

Applying HCI Principles to AR Systems design

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AR design guidelines

- AR Research is mainly technology driven
- Swann survey of major publications (1992-2004)
 - Presence, ISMAR, ISWC, IEEE VR
 - 266 AR papers
 - 38 AR HCI papers (14%)
 - 21 Formal AR user studies (8%)
- Need for AR HCI and Usability research

Interface Design Path

- 1/ Prototype Demonstration
- 2/ Adoption of Interaction Techniques from other interface metaphors
- 3/ Development of new interface metaphors appropriate to the medium
- 4/ Development of formal theoretical models for predicting and modeling user actions

Augmented Reality

Virtual Reality

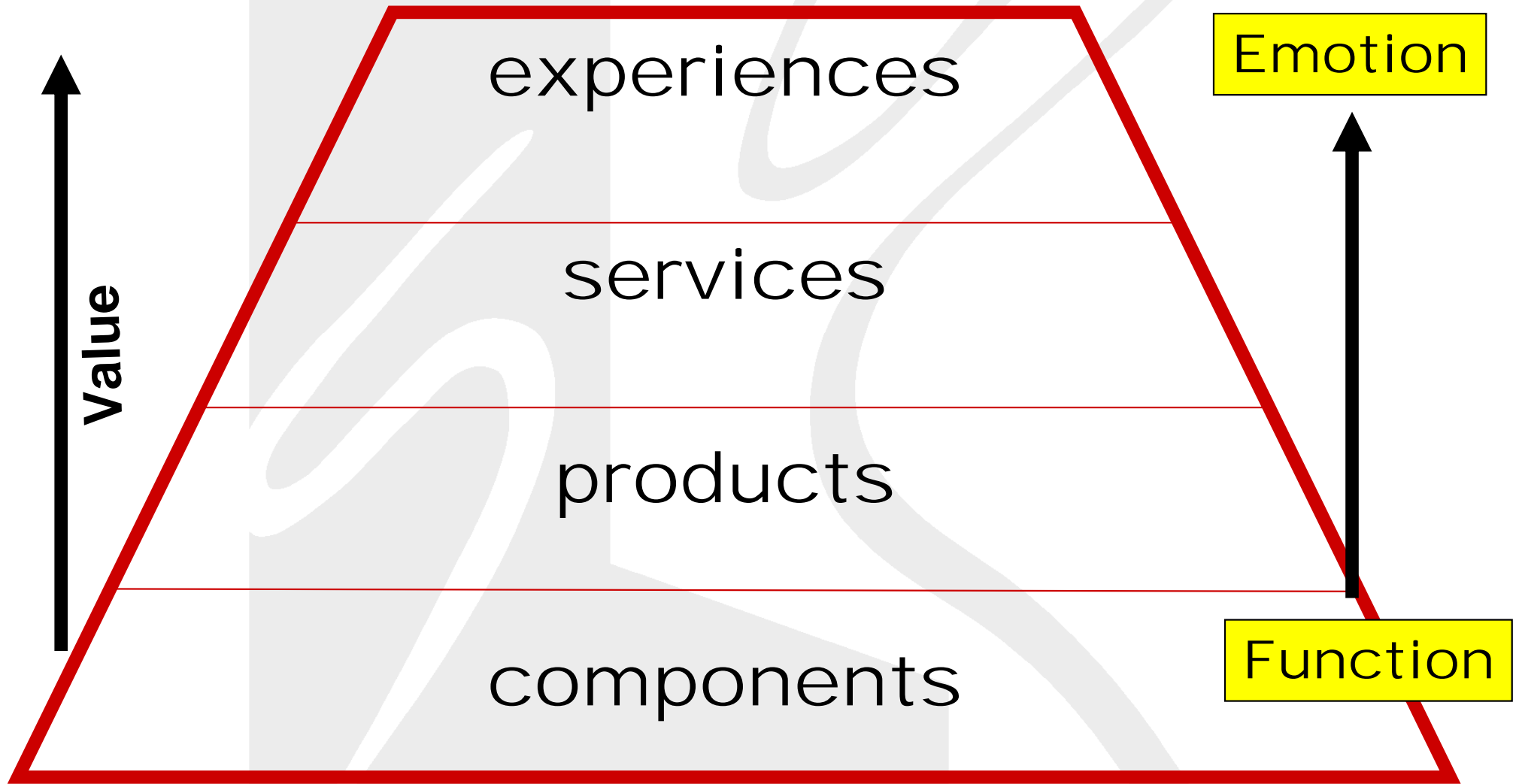
Desktop WIMP

**“The product is no longer
the basis of value. The
experience is.”**

Venkat Ramaswamy

The Future of Competition.

