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Normalized Chain Codes and Oriented Distances based Bharatanatyam Hand Gesture Recognition

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Abstract: ***We suggest a method for defining the hand movements or Mudras of Bharatanatyam. This requires a pre-processing stage in which a skin-based segmentation is performed to obtain the boundary of the hand. The extraction process of the function involves obtaining the chaincode of the entire contour of the hand followed by normalization. It also involves extracting the Euclidean distance from the centroid over 360 degrees to the outermost limits of the side. Extracted features from the training images are used to create four Naïve Bayes, KNN, Logistic Regression, Multiclass SVM recognition models. The method displays an accuracy of 88.47%, 87.06%, 89.83%, 92.3% using Naïve Bayes, KNN, Multiclass SVM, Logistic Regression, respectively. We proposed here the framework for identifying other mudras and to incorporate facial expression recognition and posture recognition, and to integrate the modules. Using enhanced noise reduction technique can also increase device efficiency.***
Keywords: Naïve Bays, KNN, Logistic Regression, SVM.

I. INTRODUCTION

Hand gesture recognition is a common application domain where the device is intended to recognize the signs representing a specific context or concept. Gestures are one of the most effective ways of interacting with system that helps to construct HCI systems. Gesture awareness is also useful for interacting with the program for physically impaired people. Dance incorporates a sub-domain for identification of movements. Few popular forms of Indian dance are Bharatanatyam, Kathakali, Mohiniattam, Odissi, and Kuchipudi. Bharatanatyam is a dance form that is more prevalent among the numerous other dance forms present in the Southern regions of India. It's a tala (rhythm), raga (music), natya (dance), and bhava (expression) composition. This type of dance is an art of expression also called Abhinayam. One of Abhinayum's influential features is physical or corporal motions (Anghika). A Bharatanatyam dance is traditionally indicative of a tale or extract from a well-known epic.

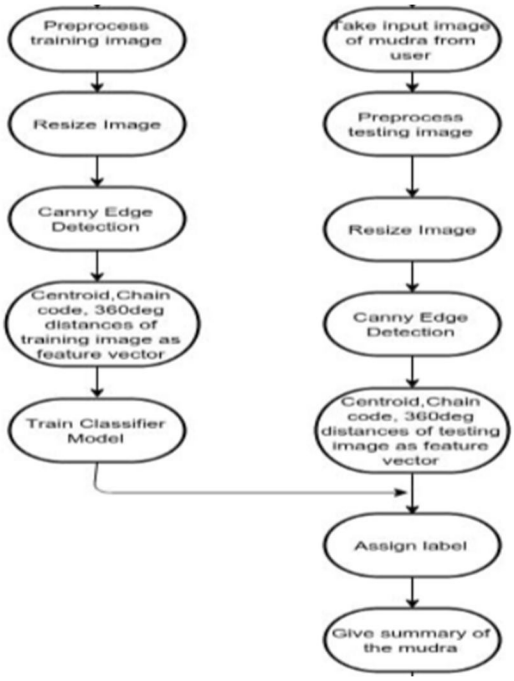

Fig. 1 Proposed System

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II. RELATED WORK

Dr. Srimani and Kavitha Sused a set of 3 modified images of one of the 24 grayscale images of the mudra as training .These set of 3 include the image itself, a rotated version of the image and a scaled version of that image. In the first phase of feature extraction, they have used orientation filter to obtain a feature vector. At the second phase, an outline of the doublehand gestures are obtained followed by generation of the skeletonized variant and evaluation of gradients at the corner points.

SriparnaSaha and Jayashree Roy proposed sensor based gesture recognition. They used Kinect sensor to obtain the joint coordinates and then used the variability of the movement to recognise if it is a single or double hand gesture. A normalization of the coordinate is done based on the hip centre coordinate of the first frame. A trajectory is then obtained which is classified as a particular known hand gesture using linear support vector machine as the classifier. They achieved an accuracy of 94.3%[4].

SriparnaSaha, Amit Konar, et al proposed "Bharatanatyam Hand gesture recognition using Polygon representation. The system approximates the extracted boundaries and compares the slopes of the straight lines to the slopes of the sides of the decagon and uses this to determine the chaincode. Classification is done by comparing the chain code of the test image with the saved templates. Accuracy of 89.3%was achieved by their approach.[5].

Mandeep kaur et al used skin color segmentation in YCbCr space. Template based matching technique using Principal Component Analysis was used for the recognition. System was tested for recognizing 4 different gestures. They reported 91.25% accuracy using their system[9]

III. PROPOSED SYSTEM

The paper focuses on Asamyukta mudra identification system. Mudra recognition is more subtle compared to hand gestures and hence need an almost precise algorithm which can differentiate between the different Asamyuktamudras .In the proposed system we have considered 6 mudras named Alapadma, Araala, Chandrakala, Pataka, Tripataka and Kartarimukha. The Mudras are depicted.

