

Image Display based on Actual Object Stereoscopic Scene

Jian Du^{1,*}, Xiao Ma¹

¹School of Mechanical Engineering, Southwest Petroleum University, Chengdu 610500, China.

Abstract

The life cycle of the traditional graphic design is short. Considering people prefer to quickly browse image information, the impression of conventional graphic is not particularly. Additionally, people every day meet various plans, so the information overload has weakened the propaganda role from any ones. Therefore, the reader can't remember any information, unless the advertising information is closely related to them. Moreover, now most of the plans are similar, it is inevitable that there will be aesthetic fatigue. Then, three-dimensional advertising is proposed to provide solutions for these problems. In three-dimensional advertising, stereoscopic scene capture as a new thing is widely used in industry and has strong publicity effect. The products are mainly for the wedding photography, advertisement making, greeting card, certificate card, desk calendar, packaging and printing, anti-counterfeit labels, magazine covers of books and other fields. The appearance of physical stereoscopic scene brings new visual impact to people. According to the above, we realize the new stereoscopic scene by image synthesis, and display it through the lenticular lens. The experimental result shows it visible and gives impressive visual impact, then to achieve publicity effect.

Keywords

Actual object stereoscopic scene; Image synthesis; Propaganda effect.

1. Introduction

We know that the technical principle of the naked-eye 3D technology is that the human left and right eyes see the same object but at different angles, which causes the "illusion" on the retina. If the image formed by the same object point through the right eye is on the right side of the image imaged by the left eye, the object point will feel "concave" in the plane; similarly, if the image imaged by the right eye is on the left side of the image imaged by the left eye, It will feel "convex" outside the screen. After software processing and calculation, the parallax image can be placed in the corresponding position according to a certain rule. Finally, a 3D image with a three-dimensional effect is formed. This method does not require wearing any auxiliary equipment. The 3D effect can be observed directly with the naked eye. And the production method is simple, convenient to use and low in cost. In summary, naked-eye 3D is an inevitable trend in the development of display technology. Research on key technologies of naked-eye 3D display will determine the future development of the display industry. The theory result, As shown in Figure 1.

The lenticular grating is also called the cylindrical lens grating, which is realized by the principle of optical refraction of the convex lens. Through the principle of cylindrical lens image separation, the two eyes can see images at different angles to achieve a stereoscopic effect, as shown in Figure 2. We use the binocular parallax depth hint of the human eye to find and record different viewpoints on the target object as needed, and then use the conversion method to convert the plane The image is converted into a stereo image. A group of images with a certain parallax are taken or obtained by a special method, and then sampled and synthesized by Matlab according to certain rules to form an image, that is, the image is recorded on the same

picture in a striped state. Knowing from the structure of the above-mentioned lenticular grating, the established volume image can only be observed in the correct direction.

