



# Spatial Tech

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# Day 2: An Expedition of XR technologies





# Talk Rules 101:

No rules though (duh!)

PS: For questions

**Wait till the end**

**OR**

**Tweet @pandastichuman**

Use #GITS and #VRpanda

# Overview

Recap

Case Studies

Design Challenge

ReactVR

Let's Play Games

WebVR

Programming  
Challenge



# Recap: Day 1

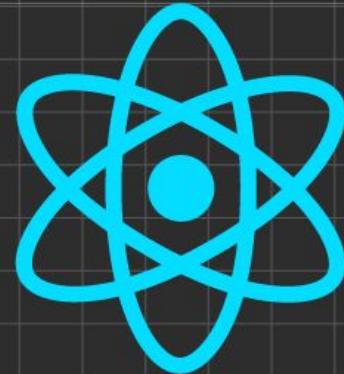


# React360



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# React Ecosystem for VR/AR



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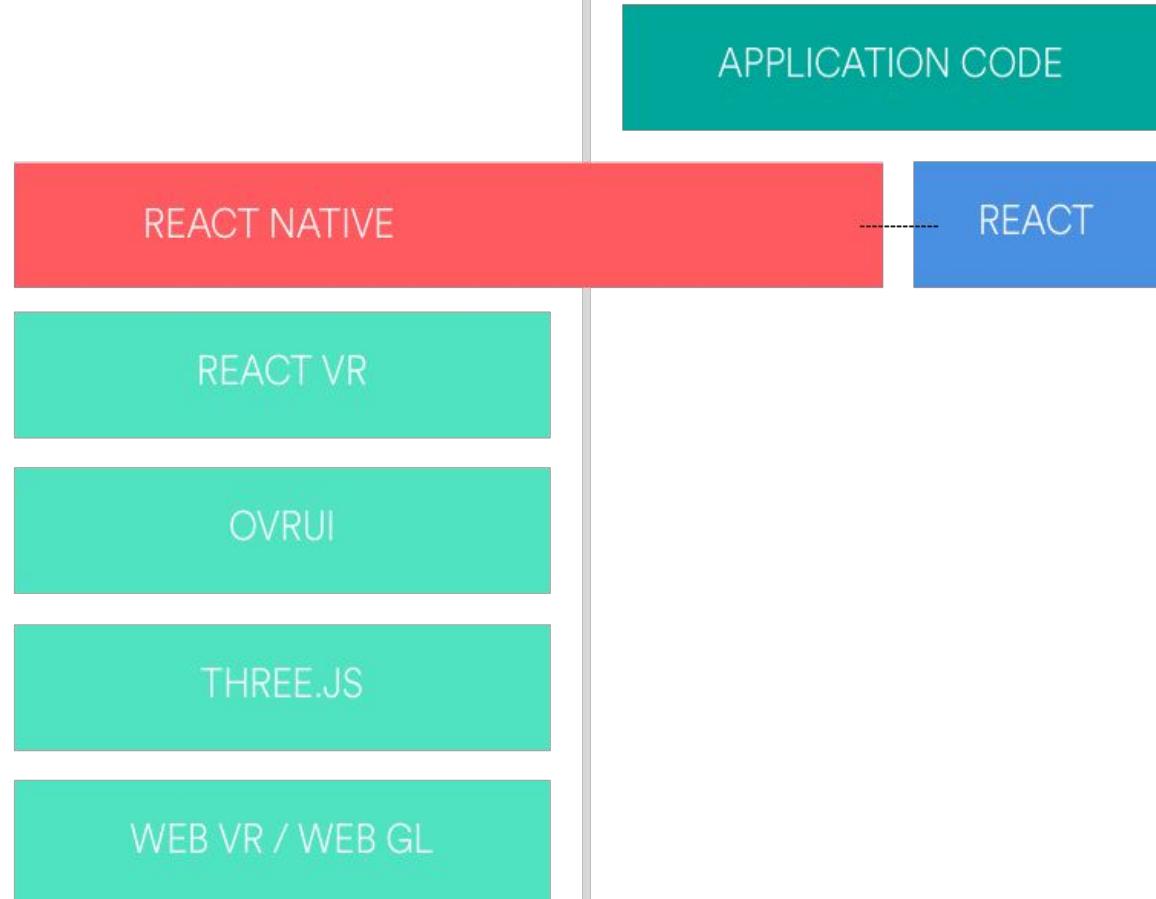
# React 360 : Facebook's own WebVR Framework

# How ReactVR?

- Based on Three.js library
- OVRUI : Oculus VR UI
- React Native Elements:  
**View, Image, Text, etc**
- React VR adds : **Pano, Mesh, Pointlight & others**
- Getting started is easy-peasy.

## BROWSER MAIN THREAD

## WEB WORKER





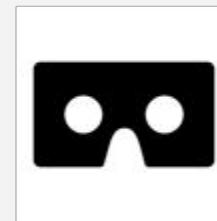
# Prototyping Tools



## React based WebAR



# React-Web-AR



Augmented Reality on web with React

# ViroReact / ViroAR



## Features

### Cross Platform Development

Write once, run anywhere across all mobile AR (ARKit, ARCore) and VR (Cardboard iOS/Android, GearVR, Daydream)



### React Native Framework

Create apps using React Native, making it easy for web developers to get started.



### Powerful Renderer

Create stunning scenes with PBR, HDR, Realtime Lighting, Physics, Particles, and more.



### Rapid Iteration

Use the free Viro Testbed app to view your app and see your changes quickly. No need to wait for recompile. It's like refreshing a browser.



### Documentation

We provide you with extensive developer support and documentation.



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# Example ;)

**Google Musical Forest Experiment Clone**

For more experiments on WebVR check : [experiments.withgoogle.com/webvr](http://experiments.withgoogle.com/webvr)

# Tesla Implemented Viro!



# Task 4: Let's Play Games

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**Try these out !!**

1. Google Daydream VR
2. FullDive VR
3. InCell VR
4. SketchFab
5. ZombieShooter VR
6. Google Cardboard Camera
7. Within VR App
8. Horizons
9. Deep Space battle
10. Google Earth VR



# Data in VR





# Data Trends

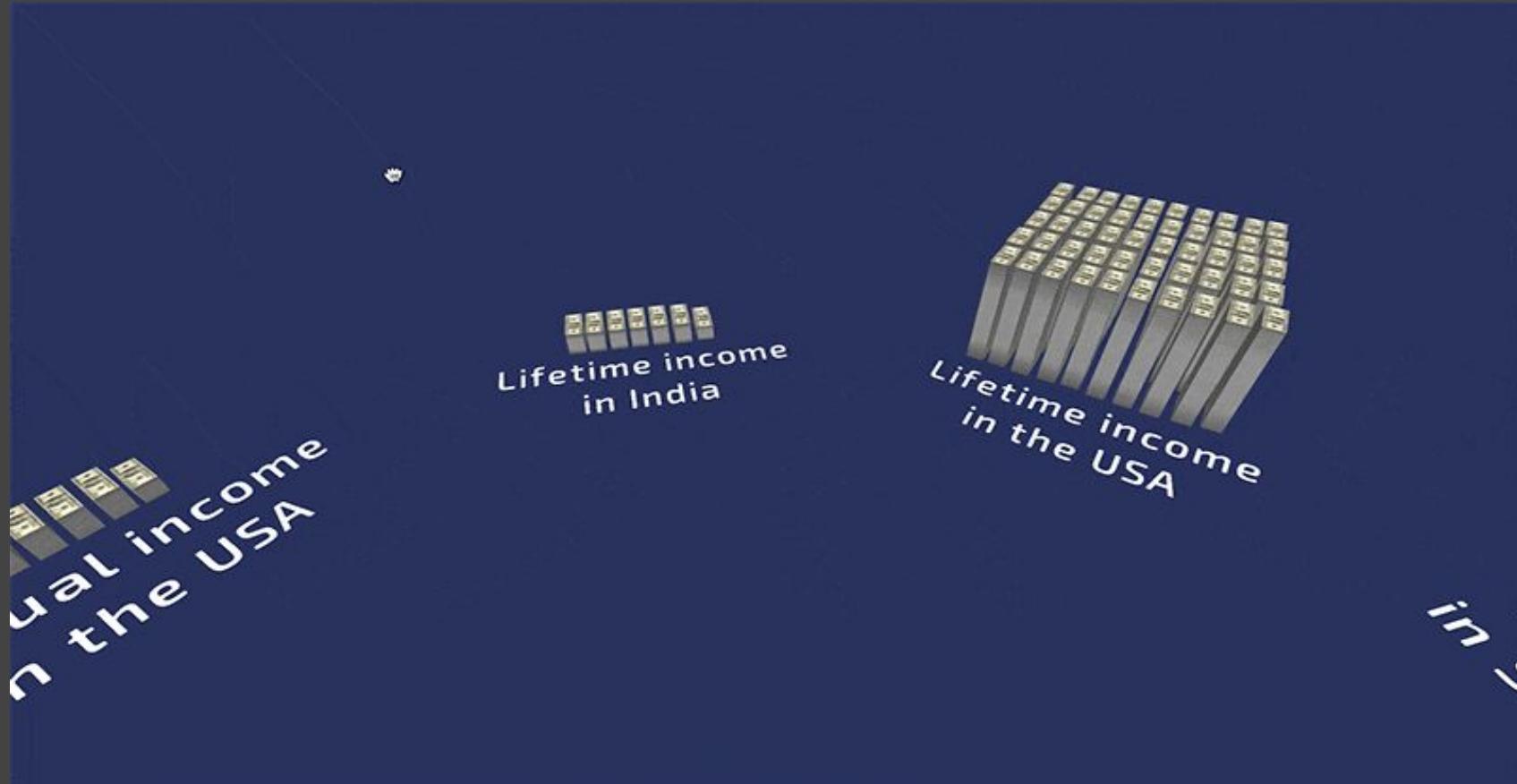
## Random Numbers



## Did you know?



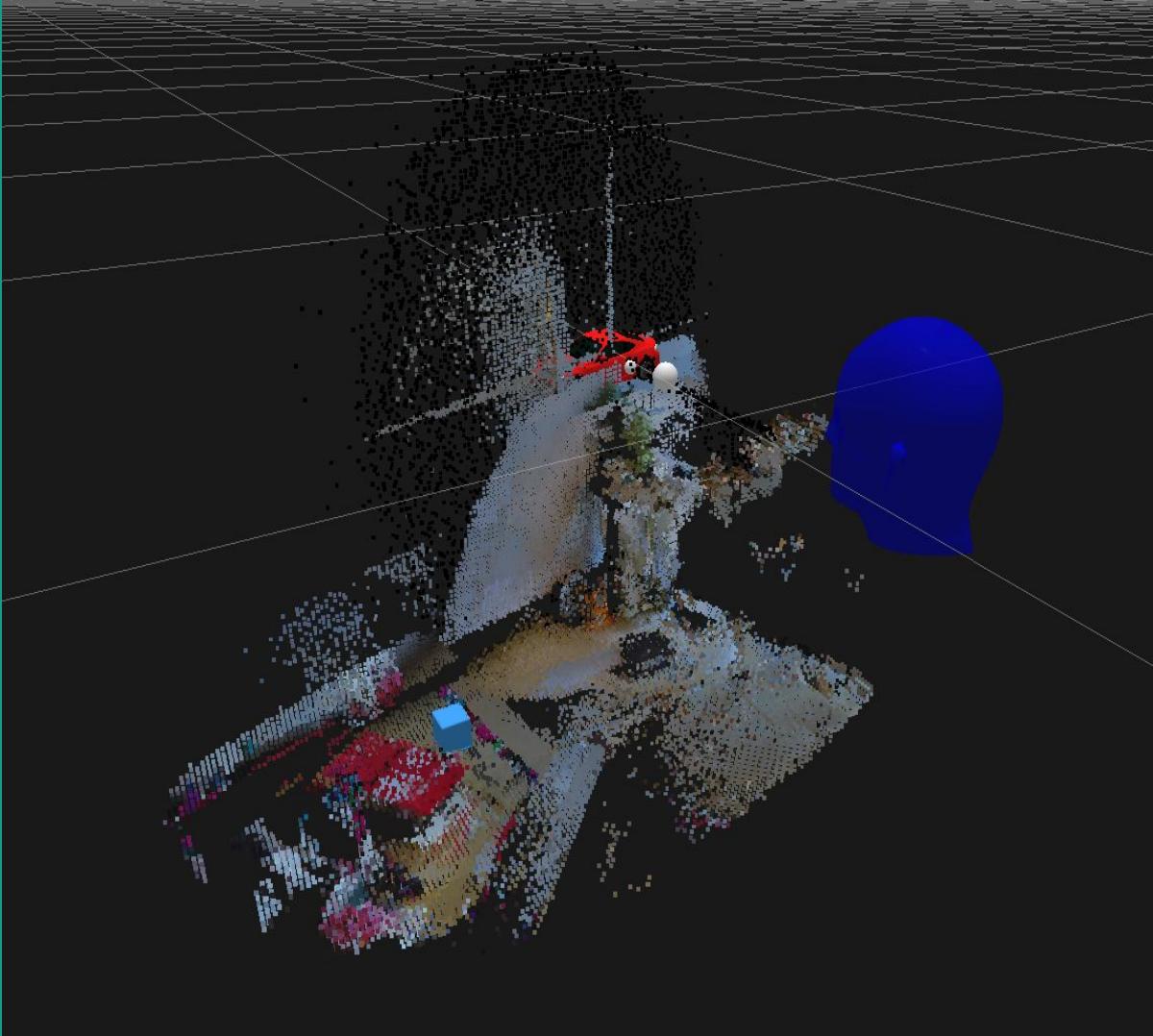
# Turns to something like this .....





## Case Study: Meta2 AR Headset

Using onboard IR sensors over the Meta2 AR device capturing, saving and replying the spatial data IRL.





