Joint Accessibility: Using AR for the Visually Impaired in Social Learning Contexts

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Figure 1: Future scenario of a joint and accessible augmented museum experience generated with DeepAI, where multiple visitors are standing in front of an augmented stature with one person directly interacting with it.

ABSTRACT

Visually impaired people try to avoid tools that indicate they have a disability in order to fit in with their environment, leading to further disadvantages in learning and social contexts such as museums. With the increased use of extended reality technologies in the future, new opportunities will arise to make assistive devices less noticeable, allowing for more inclusive and accessible learning support. Our research therefore focuses on how augmented reality can be used to create a more equal school and museum experience, taking into account not only technical and didactic factors but also social influences and related efficiency considerations. In this paper, we discuss existing challenges for low-sighted people and present possible solutions. We are convinced that our work will contribute to a future where technology connects everyone, regardless of their physical condition.

1 THE SOCIAL SIDE OF ACCESSIBILITY

Many people with disabilities still face significant barriers in society, making it difficult to access information and fully participate in public spaces. While technology has the potential to overcome these problems, most devices and applications are implemented with non-disabled users in mind, adding instead new disadvantages, especially in learning contexts. These additional challenges can have serious consequences for the respective individuals, so in the following, we will take a closer look at two well-known public learning environments, schools and museums.

When it comes to visually impaired students, digital and hardware tools such as binoculars, tablets, camera, and voice systems have been used in schools for quite some time [2, 7, 9]. While these tools make it possible to learn in classrooms with others, they often require a lot of task switching, leading to higher mental workload and lower efficiency, which can distract from the learning process. On the other hand, by focusing, for example, on the tablet instead of the blackboard students may miss announcements and social cues from their teacher and classmates, potentially distancing themselves from their social environment, slowing down the pace of the lesson, or missing information entirely. As a result, students can feel frustrated and demotivated.

Another very known public learning environment that is more unpredictable, uncontrollable, and exploratory for a diverse range of people of different ages is the museum. Most research has focused on guiding visually impaired visitors [4, 6] or providing additional information through audio [5] or haptic [1, 3] feedback. Although these are relevant approaches, there is still a lack of research on the inclusion of social exchange in this context. When we think about the importance of interaction and a sense of belonging for the growing number of older people who are prone to vision problems as they age. In addition, most museums, especially in cities, struggle with limited space, resulting in stacked exhibitions with small room or resources for additional haptic or other assistive devices. Consequently, some objects are inaccessible to visually impaired visitors or only available with self-brought assistive devices. Since these aids are only used by people who need them, again suggesting that they may be disabled, and are primarily designed to compensate for visual impairment rather than for social integration, their use can quickly isolate and stigmatize users [11]. This can lead to not

using helpful devices in the first place in order to fit in, resulting in learning difficulties and feeling excluded.

Finding a solution that allows access to information while maintaining social contact and belonging for visually impaired people is an aspect we therefore want to focus on.

2 INCLUSIVE AR FUTURES

Although social accessibility has been discussed for years [12], we could not find research using augmented reality to connect learning and social experiences for visually impaired users. AR, which adds virtual elements to our physical reality, has the potential to solve a variety of problems. In a future where AR technologies are the new smartphone in terms of population distribution, visual impairments become harder to recognize or even undetectable. Instead of using traditional glasses or other obvious tools, visual impairments will be compensated by simple apps on the devices, zooming, adding, adjusting, and blending information, making it possible to learn while being an equal part of the social environment.

In schools, AR could be used in combination with Artificial Intelligence (AI) and eye tracking [10] to display information where it is most needed. The cameras in the AR glasses, lenses, or implants can zoom in on information and people, as well as provide notifications and guidance on social cues and key areas of attention, without requiring a hand to operate. With additional sensors, mental load, and eye movement could be detected and adapted to the student's capabilities, helping to avoid overwhelming the user. This potentially creates a level playing field for students without the need for people to explain themselves or their impairment by using the same technology.

These tools could also be useful in museums: besides guiding the user through exhibitions, visitors can access information without changing the environment. Descriptions and 3D models of objects could be provided to interact with [8] alone or in groups, with the visualization adapted to each person's needs. AR can provide information that is generally difficult for visually impaired visitors to access while connecting them to their social environment. With additional haptic stimuli through wearable or implanted devices, interaction with augmented objects feels more natural to the user and could even make the experience accessible to blind visitors.

Most of the AR applications mentioned above can be transferred to virtual reality use, allowing the degree of immersion to be blended, and opening up further possibilities for accessible learning environments. Besides using AR for learning the developments could also be transferred to other use cases. While such applications are helpful for learners with disabilities, they can also be used by people without impairments, making the AR technology itself even more inclusive the more people use it. Therefore, creating a digital extended future with accessibility in mind is a future where everyone can learn with and through each other.

3 THE AUTHOR

Clara Sayffaerth is a first-year PhD student at LMU Munich under the supervision of Albrecht Schmidt. Her research focuses on the use of XR and AI for knowledge transfer. After spending six years at an inclusion school with low vision and blind students, she is now cooperating with this school to use AR technology for visually impaired students. In addition, her work as a research assistant for XR technology at the Deutsches Museum[1] in Munich for four years has helped her to understand the different needs and wishes of the diverse range of visitors. She wants to use this knowledge to make exhibitions more accessible in the future.

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