Spatial Tech

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@pandastichuman

An overview of XR Technologies

Who am I ?

- Human Computer Interaction Researcher at IIIT Hyderabad
- Associate Research Staff - Nvidia Research
- Ex- Global Co- Chair for (WebXR) Industry Committee at VRAR Association
- OSS Developer for WebVR APi and WebVR 2.0 at Mozilla..

Talk Rules 101:

No rules though (duh!)]

PS: For questions

Wait till the end
OR
Tweet @pandastichuman

Use #GITS and #VRpanda

Intro Module

Overview

Realities

Hardware

Engineering Design

VR/AR/MR

Learning Curves

XR Spectrum

Physics of VR/AR scene production

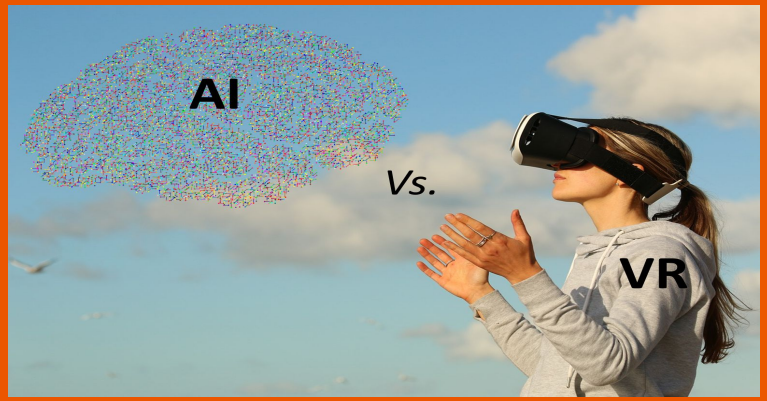
What I am excited about in 2019 ?

XR Projects

Data Visualisation

Augmented Reality and Computer Vision

Artificial Intelligence in VR




Understanding Reality Spectrum

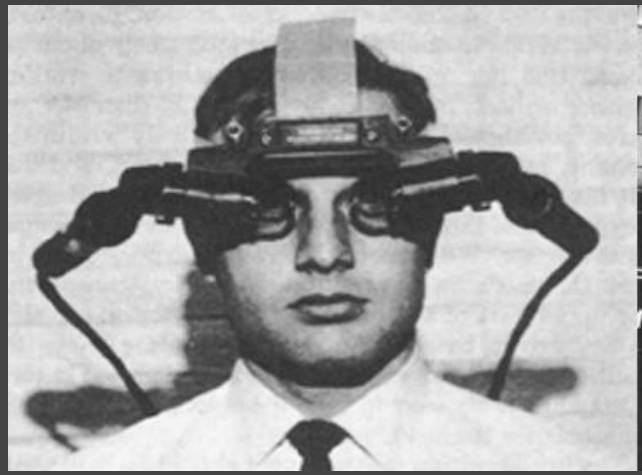
History lesson time ;P

Where it all started?

1950, Morton H Eilig built a single console Sensorama, **for watching TV in 3D.**

More history lessons ;P

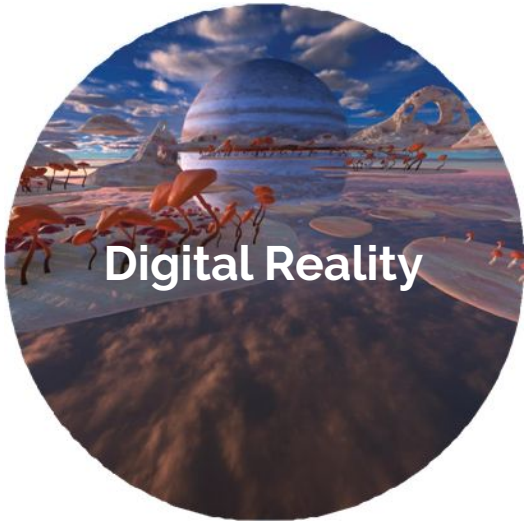
How it continued?



1961, Philco Corporation built first HMD called Headsight.

Realities, like literally!

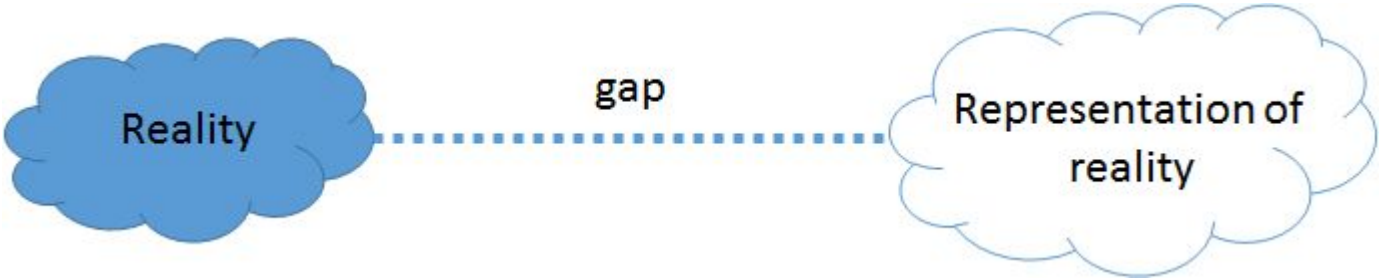
The state of things as they "actually exist" through our human senses without any technology.



Artificially created sensory experiences of people, environments and objects, which can include sight, touch, hearing, and smell.

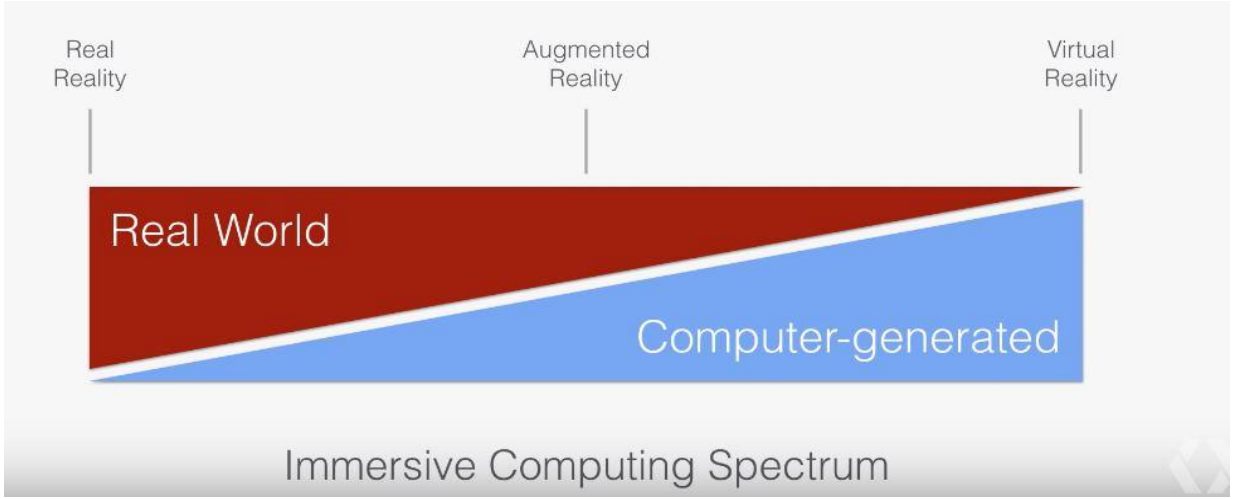
The Immersive Spectrum

The Fallacy:



The Truth:

The VR/AR Spectrum



Virtual Reality:

- Immersion into in another world
- Usually uses a headset and mobile device
- Does not interact with the real world
- Experiential Information

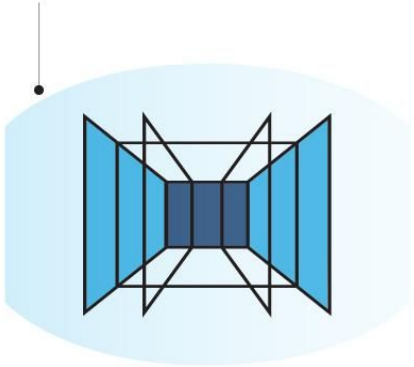
Augmented Reality:

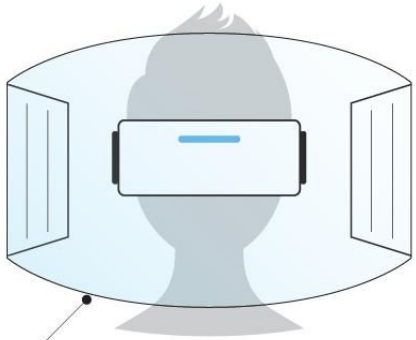
- Overlay of objects in world around you
- Use of a phone or viewing device
- Usually uses target image

Task: Which among the upcoming slides contains an example of VR/AR/MR?

VIRTUAL REALITY (VR)

Completely digital environment

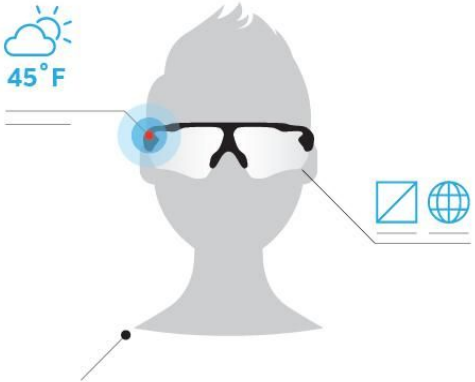




Fully enclosed, synthetic experience with no sense of the real world.

AUGMENTED REALITY (AR)

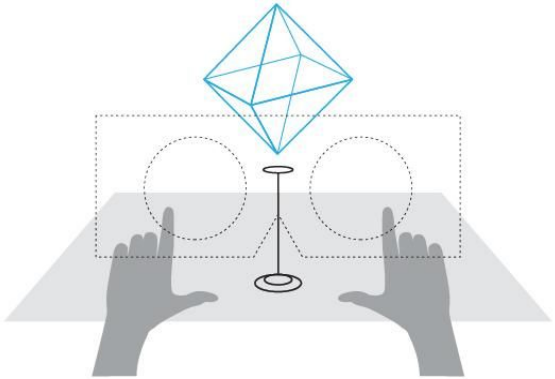
Real world with digital information overlay

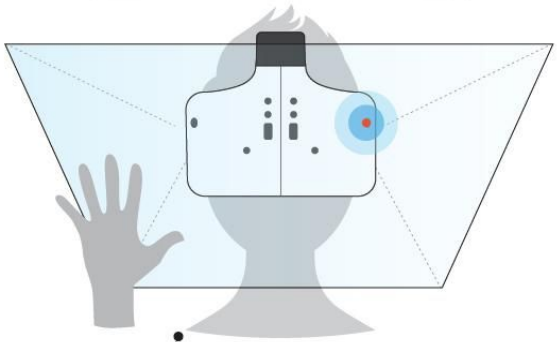


Real world remains central to the experience, enhanced by virtual details.

MERGED REALITY (MR)

Real and the virtual are intertwined





Interaction with and manipulation of both the physical and virtual environment.

DIFFERENCES

AR
(AUGMENTED REALITY)

Features

AR stands for augmented reality which is a way in which you can get an indirect view of a real life scenario or environment in a supplemented way by use of digital technology. Sound graphics and other sensory input can help to make the experience more realistic.

