Course Title

- Human-Computer Interaction

Lecturer

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- TA: TBA

Lecture Hours

- 1:30-3:10pm Thursday

References

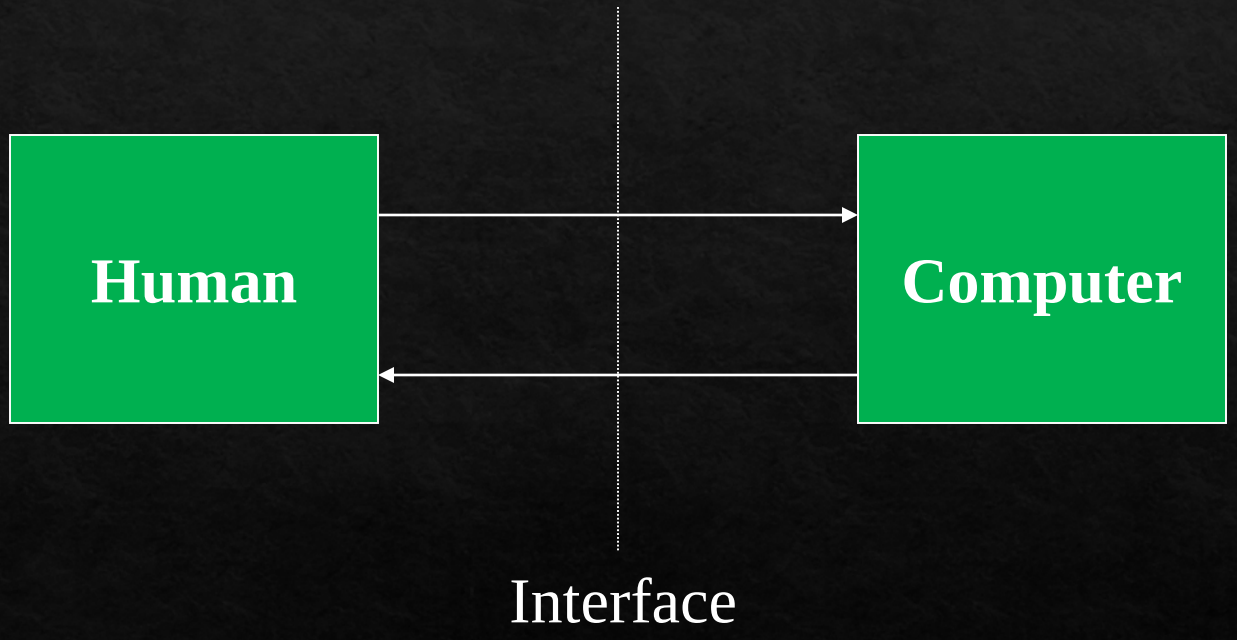
- TBA

Assessment

- Project 50%
- Assignment 40%
- Participation 10%

- Course Web Page
  - http://sse.tongji.edu.cn/~yingshen/HCI2016Spring/index.html

What is Human-Computer Interaction?



Human-Computer Interaction

- The study of how people design, implement and use interactive computer systems.
- The study of how computers affect individuals, organizations, and society.

Requirements of HCI

- Ease of use
  - GUI vs command language
  - Online help, documentation and training
- More powerful forms of communications between users and computers
  - New interaction techniques
  - New input and output devices

Requirements of HCI (cont'd)

- Universal access to information
  - Proliferation of WWW
  - Information-access interfaces
    - Must be able to deal with new kinds of data, e.g., multimedia information.
    - Permit new kinds of interaction.
    - Require collaborations between HCI and database research communities.

Importance of HCI

- Good HCI design is critical to
  - Success of products in marketplace
  - Safety, usefulness and pleasure of using computer-based systems.
- Poor HCI design have led to several well-known catastrophes.

Importance of HCI (cont'd)

- Good HCI design can decrease costs and increase productivity due to
  - Fewer errors
  - Reduced user disruption
  - Decreased task time
  - Reduced burden on support staff
  - Elimination of training

Foundations of HCI

- Computer science
- Psychology
- Sociology/anthropology
- Linguistics
- Artificial intelligence

History of HCI

- Direct manipulation of graphical objects.
- Windows
- Hypertext

Direct manipulation of graphical objects

- First demonstrated by Ivan Sutherland in Sketchpad
  - Use light pen to manipulate objects.
- Most of the direct manipulation techniques are developed in Xerox PARC in 1970's.
- "Direct Manipulation" was first coined by Ben Shneiderman (University of Maryland).

Windows

- Tiled windows
  - First demonstrated by Engelbart.
  - Other systems: COPILOT, Emacs.
- Overlapping windows
  - First proposed by Alan Kay
  - Used in the Smalltalk system (Xerox PARC)

Hypertext

- Original idea is credited to Vannevar Bush
- The term “hypertext” is first coined by Ted Nelson.
- Ben Shneiderman’s Hyperties
  - First system where highlighted items in the text could be selected to go to other pages.

Hypertext (cont'd)

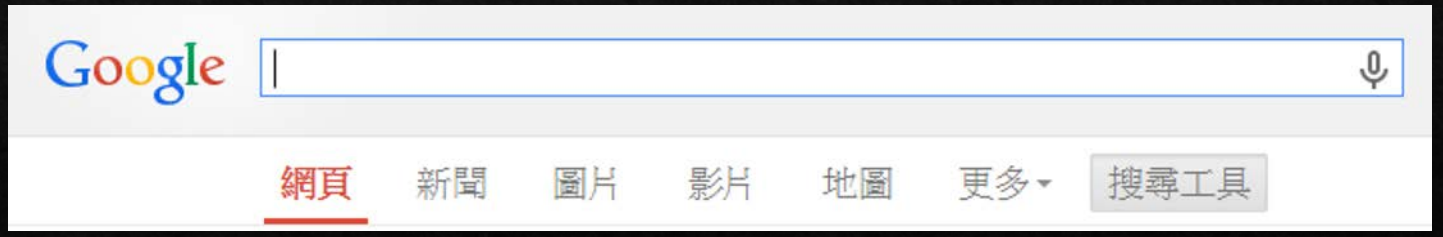
- Apple Hypercard further popularizes the idea to a wide audience.
- Tim Berners-Lee's adoption of hypertext in browser leads to spectacular growth of the World Wide Web.

