

Exhibit 1

Oculus Quest Review – The First Great Standalone VR Headset

By Ben Lang - May 21, 2019

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After months of teasing, Oculus Quest starts shipping today. After testing the headset for several weeks, our Oculus Quest review is here. Because it doesn't rely on a PC, but still has full tracking capabilities, Oculus hopes that Quest can bring VR's most immersive experiences to a much wider crowd. Does Quest deliver? Read on to find out.

As usual, we'll start with a review summary and then dig into the details further down.

Oculus Quest Review Summary



Photo by Road to VR

Oculus Quest is Facebook's first standalone headset that offers 6DOF tracking on both the head and hands. Practically, that means that the headset has the same full tracking capabilities typically reserved for high-end VR headsets that are hooked up to a computer or game console. Because Quest has full 6DOF tracking, it opens the door to significantly more immersive and interactive

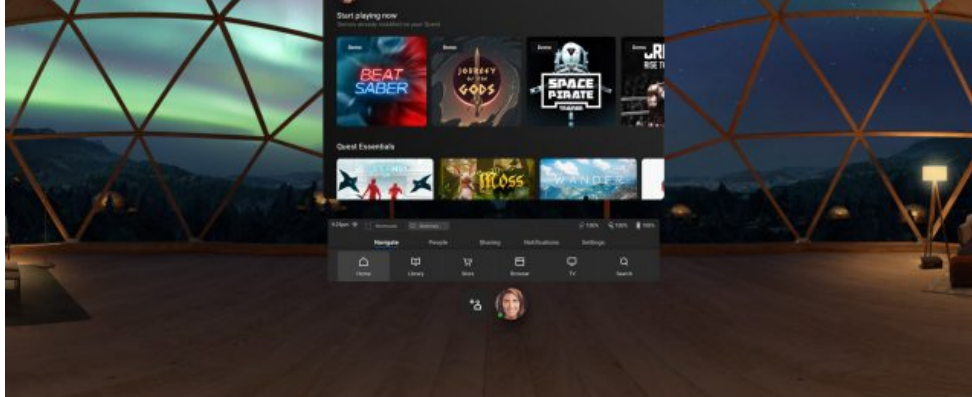


Image courtesy Oculus

Quest's menu is a bit clunky but functional, and feels snappy enough to not be annoying. From the menu you can search the Store for new games, access your Library to launch apps, and do other things like adjust settings, launch a web browser, and more. It's a familiar experience for those who have used Oculus Go, as it's largely the same interface.



Photo by Road to VR

Visually speaking, Quest looks pretty similar to what you'd expect from an Oculus Rift, but with a bit more resolution (1,440 × 1,600 per-display vs. 1,080 × 1,200). That means slightly less screen door (the black space between pixels) and sub-pixels which are now just about invisible. The lenses have also seen an upgrade over the Rift, which somewhat reduces reflections in high contrast scenes. That said, the mobile processor in Quest simply can't push the same quality image as a PC driven headset like the Rift, so in the end you'll see improved clarity through Quest, but things just aren't going to look as pretty in most cases—expect 'mobile' graphics.

That said, the visuals are more than adequate to provide compelling VR experiences. Some games look and play effectively identical to what you'd expect on PC. *Beat Saber*, for instance, looks nearly identical, runs smoothly, and feels great. This will be a little hit or miss with many of the ports that are initially launching on Quest, like *Robo Recall*, which has had much of its luster baked down into garish textures in order to get the game to run on the headset. Made-for-Quest games generally fare better graphically because they were designed for Quest's graphical limits in the first place.

Quest's inside-out tracking is perhaps the most important element because it's the hardest thing to get right. In my time with Quest, I've been really impressed with the performance and robustness of the head and hand tracking—Quest is currently leading the industry here. Headtracking is extremely solid with very little latency, and the controller tracking is surprisingly performant, even when playing some of the most demanding games like *Beat Saber*.

The second caveat is that Quest does have some blind spots to its tracking, though in general they don't cause trouble unless a game relies on a specific mechanic which frequently puts the controllers into the blind spots for extended periods. For instance, *Creed: Rise to Glory* asks you to hold your hands up in front of your face like you are blocking in a boxing match, and this would occasionally lead to the controller losing tracking for a few seconds at a time, which felt funky when one of my hands just stuck there in the air as I tried to throw a punch (before eventually popping back into the proper position).

So, edge-cases in both environmental factors and specific game gestures can trip things up, but on the whole Quest's tracking works very well.



Photo by Road to VR

Quest effectively packs all of the features that make high-end VR great into an easier to use and more affordable package (everything but high-end graphics). And that gives the headset huge potential, so long as there's great content to back it up.

Quest has a launch lineup of 50-ish titles, including probably the most important game that could be on the headset at launch—*Beat Saber*—and there's a handful of other really strong entries, but the vast majority are ports and many of those are quite dated. Oculus will need to push hard to keep Quest's library growing with quality (and genuinely new) content if they want to capitalize on its potential as an easy-to-use VR headset which has pretty much all the right stuff to deliver some really compelling experiences.

Oculus Quest In-depth Review

Hardware & Display

Quest is effectively a headset with a mid-range smartphone processor built inside. It's running a Snapdragon 835 processor with active cooling, and the headset is offered with 64GB and 128GB memory options (unfortunately with no memory expansion ports).

Clearly visible on the outside of the headset are four cameras around the visor's bezel which are used to track the headset's movement via computer vision. The same cameras also see and track the controllers (which have invisible IR LEDs on them).

Very similar to Rift, Quest uses a pair of OLED displays, but with an upgraded resolution of 1,440 × 1,600 each (compared to 1,080 × 1,200). Quest also uses single Fresnel lenses, though Oculus says they're improved over those used in the original Rift (and are in fact much closer, if not identical to the lenses used in Oculus Go). Quest has a field of view that's almost identical to Rift, which we'd guess to be around 100 degrees diagonally (though Oculus won't provide an official FOV figure).

If you've never used a VR headset before, Quest's visuals are pretty good and there's no serious complaints, save for the usual lens reflections (AKA god rays) and black smearing which are problems that every headset with Fresnel lenses and OLED displays runs up against. The field of view is wide enough that the world feels convincingly around you, and everything works well enough to easily make you forget which way you're even facing in the real world (or even which room you're in). If you *have* used another VR headset, I'll make some comparisons to try to demonstrate what's improved (or not).



Photo by Road to VR

Quest offers a decent improvement in clarity over the Rift on a pure pixels-through-the-lens standpoint, but relative power difference means this may not mean quite as much except in a handful of cases where Quest is able to match the Rift pixel for pixel (like when playing back video or browsing the web). That said, the improved resolution directly translates to a sharper image, though this is tempered in many cases by the fact that the default render resolution for Quest is lower than its total resolution for performance reasons. The increased pixel density also means somewhat less screen door effect, and makes the sub-pixels just about invisible, making for more cohesive colors.

One of the biggest improvements from Rift to Quest is the mura, which on Rift was really not great, but on Quest looks all but eliminated. Mura is caused by inconsistencies in color and brightness from one pixel to the next, and usually shows itself mostly in darker scenes. Black smear (where dark areas bleed into bright areas during head movement) is still an issue (as it is for most OLED displays) and appears to be equally as bad as Rift.

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