Shading and Shadow-Casting in Image-Based Rendering Without Geometric Models

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Image-based rendering (IBR) methods such as Light field rendering[1] and Ray-space method[2] succeed in photo-realistic representation of complex objects without geometric models. Now the key to IBR future prosperity is how to accomplish functionalities of conventional geometry-based approaches. We have already reported how to interact with image-based objects in the virtual environment[3]. The next goal is how to make objects without polygon models react to transition of lighting conditions. This sketch describes a real-time rendering method that changes the shading of image-based objects and casts appropriate shadows according to the motion of viewpoint or objects and the transition of a local lighting.

Method

A set of multiple pictures taken under a certain lighting condition while moving a camera is called an *image-set*. Our idea is based on a simple method to select the image-set with the nearest lighting condition to that of virtual environment from the image-sets taken under various lighting conditions. Let I_c be the image-set taken under ambient light. An image-set $I(l)$ stores only the luminance part of pictures of real objects taken under a lighting condition l. While changing values of l, the image data is stored into the corresponding image-set. To render an image from a given viewpoint, corresponding pixels are extracted from $I(l)$ and I_c. Then the chrominance part of I_c and luminance part of $I(l)$ are applied to the pixel in order to get the final shading. Note that as the technology of IBR is used in this process, an image seen from any point of view can be reproduced. The shadow cast by an object is represented by the texture mapping of the image contour, which is viewed from the light position, onto the surface the object resides on as shown in Fig. 1.

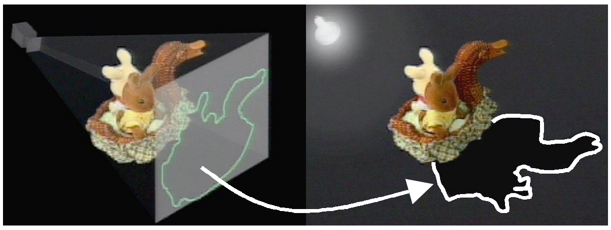

Fig. 1 Generation of cast shadow

Implementation

A system called CyberMirage 99 is realized in which ray-based data are placed in the geometry space. A light source can be switched on and off, and be moved. Of course, translation and rotation of objects and observer's walk-through are implemented. Note that all of these functions are realized in real-time. Fig. 2(a) shows an image of objects lit from a certain light source. It is noticed that the objects are appropriately shaded and cast an appropriate shadow. Fig. 2(b) is the image when an observer comes near to the objects and Fig. 2(c) is the image when an observer comes to another side of the objects. Fig. 2(d) and 2(e) are images when the light source is moved and when the objects are rotated, respectively. These figures show the effect that the shading and cast shadow are appropriately adjusted.

Future Work

The next step of our study will be how to expand the system so that it can accommodate multiple light sources and react to the change in intensity of light. Theoretically, they can be accomplished by preparing a lot of image-sets corresponding to the number of light sources and their intensity levels. However, it requires a new horizon of data compression method in order to realize the real-time interaction.

References

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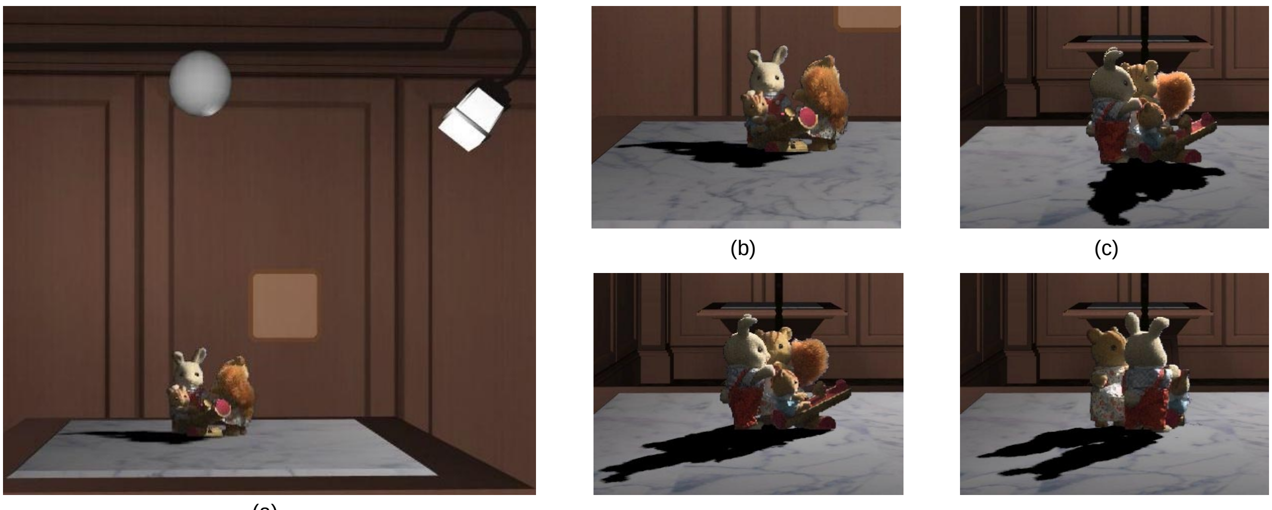
3. S. Uchiyama, et al.: "Presentation and interaction of virtual 3D objects without geometric model," *Proc. HCI'97*, Vol.2, pp.869-872, 1997.



(a) (b) (c) (d) (e)

Fig. 2 Views of the objects under different lighting conditions