Volumetric three-dimensional display using Quantum optics

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Abstract

Today some many types of 3D display are developed but that are not possibly multiviewer, multiview and full parallax. Our new research work uses the Quantum optic to develop 3D display. Quantum mechanically, we can think of the first photon making a virtual transition to the second state. If the second photon appears within the lifetime of that state, the absorption sequence to the third level can be completed. When the electron, located in the third state, shifts to the first state, that electron emits one visible photon. We controlled the two invisible lights to draw a pixel in volume.

Researchers are studying and developing 3D displays that are divided into three categories. The first is a stereoscopic display [1, 2], the second is an autostereoscopic display [3, 4] and the third is a volumetric display [5]. An advantage of the stereoscopic display is multi-viewer and a disadvantage is just one view image and not full parallax. Some display systems [6] present the multi-view stereoscopic image pair simultaneously or as a time sequence with use of projectors or display panels, but for the multi-view the optical plate or the eyeglasses with a tracking device.

Autostereoscopic displays provide 3D perception without the need for special glasses or other head gear, but the observer must locate the presence of the viewing zone. A head-tracked display [7] could be made from a two-view autostereoscopic display where head-tracking allows the display to swap the two views when the eyes move from one viewing zone to other viewing zone. The head-tracking requires some mechanism in addition to the display itself.

Volumetric displays produce volume-filling three-dimensional imagery: Each volume element or voxel (VOlume piXEL) [8] in a 3D scene emits visible light from the region in which it appears. The some techniques leverage the unique features of volumetric displays, including a 360° viewing volume that enables manipulation from any viewpoint around the display, as well as natural and accurate perception of true depth information in the displayed 3D scene [9]. That displays is full parallax, multi-viewer and multi-view but a distortion at the centre of the display is occurred which is an artifact of the physical display mechanism. Therefore, now the multi-viewer, the multi-view, the full parallax and without the mechanic problem display system is needed.

Energy three levels and Scan method

This can be explained with reference to Fig. 1, which is an energy level diagram for an idealized fluorescent center having a ground state and two unequally spaced excited states.

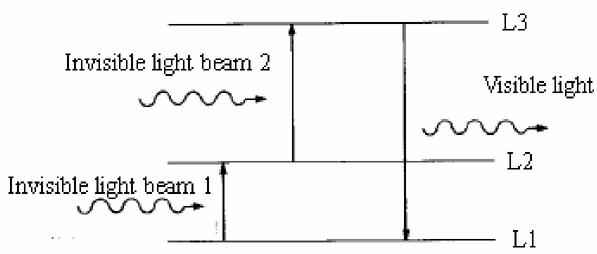

Fig. 1. Energy diagram for and three levels fluorescent.

Irradiation of such s system with light of wavelengths λ_1 and λ_2 result in successive excitation of the center fro the ground state to level 2 due to the absorption of λ_1, and subsequently to level 3 due to the absorption of λ_2. If level 3 fluoresces by decaying directly to the ground state, the system will emit light of wavelength λ_1 that is defined by λ_1 and λ_2,

$$\lambda = \frac{\lambda_1 \cdot \lambda_2}{\lambda_1 + \lambda_2}.$$

Two invisible beams are produced by two laser sources and illuminate the display volume through the two SLMs. The first SLM is used to scan the plans of the display volume. The second SLM is used to draw the points the scanned plane, as showed in Fig. 2.

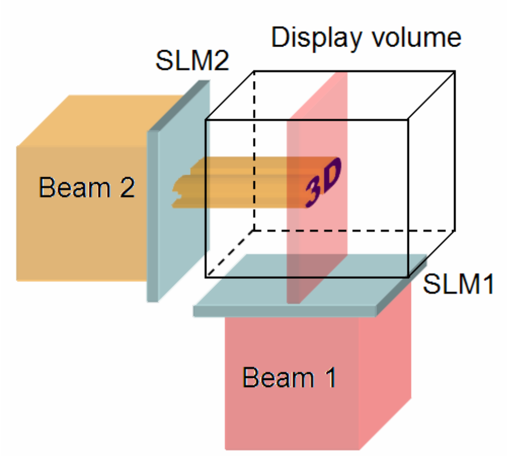

Fig. 2. The structure of the scanned method.

We scan from first plane, which is the furthest plane from the second SLM, to the closest plane from the second SLM

Conclusions

This system is monochromatic because we used two visible light sources. After electrons absorb these two sources, that electrons emit just one color light. If we use more sources, we can draw color image in the display volume.

Our method eliminates the ghost voxel problem because the plane beam, which is the beam 1, illuminates the display volume, after the image beam, which is the beam 2, illuminates the display volume. The image is drawn in the cross section of these two beams.

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