The Role of Psychologists in the Design, Analysis, and Application of Virtual Environments

Holger Regenbrecht
Outline

1. Virtual Reality: Definition and Scope
2. Short Overview on VR/AR projects
3. Presence Research „AMT I+II“
4. Usability Research „cAR/PE!“
5. Touching Cybertherapy: „ACRO“
6. Current Research and Ideas
Definition and Scope
"A virtual environment (VE) is an environment created by the interaction of a human participant with a world displayed by computer. The displays provide information in the visual, auditory, and kinesthetic (including tactile and force-feedback) modalities. In immersive VEs (IVEs) sensory input to the human from the external world is, ideally, wholly provided by the computer generated displays."
(Slater & Usoh, 1993, p. 221)

"A virtual reality is defined as a real or simulated environment in which the perceiver experiences telepresence". (Steuer, 1992, p. 76f)

- Computer generated environment
- Three-dimensional
- Interactive with real-time feedback
- Sense of presence
Virtual Reality Scope::Examples

- Computer generated environment
- Three-dimensional
- Interactive with real-time feedback
- Sense of presence


Courtesy of DaimlerChrysler Research and Technology

- Computer generated environment
- Three-dimensional
- Interactive with real-time feedback
- Sense of presence

Courtesy of NASA Ames

Courtesy of DaimlerChrysler Research and Technology
Virtual Reality Scope::Technology

- Tracking
- Visual Displays
- Auditory and Haptic Displays
- User Input
- VR-System

CAVE
HoloStage
Responsive Workbench
Cylindrical Projection
Sutherland
Sony Glasstron
Kaiser
Nomad-I

http://www.telescence.org
Virtual Reality Scope::Mixed Reality

Drascic, D. & Milgram, P. (1996)
Virtual Reality Scope::Main Disciplines

Design

Informatics

Psychology

Users & Customers
Selected Projects
VR/AR Projects::Virtual Reality Modelers

- Bauhaus University; 1995 - 1999
- *voxDesign, planeDesign, VRAM*
- Simple modeling programs for early design sketches
- Used in teaching
- Head-mounted display, Polhemus tracking system
- Technology Furniture „*Platform“
- Walking metaphor
VR/AR Projects::Collaborative Design Review

- Need for more and better tools for collaborative work in industry
- Design reviews take place very often and incorporate
  - Sketches and drawings
  - Text documents, spreadsheets, slide presentations
  - (CAD or real) 3D models of parts to be build
- AR can be used to extend today's meetings
- Four (not limited to 4) users are sitting around a real table
- wearing lightweight HMDs with built-in cameras
- To every user a standard-PC is assigned, connected via network
- Integrated into setup: presentation screen, „cake platter“ on table for 3D models, annotation cards, torch, clipping plane, PDAs, ...
VR/AR Projects::CFD Data visualization

- Work for airplane manufacturer Airbus within ARVIKA project
- Airplane interior designs are unique (seats, linings, ...)
- Variants in design are typically shown w/ partial mockups (e.g. a couple of seat rows within airplane)
- Airstreams (temperatures, velocities, etc.) cannot be experienced
- AR visualizes Computational Fluid Dynamics data in form of voxels
Creation of a freehand interaction device with directed vibro-tactile feedback

Feedback direction is spatial and encodes immediate feedback from objects out of the VE, such as collisions

Application scenario: „packaging“ of battery

Use of 6 cell phone vibration motors

Semi-immersive environment (Workbench)

Tracked with high-end optical tracking system
VR/AR Projects::Wire Placement

- Work for DaimlerChrysler truck unit
- Customers have a high degree of freedom in configuration of truck
- Almost no two trucks are identical, therefore wiring must be planned individually for almost every truck
- In production and production planning phase AR supports the interactive layout of wiring harnesses (tree-structured bundles of wires)
- Layout takes place on real girder

