

3D Display Technique of Web3D Images Using Screen Pixel Access

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Abstract

In this paper we present a new technique for displaying Web3D images furthering the reality found on personal computer screens. Recently various Web3D systems, with which the 3D objects being displayed in a WWW browser can be rotated in arbitrary directions by manipulating a pointing device such as a mouse, are being widely used. Although the information on the shape of 3D objects is included in the Web3D data, a stereoscopic view of objects has not been possible because the Web3D viewer programs currently available do not support this function. Therefore, we propose a technique in which users can observe Web3D objects with binocular parallax by using "screen pixel access," which is the technology of using memory, corresponding to the screen of a personal computer, as an interface between different application programs. To evaluate the feasibility of the proposed method, a prototype was developed using a personal computer with a parallax barrier LCD. It was confirmed by experiments using Viewpoint™, a typical Web3D system, that a user can operate the displayed 3D objects interactively with little delay. Excellent binocular vision is possible, irrespective of whether the object is moving..

Introduction

Web3D is a technology in which a user can see high quality images of 3D objects on a WWW browser. A user can change the object's direction, so that they can see the object from a desired angle, by manipulating a mouse on the displayed object. In Web3D the 3D scene data of the object, which was made by computer graphics technology, is sent from the server to the client via the Internet. No special server is necessary, as even a common HTTP server can be used on the sender's side.

The load to the network is small, because rendering is performed at the client. Web3D is a rich media representative, and since it can be easily treated, its image quality is excellent and the contents are interactive. At present, the main usage of Web3D is the inspection of commodities.

Web3D can be considered a successor of Virtual Reality Modeling Language (VRML), which is an ISO international standard, but it is not a single technology but a generic name of several technologies proposed by different companies.

A variety of 3D display methods have already been proposed [1], and personal computers with a parallax-barrier-based 3D display have already been marketed. Even in Web3D, higher reality is obtained by a kind of motion parallax. However, the strength of the reality is not stronger than that by a binocular parallax.

Therefore, it is obviously desirable to combine the two systems just described to display Web3D images on the 3D display of a personal computer. However, remodeling of an existing commercialized Web3D viewer is very difficult for some reasons. That is why we developed a new technique, in which the video memory is used as an interface between tasks that are concurrently executed on the same computer. Namely, our program reads the image data that was drawn by the viewer pixel by pixel. The data is then rearranged according to the arrangement rule of pixels, and drawn on a different area of the same screen.

We propose a 3D display technique for Web3D images and describe a prototype system that uses a parallax-barrier-based 3D display and Viewpoint™ technology as the Web3D system.

Proposed System

Figure 1 shows the principle of a parallax barrier system. Only the left eye pixels can be seen from the left eye, and only the right eye pixels can be seen from the right eye, so that the user experiences binocular parallax. With this method, right eye and left eye images are necessary.

If modification of existing Web3D viewer programs is allowed, the relatively simple solution shown in Fig. 2 would be possible for improvement of systems. With this solution the Web3D viewer is remodeled so that it can produce a synthesized image from a left eye image and a right eye image. However, this approach is basically unrealistic because it requires an enormous development cost.

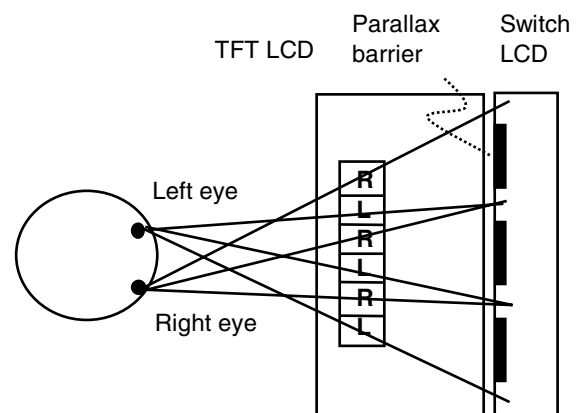


Figure 1. Principle of 3D display system using parallax barrier.

