Computer Supported Collaborative Work

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Stephen Egan
Stephen.Egan@csiro.au
CSIRO Manufacturing & Infrastructure Technology

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Computer Supported Collaborative Work is a general term that covers a number of threads that will need to converge if humans are to gain the maximum benefit from the use of IT in solving complex problems.

Multiple Points of Presence

- Teleconferencing
- Conference Calls
- Email
- Fax
- Snail mail

Shared Domain Information

- Web / Electronic documents
- CAD Models
- Whiteboard
- Drawings
- Paper documents
- Reference material

Multiple Consistent Domain Views

- Electronic Document Managers
- Watermarking
- Central Document Store
- Change Manager

Schedule

- Teleconferencing
- Shared Workspaces
  - Co located
  - Remote collaboration
- On-site Collaboration
- Immersive Environments
- Discussions

How can existing and emerging Information and Communication Technologies be leveraged and integrated to facilitate collaborative work in the AEC/FM sector?

Teleconferencing

- Video and audio conferencing in common use
- Technical limitations
  - Image and sound quality
  - Audio and video track synchronisation
  - Network lag
- Inter personnel limitations
  - Eye contact, gestures
  - Limited presence

Teleconferencing

- Next generation provides better technical experience
  - Larger bandwidth, Internet2
  - More immersive displays
  - Head tracking for facial expressions, eye contact
  - Larger capture area
  - Physical document sharing

Agora

Paper Mediated Video Conferencing

- University of Tsukuba
- King's College London
- Saitama University

Co-located Collaboration

- Majority of of collaborative interactions take place in the same physical space
- New technologies can be used to aid collaboration
  - Easier sharing of documents between individuals
  - Easier sharing on a group level
  - Ad-hoc networking of participants' equipment
  - New techniques for multiple users working on same documents

Co-located Collaboration

- Smart rooms allow computer control of a room and its facilities
- Ad hoc networking can allow heterogenous pieces of equipment to communicate automatically
- Shared screens, printers etc.
- Services offered in “Publish and Subscribe” model.

iRoom

- Stanford University
- Large wall mounted SMART boards
  - Touch panel
  - Wireless mouse & keyboard
- Table top display
- Integrates laptop, PDAs, etc
- iwork.stanford.edu

Intelligent Whitespaces

- Tracking, capture and projection
- Allows users to collaborate in a brainstorming session, remotely or locally.
- Add interactivity to whiteboard items
- “Hands on” interaction with system.

