Diving into the Data Ocean

Dieter Meiller(✉)

Faculty of Electronic-Engineering, Media and Computer Science,
East Bavarian Technical University Amberg-Weiden, Amberg, Germany
d.meiller@oth-aw.de

Abstract. In this paper we present the concept for a novel user interface that simplifies the management of data and the search of information strongly: Instead of a reactive system, a proactive system is suggested. As a substitute of the desktop metaphor we propose to model data as active creatures that move inside the ecosystem computer: a Data Ocean. The concept can be used for different applications to manage objects with varying properties.

Keywords: Graphical user interface · Information visualization · Information retrieval · Internet of things

1 Background

The desktop metaphor nowadays is established as the dominant user interface for interaction with personal computers. Since its invention in the 1970s it is almost unchanged, the dominant metaphor for searching and managing data objects aka files. After Apple transferred the desktop invented by Xerox to Macintosh and Microsoft Windows was created as competing product afterwards, classical desktop has changed only marginally [1]. Other operating concepts were displaced or could not prevail. The pre-main interface with keyboard for text input on console was replaced by the WIMP-system with the mouse as primary input device. However, there have been some other interesting concepts, such as the Zoomable User Interface [2] or Life Streams [3]. Both systems do not have a folder structure for organizing data. There, structure results from spatial or temporal arrangement of objects.

2 Problem and Approach

Mobile devices increasingly replace traditional PCs and so the classic method of computer usage is put more and more into question; alternatives are wanted. Another pestering issue is the rapidly increasing number of data objects that must be managed by users. In previous systems, users usually had to search themselves and navigate to the location (folder) of a single data object. Therefore, search functions in modern operating systems are becoming increasingly popular. There, mechanisms are reversed: Files come, figuratively, to the users, when they initiate a search. So, the challenge is to find methods of file management, which satisfy new requirements and changed user behaviors. The presented approach is based on findings from different areas:

J. Abascal et al. (Eds.): INTERACT 2015, Part IV, LNCS 9299, pp. 465–468, 2015.
DOI: 10.1007/978-3-319-22723-8_39

Artificial Life (AL): Formal description of behavior and simulation of living beings is an interdisciplinary area of research. A sub-area deals with simulation and description of swarm behavior and its wider effects, the emergence [4].

Information Retrieval: This area deals with the search in databases. Of particular interest is fuzzy retrieval, which weights search results and found documents by relevance [5].

3 Concept

The concept presented here provides no folder structure to manage data objects, like in Zoomable User Interfaces. Each object does have characteristics by which it could be identified. Files with textual content can be identified by terms that are part of their full text. Other existing attributes such as creation date or date of last modification, file size, place of production or other metadata stored in the files could also be used for identification. In addition, there should be the opportunity to mark data objects with tags (keywords). Objects should be able to move in a space (Data Ocean, O). The dimensionality and structure of this space could preferably be a 2½-D space. That means, objects are located in a two-dimensional space in which can be zoomed in and out. It would also be possible to arrange objects in a 3D space. Objects should behave like creatures in a swarm, such as fishes or birds, for example. They should behave in accordance with the following rule: objects are heading towards others with similar properties. Other objects with common characteristics should attract them. The more is in common, the greater the attraction. The attraction of two objects $o_1, o_2 \in O$ should be a function $attr : P \rightarrow [0, 1]$. P is defined as: $P = O \times O | (o_1, o_1) \notin P, (o_1, o_2) \in P \Rightarrow (o_2, o_1) \notin P$. This strength of attraction depends on specific criteria C of an amount of $n = |C|$ criteria and the strength of accordance of objects with these criteria: $c_i^{o_1}, c_i^{o_2} \in [0, 1] (0 \leq i \leq n)$. In this way, the system is self-organizing itself in groups of related data. Since data do not fit into disjoint sets, groups will be interwoven. So, users can control this process, it is necessary that they can weight the criteria with a specific weight $w_i \in [0, 1]$ and determine which features lead to formations of groups. The strength of attraction of two objects in dependence of accordance with particular criteria then will be defined as follows:

$$attr((o_1, o_2)) = \frac{1}{n} \sum_{i=1}^{n} w_i (1 - |c_i^{o_1} - c_i^{o_2}|)$$

Agility and Vitality: Data objects should have a certain agility, which decreases with age. Old, slow objects could be removed from the space by being eaten up by certain other objects. These predator-objects should have a similar function like paper baskets from the desktop metaphor, but in a more active way. It is also conceivable that the user has the ability to open these predator-objects to restore deleted content. Users could be able to delete the objects finally by removing the predator-objects. Feeding data objects could increase their agility: users could feed them by viewing or editing them. Thus, unused files become obsolete and are removed automatically.

