Evaluation of a Visualisation Design for Knowledge Sharing and Information Discovery

ICEIS 2001 Conference, 7-10 July

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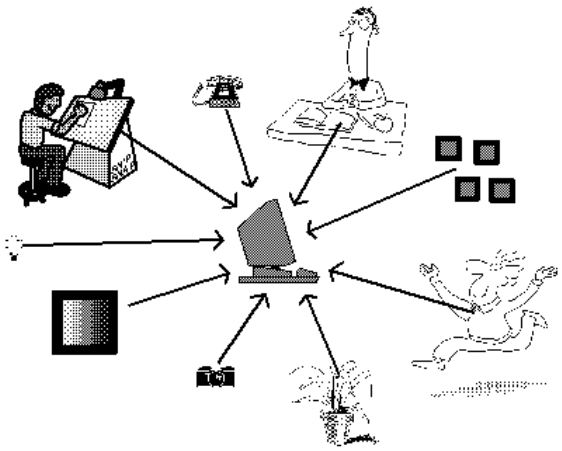
Presentation abstract

- present a tool using a 3D interactive visualisation system that allows knowledge sharing and information discovery
- propose a visualisation design using direct manipulation techniques to convey information about a structure for knowledge sharing
- the structure describes a knowledge theme described as a set of concepts provinding a particular context description about the knowledge being shared
- the application was tested using the set of concepts to direct searches in the World Wide Web

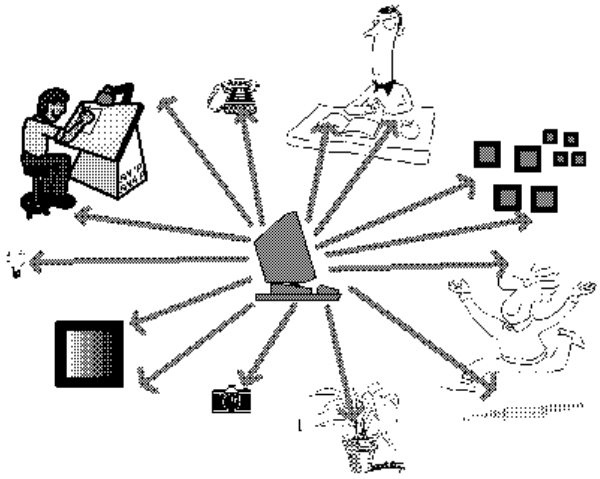
Presentation abstract

- preliminary evaluation results are reported: showing that the system tends to better support people with some *knowledge expertise* about the knowledge being shared even if they have little *Web expertise*
  - this show potential for the visualisation design as an interface for both knowledge sharing and information discovery
  - for people that have already some theme *knowledge expertise*, but suffer from information overload or lack of knowledge about the structure of large information spaces such the Web

Way One: virtual reality

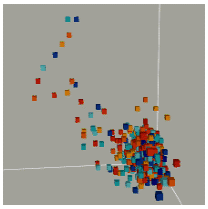
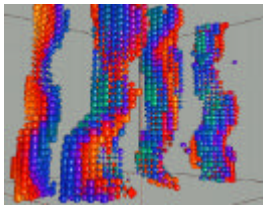
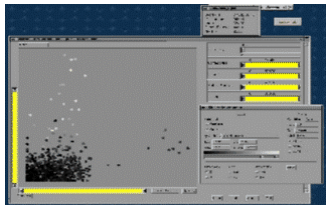


Way two: ubiquitous computing



“Two way” integration: visualisation

- definition: use of images and animations to convey information
- goal :effectively convey information to the user
  - transforms the abstract and symbolic into the geometric
  - harnesses the human perception system (visual?)

Visualisation (why?)

- 3D visualisation can offer a more convenient and natural way for people to interact with information spaces (as distinct from environments that are naturally 3D) [Tufte, 1990] and [Benedikt, 1992].
- to date there is not much evidence to support it, other than in cases where the information has a natural spatial component [Hubbold et al., 1995]
- many problems as user sense of position that can be lost if the layout changes [Ingram and Benford, 1995]

Visualisation (task approach)

- an application for testing the visualisation design:
  - information discovery: support user efforts to find relevant information within a given knowledge domain [Li-Jen and Gaines, 1998]
  - setting up a context, a query generation tool and an Information Visualisation [Card et al., 1999]; providing context and information about a particular data source for analysis and comparison.
- based on a given context shared as a 3D interactive visualisation, users can be assisted to retrieve information and analyse it information discovery [Baeza-Yates and Ribeiro-Neto, 1990]

The evaluated prototype

The prototype implements:

- a *concept space* as a 3D interactive visualisation;
- a visualisation design composed by two distinct visualisations: a *concept space*, representing the structure, and a *criteria space* that allows spatial positioning by specifying up to three criteria;
- data source integration by using an *Information Visualisation* within the criteria space visualisation;
- displaying of results using a *search engine* (the *AltaVista Search Personal eXtension 97*).

