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Interface Design for the Memory Machine

Xiaowei Pan

School of Computer Science, University of Nottingham, Nottingham NG7 2RD, UK

Abstract: With the maturation of the mobile internet, internet products in vertically segmented fields have rapidly developed, becoming crucial tools for modern individuals to acquire knowledge and record life. In the competitive landscape of major internet companies, possessing a favorable user experience has become the key to retaining users and maintaining sustainable competitiveness. In the context of the challenge faced by the older generation in embracing smart technology, how to uncover the expectations and needs of elderly users and drive product innovation through enhanced experiences is a topic worthy of exploration. This study is rooted in the era of the internet, focusing on the elderly as the primary user group. Through user research, interaction design, user evaluation, and more, it aims to explore the long-term value of Memory Machine (MeMa) by delivering an optimal interactive experience. This effort intends to assist elderly users in efficiently and conveniently recording and sharing memories from their lives. The research outcomes have a certain reference significance and practical value for current product research catering to the elderly population.

Keywords: Internet, Interface design, Interaction design, Old adults, Memories, Prototype

1. Introduction

In recent years, the rapid development of the internet and the widespread use of smartphones have brought mobile applications to the forefront, becoming an indispensable part of people's lives and making digital technology pervasive in everyday life. However, despite the ubiquity of these technological advancements, there is still a significant portion of the population that remains excluded from actively participating in this digital revolution. Barnard et al. (2013) coined the term "digitally excluded" to refer to individuals who currently have no access to the internet. Among these digitally excluded individuals, a considerable 57% are aged 65 and above (Milner, H., 2009). In the United Kingdom, the internet usage rate for the 65-74 age group stands at 40%, while for those aged 75 and above, it drops to 20% (Dutton, W., 2010). Looking ahead, projections suggest (Reis, A., 2018) that by 2050, the global population aged 60 and above will be twice that of the year 2000. This demographic shift has drawn attention to the market for smart products tailored to the needs of the elderly (Zhang, T., 2023). However, it is evident that older people lag behind younger generations in terms of technology adoption in most countries. This disparity is not solely due to the introduction of new technologies but also stems from the continuous evolution of interfaces and interaction styles, making it challenging for older individuals to adapt. Consequently, it is imperative to improve the interaction between smart products and the elderly (Liu, L., 2021).

The current design of these apps for older adults is fraught with issues such as disorganized interface layouts, complex functionality, and subpar user experiences. As a result, older users often encounter numerous challenges and difficulties when it comes to perceiving and navigating through these applications. Thus, there is an urgent and pressing need for further enhancements and refinements in app design to better cater to the needs of the elderly population.Memory Machine (MeMa) is an application specifically designed for elderly users. It captures events and moments from people's lives to preserve memories. This application demonstrates its profound concern for the overall well-being of this demographic. The product is meticulously crafted to cater to the needs of elderly individuals who either grapple with memory-related ailments or possess an inherent desire to capture the intricacies of their lives more comprehensively. In essence, the application assumes the role of a companion, aligning itself with the physical and psychological health of its users.

Through the study of this project, guided by the principles of User-Centered Design and user experience, the interactive interface design of the Memory Machine aims to comprehend the current status of elderly individuals using internet products, uncover latent needs of elderly users, and through design, provide users with a natural and comfortable interactive experience.

The remainder of this paper is organized as follows. User requirements research are discussed in Section 2, and the main components of interaction interface are introduced in Section 3. The evaluation setups and results are presented in Sections 4. Finally, Section 5 provides some concluding remarks regarding this research.

2. User Requirements Research

2.1. Selection and analysis of competing products

Competitor analysis is a crucial component of the comparative research method (Cheng, L., 2016). For this project, the author has chosen three competitors from the Lifestyle category of apps in the Apple App Store as shown in Table 1, namely "Day One Journal," "FamilyAlbum," and "Momento," as they all fulfill the user requirements related to this project's scope. "Day One Journal" stands out with over 15 million user downloads, making it an ideal candidate for analysis. "FamilyAlbum" emphasizes easy photo sharing and interactive messaging among family members, making it an interesting contender in this market segment. Lastly, "Momento" has been recognized with Editor's Choice Awards and boasts a clean and aesthetically pleasing interface. Each competitor brings its unique strengths and appeals to specific user preferences and expectations.By analyzing the ways in which different types of competitors meet user requirements

through various functional categories, such as recording, socializing, browsing comments, and backup storage, a summary comparison of the recording modules of competing products can be obtained, as shown in Table 1.