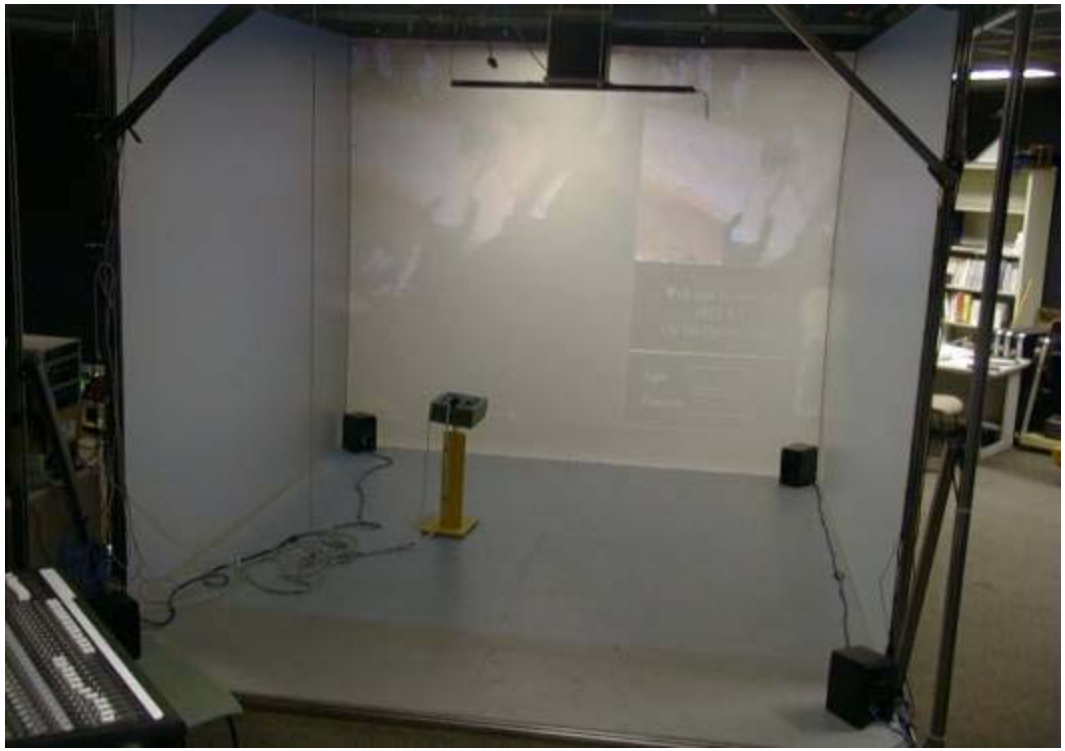
MagicBoard

Augmented Whiteboard

- CLIPS-IMAG, France
- MIT Media Lab

Enhanced Desk

CAVE

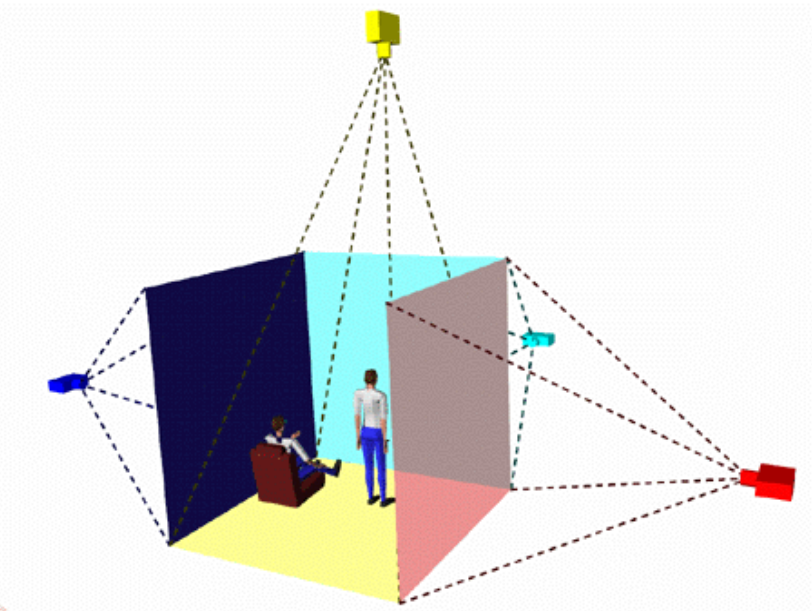


CAVE Automatic Virtual Environment

- Also known as **VR Theatre Display** and **Spatially Immersive Display (SID)**
- Developed by Electronic Visualization Laboratory, University of Illinois at Chicago
- First Demonstrated at SIGGRAPH 1992
- Now produced commercially by Fakespace Systems
- http://www.fakespacesystems.com/products/cave.htm

CAVE

- Immersive Virtual Environment created by three rear projected images on walls and one front projected image on floor.
- Stereoscopic view using shutter glasses.
- Six DOF head tracking system adjusts perspective.
- “Wand” used for user input.
- Multiple users.



