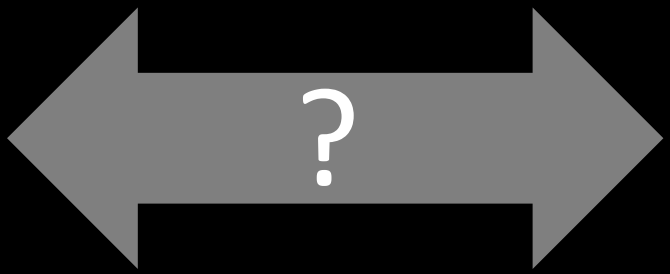
THE UNIVERSITY OF MELBOURNE



GEOM90007

SPATIAL VISUALISATION

LECTURE 10B:
DIALOGUES AND
THE USER INTERFACE

REVISION – INTERACTION THEORY

- Human perspective
  - Perceptual-motor interaction
  - Human I/O, information processing model
  - Action model, 7 steps

- Fundamentals of human interaction
  - Experience is critical
  - Discoverability
    - Human psychological concepts, 6 concepts
      e.g. affordances, signifiers, constraints, etc.
  - Other
    - Mental models, attention, memory, cognitive loading

REVISION – INTERACTION THEORY

- Device perspective
  - Device I/O
  - Dialogue
  - User interface (UI)
    - Interface types

- Human-computer interaction types
  - Activity-based:
    - Instructing, conversing, manipulating, exploring
    - Concept of direct manipulation

- Important things to consider
  - Human factors, issues of stimulus/interpretation

