Workgroup 1
Web3D Technologies

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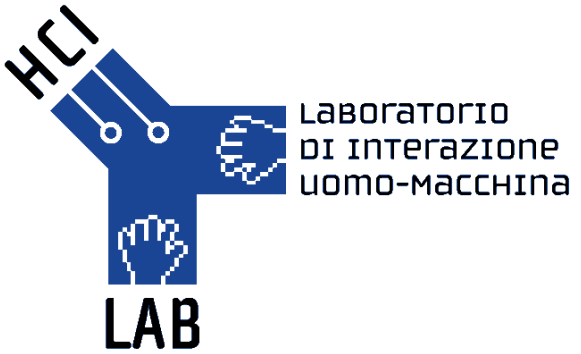


EU-India
Economic
Cross
Cultural
Programme

University of Udine
- Italy -

Outline

- Web3D technologies
  - what they are
  - potentials and some open research issues
- Activities of our Workpackage
  - Web3D technologies for educational purposes
  - developed prototypes
  - report from the WG1 Workshop (LET-WEB3D)
- Relations with the E-Content Workgroup

What is Web3D?

- Web3D means **interactive 3D graphics** (integrated with multimedia) *experienced* **through the Web**
  - i.e.: 3D Models and Virtual Environments ...
  - ... one can deliver, access and interact with (*navigate*, *play*, *learn*, *buy products, ...*) ...
  - ... over the Web infrastructure (HTTP protocol, Web servers, Web browsers, ...)
- The idea of Web3D started during the WWW'94 Conference with the proposal of **VRML** (Virtual Reality Modeling Language), the 3D counterpart of HTML

Combining interactive 3D & the Web

- The challenge of **Web3D technologies** is to effectively combine together *interactive 3D graphics* and *Web Technologies*
  - two research and application areas where big efforts have been spent in the latest years and many results have been achieved:
  - high-quality interactive 3D graphics has moved in the last 15 years from research labs and dedicated workstations to people homes and low-cost PCs and consoles;
  - Web technologies (e.g. Web services, semantic Web) are changing the way we work, learn, ...
  - moreover, Web3D has strong connections with the field of Virtual Reality, since most Web3D systems can be seen as *desktop Virtual Reality*

Example: Udine3D

http://udine3d.uniud.it

What can you do with Web3D?

- build *highly realistic* **Virtual Environments (VE)** representing existing or imaginary places, in which:
  - objects can be visualized in 3D and in their proper position
  - users can navigate (by walking, flying, ...) in the 3D space and observe the VE from their preferred position
  - objects can be animated, and can have (possibly complex) interactive behaviors (e.g. physics-based)
- integrate 3D within HTML pages
- this potentially allows to convey information in a more effective way than “traditional” 2D Web sites

Applications of Web3D Technologies

- Web3D technologies are increasingly used in a number of different application areas:

entertainment	e-learning and e-training	simulation
virtual communities	e-commerce product visualization	scientific and geographic visualization
cultural heritage and virtual museums	architecture and virtual cities	virtual design

Example: Virtual 3D stores

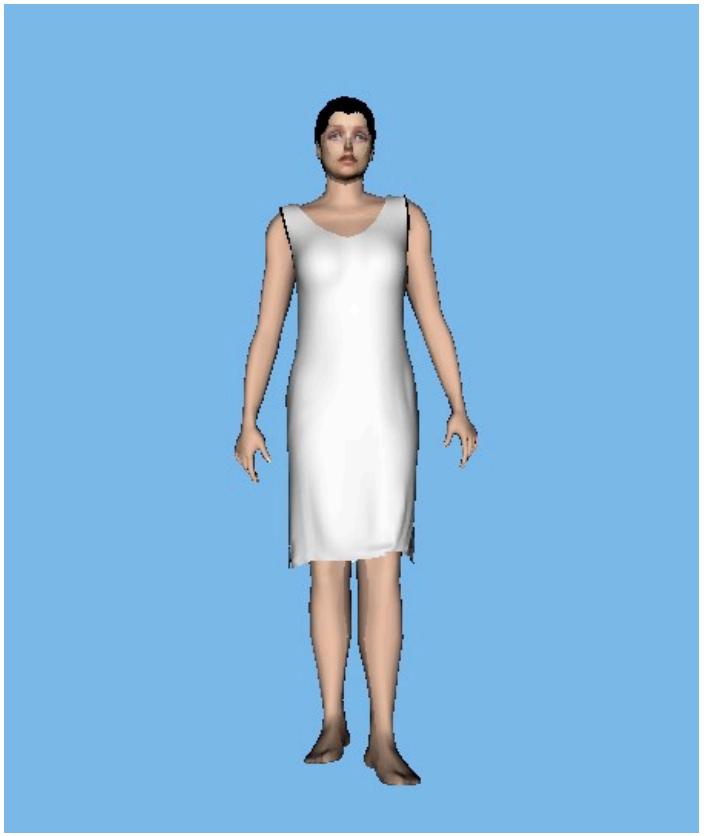
- In addition to a traditional interface, e-commerce sites can offer a 3D interface, where customers can navigate inside a virtual store.