CAVE

Immersive and Interactive
Enovia DMU

A World's First
in the
Fakespace Digital CAVE®

October 12, 2001

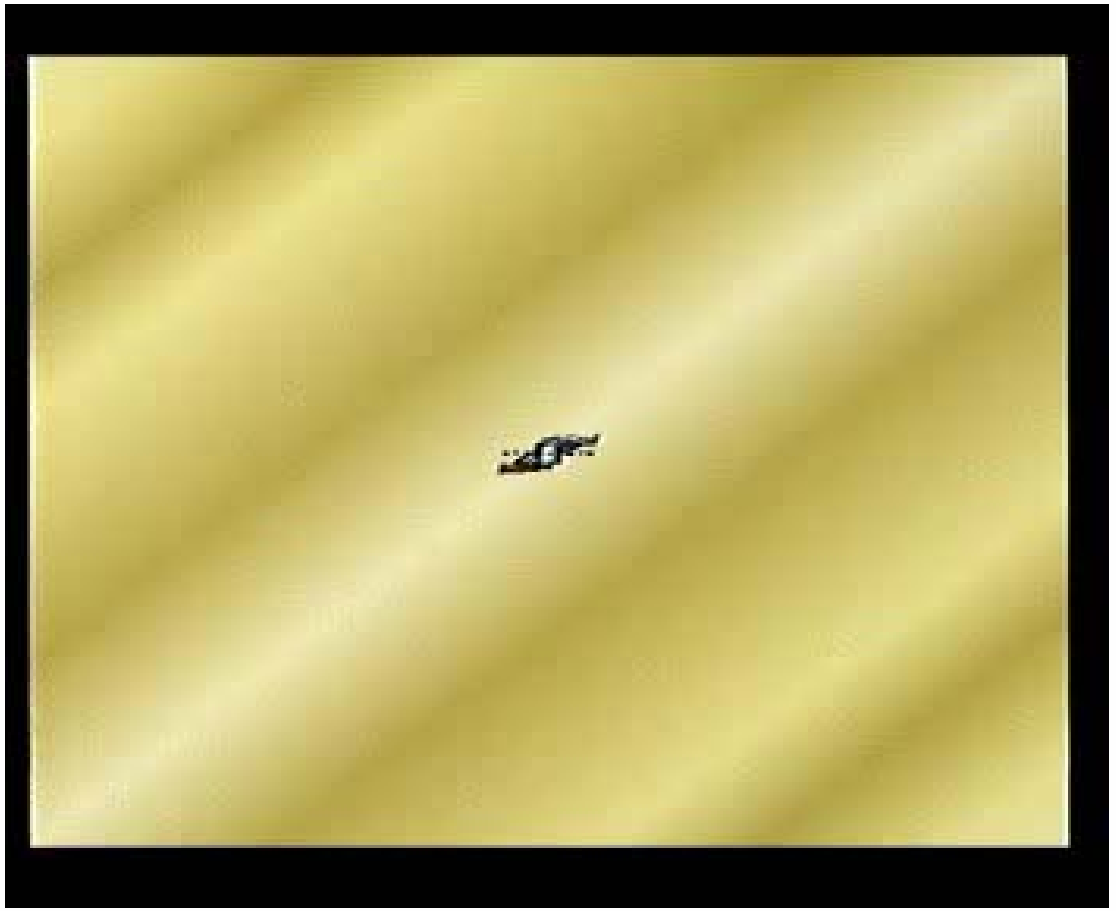
On-site collaboration

- Mobile technologies for use on site
  - Wireless devices such as PDAs and Smart phones
  - GSM, GPRS, Wireless Java, etc
  - 3G phones offer greater potential
- Parts and materials tracking
- Calibrated photography
- Surveying

On-site collaboration

- More information can be collected in the field – less data entry/transfer in office.
- Technological restrictions has kept current solutions basic
- 3G will provide “always on” high bandwidth services, newer devices and technologies will allow more to be done in the field
- Huge potential for growth

Starmate



Immersive Environments

- Virtual Reality and Augmented Reality
- Computer generated models of new and existing structures
- Virtual Reality has a long history of use, particularly for manufacturing and mechanical industries
- Underused in AEC/FM?