CLARIFYING CONCEPTS

EXAMPLE USER INTERFACE

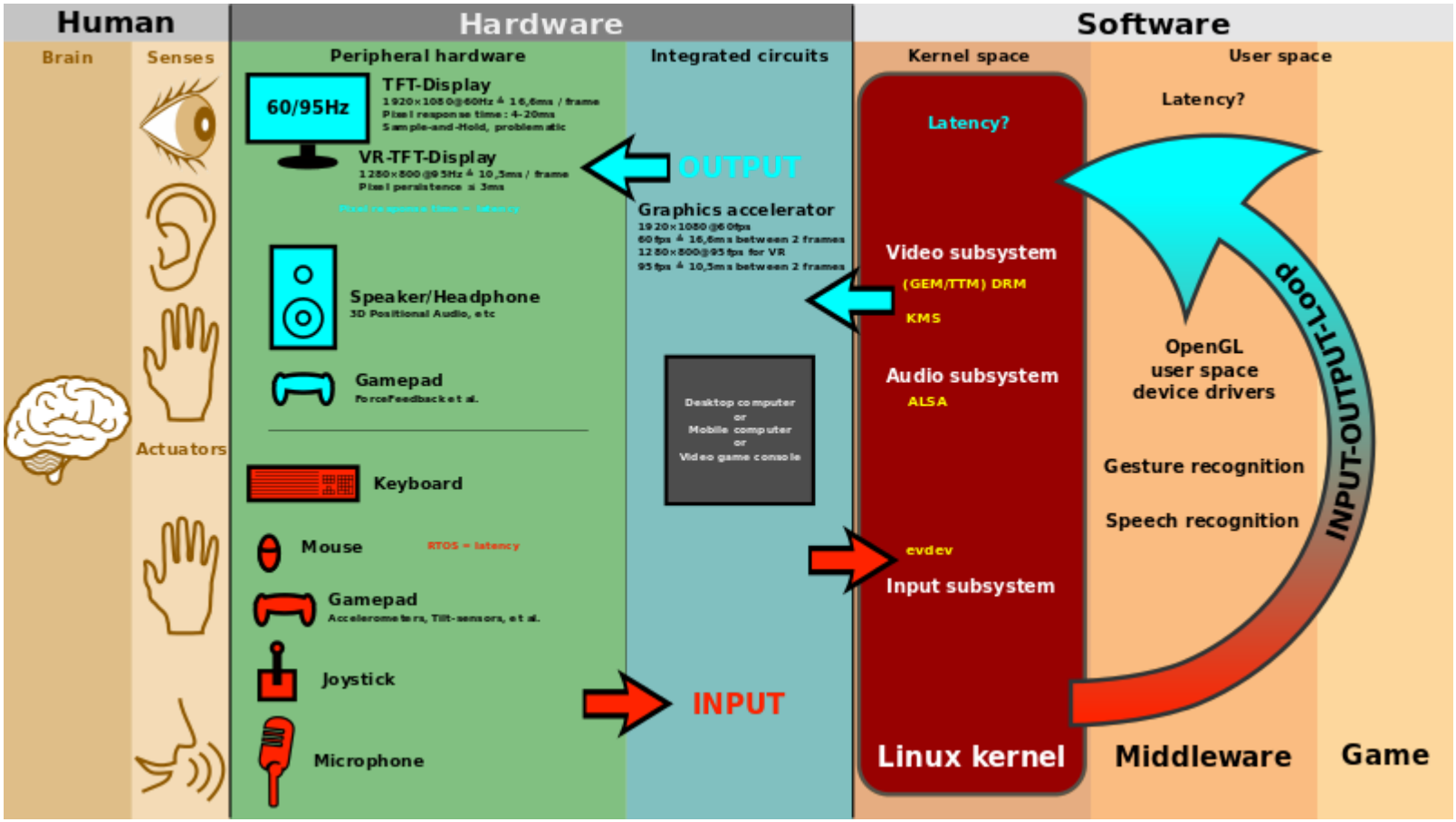


Image: Wikimedia Commons

USER INTERFACE PRINCIPLES

UI facilitates a user's (inter)action with a system to perform tasks

User's mental model of the user interface can be structured using three components:

- **Presentation of information**
- **Dialogue**
- Tool (application dependent)

(Çakir and Dzida, 1997)

INFORMATION PROCESS (ISO, 2006)

Focused on the **presentation of information** using standard principles

Data graphics

- Visual variables (Bertin)
- Design principles (Tufte)

Cartography

- Cartographic visual variables (MacEachren, Slocum et al.)
- Cartographic design principles (Slocum et al.)

Visual Design (information)

PRESENTATION OF INFORMATION (ISO, 2006)

Clarity: the information content is conveyed accurately

Discriminability: the information can be distinguished

Conciseness: users are not overloaded with extraneous information

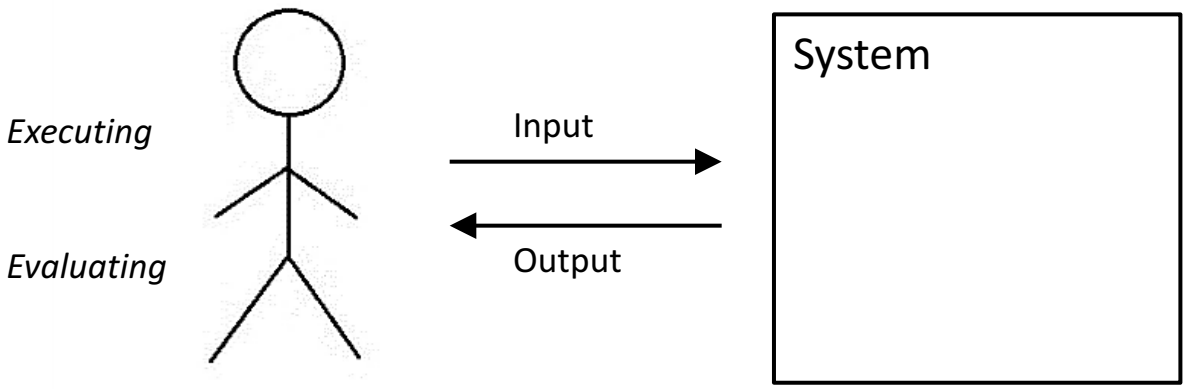
Consistency: a unique design, conformity with user's expectation

Detectability: the user's attention is directed to important information

Legibility: information is easy to read

Comprehensibility: the meaning is understandable, unambiguous, interpretable, and recognisable

THE DIALOGUE



DIALOGUE PRINCIPLES

(ISO, 2006)

"Interaction between a user and an interactive system as a sequence of user actions (inputs) and system responses (outputs) in order to achieve a goal"

DIALOGUE PRINCIPLES

(ISO, 2006)

To overcome the potential gulfs, designers should employ dialogue principles in their design:

a) Suitability for the task

The dialogue should be suitable for the user's task and skill level (rather than the technology to perform the task)

- Information not needed for the task should be avoided

b) Self-descriptiveness

The dialogue should make it clear what dialogue they are in, what the user should do and what they should do next

- Information should guide the user (e.g., input expected)

(ISO, 2006)

c) Conformity with user expectations

Should be a 'natural interface' utilising a suitable conceptual model

- Suitable processing time, adequate feedback, similar to existing

d) Suitability for learning

The dialogue should support and guide the user to learn the system

- Design should allow user to conceptualise and develop strategies

e) Controllability

The user should be able to initiate and control the interaction

- "If the volume of data relevant to a task is large, then the user should be able to control the data presented" (page 9)