- Lightweight HMD + camera
- Standard PC running AR-system
- Two tracking systems: marker and optical
VR/AR Projects::Driver Safety Training

- Using AR for training drivers in car
- Display of all kind of driving situations, even those not presentable in reality (technological, organizational, safety reasons)
- Lightweight HMD’s
- Notebook computer on back seat
- tests with customer and users show promising results
Presence and Usability
Presence Research::Overview

- Bauhaus University, University Jena, DaimlerChrysler Research
- What is the „sense of presence“? What is „immersion“?
- What are the contributing factors?
- Several empirical studies in different virtual environments
- Development of a presence questionnaire (IPQ)
- Factor analysis of dimensions of presence
- Joint work with psychologists
- Several publications
- Doctoral thesis topic
Presence Research::AMT I+II

- role of self-movement and possibility of interaction on perception of VE
- improvement of IPQ reliability
- clear separation of immersion and presence
- 35+56 subjects
- even the illusion of interaction, with no actual interaction taking place, significantly increases spatial presence
- published 2002
Usability::3D Teleconferencing (3DTC)

Goals:
- 3D-Videoconferencing on the Desk
- Enabling ad-hoc and natural communication
- One System for Communication, 3D-Data, and Presentation
- Internet based
- Distributed Data Integration (PDM)
- Remote Application Sharing
- Increasing Quality, Reducing Delays
- Reducing Travel Time and Efforts
- PC-based solution
- Prototype available for usability and pilot deployment
- Tested with 200+ participants
- Continuation of project in Germany and NZ
- Published in 2004
Touching Cybertherapy::Acrophobia

- 1996/1997 Acrophobia
- conceptualize emotion as an outcome of presence
- investigate the definition, role and measurement of presence
- fear of heights evoking environment
- IPQ: first questionnaire developed
- 37 subjects
- fear of heights and presence developed
- published 1998
Current Research
Current Research::3D Teleconferencing (3DTC)

- Dimensions of interest:
  - Quality of communication
  - Presence issues
  - 3D User Interfaces
  - Perceptual and Tangible User Interfaces
  - Usability
Current Research::3DTC::Measuring Social Presence

- Participants within-subjects design. Traditional 2DVC, 3DVC and Face-to-Face.
- Collaborate to come up with a rank on the 'desert survival task'.
- Hypotheses:
  - Social Presence increases over the conditions 2D, 3D, Face-to-Face.
  - Significant difference in Social Presence between the 2D and 3D conditions.
- 42 subjects; two different scales applied
- Significance in one scale FTF>3D>2D
Current Research::Ubiquitous Interfaces

- Living Gallery: Dynamic display of artwork and museum objects through proximity detection
- 480 research paper
- Purpose of Study:
  1. Is a proximity activated digital display of art valuable or appropriate.
  2. Is proximity triggered interaction intuitive.
  3. Can such a system be easily created for use and testing.
- Test Design Considerations:
  1. How usable is the system
  2. How appropriate is the system in the context of art display.
  3. Validity of tests!
Current Research::Telepresence

- PDA supported Tele-Presence
- 480 research project
- evaluation of degree of tele-presence (controlling different variables)
- Prototype development in progress
- Experiments in August

“Place Me There!”
Current Research::Ideas

- Collaborative Augmented Reality
  - High quality display, visualization, and tracking
  - Interaction issues
  - Usability
- Co-Work on AR and GIS
- AR Interface research
- Affordances in Virtual Environments
- Cybertherapy
  - Co-Location of Therapist and Client in VE
  - Interface issues
- 3DTC in different appl. fields
  e.g. distance learning, collab. film editing, ...
- Task Performance in 3DTC
- ...

3DTC in different appl. fields

real and virtual objects (AR)
autostereoscopic screen
tracking cameras
users w/ hmd's
real room
virtual participants
Joint Projects?

holger@infoscience.otago.ac.nz
www.igroup.org/regenbre
References


References (cont.)