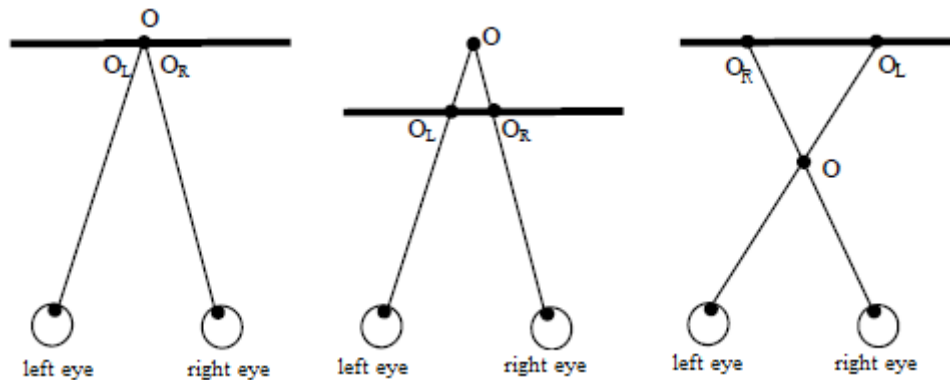


Figure 1. Horizontal parallax stereo perception

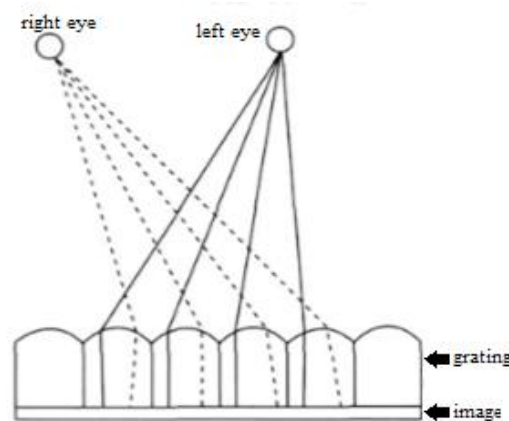


Figure 2. Cylindrical mirror grating

2. Method of Obtaining Target Parallax Image

2.1. Virtual Stereo Imaging

3D Studio Max. It is also loved by people because of its high cost performance, easy to use, and wide range of applications. This software has extremely high popularity in the fields of animation design and interior design, and it is relatively easy to get started, so we can use this virtual software to directly generate the parallax composite image we need.

In the application of 3ds max, we can easily get a visual image, and we can also shoot a visual image from multiple angles at the same time. In this way, the image obtained by the software will be more exquisite than the image obtained by taking pictures of the actual object, but the disadvantage is that it is not realistic enough and does not have the same outline feeling as the actual stereo image. When we get the source image, we can use the 3ds max software to get the required source images to replace the image obtained by taking a three-dimensional photo. As shown in Figure 3, we place cameras at multiple angles to get different parallax images. One of the camera vision can be locked in the software, and at the same time, the intuitive three-dimensional view can be observed from different angles according to the rotation module in the upper right corner. During this period, the selected camera corresponds to the top view, left view, and front view of its target. Corresponding changes will occur.

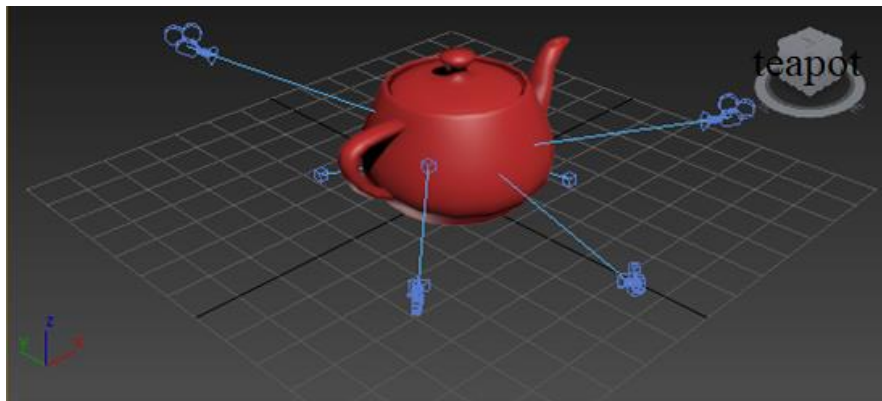


Figure 3. Multi-angle virtual camera imaging

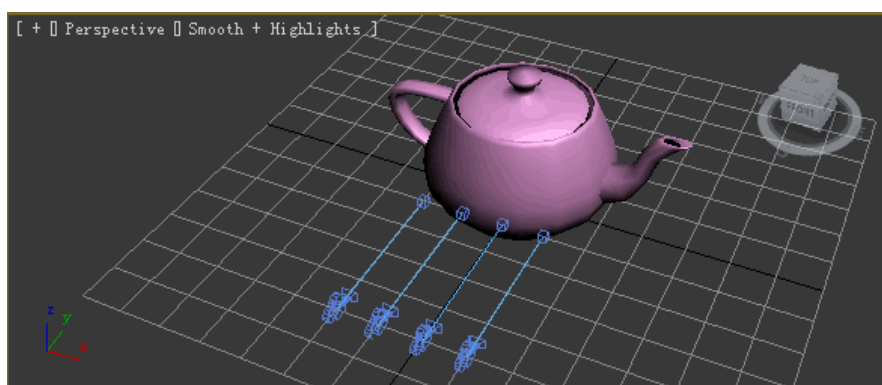


Figure 4. Parallel photography virtual camera imaging

As shown in Figure 4. It can be seen that after shooting at different angles, we can easily find an object point of this virtual object for parallax image collection, and finally find a composite image. The method of using virtual software to generate target images is a double-edged sword. On the one hand, the image synthesis is convenient and fast, on the other hand, the realism of the image is not high, and it is difficult to give people a real three-dimensional impression.

