Virtual Reality (VR) – Introduction, Application and Use Case

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Is this VR?

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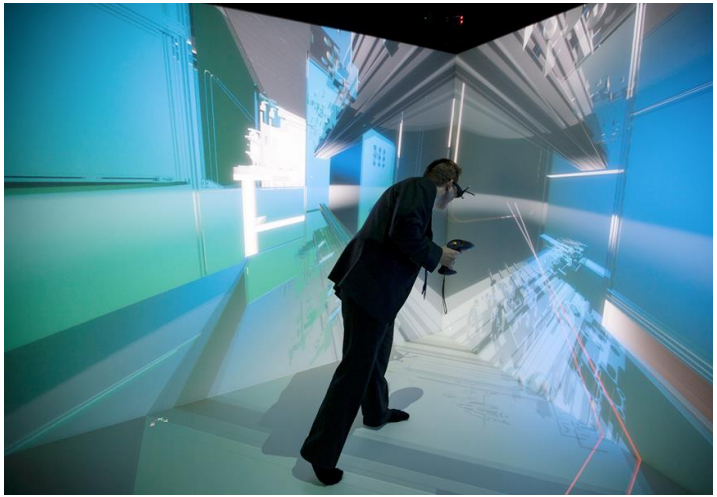

Is this VR?

What is VR?

A medium composed of interactive computer simulations that sense the participant's position and actions, providing synthetic feedback to one or more senses, giving the feeling of being immersed or being present in the simulation

- Typical VR stimuli is visual, often combined with aural stimuli.
- Sometimes haptic feedback (skin sensation and/or force feedback) is combined with visual and aural stimuli
- Less frequent are vestibular (balance), olfaction (smell) and gustation (taste)

What is VR?

Deeper & slightly different perspective

VR is defined as the use of a computer-generated 3D environment – called a ‘virtual environment’ (VE) – that one can navigate and possibly interact with, resulting in real-time simulation of one or more of the user's five senses.

- ‘Navigate’ refers to the ability to move around and explore the VE
- ‘Interact’ refers to the ability to select and move objects within the VE

Burdea and Coiffet, 2003; Vince, 2004; Gutiérrez, Vexo, and Thalmann, 2008

Important Factors in VR

Immersion (Immersive VR)

- ‘Immersion’ refers to the extent to which a user is isolated from the real world
- In a ‘fully immersive system’ the user is completely encompassed by the VE and has no interaction with the real world, while in a ‘semi-immersive’ or ‘non-immersive system’ (the latter includes contemporary 3D video games) the user retains some contact with the real world

Important Factors in VR

Presence – sense of “being there”

- The common view is that presence is the sense of being in a VE rather than the place in which the participant's body is actually located*
- A sign of presence is when people behave in a VE in a way that is close to the way they would behave in a similar real-life situation+

+Gutiérrez, Vexo, and Thalmann, 2008; *Sanchez-Vives & Slater, 2005

Reality-Virtuality Continuum

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Real Environment

We know this, right?

Augmented Reality


Virtual information layered on the real environment

Augmented Virtuality

Heavily adopted virtual interface/environment supported through real world components

Virtual Environment

True virtual environments are artificially created without capturing content from the real world – through creation of computer simulation

Application Areas of VR

Application Areas of VR

- VR films (or 360 degree films)
- Virtual prototyping
- Training personal using virtual simulations
- Data visualization
- VR for Therapy
- Experience the unexperienced

Application Areas – Virtual Prototyping

Classic genre of VR is virtual prototyping

https://www.youtube.com/watch?v=eJx7T-H00SE&ab_channel=NewAtlas

Application Areas – Virtual Prototyping

Helps in viewing and evaluating product from different perspectives e.g. ergonomics, constructability and aesthetics.

Discover little annoyances or big problems that change the direction of product design

Helps in how easy is to construct, maintain and enable workers to experience it in a realistic manner

Application Areas – Virtual Prototyping

Maintenance workers can be asked to examine probable problems and investigate successful completion of each task