HCI Applications

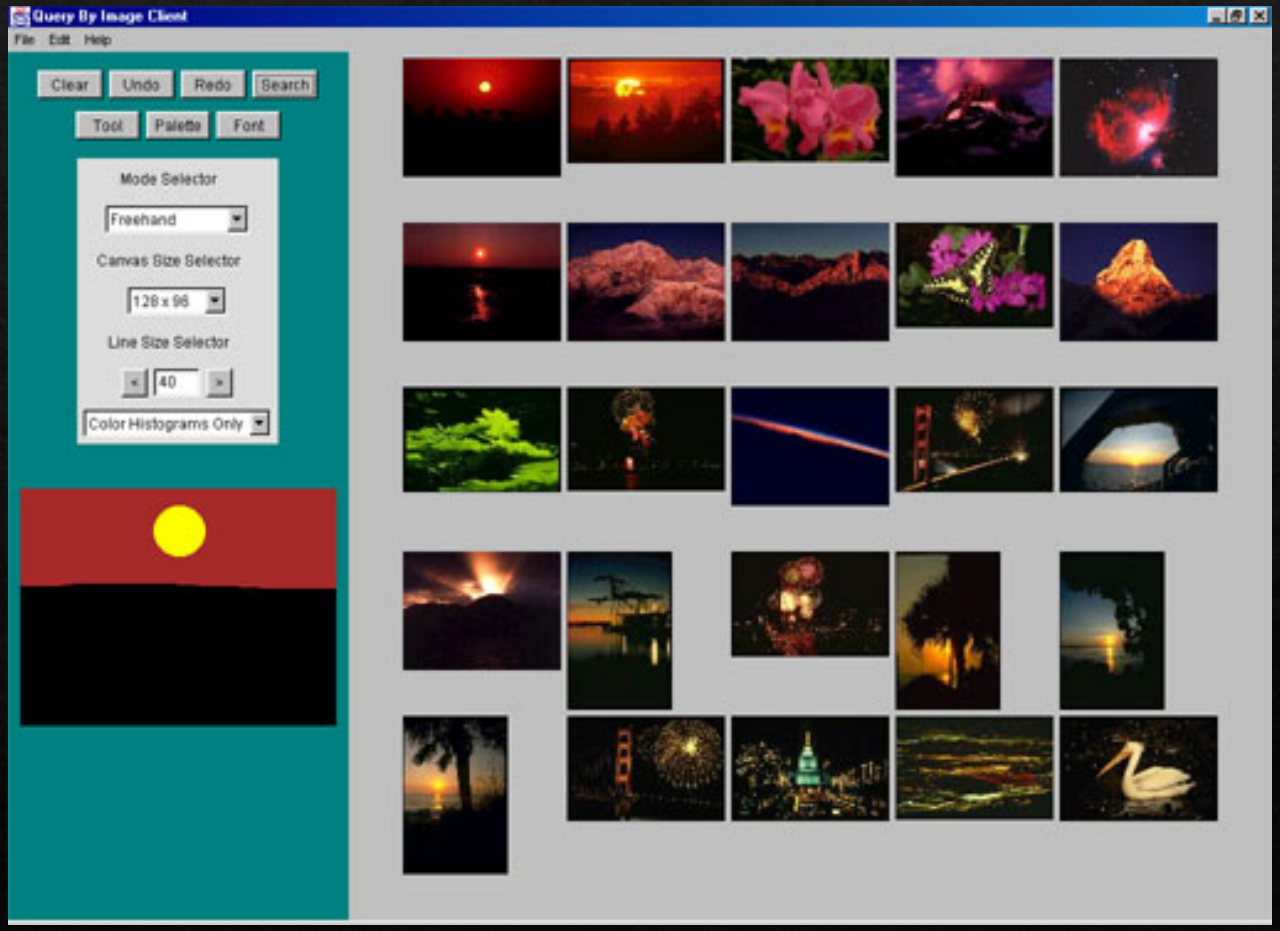
- Multimedia information retrieval.
- Education
- Interface for security enforcement
- Information visualization
- Computer-mediated communication

Multimedia Information Retrieval

- In many cases, multimedia contents cannot be easily characterized by specific keywords.
- Interfaces equipped with alternative querying mechanisms, such as example-based query specification, are required for effective retrieval.