2.2. The Real World Imaging

We have two most common ways to obtain the source image. The first is to use a professional multi-lens camera to shoot each plane image of the same object at different angles at the same time and then convert it into a three-dimensional image. Or use a single lens. The three-dimensional and real sense of the image group obtained by this method is the best. Or directly use a single produced photographic image to produce a stereo raster image through a dedicated stereo software. The three-dimensional image produced in this way also has a good sense of three-dimensionality, but the authenticity of the details is not as accurate and delicate as the first one.

Right here, We chose a photography distance of 90cm for photography, and finally filtered the parallax images. A,B,C,D is the camera. The first step is to place the object in the center of the shooting location, and then divide the object into four equidistant shooting points on the horizontal line according to the position of the object, and shoot it. When dividing the equidistant points, pay attention to parallax The distance should be moderate. The schematic diagram is shown in Figure 5. As shown in Figure 6, we select some photos with higher brightness, clear and satisfactory. If you want more powerful 3D effects, you can use 8 images or even 16 images. But pay attention to equal spacing.

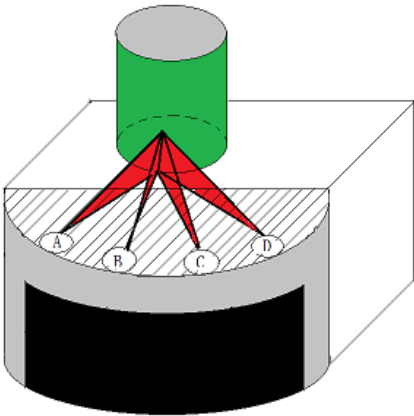


Figure 5. Shooting schematic diagram



Figure 6. Target image

3. Parallax Image Processing

In the above four parallax images obtained by directly shooting objects with cameras, the distance between the cameras cannot be guaranteed, resulting in different heights and parallax gaps of the parallax images or even large differences. The height difference of the viewpoint of each parallax image will bring about the vertical parallax that has nothing to do with the 3D display, which makes the human eyes feel tired. Finally, the effect of the synthesized 3D image is not realistic enough. Based on this, after we get the parallax image, we need to artificially process the parallax image to correct the same viewpoint position of each parallax image. In this way, after correcting the parallax images, we can clearly see that the distance between the parallax images is approximately the same. This method is used to calibrate the image to ensure the stereoscopic effect of the final composite image in the 3D display. The calibration process of the parallax image is shown in Figure 7.

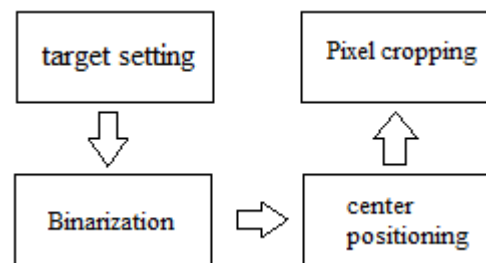


Figure 7. Processing flow

Open the four parallax images in the drawing software, use lines in these parallax images to outline the range of the can in the image, and then use dye to mark the area as black. As the picture shows Figure 8.

In an image, each pixel has a different gray value. The gray value can be artificially understood as the brightness of the color of the pixel. In short, it is the depth of the color. In a color image with RGB three channels, if $R=G=B=255$, the pixel is white. Similarly, if $R=G=B=0$, then the pixel is black. When $R=G=B$ is equal to a certain number between 0 and 255, then the pixel has a certain gray value. In fact, they refer to the gray values "0" and "255" corresponding to black and white respectively, and gray-scale image processing is to turn the entire color image into a gray-scale image. Here we specify a critical gray value, and call this gray value point the threshold. If the gray value of the image is greater than this threshold, we specify it as white; similarly, if the gray value of the image is less than this threshold, we specify it as black. At this time, the pixel set of the entire image is only related to these two values, which greatly reduces the workload of image processing. To facilitate the writing and processing of subsequent programs.

