Development of Stereoscopic Display System for Stereo Microscope

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Abstract

Many of the problems by using the microscope are related to the fact that the eyes of the surgeon must be continually fixed to the microscope eyepieces.

In this paper, we describe a development of the stereoscopic monitoring system of the stereo microscope for reduced eyestrain or operator fatigue about the long time observations of the microscope. The system consists of the stereoscopic camera part, the stereoscopic image processor device and the polarized light stereoscopic monitor. The left and right images obtained form the two CCD cameras are the same as the eyepiece images. By use of the image processor, the polarized light stereoscopic monitor displayed a real-time stereo microscope images.

1. Introduction

The stereo microscope has been used in the field of a surgical operation, biological survey, inspection of the semiconductor circuit etc. for the more precise observation. In case of the long time observations, the eyestrain or fatigue is caused by the decreasing blink of eyes because of a continuous hang to between eyes and eyepieces. Also, in case of using the video device, image of the stereo microscope is display just two-dimension image [1,2]. Therefore, we need a development of the stereoscopic monitoring system for reduced eyestrain or operator fatigue about the long time observations of the microscope [3, 4]. The goal of our approach is to develop a system which allows real stereoscopic image display for the surgeon through the stereo microscope optics.

In this paper, we describe the embodiment of the stereoscopic display systems using the existing stereo microscopes. The proposed system consists of the stereoscopic image acquisition part, image processing and record/playback device, and stereoscopic display device.

2. Stereoscopic Display System of Stereo Microscope

2.1 Stereoscopic image acquisition

The stereo microscope sees 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. 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. In this system, the eyestrain for the long time observations can minimized because of the acquired images of the CCD cameras and the eyepieces is always same.

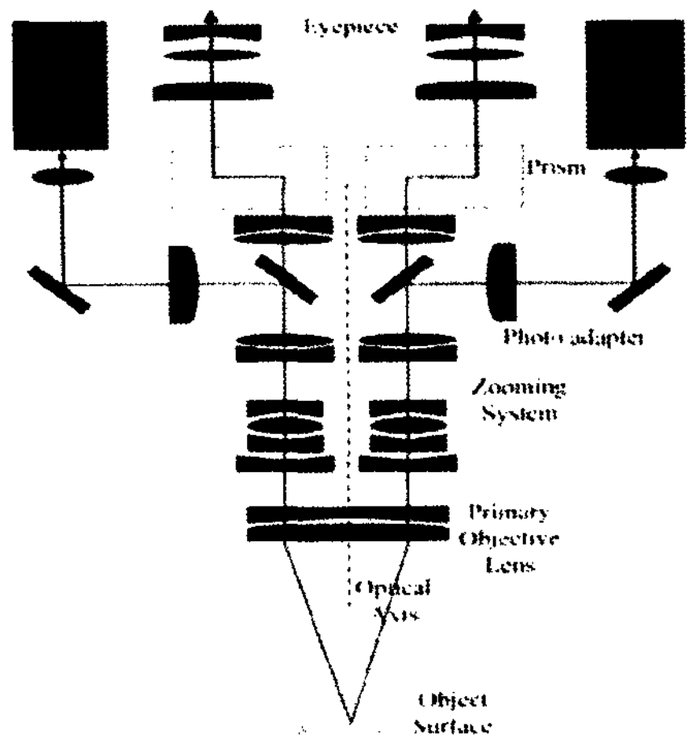


Figure 1 Schematic diagram for the stereoscopic display of stereo microscope.

2.2 Stereoscopic image processing device

The acquired stereoscopic image is necessary for processing, recording, playback etc. The PC based stereoscopic processing device consists of a dual graphics board and two frame grabbers for the display and the acquisition of stereoscopic image of real-time. The function is composed of the software application. The developed stereoscopic processing device model is shown in Fig. 2. Through the dual graphics board, they are connected to a polarized stereoscopic monitor which have two DVI signal input connectors.

The software for the stereoscopic processing device has function that concerned in the frame grabber board control for image acquisition, the image processing, and the stereoscopic image display. The acquired stereoscopic images (left and right images) from the stereo microscope process can be handled the mirroring, magnifying, reducing, etc by need. Also, through the dual graphics board embodied the two channels image output systems which is separated the left and right images.

