VIVE BUSINESS

ORamaVR Streamlines Medical Training for Healthcare Professionals

Healthcare workers now have access to new medical training and minimize errors with VIVE VR.

According to the World Health Organization, our planet will need more than 40 million new doctors, nurses, frontline healthcare workers, and other healthcare professionals by the year 2030, which is double the current medical workforce.[1] This demand will be fueled by several different factors – most notably, a growing geriatric population. People are living much longer, thanks in part to improved healthcare. But that brings a rise in chronic conditions such as cardiovascular disease, diabetes, and cancer.

In light of the COVID-19 pandemic, it's sobering to realize that if we don't act now to implement new medical training solutions, an additional deficit of 18 million healthcare workers will compound the current existing shortage.[2] However, the 150-year-old training model (a master teaching an apprentice over the course of several years) is unable to meet the level of healthcare professionals needed.

Empirical evidence from other industries clearly demonstrates virtual reality (VR) technology is an effective and efficient way of improving training. However, VR implementation in the medical industry has been slow because of the cost to develop and customize software, limiting accessibility where it is needed the most – in the hands of medical instructors and learners.

Integrating VR with Medicine

ORamaVR is a company that knows how to develop and deploy spatial computing technology in a cost-effective and impactful way. The company has built the world's most intelligent VR training simulations for healthcare and successfully deployed them on HTC VIVE VR hardware, with a focus on the rapid acceleration of human learning in medical training. ORamaVR works with medical universities, hospital systems, surgical training centers, medical device companies, non-governmental organizations, and medical VR content creators to provide its technology for medical staff to reskill and upskill more effectively, without a large time investment.

These effectiveness gains have been proven. In 2019, ORamaVR published the results of a randomized control trial in the Journal of Arthroplasty (abstract) that exposed a training cohort of surgeons to two, 20-minute sessions using VR. This produced an 8 percent increase in technical surgical proficiency versus those surgeons who did not receive VR training.

Since that study, additional research has shown the efficacy of VR medical training (see "Proof Positive: Benefits by the Numbers" on next page). Specifically, the combination of cognitive training in an experience-based learning environment enabled by advanced VR software and hardware has been successful – especially when compared to humans interacting with a traditional two-dimensional screen, keyboard, and mouse, or trying to memorize a 45-minute lecture.

MAGES to the Rescue

ORamaVR has created twelve VR simulations to date, covering areas such as surgery, dentistry, emergency medical services, behavioral health, chronic care, and recently COVID-19. But what truly drives the

Proof Positive: Benefits by the Numbers

A study by Accenture Consulting found VR training for medical students resulted in 70 percent improvement in trainee engagement and knowledge retention.

Two studies that examined ORamaVR software found that required training time dropped by 29 percent, while training costs for the school decreased by $300,000 per year for using operating rooms and $1 million in cadaver stations. The time and cost for content authoring was reduced by a factor of 10.

