Art to SMart: Automation for BharataNatyam Choreography

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ABSTRACT

BharataNatyam (BN) is an ancient Indian Classical Dance. The manuscripts namely Natyasastra and Abhinayadarpana are the only source of documentation for this Classical dance form of South India. Although few archives are available for the heritage preservation, automation is hardly attempted for the choreographic process. Choreography is an art which most of the people staunchly consider as a human domain. We have attempted to use a computer to automate the process of choreography for pure dance movements in BN. Using the power of Information Technology, an attempt has been made to aid the choreographer in this creative process. Hence we have named it as Art to SMart where SMart means System Modelled art.

In this paper, we present an evolutionary algorithm, which generates multibeat sequences. It takes an initial dance pose as an input along with n, the number of beats and generates a sequence of n feasible consecutive dance poses starting from the input initial dance pose. The experimental results and dance expert ratings of these results are promising to continue further research in this direction.

Keywords

Dance Automation, Dance Modeling, Evolutionary Approach, BharataNatyam Choreography

1. INTRODUCTION

Indian Classical Dance (ICD), BharataNatyam (BN) is an ancient form of dance which has gone through various reforms over the centuries. It has still maintained its uniqueness in its own traditional way through the guru-shishya parampara (traditional learning method from a teacher). A student initially learns the art from a trained dance teacher and then can experiment in accordance with the rule books of dance namely NatyaSastra (NS) and AbhinayaDarpana (AD).

A traditional style of dance is practiced for many years together and most of the practitioners prefer using the same choreography which was taught to them. Very few try to innovate and experiment with this classical form for avoiding criticism and many other reasons as follows. Classical dancer gains perfection by practicing the same moves for many years together and usually he/she performs from muscle memory. Thus most of them would prefer choreographing a sequence from what they have already learnt and not take additional efforts for altogether new moves. Our work is involved in this domain. We would like to use some novel choreographic patterns which are in sync with the traditional norms but unpracticed and unheard of. We propose to do it using analysis of domain knowledge and power of IT.

NS clearly divides BN into two categories: Nritta (pure dance movements) and Nritya (movements with expressions). We have focused our research to the pure dance movements only. Most of the body movements are clearly defined in this ancient scripture (NS) in depth, we also notice the use of various parts of the body like hands for expressing various animals, birds, different gods, and so on. Thus the art of storytelling (Nritya) through dance or conveying meaning for a lyric is comparatively easier once a dancer has mastered the technique. Creative choreographic ideas only for aesthetic purpose, with coordinated hand and leg movements (referred to as adavus) becomes a more challenging creative aspect in terms of unique choreographic skills. We have attempted to generate unique moves for these rhythmic pure dance movements since this challenge is rarely experimented by the traditional and modern practitioners.

The key contribution of our work is twofold. Firstly, we proposed a thirty bit dance position vector to represent any BN dance pose by modeling direction, angle, position etc. of six major limbs of body [6]. Secondly, we formulated a fitness function [5] that filters out novel still genuine BN dance poses using evolutionary approach of Genetic Algorithm (GA).

In this paper, we present our ongoing research work to obtain dance poses for multiple beat sequences. In order to generate a sequence of dance poses that are in accordance with each other, we analyzed multiple beat ideal dance steps (adavus) to extract out several rules. These rules are used while developing multibeat automated choreography system.

The Paper is organized as follows: Section 2 discusses related work in the field of ICD, Section 3 explains the automation technique used for BN choreography, Section 4 presents the experimental results, followed by Conclusion and Future

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Work in Sections 5 and 6 respectively.

2. RELATED WORK

A study of the translated versions of NS [3] showed that the body movements are very clearly defined. A simple combination of all these head, hand, waist and leg movements showed the enormous amount of possibilities in lakhs for a single beat movement [7]. Thus to get the system to choreograph, modelling of the human body had to be done. Jadhav et al [6] have used a thirty attribute dance position (dp) vector for identifying a dancers pose at the end of a beat. This dp vector shall portray the position of a dancers major limbs like head, right hand, left hand, waist, right leg and left leg. With the help of this dp vector Jadhav et al [5] have designed an unique fitness function which will help an expert choose the best possible moves from amongst several available for a single beat. Experts have evaluated these system generated moves and on an average, the expert reports show that all the poses are acceptable and unique from the existing adavus. The measurement of the goodness of the dance mudra was itself a challenging task and hence we proposed a unique method for doing this through an evolutionary approach [5]. Such type of fitness function was evolved for the first time for Indian classical dance.

Several researchers have attempted to use various classical dance forms of India for animation [9], heritage preservation [8]; e-learning [4], notating [2] and mobile applications [10] but we havent encountered any research work so far in the field of choreography. Our approach of dance poses representation as well new dance pose generations is altogether different. Results obtained for single beat are well appreciated by experts.

3. MULTIBEAT CHOREOGRAPHY

In dance, choreography is the act of designing dance. Choreography may also refer to the design itself, which is sometimes expressed by means of dance notation. A choreographer is one who designs dances. Dance choreography is sometimes called dance composition [1].

