Voxel Bay: VR as a Distraction for Pediatric Pain

Alice Grishchenko, John Luna, Jeremy Patterson*
at Nationwide Children's Hospital
and in affliation with the Advanced Computing Center for Art and Design at the Ohio State University

Abstract

Voxel Bay is a hands-free, immersive virtual reality (VR) game designed for children to play in a medical setting to offer distraction from pain and anxiety that may arise during medical procedures. The application has been developed at Nationwide Children's Hospital (NCH) by Alice Grishchenko, John Luna and Jeremy Patterson in collaboration with NCH's Director of Hematology, Dr. Amy Dunn. In addition to developing a game, a user-centered design approach has resulted in a system which encompasses a child's entire clinic experience outside of the game. Children who come to clinic will start their experience by receiving a child-sized cardboard headset, which they can customize. The game runs from an iPod touch placed inside the headset. Headphones with a built in microphone are incorporated into the device so the player can listen to the game and give audio input, thus the experience provides both visual and audio stimulation to reduce the patient's contextual awareness. The components of the headset have been reviewed by the NCH safety center. Before starting, a connection is established between the player and a networked remote control station operated by a clinician-orchestrator. From this station the clinician can end and start mini-games, restart the game, mute and unmute the audio and open a pop-up camera view into the clinic room.

1 The Bay and the Player

Voxel Bay starts by asking children to choose a character (parrot, platypus, penguin or sea lion) who will accompany them on an island journey. We utilized a gaze-based raycasting selection

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*Grishchenko.1@osu.edu, luna.56@osu.edu, jpatters@accad.osu.edu

system, where a sustained gaze directed at an object for a few seconds selects the character and then the start button, as well as several other choices throughout the game. This was intentionally designed to not only allow the child to remain relatively still during the game but also to allow easy access to the child's hands or arms for medical procedures.


Figure 1 *Voxel Bay Title Screen*

The player sets off in a boat which follows a pre-determined course at a steady speed. Sitting in the boat provides an in-world explanation for the VR trope of moving along a track and control free navigation, but also allows the player to be surrounded by the calming ocean atmosphere surrounding Voxel Bay's three islands. We developed this world with a stylized cubey aesthetic that would engage children the way Minecraft™ or Lego™ aesthetics do and allowed our team to produce quality assets optimized for mobile device display. Along the track there is always a point of interest in front of the player to keep their attention and minimize their movement, including head rotation.

2 Island Adventures and the Clinician

At each island, and at several points of interest, the boat stops and gives the player a chance to see details of the unique activities which take place on or between each island. The boat may also stop if the clinician starts a breathing exercise, using the dashboard's remote controls. In order to set the boat in motion to continue their journey the player must "summon the wind" into the sail of the boat, by exhaling into the microphone. This interaction with the microphone encourages deep breathing and may help prevent hyperventilation which, according to pain management specialist Karen McHugh-Fornadel, is relatively common in children receiving painful treatment. For every island stop players choose whether to play a mini-game. In addition to the three mini-games accessible from the island stops there are five more otherwise inaccessible mini-games that the clinician-orchestrator can start for the player remotely. Using the clinician remote control station to start games helps keep the experience
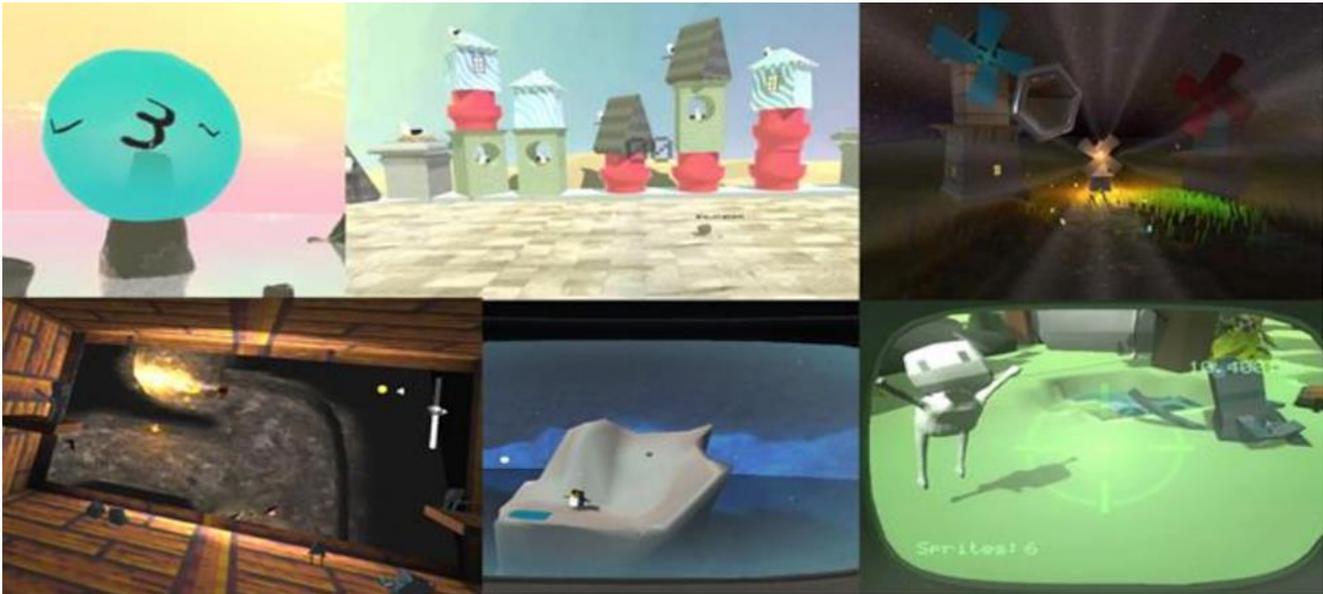
Figure 2 *Mini Game Screenshots*

interesting for players because it allows for direct response to the player's needs and adds a touch of uncertainty to the gameplay.

All of the mini games employ primary game mechanics that incorporate gaze-based and breathing input and some include a fixed reference point in frame to reduce the likelihood of motion sickness. The games are short, they take a few minutes to play with little to no barriers to the onset of gameplay, but all include elements of randomization for replay-ability's sake. In preliminary tests with children, outside of the clinic setting, all children were able to play through the games with no instruction and remained motionless. Our play testers included children with learning disabilities and English as a second language, ages ranging from six to twelve years.

Our research references an earlier study of Virtual Reality as a pain management tool for burn victims, conducted at Washington University. The system we've developed addresses the unique needs of a pediatric patient demographic and hands-free control system differing from the earlier study, which was designed to meet the needs of an adult patient demographic with differing mobility limitations.

References

"Virtual Reality Pain Reduction.*" HITLab Projects: VR Pain Control*. Washington University, 2008. https://www.hitl.washington.edu/projects/vrpain/. 2015.