Augmented Reality

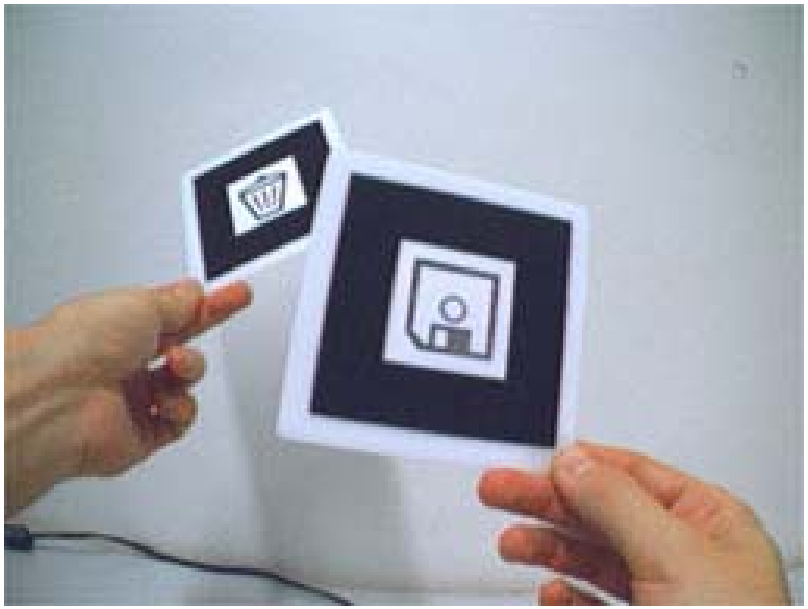
- Superimposes a Virtual Reality model, text, 2D graphics, etc., over a user's view of the real world
- Numerous potential applications for AEC/FM sector
- Location aware technologies through GPS
- Indoor and outdoor use

AR Displays

- Hand held
- Head Mounted Displays (HMD)
- Optical see-through
  - Half silvered mirror mixes graphic display and reality
- Video see-through
  - Images from camera combined with graphics and shown on display
- Retinal Laser scan (MicroVision)
  - Graphical images scanned onto retina with low power laser.

AR Optical tracking

- Symbols and shapes printed on markers are tracked optically
- Image threshold lowered so symbol may be identified
- Affined projection used to place AR image over marker



AR User Interaction

- Handheld PDA
- Optically Tracked gloves
- Optically Tracked paddles
- “Magic Wand”
- Three dimensional mouse
- Hand/Finger tracking
- Haptic Feedback

AR Location Awareness

- GPS
- Optical Markers
- Fixed IR-LED beacons
- Fixed radio beacons

Structured Visual Markers for Indoor Pathfinding

IEEE International Augmented Reality Toolkit Workshop 2002

Architectural Anatomy

Real-time Structural Feature Overlay

- Columbia University

Real World Mapping

- Existing Condition Documentation
- Site Feature Mapping
- Real Time 3D Capture

Existing Condition Documentation

- Reluctance to use new forms of modelling due to existing buildings, structures and features documented in older formats.
- Drawings may be incomplete, out of date, or non-existent!
- Remodelling is slow, costly and error prone.
- Detail can be omitted.

