worldviz

where virtual becomes reality™

The WorldViz Buyer's Guide to Virtual Reality:

Everything You Need to Know to Get Started

INTRODUCTION

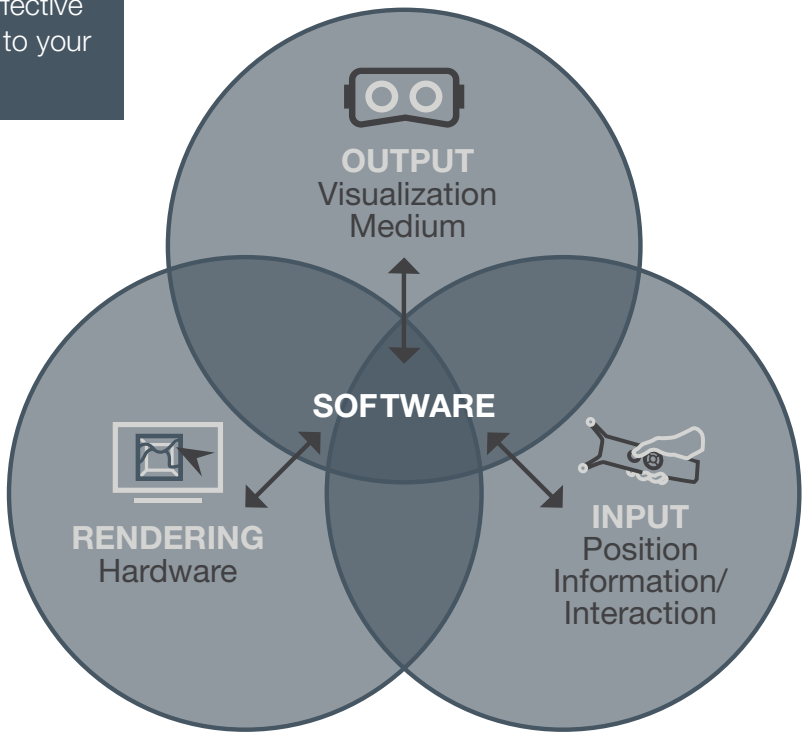
Virtual reality (VR) is all the rage and rightly so. With its potent capacity to immerse participants in a simulated environment that feels remarkably real, companies and professional experts are recognizing VR as an effective tool for training, demonstrating projects, behavioral research, and collaborative design and testing. But what do you need to know to make an informed decision when purchasing a VR system? What are the actual technical components that constitute a professional, effective VR environment, and how can you select the system that best meets your business needs? This guide clarifies the fundamental options and offers guidelines to help you start making choices as you seek a VR solution to meet your business needs.

WHAT COMPONENTS SHOULD AN EFFECTIVE VR SYSTEM INCLUDE?

To begin, three core components make up a functioning VR system, or what we call the VR system triangle:

1. **Output**—the medium of visualization that provides participants with their VR experience
2. **Input**—the sensors that track your movements and communicate to the rendering computer so it can adjust the simulated environment to your every movement
3. **Rendering**—the crucial software and hardware that fabricates the VR environment in all its detail and 3D vividness while weaving together the visual output with the tracking inputs

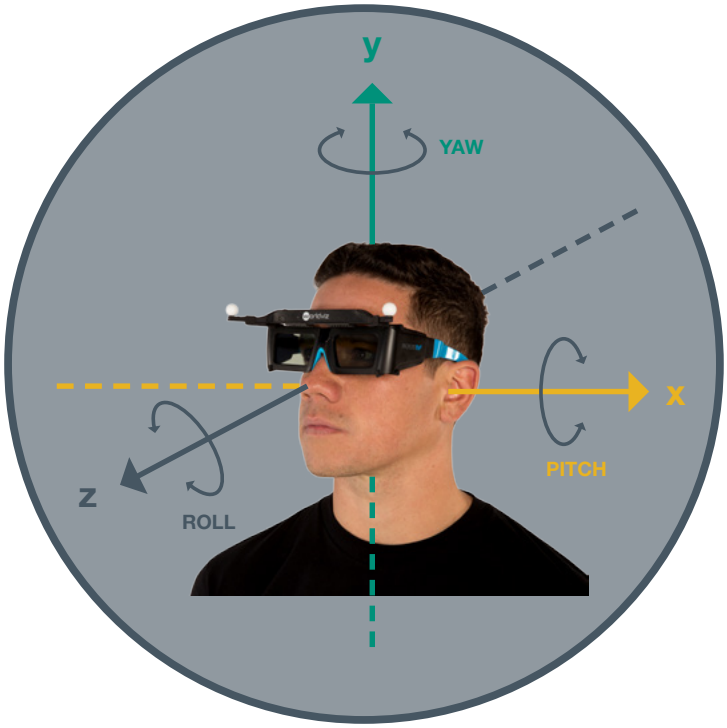
These three parts of the VR triangle need to be carefully integrated into a seamless solution to deliver an effective VR experience tailored to your specific use case.



