COMPARISON OF DIFFERENT AR AND VR PLATFORMS, THEIR ADVANTAGES AND DISADVANTAGES

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What is meant by Virtual Reality and Augmented Reality?

1. **Virtual Reality (VR):**

   Virtual Reality replaces a person's field of view completely by a virtual world. The perception of a virtual world may be further reinforced by using stereoscopic images, surround sound, haptic feedback and motion tracking.

   Examples: Oculus Rift, HTC Vive, Gear VR, PlayStation VR, Google Cardboard, 360^0 videos

2. **Augmented Reality (AR):**

   Augmented Reality supplements the real world with virtual objects or data. The augmented object can be either locked to your display, like a hovering notification, or positioned in the real world with the help of real-world objects as reference.

   Examples: Microsoft HoloLens, Google Glass, Smartphone AR apps

Experience using the different VR and AR platforms

1. **Smartphone/tablet AR**

   Smartphone AR apps, like Quiver and Spacecraft 3D, used a real-world object as a marker to identify the virtual object(s) to be shown and to determine the size and positioning of the object(s). The distance of the marker from the smartphone is used to determine the scale of the 3D object. Likewise, the orientation of the marker can be used to track user movement around the marker.

   Advantages:
   - *i. Suitable for small-scale interactive experiences*
   - *ii. Hardware is cheap and does not require additional setup*
   - *iii. Most people already have access to compatible hardware*

   Disadvantages:
   - *i. Marker needs to be "known" to the app*
   - ii. *Quality of experience is sub-par, especially when the marker becomes indistinguishable or goes out of view (of the camera)*

2. **Smartphone/tablet 360^0 videos**

   Smartphone 360^0 video apps, like NytVR, use the gyroscope sensor to render the part of 360^0 video that the user wants to look at.

   Advantages:
   - *i. User gets full control over the direction that she wants to look at in a video*
   - *ii. Hardware is cheap and does not require additional setup*
   - *iii. Most people already have access to compatible hardware*

   Disadvantages:
   - *i. Video viewing experience is not immersive*
   - *ii. Cannot view stereoscopic videos*
   - iii. *At times, following the narrator becomes difficult since the user is not always viewing the subject mentioned in the narrative*

3. **Google Cardboard**

Google cardboard allows you to experience VR using your smartphone without shelling out a ton of money. The smartphone is placed at an optimal distance and displays two images, one for each eye, to allow for a stereoscopic experience. The accelerometer and the gyroscope are used to track user movement and orientation, while the magnetometer is used to track the movement of a magnetic button to record a "click".

Advantages:

i. *Provides an immersive VR experience*
ii. *Can be used to view stereoscopic 360^0 videos*
iii. *Additional hardware is easy to assemble*
iv. *Very cheap as compared to other VR headsets*

Disadvantages:

i. *Quality of VR experience varies across smartphones due to the difference in performance, display resolution, and availability of required sensors*
ii. *Large-scale VR experiences not possible due to hardware limitations of smartphones*

4. **HTC Vive**

HTC Vive is a "room-scale" VR setup that allows you to walk around in the VR space. It uses a set of 4 infra-red lights to project a grid, thereby marking the boundaries of the VR room. This grid is used by the cameras and sensors built into the Vive VR headset and controllers to track user movement around the room. The controllers allow the user to navigate the virtual world and interact with it.

Advantages:

i. *Suitable for room-scale immersive VR experiences and playing VR games*
ii. *The user can easily navigate and interact with the virtual world with the help of hand-held controllers*
iii. *Compatible speakers can be plugged into the VR headset to provide immersive sound experience*
iv. *Quality of VR experience is way better than cheaper alternatives like Google Cardboard*

Disadvantages:

i. *VR headset is costly*
ii. *Requires a powerful (and expensive) computer to power the headset*
iii. *Needs the infra-red cameras to be set up properly in the room for it to work effectively*
iv. *Requires wires extending from the headset to the computer which can be inconvenient at times*

5. **Microsoft HoloLens**

HoloLens is an augmented reality headset with a built-in computer that generates multi-dimensional holograms. It utilizes an array of cameras and sensors to map the user's environment (room) and allows the user to place holograms around the room (visible only to the user). It uses a set of microphones and in-built speakers to listen to voice commands and deliver immersive spatial sound.

Advantages:

i. *Does not require an additional computer to power itself*
ii. *Wireless operation*
iii. *User can interact using hand gestures and voice commands*
iv. *Understands user's environment for object placement instead of using markers*

Disadvantages:

i. *Expensive*
ii. *Narrow field of view – requires the user to move her head around to view the complete hologram*
iii. *Holograms visible only to the person wearing the headset – no multi-user collaboration*

6. **CAVE2**

CAVE2 is a hybrid-reality environment. It uses an 18x4 matrix of displays arranged in an elliptical manner, to provide the users with an immersive experience without the need of wearing a headset.

Each display is powered by a dedicated node (slave) and the master node controls the entire matrix. User-movement is tracked by using a series of infra-red lights, cameras, and wearable markers; users can interact and control the system using controllers and mobile apps.

Advantages:

i. *Immersive stereoscopic AR/VR experience*
ii. *Multiple users can view virtual objects at the same time for improved collaboration*
iii. *No need to wear special headsets – a pair of passive 3D glasses is enough*

Disadvantages:

v. *Does not allow 360^0 experience due to lack of displays on floor and ceiling*
vi. *Not portable – setup is fixed in a room*
vii. *Needs a lot of computing power - very expensive to build and maintain*

References:

Patrick Catanzariti's answer to "What is the difference between virtual reality, augmented reality and virtual reality?" on Quora

Kunal Modhe's answer to "What is the use of gyroscope, accelerometer, proximity sensor and compass in the smartphones? Why is it important for the user?" on Quora

"Google Cardboard: Everything you need to know" by JT Ripton – TechRadar

"Everything you need to know about HTC Vive" by Russell Holly – VR Heads

"What is HoloLens? Microsoft's holographic headset explained" by Joe Roberts – Trusted Reviews