Evaluting Real-Time Thai Dance Using Thai Dance Training Tool

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***Abstract*— Thai dance is the valuable intangible culture heritage and it has been passed on from generation to generation. To study Thai dance, the teacher transfers the Thai dance knowledge to students as man to man process. Every student in the class follow the pose and move according then, correcting the accuracy of their movement by the teacher. To achieve more precision and accuracy on their performance, every student need to practice regularly by themselves. Without the correction from their teacher, some of the body movement error may occur while the student practice. This work proposes the developing of the Thai dance training tool that can assist the student in correcting the accuracy of their body movement by themselves. The system compares between the Thai dance expert movement recorded by Motion Capture System and Real-Time Dance movement by Microsoft Kinect motion sensor to check the accuracy and to evaluate dance movement. Finally, showing the result in form of the quality level by the Thai dance experts suggestion. The tool also compiles the mistake and analyze the associated instructions to efficiently provide the user feedbacks to improve their dancing skills.**

Keywords— intangible culture heritage; Thai dance; Thai dance training tool; Motion Capture System; Real-Time Dance movement; Kinect motion sensor; evaluation;

I. INTRODUCTION

Thai performing arts is one of the most valuable cultures that has co-existed with the lifestyle of Thai people for a long time. It has been passed on from generation to generation and played many important roles in Thai lifestyle such as Thai Buddhist ritual, traditional Thai Wedding, Songkran festival etc. The government focused on preserving the Intangible Cultural Heritage by adding the Thai dance into Thai education as a basic education core curriculum for the younger generation. Moreover, they have also established the College of Dramatic Arts in 12 provinces around the country. These colleges are using the curriculum to contribute the uniquely and delicately dance movement. Up until now, there are not many technologies or tools available to support Thai dance class due to the movement being unique, complex and take a lot of time to practice. The Thai dance knowledge transferred from the teacher to the students as man to man starting from how to pose and move. Then every student in the class will do the exact pose and move.

Each student would be thoroughly corrected regarding the accuracy of their movement by the teacher. Apart from attending classes, every student also need to practice regularly by themselves to achieve more precision and accuracy in their performance. Without the correction from teacher, some mistake may occur without the students knowing when they practice by themselves. Providing a tool that can check the movement accuracy would solve this issue. To be able to create a technology capable of teaching Thai dance is challenging as developing such tools to train the students, how to memorize their body movement, correctly and accurately execute their dances requires a great amount of knowledge in programming, understanding both Thai Dances and Dance Notations.

This paper will focus on developing the system that compares experts' Thai dance movement recorded from the motion capture information, comparing it to the real-time dance movement from the students using Microsoft Kinect, focusing mostly on the accuracy and evaluating the result of the dances. This tool will help the students to recheck their movement accuracy and providing the feedback to improve their body movement skill by themselves.

II. LITERATURE REVIEW

A. Technology for Thai Dance

Developing tool using novel technology for practicing the dance movement assisted the performing arts students to improve their body movement skill. Dance notation system such as Labanotation has been used to record the human movement and it becomes a data set for the comparing process using motion sensor device. In Southeast Asia, many researchers had tried to develop the tool for representing the Asia dance in 3D animation like Noh dance. However, there have been no attempts in trying to achieve complicated movement. Thai dance is very delicate and focuses on hand

and finger movement. Worawat et al. developed the computer-aided tool for describing and recording Thai dance movements using Labanotation system and record the movement with LabanWriter and using LabanEditor to display the 3D Animation. The system prepares labanotation scores and display human figure 3D animation model associated with the score to help new learners in understanding the Labanotation for Thai dance [1]. In 2016, to retrieve Intangible Cultural Heritage such as Thai dance, Yoottthapong et al. proposed a framework for a traditional Thai dance knowledge archive by using Labanotation system and representing Thai dance notation scores into graphic human model and 3D animation [2]. Following year, Yoottthapong et al. implemented the tool to translate dance notation score into 3D animation mainly on hand and finger movements on Thai dance. The tool is based on six steps of translation model guideline by Michael C. et al. [3] to implement Thai translation program. [4].