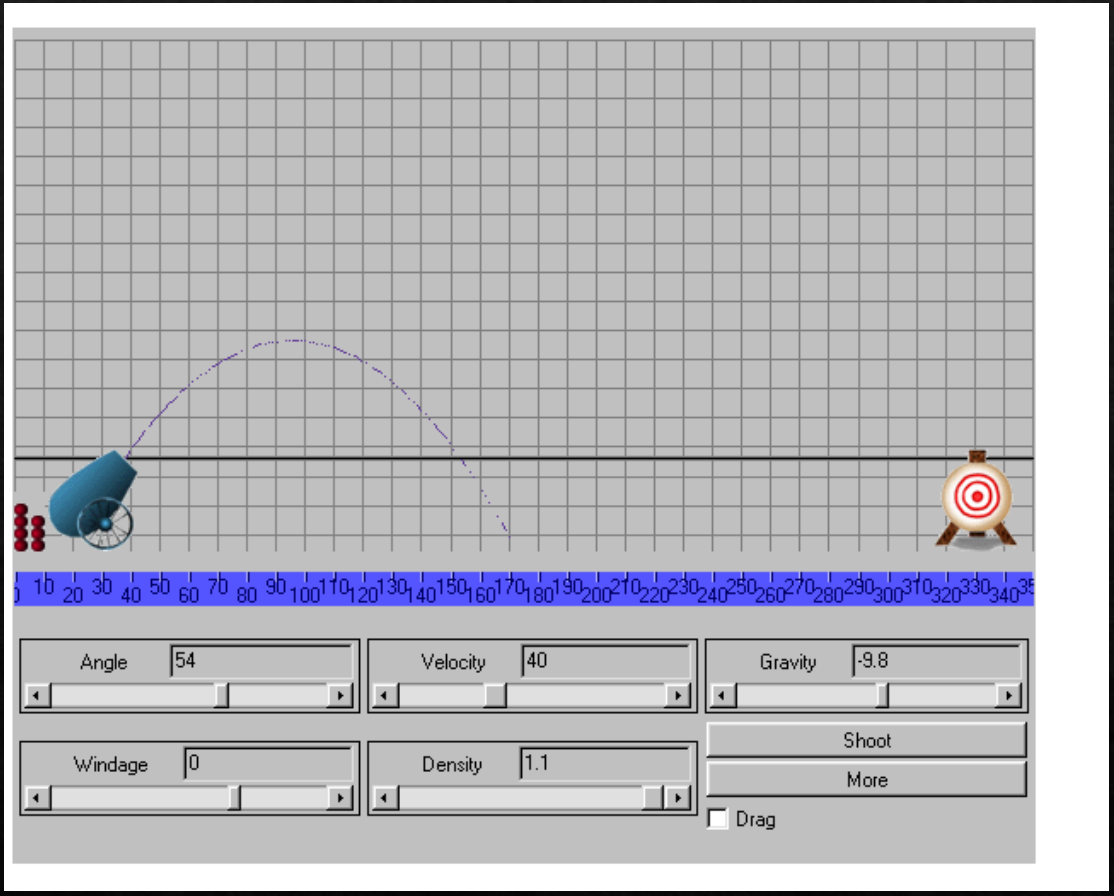
Multimedia Search Engine



Education

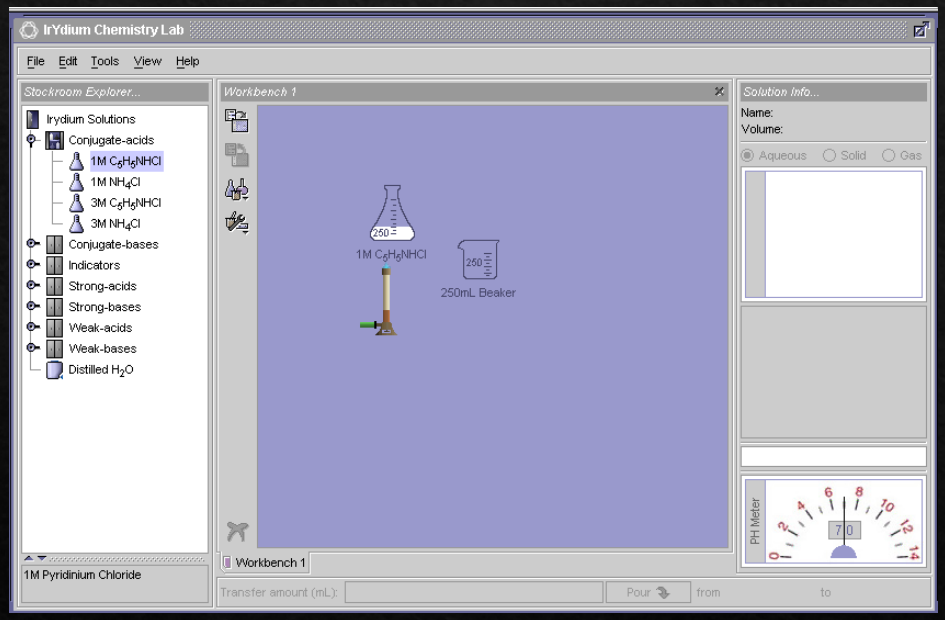
- Adoption of direct manipulation techniques in interface design.
- Design of effective learning environments, tools and media for distance learning.
- Catering for different student communities
  - Primary/secondary school students
  - University students
  - Further education
  - On-the-job training

Direct Manipulation Examples (cont'd)

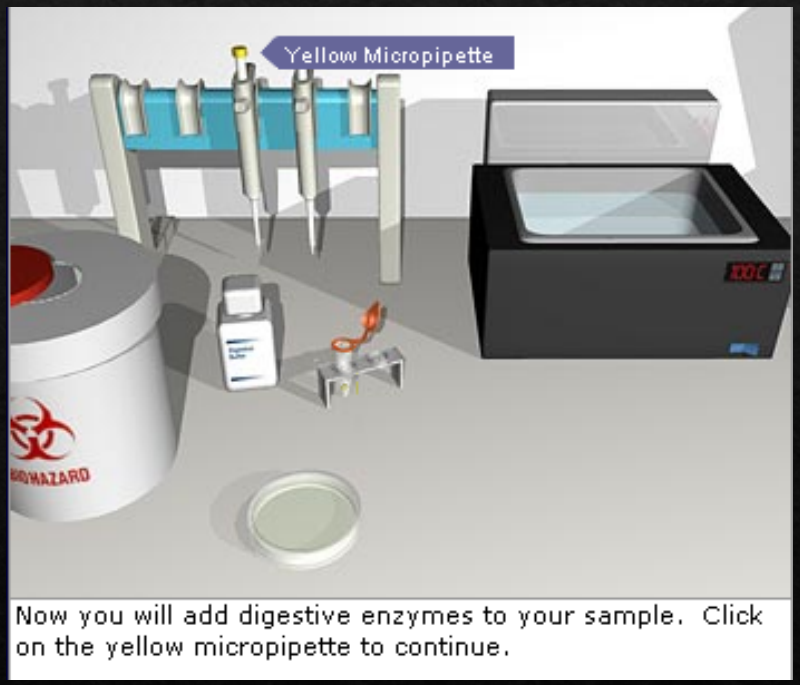


Physics

Direct Manipulation Examples (cont'd)

