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Face Recognition Using K-Means and RBFN

Abhjeet Sekhon[1], Dr. Pankaj Agarwal[2]
[1]Research Scholar, Mewar University, Chittorgharh, Rajasthan, India
[2]Department of Computer Science and Engineering, IMS Engineering College, Ghaziabad, U.P, India

Abstract: This paper presents face recognition errand by using k-means with radial basis function network technique. The facial recognition system has proposed to recognize the faces which are enrolled in the database and which are not the parts of the database. We have dealt with AT&T database which join 400 pictures of 40 individuals. The essential goal of this study is to comprehend the appropriateness and exactness of K-means and Radial basis function network for face recognition errand. Some important outcomes and observations have given.
Keywords: face recognition, k-means, database, AT & T, radial basis function network.

I. INTRODUCTION

Face recognition is used for naturally distinguishing and confirming a man from a picture. In general way, face recognition consider as identification. Recognizing of any individual from a picture is just conceivable with the assistance of facial features. Feature values are further put away in database in the PC framework to make biometric application. The vast majority of the biometric applications are utilized for security reason in airplane terminal security, get to control, travel permits, and so on. One of the ways to do this is by extracting the features from the set of images and training this set of images considered as training database using some learning strategies. Once training is complete, the new images can be recognized using the information learnt during the training process. The greater part of the facial recognition strategies recognize facial features by extricating highlights, from a picture face. These elements were then used as a part of training and used to look for different images with coordinating features. Some algorithms standardize confront pictures and compress the face data, just recording the elements in the picture that is helpful for face recognition .One of the effective frameworks depends on layout coordinating methods connected to an arrangement of notable facial elements, giving a kind of compacted face representation.

Face recognition must be hearty as for changeability over an extensive variety of conditions to catch the basic similitude for a given human face. Some statistical approaches implemented for this task but these are based on dimensionality reduction to remove redundant information from the original images. Some of the popular neural network techniques includes: back propagation neural network, radial basis function network, self organizing map etc [1]. The fundamental goal of this proposed work is to comprehend the capacity and ability of some artificial neural network system procedures for face recognition task.

Recognition algorithms can be classified into two main approaches, geometric, which look at distinguishing features, or photometric, which is a statistical approach that distills an image into values and compares the values with templates to eliminate variances.

Outside changes can likewise impacts the face recognition system, as natural light, individual's position and separation from the camera, make-up, look, and so on. To beat these outer changes most of the researchers have used neural system strategies for face recognition. Both supervise and unsupervised learning systems have been used in the past. The benefit of utilizing the neural systems is its capacity to capture the complexity of patterns.

To implement any technique for face recognition system, there are two basic requirements:

- Extract the face values for data set.
- Train the network for recognizing the face.

In this proposed work:

- With the assistance of HOG extraction strategy we have prepared a data set of face feature values.
- To implement face recognition task , two artificial neural network techniques have been implemented: **k-Means And RBFN**

II. LITERATURE SURVEY

Ashoka S.B. had carried out a research on "Face detection and recognition using k- means and neural network methods". He had implemented k-means with back propagation neural network technique for solving face recognition task. He had used k-means for face classification and back propagation technique for face recognition. He observed that his face detection system was 82.8% efficient and his face recognition system was 72.35% efficient.[1]

Nancy smith had carried out a research on "k-means clustering for detection of human faces in database". In this research she had used k-means to segment eye and mouth candidates within the face candidates. she had used principle components eigen vectors for training the system. She had trained the system for three components: one to classify faces, one to classify eyes, one to classify mouth. She observed the success rate of classification was: 88.9%, 85.4%, 97.8%. In her research 20% of the images failed to generate any valid eye or mouth candidates. She observed that k-means algorithm was able to segment valid candidates in 97% of the cases.[2]

Yuanfeng gao had carried out a research on " face recognition based on radial basis function and clustering algorithm". In his research he had implemented RBFN using K-means clustering. He had proposed a new method for classifying faces on the basis of subtractive clustering algorithm. He had tested his system on ORL database and he observed that RBFN using SCA was better than RBFN using K-means.[3]

Rohit pal et al had carried out a research on "facial expression recognition based on basic expressions and intensities using K-means clustering". In their system k-means clustering method was applied on cohn kanade image database. They had used facial expressions like: happy, angry, fear, natural, sad and surprise. They had implemented k-means for face classification and back propagation for face recognition and their system was 98% accurate.[4]

I.Sudha et al had carried out a research on "face image retrieval using facial attributes by k-means". They had proposed an approach to achieve immediate retrieval in a large scale dataset. They had used k-means for clustering of images on the basis of their attributes and proposed a novel technique for face recognition. They observed that their proposed system was accurate for face recognition task.[5]

III. PROPOSED WORK

K-Means Algorithm and Radial basis function network was implemented in this proposed work. Three stages were involved :

- Feature extraction
- Training of the network
- Recognition of faces

The K-Means is a simple clustering algorithm used to divide a set of objects which is based on their attributes or features, into the k bunches in which the k is a predefined or client characterized steady. Characterizing k centroids, one for every bunch is the primary thought. The centroid of a bunch is shaped in a manner that it is firmly related (as far as comparability capacity) to all objects of that group. Since we know the numbers of bunches to be formed, the objects which are in the input list are initially divided into random groups, that is, each and every object is assigned to a random bunch. K-means bunching plans to parcel n perceptions into k groups in which every perception has a place with the group with the mean which is the closest, filling in as a vital model of every group.

K-Means Algorithm for clustering in face recognition task:

1. Randomly *'c'* cluster centers were selected.
2. Distance between each data point and cluster centers was calculated.
3. Data point was assigned to the cluster center whose distance from the cluster center was minimum of all the cluster centers.