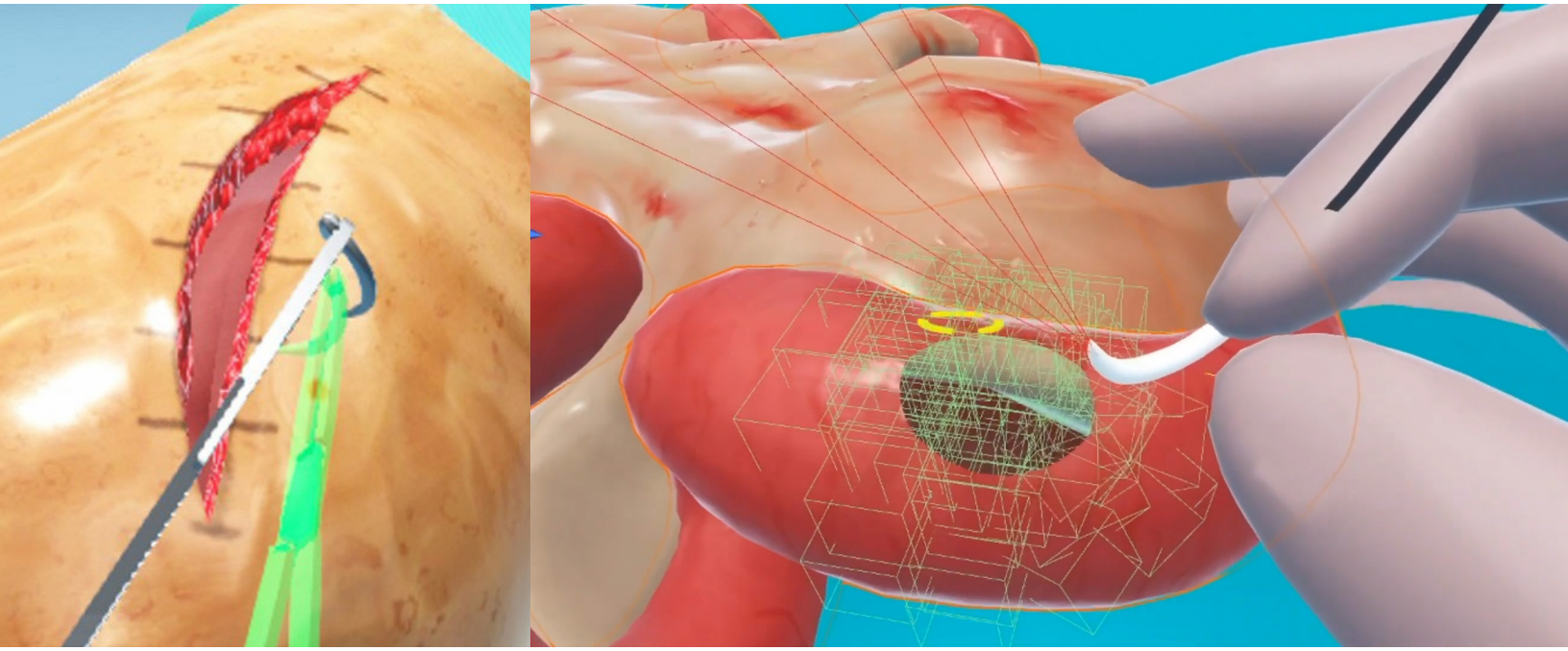
The Department of Telemedicine at the Emergency Department of the Inselspital, University Hospital (Switzerland) utilized the ORamaVR COVID-19 Swab Testing and Personal Protective Equipment (PPE) training simulation, a first-of-its-kind, controlled pilot study for the school's large medical student cohort. Preliminary study results have indicated a statistically significant improvement of sensorimotor performance of the trainees in the VR group (~16 percent) and higher learner satisfaction. Full trial results currently are being published in a scientific journal, but there is a significant indication of the efficacy and value that VR simulations produce for medical training.

ORamaVR's plan is to continue and repeat the validation of these example studies, and further establish and cultivate more partnerships with leading life sciences institutes in Switzerland.

company's value proposition is a technology called MAGES, its proprietary software development kit (SDK). ORamaVR knows healthcare organizations want to be able to use a low-code SDK to build complex, fully customizable, and highly interactive VR training simulations – at scale and without being dependent on costly third-party content creators.

MAGES is an acronym for:

- **Multi-player:** Referring to the ability to train tens to hundreds of people simultaneously.[3]
- **Analytics based on advanced deep learning:** Tracking users and recording their profiles that can be evaluated for performance with AI cloud-based assessments and provide personalized recommendations.
- **Geometric algebra:** A proprietary mathematical framework layer for three-dimensional soft and hard body deformation and animation that makes VR interactions incredibly realistic by simulating deformable objects to accurately represent the human body's tissues.



