

Research in Virtual Reality

Movement

Written By: Jack Harrison

Summary

With second generation virtual reality hardware on the horizon, it is important that developers take the best approach to creating every component that makes up an in depth and effective VR software. One large issue that we have yet to truly solve is that of movement. With current-gen VR equipment, the user is limited to a small space to navigate, and much instead explore the virtual world using only controller inputs. That's not to say that these controller inputs cannot be effective as there are quite a few that seem to work for many users, but the second generation of equipment will unlock an entirely new potential for virtual reality.

Researchers, developers, and consumers have been testing VR since late 2012 and have learned a great deal of information about movement in VR. By using my own knowledge in the field as well as the input from the VR community, researchers, and developers in the form of surveys and references, I will determine the most effective form of virtual reality movement to be used in future projects.

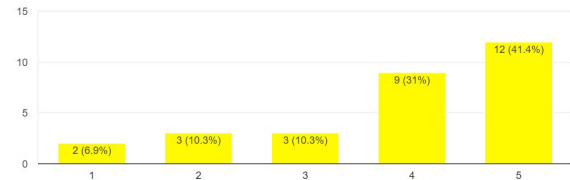
There are many different movement options in virtual reality. This brief description of each option will provide us with hardware and input for our final movement form.

Gamepad Style

This is the movement style we use currently to explore virtual worlds, on every console and computer used to play games you either push a button or push a direct a thumbstick to navigate and 1st or 3rd person object on a 2D plane (TV). The idea is the same in VR but the scene moves around you and is seen in 3D. This can cause some serious motion sickness due to a disconnect between what your eyes are seeing and what your body is feeling. What does work well about this in VR is that you are able to explore massive worlds without the need for expensive hardware or complex software, not to mention the lack of physical exercise.

Survey Results

Gamepad style movement is a favorite of current VR users, as it provides the player with freedom to explore wherever they want. When asking 30 active VR users whether or not they liked this form of movement, over 70% of them said that they did. Here are the exact results. (1 = disliked, 5 = loved. For all surveys)

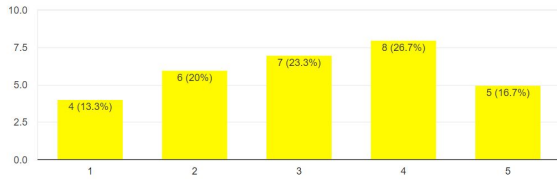


Teleportation

Teleportation moves the user from one point to another, simple as that. Most of these movement systems have the user point to where they want to go using a controller with a laser pointer on it, and then press a button. It is extremely popular due to the lack of motion sickness produced by it, your mind has very little trouble understanding how you got from point A to point B and there is no disconnect between the eyes and the body. Although this mode is very accessible, it is not an ideal form of movement as it cannot be easily adapted to other input and hardware movement solutions coming in the future.

Survey Results

When asking the same group of 30 active VR users, I found that the results were more mixed. While many did not mind teleportation, a large group of the VR community seems to hate teleportation saying it "broke immersion" and while it decreased motion sickness it made the user feel disoriented. Here are the results from the survey.

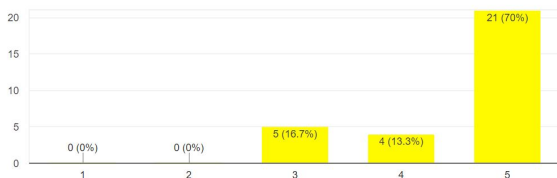


Roomscale

Roomscale is the most ideal form of VR movement that is currently available to the average consumer. The effect is a result of the accuracy and well thought out design of major computer driver VR head mounted displays (HMDs). The sensors of these HMDs track your movement in the real world and translate it instantly into the virtual world, so when you walk, you move. Simple as that. The issues with this movement option include: the cable required to plug into your PC, the limit of the sensors for the HMDs and controllers, and the lack of space available in the average user's home, studio, or arcade. These issues will require additional hardware and software to solve, these will come but not for a long while.