Goals

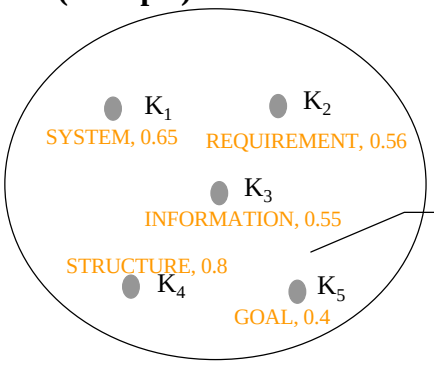
- prototype (3D interactive visualisation) goals:
  - convey information about a structure for knowledge sharing
  - test how this could support knowledge sharing by proposing a particular system to give support to users in information discovery
  - help users to build their own queries by using a textual search engine based on information from the structure for knowledge sharing
  - allows the visualisation of data source information within the visualisation design and displaying of results using an HTML browser

Goals and rationale

- tool advantages are greater when data sources do not have an underlying structure and a query returns a vast amount of results as is the case of the Web
  - information overload occurs...
- tool based on a shared interactive representation of a knowledge theme that can be used to construct queries and compare a data source with the domain representation
  - allow user individual application of shared context
- a basic *support for collaboration* is implemented within the system to share the knowledge domain representation and to enhance it

Concept definition and structure

Concept
(example) ENTERPRISE



K_i - *keywords*

Rating [0 , 1]
amount of relation with the concept

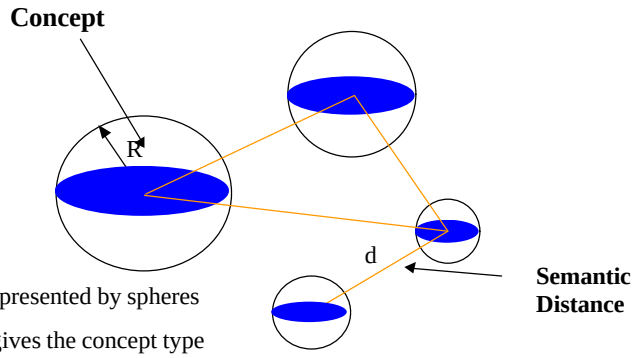
< name > < value >

Enterprise	
system	0,65
structure	0,8
goal	0,4
information	0,55
requirement	0,56

A partial concept space structure example

Computer	Interface
Order, 0.67	order, 0.34
Technology, 0.7	operation, 0.76
Automatic, 0.67	human, 0.8
Processing, 0.8	computer, 0.56
Structure, 0.7	