Existing Condition Documentation

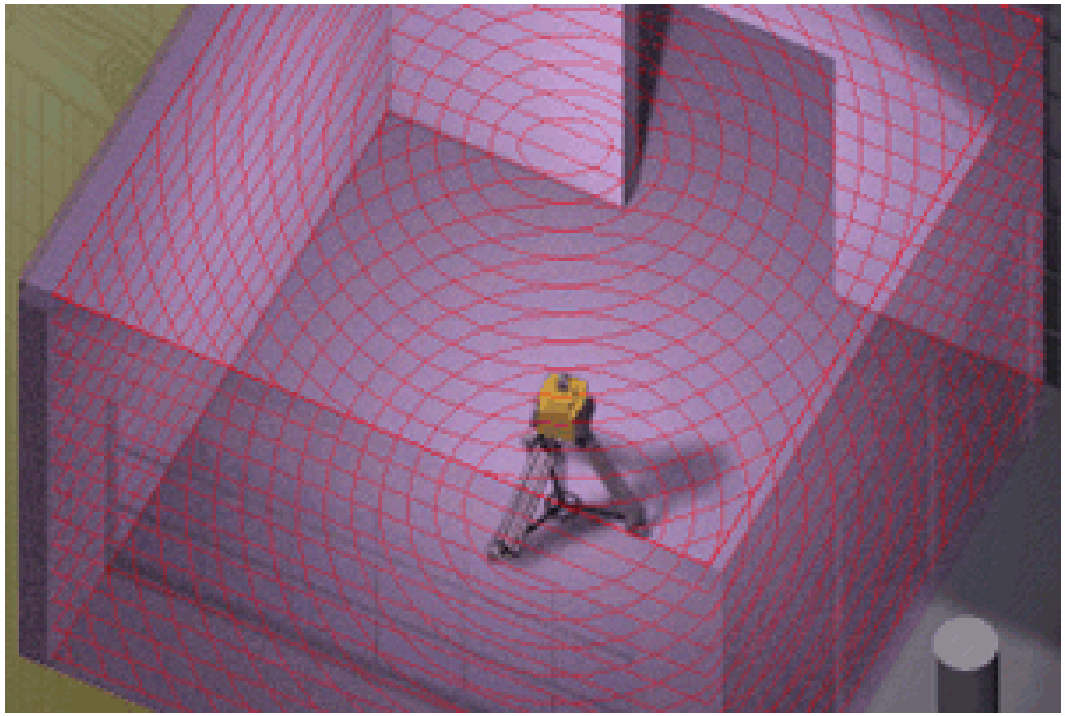
- Create 3D model of existing structures using scanning laser camera.
- Fast, accurate and cheap.
- www.quantapoint.com

Scanning Laser Camera

- Precision Laser Camera used to create very high definition models
- Data collection takes place by laser scanning structure.
- Point clouds created from different perspectives.
- Point clouds merged to produce model.

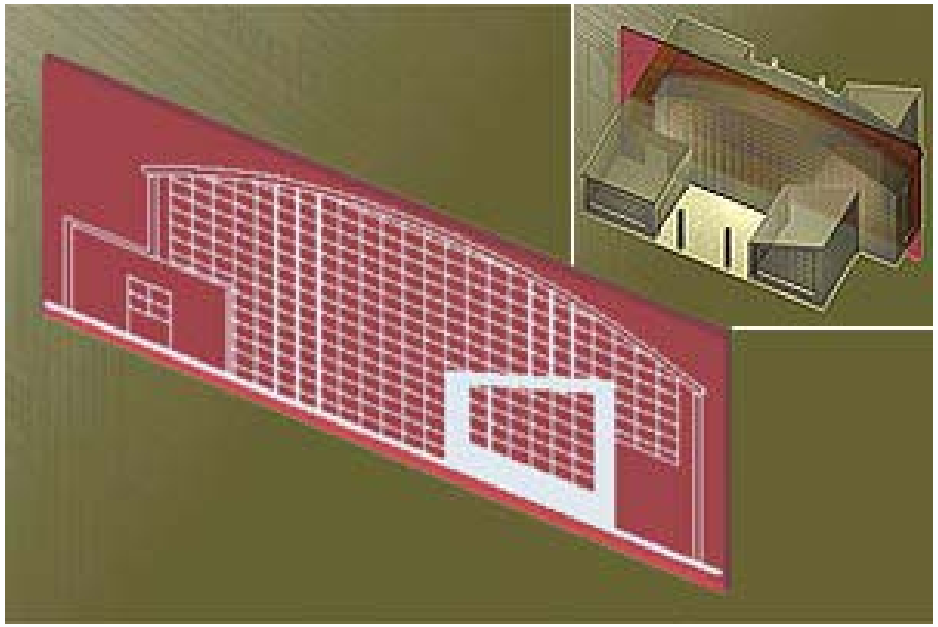
Scanning Laser Camera

- 125, 000 laser pulses per second
- 10 Million points can be scanned in 80 seconds.