Gilmore + Pine: Experience Economy



The Value of Experience



20c



50c



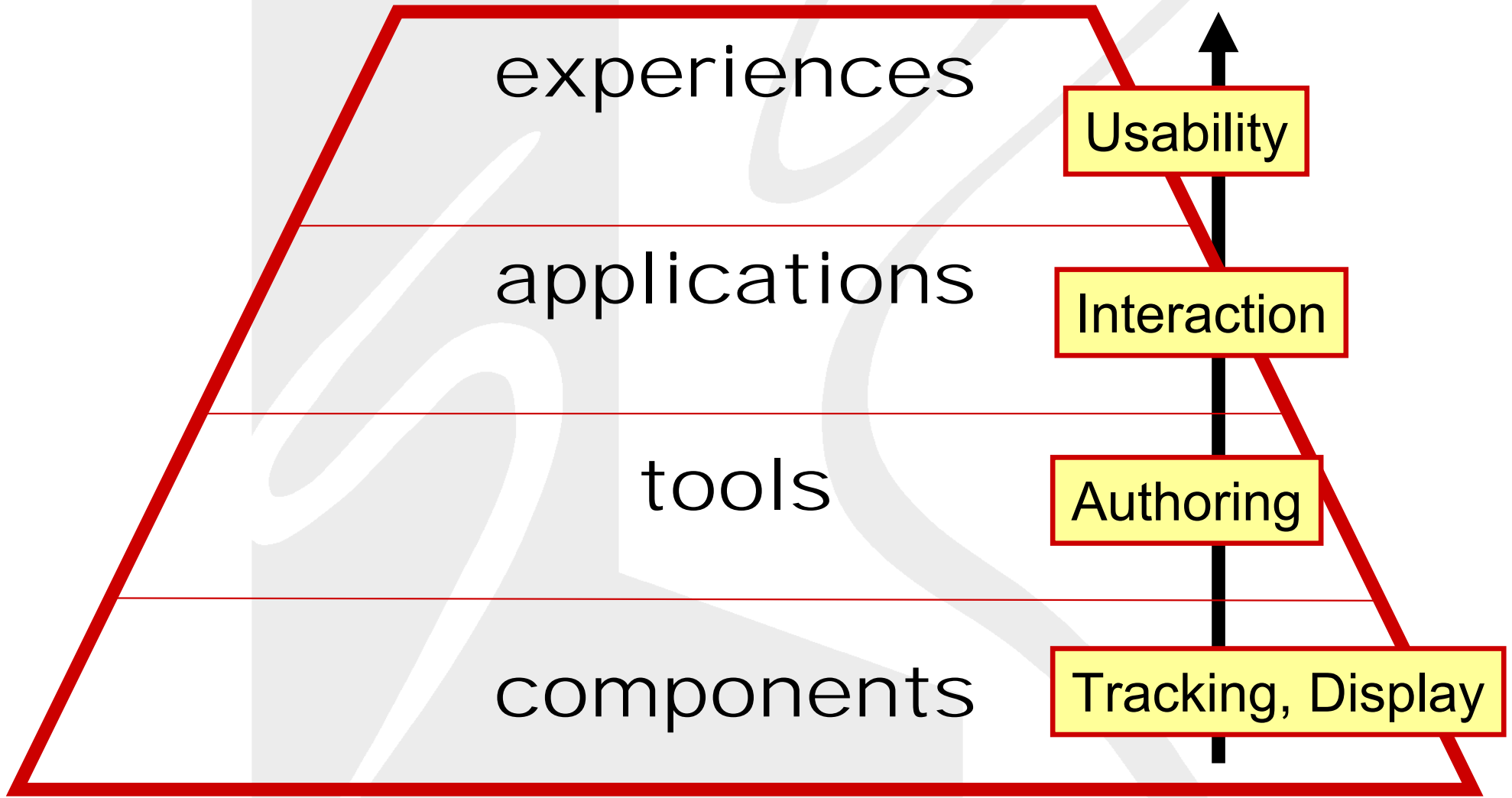
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Good Experience Design

