Bridging the Gap: Creating Accessible User Manuals to Reduce Wearable Technology Abandonment Among the Elderly

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The aging global population presents a unique challenge and opportunity in the realms of technology and design. As the number of older adults increases, so does the demand for accessible and user-friendly technological solutions tailored to their specific needs. While the digital age has resulted in numerous innovations, many of these advancements inadvertently overlook the older generation, resulting in a digital divide. This divide prevents older adults from reaping the benefits of modern technology and deprives society of this age group's valuable contributions and engagements. Addressing this gap requires a holistic approach that combines empathetic design with a thorough understanding of the physical, cognitive, and motivational changes associated with aging. This paper explores wearable technology, a field full of potential to improve older adults' lives, aiming to optimize the onboarding experience and ensure a higher adoption rate among this demographic. We identified that while wearable technologies offer significant health and wellness benefits, their complex interfaces and steep learning curves often deter adoption and lead to abandonment among the elderly. Through a literature review, we understand the reasons behind the abandonment of wearable technologies by older adults. It reveals that permanent abandonment is primarily due to a loss of motivation rather than an inability to use the devices. The study highlights the importance of user manuals in facilitating technology usage, and identifies that these manuals often contain overly complex language and instructions. In response to these findings, we propose standardized design guidelines specifically for creating senior-friendly user manuals optimized for accessibility, simplicity, and clarity. A prototype manual for a health watch is presented, showcasing the implementation of these guidelines.

CCS CONCEPTS • Human-computer interaction (HCI) • Empirical Studies in HCI • Applied Computing

Additional Keywords and Phrases: Technological Literacy, Design Guidelines, User Manuals

1 INTRODUCTION

In the era of digital health, smart wearables have emerged as pivotal tools that facilitate a myriad of functionalities ranging from monitoring vital statistics to tracking physical activities. Smart wearables include devices such as smartwatches, fitness trackers, hearables, etc which are designed to collect data, provide real-time information, and offer functionality to enhance the user's lifestyle, health, or productivity. Particularly among older adults, these devices hold the potential to significantly enhance healthcare management and promote wellness by providing real-time data and insights into their health status. According to WHO (2022)

> "*By 2030, 1 in 6 people in the world will be aged 60 years or over. At this time, the share of the population aged 60 years and over will increase from 1 billion in 2020 to 1.4 billion. By 2050, the*

world's population of people aged 60 years and older will double (2.1 billion). The number of persons aged 80 years or older is expected to triple between 2020 and 2025."

Smart wearables empower individuals with data to make informed health decisions and enable healthcare providers to deliver more personalized and timely care. According to Abouzahra et al. (2020), the technological landscape, characterized by rapid advancements and evolving interfaces, often presents a daunting challenge for older adults, who may find it intricate to navigate through the multifaceted features of smart wearables. Lee et al. (2020) have suggested that discontinuing the use of smart wearables is caused by its complex and multidimensional aspects. While smart wearables offer a plethora of opportunities for enhancing health outcomes, the complexity of interfaces, coupled with the often steep learning curves associated with new technology, can deter older adults from adopting these devices. A user Interface (UI) can be defined as the means by which a user interacts with a software application, system, or device. It encompasses all the visual and interactive elements designed to facilitate user interaction, control, and communication with the underlying software or hardware. UI interfaces serve as a bridge between users and technology, enabling users to perform tasks, access information, and manipulate settings in a user-friendly and intuitive manner. However, the disparity in technological literacy levels among the older adult demographic creates a critical barrier to the effective utilization of these devices. Designing and implementing a standardized guideline that promotes learning among its user base to engage with wearable technology effectively is challenging.

The challenges extend beyond mere device operation to encompass understanding data outputs, managing device settings, and ensuring data privacy and security. Ridgers et al. (2016) concluded that activity trackers are generally evaluated positively in terms of effectiveness and feasibility, but more longitudinal research is needed to verify actual long-term adoption. Consumers aged 50 and above are increasingly interested in leveraging these trackers to achieve better health and prevent illness. However, realizing the full potential of this market segment hinges on addressing critical usability challenges, including issues of discomfort and perceived data inaccuracy during synchronization (Project Catalyst and HomeLab, 2016). Studies have indicated that technology adoption can be influenced by cognitive abilities, which may be affected by factors like crystallized thinking relying on pre-existing information learned through experience over many years) or computer anxiety (Czaja et al., 2006). Additionally, older adults may make more errors and require more time for basic training (Kelley & Charness, 1995).

