Interpreting Thai Laban Notation into ThaiDanceXML

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Abstract— **In South East Asia, performing arts is a rich intangible cultural heritage such as Thai dance which is a living traditional art form listed by UNESCO. Using technology in today's world to preserve such living tradition can be helpful. However, in Thai dance there have been issues on the ability to translate the human understanding and perception of Thai dance movements to digital information such as video recording without losing details. Contrasting, The Labanotation system is one of the many Dance Notation Systems. Labanotation is a human readable document which records every possible human movement. Hence, to provide accurate machine-readable information to represent the Thai dance movement in 3D Animation, this paper will focus on the interpretation of Thai dance notation scores into machine readable information using Extensible Markup Language (XML), mainly emphasizing on the hand and finger movements called "*ThaiDanceXML*".**

Keywords—intangible cultural heritage; Thai dance; labanotation system; dance notation system; human readable information; machine readable information; XML; ThaiDanceXML

I. INTRODUCTION

Thailand culture is the most famous in Southeast Asia. Thailand is especially famous for the heritage, temple, rituals and performing arts. Cultural Heritage is not only found in museums, temples and archaeological sites but it is also found in the present, in our daily culture, where traditional forms of cultural heritage are passed on from generations to generations. UNESCO is calling such culture as " *Living traditional art forms*" in Intangible Cultural Heritages also known as ICH [1]. In 2010, UNESCO Thailand launched a pilot project on 4 domains in ICH and the main focus is on performing arts. Khon dance drama is a traditional performing art that performs solely in the royal court. They are performed by men in masks, accompanied by narrators and a traditional piphat ensemble. However, this traditional performing art is at a risk of disappearing from the living cultural heritage in Thai culture, since the world is focusing more towards digital advancements. Therefore, it is very important to preserve ICH for the new generation. Our studies have found that one of the many ways to archive movements like Thai dance and to record all the possible movement is by using the global standard Labanotation system. Labanotation system uses abstract symbols to define the body parts, direction, level, duration and dynamic quality of the movement. Labanotation system is capable of recording each movement in detail, using the program called "LabanWriter". It is a Labanotation editor for the Macintosh developed by the Ohio State Department of Dance]2]. There were a few programs to represent the dance from Laban scores into three-dimensional space such as LabanDancer, GenLaban [3]. However, these programs do not support the newer version of operating system.

About Labanotation, it is a score that contains information that is human readable, which could be used to interpret into machine readable information. From our studies and findings, Thai dance movement can be archived using Labanotation system, recording dance standard. The Labanotation will then be interpreted in Extensible Markup Language or XML file format such as LabanXML [4] and MovementXML [5]. LabanXML is a standard for storing data of the Labanotation. MovementXML is another standard for storing human movement notations into machine readable and is more flexible than LabanXML.

However, LabanXML and MovementXML is incapable of recording specific details of certain dance movement like hand signs and the difference between tap and stomp, thus making it incapable of storing Thai dance movement. Thai dance emphasizes on the movement of the arms, hands, fingers, knees and foots, making it very hard to write in the Laban notation score and interpreting it to XML file format. Therefore, this paper will be focusing on writing a Thai Dance XML standard using the advantages and learning the disadvantages of each written standard, creating the new structure for Laban Thai dance XML.

II. Literature Review

A. Labanotation

Labanotation system is a dance notation system for recording movement of human, originally created by Rudolf Laban in the 1920's. Rudolf von Laban studied about architecture, attentive about arts, and was very interested in analyzing and studying dance movement [6]. Then, Ann Hutchinson Guest is an American movement and dance researcher who considered the world authority on dance notation on Labanotation [7]. Using space, weight, flow, time and energy as fundamental parameters and uses physical law to create sign of Labanotation. Labanotation is analyzing of direction, level, time of body movement and type of movement. The general symbol of Labanotation is from geometry and the position of symbol is in the columns of staff notation to descript which body part is moving. [8].
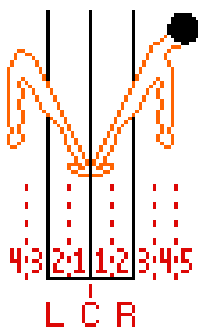

