

# Virtual Reality

# Outline

- Introduction
- The history of VR
- Types of VR
- Technologies of VR
- Architecture of VR system
- Applications of VR
- Current problems & Future work
- Summary
- Reference

# Introduction



- What is Virtual Reality(VR)?

Virtual Reality refers to a high-end user interface that involves real-time simulation and interactions through multiple sensorial channels.

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# Introduction (Cont'd)

- Why VR?

VR is able to immerse you in a computer-generated world of your own making: a room, a city, the interior of human body. With VR, you can explore any uncharted territory of the human imagination.

# Virtual Environment (VE)

- A computer generated world with which the user can interact
- Interaction can vary from looking around to interactively modifying the world.

**Virtual Reality**

# Virtual Reality Triangle

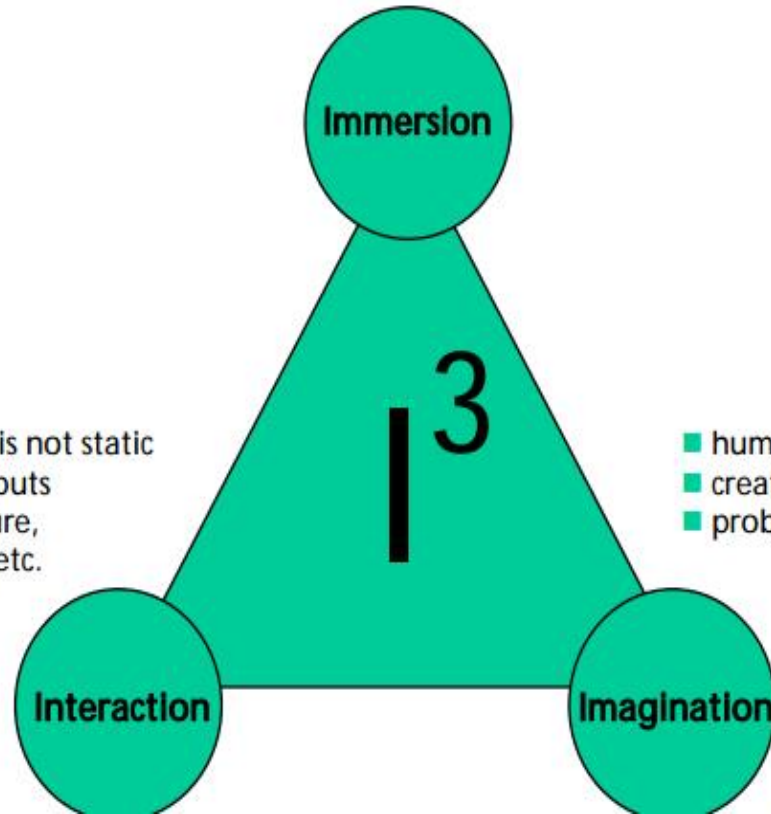


Source: Adam Opel AG

- computer graphics simulation
- create a realistic looking world
- Interactivity
- being part of the action on the screen

- synthesized world is not static
- respond to user inputs
- device input, gesture, verbal commands, etc.

- human imagination
- creation of a virtual world
- problem solving application



## Brief History

- In 1950s, flight simulators were built by US Air Force to train student pilots.
- In 1965, a research program for computer graphics called “The Ultimate Display” was laid out.
- In 1988, commercial development of VR began.
- In 1991, first commercial entertainment VR system "Virtuality" was released.

# Types of VR System

## ■ Windows on World(WoW)

- Also called Desktop VR.
- Using a conventional computer monitor to display the 3D virtual world.

## ■ Immersive VR

- Completely immerse the user's personal viewpoint inside the virtual 3D world.
- The user has no visual contact with the physical world.
- Often equipped with a Head Mounted Display (HMD).



# Types of VR System(Cont'd)

- Telepresence

- A variation of visualizing complete computer generated worlds.
- Links remote sensors in the real world with the senses of a human operator. The remote sensors might be located on a robot. Useful for performing operations in dangerous environments.