Despite significant calls for research in this area, there still exists insufficient research that systematically reviews the existing literature on older adult learning needs and preferences. This presents an opportunity to explore innovative strategies to bridge the technological literacy gap, thereby ensuring that the benefits of smart wearables are universally accessible and not confined to the technologically savvy. The remainder of this report examines the needs and preferences of older adults and evaluates their requirements and reasons for abandoning activity trackers, despite their evident benefits. Through a comprehensive literature review, a set of standardized guidelines and design implications will be devised that allow consistent manufacturing of activity trackers before they hit the market.

2 RELATED WORKS

Abouzahra & Ghasemaghaei (2020) exposed wearable devices to adults aged 65 and above during interviews and summarized some themes that emerged. The participants generally showed a positive attitude towards wearable devices despite finding some kind of complexity in device use. They perceived some value in using wearable devices to boost their self-efficacy in tracking their activity and maintaining their health. For older adults, technologies such as mobile fitness applications have the potential to not only improve physical activity levels but also increase social interaction and brain functioning to support the performance of activities deemed instrumental to their daily living (Harrington et al., 2018). Personalized and adaptive learning systems have emerged as a prominent area of research, especially for users with diverse backgrounds and

capabilities. The demographic of the older adult population evokes unique needs, experiences, and technological literacy levels. The surge in smart wearables has only further accentuated this research niche. In light of this report's research question, "How can personalized and adaptive training modules or tutorials be developed to accommodate the varying technological literacy levels among older adult users of smart wearables?" a review of the most pertinent literature is presented below.

2.1 Why do older adults abandon wearable technologies?

Understanding why older adults abandon wearable technology would allow us to craft the design guidelines for developing user manuals and training pedagogies in order to reduce the rate of abandonment. The common answer to older adults' abandonment of highly beneficial wearable devices may be that they are unfamiliar or not well-versed with technology. Contrary to popular belief, Rogers (1999) discovered that given the right training, many older adults are eager to accept and use new technologies. Vaportzis et al. (2017) found that while older adults might have initial apprehensions, they are keen learners when technology is presented in a familiar and comfortable manner. However, their learning patterns and speeds differ, necessitating adaptive modules.

Activity trackers are being abandoned even though they are designed to promote healthy lifestyles and monitor various health metrics. Attig et al. (2020) performed a comprehensive literature review to uncover why these trackers are not long-term adopted and inferred that permanent abandonment decisions were mainly related to loss of tracking motivation. They developed an online questionnaire for assessing abandonment reasons and characterized former users of activity trackers to understand their abandonment reasons as well as former tracker usage patterns (Attig et al., 2020). Due to the methodological limitations of questionnaire-based research, these studies lacked evidence that identified chains of causation leading to abandonment. Social influence, such as from family, friends, or weak ties can also be a factor in technology adoption (Abouzahra & Ghasemaghaei, 2020).

Woźniak et al. (2020) argued that though these technologies are gaining popularity, they struggle to offer long-term health benefits because of their inability to provide engaging goals. Sullivan & Lachman (2017) added that it is not well understood whether the behavior change techniques included in fitness technologies are sufficient for changing behaviors over the long term. Five participants who already used activity trackers, ages ranging from 62-74, in Rao Gadahad & Joshi (2022) were recruited for an 8-month longitudinal study to understand how they currently use these devices and what barriers they face in getting the most out of them. They found that the participant's greatest barrier was onboarding. They created short how-to videos in their local language, usually specific to the problems they faced, and offered speech input, voice prompts, personalized feedback on progress, and Q&A chat-bots to assist the older adults in their increased usage of the activity trackers. The research concluded that aspects such as lifestyle, diet, and attitudes towards fitness vary by culture and economy, which changes the requirements of the activity trackers.

These technologies still end up being abandoned for various other reasons. Clawson et al. (2015) built a dataset based on activity trackers being sold on Craigslist, and an astonishing quarter (23.4%) of the technologies in their dataset were either completely unused or had been used only once. They concluded that this was the result of a mismatch between users' hopes and expectations and device capabilities. Therefore, realizing the context of the use of these activity trackers can help designers identify potential use trajectories and design for evolving adoption.

2.2 Significance of User Manuals

Product instructionals and user manuals serve as indispensable tools for guiding individuals through the intricacies of modern digital devices. Bruder et al. (2007) compared the effectiveness of improved paper-based instruction modules against an interactive e-learning application that simulated the use of mobile phones for the younger elderly and the older elderly. There were no significant differences in training success

or self-efficacy after training between both of the training sources. Thus, a well-designed user manual can greatly assist older adults in onboarding and continued use of technology.

