VR in Gaming

Who, What, Why, Where and When?

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What is VR?

Virtual Reality (VR) experiences are typified by wearing a Head Mounted Display (HMD) and headphones to close off your perception of the real world and instead take part in an entirely different world. The main challenges are:

- For the hardware/software: To have fast enough processing and low enough latency to produce a believable output image in reaction to the user's head movements.
- For the player: In many cases, cost of entry for the relevant hardware.
- For the content creator: To make fun, novel content that deals with new input/output mechanics and doesn't make the player motion sick.

In contrast, Augmented Reality (AR) is about adding content to the real world. A user of a navigation app that implemented AR may, for example, see direction arrows on the sidewalk in front of them as they are walking. The main challenges are:

- For the hardware/software: Which display is a user going to use? Their phone screen and camera, an AR headset, (such as Meta or Hololens,) or something else? How does the application understand its environment in order to augment it, (often referring to Simultaneous Localization and Mapping or SLAM engineering.)
- For the player: Few options for AR devices and content.
- For the content creator: To make fun, novel content.

Both VR and AR can open up new experiences to users beyond gaming, with AR in particular expected to become a very large industry with only a small minority thought to be related to gaming. With that said, this document will focus on VR and the large gaming segment within that industry.

Where can I "VR"?

Mobile

Recent smartphones can be used for basic VR experiences. In most instances this involves limited input controls, (e.g. 1 button,) and limited movement detected, (head rotation only.) This can be a very cheap entry point into certain kinds of VR content though, assuming you have the phone already.

PC

Higher fidelity experiences than mobile, offering “room-scale” movement, with leaning, jumping, ducking, crawling, stepping, etc. Also provides hand tracking through motion controllers, with several other peripherals available too, such as walking platforms.
Also powers experiences such as VR Arcades, such as “The Void”, which can involve PC backpacks to help remove the issue of being tethered by a cable to a fixed point, (i.e. the HDMI cable from your HMD to your PC,) or other apparatus you can feel to heighten the immersion, (e.g. a wooden plank on the floor, where in VR you are balancing on the edge of a building at “VR Zone: Project I Can.”)

Console

So far only Sony, with their PlayStation 4, have announced VR accessories and they will be released in 2016. Having a fixed platform to target makes development easier than on PC. There may also be a larger install base of capable consoles than capable PC’s today. A console may be more likely to be in the living room, with some space, when compared to a PC on a desk in a bedroom or office, although Sony are mostly recommending seated experiences today, in part because of the tether.

Who is involved?

- HTC
    - Partnered with Valve on SteamVR.
    - Building the Vive HMD and tracked controllers for use on PC
    - Allows for room-scale movement, which requires at least 6.5ft x 5ft of playable space.
    - $799 for HMD & controllers, shipping now. Requires a high-end PC, approx. $1500+.
    - https://www.htcvive.com/us/
- Valve
    - Partnered with HTC on the Vive.
    - Have enabled the Steam client to work in VR so a player can launch their games and use their desktop within a VR environment, (i.e. not needing to take the headset off.)
    - Have developed several VR demos, such as Robot Repair Facility and The Lab.
    - Steam also sells games that work with Oculus Rift, it isn’t exclusively tied to Vive. You can filter searches on the store for either or both HMDs.
    - https://steamcommunity.com/steamvr
- Oculus (Facebook)
    - Oculus Rift was a Kickstarter project for a PC VR HMD that was later acquired by Facebook.
    - Ships with an Xbox One controller. Tracked controllers coming later this year.

