A 3D Image Player for CRT/LCD Monitors

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Abstract

In this paper, we propose a 3D image player for LCD monitors as well as CRT monitors. As we consider an afterglow and digital processing of LCD monitors, a stereoscopic images can be shown on CRT monitors as well as LCD monitors using the proposed a3D image player. We have implemented a 3D image player using FPGA (MAX 9320), We show prove that a stereoscopic images are shown on the LCD monitors.

1. Introduction

Our ability to see stereovision comes from each of our eyes seeing a slightly different view of the world. Our brain integrates these two images into one three-dimension picture. The key element in producing the stereoscopic depth effect is parallax. Parallax is the horizontal distance between corresponding left and right image points. The stereoscopic image is composed of two images generates from two relates perspective viewpoints, and the viewpoints are responsible for the parallax content of view. The methods to see stereoscopic image are glass type and no-glass type. In no-glass type, there are several theoretical techniques involving holograms, spinning cylinders and displays that are themselves three-dimensional. Glass type is color filter glass, polarizing glass, LCD shutter glass and HMD (Head Mount Display). In LCD shutter glass display, the left and right images are alternated rapidly on the monitors screen. When the viewer looks at the screen through LCD shutter glass, each shutter is synchronized to occlude the unwanted image and transmit the wanted image. So the left eye sees only the left view, and the right eye only the right view.

In this paper, we tell a function, principle and operation of 3D image mode with conventional 3D image player we cannot see stereoscopic image on the LCD monitors. Nowadays LCD monitors becomes more and more universal. So we propose 3D image player for LCD/CRT monitors with LCD shutter glass.

In addition, We propose the method to see stereoscopic image with color filter glass.

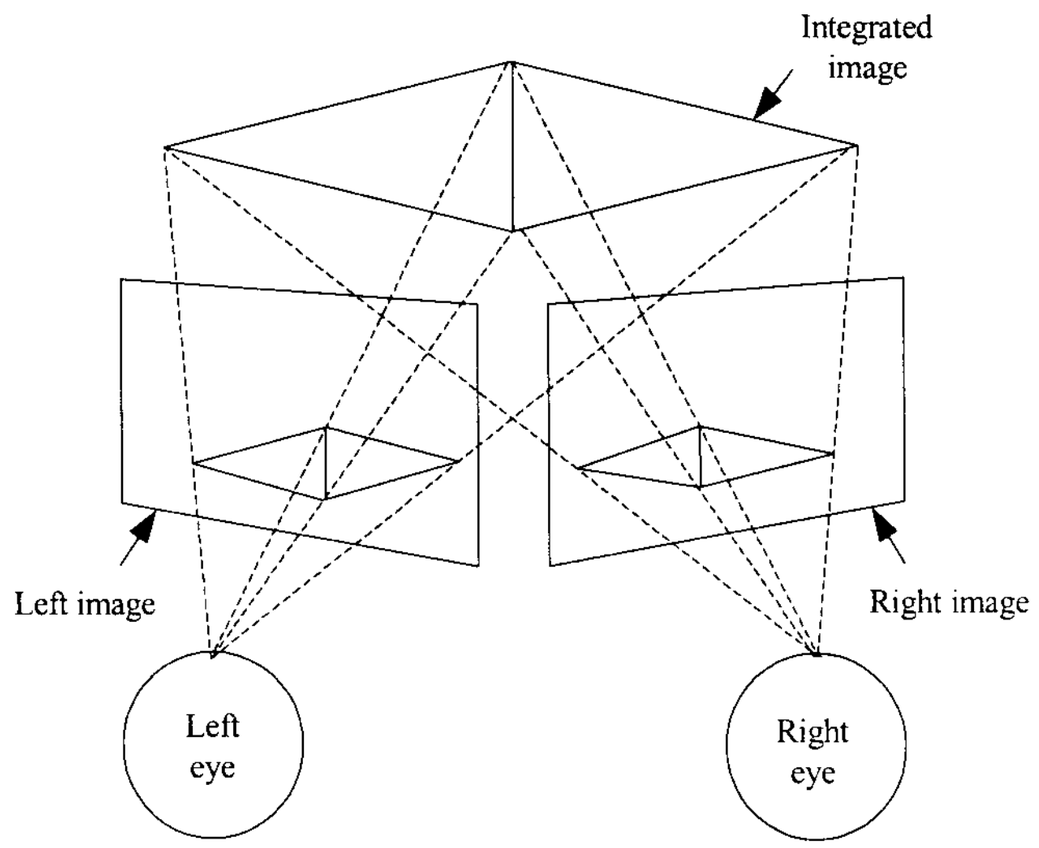
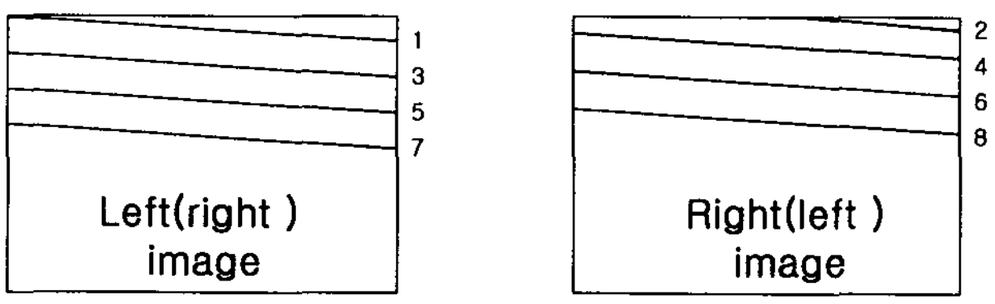


