The Design of Interactive Computational Media

Class 13: 4 Dec. 2002

Research Frontiers

Hour 1:
User Support and Intelligent User Interfaces

Hour 2: Collaborative Systems, Virtual Reality, Ubiquitous Computing, Wearable Computers

User Support and Intelligent User Interfaces

- User support
- How users learn
- Documentation
- Preventing "errors"
- Online help
- Customer support

- Theme of *adaptive* and *adaptable* interfaces

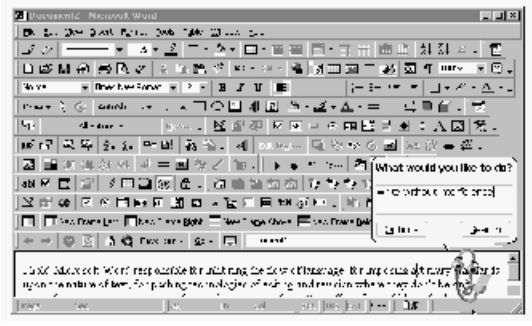
Building Systems that Work

- Many things to get right
  - "Correct" requirements analysis
  - Appropriate functionality, metaphors, and user mental models via activity design
  - Communicative "visuals" via information design
  - Elegant interactivity via interaction design
  - Insightful user testing resulting in improvements to the entire system through iterative design cycles
  - Effective deployment in a receptive, supportive organization
- But still …
  - System must be learned
  - Users must be assisted and supported when they become confused, lost, or in trouble

Technology Complexity

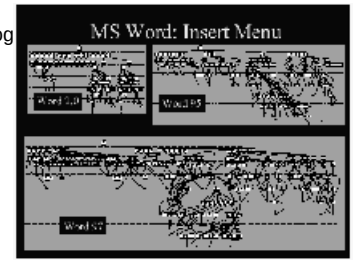
- Feature bloat
  - Over 1000 commands in Word
  - 150/250 page cellphone/PDA manuals
- Ubiquity of use
  - PCs —> Networks —> Ubiquitous computing networks
  - Specialists —> white-collar workers —> everyone
  - Need for universal usability
- Costs > U.S.$200B annually
  - User frustration and wasted time

Being Overwhelmed with Bloatware



Feature Creep in Word (Hsi and Potts 2000)

- "Feature creep" in Word: 2.0 —> 95 —> 97
- Total number operations: 311 —> 614 —> 955
- Insert Menu morpholog



Definition of User Support

- Those aspects of an interactive computer system that assist the user in his or her efforts to use a computer system
  - Making help available for a user to access, vs.
  - Actively assisting or even nurturing a user
- I.e., help in bridging the gap between "what users know and what they need to know"

- (Baecker and Buxton 1987, Ch. 13; Baecker Grudin Buxton Greenberg 1995, Ch. 10; Norman and Draper 1986, Chs. 3, 7-8, 12-13, 17-22)

Current Methods of User Support

- Documentation
- Error prevention and handling
- Online help
- Customer support
- Training
- Usability

Problems with Current Methods

- Users typically not reading documentation
- Error messages often useless or demeaning
- Online help typically not helping, assuming what's needed can even be found
- Support personnel often inaccessible, also having trouble explaining complex processes
- Training typically not available when needed
- Usability insights not being conveyed to appropriate people, or not being believed

Why Users Have Trouble

- System is inconsistent
- System is overwhelming
- System doesn't provide support

- User has incorrect or missing mental model
- User is in a hurry
- User has forgotten what to do

How Users Learn (Carroll and Mack 1984)

- Learning by doing
  - Desire to try things out
  - Tendency to jump the gun
  - Difficulty in following written sequences of instructions
  - What R&C (p. 274) term the *production paradox*
- Learning by knowing
  - Use of prior knowledge from metaphors
  - Use of prior knowledge from work experience
- Learning by thinking
  - Attempt to construct reasonable interpretations, appropriate and useful *mental model*s (sense making)
  - Purposeful problem solving activity

