ICWall or the Collaborative Blackboard

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Due to the rapid developments in computer graphics, which outperform similar development in processor architecture by a factor 2-3, all kinds of visualization techniques are playing an increasingly important role in education and research. Based on technical qualifications, one can subdivide the available hardware in four categories: immersive environments, augmented realities, standard monitor displays, and scalable displays using off-the-shelf components. The key characteristics to choose a tiled display are among:

- Scalability: The size of the display is determined by the number of projectors used. A small setup (around 8 projectors) can easily be used for medium-sized groups ($\approx$ 30+ persons).
- Standard components: The setup can be realized using commodity (off-the-shelf) components. This reduces the price substantially.
- Resolution: The resolution of the screen is the sum of the resolution of the individual projectors.
- Size: The large format allows a wide variety of different applications. An advantage is the saturation of field of view and the possibility for simultaneous projection of different types of information.

The techniques used determine to a large extent the number of people that can observe it and the type of interaction. Especially in an educational setting, this is a key factor. All these characteristics make a video wall in principal more apt to be used in educational environments than for instance a CAVE or a standard projector. Within the academia, there is a growing interest for the development and use of scalable displays as a complementary technique to CAVE systems.

The project *ICWall* focuses on visualization and scalable projection technologies in a collaborative environment. It aims at three points: first, the development of a so called tiled display [2] in a lecture room, second the development of a software environment for

Figure 1. Overview of the classroom

the use of the tiled display for 3D graphics and audio/video conference, and last the development of a number of case studies within Physics and Bio-medical sciences cursus. The main issues are both the technical and didactic aspects of hardware and software developed. Interaction and collaboration greatly determine the success of the project: interaction between the lecturer and the display, interaction with the students or the audience, local collaboration between the lecture room and our AccessGrid [1] node, and collaboration with remote sites (project between Amsterdam and Twente universities in The Netherlands).

Our project takes into account three aspects. The current trend in hardware for parallel graphics is to use clusters of off-the-shelf PCs instead of high-end super computers. This trend has emerged since the dramatic change in the price/performance ratio of todays PCs. Using large, high-resolution displays is another trend that is currently emerging. High resolution allows for detailed scientific visualization, and overcomes the limited screen resolution of standard monitors. Large displays also have applications in teaching environments, where multiple people (from small groups to full

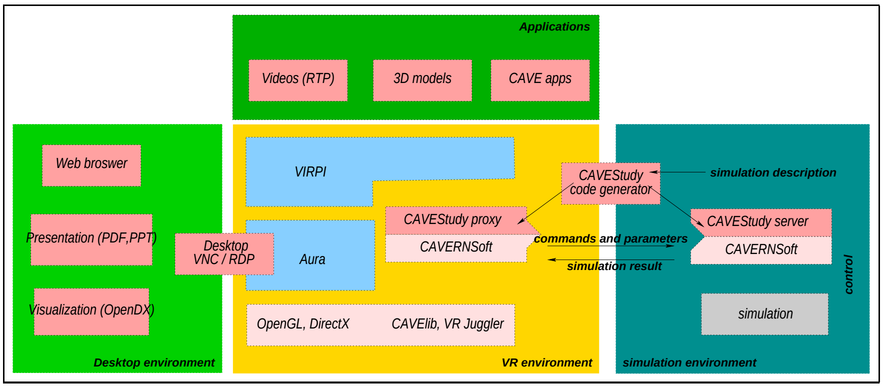

Figure 2. Software Architecture

classroom) are looking at a single large screen. Last, group-to-group collaboration becomes widespread using the AccessGrid technologies, based on commodity software and hardware components and on the increase of network bandwidth.

The global view for the room of the tiled display is given in Figure 1. The approach is that the room should be as multifunctional as possible. In the current design, several components are present, such as the large projection screen, a plasma panel with touch screen (Smarboard), and wireless network. The lecturer uses the touch screen as interface for control and interaction of the tiled display. The room is capable of seating around 40 people for a projection area of roughly 5.0 by 2.5 meters. Sliding walls make a reorganization of the room possible. Also, we plan to use the room too as an AccessGrid node (dedicated applications are under development).

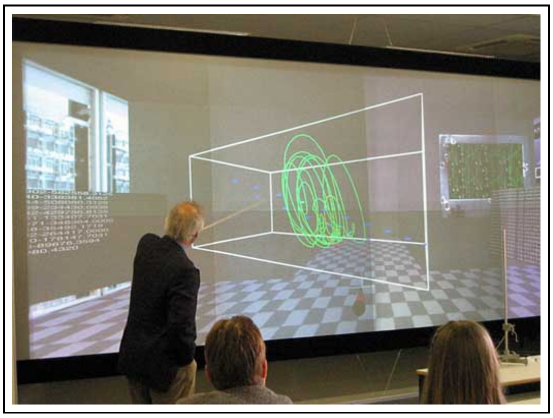

Figure 3. Computational Steering Application

We opt for a construction in which the projectors are placed in standard engineering frame, in a back-projection fashion. This solution is cost effective, and can also host the PCs. For the projector alignment, the mechanical workshops of the Vrije Universiteit developed mounting plates. The whole setup is controllable using a web browser over the wireless network. Our infrastructure is made of a 9-PC cluster (8 rendering nodes and a server) interconnected with both traditional network and high-speed network.

The software development is based on the Aura API as shown is Figure 2. Aura is conceived as a portable 3D graphics retained-mode layer for scientific visualization in virtual reality [3]. A parallel implementation has been developed to run on a cluster which to drive the tiled display. It is currently being extended to support the AccessGrid tools and desktop applications (left of Figure 2). It also enables tailor-made visualization and steering applications (top and right of Figure2). Several case-study applications have been already implemented, among them application for Motion Sciences Dept. showing the walking cycle of patients, an interactive probe of electric field in molecule for Chemistry Dept, a viewer for very large images for Geology Dept, and a steerable laser simulation for the Physics Dept. (Figure 3).

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