International Symposium on World Ecological Design
F. Ying et al. (Eds.)

doi:10.3233/FAIA240084

Enhancing Cognitive Engagement in the Elderly: Design of Entertaining Wearable Devices

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Abstract. In the context of a growing aging population, characterized by a lack of established digital product thinking models and reliance on singular physical facilities for leisure activities, this study employs user portraits of the elderly to inform the design of entertainment wearable devices. Utilizing experience design as a central methodology, the project introduces head-mounted projection headphones and touch sticks endowed with writing and drawing functionalities as primary product platforms. By synergizing these components, elderly users are immersed in an interactive crossword puzzle game, fostering an engaging and deliberative cognitive experience, thereby addressing specific cognitive and leisure needs within this demographic. This innovative approach offers a promising solution to enhance the digital engagement and cognitive stimulation of elderly individuals.

Keywords. Elderly people, entertainment wearable devices, experience design

1. Introduction

This research discourse delves into the significant demographic shift of population aging, particularly prevalent in Asia and Africa. The number of individuals aged 60 years and older has seen a substantial increase since 1950, surpassing 700 million in 2006 and projected to reach 2.1 billion by 2050 [1][2] . This demographic transition necessitates a concerted effort to mitigate communication impediments faced by the elderly. Common challenges include sensory impairments, such as hearing and vision defici[1]ts, alongside cognitive alterations, all of which are associated with healthy aging [3].

1.1. Hearing Impairment and Its Ramifications

Hearing loss emerges as a prevalent condition among aging adults, with common underlying factors being high blood pressure, diabetes, and certain ototoxic medications [4]. Hearing aids, commonly known as personal amplifying systems, offer a notable improvement in hearing capabilities [5]. Nevertheless, presbycusis, a form of

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age-related hearing deficit attributed to the diminished inner ear hair cells, remains impervious to hearing aids [5]. The psychosocial impact of hearing loss is substantial, leading to social withdrawal and diminished compensatory abilities [6].

1.2. Visual Impairment and Its Consequences

Visual impairment in elderly individuals poses significant challenges in interpreting facial expressions and non-verbal cues. Macular degeneration, a prevalent cause of vision loss, compromises central and color vision. Such impairments often result in social isolation and potential depression, as positive perceptions of the environment wane [5].

1.3. Digital Ageism and the Need for Inclusive Technologies

In an increasingly digitized world, older adults confront social exclusion and stereotypes regarding their digital proficiency [7]. Efforts are required to bridge this generational gap by developing technologies that cater to the specific needs and preferences of the elderly.

1.4. Wearable Technology as a Solution

Wearable technology, defined as technology designed to be worn, presents a promising avenue to address communication barriers in aging populations [9][10][11]. These devices, ranging from smartwatches to smartglasses, have the potential to detect and transmit vital information, providing immediate biofeedback to the wearer. Moreover, they hold promise in various domains, including health and fitness, communication, and entertainment.

1.5. Proposed Glyph Exploration Sports Headphones and Touch Stick for the Elderly

This study proposes a novel approach to address the communication challenges faced by the elderly through the design of sports headphones and peripherals. The envisioned product leverages visual projection, auditory prompts, and tactile sensing to facilitate a seamless integration of virtual content with the real environment, offering an immersive experience tailored to the specific needs of aging individuals.

1.6. Aim of This Study

As the global population continues to age, the imperative to enhance communication with the elderly becomes paramount. Wearable technology, particularly the proposed glyph exploration sports headphones and peripherals, stands as a promising solution to bridge the communication gap and improve the overall quality of life for this demographic. This study advocates for a concerted effort to develop inclusive technologies that cater to the unique requirements of aging populations, fostering a more inclusive and digitally connected society.

2. Functionalities and Features

This section outlines the key functionalities and features of the projected glyph exploration sports headphones for the elderly, highlighting their potential to revolutionize communication and sensory experiences for aging populations.

1) Three-Axis Linkage for Enhanced Stability and Projection Flexibility:

The integration of a three-axis linkage system ensures optimal stability of the projection screen, allowing for precise adjustments. Additionally, the equipment boasts a 30-degree rotation capability, enhancing its adaptability to various settings.

2) Seamless Inductive Connection between Touch Stick and Projection Interface:

The touch stick establishes an intuitive and responsive connection with the projection interface. This intuitive interface is complemented by headphone-based auditory prompts, providing a multi-sensory interaction for the user.

3) Puzzle Coloring Game with Varied Difficulty Levels:

The device offers a dynamic puzzle coloring game with three distinct modes: easy, skilled, and difficult. These modes are presented in a wireframe format, engaging users with varying levels of challenge.

4) Voice-Prompted Guidance and Touch Stick Integration:

Voice prompts are delivered directly through the headphones, offering clear and accessible guidance. The touch stick serves as a versatile tool, allowing users to interact with and manipulate projected content based on predefined key contacts.