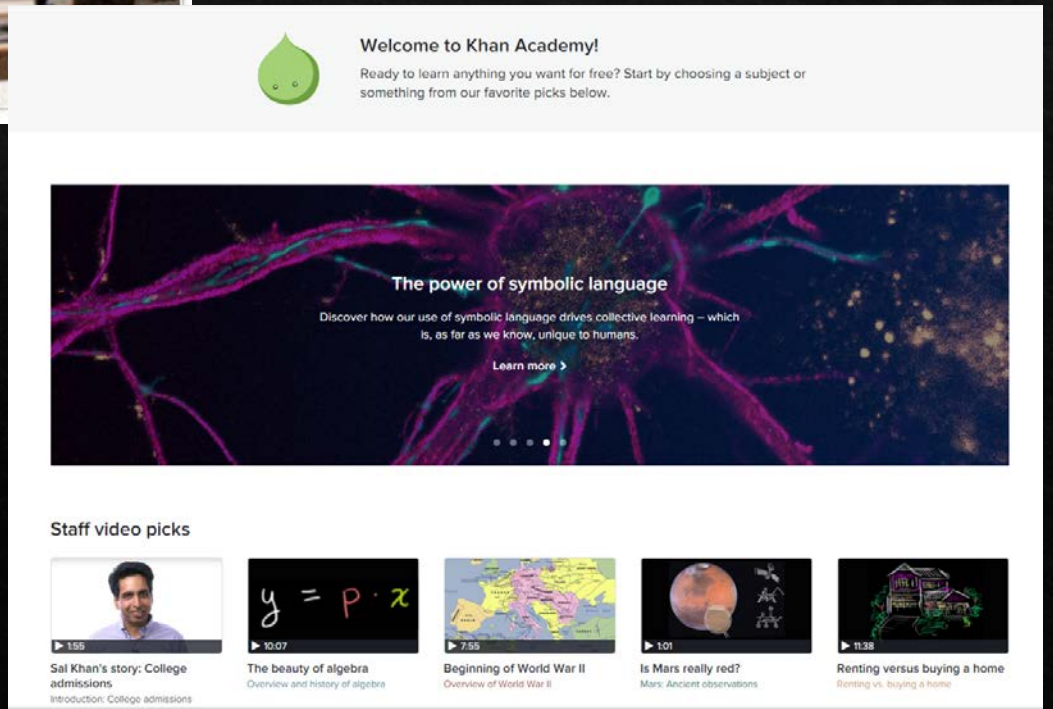


Chemistry



Biology

Distance Learning



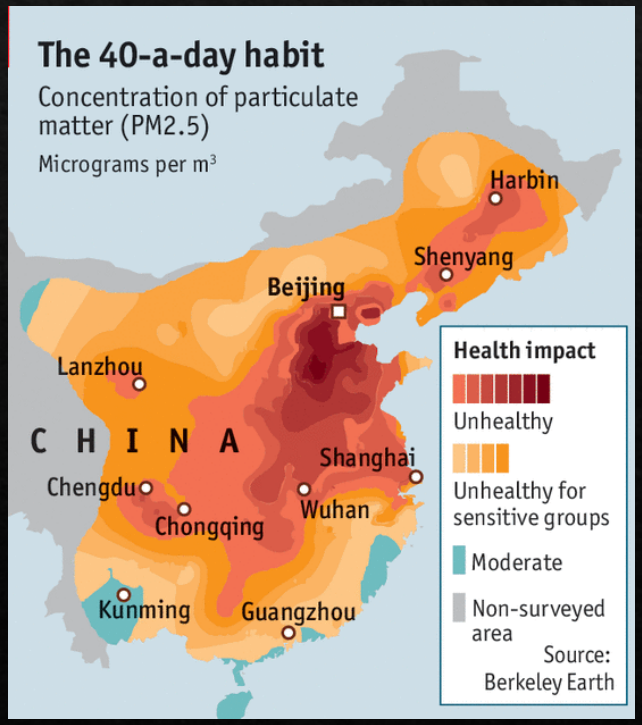
Interface for Security Enforcement

- User authentication based on a set of biometric features:
  - Fingerprints
  - Iris
  - Speech patterns
  - Facial characteristics
- Non-intrusive techniques are preferable to intrusive techniques.

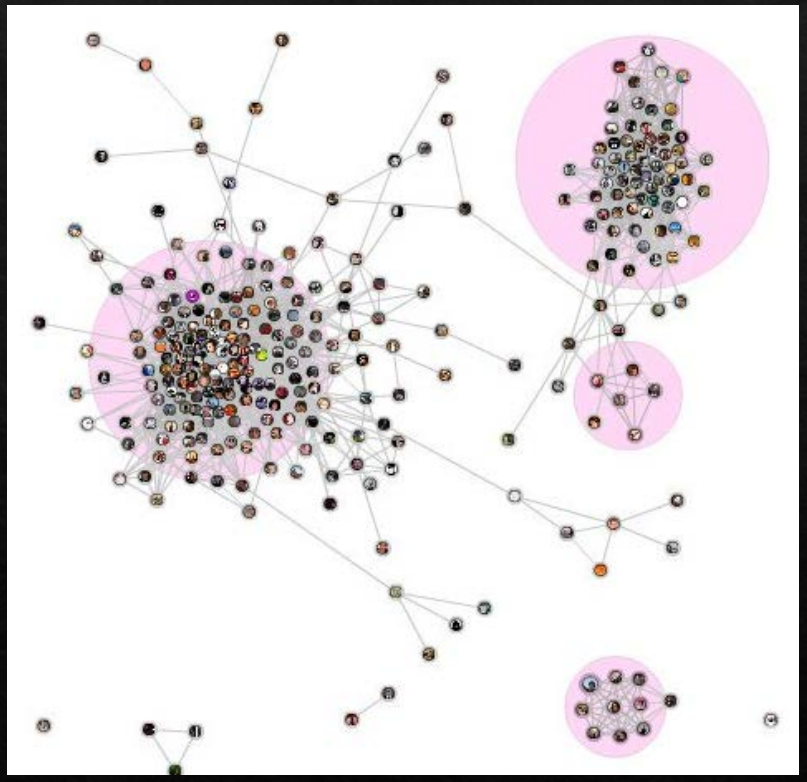
Interface for Security Enforcement

Information Visualization

- Presentation of large data sets in a suitable graphical formats for trend exploration.
- Becomes more important due to information explosion brought on by the Web.
- Examples
  - Visualizing communication networks.
    - Example
  - Visualizing the Web itself
    - Example



Visualizing Communication Networks



Computer-mediated Communication

- Communication between human users through computers.
- Examples include
  - E-mail
  - Real-time video and audio interactions

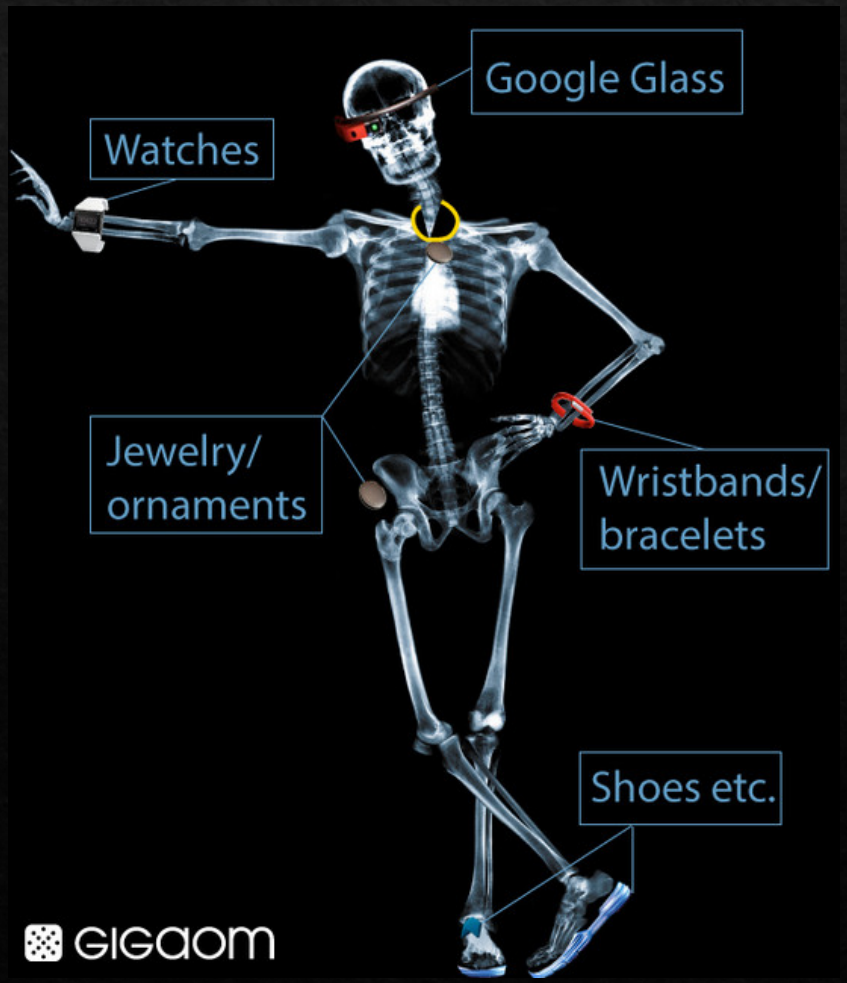
Technological Trends

- Computational devices and ubiquitous computing.
- Recognition-based user interfaces.
- Conversational interface and animated agents
- 3-D Technologies.