CRITICAL CRITERIA FOR SELECTING YOUR VR SYSTEM

This deep dive into VR hardware and software will explore the typical use cases and the advantages and disadvantages of each technical configuration. When selecting your VR solution, it's imperative to assess:

- **Budget**—Cost and potential ROI are important considerations when determining the ideal VR system for you.
- **Customizability and scalability**—A good virtual reality system can be upgraded to incorporate the latest tech advances while scaling to fit your evolving business needs.
- **Use case**—What do you want to achieve with the VR system? Different use cases sometimes require different hardware.
- **Footprint**—The installation space and storage you must permanently dedicate to your VR setup.
- **Quality of experience**—Unless a VR system is equipped with high levels of visual refresh rates and fast responses to the movement, participants can experience the environment as lagging and drifting, which can potentially cause motion sickness.
- **Responsiveness**—How well the VR system responds to your movements and interaction. This responsiveness is typically assessed by the "degrees of freedom" (DoF - up to six) that your VR system delivers. More concretely, does the VR hardware respond to the participant's *three directions of movement* - **up/down**, **forward/back**, and **left/right** - in combination with the three directions of head rotation, often termed **yaw**, **pitch**, and **roll**.



OUTPUT: THE MEDIUM OF VISUALIZATION AND IMMERSION

Output - the technology that transmits the 3D visual experience to VR participants. Typical devices are: an individual headmounted display (HMD) unit or a 3D screen projection environment that enables group viewing and interaction.

HeadMounted Display. The most common output device is an individual VR headset unit of the kind made famous (and increasingly affordable) by Oculus Rift, but there also exist less expensive models ranging from Samsung's Gear VR headset right down to smartphones inserted into cardboard boxes.

TYPICAL USE CASES

- Projects and plans demonstrations
- Architectural walkthroughs
- Psychological research and therapy

HMDs offer the strongest sensation of immersive "presence". Indeed, the engaging magic of VR stems from this ability to fool the brain into believing in an entirely new world. Depending on your use case, however, total immersion can be a sought after effect or not. In cases of psychological research and therapy or when demonstrating new projects, total immersive presence without any distractions is often very desired. In use cases such as training and team interaction, however, losing oneself in a simulated environment might divert attention from the task at hand.

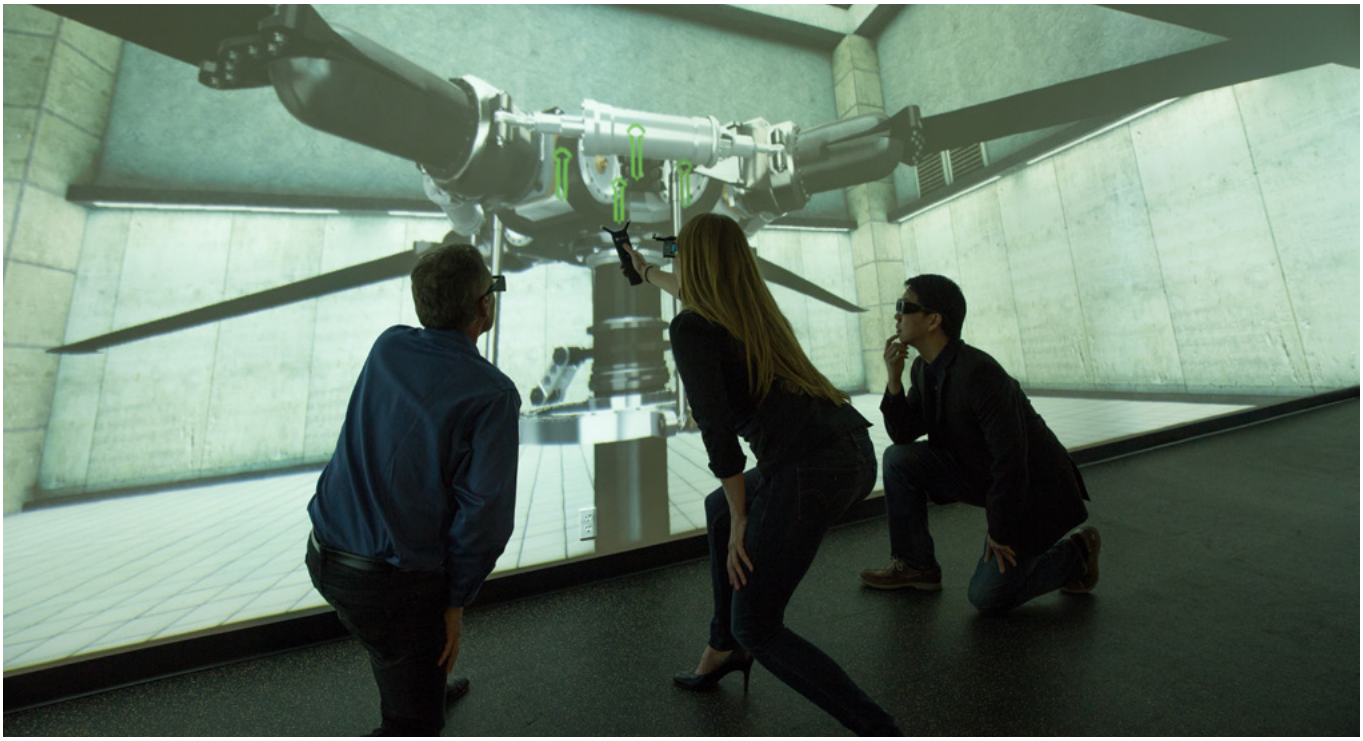
HMDs can offer a wide-area walking VR experience so the participant can fully explore a physical space and maneuver objects within it. When equipped with motion tracking, headsets can deliver the full six degrees of freedom – so the environment not only rotates with every turn of your head, but also enables you to move up/down and backward/forward in the space. Without tracking, headsets offer a more limited stationary VR experience with just three degrees of freedoms; a typical case is VR news reports from press outlets like the New York Times, which offer a full 360° perspective, but do not respond to your movements forward and back.

