Advancements in Augmented Reality

A
Seminar Report

by

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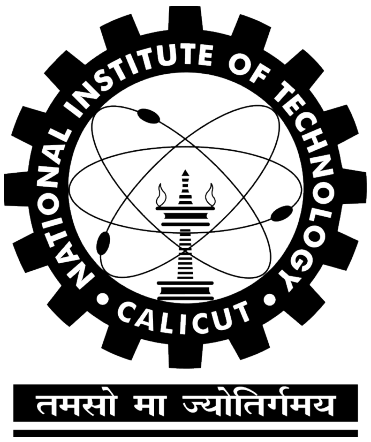

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Certified that this Seminar Report entitled

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Abstract

Augmented Reality (AR) is a technology that superimposes a computer-generated image on a user's view of the real world, thus providing a composite view. As a result, the technology functions by enhancing one's current perception of reality and replaces the real world of an individual with a simulated one. Virtual reality uses software to generate realistic images, sounds and other sensations that replicate a real environment and enable the user to interact with this space.

VR creates a totally artificial environment, whereas AR uses the existing environment and overlays new information on top of it. Recently Microsoft and Facebook's Oculus have developed their own AR and VR devices namely Microsoft Hololens and Oculus Rift respectively. Hololens works by enabling applications in which the live presentation of physical real-world elements is incorporated with that of virtual elements referred to as "holograms". The Oculus Rift is a VR headset developed and manufactured by Oculus VR.

This seminar report aims to explore these advancements in the area of AR by taking the above two mentioned devices as case studies.

Contents

1 Augmented Reality

1.1 Introduction

Augmented Reality (AR) is a growing area in virtual reality research. It is a technology that superimposes a computer- generated image on a user's view of the real world, thus providing a composite view. It is a live direct or indirect view of a physical, real-world environment whose elements are augmented (or supplemented) by computer-generated sensory input such as sound, video, graphics or GPS data. As a result, the technology functions by enhancing one's current perception of reality. It replaces the real world of an individual with a simulated one. VR creates a totally artificial environment, whereas AR uses the existing environment and overlays new information on top of it.

1.2 Working and applications

On the hardware side, AR devices have several hardware components like processor, display, sensors and input devices. Modern mobile computing devices also contain a camera and MEMS sensors besides the above mentioned. For the display, optical projection systems, monitors, hand held devices, etc. are used.

On the software side, an AR system's efficiency lies with how accurately they integrate augmentations with the real world. For the image registration, a vital part of the software, several computer vision and video tracking algorithms are used. The recording, processing and rendering of simulated environment is done in phases dynamically.

The software is integrated with and runs on several hardware devices like head-mounted displays (HMD), eyeglasses, head-up displays (HUD), contact lenses, eyetap, hand-held and spatial devices.

Main classes of applications are in the areas of Medical, Manufacturing and repair, Annotation and visualization, Robot path planning, Entertainment, Military aircraft, etc.

1.3 Issues and challenges

1.3.1 Issues

- Spam and Security
- Interoperability: The lack of data portability between AR environments (such as Wikitude AR and Layar AR browser).
- Performance Issues - Real time processing of images can be a challenge and often can slow down augmented reality systems.
- Interaction Issues - Users within a mixed environment because of augmented reality have difficulties interacting with the environment as normal.
- Alignment Issues - People working in an augmented reality are more sensitive to alignment errors. Proper calibration and alignment with the reference frame of the world is crucial.

1.3.2 Challenges

- Technological limitations - Displays, trackers, and AR systems in general need to become more accurate, lighter, cheaper, and less power consuming. Since the user must wear the PC, sensors, display, batteries, and everything else required, the end result is a heavy backpack.
- User interface limitation - We need a better understanding of how to display data to a user and how the user should interact with the data. AR introduces many high-level tasks, such as the need to identify what information should be provided, whats the appropriate representation for that data, and how the user should make queries and reports. Recent work suggests that the creation and presentation of narrative performances and structures may lead to more realistic and richer AR experience.

