CubeBrowser – A Cognitive Adapter to Explore Media Databases

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Abstract
CubeBrowser is the concept study for a six-display cube with digital screens that makes it possible to browse online databases like flickr. The control of navigation is exclusively accomplished by performing manual actions on the object. This creates a playful way of exploring image collections that are networked by tags.

Keywords
interaction, interface, cognition, flickr, tui, tagging, perception, screens, tangible, 3DOF

ACM Classification Keywords
H.5.2. User Interfaces (D.2.2, H.1.2, I.3.6)
User-centered Design

Introduction
The objective of this project has been to design an interface concept that combines several facettes of distributed cognition [4]: The concepts of embodied cognition [1,2] on the one hand and socially-distributed [8] cognition on the other. The former is describing our bodily-based existence in the world as a highly important foundation for all cognitive processes, while the latter tries to outline the distribution of intelligence across several or many people. CubeBrowser is designed to be a "cognitive adapter" [8] between a

human and a database: a collaboratively shaped data-space is mapped on a display cube in order to be travelled by an individual user.

Figure 1: The second edition of CubeBrowser

While there has been other research [5,6] towards cube interfaces with rotation input using 3DOF orientation sensing, the CubeBrowser project does not focus on developing a generic tangible user interface [3] (TUI) replacement of a traditional desktop setup. Instead, emphasis was placed on creating a detailed design for a specialized application within database search and retrieval. As far as we know, CubeBrowser brought up the first fully working prototype of a cube interface that features cable-independent operation and six full-color video screens.

Creating networks of tags and images

CubeBrowser proposes a way of experimental database browsing. Flickr stores over 100,000,000 images that are described by the users with tags. Common tags are repeated by several users simply because there are intersections between the content of many images. With this meta-data, it is possible to select the images for a certain keyword and find related images by comparing the tags of these images with all the others. By drawing connections between these related images, you can create networks.

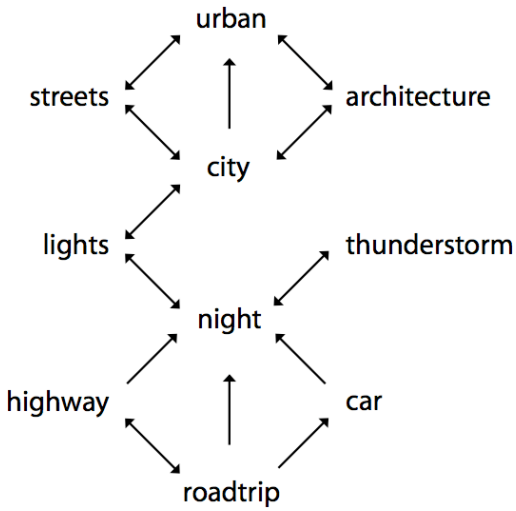

Figure 2: A small network of tags from flickr.

These networks of associations can be considered as architecture or paths that you can move along. In figure 2 you can see a small network of tags from Flickr. Even though the number of tags is small, there are numerous ways to travel this network. Using such a network, CubeBrowser allows browsing images for a certain tag and to branch off to other related tags that are offered to you at each moment.

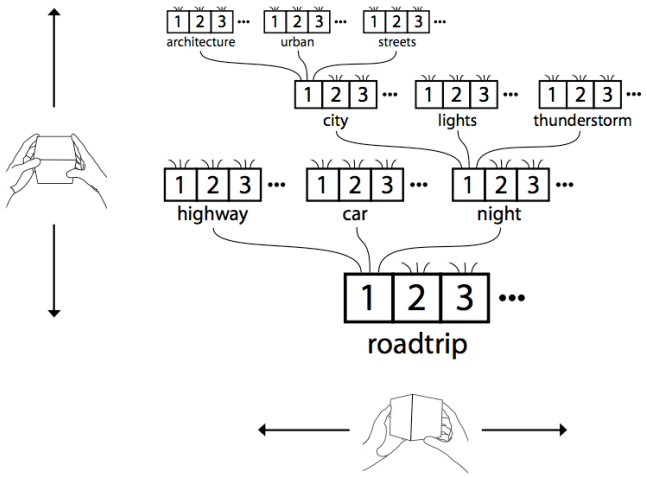

Figure 3: CubeBrowser maps a network of tags and images on a cube interface

A cube interface

One criterion for the CubeBrowser had been, that it should be possible to map the necessary actions for navigation in a large number of data structures onto it. An ubiquitous organization we find in Computer Science is the tree structure. As you can see in figure 3 the network of figure 2 is also representable as a tree. A two-dimensional structure needs four basic actions in order to be navigable: Moving to the next and the previous item along the axis of the current level as well as descending and ascending across the hierarchy.

