Protruding Aerial DFD Display in Combination of a Flat-Panel Display and AIRR

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1. Introduction

The aerial display has been gaining attention as digital signage, amusement and next-generation car interface. The aerial image is observed as if it is floating in the air without using special 3D glasses. Aerial imaging by retro-reflection (AIRR) [1] is one of the aerial imaging techniques. One of the features of aerial image is it is translucent. Therefore, it is possible to observe the aerial image while observing the object back of the aerial image. The aerial image with AIRR is a 2D image when the light source is a conventional flat-panel display. On the other hand, Depth-Fused 3D (DFD) [2] display is one of the 3D display techniques that gives stable 3D perception. Protruding DFD display [3] is a method to give a depth perception beyond the two layers.

In this paper, in order to make a new aerial 3D display, we combine AIRR and protruding DFD. An aerial image is visible in front of a conventional flat-panel display. The perceived depth of the aerial image can be controlled based on DFD. Furthermore, protruding effect is realized based on the protruding DFD between the aerial image and the flat-panel display.

2. Principle

Our optical system to form an aerial image in front of a flat-panel display is shown in Fig. 1. This optical system is composed of 5 components: a light source display, a rear display, two half mirrors and a retro-reflector. Light emitted from the light source is reflected by the horizontal half mirror and reaches the retro-reflector. Retro-reflected light is transmitted through the horizontal half mirror and reflected by the vertical half mirror and forms the aerial image. Because the rear display is placed behind the vertical half mirror, the image shown on the rear display and the aerial image are overlapped.

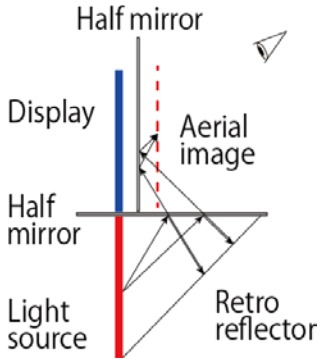


Fig.1 Optical system to form the aerial image in front of the rear flat-panel display.

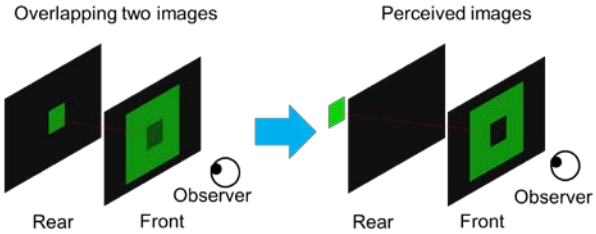
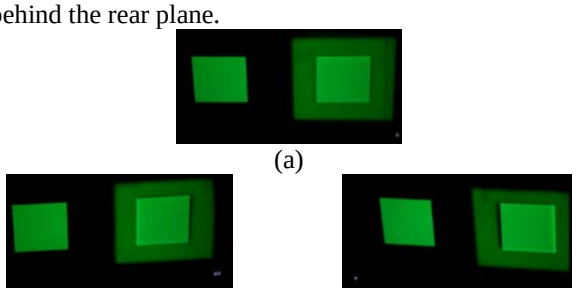


Fig.2 Concenptual diagram of protruding DFD display.

A conceptual diagram of protruding DFD display is as shown in Fig. 2. The luminance difference between the central object and the surroundings is larger at the rear than at the front. In this case, the object appears to protrude to the opposite side from the observer further than the rear plane.

3. Results

Viewed results of the aerial image overlapping the rear display are shown in Fig. 3. A left square and a right bright square are displayed on the rear display. The surrounding large square in the right is displayed on the frontal aerial screen. Fig. 3 (a), (b), and (c) are observed it from a center, a left, and a right, respectively. From Fig. 3 (b) and (c), the two squares in the right are not overlapped. From Fig. 3 (a), the right bright square is perceived as existing at the back of the left square. It means the right bright square is perceived as if it is behind the rear plane.



(a)

(b) (c)

Fig. 3 Viewed images of the proposed aerial protruding DFD display from (a) a center, (b) a left, and (c) a right.

4. Conclusion and future work

We have realized an aerial protruding DFD display. We gave the depth to the flat-panel display by overlapping the aerial image.

References

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