# Types of VR System(Cont'd)

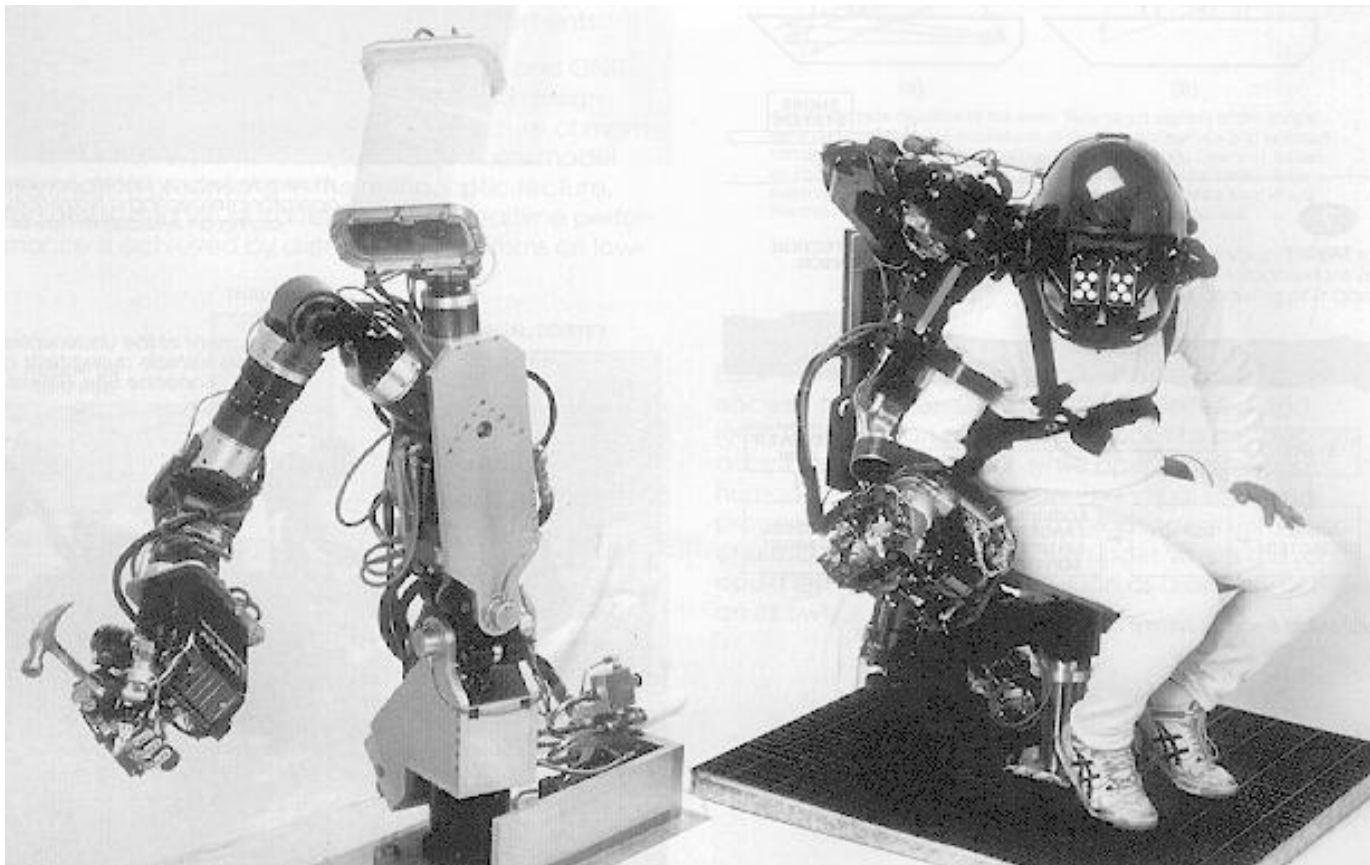
- Mixed Reality(Augmented Reality)
  - The seamless merging of real space and virtual space.
  - Integrate the computer-generated virtual objects into the physical world which become in a sense an equal part of our natural environment.

## Distributed VR

- A simulated world runs on several computers which are connected over network and the people are able to interact in real time, sharing the same virtual world.