Among the primary reasons older adults turn to user manuals is their need to decipher the unfamiliar technical terms and jargon often accompanying newer technology (Ishihara et al., 2013). Tsai et al. (2012) conducted a study with seventy Taiwanese older adults who were interviewed and completed a questionnaire about their usage of product manuals for twelve technological products. Nearly all participants reported reading all or a portion of product manuals, especially when interacting with new products for the first time. The motivations behind reading product manuals also included better understanding of the products, recalling forgotten functions, and preventing mistakes. Thus, user manuals serve as guides to enhance understanding and minimize the fear of misusing technology. According to Fan & Truong (2018), independence is a cherished aspect of aging for many older adults, and user manuals enable self-reliance by providing the guidance necessary to prevent the constant need to rely on family members for technology-related assistance.

While user manuals are undoubtedly valuable resources, the journey to use them is fraught with numerous challenges for older adults. Even though older adults used product instructions, 9 out of 12 participants in the study conducted by Fan & Truong (2018) reported that product instructions were often confusing, frustrating, complicated, demanding, too wordy, and lacked legibility and clarity. The surveys conducted by Ishihara et al. (2013) assessed the participants' familiarity with various technical words extracted from smartphone manuals and evaluated the participants' comprehension of sentences extracted from these manuals. By analyzing the results, the researchers found that the technical language and jargon present in user manuals can be overwhelming and challenging to understand, particularly for those with limited exposure to technology (Ishihara et al., 2013). Ironically, user manuals often present complex technical terminology and instructions, which can be challenging for older adults with limited experience and lower computer-related self-confidence in navigating technical devices (Bruder et al., 2007 & Tsai et al., 2012).

2.3 Learning Pedagogies for Older Adults

As the global population ages, understanding the unique learning preferences and challenges of older adults becomes increasingly crucial. Truluck & Courtenay (1999) explore learning styles using Kolb's Learning Model, pinpointing four unique learning styles: *Accommodators, Assimilators, Divergers,* and *Convergers*. Their comprehensive study encompassed 172 participants, all aged 55 and above, and found that age, gender, or educational history did not significantly influence learning style preferences. For instance, 60% of participants aged 65-75 showed a preference for the Assimilator style, while 55% of those aged 55-65 leaned towards the Diverger style. As individuals aged, the gender-related distinctions in learning preferences seemed to wane, suggesting a convergence in learning styles among older adults.

This observation is consistent with the research done by Heenan (2016), which utilized the Gregorc Learning Styles Delineator and emphasized the importance of tailoring teaching pedagogy to accommodate the Concrete Sequential learning style, as it was universally favored among participants. This insight underscores the need for educators to adapt their methodologies to cater to this prevalent learning preference, ensuring effective knowledge transfer to older adults who have a tendency to become more reflective and observational in the learning environment with age. Rogers (1999) also emphasized the significance of age-specific training for older persons that takes into account age-related cognitive abilities in system design.

2.4 Design Guidelines for Senior-Friendly Product Instructions and Onboarding

Research on developing design guidelines for creating activity trackers has been an evolving field, given the rapid advancements in technology and an increased focus on health and wellness. Meyer et al. (2015) identified factors that influence the use of activity-tracking devices in daily life through an exploratory study

that recruited participants with an age range between 25 and 70. They devised four design guidelines to assist the design of UI interfaces and concluded that no design “fits all preferences.” However, this analysis falls short of formulating a basis to create a specific set of standardized guidelines for designing smart wearables.

Fan & Troung (2018) outlined 11 guidelines developed with the feedback of study participants who modified the instructions for a device to make them clearer for the next older adult who uses it. They recognized that participants had the highest task success rate and lowest task completion time when using guideline-modified user instructions, which were edited for simplified language and seemed to enhance clarity and comprehension. The adoption of user-centered design practices can ensure that older adults' perspectives are incorporated into the development process, making the instructions more user-friendly.