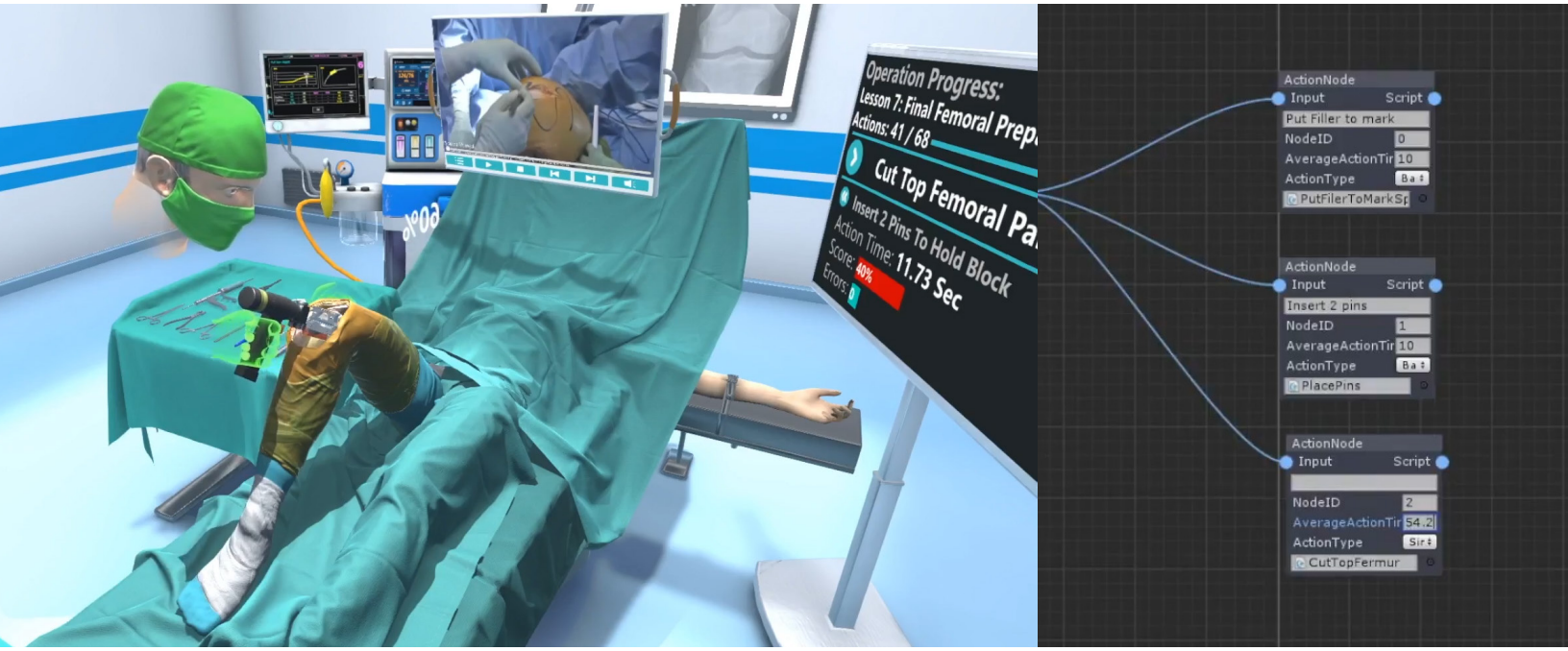
- **Educational Editor:** Changes can be made to the training modules within the VR environment to create new elements, objects, and procedures with visual scripting based on the learning objectives.
- **Semantic annotated soft-rigid objects:** Through a new proprietary prototyping algorithm, the ORamaVR software can populate new content with minimal changes. Repetitive actions performed in medical operations can be modeled to be used repeatedly throughout sessions with just seven proprietary VR design patterns, called Action Prototypes.

The SDK features an intuitive user interface (UI) that, when combined with VIVE HTC VR hardware, can be used to deploy almost any type of medical training solution. Because the UI is based on drag and drop technology, the need for cumbersome coding is eliminated and results in cost savings. Traditional VR medical training software that requires deep, complex code to design modules costs $10,000 per simulation minute over several months and large teams of developers and 3D designers,[4] compared to just a fraction of time and cost with ORamaVR MAGES SDK.

Working with the Best

ORamaVR's MAGES SDK utilizes Unity, the leading platform for content creation for virtual and augmented reality applications. Unity enables appropriate simulation rapid-prototyping tools so that the SDK can be successfully layered on top of the tools to provide the necessary medical-grade, high-precision training for ORamaVR customers and partners.