# VR Examples (Cont'd)

- Telepresence VR



# VR Examples (Cont'd)

- Augmented VR



# VR Examples (Cont'd)

- Distributed VR



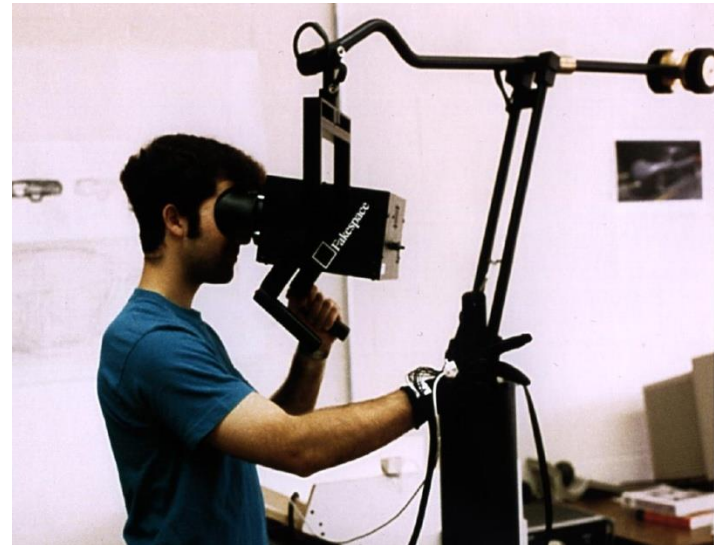
# Technologies of VR--Hardware

- Head-Mounted Display (HMD)
  - A Helmet or a face mask providing the visual and auditory displays.
  - Use LCD or CRT to display stereo images.
  - May include built-in head-tracker and stereo headphones



# Technologies of VR--Hardware

- **Binocular Omni-Orientation Monitor (BOOM)**
  - Head-coupled stereoscopic display device.
  - Uses CRT to provide high-resolution display.
  - Convenient to use.
  - Fast and accurate built-in tracking.

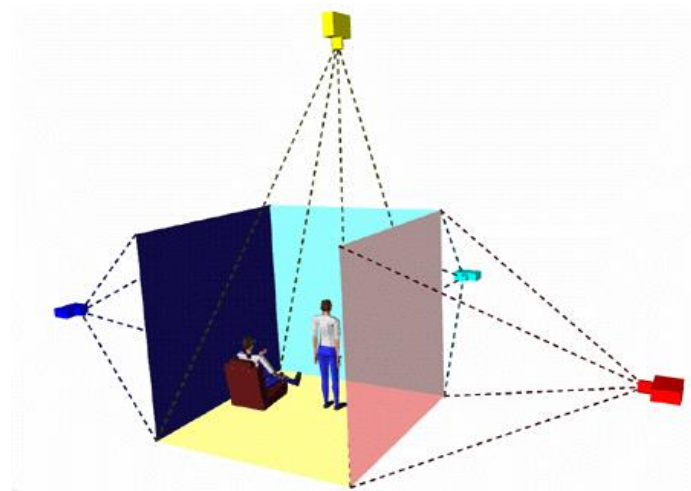
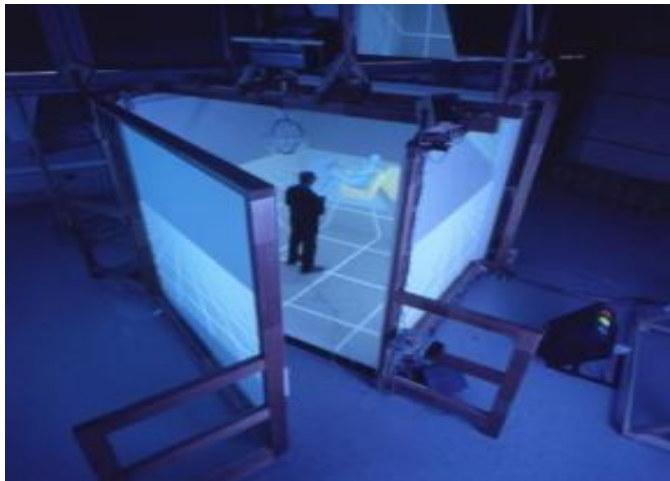




# Technologies of VR--Hardware

## ▪ **Cave Automatic Virtual Environment (CAVE)**

- Provides the illusion of immersion by projecting stereo images on the walls and floor of a room-sized cube.
- A head tracking system continuously adjust the stereo projection to the current position of the leading viewer.