    - Focused more on seated experiences, not really setup for room-scale.
    - Oculus provide their own VR store app, but you can use the HMD with external content too.
    - $599 for HMD. Touch controllers release date and pricing TBA. Requires a high-end PC, approx. $1500+.
    - https://www.oculus.com/en-us/rift/
    - Also partnered with Samsung on a mobile HMD.
- Samsung
    - GearVR requires a modern Samsung Galaxy phone, (e.g. S6, S7, Note 5,) to be placed into a HMD shell.
    - HMD adds some buttons on the side and extra motion sensors for added tracking fidelity. You could also pair a bluetooth gamepad with your phone for additional input.
    - Other accessories available from Samsung including a 360 camera.
    - Lower quality experience than other HMD's, but better than a Google Cardboard.
    - Samsung provide their own Gear VR Hub app.
    - $99 to buy, but has also been given away to people that preorder/buy the phones early or in other promotions. Additional cost for the phone.
    - http://www.samsung.com/global/galaxy/wearables/gear-vr/
- Razer
    - Started the Open Source Virtual Reality, (OSVR,) initiative.
    - An ecosystem designed to define standards for output devices, (e.g. HMDs,) and input devices, (e.g. controllers,) so that they can all work through a common SDK making game development simpler.
    - They sell a devkit headset today for $299, but the plans are open source so you can build your own. Requires a high-end PC, approx. $1500+.
    - http://www.razerzone.com/osvr
- Google
    - Cardboard is an open source standard for building VR headsets that you insert a mobile phone into. Works with iOS and Android devices.
    - They are literally made of cardboard and are very cheap or given away for free as promotional items. Others have produced more premium versions made of plastic or metal, such as the Mattel ViewMaster, with tweaks to the design like folding flatter when not in use. Of course you could also build your own.
    - Unlike the others, this one has no strap so you hold it to your face when you want to use it. This positions it more for "snack sized" content, like other mobile apps. It cleverly sidesteps issues of having to track the player's hands in the VR world though since they are by your head, somewhat restricting your movement. Input is limited with a single button on the device.
    - Available now, from free upwards. If you pay over $20 you've probably paid too much. Additional cost for the phone.
    - https://www.google.com/get/cardboard/
    - Also have several AR technologies, including Tango and investment in Magic Leap.

    - At Google I/O 2016 the company announced Daydream, with products launching in Fall 2016. This is mostly a collection of new open standards developed to promote VR on Android, which includes:
        - Android phone spec to be a “Daydream ready” device, meaning it can deliver a great VR experience with the relevant sensors and such.
        - A headset reference design, which seem similar to GearVR.
        - A controller reference design, which seems similar to the Oculus Remote with added Wiimote-style gyroscopes.
        - VR mode in Android N. That means concentrating on performance but also system UI for things like alerts and notifications.
        - Daydream Home as a hub for VR content, with the Google Play store also supporting VR.
        - Updates to existing Google apps to work in VR and support 2D & VR content including Movies, Streetview, Photos and YouTube.
- Sony
    - PSVR is launching in October 2016 as an accessory for the PS4, (and the rumoured PS4.5.) Preorders available now.
    - Uses the existing PS4 Camera plus optional PS Move controllers that were released for the PS3 for input.
    - Offers a local multiplayer experience by having the TV be a “social screen,” displaying another image for others on your couch to play.
    - HMD is $399, Camera is approx. $50, pair of optional move controllers is approx. $50, console is $350.

There are also some others developing VR HMD’s, inculding Starbreeze’s StarVR, (http://www.starvr.com/,) and various others coming from China, (http://www.aliexpress.com/popular/vr-headset.html,) plus many creating peripherals that can be useful in VR, such as Leap Motion, (https://www.leapmotion.com/product/vr.)

When is this happening?

Mobile VR has been available for about 2 years, with millions of units available. Cardboard is expected to hold around a third of the VR HMD install base in 2016. GearVR is a more recent addition but could add another 20% to the mobile VR install base. Daydream has only recently been announced, so the impact is yet to be estimated.

PC VR is launching for consumers right now. The Oculus Rift and HTC Vive both started shipping in March/April 2016 with preorders backed ordered through to Summer. Combined they are estimated to have around 15% of the VR install base.

Console VR, through PS4, is launching before the holidays in 2016 but has a larger market to target than PC. There are already around 35 million PS4’s sold so their market share could be 20% of the VR HMD market.

Why should we care?

Analysts predict that the VR market is going to explode into 2020. Up to now it has really only been driven by mobile, but we have the major PC HMD's launching now and PSVR later in 2016. Lower end market estimates:

- VR industry $5B in 2016, growing to $30B in 2020
    - 25% for VR games software means >$1B in 2016 to $7.5B in 2020
- 2016 install base:
    - Mobile: GearVR 9M, Cardboard already 5M from Google alone
    - PC: Oculus/HTC 300K consumer units (approx 10% attach rate to gaming PCs) + 200K for developers and media
    - Console: PSVR ~4M (approx 10% attach rate to PS4 sales)
- 2020 install base:
    - Expected to double each year, meaning:
    - PC: Oculus/HTC ~6-7M (assuming sales double from 300K each year)
    - Console: PSVR ~10.4M (assuming PS4 sales stay consistent at ~16M each year, means 1.6M PSVR per year at 10% attach)
- Consensus is that the AR industry will be much larger overall, but will come later and would not be driven by games but various other sectors such as military, medical and manufacturing.

So what does that mean?

- Early market should be affluent by virtue of buying into this ecosystem.
- Players will want more content and experiences to try, particularly early on, to validate their purchase.
- Likely to buy digital for instant gratification. We should make that easy for them.

