Development of the HDTV Camera and Monitor for Stereoscopic 3D Display

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Abstract

In this paper, we describe the development of the polarized-light stereoscopic monitoring system based on full HDTV. The system consists of the stereoscopic camera part, image processing device for the stereoscopic image recording and stereoscopic display. The developed stereoscopic imaging display system reduces eyestrain and viewer fatigue.

1. Introduction

Because of the perception of depth, the stereoscopic imaging system has various applications [1,2]. Recently, there has been significant development in the field of stereoscopic imaging device because of technology improvements. But, all the researches on the stereoscopic device focused on the 3D display technology. Hence, we saw a need to develop an image acquisition, recording and playback device.

Our work focused on the development of a High-definition (HD) stereoscopic imaging device with acquisition, display, recording and playback technology for the HD stereoscopic content development in the Bio-medical applications.

The stereoscopic image acquisition device consists of the 3D camera using the HDCAM and stereo microscope with two HD cameras.

The recording system consist of the 3D Multiplexer/DeMultiplexer device for the making of one channel image to the two channels images of the left and right channel. Lastly, the assessment of a wide number of display types has led to the choice of well-matched conventional television displays with images separated by polarized light filters for our Bio-medical applications.

The goal of our approach is to develop a system which allows real stereoscopic imaging system for contents development and the surgeon through the stereo microscope optics [3, 4].

2. Development of the HD Stereoscopic image acquisition, recording/playback and display device

2.1 Stereoscopic image acquisition devices

We have developed two kind of the stereoscopic image acquisition device for application for medical tests and contents. They are simple stereoscopic camera using two HDCAM and stereo microscope attached with two small HD CCD head.

The stereoscopic camera has an object of the recording the scene of the medical test or various scenes of wide angles. The camera is manufactured basis structure of the parallel camera, that is two HDCAM attached on the special camera base device.

The stereo microscope captures the object from two slightly different angles which provide the two images needed for the stereoscopic vision. Fig. 1 shows the optical schematic diagram of the stereo microscope.

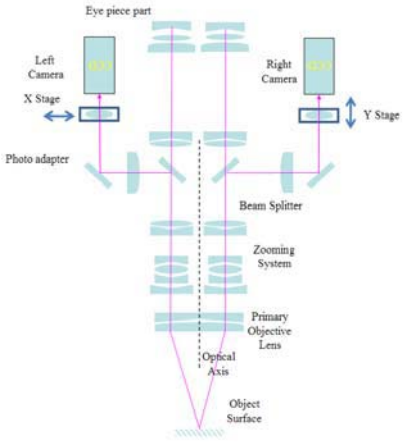

Fig. 1. Diagram of Stereoscopic microscope

By adding the beam splitters in the two optical paths of the existing stereo microscope we can acquire the

stereoscopic video images through the CCD cameras and the eyepieces are always same. The microscope HD stereoscopic image acquisition device developed compact type using the HD CCD camera which type separate a sensor part form the camera.

2.2 Stereoscopic image recording

The HDTV stereoscopic image recording uses general rule of 3D format because stereoscopic images are limited by memory capacity, synchronization problem between left and right image, and processing time for the encoding. The 3D formatters are called 3D Mux and DeMux. The 3D Mux has a function of compression that two channel video signal into one channel and the 3D DeMux has a reverse function. There are two types of the 3D Mux of the frame sequential and spatial compression (side by side) method.

In this work, we developed the frame sequential method that uses the HD YPbPr signal. Fig.2 shows schematic diagrams of two types of the 3D format and circuit of developed device.

