A Comparative Study of Certain Classifiers for Bharatanatyam Mudra Images' Classification using Hu-Moments

Basavaraj S Anami, KLEIT Hubballi, Karnataka, India

Venkatesh Arjunasa Bhandage, Tontadarya College of Engineering, Gadag, India

ABSTRACT

India is rich in culture and heritage where various traditional dances are practiced. Bharatanatyam is an Indian classical dance, which is composed of various body postures and hand gestures. This ancient art of dance has to be studied under guidance of dance teachers. In present days there is a scarcity of Bharatanatyam dance teachers. There is a need to adopt technology to popularize this dance form. This article presents a 3-stage methodology for the classification of Bharatanatyam mudras. In the first stage, acquired images of Bharatanatyam mudras are preprocessed to obtain contours of mudras using canny edge detector. In the second stage, Hu-moments are extracted as features. In the third stage, rule-based classifiers, artificial neural networks, and k-nearest neighbor classifiers are used for the classification of unknown mudras. The comparative study of classification accuracies of classifiers is provided at the end. The work finds application in e-learning of 'Bharatanatyam' dance in particular and dances in general and automation of commentary during concerts.

KEYWORDS

INTRODUCTION

Recent advancements in digital image processing have led to developments of various applications such as hand gesture recognition (Liu, Yin, & Zhang, 2012; Wang, Chen, & Li, 2016), sign language identification (Karishma & Jalal, 2013; Raut, Mali, Thepade, & Sanas, 2014; Zadghorban & Nahvi, 2016; Fagiani, Principi, Squartini, & Piazza, 2015; Zaki & Shaheen, 2011), body posture recognition (Dantone, 2013), and human action recognition (Kishore et al., 2018). One such significant application is seen in Bharatanatyam dance and mudra classification. Bharatanatyam dance is an ancient Indian classical dance form which is composed of various body postures, facial expressions, and coordinated movement of various hand gestures which are performed to the accompaniment of dance syllables. These dance movements convey some useful meaning to the audience. The semantic meaning and feelings of these dance syllables can only be properly understood by the connoisseur. The novice learners and general audience may find it difficult to understand the inner as well as outer feelings conveyed by the dancers. The *Natyashastra*, an earlier repository of Indian classical dance, has details of dance syllables used in various dance forms. A *mudra* is the most striking feature of this Indian classical dance, which uses hand gestures. The Natyashastra mentions a set of 108 dance postures called *Karanas*, 28 *Asamyukta mudras,* 23 S*amyukta mudrasi*, and 13 *Nritya mudras* or decorative

hand gestures. The 24th mudra *Avahitta* was recently added to the list of Samyukta mudras. The mudra is also called *hasta* in the literature. *Karana* means doing in the Sanskrit language. Natyashastra states that karanas are the dance frameworks which are supposed to spiritually enlighten the spectators, as opposed to other dance forms such as folk or pop dance, which can only entertain the spectators. Karanas are brief movement phrases describing specific leg, hip, body, and arm movements accompanied by mudras. It is also stated that one who performs well this karana dance will become free from all the sins.

The dance gestures, a way of non-verbal communication, are used to visually convey outer events or things, as well as inner feelings. Hand sign is a ritual gesture in Hinduism and Buddhism. There are two types of hand gestures used in Bharatanatyam dance. Asamyukta mudras are performed using single hand, and Samyukta mudras are performed using both hands. The decorative hand gestures are used to increase the beauty of dance during concerts. These karanas and mudras are prominent parts of the dancer's vocabulary. Figure 1 shows typical postures of some of Bharatanatyam dance along with some mudras.

The Asamyukta mudras are the key elements of Bharatanatyam dance and play a significant role in conveying the feelings of the dancer to the audience. Hence, the current work proposes developing a system for classification of Asamyukta mudras. Some single hand mudras are shown in Figure 2. Some of the mudras look similar and hence conflict, leading to misclassification of mudras. In this work, the most conflicting mudras are taken out and a separate list of conflicting Asamyukta mudras is formed. Non-conflicting mudras look totally dissimilar, leading to effective classification of mudras. The experiment on these separate groups gives an improvement in the classification accuracies of mudras. Hence, in this work, Asamyukta mudras are broadly classified into conflicting mudras and non-conflicting mudras. Figure 2 shows some of the non-conflicting mudras. Figure 3 shows that Mrugashirsha and Hamsapakshika mudras look similar to each other and hence are conflicting.

In order to study Bharatanatyam dance and mudras, a teacher (called a *guru*) is essential. Today the younger generation is attracted by the western dance culture resulting in scarcity of Bharatanatyam dance teachers in the future. It is difficult to find teachers in villages, semi-urban areas and foreign countries. To bridge this gap a technological intervention is felt, and the task of identification and classification of mudras is attempted through this research. The work finds many applications such as e-learning of mudras and proper postures leading to self-learning of Bharatanatyam dance, online commentary during concerts and adoption to many other forms of dances prevailing in India and outside. However, identifying the mudras from the video or online is not in the scope of this paper.

The shapes of mudras are important in the classification. Many shape descriptors have been proposed for different applications. Popularly used shape descriptors, moments, find applications in various areas like character recognition, face recognition, hand gesture recognition, and facial expression recognition (Devi & Saharia, 2018; Fernando & Wijayanayake, 2015; Premaratne, Yang, Zou, & Vial, 2013; Solís, Martinez, & Espinoza, 2016; Otiniano-Rodríguez, Cámara-Chávez, & Menotti, 2012; Hu, 1962). It is being attempted to deploy Hu-moments for the recognition and classification of Bharatanatyam mudra images. Hu-moments represent suitable shape features because they are scale, translation, and rotation invariant. The seven invariant moments are fit for the description of overall shape of the target. Hence moments are used as features in this work.

The work involves obtaining contour of the input mudra, calculation of Hu-moments from the contour, use of these moments as feature sets and classification of unknown mudras into one of the 28 categories using rule-based, artificial neural network (ANN), and k-nearest neighbor (KNN) classifiers. Finally, a comparison of classification accuracies was made for their suitability.

LITERATURE SURVEY

In order to know the state of the art in mudra classification and allied works, a literature survey was carried out. Summaries of the cited papers are given in Table 1.

Related Content

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Sana Murrani (2012). *International Journal of Art, Culture and Design Technologies (pp. 44-56).*
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Geometry in the Architectural Design of Rafael Moneo
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