Comparison of Machine- and Expert-based Thai Dance Evaluation Methods

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***Abstract*—It takes years to learn the Thai dance movements and become an expert. A Thai dance master must train close together with his or her students to transfer tacit knowledge. However, there is a lack of teachers and tools for teaching Thai dance. A Thai dance training tool prototype has to be developed to help the dance students practice dance movement outside the class. The tool is developed to give feedback to Thai dance students on basic dancing movements and to get a better performance based on the feedback. The evaluation process for the Thai dance training tool is taken into consideration. The method is to compare the machine feedback points with the Thai dance expert perspective. The comparison method is using the t-test to get a p-value between two groups and the difference within the groups to provide an evidence of significant value. Therefore, this paper is focusing on comparing machine scores with Thai dance expert scores (scores for each body part and an overall score) with 2 groups of Thai dance movement (Group A & B). The result of both groups has shown significant and insignificant values which are irrelevant to the score given by the machine and by the expert. The insignificant result provides the knowledge for improving the evaluation process of the Thai dance training tool.**

Keywords—tacit knowledge, Thai dance training tool, evaluation process, t-test, machine scores, Thai dance expert score

I. INTRODUCTION

According to UNESCO's 2003 convention on Intangible Cultural Heritage, the Thai government divided the intangible cultural heritage into the seven following domains: (1) Linguistic and Communications tool, (2) Folk Literature, (3) Performing Arts, (4) Social Practices, Rituals and Festive Events, (5) Knowledge and Practices Concerning Nature and The Universe, (6) Traditional Craftsmanship, (7) Traditional Sports [1]. The total number of Intangible Cultural Heritages under 7 domains designates 218 elements, 51 elements from the Performing Arts domain which is the focus of this research [2]. Teaching and learning Thai dance had been added into the Thai education as a basic education core curriculum by the Thai government for the next generation [3]. Every student learns the history of Thai dance and practices some basic movement to understand the idea and the structure of the Thai dance movements. There is a specific school to teach Thai dance in a high level which was established under the name College of Dramatic Arts around the country. Learning and Teaching Thai dance is challenging due to the complexity of the task of transferring the tacit knowledge from the teacher to the student. A Thai dance student must memorize all the movements which requests high concentration of practicing. During practicing, the student gets in a group and practices with no explicit knowledge. The issue occurs when they came back with an incorrect movement. The teacher then takes more time to repeat the same movement. In order to be able to handle this problem, a Thai dance training tool had been developed as a prototype providing the Thai dance students a tool to practice with after the class [4][5]. However, the system must be improved on the evaluation process to provide correct feedback to the user. Therefore, this paper is focusing on evaluating the Thai dance movement comparing the machine calculated score with the Thai dance expert feedback score.

II. RELATED WORK

In 2011, Hui-Mei J. explored the potential of using Microsoft Kinect Motion Sensor as the interactive system in teaching and learning which supports kinesthetic pedagogical practices and increases classroom participation and improves the teacher's ability to represent the knowledge [6]. In the same year, Emiko C. et. Al. compared a dance instruction video to a rhythm game interface on the player's perceptions. The results showed that the footage of a real human dancer could not be replaced by the game-inspired interface elements alone [7].

In 2012, Zoe M. et. Al. implemented a Kinect-based system called "Super Mirror" and discovered the impact on the usability on ballet instruction by using eight ballet movement. The prototype system combined the functionality of studio mirrors and prescriptive images to assist the user with real-time feedback. The teacher score provided a pattern related to the level of the student's experience while the Super Mirror showed a different score compared to the teacher when the movement was getting difficult. Yet, the result of the evaluation process must still be improved [8].

In 2017, Ob-orm M. et. Al. implemented a dance training tool using Kinect-based skeleton tracking and evaluated thee Thai dance performance. The tool used the skeleton of the 3D model to compare the motion capture data with real-time data from Kinect sensor and calculate the different position of each joint. The result showed that the system provides feedback for the user and that the evaluation method needs to be further improved [4].

