

# Development of a 3D Stereo Comic Creation Tool and a Display System for the 3D Android Smartphone

Shigeru Sasaki, Masafumi Furuta  
Department of Human Information Systems  
Teikyo University  
Utsunomiya, Japan  
e-mail: sasaki@ics.teikyo-u.ac.jp  
11M107@uccl.teikyo-u.ac.jp

Seiichi Tanaka, Marika Kishi, Yui Takifuji  
Department of Art  
Bunsei University of Art  
Utsunomiya, Japan  
e-mail: seiichi-tnk@jcom.home.ne.jp  
kishi.m.ggc@gmail.com  
takifuji.yui.1217@gmail.com

**Abstract**—In recent years, three-dimensional (3D) stereo content has become familiar, and portable information devices equipped with a naked-eye 3D liquid-crystal display, such as smartphones, have appeared on the market. In addition, images created by conventional hand drawing, such as comics, are being created more frequently using a computer. In this study, we developed a 3D stereo comic creation tool in which a stereo image is created from pictures drawn on layers. We also developed a 3D stereo comic viewer application program that displays 3D pictures on a smartphone. This 3D stereo comic content creation technique is not intended to replace techniques based on 3D computer graphics, but is a useful, additional technique for the creation of 3D stereo comic content.

**Keywords**—3D stereo comics; smartphone; naked-eye 3D liquid-crystal display; Android application; Java3D.

## I. INTRODUCTION

In recent years, three-dimensional (3D) stereo content has become familiar, and portable information devices equipped with a naked-eye 3D liquid-crystal display, such as smartphones, have appeared on the market. Many of the 3D stereoscopic images for these devices are created using 3D computer graphics (CG). However, special technology and knowledge are needed for the creation of 3DCG, and it takes considerable time and effort.

In addition, images conventionally created by hand drawing, such as comics, also are being created more frequently using a computer. When creating a hand-drawn picture on a computer, a part of the picture is drawn on a transparent sheet called a layer, and the technique of stacking them to create one picture is used. Usually, even if a lot of comic creators have the skills to hand draw pictures on layers, they rarely have the skills to create 3DCG. The authors have succeeded in creating 3D stereo comics by adding depth to individual layers. Although this technique differs from the conventional manner of creating 3D stereo images using 3DCG, it is expected that 3D stereo pictures that incorporate the benefits of hand drawing will be created using our method.

The remainder of the paper is organized as follows. In Section II, we describe the state-of-the-art in 3D stereo

comic creation. Section III describes the aim of our research. Section IV describes outline of the system. Section V describes creation procedure for 3D stereo images. In Section VI we describe questionnaire survey we conducted. Section VII provides discussions. Finally we summarize our result in Section VIII.

## II. STATE-OF-THE-ART IN 3D STEREO COMIC CREATION

Stereoscopic 3D images from a work in a comic book are created by the method using 3DCG. Creation of these works is mainly carried out as animation [1]. There are also many works that contain 3D images that were created from hand-drawn pictures, and hand-drawn animations have been converted into stereoscopic 3D images by adding depth to individual pixels [2][3].

While the creation of an animated movie is a large-scale project carried out by a lot of people, the work of creating comics is on a small scale and is usually performed by one person or a small group of people.

In Japan, many comic magazines are published every day. These techniques are unsuitable for converting a lot of hand-drawn comics into stereoscopic images immediately. Moreover, it is desirable that you can read numbers of newly released stereo comics on a ubiquitous portable device.

In this research, although it was not a precise but a simple stereo effect, we propose an easy technique of creating stereoscopic images. And we also create a viewer program for displaying those stereo comic contents. Such a tool has not been developed until now and it is useful for the comic creators who are going to make stereoscopic contents personally or in a small group of people.

## III. AIM OF RESEARCH

The aims of this study are to provide a technique by which comic creators can easily develop 3D comics and an application through which people can easily enjoy 3D comics—like a digital book—on a smartphone equipped with a 3D liquid-crystal display. To this end, we developed a 3D stereo comic creation tool, in which stereo images are created from pictures drawn on layers. In addition, we developed a 3D stereo comic viewer application program

that displays 3D pictures on a smartphone with various effects. Using these tools, we converted comic content into 3D stereo images and displayed these images on a smartphone.

#### IV. OUTLINE OF SYSTEM

##### A. 3D stereo image creation tool

In our 3D stereo image creation tool, a graphics file (in Photoshop format) that contains layers is read, and depth is added to each layer. With this tool, depth can be set for a layer in three ways: by setting a fixed depth to a layer, by setting different depths for the four corners of a layer, and by making the color of each pixel of a grayscale image correspond to depth. When depth is added to four corners of a layer, the depth of each pixel of an image is given by bilinear interpolation.

