Executive Summary of the UGC MAJOR RESEARCH PROJECT

UGC Reference No. & Date: 39-901/2010(SR) dated 12 Jan 2011 (W.e.f 01st February 2011) started from 15th April 2011

Title of the Study:	A Computational Model for "BharataNatyam"
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Project Fellow:	Mr.Shubhen Pal, (15th April 2011 to 15th April 2012) Ms.NamrataDangui, (1st June 2012 to 30th May 2013) Mr.Clelo Andrade, (12th June 2013 to 14th Feb 2014)
Institution Affiliation:	S. S Dempo College of Commerce and Economics,
(Full Address)	Serra Building, Altinho, GOA. 403001
Duration of the Study:	3 years
Date of Implementation:	15th April 2011 to 14th February 2014
Budget Approved by UGC:	Rs. 7, 81,800/-
Budget Sanctioned by UGC:	First Instalment: Rs. 5, 12, 800/-

Specific objectives of the study: To generate automated choreography for pure dance movements given the number of beats as an input.

Central idea of the problem: Dance practitioners learn and propagate their knowledge which they have imbibed from their dance teachers. Dance is learnt through rote learning and can be considered to be more of muscle memory than the brain. A dancer practices for hours together for several years to get the perfection for any classical move. Thus the choreographers and practitioners are used to movements which are taught by their teachers. They practise these set of dance moves and also pass on the same. Hence for any Indian Classical Dance performance we get to notice similar choreographic patterns especially for "Nritta" which are pure dance moves , mostly meant for aesthetic purposes.

Variations in choreography are easily possible since Natyashastra, also referred to as the bible of dance allows innovations in choreographic moves as per the specifications in its text. Thus

a computer can be used as a tool to aid in this process due to the enormous available possibilities. Choreographers can use this tool to assist them for "Nritta" or pure dance movements and choose the best innovative move.

Methodology in brief:

1) *Modelling:* The human body has been modelled as per BharataNatyam norms (Refer Fig. 1 and 2). This shall help in generating a dance position vector. This vector has the position for the head, right hand, left hand, waist, right leg and left leg. Every limb of the body mentioned above has its orientations and degrees mentioned. The final vector helps in showcasing dance poses at the end of every beat.

   The Dance Position vector of the following picture can be depicted as shown below:

Fig. 1 : [1; 1; 1; 4; 0; 0; 0;1; 0; 0; 1; 3; 0; 1; 3; 1; 0; 0; 0; 0; 0; 1; 0; 0; 0; 0; 1; 0; 0; 0]

Represented Limb	Generic Dance Vector attributes L: Left	Dance Vector Limb attributes for Dance Step of Fig.1
Head	L_{hd}= {a_1,a_2}	L_{hd}= {1,1}
Right Hand	L_{rh}={a_3,a_4,a_5,a_6,a_7,a_8,a_9,a_{10}}	L_{rh}={1,4 , 0, 0,0,-1, 0, 0}
Left Hand	L_{lh}={a_{11},a_{12},a_{13},a_{14},a_{15},a_{16},a_{17},a_{18}}	L_{lh}={1, 3,0,1,3,1,0, 0}
Waist	L_w= {a_{19},a_{20}}	L_w= {0,0}
Right Leg	L_{rl}={a_{21},a_{22},a_{23},a_{24},a_{25}}	L_{rl}={0,1,0, 0,0}
Left Leg	L_{ll} ={a_{26},a_{27},a_{28}, a_{29},a_{30}}	L_{ll} ={0,1,0,0,0}
Complete Dance Vector for Fig. 1	[1, 1, 1, 4, 0 , 0 , 0 ,-1 , 0, 0 , 1 , 3 ,0 , 1 , 3 , 1, 0 , 0 , 0 , 0 ,0 , 1, 0 ,0 , 0, 0 , 1, 0 , 0, 0]	

Fig. 2: Modelling the human body as per BharataNatyam norms

2) *Genetic Algorithm:* This helps in choosing the best possible moves from amongst lakhs of possibilities. Every time the system is run for several generations, the results are unique choreographic patterns. Thus we have obtained the fittest move first for single beat choreography and validated them through dance experts from Goa, Pune and Bangalore. After that the same was extended for multi-beat choreography after applying various filters at different stages. The results were again validated through dance experts.

   Fitness function design and Implementation: The fitness function was designed to generate unique dance poses which were not too far or too close to the ideal dance movement patterns called as "adavus". These adavus are considered to be the best for pure dance

movements in a choreographic pattern and dance teachers use only these known patterns. Our purpose was to find the closest, unique and best movement from amongst lakhs of possibilities. The unique fitness function helped us to give novel choreographic results.