# Technologies of VR--Hardware

## ▪ Data Glove

- Outfitted with sensors on the fingers as well as an overall position/orientation tracking equipment.
- Enables natural interaction with virtual objects by hand gesture recognition.



# Technologies of VR--Hardware

- Control Devices
  - Control virtual objects in 3 dimensions.



# Technologies of VR--Software

- Toolkits
  - Programming libraries.
  - Provide function libraries (C & C++).
- Authoring systems
  - Complete programs with graphical interfaces for creating worlds without resorting to detailed programming.

# Technologies of VR--Software

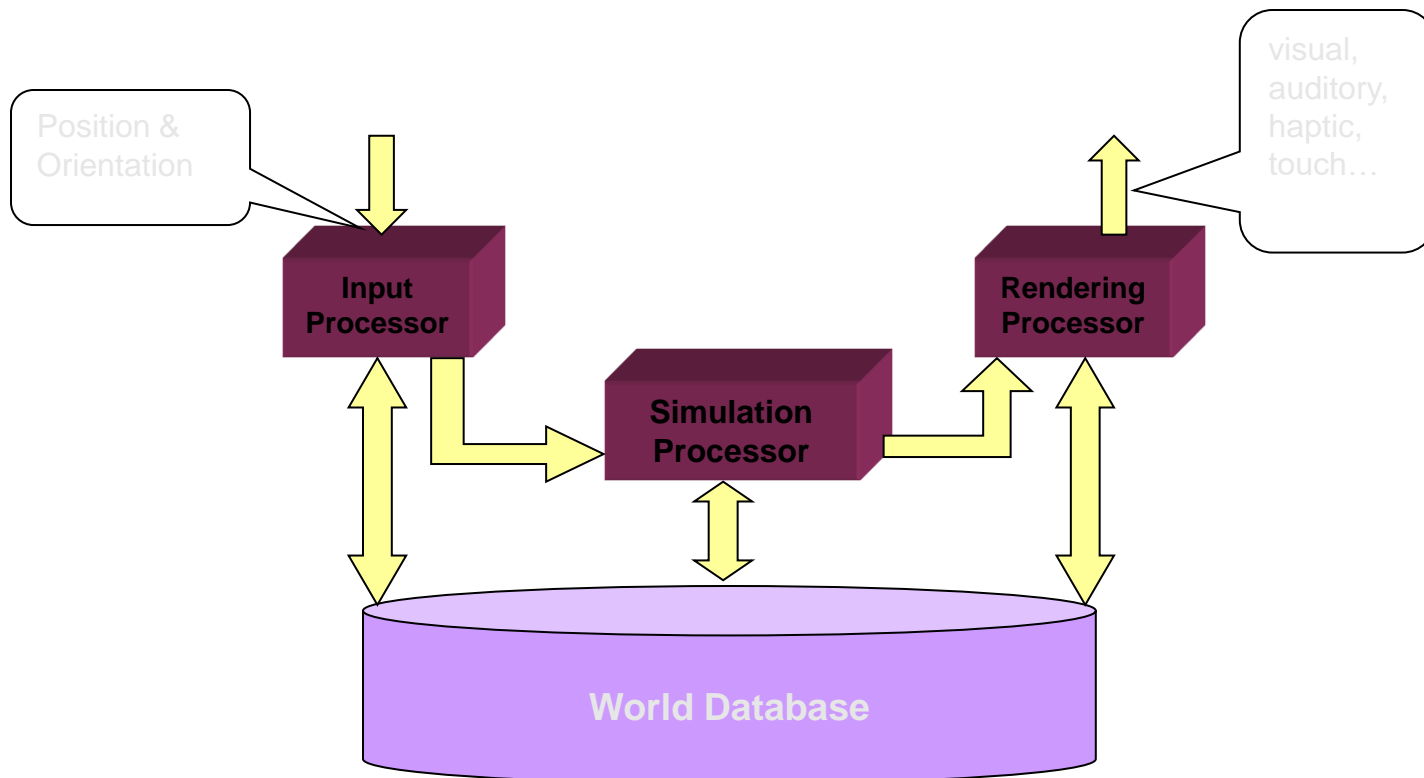
- Software packages available in market
  - **Multiverse (Freeware)**
  - **Virtual Reality Studio (\$100)**
  - **Sense8 World Tool Kit (WTK) (over \$1000)**
  - **Autodesk Cyberspace Development kit (over \$1000)**

