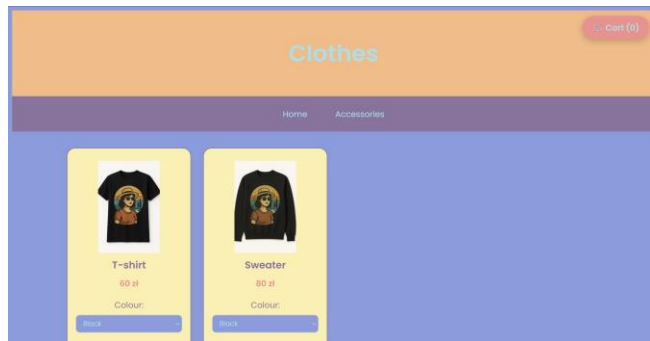


Figure 4. Online shop interface.

The prototypes were made available online (hosted, inter alia, on Render) and were presented in pairs of visual UI variants (e.g., versions differing in colour scheme and contrast). Within each module, participants worked with one of two variants: Shopping List (49 vs 24; 1 missing), Messenger (52 vs 22), Login (56 vs 18), and Shop (38 vs 36). This design enabled comparisons of UI perception and task-performance patterns (Fig. 1-4).

III. RESULTS

The analysis included N = 74 participants (women: 53; men: 21). Most participants were aged 60+ (n = 65), although a smaller group of participants aged <60 also took part (n = 9). Most participants lived in urban areas (n = 64), particularly in cities with more than 100,000 inhabitants (n = 40), whereas fewer lived in rural areas (n = 10). Self-reports regarding health-related limitations indicated that 50/74 participants reported at least one condition/limitation, including 46/74 reporting visual problems (e.g., “vision impairment”).

At the global level (all tasks combined), the mean difficulty rating on the 1-5 scale was M = 2.22, the median was Me = 2, and the standard deviation was SD = 1.09 (number of ratings = 958). Overall, 48.3% of task attempts

were completed without moderator assistance (463/958), 41.5% required moderator assistance (398/958), and 10.1% involved the use of a scenario (97/958). A detailed breakdown of difficulty and the proportion of independent completions for each task is provided in Table I, while aggregated module-level results (including time) are presented in Table II.

For the time analysis (based on task completion timestamps, excluding records of 00:00:00 treated as missing), the median total session time among participants with complete time measurements (n = 66) was 29.0 minutes, with interquartile range IQR = 18.8 minutes (Q1 = 22.0; Q3 = 40.8). At the module level, tasks in the Login/Registration module took the longest (Me = 6.0 minutes; IQR = 7.0), whereas the shortest durations were observed for the Shopping List module (Me = 3.0 minutes; IQR = 4.0) and the Shop module (Me = 3.5 minutes; IQR = 4.8) (Table II).

TABLE I. TASK DIFFICULTY AND PERCENTAGE OF COMPLETION WITHOUT ASSISTANCE (PER TASK)

#	Module	Task	n (result s)	M	Me	SD	No help (%)
1	List	List: add "cheese"	73	1.93	2	1.03	63.0
2	List	List: del"cheese"	73	2.00	2	1.08	52.1
3	List	List: mark"bread"	73	2.32	2	0.94	41.1
4	List	List: edit "water" → "juice"	73	2.48	2	1.20	38.4
5	Messenger	Send: "hello"	74	2.30	2	1.02	43.2
6	Messenger	add Jan to group	74	3.12	3	1.06	16.2
7	Messenger	Send pict	74	2.78	3	1.12	29.7
8	Login/Registration	Login	74	2.04	2	0.94	43.2
9	Login/Registration	Login pass recov	74	2.05	2	1.00	61.0
10	Login/Registration	Login account reg	74	2.34	2	0.99	47.3
11	Shop	Find item	74	1.55	1	0.88	78.4
12	Shop	Shop: add item to basket	74	1.86	2	0.96	52.7
13	Shop	Shop: buy and pay	74	2.06	2	1.04	60.8

TABLE II. AGGREGATED RESULTS PER MODULE (DIFFICULTY, INDEPENDENCE, TIME)

Module	M	Me	SD	No help (%)	Time Me (min)	Time IQR (min)
Messenger	2.7 3	3	1.1 2	29.7	5.0	3.0
List	2.1 8	2	1.0 9	48.6	3.0	4.0
Login/Registration	2.1 4	2	0.9 8	50.9	6.0	7.0
Shop	1.8 2	2	0.9 9	64.0	3.5	4.8

A. Results by module/prototype (Shopping List, Messenger, Login/Registration, Shop)

In the Shopping List module, a moderate level of difficulty was observed (M = 2.18; Me = 2), and nearly half of task attempts were completed without assistance (48.6%). The greatest cognitive burden concerned tasks requiring

interpretation of controls related to filtering and content editing (tasks 3-4; $M = 2.32-2.48$), which co-occurred with a lower proportion of independent completions (38.4-41.1%).