Unity's unique and versatile VR hardware abstraction layer also empowers ORamaVR to achieve quick and efficient deployment across the entire spectrum of HTC VIVE VR headsets. ORamaVR has chosen to deploy its solutions on HTC VIVE hardware because of HTC's enterprise scalability and support. VIVE Business Deployment allows enterprise users to centrally distribute an organization's own proprietary content and is compatible with the major MDM services. ORamaVR's medical customers have data privacy requirements, and the VIVE Business Platform provides ISO 27701-certified secure data management to meet industry standards. The ORamaVR "Covid-19 VR Strikes Back" free Covid-19



Swab testing and personal protective equipment training simulation is already available in the VIVE Business AppStore.

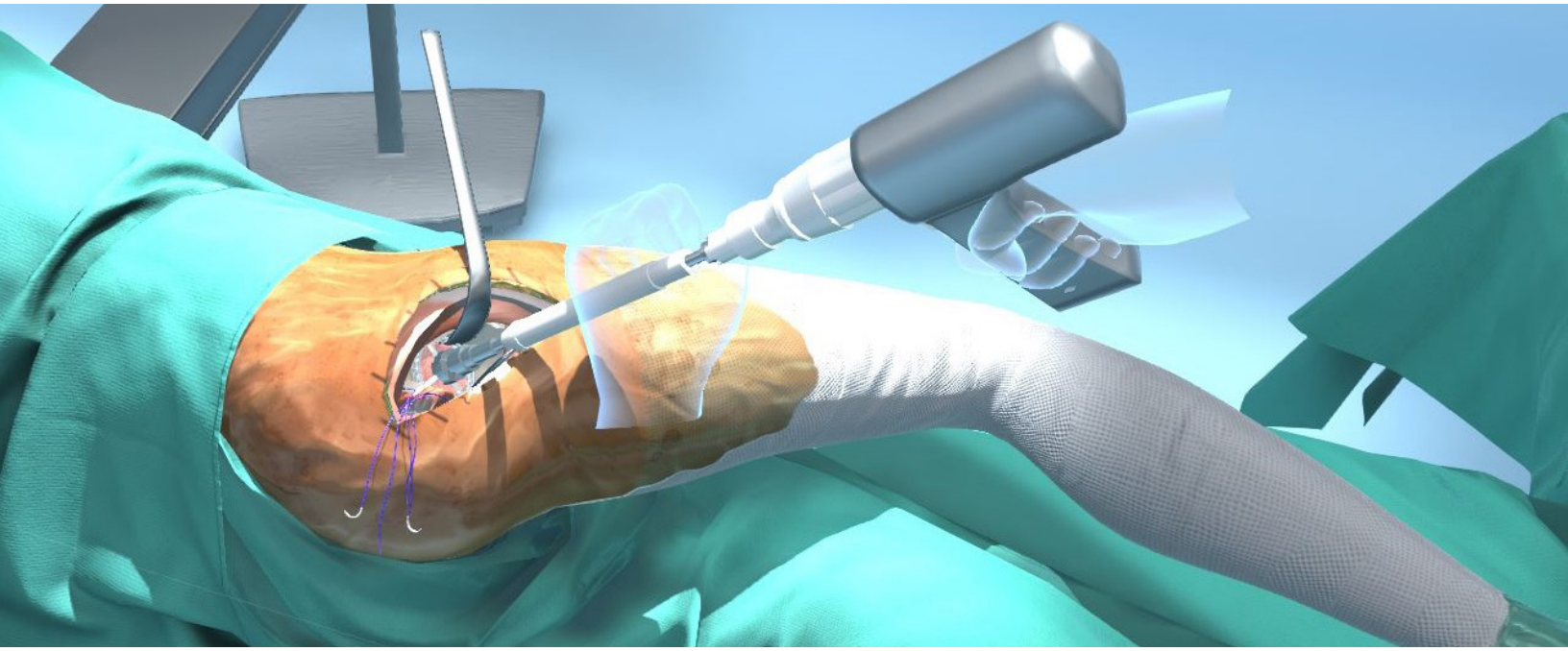
ORamaVR plans to leverage HTC VIVE's Pro Eye VR headset in a future software update, which features proprietary biometric and cognitive load tracking to sense factors such as a doctor's engagement, attention, and fatigue while working in the VR environment.