Application Areas – Virtual Training

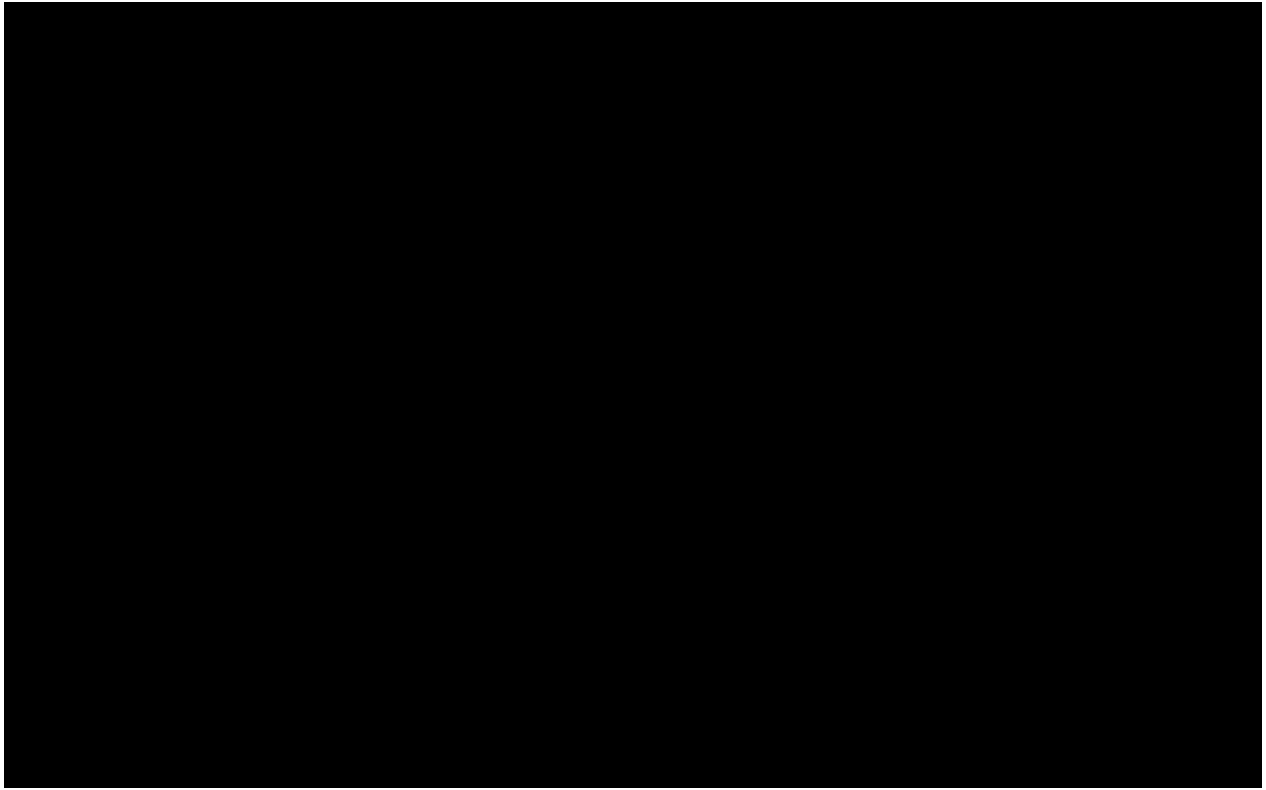
Enables virtual training (industrial and non-industrial) for expensive system in a controlled environment to save cost and provide a safe virtual training setting

Application Areas – Virtual Training

It allows the ability to practice uncommon, expensive and dangerous tasks which may be helpful to users in scenarios such as military, war, medical emergencies etc.

Allows recording and analysis of performance of the trainee to design better training modules effectively and cheap. E.g. surgical suturing, invasive surgeries, anesthesia administration and more medical training applications

Application Areas – Walk through



https://www.youtube.com/watch?v=rCpSZxlURGY&t=132s

Application Areas – Walk through

Allows client to experience it first hand, instead of imagining the drawings in 3D world.

Allows review of design prior to beginning the construction to find undesirable features in time to make changes inexpensively

Enables to view the design in different lighting and visual aesthetics, scale, accessibility and usability of the space

It allows creation of historical places and museums to experience the events from the past

Application Areas – Data Visualization

https://www.youtube.com/watch?v=u76ww3NJFgE&ab_channel=Looker

Application Areas – Data Visualization

To enable useful analysis of large dataset, VR interfaces can accommodate the space of interactive tools designed for effective visualization.

Very helpful in the space of medical imaging and data analysis, when 3D data enables viewing data from different perspectives. E.g. CT and MRI scan data visualization

VR in the domain of scientific visualization – to simulate flow under various conditions (e.g. flow of air over a wing, or blood through an artery, how atoms and molecules interact)

Application Areas – Experiencing the Non-experienced

Making the invisible visible

Learning or understanding others' point-of-view

Detour: Brain Deconstruction Ahead – project by Rita Addison gave people the ability to visually experience the world through the eyes of someone suffering the aftereffects of brain injury

FIGURE 2-2
Vision becomes cloudy and warped in the "Detour: Brain Deconstruction Ahead" VR art experience. Photography by William Sherman

Advantages and Challenges

VR - Advantages

Transcends the barrier of time and space

Lower product development and modification time

Low cost – A model based application for which a computer construction is sufficient with less money, resources and infrastructure than physical mockup, VR is extremely advantageous

Time saving & easy reachability - beneficial in viewing cases where increased travel to physical location is needed. If the computer generated world sufficiently represents the physical world, VR can reduce travel time, cost and benefit the users

