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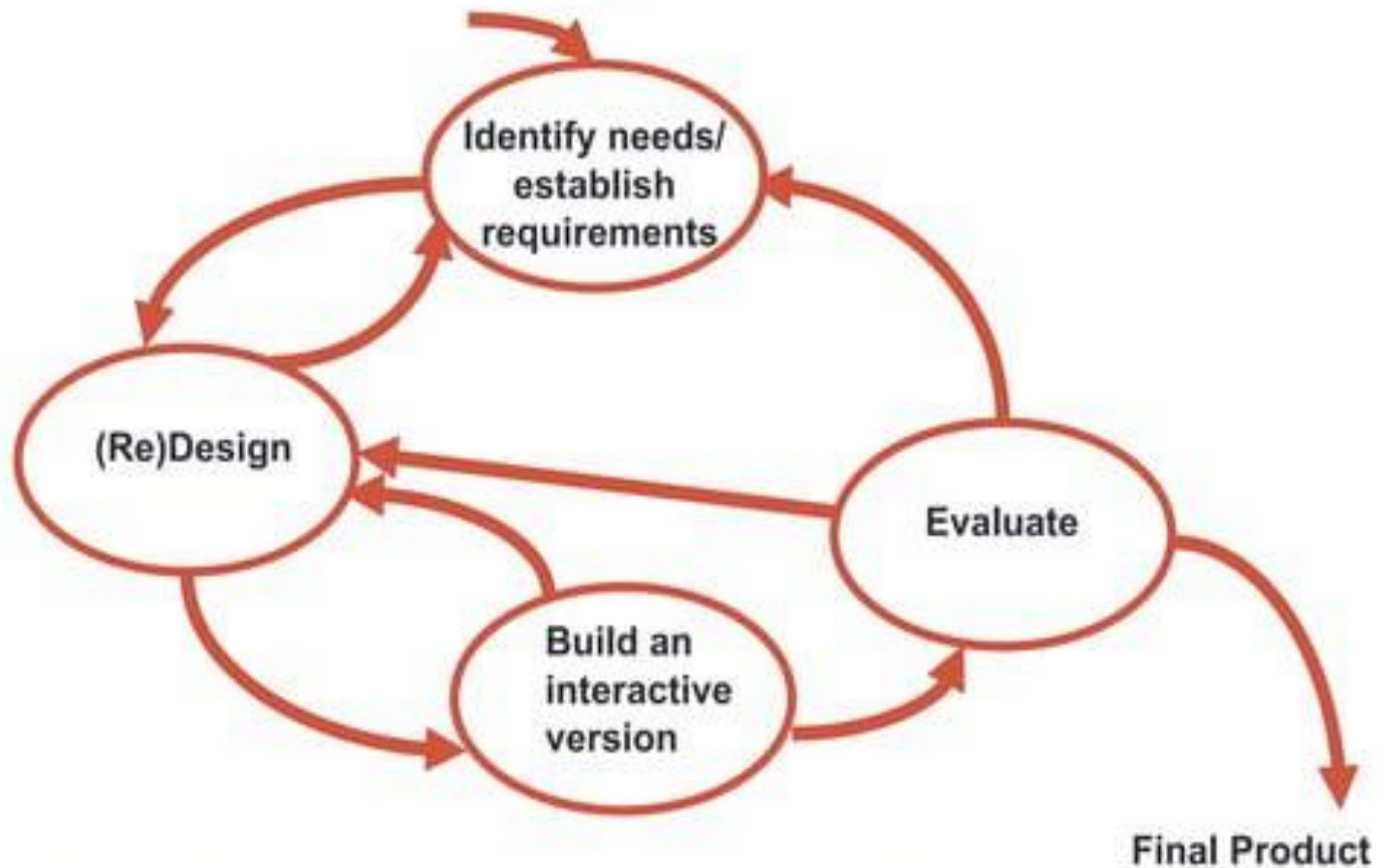
Department of Biomedical Engineering

Course Name: 19BMT401 – Virtual Reality in Medicine

IV Year : VII Semester

Unit V –APPLICATIONS

The Interaction Design Process



Develop alternative prototypes/concepts and compare them
And iterate, iterate, iterate.

