A System that Sees Your Needs

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Abstract

Today, technology plays a pivotal role in our daily lives, significantly impacting individuals. Individuals with muscular dystrophy, such as Amyotrophic Lateral Sclerosis (ALS), benefit from eye-tracking technology, allowing them to interact with computers. This technology empowers them to control computer functions using only their eye movements, eliminating the need for traditional mouse and keyboard inputs. Despite these advancements, ALS patients still face challenges with certain tasks. Our study focuses on a specific individual with ALS who utilizes eye-tracking technology to navigate Adobe Premiere's video editing software. Our objective is to address these challenges by providing a solution that leverages the shortcut commands already available in Adobe Premiere Pro while also creating a simplified interface tailored for the individual we are designing for. This approach facilitates easier access to these shortcuts during his work. Our research emphasizes the potential to adapt and personalize assistive eye-tracking technology, creating more opportunities for individuals with disabilities.

CCS Concepts

• **Human-centered computing**; • **Interaction design process and methods**; • **User-centered design**;

Keywords

Assistive technologies, Eye-tracking technology, User-center design, Accessibility, Accessibility systems and tools, Human-centered computing

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1 Introduction

Performing minimalist tasks such as moving a mouse or executing simple computer operations like pressing a key on a keyboard may appear effortless to many. Yet for a significant portion of the population, particularly individuals with physical disabilities such as Amyotrophic Lateral Sclerosis (ALS) patients, these actions pose significant challenges. ALS patients who experience problems with muscle movements and rely entirely on others find operating a mouse and keyboard exceptionally difficult [5, 7]. Eye-tracking technology can have significant psychological and social benefits for ALS patients. It can precisely capture eye movements and translate them into real-time commands, allowing patients to navigate computer interfaces and express themselves more effectively [6]. It gives them more independence and a sense of belonging in society, which can directly improve their quality of life [2, 4].

Eye-tracking technology has numerous advantages in assisting individuals with severe disabilities and those who cannot make regular movements. However, there are challenges in the interaction between the patient, the eye-tracking system, and the computer. These challenges include spatial inaccuracies, difficulty distinguishing between casual and intentional looks, mobility issues, the complexity of executing multiple actions, and the need for adjustments to the user interface [8]. As a result, only 10-20% of the population is considered suitable for this technology [3]. Moreover, there is increasing evidence that the difference in disability affects the chosen solution. For example, some solutions include making objects and buttons larger and providing clear feedback. At the same time, others use dwell time to differentiate between casual glances and intentional actions [8]. Therefore, an alternative solution based on eye-tracking technology should be enhanced with personalization mechanisms that better meet each user's specific needs and abilities.

In this work, we propose an alternative solution to improve the interaction between users and computers by utilizing the shortcut commands available in Adobe Premiere Pro software[1]. Using a case study approach focusing on a single individual living with ALS, this paper follows the design thinking methodology to design and develop our solution. Our goal was to enhance the efficiency and independence of user actions within the software. Our software is designed for a specific individual and application, aiming to support seamless integration with other software. This work is a case study to explore the broader context of adapting and personalizing assistive eye-tracking technology.

2 Method

2.1 A Case Study

The current work was intended for a specific individual named Tom (pseudonym), a person living with ALS. Tom actively participates

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[1] www.adobe.com/products/premiere

in a rehabilitation employment space that integrates people with disabilities into the community by running employment workshops in various fields. Tom is the leading video editor of the place. He is confined to a wheelchair without the possibility to move any of his limbs. Therefore, he interacts with the computer through eye tracking, where most of his computer activity is focused on working with the Adobe Premiere Pro software for video editing. However, the well-known dragging action (marking one point, moving to another, and focusing on it) that is supposed to be performed using the keyboard and mouse is performed using the movement of the eyes; therefore, it is less accurate and makes Tom's job very difficult. Majaranta and Bulling [8] identified challenges in the interaction between patients, eye-tracking systems, and computers, providing several possible explanations: (a) Spatial inaccuracy: It's difficult to determine precisely which pixel on the screen the eye is focusing on due to the wide image that the eye sees. (b) Midas touch: Distinguishing between a "casual look" and a look meant to give a command is challenging. (c) Mobility: Constant eye movement makes it difficult to move the mouse cursor. (d) Multiple actions: It's challenging to look at an object and perform an action when both interactions are done through eye movement. (e) Adjustment: The size of objects and the interface need to be adjusted to work with gaze focus. Hence, we aimed to explore alternative solutions for enhancing our users' experiences during film editing using the Adobe Premiere Pro software.

2.2 Implementation

To ensure that the proposed concept meets the needs of our individual with ALS, the development process includes all five stages of the Design Thinking methodology, from User-Centered Design: empathize, define, ideate, prototype, and evaluate [9].