Platform

It can be used to interact with the real world to help make suggestions of improvement, such as recipe ideas based on real ingredients laid out before the camera.

Headset

A headset is able to enhance the experience further, for example by adding characters in a game that are able to talk and make suggestions, immersing you only partially, to give you the feel of realism. Augmented reality can be best described as a real life overlay rather than a thorough digital and sensory experience that takes you away from it.

MR
(MIXED REALITY)

Features

MR stands for mixed reality which brings the digital world and the real world together to provide you with a totally new experience. Rather than just being added to the real world, the experiences are interactive to a point where they can be used in many applications. Characters and scenarios can be mixed with the real world surroundings.

Platform

Mixed reality allows you to get a better sense of realism, as the digital scenarios take place in the real world surroundings. This can be used in training and in gaming technology.

Headset

Using a headset allows for a better sense of realism, however, in mixed reality not all scenarios would be suitable for headset use, e.g. if you still wish to interact with others who are physically present. It can, however, allow other people using the mixed reality to interact on a shared level.

VR
(VIRTUAL REALITY)

Features

To enhance the experience and make virtual reality exciting, headsets and cameras are often used to block out the real world. It's a totally immersive experience allowing you to interact with a totally different world.

Platform

VR has already been used to help with training medical staff and military as well as in gaming, to give an experience on a totally different level. Recently, virtual reality has stepped up to the next level offering users a more realistic experience allowing for a complete immersion.

Headset

By using a headset people are able to walk around their own surroundings and yet feel as if they were in a totally different reality. They can interact with other users in games and digital characters without an interruption from the outside world.

DIFFERENCES

Virtual Reality isn't the real world but instead a simulation that draws the user into the virtual reality.

Augmented Reality is parts of the real world being overlapped so that you are able to use parts of both unlike MR which is mixed reality rather than an overlap.

Mixed Reality uses the technology of the digital world to enable it to coincide with the real world.

Hardware in Market

Google
Daydream

Samsung
Gear VR

Oculus
Rift

Sony
Playstation VR

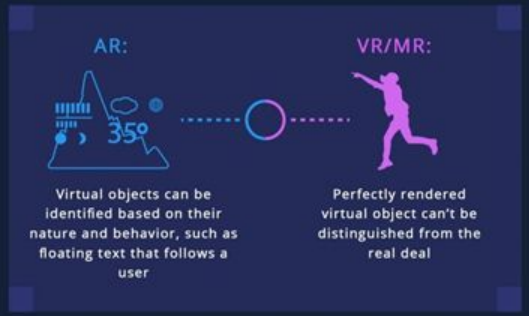
HTC / Valve
Vive

VR & AR IN LEARNING

SOME INTERESTING FACTS

DISPLAY DEVICES

AWARENESS



ENVIRONMENT

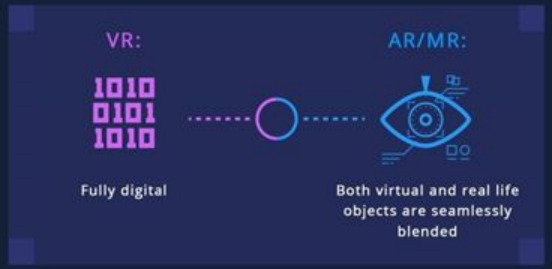
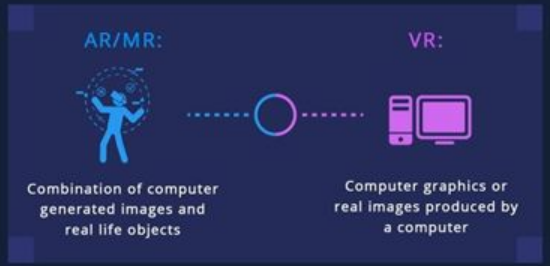
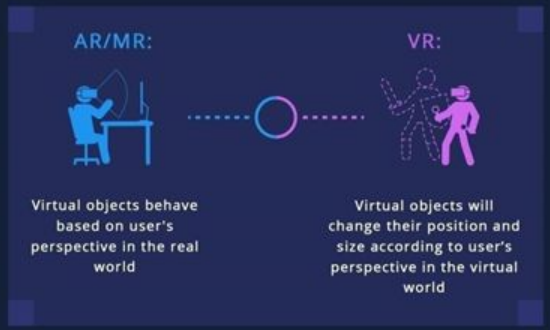


IMAGE SOURCE

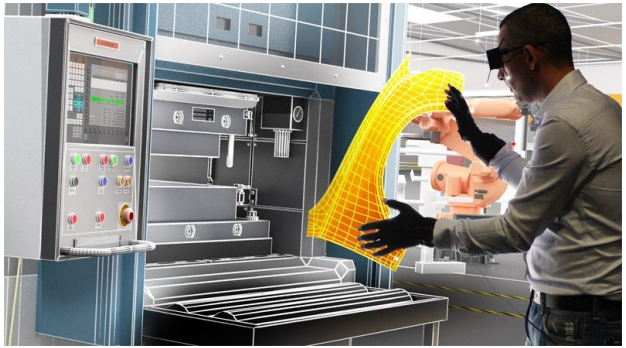


PERSPECTIVE



PRESENCE

VR, AR, MR popular applications



13 PLACES WHERE VR IS GETTING REAL

A handful of companies are integrating it into work, while a growing number use it to sell.

Ford designers and engineers use VR to test elements of new cars, saving some $8 million in one year. **Audi** is outfitting dealers with VR kits that will enable customers to configure and customize vehicles.

Surgeons at **UCLA** are using Surgical Theater's medical VR technology and Oculus Rift headsets to test-run highly technical and sensitive surgeries before they operate.

Airbus uses it to demo planes for customers; it patented a helmet that passengers may one day use for entertainment. **BAE Systems'** VR enables engineers and sailors to "walk through" warships during design.

Carnival developed a promotion to give shoppers at some AT&T stores the chance to use Samsung VR equipment to virtually explore its cruise ships and vacation destinations.

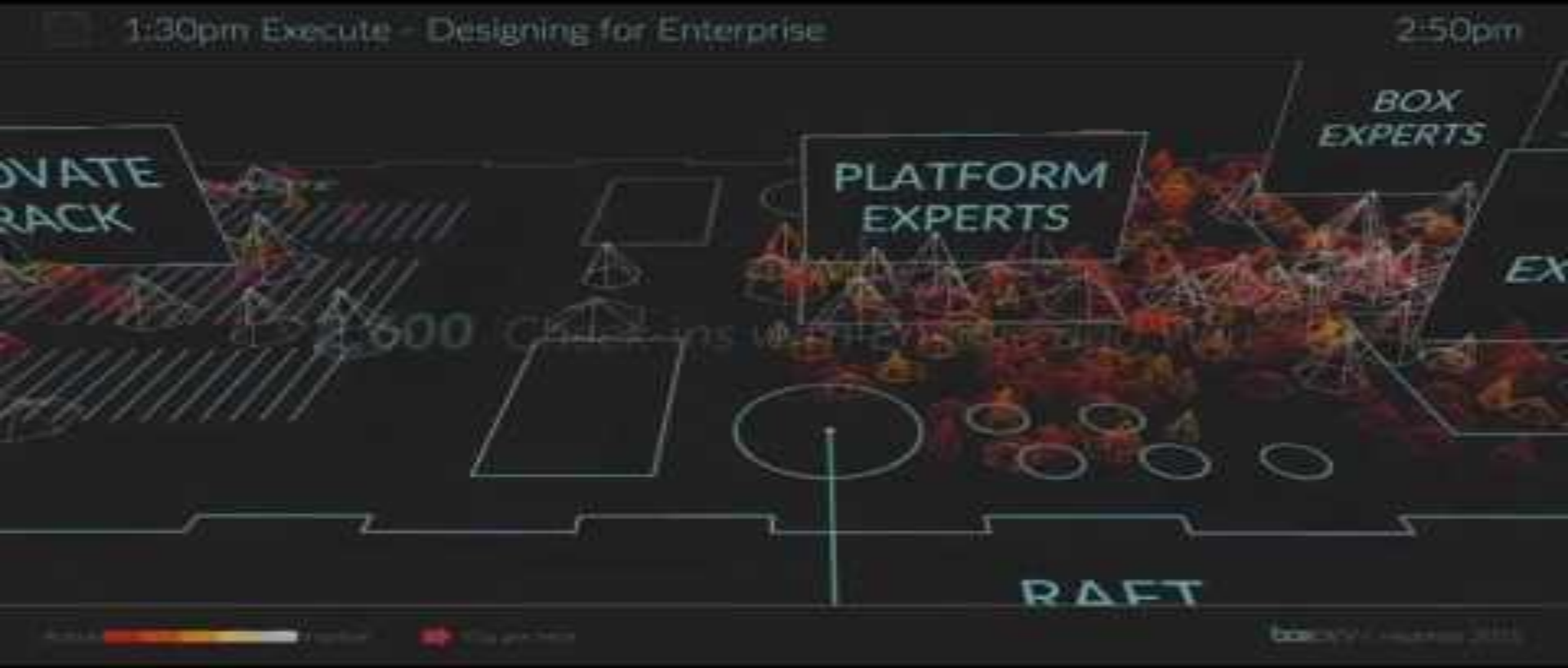
The North Face took users to a virtual Yosemite National Park and Moab at its stores. In South Korea, the company's promotion placed customers in dogsleds for extra verisimilitude.

Marriott designed a temperature-controlled virtual phone booth that, using a headset, allowed customers and the public to visit its properties in Hawaii and London.

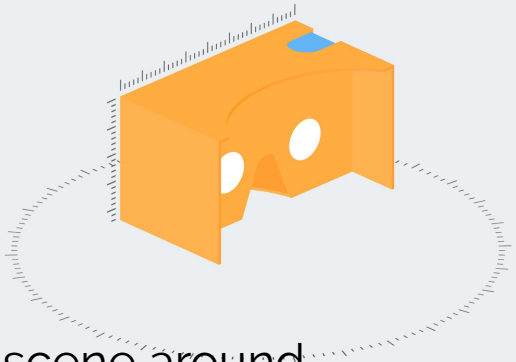
Global architecture firm **IA Interior Architects** is working with InsiteVR to build design models in virtual reality. It's also experimenting with the technology to give clients a "tour" before a project is built.

Sotheby's International Realty is using VR to host open houses to sell luxury homes. Other realty companies, such as **Halstead** and **Douglas Elliman,** are reportedly planning to use similar technology.

Luxury retailer **the Line** is using VR to create a virtual pop-up shop that enables consumers to tour the Apartment, the company's New York City store in SoHo.


