User Centred Design of a Gamified Immersive Virtual Library

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Aleshia Hayes is an assistant professor at the University of North Texas. She is passionate about developing, evaluating, and iterating on technology used for learning in formal and informal environments. She runs the SURGE XR Lab where she has led interdisciplinary research with partners from manufacturing, defense, psychology, and education. All of her work focuses on ways to make education and training more effective and engaging with existing and emerging technologies.

With the growth of ICT (internet communication technology) and the increasing necessity for individuals to shelter in place, or otherwise social distance, more people are using technology as the source of their reading and other media consumptions than ever. While people are reading more and are still as mobile as ever, there is no quality way to create an immersive experience using devices such as eReaders. Highly Immersive Virtual Reality has the capacity to enable novelty of environments for reading as well as increase users' sense of flow. Specifically, M. Csikszentmihalyi's Flow theory identifies the level of intense concentration, merging of awareness and action, loss of reflective self-consciousness, a sense that one can truly control the environment, distortion of temporal experience, and sense of intrinsic reward from an experience. Pew Research studies have found 79 percent of people ages 18-29 reported having read a book in the past year as opposed to 75 percent of people age 3-49, 77% of those aged 50-64, and 70% of those 65 and over reading print books, e-books, and audiobooks. It is known that readers frequently experience flow, while reading; Immersive Environments have the potential to increase the occurrences and intensity of flow state.[1]

This discourse is a reflection on the user centred design of an *Interactive Virtual Library* (IVL) that applied elements of gamification to increase flow while allowing users to search the contents of an extensive virtual database of approximately 50,000 open license books from *Project Gutenberg*[2] and to create a personalized Virtual Library. This IVL afforded the user access to a full library in a user selected virtual environment (e.g. a beach, forest, or Library of Congress) without the need for physical copies or the need to travel to a library. This library system uses a consumer head mounted display (Oculus Rift) and the Leap Motion hand tracking sensor mounted to the headset to simulate the experience of being in a library. The goal is for users to experience presence or the sense of 'being there' in their personalized *immersive virtual library*. C. Dede notes that the higher the level of immersion provided in the technology, the more the participants will be able to suspend disbelief, which leads to the question, "to what degree of immersion must a designer strive in order to maximize the immersion and suspension of disbelief".[3] In order to make the experience as immersive and interactive as possible, the Oculus Rift head mounted display (HMD) was used with the Leap Motion infrared hand tracking system to allow users to intuitively interact with the environment and virtual objects. Virtual environments notably create a sense of absence from the physical world; the occlusion of the physical world, by the headset, removes distractions in the user's physical environment. This phenomenon of absence provides a sort of blinders in the virtual world. The immersion afforded by the immersive virtual library also allows readers to disengage from their physical location, which may also serve to reduce distractions and interruptions.

The Oculus Rift is a consumer available Virtual Reality Head Mounted display that affords high fidelity and head tracking of a user. The IVL is rendered in the Oculus Rift HMD and users see only the environment and virtual objects presented in the HMD. All of the development for the Immersive Virtual Library was completed in the Unity engine. In order for users to have intuitive natural interaction with the books and the environment, hand gestures were employed to allow users to select books from the shelves and turn pages. This was all done through Leap Motion which tracks hand and finger movements and gestures that are then used to interact with objects within the virtual space. The Leap

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1   For more information, see: CSIKSZENTMIHALYI, M.: Flow: The Joy of Reading. In CSIKSZENTMIHALYI, M. (ed.): *Applications of Flow in Human Development and Education*. Dordrecht : Springer, 2014, p. 227-237.
2   STROUBE., B.: Literary freedom: Project Gutenberg. In *XRDS: Crossroads, The ACM Magazine for Students*, 2003, Vol. 10, No. 1, p. 3.
3   See also: DEDE, C.: Immersive Interfaces for Engagement and Learning. In *Science*, 2009, Vol. 323, No. 5910, p. 66-69.

Motion sensor attached to the front of the Oculus Rift headset and tracked the user's hands in front of them; they can see their hands in game and make certain predefined gestures. The virtual library provides access to of a large number of texts through Project Gutenberg to users who might otherwise not have access both in places such as private homes, public libraries, and schools. The search functionality allows the user to query the database, narrow book selections available in the digitally rendered library by a variety of means: meta-data (e.g. author, genre, and keyword). Digital Library shelves are generated upon completion of each search, so the virtual library allows users to browse library shelves of books in and related to their search.

Our team applied the *Octalysis gamification theory*[4] to gamify the experience of the IVL (Immersive Virtual Library). The elements of personalization by choosing the library environment are game-like elements that can gamify by empowering the user and giving a sense of ownership. Users could choose the environment their library resembled. They could also choose the music playing in their virtual library. Further, the option to choosing one's representation by the representation of one's virtual hands was another element to further gamify and personalize the virtual library experience. Tracking the number of words, pages, and books read is a way to apply the gamification element of accomplishment. Finally, providing users with sense of connection and meaning with leaderboards and connection to historical figures who have read the same books may tap into the user's core drive for meaning. While the research team made iterative user centered development, during which we regularly tested the environment with different users, the next iteration of the project will be to increase the immersion, intuitiveness, and transparency of the system. The audio control of the environment is another design element which could improve user comfort, specifically, we intend to allow users to integrate their own music into the environment.

While the hardware is still rather expensive, the newest Oculus quest currently costs 299 USD, the cost can be balanced by the level of immersion and the fact that there is no charge for books in Project Gutenberg. The newer iteration of the Oculus Quest integrates hand tracking, which will make future iterations less expensive and more intuitive for the users. This capacity can benefit many user classes, ranging from travelling adults to homebound individuals to low income students and school systems with budget constraints. Immersive Virtual Libraries offers a unique opportunity in overcome the limitation of a lack of engaging library resources for students in some schools. This project may alleviate some of the burden placed on schools by creating a library resource for students by supplementing physical books and other resources. Future iterations of the IVL would include voice command to increase accessibility of the project. As the technology evolves and becomes more affordable, easily adaptable and transportable, we can begin to see these niche, personalized reading spaces begin to become more prevalent and even necessary as the world becomes more mobile and interconnected.

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4   CHOU, Y. K.: *Octalysis: Complete gamification framework.* [online]. [2020-09-28]. Available at: <https://yukaichou.com/gamification-examples/octalysis-complete-gamification-framework/>.

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