Joko_Sutopo_Tensor Data Feature Extraction: The Result of Wayang Golek Menak Dance Capture Motion By Vector Quantization Method

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Tensor Data Feature Extraction: The Result of Wayang Golek Menak Dance Capture Motion By Vector Quantization Method

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ABSTRACT

Capturing the motion of wayang Golek Menak dance from Yogyakarta using Kinect sensore that produce motion data with format *.bvh (Biovision Hierarchy). The motion data have coordinat x,y,z, then the reduction is conducted by Principal Component Analysis (PCA) methods The result of data reduction by PCA is conducted using fituring process. Fituring is extraction feature that looking for the characteristic of feature so it can be classified. Fituring methods which is applied in this research is Vector Quantization (VQ). This method is for compressing feature data by making codebook then it's changed into code vector that can use to classified on the next process. The result from Vector Quantization (VQ) method with code vector which the value is 00, 11, 11, 00 with the codebook 0,25; 0,5;0,75 and 1.

Kata Kunci : *extraction feature, dance motion, Vector Quantization (VQ), codebook, code vector.*

I. INTRODUCTION

The art of puppetry, puppet Menak [21] or Beksa Golek Menak [24,22,23] consists of a series of dance movements that have coordinated and integrated with regard to flexibility, vibration [9], translational, and geometric transformations [6.27 , 28].

Kinect technology has the ability to interpret gestures or specific gestures by utilizing RGB camera, and projector infrared microchip to record 3D video data in certain lighting [5,7,19], by synchronizing the Kinect sensor [33] in a pose [1] motion on the body skeleton [5,16,34] with different variations [3].

A dataset motion capture (mocap) is a digital data representation of the results of body motion capture techniques at certain times [11] into a data format Biovision Hierarchy (BVH) [3,16,17], in the development of data [5,16,34]. Tensor pada dasarnya adalah bentuk umum dari skalar dan vektor, yang memiliki hubungan geometris antara operasi vector dan skalar dalam suatu proses array multidimensi [16] untuk membantu memodelkan tubuh manusia secara umum [3].

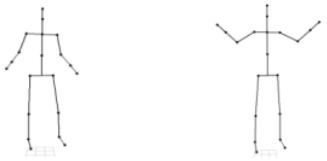
This reseach using tensor data feature extraction of wayang golek dance motion Menak, Yogyakarta from the capturing result by Kinect sensor. Feature extraction using Vector Quantization (VQ) method or known as fituring is purpose to find feature characteristic which will be used for feature classification. Position of tensor data is x, y, x from dancer which is captured by Kinect sensor. Motion position data will be in reduction proceesed and feature extraction that purpose to accelerate the computation process. The result of VQ method is code vector, it will be used in the next level for classifying.

II. LITERATURE REVIEW

A. Motion Capture Technique

Motion capture data is representation of digital data from the result of capturing technique to the actor or figure motion on real time mode [33] through the Kinect sensor [3]. Digital data which is in format motion data, or position, or coordinate orientation (points) from the position of body motion on certain time [11]. The display of mocap data format is shown on 3D format (X, Y, Z) related with figure character. Mocap data format consist of *skeleton* part [18] which is total representation of character motion, *bone* as the basic entity of skeleton which is the funtion as transformation subject, channel or Degree of Freedom (DOF) as the parameter for transformation from bone (translation, rotation, [3,16,34], move orientation) also the frame as collection channel/DOF information for each bone in a pose. Animation consist of some frame, where each animation consist of 260 frame per second (fps) maximum, evenly the frame taken consist of 30 untill 60 fps.

Biovision Hierarchy (BVH) used as mocap data format which is produced by Kinect, BVH have supporting data which is compatible for import and export at some 3D software [3]. BVH format data consist of 2 part, the first part is information about hierarchy structure frome the bone and the second is parameter data information in each channel. BVH is used for data standard of animation movement based on human body structure also as technique supporter of animation mocap and other supporting software inside the development data [20].



(a) The initial position of the frame skeleton

(b) Position the frame skeleton-1

Figure 1. Skeleton Structure BVH

BVH skeleton structure in Figure 1, in the form of dots and dashes that represented a process of

continued movement of the bones and joints of the body. With the data format of BVH mocap results can be used to import and export animation data in a variety of application programs include: 3ds Max, Motion Builder, Blender, Daz Studio, Maya, Poser and Lightwave 3D [12].

B. Tensor Data

Basically, tensor is a general form from scalar vector, and matrix [2,29,35In tensor, scalar is order-0, the vector is an order-1, and the matrix is order-2. Tensor with orders of more than 3 is a high order tensor [30].