A Taxonomy of Documentation (Price & Korman 1993)

- Learning by doing
  - Command summaries, including for quick start
  - Tutorial guides
- Learning by thinking
  - Principles of operation manuals
- Learning by knowing
  - Reference manuals

Documentation Design

- Language key to human-computer communication — interfaces and documentation (Kukulska-Hulme 1999)
  - Computer jargon — often at odds with standard usage, and is actually changing language
  - Problems worse across languages and cultures
  - Meanings vary with context — task and situation
  - Issues may be different for written and spoken language
- Language the most important determinant of success for online help (Borenstein 1985)

Documentation Design (Wright 1977,78,80,83)

- Form equally essential —> facilitates access to content
  - Appearance, typography, layout, ...
- Importance of document organizers
  - Tables of contents, indices
  - Heading+subheading structure and appearance
- Importance of diagrammatic & graphical representations
  - Tables, charts, graphs, flowcharts, other figures and illustrations
- Importance of user testing and quality assurance

Minimalism (Carroll 1990, 1998; Brockman 1990; Van der Meij 1992)

- Jack Carroll and colleagues
- Arose out of protocol analyses of individuals learning word processors
- Problems observed despite comprehensive detailed documentation
- Problems arose *because* not *despite* people's exploration, initiative, sensemaking — users wanting to jump in and do something rather than sit back and read and "learn"

Principles of Minimalism

- Be brief, don't spell everything out
- Allow reading of modular chunks in any order
- Focus on real tasks
- Get users started fast
- Support improvising and exploring
- Support error recognition and recovery
- Coordinate system use and training

- Do lots of iterative design and testing

Examples of Minimalist Design

- The minimal manual
  - Example: 45-page word processing manual < 1/4 the size of system-style manual
  - Out: previews, summaries and reviews, expository and rote material
  - In: error recognition and recovery info, open-ended exercises
  - Typical experimental results on next slide
- Training wheels processor
  - Blocking off areas of complex system functionality by greying out or removing many of the menus
  - Encourages experimentation without fear of "falling down"
  - More efficient learning, less time spent on errors

Experimental Evaluation of the Minimal Manual

- Study design
  - 19 office workers, half with minimal manual (MM), half with traditional systems-style manual
  - 8 performances tasks
- Results
  - 40% faster learning for MM
  - 2.7 times as many tasks learned with MM
- Numerous studies also show greater learning efficiency, fewer errors, faster start for MM

Human Error (Senders and Moray 1991)

- "Error" is attributed when planned actions don't achieve desired outcome, and this occurs not due to chance
- "Error" a loaded term
  - Seems to imply that the user is at fault
  - But if anyone at fault, it's the designer(s)
  - Assigning blame typically not useful, except blame for the failure to document and report errors (Norman 1990)

Human Error

- *Intention*: Highest-level specification of a desired action
- Two kinds of errors (Lewis & Norman 1986)
  - *Mistake*: Error in formation of the intention
  - *Slip*: Error of execution, in carrying out intention
- Important to describe errors
- We can, to some extent, predict errors
- We can design to minimize error

Error Message Design (Dean 1982)

- Set human goals for messages
- Apply psychology in writing messages
- Write messages for audience and situation
- Playact to evaluate messages for usability
- Edit messages for appropriate language
- Test messages along with running system

Error Message Design (Shneiderman 1982)

- Be brief
- Be as specific as possible
- Be comprehensible, not cryptic
- Be positive, constructive, and helpful, not critical and negative in tone
- Stress user's ability to control the system

Let's Discuss A Real Example

- "A Postscript Error has occurred. The error is syntax error; offending command: np."