# Case 2: IBM Watson

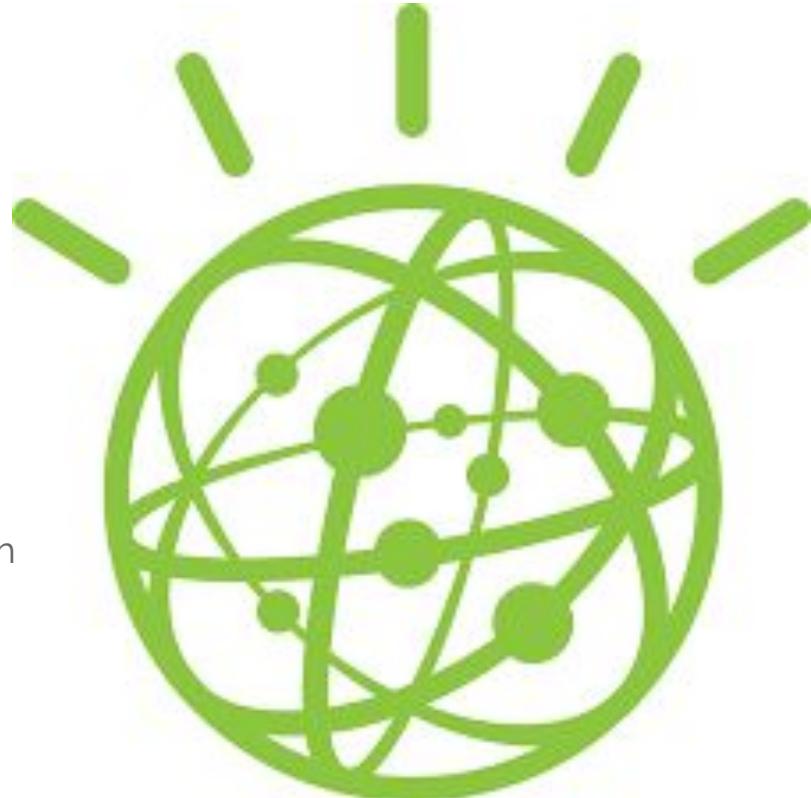
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# AI in VR Analytics

Enabling a world of "6DOF" Analytics

The combination of VR and AI is only now becoming possible due to:

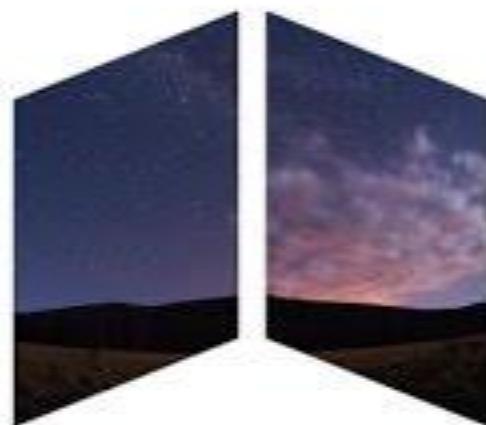
- Recent developments in AI, particularly deep learning, that foster real-time image and speech recognition
- Increased availability and reduced cost of local processing and storage
- Expanding network bandwidth, allowing richer data streams
- Availability of AI and VR/AR services in the cloud





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# How is IBM Visualising High Dimensional Data using Augmented Reality?



**IBM Immersive Insights**



# Ai in VR (NVIDIA and OpenAI Research )





# Deep-learning Autonomous Simulation

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# Deep Learning Based Simulation Engine

State-of-the-art deep learning simulation engine leverages reality-grade city mesh combined with DNN (deep neural network) and AI capabilities.

Cognata's virtual reality simulator and engine enable autonomous car manufacturers to run thousands of different scenarios based on various geographic locations and driver behaviors, and sharing the road with other users.



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# Star Trek VR Voice Assistants

The coolest part? I don't need to memorize hyper-specific phrases -- because Ubisoft teamed up with [IBM Watson](#), the closest thing we have to a real-life Star Trek computer, to process my voice in near real-time.





# OpenAI



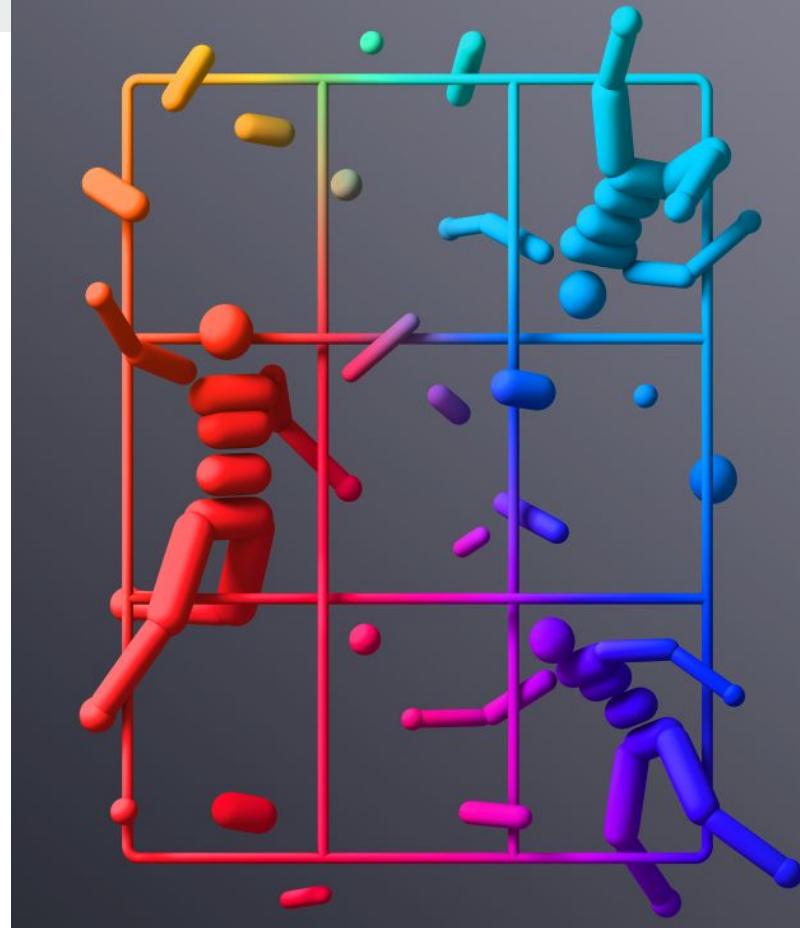
## OpenAI : Dota2 BotPlayer

\*\*Window of opportunity

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## Competitive Self Play : OpenAI

It was found that self-play allows simulated AI's to discover physical skills like tackling, ducking, faking, kicking, catching, and diving for the ball, without explicitly designing an environment with these skills in mind





# Real Time VR/AR Delivery Systems



# The AR Cloud

# HOW TO MAKE AN AR CLOUD



- 1. A SCALABLE SHAREABLE POINT CLOUD**
- 2. AN INSTANT UBIQUITOUS LOCALIZER**
- 3. REAL-TIME MULTI-USER INTERACTION**

# Task 5: Programming Challenge

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1. Creating a Rainbow using Graphics Programming in C or C++ [Easy]
2. Build a 2D/3D graphical representation of Tower of Hanoi [Moderate]

# Task 6: Design Challenge

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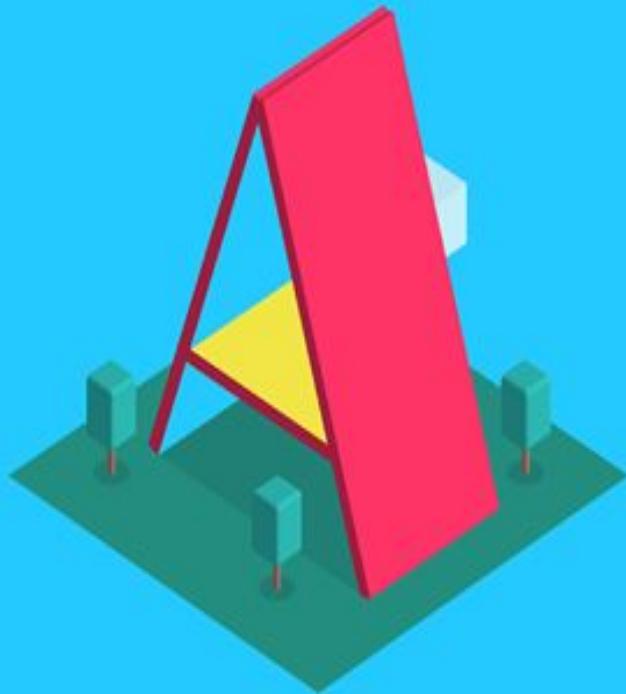


Design a flow to production of medical VR/AR application that caters a major challenge in the medical industry?

Factors To Keep in Mind:

- a. Design Process
- b. Production Cost
- c. Feedback Loops (hard/soft)
- d. Regulation Measure
- e. Testing strategies

# Aframe : The Top-Dog of WebVR





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## 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:



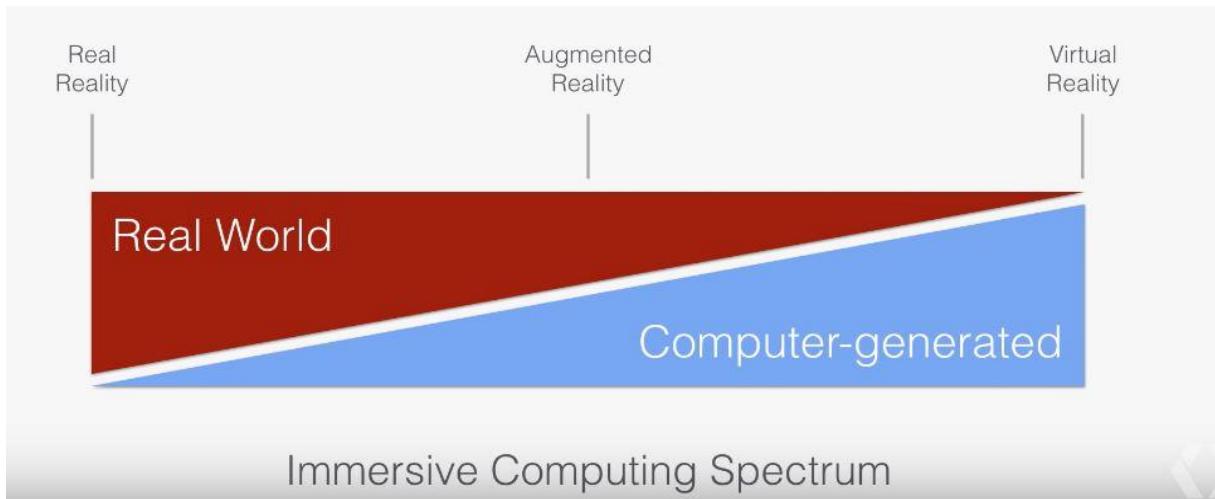
The Truth:

Real experiences

Augmented Reality

Virtual Reality

# The VR/AR Spectrum



## Virtual Reality:

- Immersion into 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

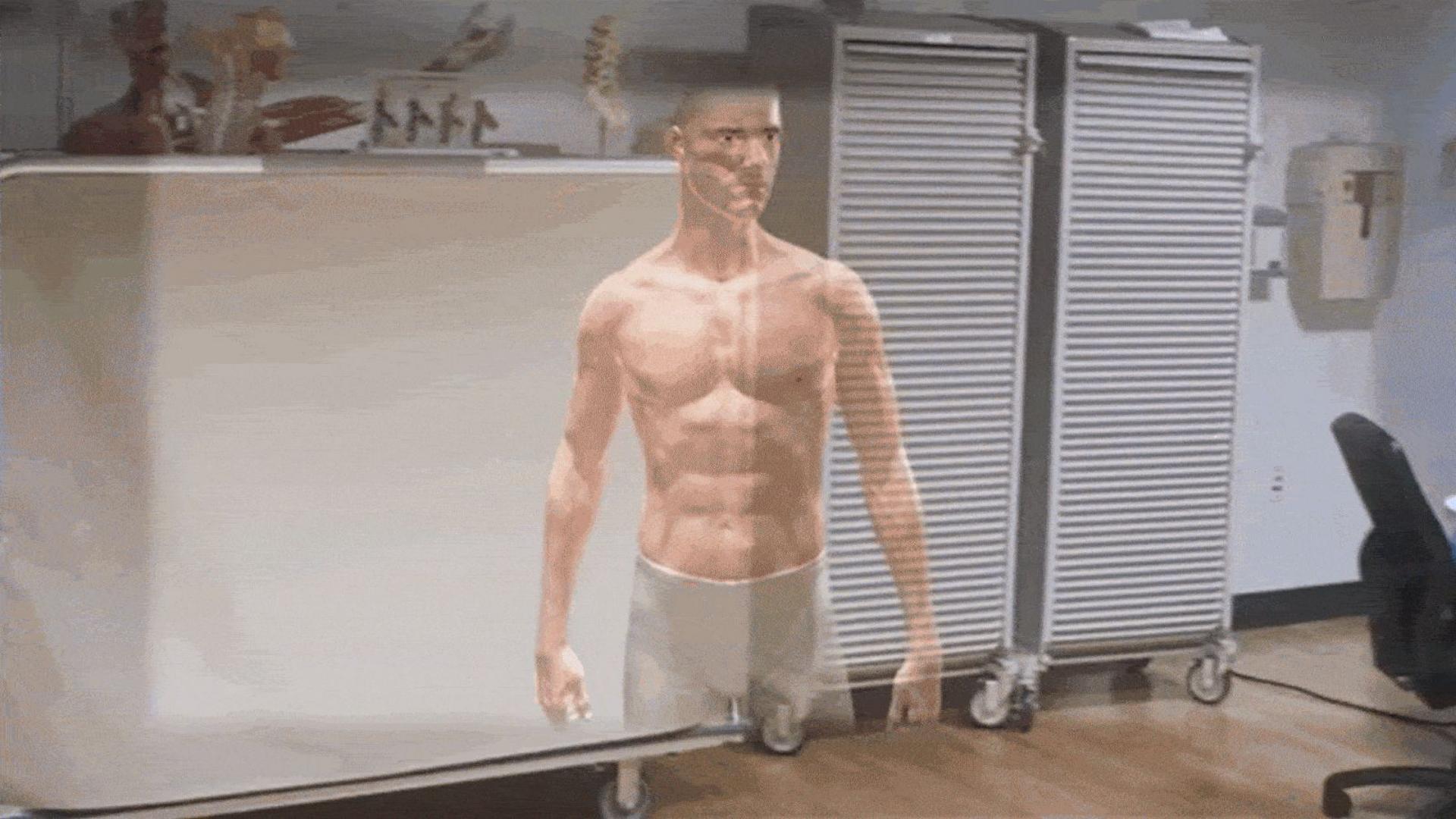


**Task: Which among the upcoming slides  
contains an example of VR/AR/MR?**





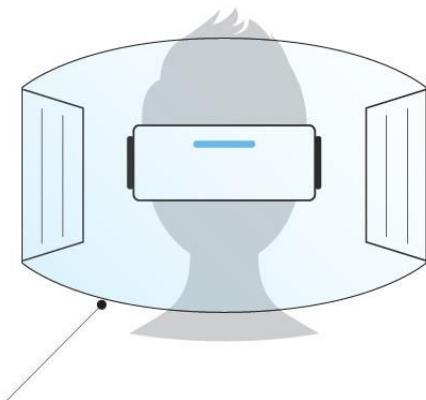
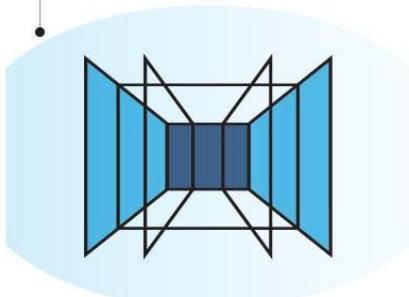






