Visorama: A Complete Virtual Panorama System

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1. Introduction

Among the first image-based rendering systems available were the virtual panorama systems. In a panorama, the user can look freely around a point in the virtual environment but cannot move continuously. Several such systems are currently available which differ in a number of ways, but they all have a few common limitations. Among these, they do not provide a natural and immersive interaction with the panorama-based virtual environment. We present the Visorama System, which uses new software and hardware components to enable an immersive interaction with panoramas. In addition, it has a set of authoring tools that allow the creation of panoramas and the specification of the environment's multimedia structure. This is the first complete system that provides all these components.

2. Immersive panoramas

Most existing systems fail to provide an immersive interaction with panoramas because the viewing direction is not correlated to the user's head motion, but is manipulated using the mouse. Several devices have been developed which could be used to solve these problems, such as head mounted displays or the BOOM [1]. These devices, however, are not appropriate for panorama-based environments because they provide more degrees of freedom than the panorama system. As a result, there might be a loss of synchronization between the user's visual and physical senses, which will lead to loss of immersibility and possibly to motion sickness. To avoid these problems, a visualization device to be used with panoramas must only have two degrees of freedom, for changing the viewing direction, which match those in the panorama system. This type of limited interaction has several advantages: the navigation paths can be

easily specified during authoring, 2D multimedia data can be realistically integrated into the environment and no 3D information is needed for collision detection, which is important in image-based environments. This is a typical case where “less is more”, by limiting the user’s navigation freedom it’s easier to create environments with more complex behaviors.

3. The Visorama Hardware Device

As part of the Visorama System, we developed a hardware device that solves the problems mentioned above. Figure 1 illustrates an artistic rendering of the Visorama observation device and Figure 3 shows the first prototype. The device uses a binocular display by N-Vision Inc. to show the image generated by the panorama system. This display is attached to a support base that can rotate around vertical and horizontal axis, which have high-resolution sensors (5000 positions) that together capture the current viewing orientation. In addition, three buttons allow the control of zoom angle and the generation of discrete events. The sensors and buttons are sampled at 60 HZ and their values are sent to the multimedia platform, where the output image is generated by the system’s software accordingly. This form of direct manipulation of the viewing parameters provides a natural interface for virtual panoramas, as can be seen in Figure 2.

4. The Visorama Software

The image generation software for immersive devices have requirements that are not satisfied by the existing virtual panorama systems. In particular, it must guarantee that there will never be any flickering or any latency between user actions and their visual feedback, which would result in a loss of immersibility. To satisfy this requirement we developed a virtual panorama viewing engine, that is compatible with OpenGL, and uses hardware-implemented texture mapping to warp the panoramic image for visualization. As the amount of texture memory is usually not sufficient for a scene represented by panoramas with multiple levels of

detail (we use a FireGL 4000 card with 16MB of texture memory), we designed an algorithm to limit the amount of data loaded into this memory per frame, avoiding latency. The image is broken into small tiles (e.g. 64x64) and the algorithm maintains an ordering of the estimated probability of each tile being visualized. The ones with higher probability are loaded into texture memory, one per frame, so that when tiles are needed for visualization they are already loaded.

5. Authoring and Applications

Besides the visualization components, we are also developing a new set of authoring tools specific for panorama-based virtual environments that allow the multimedia structure of the virtual environment to be specified using an event-based authoring language. Events are generated as the user navigates through the environment, rotating and zooming with the virtual camera. These operations determine which areas of the panorama were visualized and at which level of detail. This way, events can be specified such that the next multimedia data to be presented depends on the user's manifested interests. Applications like narrated virtual guided tours of urban landmarks (Figure 2) can gain a lot from these capabilities, since the system can progressively provide more detailed information as the user naturally shows more interest on certain areas. Other applications of the Visorama System include interactive story telling in theme parks, virtual visits to real-estate sites, history education, among others.

The Visorama Project has a web page where more information about the system is available[2].

References

[1] Binocular Omni-Orientation Monitor (BOOM). http://www.fakespace.com/product.html

[2] The Visorama Project. http://www.visgraf.impa.br/visorama/s98.

Figure 1. An artistic rendering of the Visorama observation device.

Figure 2. The Visorama prototype installed in a tourist site. The user is looking at a panorama created from the same location and edited to show the surroundings at different times in history.

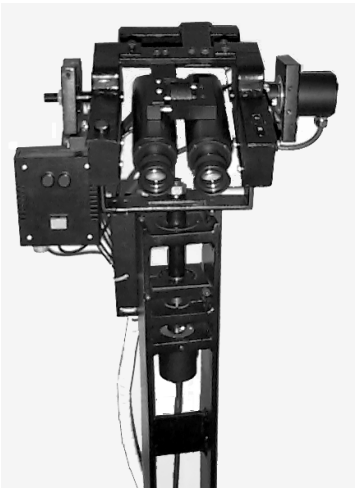

Figure 3. The first prototype of the Visorama observation device.