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 was designed aiming at promoting reflection and transformative thinking on the accessibility topic. Within the simulation, the users navigate a partial reproduction of KIT environment 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 exploiting the same services as their peers, making some services inaccessible, extra assistance needed, or experiences degrading, limiting what the student has access to and how he perceives his needs and rights are taken into account.

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

Virtual Reality has been used in the past with the goal of educating children [1] and rising awareness on the implications of disabilities [2], but with the focus on simulating the feeling of being impaired when exploring the environment, the result was that the conveyed view of reality was distorted and stereotypes reinforced. Conveying a sensation of helplessness and vulnerability, such simulations caused the users to imagine how limiting a disability can be, instead of understanding how the source of restrictions are architectural barriers and design choices, preventing environments from being equally accessible to everyone [3].

The goal of this project is to use a Virtual Reality simulation to educate about barriers, with the immersive experience of exploring buildings and areas on campus, finding signs with explanations about the space's accessibility, but without the impairment simulation. The goal of the project is to provide the user with a different exploration prospective of his surroundings, showing how differently can the perception of the environment be for people with different characteristics than his own.

Project's scope

Many factors and choices are involved in the design of a simulation, like the addressed disabilities, the size of the reproduced area, the represented season, the addressed disability group and the approach for the buildings representation, either from the inside, the outside or both. Further analysis is necessary to precisely define the features of the virtual replica, but a list of possible relevant variables is reported below.

1) Groups of disabilities:
    - Wheelchair
    - Limited mobility
    - Limited upper extremities 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 prospective:
    - 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 extensively in the sun
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 the different architectural barriers?

RQ2: how is the simulation perceived by the non-disabled users?

RQ3: are reflection on architectural barriers and transformative thinking encouraged by the simulation?

Method

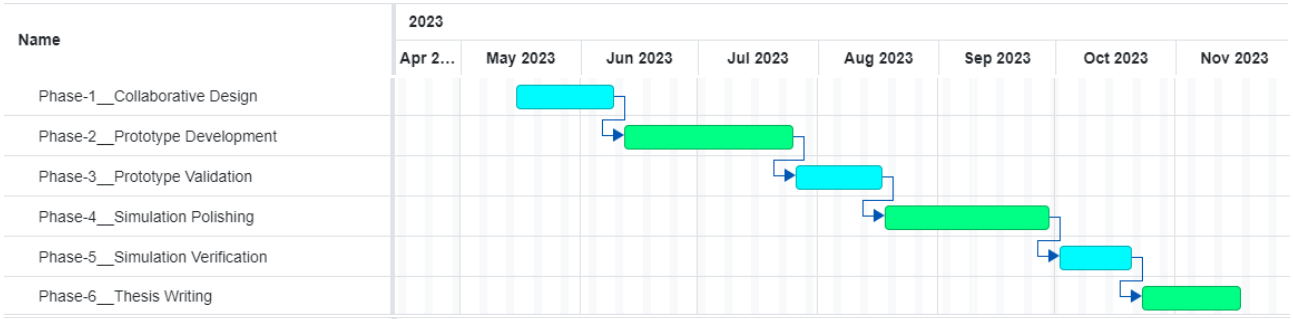
The project is articulated in three consecutive phases, two of them taking advantage of a collaborative methodology to develop the virtual environment prototype and the third one to evaluate the effectiveness of the developed simulation on stimulating reflection on the topics of architectural barriers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

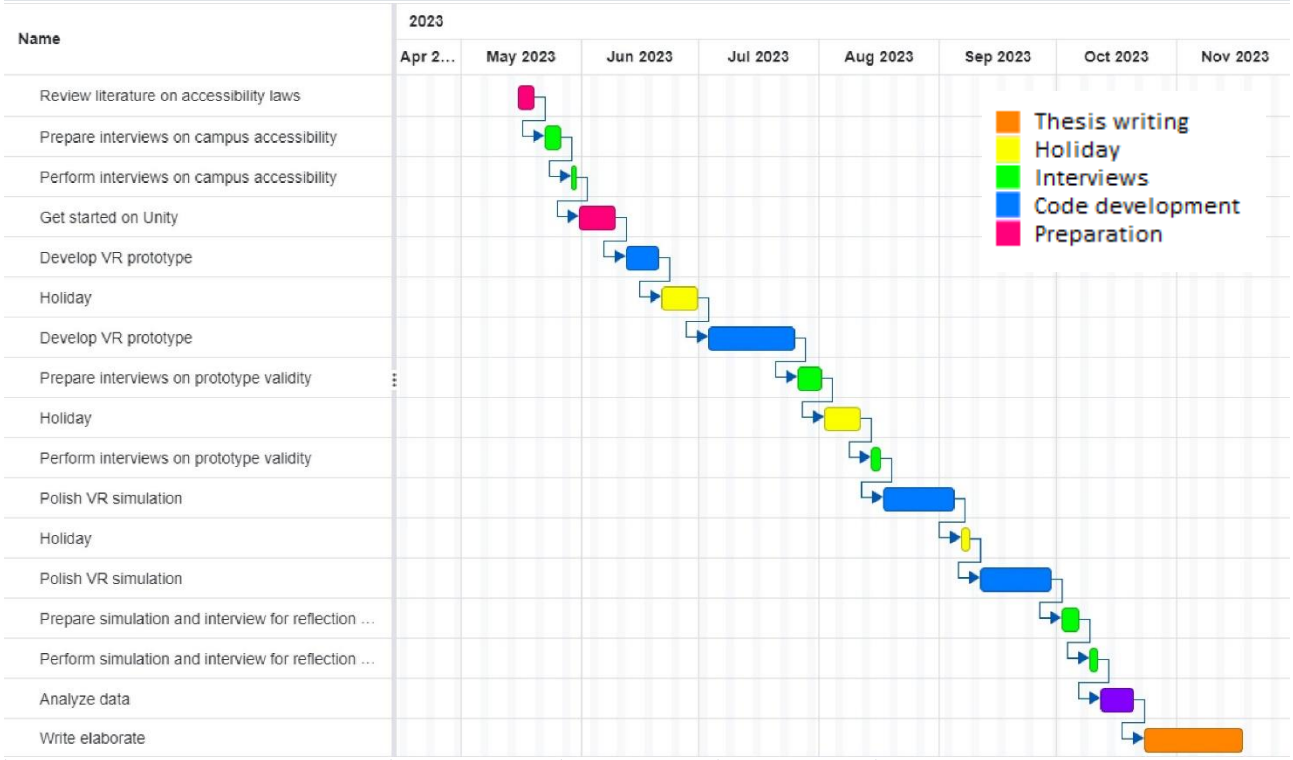
Interviewing the Disability Awareness Consultants at KIT, list of barriers affecting people with different disabilities is compiled and used to develop the first version of the virtual environment that reproduces the chosen campus section with the identified barriers.

The environment prototype accuracy and verisimilitude is then tested by a non-overlapping group of consultants to ensure that the right features are represented, and point of view conveyed. The gathered indications and suggestions on how to improve the experience will be used to polish the prototype obtaining the final version of the simulation and answering to Q1.

Finally, the final version of the simulation will be presented to a group of architecture or design students that will evaluate their experience through a questionnaire and a semi-structured interview to analyse the effectiveness of the experience to encourage reflection and transformative thinking with the aim of answering Q2 and Q3.

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. In 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