

The Design of Interactive Computational Media

Class 12: 1 April 2003

Research Frontiers

Part 1:

User Support and Intelligent User Interfaces

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

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User Support and Intelligent User Interfaces

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

- Theme of *adaptive* and *adaptable* interfaces

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Building Systems that Work

- Many things to get right
 - Insights and understanding of user needs via 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

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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

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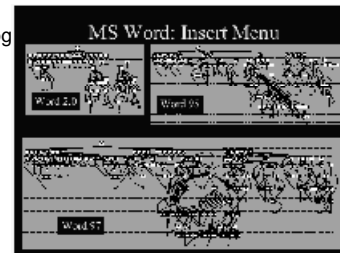
Being Overwhelmed with Bloatware



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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



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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)

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Current Methods of User Support

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

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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

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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

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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 models* (sense making)
 - Purposeful problem solving activity

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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

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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)

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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

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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"

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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

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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

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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

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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)

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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

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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

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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

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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 ?*

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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”

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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?

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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)

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Ideal Characteristics of Agents (Maes 1997)

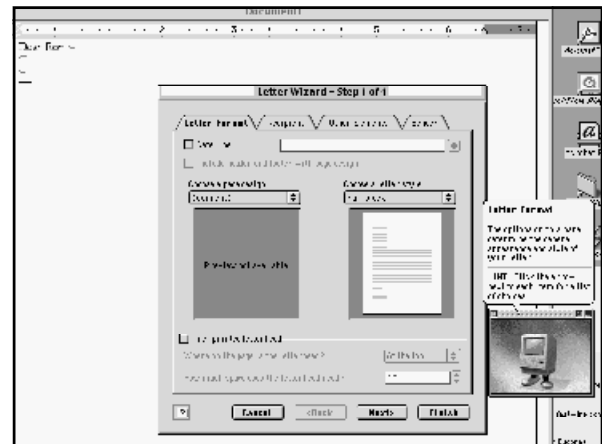
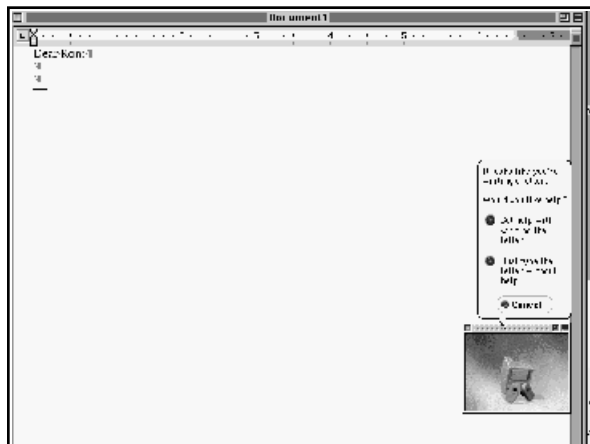
- User model available to user
- Method of operation understandable to user
- Agent able to explain its behavior to user
- Agent able to give continuous feedback to user about its state, actions, and learning
- Agent allows variable degrees of autonomy under control of user
- User need not learn new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

