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## Eye tracking in virtual reality for educational technology research

Jorge Bacca-Acosta

*Fundación Universitaria Konrad Lorenz*, [jorge.bacca@konradlorenz.edu.co](mailto:jorge.bacca@konradlorenz.edu.co)

Julian Tejada

*Federal University of Sergipe*, [jtejada@academico.ufs.br](mailto:jtejada@academico.ufs.br)

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## The Challenge of Preserving Captured Sign Language Data in Human Avatar Models

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**Jorge Bacca-Acosta**

Fundación Universitaria Konrad Lorenz

**Julian Tejada**

Rochester Institute of Technology

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Research in educational technology is taking advantage of physiological measures to capture information that complements self-report measures and to have a better understanding of the effectiveness of a particular technology implementation. Among these physiological measures one can find eye tracking. Eye tracking is “a sensor technology that makes it possible for a computer or other device to know where a person is looking” (Tobii, n.d.). The importance of this technique lies in the fact that the eye movement has been linked to attentional processes, in other words, we move our eyes in order to focus our attention on a specific object or information and to have a better image resolution (Duchowski 2017). In eye tracking research the main assumption is that following the eye movements provides information about participants’ “path of attention”.

Some metrics in eye tracking research are based on fixations, saccades and glissades. For instance, some common metrics that can be useful are: fixation count, fixation durations, saccade count, saccade duration, average saccade amplitude among others. Moreover, the definition of areas of interest (AIO) is important to collect information about how participants focus their attention to those areas.

In the field of immersive technologies such as Augmented Reality (AR), Virtual Reality (VR) or Mixed Reality (MR) eye tracking is taking a relevant place because this technique provides a lot of information about the attentional process. The information collected is useful to understand how users examine the information in these environments and how they process that information. In educational technology research eye tracking provides information about how students focus their attention on specific parts of a virtual environment and how they react to certain stimuli. This information can be subsequently used to improve the immersive learning environments.

In our research, we introduce the eye tracking technique as well as the common measures in eye tracking research. In particular, we focus on eye tracking in VR environments and how to effectively collect eye tracking measures in a 3D environment. It is important to note that collecting eye tracking data in a 3D environment is different from collecting data in a 2D desktop or mobile application. The difference lies in the fact that, in a 3D environment, it is more difficult to represent a heatmap or gaze path with the eye tracking data. In this case a different strategy is needed to capture and

analyze data. To capture data, when using Unity to develop the VR environments, it is possible to use the Unity Colliders to detect the specific point where the gaze intersects with an object. This approach has been used before in eye tracking research in VR environments (Clay, König, and König 2019).

We also present an example of using eye tracking for investigating students' visual behavior in a VR environment for learning the prepositions of place in the context of an English as a Foreign language course. In the VR application students can practice ten prepositions of place. More details of the VR application are described in Bacca-Acosta, Tejada, and Ahumada (2020). We used eye tracking to explore how students use and perceive the VR environment in order to complete the learning task. For this research we used the SMI tethered eye tracker integrated in the HTC Vive headset and we used the SMI Unity API to collect the eye tracking data. We developed a script to process the eye tracking data collected to obtain the metrics that we considered in our research study.

**Keywords**—*Virtual Reality, Eye Tracking, Educational Technology, physiological measure.*

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