2.3 Polarized light stereoscopic display

The stereoscopic display systems being developed use polarized light techniques. 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. 2 is a schematic of a

polarized light stereoscopic monitor. 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 no need.

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

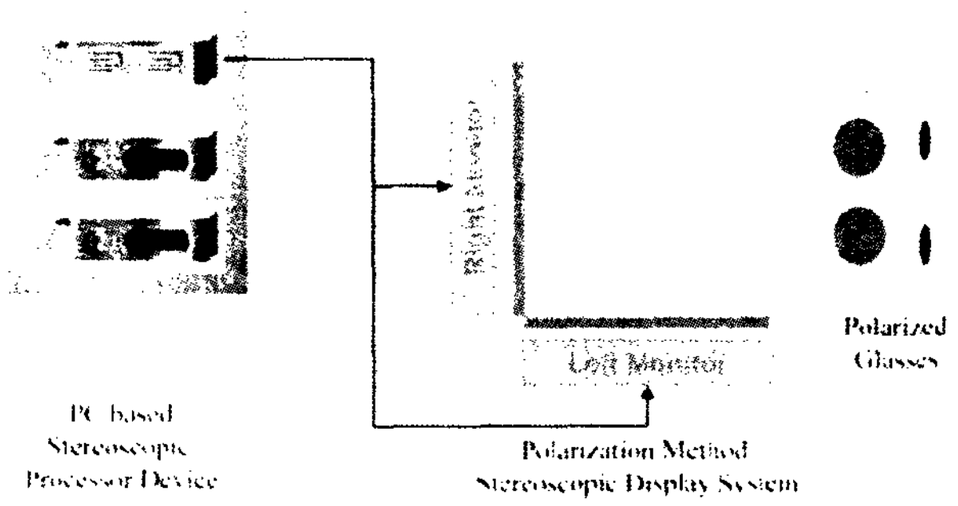


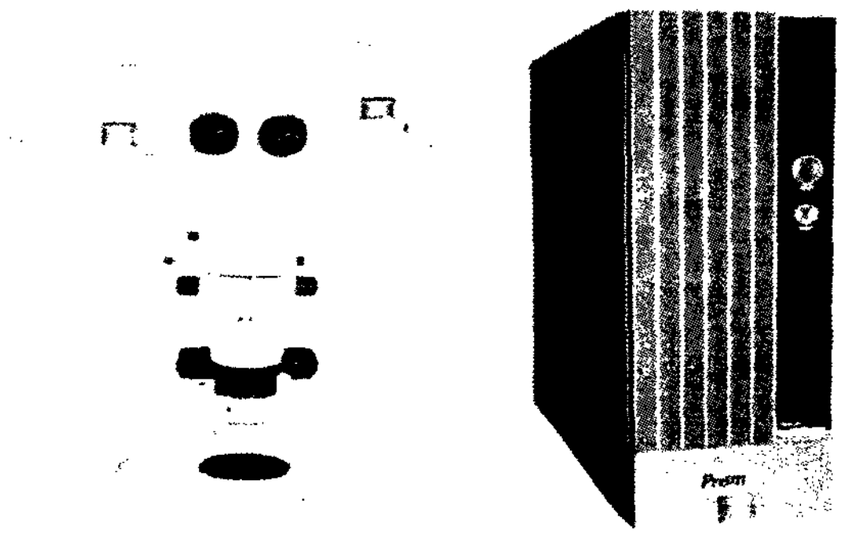
Figure 2 Schematic diagrams for stereoscopic image processing device (left part) and polarized light stereoscopic display (right part).

3. System Development and Evaluation

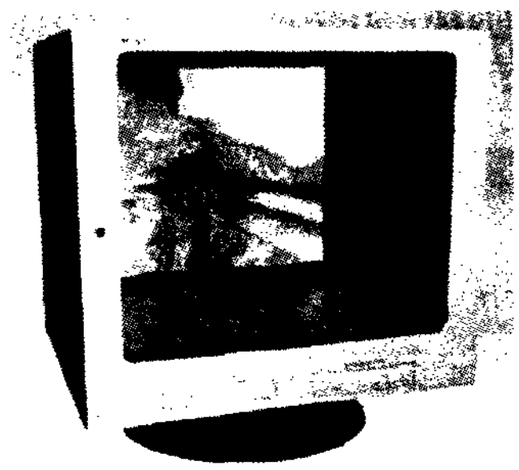
3.1 System development

In this chapter, would like to have described the system development which the stereoscopic display system of the stereo microscope. The system consist of the stereo microscope (Nikon SMZ model), the PC (include dual head graphic board and image acquisition board), and the stereoscopic monitor (polarization method stereoscopic monitor).