- **Reactrix**
 - Top down projection
 - Camera based input
 - Reactive Graphics
 - No instructions
 - No training



Building Compelling AR Experiences



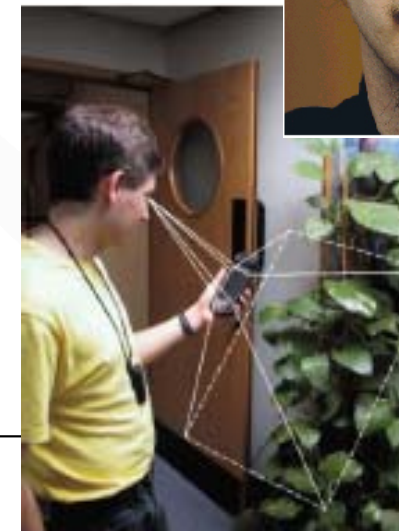
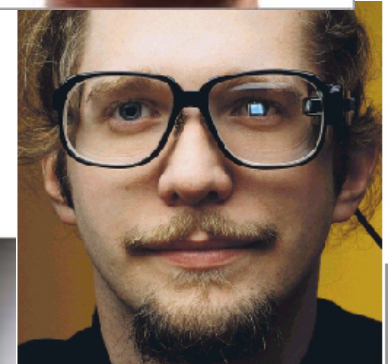
AR design guidelines

- Usable systems necessary for widespread use
- Most existing guidelines are specific design principles for specific problems
- AR design different from GUI
- AR design often different from VR design

AR design guidelines

- Problems:
 - Variety of platforms
 - Variety of I/O devices
 - Variety of interaction techniques
 - Changing hardware capabilities

- ➔ Generalisation of guidelines?



AR design guidelines

- Use general design principles from HCI
 - How can we use these for AR systems?
 - How have those already been applied?
- Develop AR specific guidelines

Norman's Principles of Good Practice (1988)

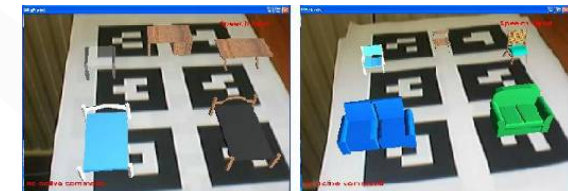
- Ensure a high degree of **visibility** – allow the user to work out the current state of the system and the range of actions possible.
- Provide **feedback** – given continuous, clear information about the results of actions.
- Present a **good conceptual model** – allow the user to build up a true picture of the way the system holds together, the relationships between its different parts and how to move from one state to the next.
- Offer **good mappings** – aim for clear, natural relationships between actions the user performs and the results they achieve.

AR Specific Guidelines

- Use of Affordances
- Reducing cognitive overload
- Requiring low physical effort
- Learnability
- User satisfaction
- Flexibility in use
- Responsiveness and feedback
- Error tolerance

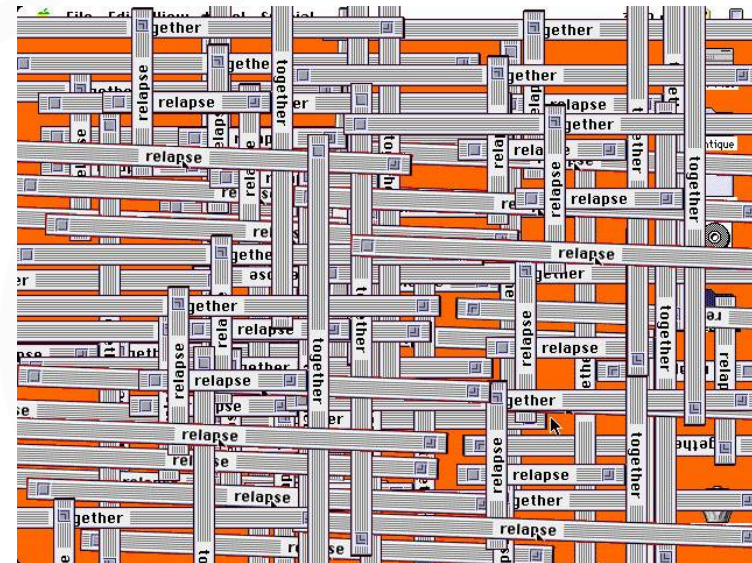
Affordance

- inherent connection between a user interface and its functional and physical properties
- Use of real world interaction metaphors
 - Tangible user interfaces
 - E.g. VORMAR
 - Direct 3D interaction
 - Construct3D?