Computational Devices and Ubiquitous Computing

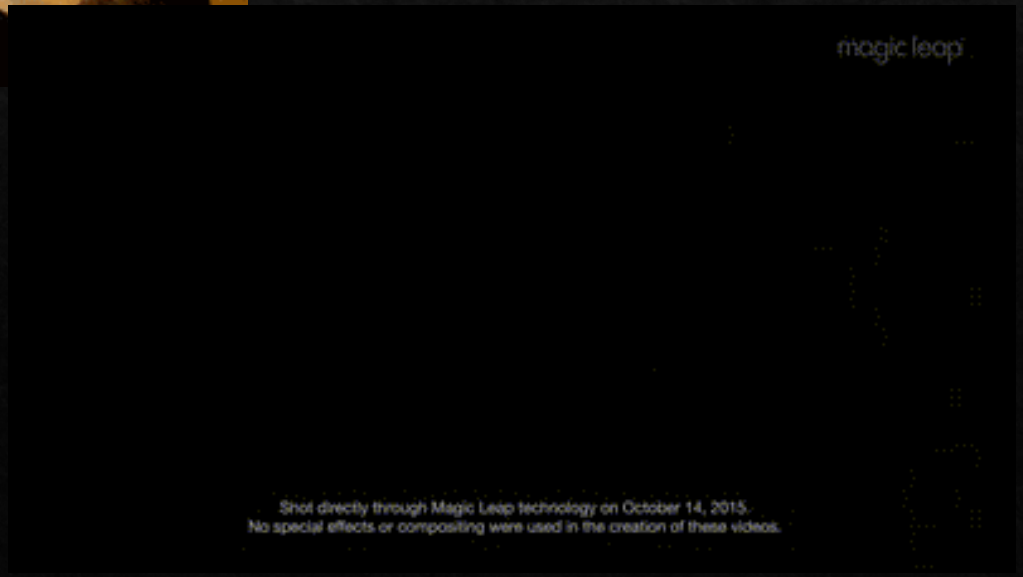
- New types of computational devices in addition to workstations and PC
  - Laptops
  - Mobile phones
  - Personal Digital Assistant (PDA)
  - Wearable computers and devices.
- Ubiquitous computing
  - Embedding computers everywhere in our environment.
    - Example: MIT's Things That Think (TTT) project

