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Action Calibration Model using Motion Extraction and Interpretation Methods for Korean Fan Dance

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Abstract: In recent years, it is gradually shifting to the digital method of motion capture from the analog method in the method of recording intangible cultural properties. Motion capture is a digital format recording of objects requiring 3D motion analysis and extracts specific information such as the position, speed and direction of the observed object. This research is focused to scientific analysis of the characteristics in the inherent movements of the fan dance as a prototype differentiated from sporadic dancing in the name of fan dance. It is a useful data to secure objectivity of motion as the basis of future dance preservation and tradition. Therefore, this study aims to analyze motion characteristics of fan dance by using motion capture of fan dancers using kinect and to suggest ways of using extracted data through motion capture.

Key words: Cultural properties, fan dance, motion characteristics, kinect, motion capture, data

INTRODUCTION

In recent years, the method of recording intangible cultural properties is gradually shifting from the analog method to the digital method. Nonetheless, the emphasis on the need to record dance through motion capture can be explored in functional terms. It is important to note that motion capture captures images as a methodological means to digitize the motion of a person who can use the computer, rather than having a purpose in the image of the image captured by the image. Motion capture is a digital format recording of objects requiring 3D motion analysis and extracts specific information such as the position, speed and direction of the observed object (Roetenberg *et al*., 2009; Muller, 2007). Therefore, the use and necessity of motion capture is important because it can produce more diverse new digital contents by secondary processing of the data extracted through motion capture and in the added value that enables more objective and scientific kinetic analysis. Motion capture is a digital format recording of objects requiring 3 dimensional motion analysis and can extract specific information such as the position, speed and direction of the observed object. Therefore, the use and necessity of motion capture is important because it can produce more diverse new digital contents by secondary processing of the data extracted through motion capture and in the added value that enables more objective and scientific kinetic analysis can be evaluated. Motion characteristics of Korean fan dance is analyzed using motion capture by kinect (Iqbal and Sidhu, 2017; Bebis *et al*., 2012).

In the study, we analyze the Korean fan dance using motion capture technology. The purpose of this study is to analyze the behavioral ability of the Korean dance middle class and to make the best use of the athletic ability by using the Korean military force. This research is a scientific analysis of the characteristics of the inherent movements of the fan dance as a prototype differentiated from sporadic dancing in the name of fan dance. It is a useful data to secure objectivity of motion as the basis of future dance preservation and tradition, respectively. In addition, research could be significant in fan dance and used as a base for various digital contents to be produced in the fourth industrial revolution era. Based on the results of this study, the following suggestions were made in this study.

First in this study, the study was limited to fan dance among Korean dance. Therefore, in the subsequent research, it is considered that the motion capture and recording of various research of Korean dance and extraction of data that can be processed by computer should be conducted.

Second in this study, motion capture was performed for upper body motion among Korean dance dancer's dances. Therefore in the subsequent research, it is considered that the study of analyzing the feature of dance by motion capture of whole motion should be continued.

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Literature review

Kinect sensors: Kinect is a peripheral that connects to the Xbox 360 to experience games and entertainment without using a controller. Kinect is the interface device of Xbox360 that Microsoft announced in 2010 for the Natural Interface (NI) game market that Nintendo Wii (Wii) attracting attention to interaction artists. It is also, actively used in other fields. Recently, individual developers and various research institutes have been trying to utilize Kinect and PC in various fields by linking them to the existing Xbox 360 console game controller. An extra power source is required to connect to the older Xbox 360 Model. The kinect sensor is a low-cost depth camera that provides real-time depth information as well as RGB video and joint tracking information. The use of data provided by the kinect sensor reduces the effort of human/body part detection and pose estimation required for gesture recognition and makes it easier to develop games and human-computer interaction applications (Lange *et al*., 2011; Chang *et al*., 2011) (Fig. 1).

As the object moves using the special sensors of kinect, the RGB sensor and the IR sensor, it is input to the computer as it is and the 3D Model created through the point sample rendering using the color and depth data of the kinect in the desired painting style. Kinect recognizes user information using built-in RGB, depth sensor and multi-array microphone, so, it can interact without a controller. Kinect is widely used in the place where motion recognition is used because it recognizes human motion without being a separate controller and is easy to use by many people. The RGB sensor acquires the color image and the IR sensor acquires the depth information using the infrared specific pattern transmitted through the project. The RGB information and depth information obtained through the kinect has a resolution of 640×480 and outputs 30 frames per sec. It is a device that can extract 3D data value by using RGB camera and infrared camera. It provides depth information and skeleton information through RGB image and IR camera, so, it has a wide range of applications and is convenient to use compared to other image devices (Thorpe *et al*., 2011; Clark *et al*., 2010).