Pachutima proposed the development of multimedia-based instruction package for training the creative dancing arts performance for the third key stage student. The research studied about the efficiency of the package and the satisfaction of the user by examining and evaluating before and after using the system [5].

B. Kinect sensor project

Involving the interactive technology to enhance the process of teaching and learning in Education has proven to give better result for the learners. In 2011, Hui-Mei J. studied on the potential of Kinect as an interactive tool and discussed how it can facilitate and enhance teaching and learning process [6]. Motion sensor device such as Microsoft Kinect is examined in terms of its affordances of technical interactivity, which is an important aspect of pedagogical interactivity. As it utilizes gesture-based technology, Kinect can support kinesthetic pedagogical practices to benefit learners who possesses strong bodily-kinesthetic intelligence.

As far as teaching tools are concerned, due to the multiple interaction types it supports, Kinect has the potential to enhance classroom interactions, increase classroom participation, improve teachers' ability to present and, manipulate multimedia and multimodal materials, creating opportunities for interaction and discussion.

As a learning tool, Kinect has the affordances to create enjoyable, interesting interaction types, to boost student's motivation, and to promote learning via its multimedia and multi-sensory capacity. In addition, students can utilize the bodily information gathered by Kinect with software programs to create highly interactive multimedia works. [6] Hence, learning in Performing Arts is tent towards involving the interactive learning tools for evaluating a learner's performance. In 2011, Dimitrios A. developed the online interactive environment system for evaluating the Salsa dance performance from the performers against a standard Salsa performance from data sets. The system receives the motion data from the performer using Kinect-Based Human Skeleton Tracking and evaluate in real-time to compare with the dance data sets. Then the system provides the visual feedback to the performer in a 3D virtual environment [7].

Sriparna created Gesture Recognition Algorithm for Indian Classical Dance Style using Kinect motion sensor device in 2013 [8]. Using the distance between different parts of the upper human body, the velocity and acceleration that generated along with the angle between different joints. The algorithm could distinguish between many Indian gestures which represent the emotions and specify whether the emotion is positive or negative.

In 2012, João developed the prototype of the Kinect Interface for Ballet dancer system called "Super Mirror". It combines the functionality of studio mirrors and prescriptive images. The system captures live motion and compare it with the record ballet movements to display the difference between two motions and provide the instructional feedback in real-time to user [9]. The system assisted the learner to practice and improve their ballet movement skill.

In 2016, the prototype of Thai dance training tool was developed by Ob-orm using Kinect motion sensor device [10]. The method is to compare data between Thai dance expert movement data captured by motion capture system and the Real-Time dance movement data captured by Kinect motion sensor devise. Using the angle of the bones which is composed from the connecting of the joints from the 3D models. The tool directly evaluates the movement accuracy giving the difference value and display the result in average percentage and grade. Besides, the tool shows the list of all joints with their performance to let user recheck their mistake of the body movement.

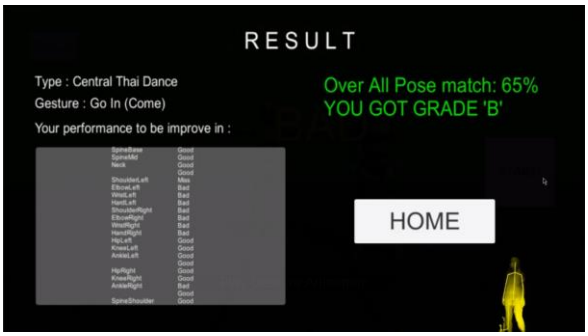

Fig. 1. The prototype of Thai dance training tool using Kinect (Result).

