Sequential Art in Real-Time 3D Applications

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Abstract. A huge amount of data is produced continually in areas of application like entertainment, industry, and science. Contemporary technologies and three-dimensional computer graphics are qualified to process and to visualize this data. However, users are more and more faced with a flood of information, unable to efficiently process the information provided by three-dimensional computer graphics. Facing that problem, arrangement systems like typographic grids serve as an auxiliary layer to organize and arrange information units on a two-dimensional canvas. Due to the continually changing of interactive 3D scenes, there is no fixed order or priority of the visualized data in a projected image. Yet, in analogy to comic strips or comic books, frames that are organized in a grid can augment information visualizations. This contribution presents an approach to structure interactive 3D visualizations with the help of panels, whereby the user can recognize essential information in a given scene.

Keywords: HCI, real-time computer graphics, narrative structuring.

1 Introduction

The progress made in hardware technology allows today's computer systems to store and process very large amounts of data. Simultaneously, exploring and analyzing the vast quantity of data becomes increasingly difficult. For this purpose, information visualization and visual data mining help to deal with the flood of information. The advantage of visual data exploration is that the user is directly involved in the data mining process [5]. As a result, the availability of 3D visualization and interaction techniques is continuously growing. The widespread usage of interactive 3D graphics consequently results in a variety of systems. In standard 3D-applications, the user is enabled to change the parameters of a visualization by for instance adjusting the camera and can perform interactive operations in the presented views [1]. Due to this interactivity, the structure of the visualized content changes continuously and can hamper the visual data mining process [7]. A user-centered and task-dependent human-computer-interaction in interactive 3D-applications can be facilitated by providing an armature on which the content can be organized [3]. This can be reached by structuring the visualized information in an arrangement intended to convey information that is independent from the camera position and orientation.

Arrangement systems serve in comic strips and comic books as an auxiliary layer to organize and arrange information units on a two-dimensional canvas. Comparable

arrangement systems are able to serve as a reference grid in space and thus structure three-dimensional content in visualizations. This contribution discusses the capability of two-dimensional panels as a reference grid in three-dimensional real-time applications. In analogy to comic strips or comic books, individual frames or multiple panels augment information visualizations by the implementation of concepts of sequential art in interface design of interactive real-time applications.

2   The Sequential Art – Comic

Our consideration is focused on providing interfaces that assist the user in perceiving spatial information as effectively and efficiently as possible [4]. We propose that design principles of comics are beneficial in enhancing interfaces as an efficient communication tool. Primarily, comics have a great capacity as a communication medium of images [2]. In spite of that, a precise definition of the medium in all its diversity is difficult. In [2] comics are described as sequential art. The crucial attribute of sequential art – the grid – is used to arrange pictures. The panel as the basic part of a comic is an individual frame and a single drawing within a grid. Each panel contains a picture that depicts a point in time within the story and is confined by using a grid as shown in Fig. 1. The whole story of a comic is narrated by the content and the sequence of pictures that constitutes a comic strip [8]. The grid delimits the images from each other and determines the order of the visual attention – the reading direction – of the observer. Therefore, it is important that obvious and intuitive arrangements of the panels guide the visual attention of the viewer subconsciously.
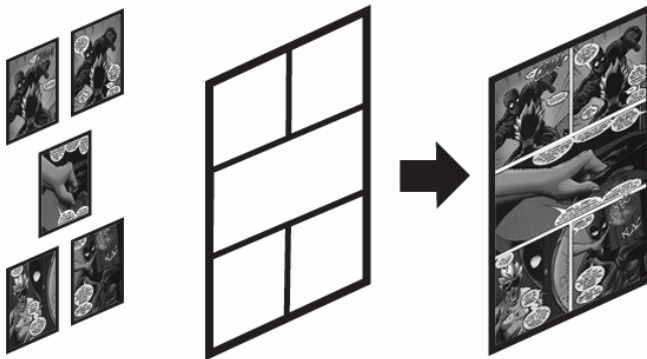

Fig. 1. Individual images, framed by panels are arranged by a grid and result in a comic strip (scenes from [6])

3   Structuring of Images

Comics enable an efficient perception of information with the aid of useful-structured content. Our aim is to adopt design principles of comics for computer generated

images. By structuring the visualized objects of a virtual three-dimensional scene with the help of panels, a viewer can recognize essential information in a given context. Moreover, establishing a narrative structure by using panels allows guiding the attention of the observer. Prioritized objects of three-dimensional scenes are tagged appropriately to be detected faster. To this end, the properties of comics and its structure which lead to an intuitive understanding were analyzed. Especially the reading direction of panels in comics were considered. Yet, comics are read according to the reading direction in books, which cannot be directly applied to real-time computer generated images. The visual attention of users while observing pictures shift depending on characteristics shown in the image. Hence, the rules of sequential art are adopted and modified to visualize narrative structures of computer graphics images (Fig. 2):

