The IGD-HEyeWall for Visual Analytics - Concepts and Applications

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Abstract

In this short paper, we introduce the large scale display (HeyeWall® [1]) implemented at Fraunhofer Institute for Computer Graphics Research IGD in Darmstadt, Germany. We briefly outline its technical specifications, and discuss concepts for interaction as well as several applications currently under development at IGD.

1. Technical Specification

We briefly outline technical specifications of our system, and the interaction technology we employ.

1.1. Technical Description

The Virtual and Augmented Reality department of Fraunhofer IGD, together with the I.S.I. Company, developed this projection system in 2003. It offers a visual resolution higher than the resolution of the eye. Each tile of the HEyeWall® consists of two standard projectors and two commercially available PCs.

The system display is 5 meter wide. 48 projectors and 48 PCs in a six by four tile array achieve a resolution of 18 mega pixels (6144x3072 pixels). The projectors are arranged together in a steel construction one meter behind the screen (cf. Figure 1 left). The modular system can be scaled arbitrarily. A wide range of sizes and configurations is consequently possible. One major development carried out by IGD is the software solution for color calibration and color matching of the projectors. For 2008, a major upgrade is planned: The improved system will provide more than 35 mega pixels in total, and offer doubled brightness of the combined image.

Together with exact geometric adjustment, all tiles make up a single, seamless image. An OpenSG based software system allows for the synchronization of the PC cluster in real-time, thus all projectors show the correct part and content of the image. With this technology, customers are able to visualize their projects, sketches, and processes in real-time on the HEyeWall®.

1.2. Interaction

The HEyeWall® is not limited to a single interaction device or technique, but provides a number of indirect 2D and 3D interaction methods. Ranging from classic mouse and laser-pointer for 2D content, up to space mouse, Wii-mote, electromagnetic tracker and an multi-touch-table [5] in front of the wall for 3D stereo applications. The improved version will provide a multi-touch surface which will enable the user to interact with 2D content directly on the wall.

2. Applications

The IGD HEyeWall® is used in several different application areas, including photorealistic rendering as well as abstract visualization of complex data sets.

Any industry which has applications based on complex data or objects and needs to display them in a high resolution can successfully use the HEyeWall®. Various possible fields of application areas emerge: From efficient product development, to the simulation of heavy flow of traffic, the visualization of highly structured 3D areas, and city models for planning of rescue operations. Geologists can, for example, carry out exact drilling plans for oil and gas deposits with the help of the display.

Fig 1: IGD HeyeWall® [1] consisting of a 6x4 array of stereo-projectors (left). Photorealistic interactive rendering on HEyeWall® for industrial design and production, e.g., for the automotive (middle) and garment (right) industries.

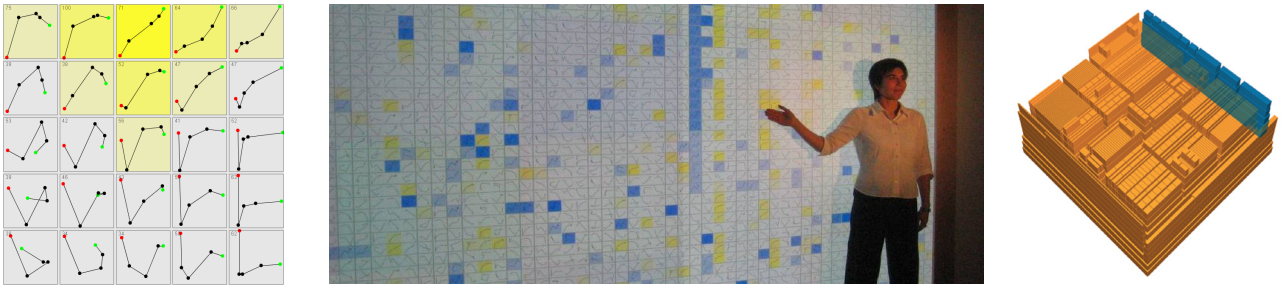

Fig. 2: Information Visualization applications on HEyeWall® under development in Darmstadt. The large-scale display allows the effective visual correlation analysis in large trajectory-databases [2] (left and middle images). Future work will explore the stereoscopic capabilities for 3D information visualization applications, like e.g., application of the Ghostview Technique to 3D TreeMaps [3] (right), for effective visual analysis of hierarchically structured data.

For data mining, HeyeWall® opens up completely new ways of presentation of complex information. It is also useful for experts, who can in great detail elaborate effective security measures in companies, public areas, or for the monitoring of flights.

2.1. Photorealistic Rendering Applications

Design review is one the main applications which helps the automotive industries to optimize various steps in the early design process stages. Especially the real-time visualization of varnish and detailed internals lit surfaces demand high quality photorealistic rendering methods. The HEyeWall® provides the resolution and CPU/GPU power to support this techniques to produce unique results in this area (cf. Figure 1 middle).

In the G*arment design industry,* as well, there is a need for photorealistic, interactive rendering of the visual appearance of clothing in the designer process allowing for virtual prototyping of garments. At IGD, a system for real-time interactive simulation of garment fit, considering complex interaction between garment and body tissue has been developed. Together with the 3D stereoscopic visualization capabilities of the HeyeWall®, the system allows visual analysis of the garments in real life size, supporting the evaluation of the fit of the patterns, and the simultaneous comparison of different candidate cuts on one screen (cf. Figure 1 right).

2.2. Visual Analytics Applications

We currently develop visualization support for visual analysis of large *financial data sets*. In these data, the analyst often searches for correlations and recurring patterns in sequences of e.g., trading price data. In previous work, we developed a visualization system to reduce large financial data sets to a small number of cluster prototypes [2]. Still, the number of patterns the user would like to consider for correlation analysis is too large for visualization on a standard display. Therefore, we took the visualization to the HeyeWall®, providing an effective way to visually analyze for correlations also in such in large data sets (cf. Figure 2 left and middle).

The second Visual Analytics application we consider is *network analysis*. For example, in a modern economy, large structures of cross-corporation, cross-border shareholder relationships exist, which can be effectively analyzed using network visualization tools [4]. However, it is very difficult to present the large networks (hundreds of thousands of nodes) on a standard screen even using modern layout algorithms. Visualization of such networks on large displays helps to reduce the difficulties.

As a third line of Visual Analytics applications, we plan to consider 3D Information Visualization techniques. Often, such techniques suffer from user acceptance owing to 2D screens and large amounts of data displayed on small desktop screens. Therefore, we see many advantages of 3D stereoscopic views on large displays, as offered by our system. Possible applications are Visual Analysis of large molecules and enzyme reaction data, applications on geo-referenced data, or 3D TreeMaps for hierarchically structured data (cf. Figure 2 right).

3. Conclusions

The IGD HEyeWall® offers advanced possibilities for real-time photorealistic rendering and Visual Analytics applications. We sketched several applications in both areas. Many more applications are possible. Further discussion and research on the subject of large-scale displays, interaction, applications and future trends is an ongoing topic at Fraunhofer IGD.

4. References

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