Use a gray-scale processing function `rgb2gray` in matlab to convert color images into black and white images. The gray scale method of the function `rgb2gray` in matlab is to use the weighted average method. The gray value obtained by the weighted average method is as (1).

$$f(i,j)=0.2989R(i,j)+ 0.5870G(i,j) + 0.1140B(i,j) \quad (1)$$

The three values in the formula are the sensitivity of red, green, and blue light in people's eyes, and are the weights of the respective colors after a large number of experiments. And the result is following fig.9.

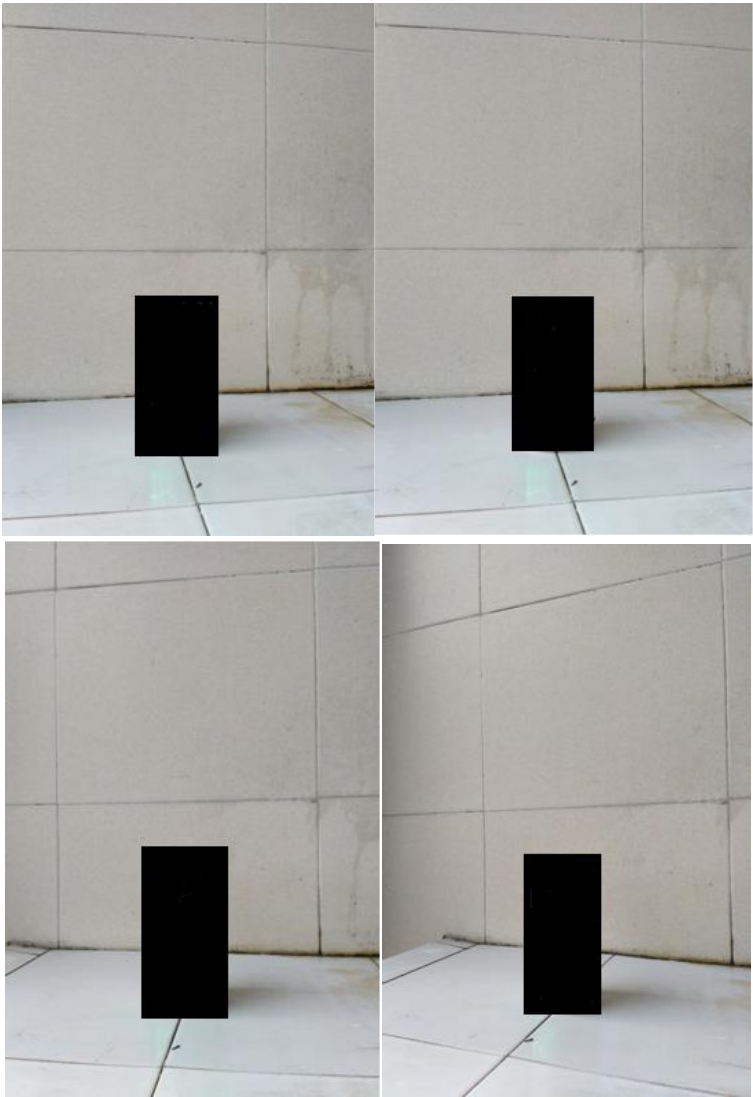


Figure 8. Initialization

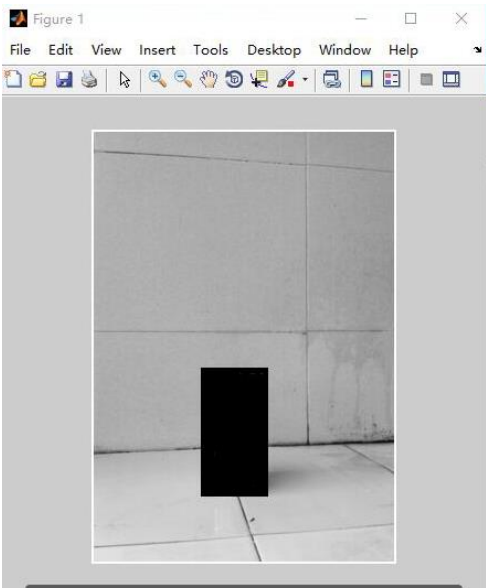


Figure 9. Binarization

Workspace		
Select data to plot		
Name	Value	Min
n3	10163	1016.8
xavg	188.8163	188.8
xavg1	193.4277	193.4
xavg2	198.9667	198.9
xavg3	192.5156	192.5
xc	2144198	2144.2
xc1	2422682	2422.7
xc2	2317365	2317.3
xc3	1956536	1956.5
yavg	188.8499	188.8
yavg1	227.7214	227.7
yavg2	313.4484	313.4
yavg3	362.5315	362.5
yc	2144579	2144.6
yc1	2852211	2852.2
yc2	3650734	3650.7

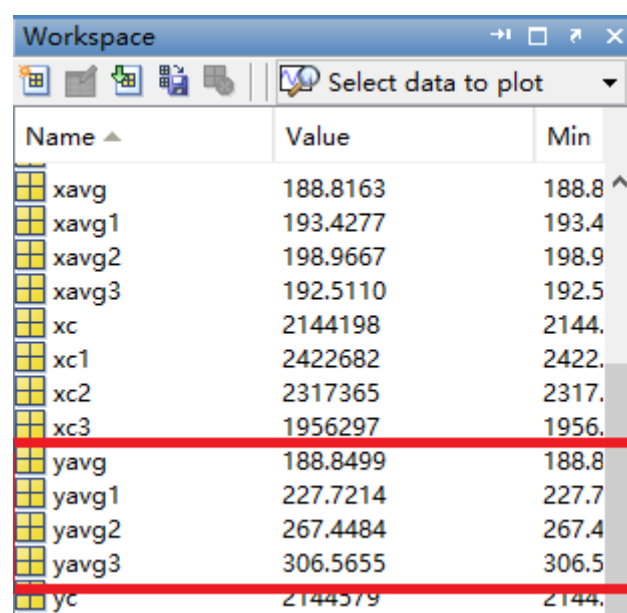
Figure 10. Center Data

After the four parallax images are grayed out, the processed images are programmed to calculate. Matlab will automatically generate the average value of the horizontal coordinates of each image and the average value in the vertical direction. According to these parameters, we can see the center value of the corresponding area after each image target is located. as the picture shows Figure 10.

It can be seen from the parameters that the Distance between the first parallax image and the second parallax image is approximately $227-188=39$ pixels. In order to ensure the same distance between the centers of every two adjacent parallax images. Then the center point of the third parallax