After setting the depth, the spatial relation of a layer can be previewed.

Finally, the tool creates a 3D stereo image using the depth information and saves the image file in jpeg format. The stereo image files were output in side-by-side-half format, because the smartphone used in this research could handle only stereo images in this format. However, the tool can also save stereo images in a standard side-by-side format for other applications. The 3D stereo-image creation tool was made as a Java application. The spatial arrangement of layers can be previewed by 3DCG. In this program, a PSD parser [4] is used for reading files saved in Photoshop format (PSD), and Java3D is used for the 3D preview.

##### B. Viewer application program

The viewer application program is intended for displaying the 3D stereo images created with the 3D stereo image creation tool on a smartphone equipped with a naked-eye 3D liquid-crystal display. This application can apply a number of effects to comics. The first effect is to place a 2D image on a 3D stereo image, in which process parallax can be added to the 2D image. The second effect is to animate the 2D image displayed on the 3D image. The third effect is to play a sound file when images are displayed. Operations are performed by tapping and flicking. A page is turned over by flicking, and another image—such as a word balloon—is displayed or a sound file is played by tapping. The comic image files are saved in a folder for each work on a microSD card. The viewer program was created as an Android application. In this program, the SHARP SDK AddOn [5] distributed by SHARP was used.

#### V. CREATION OF 3D STEREO IMAGES

The procedure for the creation of 3D stereo images is shown below.

##### A. Save image data in Photoshop format

Pictures with different depths are drawn on different layers. However, even if the order of depth and layer is not in agreement, 3D stereo-image creation can still be performed. When adding depth by using a grayscale image, the grayscale image layer should be placed immediately before

(above) the target layer. An example of a grayscale layer for adding depth is shown in Fig. 1. A 3D preview of depth given by a grayscale image is shown in Fig. 2.

The image data are then saved in PSD format.

##### B. Read a PSD file into the 3D stereo comic creation tool

A PSD file is read into the 3D stereo comic creation tool.

##### C. Set depth for each layer

There are input columns for setting the depth for each layer. A fixed depth or different depths for each of the four corners can be input. If a check box is unchecked, the layer will not appear on the 3D stereo image. When using a grayscale image for setting depth, the value of the grayscale color to the amplitude of depth is set. The main window of a 3D stereo comic creation tool is shown in Fig. 3.

##### D. Check spatial arrangement of a layer in 3D view

After setting the depth, the spatial arrangement of a layer can be checked by a 3DCG preview, as shown in Fig. 4.

##### E. Save 3D stereo-image data in side-by-side-half format

Finally, image data is saved in a side-by-side-half format. A sample of a stereo image is shown in Fig. 5. The image files should be saved in a separate folder for each work. A numbering system (such as 1.jpg, 2.jpg ...) is used for naming the image files.