DIALOGUE PRINCIPLES

(ISO, 2006)

f) Error tolerance

The dialogue should be forgiving in terms of error correction

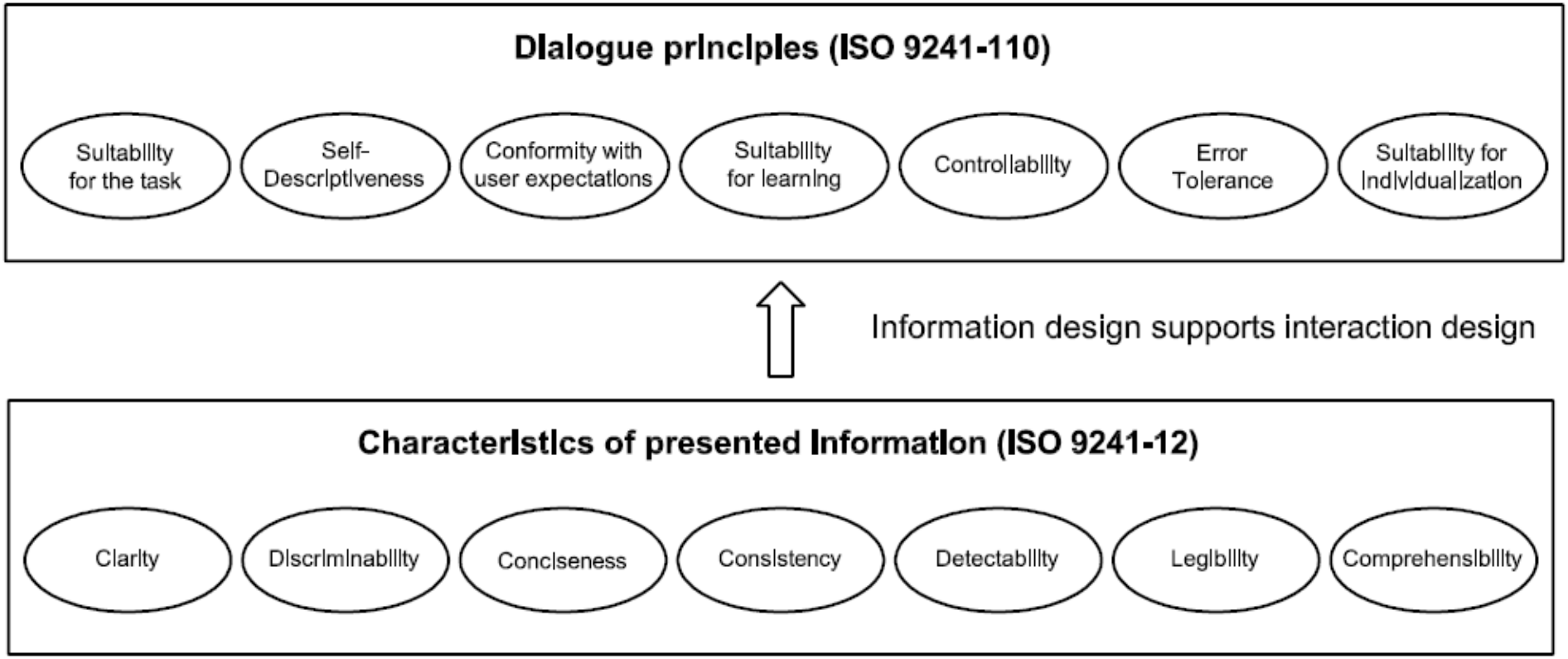
- Assist the user in detecting and avoiding errors in input

g) Suitability for individualization

Users are able to modify the interaction and presentation of information to suit their needs

- Icons and graphics for an audience with limited reading skills
- Output representation can be customised (format and type)
- Help can be turned off for advanced users

(ISO, 2006)


Dialogue principles (ISO 9241-110)
Suitability for the task
Self-Descriptiveness
Conformity with user expectations
Suitability for learning
Controllability
Error Tolerance
Suitability for Individualization
Information design supports interaction design
Characteristics of presented Information (ISO 9241-12)
Clarity
Discriminability
Conciseness
Consistency
Detectability
Legibility
Comprehensibility

THE USER INTERFACE

Interaction primitives (Roth, 2012)

The smallest interaction element of an interaction (Bram et al., 2011)

Used to describe the interaction of user-system at a finer granularity

Cartographic interaction primitives (Roth, 2012)

- Objective
- Operator
- Operand

EXAMPLE PRIMITIVES (Roth, 2013)