C. Thai dance learning process

Thai dance is the performance arts which represents gesture, action, behavior of natural things and communicate emotion to the audiences. Three steps in learning Thai dance in Chiang Mai College of Dramatic Arts, Thailand. First step, students will start learning from the meaning of posture, terminologies which is the jargon of Thai dance for specifying posture and movement. For example, "Jeeb" is a specific posture terminology for the hand and finger. The specific movement is described by bringing the tip of the thumb, touch the inside of the first knuckle of the index finger and stretch out the other fingers tensely. Second step, after learning the meaning and practicing the movement of each terminologies, the students will learn to combine terminologies together in order to express body languages such as emotions or behavior.

The body language is the posture of gesture, action, and expression of the character giving a meaning depending on the situation. Last step is to combine the body language movements continuously as an action for a Khon performance and for a song performance. The paper is focusing on the first step, learning the meaning and practicing terminologies according to Subject 21201: Khon Dance for Actor 1, the Basic curriculum from Chiang Mai College of Dramatic Arts A.D. 2008, Thailand.

III. Methodology

To implement Thai Dance Training Tool, the system architecture had been created to serve the need for the user and reflected on preserving intangible cultural heritage such as Thai dance. In addition, the tool provides the user the movement according to their subject on the Thai dance curriculum and focuses on evaluating and displaying the precise feedback on each body part.

A. System Architecture

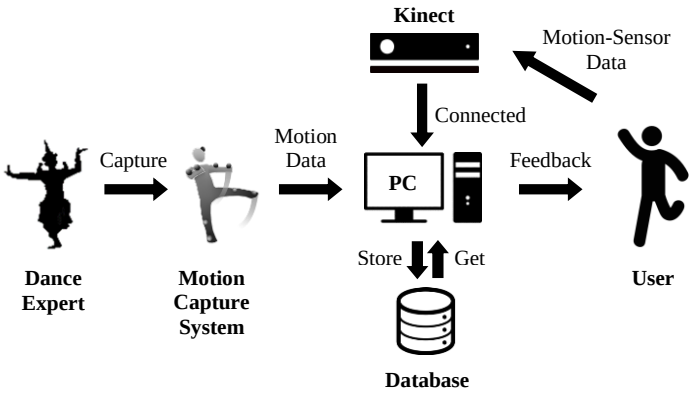

Fig. 2. Thai Dance Training Tool Architecture

The main function of Thai Dance Training Tool is to compare the Thai Dance Expert Movement to the Real-Time Dance Movement from user and giving the user feedback for rechecking their movement accuracy. The movements of Thai dance expert are captured using Motion Capture system, then applied to the skeleton of 3D human model and storing into a database in form of 3D Animation.

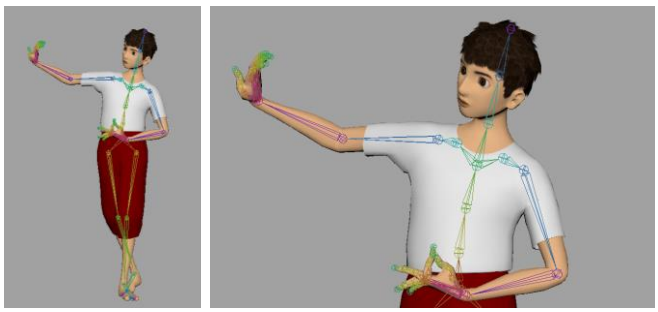

Fig. 3. Skeleton and joints of the 3D model.

Using the Microsoft Kinect sensor, receiving the dance movements from the user and applying this motion data to the skeleton of another 3D human model. The comparison both motion information is using the joints which is the subunit of the skeleton to control each body part of model.

B. Comparing Process

Two processes are used to compare between the skeleton of two models, each joint in every frame. First, starting from setting the distance between the models. For example, showing in Figure 4, the distance between skeleton number 1(Motion Capture Data) and skeleton number 2 (Kinect data) in X axis is 10 units. Then, manually subtracts the value of skeleton number 2 which is X axis to zero value as same as skeleton number 1.

