

# 360 Vr Content Production Based On the Analysis Of The Movements In The Korean Traditional Court Dances, Cheoyongmu And Bosangmu

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**Abstract:** Recently, virtual reality technology has been combined with performing arts to provide new performance contents. Traditional performances, one of the areas where the latest technology can be applied, have recently been reborn using VR technology. This study aims to investigate the process of obtaining 360 VR contents based on the movements of Korean traditional court dance, namely Cheoyongmu and Bosangmu. By analyzing the stage characteristics, movements, and storytelling of traditional performances, we determined the appropriate camera positions for the shooting. By the means of rehearsal shooting, the dancers were able to understand 360 VR shooting and the camera positions were adjusted after analyzing the recorded video. The recorded performance video was broken down into 360 VR contents and an application for experiencing 360 VR contents was created through HMD.

**Keywords:** Korean Dance; Traditional Culture; Movement Analysis; Virtual Reality; 360 VR;

## 1. Introduction

Virtual reality is a future-oriented technology that combines 3D images and interaction technology to convey the sense of immersion and presence to users. Virtual reality content developers create interactive contents where users can move around in virtual environments by modeling real space and utilizing game engines. Further, by synchronizing movements, visual, auditory, and tactile sensations of the user based on their actions, the user can maximize the experience of immersion. Since VR contents are created in real time according to user's movements, high-performance computers capable of tracking HMDs and controllers such as HTC Vive and Oculus Rift [1, 2]. By immobilizing smartphones or tablet devices, such as Google Cardboard and Samsung Gear, immersive virtual reality display devices can be easily configured at a relatively lower cost [3, 4]. By utilizing game engines such as Unity and Unreal, developers can obtain VR contents using modules such as high-end graphics, physics, and interaction. These VR contents are also being used in the field of travel and tourism, mechanical engineering and industrial design, architecture and civil engineering, real estate, medicine, mental health, education training, and entertainment and journalism [5].

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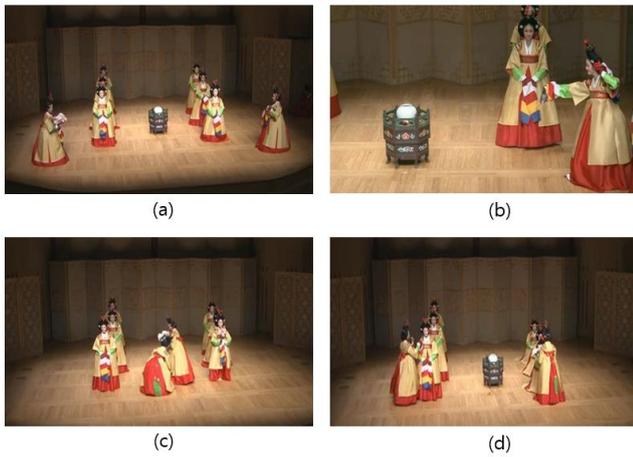
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Through the broadcast and social network services, 360 VR videos are shot and broadcast or shared with other users using VR contents sharing platforms. 360 VR camera is a device that can acquire images in various directions by arranging multiple lenses or cameras. VR cameras are available from low-end cameras for personal use to high-end ones for professional use such as movie shooting. The spread of low-end 360 VR cameras is playing a vital role in the expansion of the 360 VR industry, i.e., people can create, upload, and share 360 VR contents easily on social platforms. Among the images that are obtained using multiple camera lenses, duplicated parts are removed and other parts are seamlessly combined into one image by analyzing the correlation of camera lens' positions and directions as well as captured images. Equirectangular projection (ERP) method and cube map projection (CMP) method are mainly used. The ERP method projects a combined omnidirectional image onto a sphere and the CMP method project to a square [6, 7]. While the existing video media is planned, directed, shot, and post-produced considering the characteristics of a limited square screen, the 360 VR video can be characterized as a media that can be viewed from all directions and does not get affected by the user's movements [8]. 360 VR technology is being studied for the further application to traditional performing arts, such as film, drama, and dance. Development of high-tech devices empowered by the fourth industrial revolution and dance performances can cooperate organically and complement each other. It brings about changes in the contents and forms of different dance performances [9]. Therefore, if VR technology is applied to performing arts, the paradigm of the relation between the performance and audience can be changed [10, 11]. For traditional performances, the stage and audience are separated by '4th wall'. It makes the audience to be the third party (outsider) of the ongoing story. On the contrary, VR technology through 360 VR brings the audience into the space of the ongoing story, making it possible for them to participate as a part of the story. Virtual reality media is capable of new expression because it can express characteristics such as immersion, presence, and embodiment better than existing media. To maximize the effect of such expressions, storytelling suitable for new media is required and relevant researches have been constantly conducted [12]. In a previous study, from the viewpoint of existence, the audience was classified as a participant who exists as a character in the story and the observant who does not exist in the story. In terms of influence, the audience can be classified into the active audience who can change the story and the passive audience who accept the story as intended by the storyteller [13].