(Chittaro and Ranon, ACM AVI 2002 Conference)

Example: Virtual Product Design

- Web3D allows to visualize industry CAD data for both early design evaluation and product visualization
- Example: textile industry,
- project in cooperation with

UNITED COLORS OF BENETTON.



(Chittaro and Corvaglia, ACM Web3D 2003 Symposium)

Example: Entertainment, Edutainment

- Fly with the Italian Aerobatic Team!

http://frecce3d.uniud.it

Open Issues in the field of Web3D (1)

- Complex Web3D content is heavier than 2D Web content in terms of file size (and download times)
  - there is the need for better compression, streaming and optimization algorithms
- Web3D authoring is (at present) harder than 2D Web authoring
  - there is the need for high-level, simpler authoring tools
- The Web3D is like the Web in the 1995:
  - dynamic generation of (database-driven) content, indexing and search, personalization, access from mobile devices, ... are today not possible or very difficult to implement

Open Issues in the field of Web3D (2)

- More Human Computer Interaction - related issues:
  - Difficulties in navigation: users are typically insufficiently assisted in navigating the environment, discover points of interest, and effectively interact with objects and functions
    - there is the need for effective design guidelines and navigation aids
  - Scarcely usable (and not accessible) interfaces
    - guidelines and widgets developed for 2D interfaces are not guaranteed to work in 3D
  - Users' disappointment due to high realism expectations
    - the challenge is to find which abstractions are effective and when

(Major) Current Web3D Technologies

- Open standards (more info: www.web3d.org):
  - VRML (Virtual Reality Modeling Language)
  - MPEG-4
  - Java3D
- Proprietary Technologies (Adobe Atmosphere, Macromedia ShockWave, ...)

The Upcoming Web3D: X3D

- e**X**tensible **3D** Graphics
- new ISO open standard for (Web-enabled) interactive 3D content integrated with multimedia
- developed by the Web3D Consortium as a successor of the VRML language
  - X3D introduces a XML encoding (easier integration with recent and future Web technologies)
- already officially incorporated within the MPEG-4 multimedia standard

WG1 Activities

- Main focus: Innovative applications of Web3D technology for educational purposes.
- We considered two different domains (*Museums and Cultural Heritage* and *Virtual Training*) that span many of the technical and scientific issues raised by these new educational technologies.
- We developed some innovative prototypes that:
  - demonstrate effective features of Web3D technologies in each of the two considered domains
  - propose solutions to typical Web3D issues