Figure 1. Principle of 3D image

2. The 3D Image Modes

2.1 Interlace Mode

Interlacing means orderly presentation; first the odd scan-line 1, 3, 5, 7 ····· is presented followed by the even line 2, 4, 6, 8 ·····. Process is repeated in a cyclic presentation pattern. (The figure2 is an illustration of the odd-even scanner line pattern.) Initially, interlacing was not designed for 3D image; it was designed according to the prescribed by the television standards. When the interlace mode is used for 3D image, we are able to divide the left eye image and the right eye image into the odd and even scan-line fields, or vice versa. The primary disadvantage of this mode is poor image quality and the flicker caused by the halved refresh rate of interlacing the raster.



(a) previous frame **(b) present frame**

Figure 2. Interlace Mode

2.2 Page-flipping Mode

Page flipping means alternately showing the left and right images on the screen. Page-flipping provides full resolution picture quality. Hence it has the best visual effect among the various 3D modes. Since synchronized registration of left and right eye frames is necessary, the minimum capacity of its frame buffer is twice as usually required. In order to overcome the flicker problem of 3D image, frames provided should be at least 120 frames less per second; so V-sync frequency should be 120Hz or higher

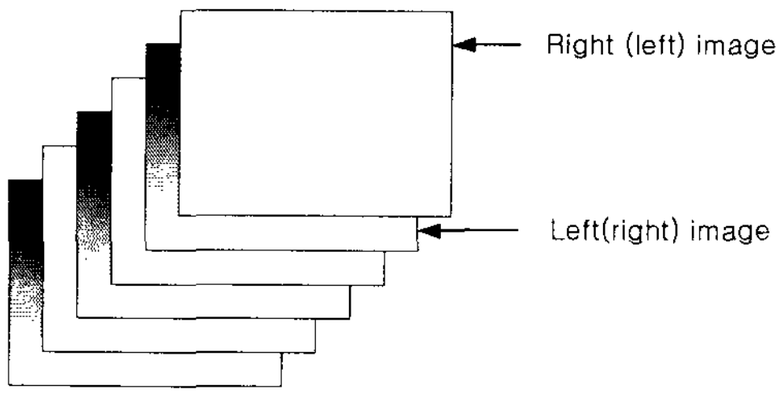


Figure 3. Page-flipping Mode

2.3 Sync-Doubling Mode

It most obvious different from interlace and page-flipping is that sync-doubling does not need to change any computer display peripheral. It only needs to arranger the left and right images up and down. The principle of Sync-Doubling is to use external circuit to insert additional Frame V-sync between the left and right frames. This will allow the left and right eye images to appear in an interlaced pattern on screen. Using the frame V-sync as the LCD shutter alternating sync allows us to synchronically transmit the right and left frames to agreeing double eyes, creating a 3D image. Since sync-doubling will multiply the original V-Sync, it is necessary to pay attention to the scan maximum frequency of display equipment.

