

Architects of information: Designing Architectural metaphors

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Abstract. *Recently, the handling of information design by architects was motivated by the progress and exploration of digital technologies. They began to experiment with the use of informational metaphors and their application in virtual environments. This paper presents these new experimentations in 3D information visualization designed by architects interested in experimentation with digital media as information environments in design. The examples presented in this paper attempt to demonstrate the design of information and aim to illustrate approaches to the representation of the structure and relationships within abstract datasets. The architectural exploitation of metaphors may constitute unique formulations of knowledge structures capable of communicating information in unique ways.*

Keywords. *architectural metaphors, information visualization, data structure, information representation, visual metaphor.*

1. Introduction

In recent years, the development of faster information processing methods techniques has generated a large amount of data that needs to be processed. In an attempt to find a solution to the problem of information overload, an improvement in strategies for organizing and presenting information is required. A great challenge today is not necessarily to produce new knowledge, but to develop improved ways of working with and making sense of that knowledge we already count on. The processing of visual information is a way of representing and managing data. Architects have a close relationship with the use of information and its representation. We see this phenomenon in the daily activities of the architects. They are experts displaying information for understanding or communicating the data involved in their projects (Burkhard 2005). In addition, the ability of architects to communicate and present information can be seen in historical and contemporary examples of built structure. These architectures are the materialization of structures of information and lead to concrete space (Fersch 2004, Vande Moere 2005).

The purpose of this paper is to present and analyze new information representations made by architects for the digital space. We call these new visualizations generated by the experience of the architects: "digital architectural metaphors" and we analyze them using the Tufte's principles of Information Design. Thus, we show new alternatives to solve the problem of complex information through the knowledge of architects.

2. Architects and information visualization (IV)

This section presents an overview of the relations between architects and the use of representation of information for different purposes. We will see this relationship from two sources, the first in the daily activity of the architect, analyzing and representing information to understand the data involved in their projects and the second, in the use of information visualization as a generator of architectonic structures encoded with information.

Architects use IV as a representation and analysis tool. At different stages of the design process they have the skills to collect, analyze and display information to understand the data involved in their projects. Burkhard describes how architects employ different visual representation to transfer knowledge. He presents five main visualization types: Sketch, Diagram, Image, Object, and Interactive Visualization. (Burkhard 2004). Furthermore, we find advantages of

visual representation by architects. Many of these representations differ from traditional approaches in the careful attention on visual design, aesthetical quality, user engagement, and the exploration of novel visual and interaction metaphors (Vande Moere 2005). Thus, we have presented the need to explore and communicate information as one of the most common relations between architects and the use of IV.

The other relationship between architects and IV is seen in the use of visual information as a tool for generating architectural spaces. Historical and contemporary examples of built structures can prove architectural design towards the visual information (Fersch 2004). Some examples of information visualization in three dimensional physical environments are the Observatory of Jai Singh II in Jaipur (1730 ad) The Memory Theater by Giulio Camillo (1550 ad) and The Astral Memory of Giordano Bruno (1591 ad). In the case of Theater, standing on a stage, the visitor can survey seven different categories of knowledge situated in the auditorium and badged with allegoric images. In this sense Camillo's design is a prototype of information architecture.

Other examples of contemporary architecture that make use of the IV to generate their spaces are Moebius House by Van Berkel and Bos and the Dutch Pavilion at the World Expo 2000 by MVRDV. In the case of Moebius house, the study of the design information preceded and directed the generation of the form of the final project (Van Berkel 1999). The architects then exploited architectural design information structures, and transposed them as spatial structures to design visualizations of the project. On this issue, Vande Moere tells us in this paper: Form follows the data that "Analytical data can be literally translated into an architectural program and formality, perpetual shaping daily activities, or layering the essential features of a country as human-scale information visualization." (Vande Moere 2005). These historical and contemporary examples of built structures with encoded information demonstrate a new relationship between architectural design and the field of Information Visualization.

3. Designing architectural metaphors

In this section, we aim to present the development of new ways to organize and communicate information for different disciplines. These generated by architects whose knowledge about new digital technologies allowed them to arrive to the methods. We will call these representations "digital architectural metaphors of information".

The "digital architectural metaphor" in the virtual space comes to exist as a new means to develop in order to structure, content, and communicate information for better understanding. As any visual metaphor, the architectural metaphors try to exploit the unique human ability to organize objects in space, using spatial cognition and perception (Vande Moere 2005). Metaphors in the visual communication field are used to help users understand systems in conceptual terms they already know, by appealing to initial familiarity and experience.