Figure 1. Example of a grayscale layer that adds depth



Figure 2. Depth added by grayscale image

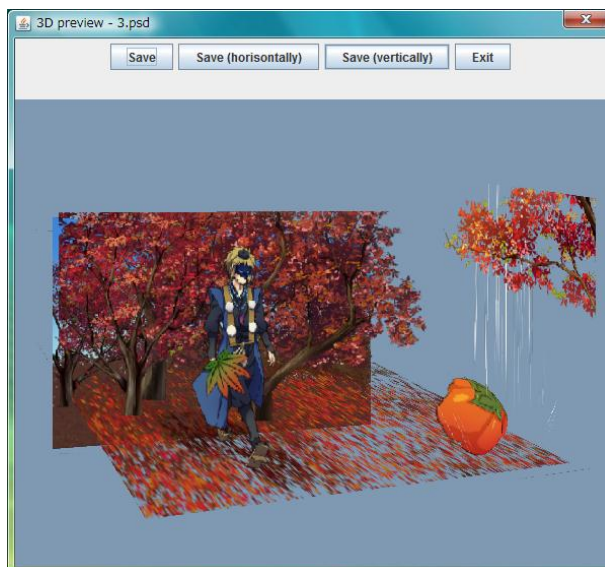


Figure 4. Preview of an entire image in the preview window

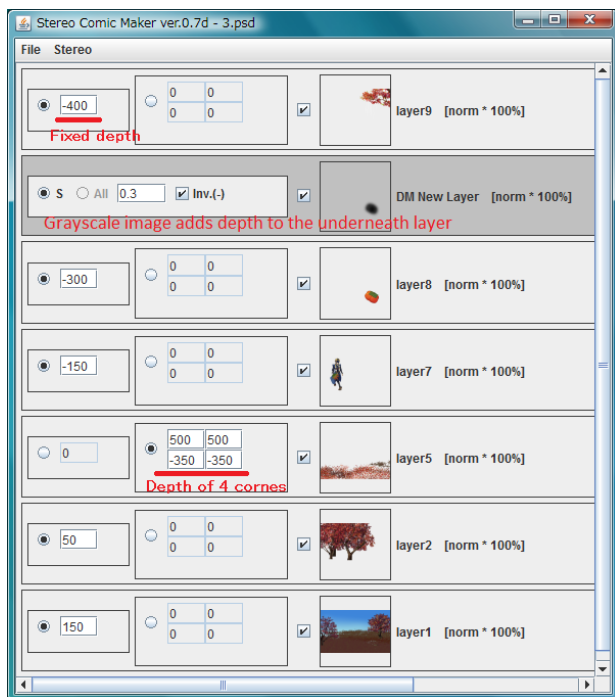


Figure 3. Main window of the 3D stereo image creation tool

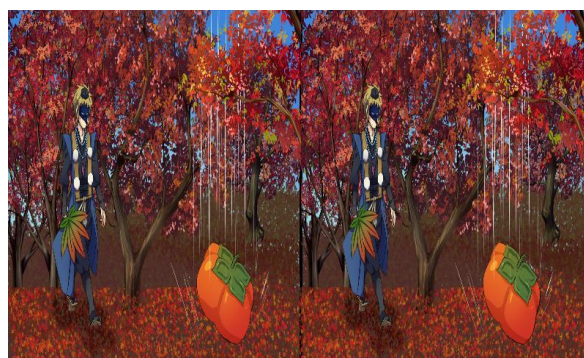


Figure 5. Main window of the 3D stereo image creation tool

## VI. QUESTIONNAIRE SURVEY

After we created 3D comic content using the tool developed in this research, we asked people to view the contents on a smartphone and answer a questionnaire survey. Responses were received from 57 persons, most of whom were under 20 years. In answer to the question whether they found the 3D stereo comic interesting, 91% replied “interesting” or “interesting to some extent.” In answer to the question on whether they would like to continue to read 3D stereo comics, 78% said “yes.” From these responses, we can say 3D stereo comics made by adding depth for individual layers of a Photoshop file are accepted in a friendly, positive manner.

## VII. DISCUSSION

The 3D stereo comics created by the tool developed in this research offer the advantage of allowing 3D comic content to be created using conventional comic-drawing techniques.

For comic creators who are already using computers in their work, it would be very easy for them to create 3D stereo comics from their existing digital image data. Two undergraduate students at the University of Art, who are co-authors of this paper, created two 3D comic works by converting 2D images into 3D images using our tool. Although they set the depth numerically, they did not set the depth using grayscale images. We need to add a function that helps the generation of grayscale-depth image easily.

Using this tool, 3D stereo comics can be created without losing the merit of a hand-drawn picture. This 3D stereo comic content creation technique is not intended to replace techniques based on 3DCG computer graphics, but be a useful, additional technique for the creation of 3D stereo comic content.

## VIII. CONCLUSION

In this study, we developed a tool to create a 3D stereo-image from pictures hand drawn on separate layers. We also developed an Android application that displays images created using this tool on a smartphone with a 3D stereo liquid-crystal display. From responses to a questionnaire

survey, it seems that our 3D stereo comic content creation method will prove useful as a technique for creating 3D stereo images.

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## REFERENCES

- [1] J. Gaudiosi, "3D wow!," *Computer Graphics World*, Volume 32, Issue 9, 2009, pp.31-34
- [2] K. Tucker-Fico, E. Goldberg, K. Koneval, D. Mayeda, R. Neuman, Riley, and M. Schnittker, "Design and realization of stereoscopic 3D for disney classics," *ACM SIGGRAPH 2011 Talks*, art. no. 12, 2011, pp.12
- [3] M. Salvati, M. Kinoshita, Y. Katsura, K. Anjyo, T. Yotsukura, and H. Uchibori, "Developing tools for 2D/3D conversion of Japanese animations," *ACM SIGGRAPH 2011 Talks*, art. no. 14, 2011, pp.14
- [4] PSD-parser download page, <http://blog.alternativaplatform.com/en/2007/07/09/parser-psd-formata/> (last access July 10 2012)
- [5] SHDevelopersSquare3D, [https://sh-dev.sharp.co.jp/android/modules/download/?api\\_stereo3dlcd](https://sh-dev.sharp.co.jp/android/modules/download/?api_stereo3dlcd) (last access July 10 2012)
- [6] Enago, [www.enago.jp](http://www.enago.jp) (last access July 10 2012)