Table 1 Summary Comparison of Competing Products' Recording Modules

Comparison Dimensions	Day one Journal	FamilyAlbum	Momento
Unique Features	Voice-to-Text Comments, Data Statistics	Invite Family Members, Family Members Reply to Each Other	Recording Special Events and People
Design Advantages	Clear Page Hierarchy, Rich Features	Emotion-Driven Design, Simple Upload Process	Warm Interface, Reduced Page Switching
Design Disadvantages	Complex Upload Process	Direct Access to Local Albums Causes Insecurity	Does Not Support Audio Recording and Audio Upload

2.2. MeMa User research

In previous research, a research team from the University of Nottingham (Price, D., 2019) conducted preliminary explorations in the design and development of the Memory Machine, which was approved by Computer Science's Ethics Committee at with reference CS-2017-R34. Another study (Gibson, R., 2023) focused on creating gifts for others through MeMa and designed a simple software interface, including the use of photos, videos, audio recordings, and notes to record memories, as well as creating collages and albums. Building upon this, the research team from the University of Nottingham continued the development of MeMa2 and provided me with interview data. By using the reflexive approach outlined by Braun and Clarke (2006), the interview data was subjected to thematic analysis to understand users' mental models and discover points for product optimization.

A total of 15 individual participants and 10 spouse, close family and carers of older adults were recruited for this study. The interview data was first automatically transcribed into textual data and then anonymized. After that, the data was coded and subjected to thematic analysis. Two themes emerged from the analysis: "Attitudes towards using media to preserve memory" and "Suggestions to MeMa.". The identification of the first theme was due to participants describing their experiences using MeMa and their views on this form of memory preservation. We divided this theme into two sub-themes: "Create opportunities for old adults" and "Technology and media can better preserve memories". The suggestions put forward by the participants during the interviews have been summarized and organized into 25 user requirements. User requirements are crucial because designing and developing using the UCD approach requires considering the user's perspective. However, not all requirements can be fulfilled, and the development team may not be able to deliver all the requirements before the predetermined initial delivery date. Therefore, this research described the user requirements, considered how to address these requirements, and assigned priorities to each requirement, aiming to optimize the user interface based on MeMa2.

Based on the previous research and synthesis, the elements of the product determine the impact of the user experience, while the effectiveness of the features supports the product's tasks and actions. As our software is designed for seniors to aid memory and record memories, functionalities related to recording are especially important. Additionally, enhancing the social and review experiences of the product can meet user expectations. We will prioritize the higher-priority basic user requirements and then strive to fulfill as many other user requirements as possible.

3. Interaction Interface Design

This section will introduce the interactive interface prototype designed based on the previous understanding of the current situation of Internet products for the elderly, the analysis of competing products and the research requirements analysis of the MeMa users.

