Master Thesis Exposé- Virtual reality to stimulate reflection on barriers: The KIT Campus as a case study [Virtuelle Realität zur Stimulation von Reflektion über Barrieren: Der KIT-Campus als Fallstudie]

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Introduction and literature review

To improve students' critical thinking and awareness towards architectural barriers for disabled people on campus, a virtual environment reproducing parts of the KIT campus will be designed, aiming at promoting reflection on the topic of accessibility. Within the simulation, the users navigate a partial reproduction of the KIT campus while being instructed, through examples and explanations, on what is considered an architectural barrier and what is, instead, an adopted solution to favour accessibility.

Different physical barriers on campus prevent specific groups of students from having the same experience and utilising the same services as their peers, making some services inaccessible, assistance necessary, or diminishing their overall experience, limiting what students have access to and how they perceive their needs and rights are considered.

Common examples of architectural barriers for people in a wheelchair or with limited mobility are steep ramps, heavy doors, elevated thresholds, and similar constructs [1], however, a wider variety of design choices can create obstacles for different groups of disabled people that, for example, have limited dexterity, have visual or hearing impairments, or are neurodivergent.

Virtual Reality has been used in the past with the goal of educating people [1] and raising awareness on the implications of disabilities [2], but with the focus on simulating the feeling of being disabled while exploring the environment. The result was that the conveyed view of reality was distorted, and stereotypes reinforced. Increasing sensations of helplessness and vulnerability, such simulations caused the users to imagine how limiting a disability can be, instead of showing how architectural barriers and design choices can be source of restrictions [3], preventing environments from being equally accessible.

However, there is potential in solutions that use Virtual Reality to educate people about barriers; the project's goal is to use the immersive experience of exploring the campus buildings and common areas in an enriched version of reality, containing interactive and playful elements, to raise awareness on barriers and stimulate reflection on how common spaces could be improved to favour inclusion. Juiciness elements will be used to improve the players experience and increase the simulation aesthetic appeal [4]. Mechanics that allow the user to get more information on the barriers he encounters, a progress bar to show progress within the simulation and other visual embellishments are examples of tools that will be used to increase the players curiosity and immersion, improving their involvement with the simulation.

Project scope

Many factors and choices are involved in the design of a simulation, such as the addressed disabilities, the size of the reproduced area, the represented season, and the approach for the building's representation, either from the inside, the outside or both. Further analysis is necessary to precisely define the features of the virtual replica, but a preliminary list of relevant variables includes:

1) Groups of disabilities:
    - Wheelchair
    - Limited mobility
    - Limited upper body mobility/dexterity
    - Visual impairment
    - Hearing impairment
    - Neurodivergence (ADHD/Anxiety/autism)
2) Size of the simulated area:
    - Exterior of building complex with less detailed features (example: campus area including AKK, library, mensa and connecting garden)
    - Single building represented in detail (example: mensa building)

3) Interior/exterior perspective:
    - Building(s) indoor view
    - Building(s) outdoor view
    - Building(s) outdoor and indoor reproduction with possibility of analysing the transition from inside to outside and vice versa
4) Season of the year:
    - Autumn with leaves on the street and wet surfaces
    - Winter with cold temperature and snow
    - Summer with hot weather and consequent difficulty to stay in the sun for prolonged periods of time
5) Time of the day:
    - Crowded times during the day
    - Unavailability of services during different hours of the day

Research Questions

The goal of the project is to address the following three research questions:

RQ1: what design features are required ~~by the virtual environment~~ to accurately simulate the experience of moving in the designated campus area while encountering different architectural barriers?

RQ2: how can interactivity mechanics and playful elements affect the player experience and his perception of the simulation?

RQ3: does the simulation have potential to trigger reflection and how is reflection affected by the interactive and playful elements?

Method

The project is articulated in five consecutive phases, taking advantage of a collaborative methodology to design the virtual environment prototype and to evaluate the effectiveness of the developed simulation in stimulating reflection on the topics of architectural barriers for different disabilities in a university environment.

Interviewing the Disability Awareness Consultants at KIT, a list of barriers affecting people with different disabilities is compiled and relevant features to include in the simulation are identified.