1:30pm Execute - Designing for Enterprise
2:50pm
OVATE
RACK
PLATFORM
EXPERTS
BOX
EXPERTS
EX
600
RAFT

Physics of Simulated Reality (VR)

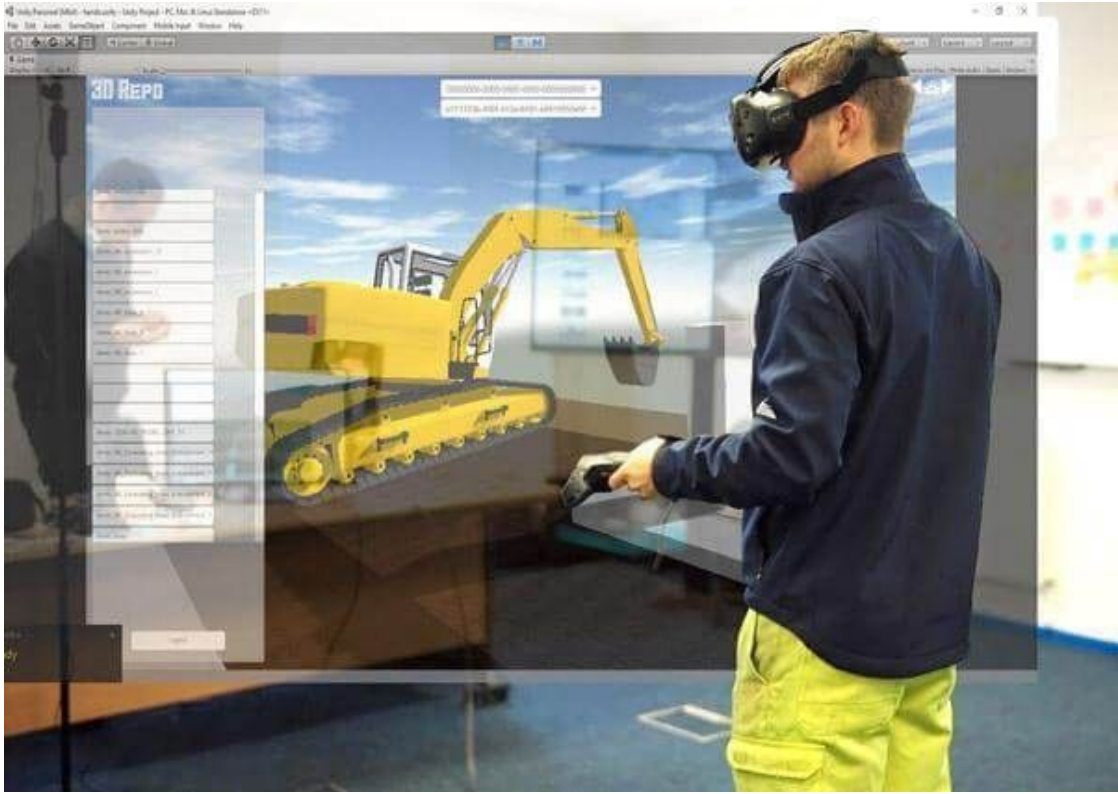


1. Uses gyroscope and accelerometer to align the scene around you.
2. These devices help in determining the DOF.
3. Stereoscopics helps you to view in 3D.
4. HUD's use fresnel lenses to form images at infinity.
5. Images formed in VR mode are slightly offset for fake 3D vision perception.

VR for Design

Tools popularly used to design for VR:

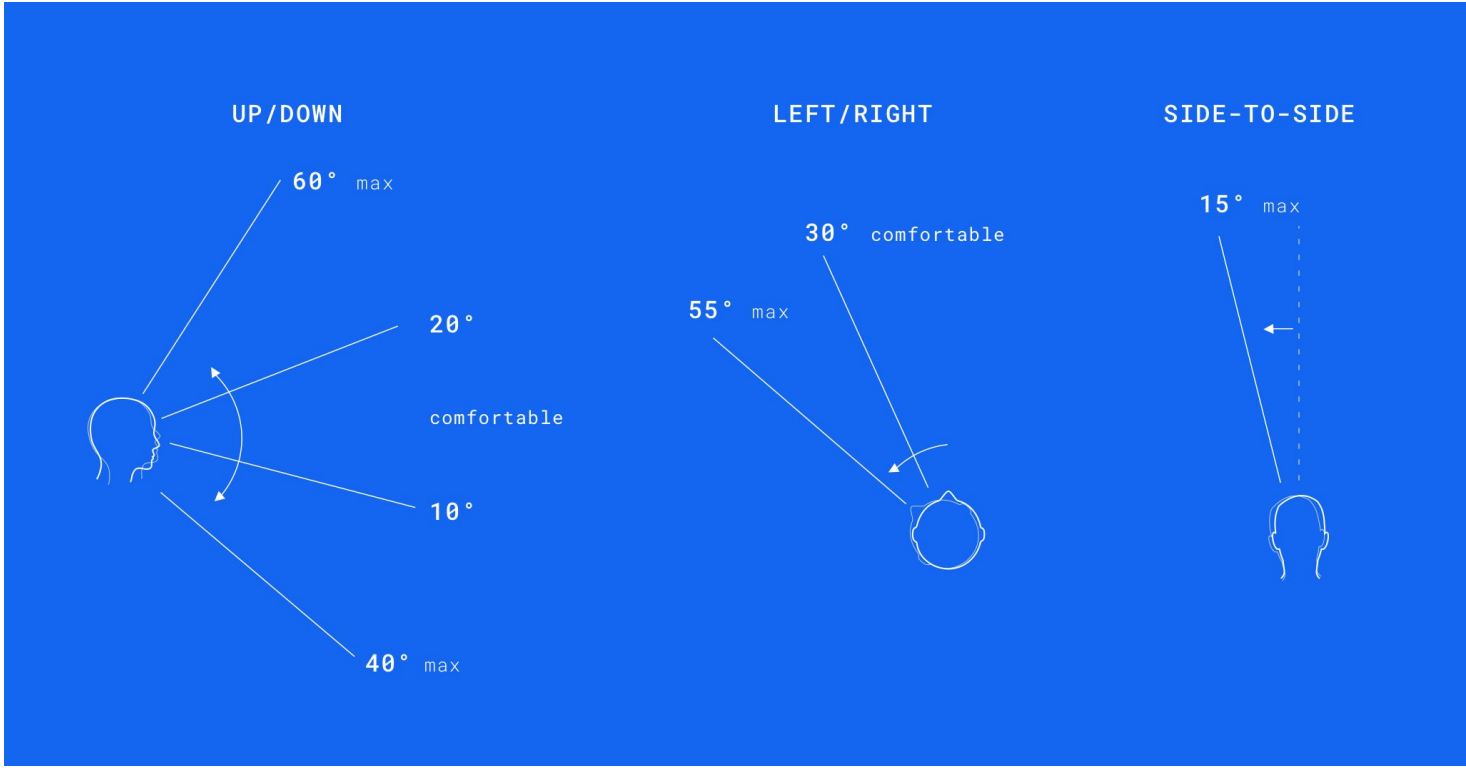
1. Gravity Sketch
2. Unbound Alpha
3. Tilt Brush
4. Mozilla A-Painter



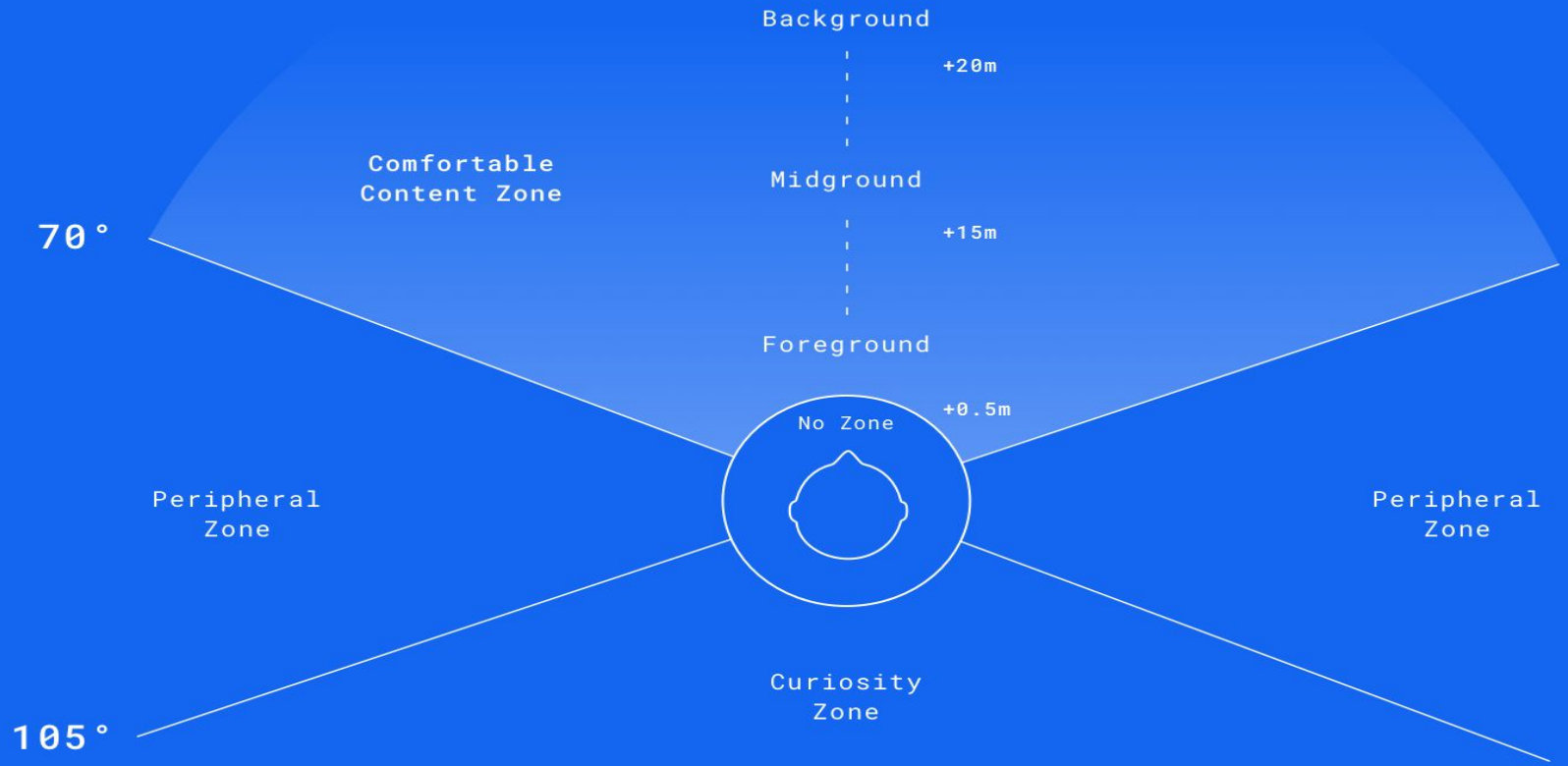
Google Blocks

UX of Design: Ergonomics

Range of Motion:



VIEWING ZONES



TASK 2: What is Norman's Affordance for XR technologies?

