Closed Haptioning: A Demonstration of using mid-air Haptics for Improving Accessibility of audio-visual content beyond Closed Captions and Audio Description

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Abstract. Closed captions and audio description became the de facto method of creating accessible audio-visual content for people with hearing and visual impairments respectively. However, in some cases it is not possible to adequately convey all relevant information through the existing channels of creative content and its assistive alternative. For example, in educational videos, a continuous narration of a scientific concept, illustrated via animated content may not afford the use of audio description to detail the visual scene. Thus, in this demonstration, we propose to use ultrasonic mid-air haptic technology for including "closed haptions" with a three minute long video. Our video illustrates the concept of Single-Stroke and Multi-Stroke Dynamic Tactile Pointers – a novel method of rendering tactile shapes in mid-air. Recent research has shown that using a Multi-Stroke Dynamic Tactile Pointer instead of Spatiotemporal Modulation, to render geometric forms in mid-air, increases the ability of users to identify shapes by $\approx 30\%$. This is a significant finding with implications in tactile icon design for various user interfaces, and accessibility of teaching geometry for visually impaired students in secluded regions. Besides the closed haptioning of our video, attendees will be tasked with determining the order of five tactile geometric shapes in mid-air, presented in random order, using three different methods of rendering.

Keywords: Mid-Air Haptics · Closed Haptioning · Dynamic Tactile Pointer · 2D Geometric Shapes · Accessibility.

1 Background: Methods of rendering tactile shapes in mid-air

Recent work by Hajas et al. [1], Rocchesso et al. [4], and Rutten et al. [5] showed that tactile pattern recognition accuracy in mid-air is significantly increased via new methods of rendering. Namely, the concept of a Dynamic Tactile Pointer (DTP) was introduced, where a tactile focal point is slowly tracing the outline

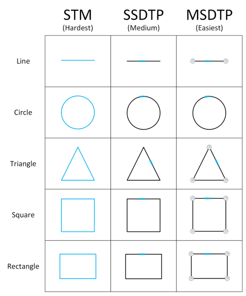

Fig. 1: Illustration of the demo activity. Five shapes are rendered using three different techniques, associated with three difficulty levels of pattern identification. The shapes are presented in a random order in each level.

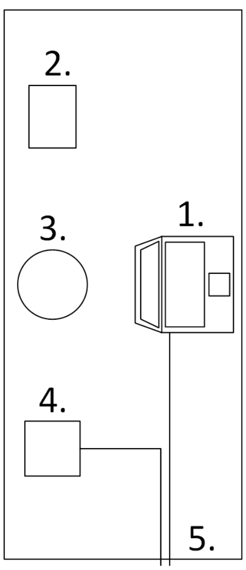

Fig. 2: Illustration of the technical setup.

of a shape [1]. This method of rendering contrasts the previously known Spatiotemporal Modulation (STM), where the path is rendered at a high draw speed, resulting in a perceptually static outline [2]. It was also shown that breaking up 2D geometric shapes into multiple haptic strokes, with a short pause of tactile movement between them, the accuracy of pattern identification drastically increased [1]. For instance, a square rendered with a Multi-Stroke Dynamic Tactile Pointer (MSDTP), which pauses movement on the corners for 300 ms is 30% more likely to be recognised correctly, than a square rendered without a corner pause. Naturally, this suggests that using a Multi-Stroke DTP instead of a Single-Stroke DTP is the preferable choice during the design of mid-air haptic icons in various application areas.

2 A shape quiz and closed haptioning of short videos

This demonstration will be catered in form of a playful challenge. Attendees will be asked to complete three difficulty levels in SQuiz – a shape quiz ($\sim$ 1 min per level), where each level is associated with a method of rendering. Each level will include a straight line, circle, triangle, square, and rectangle, presented in a random order as illustrated in Figure 1. Upon revealing the number of correctly identified shapes in each level, the demonstrator will discuss how the stimuli were rendered, and the working hypothesis on why different methods are perceived more or less difficult.

For queue management, an illustrative video of the findings will be on display. Beyond vocal narration and closed captions, the visualisations of haptic stimuli will be synchronised with a corresponding haptic channel, displayed via the ultrasonic mid-air haptic array. The haptic stimuli will match the visual animations, both in content and time, thereby functioning as closed haptions. Similar efforts of closed haptioning were published by O'Conaill et al. [3] in context of improving the accessibility and immersive experience of a short documentary on oceanography. Members of the conference community will be encouraged to leave suggestions for future work on a "research feedback tree" (a cardboard desktop tree with branches, where wooden tags can be hung with short messages).

The space and technical requirements (see Figure 2) of this demo are minimal. A $\approx 1\,\mathrm{m}^2$ table is required to place the equipment on top. Two power sockets are needed for the haptic device and laptop computer. A cooling pad, two Ultrahaptics UHEV1 kits, plug adapters, will be brought by the demonstrator. In addition, an iPad stand with an iPad will be on display, serving as a digital information point for visitors in a queue, showcasing the video and closed haptions.

3 Acknowledgements

Many thanks to Giada Brianza and Dominic Ransom for their help with the video, Dr Orestis Georgiou for feedback and the European Research Council for funding (Grant 638605).

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