# VIRTUAL REALITY (VR)

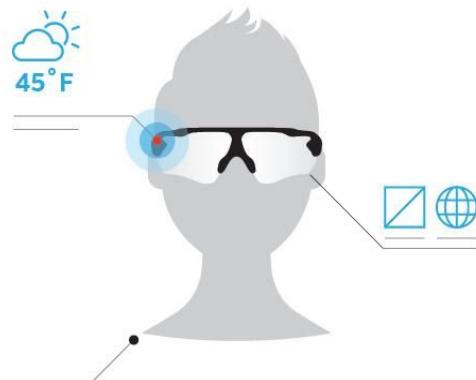
Completely digital environment



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

# AUGMENTED REALITY (AR)

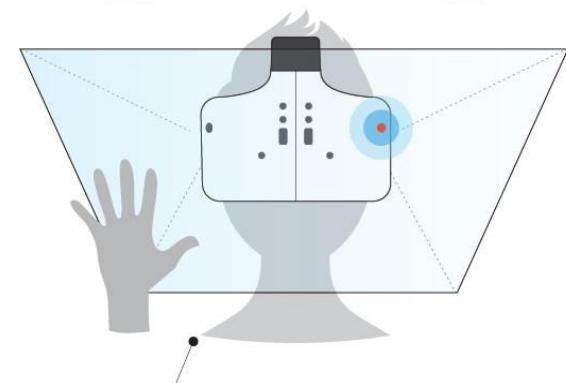
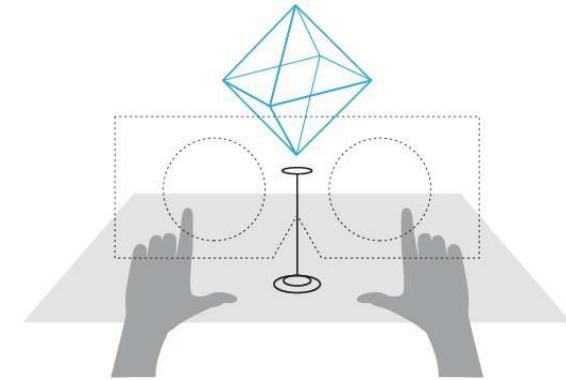
Real world with digital information overlay



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.

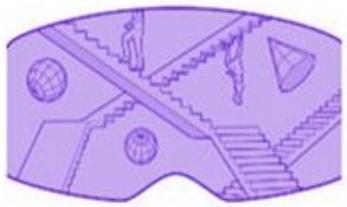
### Platform

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.

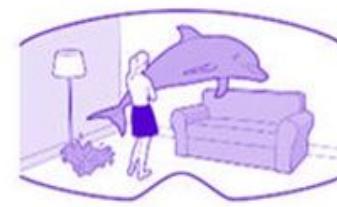
# DIFFERENCES



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

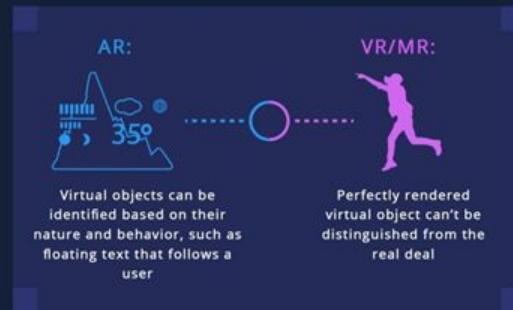
# VR & AR IN LEARNING

## SOME INTERESTING FACTS

### DISPLAY DEVICES



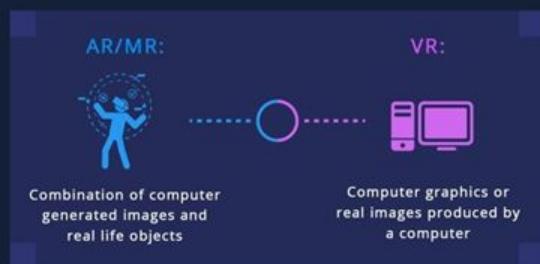
### AWARENESS



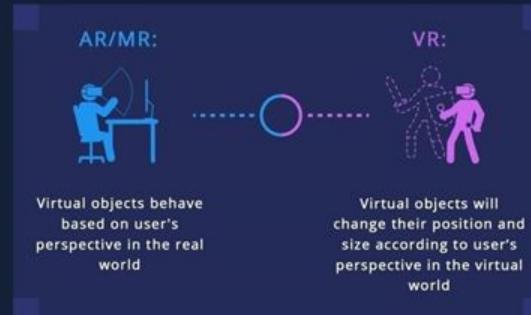
### ENVIRONMENT



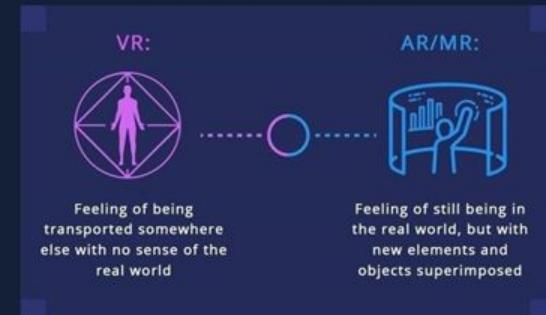
### IMAGE SOURCE



### PERSPECTIVE



### PRESENCE



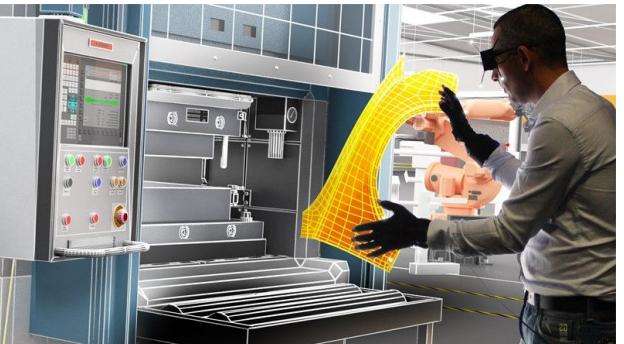
# VR, AR, MR popular applications



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.

## 13 PLACES WHERE VR IS GETTING REAL

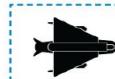
A handful of companies are integrating it into work, while a growing number use it to sell.



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.



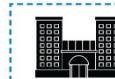
Sotheby's International Realty is using VR to host open houses to sell luxury homes. Other realty companies, such as Halstead and Douglas Elliman, are reportedly planning to use similar technology.



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 dog sleds for extra verisimilitude.



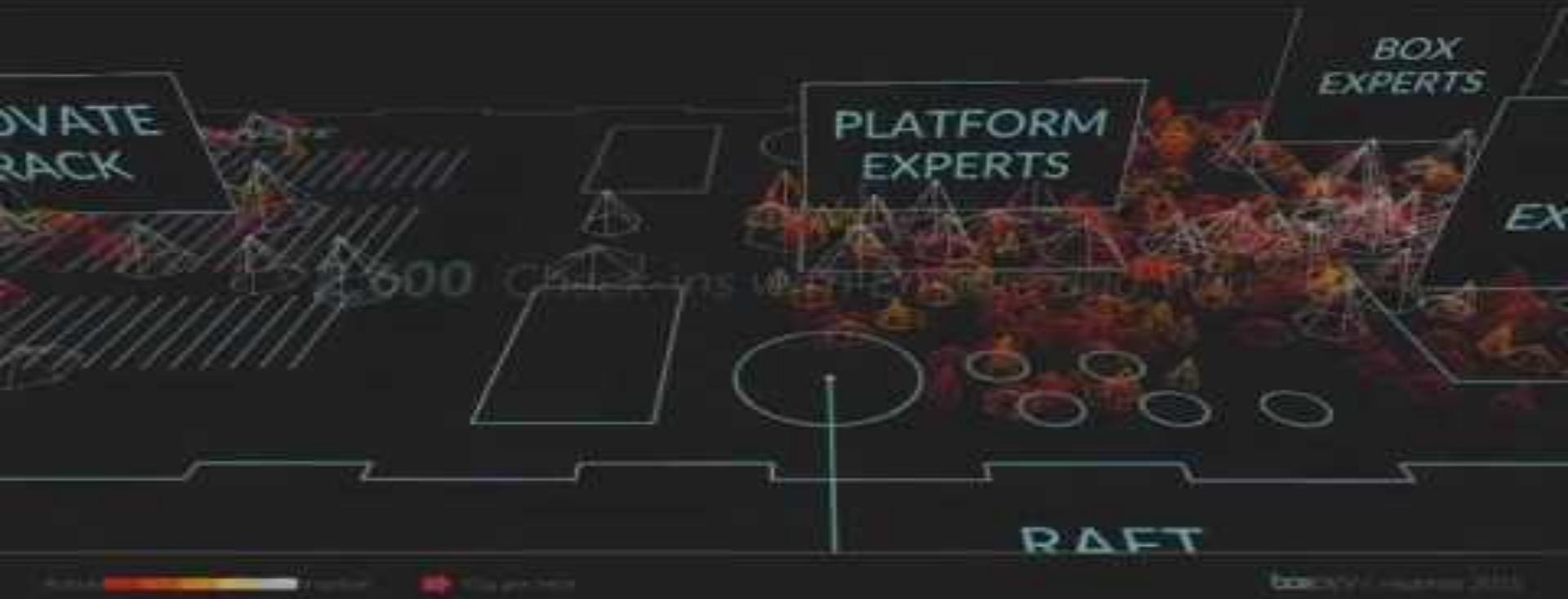
Marriott designed a temperature-controlled virtual phone booth that, using a headset, allowed customers and the public to visit the Apartment, the company's New York City store in SoHo.



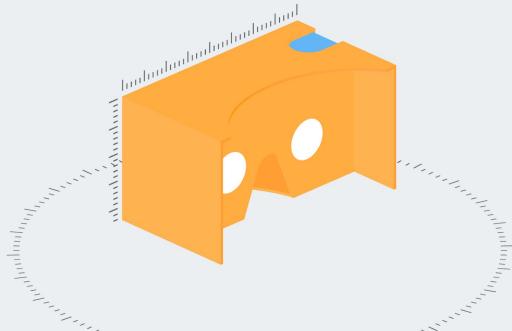
Luxury retailer the Line is using VR to create a virtual pop-up shop that enables consumers to tour the Apartment, the company's New York City store in SoHo.

1:30pm Execute - Designing for Enterprise

2:50pm



# Physics of Simulated Reality (VR)



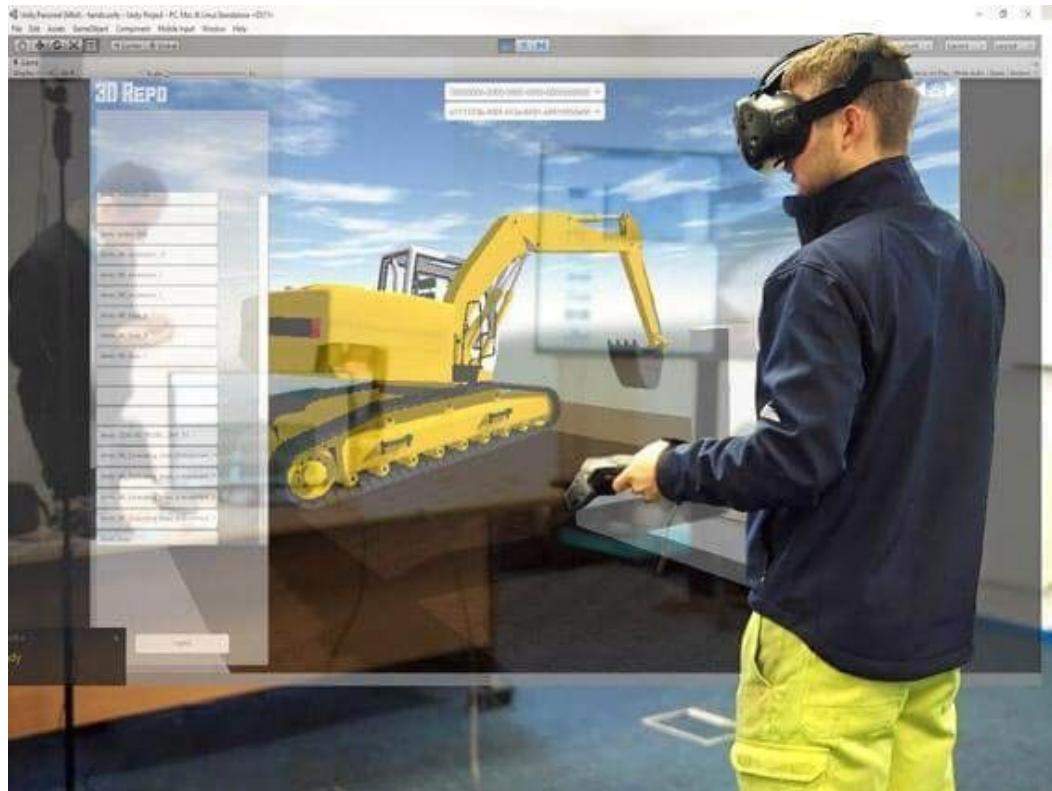
1. Uses gyroscope and accelerometer to align the scene around you.
2. These devices help in determining the DOF.
3. Stereoscopics helps you to view in 3D.
4. HUD's use fresnal lenses to form images at infinity.
5. Images formed in VR mode are slightly offset for fake 3D vision perception.