Hint: Don Norman, 1988

Answer:

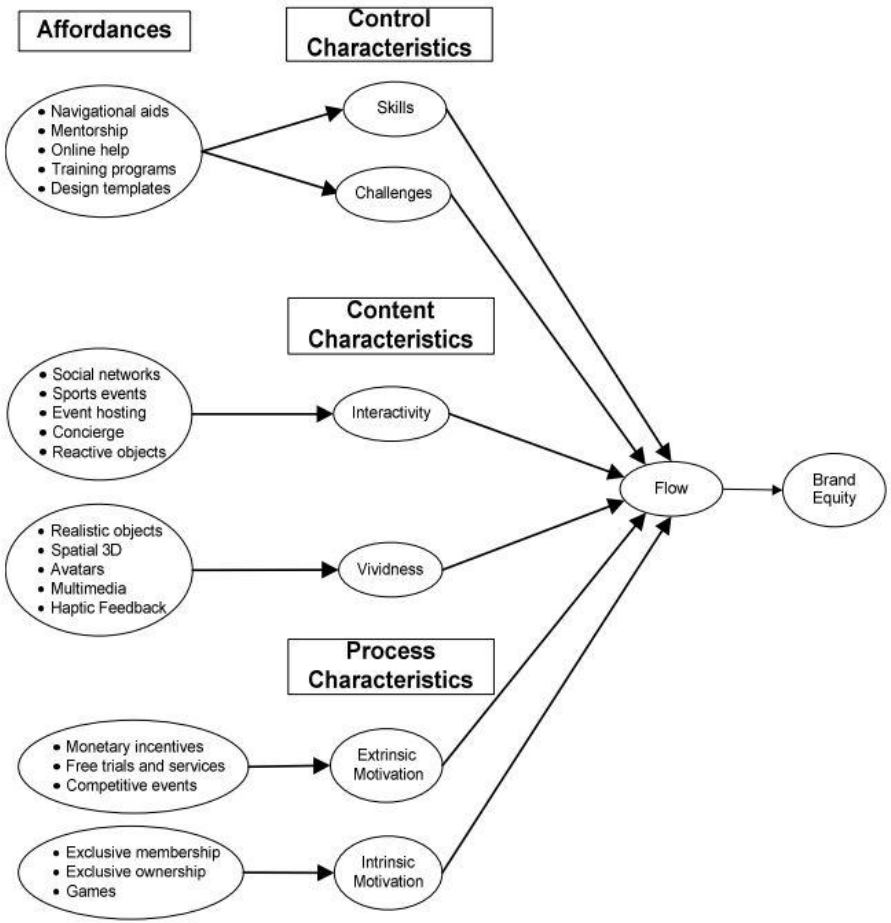


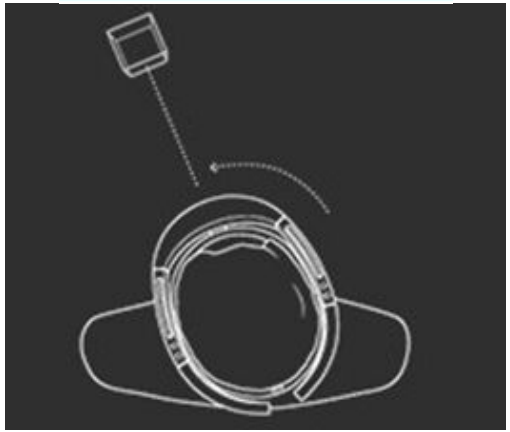
Figure 2. Conceptual Model

Technical Module

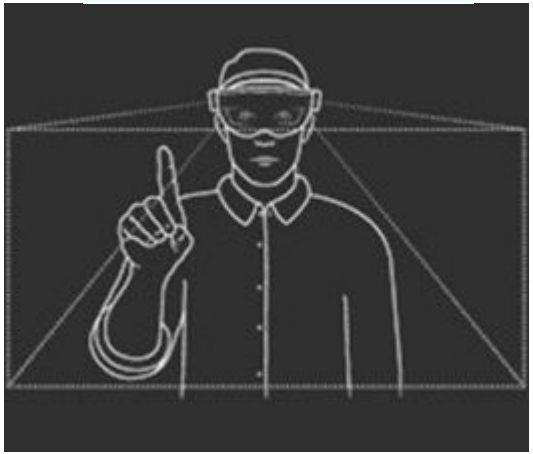
Design Cycle of VR/AR

Features XR devices have?

Gaze



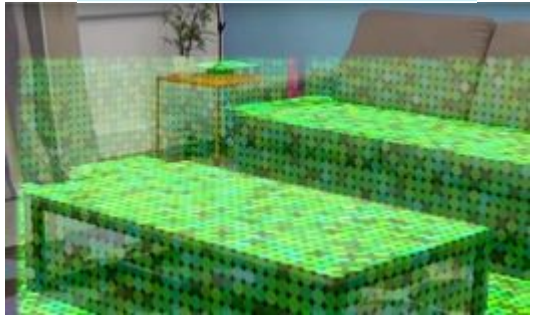
Gesture



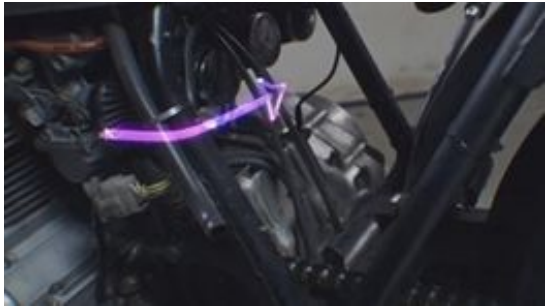
Voice commands

Spatial sound

Spatial mapping



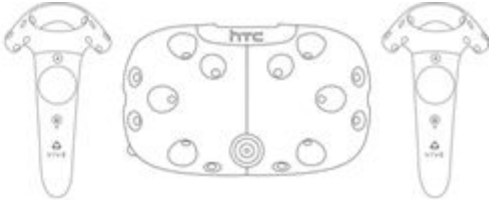
World coordinates



WebVR

WebVR

WebVR is a *JavaScript API* for creating immersive 3D, *Virtual Reality* experiences in your *browser*. It provides access to VR devices.



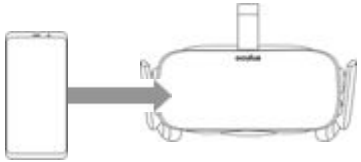
Web Realities Infrastructure

Why WebVR?

Google VR SDK
(iOS/Android/Unity)

Oculus Mobile SDK

Viveport SDK
(Android/Windows)

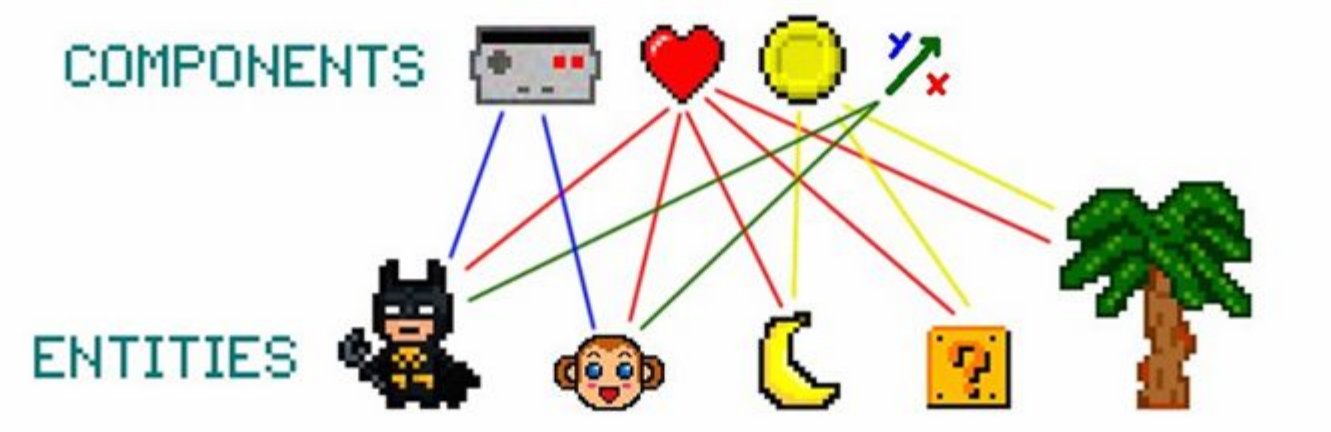


WebVR

Widest **delivery** network in existence: the **Web**

Cost of entry for simple experiences for consumers translates to access to a browser in a device.

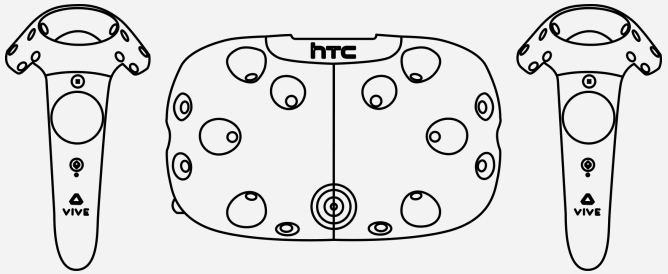
Aframe : The Top-Dog of WebVR

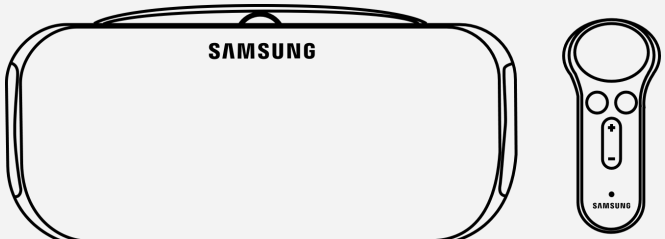


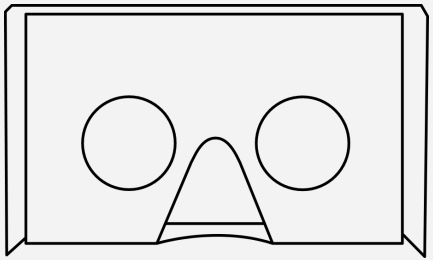
Entity-Component System

Other Players in Market?