Objective based: the user's goals

- Identify (e.g., similarities and differences within a map)
- Compare (e.g., similarities and differences across multiple maps)

Operator based: specifying the actions (bridging UI to the user)

- Assignment: mapping of variables to graphical primitives
- Brushing: highlighting information items across displays
- Focusing: provide more or less detail as required (e.g., zoom in/out)
- …

Operand based: the visual objects as feedback to the user

- Representation of data (e.g., 1D, 2D, temporal) including visual variables (e.g., shape, position, pattern)

THE EVOLVING USER INTERFACE

WIMP, GUI and Advanced widgets

THE USER INTERFACE

Classic WIMP

- Windows
- Icons
- Menus
- Pointer

Graphical User Interface (GUI)

- 3D components
- Multimedia such as audio icons/menus
- Advanced widgets

Multimodal user interface

WIMP (Preece et al., 2015)

- Windows
  - Overcome constraints of the physical display
  - Allow more information to be displayed
    - Widgets such as scroll bars allow more information
  - Single or multiple

- Icons
  - Symbolic representation of objects, tools or operators
  - Mapping can be:
    - Similar: A picture of a paper file representing a digital file
    - Analogical: A picture of a pair of scissors to represent cut
    - Arbitrary: An ‘x’ to represent close window
  - More information: http://communicationtheory.org/the-meaning-of-meaning-model/

WIMP

(Preece et al., 2015)

- **Menu**
  - Graphic elements (e.g. headings) to structure options
  - Hierarchies such as tree structures common
  - Contents are usually invisible until a parent option is highlighted
    - Good for cognitive loading (only relevant information)
  - Various styles: flat, drop-down, pop-up, contextual, expanding

- **Pointer** (mouse/touchpad cursor)
  - Traditionally indirect input
    - A mouse controls the cursor to interact, e.g., windows, icons and menus

Image: www.clipartbest.com

GUI AND WIDGETS

Graphic User Interface (GUI) elements that directly suggest where an action should take place (may comprise multiple signifiers)

e.g., http://jqueryui.com/draggable/

a) **Clickable** button, hyperlinks and tabs
b) **Draggable** sliders
c) **Swipeable** touchscreen slider
d) **Pressable** buttons
e) **Spinnable** controls of a touchscreen widget
f) …

Source: https://www.interaction-design.org/literature/book/the-glossary-of-human-computer-interaction/affordances

POST-WIMP/GUI

WIMP/GUIs have limited interaction, e.g., keyboard + mouse

- Command line or manipulation interaction only
- Dialogues use simple controls, e.g., menu and buttons

Challenges

- Performed linearly, i.e., serial (e.g., wizard dialogue box)
- Rudimentary I/O

MULTIMODAL INTERACTION (Oviatt, 2012)

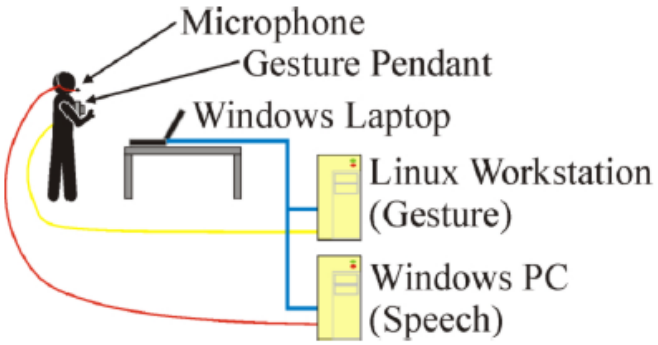
People interact multi-modally in their everyday lives

Multimodal interfaces inspired by
- Cognitive engineering
- High fidelity simulation

Example combinations
- Voice and touch input
- Voice and lip movements
- Voice and gesturing
- Gaze tracking and keyboard/mouse/touch input

MULTIMODAL INTERACTION

(Krum et al, 2002)



MULTIMODAL INTERACTION (Krum et al, 2002)

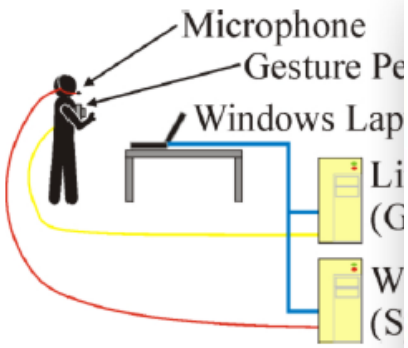


Figure 5: Moving the right index finger up and down causes vertical panning. Moving a vertical index finger left and right causes horizontal panning.