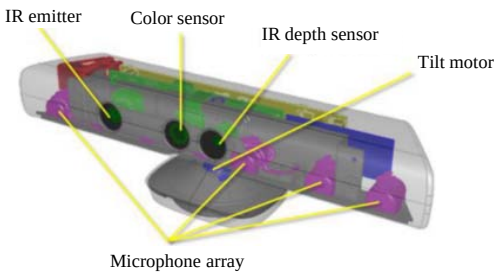

Fig. 1: Kinect sensors

IR projector and deep image: IR projectors in kinect are scattered through a scatter film and projected (Fig. 2). In the reference scene, the projected infrared pattern is changed in the object plane which is an interval where information is changed in the kinect memory. The changed pattern is compared with the pattern in the reference area. In addition to RGB images, the kinect also, provides depth information and skeleton tracking by analyzing the characteristics of point patterns by projecting specific infrared dot patterns onto the object. The kinect camera detects the pattern of the infrared rays reflected by the object by the light receiving sensor to generate the depth image. However, due to the occurrence of blind spot due to the difference in distance between the light emitting device and the light receiving sensor, the irregular reflection of the infrared rays due to the smooth surface of the object is small and the infrared ray pattern could not be detected when the laser could not return to the light receiving sensor. The value appears in the form of a hole in the depth image. Also, when the discontinuity of the depth information and the infrared ray emitting section are vertical, a hole occurs around the object boundary. Therefore, if each depth image is continuously played back as a moving image, the shaking phenomenon around the boundary can be confirmed. In order to generate a virtual view image, such a shaking phenomenon must be eliminated. Lee, Young-Sang creates an infrared pattern scanned by an infrared projector using an infrared camera and generates a pattern matching method. Since, the object could not be distinguished only by the depth image, the depth information of the specific pixel can be obtained by simultaneously using the color image obtained from the RGB camera. This information is being used in various fields such as motion recognition, face tracking and 3D reconstruction. In addition, in the kinect sensor, the RGB camera focal distance is shorter than the focal length of the infrared camera, so that the color image acquires a wider range of image than the depth image. For accurate matching of two images, the focal length of two images should be adjusted. An additional interpolation technique is needed to broaden the depth image.

MATERIALS AND METHODS

Calibration action for motion capture: First, in this study, Kinect initial calibration operation was performed before filming of the fan dance. The related contents are as follows (Fig. 3).

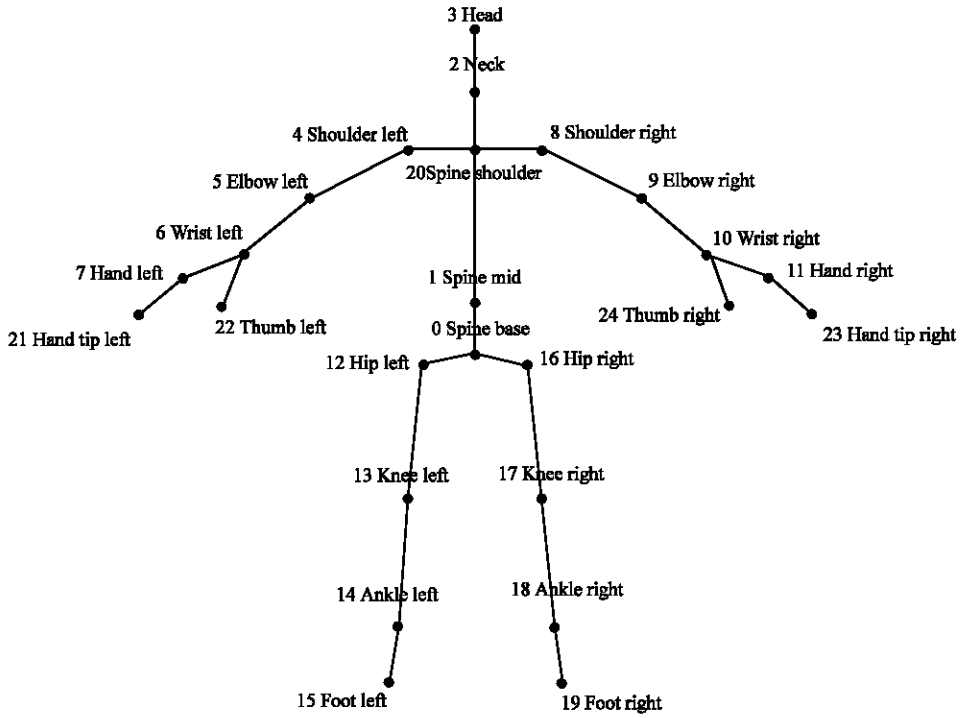

Fig. 2: Kinatic sencing joints and connection; the kinatic treat joints as through you were looking in the mirror. So, the left side body joints appear onthe left in the diagram and the right side joints appear on the right