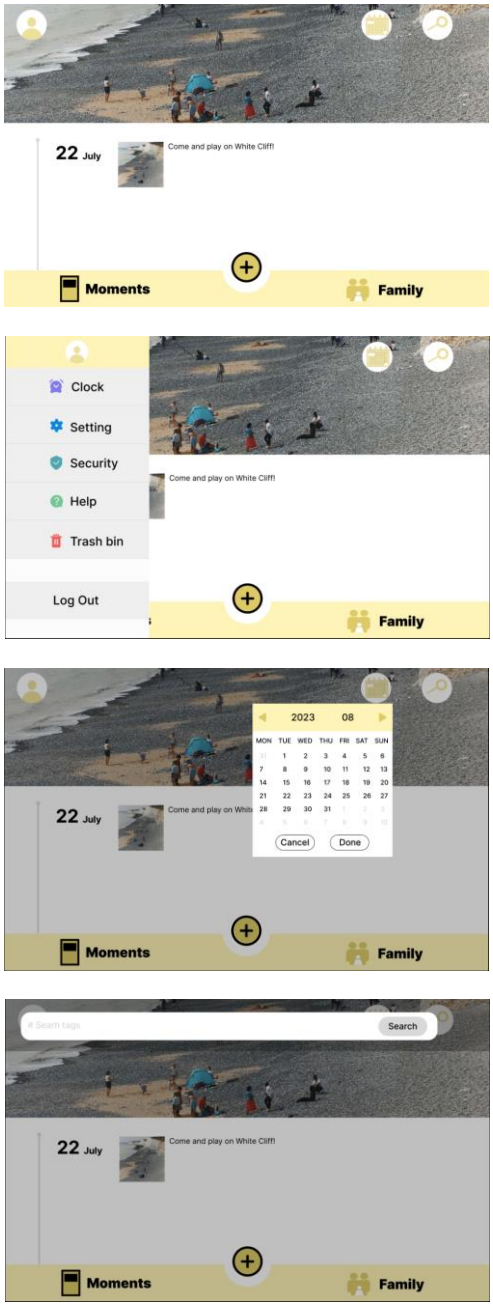

Figure 1 Homepage

The design of the application's homepage is particularly important as it serves as the central hub for most user

interactions and a focal point to attract users. It should convey the application's positioning and functionality in a way that's easily understood by users. The overall color scheme is warm yellow, and buttons and page edges feature rounded corners as shown in Figure 1. Font sizes and button sizes are enlarged for better usability by elderly users (User Requirement 19). As soon as you enter the homepage, your attention is drawn to the background image area, which occupies one-third of the page. This area displays a randomly selected photo that the user has uploaded into the application, creating a warm atmosphere (User Requirement 12). Based on earlier research, most users prefer recalling events in chronological order. Therefore, the review browsing module on the homepage is designed with a "timeline" concept, reinforcing the feature of recording events. This design highlights both the timeline and event content. The card-style design showcases events in reverse chronological order, allowing users to infinitely scroll through the timeline with a simple swipe gesture, enhancing the immersive experience. Each card displays the first photo of the event, and users can tap the card to view all the event's contents (User Requirement 3). At the bottom of the homepage, similar to typical application designs, three functional areas are provided. The central "Add" button navigates to the main function of the application - creating an event. The "Moments" button on the left navigates to the Moments page, while the "Family" button on the right leads to the family management page. At the very top of the homepage, there are three small buttons. These are the "Personal Profile," "Calendar," and "Search" buttons. The "Calendar" and "Search" buttons allow users to quickly find memories by date and tags, The "Personal Profile" is a module for users to personalize their settings, which may be used less frequently but is indispensable. It adopts a list-style interaction framework. Users can set up alarm reminders, personalize their preferences, manage privacy and security, access help, view the trash bin, and log in or out here (User Requirements 9, 11, 17). When clicked, they appear as pop-up overlays, maintaining a strong connection to the homepage and reducing the need for frequent page switches and waiting times caused by page loading.

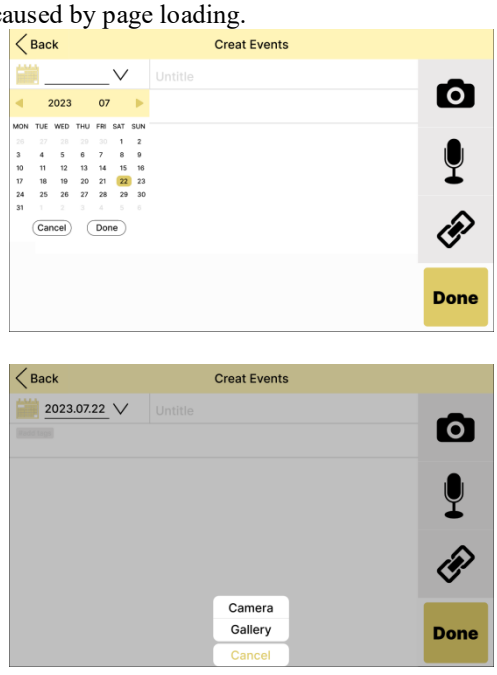

Figure 2 Create Events

On the homepage, users can directly access the event creation page by clicking the central button at the bottom as shown in Figure 2. This page combines Mema2's features of photos, videos, audio, and notes into one. Users first need to select the date and time of the event they want to record. Then, they have the option to fill in the title, add tags, and input notes (User Requirements 2, 6). Following this, users can record an event by adding an unlimited number of photos and audio recordings, among other content (User Requirement 5).

