Development of
Direct Light Scanning 3-D Display Proto-type System

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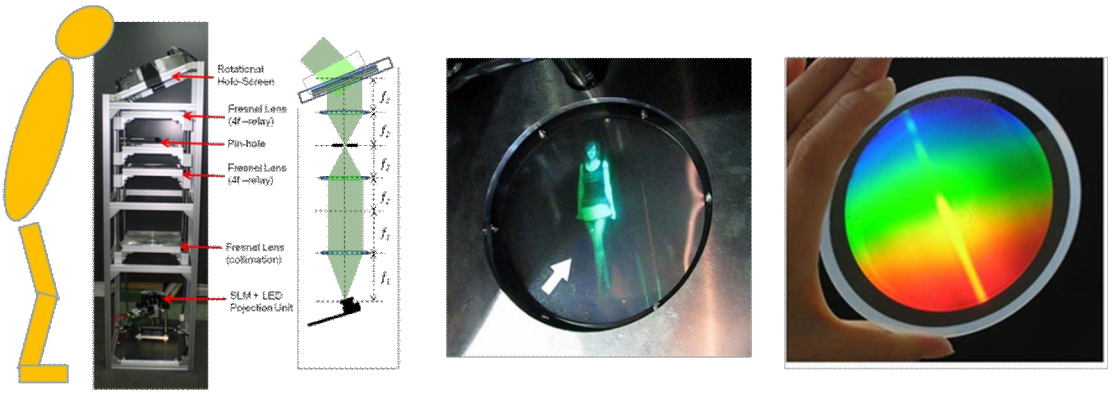
1. INTRODUCTION

A new method of 3-D display system, named Direct Light Scanning 3-D Display System, was developed and its performance was demonstrated. In this method, holographic screen was utilized as a beam scanner and a directional 2-D image was projected according to the scanned direction [1-2]. Figure 1 shows the developed prototype system based upon this method. The dynamic 3-D motion images with high resolution (XGA) with smooth motion parallax were observed in front and behind of holographic screen.



(a) (b) (c)

Fig. 1: Direct Light Scanning 3-D Display System Prototype. (a) System configuration of prototype (b) Displayed 3-D motion image (c) Holographic screen made by photopolymer material.

2. PRINCIPLE

High density directional images displaying is promising glasses free 3-D display method [3-4]. This method has many features; (1) any special glasses are not required, (2) the eye accommodation function may work, (3) the smooth motion parallax is obtained, and (4) the observation position is not restricted. In this method, however, considerably large number of spatial light modulators (SLMs) corresponding to the number of spatial beam directions are needed. To solve this problem, we developed the method of Direct Light Scanning 3-D Display. To change the direction of a beam, a

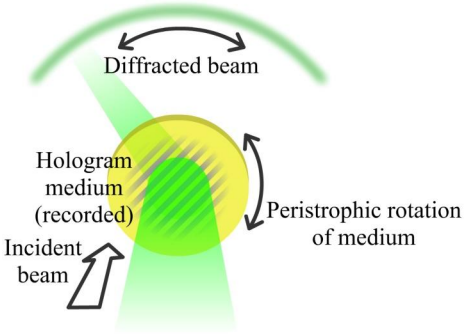


Fig. 2: Beam scanning by peristrophic rotation of holographic screen.

simple two-axis interference hologram was used. By peristrophically rotating the hologram, the incident angle of reference beam is relatively changed. As a result, the diffraction beam angle changes due to Bragg-mismatch (Figure 2). This holographic medium acts as a screen. As the result, high density directional images were projected by only one SLM.

3. SET UP OF 3-D DISPLAY SYSTEM

Based upon the principle described in 2, a 3-D display system prototype was constructed. Figure 3 shows the system diagram schematically. The screen size of this prototype system is 120[mm]. The optical systems were constructed as a telecentric system. The high speed SLM is required to project parallax image. In the current system, Digital Micromirror Device (DMD) of Texas Instruments and Green LED illuminant light source were employed. The holographic screen was held at the top of the system by a rotation holder. Disc rotation and switching of projected images were synchronized by the photo interrupter which set outside of rotating screen.

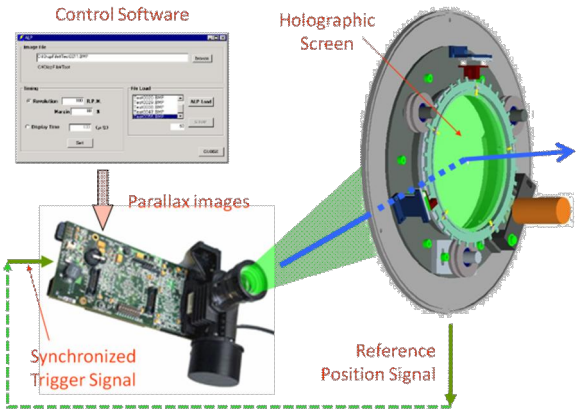


Fig. 3: System diagram of 3-D display prototype.

4. 3-D IMAGE OBSERVATION AND CONCLUSION

A new method of 3-D display with high-density directional display system composed of the holographic screen and single SLM was constructed and its performance was demonstrated. The results revealed that the combination of the holographic screen and the directional displaying is considerably satisfactory for obtaining high-resolution 3-D images. In fact, displayed image is glasses free and sufficient motion parallax and binocular parallax was confirmed (Figure 4). Most important feature of the system is the use of single SLM. To display much realistic 3-D movie images, RGB color display system is now under constructing. By employing another high-speed SLM, such as magneto-optic SLM is also considered.

Fig. 4: 3-D image observation results.

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