The Development of scientific learning material with 3-D

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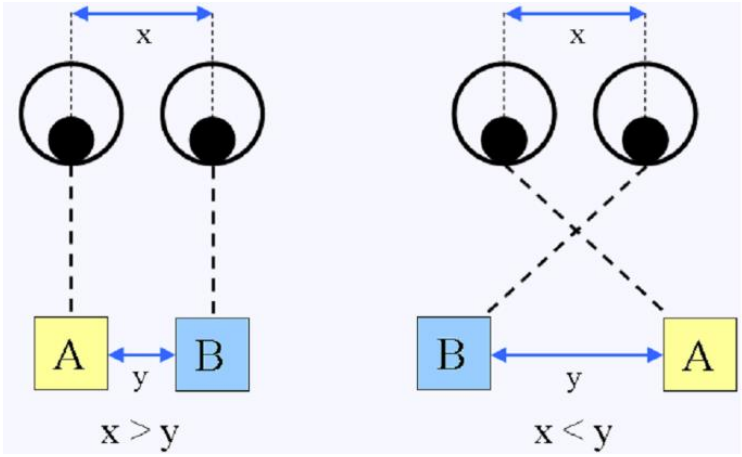
Abstract. Scientific learning material for teaching the principle of stereopsis to children is developed. Two wireless CCD cameras are equipped on the radio-controlled model car. Two images are taken by using these cameras. One is converted into red and the other is converted into cyan. These images are superimposed in real time by using the development program. This superimposed image can be viewed stereoscopically by wearing glassed composed of red and cyan film. In this learning material, children experience stereopsis by controlling the radio-controlled model car.

1. Introduction

The using of the 3-D image as a scientific learning material for teaching has been improved in recent years such as in astronomy subject [1], and medical education [2]. The aim of using the 3-D image as a scientific learning material is for enhance the interest in science and made science easier to learn. It's already proven that the teaching approach for science with science activities on student with an appropriate learning material give positive value to their comprehensive understanding of science [3-4]. Therefore, every year Gunma university has planned a scientific school for children. This activity is designed as contribute Gunma University to the local community. Science school was conducted in Takashimaya department store. A topic of science school is understanding stereopsis to children.

One of the ways to achieve stereopsis is the stereogram. Two images shifted a little in angle are taken. Two images are viewed as a superimposing image. There are two methods of the stereogram, i.e. the parallel method and the intersection method. Figure 1 shows these two methods for stereopsis. The parallel method is used to view the images whose interval is smaller than that of human's both eyes. On the contrary, the intersection method is used to view the images whose interval larger than of human's both eyes. An anaglyph image is made as follows: 1) The colors of two images are changed to red and cyan. 2) The color of image A is changed to cyan, while that of image B is changed to red. 3) Two images are viewed by wearing glasses composed of red and cyan film. Figure 2 shows a photograph of the glasses composed of red and cyan film. The red image is viewed through a red film. The cyan image is viewed through a cyan film. Two images are easily superimposed as one image. This image is easily viewed stereoscopically.

A scientific learning material is developed for the scientific school that is a radio-controlled model car equipped with two wireless CCD cameras, a course to run the radio-controlled model car, two programs to take images and to process images. The children will learn a stereopsis using a learning material with an enjoyable activity that is playing the radio-controlled model car. The stereoscopic animation is developed and the children can experience and learn stereopsis using the radio-controlled model car equipped two wireless CCD cameras.



(a) The parallel method (b) The intersection method

Fig. 1. The parallel method and the intersection method

Fig. 2. The glasses composed of red and cyan film

A program for taking images is reprogrammed of the program developed by e-JIKEI Network. The Society for e-JIKEI Network proposed “e-JIKEI Network” [5]. The project intends to recreate the mutual watching system, which had usually functioned in old communities, in the present days but in a much more powerful and flexible form with the aid of the information technologies. The project is discussed from the viewpoint of social dimension [6,7], security of residential area [8], and national security [9].