- **Avoid Gaps**: Gaps in the horizontal adjustment have to be avoided. Straight lines navigate the attention intuitively and the natural reading direction is supported.
- **Intelligible Reading Direction**: A single panel can be subdivided vertically. Indeed, it is important to avoid ambiguous adjustments of panels to avoid ambiguity in the navigation. Subdivisions have to be carried out on the right side of the original panel only and should be maintained until the end of the line.
- **Depth by Overlap**: If the position of prioritized panels acts contrary to the reading direction, the grid is divided and a new level is generated. The grid receives a new dimension with the result of depth and therefore the metaphor of stacked comic pages. By a spatial arrangement of panels, the viewer reads the grid like pages of a book.
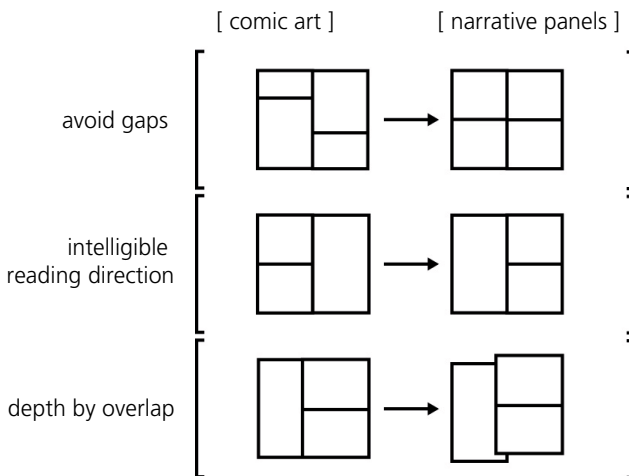

Fig. 2. Design principles to rasterize panels in (real-time) computer generated images

Henceforth, identified design principles of comics are transferred from comic books to narrative panels in computer graphics images. Building up on this design principles, arrangement systems can be generated to structure three-dimensional content

in visualizations. The absence of a fixed 'reading direction' due to the interactive character of 3D-applications is counteracted by a priority-sustaining grid. The information value of the scene is clarified by panels and enhanced by defining a narrative structure of the projected scene. More precisely, the observer is supported in identifying relevant or prioritized information and its context, whereby the visual attention of the viewer in interactive computer generated images is guided.

4 Panels in Real-Time Applications

The implementation of the presented approach requires interactive computer systems. To this end, an application was implemented to realize the concept on the one hand and to verify the applicability of the interactive panels approach on the other hand [9]. Comparable with other 3D graphic applications, the interactive three-dimensional environment enable the user to navigate within virtual worlds and manipulate contained objects in real-time. The panels are created by framing the bounding box of the visualized three-dimensional objects or parts of the scene. Furthermore, the user assesses them by defining an order to serve as a reference grid in space. The panels are computed based on the rules of narrative panels as described in the last section. If the arrangement of the panels varies by changes in the virtual scene, the panels will be recalculated automatically. Therefore, a basic arrangement of the narrative panels as a reference grid is achieved. Fig. 3 shows the implementation of interactive panels in our real-time application. Crucial elements in this information visualization are accentuated with regard to the context, for example important elements of the molecule (Fig. 3).
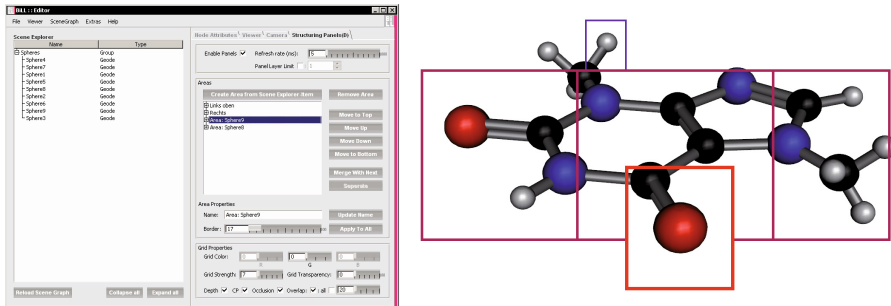

Fig. 3. The interface of the interactive 3D application visualizing a theobromine molecule structured by panels and an editor window for the panel management

5 Discussion and Future Work

This paper presents a novel approach to enhance visualizations of datasets. Panels act as a regulative approach to structure information in real-time applications. In spite of some elements of the scene being covered by frames, relevant information becomes accentuated. Additionally, a prioritization of the visualized objects is achieved, even

though the objects are not centered in the image. Obviously, implementation of panels in real-time applications is an ongoing research topic.

With the foundation of narrative panels, different approaches for a more interactive use of panels can be developed. Multi-touch offers new styles of interaction and is therefore a technology with a great potential to enhance human computer interaction in combination with panels. For instance, the user groups objects in panels, presenting individual details of the framed part of the scene. Furthermore, panels as an interactive element are used to rearrange the scene context or to realize multi-views. Visualizations using panels with different perspectives on a dataset offer a better perception of details in context.

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