Methods for Identifying User Needs

Learn from people



Learn from Experts

Learn from analogous settings


Immersive yourself in context

VR Design Considerations

- **Use UI Best Practices**
 - Adapt known UI guidelines to VR
- **Use of Interface Metaphors/Affordances**
 - Decide best metaphor for VR application
- **Design for Humans**
 - Use Human Information Processing model
- **Design for Different User Groups**
 - Different users may have unique needs
- **Design for the Whole User**
 - Social, cultural, emotional, physical cognitive

Typical Development Steps

- Sketching
- Storyboards
- UI Mockups
- Interaction Flows
- Video Prototypes
- Interactive Prototypes
- Final Native Application



*Increased
Fidelity &
Interactivity*

VR Prototyping Tools

- **Low Fidelity**

- Sketched Paper Interfaces – pen/paper, non-interactive
- Onride Photoshop tool – digital, non-interactive
- InstaVR - 360 web based tool, simple interactivity
- SketchBox – create VR interface inside VR
- Microsoft Marquette – mock up VR interfaces in VR

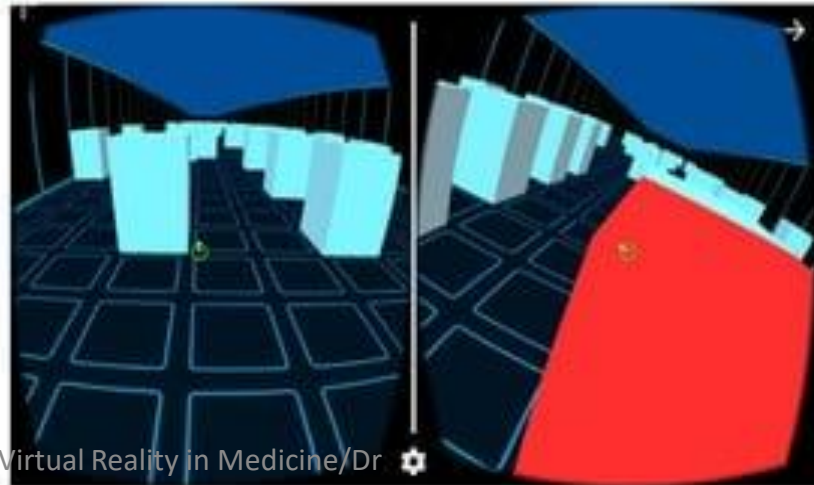
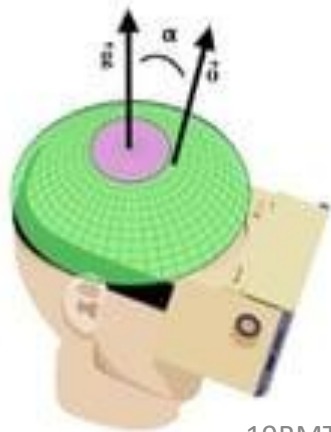
- **High Fidelity**

- EditorVR – Unity wrapper inside VR
- Unity/Unreal Game Engine – programming needed

Four Evaluation Paradigms

- ‘quick and dirty’
- usability testing (lab studies)
- field studies
- predictive evaluation