A program for processing images is reprogrammed of the program developed by Society for Recorded Image Restration [10]. The authors have proposed some methods for restoring the image of the suspected person recorded by security cameras with dirty lens [11-14]. These studies make the best use of peculiar characteristics of security camera systems that all the things except suspected person are usually preserved and can be used for criminal investigation. A method for restoration of the suspected person recorded by security cameras with dirty lens under oblique illumination has been proposed and its performance has been demonstrated in the experiment [11]. A method for measuring the space-variant PSF using a LCD has also been proposed [12]. A method for estimating color from images recorded by monochrome security cameras with dirty lens has been proposed [13]. The possibility of estimating color from images recorded by monochrome security cameras has been discussed for the first time in this article. This possibility has been discussed in detail. In the previous study , a space varian color filter, which consists of red, green and blue glasses and gives color estimation ability to monochrome security cameras has been developed [14].

2. Configuration

Figure 3 shows the photograph of the scientific learning material which is the radio-controlled model car and the course to run the radio-controlled model car. Two wireless CCD cameras are equipped on the radio-controlled model car with an interval of two wireless cameras approximately 35 mm. The interval of human's both eyes are about 70 mm. Therefore, the intersection method was used. In order to use a stereogram, two cameras take images from two directions. The heigh and fixed position of the lens of two cameras are needed to arrange correctly. The electric current source of a camera is supplied from the battery of the radio-controlled model car. Two programs are developed for stereograms. The functions of the programs are as follows: 1) In the first program, images are taken with a constant period from the CCD and saved in a PC via USB interface. 2) In the second program, the value of RGB of the saved image is averaged over the pixels. In case of the red image, the averaged RGB value is transposed to the value of R, and the other value is set to 0. In case of the cyan image, the averaged RGB value is transposed to value of B and G, and the other value is set to 0. The color of image is converted into red or cyan by means of the averaged values. Two images of red and cyan are superimposed.

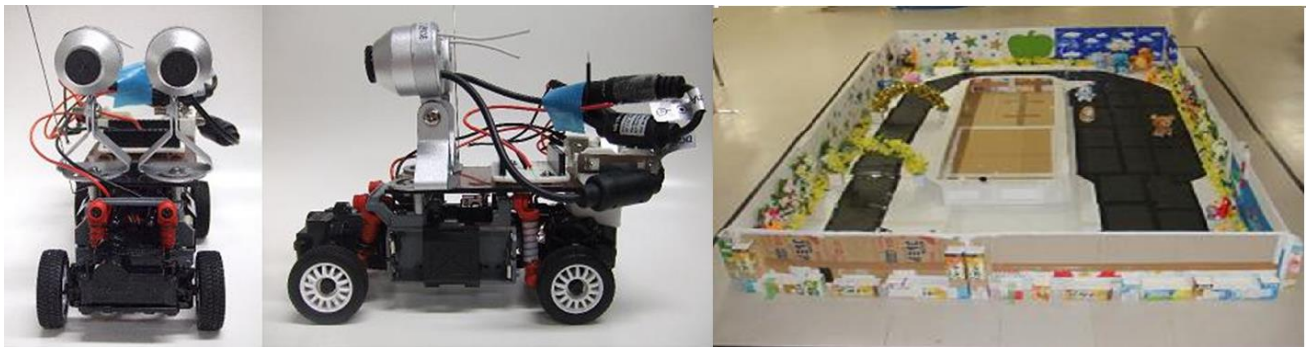


Fig. 3. Photograph of the scientific learning material.

Figure 4 shows the color converted and the superimposed images. The superimposed image is outputted on the display. The course decorated with dolls is created. Children view a monitor displayed superimposed image and control the radio-controlled model car. Dolls is viewed stereoscopically, controlling the radio-controlled model car on this course.