2 Virtual Reality

2.1 Introduction

Virtual reality (VR) typically refers to computer technologies that use software to generate realistic images, sounds and other sensations that replicate a real environment (or create an imaginary setting), and simulate a user's physical presence in this environment, by enabling the user to interact with this space and any objects depicted therein using specialized display screens or projectors and other devices. It is basically a realistic and immersive simulation of a three-dimensional environment, created using interactive software and hardware, and experienced or controlled by movement of the body. Virtual realities artificially create sensory experiences, which can include sight, touch and hearing. VR is a computerized simulation of natural or imaginary reality.

2.2 Working and applications

There are many types of Virtual Reality like Enhanced Reality, Desktop Virtual Reality, Telepresence, Immersive Virtual Reality, QTVR (QuickTime Virtual Reality). It is being used in diverse areas like Design Evaluation, Architectural Walk-through, Planning and Maintenance, Concept and Data Visualisation, Operations in hazardous or remote environments, Training and simulation, Sales and Marketing, Entertainment and Leisure and Enhanced Realities.

Some of the other projects involving engineering are simulation-based design, multipurpose design optimization and visualization in High Performance Computing - Computer Formulated Design structures. In the Biomedical Engineering department some of the projects mentioned are use of virtual reality for viewing of X-RAY's and MRI's, using stereolithography to make prototypes of joints, and even having students perform test surgery. In the Computer Science department some of the projects range from creating a toolkit for non-computer science designers, rendering and 3-D lighting, viewing non-euclidean geometries, and modeling for resource management.

2.3 Issues and challenges

2.3.1 Issues

- The hardware needed to create a fully immersed VR experience is still cost prohibitive.
- The technology for such an experience is still new and experimental. VR is becoming much more commonplace but programmers are still grappling with how to interact with virtual environments.

3 Augmented Reality vs Virtual Reality

In the augmented reality systems, the system augments the real world scene whereas the environment is totally immersive in virtual reality. In AR, user maintains a sense of presence in real world and in VR senses are under control of system. The challenge in AR is to develop a mechanism to combine virtual and real worlds, whereas in VR, it is to develop a mechanism to feed virtual world to user.

4 Microsoft Hololens

4.1 Introduction

A hologram is an object that is made entirely of light and can be viewed from different angles and distances, just like physical objects. They don't have any mass and hence do not offer any physical resistance when touched or pushed. Microsoft HoloLens is a pair of mixed reality head-mounted smartglasses developed and manufactured by Microsoft. It allows user to pin holograms in his physical environment and provides a new way to see his world and is completely unattached (no wires, phones, or connection to a PC needed).

4.2 Working and applications

4.2.1 Structure of Holoens

The inside of hololens consists of:

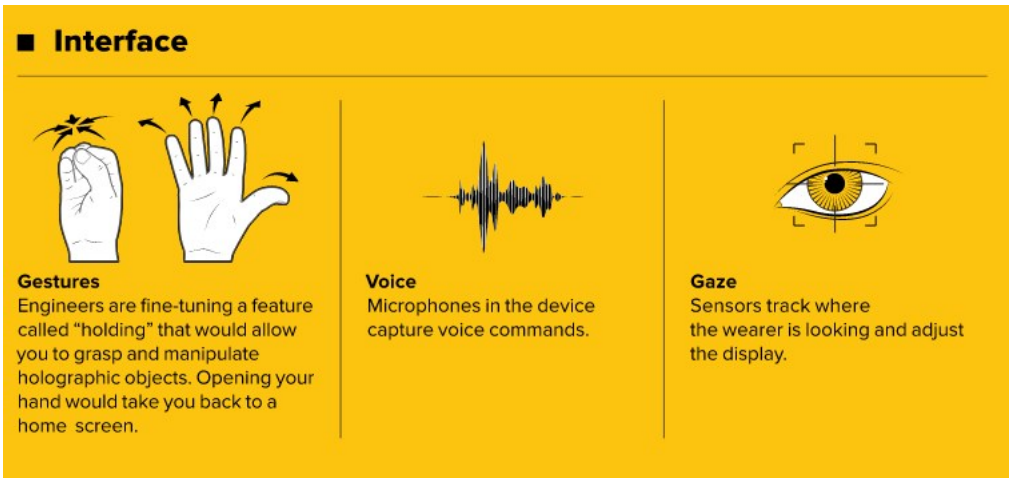
- camera
- computer
- lenses
- vent
- sensor
- few buttons