Fig.1.Separation staff column of Labanotation system

Laban column separate into left and right parts of the human body from the support, foot, body, arm and head [8]
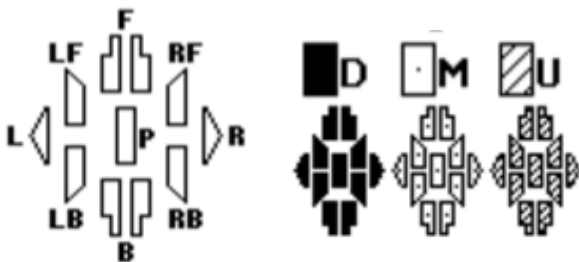

Fig.2.Directions and level sign of Labanotation

Simple direction sign is used to give direction of the dance movement when placed on the column. Three kinds of shades are used to indicate the vertical dimensions. For Example, slight shade indicates a high direction, Middle is represented as white and Down is represented as black indicating a low direction. Additionally, Labanotation is flexible enough to record every human movements, including Thai dance especially on hand and finger movement. Using Labanotation system assist to preserve dance movement and benefit the notators to archive specific dances. Therefore, Labanotation is the innovation to record the movement of human and any dancing steps in the world especially, Thai dance [9].

B. XML

Extensible Markup Language) XML(is a markup language that is used to descript data. XML structure is flexible to create information formats. XML data can be self-describing or self-defining, meaning that the structure of the data is embedded with the data. Thus, when data arrives, there is no need to pre-build the structure to store the data. Because of flexibility of XML, many people had tried to create XML to creatively develop software and applications [10].

1) Translation to 3D animation

To represent dance notation into 3D animation generated several stages to convert human readable information to machine readable information. In 2002, Matthew Gough present a novel form of dance notation which has a hand written in machine-readable format called "eXtensible Dance Scripting Notation" (xdsn) [11]. Xdsn was designed for a quick to write, simple to study and uncomplex platform for giving illustrating context in current contemporary dance ontology and demonstrating in 3D animation. Minako Nakamura and Kozaburo Hachimura focused on Labanotation system and extensively developed LabanXML to translate human readable information from Laban notation score to machine readable information for a general body motion, not specific dance movements which represents and demonstrates the dance movement based on human body model in 3D graphics animation [4]. Matevž Baloh, Ciril Bohak and Matija Marolt had tried to provide format, standard and software in which supported transcription, analysis of dance and production of dance tracks in 2015. By analyzing LabanXML and MovementXML, and create the new digital Labanotation called "Streaming LABAN" [12]. Streaming Laban is a format file to encode Labanotation which is small in size, work in sequence and analyzes real-time. Besides, Yootthapong and his co-researchers analyzed Labanotation and found Thai dance movement to be recorded on Labanotation system and developed a technology to represent the movement in 3D animation for preserving Thai dance knowledge on intangible cultural heritage [13]

Besides, inventing Thai dance training tools for training Thai dance students using real-time motion information from Kinect motion sensor device and comparing Thai dance data sets capturing by motion capture system. The tools provides feedback to the students and help to improve their Thai dance movement [14][15].

2) LabanXML Standard

LabanXML developed by Minako Nakamura and Kosaburo Hachimura, found that the Principles of Labanotation resembles both staff notation and music notes. Thus, they created LabanXML base on the principles of MusicXML

Structure of LabanXML starts off with the root >Laban> Element which give the attribute that use to tell characteristic

of song such as Time, Beat, Beat-Type and <Notation> Elements is used for starting the first part of Laban Notation score.
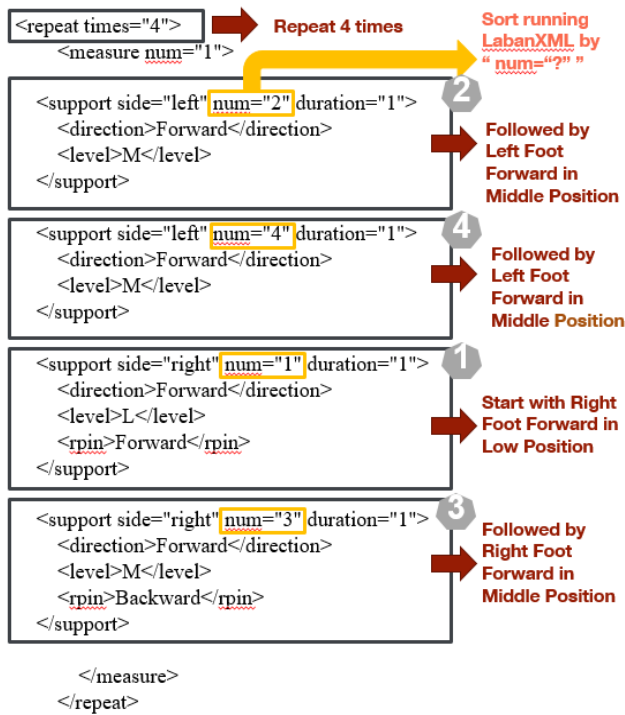

