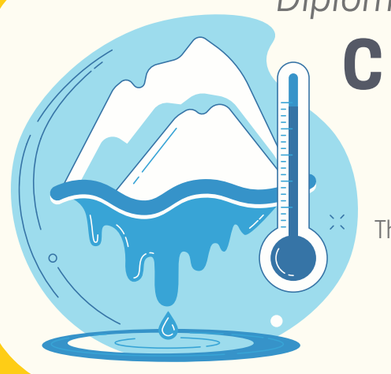
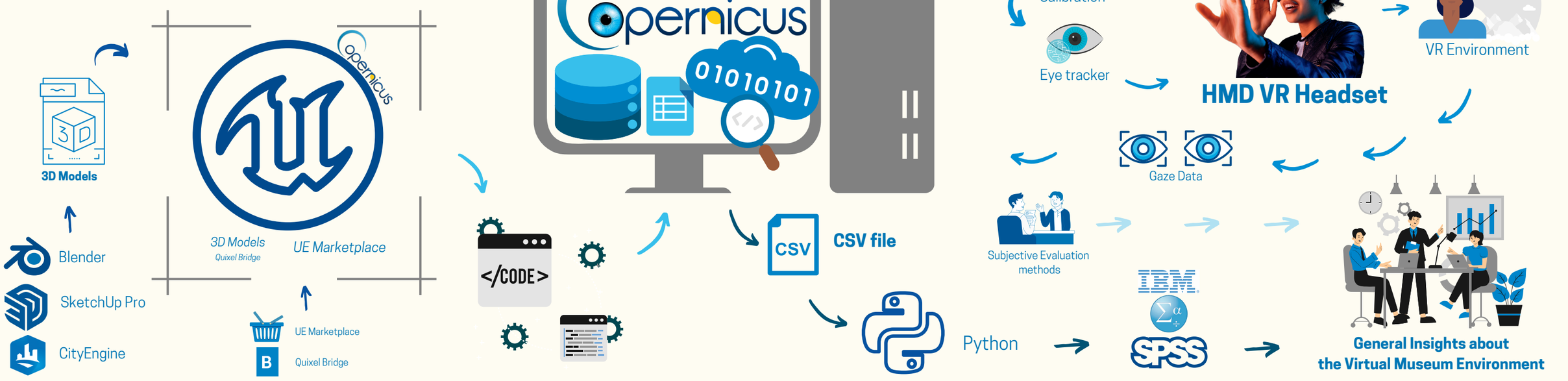
Diploma Thesis



CREATING A VIRTUAL GEOGRAPHIC LEARNING ENVIRONMENT AND ITS USER ASSESSMENT

The warming of the ocean and the melting of land ice, such as glaciers and the ice sheets in Greenland and Antarctica, have a direct consequence: Sea Level Rise. Raising public awareness is essential in combating this issue. Traditional media like films and brochures can visually represent climate change's effects, but Virtual Reality offers a more immersive experience, enhancing environmental consciousness. The thesis focused on creating a VR-based virtual learning environment with geographic content and evaluating its usability through eye-tracking. To contribute to the achievement of SDG13, the COPERNICUS MUSEUM IVLE was developed, focusing on the Copernicus Sentinel-6 mission and the topic of Sea Level Rise. By analyzing eye-tracking data and conducting subjective evaluations, the study provided general insights of this environment, and areas for improvement were identified.

WORKFLOW



RESULTS

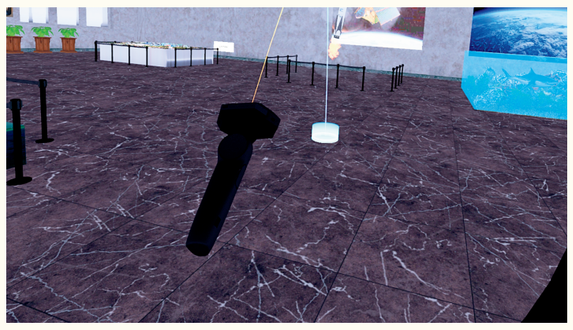
Objective 1: Through a comprehensive literature review and careful selection process, the COPERNICUS MUSEUM environment was established, focusing on Sea Level Rise and the Sentinel-6 mission. This contribution outlines the successful development and implementation of a virtual learning environment for the COPERNICUS MUSEUM virtual reality application, specifically designed for the Varjo XR-3 VR system. The VLE was designed to provide an immersive and interactive platform for geographic education, incorporating realistic 3D visualizations, accurate geographic data, and interactive features. The VLE has provided participants with an engaging and interactive platform to explore geographical concepts, fostering a deeper understanding of Sea Level Rise and the Sentinel-6 mission.

