LED Scanning Backlight Stereoscopic Display with Shutter Glasses

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Abstract

LED Scanning Backlight Stereoscopic Display with Shutter Glasses is provided to realize stereoscopic image viewing even in a liquid crystal display. The eye shutter signal is alternately switched from the left eye to the right eye with 120Hz of LCD Vertical synchronization (V-sync)

1. Introduction

A stereoscopic display device in which images having respective parallax for left and right eyes are displayed on a panel and shown to a viewer through a parallax barrier or a lenticular plate is known hitherto. In this device, however, image resolution is low because the images are shown through the parallax barrier or the lenticular plate. In addition, image brightness is decreased in the case the parallax barrier is used, while an image focus is blurred due to lens aberration in the case the lenticular plate is used [1-3]. To cope with these problems, time-multiplexed stereoscopic systems, utilizing shutter-glasses and LED scanning switchable backlight screens are well known and have been the objective of much research. Shutter-glasses system has two wearable optical switches, capable of switching their transparency thus blocking left or right eye (Fig.1).

2. Experimental

Shutter glasses have typically had issues with LCD displays because of the different display technologies. The individual pixels in LCD displays persist for much longer than the pixels on a CRT, which is why LCD display quality is accompanied by a response time; a term that is irrelevant for CRTs. As a result, flicker free images are actually much easier to achieve on an LCD panel. Unfortunately for 3D shutter glasses this causes a problem. After the image for the left eye has been presented, the image for the other eye immediately follows while the former image still persists on the screen. Almost all digital watches use liquid crystals for their displays. The relevant property is that an electronic signal can make the crystal turn from transparent to opaque. Some clever folks realized that if a pair of glasses were made with each lens being a single, large, liquid crystal, they could be used to get the required two-separate-images-from-the-same-view that is the basis of any 3D display. This is how the technique works: one of the lenses is made opaque (say the left one) so that the viewer can only see through the right lens. At the same time, the right eye view is displayed on the monitor. Now, the situation is reversed, and the right lens is made opaque while the left view is displayed on the monitor. If this is done rapidly enough the result is that each eyes percieves a differant image from viewing the same monitor.

A backlight module has multiple sets of LEDs, where each set of LEDs has multiple white light source LEDs. The corresponding LED is placed at back of every region of the panel. The scanning beams of any adjacent scanning regions gradually scan from upper to down direction of the panel. In this paper, we have successfully designed and demonstrated a decent performance with 120Hz Optimized synchronization signal between LED brightness/darkness flash and adjusted shutter glasses signal. It has been demonstrated that the 120Hz scanning characteristic from upper row to lower row of the horizontally arranged of stereoscopic image.

A stereoscopic image display device is composed of a flat display panel, driver circuits for driving the display panel and an eye shutter to be worn by a viewer. An left eye image and a right eye image are alternately shown on the display panel, and the eye

shutter is alternately switched from the left eye to the right eye with 120Hz, in response to display of the respective left and right eye images. Thereby, the displayed image is recognized as a stereoscopic image by a viewer wearing the eye shutter.

3. Results and discussion

This paper is characterized by that in a frame time defined by LCD V-sync signal, each row of LED of a backlight module is controlled to flash in brightness and darkness so that the LCD with physical delay characteristic (low response speed) of liquid crystal and essentially a hold type can be made similar to an impulse type display device like a cathode ray tube display, also alleviating the drawbacks such as blurring and flicking of the LCD.

The method of the proposed is classified into two categories. One is to display, in a frame time, some kinds of brightness/darkness characteristic from upper row to lower row of the horizontally arranged rows of LED in the backlight module, cooperating with the scanning of the LCD, to thereby realize an effect similar to scanning. The other method is to synchronously apply a same control signal to all the rows of LED. In other words, this method provides flashing rather than scanning effect. Both methods can control the brightness of the backlight module by adjusting the duty cycle of the control signal(Fig.2). The waveform in Fig. 3 is optimized because the shutter glasses signal could be adjusted by vertical synchronization modulation to attain stereoscopic image.