Figure 1: Constant change in limb difference for a 3 beat sequence, with no leg movements.

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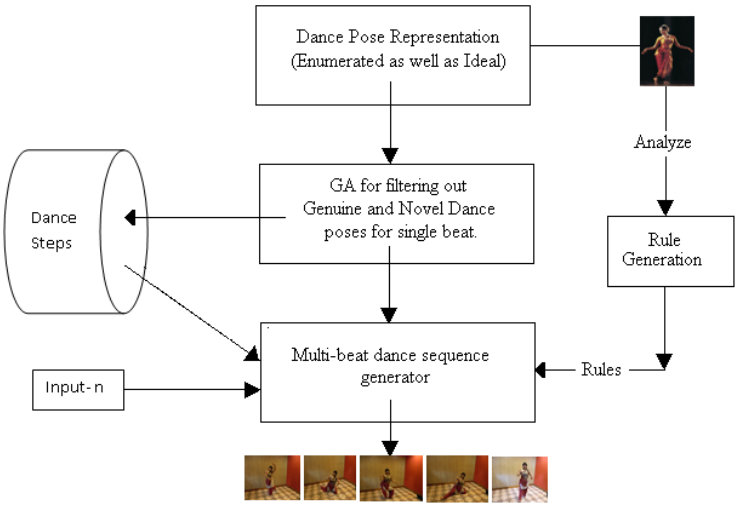

Figure 2: Multibeat Dance Generator Module.

Figure 2 shows overall architecture of the multibeat sequence dance generator system. It consists of modules for dance representation, an evolutionary module for single beat dance pose generation, rule generation module and multibeat choreography generation module. Following subsections elaborate individual units of the multibeat sequence dance pose generator system.

3.1 Dance Representation

The foremost thing is to model the dance pose. Thus a thirty attribute dance position vector which models the human body for a dance pose w.r.t the major limbs of the body namely head, right hand, left hand, waist, right leg and left leg was developed. Each of the limbs i.e. head,hands, waist and legs have positions, orientations or angles strictly as per BN norms explained in detail in [6].

3.2 Single beat dance pose generation

To generate feasible single beat new dance steps a Genetic Algorithm is used in [5]. These are used as the initial population to generate multibeat sequences using the fitness function presented in [5].

3.3 Multibeat dance generator

Let P= $p_0, p_1, p_2, p_3, ...p_n$ be the set of all the feasible single beat dance poses generated using the Genetic Algorithm proposed in [5]. Each p_i is a 30 attribute dp vector. Figure 3 shows the snapshot of multibeat choreography. The algorithm for the program can be explained in simple words as follows:
Initially the user is asked to enter the number of beats for which choreography is to be generated. After this it chooses a vector at random from the goodvector table. The entries in this table are output from the Single beat choreography program [6].

3.3.1 Rule generation

A sequence of m dance poses can be considered for chore-

ography if it satisfies certain constraints. Adavus are considered to be ideal dance moves for pure dance movements [10]. Hence they serve as good reference points for generating choreography. The filters/ constraints identified to be applied to simulate adavu patterns fall under the following main heads.

- Hand mudra Filter- All the hand mudras have restrictions between beats and too many changes in them frequently are not aesthetically good. For e.g. a pataka can be followed by any of the mudra but not vice-versa. The main reason behind these is the ease of finger movements. Also changing mudras for every beat in the same sequence is rarely done by dancers and hence we too restricted our system with the same.

- Leg Filter- The leg needs to move or change positions for most of the beats else an adavu does not look appealing. So we designed the filter in such a way that the program finds the vectors which has leg position changes first.

- Fitness Function Value Filter- This is calculated on the basis of 3 parameters namely Absolute Vector Difference (AVD), Fitness function (FF) and Limb Difference value (LD). The single beat choreography results were based on the same parameters [5] and we have reproduced the same for continuity in multibeat results also.
  Absolute Vector Difference: A dance pose with least AVD is found to give good representation for the population since its the closest to the earlier dp vector. *Fitness Function Value:* This is calculated on the basis of LD and AVD. *Limb Difference Value:* Consistency in LD value across the poses increases the aesthetics of the dance sequence generated.

4. EXPERIMENTAL RESULTS

The experiments have been carried out using an Intel Core i7 Processor with 4GB RAM for our experiment purposes. The Operating System used was 64 bit Windows 7, JDK 1.7, MyEclipse 7.1, My SQL Workbench and XAMPP server for the development of the Java code.

Fig. 4 shows the generated dance steps[1]. Fig.5 and Fig. 6 shows the results with different values with and without use of filters. When no filters were used the results were repeated several times. Fig. 5 shows that dance position vector 5 and 98 are repeated several times for a starting dance pose with index number 96.

5. CONCLUSION

We can thus observe that as the size of the population and number of beats increases, the time taken to generate the sequence also increases. An opinion by most of the dance experts has been that the results are good enough to evoke the creativity process for unique choreographic sequences. The poses shown now by the system for a single and multibeat are unique and can help a teacher to also teach her students new sequences or help in teaching them the choreographic process by asking them to do so. Thus a unique attempt has been made to use the power of Information Technology for an ancient Classical dance form of India which will help in promoting and evolving BN.