The Messenger module yielded the highest mean difficulty ratings among all modules ($M = 2.73$; $Me = 3$) and the lowest share of independent completions (29.7%). Adding a user to a group was particularly problematic (task 6; $M = 3.12$; 16.2% without assistance), as was a compound action involving sending a photo with a caption and an emoji (task 7; $M = 2.78$; 29.7% without assistance). This pattern suggested that barriers in this prototype were more strongly related to locating functions and understanding interaction logic than to entering short text messages per se (task 5; $M = 2.30$).

In the Login/Registration module, difficulty was similar to that of the Shopping List module ($M = 2.14$; $Me = 2$), whereas completion time was the highest ($Me = 6.0$ minutes). The account creation task was the most demanding (task 10; $M = 2.34$). Notably, password recovery using a code was associated with relatively higher independence (task 9: 61.0% without assistance) than login (task 8: 43.2%), which may have resulted from a more unambiguous step-by-step sequence.

The Shop module was rated as the easiest ($M = 1.82$; $Me = 2$) and exhibited the highest independence (64.0% without assistance). The easiest task in the entire study was finding a product (task 11; $M = 1.55$; 78.4% without assistance). Difficulty increased for actions requiring multiple decisions (product variant selection and order finalisation; tasks 12-13), but ratings remained moderate overall ($M = 1.86-2.06$).

B. UI evaluation (font legibility, colours, button size; emojis in the messenger)

Evaluations of interface elements were predominantly positive, although clear differences emerged across modules. Overall (aggregated across all modules), font legibility was rated positively in 223/286 responses (78.0%), colour selection in 220/287 responses (76.7%), and button size in 232/287 responses (80.8%). In the Messenger module, emojis received positive ratings in 60/74 responses (81.1%).

The lowest proportion of “Yes” responses was observed for colour scheme in the Shop module (39/71; 54.9%), and a relatively low proportion was also found for colour scheme in the Messenger module (48/72; 66.7%). Negative comments in open-response fields related to UI questions included, among others, overly intense colours or insufficient contrast, as well as excessively small text and controls.

IV. DISCUSSION

Interpretation suggested that the observed difficulties resulted primarily from limited discoverability of functions and ambiguity of controls, and only secondarily from the intrinsic “content complexity” of the tasks. Across the entire study, difficulty was moderate ($M = 2.22$; $Me = 2$; $SD = 1.09$; $n = 958$ ratings), yet the proportion of completions without assistance was only 48.3% (463/958), indicating that many barriers emerged at the stage of selecting the appropriate action in the interface rather than during execution itself.

The Messenger module exhibited the highest difficulty among all modules ($M = 2.73$; $Me = 3$; $SD = 1.12$; $n = 222$ ratings) alongside the lowest independence (29.7% without assistance). The most difficult task was adding a group member (task 6), with $M = 3.12$ ($Me = 3$; $SD = 1.06$) and the lowest proportion of independent completions (16.2%). This profile was consistent with the qualitative material: an illustrative statement directly noted: “Finding the option to add to the group.” The qualitative responses were consistent with the quantitative findings and helped clarify that the main barriers were not task goals themselves, but rather the discoverability of controls, uncertainty about next steps, and the perceptual accessibility of key interface elements.

A second source of difficulty was the increased number of steps and context switches in the task involving an attachment, caption, and emoji (task 7): $M = 2.78$ ($Me = 3$; $SD = 1.12$) with 29.7% independent completions. By comparison, the relatively simpler operation of sending a short text message (task 5) had lower difficulty ($M = 2.30$; $Me = 2$; $SD = 1.02$) and a higher proportion of independent completions (43.2%). This gradient (text → multi-step action) suggested that the key issue in the messenger was not the concept of “communication” itself, but rather navigation across functions, symbolism, and interface states. The Human-Computer Interaction (HCI) literature has noted that older adults are particularly sensitive to hidden actions and the cognitive demands of interface exploration, which translates into slower and less confident performance in navigation tasks.

Shop results indicated an apparent paradox: this module was simultaneously the least difficult ($M = 1.82$; $Me = 2$; $SD = 0.99$; $n = 222$) and the most independent (64.0% without assistance). The easiest task overall was product search (task 11): $M = 1.55$ ($Me = 1$; $SD = 0.88$) with 78.4% independent completions. In e-commerce contexts, users often achieve task success despite mediocre aesthetics due to well-established interaction schemas, which may explain high effectiveness and independence. By contrast, colour evaluation reflected perceptual comfort rather than “ability to complete,” and qualitative comments included remarks about tiring colour combinations (e.g., “Too sharp a colour; in the long run it is tiring...”).

Accordingly, the findings were interpreted as reflecting two separable UX dimensions: efficiency/feasibility of task completion (relatively high here) and perceptual accessibility (relatively lower). Accessibility requirements indicate that legibility depends, among other factors, on minimum contrast thresholds (e.g., 4.5:1 for standard text).

At the perceptual and ergonomic level, efforts should focus on modules with the weakest UI evaluations. Accessibility standards, including criteria for text contrast (e.g., 4.5:1 for standard text), provide clear directions and measurable thresholds for auditing such changes. Additionally, given the comments concerning ergonomics and clickability (22 mentions in reported difficulties and 22 in improvement suggestions), increasing target sizes and/or spacing was justified, consistent with accessibility-oriented approaches to minimum target size (including 24×24 CSS px in Web Content Accessibility Guidelines 2.2 for certain

cases). Finally, considering the substantial age-related differences (independence 38.5% vs 92.3% and time 32.0 vs 17.0 minutes; $p < 0.001$), personalisation features supporting readability (larger text, high contrast) and explicit labelling should constitute a permanent interface component, given their potential benefit for the most sensitive user group.