4.2.2 Working

- Lenses and Display:- Microsoft hololens has two display. they are transparent so that wearer can see the real world behind virtual object. To create project hololens image, light particles bounce around millions of times in the so called light engine of the device. Then the photons enter the two lenses(one for each eye), where they ricochet between layers of glasses before finally hitting of wearer eye.
- Sensor:- Sensor tracks where the wearer is looking and adjusts the display accordingly. Motion sensor detects the wearers movement. The sensor can also see wearers hands. The hands are an input system: user can interact with whatever he sees by just touching it. Wearer can also give gestures as input sensor enables the tracking of user movement.
- Computer:- Hololens is not just a visor connected to a computer, it is a computer on its own. Hololens contains a CPU, a battery, a GPU and first of its kind HPU (holographic proceesing unit). 18 sensors flood the brain of the device with terabytes of data every seconds.
- Camera:- The depth camera has a field of vision that spans 120 by 120 degree, so it can sense what your hands are doing even when they are nearly outstreached.

- Vent:- The device is more powerful than a laptop but won't overheat- warm air flows to the sides, where it vents up and out.
- Buttons:- On the right side, there are a few buttons that allow the user to adjust the volume and to control the contrast of the hologram.

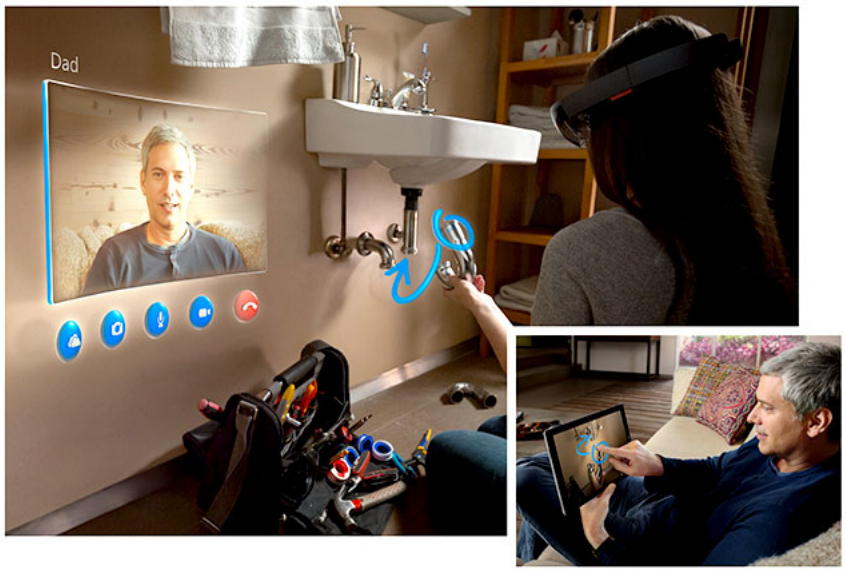
Microsoft hololens has user interface so it takes voice, gaze and gestures as input command. Than internal computer works on input command. For projection of holograms, hololens uses the HUD (head up display) method. Two nanoprojectors located at each side of head and semi transparent visor which reflect the image as light on users eye aid in achieving the same.



