Wide Area Projection Method for Active-shuttered Real Image Autostereoscopy

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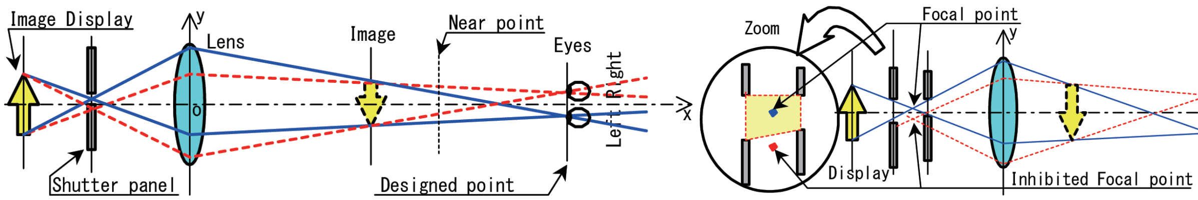

Figure 1: *(a)The method of an Active-shuttered Real Image Autostereoscopy,(b)The method of double layers system*

1 Introduction

In the field of glass-free autostereoscopic display, the working area of the display is an important topic for research. It is desirable to have a display that provides a projected image with a large working area. The working area is defined on the basis of two parameters: the distance and the direction from the display to the target user. We have previously proposed the glass-free autostereoscopic display using Active-shuttered Real Image Autostereoscopy (ARIA) technology[Nii et al. 2012]. To increase the work distance of this system, we propose the double-layer active-shutter control method. ARIA is a simple technology for developing a glass-free auto-stereoscopic display without any mechanical moving components. The display made with this technology consists of two LCD devices and a large projection lens with an eye-tracking system. One of the LCD devices acts as the image display while the other serves as an active-shutter panel made of a set of pixels. This panel controls the light source by changing the level of transparency of its pixels in order to control the direction of the projection area on the basis of the eye location. As shown in Fig.1(a), the image projected at the left eye while a shutter blocks the light travelling to the right eye, so that the next image is projected at the right eye in the next frame. This mechanism enables time division for the stereo images. The shutter was installed at a fixed distance from the lens. When the user moves from the designated position, thus changing the distance from the display, the image for the right eye may be received at the left eye. Please observe the line at the "Near point" in Fig. 1(a). When the user moves to the near point of the real image, the right eye views the image intended for the left eye. To avoid this problem, the image size is decreased to be smaller than the designated distance. The method for estimation was described for a specific distance.

2 Discussion

In the design of the shutter, it is required to find a mechanism for projecting light rays from the image display to the right eye while completely blocking the light to the left eye. All the light rays that reach the eye through the lens pass through the conjugate focal point. Accordingly, the original problem converts to a geometric problem. The problem is described as one where light rays reach the focus point but all the light rays do not pass through the inhibited focus point, this point is conjugate focal point of the left eye.

The ideal approach to solving this problem is to changing the mechanical position of the active-shutter panel along the line between the object and the lens, depending on the user's distance. Hence, we exclude this solution to keep the system without mechanical moving components.

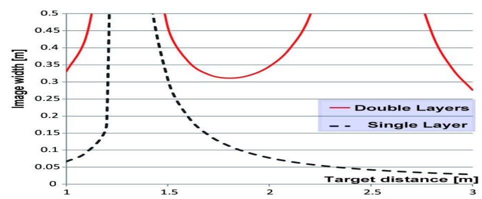

Figure 2: *The comparison between single layer and double layer shutter method*

The proposed approach is the double-layer shutter method (Fig.1(b)). In this method, the light rays can be precisely controlled by suitably controlling the double-layer shutters to shut at the conjugate focal point, as shown in Fig.1(b). We estimate the image width for both single and double layers under the same conditions. 1) The first shutter is installed 0.31m behind of the lens, and the second shutter(proposed in this report) is installed 0.28m behind of the lens. 2) The lens diameter is 0.5 m and the focal length is 0.25 m. 3) The image display is installed 0.5 m behind the lens. The results are shown in Fig.2. For the same image width of 0.3 m, the user can view the correct image from 1 to 2.9 m on the double-layer system and from 1.3 to 1.5 m on the single-layer system. The limitation of this system is with regard to the brightness of the projected image. The transparency of one of the LCD panels used is approximately 0.3 under polarized light. The double-layer system provides reduced brightness as compared to the single-layer system.

3 Conclusion

We report on the approach for increasing the work distance of the ARIA display system. The use of the double-layer shutter can increase the image size as compared to that obtained with the use of the single-layer shutter. Further, the double-layer shutter system has a wide application range. The limitation of this system is in terms of brightness, but this can be resolved by using a bright LCD panel in the near future.

References

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