DEVELOPMENT OF DANCE MOVEMENT MODEL USING LABAN MOVEMENT ANALYSIS

JOKO SUTOPO

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Faculty of Information and Communication Technology

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DECLARATION

I declare that this thesis entitled "Development of Dance Movement Model Using Laban Movement Analysis" is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in the candidature of any other degree.

Signature :

Name : Joko Sutopo

Date : March 14, 2023

APPROVAL

I hereby declare that I have read this thesis and in my opinion this thesis is sufficient in terms of scope and quality for the award of Doctor of Philosophy.

Signature :

Supervisor Name : Profesor Dr. Mohd Khanapi Bin Abd Ghani

Date : 14/3/2023

DEDICATION

“To my beloved Mother Ibu Rusmini and Father Katiyo”

“To my beloved Mother Ibu Hj Sutani and Father in Law Bapak H. Kawit ”

“To my beloved wife Sri Haryani”

“ To My Children Aulia Nur Septiani and Aufa Luthfi Zulfariyanto ”

“To my beloved brother and sister”

ABSTRACT

Dance is an art product that represents aspects of religion, culture, and community tradition. Each dance movement is a combination of body movements that represent meaning. So far, students and dance teachers have learned dance movements based on rote learning, where the obstacle that arises is that a dancer finds it difficult to adapt dance movements according to the meaning of the dance. A problem that often arises is that dynamic dance movements cause dancers or dance students to not be able to adjust their movements, especially since each dancer has a different body shape causing accuracy, flexibility and less optimal performance. Therefore, this research tries to solve the problem of accuracy and flexibility of dance movements by using the method and evaluation that is Laban Movement Analysis (LMA) which is the notation of dance movements created by Rudolf Laban and has become the international standard in dance notation. LMA has four variable components, namely Body, Space, Shape, and Effort, which are used in the process of evaluating movement and extracting movement data that has multidisciplinary aspects, including anatomy, kinesiology, psychology and aesthetics. LMA is widely recognized as an analysis for studying movement, meaning, and documentation of movement sequences. Dance movements have aspects of space, time, coordinates, beauty and speed, which are then carried out by the data mining process for the feature extraction process to study and evaluate the dance movement data. In this study, develop all aspects of LMA components (Body, Space, Shape, and Effort) to carry out the process of analyzing movement patterns in the feature data processing. Several studies have used aspects of LMA in analyzing dance movements, but no researcher has involved all aspects of LMA components, especially the Effort element. In this study, the researcher has conducted a study to identify dance movement patterns using all components of Body, Space, Shape, and Effort (BSpShEf) and pay attention to the composition of LMA components. After being analyzed and processed using the Hidden Markov Model (HMM) method, the average accuracy of the results exceeded 95%. This study uses two types of dance movement data, namely classical and contemporary movement data. From the results of the study, the accuracy of recognizing classical dance moves was 96.19%, while the accuracy of recognizing contemporary dance moves was 96.13%, so it can be said that this study was successful in recognizing classical and contemporary dance moves so that dancer students and dance teachers in the process of learning dance moves, especially classical dance and contemporaries do not need to bother finding the exact movement point according to the sequence and rhythm of the actual dance movements, after doing this study.

PEMBANGUNAN MODEL PERGERAKAN TARIAN MENGGUNAKAN LABAN MOVEMENT ANALYSIS

ABSTRAK

Tarian ialah produk seni yang mewakili aspek agama, budaya, dan tradisi masyarakat. Setiap gerak tari merupakan gabungan gerak badan yang mewakili sesuatu makna. Setakat ini, murid dan guru tarian mempelajari gerak tari berdasarkan aspek hafalan, di mana halangan yang timbul ialah seseorang penari sukar menyesuaikan pergerakan tarian mengikut maksud tarian tersebut. Masalah yang sering timbul ialah pergerakan tarian yang dinamik menyebabkan penari atau pelajar tari tidak dapat menyesuaikan pergerakan mereka, lebih-lebih lagi setiap penari mempunyai bentuk badan yang berbeza menyebabkan ketepatan, fleksibiliti dan persembahan yang kurang optimum. Oleh itu, penyelidikan ini cuba menyelesaikan masalah ketepatan dan kelenturan pergerakan tarian dengan menggunakan kaedah dan penilaian iaitu Laban Movement Analysis (LMA) iaitu notasi pergerakan tarian ciptaan Rudolf Laban dan telah menjadi piawaian antarabangsa dalam notasi tari. LMA mempunyai empat komponen pembolehubah iaitu Body, Space, Shape, and Effort yang digunakan dalam proses menilai pergerakan dan mengekstrak data pergerakan yang mempunyai aspek pelbagai disiplin termasuk anatomi, kinesiologi, psikologi dan estetika. LMA diiktiraf secara meluas sebagai analisis untuk mengkaji pergerakan, makna, dan dokumentasi urutan pergerakan. Pergerakan tarian mempunyai aspek ruang, masa, koordinat, keindahan dan kelajuan yang kemudiannya dijalankan oleh proses perlombongan data untuk proses pengekstrakan ciri bagi mengkaji dan menilai data pergerakan tarian. Dalam kajian ini, membangunkan semua aspek komponen LMA (Body, Space, Shape, and Effort)untuk menjalankan proses menganalisis corak pergerakan dalam pemprosesan data ciri. Beberapa kajian telah menggunakan aspek LMA dalam menganalisis pergerakan tarian, namun tiada pengkaji melibatkan semua aspek komponen LMA terutamanya elemen Effort. Dalam kajian ini, pengkaji telah menjalankan kajian untuk mengenal pasti corak pergerakan tarian menggunakan semua komponen Body, Space, Shape, and Effort (BSpShEf) dan memberi perhatian kepada komposisi komponen LMA. Selepas dianalisis dan diproses menggunakan kaedah Hidden Markov Model (HMM), purata ketepatan keputusan melebihi 95%. Kajian ini menggunakan dua jenis data pergerakan tarian iaitu data gerakan klasik dan kontemporari. Daripada hasil kajian, ketepatan mengenal gerak tari klasik adalah 96.19%, manakala ketepatan mengenal gerak tari kontemporari adalah 96.13%, sehingga dapat dikatakan kajian ini berjaya mengenal gerak tari klasik dan kontemporari, sehingga pelajar penari dan guru tarian dalam proses pembelajaran gerak tari khususnya tarian klasik dan kontemporari tidak perlu bersusah payah mencari titik pergerakan yang tepat mengikut turutan dan rentak gerak tari yang sebenar, setelah melakukan kajian ini.