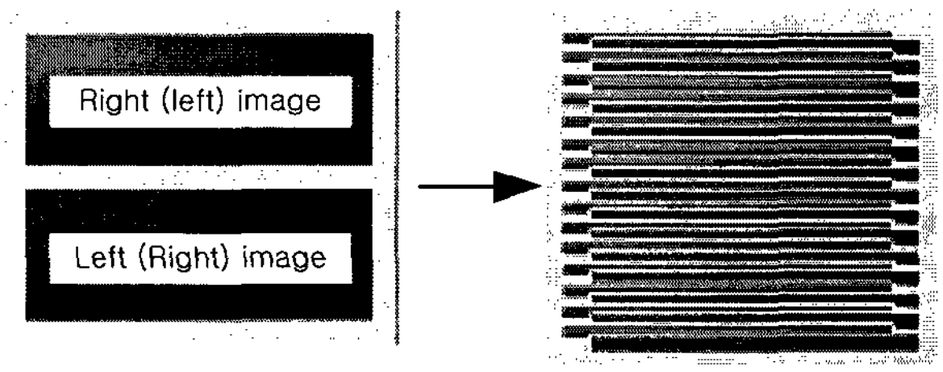


Figure 4. Sync-Doubling Mode

3. The Proposed 3D image player

3.1 Control signal

3.1.1 Frame control signal

Interlace mode divides a single frame into two fields (the odd scan-line field and the even scan-line field). A frame control signal is two times of H-sync period that indicates change of line. So when this signal is high, R, G, B signal is displayed on the screen. When this signal is low, R, G, B signal is not displayed on the screen. This is principle of interlace mode. According to resolution and frequency of each mode, number of total H-sync between V-sync is odd or even. In the case of odd, a phase of frame control signal is reversed automatically every V-sync. In case of even, a phase of frame control signal is same every V-sync as shown in fig.5. It is necessarily to reverse a phase of frame control signal oppressively every V-sync. So even scan line field and odd scan line field is displayed alternatively.

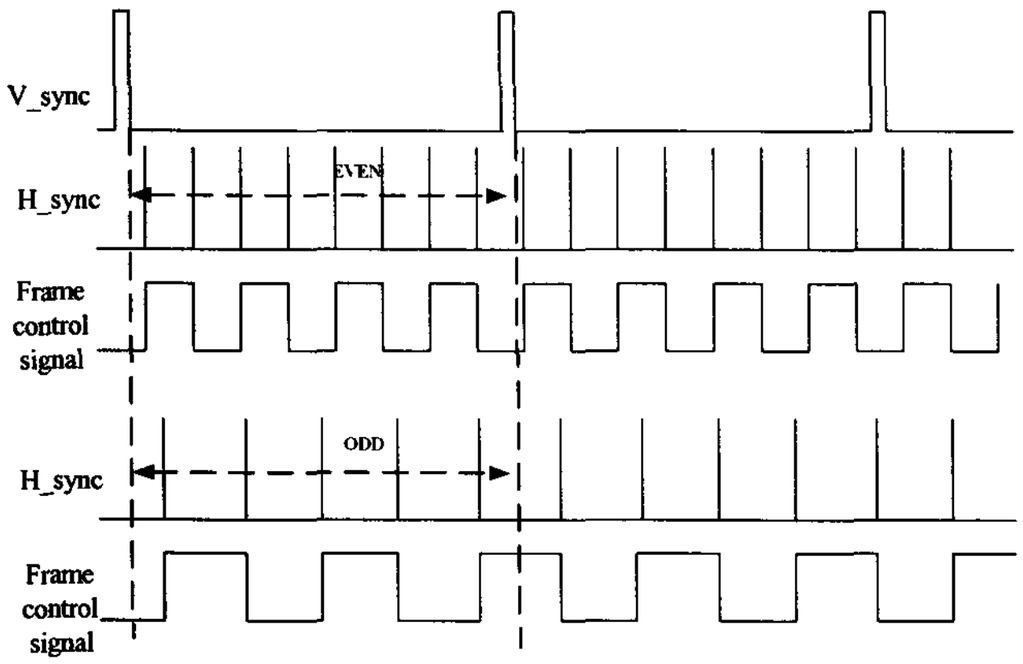


Figure 5. Frame control signal

3.1.2 LCD shutter glass control signal

The key to view stereo images is to get a different perspective for each eye. The LCD Shutter Glasses can help us to achieve this goal. People put on the LC Shutter Glass and look through the lenses at high-resolution full color display while the lenses "shutter" on and off alternatively. The monitors displays only the left view while the right lens of the glasses shutters, and display the right view while the left lens of the glasses shutters. A frequency of right glass control, left glass and vcom is 1 KHz. In the case of right glass is high and vcom is low, right glass is on. In the case of left glass is high and vcom is low, left glass is on as shown fig. 6. So vcom is reversed every V-sync.