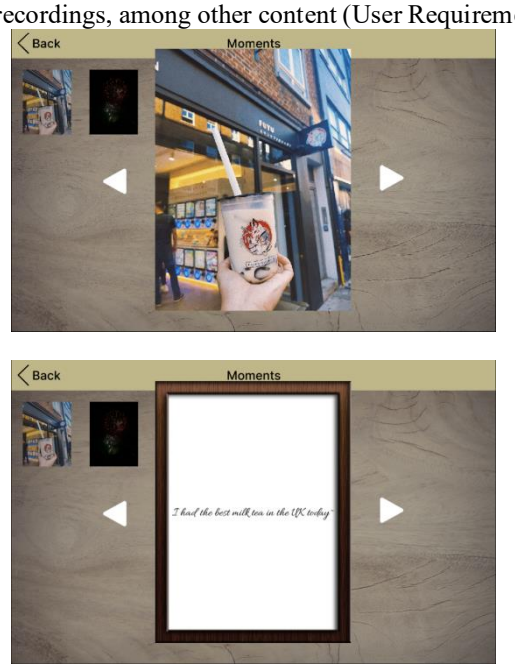

Figure 3 Moments

Sometimes users may not want to fully document an entire event; they may just want to capture a specific moment. In such cases, they can enter the "Moments" section and quickly record by adding a photo and a note as shown in Figure 3. The "Moments" section features a wooden background, simulating a memory board with pictures pinned to the wall. At the end of all the photos, there's the "Add New Moment" button as shown. Clicking on this button allows users to choose between taking a new photo or selecting one from their local album. After selecting a photo, users can also edit it and then add a note to the back of the photo.

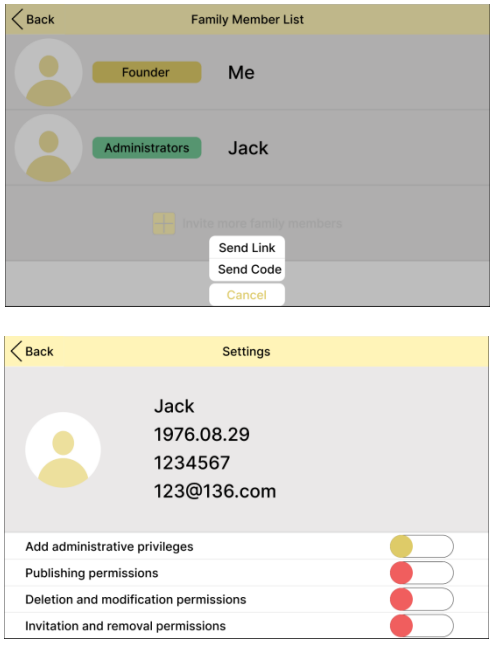

Figure 4 Family Member List

Inviting family members and interacting with them on the platform is an important tool to enhance users' sense of presence and achieve emotional communication. On the Family Management interface homepage, all family member lists along with their names and roles are displayed as shown in Figure 4. Users can also invite new users by clicking the invitation button at the bottom. Photo uploads are private and secure, and only family members invited by the user can view the photos (User Requirement 22). By inviting family members to join the family and granting them management permissions, the issue of password loss can be prevented (User Requirement 23). Through permission settings (allowing the family member to upload/edit), multiple sources of photo uploads can be managed, addressing the complexity of managing photos from various sources (User Requirements 24, 25).

4. User Evaluation

Usability evaluation is a systematic process of assessing the effectiveness, efficiency, and overall user satisfaction of a product, system, or interface. It involves testing the usability of a design through various methods and techniques to identify usability issues and gather insights that inform improvements. Usability is not a one-dimensional attribute of a product, system, or interface, but a combination of factors such as intuitive design, learnability, efficiency of use, memorability, error frequency and severity, and subjective satisfaction. In this study, 5 participants from University of Nottingham were recruited to attend user-based evaluation and full ethics is not required.