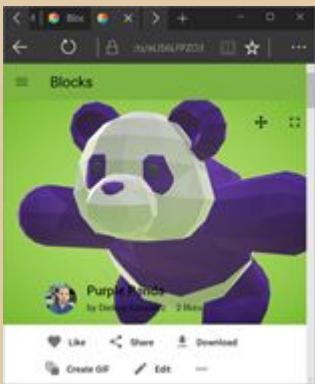


# VR for Design

Tools popularly used to design for VR:

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



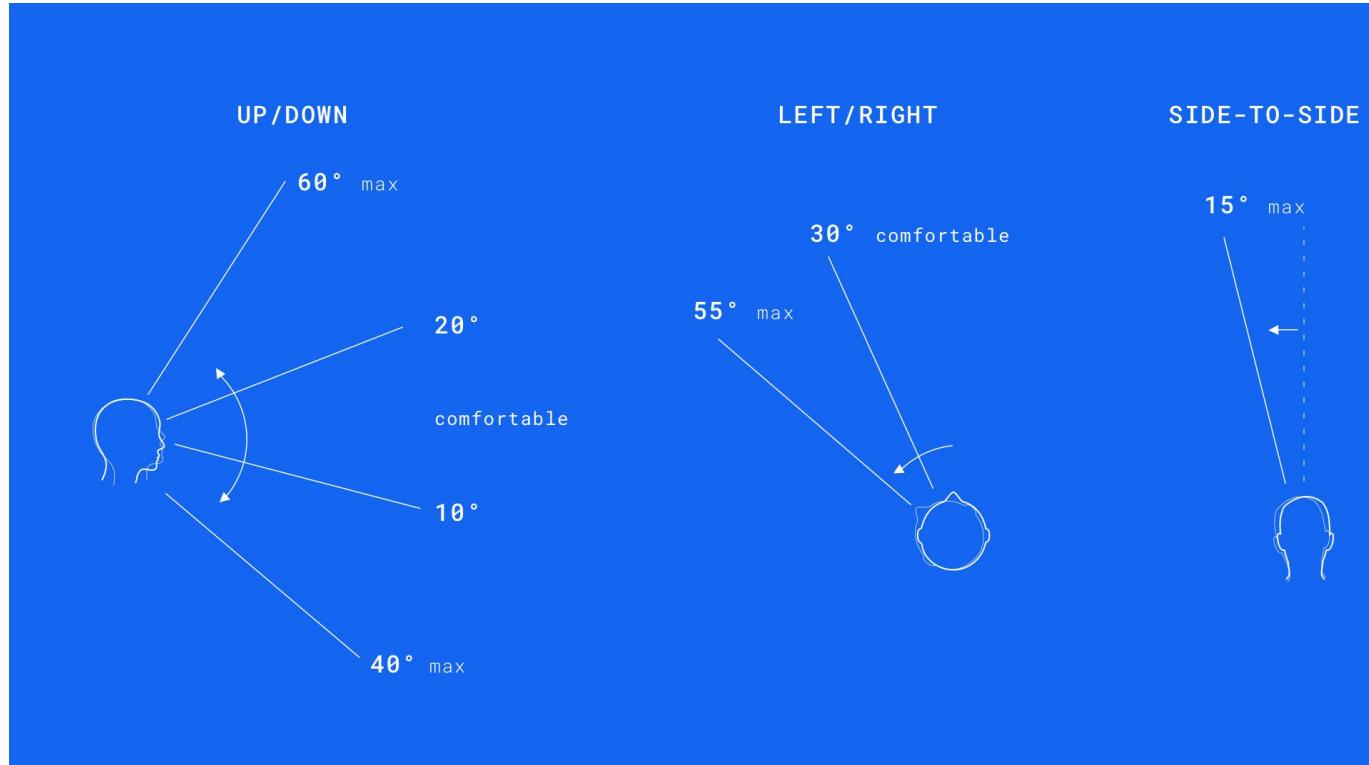


# Google Blocks

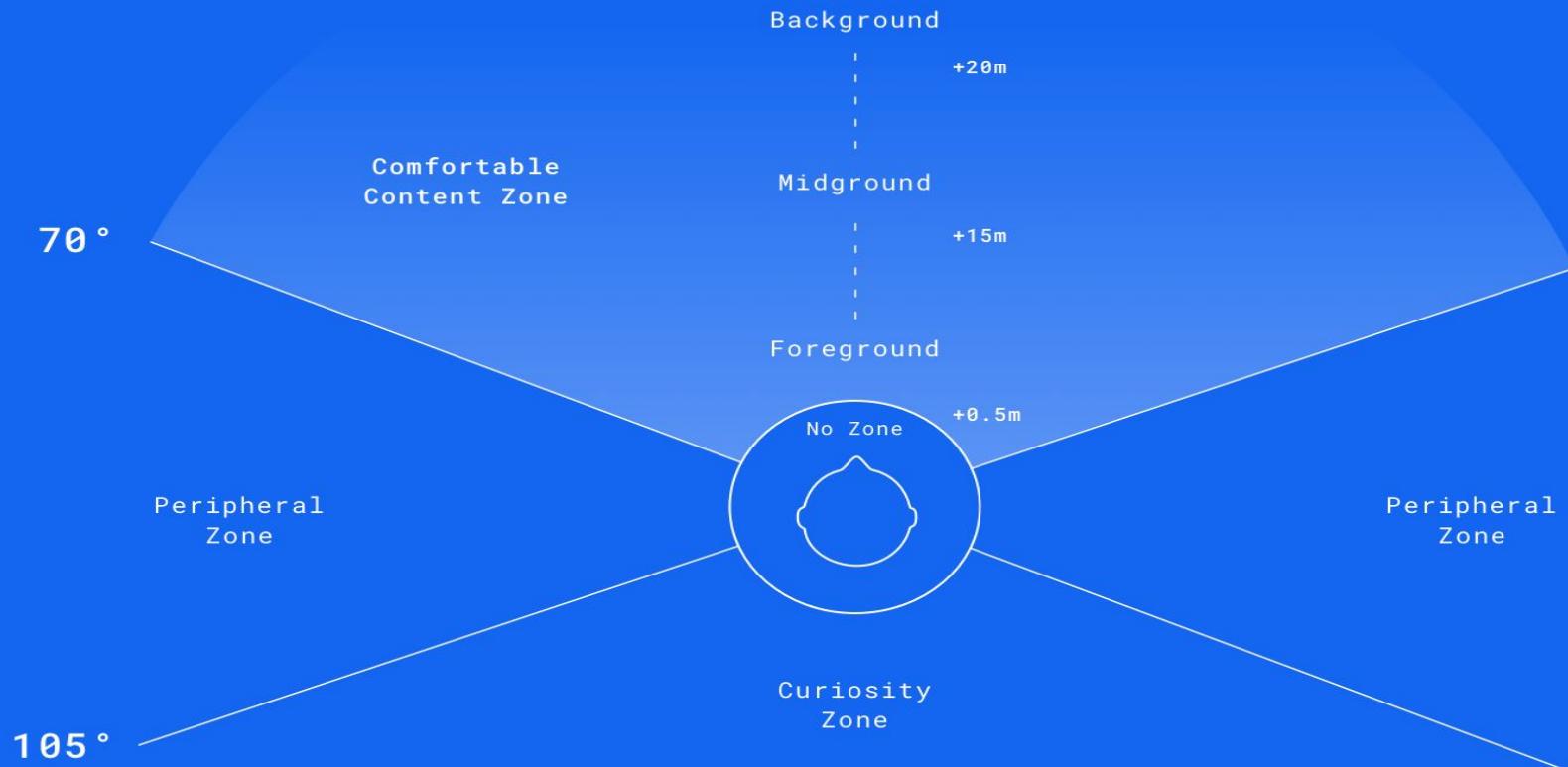
# UX of Design: Ergonomics



Range of Motion:



# VIEWING ZONES





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

Hint: Don Norman, 1988

# Technical Module



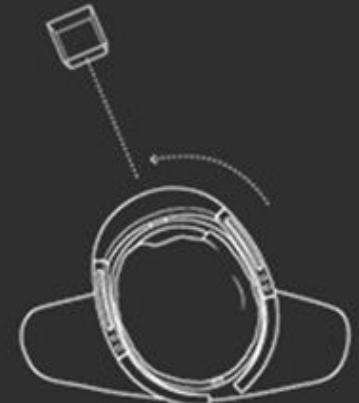
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# Features XR devices have?

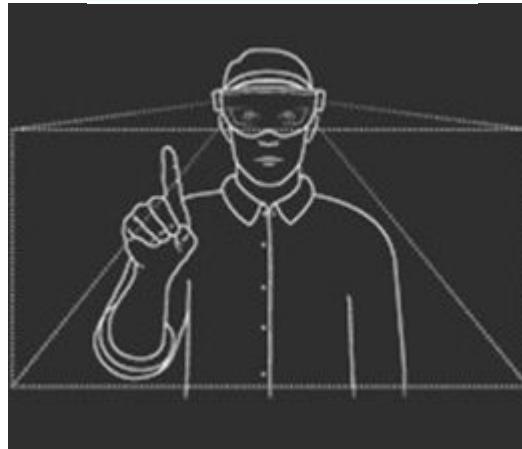




Gaze



Gesture



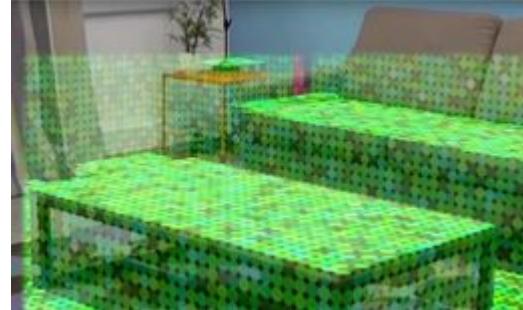
Voice commands



Spatial sound



Spatial mapping



World coordinates



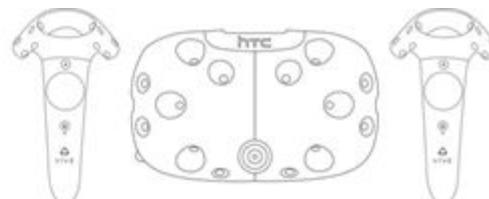
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# WebVR

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?

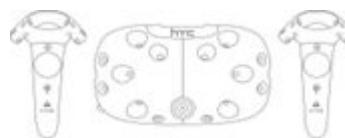
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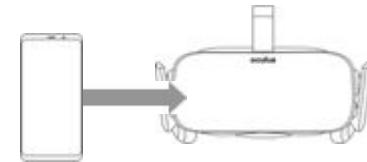
Google VR SDK  
(iOS/Android/Unity)



Oculus Mobile SDK



Viveport SDK  
(Android/Windows)

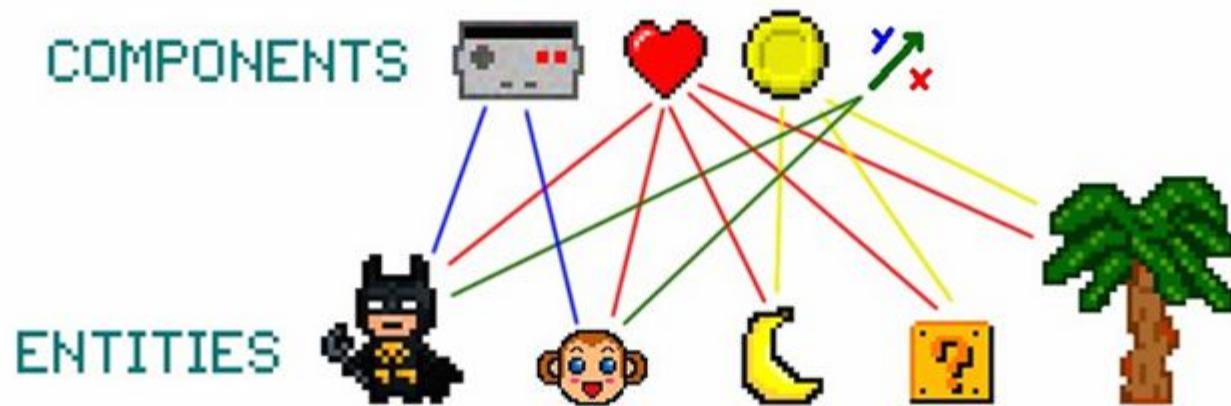


WebVR

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



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



# Entity-Component System



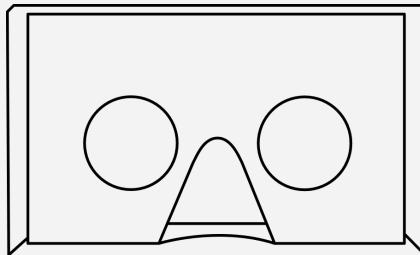
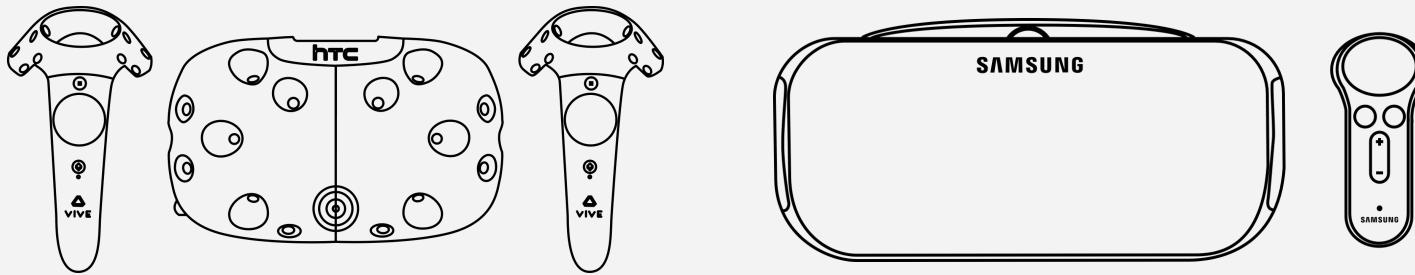
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Other Players in Market?