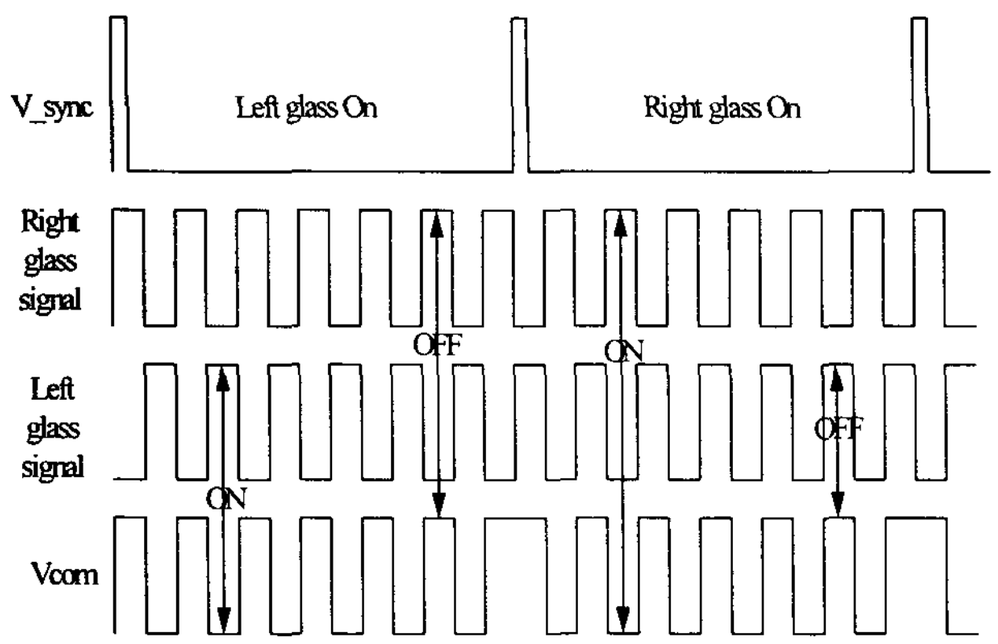


Figure 6. LCD shutter glass control signal

3.2.2 R, G, B control signal

We can see stereoscopic image with color filter glass. This method is similar to interlace mode. With interlace image source, red signal's even lines displays on screen every even frame and green signal's odd lines displays on screen every odd frame.