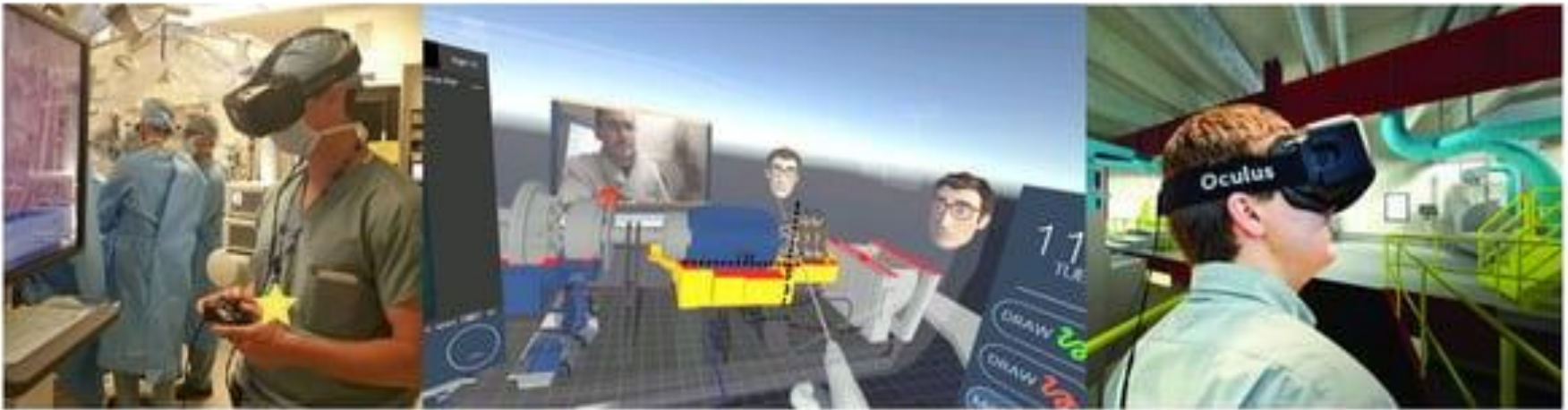
Examples Mentioned





EXAMPLE VR APPLICATIONS

Virtual Reality Applications



- **Ideal applications for VR should:**
 - Be strongly visual, have 3D spatial elements
 - Benefit from first person immersion
 - Benefit from 3D manipulation/navigation
 - Support Autonomy, Interaction and Presence (AIP Cube)
 - Etc..

Not Everything Should be Done in VR



Virtual Reality Spreadsheets

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Dr Fun - 1990

Many Possible Types of VR Applications

Healthcare

Surgeons operate in VR to practice difficult procedures ahead of time



Entertainment

Fully immersive cinematic experiences (Virtual stadiums, Concerts, Theatre)



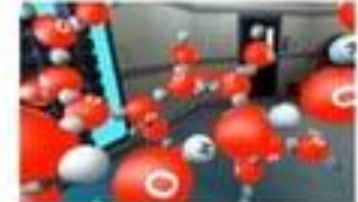
Manufacturing

VR Headsets used to experience, build and inspect prototyping designs



Education

Virtual classes to observe historic, natural and architectural sites to drive deeper subject engagement



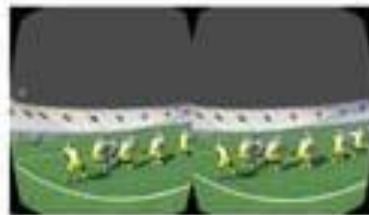
Charity

Charities are allowing people to experience first hand hardships such as war, poverty and natural disaster for a deeper impact



Sporting

Coaches using player point of view simulations to train teams, devise plays and re-visit past games



Military

Virtual combat simulations are used to train soldiers before they are deployed in real life



Travel

Travel agencies let customers experience destinations in VR before they book, from views such as helicopter or submarine



Expected VR and AR Market Sizes in 2025

- Healthcare
- Engineering
- Real Estate
- Retail
- Military
- Education
- Video Games
- Live Events
- Video Entertainment



Potential Disruption for Existing Domains

SOCIAL

"[VR] has the potential to be the most social platform ever. Immersive, virtual and augmented reality will be part of people's daily lives."

Mark Zuckerberg
CEO of Facebook

GAMES

"Working on game development, we always try to create a new kind of experience, and having VR technology is almost unfair."

Shuhei Yoshida
President of Sony PS Studios

FILM

"We're right on the cusp of a major upheaval of the entertainment world once [VR] technology really kicks in."

Peter Jackson
Director of Lord of the Rings Trilogy

MUSIC

"I can only do so many concerts. So to be able to have more people experience them through VR... that would be epic."

Miley Cyrus
Singer / Songwriter

ADVERTISING

"[VR] is a perception changer for any advertiser that wants to associate with a new frontier in media."

Mitch Gelman
VP of Product for Gannett Digital

EDUCATION

"[VR] is going to be really important for education. Because kids don't learn best from reading a book or looking at a chalk board."