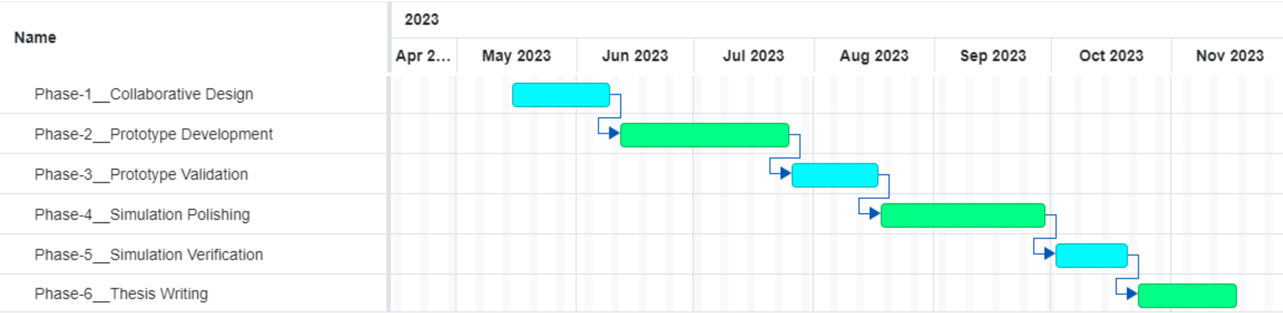
Afterwards, the guidelines obtained from the collaborative design are used to develop an initial version of the virtual environment, that reproduces the chosen campus section with the identified barriers and contains the basic interactivity mechanisms of the simulation.

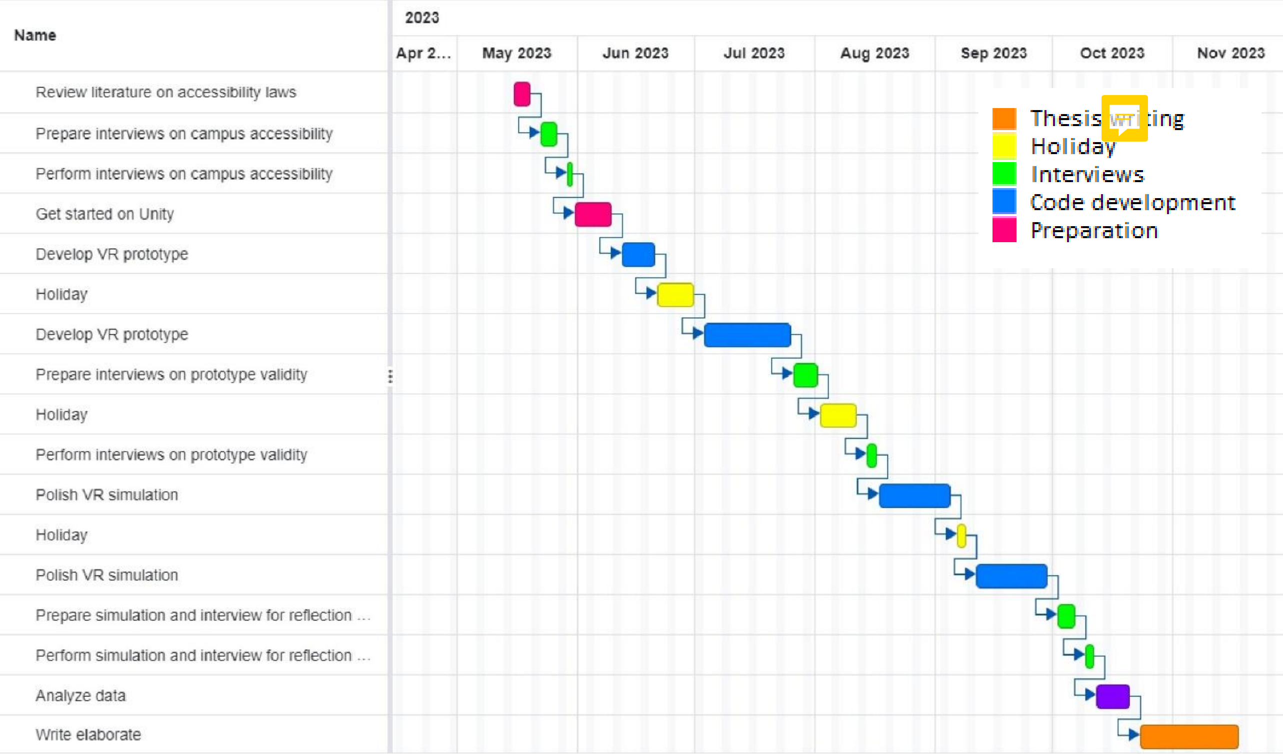
The prototype's accuracy in representing reality and the effectiveness of interactive/playful elements is then tested by a non-overlapping group of consultants to ensure that the right features are represented, and that the desired prospective is conveyed, addressing RQ1 and RQ2.