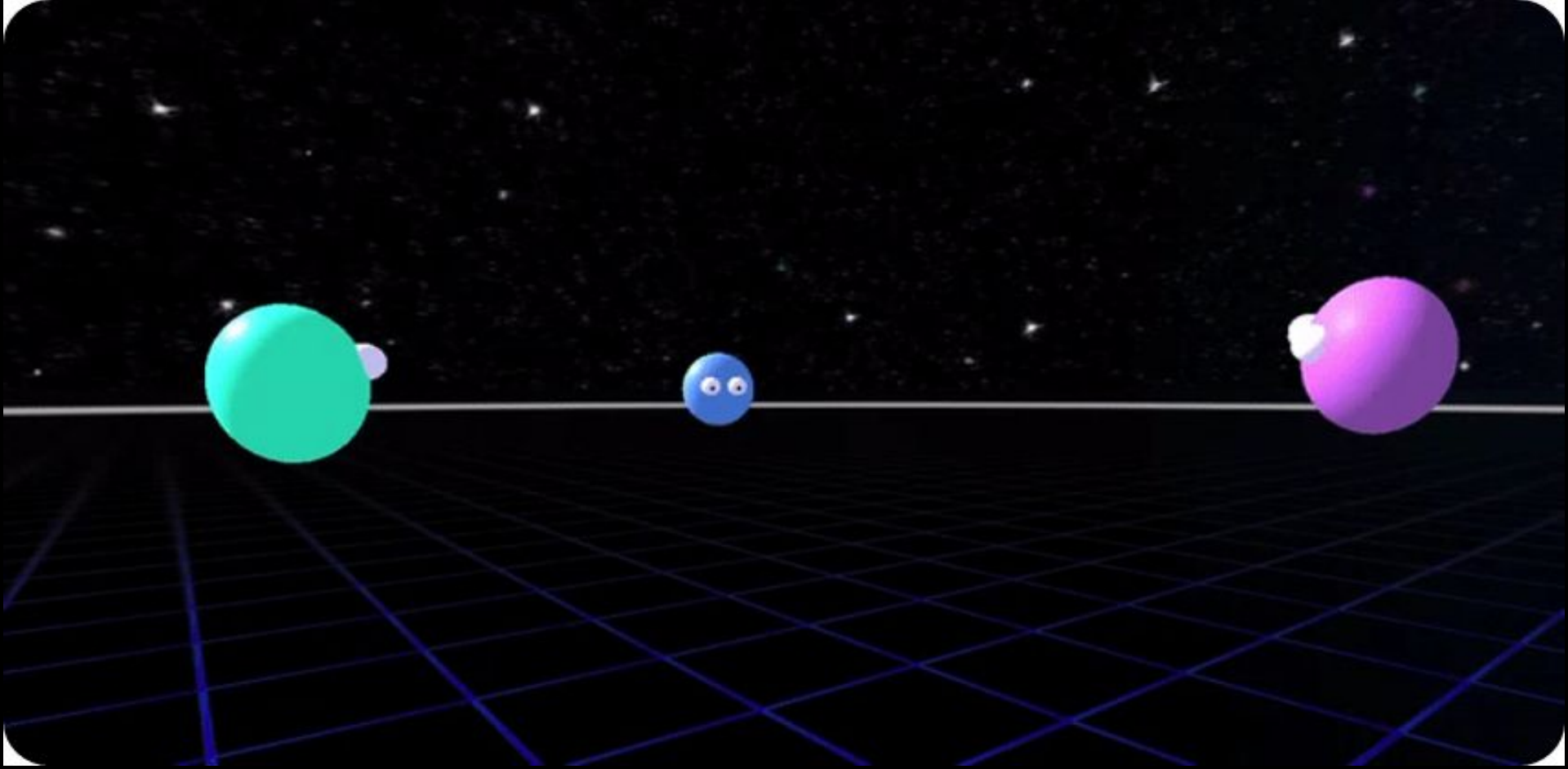
Cross Device Support for VR/AR/MR



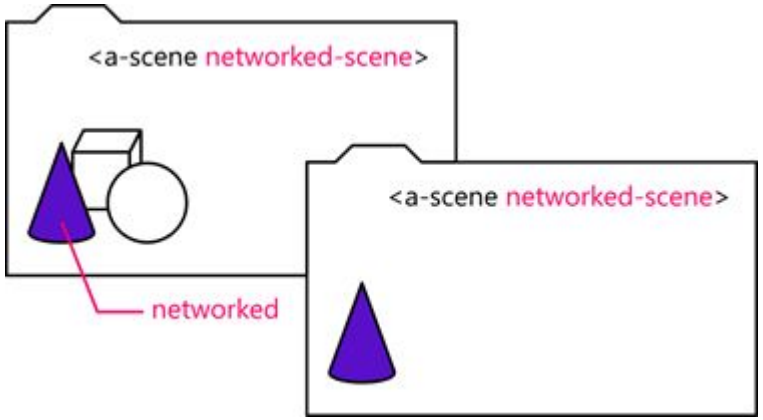




Social VR : Networked Aframe



How does it work?



Uses a 'networked-scene' system for the scene identifying sessions by 'app' and 'room'.

Uses a 'networked' component on entities to sync them.

Utilizes templates to represent the networked entity.

It can broadcast messages to connected peers.

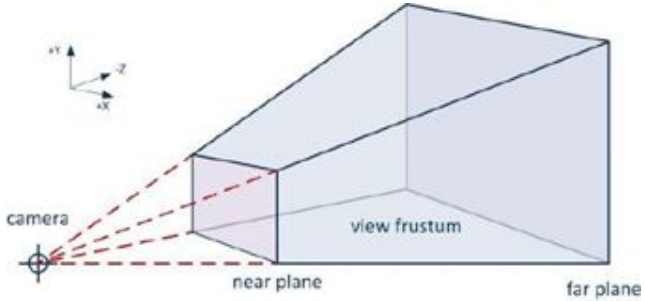
Based in WebRTC / WebSockets and PEER.js

PEERJS

WebRTC

Standalone VR : Unity vs Unreal

Why a Game Engine?

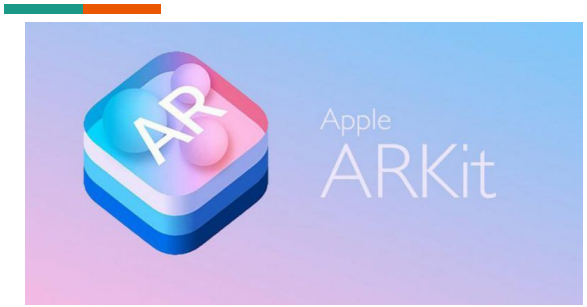


Viewing Frustum of Camera

Unity vs Unreal

Unity 5	Unreal Engine 4
Development feature	
Mainly based on C# & JavaScript	Mainly based on C++ & UnrealScript
Requires knowledge of programming (at least C# or JavaScript) for project development	Include Blueprint feature, which allows developing a project with minimum knowledge of Coding
Provides wider tweak & settings for the environment and object	Environment & object settings in Blueprint are limited. Requires custom-made model & platform for more settings
Graphic is good enough for mobile users, but limited compared with Unreal Engine	Graphic is generally better, including better shadow, physic, terrain
Better performance for mobile use	Better performance for PC & Console
Supports a wide range of platforms, including mobile & web	Supports mainly PC and Console
Development fee	
• Free for personal use or commercial use with annual venue less than $100 k. • The Free edition lacks of Profiler feature, which is used for performance benchmark for the project	• Free for personal use. Includes all features, it is no difference between Free edition & Premium edition. • Requires 5% profit for commercial use
Community	
Huge user base	Moderate user base
Extensive asset library, including objects, scripts, animation, tools required for a complete game with low fee	Small asset library. High fee of use
Huge database of the tutorial, including videos, demo & scripts. Requires less time for training	Limited database of tutorial
Community & Tutorials suitable for all types of developers, including beginners and hobbyist	Tutorials largely are designed for designers rather than programmers

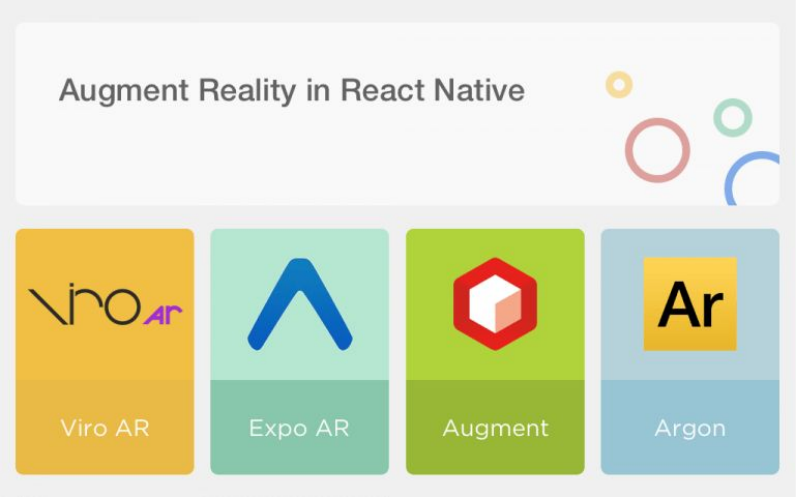
Starter Kit: VR/AR Design and Production?



Vs.

ARCore

React based WebAR

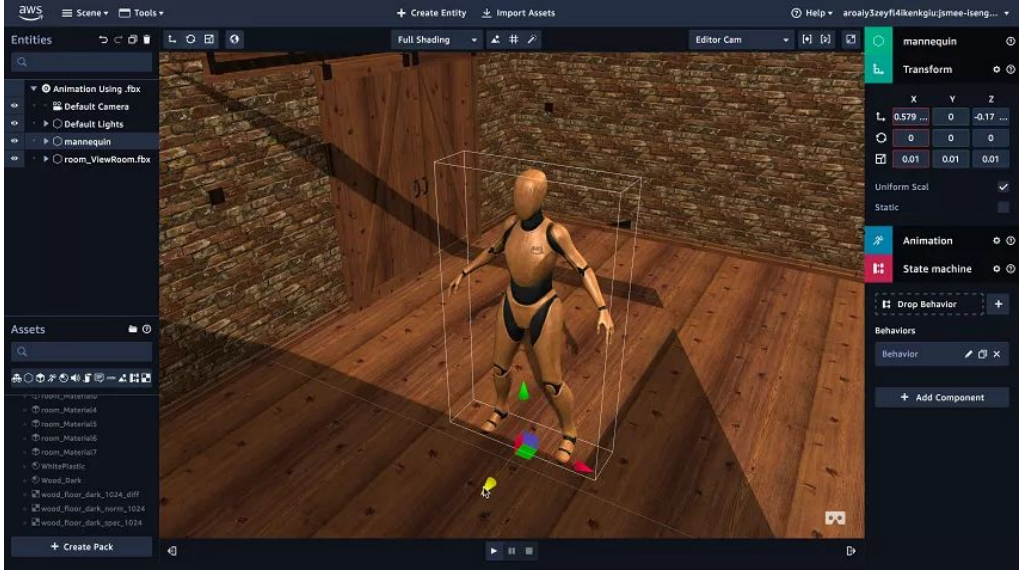


Viro AR

React-Web-AR

Augmented Reality on web with React

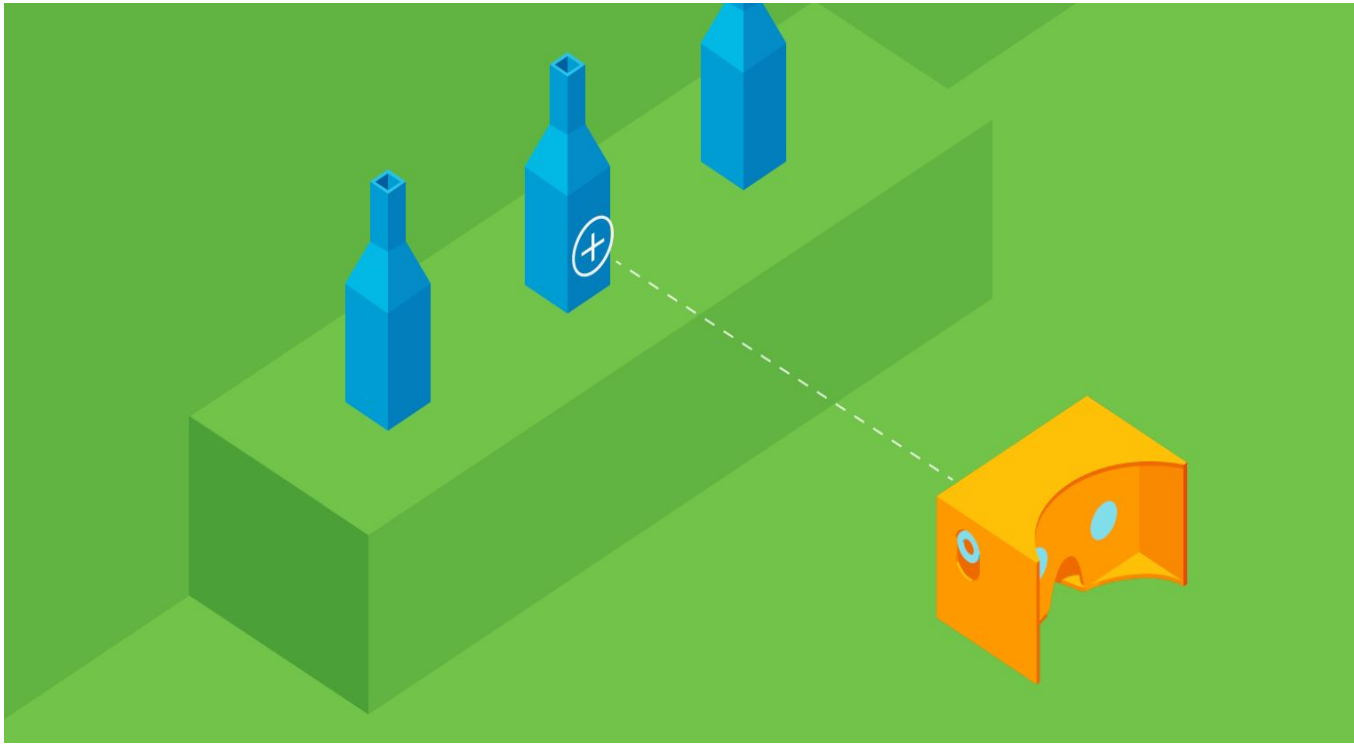
For all the Non-coders



amazon web services

InstaVR

Entry Point :



Prototyping:

1. Unity VR
2. Unreal
3. Vuforia
4. WebVR: Aframe, React etc

Frameworks

There are three major frameworks to choose from when designing for VR: Mozilla A-Frame, Daydream VR, and Unity VR/Unreal SDK.