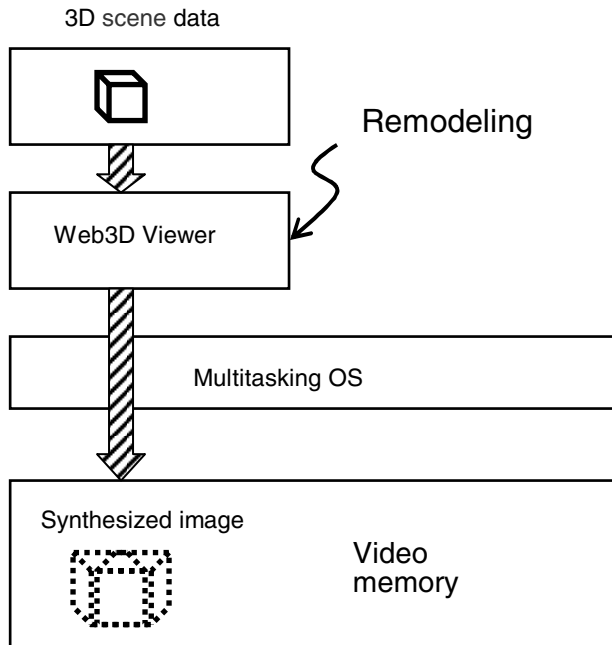


Figure 2. Simple but impossible system.

Therefore, we developed a solution in which any modification of an existing Web3D system is required. As shown in Fig. 3, the proposed technique is composed of two parts.

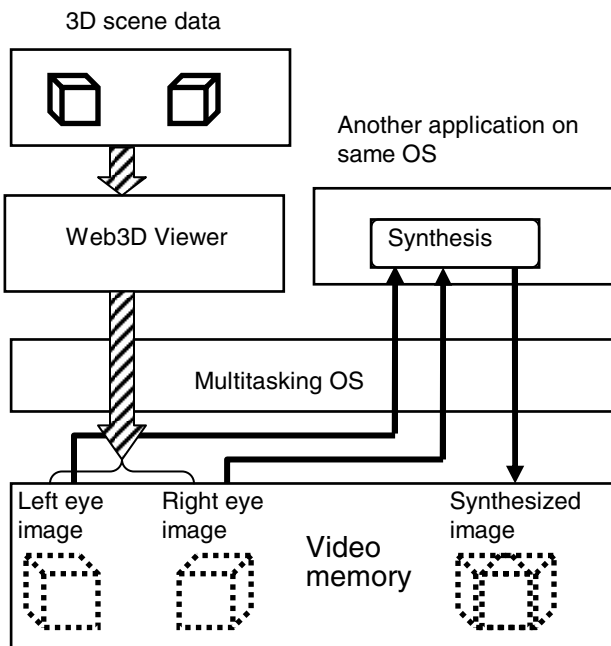


Figure 3. Proposed system.

The first part is a process of obtaining a parallax image for binocular vision in the video memory of a personal computer. The

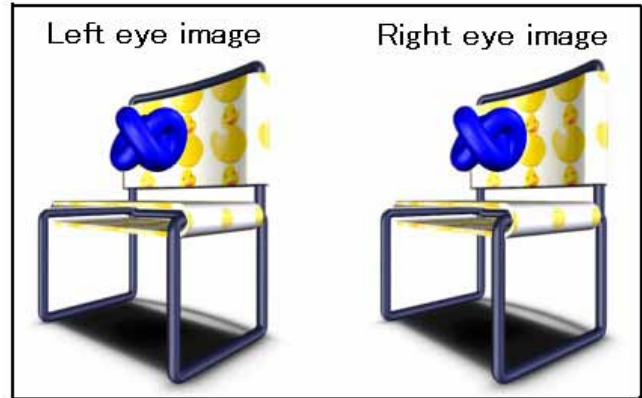


Figure 4. Images of two objects for binocular parallax

parallax image consists of two images, one is for the right eye and the other is for the left eye (Fig. 4).

The parallax image should meet two requirements. The first requirement is that the proper parallax between the left eye and right eye images must be set beforehand. The second requirement is that one of the two objects displayed on the screen must rotate in the same direction as the other objects whenever one of the two objects is rotated with the mouse. The method for achieving this is different depending on the Web3D method.

The second part is the process in which another program accesses the pixel data of the left eye and right eye images that are drawn on the video memory by the Web3D viewer, synthesizes them, and writes the synthesized image back to a different area of the video memory. For this operation, the OS has to be a multitasking OS, and each task must be able to access the video memory.

The proposed approach looks a little more complex, but it is actually feasible because no viewer remodeling is required.

Experiments

In the experiments described in this paper, we used Viewpoint™, because the quality of the displayed objects is excellent and the functions are rich. Viewpoint Media Player (VMP), which is executed on Microsoft Windows XP, was used as the viewer.

First of all, it is necessary to have 3D scene data based on the Viewpoint method. Each of the two objects, one for the left eye and the other for the right eye, are described in an .mtx file (XML form of Viewpoint) respectively, and they are controlled from one HTML file with a JavaScript (Fig. 5). The .mtx file is a Viewpoint XML scene file in which hierarchical relationships between objects and other elements in the scene are described. This file contains the script for staging the scene elements and usually references an .mts file. The .mts file is a binary resource file containing geometry, material, and texture information. In this case, two .mts files refer to the same .mts file, since the object for the left eye is identical to that of the left eye. Usually an html file and two or more Viewpoint files (.mts & .mtx) are placed in the same folder.

