

The impact of context-aware fisheye models on understanding business processes: An empirical study of data flow diagrams

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Abstract

We investigated whether a “context-aware” fisheye view can more successfully communicate the information contained in a set of process models (data flow diagrams) than a traditional “context-free” presentation. We conducted two controlled experiments: the first included a simple set of DFDs and tasks that required a basic understanding of the system, while the second involved more detailed views of the same processes, and also a more complex task. Subjects who used the fisheye process models outperformed those using the traditional presentations. This difference was reflected in task performance for all subjects, and in task completion time for inexperienced subjects.

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1. Introduction

Business processes were defined by Davenport and Short [8] as “a set of logically related tasks performed to achieve a desired business outcome;” they are the building blocks of a business system. Once those processes are understood, they can be improved or radically redesigned in order to improve an organization’s productivity [18]. Thus representing processes by means of easily understandable models is essential.

The process models to represent complex systems can also become complex. In such cases, multiple

interrelated diagrams are often used [22]. Human capacity for simultaneously processing multiple pieces of information is limited [28,29]. Therefore, an effort to simultaneously explore all relevant business processes in detail would create a quantity of information that cannot be processed easily: an *information overload*.

To avoid this, process models are simplified into levels, depending on the degree of detail. For models representing nontrivial systems, there will be several levels, and the viewers of these diagrams must integrate context and details while switching back and forth between levels. Such integration is not easy and may cause disorientation with viewers feeling lost. System analysts are therefore faced with a dilemma: one option is the creation of a single comprehensive model, while the other is the creation of separate models representing different parts of the overall system, possibly causing confusion when switching between diagrams at

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different levels of detail. According to Kim et al., this effect complicates the cognitive processes in integrating these diagrams to understand the system as a whole.

This dilemma is not unique to process models. For example, while browsing hypertext, the user can become confused about the link structure between nodes and how one leads to another. This phenomenon has been called “lost in hyperspace” [6,31] and presentations of web sites that provide better integration of context and details have been shown to be more successful [5]. Similarly, Schafer et al. [33] found that context clues improved viewers’ performance when navigating and rerouting the links of a simulated telephone network. We suggest that process models would be more useful if they had “context-aware” features so that the diagrams were organized to integrate context and details smoothly. The fisheye view concept introduced by Furnas [10] seemed particularly promising. It has been applied to graphical presentations of hierarchies for groupware [16], hypertext [9], and search on the World Wide Web [41]. Turetken et al. [40] and Turetken and Schuff [39] proposed the use of fisheye views with systems analysis and design diagrams. Specifically, the data flow diagram (DFD) is a good process model for such a visualization technique because of its strong hierarchical structure and due to the fact that it is a classic tool for process analysis. Accordingly, our research question is:

Can the presentation of Data Flow Diagrams (DFDs) through fisheye views convey the business processes that they represent more successfully than the standard presentation of such diagrams?

2. Background

2.1. The role of context in understanding details

Gestalt theory can be used to explain visual cognition of a system. One applicable gestalt principle states that details have more meaning when presented within their context [42]. This theory has implications for IS. Gottschalk [13] states that a gestalt approach is essential in IS planning. We believe that, in addition to guiding the general approach to system development, the implications of gestalt theory are important in constructing diagrammatic representations (such as process models) since it has implications for information visualization [21]. Tan and Benbasat [37] examined two aspects. *Proximity* assumes that items closer together will be perceived as part of a group and therefore related while *continuity* is enforced through

lines connecting items. Those elements that are directly connected are understood to be more closely related than those that are not. Smelcer and Carmel [34] introduced similar concepts of adjacency and containment, where the first occurs when the entities are touching and the second when one entity is placed within another.

2.2. Fisheye views

According to Furnas, an efficient way of embedding a piece of information in its context is to represent the portions that are closer to the area of interest in more detail while including only a grouping of those further away. These “fisheye views” are created by using the concept of degree of interest (DOI): a function of the initial importance of a visual element and its distance from the current view. Thus the DOI decreases as the distance from the focus increases.

Using variants of this concept, fisheye views can be defined in a number of different structures [24]. Furnas demonstrated its use for tree structures and tree-structured text files. Sarkar and Brown [32] applied the fisheye view in browsing computer graphs. Bederson [4] developed *fisheye menus* as an alternative to the traditional hierarchical view and found that this technique was preferred by users for general browsing, but that hierarchical menus were preferred for goal-directed tasks. The FISPA system applied a variant of fisheye views to visualizations (zoomable treemaps) of clustered web search results. In controlled experiments, the fisheye zoom version of FISPA resulted in speed improvements over the list-based presentations and zoomable treemap without fisheye zooms.

Lamping and Rao [23] described an implementation for presenting a two-dimensional graph using a fisheye zoom. The hyperbolic browser provided a smoothly varying “focus plus context” view where the display space allocated to a node decreased continuously with the distance from the focus, yet did not disappear abruptly. Inxight[®]’s “Hyperbolic Tree” [19], as well as Sarkar and Brown’s work at Xerox Parc are well known and successfully commercialized applications of the fisheye view. Display of a specific node in the graph within the context of the other nodes is shown in Fig. 1. Fig. 2 shows the effect of carrying a node to the focus. The integration of details within context through such a distortion method proves to be a good way of looking at those details without losing the overall picture.

However, empirical studies of fisheye views do not always give evidence of their usability. Skopik and Gutwin [35] found that the degree of visual distortion in

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