In the following cases, architectural metaphors are designed by architects interested in experimentation with digital media. These architects see information as a raw material (e.g., like a brick) that allows to create spaces, structures, and possibilities for interaction in the digital space (Engeli, 2001, Schmitt, 1999). They apply their skills (e.g., to envision, structure, and think in concepts) to create novel representations, which allow navigation within information or information to be visualized in new ways (Burkhard, 2004).

Besides presenting the examples in this section, we examine in each of them, new ways to represent the principles of Tufte, a major referent in the field of Information Design and Information Visualization. He is the author of several books about data presentation and information graphics (Tufte 1983,1990,1997,2006). Consequently, we relate the architectural metaphors designed by architects with the principles of Tufte.

Architectural Metaphor for Finance: Virtual New York Stock Exchange

The first example of architectural metaphor is the 3D trade floor visualization (3DFTV) by Asymptote Architecture (1999). The original project created an information space whereupon an abstract representation of the trading floors of the New York Stock Exchange. It was mapped with real time data streams, stock tickers, real-time CNN, three dimensional index charts, and a complex system to oversee technical and business alerts (Delaney, 1999). This example of architectural metaphor was among the first projects that applied the skills of architects to create an appealing and original interactive visualization.

Today, you can navigate through a simplified model of Virtual NYSE on the Internet [<http://marketrac.nyse.com/>]. This model is accompanied by tables, texts and graphics (Fig.1). Wherefore, we see relation between the metaphorical architecture and one of Tufte's principles, the principle of "Completely integrated words, numbers, images, and diagrams". This combination of multiple visualizations helps the understanding and communication of data from the stock market.

Architectural Metaphor for Statistics

Another example of architectural metaphor is the project designed by the architectural studio MVRDV. This project, called Metacity / Datatown use statistic data of Netherlands. Datatown is a city described as 3D visual information through extrapolation of statistics data (Fig.2). The statistics are used to generate the basis of the new town like a Piet Mondrian's paint. In this way, the basis generated different areas (e.g. living, industry, agriculture, water, and others) that will serve as sectors for different scenarios. Datatown is based upon a series of assumptions. Each sector exists in several variations. They are constructed on a series of what-ifs that embody different conditions. In each of the areas, architects representing different alternatives for the same data. For example, in Living Area for a reserved area of 8206.89 km³, architects represent various 3D models as if they all lived within one massive volume, as if they all lived in free-standing houses on plots, as if they all lived in Barcelona-blocks; and others (Bolt 1999).

In this example of architectural metaphor, the most representative

Tufte's principle is "Show comparisons". Datatown allows users not only to compare data in different sectors, but also view and analyze each sector with different alternatives for the same data. Thus, the accessibility of statistical information using architectural metaphor makes it a useful instrument for extrapolation into three-dimensional visual representation for design study.

Architectural Metaphor for Anesthetists

The next example of architectural metaphor represents physiological data for anesthesiologists. Jim Agutter and Julio Bermudez are the architects who designed this novel representation. They are part of the group Inter-disciplinary Center for the Representation of Multi-Dimensional Information (CROMDI) dedicated to the creation of new visualizations. This group studied that clinicians must observe and integrate information generated by independent sensors to observe significant changes. In order to address this matter, the architects designed two dynamic visual metaphors in a 3D environment. This representation seeks to reduce recognition time for detecting, diagnosing and treating anesthesia-related critical events (Agutter 2000-2005). This display is comprised of two dynamic metaphors. The first one is a red sphere with incorporated cardiac representing variables and the second one is a light green background standing for respiratory variables (Fig.3). Each of the attributes of metaphors (e.g., dimensions, color, saturation, opacity, location,) represents the respiratory or cardiac variables. (e.g., Stroke Volume, Cardiac Output, and Heart Rate)(Bermudez 2005).

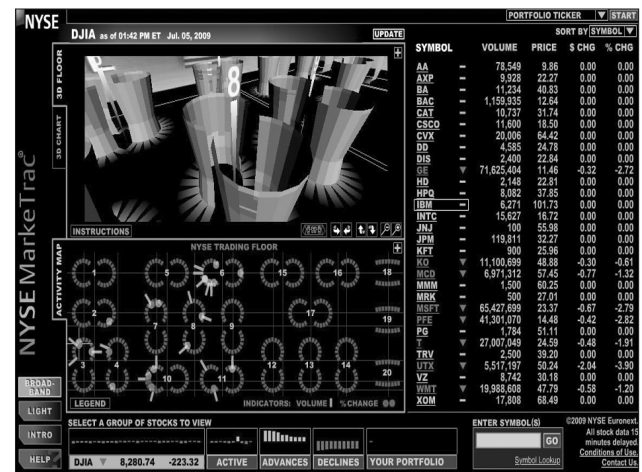


Figure 1. NYSE Marke Trac.