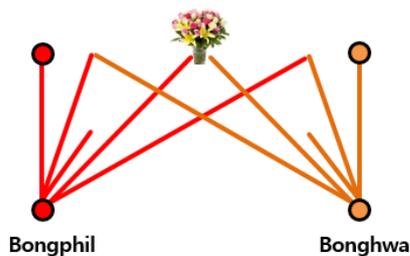






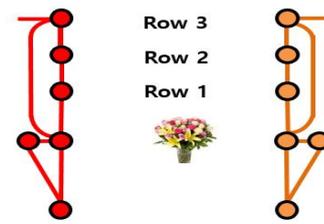
**Fig. 3:** Court dance Bosangmu: (a) Six dancers standing on the left and right, dancing at the front of Bosangban; (b) Dancers throw the ball toward the front; (c) If the dancers hit the can on Bosangban, the musicians stick the flower to the hair of the dancers; (d) If they fail to hit the can, the musicians mark their cheeks with the ink.

Analyzing the movements of Bosangmu, dancers can be divided into two dancers, Bonghwa and Bongphil, and six other dancers. Bonghwa and Bongphil dancers would come from both sides with flowers and brushes with the Bosangban located at the center. When six dancers come out to dance, they would bring a ball to the dancers and return to their place. If six dancers throw the ball into the Bosangban, Bonghwa would give them flowers and, if they fail to do so, Bongphil would go to mark the cheek of the sex dancers with ink. In addition, they would also pick up the balls, which fell outside the cask to place them back to their original position. When they finish performing, they would move to their original place from where they entered, bow toward the audience, and exit, as shown in Figure 4.



**Fig. 4:** Analyzing movements of Bonghwa and Bongphil

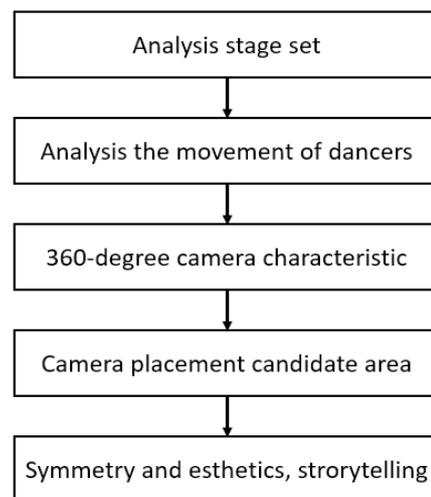
The movement of dancers shows that six dancers from both sides of the backstage would come out in pairs forming three rows. Two dancers in the first row would come forward and sit and dance with the ball that Bonghwa and Bongphil brought. Two dancers of the first low move back in an oblique line, move to both sides, throw a ball into the Bosangban. Then they go back and stand behind the dancers standing in the third row. Dancers in the second and third rows would dance in the same order as those in the first row, and when all the dancers are done performing, they would leave the stage.



**Fig. 5:** Analysis of movements of 1~3 rows

### 3. Production of 360 VR Contents

To obtain 360 VR contents for Korean traditional dance, it is necessary to study classical literatures and data on performances to investigate the significance and storytelling of the performance as well as movements of dancers on the stage. In this paper, we used the method shown in Figure 6 to set the most suitable camera position. First, the location of stage equipment and props should be analysed. Since the stage device interferes with the field of view of the camera, the camera should be located away from the stage device. The movements of performers should be analysed. However, since most traditional dances do not have detailed document expressing the stage movement, it is necessary to organize the movement through shooting at the rehearsal shooting stage. The 360-degree camera company recommends a minimum distance from the subject for stable 360 image capture, depending on the lens and design characteristics of the camera. The minimum distance also depends on whether 360 movies is monocular or stereoscopic. In order to acquire the camera location candidate area, the stage setting and the movements of the dancers from the previous process are overlapped in the stage image. The camera placement candidate area is set as the position that does not overlap in the minimum 360-degree camera distance range and the stage image in which dancers' movement of performers and stage devices. It is preferable to arrange a camera in a location that is basically symmetrical among the position candidates of the camera, but the artist can change visual style by setting various position of the camera in the process of analysing the aesthetics and the story of the artwork.