Wearable Computers



Wearable Computers

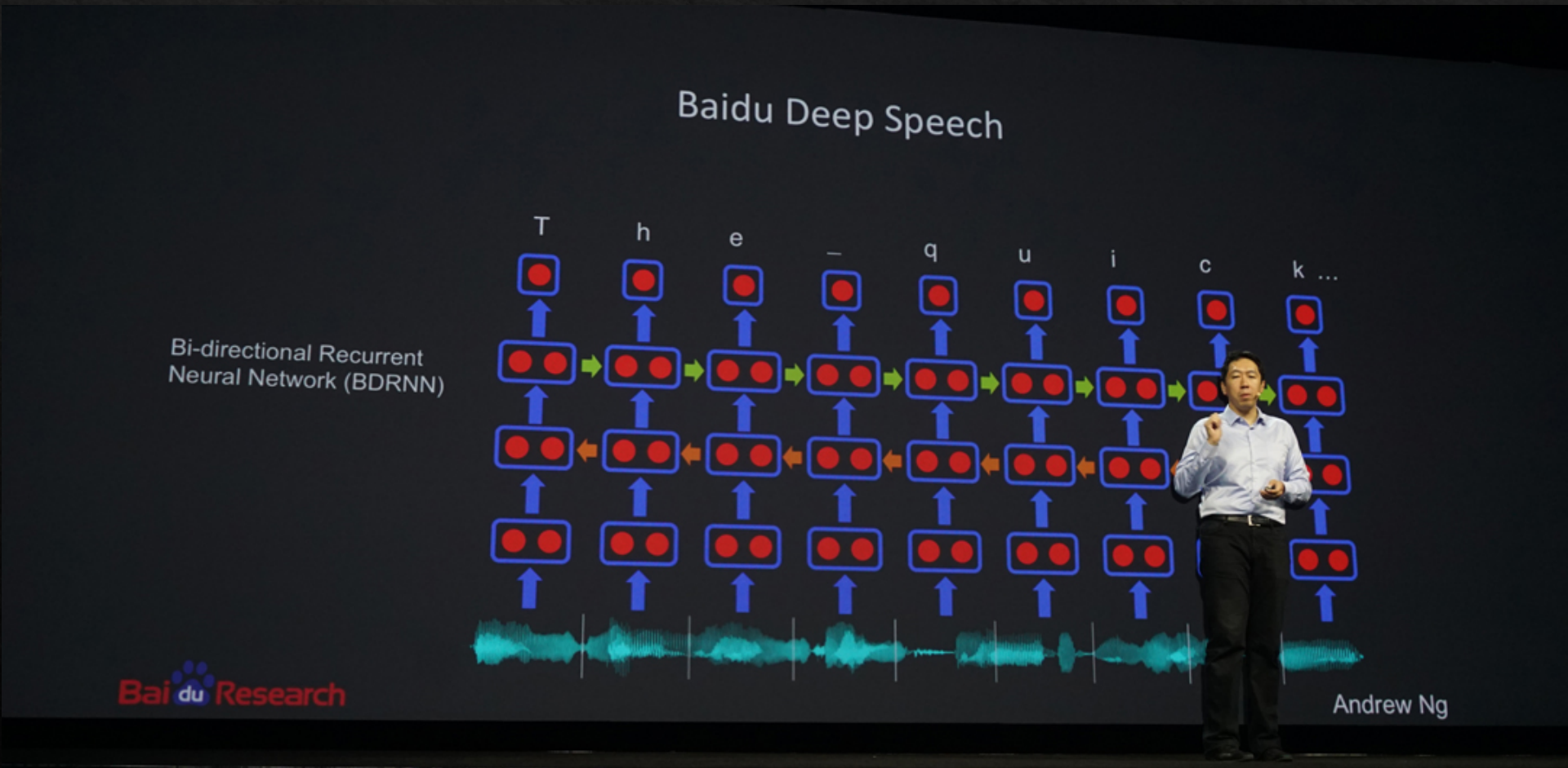
Magic leap



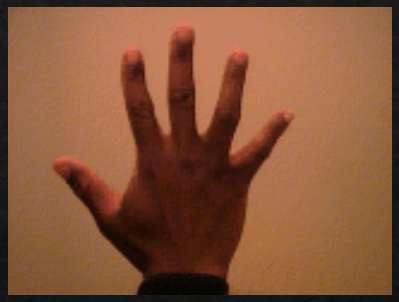
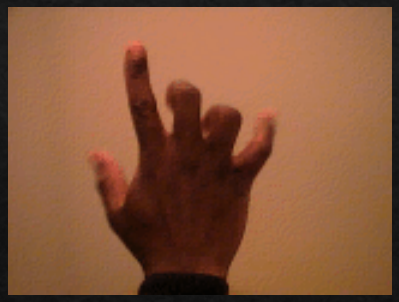
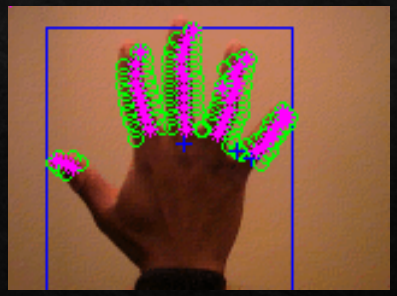
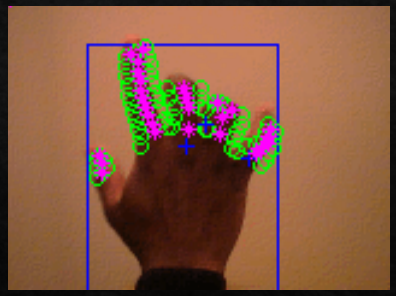
Recognition-based User Interfaces

- Current user interface mainly uses keyboard and mouse for input.
- Recognition-based user interface will become more and more important
  - Speech input and output
  - Handwriting
  - Gestures

Example: Speech Recognition



Example: Gesture Recognition

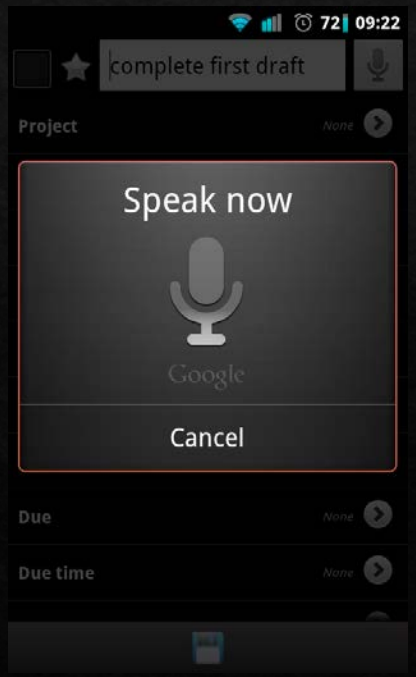





Recognition-based User Interface

- Fundamental differences from today's interfaces
  - Sophisticated pattern recognition techniques are involved in the interface design.
  - Interface with feedback facilities are required due to recognition error.

Conversational Interface

- Interfaces which can respond intelligently to human conversations.
- The most famous example is the computer program ELIZA.
- An example of a conversational interface.



ELIZA: An Example Conversation

He says I'm depressed much of the time.

I AM SORRY TO HEAR YOU ARE DEPRESSED

It's true. I am unhappy

DO YOU THINK COMING HERE WILL HELP YOU NOT TO BE UNHAPPY

I need some help, that much seems certain.

WHAT WOULD IT MEAN TO YOU IF YOU GOT SOME HELP

Perhaps I could learn to get along with my mother.

TELL ME MORE ABOUT YOUR FAMILY

My mother takes care of me.

WHO ELSE IN YOUR FAMILY TAKES CARE OF YOU

My father.

ELIZA

- The input is inspected for the presence of a keyword.
- When such a word is found
  - The sentence is transformed according to a rule associated with the keyword.
  - The text is then displayed.
- Keywords may have a rank or precedence number.

ELIZA

- A kind of template is applied to transform the original sentence.
- Example:
  - “I am very happy these days”
  - “How long have you been very happy these days?”
- Templates:
  - “I am X”
  - “How long have you been X ?”

ELIZA

- Another example
  - “It seems that you hate me”
  - “What makes you think I hate you ?”

(1) (2) (3) (4)

“It seems that | you| hate |me”

ELIZA

- Search for the pattern
  - “(1) you (3) me”
- Reassembly rule
  - Throw away component (1).
  - Apply the following rules:
    - you→I
    - me→you
  - Tack on a relevant phrase to the front.

ELIZA

- Formal notation
  - “(1) you (3) me”
  - “What makes you think I (3) you”

