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Hand Gesture Recognition Using PCA, KNN and SVM

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ABSTRACT

To interact with world using expressions or body movements is comparatively effective than just speaking. Gesture recognition can be a better way to convey meaningful information. Communication through gestures has been widely used by humans to express their thoughts and feelings. Gestures can be performed with any body part like head, face, hands and arms but most predominantly hand is use to perform gestures, Hand Gesture Recognition have been widely accepted for numerous applications such as human computer interactions, robotics, sign language recognition, etc. This paper focuses on bare hand gesture recognition system by proposing a scheme using a database-driven hand gesture recognition based upon skin color model approach and thresholding approach along with an effective template matching with can be effectively used for human robotics applications and similar other applications .Initially, hand region is segmented by applying skin color model in YCbCr color space. Y represents the luminance and Cb and Cr represents chrominance. In the next stage Otsu thresholding is applied to separate foreground and background. Finally, template based matching technique is developed using Principal Component Analysis (PCA), k-nearest neighbour (KNN) and Support Vector Machine (SVM) for recognition. KNN is used for statistical estimation and pattern recognition. SVM can be used for classification or regression problems.

Keywords : Hand, Gesture, Recognition, Segmentation.

I. INTRODUCTION

Gestures are the movement of any body part used to convey the useful information. Communication through gestures has been widely used by humans to express their thoughts and feelings. Gestures recognition refers to the process of identifying gestures performed by human so that machine can perform the corresponding action. Gestures have been classified in two categories static and dynamic. Static gestures refer to still body posture and dynamic refers to movement of body part.We use hand to perform gesture like we wave hand to say 'good bye'. Hand gestures have been widely used for many applications like human – computer interaction (HCI), robotics, sign language, human machine interaction, TV interaction etc. With the advancement of technology, human robot interaction (HRI) has become an emerging field in recent years. Hand gestures can be effectively used to give commands to the robot which in turn can be employed in large number of applications. Now-a-days, human robot interaction using hand gestures has widely been used in medical sciences.

In this paper we present a novel method for hand gesture recognition based on K-nearest neighbour(KNN) and support vector machine (SVM). SVM is a regulated learning model for gesture acknowledgment, yet its rate and dimension has a

point of confinement in learning and testing stage. The principal components analysis (PCA) method is used to reduce the dimensionality of the feature space. SVM is trained and exploited to perform the hand gesture recognition tasks. To confirm the robustness of the proposed method, a dataset with large posed-angle (>45 deg.) of hand gestures is created. The experiment result shows that the recognition rate of 95.2% can be achieved when SVM is used. A real-time video system for hand gesture recognition is also presented with a processing rate of 0.2 s for every frame. All pictures in all of the categories were recognized using K-nearest neighbor. Performances of different Feature Classifiers with metrics, Confusion Matrix for SVM and KNN Classifier, 2nd Order Cumulants Based Feature Extraction, PCA Based Feature Extraction are obtained with comparison plots and tabulations. This result proves the efficiency and superiority of the proposed KNN and SVM method.

II. ADVANTAGES

- ✓ This low cost system with minimum requirements.
- ✓ The main advantage is by using SVM and KNN functions we will get exact results.
- ✓ Hand gesture recognition has the various advantages of able to communicate with the Technology through basic sign language.
- ✓ The gesture will able to reduce the use of most prominent hardware devices which are used to control the activities of computer.
- ✓ Low power, compact and robust sensing.

III. METHODOLOGY

In this section we will discuss our proposed methodology step by step.

Multi-class Support Vector Machine (SVM) and k-Nearest Neighbors (KNN) classifiers are used to classify the hand gestures. The proposed algorithm achieves average recognition rate of 97.69% under different hand poses and complex background with changes in lightning. Our proposed algorithm reduces gesture matching computational cost and memory requirements by 98.6%.

A. Image Acquisition: Images are acquired using the 13 megapixel real-aperture camera in controlled background as well as by varying the lightning conditions.

B. Hand Segmentation: The main and basic step in hand gesture recognition is to segment the hand from the whole image so that it can be utilized for recognition. In our proposed color skin color segmentation is applied to segment the hand. As skin color of different person can vary and background image can also contain the skin pixels so after skin color model Otsu Thresholding is applied to remove the background.

