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CLASSIFICATION OF KATHAKALI HAND GESTURES USING MACHINE LEARNING AND DEEP LEARNING TECHNIQUES – A REVIEW

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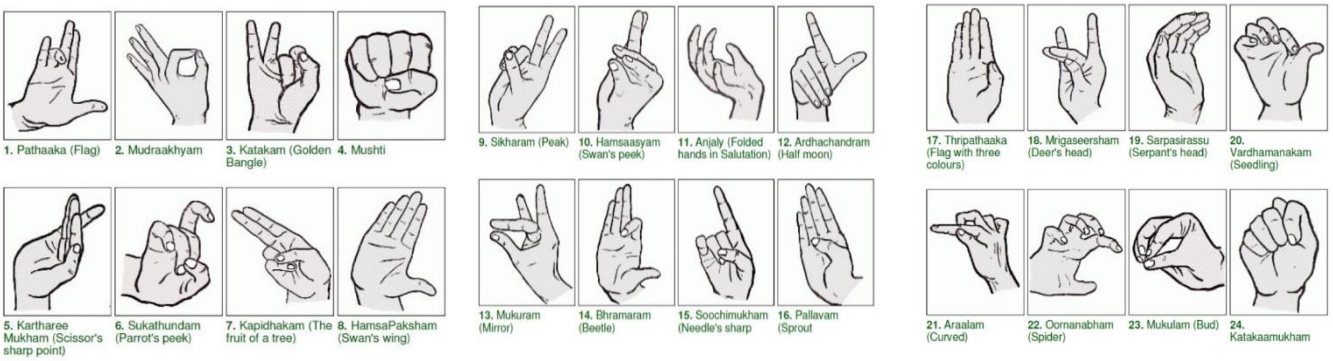
Abstract: - Kathakali is an Indian classical dance composed of complex hand gestures, body moments, facial expressions and background music. Kathakali mudras are difficult to understand common peoples. We generate dataset for kathakali hand gestures and explore ways to recognize kathakali hand mudras performed by artistes by using machine learning and deep learning techniques. There are 24 classes of hand gestures. We propose Convolutional Neural Network (CNN) and Artificial Neural Network (ANN) for classification of hand gestures This is an attempt to generate dataset of kathakali hand gestures, explore data preprocessing for machine learning techniques and classification using Deep learning techniques.

Key Words: Kathakali, Mudra, Gesture CNN, ANN, Deep Learning, Machine Learning

I Introduction

Kathakali is an Indian classical dance drama from the south Indian state of Kerala originated in 17th century. The story of Kathakali dance performance is communicated to audience through hand gestures, facial expressions and dances along with music support. Kathakali is traditionally performed by male dancers in courts and theatres of Hindu religions. Kathakali hand gestures are considered as a complete language by itself with necessary grammatical elements and language structures associated with it. With the help of 24 hand gestures available, one can communicate any message to another completely using hands. Generally, it is very difficult for a common man to understand the meaning of Kathakali dance drama because of its complicated hand gesture language structure and dance movements. Unless you know all the hand gestures and the words and sentences you can make using these hand gestures, it is difficult for one to appreciate the meaning conveyed by the artiste through the gesture language. So we focus on how to easily understand the hand gestures to common people and create data set then classify the gestures.

Kathakali hand gestures are based on an ancient text Hastalakshana Deepika [1]. There are a total of 24 hand gestures as specified in this text. Using single hand as well as using both hands, mudras are formed. Combination of these hand gestures convey certain meaning to them. Mudras are illustrated in Figure 1 and the mudra names are summarized in Table I. Due to different combination of mudras in certain ways represent different meaning, some even depending upon the context, unless one is well versed with these mudras, their combinations and meanings, it is difficult for one to understand and appreciate this art. We have attempted to solve this problem and this is the first step towards the same. In this work, first we build a dataset of Kathakali hand gestures. As a second step, we examine and devise strategies for data preprocessing to be applied to the generated dataset and finally, we study machine learning and deep learning techniques for classification of hand gestures.



II LITERATURE SURVEY

We focussed on Kathakali dance mudras. All the previous works have mostly focussed on other dance forms such as kuchipudi, baratanatyam, kathak, odissi, sattriya, Manipuri, Aceh (Indonesian) and Korean pop dance (k-pop). In this section, we focus primarily on giving current advancement in human gesture recognition and how it is used in classifying dance hand gestures in above mentioned dance forms.

Basavaraj S. Anami et al. [2] have proposed a 3 stage method which involves pre-processing of mudras by obtaining contours of images, extracting features by using Eigen values, Humoments and intersections and finally classifying the mudras using Artificial Neural Network. The Baratanatyam dataset is created with 2800 images (100 images per mudra). Mudras are divided into conflicting and non-conflicting mudras. The reported accuracy is 97.1%, 99.5% and 96.03% for whole hand mudras, conflicting and non-conflicting hand mudras respectively.

P.V.V.Kishore et al. [3] have proposed architecture for Deep Neural Network for classification of Indian classical dance actions. The dataset of videos are collected from both online (YouTube, live performances) and offline (recordings) and. The overall recognition rate of 93.3% is obtained for the CNN.