PWA



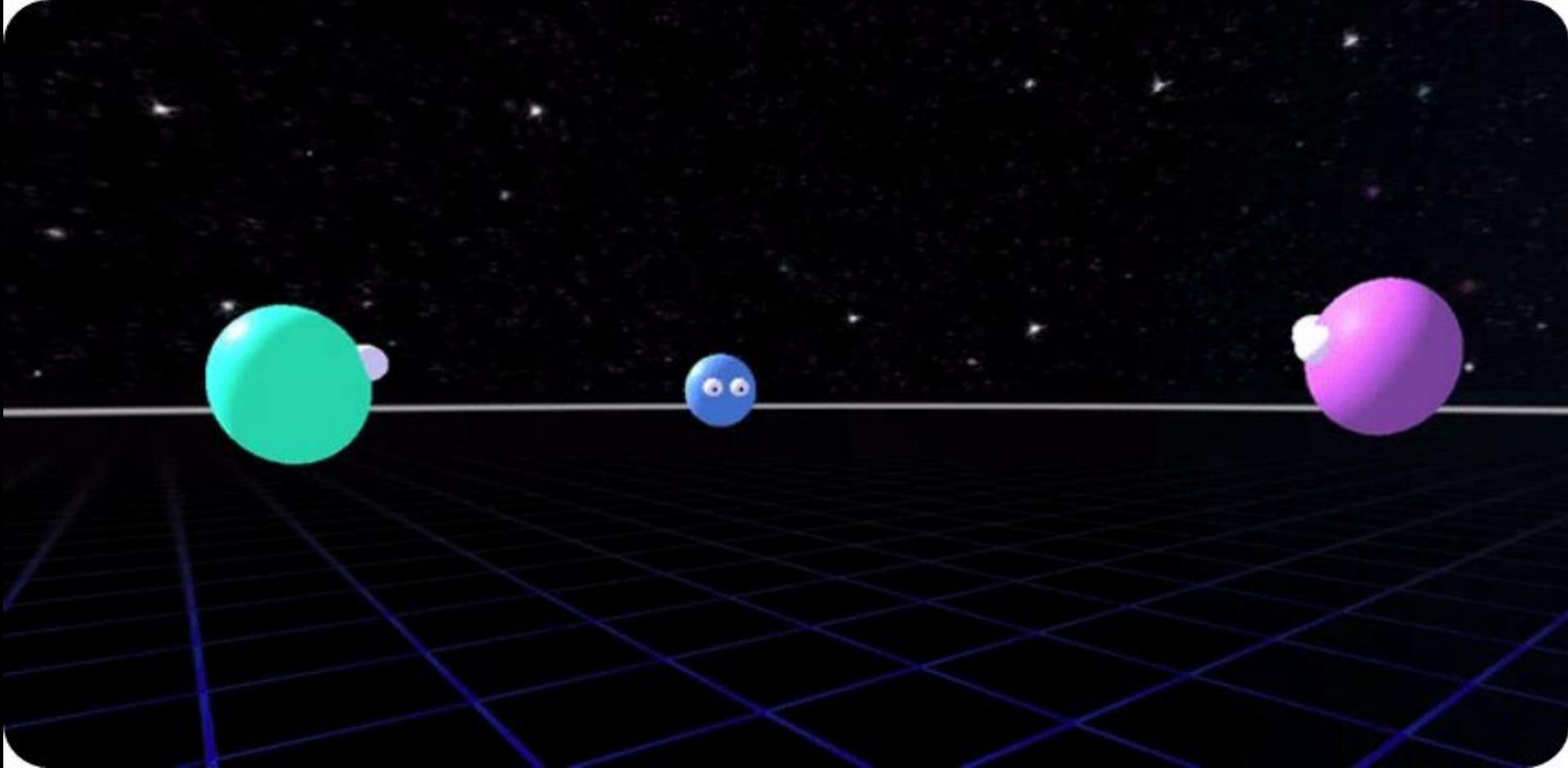
# Cross Device Support for VR/AR/MR



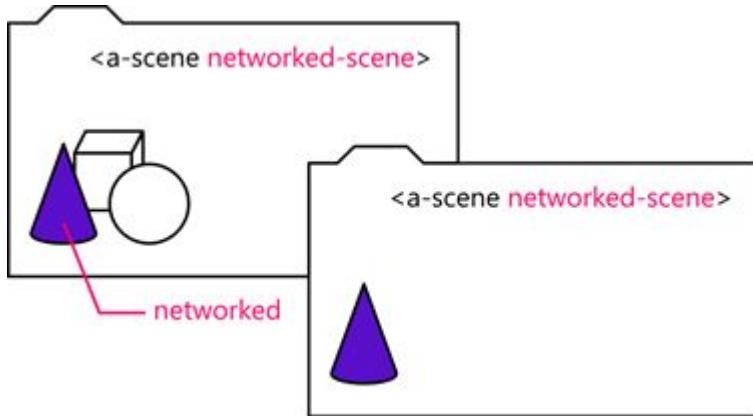


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# Social VR : Networked Aframe



# 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

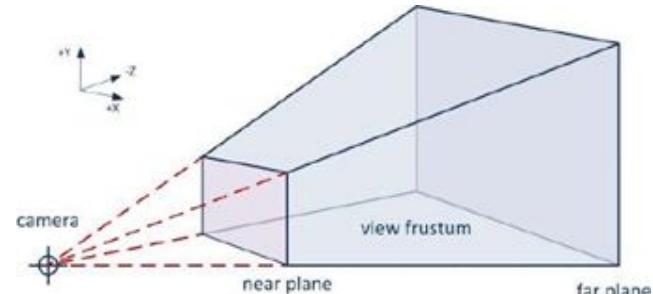




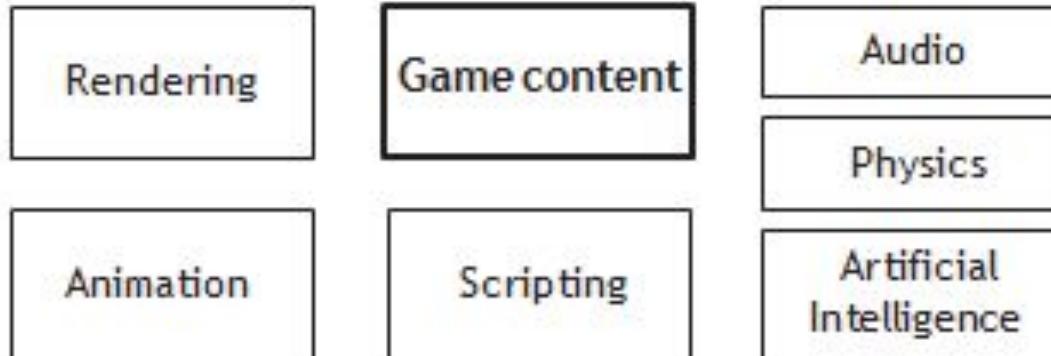
# Standalone VR : Unity vs Unreal



# 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 (atleast 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	
<ul style="list-style-type: none"><li>Free for personal use or commercial use with annual revenue less than \$100k.</li><li>The Free edition lacks of Profiler feature, which is used for performance benchmark for the project</li></ul>	<ul style="list-style-type: none"><li>Free for personal use. Includes all features, it is no difference between Free edition &amp; Premium edition.</li><li>Requires 5% profit for commercial use</li></ul>
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

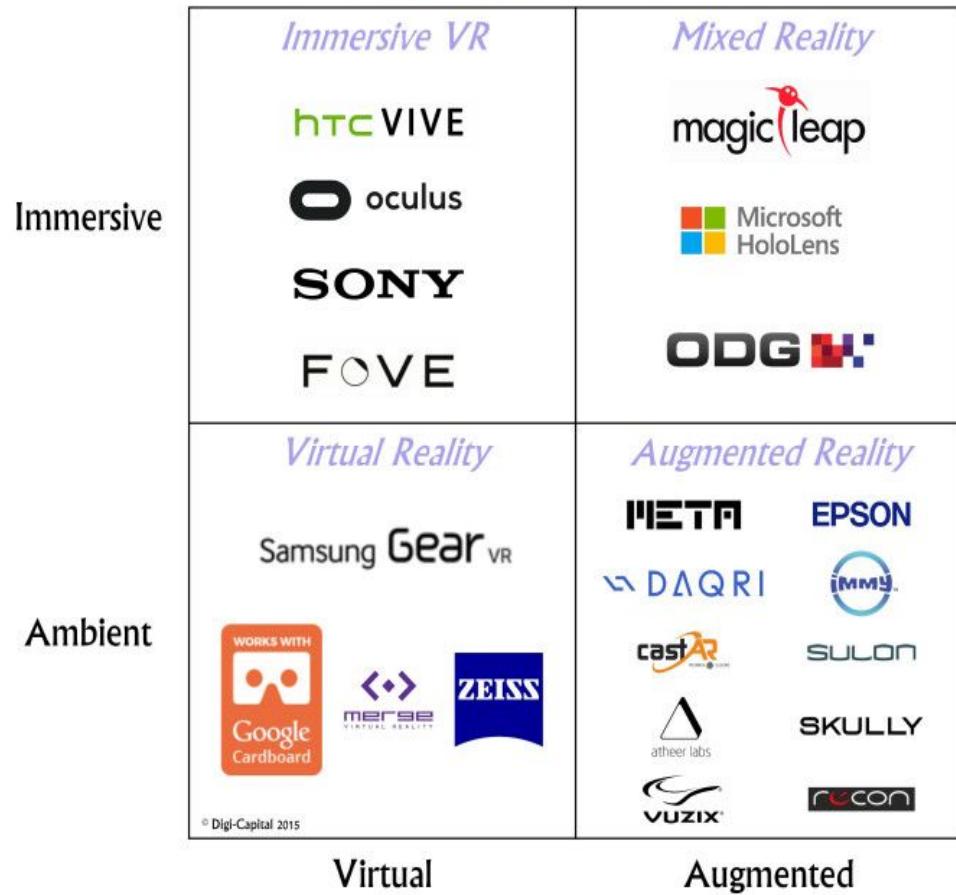


# Starter Kit: VR/AR Design and Production?



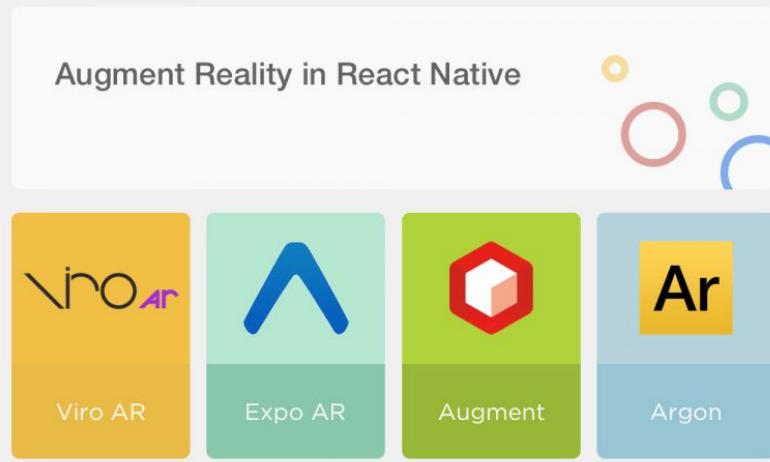
Vs.