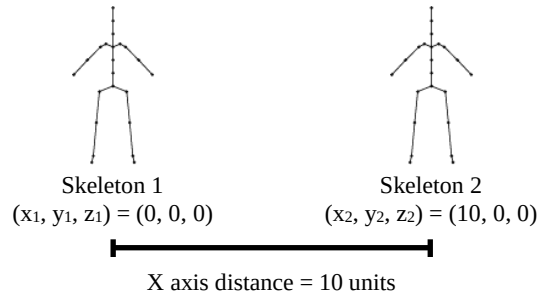

Fig. 4. Skeleton and joints of the 3D model.

Second process is comparing the position of each joint on both skeletons and evaluating the distance between joint in percentage. Figure 5 shows the examples of comparison.

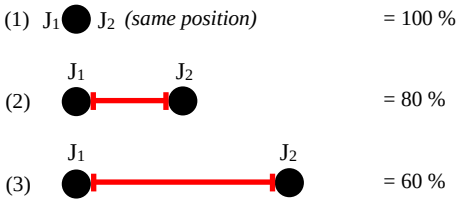

Fig. 5. The examples of comparison.

To find the position accuracy percentage, we set a maximum threshold in unity units which will define the range the user accuracy would be measured in. After which minus the user joint position from the Motion Capture data joint position giving the distance. Dividing the distance by the maximum thresholds and multiplying it by 100 to give us the inaccuracy of the joint comparison. Therefore, to get the accuracy, simple minus the percentage calculated from 100.

$$\text{Position Accuracy Percentage (PAP)} = 100 - \left(\left(\frac{JP2 - JP1}{Threshold}\right) * 100\right)$$

To find the rotation accuracy percentage we simply follow the same method as the position accuracy with two differences as follows. Joint position now will be rotation angle and the Threshold would be fixed to 360 degrees.

$$\text{Rotation Accuracy Percentage (RAP)} = 100 - \left(\left(\frac{|JR2 - JR1|}{360}\right) * 100\right)$$

To calculate the overall percentage simply add both the percentages and divide it by two, to get an average.

$$\text{Overall Accuracy Percentage} = \frac{PAP + RAP}{2}$$

C. *Evaluation process and providing feedback*

The result in percentage is from the comparing process, it is still unable to simplify how accurate of the movement according to the scoring criteria from the curriculum that has been using in the classroom. The system evaluates and provides 2 forms of feedback using the percentage by the comparing process. First, the real-time feedback display in form of quality level categorized into 3 ratings, excellent, good and bad. Second, the ultimate result shown in the form of grade. Both quality level and grade are defined by the Thai dance teachers as shown in figure 6 and 7.

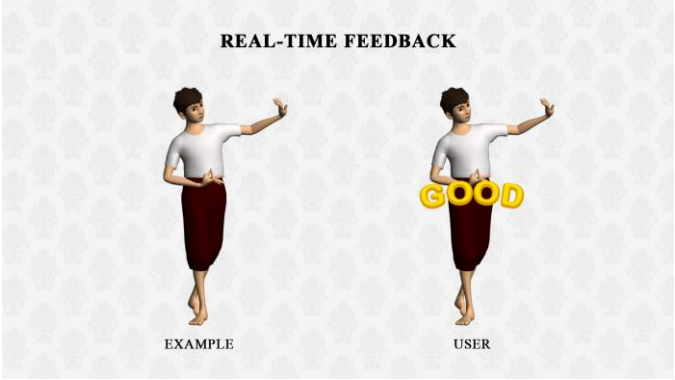

Fig. 6. Real-time feedback.

Fig. 7. Ultimate Result.

The quality level determined by each body part depending on how difficult of the movement. To set the range of percentage appropriate with the quality level result, the tool uses the analysis, testing and specifying by Thai dance expert. In addition, the system compiles all the mistake and analyze the associated instructions to give user the efficient feedback.

