Virtual & Augmented Reality Technology in Computer Games

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With the release of first prototypes of Oculus VR in 2012 and Samsung Gear VR and HTC Vive in 2015 equipped with the hand controllers and tracking technology, the new age of virtual reality has started. Global revenues of Virtual Reality in the gaming industry reached $4.3 billion by the end of 2015. In 2016, there were 230 VR development companies, producing both virtual reality hardware and software. VR has become more mobile than ever and still holds great potential for indie game development.

Aligned with these developments, there were over 100 independent video games or indie games released for PC & consoles in 2016, in addition to others released for mobile platforms. We all know that indie games, are commonly created by individual or small teams of video game developers and usually without significant financial support of a video game publisher or other outside source. So, it is a more communal but still individual economy model, similar to emerging shared economy models.

Combining the advances in VR headsets, and the rise of indie games development, the Virtual Reality gaming industry has already won significant market size. As an award winning example of indie game development, we can list Minecraft, a 2011 sandbox video game that has also been used in educational environments (with *Minecraft Education Edition*). In a relatively short time since Mojang's Minecraft first entered the scene, it has sold over 4.5 million copies. By late 2018, over 154 million copies had been sold across all platforms, making it the second best-selling video game of all time, behind *Tetris*. By mid-2018, the game had 91 million monthly active players. Microsoft and Mojang partnered with Oculus in 2016. We have seen many different versions of Minecraft, such as PS4 VR, Vivecraft for HTC Vive, and The Rift version with Oculus Touch. They even talk about running a Mixed Reality version for Hololens.

Another example is Pokémon Go by Niantic, an augmented reality (AR) mobile game released in 2016. It was one of the most used and profitable mobile apps, having been downloaded more than 500 million times in 2016 and 800 million times in mid 2018 worldwide. It was launched with 150 species of Pokémon, which had increased to over 420 by late 2018. It was given credit for making location-based AR technology popular, promoting physical activity, and helping local businesses grow due to increased foot traffic. It has 147 million monthly active users and grossed $2.01 billion worldwide in 2018.

In summary, Virtual Reality in Games shows fast growth rate and hold the potential to become the next "big thing" in gaming. Experts predict 25-27% annual growth rate in VR gaming market, with total revenue exceeding $45 billion in 2025. This forecast of growth is based on the current three major VR game market trends: First, hardware production leaders like Oculus, HTC, Sony, Google are tending to develop more mobile and affordable VR headsets; second, new innovative technologies in VR headsets, which provide the freedom of movement and recreation of 5 senses, are likely to define the growth of VR content; third, Nintendo, Microsoft, and Sony are predicted to reduce the price of VR game products in the next few years.

On the other hand, VR games try to introduce immersive experience such as 360-degree video content and dense graphics to provide the feeling of presence, a novel level of interaction with the release of new controllers addressing all human senses, and creative content. VR technology is becoming a new boosting factor in creating gaming content. Genres like shooters, adventures or simulations, got enhanced due to VR. Each of the existing headset vendors is still working on improvements. The aim

is to make headsets lightweight, ergonomic, mobile and more immersive. The challenges that still remain unsolved with VR hardware are: Mobility, Freedom of movement, 5G Internet speed, Quality content and Data security.

Today, due to the variety of VR headsets, new games and new content are emerging regularly. Both high-end and mobile games are pushing the boundaries of VR even further. Engineers focus on bringing smell, taste and tactile senses into VR, alongside hearing and sight. If these attempts are successful, it will surely turn the world upside down. In near future, we may expect to see full body suits that are likely to offer tactile feedback, pressure and weight simulation, temperature changing senses and novel motion tracking systems, such as omni-directional treadmills.

VR game libraries, like PlayStation or SteamVR provide hundreds of games today. When VR technology overcomes the problem of movement for players and addresses all five senses we have, virtual reality in gaming could become as powerful as the real world gaming. In fact, the further development of the VR industry will determine the direction of the indie games market in future.

Industry survey results state that startup founders, tech executives, investors, and consultants expect gaming to attract the most investment for the coming year. More social and collaborative applications of VR and AR are expected to appear as well as smartphone applications. High prices, overhyped hardware, and lack of compelling content are seen as the biggest missed opportunities in this domain. Number of headsets sold are expected to increase. AR market is predicted to be four times bigger than VR, due to its accessibility. The top unsolved problems include comfortable locomotion, light and inexpensive headsets, as well as quality content. Other major challenges are the lack of skills due to the fast pace of technology and being up to date with the practical skills, low number of domain experts in VR, the number of start up funds and the size of grants, as well as mindset of corporates.

Solutions I suggest to overcome these challenges are university and vocational education courses focusing on VR and AR content development, collaboration and close-knit partnerships to build learning communities, novel subscription models for sharing infrastructure and expertise to boost indie game development, better and easier access to large funding, easy to use VR and AR libraries and toolkits, and encouraging the corporates to take risks for long term benefits rather than short term rewards. I also recommend to build an Asia-Pacific version of Silicon Valley across boundaries and a large international VR and AR Training Center to transfer knowledge and to drive innovations and industry access to talent. In China, there are noteworthy attempts toward this direction with the establishment of a techno park in Shijahuang specially for Animation, Games, Comics. With the inclusion of Taiwan, Korea, Japan, and Australia, it is possible to build strong partnerships in software and hardware technology to support this area.

Last but not the least, I would like to thank you all for being here with me in this space and time. Future has not been written yet, but I am excited to be here together to design the future using VR & AR technology.