- ✓ Conversion from RGB to YCbCr: The proposed skin color segmentation in applied to YCbCr color space. So first of all RGB color space is converted to YCbCr color space. Y represents the luminance and Cb and Cr represents chrominance. The RGB color space is converted to YCbCr color space using the equation.
- ✓ Skin Color Segmentation: The skin color segmentation is used to classify the pixel as skin pixel or non-skin pixel. As or hand is connected component made of skin pixels we will get the hand after skin color segmentation. Steps for skin color segmentation: 1. The first step in skin color segmentation to specify the range for the skin pixels in YCbCr color space like lower and upper bound for Cb component and is lower and upper bound for Cr component 2. Find the pixels (p) that are in the range defined above. 3. Summation of all the pixels in the above step belongs to Region of interest i.e hand. After Skin color segmentation we will the hand but may be

some other pixels in the background also. To remove that background pixels we will use Otsu Thresholding.

- ✓ Otsu Thresholding: Thresholding is used to separate the object from its background by assigning pixel to either background or foreground based on threshold value. In our proposed system hand is in foreground. Otsu threshold is a global thresholding method which chooses threshold that minimizes within class variance. 1. Calculating threshold value: In MATLAB there is a function Graythresh(I) which calculate global threshold value using Otsu Threshold. TH = graythresh(I) 2. Convert Image pixel values into binary value according to THR.

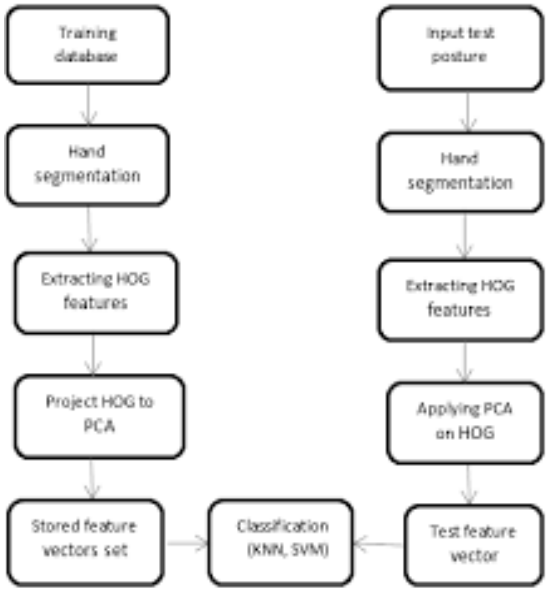

Fig 1: PCA KNN and SVM

IV. GESTURE RECOGNITION

One of the important technique of recognition is template matching in which a template to recognize is available and is compared with already stored template. In our approach PCA method for feature extraction and matching is used. Principal Component Analysis: PCA is used to reduce the dimensionality of the image while preserving much of the information. It is the powerful tool for analyzing the data by identifying patterns in the dataset and reduces the dimensions of the dataset such that maximum variance in the original data is visible in reduced data. PCA was invented by Karl Pearson in 1901. It works by converting set of correlated variables to linearly uncorrelated variable called principal components. Principal components are calculated by computing Eigen vectors of covariance matrix obtained from the group of hand images. The highest M eigenvectors contains the maximum variance in the original data. These principal components are orthogonal to each other and the first component is in the direction of greatest variance.

Fig 2: Hand Gestures

V. FURTHER SCOPE

In this technology, devices can get visual input and recognize people's gesture without touching keys or screens. Therefore, in the field of human computer interaction based on user-centered theory, gesture-based interaction has received great attention around the world and even is considered as the trend of future. The robot control system to regulate machine activity at remote sensitive sites. Also by using only PCA will give realted results, but by using the svm and knn functions the accurate and exact results will be produced. Moreover, a distinguished performance up to 92% on the sensitivity and 99.75%

on the specificity is obtained with a set of 450 test activities when the proposed cascaded classifier with SVM.

VI. CONCLUSION

In this paper the hand gesture recognition system is developed using skin color model, Otsu thresholding and PCA,KNN and SVM. The system is tested in controlled background and in different lightning conditions. The database collected in the ideal conditions has proved to be the most efficient database in terms of accuracy and gives 100% accuracy and when the lightning conditions are changed the accuracy decreases as compare to the previous one. The system shows 91.43% with low brightness images .The hand images have been obtained for the purpose of humancomputer interactions for the operation theatre robots, which must understand the hand language in order to take the actions. Our research empowers the medical experts to pass the instruction to the robotic hands remotely to add the accuracy in the operations. But the proposed model is not capable of working with the images containing hands of other than skin color. The proposed model does not evaluate the images clicked in other light colors where the hand gestures has been clicked and the model work only with statc gesture .In future the system can be upgraded to support dynamic gestures and an application for controlling medical operations can be developed using the system.

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