Reducing cognitive overhead

- enable the user to focus on the actual task
- reduce cognitive overhead needed to interact with the system
- Registration errors:
 - Associating graphical elements with the real environment requires cognitive effort



Low physical effort

- No “unnecessary” actions by users
- Physical interfaces (e.g. HMD) lightweight to reduce fatigue or discomfort
- Simulator sickness



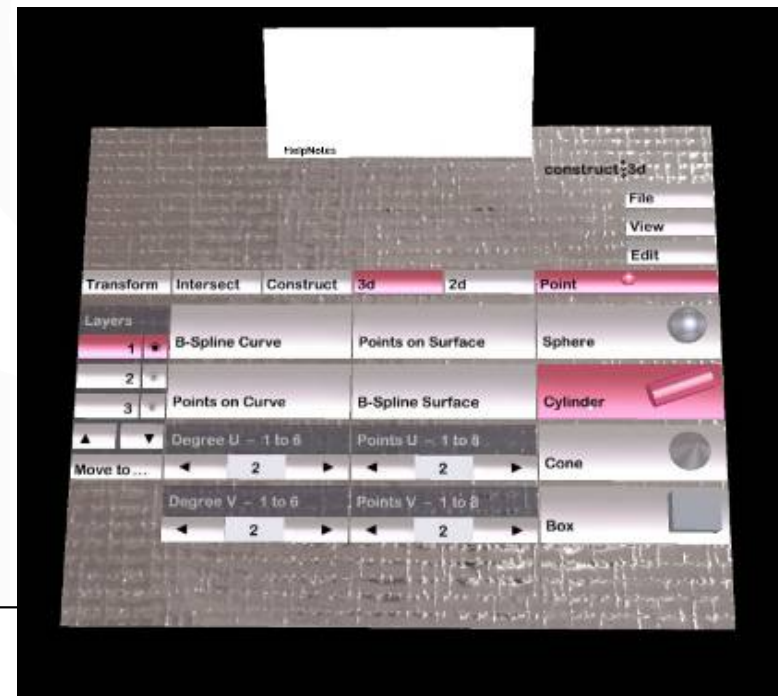
Learnability

- Easy and fast learning to use the system
- Intuitive interaction (akin to real world)
 - MagicBook
turning book pages



Learnability

- Familiar interaction, labelling, etc. (e.g. from desktop computer programs)
 - Construct3D – menu labelling similar to CAD programs
- Consistency



User satisfaction

- Subjective user perception
- User experience!
- e.g. engaging students in fun learning environment



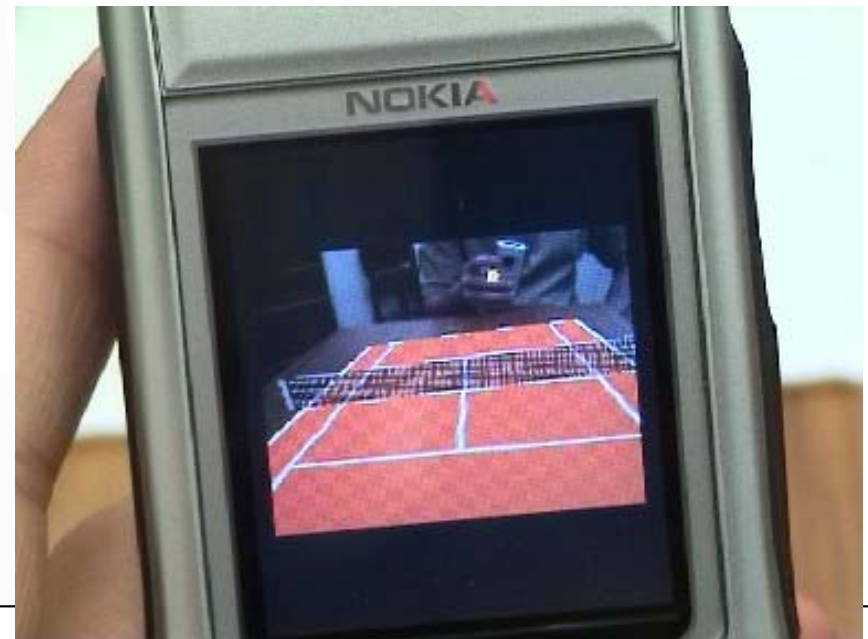
Flexibility in use

- Different user preferences and abilities
 - Integration of different I/O devices, interaction techniques
- Multimodal interaction
 - preferred by users