Figure 2. Metacity/Datatown by MVRDV.

In this case, we present the use of dynamic metaphorical architecture not only as a solution to the representation of different variables changing in real time but also as a translation and understanding between numerical parameters and images or shapes. Thus, we see that the use of architectural metaphor, as a solution to the principle of "Show multivariate data".

Architectural Metaphor for Music

Another example of architectural metaphors involves the creation of virtual spaces through the materialization of music. This materialization uses music as its "genetic information", the virtual space as its medium, and the execution time of the musical piece as the fourth dimension of a three-dimensional virtual space (Levy 2004). Within this space, the execution of each instrument is represented by a 3D metaphor. The attributes of the metaphor are modified by the musical information, thus generating a dynamic or "living" metaphor (Fig.4). This new representation of music composed of different metaphors shows the Tufte's principle "Layer and Separation". Thus, we can either see each metaphor or instrument individually or appreciate the whole.

A new interpretation of the principle of Tufte "Narrative Graphics of Space and Time" is present in this case. The changes that generate the music information to the metaphors in the virtual space are recorded by several cameras along the length of each song. The use of different cameras serves the designer to narrate and report the transformations of "living" metaphors in space and time. So this visualization is presented as an animation and the architect is proposing a sort of "video clip" of what happens in the virtual environment.

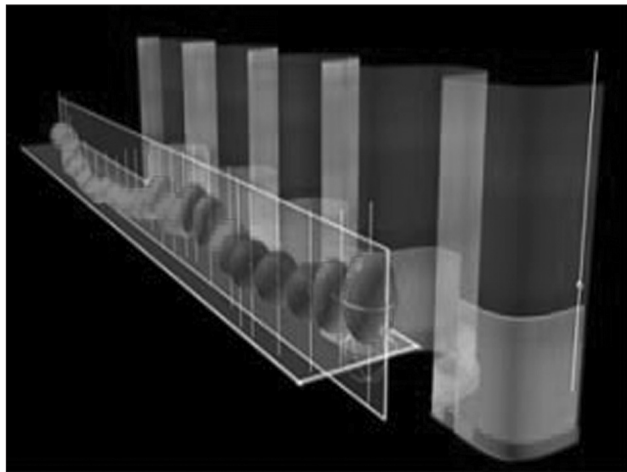


Figure 3. Architectural Metaphor for Anesthetists by CROMDI

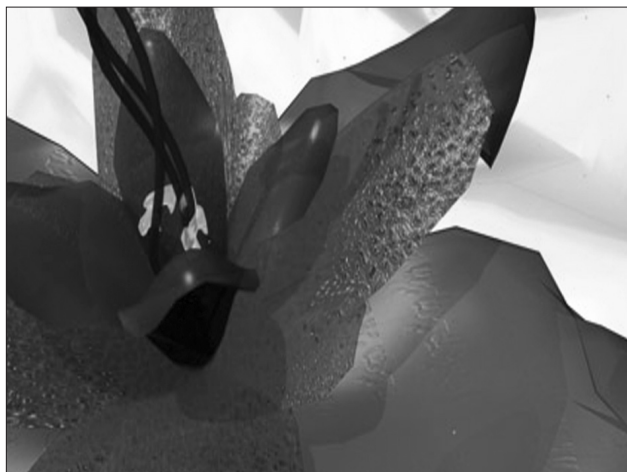


Figure 4. Architectural Metaphor for Music by Levy

4. Summary

This paper presented architects who are becoming experts in interpreting the collection of abstract datasets and are developing suitable data representation metaphors that create ambient, spatial and uninhabitable experiences. We have shown the capacity of architects to represent information using different case studies. The new cases in IV are also an example to show the differences between architects and programmers. The architects, instead of focusing on efficiency and task algorithmic architectural design optimization, use their knowledge and experience to design spatial visualization.

We presented the "digital architectural metaphors" as a new way to visualize complex information in 3D virtual environments. These new designs represent the structure of and the abstract relationships within datasets of information and employ them in various methods of real and virtual design. We have seen that these architectural metaphors have at least the following characteristics: architectural representations of data that can be dynamic and interactive; existing in real or virtual space, in some cases employed to help users understand systems in conceptual terms and in other cases exploited data structures to organize objects in space. To conclude, we see a growing number of architects becoming potential generators of new representations of information.

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