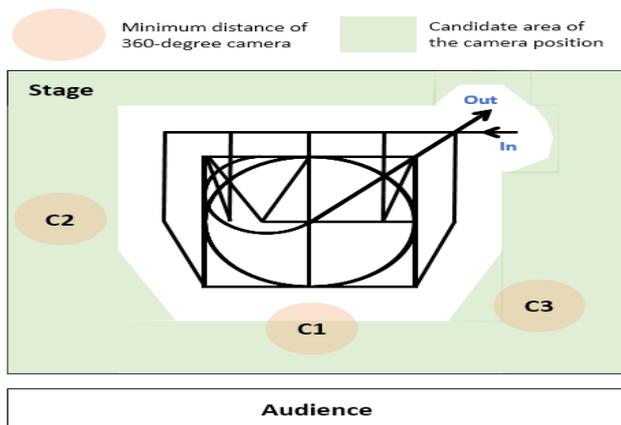


**Fig. 6:** Block Diagram for setting shooting position



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In Chapter 2, the movement of five dancers of Cheoyongmu analyzed and the entire movement altogether is shown in Figure 7. The 360-degree camera's minimum distance can be used to obtain candidate area of the camera position. Since the movements of dancers cover center of the stage, it's impossible to place the camera in the center of circular path of dancers. Three positions can be taken into consideration in the performance 'Cheoyongmu'. The position C1 is in the front of the stage, C2 is at the side of stage, and C3 is at the diagonal. Analyzing the performance production shows that dancers are performing in front of the stage and moving back and forth in the stage, so that the camera is installed at position C1, which can represent spatial movement well.



**Fig. 7:** Overall movements in Cheoyongmu and candidate area of the 360-degree camera position

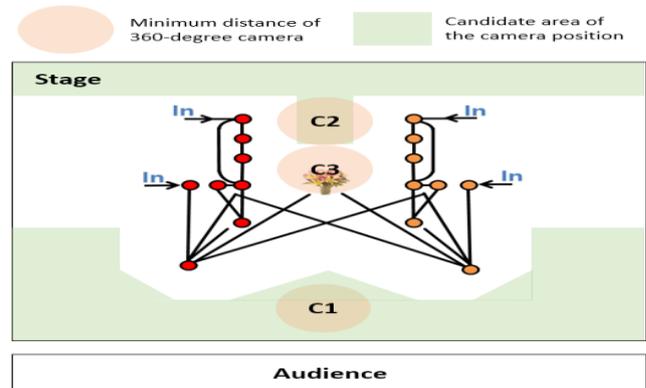
Since the performances of the same repertoire can differ according to the size of the stage and the intention of the director, as shown in Figure 8, we participated in the rehearsal of the performances of Cheoyongmu and confirmed the actual movements of the dancers to shoot 360 VR videos. Then, we reviewed the filmed video to check the distance between the dancers and cameras as well as the rehearsal video through the HMD to prepare for shooting the actual performance. Dancers should also recognize the locations of 360 VR cameras installed for the shooting.



**Fig. 8:** Shooting of Cheoyongmu rehearsal

The overall movement of the Bosangmu and the candidate of the camera position can be obtained as shown in Figure 9. Because the dancers are divided into two rows toward the center of the stage in the perform 'Bosangmu', installation of 360-degree camera on the center line of the stage can be considered. Two positions on the center line were considered. The position C1 is in the front of the stage and C2 is located inside the stage and included between two rows. The position C3 is the position where stage set 'Bosangban' is located, so it is not appropriate if it is close to the camera. However, the height of the 'Bosangban' is so

low that the camera could be installed on it. Because a 360-degree camera is installed above the 'Bosangban', all the dancers performing Bosangmu dance can be seen. During the performance, the dancers look toward the Bosangban, which means viewers watching the video using 360 VR camera feel as if the dancers are watching them back, making this performance perfect for the production of 360 VR video.



**Fig. 9:** Overall movements of Bosangmu candidate area of the 360-degree camera position

To obtain the VR contents of court dance Bosangmu, we participated in the rehearsal of the performance "The 50th Year of In Nam Soon Court Dance" at the National Center for Korean Traditional Performing Arts in November 2017. For 360 VR video shooting, RICOH THETA V camera was used to record 4K video at 30FPS. Since the 360 camera used two fisheye lenses, the output images were stored as images taken by two fisheye lenses, as shown in Figure 10. For the stored image to be used as 360 VR content, it is necessary to combine two camera images into one image. Based on the camera position and lens' characteristics, images are to be analysed and combined seamlessly into one image as shown in Figure 11.