image should be moved to the $227+39=266$ th pixel, that is, the third parallax image is moved to the left by 47 pixels. In the same way, the fourth parallax image is moved to the $266+39=305$ th pixel, that is, the fourth image is moved 57 pixels to the left, which ensures that the center spacing of the four parallax images is consistent.

After processing, we ensure that the spacing between the parallax images is the same. It can also be seen from these parameters that when shooting real objects, the distance observed by the naked eye is slightly different from the actual distance, and this difference will eventually affect the 3D visual effect. However, these small differences can also be modified by software. We can start from this algorithm to further enhance its 3D display effect. However, it should be noted that this method has limitations. Undering higher accuracy requirements, this method is not applicable.

Assume that the lower left corner of the image is the origin of coordinates. We define a certain sub-pixel position of a black and white image that has been binarized in matlab as $f(i, j)$, where i and j represent the vertical and horizontal coordinates of the pixel respectively. Then at this time, any point on the image can be found using the coordinate values in a quadrant. According to the principle of center positioning, the third parallax image and the fourth parallax image need to be shifted to the left by 47 and 57 pixels, respectively. In other words, for the third image and the fourth parallax image, we can cut off the 47 and 57 pixel columns to the left. So as to achieve the purpose of pixel cutting. After running the program, overwrite the original image. Figure 3.10 is the fourth disparity map to modify the pixel pattern. As the picture shows Figure 11.