Web3D technology in education

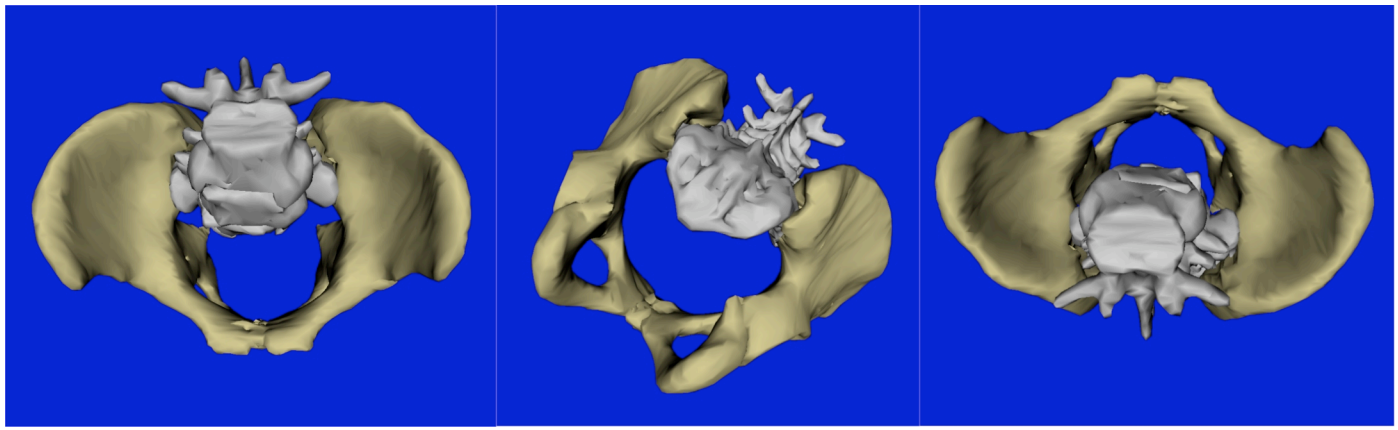
- The use of Virtual Reality as an educational tool has been proposed and discussed by several authors.
- Developing and delivering applications with proprietary VR technologies can be very expensive, and thus not accessible to many learners.
- Web3D open standards allow for:
  - cost reductions
  - product standardization
  - content delivery through the Web:
    - large numbers of learners, all over the world, at any time

Educational Contexts

- **Formal education** (from kindergarten to college).
- **Informal education** (museums, cultural sites, aquariums and zoos,…)
- **Distance or electronic learning** (both self-instruction and computer-mediated learning)
- **Vocational training** (industry, medicine, military,…)
- **Special needs education** (both physical and psychological handicaps).

Advantages of Web3D Technologies in Education (1)

- Three dimensional graphics: more realism, details and inspection capabilities compared to 2D representations

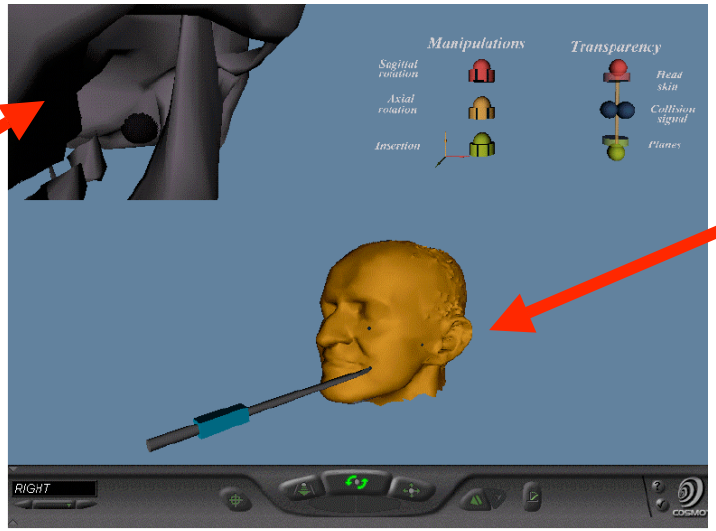


http://www.hpv.informatics.bangor.ac.uk/Sim/Pelvis/index.html

Advantages of Web3D Technologies in Education (2)

- Analyzing the same subject or phenomenon from different points of view allows for deeper understanding and building of correct mental models

- Example: training simulator for percutaneous rhizotomy (Li et al., 2000)