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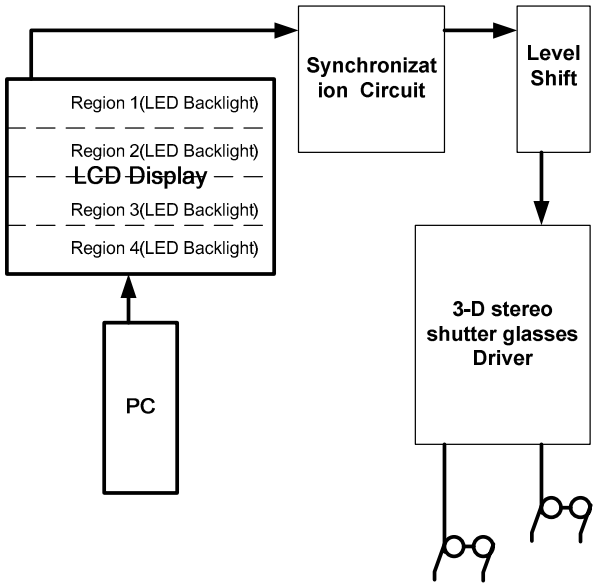

Fig. 1. Stereoscopic Display system.

The images are displayed in page-flipping mode using the resolution and color-depth set in 'Stereo/Page-flip Setup' and the monitor refresh-rate setup in Winx3D or NVidia control-panel 'Stereo Properties/Stereo Setup and Test'.
For Winx3D the alignment test is briefly displayed so that operation of the shutter-glasses may be confirmed and then the image is displayed full-screen. If there is visible flicker, use the monitor's OSD (on-screen display) to check the refresh rate. Anything less than 100Hz will produce flicker, depending on the ambient light conditions.

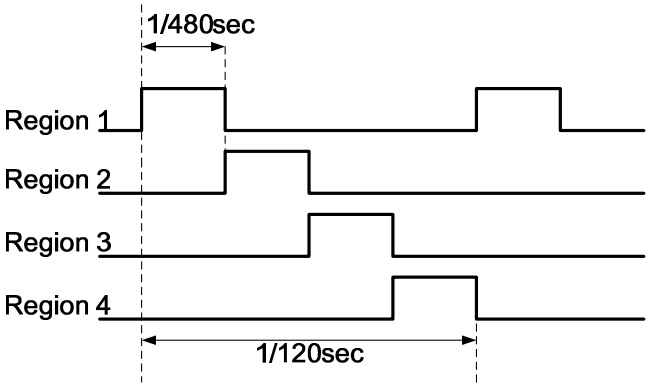

Fig. 2. LED scanning backlight duty cycle.

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The relationship between regions(in Figure 1) and a pair of stereoscopic images. Page flipped stereoscopic images use a special feature of some video hardware to rapidly switch the monitor between the right and left images. A special pair of glasses must be used to view these images. The glasses have high-speed electronic shutters (typically made with Liquid Crystal material) which open and close in sync with the images on the monitor. When the left image is on the screen the left shutter is open and the right shutter is closed which allows the image to be viewed by your left eye only. When the right image is on the screen the right shutter is open and the left shutter is closed. If this process happens at a very rapid rate, your brain thinks it is seeing a true stereoscopic image. If this shuttering speed is not fast enough, you can still see a stereoscopic image, but you may also see some flickering.

Page flipping methods allow you to see full color 3D stereoscopic image in high resolutions. The draw back is that typical video systems will exhibit some flicker. Special purpose video boards which support high-speed page flipping are available.

Shutter glasses come in many forms. Some have wires which connect to your video card. Some connect to your serial port or parallel printer port. Some are wire-less and use special transmitters which send out infra-red pulses to the glasses.

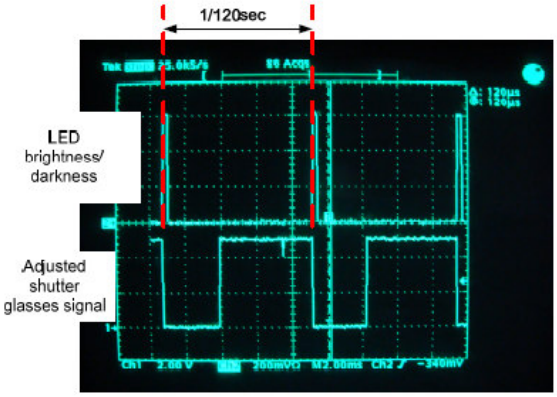

Fig. 3. Optimized synchronization signal

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To cope with these problems, time-multiplexed stereoscopic systems, utilizing shutter-glasses and LED scanning switchable backlight screens are well known and have been the objective of much research. Shutter-glasses system has two wearable optical switches, capable of switching their transparency thus blocking left or right eye.