Senior-friendly instruction manuals could be a good reference for device setup or maintenance. However, reliance on a physical manual can slow down technology adoption for its users. When relevant information is available within the wearable device itself, the users can feel more confident in the usage of the device. Toscani et al. (2018) focused on a Gamification Design Process for onboarding newcomers to FLOSScoach. Based on three pilot tests with Brazilian researchers in the area of Collaborative Systems and HCI, they created a high-fidelity prototype that contained gamification elements. The evaluation of this prototype yielded positive results with some tweaks that were suggested on a graphic design level. Gamification is a great way to hold a user’s attention, but this study did not involve older adults. More research needs to be done on whether the positive reaction to gamification also holds up for the older adult population.

The reliance of older adults on product instructional/user manuals highlights their determination to bridge the digital generation gap and actively engage with modern technology. Despite the challenges posed by unfamiliar terminology, limited computer literacy, cognitive decline, and the fear of mistakes, these individuals turn to user manuals for assistance. Design guidelines that emphasize clear language, simplified structure, and user-centered approaches are instrumental in empowering older adults to navigate the digital world confidently. This paper will draw from the problems described by the above data and outline design guidelines specifically to improve the adoption of wearable technology for older adults.

3 PROPOSED DESIGN GUIDELINES

Current research focuses on the effectiveness of teaching methods tailored for older adults in mastering digital technologies. While numerous studies address this topic, there is still a lack of standardized industrial design guidelines that set rules for designing and developing smart wearables. We formulated two research questions that defined the scope of this study.

RQ1 - How can personalized and adaptive training modules or tutorials be developed to accommodate the varying technological literacy levels among older adult users of smart wearables?

RQ2 - What are the preferred learning styles and information processing methods of older adults when it comes to technology adoption, and how can these preferences inform the design of training and onboarding materials?

To address the issue of older adults abandoning wearable technologies, it is important to consider a range of solutions that cater to their unique needs and preferences. Creating user manuals for wearable technology specifically designed for older adults requires a focus on accessibility, simplicity, and clarity.

3.1 Design Guidelines for User Manuals

1. Clear and Large Font: Use a large, easy-to-read font size to accommodate potential visual impairments. Sans-serif fonts like Arial or Helvetica are often easier to read (Farage et al., 2012).

2. Provide context before instructions: Give a brief overview of what the technology does and how it will benefit the user before diving into specific operations
3. Simplified Language: Using straightforward, simple language. Avoid technical jargon and use terms that are familiar to older adults. Keeping sentences short and to the point can aid in comprehension.
4. Step-by-Step Instructions: Provide clear, step-by-step instructions for each function of the wearable device. Break down each task into small, manageable steps, and avoid assuming prior technical knowledge.
5. High-Contrast Colors: Use high-contrast colors for text and backgrounds to make the manual more readable. For example, black text on a white background is a classic high-contrast combination.
6. Use of Images and Icons: Include images, diagrams, or icons to illustrate steps or parts of the device. Make sure these visuals are large and clear, with labels if necessary.
7. Accessibility Features Explanation: If the wearable device includes features specifically designed for older adults (like fall detection or large buttons), highlight and explain these features in detail.
8. Safety and Health Information: Outline any health and safety information clearly, especially if the device will be used for health monitoring. Also, include any warnings about potential risks and guidelines for safe use.

3.2 User Manual Example Prototype

We created a prototype of how a user manual that incorporates the above design guidelines may look. Our solution focuses on smart wearable devices - Health Watch. This manual, as shown in Figure 1 and Figure 2, is designed to guide users through the features and setup process of the HealthWatch 2, a smart wearable device aimed at tracking various health metrics.