Combining these points means that presenting an interesting destination in VR for players to try gives us a great opportunity to put a store in front of them to upsell content.

Bonus: How can I make VR content?

- 360 photos and video using special cameras/rigs or rendering from virtual environments. This content is not necessarily stereoscopic so may not have depth.
    - http://www.google.com/get/cardboard/jump/
    - https://theta360.com/en/
    - http://www.samsung.com/global/galaxy/gear-360/
- Light field images or video using another type of camera/rig, which allows for viewer movement beyond just tilting your head.

    - https://www.lytro.com/immerge
- 3D environments from Game engines such as Unity & Unreal.
    - https://unity3d.com/learn/tutorials/topics/virtual-reality
    - https://www.unrealengine.com/vr-page
- Add support to your own custom game engines, (e.g. Frostbite,) using SDKs from Oculus, Steam, Sony, Google, Razer, etc.
- Build for the web with WebVR, WebGL, A-Frame, Three.js and more.
    - Only really supported in special builds of browsers, but can polyfill to add support in older browsers and degrade to a non-VR 3D scene on your phone or PC, for example.
    - http://mozvr.com/

Assuming you are making a PC game, you would probably use Unity with a SteamVR plugin or some other engine with the OpenVR SDK. Once done you would publish on Steam. For a little more information on what this gets you:

- https://partner.steamgames.com/documentation/steamvr
- Steamworks is still available as a separate set of services for matchmaking, etc.
- The OpenVR SDK or SteamVR Unity plugin help add support for running Steam in VR.
- There is a System button on the controllers that work like the Xbox Guide button, which brings up a simple VR HUD world, (by default it is a grey world with a grid, but it is possible to choose other environments, such as one based on a recent game called Rocket League,) with the Steam client shown in a floating window running in big picture mode. From that you can browse the web, browse and buy through the store, boot other games, (including in VR theatre mode, or mixed VR such as DotA2,) etc.
    - http://www.tomshardware.com/news/steamvr-interface-customization-options,31350.html
    - https://www.youtube.com/watch?v=uFs4wWjLaas
- Your game can also optionally add tabs to that dashboard with your own content.
- Use of SteamVR is optional and you can flag your game as such when publishing on Steam, e.g if you use Oculus SDK directly.

Further Reading

1. (2015) Augmented/Virtual Reality to hit $150 billion disrupting mobile by 2020 - http://www.digi-capital.com/news/2015/04/augmentedvirtual-reality-to-hit-150-billion-disrupting-mobile-by-2020/#.Vvqv1aQrKhf
    a. (Update Jan 2016) Augmented/Virtual Reality revenue forecast revised to hit $120 billion by 2020 - http://www.digi-capital.com/news/2016/01/augmentedvirtual-reality-revenue-forecast-revised-to-hit-120-billion-by-2020/#.Vvr8hqQrKhc
    b. http://techcrunch.com/2016/04/05/the-reality-of-arvr-business-models/
2. (2014) Virtual Reality Market worth $15.89 Billion by 2020 - http://www.marketsandmarkets.com/PressReleases/ar-market.asp

3. (Dec 2015) Virtual Reality Could Generate $70 Billion in Real Money by 2020 - http://recode.net/2015/12/03/virtual-reality-market-seen-actually-generating-70-billion-by-2020/, http://press.trendforce.com/press/20151204-2210.html
4. (May 2014) Consumer Virtual Reality market worth $5.2bn by 2018 - http://www.kzero.co.uk/blog/consumer-virtual-reality-market-worth-13bn-2018/, https://www.linkedin.com/pulse/virtual-reality-whats-vr-market-size-frank-ravanelli-, http://www.prweb.com/releases/2014/05/prweb11834457.htm
5. (Mar 2016) Reality or Delusion? The VR Sales Numbers You Can Count On - http://www.gamasutra.com/blogs/NeilSchneider/20160301/266662/Reality_or_Delusion_The_VR_Sales_Numbers_You_Can_Count_On.php
6. (Jan 2016) Google shipped 5M Cardboad units - http://phys.org/news/2016-01-google-cardboard-shipped-million-virtual.html
7. (Jan 2016) Goldman Sachs predicts boom of VR - http://www.vrrebels.com/goldman-sachs-predicts-vr-ar-boom/
8. (Nov 2015) Console sales breakdown - http://arstechnica.com/gaming/2015/11/analysis-sony-continues-to-widen-its-console-sales-lead-over-microsoft/
9. (Oct 2015) VR Headset Market Share - http://www.investors.com/news/technology/click/fb-sne-googl-vying-for-virtual-reality-vr-market-share/