Proposed Approach consists of a skin based segmentation, followed by feature extraction. The features considered are centroid, chain code , Oriented distances. Extracted Features are used to build the different classifiers and performance of different classifiers is compared. Also further proposed the performance of the system can be improved by using enhanced noise removal technique and introduced two hand mudras.

The Various steps involved are as follows

i. Preprocessing ii. Segmentation iii. Feature Extraction a. Determining Centroid b. Chain code estimation c. Boundary Distance Measurement iv. Training v. Testing

IV. METHODOLOGY

A. Preprocessing Hand size varies from one image to other which may result in an error in the performance of the system. In order to overcome this error all the images are size normalized fine.

B. Segmentation In this section, segmentation is done based on skin color. The isolation of the foreground from the background is done by specifying the skin tone range in HSV color space. The methodology also accounts for red color applied on the fingertips of the dancers. Each of the range boundary values are specified in numpy arrays. The pixel colors are compared with the numpy ranges and decided on whether it is the foreground or not.

C. Feature Extraction The proposed system uses centroid, chain code and oriented boundary distances to build the feature vector.

1) Centroid: Using image we calculate the center of the ROI along both the axes. This is done by checking if the pixel value is white and aggregating the white pixel's xcoordinate and y-coordinate values. Also a count of the number of white pixel is maintained. Dividing the respective sums by the number of white pixels give us the mean x and y co-ordinates respectively.

2) *Chain Codes:* Using image2 we use a connectivity graph to decide the direction of the traversal.

3) *Oriented Boundary Distances:* We first consider an angle matrix of the size of the image. This is obtained by performing an elementwise division of 2 matrices, each of the size of the image matrix.

D. Classification We performed classification using 4 classifiers: Naive Bayes, KNN(for K=1 and K=5), Logistic Regression and SVM. Our dataset consists of 300 images (50 images per mudra). 80% of the images are used to train the system and remaining 20% to test the system. Thus the new incoming image is classified into one of the 6 mudras that we have used .

1) Naive-Bayes Naïve Bayes is a generative model .It builds the model with the assumption that feature vectors are iids. This classifier is trained using the maximum likelihood algorithm. For classifying the test image, features are extracted from the image and posterior probability is determined for each of the k classes and Label is predicted as the class having showing the maximum probability

2) ii. K-NN classifier This classifier maps the feature vectors onto the feature space. The incoming sample is considered in term of its closeness to its 'k' neighbours for classification. The closeness factor uses distance metrics such as Euclidean or Hamming distances to approximate the class label for the unclassified sample. A good value for k reduces any noise if present and gives better approximation of the class the sample belongs to. The classifier does not use any information of the feature values until classification an hence is an instance-based learner

3) Logistic Regression This classifier uses a cumulative logistic curve to predict the value of the dependent variable (which is the outcome of the classification) and weigh the odds that it belongs to a particular class (categorical variable). The logarithm of ratio of the odds are plotted to give a continuous representation of the dependent variable.

4) Multi-class SVM This classifier uses binary SVMs where the probability of prediction to one class is compared with respect to all the other classes. Each binary SVM returns a confidence value that the sample belongs to that class. For M classes a total of {M(M-1)/2} binary classifiers are used.