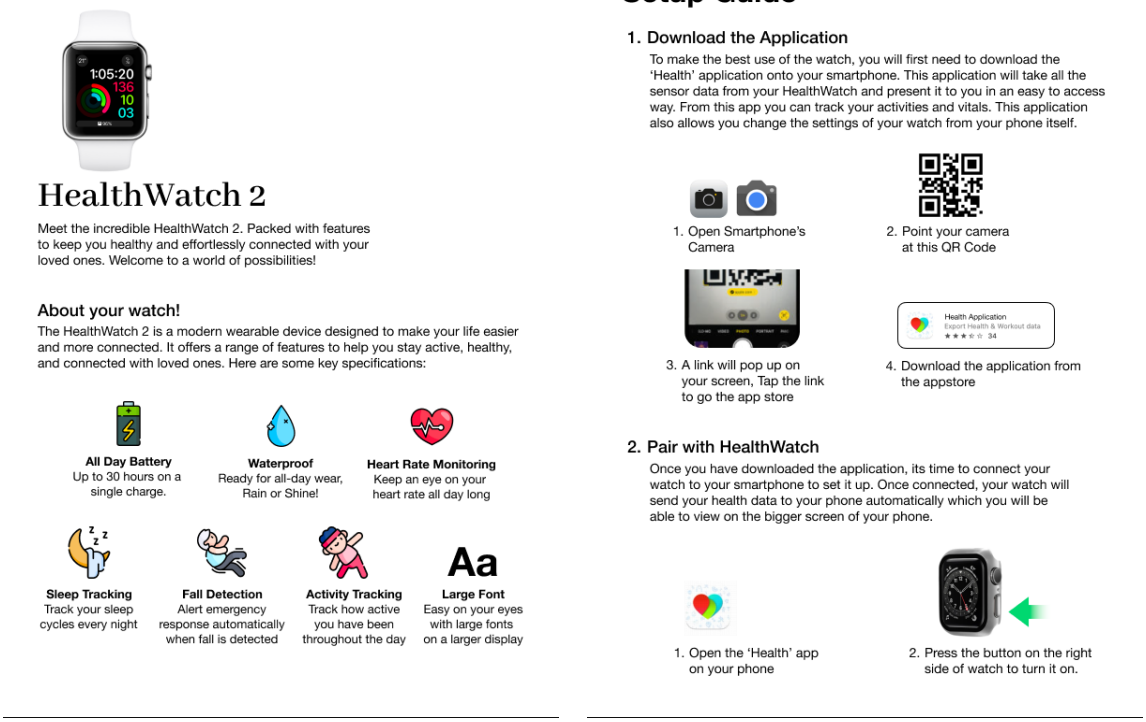

Figure 1: Introduction to the HealthWatch 2 showcases main features such as all-day battery life, waterproof design, heart rate monitoring, sleep tracking, fall detection, activity tracking, and an interface with a large font for easy readability. The setup guide instructs users on how to download a companion smartphone application that works with the watch, how to pair the watch with a smartphone, and the initial steps required to start using the device.

The manual starts with an introductory section (Fig. 1) with the name of the device, which provides an overview of the device and its benefits. This context setting is in line with the guidelines and helps users understand the purpose of the technology before learning how to use it. The language used in the manual is simple and direct, avoiding technical jargon. This is evident in sections such as the setup guide and how to charge the watch (Fig. 2), which use straightforward language to describe the steps. Each function of the device is explained with step-by-step instructions, such as how to download the application, pair the watch, and charge it. This breakdown into manageable steps makes it easier for users without prior technical knowledge to follow along. The text is mostly in black set against a white background, offering a high-contrast visual that is easy to read. This is a classic high-contrast combination that enhances readability.

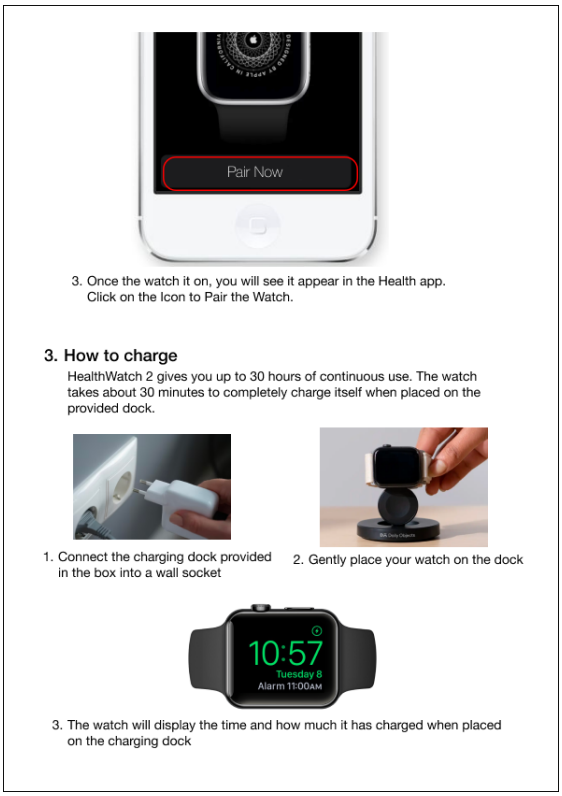

Figure 2: Setup continued - Detailing the device's charging process, including connecting the charging dock to a power source and placing the watch on the dock to charge. Maintenance of the watch emphasizes what is required by the watch to use it productively for a longer time.