Concept space



Concepts are represented by spheres

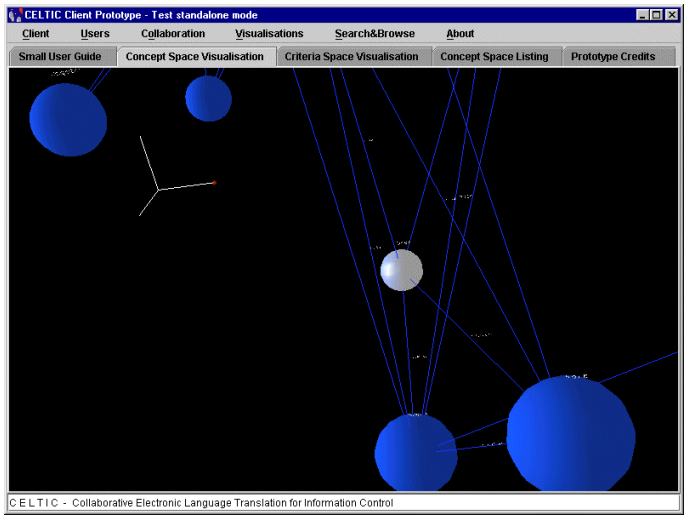
Sphere colour gives the concept type

Sphere size gives the concept description rate

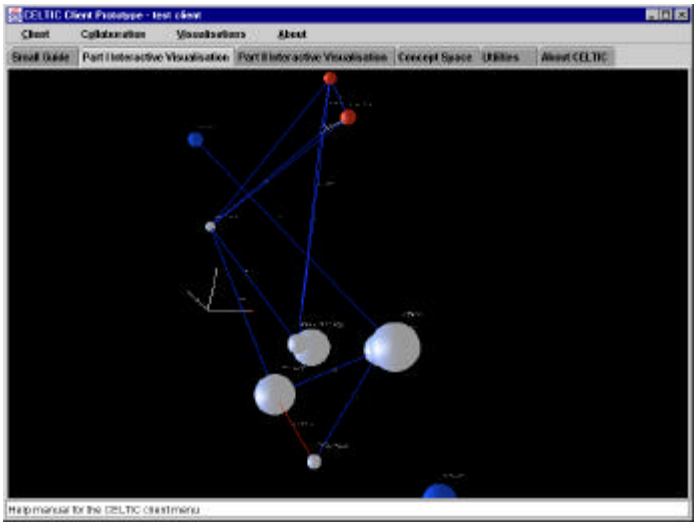
Semantic Distance is represented by lines between spheres

Spatial position is used with no other meaning than to place concepts for increase readability