This can be mapped to a cube quite easily, since each face has exactly four edges. By turning over one of these edges, two things will happen: On the one hand, you leave the side that you have faced so far, which will actively give you the impression of *leaving* something behind. And on the other hand, you are moving in a *direction* that will bring you to something new. Thus, turning a cube in space provides the necessary steps for tree navigation and gives a spatial notion to navigation.

All faces of a cube have the same square format, and from each side you can be sure, that after a turn you will come to another "place" that will have precisely the same shape. Furthermore, the square format is ideal for images, since it is the neutral middle between landscape and portrait format, which both are very common for photos.

The last feature of a cube is its edges: Their tactile impression tells you exactly about its orientation, even without looking. Without them, it would not be possible to separate discretely between the individual faces. The orientation of a ball for instance is hard to tell.

Control principle

The amount of "commands" that have to be learned is very small. The only things you have to do is turning, pushing and shaking the cube in order to navigate through the networks of tags and images. As you can see in figure 4 a result set for a given tag is loaded on the horizontal faces of the cube. There is always one side that is the closest to your calibrated position and therefore known as current face by the system. If you turn the cube left or right from that current face, you browse through all the images in the current result set, which will wrap and start over from the beginning, when you hit the end of it. For each image on the horizontal axis, you are given a proposal on the top face, which is the first image of another tag's result set. This other tag has been identified as related by the cluster algorithms of Flickr.

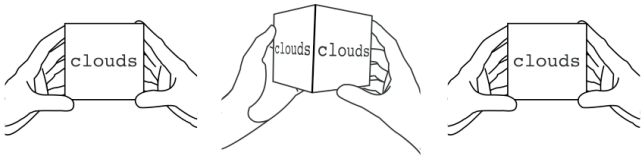

Figure 4: Horizontal turn: Navigate through images

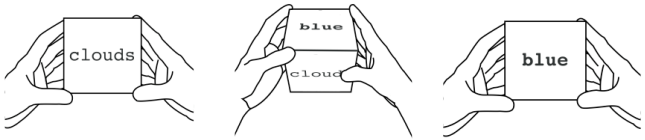

Figure 5: Vertical turn: Navigate through tags

As shown in figure 5 you can select this related tag by turning the cube upwards. From that moment on, the images on the horizontal axis are loaded from that new result set the same way as before in figure 4.

Furthermore, you can go back to all the images and tags you came from at any time, reconstructing the history of your actions, by simply turning the cube downwards again. The bottom face will present precisely the last image from which you came from.

Since the clustering algorithm of Flickr usually does not only provide a single related tag but several ones, the proposed tag on the upper face can be between all the other related tags by simply giving the cube a little push. In order to start over completely, you simply shake the cube heavily for about one second. This will reset the system and you start again with a tag that is randomly picked from flickr's list of popular tags.

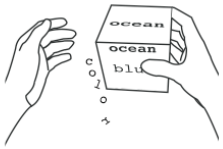

Figure 6: Little push: Switch between proposed tags

Key Findings

Tangible user interfaces are bound to physical objects, which are by far not as flexible and dynamic as purely digital system representations. Therefore, it proofed valuable to limit the purpose of this project to a single application. In doing so, form and function of the whole system can be adapted to fit perfectly in order to create an intuitive and inspiring user experience.

The initial concept had been made demoable already as a first 3D-simulated prototype with a wireless, physical control cube for tests and exhibitions such as the Yahoo! Design Expo 2007 [7] within as little as 6 weeks time. With both prototypes the users were deeply engaged in tactile contact with the flickr database. Numerous needs could be pointed out for further functionalities such as bookmarking and finger touch interactions with the images.

Conclusion

In this paper the motivation and working principle behind CubeBrowser has been presented shortly. This project realized a working prototype of a cable-independent cube interface that was designed for database exploration. Additional material and documentation as well as the GPL-ed software is available online at http://www.cubebrowser.de.

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