V. EXPERIMENTAL RESULTS

Fig 2:Home Screen

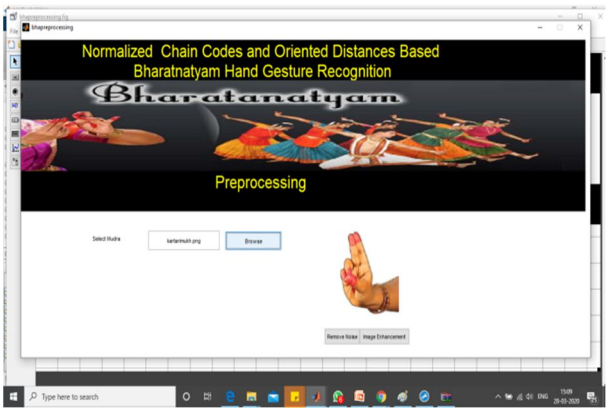

Fig 3: Read Image

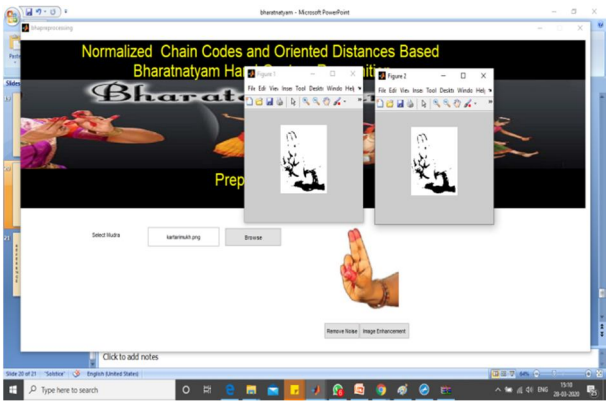

Fig 4: Noise Remove

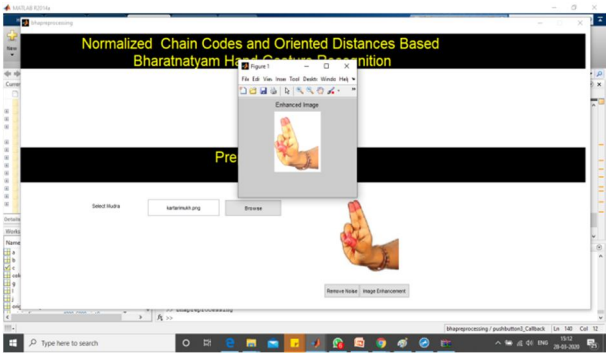

Fig 5: Enhanced Image

VI. CONCLUSION

The proposed system can be combined with the facial expression recognition module and posture recognition module to create a complete system for the online training of the dance form by constructing an interactive system that takes every frame from the dance video and provides complete details of the mudra, posture and expression and can give a gist of the drama portrayed in the sequence. Unit for the identification of other mudras and the implementation of facial expression identification and posture recognition and combination of the modules. Using enhanced noise reduction technique can also increase device efficiency.

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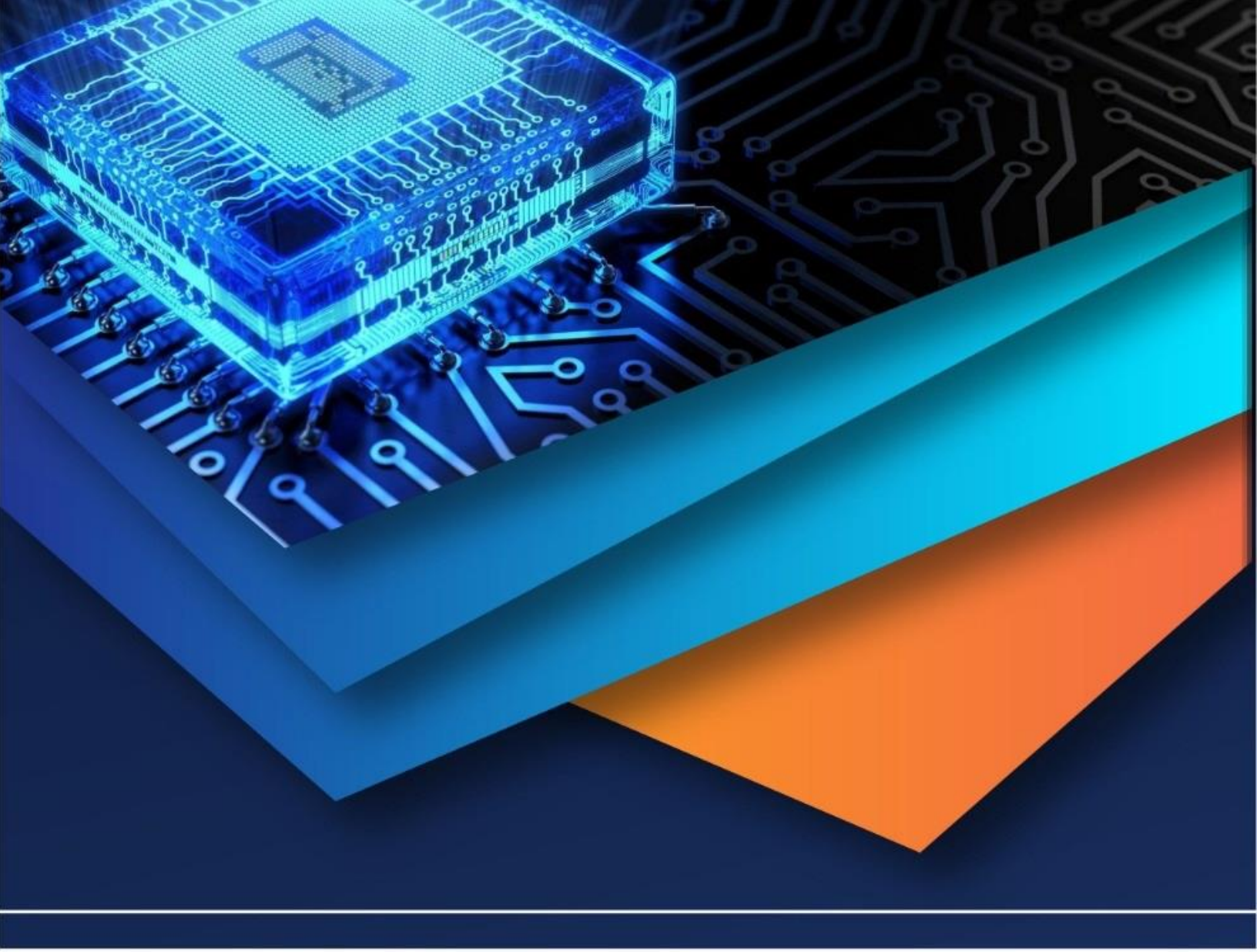

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