The gathered comments and suggestions on how to improve the virtual reality experience are then used to polish the prototype in a second iteration of development, obtaining the final version of the simulation.

Finally, the most recent version of the simulation is presented to a group of architecture or design students and their experience is discussed through a questionnaire and a semi-structured interview to analyse the effectiveness of the simulation to encourage reflection and transformative thinking, aiming at answering RQ3.

Gannt plot





Name	Start Date	End Date	Duration	Color
Review literature on accessibility laws	May 15, 2023	May 19, 2023	5 days	
Prepare interviews on campus accessibility	May 22, 2023	May 26, 2023	5 days	
Perform interviews on campus accessibility	May 29, 2023	May 30, 2023	2 days	
Get started on Unity	May 31, 2023	Jun 09, 2023	8 days	
Develop VR prototype	Jun 12, 2023	Jun 20, 2023	7 days	
Holiday	Jun 21, 2023	Jun 30, 2023	8 days	
Develop VR prototype	Jul 03, 2023	Jul 25, 2023	17 days	
Prepare interviews on prototype validity	Jul 26, 2023	Aug 01, 2023	5 days	
Holiday	Aug 02, 2023	Aug 11, 2023	8 days	
Perform interviews on prototype validity	Aug 14, 2023	Aug 16, 2023	3 days	
Polish VR simulation	Aug 17, 2023	Sep 04, 2023	13 days	
Holiday	Sep 06, 2023	Sep 08, 2023	3 days	
Polish VR simulation	Sep 11, 2023	Sep 29, 2023	15 days	
Prepare simulation and interview for reflection ev…	Oct 02, 2023	Oct 06, 2023	5 days	
Perform simulation and interview for reflection ev…	Oct 09, 2023	Oct 11, 2023	3 days	
Analyze data	Oct 12, 2023	Oct 20, 2023	7 days	
Write elaborate	Oct 23, 2023	Nov 17, 2023	20 days	

References

1. Pivik, J., McComas, J., MaCfarlane, I., & Laflamme, M. (2002). Using Virtual Reality to Teach Disability Awareness. Journal of Educational Computing Research, 26(2), 203–218. https://doi.org/10.2190/WACX-1VR9-HCMJ-RTKB

2. Götzelmann, T., & Kreimeier, J. (2020). Towards the inclusion of wheelchair users in smart city planning through virtual reality simulation. Proceedings of the 13th ACM International Conference on PErvasive Technologies Related to Assistive Environments (PETRA '20). Association for Computing Machinery, New York, NY, USA, Article 61, 1–7. https://doi.org/10.1145/3389189.3398008

3. Nario-Redmond, M. R., Gospodinov, D., & Cobb, A. (2017). Crip for a day: The unintended negative consequences of disability simulations. Rehabilitation Psychology, 62(3), 324–333. https://doi.org/10.1037/rep0000127

4. Hicks, K., Gerling, K., Dickinson, P., & Abeele, V. (2019). Juicy Game Design: Understanding the Impact of Visual Embellishments on Player Experience. Proceedings of the Annual Symposium on Computer-Human Interaction in Play (CHI PLAY '19). Association for Computing Machinery, New York, NY, USA, 185–197. https://doi.org/10.1145/3311350.3347171