Content Based Image Retrieval System Using Perceptron Neural Network

Richa Soni[1], Prajyant Pathak[2]
[1, 2] Department of Electronics & Telecommunication Engg.
[1, 2] LNCT, Jabalpur, Madhyapradesh

Abstract- *The effective and illustrious characteristic of the multilayer perceptron with content based image retrieval system enables us in estimation on the different data, for classification of images. The idea behind is to classify the image into different categories based on the mathematical properties of images and the image processing of retrieving. The multilayer perceptron network gives us a new point of reference in accuracy. In this paper we present an algorithm which does not has any previous knowledge of image sample appearance in the database, but retrieves images based on content information of image called content based image retrieval. We are trying to enhance the efficiency of image retrieving with more efficient accuracy in Image similarity through multilayer feed forward perceptron network.*

Keywords- CBIR, image processing, neural network, perceptron neural network.

I. INTRODUCTION

An image retrieval system is an automatic computer system for traversing and retrieving images from a large digital image database. Mostly the common methods of image retrieval utilize methods of adding metadata such as descriptions, captions, and keywords to the images so that retrieval can be performed over the annotation words. Manual methods of image annotation are prolonged, difficult and expensive. To overcome this, there has been a large amount of research done on automatic image Annotation. Additionally, the raise in social web applications and the semantic web have stimulated the development of several image based image annotation tools. Image search is a special data search used to find images. Most commonly, to search for images, a user provides query terms such as keyword, image description, or click on some image, and the digital computer system returns images "similar" to the query made by the user. The similarity used for search criteria could be Meta-tags, color distribution in images, region or shape parameters, etc. Thus image retrieval is the processing of searching and retrieving images from a huge database. As the images grow complex and diverse, retrieval the right images becomes a complicated and tricky challenge.

Image Retrieval System is a type of Machine simulation of human reading. The objective of our work is to find out the images containing some special features using a query image obtained by the camera, scanner or by any other network means. This main objective can again be subdivided into different sub-objectives explained below:

1. Image acquisition.
2. Normalization of images.
3. Image processing and generation of the image matrix.
4. Acquirement of image characteristics.
5. Creation of database.
6. Training and testing of neural network for image retrieval

A. IMAGE PROCESSING:

In computer science, image processing is a form of signal processing only for which the input is an image and the output of image processing can be either an image or a set of characteristics or parameters related to the input image. In most image-processing techniques the image is considered as a two-dimensional signal and applied to the standard signal-processing techniques.

During our work the image obtained by the camera or network is processed by using the MatLab signal processing tool. Different steps involved in image processing are as follows:

1. Firstly the desired image is converted into a two dimensional matrix.
2. Then extra blank space from the image is removed.
3. Now these images are resized into a 40 x 40 matrix.
4. This image matrix is then further processed and image characteristics in form of the matrix are obtained and stored in a mat file called the dataset
5. This dataset is further passed to neural network module for training and testing.

B. NEURAL SYSTEMS:

A Neural Network (NN) is defined as a computing structure that consists of massive parallel interconnections of the adaptive “neural” processors. The main advantages of neural networks are the ability to be learned automatically

from examples, good performance with noisy data, possible parallel execution, and efficient tools for learning of large databases.

During the present work neural networks are trained to recognize and retrieve the images from database. Matrices obtained from the image processing module are passed as input to the neural network. Finally this neural network subsystem is tested for identifying and retrieving the images.

C. RECOGNITION STRATEGIES:

Matching techniques can be grouped into three classes: direct matching deformable templates and elastic matching and relaxation matching. Several popular image retrieval approaches belong to this domain:

1. The k-Nearest-Neighbor (k-NN) rule
2. The Bayesian classifier
3. The polynomial discriminant classifier
4. Hidden Markov Model (HMM)
5. Fuzzy set reasoning

In structural techniques the characters are represented as unions of structural primitives. It is assumed that the image primitives extracted from images are quantifiable, and one can find the association among them. Principally, structural methods can be categorized into two classes: grammatical methods and graphical methods.

The image retrieval is subject of much attention since the first years of research in the field of image recognition. The reason is the potential number of applications, and also because the solutions for this split of characteristics are simpler and robust.

In this work, image retrieval is done for different query images. This work can be further extended for more and less number of categories. The main use of this program is in electronic search of images based on a query image. Apart from this the program can be used in following places:

1. To recognise a specific person from a big dataset.
2. In certain sections of electronic library where retrieving images from multiple books for a specific task is required.