1. Mozilla A-Frame is for Web VR and can be used platforms such as Google Cardboard, Samsung Gear, and Oculus Rift.
2. Daydream VR is for mid range VR and works with mobile phones only.
3. Unity VR/Unreal SDK are for high end headsets including Oculus Rift, HTC Vive, HoloLens (AR) and LeapMotion (MR)

Input Methods

VIVE

oculus

Sound

3D Sound — aka Holophonic sound — is still in its infancy, but will be transformative in how we experience VR.

We are all used to stereophonic sound, which provides sound coming from two channels (left/right), but holophonic sound allows us to tell if sound is coming from above, below, or behind us. Think of when you are outside and hear an airplane. You intuitively look up, right? Having this sound experience in VR is what will make it truly immersive.

Exit Notes:

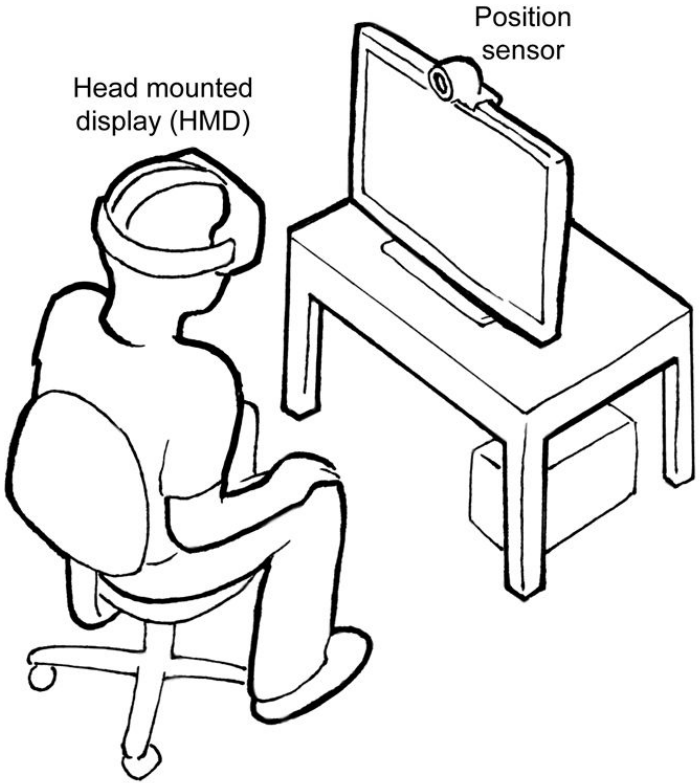
There are some fundamental design steps to be followed when designing for any immersive surface.

These are ：

1. 3D and Visual Design
2. Understanding Scale and Positioning
3. Tracking and Movement
4. Animation and Transition Principles.

How any VR works?

1. Navigator.getVRDisplays() is used to get a reference to your VR display.
2. VRDisplay.requestPresent() is used to start presenting to the VR display.
3. WebVR's dedicated VRDisplay.requestAnimationFrame() method is used to run the app's rendering loop at the correct refresh rate for the display.
4. Inside the rendering loop, you grab the data required to display the current frame (VRDisplay.getFrameData()), draw the displayed scene twice — once for the view in each eye, then submit the rendered view to the display to show to the user (VRDisplay.submitFrame()).



Augmented Reality

WebAR

Augmented Reality in Aerospace

Key Innovations and applications to look for

These are :

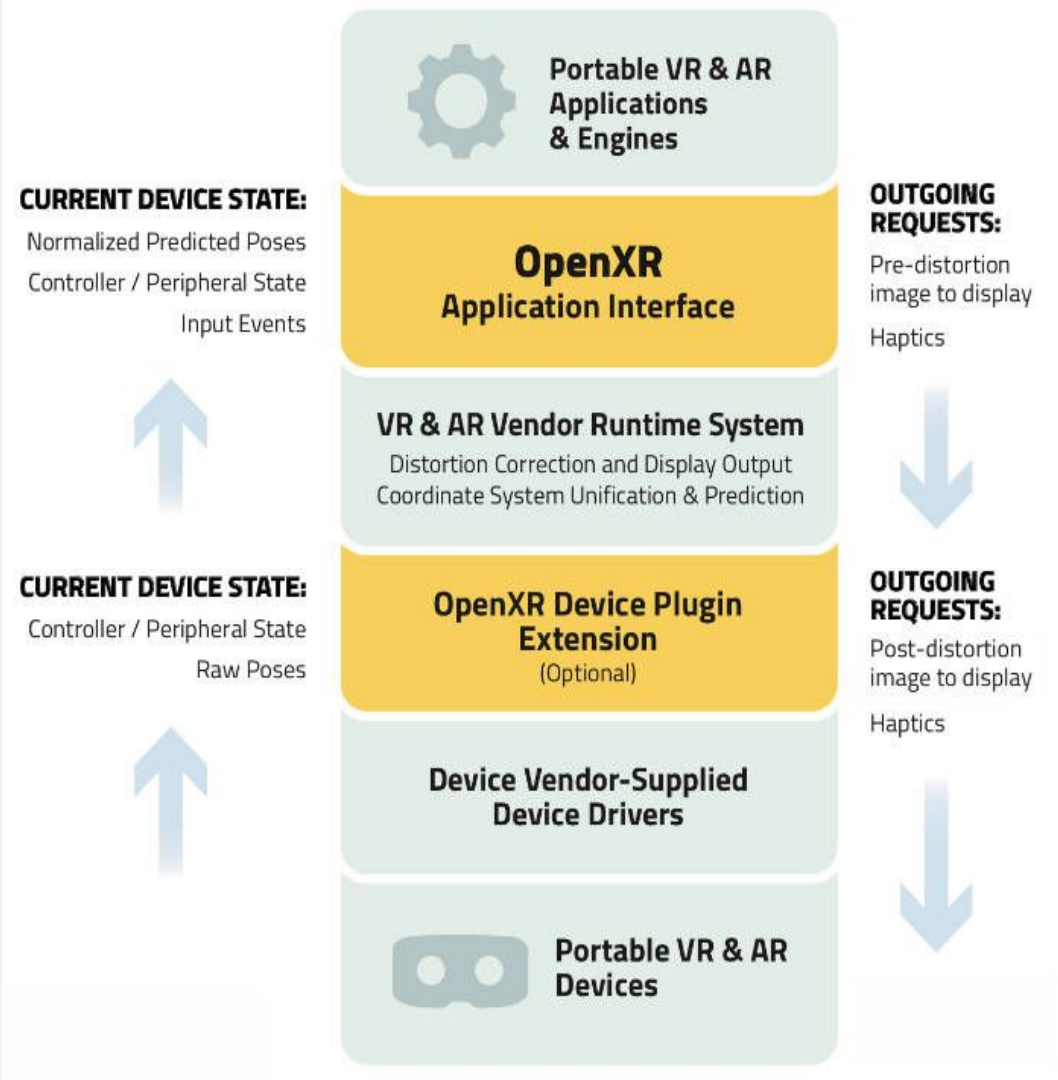
1. Pratt and Whitney's : **AR engine Maintenance**
2. AeroGlass : **AR Data Visualisation**
3. AirFrance: **Immersive Entertainment**
4. Bell Helicopters: **FCX-001**


The XR Spectrum

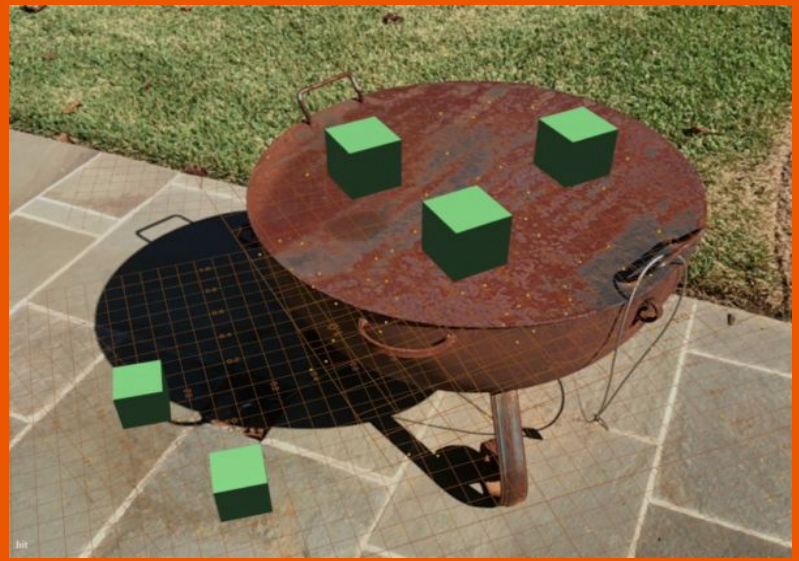
What is XR?

Extended Reality (XR) refers to all real-and-virtual environments generated by computer graphics and wearables. The 'X' in XR is simply a variable that can stand for any letter. XR is the umbrella category that covers all the various forms of computer-altered reality, including: Augmented Reality (AR), Mixed Reality (MR), and Virtual Reality (VR).

OpenXR Architecture



WebXR: A combined framework



Proposing a WebXR API

We have created a draft WebXR API proposal for providing access to both augmented and virtual reality devices.

The WebXR API formalizes the different ways these technologies expose views of reality around the user, and it exposes concepts common in AR platforms such as the Anchors found in Hololens, ARKit, and ARCore.

and who is supporting us?

Human Factors and Challenges

1. MRO
2. General aviation maintenance organizations
3. Use of Technical Publications,
4. Fatigue/Alertness,
5. Safety Culture,
6. Event Data,
7. Return on Investment for Human Factors,
8. Prioritization of Human Factors
9. Professionalism and Generational Issues
10. Attention to Required Inspection Items.

Source : Federal Aviation Administration's Office of Aviation Safety

TASK 3: Prioritise your stack (30 mins)

List 5 Pros and Cons you wish like about the stack you wish to learn for next 4 days.

Business Module

How does VR/AR tech makes a difference in Aerospace and Energy?