Objective 2: The eye-tracking analysis provided valuable insights into participants' visual attention patterns within the virtual reality environment. The data revealed variations in attention across different exhibits, suggesting the importance of content and presentation in directing users' visual attention. Gender and age differences were observed, indicating that personal preferences and interests influence visual attention and engagement. The analysis of initial gaze dispersion also highlighted the influence of subtle hints or cues on participants' exploration patterns. The interviews with participants further enriched the understanding of their perceptions and experiences, providing suggestions for improvement.

DEVELOPMENT

Objective 1

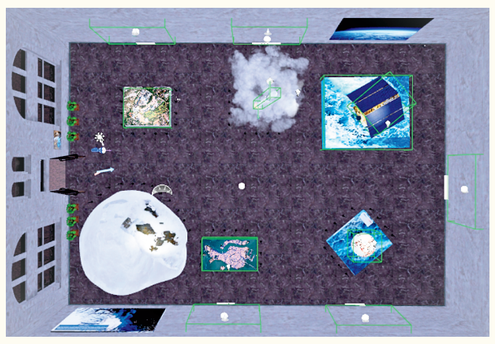
OF VIRTUAL GEOGRAPHIC LEARNING ENVIRONMENT



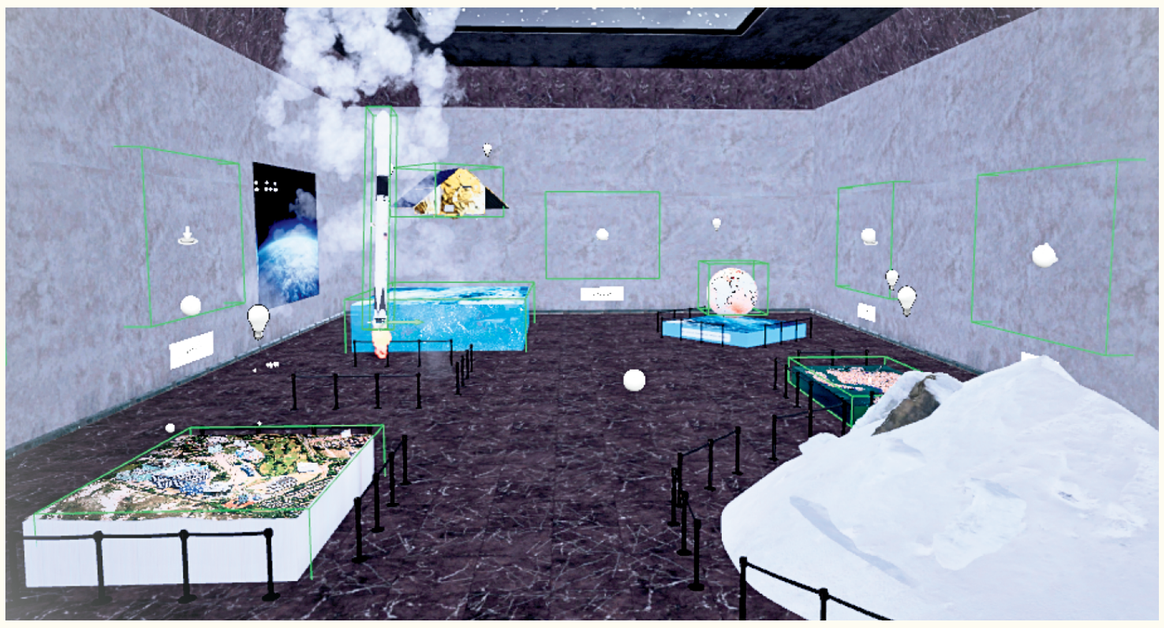
Teleportation

Video Playback Controller

Outside view of VR Museum



Top view of VR Environment



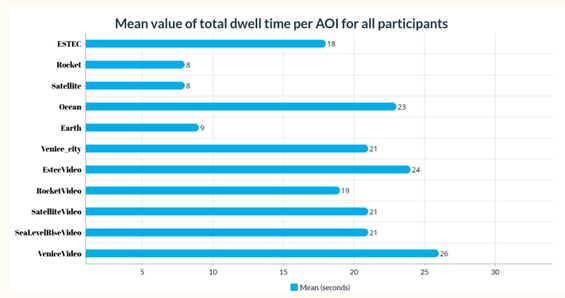
Final version of the COPERNICUS MUSEUM Immersive Virtual Geographic Learning Environment