Table 1. Matrix To High Order Tensor

Matrik	High order tensor
(Columns/Rows) $A_{i,:}, A_{:j}$	(Fibers) $X_{ij:}, X_{i:k}, X_{:jk}$ (slices) $X_{i::}, X_{:j:}, X_{::k}$ Mode-3,2,1;Horizontal,Lateral,Frontal slices
$A:B = \sum_{i=1}\sum_{j=1} A_{ij}B_{ij}$	$X:Y = \sum_{i=1}\sum_{j=1}\sum_{k=1} X_{ijk}Y_{ijk}$
$\|A\|_F = \sqrt{\sum_{i=1}\sum_{j=1} A_{ij}^2}$	$\|X\| = \sqrt{\sum_{i=1}\sum_{j=1}\sum_{k=1} X_{ijk}^2}$
(Rank one matrix) $A = ab^T$ $A_{ij} = a_i b_j$	(Rank one tensor) $X = a \circ b \circ c$ $X_{ijk} = a_i b_j c_k$
(symmetric) $A = A^T$	(Supersymmetric: cubical+symmetry) $X \in \mathbb{R}^{IxIxI}$ X_{ijk} is constant when permuting i, j, k
$A = I, A_{ij} = \delta_{ij}$	$X = T, X_{ijk} = \delta_{ijk}$

scalar, vector, matrix and rank tensor [3.29] from the table above, can define by:

$a = \partial_i \mathbf{e}_i \; b = b_j \tilde{\mathbf{e}}_j \; c = c_k \hat{\mathbf{e}}_k$ (Vector spaces)

$A = a \circ b = \underbrace{a_i b_j}_{=:A_{ij}} \mathbf{e}_i \circ \tilde{\mathbf{e}}_j$ (Matrix, second order tensor)

$X = a \circ b \circ c = \underbrace{a_i b_j c_k}_{=:X_{ijk}} \mathbf{e}_i \circ \tilde{\mathbf{e}}_j \circ \hat{\mathbf{e}}_k$ (Third, order tensor)

Tensor data is data that has three or more point coordinates (ie coordinates x, y, z). Data dance Wayang Golek Menak the catch (Motion Capture) with Kinect sensor already has a data tensor (x, y, z). The tensor data that will be used in the next process [14].

C. Feature Extration

Knowing or classifying object at picture should extration picture features first, then those features are used inside of patter to get classifier final class. Extraction feature [13,16] purpose to looking for significant feature area at the picture. Those area can be defined in global environment or local and can be differented by form, texture, size, statistic trait, and others [8]. Local features extraction method can be divided into being suitable intensity and based structure. Method intensity based on pattern analyze of local intensity to find the area which have uniqueness desired or stability criteria. Extraction feature consider to identify the characteristics which can be made good representation from object, so it can differentiate object categoried with the variant tolerance [10].

D. Vector Quantization (VQ)

Vector Quantization (VQ) is lossy data compretion methode based on coding block principle. This transformatin using codebook. In some case, codebook can be used to code entropy of discrete value at the same way, it will produce value code that encoded length-variable as the output first. [4,31]. Codebook which is made is synchronized by motion data which produce code vector. Code vector is the result of feature reduction, then the result will be used in the next step introducing wayang golek motion dance Menak, Yogyakarta.

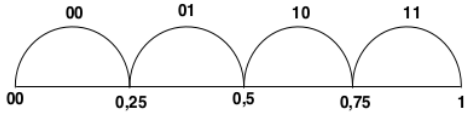


Figure 3. *Codebook* and *Code Vector*

E. Principal Component Analysis (PCA)

Data tensor dance Wayang Golek Menak have dimensions large matrix so that required data reduction tensor dance. The purpose of this tensor data reduction process to become lighter computing. The method used to reduce the data tensor is Principal Component Analysis (PCA) [22,23]. If be defined a matrix A, with x an eigenvector and λ is the eigenvalue, then to get the eigenvector and eigenvalue can use any general equations of PCA:

$$Ax = \lambda x$$
$$(A - \lambda I)x = 0$$

The results of the reduction, in the dance motion sensor data, is used to classify the dance movement into two classes, namely Jogetan and Sabetan.