# Technologies of VR--Software

- VRML(Virtual Reality Modeling Language)
  - Standard language for interactive simulation within the World Wide Web.
  - Allows to create "virtual worlds" networked via the Internet and hyperlinked with the World Wide Web.
  - Aspects of virtual world display, interaction and internetworking can be specified using VRML without being dependent on special gear like HMD.
  - VR models can be viewed by Netscape or IE with a browser plug-in.

# Architecture of VR System

- Input Processor, Simulation Processor, Rendering Processor and World Database.



# Components of VR System (Cont'd)

- **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.
- Keyboard, mouse, 3D position trackers, a voice recognition system, etc.

# Components of VR System (Cont'd)

- **Simulation Processor**
  - Core of a VR system.
  - Takes the user inputs along with any tasks programmed into the world and determine the actions that will take place in the virtual world.



# Components of VR System (Cont'd)

- **Rendering Processor**
  - Create the sensations that are output to the user.
  - Separate rendering processes are used for visual, auditory, haptic and other sensory systems. Each renderer take a description of the world stat from the simulation process or derive it directly from the World Database for each time step.

# Components of VR System (Cont'd)

- World Database (World Description Files)
  - Store the objects that inhabit the world, scripts that describe actions of those objects.

# Applications

## ▪ Entertainment

- More vivid
- More exciting
- More attractive



# Applications

- Architecture
- Training
- Medicine
- Engineering and Design
- E-Commerce
- Entertainment
- Manufacturing

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# Architecture

An area in which virtual reality has tremendous potential is in architectural design. Already being created are architectural "walk-throughs" that allow designers and clients to examine homes and office buildings, inside and out, before they're built. With virtual reality, designers can interactively test a building before construction begins.



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# Medicine

- researchers are using virtual reality technology to create 3-D ultrasound images to help doctors diagnose and treat congenital heart defects in children.
- The medical application of VR was stimulated initially by the need of medical staff to visualise complex medical data, particularly during surgery and for surgery planning, and for medical education and training.

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# Training

- United States: The military used it as flight simulators to train pilots.
- National Aeronautics and Space Administration (NASA) use VR technology to construct a model of the Hubble Space Telescope (HST) .in September, 1993, approximately 100 members of the NASA HST flight team received over 200 hours of training using the VR...

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# Devices

## Head Mounted Displays (HMD):

Was the first device providing its wearer with an immersive experience. Evans and Sutherland demonstrated a head-mounted stereo display already in 1965.



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# Binocular Omni-Orientation Monitor (BOOM)

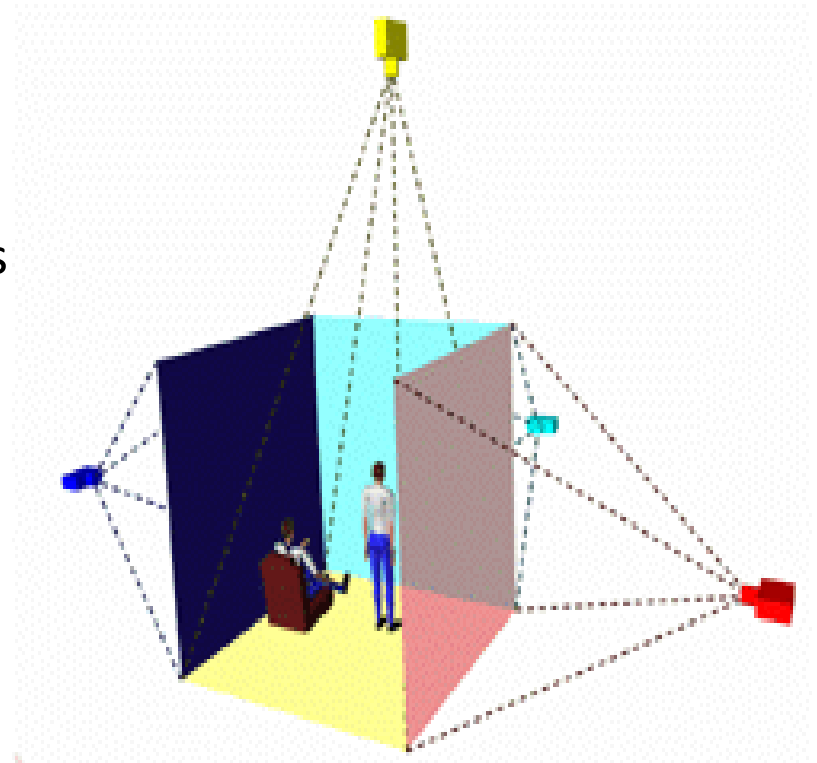
BOOM is a head coupled stereoscopic display device. Screens and optical system are housed in a box that is attached to a multi-link arm.