In 2018, Yootthapong T. et. Al. continued developing the Thai dance training tool and focused on the evaluation of real-time movements using the Kinect Motion Sensor device. The proposed method compared two data sets, namely the position accuracy percentage and the rotation accuracy percentage. The result showed that the user could get 2

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feedbacks from the system, one for each body part scores and another of the total score [5]. In addition, a questionnaire was used regarding the attitude of the performing arts students towards the dance game as a Thai dance training tool. The results showed that the game increases engagement towards the Thai dance training tool [9]. If the game can provide game elements such as leaderboard and badges in the learning environment, it will provide a positive outcome regarding student performance [10]. Chernbumroong et al. implemented the leaderboard as a gamification element for fostering the motivation and performance of Thai students. Besides, the Thai dance training tool can indicate a different kind of outcome. Methodology [11].

As regards the comparison between the two data sets - one being machine scores and the other being the evaluation from an expert the data were collected from twenty participants who didn't not have any experience in training Thai dance. The system provided two dance movements for the user to play in front of the Microsoft Kinect motion sensor. Each user started with typing his/her name in the system, selecting the dance movement number one, then the system demonstrated how to dance, and the system started the dancing process. When the dance is finished, each body part score is shown on the screen, just like the overall score. Subsequently, the user starts the second Thai dance movement. Each dance of each user is recorded on a video for the expert to be evaluated in the next process. Figure 1. shows the methodology of the process of evaluating the Thai dance movement by the machine and by a Thai dance expert. One minute to one minute and thirty seconds is used per dance movement.

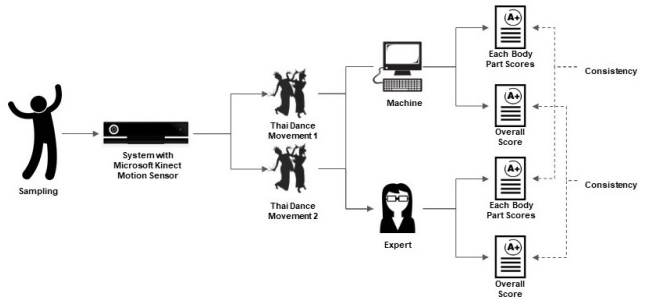

Fig. 1. The process of evaluation Thai dance movement by machine and Thai dance expert methodology.

Methodology of the process of evaluating the Thai dance movement by the machine and by a Thai dance expert The Thai dance expert fills the evaluation form marking each user body part score and the overall score as shown in Figure 2. Each body part form contains eleven body parts which are Head, Upper Torso, Lower Torso, Right Upper Arm, Right Forearm, Right hand, Left Upper Arm, Left Forearm, Left hand, Right Leg and Left Leg. In the overall score form, the expert gives the overall score, comments on the mistakes of the dance movement and gives suggestion on each movement. The expert watches the video one time per movement only and marks the score on the form.

The hypothesis of this research is that the evaluation value of the machine and the expert is not different. We expect the Thai dance training tool to evaluate the student's movement similarly to the Thai dance teacher.

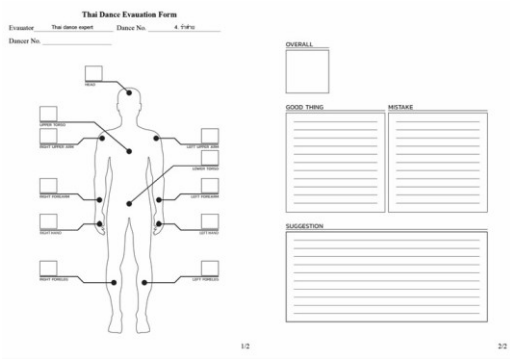

Fig. 2. Expert's evaluation form for each body part scores and for the overall score.

III. RESULT

The result is given in two difference results (Group A & Group B) which compares the data from the machine and from the Thai dance expert in each group, using the t-test also called Student's T-Test to compare two averages (means) and inform us if they are different from each other. Besides, the t-test tells how significant both compared data sets are. Thus, there are two group of paired sample tests which are Group A with the 1st dance movement and Group B with the 2nd dance movement as shown in Figure 3.