4.1. First Click Testing Method

First click testing (Sauro, J., 2011) is a usability testing method that focuses on evaluating the usability and effectiveness of a user interface by analyzing participants' initial clicks when faced with specific tasks or scenarios. The primary goal of first click testing is to determine the ease with which users can accomplish specific tasks on a website, application, or interface and identify any potential issues that could impact the user experience. It provides insights into how intuitive and user-friendly the navigation and layout of a website, application, or interface are.

Participants were presented with the interactive interface prototype of the Memory Machine application and were asked to point and click to view the location of previously recorded events. The test results indicated that all participants took a few seconds (average of 10 seconds) to scan the design as it was a new experience. Some participants immediately found the timeline and clicked on event cards (P2, P3), while others accidentally clicked the Moments button or mistakenly believed that reviewing required searching (P1, P4, P5). The time participants spent is shown in Table 2. This demonstrates that the homepage interface design I created is relatively easy to understand, but annotations need to be added around the timeline to clearly guide users on how to view memories.

Table 2 Time cost for first click testing

Participants ID	Time(s)
P1	22.97
P2	11.93
P3	19.61
P4	16.26
P5	21.17

4.2. System Usability Scale

We also utilized the System Usability Scale (SUS) method for user testing (Brooke, John., 1995). This test involves a simple ten-item Likert scale to provide a subjective overall view of usability assessment. Participants were asked to immediately record their reactions to each item on the scale rather than spending an extended time contemplating these items. This is a robust and reliable testing approach that aids in understanding users' cognitive processes such as situational awareness, decision-making, mental models, error handling, etc. Table 3. presents the SUS scores of five participants who tested the prototype design.

Table 3 SUS Score

Participants ID	SUS core for design prototype
P1	90
P2	77.5
P3	85
P4	65
P5	75

The score has been converted from a 0-4 scale to a 0-100 scale, indicating the general concept of designing prototypes from "above average" to "high level". The disadvantage of this user testing method is that it requires support from other methods.

4.3. User Experience Questionnaire(UEQ)

The User Experience Questionnaire is a structured survey tool designed to assess users' opinions, attitudes, and feelings towards the experience of a product, service, or system (Schrepp, M., 2017). The survey includes 26 items across six dimensions—Attractiveness, Persuasion, Efficiency, Reliability, Stimulation, and Novelty—on which participants rate their experiences using a 7-point Likert scale based on their perceptions and feelings. The User Experience Questionnaire (UEQ) is known for its simplicity and user-friendliness, and it has been validated for reliability and effectiveness across various domains and products. We selected the UEQ questionnaire due to its widespread usage, leading to content optimization and regular updates. As such, we consider its results scientifically reliable and persuasive, making it an ideal choice for our needs assessment.

The data results show the average and variance of six different user experience questionnaire (UEQ) scales, namely attractiveness, insight, efficiency, dependence, stimulation, and novelty, as shown in Table 4.

Table 4 UEQ Scales(Mean and Variance)

Statistics

		Attractiveness	Perspicuity	Efficiency	Dependability	Stimulation	Novelty
N	Valid	5	5	5	5	5	5
	Missing	0	0	0	0	0	0
Mean		2.3000	2.4500	2.4500	2.0500	1.6000	1.3500
Variance		.700	.575	.325	.325	3.081	4.519

We carefully studied each dimension evaluated in the user experience questionnaire as shown in Table 5 and Figure 5:

Table 5 Benchmark Data

Scale	Mean	Comparison to benchmark	Interpretation
Attractiveness	2.3	Excellent	The evaluated product is among the best 10% of results.
Perspicuity	2.45	Excellent	The evaluated product is among the best 10% of results.
Efficiency	2.45	Excellent	The evaluated product is among the best 10% of results.
Dependability	2.05	Excellent	The evaluated product is among the best 10% of results.
Stimulation	1.6	Excellent	The evaluated product is among the best 10% of results.
Novelty	1.35	Good	10% of the results in the benchmark are better than the evaluated product, 75% of the results are worse.