The manual includes images and icons alongside the text to visually represent the instructions, such as images of the watch, the charging dock, and icons for various features like sleep tracking and fall detection. These visuals are large and clear, aiding in comprehension. The manual explains accessibility features such as fall detection, activity tracking, and large font, which are especially useful for elderly users. These features are represented with both text and accompanying icons, making them stand out. While the provided excerpts do not explicitly show safety and health information, such sections are typically included in comprehensive manuals, especially for devices that monitor health. For elderly users, the design considerations implemented in the manual ensure ease of use and understanding. The large font size and high-contrast colors cater to common visual impairments among the elderly. The simplified language and step-by-step instructions accommodate users who may not be familiar with technology or who have cognitive challenges that make complex instructions difficult to follow. The inclusion of images and icons helps in the cognitive processing of the information, as it provides visual cues that can be easier to understand than text alone. Additionally, the manual's emphasis on accessibility features ensures that elderly users are made aware of the specific functionalities designed for their benefit, like fall detection, which can be a crucial feature for their safety.

This prototype is designed with the elderly in mind, adhering to guidelines that promote clarity, simplicity, and ease of use. Its design choices, from the visual elements to the language used, show an understanding of the needs of older adults, making it a helpful guide for them to utilize the technology effectively and safely.

4 LIMITATIONS AND FUTURE WORK

The current project is aimed at developing digital user manuals for the elderly, and marks a significant advancement in making technology more accessible. However, it faces limitations that must be addressed in future developments. A primary constraint is the absence of real-world testing with the intended user demographic. Due to time constraints, the prototype of the user manual was not presented to older adults, which meant that further iterations based on feedback were not incorporated. As previous research suggests (Fan & Troung, 2018), including the perspective of older adults in the design process of user manuals ensures that the manuals cater effectively to their specific needs and preferences and can make the product more usable Additionally, the project is challenged by resource and technical constraints. Developing sophisticated digital solutions demands substantial financial and technical investment. Future iterations need to focus on creating scalable, cost-effective solutions that can adapt to the ever-evolving technological landscape. Another critical aspect is the varying level of digital literacy among elderly users, highlighting the need for hybrid solutions that bridge physical and digital mediums.

This project holds the possibility of expanding physical user manuals to their digital versions to make them universally applicable and beneficial. This involves understanding the most commonly used devices by the elderly and developing specific guides or tutorials for these devices. Moreover, the integration of these digital manuals with existing systems used by the elderly, such as health monitoring devices, could significantly enhance their practicality. Continuous support and regular updates are essential for the long-term sustainability of digital solutions. Lastly, addressing legal and ethical considerations, particularly in terms of data protection and user privacy, is crucial. Further research will be instrumental in overcoming the current limitations, thereby significantly enhancing the effectiveness of the project, ultimately making technology more accessible and user-friendly for the elderly population.

5 CONCLUSION

This paper has examined the factors influencing wearable technology abandonment among elderly users and proposed design guidelines to enhance accessibility through improved user manuals and training. The introduction established that while wearables promise numerous health and wellness benefits for the elderly, complex interfaces and steep learning curves often deter adoption and lead to abandonment. The literature review analyzed key research on abandonment motivations, the significance of user manuals for technology adoption, the learning preferences of older adults, and existing design guidelines. Key findings show that permanent abandonment primarily relates to motivational loss rather than an inability to use devices. However, inadequate onboarding and training resources often contribute to initial struggles. Moreover, user manuals play a vital role in facilitating usage and preventing mistakes. Yet frequently, they employ overly complex language and instructions. Research also reveals that older adults converge towards concrete, sequential learning styles.

In response, a set of standardized design guidelines have been proposed specifically for creating senior-friendly user manuals optimized for accessibility, simplicity, and clarity. Guidelines encompass the use of large, high-contrast fonts, simplified language, context setting before instructions, step-by-step guidance suited for linear learning styles, the inclusion of illustrations, and emphasis on safety. A user manual prototype for a health watch designed and presented in this paper showcases the implementation of guidelines. Ultimately, this paper demonstrates that targeted training and user resources can significantly impact technology adoption among the elderly. While the proposed guidelines have limitations regarding real-world validation, they provide a robust foundation for improving manuals. Moreover, they highlight the need for adaptive solutions catering to diverse literacy levels. Extending guides digitally also offers increased flexibility. In conclusion, by employing human-centered design, the user manuals and onboarding tutorials can enable fuller access to wearable technology benefits, especially across aging populations. This has profound implications for leveraging health-promoting innovations to support reliability and productive longevity.

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