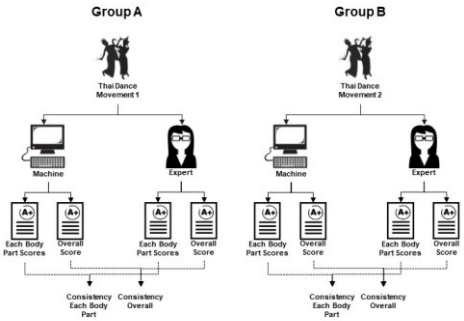

Fig. 3. Two different Thai dance movements (Group A & B)

A. Group A

The first dance movement is called "*Sod Soi Ma Ra Preang*". The score from the machine is compared to the one of the Thai dance expert using the t-test (each body part score and the overall score) showing that it is significant because the p-value is less than 0.05 indicating a strong evidence for both compared data sets.

TABLE I. MEANS, DIFFERENCE AND PAIRED SAMPLES TEST OF 1ST MOVEMENT (SOD SOI MA RA PREANG)

No.	List	No. of user	Mean	Diff.	SD.	t	df	Sig. (2-tailed)
1	Head (Machine)	20	55.30	-5.70	5.34	-2.716	19	.014**
	Head (Expert)	20	61.00		9.67			
2	Upper Torso (Machine)	20	54.85	-22.15	1.56	-14.049	19	.000**
	Upper Torso (Expert)	20	77.00		7.32			
3	Lower Torso (Machine)	20	53.00	-22.50	0.00	-14.661	19	.000**
	Lower Torso (Expert)	20	75.50		6.86			
4	R Upper Arm (Machine)	20	54.80	-9.70	5.29	-4.492	19	.000**
	R Upper Arm (Expert)	20	64.50		8.87			

No.	List	No. of user	Mean	Diff.	SD.	t	df	Sig. (2-tailed)
5	L Upper Arm (Machine)	20	54.15	-10.35	4.66	-4.960	19	.000**
	L Upper Arm (Expert)	20	64.50		8.87			
6	R Forearm (Machine)	20	46.85	-14.65	3.32	-6.814	19	.000**
	R Forearm (Expert)	20	61.50		8.75			
7	L Forearm (Machine)	20	43.25	-18.25	1.77	-9.984	19	.000**
	L Forearm (Expert)	20	61.50		8.75			
8	R Hand (Machine)	20	44.00	-20.00	1.17	-6.603	19	.000**
	R Hand (Expert)	20	64.00		13.5			
9	L Hand (Machine)	20	44.05	-19.95	0.22	-6.547	19	.000**
	L Hand (Expert)	20	64.00		13.53			
10	R Leg (Machine)	20	53.65	-8.85	2.41	-3.220	19	.000**
	R Leg (Expert)	20	62.50		12.5			
11	L Leg (Machine)	20	50.35	-12.15	1.49	-4.344	19	.000**
	L Leg (Expert)	20	62.50		12.5			
12	**Overall Score (Machine)**	**20**	**50.45**	**-19.05**	**1.53**	**-14.127**	**19**	**.000****
	Overall Score (Expert)	**20**	**69.50**		**6.04**			

** is a variable between machine and expert that is significant, and it has a 95% confidence level or Sig. is less than 0.05.

However, the difference value of each body part is high. For example, Lower Torso value between machine and expert is Diff.=-22.50 and t = -14.661. Right Hand is Diff.=-20.00 and t=6.603 and Left Leg is Diff.=-12.15 and t=4.344 which indicates that the machine might evaluate those body parts differently from the Thai Dance expert. Hence, the algorithm must be improved for the better evaluation of the Thai dance movement. Nevertheless, there is a small number of differences in value. For example, Head Diff.=-5.70, t—2.716, Right Upper Arm Diff.=-9.70, t=-4.492, and Right Leg Diff.=-8.85, t=-3.330 which is quite low. That means that the evaluation scores are nearly the same.