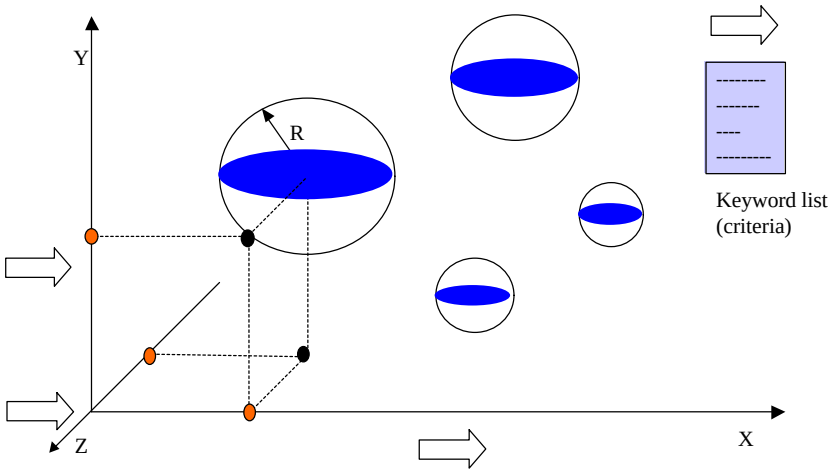
Concept space visualisation



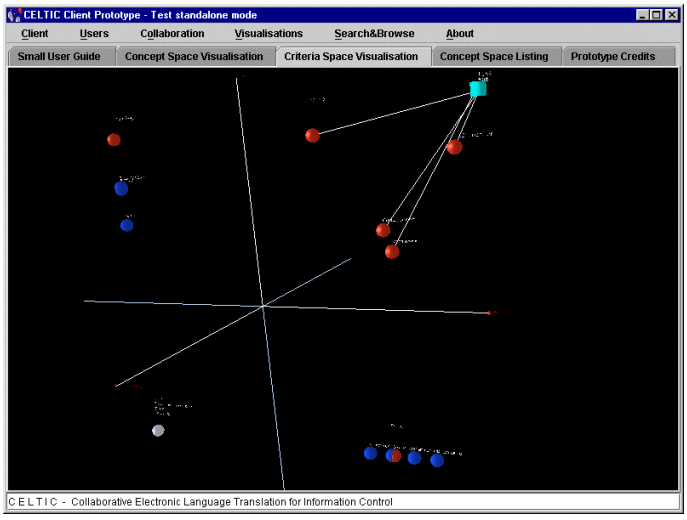
Concept space visualisation



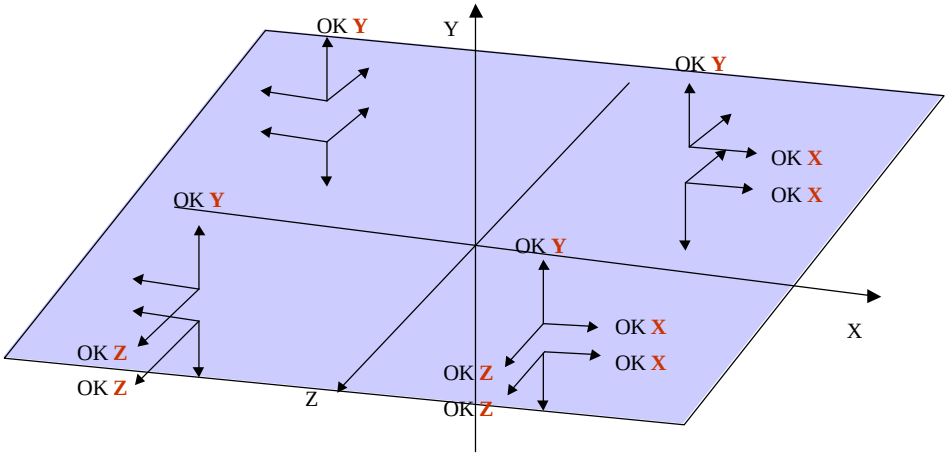
Criteria space



Criteria space Visualisation

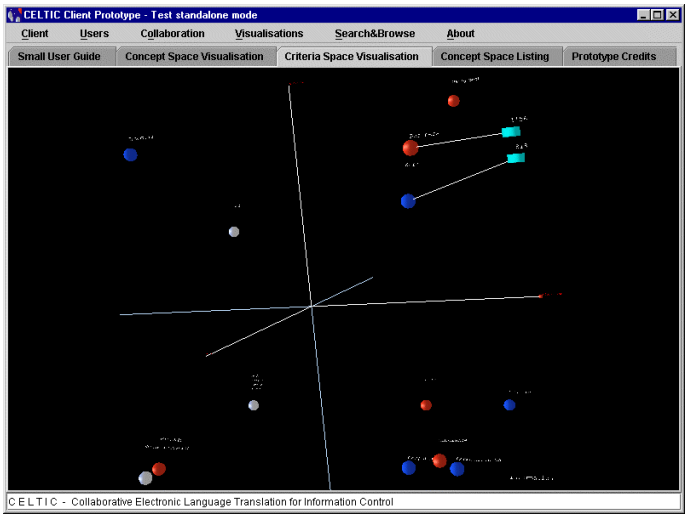


Criteria space quadrants analysis

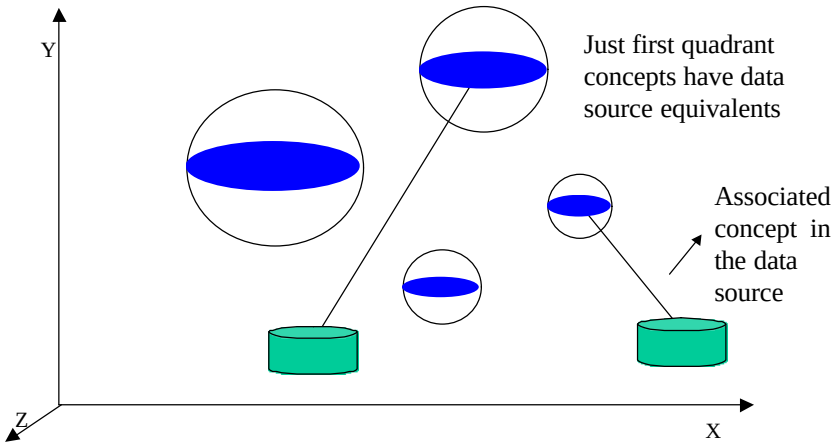


Criteria sequences: for three dimensions, eight possible sequences

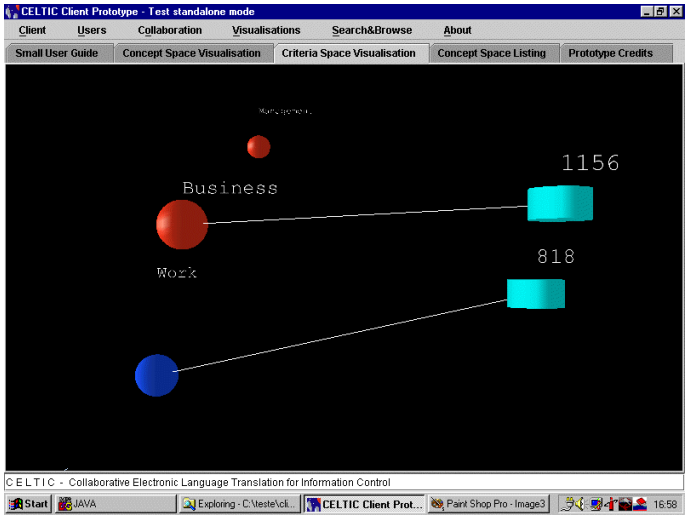
Mapping concepts in criteria space quadrants