5) Engaging Learning Experience through Color Fill-In and Text Examination:

Users are encouraged to actively participate in the learning process by filling in colors, examining text reserves, and assessing font sensitivity. Upon successful completion, the headphones provide explanations regarding the source of the text, promoting an enriched learning experience.

3. User-Centric Emotional Journey: Curiosity, Doubt, and Excitement

The user experience is designed to elicit a progression of emotions, starting with curiosity, transitioning to doubt, and culminating in excitement. This carefully crafted emotional journey aims to enhance user engagement and enjoyment.

The design of glyph exploration sports headphones and touch stick offer a host of innovative features designed to cater to the unique needs of elderly users. From advanced projection stability to intuitive touch interactions and engaging puzzle games, these headphones promise to revolutionize the way aging populations interact with digital content. Additionally, the incorporation of voice prompts and a user-centric emotional journey further enhance the overall experience. This comprehensive set of functionalities positions the proposed device as a promising solution for addressing communication barriers and promoting an inclusive, interactive digital environment for the elderly.

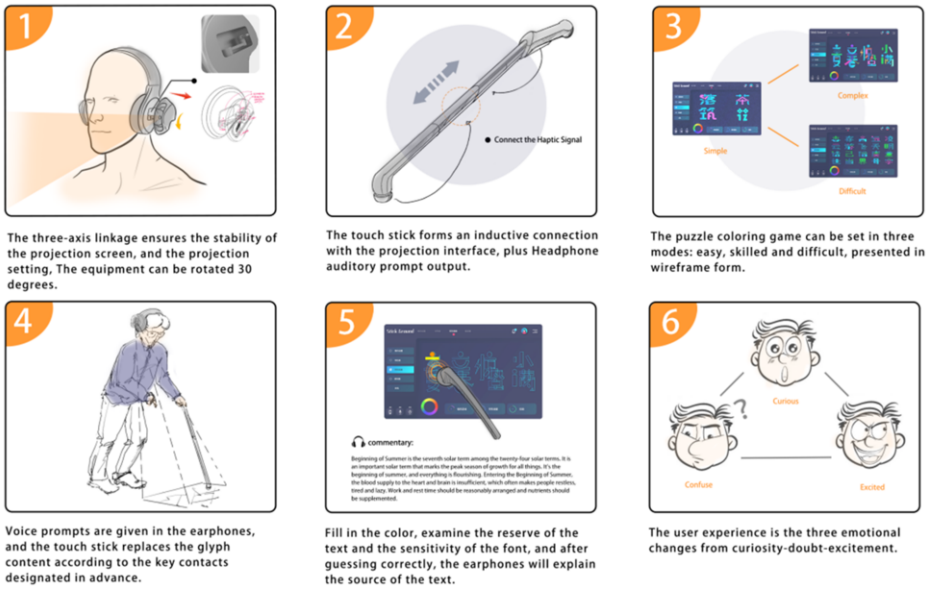

Figure 1. Using Scenario.

4. Material Selection

This section provides a detailed overview of the critical factors to consider when selecting materials for entertainment wearable devices tailored for elderly users. Emphasis is placed on ensuring comfort, durability, and safety in the design process.

1) Soft, Breathable Sponge for Earmuffs:

To optimize comfort, earmuffs should be constructed from a soft and breathable sponge material. This choice not only enhances wearability but also minimizes skin irritation. Additionally, it is imperative to select an environmentally-friendly dye for the sponge to further prioritize user well-being.

2) Lightweight, High-Strength Metal, Specifically Aluminum Alloys:

Incorporating metal components requires careful consideration to prevent undue strain on the user. Options for lightweight, high-strength metal materials, such as aluminum alloys are considered. This choice ensures durability without compromising comfort. It is equally crucial to verify that the metal surface is impeccably smooth to avert any potential discomfort or skin abrasion.

3) Silicone for Waterproof and Durable Components:

Silicone proves to be an ideal material for crafting waterproof and resilient components like watch straps or outer shells. Its softness, combined with its exceptional durability and water resistance, makes it an excellent choice for wearable devices. It is imperative, however, to prioritize environmental sustainability and safety in the selection of silicone materials to safeguard the user's health.

5. Design Concept of Earphone and Touch Stick

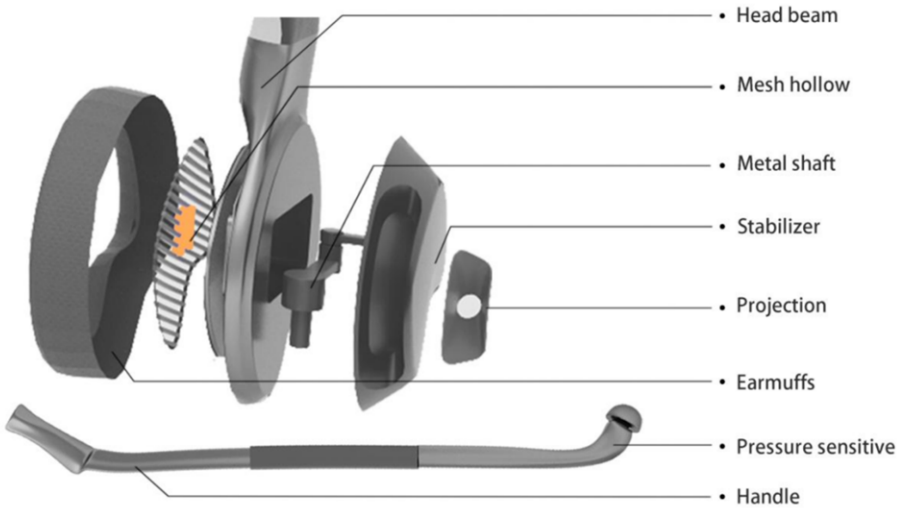

Figure 2. Design Details.