For the overall score there is a significantly different value for -19.05 and t=-14.127 which shows that there is quite a big difference between the scores given by the machine and the expert. This will help the developer to calculate the new algorithm for a better evaluation.

B. Group B

The second dance movement is called "Ram Soi", the score of both machine and expert were compared using the t-test method. Thus, the result of the p-value for each body part indicated the significance of eight parts and the rest were not significant. The reason of insignificance is the inconsistency of assessment of each user. This is interesting for the different Thai dance movements; the value is not relevant as expected due to the reason. The same reason happened to the comparison of the overall score of both the machine and expert scores, the result of the p-value is not significant, and the difference value is high. Therefore, a different method might be applied for the evaluation process of the machine and Thai dance expert.

TABLE II. MEANS, DIFFERENCE AND PAIRED SAMPLES TEST OF 2ND MOVEMENT (RAM SOI)

No.	List	No. of user	Mean	Diff.	SD.	t	df	Sig. (2-tailed)
in1	*Head (Machine)*	*20*	*59.50*	*-4.500*	*12.17*	*-1.354*	*19*	*.192*
	Head (Expert)	*20*	*64.00*		*7.53*			
2	Upper Torso (Machine)	20	57.00	-7.000	3.62	-2.839	19	.010**
	Upper Torso (Expert)	20	64.00		10.95			
3	Lower Torso (Machine)	20	56.00	-7.500	2.05	-2.870	19	.010**
	Lower Torso (Expert)	20	63.50		10.89			
4	R Upper Arm (Machine)	20	68.50	12.000	19.56	2.241	19	.037**
	R Upper Arm (Expert)	20	56.50		10.89			
5	*L Upper Arm (Machine)*	*20*	*58.80*	*2.300*	*13.13*	*.593*	*19*	*.560*
	L Upper Arm (Expert)	*20*	*56.50*		*10.89*			
6	R Forearm (Machine)	20	67.55	11.550	24.34	2.113	19	.048**
	R Forearm (Expert)	20	56.00		15.35			
7	*L Forearm (Machine)*	*20*	*66.00*	*10.000*	*23.93*	*1.874*	*19*	*.076*
	L Forearm (Expert)	*20*	*56.00*		*15.35*			
8	R Hand (Machine)	20	47.80	-8.200	1.90	-2.377	19	.028**
	R Hand (Expert)	20	56.00		15.35			
9	L Hand (Machine)	20	47.35	-8.650	1.63	-2.466	19	.023**
	L Hand (Expert)	20	56.00		15.35			
10	R Leg (Machine)	20	83.85	29.350	21.76	4.695	19	.000**
	R Leg (Expert)	20	54.50		12.34			
11	L Leg (Machine)	20	68.95	14.450	24.53	2.274	19	.035**
	L Leg (Expert)	20	54.50		12.34			
12	***Overall Score (Machine)***	***20***	***50.25***	***-6.750***	***2.35***	***-2.031***	***19***	***.056***
	Overall Score (Expert)	***20***	***57.00***		***15.25***			

** is a variable between machine and expert that is significant, and it has a 95% confidence level or Sig. is less than 0.05.

IV. CONCLUSION

In conclusion, using the t-test method to compare two averages or means between the machine score and the expert score for two Thai dance movements is not relevant due to the given outcome of both scores. As regards Group A, the p-value is significant for both the body part scores and the overall score. However, the difference value of the body part scores is high for some body parts which shows a weak correlation between the scores of the machine and the expert. Nevertheless, the difference value of the overall score is quite high which can be a good information to improve the evaluation system of the Thai dance training tool. As regards Group B, the p-value shows some significance of eight body parts which means that the given scores of the machine and the expert are relevant. But for another three body parts it is irrelevant due to the inconsistency of the given score to each user. In addition, the overall score turned out to be insignificant too, shown by the p-value, again because of the inconsistent scores given to each user.

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