- *What's wrong with this message?*
- *Why is error handling particularly difficult in modern computer systems ?*

Forms of Online Help (Kearsley 1988, Horton 1990)

- Online manuals with literal text supplied by writers
- Indexed lists of keywords and explanations
- Self-explanatory objects, e.g., bubble help, tooltips
- Context-sensitive help
- Active demonstrations, tutorials
- Guides, wizards
- Intelligent help, with explanations computed by "intelligent interfaces"

A Taxonomy of User Questions that Help Should Answer (Baecker Small Mander 1991)

- Identification: What is this?
- Transition: Where have I come from and gone to?
- History: What have I done?
- Orientation: Where am I?
- Choice: What can I do now?
- Demonstration: What can I do with this?
- Explanation: How do I do this?
- Feedback: What is happening?
- Interpretation: Why did that happen?
- Guidance: What should I do now?

Artificial Intelligence (AI) for Online Help

(Maybury and Wahlster 1998)

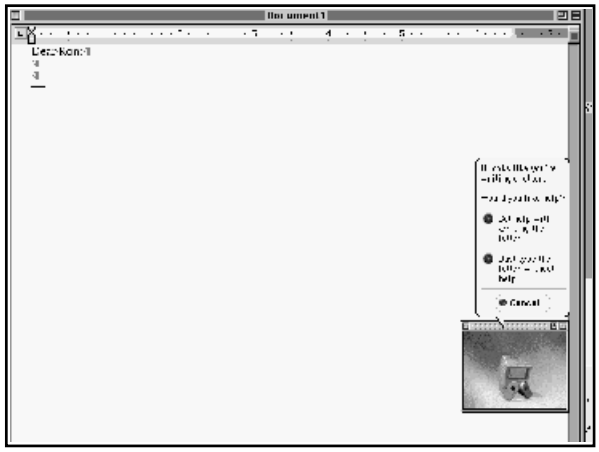
- *Agents*: AI programs that carry out tasks on behalf of users, e.g., intelligent help agents
  - Should "know" the user's habits and preferences, be proactive, be always available in the background, and be adaptive
- *Adaptive interfaces*: AI programs that dynamically modify interface based on user characteristics
  - User characteristics represented in *user models* (Kobsa 1993)

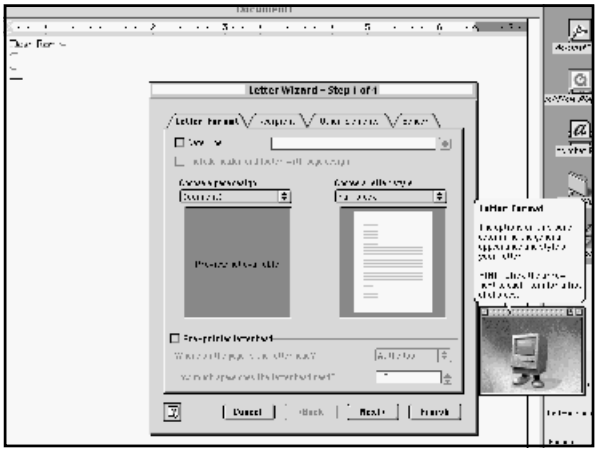
Ideal Characteristics of Agents (Maes 1997)

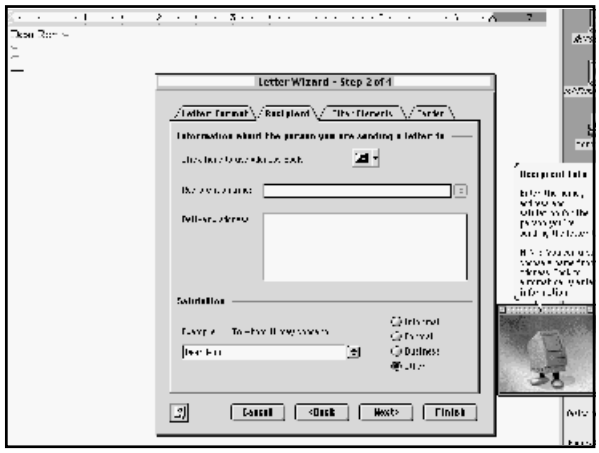
- User model available to user
- Method of operation understandable to user
- Agent able to explain its behavior to user
- Agent able to give continuous feedback to user about its state, actions, and learning
- Agent allows variable degrees of autonomy under control of user
- User need not learn new language to deal with agent

