**Telepresence**

- The use of VR to visit a real remote location
  - And interact with it?
- Has applications in many areas like:
  - Remote driving or flight (combat?)
  - Operation of machinery in hazards
  - Remote medicine

**Telepresence examples**

- Greenman
- 1986

**Telepresence examples**

- TOPS
- Tele-diver
- 1991

**Telepresence for medicine - Telemedicine**

- Allows surgeons to operate remotely
  - Useful for rarely carried out operations
  - Useful for patients in remote areas
  - Battlefield medicine?
- NASA test for ISS 2004-10-13
- Becoming possible through a number of new technologies:
Surgical trainers…
- e.g. PROMIS
- Laparoscopic surgical trainer
- Tracked handles
- Camera
- Force feedback?
  - probably not

...and reliable networks...
- Need reliable and fast communication
  - No dropouts
  - no lag
- Can be provided by technologies like ATM over fibre

...to robotic devices...
- Complex precise robotics
- ‘Waldo’ devices for micromanipulation
  - mechanical devices in use for years
  - electronic ones now becoming more commonplace.

...for remote interaction
Remote surgery: Operation Lindbergh
- Surgeon in New York, USA
- Patient in Strasbourg, France
  - 68 year old woman
  - Laparoscopic Cholecystectomy (gallbladder removal)
- Video and control signals sent over ATM using dedicated OC3 fibre link.
  - Constraint 0.6 seconds round trip time
Operation Lindbergh had no haptic feedback — Common in laparoscopy

How can haptics be incorporated?
- Research being done at KTH on this
  - Project ran to June 2003
- Built system based on 2 phantom devices

Collaborative haptics at KTH
- Used 2 stations
- In separate rooms
- Connected using ethernet and voice
- 2 users work in same VR scene
  - Can’t see each other’s ‘pointer’
- Build things out of blocks

Users can feel each others actions
- Can speak to each other to share information
- Try to work together to build things
- Very difficult – can’t see one another
- Problem with update rates?
  - Surface interactions need ~1KHz

Collaborative VR: Collaborative visualization
- Collaborative visualization has been a popular goal
  - Visualization shared across multiple users
  - In the same place
  - In different places
- Real science and medicine
  - and games!

Tele-collaborative medicine
- Java (or DirectPlay)
- Central server?
- Distributed clients
- Shared data
- Shared view
- Interaction
**Collaborative VR: Problems**

- Two users can’t share a space
  - Head-tracking works for a single user
    - perspective problem
    - parallax problem
- Unless they are wearing HMD’s
- Or have well-separated displays

**The PIT**

- Protein Interactive Theatre
- Collaborative Chemistry system
  - Designed for Structural- and Bio-chemists
- Allows two users to work together
- Both see well displayed VR stereo scene

**Distributed (collaborative) VR**

- Similar goals
  - Share scene between multiple users
  - Possibly on distributed sites
  - Shared interaction
- Similar client(-server) models
  - Usually central server with multiple clients
- More interaction methods required
  - E.g. haptics

**Distributed collaborative VR**

- DEVA - Advanced Interfaces Group
  - Manchester-based research centre
- Centralized ‘world’ server
- Clients download and display scene locally
- Interaction shared through server
- Avatars show other users
DEVA

Example: DI VI PRO -
Distributed Interactive Virtual PROtotyping

TNM053 - VR Technology and programming
Lecture 12.5: Summary, Applications, future
Matt Cooper

So, what is VR?
- Bringing together many technologies:
  - High quality computer graphics
    - Photorealism
  - High performance rendering
    - Large and complex scenes
  - Accurate tracking in many DOF's
  - Accurate, fast force feedback
  - High quality audio rendering

What is VR? (2)
- ...Using sophisticated approaches...
  - sophisticated scene rendering
  - Appropriate, complex interaction techniques
  - Accurate, realistic physical modelling
    - Game engines
  - addressing many senses simultaneously:
    - Sight, hearing, smell, touch (& heat, wind…)

What is VR? (3)
- ...to create a virtual world...
  - designed to meet a need
  - creating a sense of presence
  - and of immersion
  - and hence (with good goal design) involvement
What is VR? (4)

- ...so that the user can do something!
  - Be entertained
  - Learn something
    - practice a skill or a new technique
    - memorize an escape route
  - Carry out a task
    - Examine some data
    - Operate on a patient

VR has always been...