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# Cave Automatic Virtual Environment (CAVE)

- A room with projections on all walls, floor and ceiling
- The users wear shutter glasses to get a 3D view of the world.
- The users are able to move and control the environment with some kind of input mechanism
  - Camera
  - Device in hand



**Virtual Reality**

# 3D VIDEO Eyewear

winner of a 2005 & 2006 Consumer Electronics Show Design Award.

**VR Price: \$499.00**



**virtual Reality**

# Virtual reality Modeling Language (VRML)

Most exciting is the ongoing development of [VRML](#) on the World Wide Web. In addition to **HTML** (Hypertext Markup Language), that has become a standard authoring tool for the creation of home pages, **VRML** provides three-dimensional worlds with integrated hyperlinks on the Web. Home pages become home spaces.

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# Job Opportunities

The Swiss Federal Institute of Technology's (EPFL) Computer Graphics Lab has several openings for PhD students and Post Doctoral fellows in the areas of Computer Animation, Virtual Reality, and Computer Vision. Selected candidates will work on one or several of the following topics:

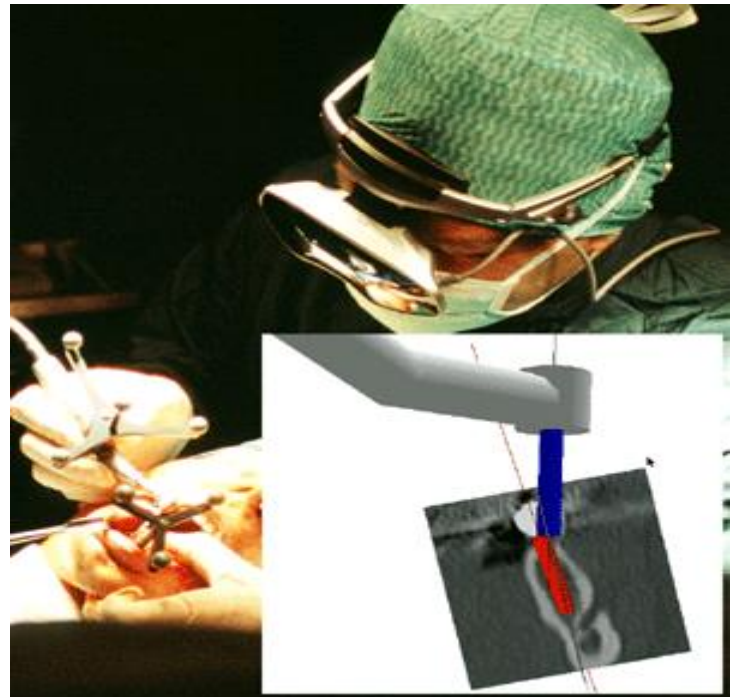
- Motion Control of virtual characters (kinematics, dynamics, and capture)
- Human body deformations
- Parametric animation models (e.g. running) from video analysis
- Interaction between virtual humans and objects in the Augmented Reality framework.

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# Applications (Cont'd)

## ▪ **Medicine**

- Practice performing surgery.
- Perform surgery on a remote patient.
- Teach new skills in a safe, controlled environment.



# Applications (Cont'd)

- Manufacturing
  - Easy to modify
  - Low cost
  - High efficient



# Applications (Cont'd)

- Education & Training
  - Driving simulators.
  - Flight simulators.
  - Ship simulators.
  - Tank simulators.