The right graphics processing units (GPUs) also are critical to ORamaVR's solutions, which is why the company works with NVIDIA as its GPU supplier of choice. ORamaVR prefers NVIDIA technology because of its stability, performance, and API availability. The company is using RTX GPUs throughout its entire development pipeline, from 3D asset creation to training the deep learning models for automated learning recommendations and assessment. It also is using NVIDIA GPUs for VR training in the HTC VIVE tethered head-mounted displays, when maximum visual fidelity is required.

The Awesome Power of Spatial Computing

Memory and knowledge are spatial. In the case of a learner pursuing medical training, this is why clinical rotations and live teaching classes are so important. Repeated hands-on experiences are necessary for a doctor, surgeon, or other essential workers to become proficient in healthcare processes. The positive effects are similar for VR, in that a trainee performing a procedure in a VR environment will remember it much better than if merely reading about it or observing. This is called autobiographical memory and is a very efficient process for coding and retrieval of knowledge.

When a trainee experiences a simulated ORamaVR environment using a VIVE HTC headset and hand controllers, his or her body moves naturally as if it was performing that event in the real world. This produces embodied cognition or the sense of presence. In less technical terms, it is proof of the old adage: learning is best done by doing.



Mel Slater, Distinguished Investigator at the University of Barcelona and a renowned researcher in neuroscience and VR, explains,

> *"VR enables doing, not simply observing. Doing engages the whole body in a multisensory way. And the more the body is engaged, the greater the chance of learning and retention."*

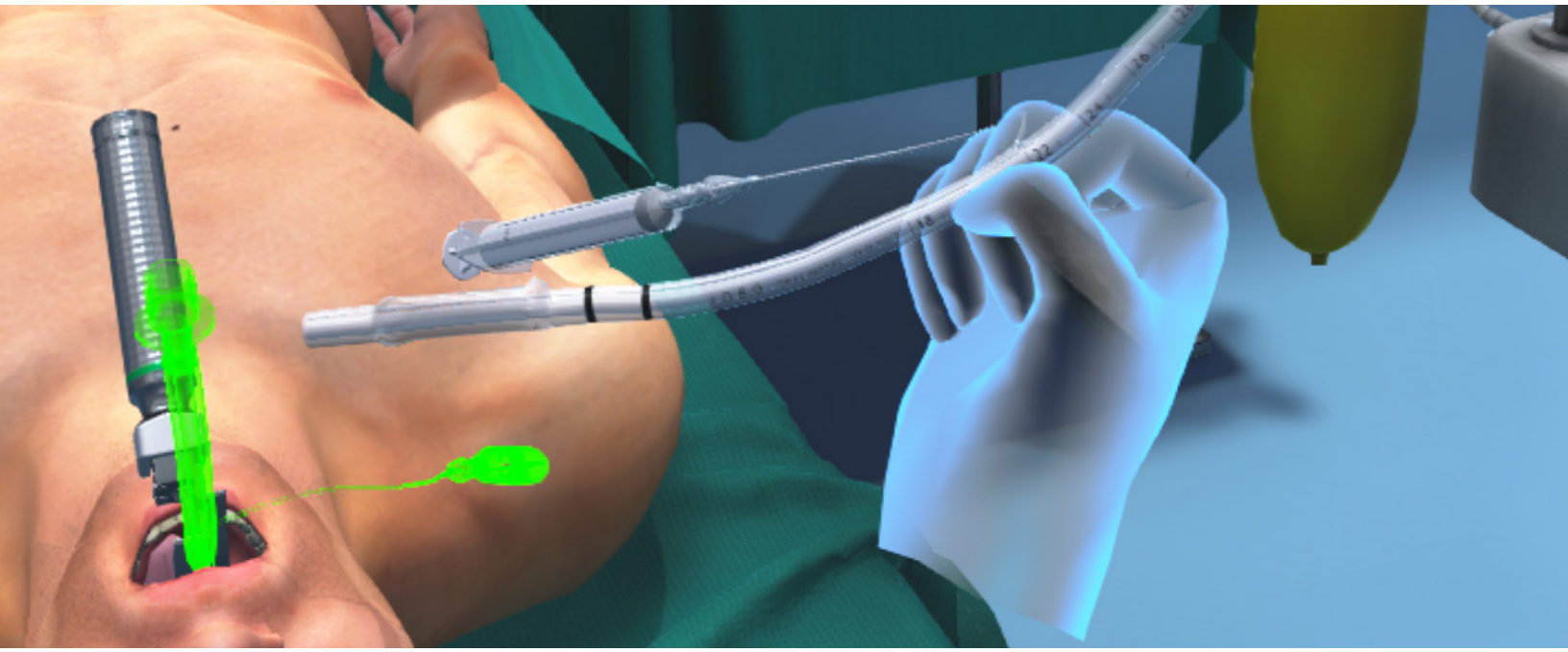
ORamaVR and HTC VIVE also enable healthcare professionals to perform collaborative operations in a virtual operating room. This cooperative system supports the simultaneous training of up to seven staff members within the same virtual space, thereby reducing both the time and cost required to train surgical staff.