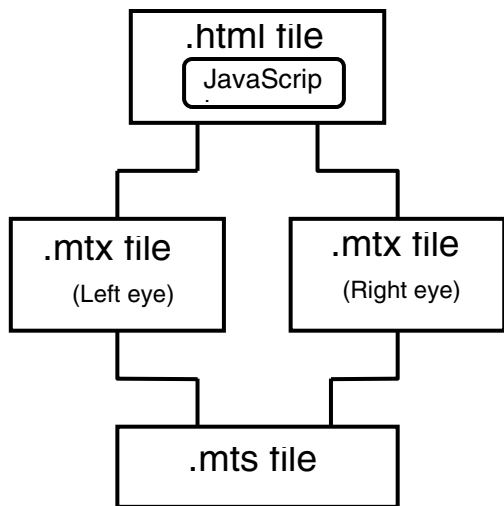


Figure 5. Files required for displaying 3D objects with parallax barrier method.

Figure 6 shows a personal computer used in the experiment. In the initial stage the display is not in a 3D display mode. By pushing the 3D button, the display enters the 3D display mode, regardless of the programs being executed.



Figure 6. Personal Computer used in experiment. (Sharp parallax barrier 3D display)

In Fig. 7, the objects displayed in the left window were drawn by the VMP. Therefore, it is possible to change the direction of the objects by dragging with the mouse. However, no feeling of depth by binocular parallax can be obtained.

On the other hand, the image in the right window is the one drawn by our synthetic program. The program reads the pixel data from the personal computer screen, synthesizes the data according to the arrangement of right eye pixels and left eye pixels of the personal computer screen, and writes the data in the right window.

The program was developed with Microsoft Visual C++.net. During the development of this program, Microsoft DirectX 9.0 was used for speeding up processing and decreasing the screen flicker. DirectX is a set of APIs for creating games and other high-performance multimedia applications on Microsoft Windows.

It was confirmed that viewers were able to perceive the depth of a displayed object that is changing direction by the binocular parallax. The processing speed of a synthetic program was about 12 frames per second and the flicker was hardly perceived. The process was able to keep pace with the rotation of the object. However, the operation occasionally became heavy when the shape of the object was complex, and the solution to this problem is an issue for the future.

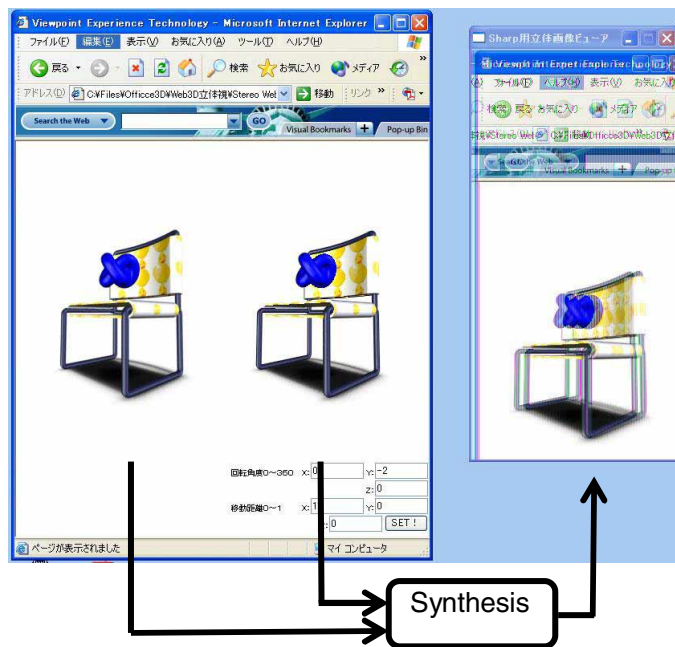


Figure 7. Personal computer screen display.

Conclusion

We propose a technique for displaying Web3D images using only one notebook computer with the parallax barrier display function, in which no remodeling of the Web3D viewer is required. Using a Viewpoint Media Player, the experiment confirmed that realistic binocular vision was possible. This method can be applied along with the Viewpoint method. In addition, using video memory as an interface can be widely applied.

References

- [1] Graham Saxby, The Science of Imaging: An Introduction, (Institute of Physics Publishing, Bristol, UK, 2002) .

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Kazuhiya Yanaka received his BE, ME, and Dr.Eng. degrees from the University of Tokyo in 1977, 1979, and 1982. He joined Electrical

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