Figure 5 Benchmark Graph

(1) Attractiveness: The average score is 2.3, indicating that the product is considered above average in terms of attractiveness. This suggests that the product is visually appealing with an enticing design and layout. Being within the top 10% of best results range indicates that users find the interface highly suitable for elderly individuals. Through clear icons, distinct text, and easily recognizable color choices, the product offers a comfortable experience for older users.

(2) Perspicuity: The average score is 2.45, indicating that its clarity surpasses the average level. This implies it is easy to understand, use, and operate. This score also suggests that users can easily locate what they are looking for on the product.

(3) Efficiency: The average score is 2.45, indicating high efficiency of the product, with quick and convenient usage. Being within the top 10% of best results range signifies that users can swiftly and effortlessly complete tasks.

(4) Dependability: The average score is 2.05, signifying that the product demonstrates outstanding dependability, maintaining stable performance across various functional modules. Users encounter minimal issues or errors while using the product, leading to high trust and confidence in the product.

(5) Stimulation: The average score is 1.6, slightly above the Excellent benchmark, rating it as an outstanding product. This indicates users find the product engaging and pleasurable to use.

(6) Novelty: The average score is 1.35, not reaching the Excellent benchmark but still being classified as an good product. This implies it is perceived to have a certain level of novelty but still requires further improvements in some areas. User feedback highlights that the experience with certain features is not entirely smooth and requires more user guidance.

Overall, the research findings indicate that the product possesses significant strengths, including attractiveness, perspicuity, efficiency, and dependability. However, there are also areas of relative weakness, such as novelty. The product could benefit from improvements in terms of stimulation and novelty, aiming to enhance user experience and overall satisfaction.

5. Discussion and Future Work

Guided by the User-Centered Design (UCD) approach, the design of the Memory Machine's interaction interface consistently focuses on users and their tasks to effectively meet user requirements. This approach holds significant implications for the development of similar products. For instance, to facilitate ease of use for elderly users and reduce page transitions, various recording methods have been integrated into a single functional area. Furthermore, to cater to the more ceremonial requirements of the elderly, the "Moments" feature was introduced, allowing users to add notes to the back of photos. Additionally, this application goes beyond mere backup and recording; it acts as a bridge and bond for emotional communication within families. Therefore, a "Family" page has been incorporated, enabling users to invite family members for collective management and viewing of memories.

The leisurely lifestyle of elderly users determines that they have more time to dedicate to memory products. They require a convenient, comforting, and powerful product. The user experience of internet products for the elderly is still a subject worthy of in-depth exploration.

The research project in this paper employed an iterative approach in actual practice, with a short development timeline, resulting in several shortcomings. In the interface design phase, lower-priority user requirements, such as security design, dynamic linking, and switching between portrait and landscape modes, have not been incorporated into the prototype. In the user testing phase, due to time constraints, regular university students were recruited for testing instead of elderly users. This has led to inaccurate test results since the learning efficiency and adaptability to new things differ significantly between young people and the elderly.

The internet has permeated every aspect of our lives, and this has compelled senior citizens to accelerate their adaptation to the internet. However, what they face is not merely learning a single feature but rather the need to adjust to a series of complex operations. This poses a new challenge for both the elderly and society as a whole. Currently, through preliminary competitive analysis and user requirements analysis, only the interactive interface prototype design of the application has been implemented in the Figma software, not the actual functional operations. The future work required includes:

User Testing: Conduct real user testing by inviting actual

target users, especially the elderly, to use the prototype and provide feedback. This will help identify issues and points for improvement in real usage scenarios.

(2) Product Implementation: Develop the actual application based on the prototype, which can be used on tablets, smartphones, or the physical MeMa device.

(3) Function Expansion and Improvement: Based on further user testing, consider adding new features or improving existing ones. This may involve more in-depth research and design of functionalities.

The integration of the internet into the lives of senior citizens represents not only an educational challenge but also a fundamental shift in their daily activities. Therefore, it is essential to approach this transformation with careful consideration of the unique needs and challenges faced by older generations. The identified future work will contribute to refining and enhancing the product, ensuring its usability and effectiveness for the elderly user demographic.

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