Survey Results

Roomscale is the clear winner of the 3 main movement styles. Simply put because it is the closest thing to reality, and isn't that the point of virtual reality? Answers given by surveyors stated that this is the most immersive, but also that the game must be designed with roomscale in mind or else sneaky players will abuse it (clipping through walls). Overall it was the most praised form and had no users disliking it at all. Here are the results.



Treadmill Locomotion

This style of movement is not quite here, but we have a good idea of what it is going to look like, and can therefore build experiences with it in mind. Treadmill Locomotion involves a piece of external hardware and allows the user to walk or run in any direction, while staying in one place. There are currently 2 versions of omnidirectional treadmills. The first is a slippery circle in which the user wears a pair of slippery shoes and slides along the circle, being held in place by a harness of some kind. The second is a little more intriguing but a lot more expensive. It is essentially a traditional treadmill, made of treadmills going in the perpendicular direction, allowing the entire unit to move in X and the smaller treadmills to move in the Y. This gives the user the feeling of actually walking, rather than simply sliding along the ground. Eventually the more privileged and dedicated VR users, as well as VR arcades will begin buying various versions of this hardware, resulting in the need for developers like myself to build experiences that work for them.



Survey Results

Because the technology is new, many responders in the survey had not had the opportunity to try

any of these potential movement solutions, myself included. Those who had got to try the hardware had only tried the first rendition of omnidirectional trackpad, the slippery circle method. Out of the four users who had tried either only one of them liked it and the others described the experience as “laggy and not great” or “terrible”. It seems we will have to wait a bit longer to see if this will be a solution to the movement problem in virtual reality, until then, roomscale and locomotion games will have to suffice.

Diegetic Rooms

Diegetic rooms are also sometimes referred to as “Mixed Reality”. This is because they sit somewhere between virtual and augmented reality. This form involves mapping real world objects into the virtual, so if you saw a chair in virtual reality, you could walk up to it and actually sit down, or if there was a wall you could reach out and touch it. While extremely effective in terms of immersion and user engagement, they are much harder and expensive to set up, having every object in the virtual needing a physical counterpart. This is therefore not an ideal form for use in a virtual reality game that is to be sold to others with VR headsets, as you would have to rely on them to set up the same physical objects as you did in your development studio. Due to the lack of diegetic room setups I did not include it in the survey.

The Oculus Quest

Announced only weeks ago the Oculus Quest is facebook’s newest VR headset. The Quest is a very big deal as it is the first standalone VR headset to offer 6 DoF tracking in both the headset and 2 controllers. This gives the user a similar experience that is found in headsets like the HTC Vive and facebook’s previous headset, the Oculus Rift. The headset changes a lot in terms of how VR will be used, specifically how users will move while using VR. We no longer need to use the headset while tethered to a

nearby gaming computer, and can bring the headset to any number of locations. This means a user can bring their Quest to a nearby gym and their boundaries become a lot larger. For my game I want to take advantage of the fact that the Quest will be launching around spring 2019, right around when I was planning on releasing my game. I will therefore be building my game for the quest as a launch title. This is possible without a Quest headset as Oculus is planning on releasing it with the same controller scheme and development tools as the Oculus Rift, a headset I have been using for over a year now.

Going Forward

For my game I have decided to focus on the Roomscales form of movement, with a touch of Gamepad locomotion. This will allow me to build the game using the Oculus Rift with Gamepad locomotion, and then quickly adapt it for the Quest using Roomscales upon release. Luckily, this is also the easiest form of movement to get right, having only to build a system that stops the user from cheating by clipping through walls, as well a system that automatically detects the size of your room in order to procedurally build the game around it.

Sources and Bibliography

<https://www.pcgamer.com/the-quest-to-solve-vrs-big-gest-problem-walking-around/> - Solving VR Movement

<https://goo.gl/forms/oNMK8olQaohqpZXQ2> - My Survey

<https://www.media.mit.edu/research/?filter=everything&tag=virtual-reality> - Research in VR at MIT

<https://research.fb.com/category/augmented-reality-virtual-reality/> - Research in VR at Facebook

<http://katvr.com> & <http://www.infinadeck.com/> - Omnidirectional Treadmill Examples

<https://www.jackh.ca/research-in-virtual-reality>