VISUALISATION AND DIRECT MANIPULATION
Issues for human systems development

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presentation plan

- discuss the role of Visualisation and Information Visualisation in next generation of user interfaces
- system issues to take advantage of emergent computer 3D facilities and Virtual Reality
- visualisation can foster user interaction and the ability of the computer to mediated humans
- a proposal of four main issues to be researched in order to develop better human systems

introduction

- information management and information flow are critical success factors in human systems
  - if handled conveniently it is possible to **change** dramatically productivity
  - information systems can use technology to **enable** information flow

introduction

- Information Visualisation
  - technologies that improve the way humans **perceive** and use large and complex data sets, and help manipulate information
- Visualisation
  - provide an **interface** between the human mind and the computer.
- Virtual Reality (VR)
  - the **delivery** to a human of the most possible convincing illusion that they are in another reality

introduction

- How can we relate Virtual Reality and Visualisation technologies?
  - Visualisation goal is to **represent** data in ways that make them perceptible, and able to engage human sensory systems
  - Virtual Reality makes it easier to **interact** with visualisations, and the user can have its own presence in a 3D space
  - users can interact directly both with data and other users using the same visualisation, allowing the creation of **environments** for supporting human/human interaction

motivation

- approaches to educational systems based on well-tested and conventional techniques have limitations :
  - **complexity** resulting from large amounts of unstructured information, and the difficulty of keeping pace with change
  - complexity of **co-ordinating** information sources even with distributed solutions does not seem to be reduced as heterogeneity, and interoperability problems arise easily
  - shift in information content from pure data to **knowledge** does not seem to fit well with conventional available systems

issues to be considered

- use graphics as **dialogue extenders**
- the **human side** of technology users
- systems to support **knowledge share**
- the **direct manipulation** factor
- the importance of a **common language**
- from **abstraction to action**
- **information artefacts**
- experiential and reflective **learning**

use graphics as dialogue extenders

- need for better ways for representing information and dealing with the increasing complexity and volume of information
  - new forms of **dialogue** between users and computers - a graphical dialogue [Sutherland 1963]
  - new forms of computer **interaction** [Engelbart and English 1968].
  - graphics and other visuals **roles** in helping visualising information and convey meaning [Tufte 1983]
  - a performing **medium** where the focus is on live manipulation of text and graphics [Lakin 1988]

the human side of technology users

- the human, his perceptual limitations and the way he understands visuals
  - humans are thinking, interpreting creatures, that are **active**, **creative**, **social** beings [Norman 1993]
  - cognition is **socially distributed** [Hutchins 1995]
  - human cognition is a different cognition when compared with other animals, because is intrinsically a **cultural** phenomenon with three kinds of space: the physical space, the social space and the **conceptual space** [Hutchins 1995]

systems to support knowledge share

- main material each individual can use, share, and communicate is knowledge
  - Memex: **individual** appliance. Its associative indexing introduces the concept of creating an **information space** from new material and active **links** to existing material [Bush 1945]
  - Xanadu: a **collective** appliance proposing a new type of a **publishing** medium which turn possible the creation of new meanings and interpretations by elaborating **dynamic** structures [Ted Nelson 1962]
  - World Wide Web: **distributed** hypermedia system with client-server architecture has become a **global** system to **access information** [Berners-Lee et al. 1994]

the direct manipulation factor

- criteria for a direct manipulation system [Shneiderman 1982, 1987] :
  - continuous **representation** of the object of interest;
  - physical **actions** or labelled button presses instead of complex syntax;
  - rapid incremental reversible **operations** whose impact on the object of interest is immediately visible
- creation of **environments** where users:
  - comprehend the display
  - feel the control
  - and the system is predictable

the importance of a common language

- to share information we need a common language that specifies and enables the basic communication operations to **share** meaning by known **abstractions**
  - the boundary between inside and outside the human mind became the boundary between **abstract** symbols and the **world** of phenomena **described** by the symbols
  - humans spend their time producing symbolic **structures** for others [Hutchins 1995]
  - the representation **form** makes a dramatic difference in the ease of the task and their proper choice depends upon the knowledge, system, and method being applied to the problem [Norman 1993].

from abstraction to action

- the more higher the level, more symbolic abstraction is on use, taking a education context [Lengel and Collins 1990]:
  - what education is supposed to do is to get students to see **data** (facts) in such as way as to inform themselves
  - the data in their mind are combined into **information**
  - information is then related to other information to produce ideas in the students' minds - concepts that help explain the world - **knowledge**
  - some students combine these ideas to produce a **wisdom** that understands the whys and wherefores of life and truth

information artefacts

- **external representations**, especially ones that can be part of a **workspace** shared with others, require some sort of constructed device to support them: an **artefact** [Norman 1993]
- through **metarepresentations** we can generate new knowledge, finding consistencies and patterns in the representations that could not readily be noticed in the world [Norman 1993]
- use concept maps for **representing** knowledge and its application for supporting learners within an external **learning space** [McAleese 1998].

experiential and reflective learning

- **experiential** mode: state in which we perceive and react to the events around us, efficiently and effortlessly
  - related with expert behaviour and efficient performance
  - experiental artefacts provide mediation between the mind and the world
- **reflective** mode: comparison and contrast, of thought, of decision making.
  - related with the creation of new ideas and novel responses
  - reflective artefacts allow us to ignore the real world and concentrate only on artificial, representing worlds

research problem and activities

- use of 3D visualisation techniques and information visualisation to develop direct manipulation interfaces in a perspective of enabling a collaborative interface

"*think of the computer, not as a tool, but as a medium*"

Laurel, 1993

research problem and activities

- study which **restrictions** must apply to a 3D representation when compared with a n-dimensional
- propose a parameter based **model** for knowledge representation and visualisation
- develop a set of 3D **symbols** to serve as demonstrators for 3D concept maps to implement the 3D space for (i) individual control and (ii) for sharing by several users
- select an **application** context where these ideas can be tested

final remarks

- **Question**: how we can use 3D facilities to improve human capacity to deal with information
- **Hypothesis** Visualisation can provide a useful way for sharing knowledge representations that can be collaboratively enhanced
- **Applications**
  - education, learning and training
  - workflow
  - content management
  - e-business