Morphovision

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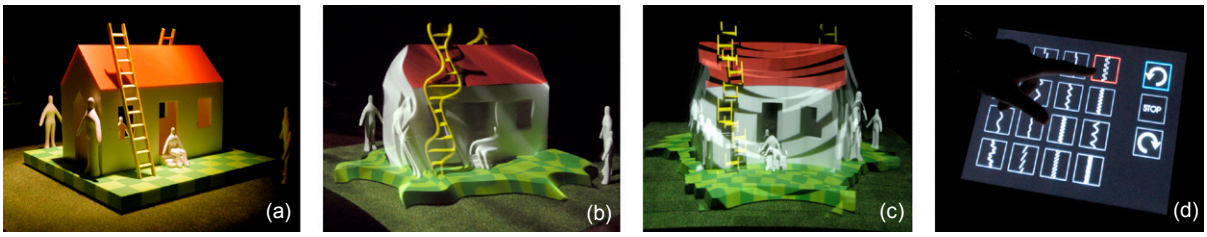

Figure 1: (a) Actual object, (b) Distorted image, (c) Another selected shape, (d) Operation panel interface

1 Introduction

New 3D display techniques have been made possible by recent progress in digital technology and device technology [1]. Those techniques share the ability to heighten viewer interest by presenting 3D images that can be appreciated in natural circumstances with the naked eye. In reflection of this demand for 3D images, we devised a method for generating 3D images utilizing persistence of vision, and achieved a new representation by distorting the 3D images in real time. We call this new method "Morphovision". Morphovision is a unique display system that interactively transforms and animates a 3D solid object before our eyes. In this system, a model house is rotated at high speed, and is illuminated with special lighting from a projector. This enables the model to be distorted into various shapes.

2 Development of Morphovision

2.1 System configuration

A technique of Morphovision is to scan 3D objects rotating in a darkened environment with slit lighting to display the 3D objects in distorted form. The system configuration is illustrated in Fig.2. Morphovision comprises a projector that produces the image that serves as the slit lighting, a polygon mirror for sequential scanning and a three-dimensional subject that is illuminated with the slit lighting.

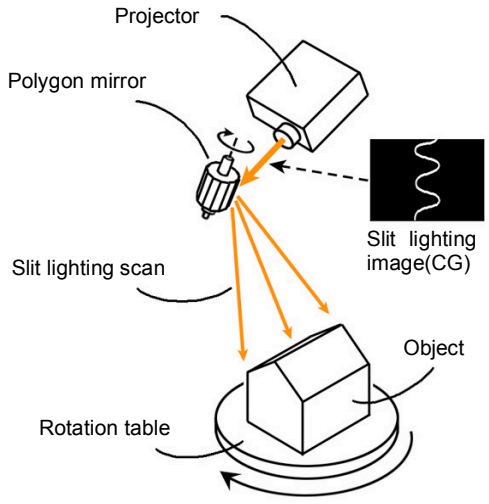

Figure 2 : System configuration

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For the projector that emits the slit lighting images, a high contrast, and high resolution DLP projector was used. By making a 12-faces polygon mirror, a scanning angle of about 60 degrees is produced. The slit lighting illuminates the entire object, but does not hinder the viewer.

2.2 Distortion principle

When the illuminated object is scanned with slit lighting as it rotates in darkness, the relative displacement caused by the timing of the slit lighting and the rotation of the illuminated object produces a 3D image in which the object proportions appear to differ from the actual proportions. By changing the shape of the video image that constitutes the slit lighting, it can be matched to the rotation of the illuminated object to distort the image in the direction of rotation at any time. When the slit lighting is given a wavy shape, the timing becomes even more complex, as can be seen in Fig. 1 (b).

2.3 Creating the distorted house

We used Morphovision to create the "Distorted House" exhibit Fig.1 (a)(b)(c). The distortion effect is enhanced by using a house and ladder, which we are accustomed to see as shapes formed from straight lines and right angles, to compose the illuminated object scene. The display frequency is 20 Hz, the rotation speed of the polygonal mirror is 100 rpm and the rotation speed of the illuminated object is a little over 600 rpm. The system provides 16 slit lighting patterns and two rotation directions, which the viewer can select from a touch panel labeled with icons (Fig.1 (d)). When the user touches the operation panel, the model house begins to rotate, and the shape of the solid model becomes distorted. The touch panel has a selection of icons showing different patterns. The distortion can be viewed simultaneously by any number of people, from any angle, without the use of special glasses.

3 Conclusion

We achieved the objectives of this work, which were a new form of 3D image generation and its application to a new kind of 3D representation. By using Morphovision to construct the “Distorted House” exhibit, we demonstrated the generation of a natural 3D image by means of slit lighting illumination of 3D objects that are rotating at high speed. Morphovision employs persistence of vision, which is a characteristic also utilized in TV systems. Therefore, it holds potential as a new 3D image display technique for TV systems.

Reference

[1]:"Perspecta Display", Actuality Systems, Inc., 2002
http://www.actuality-systems.com/site/content/pdf/Actuality_Whitepaper_AeroSense_2002.pdf