Customer Journey: A Bell Product

An HTC Vive collaboration.

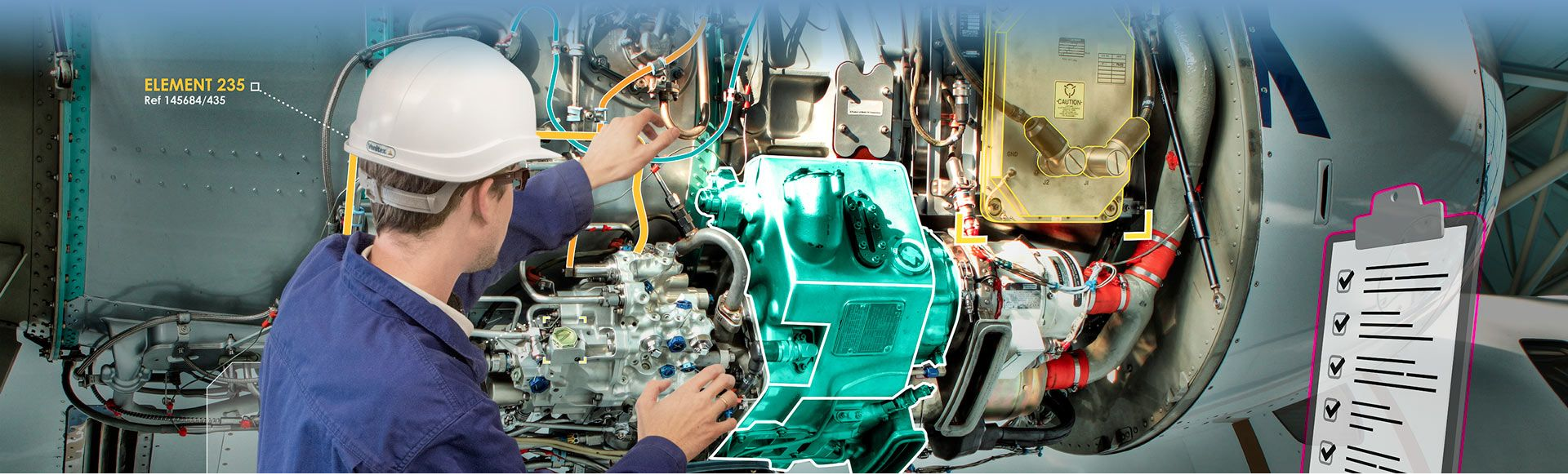
The team decided to build their mock-ups in VR, and it had a profound effect on their entire concept process. Bell worked with S5D, an innovative 3D design and production agency, to help design and sketch the initial model, then create the aircraft in 3D using Computer Aided Design (CAD) software. The model was then transferred into Unity (a real-time game engine) so the design could be experienced and modified in VR on HTC VIVE.

Customer Journey: A Bell Product

An HTC Vive collaboration.

Lets see how they did this?


GoodWorkLabs
Technology Superstars
How AR can improve
Safety Standards for Commercial Aviation



How AR can help?

1. AR navigation in commercial flying.
2. AR in air traffic visualization
3. AR in aircraft maintenance

Applications in Energy Industry:

Applications of VR in energy space can be classified as:

.

a. Direct Applications
b. Passive Applications

Direct Application

VR primarily being a training and familiarization tool is ideal for helping professionals in the energy sector understand their craft better.

VR based Training and Field trips
Immersive Oil Rig Training

Passive Application

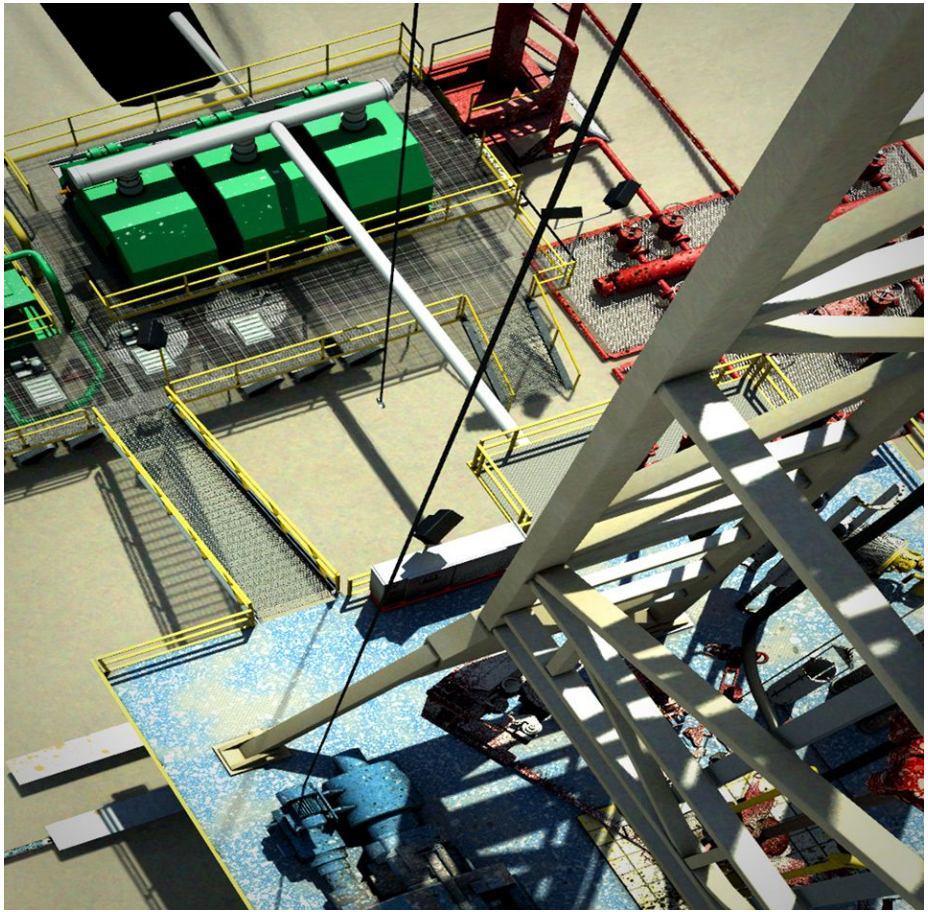
VR has also proven to be an invaluable tool for helping energy companies run their design process faster, safer and cheaper, too .

VR Compressor Design.
Oil Rig Visualisation Tools.
Operator Essentials Toolkit

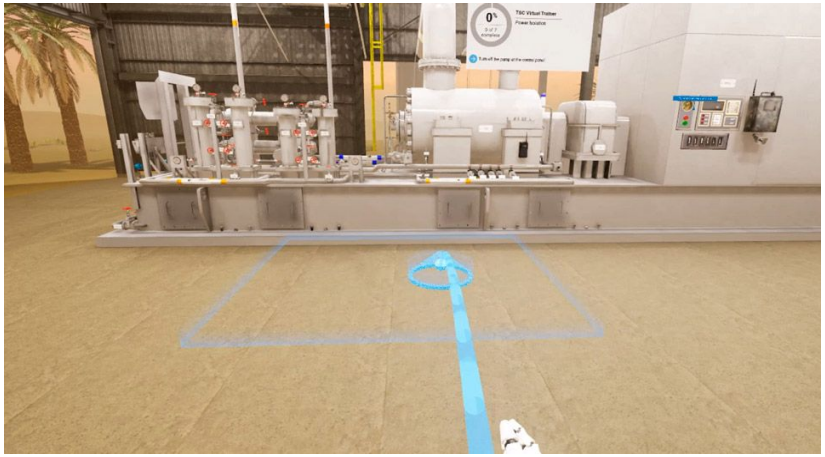
Field trip VR Simulations

Competence Assessment of Oil Rig Workforce

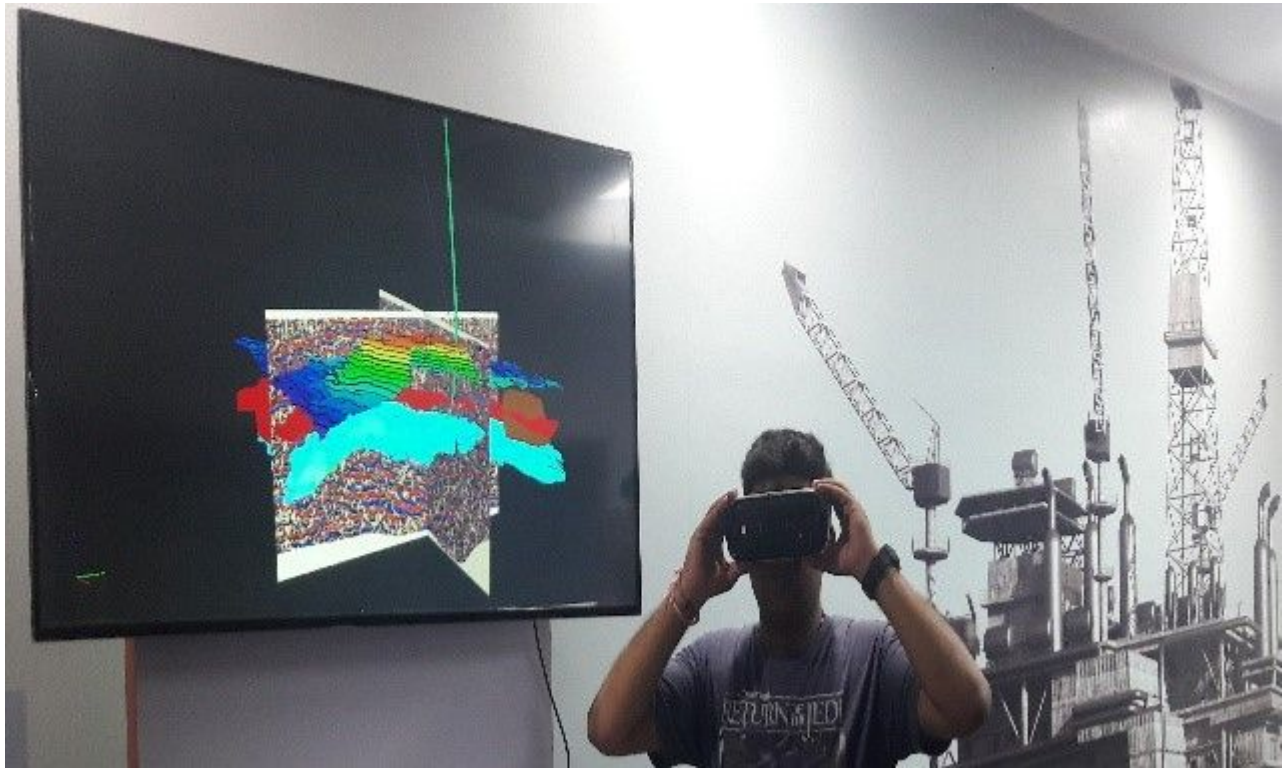
Oil Rig Training



Compressor Design



VR Simulations for Drilling Operations



Application Journey: EPRI, Palo Alto

Lets see how they did this?