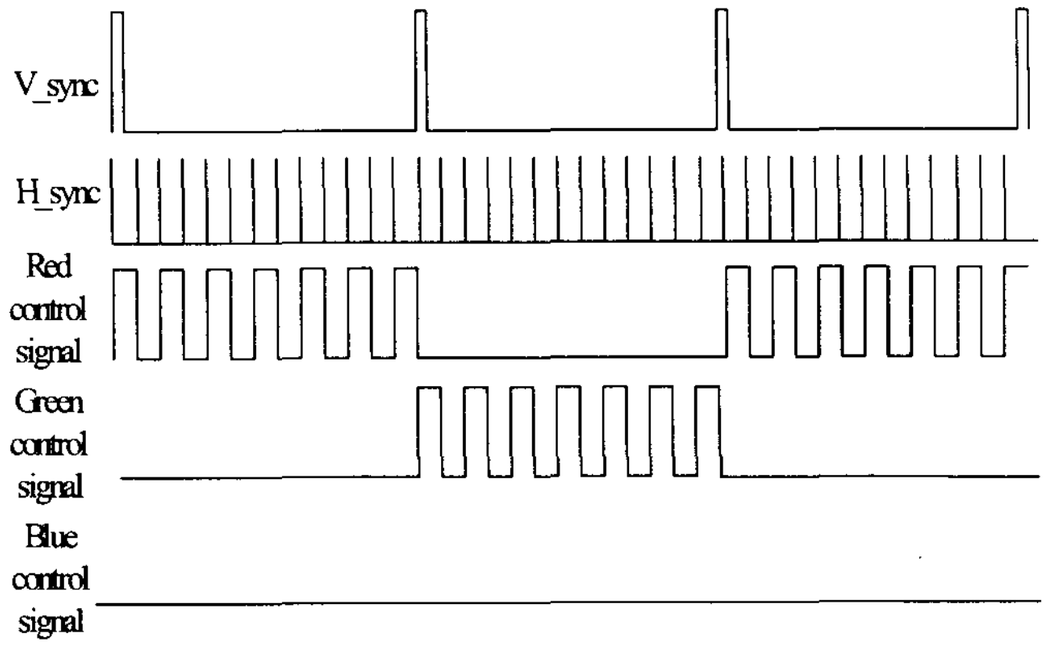


Figure 7. R G B control signal

4. 3D image player for LCD Monitors

An afterglow time of LCD monitors is longer than CRT monitors. Because of a afterglow time, an afterimage of previous frame is shown at present frame. So left image and right image is shown simultaneously every frame on the LCD monitors. Therefore we cannot see stereoscopic image. We cannot decrease afterglow time because of LCD monitors' physical character. To compensate afterglow time, we decimate frames and lines. A CRT monitors conduct image in the analog manner. On the other, LCD monitors process image in the digital manner. In the process of digital processing, V-sync is changed to another signal. So we synchronize another signal with LCD shutter glass control signal.

5. Implementation

Fig. 8 shows the main block of the image player. FPGA provides two main signals that control frame and LCD shutter glass. A function of LCD shutter glass control block is to change the magnitude of glass control signal form FPGA. So the glass signal is adjusted to use LCD shutter glass. A function of video switch block is to pass or occlude RGB signal, according to frame control signal.

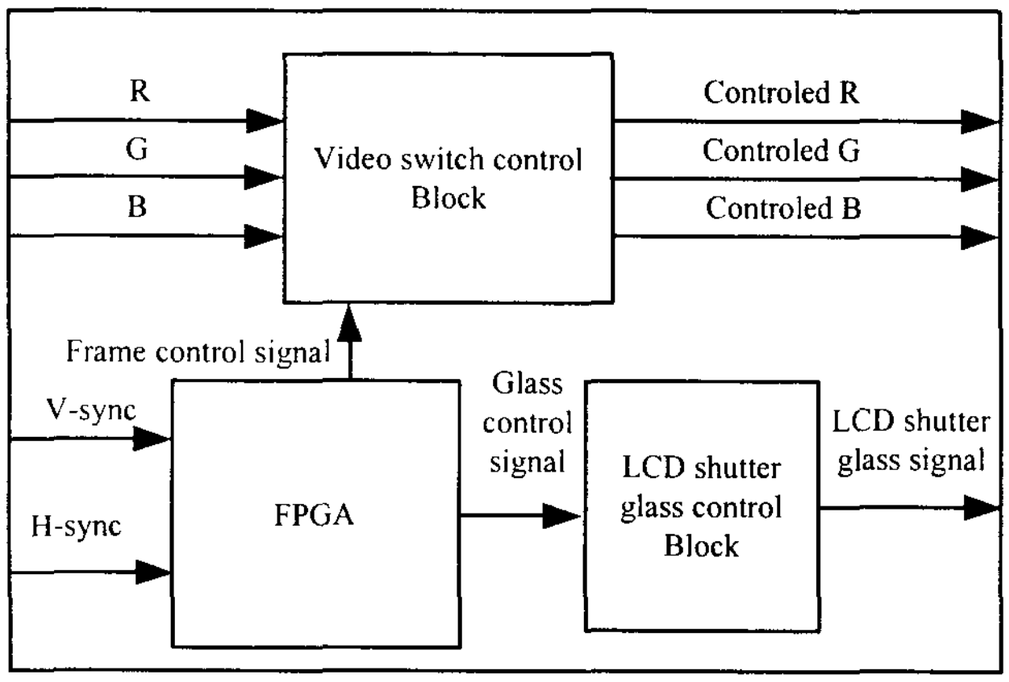


Figure 8. Block diagram of the proposed 3D image player

We have coded VHDL using MAX+PLUS II of Altera corporation and then made real 3D image player using the programmed MAX EPM9320 chip. This 3D image player supports interlace and page-flipping mode. 3D image player functions that with LCD shutter glass we can see stereoscopic image at the LCD/ CRT monitors and with color filter glass we can see stereoscopic image as controlling RGB signal.