3D Projection. The second most common system for visual display is 3D projection. Screening a simulated environment onto one or more walls conveys an interactive virtual experience for groups and large audiences. The participants can collectively navigate and interact with the virtual space.

Projection systems start with easily installed systems operating in a classroom and screened on one or two walls, or they can scale up to fully enclosed systems. In an advanced projection layout known as the CAVE™, the simulated environment is projected onto the front, left, right, and bottom walls to create a powerful sense of an encompassing virtual world.

TYPICAL USE CASES

- Training and simulation
- Design review and product development
- Training, collaboration and education "classroom" environments
- Marketing presentations



HMD VS. PROJECTION: SIDE-BY-SIDE COMPARISON

HMD	PROJECTION
Creates a highly immersive VR experience — best for "lifelike" simulations	Lower immersive experience — not as all-encompassing or engaging as a HMD
Can offer full freedom of 360° movement & interaction	A full 360° rotation is harder to accomplish requiring projection on all four walls
Less costly than projection	Projection technology is typically more expensive than HMDs
One person use only	Ideal for multiuser experience and group collaboration

INPUT: THE SENSORS TRACKING YOUR MOVEMENTS

VR's motion tracking and sensor capabilities are what distinguish it from all other media. The tracking of your body's position and rotation is processed in milliseconds to create updates in the displayed environment so that it appears to shift in exact response to your every movement, as if you were inhabiting an actual physical space. Motion tracking can extend to a 50 x 50 foot space and beyond, enabling users to experience the virtual environment at full scale and perform tasks in a realistic fashion. In addition, inputs can include all types of interaction with virtual objects in the simulated environment, thus enabling true to life training and testing.

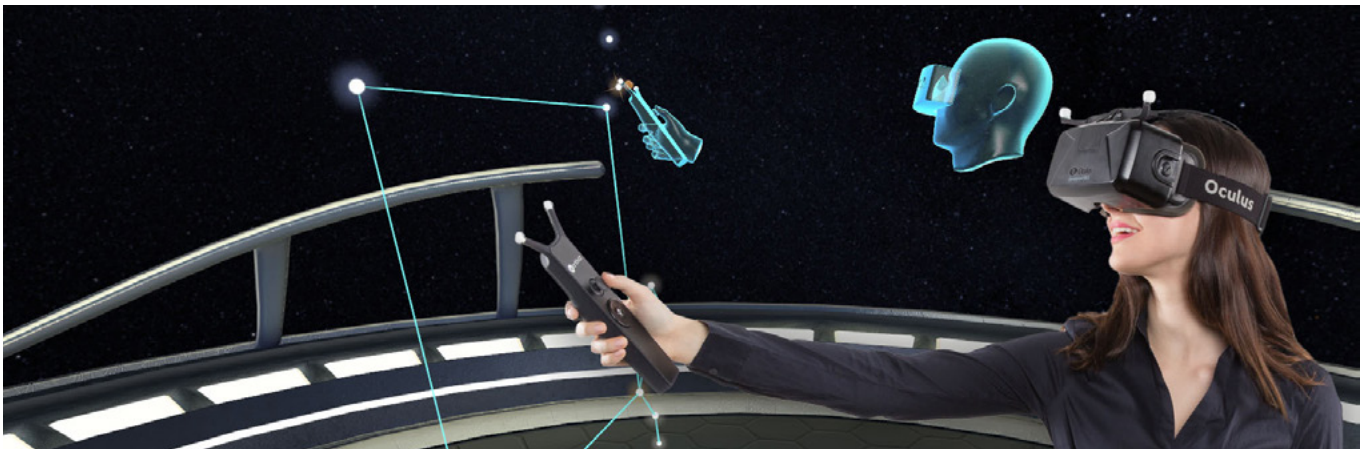
The main types of input devices are: Keyboard/Joystick, Orientation Tracking (3 DoF), Motion tracking (6 DoF), and additional types of body feedback sensors, for example, gloves, heartbeat monitors, etc. are possible.