Fig.3.LabanXML)Four Measure of Walking for Legs(

In XML, Laban score is presented in the <Notation> Element which uses the <Repeat> and <Measure> Element. Column of Laban score is divided into 3 parts: Left part of the body, Support, Right part of the body. LabanXML is written by reading the Laban score from left column to right column and from bottom to top. LabanXML starts from measure number zero, followed by <Relationship> Element if there are any symbol in relationship with another body part. The structure of a <measure> starts with measure number as its parameter. In <measure>, <path> element will have duration as its parameter. <path> includes a <direction> as shown in Figure 3.

Fig.4. Structure of LabanXML represented by DTD file

For Thai Dance movement, the beat of the song changes sometime. However, in LabanXML, the beat of the song is defined strictly and cannot be changed. Therefore, LabanXML is not suitable to record Thai Dance. Another reason is Thai Dance has repeat measure that exchange movement of the dance laterally. LabanXML <repeat> element do not have attribute nor parameters to support such changes. Thus, LabanXML has its limitation when it comes to Thai Dance.

3) MovementXML Standard

Structure of MovementXML is a representation from human movement base on Labanotation that is more flexible than LabanXML. [4[. MovementXML starts with element. The Movement Element also has a <measure> element and it has parameters that define the measure number, beat, beat-type, beat-duration and meter (beats per minute). The measure has two elements, <support> and <gesture> in which describe movement of the body part. The <description> element found in both <support> and <gesture> describes how body part moves and each includes element such as <direction>, >level> to define the movement. MovementXML also has a <repeat> element that contains parameter that defines how to repeat the movement. For instance, <repeat count = "4" repeat-type = "exact" exclude-path= "false">, it repeats the movement 4 times which made the movement more flexible.

Fig.5. Movement XML of Noh dance

MovementXML stores both functions and data. MovementXML is more flexible than LabanXML but there are still some limitations to Thai Dance movement. MovementXML is not capable of storing the strength of a foot tap. Example like light tap or a stomp. Thai Dance Hand Terminology is too complex and complicated as it is stored as a long piece of data, making it hard to keep track when some editing needs to be done when using MovementXML standard.

III. METHODOLOGY

This paper is focusing on archiving Thai dance movement using Labanotation system as Human-Readable Information and interpreting it into Machine-Readable Information. There are two standards to use for translating Laban notation scores,

either Extensible Markup Language or XML into machine readable information using both LabanXML [4[and MovementXML] 5[. Both standards have advantages and disadvantages yet, it is not capable of supporting Thai dance movement. Therefore, ThaiDanceXML is created to support the delicate and unique movement, focusing on hand and finger movement in traditional Thai dance.
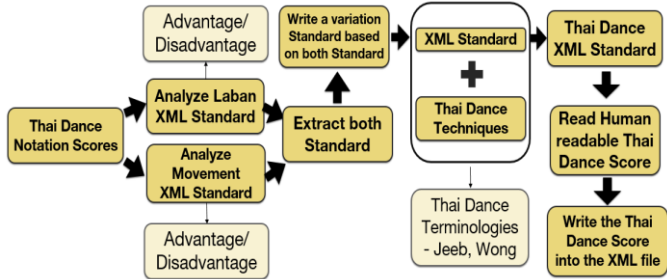

Fig.6. Interpreting Thai Notation Scores to Thai Dance XML Diagram.

Analyzing between both LabanXML and MovementXML structure to understand and extract both standard to write out a ThaiDanceXML standard. Table 1. Shows five different structures. First, the number of beat in LabanXML is defined for all measure but MovementXML can change number of beat in every measure. Second, LabanXML can write only from left column to right column but MovementXML can start with left column or right column. Third, LabanXML <repeat> parameter only contain count but MovementXML <repeat> parameter contains count and repeat-type. Repeat-type can be exact, sagittal-symmetry. Fourth, the position of LabanXML body part is described together but the position of MovementXML body part is described separately. Five, only in MovementXML, exclude-path is used, giving MovementXML more versatility.