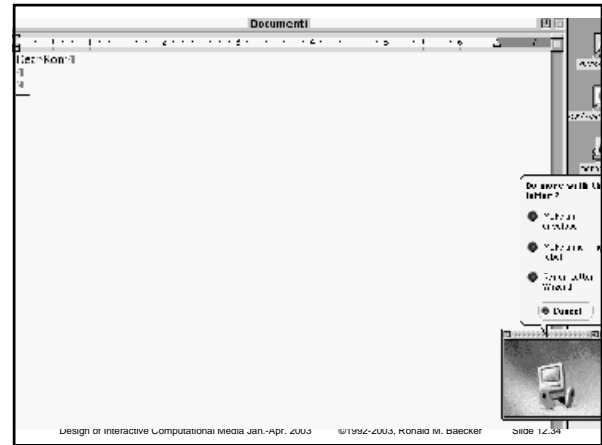
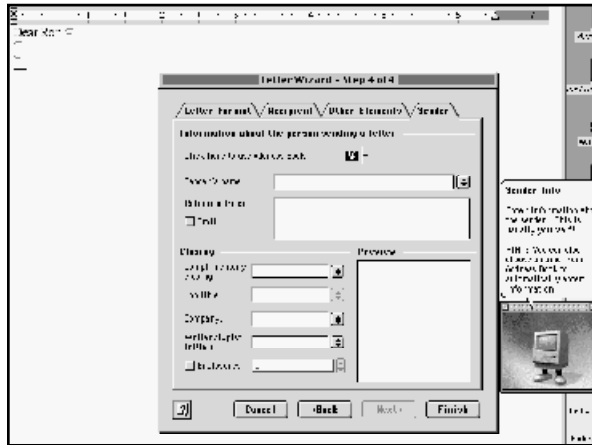
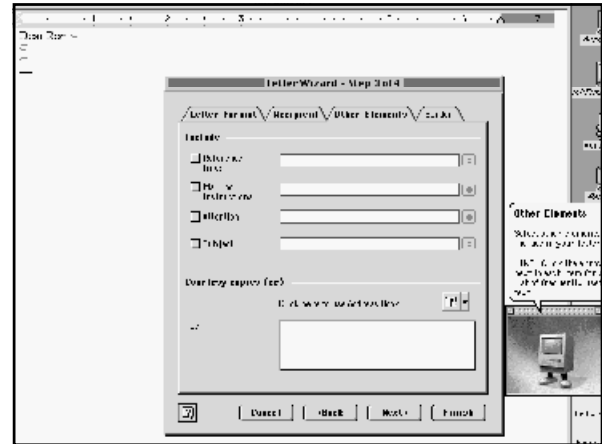
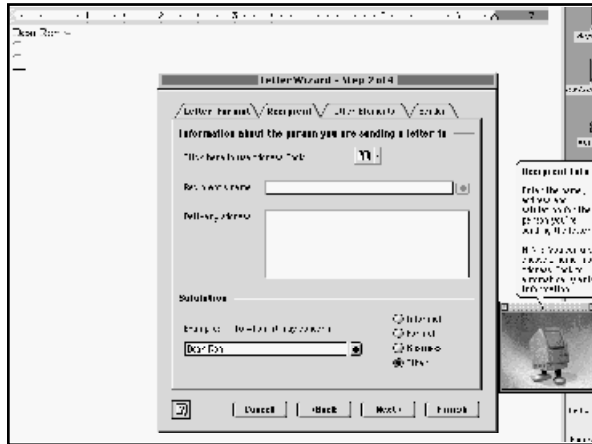
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Microsoft Intelligent Agents

- 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

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Clippy

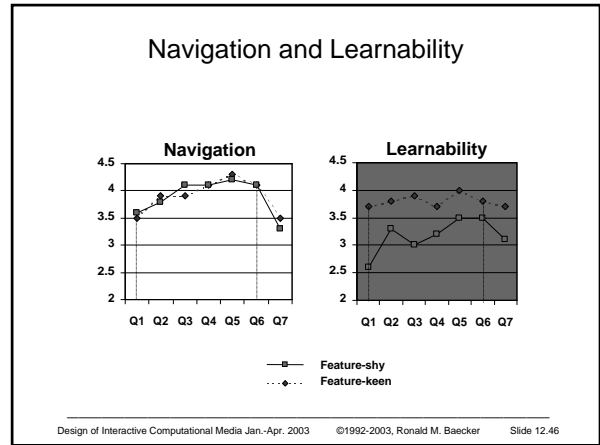
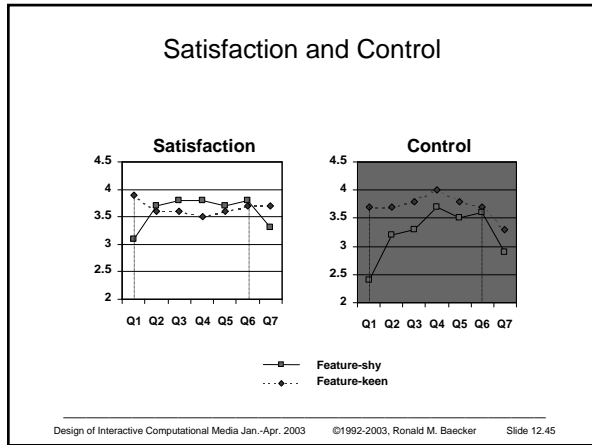
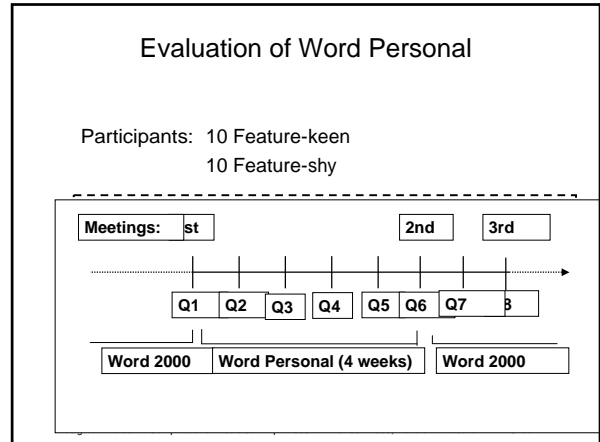
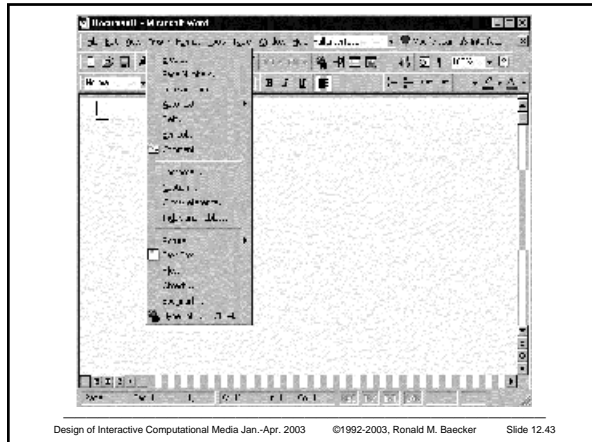
- Theoretical Foundations (Horvitz et al. 1998)
 - Lumiere Project at Microsoft Research
 - Based on Wizard of Oz studies of experts helping users with spreadsheet tasks
 - Goal is “intelligent help” via Bayesian user modeling
 - Uses evidence (e.g., searching, attending to parts of screen, introspection, 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

