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# A Study on Smart Phone-based Shooting Device of 3D Stereoscopic Image

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## Abstract

As the stereoscopic image provides the depth-of-focus to feel a real sense of distance, it has been actively studied in various fields including simulation, stereoscopic animation, interactive computers, etc. In this study, the platform which allows learning the stereoscopic image by utilizing a smartphone that is currently being used by public when taking the stereoscopic image and taking a simple stereoscopic image was proposed. The platform presented in this study will help in learning the stereoscopic image and taking a simple stereoscopic image to increase the understanding on the stereoscopic image and its utilization.

**Keywords:** 3D Stereoscopic Image, Side by Side Rig, Shooting Device, Smart Phone Shooting

## 1. Introduction

The stereoscopic image is attracting the audience by enhancing the live sense in the history of media which has evolved targeting for the human 'eye'.

In other words, it is to make a three-dimensional feel from two sheets of two-dimensional images by using the binocular disparity such as the human eye. As the stereoscopic image provides the depth-of-focus to feel a real sense of distance, it has been actively studied in various fields including simulation, stereoscopic animation, interactive computers, etc[1].

Especially, when it comes to the shooting of the three-dimensional image, disparity between the lenses (IOD) and convergence have to be adjusted in the process of making with two cameras and synchronization, distortion, etc. of two cameras should be considered as well.

Furthermore, the stereoscopic value should be also maintained for the smooth deployment of the images being filmed separately.

"While the disparity depends on the distance between two cameras and the distance to the subject, it is possible to observe the optimal disparity by checking in the indication on the display screen. So, the work of adjusting the disparity is to be implemented for every scene in the editing phase."

In this study, the platform design, which allows easy shooting of the stereoscopic image using two smartphones and its learning, and its development details are explained and furthermore, an effective method for shooting was investigated.

## 2. The Principles of Stereoscopic Image

First, confirm that you have the correct template for this. It would contribute to the production of the stereoscopic image and the learning of shooting by providing the platform where even elementary school students can easily understand the principle of the stereoscopic image and can take a shoot.

The principle of the stereoscopic image is based on the principle where the human eyes have disparity caused by interocular and then the stereoscopic feel is formed as shown in Figure 1.

In the human eyes, the disparity in sight happens due to interocular distance and the stereoscopic feel is recognized while it's integrated and recognized in the brain[2]. A stereoscopic image is produced using two cameras like a 'binocular' together with the element which can be felt with a monocular [3].

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**Figure 1.** Interocular distance.

When taking a stereoscopic image with two cameras, the disparity between lenses is to be generated for the same effect as the interocular distance and the protrusion area and the recessed area are to be determined through the process of convergence toward the main subject.

However, while the human eye automatically recognizes the target sterically, the disparity between lenses, the convergence, the stereoscopic value, etc. have to be effectively combined when implementing the stereoscopic image artificially.

Otherwise, it brings "visual fatigue by headaches or tiredness due to the excessive protrusion feeling and depth"[2].

# 3. Shooting Method of Stereoscopic Image

## 3.1 Beam Split Rig

As two cameras must record the same image data when shooting a stereoscopic image, it was explained that the equipment called the rig is used.

When it comes to the type of rigs, the various rigs have been developed and they are divided into the vertical rig and the horizontal rig depending on how the camera is positioned.

It's because of this situation, where it's difficult to record as much as interocular distance (6.5 cm) due to the camera lens's size, and also the situation, where shooting has to be different from interocular distance. Pros and cons of the vertical rig are shown below.

### *3.1.1 Vertical League Advantages*

- To minimize the distance between axis, it is possible to close-up.
- Can be incorporated into a variety of camera and lens.

### *3.1.2 Vertical League Disadvantages*

- The quantity of light loss generated by the half mirror (about 1/2 stop).
- By the mirror quality L, generates a color difference of the R image.
- Poor mobility due to the volume and weight.
- The filter has a restricted use.
- Set the alignment is difficult as well as time consuming.
- Additional personnel and equipment are needed.

## 3.2 Side by Side Rig

The Side by side rig is the equipment which shoots by placing the camera most similar to the human eye. However, it's not free to adjust the inter ocular distance due to the camera lens's size and pros and cons of the horizontal rig are shown below.

### *3.2.1 Side by Side Rig Advantages*

- League match settings and alignment is relatively easy.
- There is no reduction in exposure and color differences left and right images.
- This is similar to the still camera and the environment.