Palmer Luckey
Creator of the Oculus Rift

Example VR Applications

- **Education**
 - Google Expeditions
- **Medicine**
 - Virtual Characters
- **Entertainment**
 - The Void, Zero Latency
- **Art + Design**
 - Tilt Brush
- **Collaboration**
 - Facebook Spaces





EDUCATION

Google Expeditions

Google Expeditions

About

How it works

Explore

Get started

EXPEDITIONS AR

GET THE APP



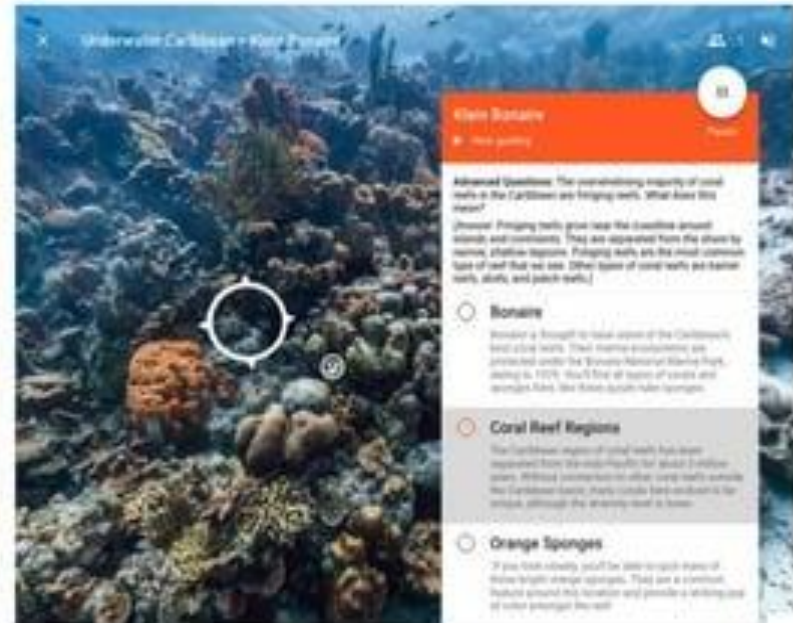
- <https://edu.google.com/expeditions/>
- Mobile VR Educational application (Android, iOS)
- Designed for classroom experiences

Google Expeditions



- **Goal:** Provide low cost educational VR experience
 - Based on Google Cardboard VR platform
- **Different roles:**
 - **Guide**— person leading an expedition on a tablet
 - **Explorer**— person following an expedition on a phone.
- **Usage**
 - Used by millions of students
 - Over 1000 educational experiences developed
 - Royal Collection Trust, American Museum of Natural History, etc.

Teacher Led VR Experiences



Guide Interface

- **Teacher/Guide uses tablet to control the experience**
 - Selects the virtual tour experience
 - Guide sees tour script, can select immersive scenes to view
 - Guide sees focus point and where individual students are looking
 - Students connect as followers, look at what guides highlight

System



- **Hardware**

- Google Cardboard mobile viewer
- Smart phones + tablet (class set)
- Wireless router

- **Software**

- Viewer and Guide applications (iOS/Android)
- 360 image/video VR experiences



Class set for 30 students

Example Experiences



• Over 1000 locations/experiences

• Great barrier reef, Great Wall of China, Grand Canyon, etc.