Empathy: To foster empathy and deepen our understanding of the development field, we organized a meeting with Tom to gain insight into his work. We first observed him using the Adobe Premiere Pro software for video editing during this meeting. Following that, we conducted informal, unstructured interviews with both him and his caregiver. We learned that Tom uses the PCEye[2], a solution developed by Tobii[3]. This solution includes Tobii Dynavox (TD) Control software that uses eye movements to replace mouse and keyboard actions. Through our interviews, we discovered that Tom uses the TD Control software to select files he wishes to insert into a timeline. He begins this process by clicking on the drag action icon and carefully focusing on the specific point on the timeline where he intends to position the file. Tom identifies a starting point and then an endpoint to execute the drag operation between these two markers. However, the software presents challenges in accurately measuring these points, making the procedure cumbersome and affecting its precision. Occasionally, he requires assistance from his caregiver, who uses a mouse to help him make precise adjustments.

Define & Ideate: To define user needs, we used the co-design methodology [10]. This approach ensured that Tom was not only a source of requirements but also an active co-designer. Our creative thinking concentrated on the dragging action, which Tom found particularly challenging while using eye tracking with the PCEye software. Together with Tom, we identified that the difficulty arose from determining exactly which pixel on the screen he was concentrating on and distinguishing whether he was glancing at it or issuing a deliberate command. Instead of improving the dragging action itself, we opted to enhance the mechanics behind the dragging function. During our exploration, we found that Adobe Premiere Pro offers a variety of keyboard shortcuts, so we integrated buttons on the panel that correspond to these functions. Each button was specifically designed to trigger a corresponding command. Consequently, we proposed concepts for a customized side panel with buttons to help Tom work more efficiently through rapid prototyping techniques to communicate our ideas effectively [11] (see Figure 1).

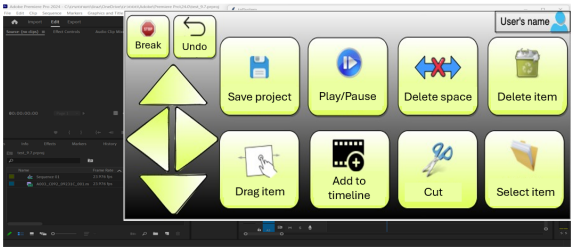

Figure 1: The initial panel.

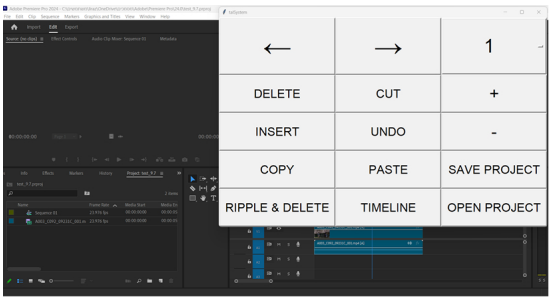

Figure 2: The final panel.

Prototyping: We designed several panels for the client to test. We held three meetings with Tom and his caregiver. During these meetings, we addressed various issues regarding the panels' size, location, and appearance. We found that the dimensions of the buttons were critical to the overall design. It was essential for the buttons to be large enough for Tom to easily focus on using the eye-tracker sensor while ensuring they did not occupy excessive screen space. After analyzing his eye-tracking data and considering his limited eyesight, we determined that implementing a larger panel would be the most effective approach. As a result, we simplified the design by eliminating button images and reducing the use of colors and text (see Figure 2).

Evaluating: To assess Tom's user experience with the panel, we conducted summative usability testing of each button's functionality with Tom. We observed that the size and placement of the buttons enabled him to work effectively and maintain better focus.

[2]https://www.tobiidynavox.com/pages/pceye
[3]www.tobii.com

Additionally, we rigorously tested the panel to identify any potential bugs, ensuring that he could edit videos seamlessly. We aimed to demonstrate that the panel is efficient, beneficial to Tom, and fulfills all his initial requirements. Tom and his caregiver provided valuable feedback on the panel's usability and capacity to enhance his independence. Tom shared his thoughts, saying, "This is a breakthrough for me. Using the panel has significantly improved my work wonders." Moreover, we assessed the system's usability using the System Usability Scale (SUS) developed by Brooke [1]. The final SUS score of 97.5 indicates that the panel successfully achieves the established goals and substantially enhances Tom's user experience.

3 Conclusions And Future Work

In our research, we addressed the challenges faced by an individual living with ALS who relies on eye-tracking technology to navigate Adobe Premiere's video editing software. To tackle these challenges, we developed a customized panel with buttons that activate the keyboard shortcuts already available within Adobe Premiere. This specialized auxiliary panel streamlines various actions, enhancing the editing process and enabling him to work seamlessly in his professional environment. While our primary objective was to assist a specific individual, the panel we designed is compatible with Adobe Premiere's keyboard shortcuts and can be easily integrated into other software that utilizes similar shortcut functionality, if desired.

In our future work, we plan to implement the proposed solution for individuals with ALS using software other than Adobe Premiere. Our goal is to customize our interface to effectively address the specific needs of individuals living with ALS through the use of eye-tracking technology in software that offers a range of functionalities. This customization will involve selecting which features to incorporate, designing the corresponding buttons on the interface, and determining the number of programs that our panel can connect with. Furthermore, we are committed to adapting this interface to support individuals with other disabilities who utilize eye-tracking technology across various software platforms. We aim to enhance their work experience and promote satisfaction and independence. Ultimately, we strive to develop an intelligent system that identifies and adapts to the specific needs of each user. This system will allow users to select their type of disability and the software they wish to use, and it will adjust the interface accordingly to suit their needs.

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