The entire paper can be explained by using the block diagram shown in Fig. 1

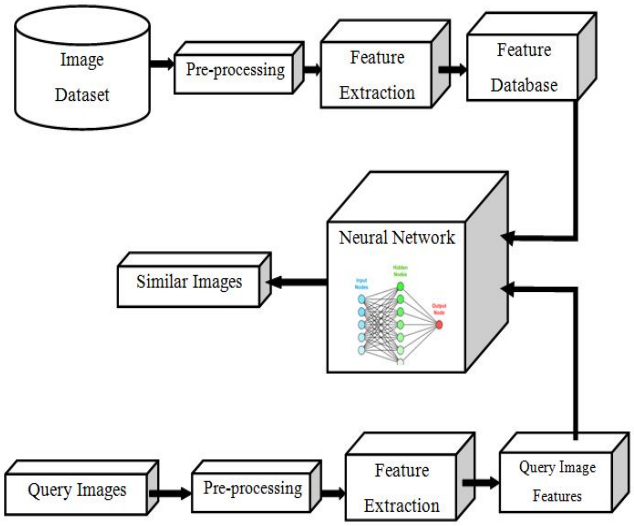

Fig. 1 Plan of the Work

Firstly the image is acquired with the help of a camera which is then processing with the image processing tool. The obtained image is then further processed and then converted into the image matrices. These image matrices are normalised and reduced into a 40 X 40 matrices. Then features of the image are detected and stored in dataset. Finally these matrices are then passed to the neural network module to recognise the character and its shape. After that result analysis is done to calculate the efficiency of the system.

II. LITERATURE SURVEY

Content-based image retrieval (CBIR) technique is also known as query by image content (QBIC) and also the content-based visual information retrieval (CBVIR).

It has application in computer vision techniques to the image retrieval problem. In this section different works performed and algorithms developed in this area have been discussed.

TK Rama Krishna Rao et. Al. explains process method that has no previous knowledge of image appearance sample within the database. An efficient accuracy in image similarity is tried to obtain through multilayer feed forward perceptron network named as “Radial basis Function” neural network such that the input parameters given will able to provide the most relevant image to that of given query image, promoting through applying k means clustering to form clusters that are parameterized by applying Gaussian function application. RBFNN approach which uses Differential Evaluation and Gaussian function to retrieve images that are similar to initial image given to the images in database. This work can have its extension through reporting of weather forecasting accuracy rate betterment.

Karamti et. al. describes vector representation of images and its proper use in image retrieval. A new model of content-based image retrieval is proposed where each low level query can be transformed into a score vector. This image retrieval system has been implemented with a general image database. The performances are measured by the MAP (Mean Average Precision), which is maximum 60% for different images. The main idea of this model is to build a connection between the query image and the result score directly via neural network architecture.

Nagathan et. Al. described a global image properties based CBIR using a feed-forward backpropagation neural network. Firstly, the neural network is trained about the features of images stored in the database. The image features are color histogram as color descriptor, GLCM (gray level co-occurrence matrix) as texture descriptor and edge histogram as edge descriptor. The training is done using backpropagation algorithm. The trained network, when presented with a query image retrieves and displays the images which are relevant and similar to query from the database. The experimental work is carried out using the database covering a wide range of semantic categories from natural scenes to artificial objects for experiment. An average retrieval accuracy of about 88% and average recall rate of about 78% is achieved using this system.

H. Selvaraj et. al. presented a neuro-fuzzy technique the CBIR system. This technique is based on fuzzy interpretation of natural language, neural network training and searching algorithms. A fuzzy logic is developed to interpret natural expressions such as few, many and mostly. Secondly, a neural network is designed to learn the meaning of mostly red, many red and few red. Then a binary search algorithm is used to match and display network output and images from dataset. Success rate of about 92% is achieved in this approach.

On the basis of literature survey problems are being identified which are discussed in the next section

III. PROBLEM IDENTIFICATION

For centuries, most of the images retrieval is text-based which means searching is based on those keyword and text generated by human's creation. The text-based image retrieval systems only concern about the text described by humans, instead of looking into the content of images. Images become a mere replica of what human has seen since birth, and this limits the images retrieval. Text-based approach is also employed for image retrieval. In text-based approach, the images are manually annotated by text descriptors and then these descriptors are used by database management system to perform image retrieval. This technique requires vast amount of labour for manual image annotation and also there are inconsistencies between user textual queries and image annotations.