(a) Cyan image (b) Red image (c) Superimposed image

Fig. 4. Cyan, red and superimposed image.

Children can view a doll stereoscopically on the monitor. To make children understand the principle of stereopsis, we performed following procedure in scientific school. The radio-controlled model car is controlled on the course. The image of three-dimensions (3-D) is viewed by wearing the glasses. Children get to questions: how to view stereoscoplically. The principle is explained by using two posters. Figure 5 shows a poster for explaining a principle of stereopsis. The following

procedure is explained by the poster. Stereopsis is parallax. Outlook of superimposed colors : red and cyan. The superimposed image is viewed by wearing the glasses composed to red and cyan film.

3. Results

Performance using learning material in scientific school is discussed in detail. Scientific school was conducted for three days. There were about fifteen booths which is scientific school, thousand people came to scientific school in a day and a hundred children came to our booth.

The authors performed as follows.

(1) The principle of stereopsis was explained by the poster as shown figure 5.
(2) Children viewed a superimposed image wearing a glasses composed of red and cyan film.
(3) Children practiced to controlling the radio-controlled model car while looking at a course.
(4) Children tried to control the radio-controlled model car while looking at a stereoscopic image on a display monitor.

The children had experience of the stereopsis through this activity. Children got impressions that dolls can be seen stereoscopically on the display and this activity was enjoyable. On the other hand, some children can't see the image stereoscopically and had difficulty on controlling the radio-controlled model car because the images received from two wireless CCD cameras were distorted.

Generally, the children enjoyed with this learning activity and they can learn the principle of stereopsis.

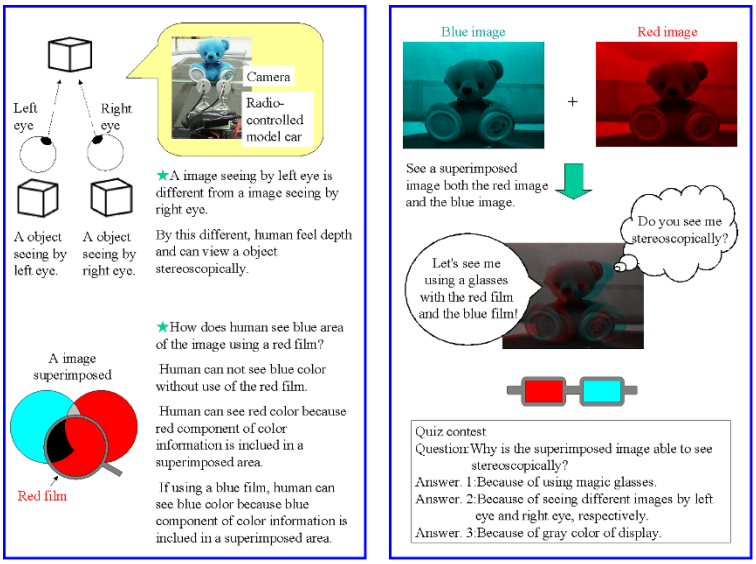


Fig. 5. Poster for explaining a principle of stereopsis

4. Discussion

There are some problems with scientific learning material. For example, the images received from two wireless CCD cameras were distorted because the radio waves of two cameras interference and the delay of two programs took several times. By using two programs, a delay between the output animation on the display and a real-time view by human's eyes is extended. In addition, frame rate is also decreased. This problem is solved by reprogramming with function called "DirectShow". Taking images using two cameras and image processing can be performed much faster than current programs only by one program using "DirectShow". The delay is shorted, the frame rate is also increased.

The dolls arrangement ware also important to view more clearly stereoscopically. The anteroposterior relation of the dolls can be clarified.

5. Conclusion

The scientific learning material in learning stereopsis for the children is developed. There are some points for improvement of this learning material. The purpose of developing this learning material is to educate idea of children and enhance their interest in science. In future, more improvement in scientific learning material will enhance the quality of children's education.

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