Name	Value	Min
xavg	188.8163	188.8
xavg1	193.4277	193.4
xavg2	198.9667	198.9
xavg3	192.5110	192.5
xc	2144198	2144.
xc1	2422682	2422.
xc2	2317365	2317.
xc3	1956297	1956.
yavg	188.8499	188.8
yavg1	227.7214	227.7
yavg2	267.4484	267.4
yavg3	306.5655	306.5
yc	2144579	2144.

Figure 11. Pixel cropping

After the processed parallax images are organized, they are placed in the corresponding folder for easy recall. Thus. We have obtained four parallax images with roughly the same distance between the cameras to provide us with a four-view 3D physical display. The Cylindrical mirror grating parameter is fig.12.

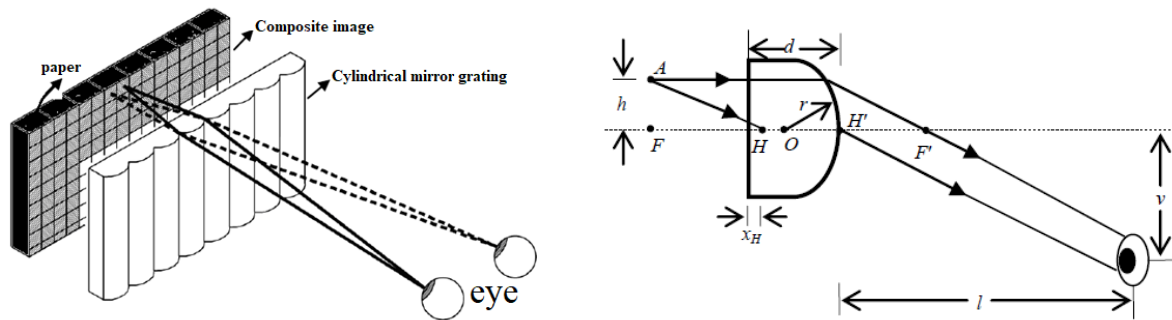


Figure 12. Cylindrical mirror grating parameter

Theoretical parameters is as the picture shows Figure 13.

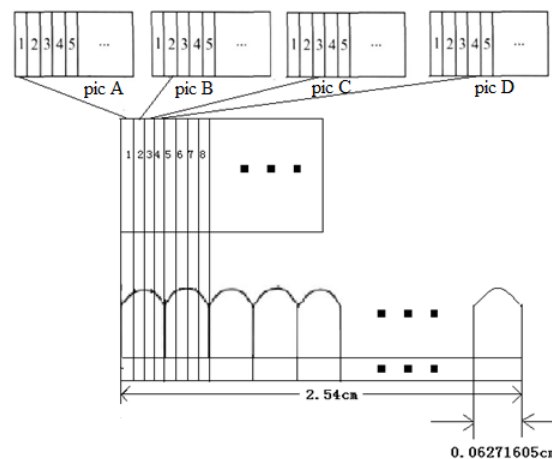


Figure 13. Theoretical parameters

In order to make the actual three-dimensional display effect under the lenticular grating is good. It is necessary to make the pixel column size of the image correspond to the raster. The LPI of a lenticular lens grating is the number of lines with unevenness in one inch. For example, if the measured LPI value of the grating is 40.5, it means that the total distance of 40.5 cylindrical lens elements is one inch. Based on this, we can calculate the length of the unit cylinder element as $M=2.54/40.5=0.06271605\text{cm}$.

In the principle of imaging by cylindrical lenses, we intend to place 4 parallax images evenly within a grating period. As shown in Figure 4.3. Since D from raster to printed drawing is determined, we can get the value of N through the similar triangle relationship $M/N=L-D/L$. In the final theoretical printing image pitch N/K , the width of each sub-pixel column is obtained. Change the width of the sub-pixel column to display the corresponding image. As the picture shows fig.14.