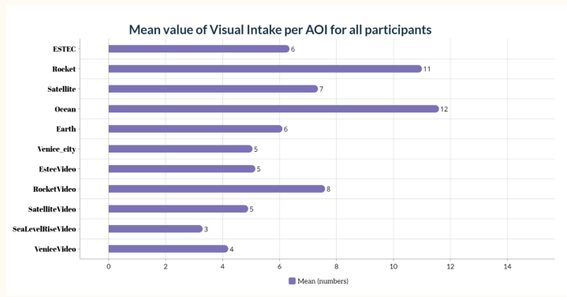
INSIGHTS

Objective 2

FROM EYE-TRACKING EXPERIMENT

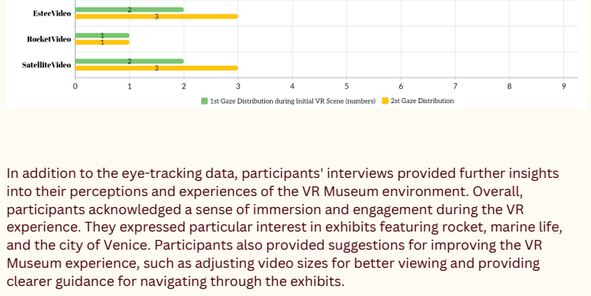
The data revealed that certain areas of interest attracted more attention than others. For example, the VeniceVideo exhibit had the highest TDT, indicating that participants spent more time focusing on this particular area. Similarly, the EstecVideo exhibit also captured a high amount of visual attention. On the other hand, the Rocket exhibit had the lowest TDT, suggesting that it attracted less attention from participants. One possible explanation for this observation could be the duration of the videos, as each of them had a duration more than one minute. This could be influenced by factors such as the video's content and the exhibition's location. These findings indicate that the content and presentation of different exhibits play a crucial role in directing users' visual attention.





Analyzing the Visual Intake (VI) offers further insights into participants' visual attention. The exhibit that received the highest mean VI was Ocean, indicating that it attracted the most attention from participants. Conversely, the SeaLevelRiseVideo exhibit had the lowest mean VI. These findings highlight the varying levels of engagement participants had with different exhibits. Factors such as the relevance, complexity, and visual appeal of the exhibits may have influenced the overall visual attention.

Participants aged 29-59 had a higher mean TDT for the VeniceVideo exhibit compared to participants aged 18-28. Conversely, participants aged 18-28 showed a higher mean TDT for the Venice city exhibit. The age category of 29-59 generally had higher mean TDT values across AOIs, particularly for videos highlighting exhibits in the Virtual Museum. In contrast, participants aged 18-28 showed higher mean TDT values for dynamic exhibits like Rocket and Earth. These age-related differences suggest that different age groups may have distinct preferences and interests when exploring virtual exhibits.



Analyzing the initial gaze distribution provides insights into participants' first points of focus within the VR environment. The data revealed that participants' first gaze scatter were predominantly on the Ocean exhibit, followed by ESTEC. However, the intended exhibit order within the COPERNICUS MUSEUM was different, with ESTEC as the starting point. This deviation from the intended order suggests that participants may have been influenced by subtle hints or cues, leading them to different exhibits initially. These hints may have influenced participants' exploration patterns and initial visual attention.

In addition to the eye-tracking data, participants' interviews provided further insights into their perceptions and experiences of the VR Museum environment. Overall, participants acknowledged a sense of immersion and engagement during the VR experience. They expressed particular interest in exhibits featuring rocket, marine life, and the city of Venice. Participants also provided suggestions for improving the VR Museum experience, such as adjusting video sizes for better viewing and providing clearer guidance for navigating through the exhibits.

CONCLUSION

The development of the COPERNICUS MUSEUM environment, combined with the eye-tracking analysis, offers valuable insights for optimizing the Virtual Learning Environment. This study presents a pioneering approach to integrating geographic content into a VLE and leveraging eye-tracking technology for user assessment. By showcasing the potential of immersive virtual environments and eye-tracking technology, this research not only enhances the learning experience but also provides valuable information on user engagement and attention.

The knowledge gained from this study holds significant implications for the field of geographic education. It can guide future improvements and refinements in VLE design, ensuring that educational platforms effectively incorporate geographic content. Moreover, the findings underscore the importance of utilizing eye-tracking technology to gain deeper insights into user behavior and preferences, enabling educators to create more engaging and interactive learning environments. This study contributes to the ongoing advancement of geographic education and serves as a foundation for the creation of innovative educational platforms.

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COPERNICUS MASTER IN DIGITAL EARTH

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