4.3 Future and scope

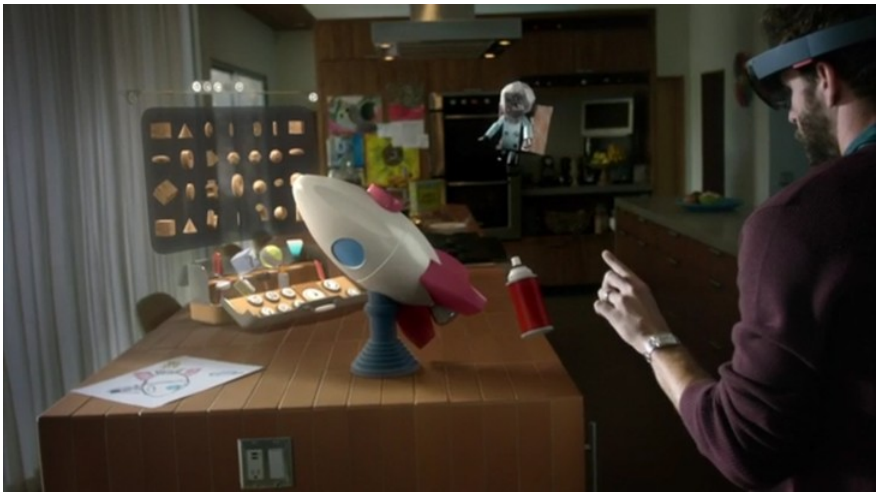
4.3.1 Scope

Instruction and sharing ideas



Design and develop

Create



- Visual diagrams would actually show up in space around the user indicating exactly what you need to do next.
- This application could even extend to the battlefield, where detailed medical instructions could be given to untrained personnel in the midst of combat.
- Pin holograms to physical objects so user can size and scale them in each angle and with gestuer do all new creation.

5 Oculus Rift

5.1 Introduction

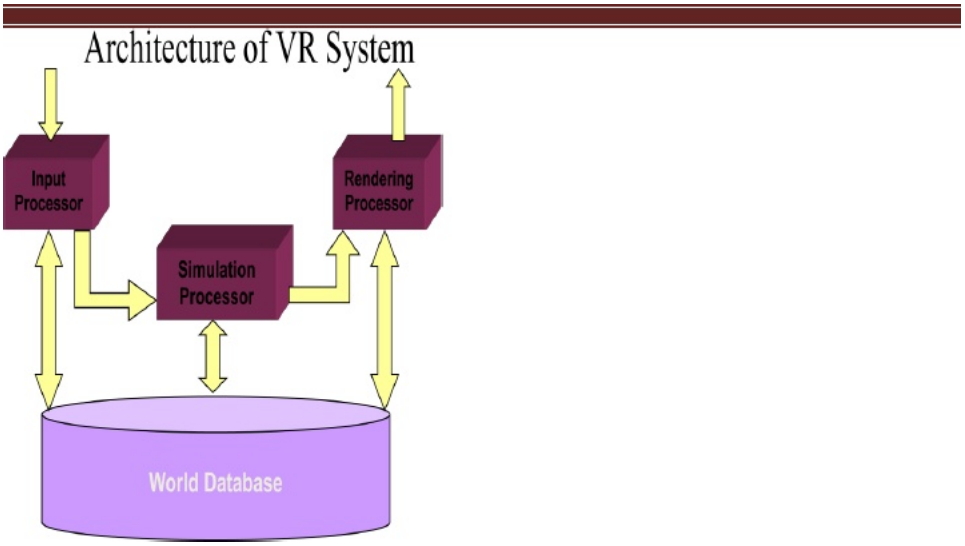
The Oculus Rift is a virtual reality headset developed and manufactured by Oculus VR. The headset fits over the eyes, completely covering the wearer's field of vision. It is set up to appear exactly as if the virtual world was being seen in real life. The oculus rift is the first VR system of its kind which is affordable, high-quality device with a wide field of view and minimal lag. With the Oculus Rift, developers, designers, and artists are now leading the way toward delivering imaginative realms to a global audience.

5.2 Working and applications

5.2.1 Working

Components of a VR system:

- Input Processor: Control the devices used to input information to the computer. The object is to get the coordinate data to the rest of the system with minimal lag time.
- Simulation Processor: Takes the user inputs along with any tasks programmed into the world and determine the actions that will take place in the virtual world.
- Rendering Processor: Create the sensations that are output to the user, like the visual, auditory and haptic sensations.
- World Database: Store the objects that inhabit the world, scripts that describe actions of those objects.