Demonstration

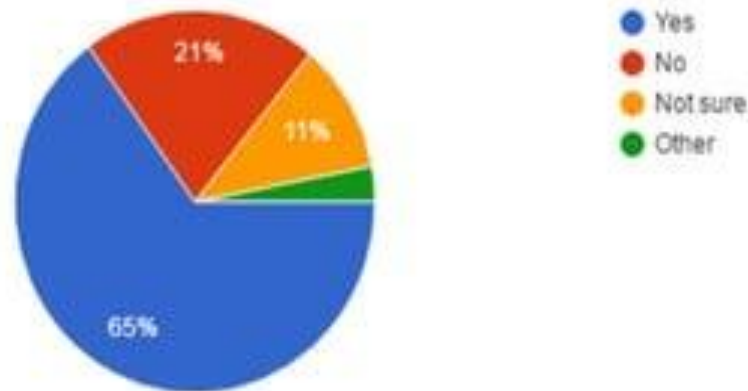


• https://www.youtube.com/watch?v=3MQ9yG_QfDA

Feedback

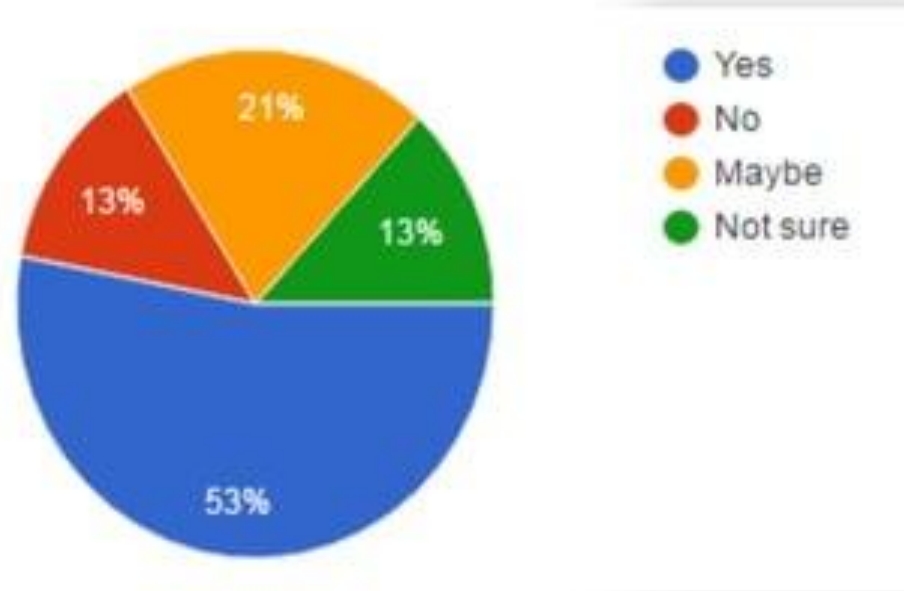
Did you experience a "wow" moment during your experience with Google Expeditions?

(100 responses)



- **Teacher/student survey (100 people)**
 - 65% experienced a "Wow" moment during Google expedition
 - Noted the variety of educator styles and approaches possible
 - People enjoyed "The feeling of 'being' there"

Limitations



- **But 53% of participants identified some problems:**
 - Difficult for some people who wore glasses
 - Some complained of eye strain, headaches or nausea
 - Some staff were reluctant/resistant to use the leader tablet
 - **Issues of disabilities and inclusion**

Key Findings

- **Low cost VR/mobile VR can provide a valuable educational experience**
 - Visit different locations, different times, etc.
- **Teach interaction key**
 - Acting as guide, providing educational context
- **VR requires more work**
 - Address simulator sickness, ergonomic issues, etc.
- **Immersion/Presence creates learning**
 - Immersion creates memorable educational experience

Challenges/Solutions

- **Making VR accessible**
 - Designing for phones, tablets, low cost viewers
- **Synchronizing content with all viewers**
 - Teacher controlled viewing
 - Teacher can guide experiences
- **Engaging interaction on simple viewers**
 - Head pointing based interaction, button input
- **Supporting Educational goals**
 - Providing compelling educational content



