Development and Evaluation of Calibration Methods for an Autoscopic 3D Display using Light Diffusion within Micro Regions

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Many auto-stereoscopic displays have been reported in the past [1]. However, there remain some challenges in the displays, for example restriction of view points and vergence-accomodation conflict [2]. Nayer et al. proposed a 3D display using light diffusion within 3-dimensionally positioned micro voids processed in a crystal glass cuboid [3]. It is able to present 3D objects to any number of simultaneous viewers at any viewpoint, without wearing any kind of special glass-like equipments. However, in order to successfully present 3D objects, the projection must be adjusted precisely for each individual micro void by investigating the correspondence between each projector pixel and micro voids. This process not only requires a great amount of user's effort but also consumes a lot of time.

In this research, hence, calibration methods which can automatically find out correspondence between each projector pixel and micro voids by using a camera were developed. The setup of the display with calibration system are shown in Fig. 1. At the time, three different methods which vary in projection pattern were developed, namely; Pixel-Scan Method, Line-Scan Method and Structured-Light Method. Specifically Line-Scan Method and Structured-Light Method were developed in aim of shortening the processing time of the calibration. The processing time of Line-Scan Method for 3,000 voids was 392 sec., and that of Structured-Light Method was 236 sec., while that of Pixel-Scan Method was about 10 hours. Fig. 2 shows the example of the image generated with the result of Pixel-Scan Method. Additionally, subjective experiment was conducted in order to evaluate accuracy of the calibration methods.

The results show that Structured-Light Method resulted to be faster in processing time but degraded in quality for the presented images. However, despite Line-Scan Method being faster than Pixel-Scan Method in processing time, the degradation of the presented images was minor.

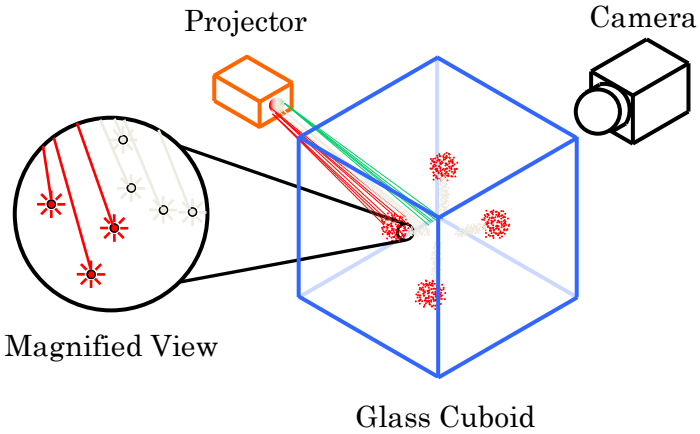

Fig. 1. The setup of the display with calibration system.

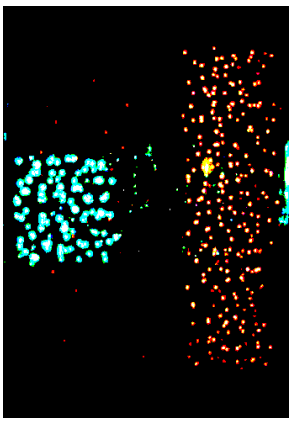

Fig. 2. The example of the image generated with the result of Pixel-Scan Method.

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References

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