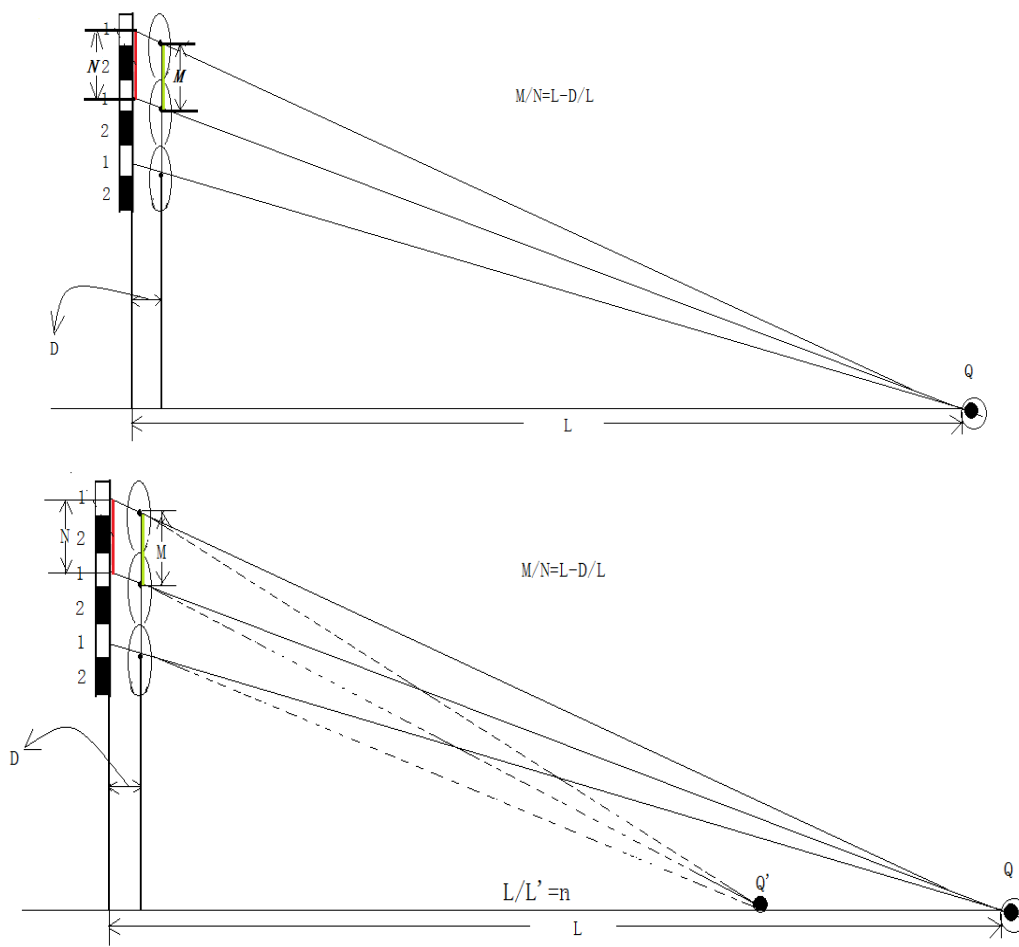


Figure 14. Theoretical parameters

According to the above, it can be known from the characteristics of the grating that when the human eye observes an image through the lenticular grating, each lenticular lens unit refracts the light of each parallax image placed at different positions on its focal plane to different directions. Taking the two-view 3D display as an example, the odd and even columns of pixels on the display panel respectively display two parallax images on the left and right. The pixels seen from a point Q of the display panel L are all pixel columns of the parallax image 1. However, in fact, because the theoretical calculation formula does not consider the effect of the optical parallel plate on the optimal viewing distance, the optimal viewing distance will be refracted to a closer distance. when light exits through the lens, the light path will change at a certain angle due to refraction. The exit light of each pixel column re-converges at a new point Q', making the final L' closer to the display panel. Where n is the refractive index. As it shown (2).

$$Q/Q' = n \quad (2)$$

Then use matlab programming. Synthesize a new image as shown fig 15.