4. The new cluster center was recalculated using:

$$vi = (1/ci)\sum xi$$

where, 'c_i' represents the number of data points in i^{th} cluster.

5. The distance between each data point and new obtained cluster centers was calculated.
6. If no data point was reassigned then stop, otherwise repeat from step 3).

Radial basis function network

Radial basis function network uses radial basis functions as activation functions for calculating the output of the system. This network technique was used for recognition process in this proposed work.

Algorithm:

1. Weights were initialized.
2. Centroids was chosen from the set of inputs with the help of **k-means algorithm**.
3. Output of the hidden layer was calculated.

$$vi(xi) = e(-\sum[xji - \hat{}xji]^2/\sigma\hat{}2$$

xji was jth variable of input pattern.

4. Outputs of output layer was calculated.

$$ynet = \sum wimvi(xi) + w0$$

Here w for weight, ynet for output of network.

5. Errors were calculated and found stopping condition.

Architecture of K-Means and RBFN

K-means is an unsupervised learning technique. We have only two layers input and output layer in k-means algorithm. In fig1,we have six inputs in the form of face feature values from x1 to x6 and we have chosen five number of centroids. So that system made five number of clusters (c1 - c5)of the face values in the database . These cluster values further used by radial basis function network for face recognition task.

fig2, shows the network topology of RBFN. It is a supervised learning technique. It has three layers. first is input layer, second is hidden layer and third is output layer. In input layer we have six number of inputs as face feature values from x1 to x6. We chosen five number of centroids so five number of clusters were used in hidden layer from c1 to c5 by using k-means. In hidden layer we use two things one is width and second is cluster values. For calculating output of the system we use weights for output layer. y1 to y6 are the outputs of the system.

The combination of these two algorithms performed face recognition task.

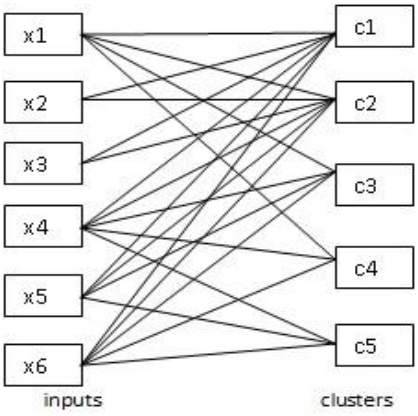

fig1 network topology of K-Means

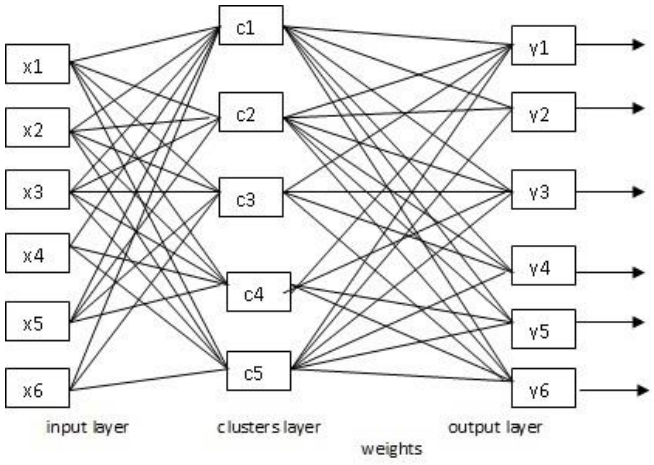

fig2 network topology of radial basis function network

By implementing these techniques we derived some results and observations of the proposed network.

IV. RESULTS AND OBSERVATIONS

In this section we will focus on the results and observations of proposed work. The proposed work was experimented on AT & T database. k-means algorithm implemented to making clusters of faces in the database. We have 10 different posses of one person in the database. We wanted to make clusters of same images in one cluster. But in some cases k-means put wrong face in the wrong clusters. So for this we can understand the efficiency level of k-means in clustering of faces in the database by using table1.

In table1 , we have 100 faces in the database. When we chosen five number of centroids then the success rate of making clusters by k-means was 76%, when the number of centroids increased from 5 to 10 then success rate was 80%. It means when we increase the number of centroids then the accuracy in this task will increase.

In table II, we can understand the efficiency level of face recognition task in this proposed work. When we have 80-20 ratio of training size then the system was 85% accurate. When we changed training size from 80-20 to 60-40, that time system was 90% accurate. So we can say this proposed system is more accurate in small databases rather than large databases.

Some observations that were concluded from this experimental study:

- K-means algorithm can be used for face classification or making clusters of similar type faces in the database but independent face recognition errand cannot be conceivable by k-means.
- Large number of centroids increases the efficiency of k-means.
- Radial basis function network with k-means is accurate for face recognition task.
- But it is more accurate in small databases instead of large databases.

TABLEI EFFICIENCY TABLE OF K-MEANS CLUSTERING

Number of epochs	Number of Training data	Number of centroids	Success Rate(%age)
100	100	5	76
		8	79
		10	80
		12	82

TABLEII EFFICIENCY TABLE OF FACE RECOGNITION(K-MEANS WITH RBFN)

Number of epochs	Training Size	Accuracy(%age)
100	90-10	82
	80-20	85
	60-40	90
	40-60	95

V. CONCLUSION

In this proposed work, K-means and RBFN techniques for face recognition errand is reviewed. We have been approving exactness of k-means and rbfn strategies in face recognition framework. When we have large number of face pictures in database then framework was less exact as contrast with little database of face pictures. k-means technique was accurate for face classification and rbfn technique was accurate for face recognition. The system work impeccably on still pictures.

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