In 2018, ORamaVR demonstrated the first international VR collaborative surgical training. Surgeons and medical residents from participating institutions – Stanford Medical School, the USC Keck School of Medicine, the New York University Langone Medical School, and the Aristotle University Medical School -- collaborated to perform a total hip arthroplasty operation with five of the participants located remotely.

The training session was real-world proof of the MAGES SDK and HTC VIVE headsets in delivering a truly collaborative, synchronized, and unconstrained multi-user interaction shared VR experience (MUVR). ORamaVR uses machine learning to provide each user a personalized learning experience, offering recommendations and assessments, as well as visual and audio cues to help the learner progress towards proficiency.

Professor Bill Macaulay of NYU said, "We anticipate that life-like immersive VR will facilitate and enhance the transfer of surgical skills to real-world surgical procedures, allowing for improved proficiency in the operating room."

Prof. Thomas Sauter from Inselspital, Bern added, "The collaboration with ORamaVR has helped us enormously within the "Virtual Reality Inselspital



Simulation Lab" (VISL) at the Emergency Telemedicine of the University Bern to really make our simulation center a success."

Empowering Medical Professionals

The abilities of users to perform rapid prototyping using the MAGES SDK and deploy exceptionally rich, complex, and highly interactive simulations has broad applications throughout the healthcare field. This includes orthopedics general surgery, trauma, ICU, pediatrics, obstetrics, nursing, and more. Leveraging economies of scale, the ORama Reality Lab has developed code-free software so that it can respond to customer requests by quickly bolting on new scripts and import new 3D models through existing builds.

Because VR enables trainees to gain experience in procedures in a realistic environment before picking up items like a needle or scalpel, ORamaVR helps to minimize errors by healthcare professionals. ORamaVR also can solve problems that result from the use of cadaver models to train surgeons. Cadavers increase the cost of training and limit the number of training sessions per surgeon. With VR, training institutions need fewer cadavers and less time to train multiple surgeons because of the ability to collaborate with up to multiple remote users simultaneously.

The tools ORamaVR has built are designed to streamline the creation of VR training programs. The mission now is to democratize this power to enable users to be able to build complex advanced and highly interactive training simulations at scale – and to deploy these creations where they are needed most to prepare healthcare professionals for the future. Through these efforts, we can help to close the gap to doubling the current medical workforce by 2030.

[1] Kamineni, Shobana. "5 Ways to Bridge the Global Health Worker Shortage." World Economic Forum, 15 July 2019, www.weforum.org/agenda/2019/07/5-ways-to-bridge-the-global-health-worker-shortage/.
[2] Global Strategy on Human Resources for Health: Workforce 2030. World Health Organization, www.who.int/hrh/resources/global_strategy_workforce2030_14_print.pdf.
[3] The number of users that can be accommodated will depend on the type of network and interactivity of users.
[4] Fade, Lorne. "VR & AR Application Development Costs Explained." VR Vision Group, 27 Aug. 2019, vrvisiongroup.com/vr-ar-application-development-costs-explained/.

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