Age-Inclusive Design of Video Streaming Services: Integrating Insights and Design Implications

Sruti Subramanian*[0000−0001−6286−9789] and Katrien De Moor[0000−0002−8752−3351]

Department of Information Security and Communication Technology, Norwegian Univeristy of Science and Technology, Trondheim, Norway
sruti.subramanian@ntnu.no*; katrien.demoor@ntnu.no

Abstract. With the rapid growth of video streaming services, understanding user needs, preferences, and behaviors has become crucial. However, older adults, are a significant yet often overlooked user segment, have received limited attention. This paper aims to bridge this research gap by integrating insights from HCI, QoE, and health sciences. By fostering an age-inclusive design process, three key design implications for video streaming services are highlighted. These implications have the potential to enhance the user experience for older adults, specifically in the context of video streaming services. Additionally, the study's implications provide valuable guidance for future empirical research on video streaming services with older adults. By considering interdisciplinary knowledge, we can address the unique requirements of older adults, promote engagement, and improve accessibility within video streaming services. Ultimately, these implications contribute to healthy aging and the promotion of a healthy lifestyle through the utilization of video streaming services.

Keywords: video streaming· Age-inclusive design · dynamic adaptation.

1 Introduction

Video streaming services (such as Netflix, YouTube, Disney+, etc.) have witnessed a significant surge in recent years. Consequently, there is a growing interest in understanding users' needs, preferences, and behaviors related to the use of these multimedia platforms. Improved comprehension of various human factors are known to be crucial not only for enhancing user experience but also for increased technological optimization [3, 13]. Currently, video streaming services are widely used by diverse age groups and user segments globally [8, 20]. However, when identifying the needs, preferences, and behaviors of users, the focus has predominantly been on younger and middle-aged individuals, who are considered more accessible [10]. Although they are prominent users of video-on-demand (VoD) and video streaming services, there is a lack of consideration for other user groups, particularly older adults, who are also significant but less represented users in this context. This poses a significant challenge as different user

groups have distinct requirements and preferences when it comes to using the same technology [7]. While previous studies have explored aspects of designing interactive technology for older adults in the fields of HCI, health sciences, and little knowledge in quality of experience (QoE), there is a lack of integration between these disciplines to ensure an age-inclusive design of video streaming services. This paper aims to bridge this research gap by integrating insights from the different disciplines.

2 Background

2.1 Physiological Changes in Older Adults

Medical advancements over the past century have resulted in increased life expectancy than ever before, resulting in an increasing global population of older adults. The global numbers of older adults are rapidly increasing and expected to reach over 1.5 billion in the year 2050 [15]. Older adults are a distinctive demographic as the natural process of aging contributes to various impairments affecting ones' sensory (i.e., visual, auditory), physical (e.g., skeletal, and muscular system), cognitive (e.g., memory, attention) and perceptual capabilities [22, 16]. Hence, though numerous older adults are currently living longer lives, several of those years are with disabilities and chronic conditions [11]. Such physiological changes largely contribute to the needs, preferences and behaviors of older adults using VoD and video streaming services.

2.2 Understanding Older Adults' Preferences and Needs with Interactive Technology

Numerous technological applications are widely being used by older adults for various purposes such as healthcare, social well-being, and entertainment to mention a few. Despite not having previous experience or sufficient knowledge about technology, older adults have shown to be tech savvy to adopt and use new technologies that are of value and relevance to them [6, 18].

Despite the speculations of older adults and the use of modern technology, it is known however, that Televisions (TVs) are a well accepted form of technology and are widely used by this segment of the population[17, 2]. TV viewing is one of the most popular leisure time activities which is particularly prominent among older adults. Studies [1, 14] further suggest that as people get older, they watch more TV, with viewing time significantly increasing after retirement. In this regard, with the modern smart TV's functional spectrum encompassing not only traditional network channels but also VoD and video streaming services among others, the need for opting an age-inclusive design of such services is imperative.

Coelho et al., [4] suggest integrating multi-modal interaction, and various adaptation techniques in the design process of TV applications to adapt user interfaces to the individual needs and limitations of elderly users. Bobeth et al.,

[2] further explored the use of free hand gestures for TV menu control among older adults and identified that participants were positive towards gesture-based interaction. Furthermore, with respect to the UI design of applications for older adults in general, numerous studies have provided design guidelines to accommodate some of the common physiological limitations experienced by the user group providing recommendations such as increasing font size, increasing button size, increasing contrast, reducing content, etc., [19].