D. *Application Flow*

Three main stages are clarified the flow of the Thai Dance training tool, the menu stage, gameplay process and providing the feedback to the users.

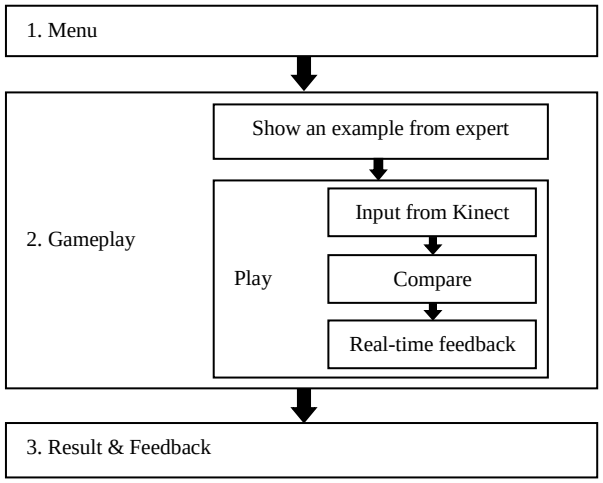

Fig. 8. Thai Dance Training Tool Application Flow

1)Menu

The menu stage will show the terminology choices to let the user chooses a terminology that they want to practice. User could choose the Thai Dance terminologies for practicing one by one.

2)Gameplay

The tool will enter the gameplay stage after the user choose a terminology choice. Thai Dance training tool will explain the meaning and start demonstrating the terminology that has been selected by the user. After that, the user can start moving according to the terminology. In the meantime, the system will receive the input data from Kinect sensor, comparing it with motion data and giving the Real-Time feedback such as movement accuracy.

3)Result & Feedback

This stage is giving the user an ultimate result which is evaluated from comparison and thoroughly pointing out the mistake from the user movement second by second with the analyzed instructions to improve the movement. Hence, the final result shown in the form of grade for easy understanding as shown in figure 7.

E. *Visualization and interface development*

In part of visualization, Thai Dance Training Tool will focus on the traditional Khon dance concept for designing the characters, environments, storyline and mini training of Thai Dance terminologies. The designing of the visuals could make this tool become more interesting and enjoyable.

To design the interface of Thai Dance training tool is very important, the program which is not designed to relate with the flow and be appropriate with user experience might be difficult to use, making the user feel uncomfortable. The user might get confuse at some point after navigating through the

menu or feel lost about where they need to focus. The interface design is the focal point to catch the attention of the user and these will make the process of learning easier.

With the User-Friendly interface and interesting visualization, our beta testers are from Chiang Mai Dramatic Arts College, Thailand, will be able to enjoy their lesson. Moreover, it would be attractive enough to capture the attention of the people who are interested in learning Traditional Thai Dance.

IV. Conclusion

In conclusion, this work proposes the system design and the prototype of the Thai dance training tool using Kinect motion sensor. The prototype mainly focuses on comparison process, comparing between the Thai dance expert movement from motion capture data and the Real-Time dance movement from Kinect motion sensor, evaluating the accuracy in percentage. With the analysis, testing and specifying from Thai dance expert, the system uses the percentage from the comparison to evaluate and display the ultimate result in the form of quality level to simplify how accurate of the user's movement by the Thai dance expert's suggestion. The result is sufficient by comparing both movement on setting the distance between the models and comparing the position of each joint on both skeletons and evaluating the distance between joint in percentage. In addition, setting the full function on Thai dance training tool with displaying the feedback. Because of the limitation of the single Kinect sensor, some complexity of Thai dance movements cannot be clearly captured. For future works, Multiple Kinect will be developed and implemented to capture more complex movement, improve the evaluation process for whole performance and represent more details on the feedback.

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