K.V.V. Kumar et al. [4] have presented an approach for classifying kuchipudi dance mudras into text messages (meaning of mudra) by using Histogram of oriented Gradients(HOG) features as a feature extraction algorithm and Support vector machine (SVM) is used as the classifier. The Graphical User Interface (GUI) is developed for calculating Mudra Recognition Frequency (MRF). The SVM classifier has acquired an MRF of 90%.

P.V.V. Kishore et al. [5] have proposed a Super pixel based Linear Iterative Clustering (SLIC) and Marker Controlled Watershed algorithms to perform segmentation out of which SLIC performs better than Watershed algorithms. The result shows that a SLIC algorithm performs better than Watershed algorithm. The experiments are performed on dataset collected with 120 kuchipudi images (both training and testing images). An average of 52.55% of the total images is segmented correctly by watershed algorithm whereas 74.25% of images are segmented well by SLIC algorithm.

Soumitra Samanta et al. [6] have created their own Indian Classical Dance dataset from the YouTube videos. Each class contains of 30 videos with different resolutions (maximum resolution. 400x350). The proposed sparse representation based Dictionary learning technique involves representing every frame of the video by a movement descriptor based on HOOF (Histogram of Oriented Optical Flow). An average accuracy of 86.67% is achieved for classifying the videos frames using SVM.

D.Anil Kumar et al. [7] have proposed a new segmentation model using Local Binary Patterrn (LBP) and wavelet transform for segmentation. The Adaboost multi class classifier is used to identify the Indian Classical Dance Action from the five different features such as Zernike moments, Hu moments, shape signature, Haar features and LBP features. The overall accuracy of 86.67% is obtained on the dataset created from online videos of Bharatanatyam and Kuchipudi and offline videos captured from lab.

Mampi Devi et al. [8] have classified the asamyukta hastas of Sattriya dance form by using a two level classification method. Based on the structural similarity the images from the collected dataset of 1015 images are classified into twenty-nine classes and extracts the Medical Axis transformation (MAT) to identify the groups. The accuracy acquired by using SVM with PBF kernel is 97.24%.

Ankita Bisht et al. [9] have proposed a framework for classifying the Indian Classical Dance forms from 626 videos collected from both offline and online. The videos are of different dance forms such as Sattriya, Bharatnatyam, Kuchipudi, Kathak, Odissi, Manipuri, Mohiniyattam. The framework had achieved the accuracy of 75.83% when feeded 211 videos to a Deep Convolutional Neural Network (DCNN).

Nurfitri Anbarsanti et al. [10] have recorded several gesture instances of Aceh Traditional Dance by the XBOX Kinetic sensor. The complete recognising system was proposed by using the Simulink programming package by MatLab. The system classifies the input testing gestures into one of six different classes of predefined gestures or a single class of undefined gesture. For a single gesture the classifier system has achieved an accuracy of 94.87%.

N. Y. Tongpaeng et al. [11] have implemented a tool which compiles the mistakes and also analyses the instructions and gives a feedback to the dancer for improving the dancing skills. The system compares the pose from Thai dance expert and real-time dancer pose to calculate accuracy.

Dohyung Kim et al. [12] have designed an efficient Rectified Linear Unit (ReLU) based Extreme Learning Machine Classifier (ELMC) 800 dance movement data points of 200 types of dances. The proposed method performs a better classification than those of KNN and SVM.

Zhi-huaChen et al. [13] have proposed a framework for classifying and predicting the labels of hand gestures. The framework will extract the hand region of 1300 images by subtracting the background using background subtraction method and then segmenting palm and fingers to recognize the fingers and to predict the labels using a rule classifier.

Neelakanta Iyer, Ganesh et al. [14] have proposed a data set with 659 images of Kathakali hand gestures in 2019. There are 24 classes of images. This dataset has been generated from scratch to apply deep learning principles for classifying Kathakali hand gestures.

Table -1: Kathakali Mudras

List of Kathakali Mudras			
No.	Mudra Name	No.	Mudra Name
1	Pathaaka	13	Mukuram
2	Mudraakhyam	14	Bhramaram
3	Katakam	15	Soochimukham
4	Mushti	16	Pallavam
5	Kartharee Mukham	17	Thripathaaka
6	Sukathundam	18	Mrigaseersham
7	Kapidhakam	19	Sarpasirassu
8	HamsaPaksham	20	Vardhamanakam
9	Sikharam	21	Araalam
10	Hamsaasyam	22	Oornanabham
11	Anjaly	23	Mukulam
12	Ardhachandram	24	Katakaamukham

III. CONCLUSION AND FUTURE SCOPE

We proposed different literature reviews about classification of kathali hand gestures and created dataset from scratch for Kathakali hand gestures, identified appropriate pre-processing techniques and compared deep learning techniques for mudra classification. Future works include, generating larger dataset, identifying mudras shown in both hands, interpreting the mudra meaning from a video, identifying mudras from video streams etc.

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