[1]Picture Courtesy Ms. Sapna Naik, BharataNatyam Lecturer, Kala Academy,Goa.

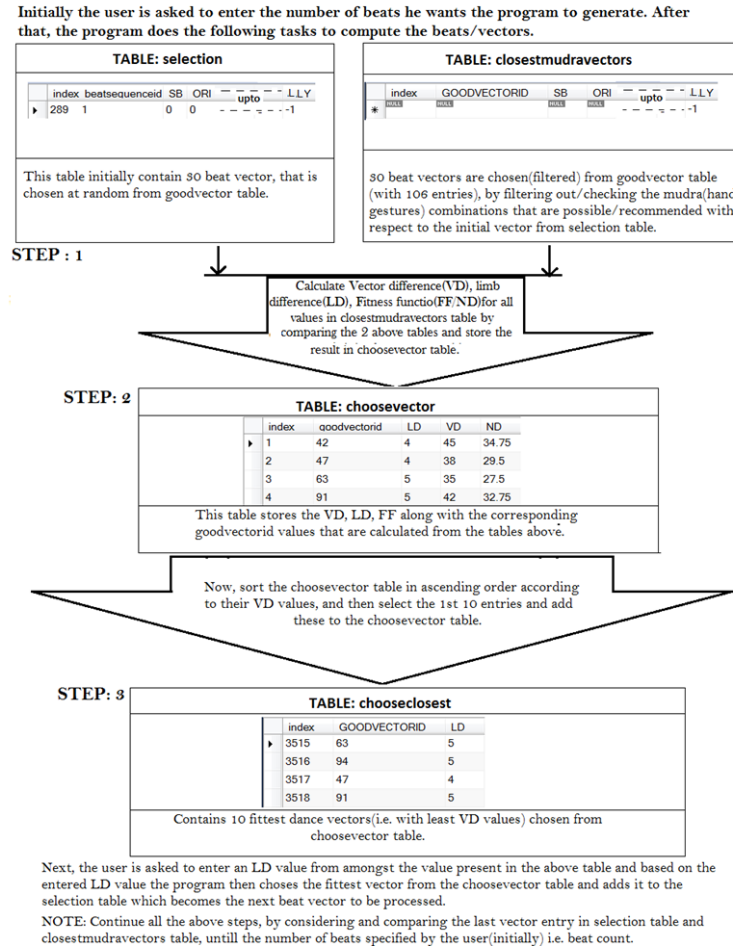

Figure 3: A Snapshot to explain the Multibeat Choreography.

Figure 4: Dance poses generated for 3 beat sequences.

6. FUTURE WORK

We need to keep pruning and refining the constraints for

No. of goodvector entries = 100					
No of beats	Sequence of dp_vectors(results)	Corresponding VD values	Corresponding LD values	Corr. Fitness value = (0.75*VD + 0.25*LD)	Time(sec)
3	96, 5, 98	19, 18	4, 3	15, 14	1.422
5	96, 5, 98, 5, 98	19, 18, 18, 18	4, 3, 3, 3	15, 14, 14, 14	2.07
7	96, 5, 98, 5, 98, 5, 98	19, 18, 18, 18, 18, 18	4, 3, 3, 3, 3, 3	15, 14, 14, 14, 14, 14	3.005

Figure 5: A Comparison Chart to explain Multibeat Choreography module without filters.

1. No. of goodvector entries = 200					
No of beats	Sequence of dp_vectors(results)	Corresponding VD values	Corresponding LD values	Corr. Fitness value = (0.75*VD + 0.25*LD)	Time(sec)
3	96, 138, 133	16, 33	3, 4	12, 25	2.357
5	96, 138, 133, 200, 130	16, 33, 20, 12	3, 4, 4, 4	12, 25, 16, 10	6.306
7	96, 138, 133, 200, 130, 155, 196	16, 33, 20, 12, 9, 15	3, 4, 4, 4, 3, 4	12, 25, 16, 10, 7, 12	9.849
2. No. of goodvector entries = 500					
3	96, 138, 275	16, 25	3, 4	12, 19	4.417
5	96, 138, 275, 300, 280	16, 25, 8, 10	3, 4, 3, 4	12, 19, 6, 8	7.618
7	96, 138, 275, 300, 280, 295, 470	16, 25, 8, 10, 8, 10	3, 4, 3, 4, 3, 3	12, 19, 6, 8, 6, 8	11.005

Figure 6: A Comparison Chart to explain Multibeat Choreography module with filters.

getting the best choreographic move. For this we need to meet many more experts and work closely with them. The constraints need to be refined further based on their analysis of data gathered from experts. We have identified few more constraints for hand mudras . Certain combination of mudras cannot work together for both hands since they convey meaning , so we need to prune them. For. E.g. shikhara in the left hand and kuttuckamukha in the right hand indicates a bow and arrow position. There are many more such constraints which need to be worked on so that the resultant system generated choreography are not only unique but also as per the dance experts choice. We are working on various alternate Data Structures on the use of Machine Learning algorithms so that we can compare and derive better results.

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