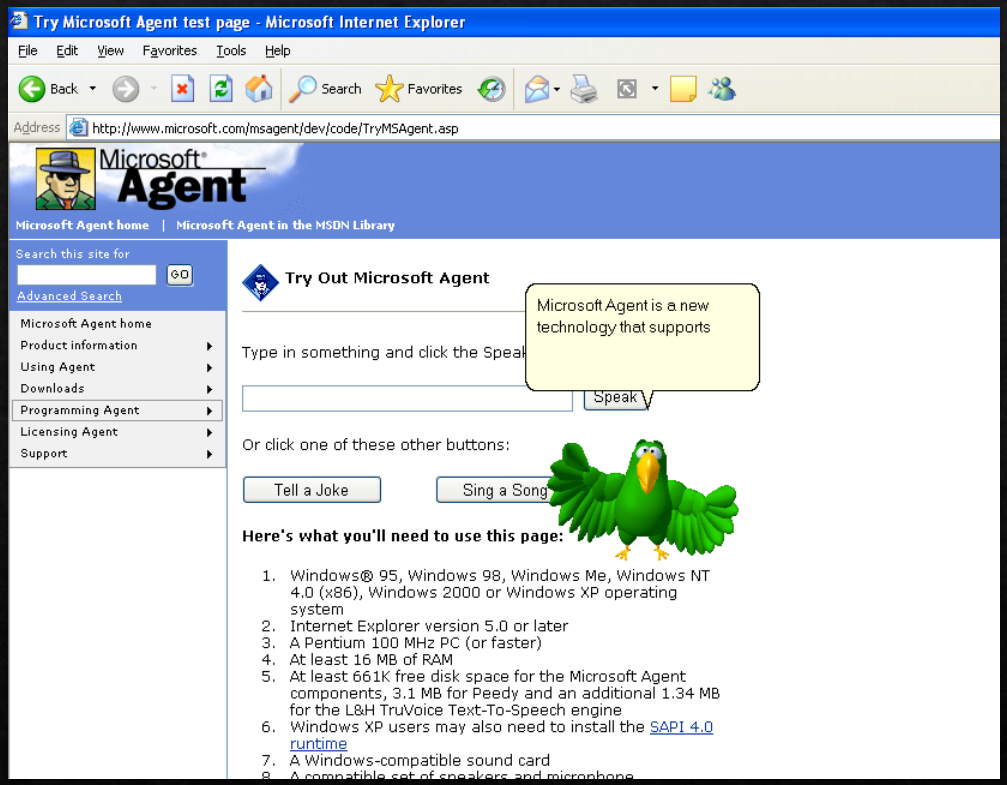
Complete System

- Speech recognition
  - Conversion of sound waves to discrete words.
- Natural language understanding
  - Understand the meaning of the words.
- Natural language generation
  - Generate appropriate responses.
- Speech synthesis
  - Generation of natural-sounding speech.

Animated Agents

- Combine spoken dialogue with human-like animated characters.
- The characters can augment speech with body language, facial expression and gaze.
- Requires computer graphics and animation techniques.

Animated Agents

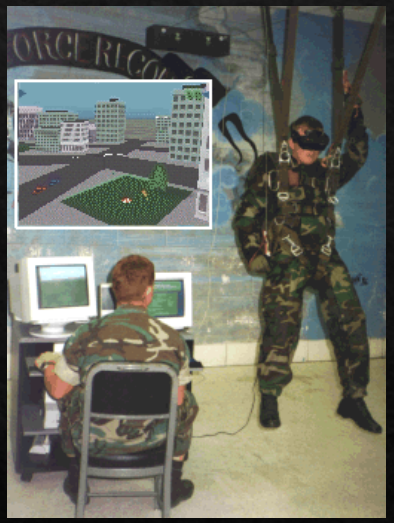


3-D Technologies

- Migration from 2-D presentation space to 3-D space.
- Applications areas that benefit from 3-D technologies
  - Training
  - Simulation
  - Interactive exploration of complex data environments.

Examples

Football Training



Parachute Training

Flight Simulator

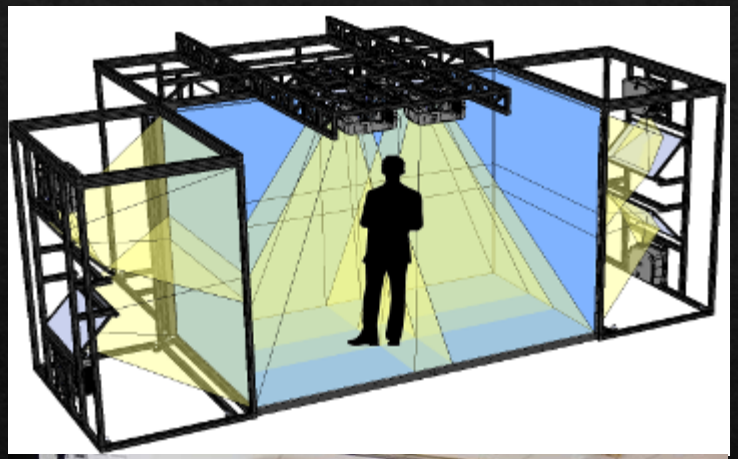
3-D Technologies (cont'd)

- Previous 2-D notions need to be revised
  - How to interact with information ?
  - How to select objects in 3-D space ?
  - How to navigate through information spaces ?
- Objective: "near-real-time" interactivity to achieve the effect of direct manipulation