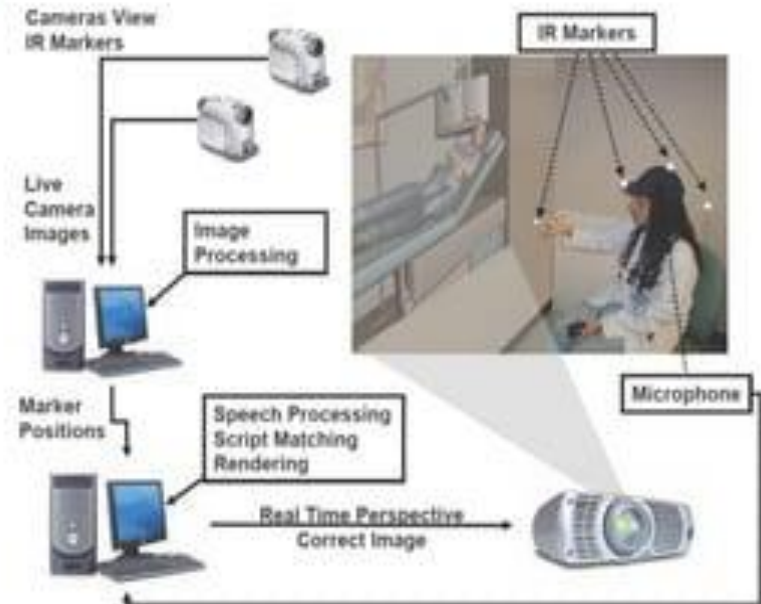
MEDICINE

Virtual Patients



- **Problem**
 - Many doctors have poor doctor/patient skills
 - Have limited opportunity during training to learn skills
- **Solution**
 - Virtual patients that doctors can communicate with naturally
 - Artificial agents with speech understanding

Typical System Setup



- Trainee in front of projection screen
- Speech and gesture recognition
- Intelligent agent on screen

Johnsen, K., Raij, A., Stevens, A., Lind, D. S., & Lok, B. (2007, April). The validity of a virtual human experience for interpersonal skills education. In *Proceedings of the SIGCHI conference on Human factors in computing systems* (pp. 1049-1058). ACM.

Demo:



• https://www.youtube.com/watch?v=xC70_tRG00k

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Key Findings

- **Virtual Humans can replace actors in training**
 - interaction skills used with a virtual human translate to the interaction skills used with a real human
- **Students feel a strong sense of co-presence**
 - Having character respond to speech and gesture increases immersion
- **VR is capable of creating realistic characters**
 - Life size, intelligent backend, speech recognition
- **Skills learnt transfer to real world**

Challenges/Solutions

- **Training in medical environment**
 - Design for training in medical exam room
 - Use projected VR not HMDs
- **Natural interaction**
 - Support speech and gesture interaction
- **Tactile/haptic feedback**
 - Use prosthetics to add support for palpation and other tactile interaction between doctor and virtual patient
- **Supporting Educational goals**
 - Give virtual character domain knowledge



ENTERTAINMENT

Large Scale VR Gaming



- Provide multi-player VR gaming in warehouse space
- Examples
 - The Void - <https://www.thevoid.com/>
 - Zero Latency - <https://zerolatencyvr.com/>

Typical System



Tracking cameras



- **Wide Area Tracking**
 - Computer vision, lights/reflective balls
 - > 120 cameras for 300 m² space
- **Backpack VR system**
 - Haptic feedback, wireless HMD
- **Real Props**
 - Tracked objects, walls



Backpack system

The Void Demo



• <https://www.youtube.com/watch?v=XgetffuOgBA>

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Key Findings

- **Wide area tracking possible**
 - vision based systems can create large scale wide areas tracking, fast enough for game play
- **Shared gameplay improves experience**
 - Focus on collaborative experiences, using avatar representations and roll division
- **Haptic feedback significantly increases presence**
 - Use of physical props (objects, walls)
- **Content is king**
 - Systems need compelling content/game place

Challenges/Solutions

- **Wide area tracking**
 - Computer vision tracking of people
 - Over 100 cameras + multiple servers
- **Freedom of movement**
 - Custom wireless VR backpacks
 - Ruggedized HMDs, weapon props
- **Natural interaction**
 - Redirected walking, tangible props
- **Compelling content**
 - Multi-sensory feedback, custom game platform



ART + DESIGN

Tilt Brush



- Intuitive 3D immersive drawing/sculpting program
- Developed by Patrick Hackett and Drew Skillman 2014
- Acquired by Google in 2015
- <https://www.tiltbrush.com/>

Functionality



- **Goal:** Extremely natural 3D painting/sculpting
- **User Interface**
 - Two handed interface designed for two controllers (Vive, Rift)
 - Brush in dominant hand, tool palette in non-dominant
 - Typical drawing functionality – color, brush width, undo/redo, etc..
- **Content sharing**
 - Created content can be exported/shared in 2D/3D formats