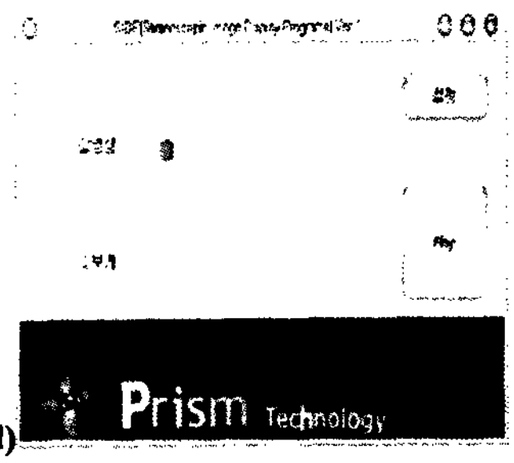
The stereoscopic image can be acquired by each of the two CCD camera ports of the Nikon SMZ stereo microscope. The PC based stereoscopic image processing device play an important role of the image acquisition and display by the frame grabber board and the dual head graphic board. Lastly, the stereoscopic monitor is a polarization-mode stereoscopic monitor using two high resolution TFT-LCDs and that shows the stereoscopic image through two input image. Fig. 3 shows the developed stereo microscope stereoscopic display system.



(a) (b)



(c)



(d)

Figure 3 Embodied Stereoscopic display system of stereo microscope; (a) stereo microscope, (b) stereoscopic image processing device, (c) polarized light stereoscopic monitor, (d) stereoscopic image viewing software.

3.2 System evaluation and applications

For the evaluating and looking for the application area of the embodied stereoscopic display system of the stereo microscope, we have experimented on animals and inspection of the PCBs. Fig. 4 shows experiment on animals.

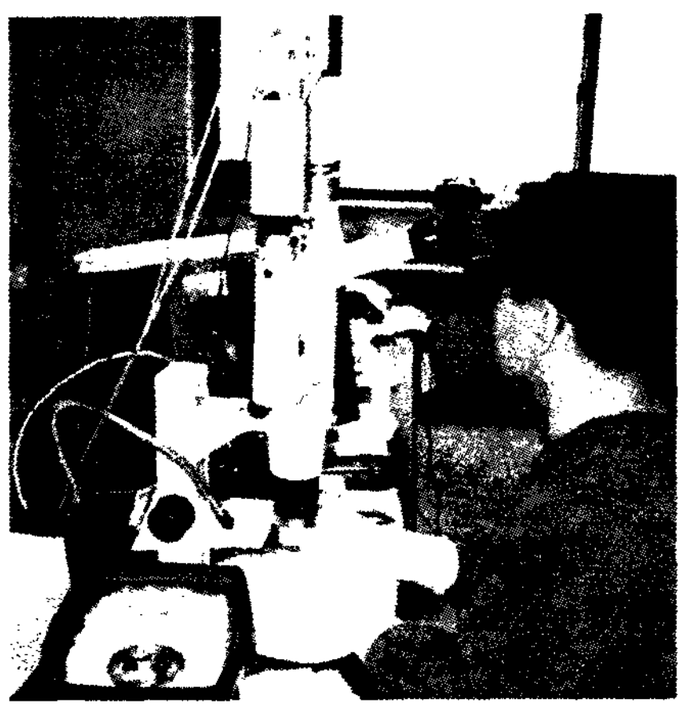


Figure 4 Experiment on animals

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

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 his 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 parfocal capability, and loss of depth and width from this study's preliminary data has helped guide 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 the work to view a micro working field on a video monitor in three dimensions without the necessary of physically looking through the microscope eyepieces.

Development of 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 inspect.

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

5. Acknowledgements

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6. References

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