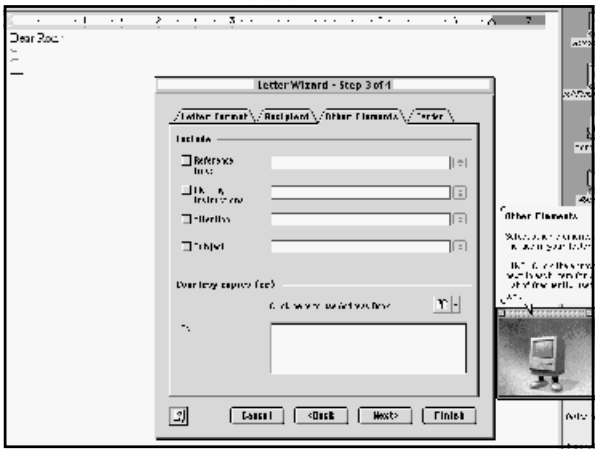
Microsoft Intelligent Agents

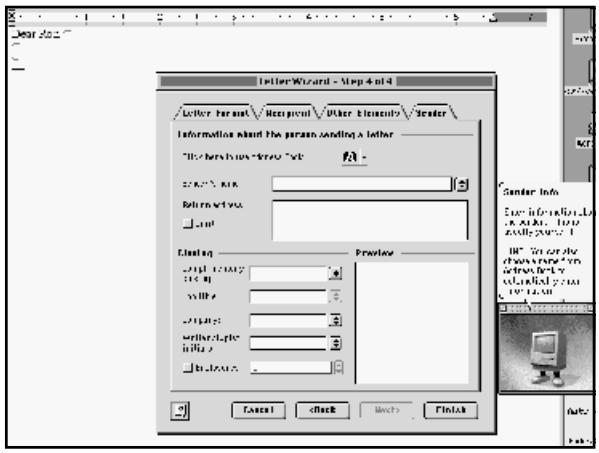
- In early days, called "social interfaces"
- 1994-1997: Microsoft Bob
  - Anthropomorphic help, e.g., Rover the Dog
  - Usually viewed as silly and simplistic
- 1997-2002: Office Assistant aka "Clippy"
  - Again, represented by various characters, e.g., Paper Clip
  - Often viewed as obtuse and obnoxious

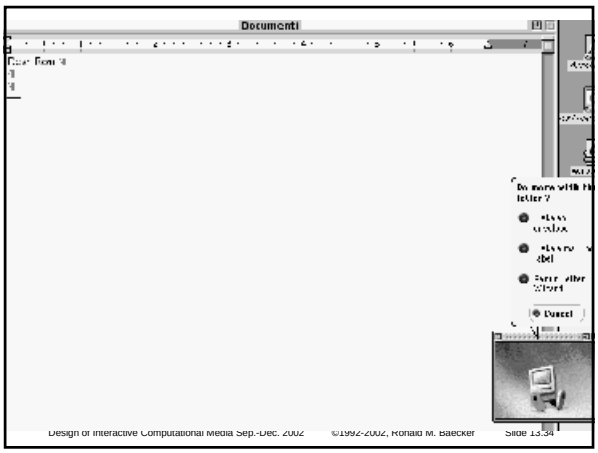












Clippy

- Theoretical Foundations (Horvitz et al. 1998)
  - Lumiere Project at Microsoft Research
  - Based on Wizard of Oz studies of experts helping users with spreadsheet tasks
  - Goal is "intelligent help" via Baysian user modeling
    - Uses evidence (e.g., searching, attending to parts of screen, introspection, errors) from user behaviour
  - Key research not (yet) reflected in Clippy
- Clippy — Gone today, here tomorrow?
  - Clippy controversial, to say the least
  - Media hype over the "retiring" of Clippy
  - Not really retired, just turned off as default