Needle's viewpoint

Surgeon's viewpoint

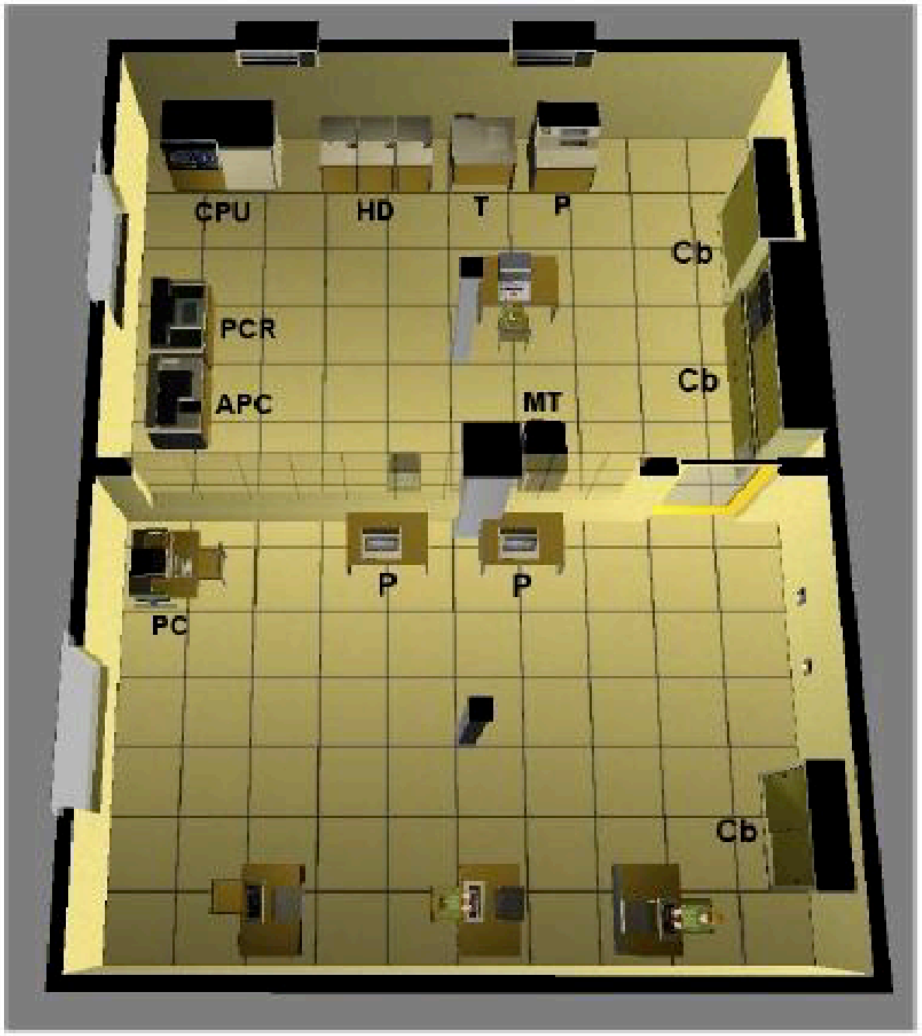
Advantages of Web3D Technologies in Education (3)

- Web3D technologies allow one to develop Web-based educational environments that provide the knowledge-building experiences discussed by (Winn, 1993):
  - *Size*: users can shrink and grow until they gain a good viewpoint
  - *Transduction*: virtual environments can transduce any kind of information into perceptible stimuli
  - *Reification*: virtual environments can create perceptible representations of abstract concepts (that have no physical form).

Virtual Museums and Cultural Heritage

- Web3D technologies can be used in the context of museums and cultural heritage:
  - to promote real-world exhibitions, historical places, ...
  - to show museum items in their original (historical, curltural, ...) context
  - to provide educational experiences based on the museum items
- Another possibility is to use them to complement real world exhibitions (e.g. by providing VR kiosks)