ARCore

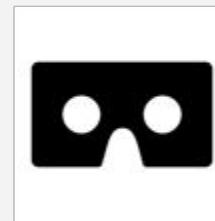




## React based WebAR



# React-Web-AR

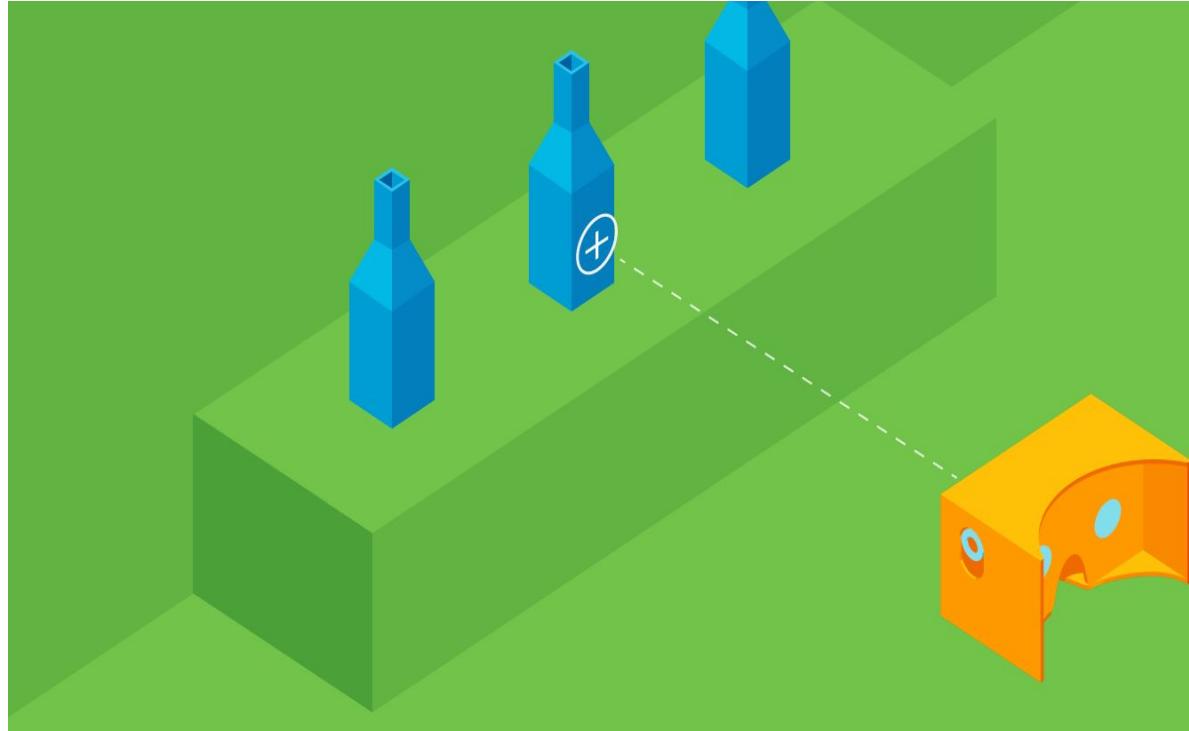


Augmented Reality on web with React

# For all the Non-coders



**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)

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# 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.



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## Exit Notes:

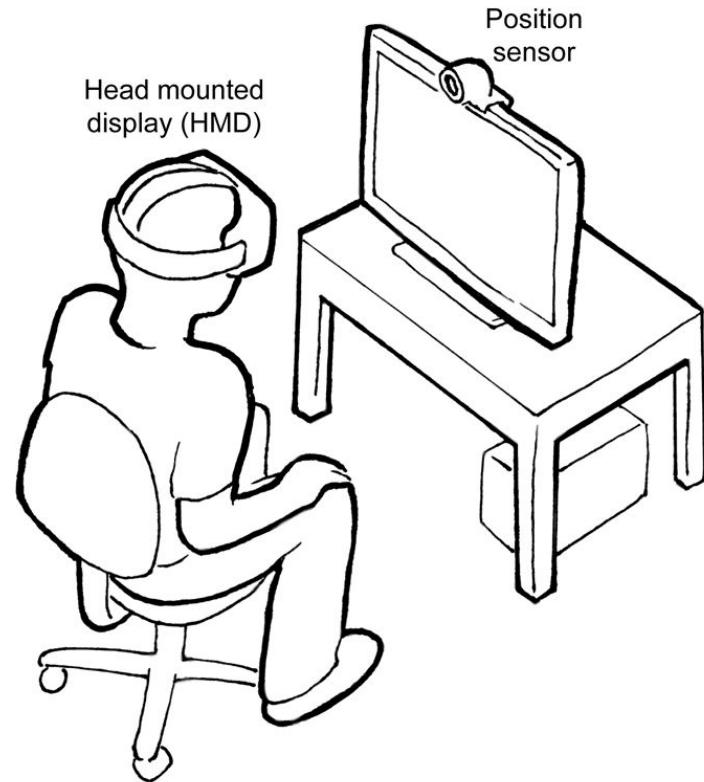
There are some fundamental design steps to be followed when designing for any immersive surface.

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\(\)`](#)).



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# Augmented Reality



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# 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

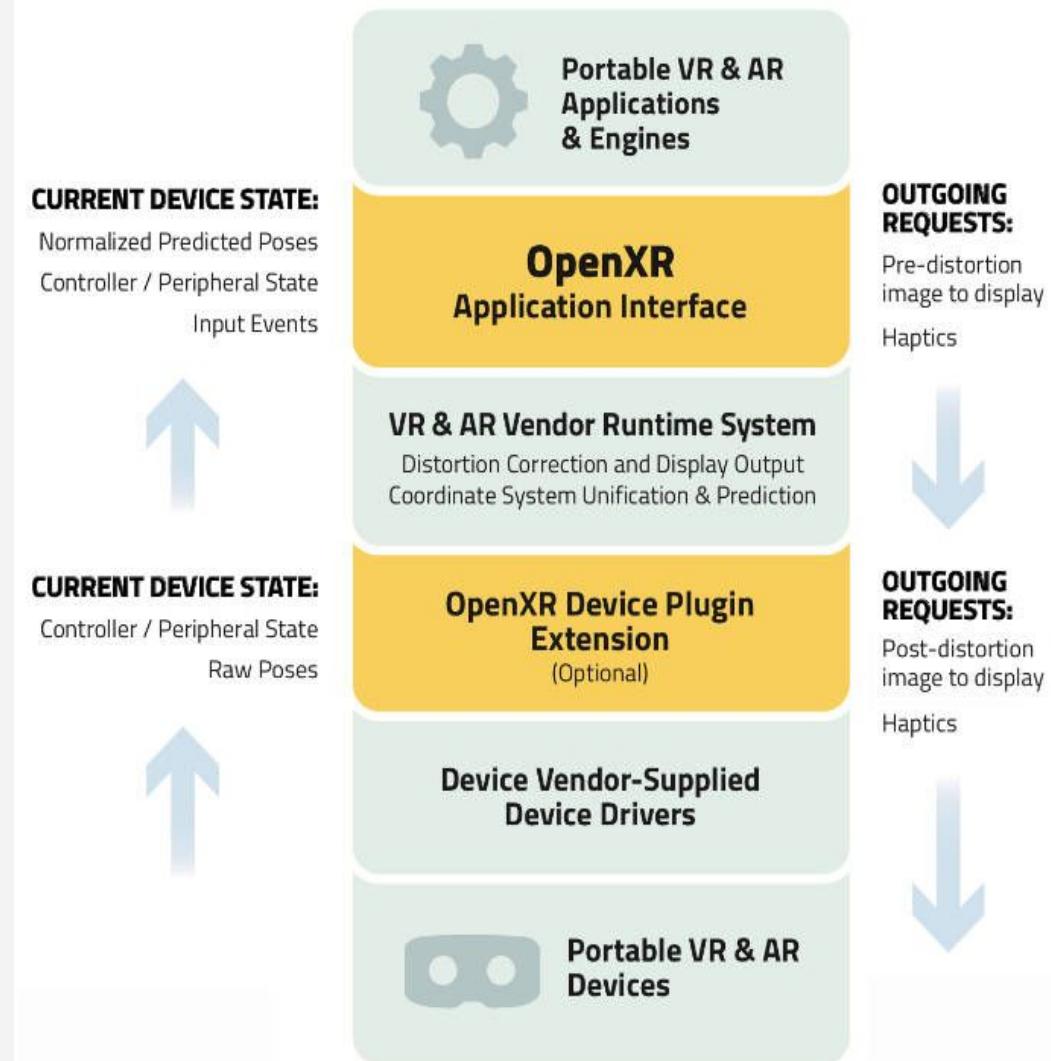


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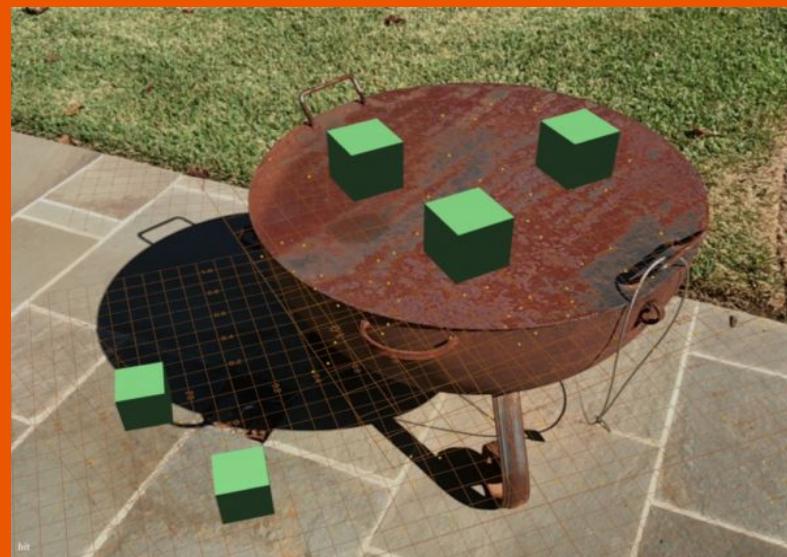
## What is XR?

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

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1. Aircraft 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.





## **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?



# 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.

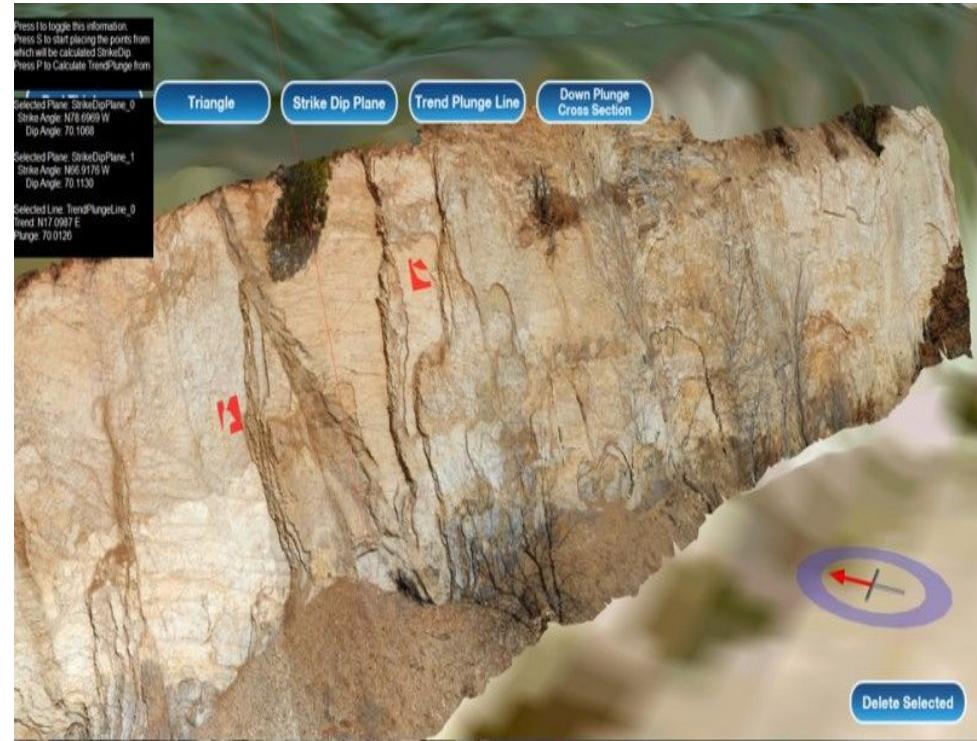
VR based Training and Field trips  
Immersive Oil Rig Training

## **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

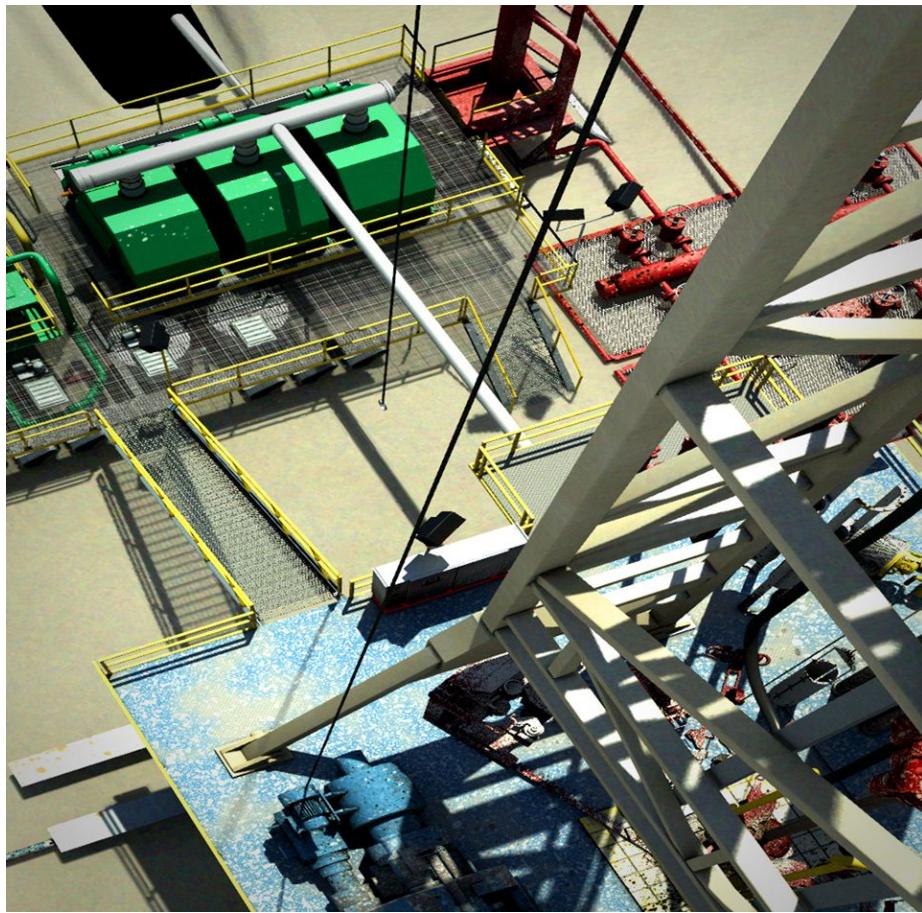
# Field trip VR Simulations



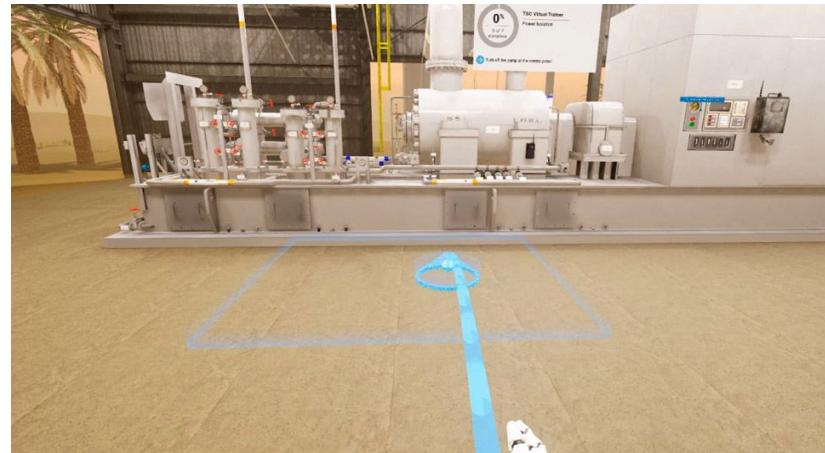
# Competence Assessment of Oil Rig Workforce



