

**Developing Virtual Reality Data Kit for Education Researchers**  
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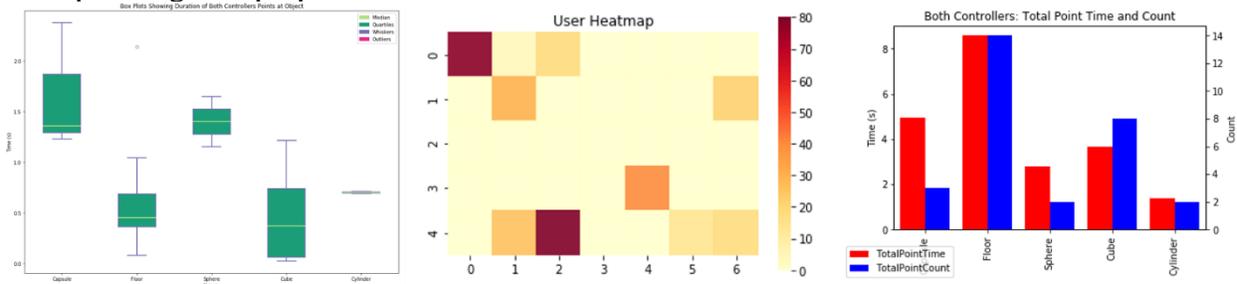
**Abstract:** Interesting aspects of immersive virtual reality (VR) is its ability to leverage interactivity (Bailenson et al., 2008), and the diversity of interactions between learners and simulations has significantly increased (Johnson-Glenberg, 2018). Consequently, interactions in VR environments produce vast amounts of log data. The volume and complexity of this log data engender various challenges for its storage, analysis, and presentation, but simultaneously, this data is suggested to open up opportunities for those who can handle it (Teras & Raghunathan, 2015). For example, cutting-edge features (e.g., interaction modalities) in VR together with machine learning capabilities allow for an understanding of students’ learning processes. On the other hands, some studies argue that there are limitations of measuring students’ learning process in VR environments through traditional summative tests (Shute et al., 2016) and video analysis (Lisa et al., 2018). In response to these needs, we developed a Virtual Reality Data Kit (VRDK) to support education researchers.

VRDK is an open-source software platform developed to extract various user interaction data generated in an Oculus-based VR environment. VRDK consists of two major features: data extraction and data visualization. The data extraction feature can be used with the Unity engine to parse and export user interaction data without writing additional code. The extracted data will be automatically sent to a researcher’s email address in the form of a CSV file. Additionally, data visualization scripts will allow the researcher to explore the data through various forms of visualizations which inform diverse user behaviors and support decision making for further analyses. A total of five sets of data can be extracted and a brief explanation of these data sets are presented in Table 1.

**Table 1.**  
 Brief description of data sets and visualization ideas

Data set	Description	Proposed Visualization
User position	<ul style="list-style-type: none"> <li>Calculate environment map size automatically</li> <li>Stores user position over time</li> </ul>	<ul style="list-style-type: none"> <li>Time series heat map</li> </ul>
Controller position	<ul style="list-style-type: none"> <li>Stores controller position and rotation</li> </ul>	<ul style="list-style-type: none"> <li>Third person replay system</li> </ul>
Gaze	<ul style="list-style-type: none"> <li>Using “Raycast”, tracks objects that the headset is looking at</li> </ul>	<ul style="list-style-type: none"> <li>Bar Graph comparing average interaction time per object</li> <li>Dual-Axis Bar Graph comparing total interaction time and count per object</li> <li>Box Plot</li> </ul>
Grab	<ul style="list-style-type: none"> <li>Stores which object was grabbed</li> <li>When the grab event began and ended</li> <li>How far the object was moved from its initial position</li> </ul>	
Pointing	<ul style="list-style-type: none"> <li>Stores which object was pointed at using a laser pointer and when pointing began and ended</li> </ul>	

**Fig. 1.**  
Example images of proposed visualization



To verify the possibilities and to further develop the first version of VRDK, we are developing embodied VR learning environments in various STEM domains such as biology, astronomy, and mathematics that integrating VRDK. We believe more in-depth exploration will be possible through VRDK, such as analyzing associations between students' gesture usage patterns and learning outcomes or categorizing the way students interact with objects and verifying how different interaction types affect students' understanding. Further, we hope that having a common data collection and visualization platform will allow researchers of different types of VR education application to make comparisons and share ideas.

## References

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