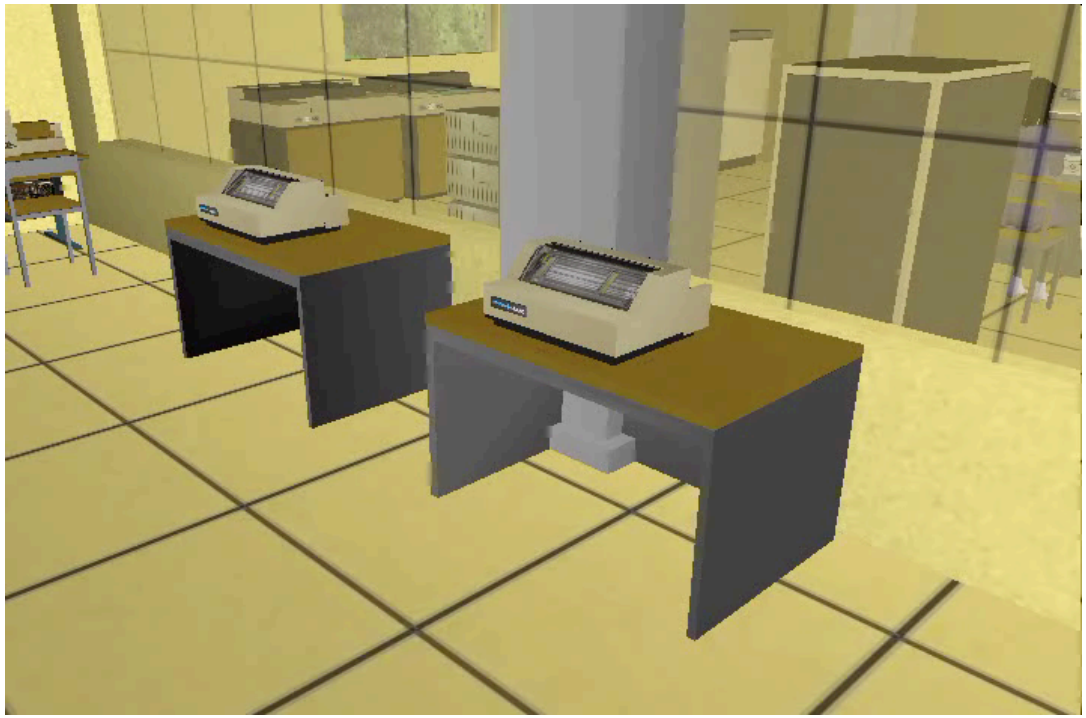
Example: Computer Science Museum



Using Virtual Humans as Guides

- Virtual humans can enhance an educational virtual environment by providing:
  - navigational and interaction guidance
  - emotional response (more involvement)
  - social dimension (the "persona effect")
  - non-verbal language for explanation and feedback (more immediate and inobtrusive)
- We added to the Computer science Museum a virtual humanoid acting as a museum guide, i.e.presenting the museum items in a suitable order
  - formal experiments with users show that the Computer Science with the virtual guide is preferred and more effective in learning

Example: Virtual Museum Guide



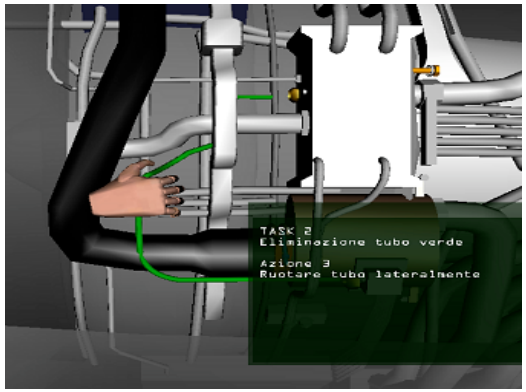
(Chittaro et al., 2003; Ieronutti, 2004):

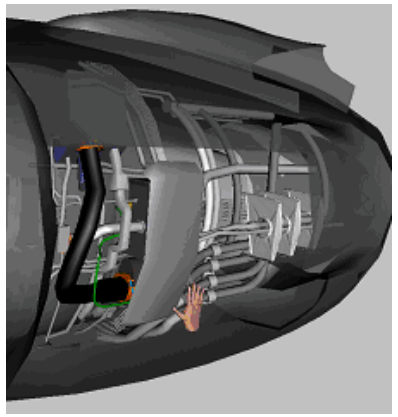
Virtual Training

- We developed a software architecture (called **iVT**, *immersive Virtual Training*) for developing virtual training applications;
- Using iVT, trainees can learn hand-operated tasks related to assembling or disassembling mechanical items:

