Reflecting on the Design Process for Virtual Reality Applications

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Outline

- Introduction to the Problem
- Background
- Novelty and Innovation
- Methodology and Relation to HCI
- Applications
- Conclusion and Critical Thoughts

Introduction to the Problem

- When virtual environments are evaluated
- Mix of user experience and effectiveness reported
- Studies rarely discuss
  - how HCI/cognitive–exptl. knowledge was applied to design
  - how design might be improved by application of advice

Background

Heuristic evaluation of virtual reality applications. Alistair Sutcliffe and Brian Gault. Interacting with Computers 16 (2004) pp. 831-849

Reflecting on the Design and Implementation Issues of Virtual Environments. Wingrave and LaViola. Presence 19:2 (2010) pp. 179-195

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Background Paper 1

- Applied HCI principles to VE design
- Developed heuristics for evaluating VEs
- Twelve HCI design heuristics for VR applications
    - Natural engagement
    - Compatibility with the user's task and domain
    - Natural expression of user's action by devices, metaphors, and UI controls
    - Close coordination of action, feedback, and representation
    - Realistic feedback using VE components rather than GUI components

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Background Paper 1 contd.

- Twelve HCI design heuristics for VR applications contd.
  - Faithful viewpoints
  - Navigation and orientation support
  - Clear entry and exit points
  - Consistent departures
  - Support for learning
  - Clear turn-taking, between user and system initiative
  - Sense of presence

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Background Paper 2

- Surveyed VE design issues, 67 issues under 11 themes
  - design for human experience and perception
  - need for design knowledge
  - prototyping
  - model representation
  - events handling
  - call-back handling
  - lack of early evaluation
  - hidden dependencies
  - poor design practice
  - user issues
  - implementation problems
- Proposed 5 research challenges for improvement
  - natural representations
  - layered abstractions
  - creating models of systems
  - supporting reuse
  - trade-off techniques to deal with difficult problems

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Novelty and Innovation

- How to develop and apply knowledge from
  - cognitive psychology
  - HCI
- To VR design
- ---Details
- Reflects on VR design experience
- To apply human factors design advice
- Focus on trade-offs
- How to organize design advice
- To deliver more effective immersive experience

Novelty and Innovation contd.

- Proposed a trade-off framework for design options
- Set against criteria
  - usability
  - efficient operation
  - realism
  - presence

Methodology and Relation to HCI

- 2 case studies
- Apply HCI principles
- Reflect on the effectiveness of
  - methods applied
  - lessons learned
- Cyprus CAVE project at CUT
- Participant training + application
- Marine archaeology
  - user-centered design, early user engagement
- VE for vehicle driver expts
  - user-centered design, 2 hazard warning options
- (Accessibility) Top figure – UI of Marine archaeology case showing display panels and menus, and regular and highlighted amphorae. Highlighted amphorae are linked to external data and photos
- (Accessibility) Bottom figure – VE view of Vehicle driver case showing head-up display where the red circles that are present warn driver about vehicles approaching on left side

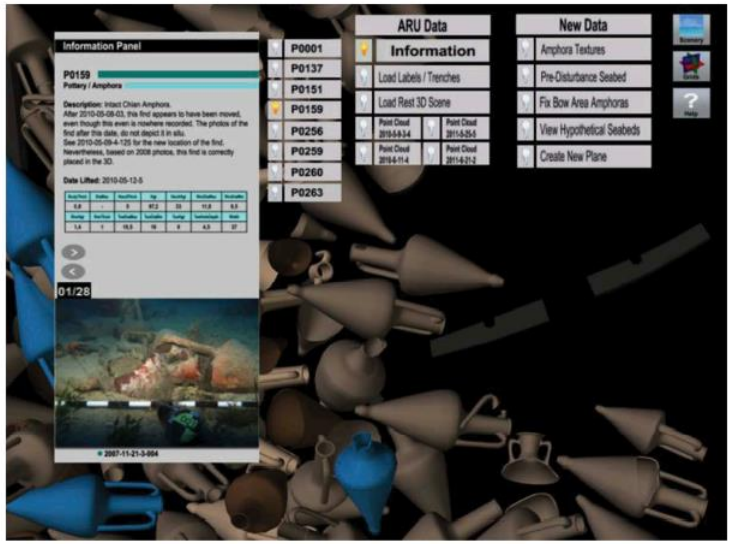

Figure 1. User interface of the Marine Archaeology VE, showing amphorae in situ, with information display panels and menus. Highlighted amphorae are associated with external data and photographs.

Figure 2. Driver VE view with the radar HUD depicting surrounding vehicles. The red circles are warnings about cars approaching on the left side.

Applications

- Application area
  - VE design
- How it improves performance
  - Highlights areas to address in VE design
    - need for trade-off advice to guide designers' choice
    - 4 design questions for translating the user's task into actions in the VE
  - 3 new heuristics for better presence, plausibility, flow -> more engaging UX
  - 18 citations

Conclusion and Critical Thoughts

- Conclusion
  - Case study 1 – partial success, time-efficient, not adopted
  - Case study 2 – immersion, realism mean rated high; presence and plausibility
- Future Works
  - Further research on design trade-offs

  Investigating the Potential Impact of Values on Requirements and Software Engineering.
  Sutcliffe et al. (2021) IEEE/ACM (ICSE-SEIS)
- Critical Thoughts
  - Solid contributions to HCI through VE design
  - More details on user feedback and more statistical analysis might be useful
    - objectivity
    - credibility
    - compare performance between studies