2.3 Optimized Video streaming services

Adaptive bitrate streaming (ABR) [23, 21] dynamically adjusts the quality of a video stream based on the viewer's network conditions. It enables the video player to automatically switch between different bitrates (i.e., levels of video quality) during playback in response to changes in the available bandwidth and network stability. This adaptive approach ensures a smoother viewing experience by reducing buffering, minimizing startup delays, and optimizing video quality based on the viewer's specific device and network capabilities. With the use of mobile devices, due to the limited screen size, the increase in bitrate becomes unrecognizable for the user after a certain degree [21]. The authors further state that more energy-efficient decisions can be made by avoiding higher bitrates if there is no gain in the perceived quality.

3 Design Implications and Discussion

3.1 Dynamic adaptation of age-inclusive design

Considering that older adults' needs, and preferences are vastly different from other user segments, implementing a complete age-inclusive design may not be attractive to the other users such as the younger adults. However, incorporating a dynamically adaptive version of the application which is age-inclusive, and encompasses features such as multi modal interaction techniques [5, 9, 12], in addition to various guidelines and adaptation techniques specific to older adults [19] could be a potential implementation. Such that, based on the identified users' interaction with the application (e.g., ease/difficulty) the version (e.g., age-inclusive version, original version) of the application could be dynamically adapted to the individual user and displayed accordingly. This also has implications for potential QoE evaluation of such services, which should also be adapted to the abilities and preferences of the older adults user segment (e.g., increasing font size, increasing button size, increasing contrast, reduced complexity of the set-up, etc.).

3.2 Optimizing video bit rate

A lot of research, and resources are being implemented towards increasing the Quality of Experience while simultaneously trying to achieve technological optimization [23, 21]. In this regard, considering older adults' needs, preferences and

behaviors and designing accordingly may not only have a positive influence on the user experience and QoE of this demographic but in turn may also have a positive influence in terms of technological optimization. For example, considering the natural visual and auditory decline among the user segment [22, 16] , the video and audio quality might be scaled down without necessarily compromising QoE and the overall user experience. As mentioned by [21], perceived quality does not increase beyond a specific point despite increasing the bit rate. For instance, a slight difference in video/audio quality may not even be distinguishable. So watching a video with bitrate of 750/450 kbps instead of 1500 kbps for e.g., may not make a significant difference in terms of the viewing experience among older adults. In such a case, while user experience may not necessarily be influenced by the difference in bit rate, from a technological perspective this difference can potentially contribute towards achieving better optimization. Such an implementation could further be integrated into the dynamically adaptive age-inclusive version of the application.

3.3 Integrating external sensors for multi-modal interaction

Earlier studies [9, 12, 5] have emphasized the need to design for multi-modal interaction techniques when designing for older adults. Furthermore, various studies [2] have identified that movement/body-based interaction techniques (such as hand gestures/whole-body movements) for controlling interactive applications and Televisions have been well received by the demographic. In this regard, integrating additional sensors to the TV to allow for the implementation of such body-based interaction could potentially be an additional means of interacting with the application. With the option of being either the primary mode of interaction or a supplement, such a hardware integration could be of potential benefit. In addition to the purpose of facilitating body-based interaction, the integrated sensors can also be programmed for a more serious purpose such as detecting unusual movements among older adults (such as falls). Hence, such an implementation of external sensors to not only enable multi-modal interaction but to also detect falls could be highly beneficial particularly among the older adults who are living alone.

Conclusion and Future Work

Based on integration of existing studies, we provide the following three implications for the design and evaluation of age-inclusive VoD and video streaming services: 1. Dynamic adaptation of age-inclusive design 2. Optimizing video bit rate 3. Integrating external sensors for multi-modal interaction.

While the discussed implications largely reflect the physiological changes experienced by older adults, future studies should also consider the various other factors (age, sex, culture, etc.,) influencing this heterogeneous user groups' use of VoD. In this regard, further conducting extensive user studies focusing on older adults' use of VoD and video streaming would allow for gaining better

insight and reflections for the design and evaluation of such services and actively contribute to expanding current knowledge as there are several potential areas to explore. For instance, field studies in addition to different research methods can be opted to better understand the various human factors (i.e., physical, cognitive, social, cultural, and emotional) influencing older adults use of VoD and video streaming services and contribute to the limited knowledge available. Furthermore, while the current work focuses more on TVs, further studies could explore older adults' use of VoD and streaming services on different devices (such as mobile phones, tablets). Studies focusing on older adults behavior in this regard could be further beneficial and contribute to the existing design knowledge pertaining to the demographic, as well as unravel important considerations for QoE evaluation involving this user segment.

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