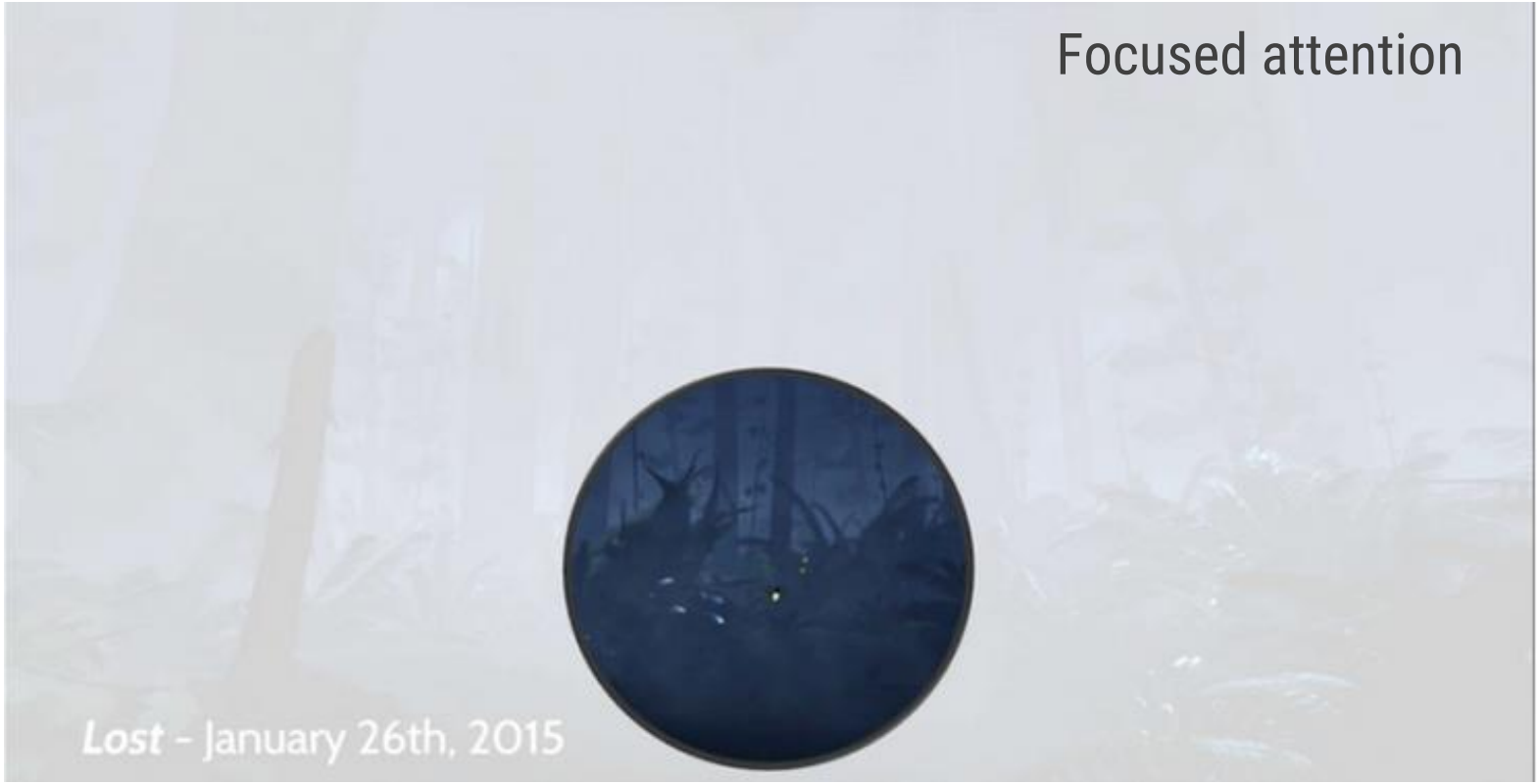
VR - Advantages

Improved learning and skillset creation

Enhance engagement among users, which often results in increased learnability and memorability

Enables imaginary visualization extracted from real world. For example, VR allows to change the surface of the objects to show additional information such as stress, temperature and other attributes which are normally not visible.

VR - Advantages



VR - Advantages

Support collaborative work environment, especially among distant colleagues and friends.

The CAVE like environment is best for collaborating in same physical space

VR - Challenges

No standards on input interaction techniques and user interactions for VR headsets

Vection - (vision + balance) - this situation occurs when user knows he/she is not moving but convinces the brain that he/she is moving through controller. Similar experiences are observed at train stations, where other train is moving but an illusion is created that feels like you are moving, although your mind knows it is not moving.

VR - Challenges

Seamless integration of real world experiences

- head movement to picture movement ratio
- head movement to audio movement ratio
- immersion using other senses
- degree of freedom
- field of view - this all leads to comfort & reduce effect of nausea

Latency - meaning the movement of your head should sink to the display, so your brain does not have to train itself (between user moving and system reacting to it)

VR - Challenges

Challenges exist in form of physical safety (with HMDs), physical comfort and psychological safety for the virtual environments we design

The absence of synchronization between displays leads to negative artifacts, poor user experience and effectiveness such as world appearing discontinuous between two neighboring screens (for cases of multiple projections or CAVE)

Thank You