**Fig. 10:** Data of Bosangmu performance shot through 360° camera



**Fig. 11:** Editing 360 VR video of Bosangmu performance

We obtained 360 VR videos by editing the converted 360 VR images. The contents created can be registered and shared on SNS platforms, such as YouTube or Facebook. Users can change the direction of 360 contents using a mouse while watching videos. In the case of using immersive displays such as HMD, an application capable of playing 360 VR video is required. In this study, a player was created using the Unity Game Engine, as shown in Figure 12. To apply the contents obtained using the ERP method, a sphere was arranged in a virtual space, where video data is mapped to the user's viewpoint at the center of the sphere. Therefore, the user can watch all directions while moving his/her head with the HMD on.



Fig. 12: Production of 360 VR contents player

#### 4. Conclusion

The performance contents using 360 VR technology are different from the conventional screen-based video contents in terms of the method of shooting and editing and it enables to experience a high sense of immersion and presence using VR equipments such as HMD. Since 360 VR contents are filmed in all directions, it is important to consider the location of 360 cameras on the stage based on the dancers' movements. In this study, we analyzed the movements of dancers in the representative works of Korean traditional dances, Cheoyongmu and Bosangmu. Considering the entire movements in the proposed study, we determined the installation position of the cameras and performed 360 VR shooting. Through rehearsal shooting at the pre-production stage, 360 VR contents based on the distance between the 360 camera and the dancers were checked to adjust shooting plan. We also developed a 360 VR player that can play 360 VR contents in VR.

We conducted user survey by screening 360-degree movies to 34 major students as shown in Figure 13. Most students were interested in seeing performances at new viewpoints. Specially, the performance 'Bosangmu' was more impressive that the camera was installed in the center of stage, and

students replied that the scene in which the dancers threw the ball at the camera was the most interesting. They hope to use virtual reality technology in various art related classes. This paper has limitations in not analyzing user evaluation according to various shooting positions. The 360 VR contents obtained in this study show the possibility of the utilization of fusion research in the field of traditional art.



Fig. 13: User survey of 360 VR movies

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#### REFERENCES

1. HTC Vive, <https://www.vive.com>, (2018)
2. Oculus Rift, <https://www.oculus.com>, (2018)
3. Brown A & Green T, "Virtual reality: Low-cost tools and resources for the classroom", *TechTrends* VOL.60, NO.5, (2016), pp:517-519.
4. Powell W, Powell V, Brown P, Cook M & Uddin J, "Getting around in google cardboard—exploring navigation preferences with low-cost mobile VR", *Everyday Virtual Reality (WEVR), 2016 IEEE 2nd Workshop on*, (2016), pp:5-8.
5. J. Linowes, *Unity virtual reality projects*. Packt Publishing Ltd., (2015)
6. Podborski D, Thomas E, Hannuksela MM, Oh S, Stockhammer T & Pham S, "Virtual Reality and Dash", *In Proceedings of the International Broadcasting Convention*, (2017), pp:14-18
7. Presentation of OMAF, ISO/IEC 23000-20, MPEG 115.
8. Shin M, "Exploration and application of 360° VR-based dance contents", *The Korea Dance Education Society* VOL.28, NO.3 (2017)
9. Sim J, Seong J, Kim H, Kim S, Lee M and Lee G, "A Study on the production of virtual reality contents using traditional cultural resources – Focused on the cases of VR contents of Okyoujeongsa in Hahoe village", *Proceedings of the Academic Association of Cultural Contents*, (2015)
10. Lee J and Yang S, "A Study on VR contents in the field of Performing Arts – focusing on the Jultagi (traditional performing arts genre)", *The Korean Journal of Arts Studies* VOL.14 (2016)
11. Dooley K, "Storytelling with virtual reality in 360-degrees: a new screen grammar", *Studies in Australasian Cinema* VOL.11, No.3 (2017)
12. Tricart C, *Virtual Reality Filmmaking: Techniques & Best Practices for VR Filmmakers*. Taylor & Francis (2017)
13. Dolan D and Parets M, "Redefining the axiom of story: The VR and 360 video complex", *Tech Crunch* (2016)
14. Kim Y, Nam J and Nam S, "A Study on Spatial Allocation of 360 VR Contents: Centered on Korean Traditional Dance Bosangmu", *International Journal of BioSciences and Technology* VOL.2, NO.2 (2018)