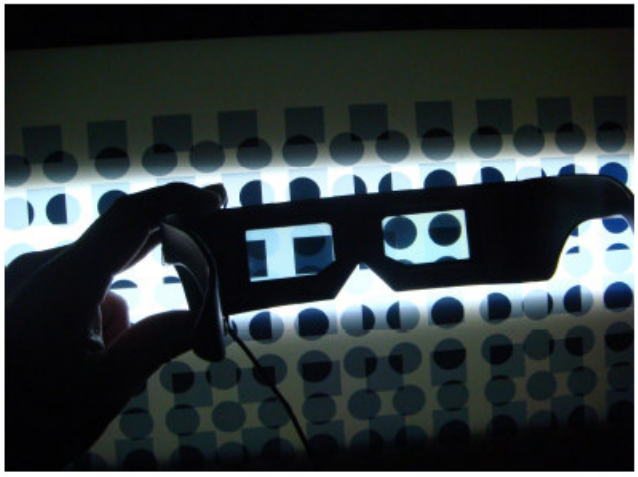

Fig.4. Special pattern with eye shutter.

In the shutter glass 3D display, the left and right images are alternated rapidly on the monitor screen. When the viewer looks at the screen through shuttering eyewear, each shutter is synchronized to occlude the unwanted image and transmit the wanted image. Thus each eye sees only its appropriate perspective view. The left eye sees only the left view, and the right eye only the right view.

A stereoscopic image display device is composed

of a flat display panel, driver circuits for driving the display panel and an eye shutter to be worn by a viewer. An left eye image and a right eye image are alternately shown on the display panel, and the eye shutter is alternately switched from the left eye to the right eye with 120Hz, in response to display of the respective left and right eye images. Thereby, the displayed image is recognized as a stereoscopic image by a viewer wearing the eye shutter (Fig. 5).

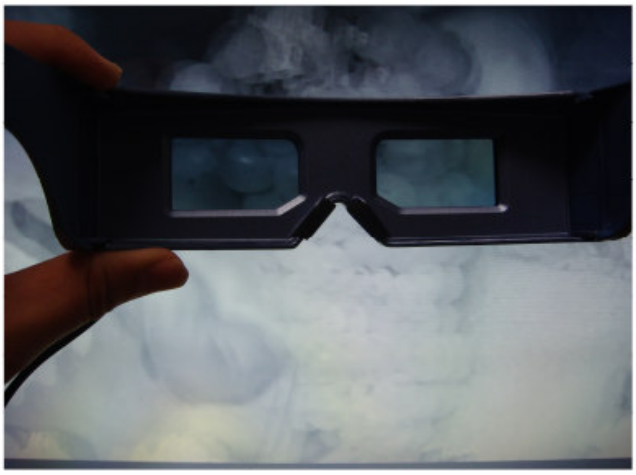

Fig.5. Stereoscopic image with eye shutter.

However because pixel transition speed has become a strong selling point of LCD monitors,the cross-talk images appear only on a limited number of scanning electrodes which are last scanned in each field. The voltage supplied to the scanning electrodes in the holding period may be lowered to decrease image brightness in the holding period, so that the cross-talk images are suppressed. Alternatively or in addition to decreasing the holding voltage, the image held in the holding period may be eliminated earlier to suppress the cross-talk images.

4. Summary

we have successfully designed and demonstrated a decent performance with 120Hz Optimized synchronization signal between LED brightness/darkness flash and adjusted shutter glasses signal. It has been demonstrated that the 120Hz scanning characteristic from upper row to lower row of the horizontally arranged of stereoscopic image. A quadrate image for a left eye is projected by the light from the left eye image file and a circle image for a right eye is projected by the light from the right eye file through a liquid crystal panel.

5. References

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