3) *User Interface:* This was developed to help in visualizing the results obtained from the system. A user-friendly interface has made the tool easier for any operator in general, as can be seen in Figure 1 and 2.

Results

Figure 1

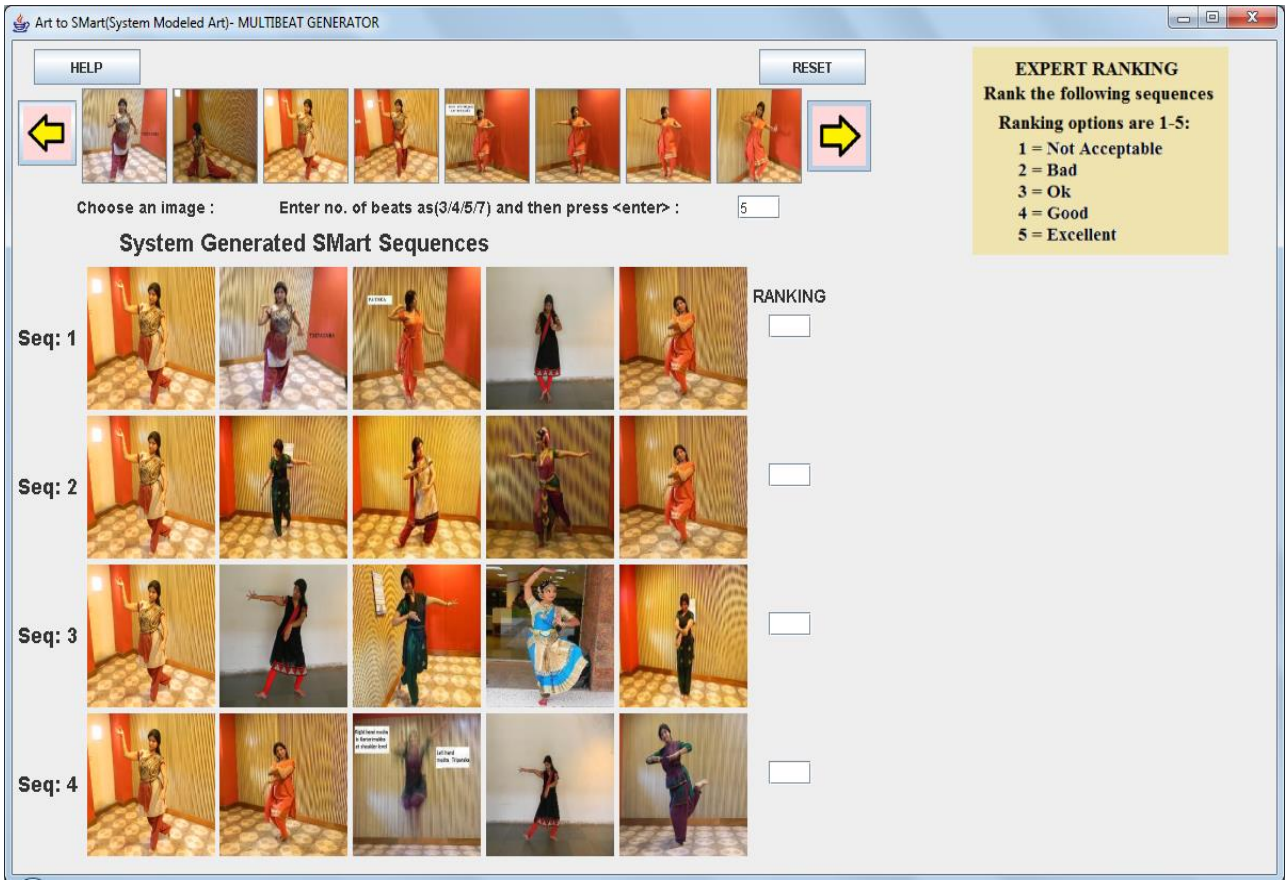
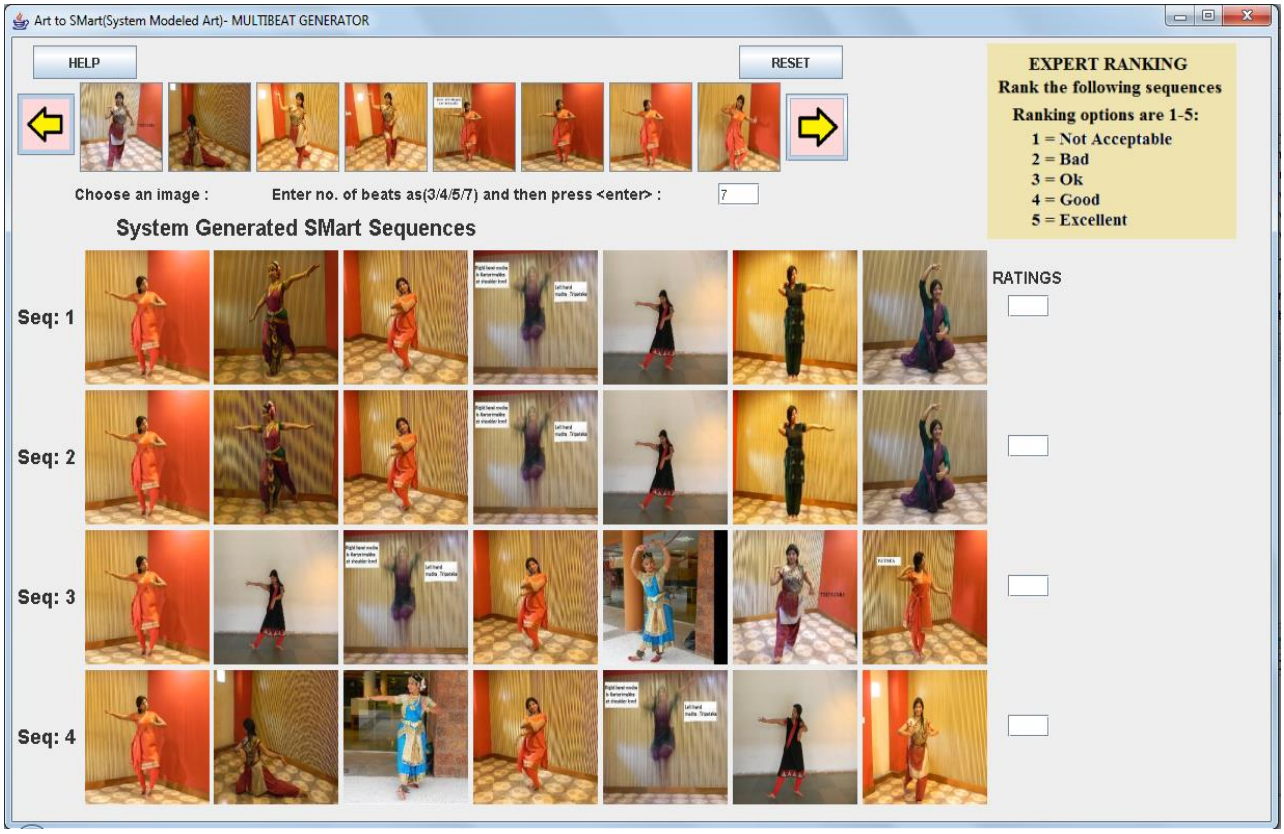