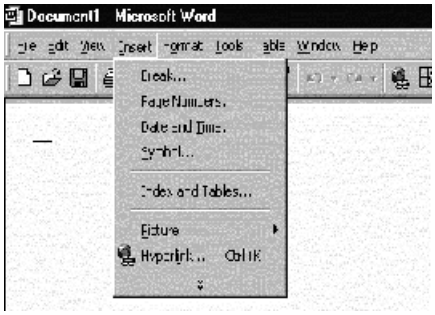
Adaptive versus Adaptable Interfaces

- *Adaptive — The system* modifies its interface automatically based on what the user does
  - The importance of *user modelling* — System building a model or representation of user behaviour and user knowledge
- *Adaptable — The user* modifies the interface based on his or her needs

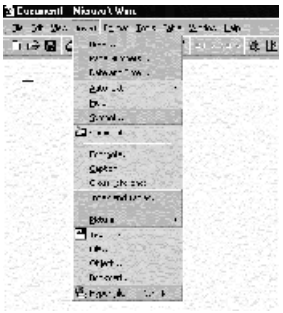
Word 2000 Adaptive Menus

- To deal with perceived bloat, menus vary with user behaviour, often changing
  - Long menus and short menus
  - Items chosen from long menu then appear in short, but disappear after "sufficient" non-use
- But …
  - No user testing results reported publicly
  - Anecdotally, users don't understand method, and are often mystified by menu change

"Short" Insert Menu

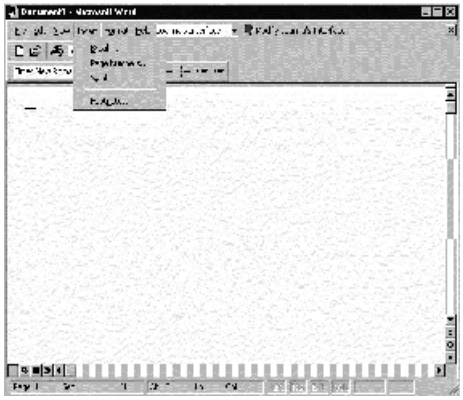


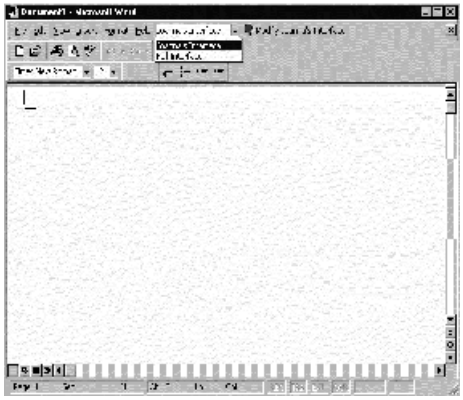
"Long" Insert Menu

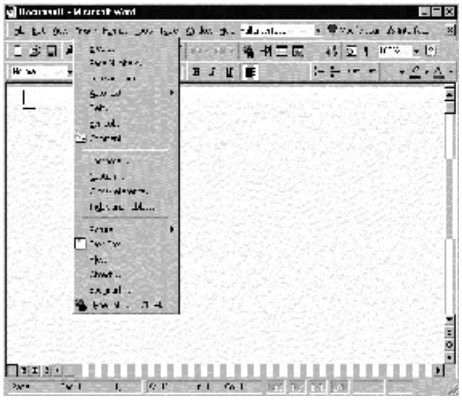


Adaptable Interfaces Research

- Joanna McGrenere's Ph.D. research (McGrenere et al. 2002, McGrenere 2002)
- Having your cake and eating it too — multiple interfaces to one system
- "Word Personal" — concurrent availability of:
  - Personalized Interface: The functions I use
  - Full Word Interface: 265 functions + 709 + …
- Personalized Interface
  - Starts very small, easy to adapt, easy to switch to Full Word Interface