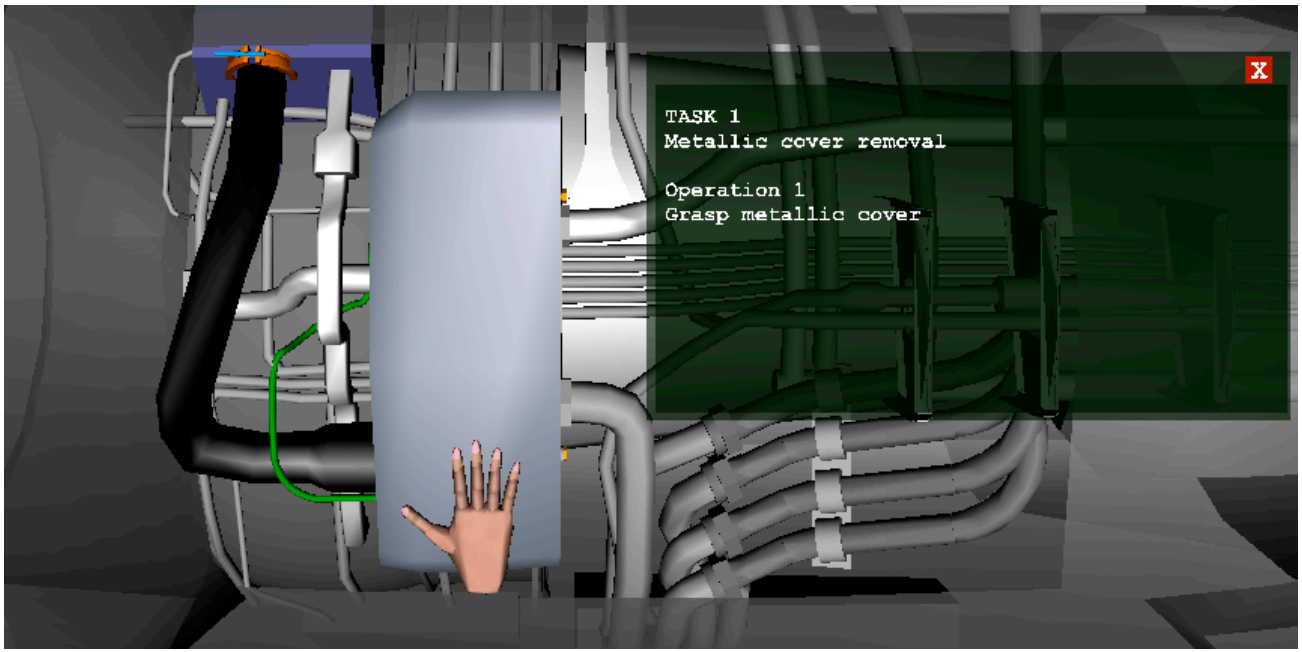
  iVT suggests the task to perform;

  trainees can move their virtual hand and try to execute the task.





Training Example



- Two basic operations:
  - Metallic cover **grasping**;
  - Metallic cover **releasing**.

Adding more intuitive interaction …

- By controlling the virtual hand with a dataglove, users can interact in a more natural and realistic way
- The 3D learning scenario can also be shown in stereo using HMDs or LCD glasses.

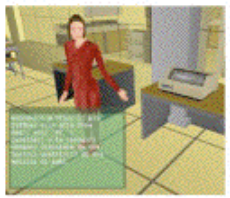
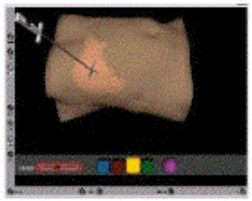
WG 1 Workshop (LET-WEB3D)

CO-FINANCED by EUROPEAN COMMISSION

ICT for EU-India Cross Cultural Dissemination

workshop website

Dipartimento di Matematica e Informatica **in cooperation with:** SIGCHI Italy

LET-WEB3D

September 30 - October 1, 2004
Udine, ITALY

First International Workshop on

Web3D Technologies in Learning, Education and Training

Latest additions to this site:

Workshop Proceedings, Tutorial and Keynote slides are downloadable from the program page .

New 3D Web technology (such as X3D, VRML, MPEG4, OpenHSF, Java3D,...) makes it possible to build interactive 3D virtual environments experienced through the Internet as educational and training platforms. The LET-WEB3D Workshop aims at providing a forum to discuss the challenges and potential solutions for effective combination of 3D environments, Web technologies, innovative user interfaces and pedagogical strategies.

WG 1 Workshop (LET-WEB3D)

- Workshop theme: Web3D Technologies in Learning, Education and Training
  - held in Udine from 30 Sept to 1 Oct 2004
  - 33 participants from 10 different countries (3 from India)
- papers and tutorials are publicly available on the Workshop Web site: http://hcilab.uniud.it/let-web3d

Connections with the E-Content WG