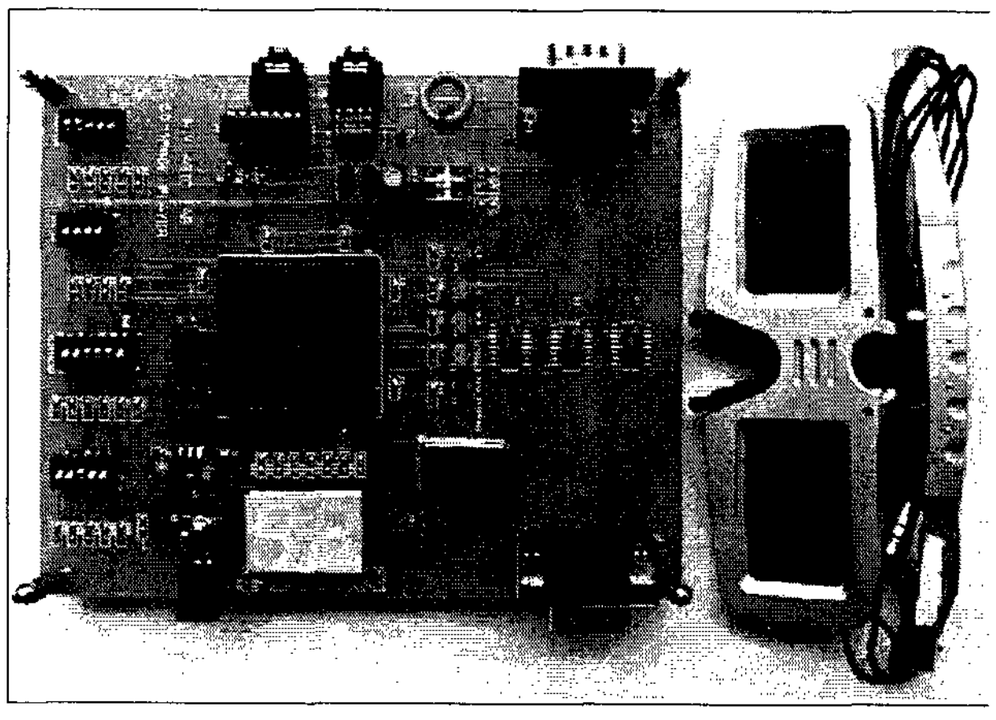


Figure 9. 3D image player

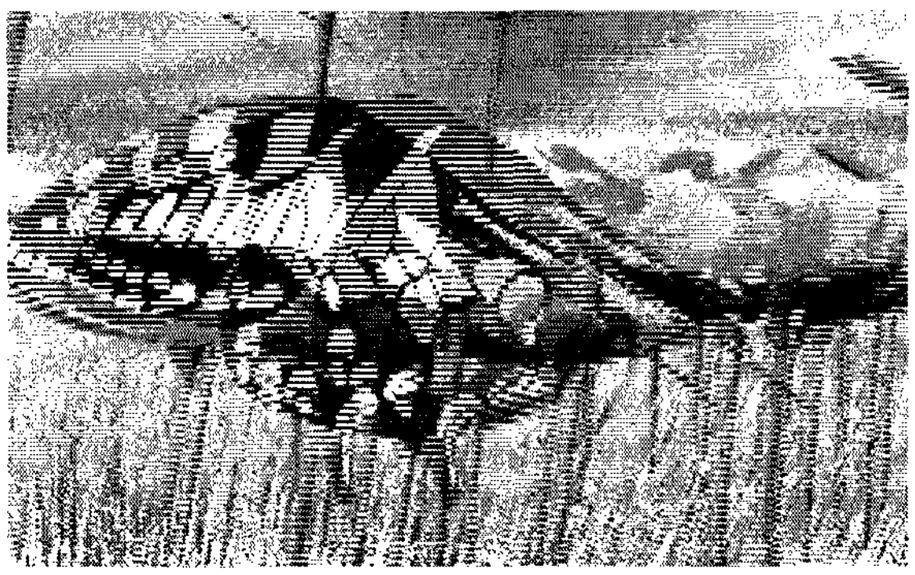


Figure 10. Example of stereoscopic image

6. Conclusions

In this paper, we explained a function, principle and operation of 3D image mode. Also we explained LCD shutter glass control signal and frame control signal (the main signals of 3D image player). With conventional 3D image player we cannot see stereoscopic image on the LCD monitors. Nowadays LCD monitors becomes more and more universal. So we propose 3D image player for LCD as well as CRT monitors with LCD shutter glass by considering afterglow and digital processing. In addition, we proposed the method to see stereoscopic image with color filter glass.

We have made 3D image player using FPGA. And we prove that we can see stereoscopic image on LCD monitors with LCD shutter glass.

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7. References

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