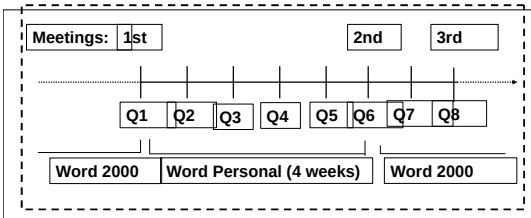




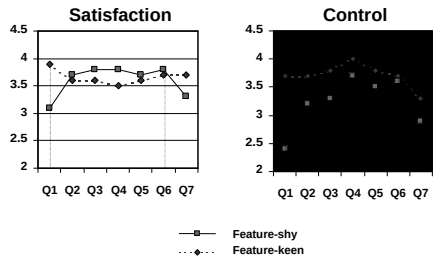


Evaluation of Word Personal

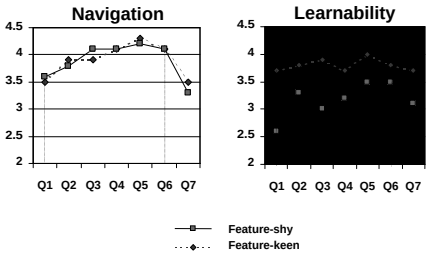
Participants: 10 Feature-keen
10 Feature-shy



Satisfaction and Control



Navigation and Learnability



Customer Support

- Experts helping users
- Users helping themselves
- Users helping users

Experts to Help Users

- People
  - In-house support personnel
  - Outsourced help desks
- Communications media
  - Phone, VOIP (Voice over Internet), email, chat
  - Live machine hookups
- Problems
  - Cost
  - Lack of trained personnel (500,000 vacancies?)

Live Machine Hookups

- Used for diagnosis and remote control
- First implementation — Timbuktu — www.netopia.com
- Now included in Microsoft NetMeeting
- Also useful for Web tours

Users Helping Themselves with Web Support

- Self-help over the Web
  - eService, part of eCRM — electronic Customer Relationship Management (www.siebel.com, www.kana.com, www.pivotal.com, …)
  - Web knowledge bases, e.g., answers to FAQs
  - Access to human agents when needed
- Research frontiers of applied artificial intelligence
  - Intelligent help agents
  - Automated repair agents

Users Helping Users

- Local experts and local expertise
  - The phenomenon of the local expert
- Distributed expertise: in organization, on the net
  - Collaborative networks and technologies
  - *Organizational memory*: information and human resources

Questions and Discussion

Break

Other Research Frontiers

- Global networking
- Collaborative systems
- Computer-supported cooperative work
- Ubiquitous computing
- Wearable computers
- Research on memory aids

Global Networking

- The Internet — global communications
- The World Wide Web — global hypermedia
- Access to all the world's people and knowledge?
- Example application: customer support
- Web usability — why so hard?
  - Huge varieties of machines, screens, printers, bandwidths
  - Incredible pace of technological change
  - Varieties of users, purposes, strategies
  - 1-2 seconds to grab them or they're gone
  - Marketing and sales tool, not just production tool
  - Degree of public scrutiny, communication

Collaborative Systems

- Consider the provision of support
  - Can be viewed as expert helping novices
  - Alternatively, as collaborations among communities of users who form learning communities
- Technologies for collaboration enabled by the Internet
  - Email as an example
  - Instant messaging as an example
  - Threaded discussions on newsgroups as an example
  - *Class: Name some more examples*
- Collaboration technologies enable the discipline of computer-supported cooperative work

Computer-supported Cooperative Work

	Same place (local)	Different place (remote, distributed)
Same time (synchronous)	Electronic decision rooms Digital whiteboards	Media spaces Shared editors Video/audio conferencing
Different time (asynchronous)	Shared files Workflow systems	Email Computer conferencing Structured messaging (I.e., newgroups) MUDS and MOOs

"CSCW" with Digital Photography

	Same place (local)	Different place (remote, distributed)
Same time (synchronous)	*Co-present sharing* Photo viewing devices & software	*Remote sharing* Application sharing Instant messaging Video conferencing
Different time (asynchronous)	*Archiving* CD-ROM PC filestore Photo website	*Sending* Email attachments Website references Internet photo frames