Search and User Actions: In traditional desktop systems, the user has to go towards the data objects by navigating through file trees. This principle is reversed here: Files will be attracted and come to the user. Files are lured by the prospect for food: the chance to be used or viewed. Attributes, which the desired files should have, can be scattered as "attractors". Specifying weights can change intensity of the attractors. Best matching files are most attracted to the attractors (Fig. 1). In addition, agile file objects, which are used more often, will be faster on target. Attractors could be temporarily spread for spontaneous search tasks or can serve as an anchor to organize data. Users could be able to look at this world from two perspectives: from the outside as observers, or from the inside, almost as a diver in the data ocean.

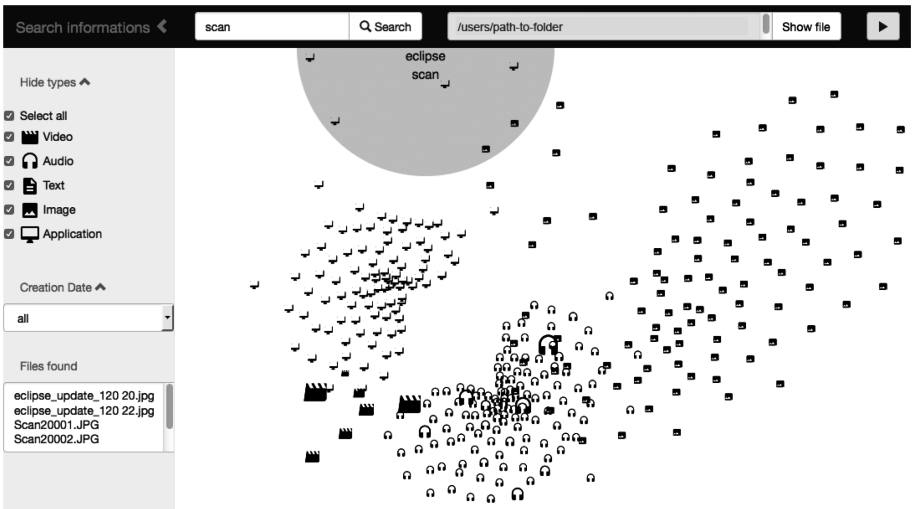

Fig. 1. Prototype of the concept

4 Implementation and Evaluation

The concept was implemented by a group of students. 26 participants of a subject "Information Visualization" had to solve the following task: They should implement the concept above. The prototypes should be able to visualize a part of the files of a file system. They should allow searching for files like mentioned. Teams with maximum three students released 13 different versions. These varying programs are useful for evaluating the capability of the concept. Furthermore, the best ways to implement the mentioned features could be identified. A screenshot of one of the best implementations is shown in Fig. 1 (Student: Johannes Wisneth). It has a web-based surface with responsive layout. The program allows filtering and finding all desired files in a specific folder very quickly. It provides a useful stop-button to freeze all movements. This helps to pick single objects.

5 Summary and Future Work

Due to the large amounts of data and the fact that many modern systems don't provide access to their file systems, users of today's devices are often no longer able to cope with them. Search functions are intuitive and fast, and so they are preferred for accessing files. Hence, a reversal of the usual concept would be suitable: In a modern system, users should not have to navigate towards the file, but the desired data should come to the user. This implies an active behavior of data objects. Therefore, a new metaphor as a replacement for the classic desktop is proposed: An ecosystem in which data behave like living things, which organizes themselves and can be lured by the user. The next step will be to find some practical applications for the concept.

We plan to realize interfaces for industrial applications. In modern production processes products are often highly customized. End users are increasingly able to configure individual products by their own. There must be a way to monitor and control these products. Our concept could be useful to control all kind of data, even real physical objects, which could be represented as data objects. The Internet of things and "Industry 4.0" are hot topics for industry [6] and the concept Data Ocean could be a building block to realize it.

Acknowledgements. We would like to acknowledge all participating students for their contribution.

References

1. Reimer, J.: A history of the GUI. http://arstechnica.com. Accessed 5 May 2005
2. Bederson, B.B.: The promise of zoomable user interfaces. Behav. Inf. Technol. **30**(6), 853–866 (2011)
3. Freeman, E.T.: The Lifestreams Software Architecture. Yale University, New Heaven (1997)
4. Mataric, M.J.: Designing emergent behaviors: from local interactions to collective intelligence. In: Proceedings of the Second International Conference on Simulation of Adaptive Behavior, pp. 432–441 (1993)
5. Cross, V.: Fuzzy information retrieval. J. Intell. Inf. Syst. **3**(1), 29–56 (1994)
6. Atzori, L., Iera, A., Morabito, G.: The internet of things: a survey. Comput. Netw. **54**(15), 2787–2805 (2010)