5.1. Design of Earphone

This section delineates the prominent features of the proposed earphones, aiming to provide an engaging and enriching experience for elderly users. These features encompass font projection in wireframe format, a three-axis stabilizer for consistent projection angle maintenance, and auditory prompts to address user inquiries and uncertainties.

1) Font Projection with Wireframe Templates:

The earphones are equipped with an innovative font projection system, presenting a range of font library templates. These templates are organized into three distinct themes: elementary, intermediate, and advanced. As users progress through the themes, the level of difficulty increases, challenging them to fill in colors and decipher words. This interactive activity not only entertains but also serves as a cognitive exercise, testing eyesight and mental acuity.

2) Three-Axis Stabilizer for Continuous Projection Stability:

To enhance user experience, a three-axis stabilizer is integrated into the earphone design. This stabilizer ensures that the projection angle remains steady and accurate, even as the elderly move within a confined range. This feature guarantees uninterrupted and precise projection, contributing to a seamless and enjoyable interaction.

3) Auditory Prompt Output for User Guidance:

The earphones offer an auditory prompt output feature, providing users with verbal cues and guidance. This element is particularly valuable in addressing any uncertainties or questions that may arise during interaction with the device. Users can rely on these voice prompts to navigate through the various features and functionalities, enhancing the overall usability of the earphones.

Figure 3. User Interface Design.

5.2. Design of Stick

This section highlights the pivotal features of the touch stick designed to facilitate an immersive glyph exploration experience for elderly users. These attributes encompass pressure sensing capabilities, a telescopic structure for adaptability to varying heights, and the integration of tactile signals to ensure a comprehensive exploration process.

1) Pressure Sensing for Intuitive Interaction:

The touch stick is equipped with advanced pressure sensing technology, establishing a dynamic connection with the projection interface. This functionality enables the touch stick to replace glyph content based on predefined key contact points. By responding to the user's touch, the touch stick enhances the interactivity of the exploration process, providing a seamless and intuitive interaction.

2) Telescopic Structure for Height Adaptability:

Recognizing the diversity in user heights, the touch stick features a telescopic structure. This adjustable design allows the touch stick to accommodate individuals of different statures, ensuring that each user can comfortably engage with the device. This adaptability contributes to a personalized and user-centric exploration experience.

3) Integration of Tactile Signals for Comprehensive Exploration:

In tandem with pressure sensing capabilities, the touch stick is designed to connect tactile signals. This integration complements the pressure sensing function, forming a cohesive and comprehensive exploration process. By incorporating tactile feedback, the touch stick provides users with a multi-sensory experience, further enhancing the overall engagement and effectiveness of the exploration.

Figure 4. Design Sketch.

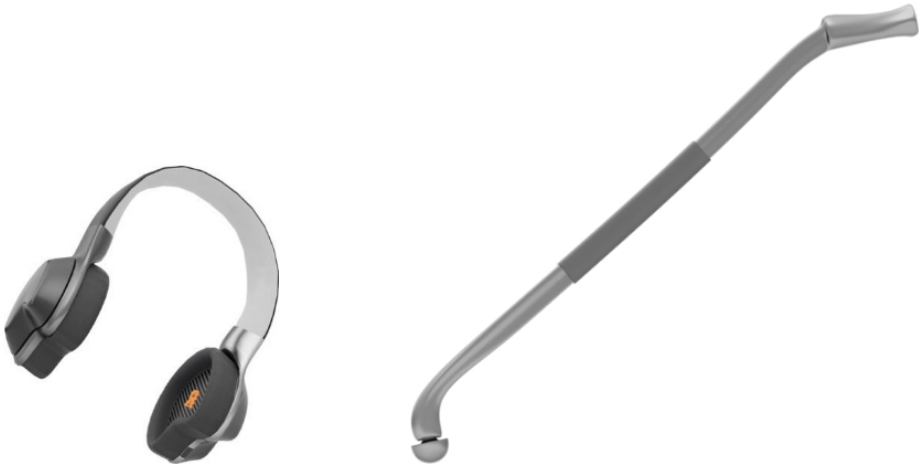

Figure 5. Design Rendering.

Acknowledgments

The authors wish to express their gratitude to the Digital Arts and Culture Industry Development Research (Project No. 9028) for its generous support of this research endeavor.

Figure 6. Design Application.

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