# Cont....



Web- Supported textbook courses – Based on specific text books

- Peer-to-peer courses – Courses on -demand text books without a prepared curriculum new one emerged in 2007.

- Social networking – Students can address a problem Teacher will act as guides and resources but it is up to the discuss etc.



# Cont....

## Communication and interaction

- ❖ Asynchronous instruction
- ❖ subsequent discussion
- ❖ Content delivered at the students pace
- ❖ Teacher acts as a guide
- ❖ Communication through discussion boards and email
- ❖ Students can interact with other students via notes, texts etc.
- ❖ Assignment submission electronically
- ❖ Collaborative communication outside occur through blogs, wikis multimedia tools etc.



# Virtual learning environment

## Definition:

It is an education system based on the web that models conventional real – world education by integrating a set of equivalent virtual concepts for tests, homework, classes classrooms and the like even museums and other external academic resources

## Similar terms used

- ❑ Learning management system (LMS) related concepts)
- ❑ Content management system (CMS) (only content)
- ❑ Learning content management system (LCMS) for corporate training overall infrastructure in a institution
- ❑ Managed learning environment (MLE)
- ❑ Learning support system (LSS)
- ❑ Online learning centre (OLC)
- ❑ Learning platform (LP)
- ❑ Computer –mediated communication (CMC)
- ❑ Online education
- ❑ Library management system (LMS)  
(now integrated library system ILS)



# Components of VLE



## ❖ Course syllabus

- ❖ Administrative information about the course
- ❖ Notice board for current information
- ❖ Additional resources e.g. supplementary reading
- ❖ Self assessment
- ❖ Formal assessment
- ❖ Support for communications (e-mail, twitter etc)
- ❖ Access rights for instructors, course staff and students
- ❖ Documentation and statistics
- ❖ Submissions by the students
- ❖ Provision for presentation with hyperlinks

# Use of VLE by educational institution

- ❖ Economize on the time of teaching staff and the cost of instruction
- ❖ Facilitate the presentation of online learning
- ❖ Provide students instruction in a flexible manner
- ❖ Provide instruction to the current generation
- ❖ Facilitate the networking of instruction between campuses and colleges.
- ❖ Provide for the reuse of common material
- ❖ provide automatic integration of the results of students learning in to campus information sy



# Current problems & Future work

- ☹️ Cybersickness / simulator sickness
- ☹️ Low-fidelity
- ☹️ Expensive
- ☹️ Lack of integration between application packages
  
- 😊 High-fidelity system
- 😊 Cost-saving
- 😊 Collaborative
- 😊 High-level contact between participants in distributed VR

# Benefit of Virtual Reality

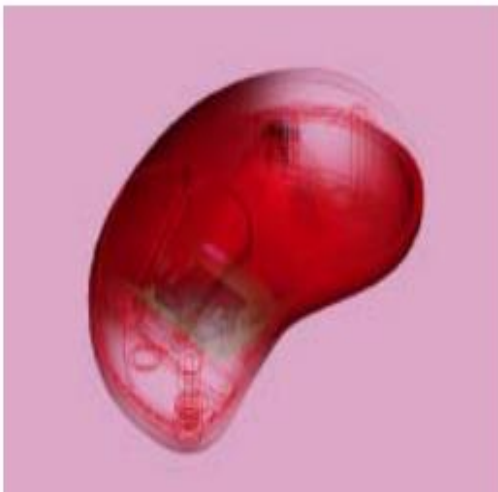
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Source: Fraunhofer IPT

## What benefit do you have?

- 20% reduction of physical prototypes
- reduction of constructional fault
- shorter product development time
- higher product quality
- improvement of communication in interdisciplinary teams
- faster and cheaper check of different versions  
e.g. DaimlerChrysler has 8 different versions of a new car which are evaluated with VR, only 3 versions are build as physical prototypes
- perception of depth due to stereo visualization
- better visualization due to large projection screens
- intuitive human machine interface due to tracking





# Summary

- Visualization of complicated, large data is helpful for understanding and analysis.
- VR offers us a new way to interact with computer.
- VR enables us to experience the virtual world that is impossible in real world.
- VR is changing our life, eventually VR will increasingly become a part of our life.



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