III. RESEARCH METHOD

The methods of this research is observation and direct interview, the informant is expert dancer of wayang golek Menak, Yogyakarta to knowing basic motions of wayang golek dance Menak. Below this is the process ofdata feature extraction wayang golek dance Menak, Yogyakarta:

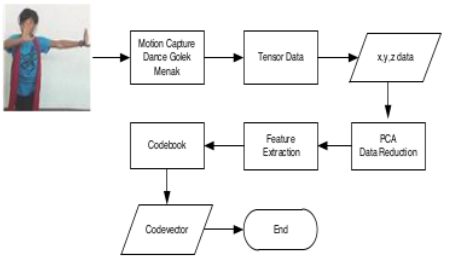


Figure 4. *Flowchart* Feature Data Extraction of Wayang Golek Menak Dance Motion, Yogyakarta

IV. RESULT AND DISCUSSION

Capturing motion of wayang golek dance Menak, Yogyakarta by Kinect sensor will be produce motion data with *.bvh (Biovision Hierarchy) format. That motion data is tensor data such as point x, y, z so the position happen is $hr, h\varphi, h\theta$. The next step is doing data reduction by Principal Component Analysis (PCA) method then the fiture extraction is held by Vector Quantization (VQ). Below this is the process of fiture extraction:

1. Matrix of head motion data from wayang golek motion dance Menak, Yogyakarta with 50 X 183 dimention is:

Table 2. BVH Dance Motion Data

Feature	1	2	...	182	183
1	49,1575	-459,115	...	-460.3857	112,4401
2	55,8285	50,4966	...	52.4788	-463,826
3	-458,651	54,602	...	113.0160	47,37443
4	49.1111	-459.7830	...	-461.5900	112.4401
5	55.9189	50.4966	...	52.4788	-463.8257
6	-458.6820	54.6020	...	113.0160	45.6038
7	49.1111	-459.7830	...	-461.5900	111.9682
8	55.9189	50.4966	...	52.4788	-464.6176
9	-458.6820	54.6020	...	113.0160	44.7971
10	49.2492	-459.7830	...	-461.5900	111.8297
11	55,901	50,6734	...	52,4788	-465,200
12	-458,812	55,0423	...	113,016	44,6894
13	49,2492	-460,004	...	-461,590	111,826
14	55,901	50,7066	...	52,4788	-465,253
15	-458,812	54,8777	...	113,016	44,6894
16	49,2492	-460,027	...	-461,590	111,826
17	55,901	50,7865	...	52,9786	-465,253
18	-458,812	54,6818	...	113,299	44,6894
19	49,2492	-459,985	...	-461,985	111,826
20	55,901	50,7865	...	53,2832	-465,253
.	.		.	.	.
.	.		.	.	.
.	.		.	.	.
49	49,6509	459,328	...	-463,537	112,7761
50	55,5504	47,3258	...	47,37443	-462,896

2. Data reduction by Principal Component Analysis (PCA) method. The function of this data reduction is accelerating computation process. The result of this data reduction by PCA method is :

Table 3. The result of data reduction withPCA

Fature	1	2
1	0,987	0,002
2	1,000	0,991
3	0,001	0,999
4	0,987	0,000
5	1,000	0,991
6	0,001	0,999
7	0,987	0,000
8	1,000	0,991
9	0,001	0,999
10	0,987	0,000
11	1,000	0,991
12	0,000	0,999
13	0,987	0,000
14	1,000	0,991
15	0,000	0,999
16	0,987	0,000
17	1,000	0,992
18	0,000	1,000
19	0,987	0,000
20	1,000	0,992
.	.	.
.	.	.
.	.	.
49	0,988	0,001
50	0,999	0,985

3. Then make codebook based on value from data reduction result. Codebook of this reserach is:

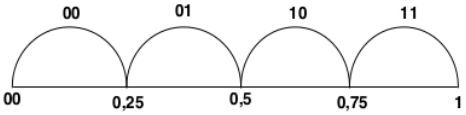


Figure 4. *Codebook*

4. Using the codebook, the reduction result is changed into code vector. The result is:

Table 4. The result of Extra*tion Feature on Code Vector*

Feature	1	2	Code Vector		
1	0,987	0,002	11	00	0011
2	1,000	0,991	11	11	1100
3	0,001	0,999	00	11	1111
4	0,987	0,000	11	00	1100
5	1,000	0,991	11	11	1111
6	0,001	0,999	00	11	0011
7	0,987	0,000	11	00	1100
8	1,000	0,991	11	11	1111
9	0,001	0,999	00	11	0011
10	0,987	0,000	11	00	1100
11	1,000	0,991	11	11	1111

12	0,000	0,999	00	11	0011
13	0,987	0,000	11	00	1100
14	1,000	0,991	11	11	1111
15	0,000	0,999	00	11	0011
16	0,987	0,000	11	00	1100
17	1,000	0,992	11	11	1111
18	0,000	1,000	00	11	0011
19	0,987	0,000	11	00	1100
20	1,000	0,992	11	11	1111
.	.	.	.	.	.
.	.	.	.	.	.
.	.	.	.	.	.
49	0,988	0,001	11	00	1100
50	0,999	0,985	11	11	1111

V. CONCLUSION

The conclusion of this research is extractioning character by Vector Quantization method will be produse code vector fiture character so it can be used for fiture classification process.

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GENERAL COMMENTS

Instructor

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