A. Study limitations

Several variables were self-reported (e.g., health-related limitations), which may have reduced the validity of classifying participants as “with limitations” versus “without”. UI/CSS variants were not fully randomised and balanced; therefore, differences in UI ratings may have been partly modulated by expectations and aesthetic preferences. Furthermore, time measurement based on task end-time stamps was sensitive to missing values, and the presence of a moderator may have reduced variability in outcomes, particularly in tasks where assistance was frequent. The study did not include a formal cognitive screening measure (e.g., the Montreal Cognitive Assessment or Mini-Mental State Examination), which limits the precision of interpreting whether some observed difficulties were primarily perceptual, functional, or partly cognitive in nature. Participant characterization relied on self-reported information regarding physical health, digital skills, and everyday technology use. The study design and sample size were sufficient to identify the main interaction difficulties associated with the perceptual and functional demands of the tasks. Future studies should include standardized cognitive assessment to strengthen interpretability.

V. CONCLUSION AND FUTURE WORK

As part of the completed work, a full set of research materials was developed (task scenarios, a UX/UI evaluation questionnaire, and visual interface variants), and usability tests were conducted for four prototypes: Shopping List, Messenger, Login/Registration, and Shop. The study provided a coherent account of how older adults perform tasks in web-based interfaces and which UI elements constitute genuine barriers to independent task completion. Quantitatively, overall task difficulty was moderate ($M = 2.22$; $Me = 2$; $SD = 1.09$), yet independence proved limited. Only 48.3% of task attempts were completed without assistance. This indicated that the primary obstacle was not the substantive content of the tasks but rather the stage of “locating the appropriate function” and understanding how to execute the next step within the interface.

The most consequential practical insight was that the weakest outcomes were observed in the Messenger prototype (module-level $M = 2.73$; independence 29.7%), particularly for the task of adding a user to a group ($M = 3.12$ and only 16.2% completed without assistance). The qualitative data consistently pointed to a discoverability issue (“Finding the option to add to the group.”), which mapped directly onto Jakob Nielsen’s heuristics (recognition rather than recall; consistency and standards; visibility of system status). At the same time, the Shop prototype achieved the best performance parameters (module-level $M = 1.82$; independence 64.0%) while receiving the weakest evaluation

of colour scheme (54.9% positive responses). This pattern suggested a separation of two dimensions: participants were able to accomplish task goals by relying on familiar e-commerce conventions, yet they experienced reduced perceptual comfort. This, in turn, provided a direct rationale for adjustments aligned with the Web Content Accessibility Guidelines (WCAG) developed by the W3C (notably with respect to contrast and the legibility of components).

Overall, the findings indicated that, when designing interfaces for older adults, priority should be given to solutions that increase discoverability and the unambiguity of key actions. Accordingly, the following should be treated as critical: (a) exposing primary actions as visible, clearly labelled buttons (rather than unlabeled icons or hidden functions), (b) guiding users through multi-step tasks (stepwise structure, clear process state, and confirmations), (c) reducing the cost of errors through intelligible messages and timely feedback, and (d) improving interaction ergonomics (larger clickable targets and more salient component states). In form-based contexts (login/registration/checkout), mechanisms that support data entry (e.g., “show password” and real-time validation) were practically important, as they reduced hesitations and the need for assistance. From an accessibility perspective, removing solutions that reduced legibility (mainly in the Shop module) was essential, because even when tasks could be completed successfully, such design choices lowered comfort and increased the risk of errors during extended interaction.

In subsequent iterations, development should proceed along two parallel tracks: refining interaction structure (navigation, labels, and function visibility) while simultaneously improving the perceptual layer (contrast, visual hierarchy, and element sizing). In practice, this entails starting with “high-impact” fixes in areas with the lowest independence (notably within the messenger), and only then refining aesthetics which (as the results demonstrated) may improve UI ratings but cannot substitute for structural changes. Future research should extend usability testing with more fine-grained process measures (errors, backtracking, misclicks, and step-level time), and randomise assignment to UI variants. Additionally, one should focus on a deeper qualitative analysis of participants’ open-ended responses and combine user studies with a formal WCAG conformance audit. In addition, including a formal cognitive screening measure (e.g., the Montreal Cognitive Assessment) would strengthen the study by providing a standardized measure of cognitive abilities that may affect user interface interaction. It is also advisable to test across devices (smartphone vs desktop) and in more naturalistic conditions, as certain barriers for older adults may become more pronounced in real contexts of use (visual fatigue, distractions, and time pressure). Ultimately, the completed work underscored that the decisive success factor was not a one-off “prototype assessment” but an iterative, evidence-based design cycle: identifying points of breakdown, implementing improvements, retesting, and verifying whether independence increases where it previously declined.

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