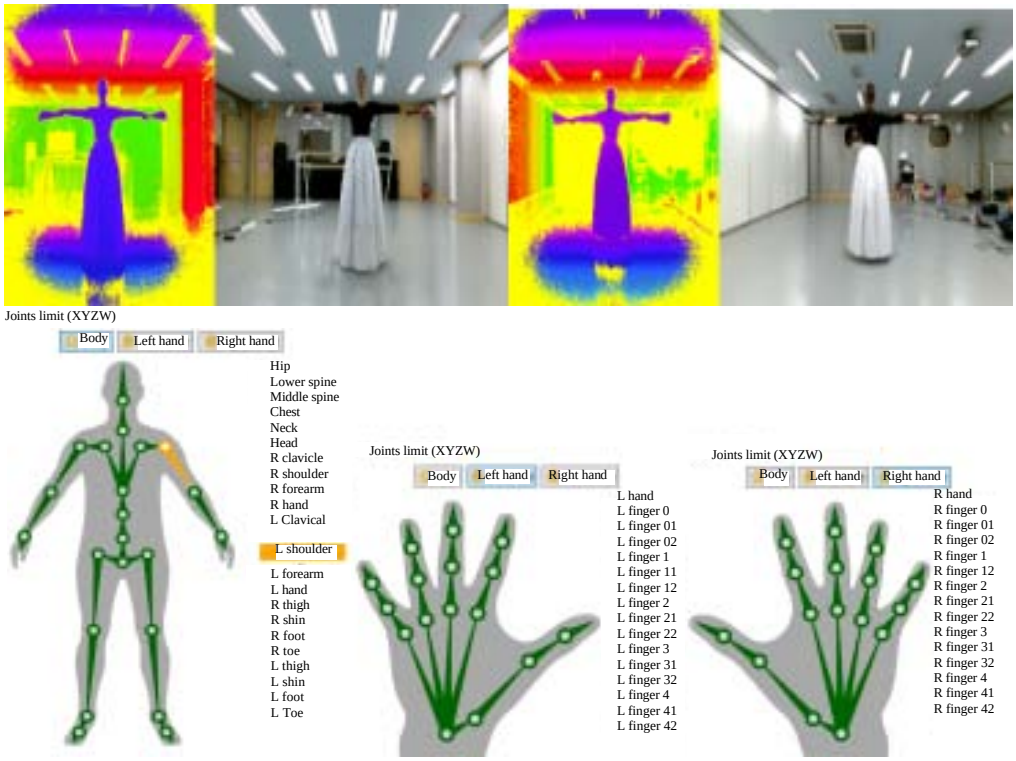

Fig. 3: Motion capture of kinect initial calibration behavior

Basic motion extraction: The most suitable dancing stage was selected for the extraction and interpretation of motion in fan dance dance. We selected the "good manners" as the target and extracted the motion as follows and then analyzed its operation. After the interpretation of the operation, it is possible to develop into a choreographable system from the perspective of an expert using data (Fig. 4-6).

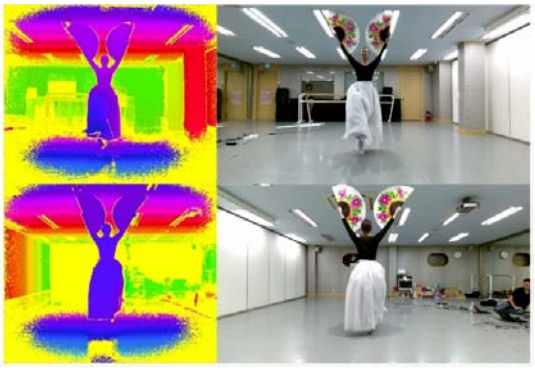

Fig. 4: Motion capture of kinect basic motion extraction (Action 1)