Demo



• <https://www.youtube.com/watch?v=TckqNdrdbgk>
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Artist Feedback



- <https://www.youtube.com/watch?v=91J8pLHdDB0>

Example Tilt Brush Sketches

tilt brush Tilt Brush

Filter



The Upside Down
Sethu Eero Flors
Nov 5, 2017



mother
Are You Real? VR
Mar 4, 2018



Eccles City
FL Films
Mar 11, 2018



Butterfly Metamorphosis
Estelle Tse
May 28, 2017



Trainscape
Tilt Brush
Jul 19, 2017



The Birth of Venus
Are You Real? VR
Jan 29, 2018



Valerian VR
Steve Temple
Jul 28, 2017



Yggdrasil
Steve Temple
Apr 26, 2017

• <https://poly.google.com/>

• Explore in desktop VR

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Key Findings

- **Use familiar tools**
 - Tilt brush interface has familiar sculpting/painting tools – e.g. brush size, colour pallet, etc
- **Use intuitive interface**
 - Two handed tools with natural metaphor – one hand for pallet/menu, one hand for painting/sculpting
- **Provide Magical experience**
 - Provide experience not possible in real world, e.g. changing body scale, painting in 3D, etc.
- **Create a community**
 - Provide ways for people to share content

Challenges/Solutions

- **Intuitive Interface**
 - Very natural metaphor – painting in space
 - Two handed interface – map to VR controllers
 - Familiar menu objects from paint programs
- **Need for limited training**
 - Provide in app training, tool tips
- **Content sharing**
 - Enable content to be exported in variety of formats
 - Video, animated GIFs, 2D images, 3D files
- **Engaging Experience**
 - Provides novel immersive artistic experience



COLLABORATION

Facebook Spaces



- Collaborative VR environment
 - VR meeting and interaction space (up to 4 people)
- Focus on communication
 - Speech and gesture based
- <https://www.facebook.com/spaces>

System Interaction



- **Designed for Oculus Rift/HTC Vive**
 - Upper body tracking, touch controllers
- **Simple interaction**
 - Loading scenes, direct object manipulation
- **Content creation**
 - Selfie pictures, simple sketching

Demo



- <https://www.youtube.com/watch?v=Pvf3m7e7OKU>

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Key Findings

- **Minimal social cues okay**
 - Even simple avatars can provide rich social experience
- **Create shared social context**
 - Important to place users in same shared Virtual Reality environment/shared social context
- **Audio is key**
 - Provide low latency audio, spatial audio cues
- **Create a reason for communicating**
 - Why should people want to connect? Create shared activity/reason for people to conference

Challenges/Solutions

- **Create shared sense of Presence**
 - Use common background, shared objects
- **Natural communication**
 - Support non-verbal behaviour, speech/gesture input
- **Intuitive interaction**
 - Map real body motion onto Avatars
 - Limited ability to navigate/move through environment
- **Engaging Experience**
 - Shared content creation, experience capture

Other Examples



- Many other examples of collaborative VR
 - Rec Room, High Fidelity, AltspaceVR
 - Sansar, VR chat, etc..

Example: High Fidelity Worlds



• <https://www.youtube.com/watch?v=-ivL1DDwUK4>



OTHER APPLICATIONS

Collisions – Australian VR Film



• <http://www.collisionsvr.com/>

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• https://www.youtube.com/watch?v=-NZHLtmNi_s
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Best VR Apps of 2019 (Digital Trends)



- ALLUMETTE – VR Stop motion film
- Google Earth – Travel/geography
- Kingspray Graffiti – Art/content creation
- The FOO Show - VR Talk show
- Virtual Desktop – Use desktop in VR
- www.digitaltrends.com/virtual-reality/best-virtual-reality-apps/

Google Earth



• <https://www.youtube.com/watch?v=SCrkZOx5Q1M>

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Allumette



• <https://www.youtube.com/watch?v=AkzdxgMBDi8>

KingSpray Graffiti



• https://www.youtube.com/watch?v=3ygZBR_WPml

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Thank You