Keyboards, joystick and other types of handheld movement command systems. These input devices are the most rudimentary and most affordable. They are also the easiest to use, in part because people are familiar with joysticks, keyboards, and so on from everyday gaming and computing. With such controllers, you typically navigate the environment, not by actually changing your position, but by moving the joystick in the direction that you wish to move. They thus lack the responsiveness to actual physical movement that promotes the strongest sense of immersion in VR. This is the least desirable solution for VR systems.

Orientation tracking (3 DoF). The tracking of shifts in the VR participant's angle of viewing typically occurs through inertial sensors. Orientation is a minimum requirement for effective VR experiences as it enables the user to look around in the environment vs. looking at a fixed viewpoint like on a computer monitor or TV screen.

Motion tracking (6 DoF). This technology enables full tracking of the participant's entire range of position movements and orientation to provide a powerful, intuitive immersive experience. This is the most desirable solution for VR systems as it provides full interaction and walking capabilities. Participants experience true freedom of movement – walking, running, crouching, turning, and gesturing – in a total 3D space. The VR experience can be so strong and visceral that participants retain a memory, a feeling of "I have been there" - so called presence. In addition, motion sickness can be kept to a minimum, provided the application is setup appropriately and the hardware components are aligned.

Body feedback monitors, gloves, etc. As VR technology rapidly advances, the number and types of monitoring tools is growing exponentially. Such devices are typically use case specific, designed to accomplish a very particular type of interface with virtual objects. Training for welders, for example, or practice sessions for medical procedures, such as surgical ophthalmology, depend upon monitoring devices that measure the movements of the VR participant in exceedingly precise terms and then calibrate those actions with the virtual object, whether a metal joint or the muscle tissues of an eyeball.



RENDERING: THE HARDWARE AND SOFTWARE THAT GENERATE THE VR ENVIRONMENT

At the heart of every VR environment is a software program used to construct and then display the simulated 3D experience, along with a computer processor. The invented worlds of VR can run the gamut from the most simple geometrical block shapes to the most intricately detailed universes that call forth a true sense of awe and wonder. Some VR applications – for example, those delineating the complex worlds of VR games – may take months to develop. Most industry applications don't need (or want) such elaborate complexity, nor do they have the time to wait for such development. If you and your team are doing the development, important considerations for evaluating such software are:

- Ease of use, even for non-programmers
- Robust open source community libraries of VR code that can accelerate development of simulated environments
- Enhanced "rapid application development" to speed the building of VR environments – often one of the key requirements for industrial applications
- Compatibility with different types of VR system setups and, in particular, with a variety of VR input and output technologies (for example, desktop walkthrough, CAVE, and HMD). Rendering software should support those integrations hassle-free.

CONCLUSION

Virtual reality is a powerful communication tool that helps businesses and professionals surmount bottlenecks in collaborative design and testing, training, and project presentations. By offering an astoundingly tangible and lifelike interaction with simulated environments and objects, VR enables participants to quickly understand and practically experience plans and issues in a manner unachievable by mere written descriptions or two dimensional renderings.

But as VR technology rapidly advances and the technical options become ever more complex, it becomes mission critical to know which components will best serve your business needs. Now, with the help of the WorldViz Buyer's Guide, you can begin implementing a VR solution and start taking advantage of its revolutionary communication impact to elevate your team's performance.

NEED MORE GUIDANCE?

With our decade long experience in helping firms and professionals find exactly the right VR solution, the WorldViz team can help you select the perfect, affordable VR setup to meet your professional needs.

About WorldViz

WorldViz is the industry leader in immersion-ready virtual reality (VR) solutions. WorldViz's patent-pending interactive visualization and simulation technologies are deployed across 1500+ Fortune 500 companies, academic institutions and government agencies.
WorldViz's core products are Vizard, the premier development platform for professional VR application design, and VizMove, the world's only enterprise-class VR software and hardware solution. WorldViz also offers PPT, a high-precision wide-area motion tracking system, as well as professional consulting and content creation services. WorldViz technology enables users to replace physical processes with immersive virtual methods. Applications range from design visualization and industrial training to interactive education and scientific research.
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