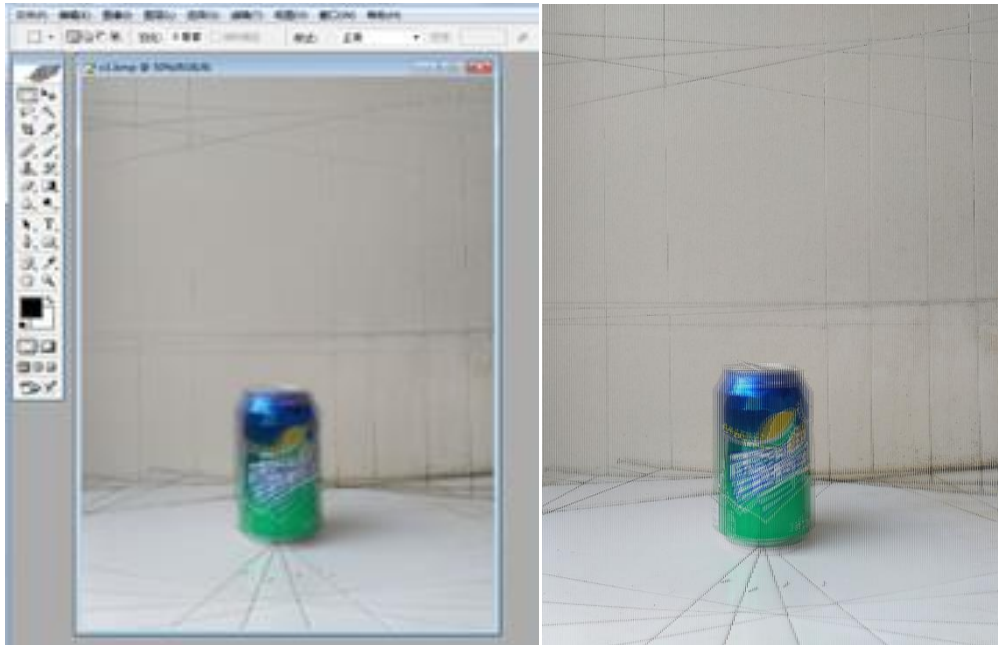


Figure 15. Target image

4. Conclusion

Then we posted on the surface of Cylindrical mirror grating. We make it. As fig 16.

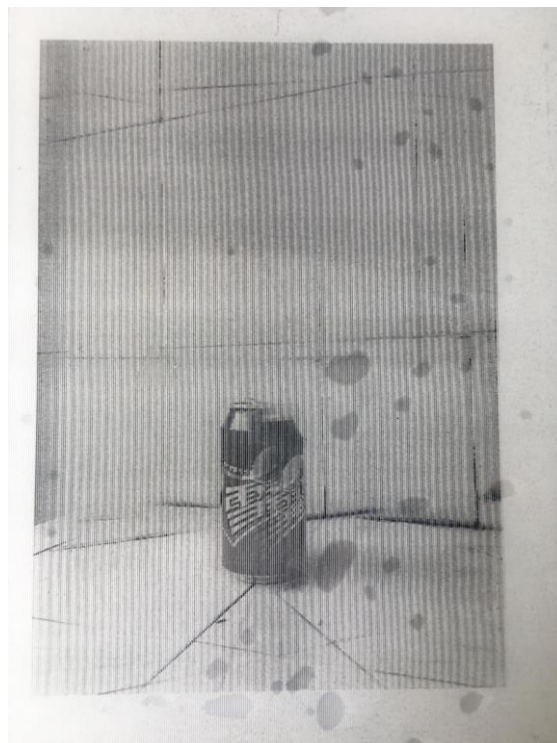


Figure 16. Finished product

After tens of parallax images are used, the computing power of the software is used to synthesize the images. Before that, if we adopt the image processing capabilities in Photoshop in advance, we will get a better composite image. First, convert it into the grayscale mode of the image in PS, and then use Matlab for synthesis. And we know that the principle of 3D display is to use the depth parallax of the human eyes. The mirror images seen by the left and right eyes

are usually slightly different. If the lenses of multiple cameras are regarded as human eyes. Then each photographic lens will have slight differences when facing the same object point. At this time, it is also necessary to use matlab software to write a program to process the image center point. Use software to adjust and synthesize the center value of the image. It is much better than directly using the original parallax image to synthesize the target image. This front-end optimization method for image synthesis is worth trying.

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