TABLE I. ANALYZING LABANXML AND MOVEMENTXML STRUCTURE

LabanXML	MovementXML
1. Number of beat is defined for all measure.	1. Can change number of beats in each measure.
2. Always write from Left to Right	2. Can start with Left or Right
3. Only contain repeat count.	3. Contains repeat-type element. Example exact, sagittal-symmetry etc.
4. The position of the body part)Example: Left Foot move to the left in front of Right foot(is described together.	4. The position of the body part is described separately.
5. Exclude-Path is not used in LabanXML.	5. Exclude-Path is used, giving MovementXML more versatility.

A. *ThaiDanceXML*

The main purpose of XML in ThaiDanceXML is to store a representation of the Laban Notation System. Therefore, the way of writing ThaiDanceXML is to represent the parameter of the dance movement. ThaiDanceXML adapts from both LabanXML and MovementXML. The structure of ThaiDanceXML will start with <Laban> Element as its root. <Laban> element will include the <Notation> Element. In the <Notation> Element, it will include the <attribute> element.

The <attribute> element will store the beat count of a measure. The <attribute> element includes <Measure> element. The <Measure> element contains number parameter, <Beat>, <Beat-type>, <support>, <leg>, <body>, <arm>, <hand> and <head> element. The support, leg, body, arm, hand and head element will each contain a <Level>, <Direction>, <Speed>, <Hold>, <Sign>, <Degree>, <Contact>, <Rotate>, <Rpin>, <Relationship>, <Bodypart> and <Terminology> element. However, Thai dance hand sign has their own <Direction>, <Level> etc.

```
<Laban>
  <Notation>
    <attribute>

      <Measure num ="0">
        <Beat-Type>4</Beat-Type>

        <Support side ="Left">
          <Level>M</Level>
          <Direction>Place</Direction>
        </Support>

        <Support side ="Right">
          <Level>M</Level>
          <Direction>Place</Direction>
        </Support>

        <Arm side ="Left">
          <Level>L</Level>
          <Direction>Place</Direction>
        </Arm>

        <Arm side = "Right">
          <Level>L</Level>
          <Direction>Place</Direction>
        </Arm>

      </Measure>
```
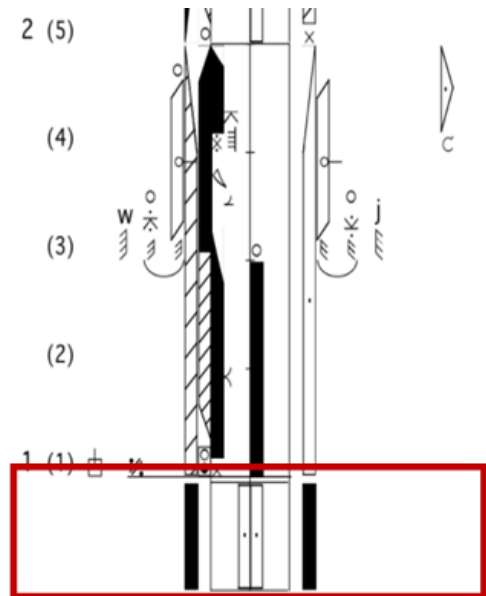
Fig.7. ThaiDanceXML)Kaii-Mue(