- a lot of hype!...
- ...but it’s becoming more and more useful
- Finding a place in niche markets
  - Oil and gas survey (geological)
  - Medical – training and diagnosis
  - Engineering (data analysis)
  - Design and engineering (CAD)
  - Training and education
  - Entertainment
  - ...

It needs the best and most expensive cg hardware

- But that’s becoming available in hardware down to the level of a PC
  - Rendering performance quite adequate to some tasks is already available
  - Single screen trainers based on 3D graphics cards in PC’s are becoming commonplace

Needs complex software

- Needed to manage complex 3D scenes
- Which you can now download for free from the web
  - OpenGL
  - OpenInventor
  - OpenScenegraph
  - VR Juggler (replacement for CaveLib)

Very expensive displays

- Bright and powerful projectors...
- which you can now buy for ~$2000
  - ASK-DLP
- Expensive head-mounted displays...
- which you can now buy for ~$2000
- Or expensive shutter glasses (<$100)
- Or polarized glasses (<$10)

Expensive tracking equipment

- Commercially that’s still true...
  - Still costs many thousands of dollars
  - Which affects things like head and pointer tracking badly
- ...but building your own *mechanical* devices is not prohibitive
  - Building Stefan’s monkey cost $300
Very expensive haptic kit

- Sadly still true and not much to be done about it
  - Building your own is difficult
  - The ‘toy’ equipment isn’t much use
- Prices are coming down
  - Still costs thousands
  - Won’t be available for general (home) use for several years at least

Hard to interact with

- Yes, it can be
- Needs:
  - Careful design
  - Some (more) imagination
  - More research and development
- In 1976 someone implemented ‘WIMP’
  - Took ~15 years to become commonplace

And so...

- Is finally becoming a main-stream technology
- Ten years ago it was science-fiction
  - (Ok, almost)
- Now it’s expected to be the norm in less than 20 years time

Application areas

- Oil and gas
  - Major buyers of cylindrical semi-immersive display technology
  - Use it for collaborative discussion of geological data
  - Norsk Hydro use it routinely

Application areas

- Medical
  - In Trainers
  - In surgery
- Engineering (data analysis)
Application areas

- Design and engineering (CAD)

Application Areas

- Trainers

So...

- The range of applications is expanding
  - Few have completely converted
  - Many have taken on components of VR
- VR trainers are becoming common
  - Because they're a cheaper alternative
  - Because they're convenient
  - Because they can now be authentic

Future developments

- Other than more and better examples of VR...
- Collaborative VR
- Augmented reality
- Better user interface design
  - More imagination!

Augmented Reality

- The use of VR to add objects into the real world
- Requires very precise tracking
- Requires very precise maps of the world
- Never really found a general use
- Clinical users have always been a target audience
Clinical augmented reality

- Systems have been tried for several years
- Sophisticated, accurate tracking
- Powerful graphics (for the time)
- Never (yet) successful
  - too much for the doctor to take in one go
  - too alien a working method

Augmented reality: an example

Augmented Reality

- New technologies in vision systems and tracking enabling other uses
- Mark Ollila showed you some of these.
- Sneaking the technology in the back door:
  - Get people used to it in small ways
  - Then hit them with the big ideas.

And that’s it!

- Lecture notes, papers, labs all available from:
  http://www.itn.liu.se/~matco/TNM053/TNM053.html

Labs

- Final date for lab demonstration: 2004-12-17
- After that there will be sessions in the examination period in March (April?)

Examination

- To be held Tuesday (19th)–Friday (22nd)
- Booking sheets up outside my office
  - 6th floor
- Each slot 30 minutes.
- Examination is oral
  - Spoken ‘Interview’ Q&A
Preparing for the exam

- Orals are quite like any other exam
  - Read and understand the lecture notes
  - Read and understand the papers
  - We ask you questions...
  - ...(hopefully) you answer them.
- But not exactly the same
  - Presenting the material isn't the same.

Preparing for the exam

- Talking about the material isn't the same as writing about it:
  - More immediate
  - Less thinking time.
- Prepare by talking about it.
  - Work in small groups (two or more).
  - Discuss the material
  - Discuss your *understanding* of it

And that’s it!

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