**Figure 2.** Beam split rig.

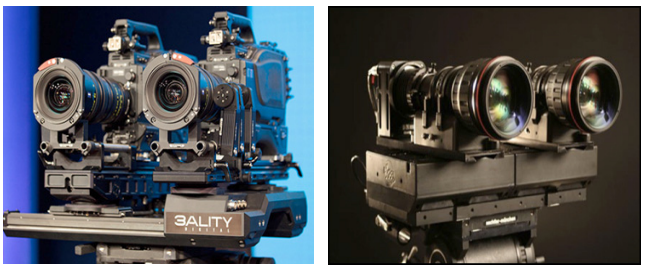

**Figure 3.** Side by side rig.

- Grip equipment is easy to use. (Steadicam, Jimmy Jib, etc.)
- It is easy to shoot distant landscape.

#### *3.2.2 Side by Side Rig Disadvantages*

- The camera close-up axes difficult due to distance constraints.
- A three-dimensional stability disadvantage in near-field recording to generate the fatigue.

### 3.3 Changes in the Three-dimensional According to the Center Distance and Convergence

It's divided into parallel type, mixed type and divergence type depending on the convergence control method which controls two cameras installed in the rig during shooting the stereoscopic image.

Figure 4 shows the main view configuration method. When shooting with the parallel type as shown in Figure, all subjects happened to have the images which looks protruded out of the screen and the floating stereoscopic window occurs at each end of the recoded image.

When it comes to the mixed type, while the image data taken from the camera on the left has the same data as an image taken with one camera, the keystone distortion occurs on the right image data so that inconsistency in the image on the top and bottom of the left occurs. Also the image data taken with the divergence type has the keystone distortion occurred on the top and bottom of the left and right.

While there's the system developed which shoots correcting such distortions, it's supporting with very high price so that the reality is that there's the limits of use. The rig consists of the function of mounting two smartphones to take a stereoscopic image using the smartphone and the other function of moving up and down, left and right and rotation to adjust the position of the camera.

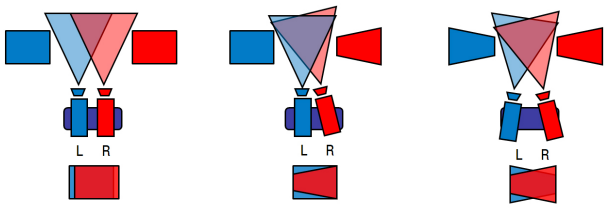


**Figure 4.** 3D shooting convergence.

The rotating plate is a luggage mount which can control the rotation through the smartphone and Bluetooth communication and automatically rotates in conjunction with shooting[4].

## 4. 3D Rig Design and Production

Table 1 shows the parts list used for the 3D rig. Using a parts list was creating 3D Rig as shown in Figure 5, 6, 3D Rig performance was improved through the scale improved by trial, right and left movement improved, smartphones mounted, improvement and improved performance through improving vertical movement.

**Table 1.** Parts list

| Item Number | File Name (No Extensional) | Author | Quantity |
|---|---|---|---|
| 1 | JKSC16_430_C1 | PART user 1 | 1 |
| 2 | Shaft Holder_2 | Kim | 1 |
| 3 | Shaft_C | Kim | 2 |
| 4 | Shaft Holder_R | Kim | 1 |
| 5 | Shaft Holder | Kim | 1 |
| 6 | CHBS4_20 | PART user 1 | 2 |
| 7 | BPK04 | Kim | 2 |
| 8 | Battom_2 | Kim | 2 |
| 9 | Holder | Kim | 2 |
| 10 | IPhone 5S | Kim | 1 |
| 11 | CHBS4_25 | PART user 1 | 2 |
| 12 | Galaxy Tab7 | Kim | 1 |

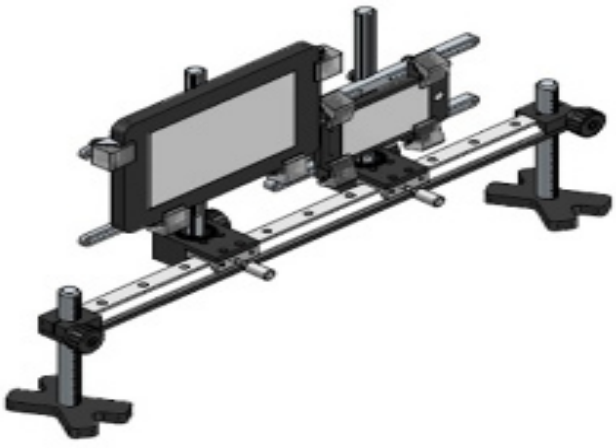

**Figure 5.** Design of 3D rig for smart phone.

**Figure 6.** 3D rig product.

## 5. Smartphone Turntable for 3D Stereoscopic Shooting

Smartphone control turntable has been designed as follows in the following order.