Scanning Laser Camera

- Model created by merging point clouds.
- Common points on X, Y and Z axes are precisely registered.
- Point cloud can be sliced for plan, elevation or section views.



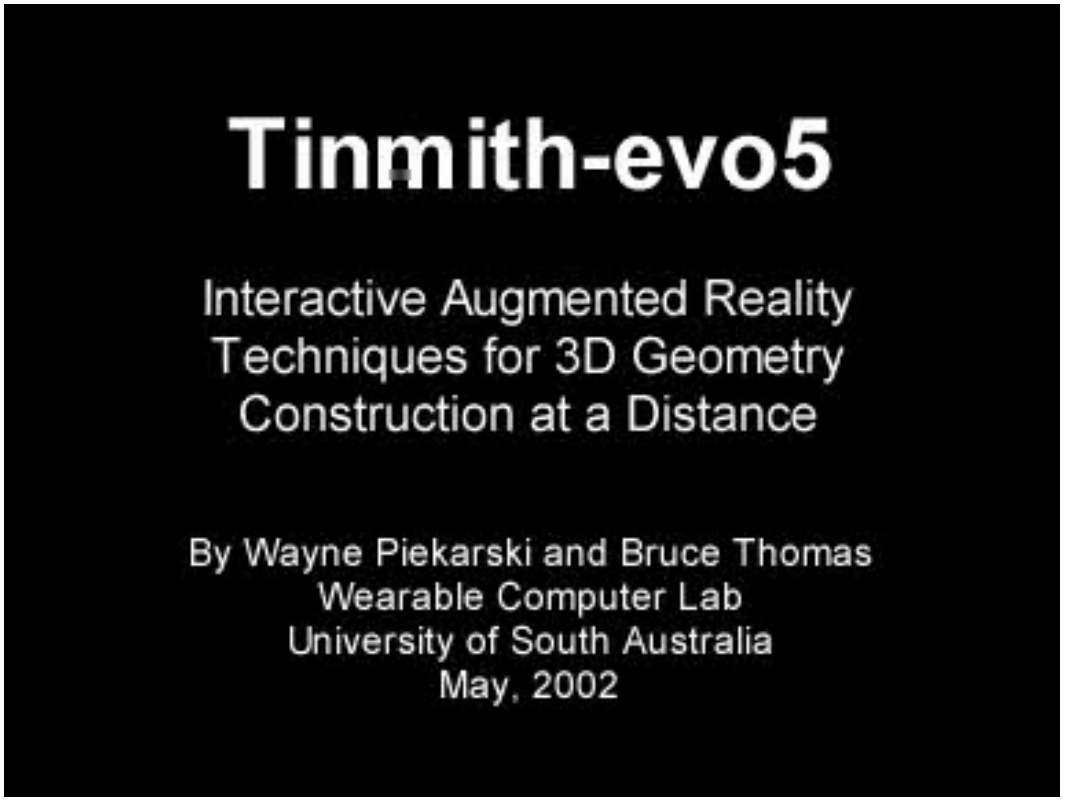
Site Feature Mapping

- Collect data from an existing site to add to a Virtual Environment.
- Place existing models in correct position and orientation.
- Create models in Virtual Environment from existing features.

Tinmith

Interactive Augmented Reality Techniques for 3D Geometry Construction at a Distance

- University of South Australia



Avatars in Immersive Environment

- Avatars are used to represent other entities in an immersive environment.
- Avatar may represent another user of the system, or may represent a synthetic entity.
- Easy to implement.
- Unrealistic representation.

Avatars in Immersive Environment

- Computer generated body double
- Little scope for gestures, facial expressions or body language.
- Does not necessarily resemble user's real appearance.