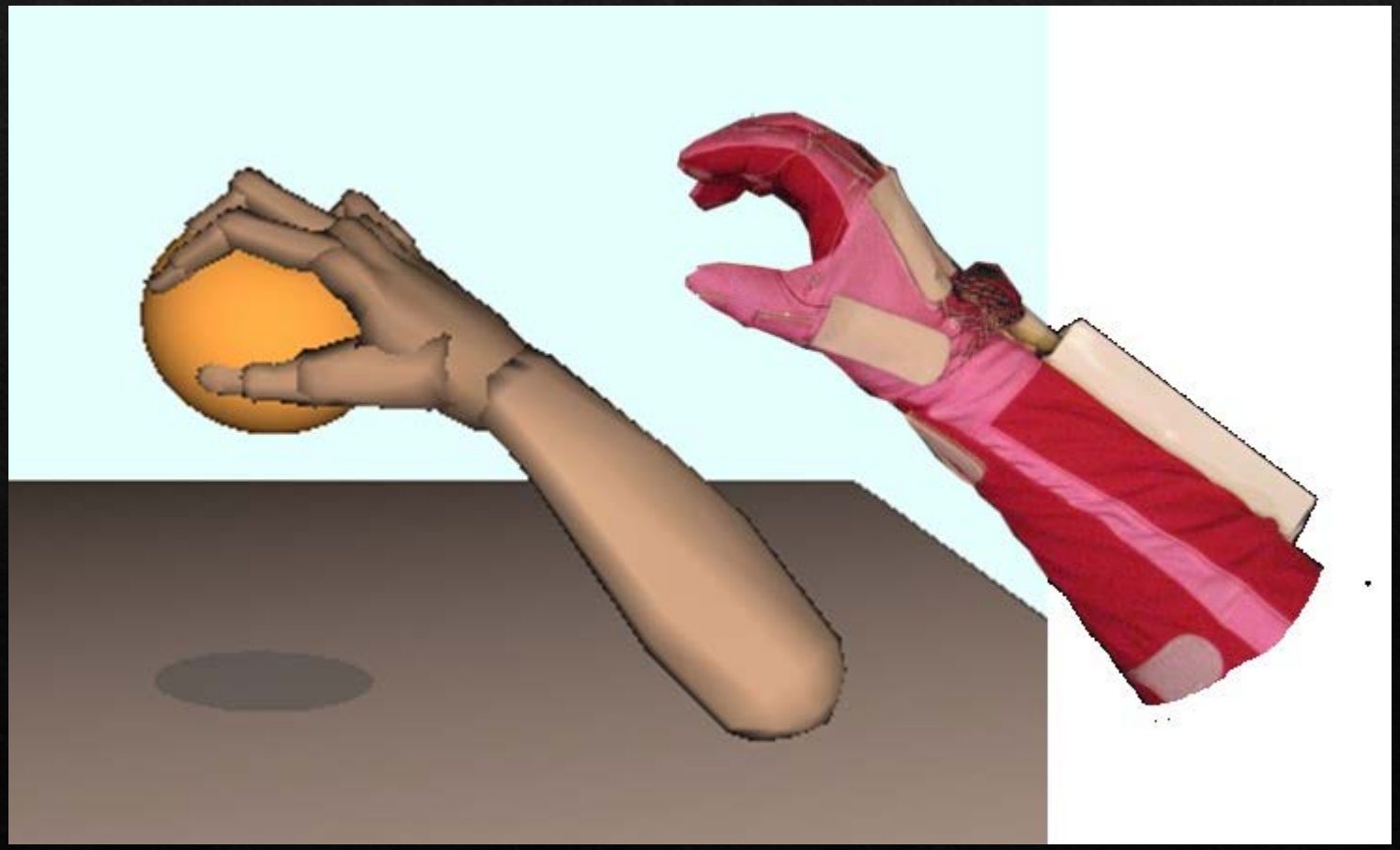
Head-Mounted Display

Binocular Omni-Orientation Monitor (BOOM)

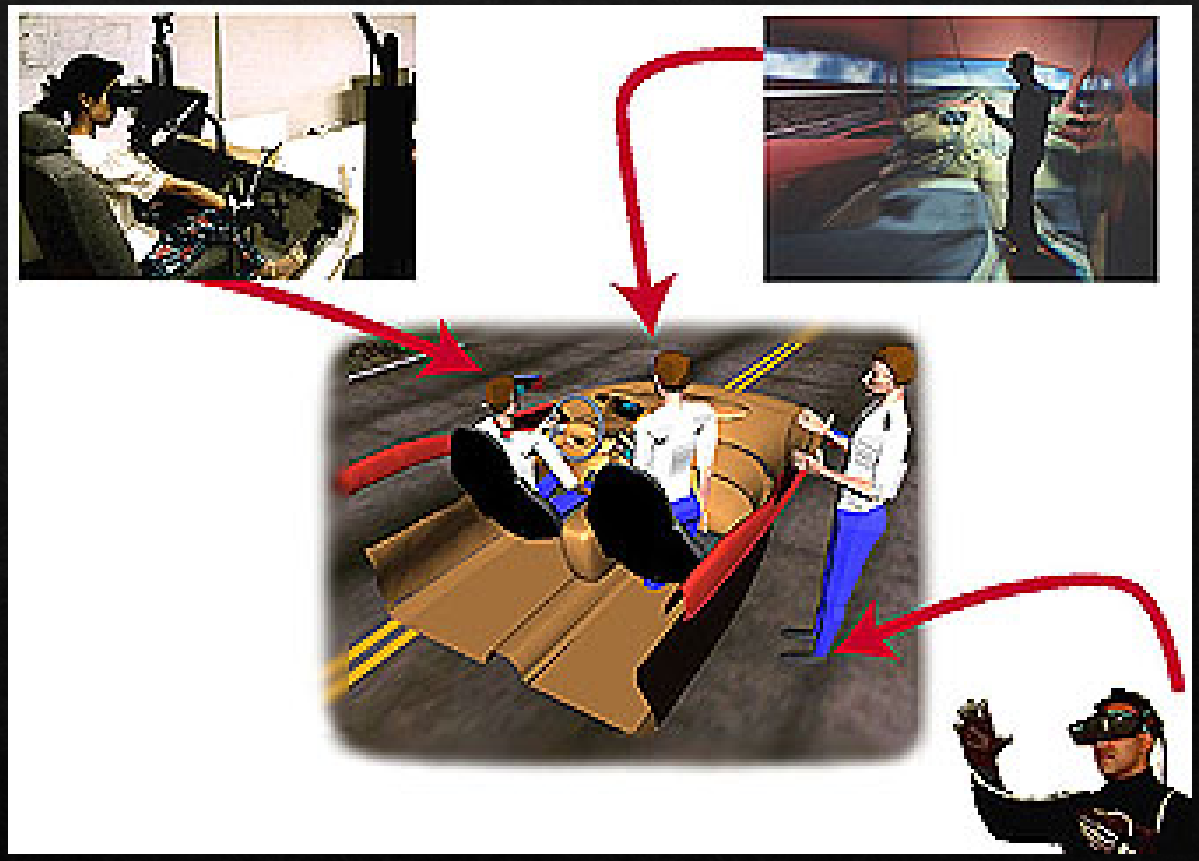
Cave Automatic Virtual Environment (CAVE)



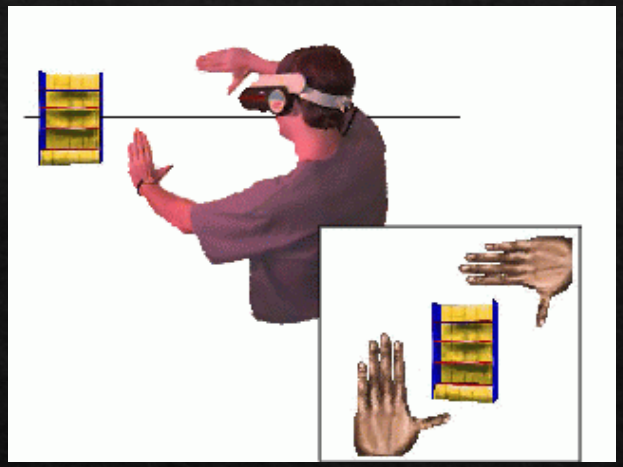
Data Glove

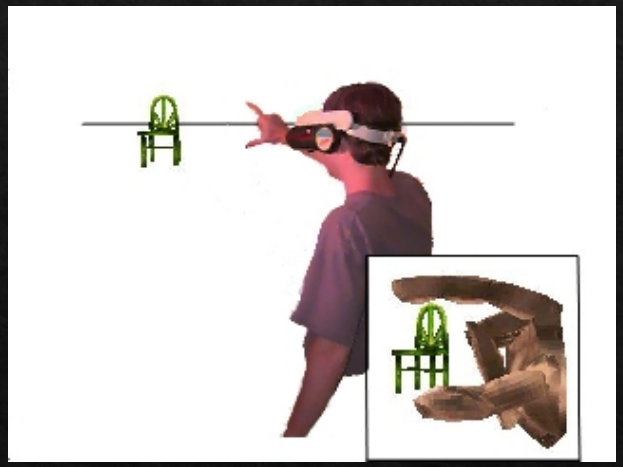


Collaborative virtual environment



Selecting Objects in 3-D Space





Browser in 3-D space