More business applications of VR

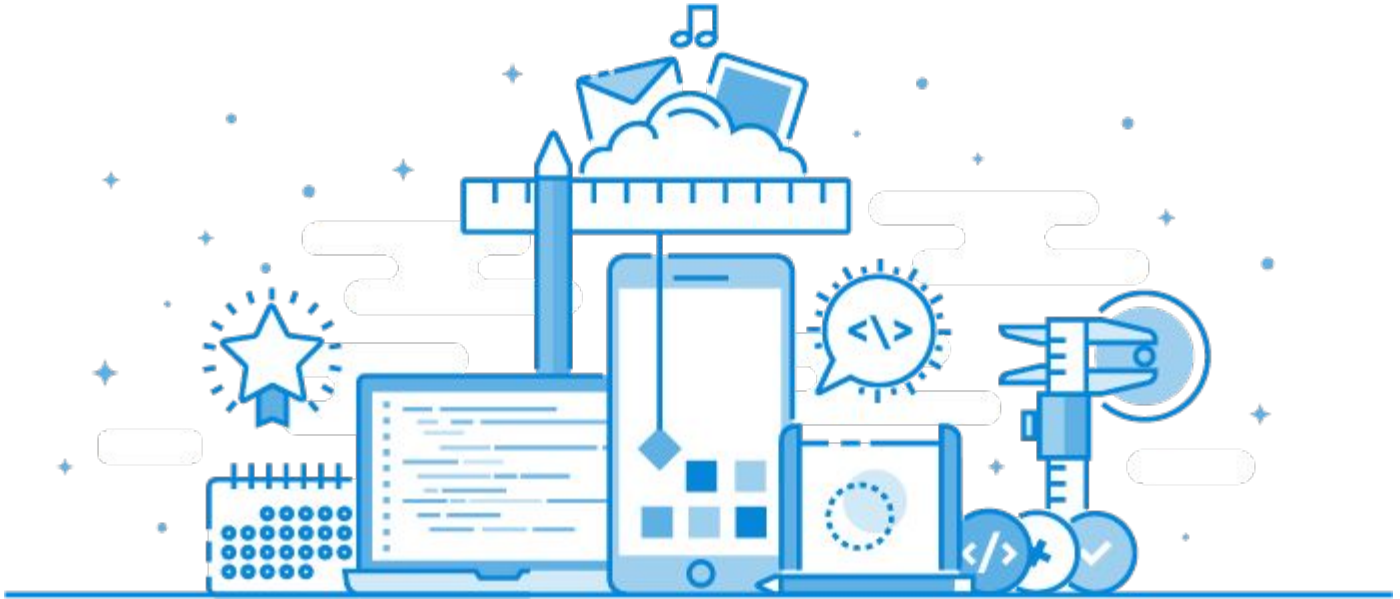
VR can enhance passenger flying experience

VR can help train pilots better

VR can help treat passengers suffering with aviophobia

In a  Shell

VR reduces turnaround time



Most Impactful application (Market-wise)

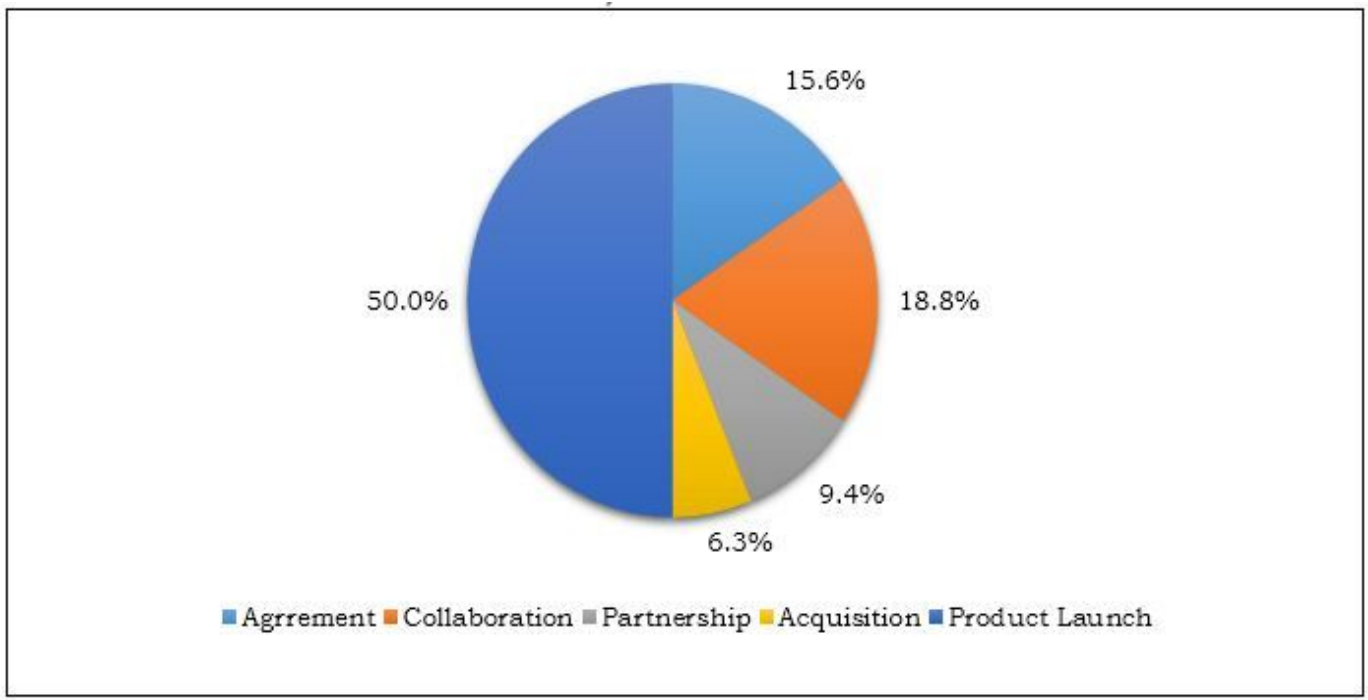
Virtual Training and Simulation Market is expected to garner **$329 billion** by 2022, registering a **CAGR of 16.8%** during the forecast period 2016 - 2022. The Market is a method in which a simulated virtual environment is created to test certain abilities of a trainee that can contribute to the learning process.

It is used in the wide area of applications, including in flight simulation, simulation-based gaming, serious games, healthcare training, energy, transportation training, e-learning, military & navy, digital manufacturing, and others. Virtual training and simulation tools comprise hardware and software.

Ground Truth: Adoption Rates

The pie chart shows the percentage share of **adoption of strategies by various players in the virtual reality training and simulation market.**

Key players operating in the market use numerous strategies to strengthen their market presence, including partnerships, collaborations, product launches, agreements, and acquisitions.



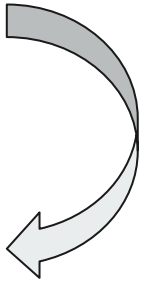
Source : Allied Market Research

Areas where VR affects Energy Industry

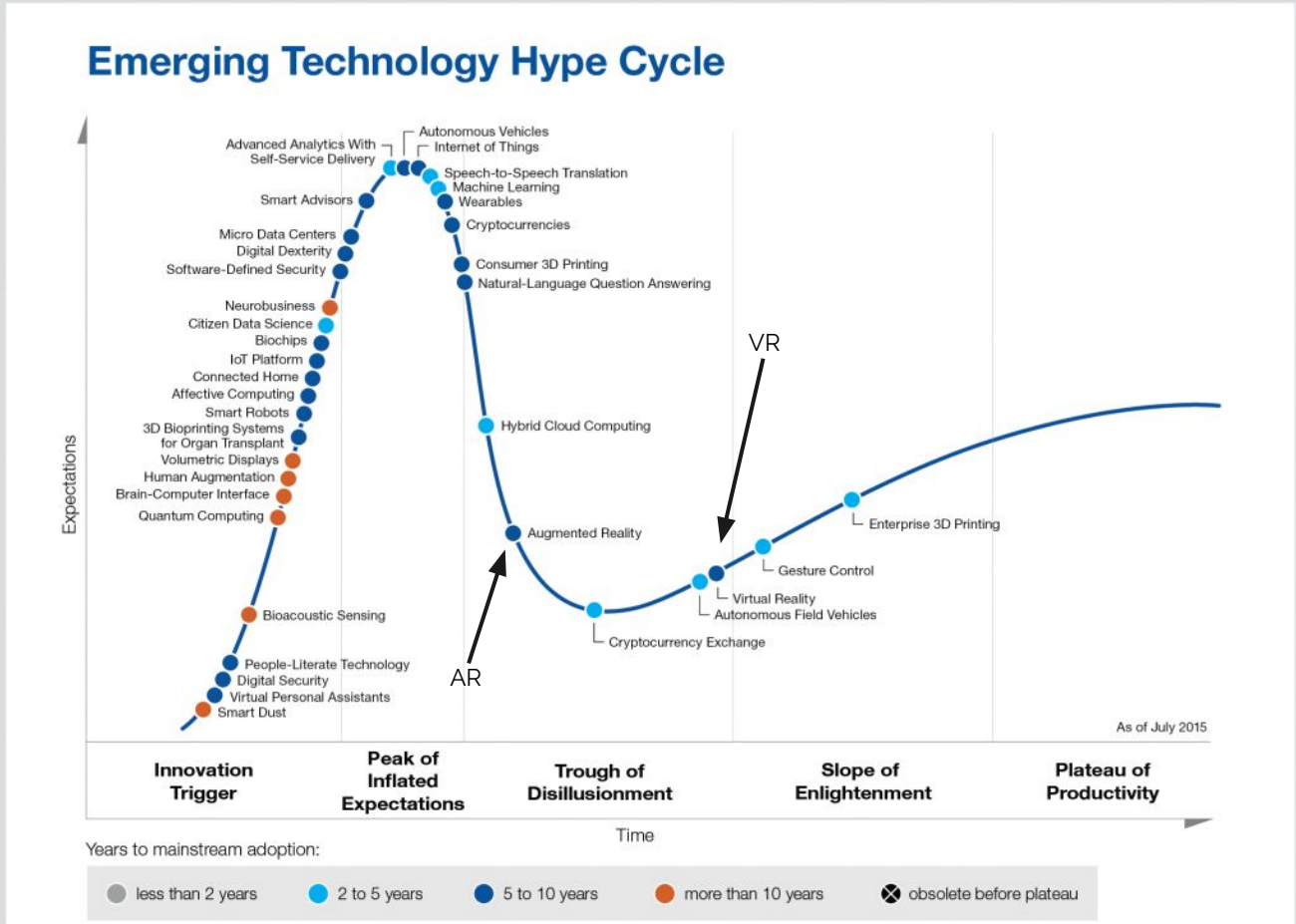
Real Time application of AR-VR technologies to revolutionize Energy Industry

Application areas :

1. E&P Companies specifically cater Drilling and Completions Operations.
2. Rig Monitoring Systems
3. Maintenance Activities
4. Anomaly Detection systems with AR lenses to remotely monitor
5. Virtual Reservoir Explorations.



Gartner's Hype Cycle



gartner.com/SmarterWithGartner

Gartner

Ending Notes:

How does VR/AR affect your aerospace business and why its necessary to upgrade.?

Overall Benefits for Aerospace:

.

a. Reducing risk in high stake conditions.
b. Design timecycle is massively cut.
c. Recruiting and onboarding
d. Speeding up the whole assembly.

Overall Benefits for Energy :

a. Disaster planning: assess risks and safety,
b. Detect and measure features,
c. Validate new equipment design,
d. Path planning validation for dwell drilling,
e. Big-data visualization,
f. Training sessions: familiarize with vessels and task to be performed later on site.

Questions?

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Questions?

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