Figure 2



Collaborations generated through the Project:

North Maharashtra University, Jalgaon

CDAC, Mumbai

BITS-Pilani, K K Birla Campus, Goa

IIT-Kanpur, Kanpur

Goa University, Goa

Kala Academy, Goa's Performing Arts Faculty, Panjim Goa

Papers Published:

[1] S. Jadhav, M. Joshi, and J. Pawar. Art to SMart: Automation for BharataNatyamChoreography. In Proceedings of the 19th International Conference on Management of Data COMAD,Ahmedabad, DEC. 2013.

[2] S. Jadhav, M. Joshi, and J. Pawar. Art to SMart: An Evolutionary Computational Model for BharataNatyam Choreography. In IEEE Xplore, pages 384-389, DEC.2012.

[3] S. Jadhav, M. Joshi, and J. Pawar. Modelling Bharata Natyam dance steps: Art to SMart. In the Proceedings of the CUBE International IT conference & Exhibition Proceedings, PUNE, ACMDL, pages 320-325, SEP. 2012.

[4] S. Jadhav and M. Sasikumar.A computational model for BharataNatyam Choreography. volume Vol. 8, No.7, pages 231{233. (IJCSIS) International Journal of Computer Science and Information Security, OCT. 2010.

Papers in the Review Process for Journals and Conference:

2 Journal Papers and 1 Conference Paper, submitted from November end 2013 till February 2014.

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