Demo: Digital Audio-Tactile Graphics for Inclusion in Education, the Workplace and Everyday Life

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***Abstract*— Graphics and pictures play a dominant role in education, professional, and everyday life. Visually impaired persons however encounter considerable hurdles in contemplating and understanding graphics. In their project „Dotted Pictures", the Centre for Blind and Disabled Students at Technical University Mittelhessen, BliZ, attempt to at least partially fill these accessibility gaps. In this project, complex real-world pictures are digitally analyzed and converted into layers of tactile formats. Blind and visually impaired persons can self-serve in their conversion of pictures of interest. This presentation is supplemented by a demonstration and subsequent exhibition of the technologies. The software is available as a beta version to interested institutions upon request.**

Keywords*—Inclusion in Education; Inclusion in Everyday Life; blind and visually impaired students.*

I. INTRODUCTION

Graphics and pictures play a dominant role in education, professional, and everyday life. They are encountered in mathematics, biology, traffic education and orientation, for training-on-the-job, as well as on layout and evacuation plans. Moreover, graphics support social communication over complex givens and intercultural understanding. Therefore, it is ever more so vital to make pictures and pictograms accessible for all audiences [1].

Visually impaired persons encounter considerable hurdles in contemplating and understanding graphics. Whereas able-sighted people can capture a spatial arrangement at one glance, blind users have to touch the windings of a surface and mentally compose a picture in their memory. Moreover, colors are not experienced by blind persons. Information highlighted by coloring, e.g., in a subway plan, therefore have to be conveyed by other means of differentiation such as varying dotting and boldness of lines. Finally, as Braille text has to command a minimum size for tactile legibility, legends in graphics cannot always be translated from conventional pictures.

The following demo describes, how audio-tactile graphics for blind and visually impaired students may be used in higher education.

II. DIGITAL AUDIO- AND VOICE-BASED TOOLS

In their project „Dotted pictures", the Centre for Blind and Disabled Students at Technical University Mittelhessen, BliZ, attempt to at least partially fill these accessibility gaps. In this project, graphics and even more complex real-world pictures are digitally analyzed and converted into several potential layers of tactile formats. Blind and visually impaired persons can, with Dotted Pictures, experiment with any picture they want to touch by trying different levels of resolution. Individual meaning according to the user's requirements can thus be created. Individuality is also maintained by the variety of output formats: whereas some blind users traditionally prefer (or only have access to) printed tactile sheets, others prefer cognition via braille display, e.g. a braille pad linked to their computer.

Whereas programs in cultural and language sciences often convey predominantly verbal knowledge, STEM (science, technology, engineering, and mathematics) subjects in particular draw on a variety of graphics and blueprints [3]. It has been acknowledged that this form of representation often excludes blind students who have been trained using expensive and not instantly available 3D-models that are prepared by able-sighted specialists. To make the common semiotics accessible for those students and enable them a seamless work experience, a self-serving audio-tactile conversion of graphs and graphics is of prominent importance.

To enhance in particular the braille pad technology experience, BliZ have also developed a preliminary method for tactile-induced supplementary audio description. Tactile recognition on a braille pad is a unique feature that enhances the didactical possibilities and enables blind users to control their individual learning path. This feature is thus comprehensively self-service enabled, enabling not only the autonomous conversion of pictures, but also filling them with tailored information by affected persons. Thus, an ongoing self-efficacy in learning and everyday life can be secured in the long run.

This presentation is supplemented by a demonstration and subsequent exhibition of the technologies provided to THM

BliZ students, staff, and alumni. The software is available as a beta version to interested institutions upon request.

Among others, the following self-serviced conversion of a world map with the programme developed in BliZ to be displayed on a Braille pad or printed on a Braille printer will be shown:

Figure 1: Audio-tactile representation of the world map on a Metec pad. Own representation.

In Figure 1, a device for displaying converted digital graphics and photographs in real-time is shown. By scrolling in an acoustic menu, any blind person can load, convert and customize these graphics. Additional features include tactile feedback by fingertip recognition, which can yield in additional acoustic information being provided for a given position in the graphic. The extent and nature of this acoustic information can be determined by operating buttons on the pad. The graphic can also be shifted, magnified, or altered by simple commands.

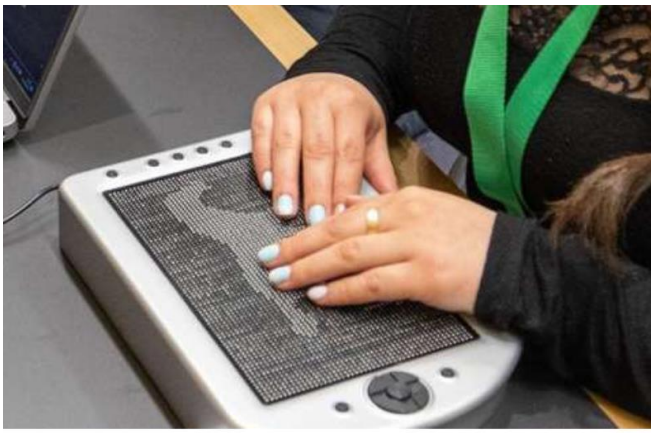

Figure 2: Dynamic representation of a galoping horse on a Metec pad. Source: Frankfurter Rundschau, 12.5.23.

Sometimes, movies and sequences of graphics help conveying complex givens, such as the development of a flower or the movement of an animal. In figure 2, a sequence of a geloping horse, projected on the Braille pad like a cartoon, enables the comprehension of the moment in which all four legs are in the air.

The program also twists objects perspectively. So, the concept of horizon and diminishing sizes over distances can be taught. These regularities are widely unknown even to blind high school graduates, as our tests have shown.

Still, the technology employed for immediate diplay is expensive, making it a research tool in the first place for the time being. However, with increasing awareness and demand, this could be a viable path toward socio-technical inclusion of blind disciples and workforce alike [3].

CONCLUSIONS

This paper shows the technology and uses that will be on display on the booth. The programme and the Braille pad can be accessed individually for trial. A visually disabled counsellor of the BliZ Centre for Blind and Disabled Students at Technische Hochschule Mittelhessen will navigate through various possibilities for addressing hurdles in graphical understanding.

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