- When you apply power to the spindle MCU initialization, blue-tooth initialization, the motor must initialize PID.
- By changing the Bluetooth mode to standby waiting the packet from the mobile device
- Change command and each mobile, a certain amount of time one rotation is the packet error checking through the CRC.

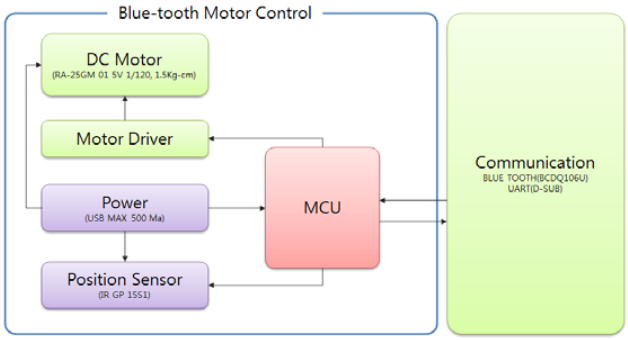


**Figure 7.** Structure of smartphone control turntable.

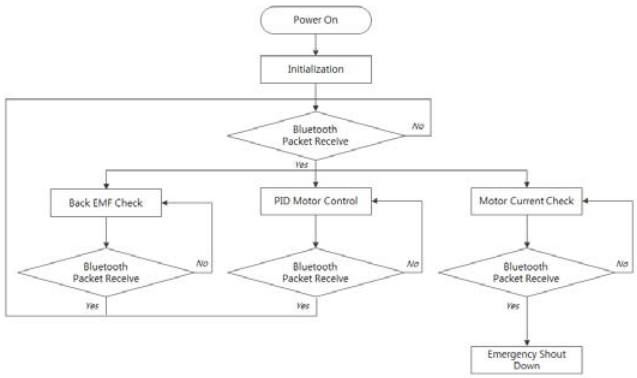


**Figure 8.** Flowchart of smart control turntable.

- Recognizing in each moving Back EMF is moved by measuring the rotational speed and the motor speed.
- A certain amount of time one rotation is measured by the rotation speed and the motor speed by recognizing a Back EMF constant for each packet and transmits the response on the go.

- Recognizing the back EMF by measuring the rotational speed and the motor speed moves at an angle.
- Minimizing the flow of the spindle motor by PID control.
- Emergency stop by measuring the motor current excess.

### 5.1 Turntable Function

Figure 10 is a description of the product turntable. This uses a blue-tooth communication, the power on/off function, the function of the rotation through the number of rotated and the function of the rotation through the angle.

**Figure 9.** Smartphone control turntable product.

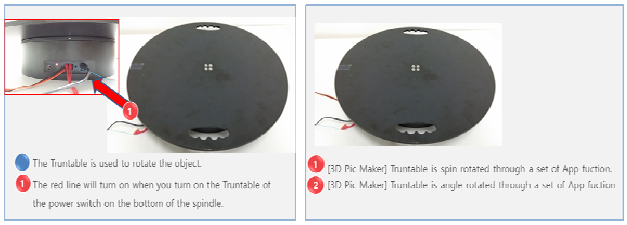


**Figure 10.** Turntable power on/off function (left), Turntable rotated function (right).

## 5.2 App for 3D Stereoscopic Shooting

3D PicMaker is the app which allows shooting while controlling the rotating plate and it's the app where resolution matching, shot timing synchronization, the number of shots and the number of shot step can be set as the app which allows one smartphone to shoot while it controls the other smartphone by connecting smartphones via Wi-Fi Direct.

The smartphone viewer is developed to watch by utilizing Oculus VR and the viewer for PC is developed to allow utilizing the polarization type's display.