Responsiveness and Feedback

- Users only tolerate a certain amount of system lag
- cause ==> effect (problematic with delay)
- Feedback
- Slow tracking
 - Not so problematic in cooperative interaction (Henrysson)



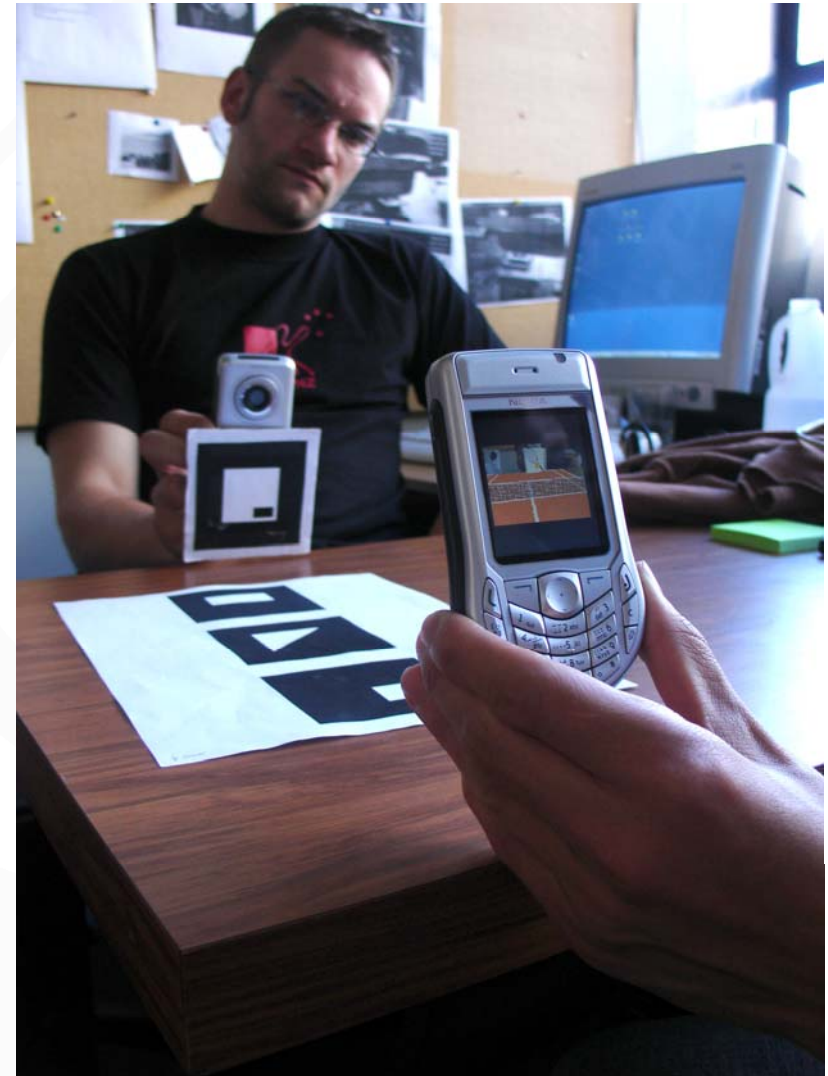
Error tolerance

- Major problem for AR systems
 - Poor tracking
 - Instability of systems
- Use of redundant systems (e.g. hybrid tracking,...)

Example: AR Tennis



- **AR Tennis**
 - Virtual tennis court
 - Two user game
 - Audio + haptic feedback
 - Bluetooth messaging





- **Norman**
 - Visibility – can always see state of system
 - Feedback – graphic, audio and tactile feedback
 - Good conceptual model – just like tennis, phone is racquet
 - Good mapping – swing phone to hit ball
- **Other guidelines**
 - Affordances – phone as handheld lens
 - Reduced cognitive overload – only 1 button used
 - Low physical effort – no HMD, limited motion
 - Learnability – similar to tennis
 - User satisfaction – users prefer AR game
 - Responsiveness – multimodal output

Conclusion

- Usable systems necessary for accessible AR
- Using general HCI principles as a first step
- Multidisciplinary research
- Success of AR will depend on well designed user experiences

More Information

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