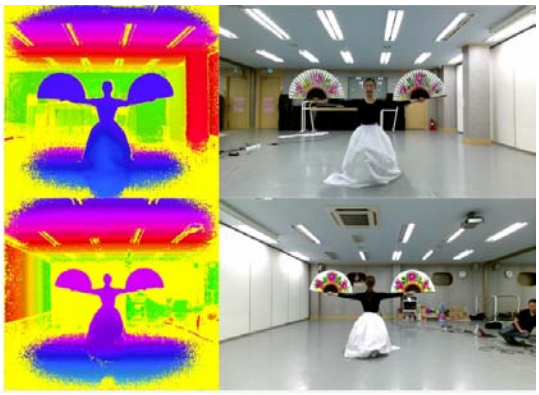

Fig. 5: Motion capture of kinect basic motion extraction (Action 2)

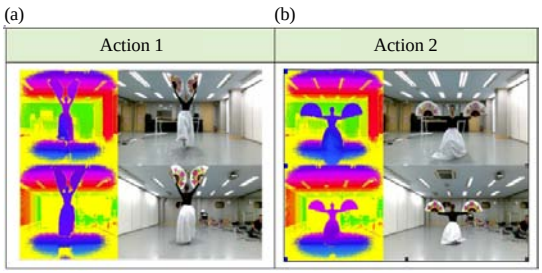

Fig. 6: Operation analysis used motion capture: a) Action 1 and b) Action 2

Operation analysis: In this study, we propose an analysis method of motion data by selecting one motion that is considered to have the most significant motion change during the fan dance motion extracted by kinect-type motion capture. The motions selected for the data analysis of this study are "good-looking" and the motions captured using kinect are shown in Fig. 6.

RESULTS AND DISCUSSION

The following is an analysis of the data change value for each sensor extracted through kinect. The X and Z that is the positions of the left and right and front and rear positions of motion do not start at 0 cm because the demonstration was not performed according to the coordinate values of the two cameras obtained through calibration before the operation. The results of this study are as follows. Since, the content of the analysis is too vast, we have analyzed the chest movement, neck movement and head movement (Table 1-3).

First, chest data analysis results. The X position value that is the lateral shift, shifted 0.5 cm to the right from 0.17-0.67 cm. The Y position value that is the height change, shifted 48.38 cm from top to bottom from 121.94-73.55 cm. The Z position value that is the change before and after, shifted from -19.94 to 18.00 cm in the backward direction by 37.94.

Second, it is the result of neck data analysis. The X position value that is the lateral shift, shifted 0.03 cm to the right from 0.39-0.41 cm Y position.

Third, head data analysis result. The X position value that is the lateral shift, shifted 0.32 cm to the left from 0.77-0.45 cm. The Y position value that is the height

Table 1: Chest motion capture results

Sensor name (X-Z)	Operation 1; coordinate values	Operation 2; coordinate values	Operation change values
Chest			
X	0.17	0.67	0.50
Y	121.94	73.55	-48.38
Z	-19.94	18.00	37.94

Table 2: Neck motion capture results

Sensor name (X-Z)	Operation 1; coordinate values	Operation 2; coordinate values	Operation change values
Neck			
X	0.39	0.41	0.03
Y	144.41	96.08	-48.33
Z	-22.85	15.54	38.39

Table 3: Head motion capture results

Sensor name (X-Z)	Operation 1; coordinate values	Operation 2; coordinate values	Operation change values
Head			
X	0.77	0.45	-0.32
Y	157.50	109.13	-48.37
Z	-20.81	17.85	38.66

change, shifted 48.37 cm from the top down to 109.13 cm from 157.50 cm. The Z position value that is the change before and after, moved from -20.81 to 17.85 cm and backward to 38.66 cm forward.

CONCLUSION

The purpose of this study is to analyze motion characteristics of fan dance by motion capturing fan dance in Korean dance using kinect and to suggest ways of using extracted data through motion capture. In order to accomplish the purpose of this study, we analyzed the limitations of the existing motion capture system and found the necessity of kinect-type motion capture. Next, three motions of upper body 12 motion of fan dance were motion capture by kinect method and the utilization method was suggested. The results of the study are summarized as follows.

First, it is the operation analysis result of Korean dancing fan dance through kinect-type 3D motion capture. The extracted values are the left and right coordinate values X, the height Y of the coordinate values. As a result, 684 data values were extracted from 19 joints and 57 coordinates for each motion. In this study, we interpreted the extracted value as a representative example of "Yongseon-gui" and suggested the interpretation method of each data value in terms of kinematic and spatial utilization.

Second, the application of the motion capture result of Korean dance dancer dance motion was suggested. The utilization of the result data obtained by motion capture of fan dance motion shows the possibility of safety use in virtual reality space, improvement of movement technique of dance through motion analysis, formation of organic network of dance choreography environment.

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