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LIST OF ABBREVIATIONS

3D	-	Three Dimension
BVH	-	Bio Vision Hierarchy
BSSE	-	Body Space Shape Effort
CSV	-	Comma Separated Value
DOF	-	Degree Of Freedom
DTW	-	Dynamic Time Warping
FPS	-	Frames Per Second
HMM	-	Hidden Markov Model
LMA	-	Laban Movement Analysis
MLP	-	Multi-Layer Perceptron
RDF	-	Random Decision Forest
RGB	-	Red Green Blue
Skl	-	Skeleton
C	-	Calculation
f	-	Defined using the major and minor
L	-	Likelihood
R_i	-	Rotation matrix, with i =1,2,3,..,n
Rx,Ry,Rz	-	Rotation of the dance motion matrix in the order x, y, z
s	-	Distance
v	-	Speed
t	-	Time
x	-	Coordinate Horizontal
y	-	Coordinate Vertical
z	-	Coordinate Diagonal
T	-	Number of frames
ϴ	-	Teta
$h^{l/r}$	-	Left-hand leg joints

$f^{l/r}$	-	Right-hand leg joints
$sh^{l/r}$	-	Shoulder joint left/right
$h_i^{l/r}$	-	Hip joint left/right
$el^{l/r}$	-	Left/Right elbow joint
$kn^{l/r}$	-	Left/Right knee joint
$\mathrm{L}^{\mathrm{l/r}}$	-	Labanotation
$P_t^{l/r}$	-	Position of the left hand
$P_{t+1}^{l/r}$	-	Position of the right hand
x_n	-	Normalization
x_k	-	Quantization
Q_1	-	Lower value
Q_3	-	Top value
G_n	-	Gesture
$*$	-	Hadamard Product
$*$	-	Multiplication
$\vec{a}$	-	Vector
ℓ	-	Script Lowercase
Σ	-	Summation
$\sqrt{}$	-	Square Root
λ	-	Lambda
α	-	Learning Rate
$\circ$	-	Outer Product
$\prod$	-	Cartesian Product

LIST OF PUBLICATIONS

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CHAPTER 1

INTRODUCTION

1.1 Background

Dance is an artwork that has been highly valued since ancient times, representing the spiritual, cultural, art, and community (Aristidou, Stavrakis, and Charalambous, 2015). Dance in various forms is inherited from generations as a work culture with the meaning and beauty of each motion. The dance element is a series of basic body movements that represent meaning. Every country and geographical location has dance works by their respective cultures. In order to maintain the dance work, various countries have introduced dance learning subjects in further education.

Students dancers and mentors do dance learning through motion exercises by relying on the ability to memorize motion and tutorials. The problem that often arises is the dynamic nature of dance movements with various types of movements that are practiced, making beginner dancers unable to follow accurately. In addition, a dancer often has dance moves that differ from the actual dance moves (Rallis et al., 2018). From the problems arising from the different dance movements, a tool is needed that can evaluate dance movements, even though there has been a development of dance learning media, both through books, videos, tutorials, and multimedia, so that they can help the learning process have the flexibility of the right movements.

With the help of information technology, dance learning can be assisted in the presentation process so that the dancer's movements can be appropriate. However, the obstacle that dancers often face can master the basic movements of the body and the creation of the dance movements that follow the speed of movement, the accuracy of the position of the body, the suitability of the rhythm of motion and music and the flexibility of each gesture according to the sequence. There are limitations of the algorithm in being able to do all the dance motion analysis processes to fit the aspects of rhythm, emotion, and accuracy of motion. For this reason, we need a tool that can evaluate changes in dynamic dance motion data to be able to document and analyze dance movements appropriately and according to their meaning (Rallis et al., 2018).

The tool for documenting and evaluating the dance movement learning process is the Laban Movement Analysis (LMA) which is a dance motion notation method developed by Rudolf Laban (1897-1958). LMA which is internationally recognized has been widely known as an analysis to make observations on motion, meaning, and documentation of the sequence of motion (Aristidou, Stavrakis, and Charalambous, 2015). LMA can also be applied to fields other than dance, namely health, psychology, behavior, performing arts, medicine, sports, and physiotherapy (Jerak, Vidrih, and Žvelc, 2018). LMA has four component variables, there are body, space, shape, and effort (Dewan, Agarwal, and Singh, 2018) used in the motion evaluation process and extracts motion data that have multidisciplinary aspects, including anatomy, kinesiology, psychology, and esthetics (Maranan et al., 2014). As in music that has musical notation, dance also has a notation aids in the learning process and presentation with Laban notation, but in the implementation, it has not yet understood the accuracy of dance movements, especially in aspects of movement speed and flexibility so that it influences the meaning of the dance (Aristidou, Stavrakis and Charalambous, 2015). This accuracy is related to the LMA component extraction process, which is a more optimal body, space, shape, and effort. The accuracy of the feature extraction process with the LMA component will help the learning process for beginner dancer students in assessing the suitability of dance movements in the learning