Example: Synchronous Collaborative Writing

- Shared workspaces
- Coordination of tasks
- Views and other (visual) representations

Example: Interactive Webcasting Systems

- Scalable visual communications
- Interactivity
- Structured, navigable, searchable archives

Virtual Reality

- Simulated entire three-dimensional environments — the computer becomes the environment
- Technology
  - Stereoscopic display glasses for both eyes
  - Head-mounted displays
  - Data gloves
  - Force feedback
  - Even room movements and vibrations
- Applications
  - Military and aerospace
  - Medicine
  - Entertainment
  - Architecture and planning

Ubiquitous Computing

- Computational media everywhere — the environment becomes a computer
- Technology
  - Wall-sized displays
  - Laptops
  - Palmtops
  - Active badges, wearable computers
- Applications — Telephone forwarding, social awareness, intelligent and adaptive systems
- Social issues — Privacy and monitoring

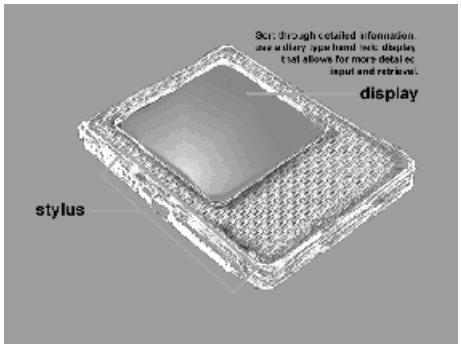
Wearable Computers

- Technologies
  - Mobile devices, e.g., PDAs, cell phones
  - VR technologies, but superimposed over real world, known as *augmented reality*
- Sensory modalities
  - Vision, hearing, touch, motion, movement
- Example users
  - Businesspeople
  - Those in hazardous occupations, e.g., policewomen, firemen, explorers
  - Kids

Example: Research on Memory Aids

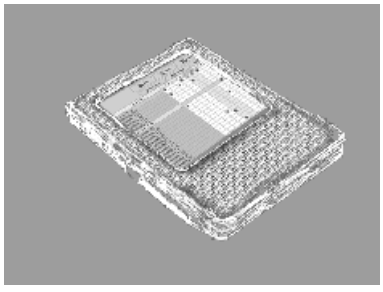
- Goal is to help people, including aging populations, better remember or be able to find when needed
  - Names, faces, numbers, addresses
  - Where something (e.g., glasses, wallet, keys) was left
  - Appointments
  - What medication to take when
  - How-to-do it instructions, e.g., taking medications

The Diary



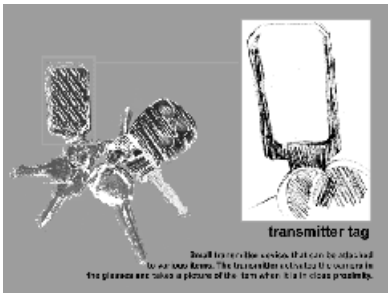
The Diary as a Retrospective Memory Aid

- Influences from concept of episodic memory



ID Tags as a Working Memory Aid

- Assistance in finding critical items often misplaced

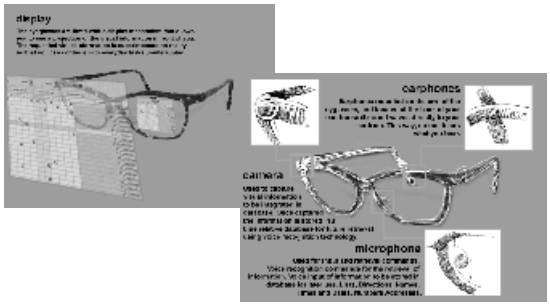


The Watch as a Prospective Memory Aid

- Assistance in remembering what to do when
- Likely to be prototyped with Pocket PC technology

The Glasses

- Augmented reality for aiding memory



Questions and Discussion