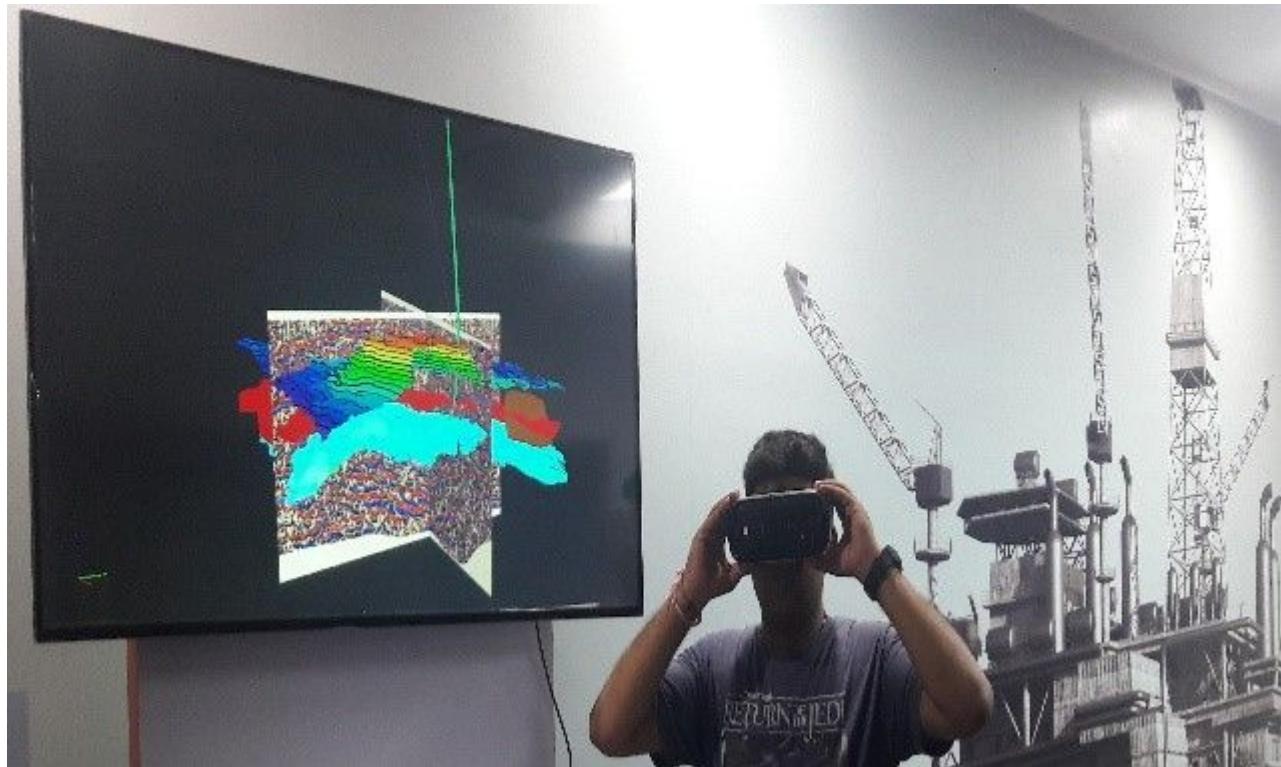
# Oil Rig Training



# 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



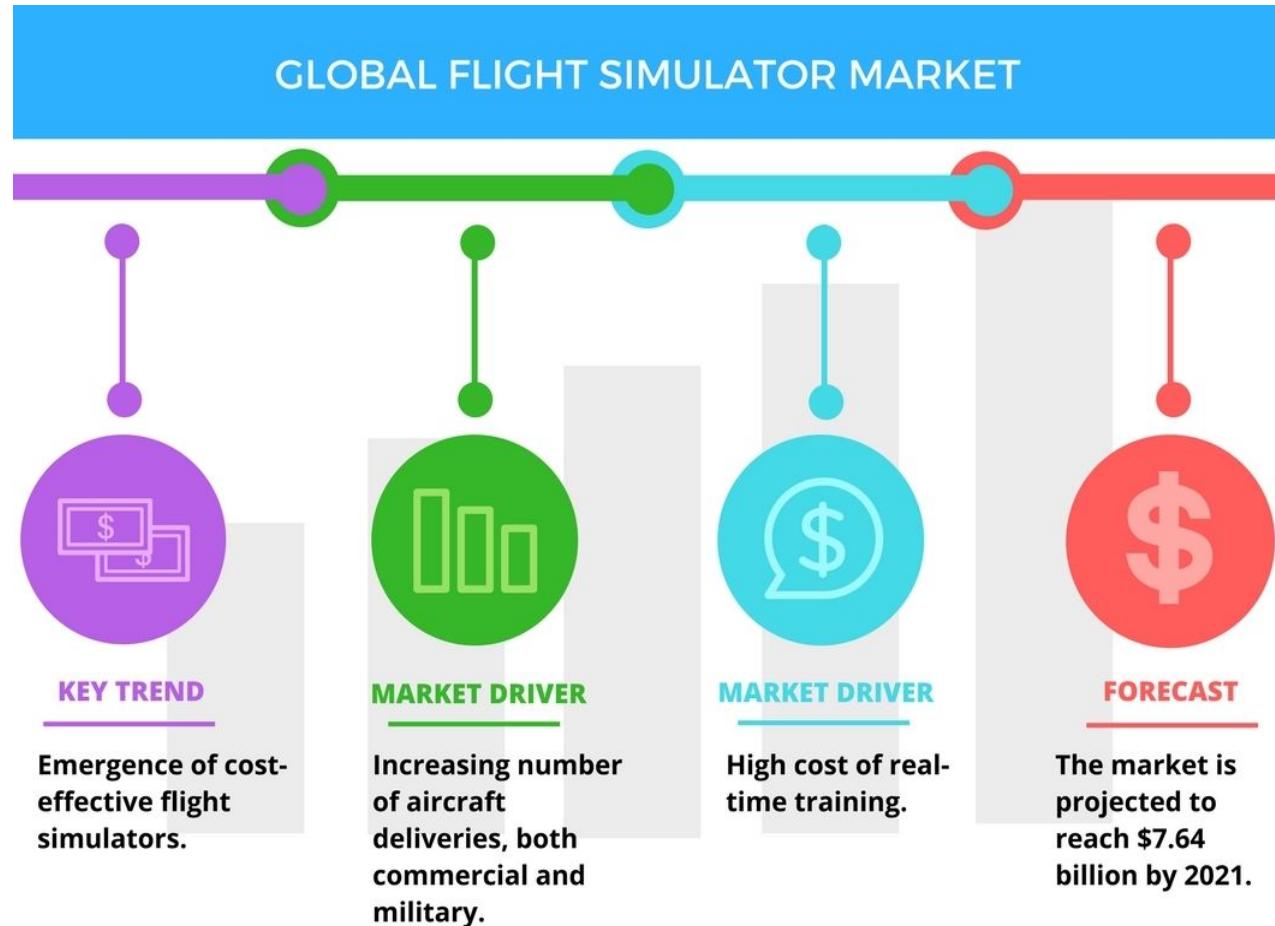
## VR reduces turnaround time



# 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.

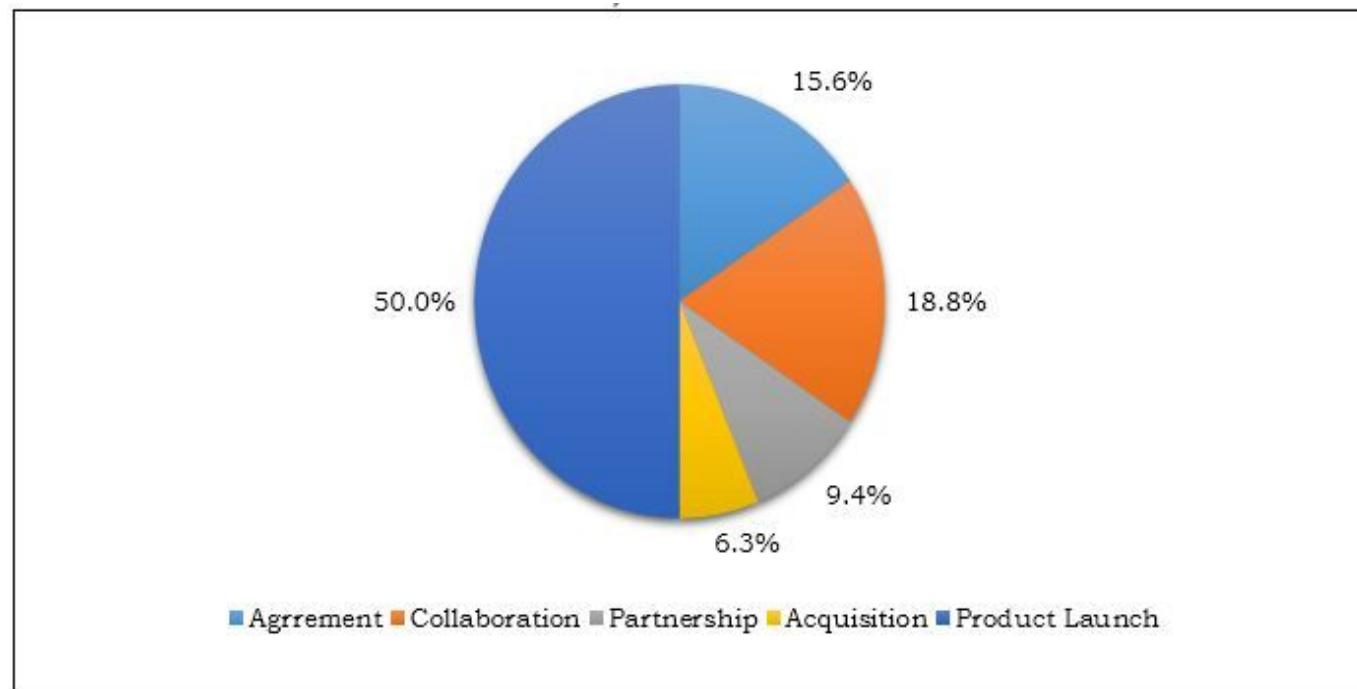
It is used in the wide area of applications, including in flight simulation, simulation-based gaming, serious games, healthcare training, energy, transportation training, e-learning, military & navy, digital manufacturing, and others. Virtual training and simulation tools comprise hardware and software.



# 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



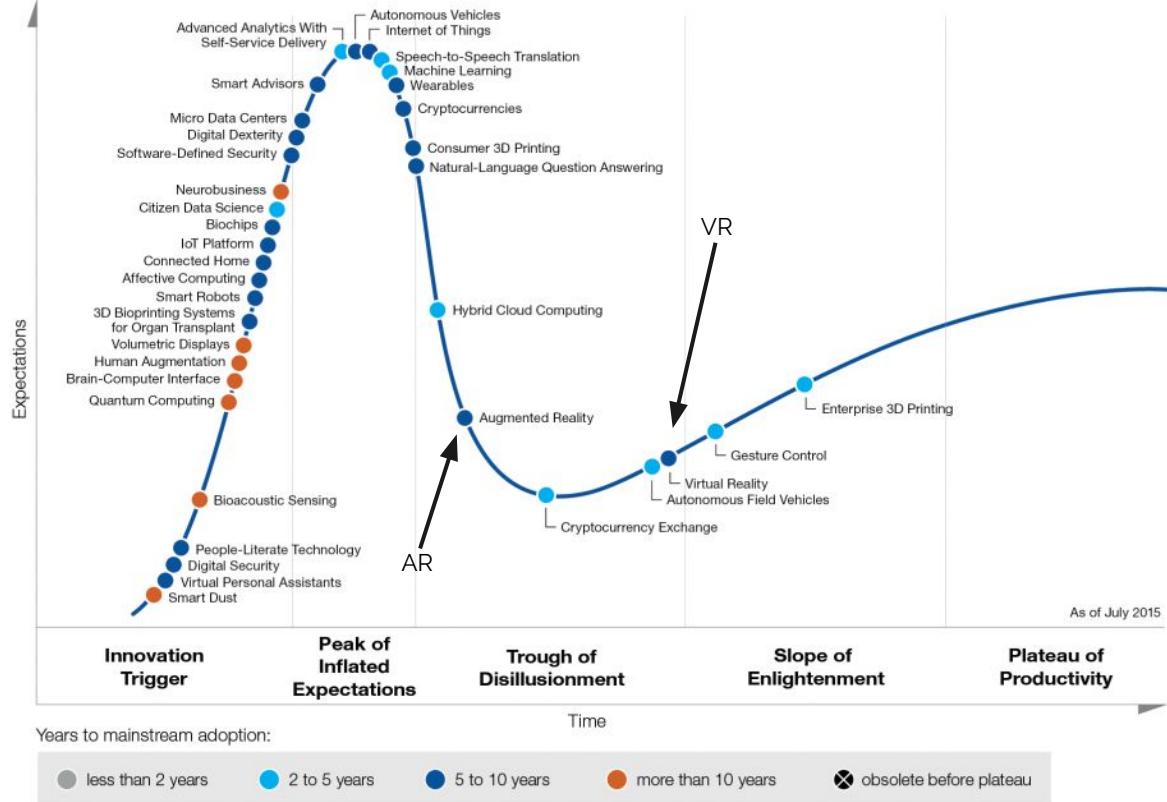
# Real Time application of AR-VR technologies to revolutionize Energy Industry

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.