Avatars in Immersive Environment

- Tracking and orientation is simplified
- Low rendering overhead.
- Support for primitive gestures.

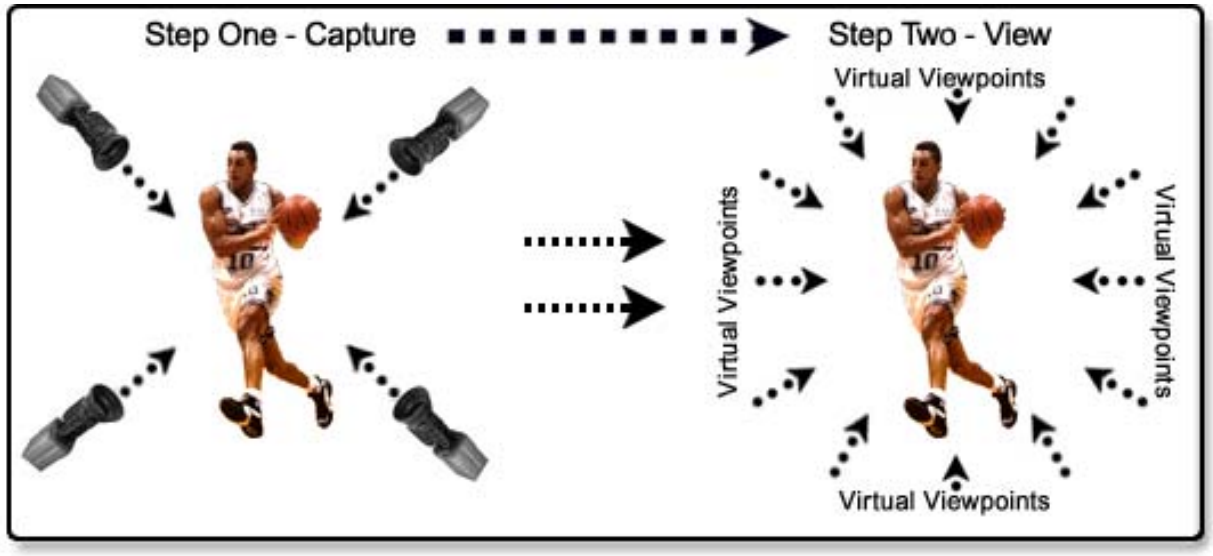
Real Time 3D Capture

Real Time 3D Capture

- 3D Live system captures a 3D model of a user in real-time.
- Model may be used as a realistic avatar in an immersive environment.
- May be used for teleconferencing, virtual tours, etc.
- www.zaxel.com

Real Time 3D Capture

- Multiple cameras used to capture user.
- Virtual viewpoint created on demand.



Real Time 3D Capture

- System uses at least three cameras.
- One PC workstation used for every three cameras.
- Proprietary software used to create Virtual Viewpoints.

Real Time 3D Capture

- Realistic representation of user
- Gestures, facial expressions and body language are captured
- Mini studio required for capture
- Not ideal for two way use
  - No eye contact due to HMD.
- More suited to virtual tours, presentations, etc.

3-D Live

Real-time Interaction for Mixed Reality

- National University of Singapore
- Zaxel Systems
- University of Washington
- Hiroshima State University

For Discussion…

- Tele conferencing
  - How useful will new technologies be?
    - Will a more “real” presence be beneficial?
    - Are existing solutions adequate?
- Shared workspaces
  - What kind of work will leverage new advances?

For Discussion…

- On-site collaboration
  - What kind of work can benefit from smaller, faster and cheaper mobile devices?
  - What new work methods can be developed from the new generation of wireless devices?

For Discussion…

- Immersive environments
  - Moving away from WIMP
    - How can a user interact more intuitively within an immersive environment?
  - New worlds, new opportunities
    - Adding value with immersive environments
- Other topics…