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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

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- ### Customer Support
- Experts helping users
 - Users helping themselves
 - Users helping users
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- ### 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?)
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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



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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

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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

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Questions and Discussion

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Break

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Other Research Frontiers

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

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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

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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

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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., newsgroups) MUDS and MOOs

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"CSCW" with Digital Photography

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

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Example: Synchronous Collaborative Writing

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



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Example: Interactive Webcasting Systems

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



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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

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Ubiquitous Computing

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

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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

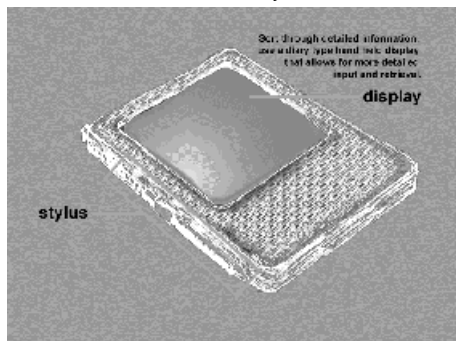
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Example: Research on Memory Aids

- 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

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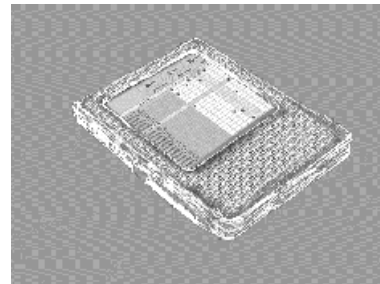
The Diary



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The Diary as a Retrospective Memory Aid

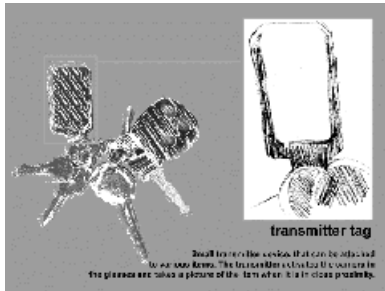
- Influences from concept of episodic memory



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ID Tags as a Working Memory Aid

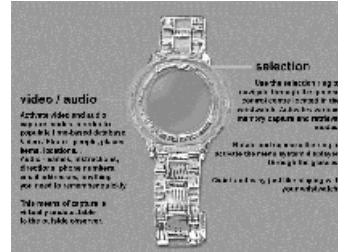
- Assistance in finding critical items often misplaced



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The Watch as a Prospective Memory Aid

- Assistance in remembering what to do when



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The Glasses

- Augmented reality for aiding memory



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Questions and Discussion

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