Fig.8. Thai Dance Notation Score on Kaii-Mue terminology

Thai Dance Notation Score) red box(interprets into ThaiDanceXML in figure 7, and the structure of Thai Dance XML is defined in DTD file that show in figure 9.

```
<!ATTLIST measure num CDATA #IMPLIED>

<!ELEMENT support(level?, direction?,speed?, hold?, sign?,degree?,contact?,rotate?,rpin?,Relationship?,bodyPart?)>
<!ATTLIST support side CDATA #IMPLIED>

<!ELEMENT leg (level?, direction?,speed?, hold?,
sign?,degree?,contact?,rotate?,rpin?,Relationship?,bodyPart?)>
<!ATTLIST legside CDATA #IMPLIED>

<!ELEMENT body(bodyPart,level?, direction?,speed?, hold?,
sign?,degree?,contact?,rotate?,rpin?,Relationship?)>
<!ATTLIST body side CDATA #IMPLIED>

<!ELEMENT arm(level?, direction?,speed?, hold?, sign?
,degree?,contact?,rotate?,rpin?,Relationship?,bodyPart?)>
<!ATTLIST arm side CDATA #IMPLIED>

<!ELEMENT hand(level?, direction?,speed?, hold?,
sign?,degree?,contact?,rotate?,rpin?,Terminology?,Relationship?,bodyPart?)>
<!ATTLIST hand side CDATA #IMPLIED>

<!ELEMENT head (level?, direction?,speed?, hold?, sign?,degree?,contact?,rotate?,rpin?,Relationship?,bodyPart?)>

<!ELEMENT beat (#PCDATA)>
<!ELEMENT beat-type (#PCDATA)>
<!ELEMENT level(#PCDATA)>
<!ELEMENT direction (#PCDATA)>
<!ELEMENT speed (#PCDATA)>
<!ELEMENT hold (#PCDATA)>
<!ELEMENT sign (#PCDATA)>
<!ELEMENT degree (#PCDATA)>
<!ELEMENT contact (#PCDATA)>
<!ELEMENT rotate (#PCDATA)>
<!ELEMENT rpin(#PCDATA)>
<!ELEMENT bodypart (#PCDATA)>
<!ELEMENT terminology(#PCDATA)>
<!ELEMENT relationship (#PCDATA)>
```

Fig.9. DTD of Kaii-Mue terminology on ThaiDanceXML

B. Process to write Thai Dance XML

First of all, to write ThaiDanceXML, it is necessary to know all the structure of Thai Dance XML that is shown in figure5 and tags of Thai Dance XML.

TABLE II.   SYNTAX RELATED ON THAIDANCEXML

Tags	Descriptions
<Laban>	This tag is used for indicating the start of the Laban record.
<Notation>	Identify that the data within is recorded from the notation.
<Beat-Type >	Indicate the total beat in the rhythm of the song.
<Repeat>	Address the total repeat time of the data within the tag.
<Measure>	The counter tag for the beat.
The body is related tag which directly be the tag on body part.	
<Support>	Supporting body part
<Arm>	Arm
<Leg>	Leg
<Body>	Body
<Bodypart >	is used when the writer wants to be more specific about the part of the body that they are mentioning.
Placement Related	
<Level>	Identify the height of movement of the mentioned body part according to the Laban notation.
<Direction>	Identify the direction of the mention of body part according to Laban notation.
<Degree>	Identify the intensity of the sign mentioned within the tag according to the Laban notation.
<Hold>	Address the action of keeping a dance move at its position.
<Sign>	Define the action of the specific body part. (fold or wide)
<Speed>	Define how long it take to do the dance move.
<Contact>	Indicate the part of the foot that is in contact with the floor.
<Rotate>	Indicate the direction of rotation which is clockwise or anticlockwise.
<Terminology>	Finish set of specific movement or gesture which is considered a Thai dance terminology.
<rPin>	Define the degree of rotation of the specific body part.
<Relationship>	Define the relationship between a bodypart and another

C. ThaiDanceXML standard

1) Starting to record from the bottom of Laban notation score then move up beat by beat.
2) Within a beat, starting from the support, record the left side first, followed by the right side and move on to the legs and etc..
3) In case the step takes more than one beat of duration, that step will be recorded only once in the starting beat and the duration for the step will be recorded by `speed' tag.
4) Use the measure tag as the counter.

IV. CONCLUSION

Currently, living traditional art form like performing arts are disappearing from the living cultural heritage in Thai culture. Therefore, the preservation of performing arts using dance notation system such as Labanotation has been used to archive the delicate and complex dance movement. Because of the advanced technology people possess in the modern century, it is almost integrated into our daily lives. Interpreting Thai notation scores to machine readable information to represent the movement into 3D animation by analyzing both LabanXML and MovementXML. Extracting both standards, advantages and disadvantages, comparing the complex and delicate Thai dance techniques, especially the hand and finger movements. In addition, define ThaiDanceXML standard compatibility with Unity 3D program to display the Thai dance movements into 3D virtual environments. Future work is to improve ThaiDanceXML standard for more complex Thai dance movement, writing Thai dance terminologies and record dances of a full song to represent it into 3D animation.

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