## 5.3 App for 3D Stereoscopic Shooting

Figure 12, 13 is a description of 3D stereoscopic shooting method for Smart 3D Rig and Smart Turntable. Figure 12 in right is the optimal distance settings that can be taken to utilize this platform. Figure 13 is smartphone of installation using Smart 3D Rig. Figure 13 in right is Example of 3D stereoscopic shooting.

Smartphone viewer has been developed to be viewed by utilizing the Oculus VR. And the other viewer has been developed of a PC-based 3D Viewer. This Viewer has five areas.

- Player area: Shows the steps that are being played and the frame number, 2 shows the content displayed image. There can drag left or right to move the frame.
- Thumbnail Area : Shows a thumbnail of the content according to the reproduction method.


**Figure 11.** App for 3D stereoscopic shooting.

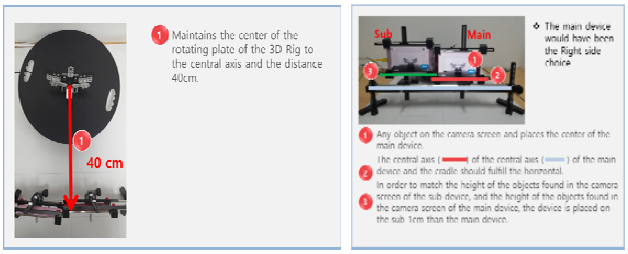


**Figure 12.** 3D stereoscopic shooting distance (left), 3D rig setting front (right).

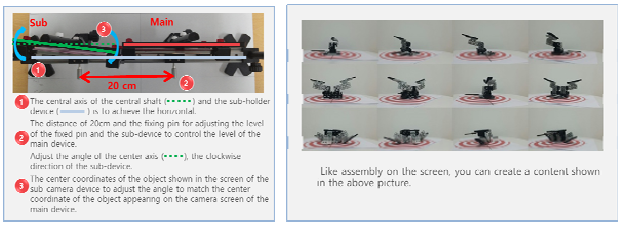


**Figure 13.** 3D rig setting top (left), 3D stereoscopic shooting example (right).

  - Play All: Shows a thumbnail of the first image of each step.
  - Stage play: show thumbnails of all the images in that step.
  - Frame Playback: It seems a thumbnail of a specific frame in every step of the way.
  - Cyclic and reproduces the frame.
- Seek bar : Represents the full-size reproduction, Shows a frame playing position, Go to the frame you want to play and drag.
- Toolbar: Play, Pause, Stop, Move to the next frame, Play back status, Thumbnail bar Show/Hide, Play mode select, 2D/3D mode, Change Color (Brightness, Contrast, Saturation, RESET), Play speed (Default, fast, slow, RESET), Project List Show/Hide
- Project List: Page movement, Project Search, Login, Total List, Play List, My List, Thumbnail, Contents Title, Contents etc.

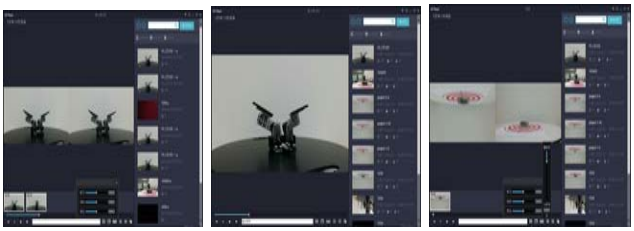

**Figure 14.** PC-based 3D Player.

## 6. Conclusion

What you can do if you know how to take a shooting 3D stereoscopic image as a physical principle has a very big difference. Shooting of a variety of conditions is simple principles and experience the total amount, and continues to be a need for more.

The stereoscopic image is attracting the audience by enhancing the live sense in the history of media which has evolved targeting for the human 'eye'.

As the stereoscopic image provides the depth-of-focus to feel a real sense of distance, it has been actively studied in various fields including simulation, stereoscopic animation, interactive computers, etc.

In this study, the platform which allows learning the stereoscopic image by utilizing a smartphone that is currently being used by public when taking the stereoscopic image and taking a simple stereoscopic image was proposed.

Even now, it has been studied and produced on techniques to shoot and watch using smartphones. The platform presented in this study will help in learning the stereoscopic image and taking a simple stereoscopic image to increase the understanding on the stereoscopic image and its utilization.

## 7. Acknowledgment

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