# **Emerging Technology Hype Cycle**



[gartner.com/SmarterWithGartner](http://gartner.com/SmarterWithGartner)

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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.

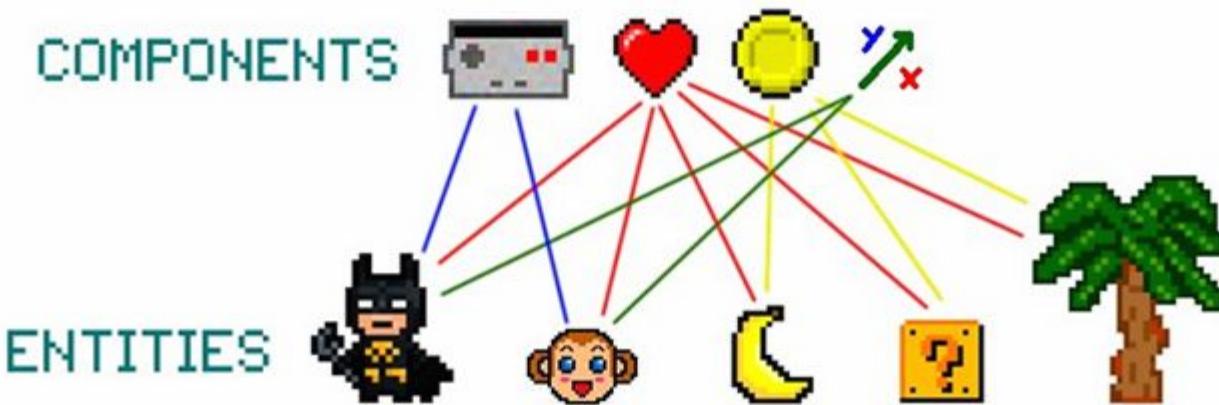
Overall Benefits for Energy :

- 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.

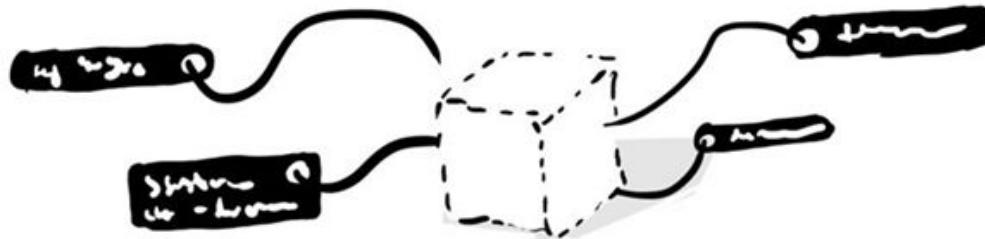


# Questions?

For Slides follow  
Twitter: **@pandastichuman**



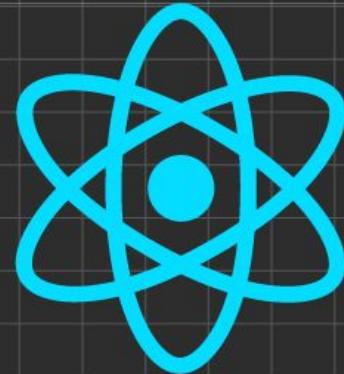
# Entity-Component System





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# React Ecosystem for VR/AR



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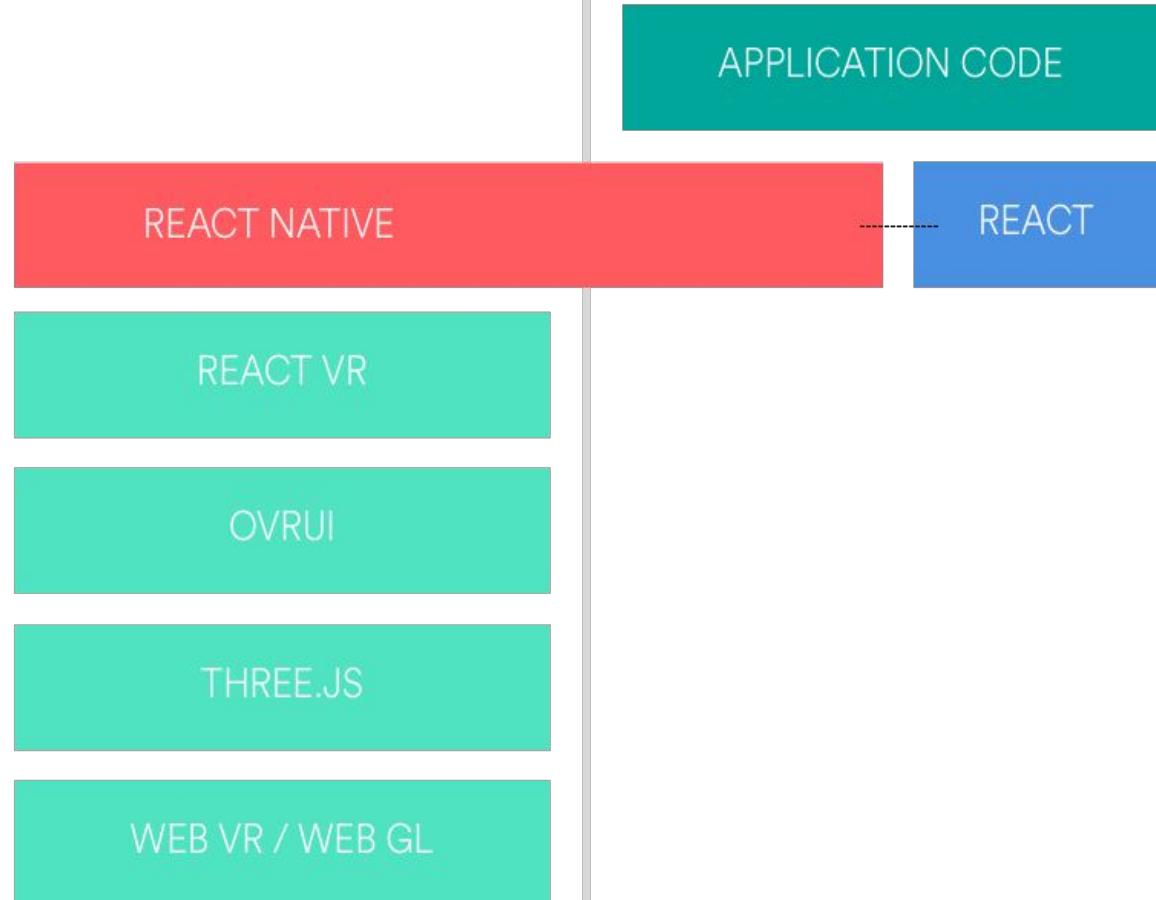
# React 360 : Facebook's own WebVR Framework

# How ReactVR?

- Based on Three.js library
- OVRUI : Oculus VR UI
- React Native Elements:  
**View, Image, Text, etc**
- React VR adds : **Pano, Mesh, Pointlight & others**
- Getting started is easy-peasy.

## BROWSER MAIN THREAD

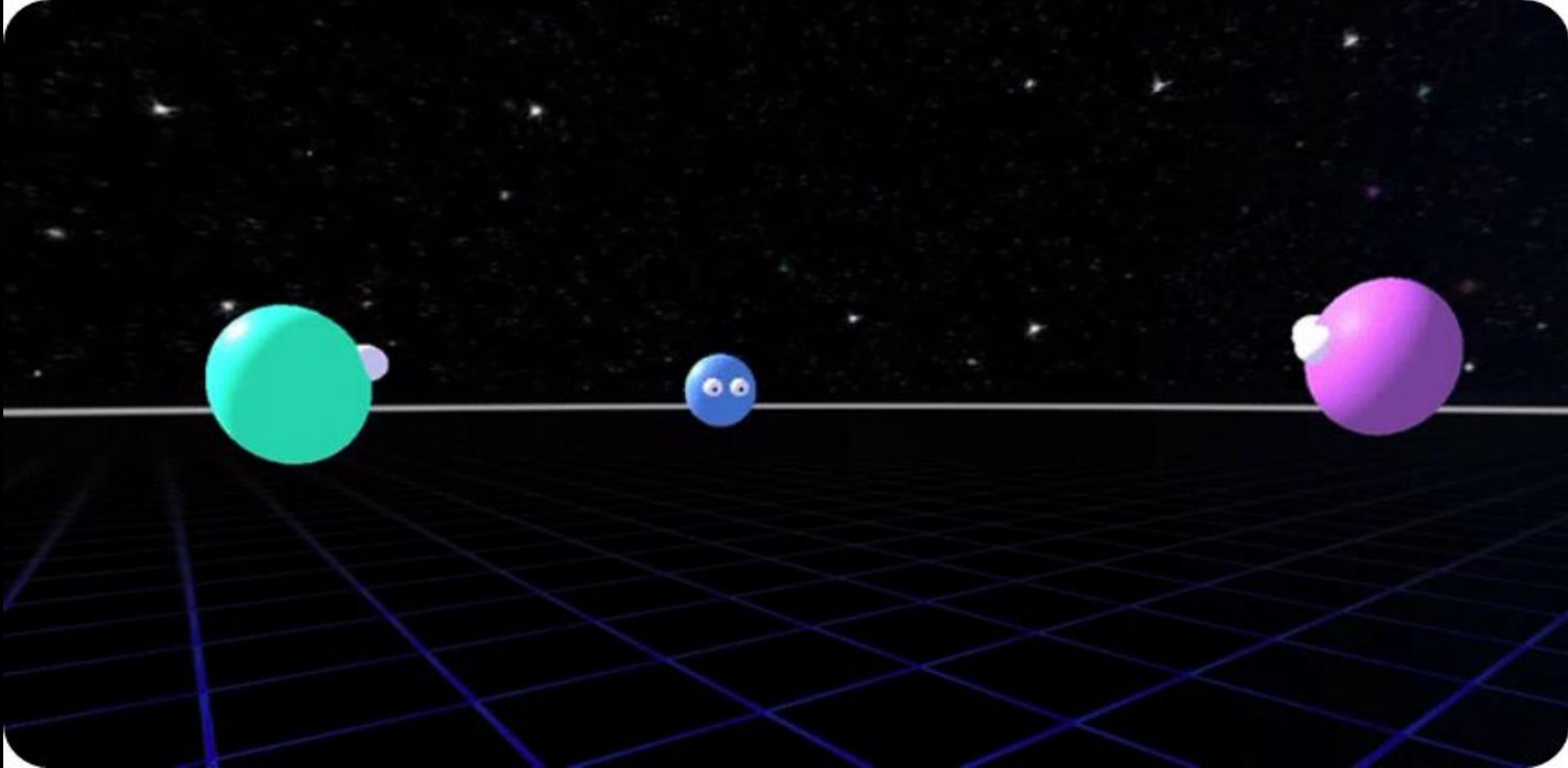
## WEB WORKER



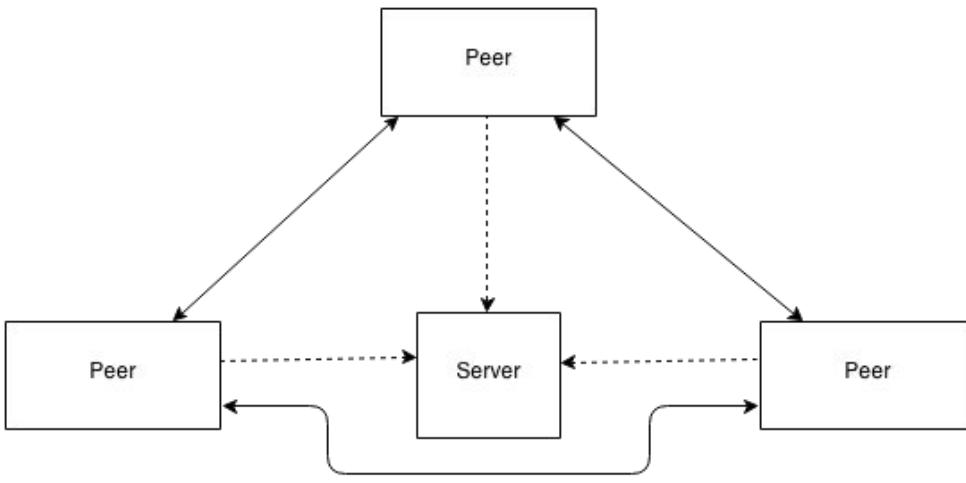


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# Social VR with ReactVR



# 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



# Prototyping Tools

# ViroReact / ViroAR



## Features

### Cross Platform Development

Write once, run anywhere across all mobile AR (ARKit, ARCore) and VR (Cardboard iOS/Android, GearVR, Daydream)



### React Native Framework

Create apps using React Native, making it easy for web developers to get started.



### Powerful Renderer

Create stunning scenes with PBR, HDR, Realtime Lighting, Physics, Particles, and more.



### Rapid Iteration

Use the free Viro Testbed app to view your app and see your changes quickly. No need to wait for recompile. It's like refreshing a browser.



### Documentation

We provide you with extensive developer support and documentation.



# Questions?

Connect with me:

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Twitter: @shivank1995