It is similar to a set of ski goggles in which a large cell phone screen replaces the glass. The screen displays two images side by side, one for each

eye. A set of lenses is placed on top of the screen, focusing and reshaping the picture for each eye, and creating a stereoscopic 3D image. The goggles have embedded sensors that monitor the wearer's head motions and adjust the image accordingly. The result is a sensation that one is looking around a 3D world. The Rift has an OLED display, 1080Œ1200 resolution per eye, a 90 Hz refresh rate, and 110ř field of view. It has integrated headphones which provide a 3D audio effect, rotational and positional tracking. The positional tracking system, called Constellation, is performed by a USB stationary infrared sensor that is picking up light that is emitted by IR LEDs that are integrated into the HMD. The sensor normally sits on the user's desk. This creates 3D space, allowing for the user to use the Rift while sitting, standing, or walking around the same room.

5.2.2 Applications

- Gaming: Rift is being primarily developed as a gaming device. Existing games with a first person or fixed-camera perspective can be ported to VR with some development effort.

- Media: An application known as Oculus Cinema is available, that allows the Rift to be used to view conventional movies and videos from inside a virtual cinema environment, giving the user the perception of viewing the content on a cinema sized screen. Spherical videos can be viewed simply by the users moving their head around.

- Oculus Cinema will also have a networked mode, in which multiple users can watch the same video in the same virtual space, seeing each other as avatars and being able to interact and talk to one another while watching the video

- Social: A number of social applications for the Rift are in development like the AltspaceVR, that allows people to inhabit a shared virtual space with spatial voice communications, cast content from the internet on virtual screens, interact with objects and supports extra hardware like eye tracking and body tracking.

- Industrial: Can be used for productivity enhancement, visualization, and advertising. A number of architecture firms have been experimenting with using the Rift for visualisation and design. With the right

software, the Rift allows architects to see exactly what their building will look like, and get an understanding of the scale that is impossible on a traditional monitor.

5.3 Future and scope

- Medical Training: Research is being undertaken in the area of virtual reality to make it available for laparoscopy surgery, also known as keyhole surgery. The surgery environment is simulated and trainees are trained for a real life surgery. Their training and evaluation is done as if on a real life patient.
- Conferencing: Using virtual conferencing, attendees can view and interact in proceedings without leaving their office or home. Also enables likeminded students and teachers to work together while studying, which really helps to give the student an idea of the placement of their work in the larger scheme.
- Military: VR allows virtually any scenario or environment to be played out for the purposes of training. This makes the cost of setting up simulations of environments for training much more affordable.

References

[1] www.studymafia.org.
Augmented Reality.
Link: http://studymafia.org/wp-content/uploads/2015/01/Augmented-Reality-report.pdf

[2] Taani Bohra
Knuth: Oculus Vr, a Virtual Reality
Link: https://www.scribd.com/doc/242295486/Oculus-Vr-a-Virtual-Reality-Seminar-Report

[3] Donald Knuth
Virtual Reality
Link: http://studymafia.org/wp-content/uploads/2015/01/Elec-Virtual-Reality-report.pdf

[4] Wikipedia
Augmented reality
Link: https://en.wikipedia.org/wiki/Augmented_reality

[5] Wikipedia
Virtual reality
Link: https://en.wikipedia.org/wiki/Virtual_reality

[6] Wikipedia
Oculus Rift
Link: https://en.wikipedia.org/wiki/Oculus_Rift

[7] Wikipedia

Microsoft HoloLens
Link: https://en.wikipedia.org/wiki/Microsoft_HoloLens

[8] Ronald Azuma, Yohan Baillot, Reinhold Behringer, Steven Feiner, Simon Julier and Blair MacIntyre.
Recent Advances in Augmented Reality
Link: http://www.cc.gatech.edu/fac/Blair.MacIntyre/papers/cga2001.pdf

[9] Abrar Omar Alkhamisi and Muhammad Mostafa Monowar
Rise of Augmented Reality: Current and Future Application Areas
Link: http://file.scirp.org/pdf/IJIDS_2013112914255991.pdf