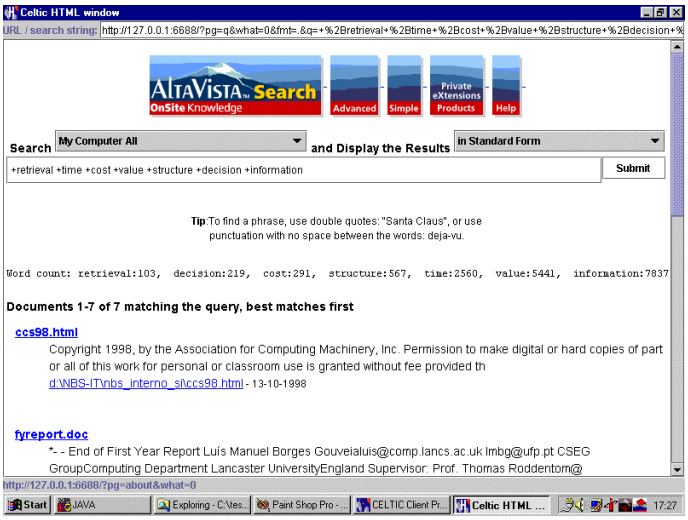
Information Visualisation in criteria space



Information Visualisation in criteria space



Accessing results



Evaluation

- selected 11 undergraduate students from UFP
  - the subjects were volunteers and no payment has been made for their participation
  - the knowledge domain was *Information Management*
  - the subjects were asked to use the prototype in six activities covering the following issues:
    - use the concept space;
    - use the criteria space;
    - analyse one concept relations;
    - create a criteria space;
    - perform a concept search;
    - perform a keyword search;

Evaluation script

- one-hour and half composed of the following activities:
  - a pre-experiment questionnaire (5 minutes);
  - a general overview of the tool functionality (10 minutes demo) giving by the evaluator;
  - a lab training period (10 minutes);
  - break (5 minutes);
  - continuous session for performing the proposed six activities (50 minutes);
  - a post-experiment questionnaire (10 minutes)

Evaluation factors

- asking each student:
  - what they have *learned* (as measured by a multiple-choice questionnaire);
  - how they think the system *helped* them (like/dislike rating);
  - what is their *opinion* about using the system (like/dislike rating);
- taking the *time to complete* of the six activities;
- performance is examined taking into account students own rating as low or high in:
  - Web expertise
  - Knowledge domain expertise (*Information Management*)

Data analysis

- about the *learn* variable (test questionnaire):
  - *web* expertise has significance at a 5% level;
  - *knowledge* expertise has significance at a 1% level;
  - *both web* and *knowledge* expertise are significant but with subject being more significance.
    No important interaction between both variables has been reported.

Data analysis

- about the *relation* between *web* and *knowledge* experience:
  - in the presence of *knowledge* expertise, the web expertise is no more significant at a 5% level;
  - in the presence of *web* expertise, the subject expertise is approximately significant at a 5% level.
- about the *help* variable (low/high help for the users):
  - there is no evidence of meaningful effects with *web* and *knowledge* expertise;
  - with both *web* and *knowledge* expertise together there is also no effects.

Data analysis

- about the *opinion* variable (low/high help for users):
  - *web* expertise is not significant;
  - *knowledge* expertise is approximately significant at a 10% level;
  - with both *web* and *knowledge* expertise there are no effects.
- about the *time to complete* variable (taking into account subjects that complete all tasks):
  - *web* expertise is significant at 1% level;
  - *knowledge* expertise is significant at 5% level;
  - both *web* and *knowledge* expertise do not have any relation

Concluding remarks

- people *learn* more when they had already some *expertise* in the knowledge area
- the importance of using the *web* before was moderate although not so important as the *knowledge* expertise to explain questionnaire results (*learn*)
- the users feeling about how the system *helps* them has not any impact from their *web* or *knowledge* expertise
- when considering user *opinion* about the system, *knowledge* expertise seems to have some importance, regardless of the *web* expertise

Concluding remarks

- operation of the system seems to be influenced by the users *web* expertise in a very important way
  - *knowledge* expertise also assists users in system operation
- overall, the system tends to better support people with some *knowledge* expertise and little *web* expertise
  - seems to show some potential as an interface to access information for people that have already some *knowledge* expertise - more evaluation needed!

Concluding remarks

- use of visualisation techniques can improve the interface by supporting familiar cues to user perception
  and
  thus convey information for knowledge sharing
- people were able to use the visualisation design