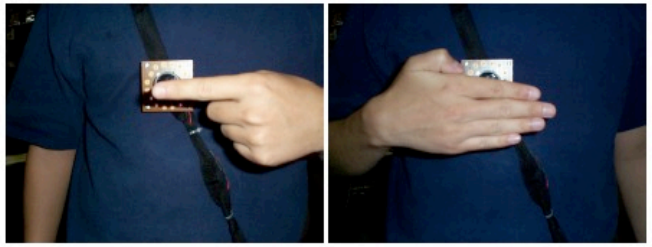


Figure 6: Moving the left index finger up and down causes zooming. An open palm stops movement.

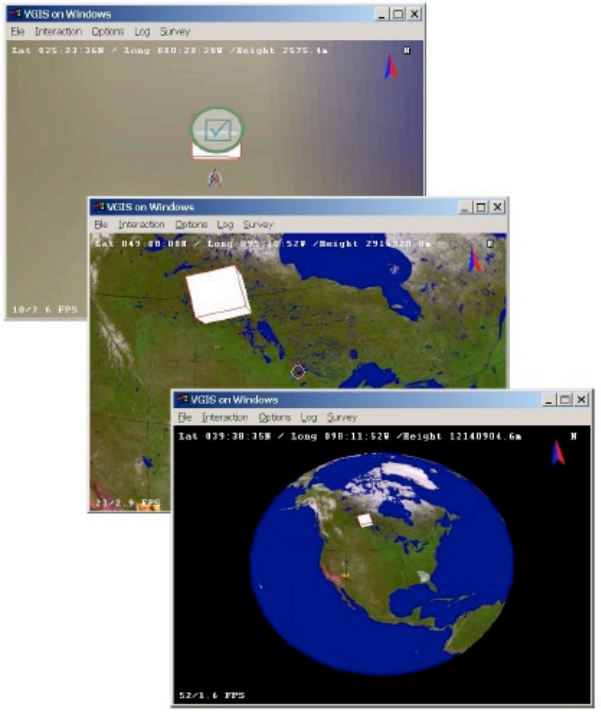


Figure 7: Sequence of Images from an Experimental Task

Early multimodal geovisualisation example:

http://dl.acm.org.ezp.lib.unimelb.edu.au/citation.cfm?id=2664321

REVISION – EXECUTION AND EVALUATION (Lecture 14/15)

Gulf of execution

Interface mechanisms can bridge the gulf of execution,
i.e., the user can translate their goals/intentions into actions

Interface mechanisms

- Signifiers, constraints, mappings, conceptual model

Gulf of evaluation

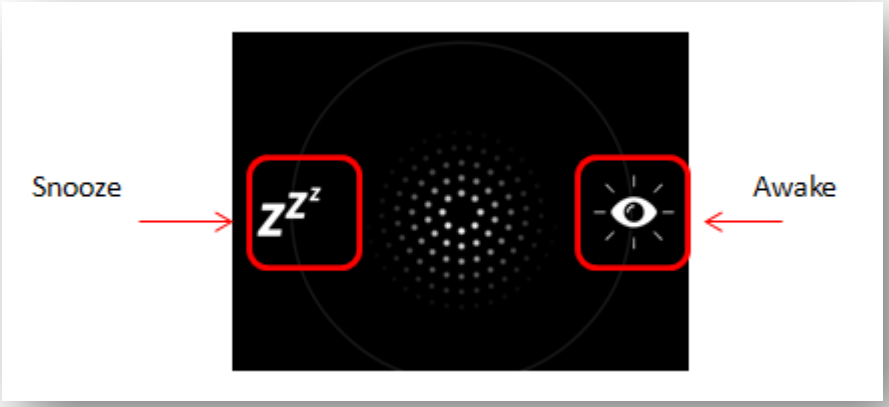
Adequate feedback (using a suitable conceptual model) can bridge the gulf of evaluation so the user can understand what actually happened

Interface (feedback) **Interpretation** (conceptual model makes sense)

EXAMPLE – An interaction with a haptic display

User goal: Unlock phone
3x Signifiers: Arrow button, Text ‘slide to unlock’, Animation effect

Image: Vermeulen et al. (2013), http://dl.acm.org.ezp.lib.unimelb.edu.au/citation.cfm?id=2466255



“swipe left to **Snooze**, swipe right to **Turn Off**”

Image: motorola-global-portal.custhelp.com

USING PROCESSING

Input

- Mouse (e.g, position, wheels, buttons
- Keyboard (e.g., keyPressed)
- Files (e.g., reader, JSONXML)
- Time/date

Output

- Text Area
- Image
- Files
- ….

NEXT

- The Design Process