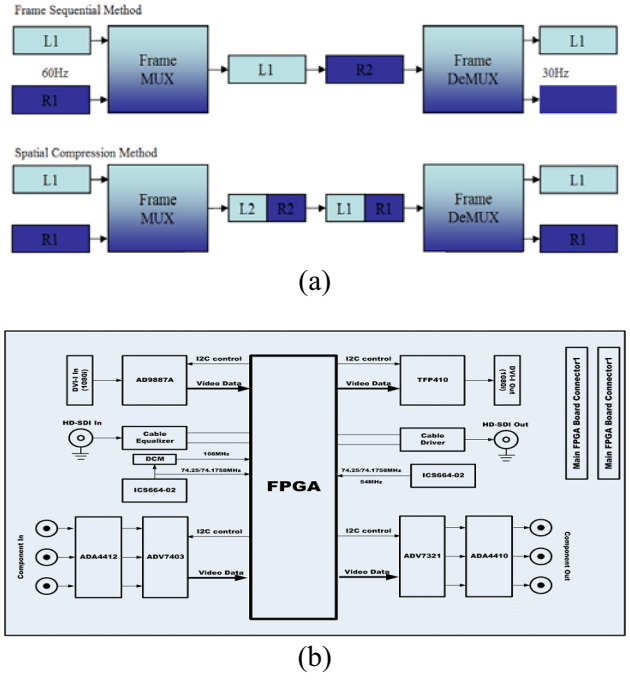

Fig. 2. 3D Mux/DeMux Device; (a) Two types of the 3D format diagrams, (b) diagram of frame sequential method circuit.

2.3 Stereoscopic display device

The stereoscopic display systems being developed use polarized light techniques. The polarized light stereoscopic display technique, which uses undulation of the light wave, separates a combined stereoscopic image into right and left image using orthogonal oriented filter sheets.

Although such displays are more bulky than many alternatives, they do give a display which does not reduce the information content of the picture and only requires the viewer to wear polarized spectacles. Fig. 3 is a schematic of a polarized light stereoscopic monitor.

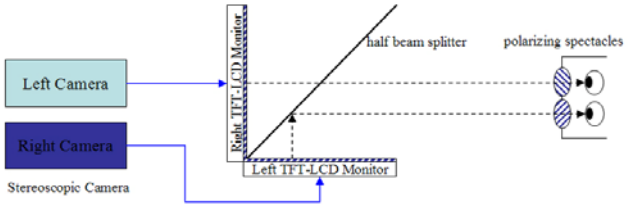

Fig. 3. Schematic diagram for polarized light stereoscopic display

The display type using TFT-LCD monitors uses a half beam splitter to accurately combine the two pictures. The monitor faces are arranged at 90 ° to one another either horizontally. The TFT-LCD monitors use the polarizing filter, so our stereoscopic monitor is not needed.

Through the polarizing glasses, we can watch the right image directly and the left image is reflected image by semi reflective mirror.

3. System Development and Evaluation

3.1 System development

In this chapter, would like to describe the system development of the HD stereoscopic display system of the stereo microscope. The system consists of the stereo microscope (Olympus SZX model), the 3D Mux/DeMux, and the stereoscopic monitor. The stereoscopic image can be acquired by each of the two Full HD CCD camera ports of the Olympus SZX stereo microscope.

The 3D Mux/DeMux device play an important role in the image recording and play back with recording device like a tape recorder or semiconductor memory.

Lastly, the stereoscopic monitor is a polarization-mode stereoscopic monitor using two high resolution TFT-LCDs that shows the stereoscopic image through two HD input image. Fig. 4 shows the developed stereo microscope stereoscopic display system.

(a)

(b)

(c)

Fig. 4. Embodied Stereoscopic microscope display system; (a) HDTV stereoscopic microscope, (b) 24inch polarized light stereoscopic monitor, (c) 3D Mux/DeMux

3.2 System evaluation and applications

For the evaluation and testing of the application of the embodied stereoscopic display system of the stereo microscope, we have experimented on animals and inspection of the PCBs. Fig. 5 shows experiment on animals.

The evaluation compared the existing stereo microscope with the stereoscopic display system of the stereo microscope. Table 1 shows the result of the system evaluation.

Fig. 5 Experiment on animals

Table 1. Compare with the existing system

Items	Existing System	Embodiment System
1. accuracy	very good	good
2. eyestrain	high	low
3. working time	bad	good
4. employment	difficult	easy

In the present study, we evaluated the use of the stereoscopic display system and found that this technique provides several advantages over conventional micro working technique.

However, our evaluation of the technology of the equipment showed less than optimal image resolution, loss of illumination, inadequate par focal capability and loss of depth and width. This study's preliminary data has guided the refinement of the stereoscopic display system for stereo microscope.

4. Discussion

As an alternative to the operating microscope, advances in video technology can now permit viewer to work on a micro working field on a video monitor in three dimensions without the necessity of

physically looking through the microscope eyepieces.

Development of HD stereoscopic display system capable of providing a clear and accurate sense of depth perception has been a critical requirement of the rapidly evolving field of minimally invasive surgery and inspection.

Our stereoscopic display system for stereo microscope will be ready for widespread implementation and will positively affect the way microscope work performed today.

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