To overcome those drawbacks of text-based image retrieval, content-based images retrieval (CBIR) is used for extracting the images features, CBIR perform well than other methods in searching, browsing and content mining etc. The need to extract useful information from the raw data becomes important and widely discussed. Furthermore, clustering technique is usually introduced into CBIR to perform well and easy retrieval. Also to overcome the inconsistency problem, content-based approach is used. Content-Based Image Retrieval (CBIR) aims at constructing meaningful descriptors of physical attributes from images to facilitate efficient and effective retrieval.

IV. METHODOLOGY

In the proposed method system is designed which will first learn features of the images from database. Once trained, this network is able to retrieve the accurate and similar images efficiently on its own.

An image retrieval system is first designed based on neural network, as shown in Figure 3. This system is having two stages: training and testing. While training query image and all the images in database are preprocessed and are performed with feature extraction. In preprocessing images are send through color conversion (RGB to HSV) and image resizing. In feature Extraction, arithmetic features of an image are evaluated on the basis of color, texture and edge descriptors. Now comes neural network part. It is also having two phases viz training and testing phases.

A. Training:

A three-layered neural network is configured for extracting features based on color, texture and edge of training set images. The learning process is carried out using perceptron where weights are updated to minimize the error. In this phase network is made to create its knowledge base which can be used for comparison and decision making. The comparison task includes comparing the features between query and training set images. And decision making task includes making decision about which two image features are most matched with respect to color, texture and edge. And finally, retrieve the best matched features' images.

B. Testing:

This phase includes the querying and retrieving task. The query image is first preprocessed and also its features are extracted. The trained network is presented with query image features. The network retrieves best matched image from the database.

V. EXPERIMENTAL RESULTS

This work is performed by using MATLAB 2010Ra software. Database being used is self created. Database provided 800 numbers of images. Out of these images 600 images are taken for training and remaining 200 numbers of images are taken for testing.

Fig. 2 Query image and Retrieved images

For classification purpose perceptron based neural network is used. For perceptron learning rate is set to 80%, and permissible error at 0.003.

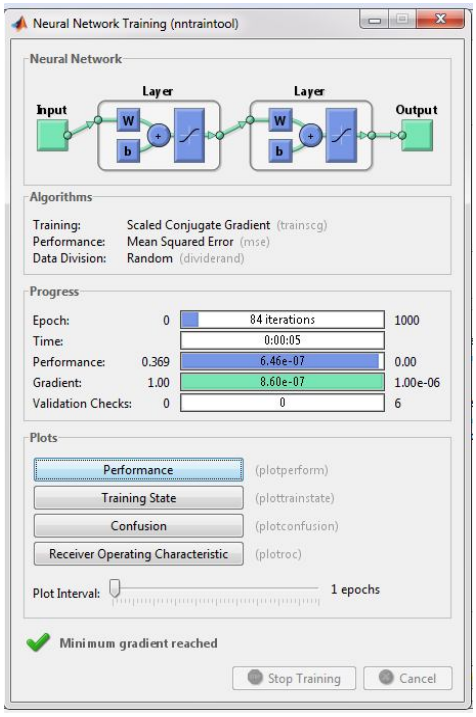

Figure 3: Training of Neural Network Module

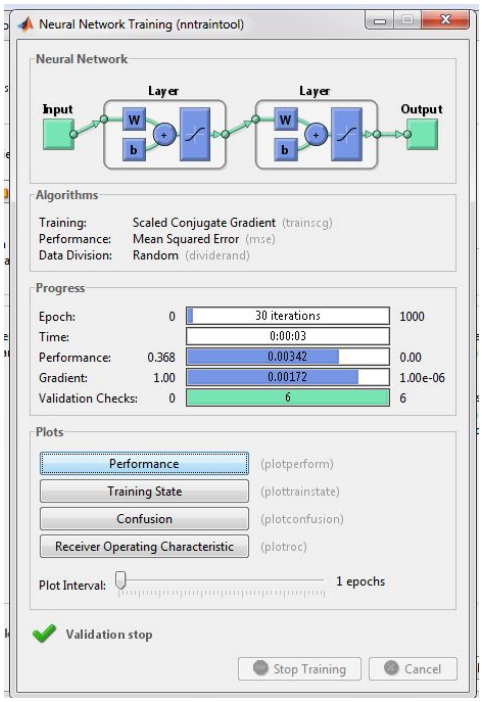

Figure 4: Final Training Results

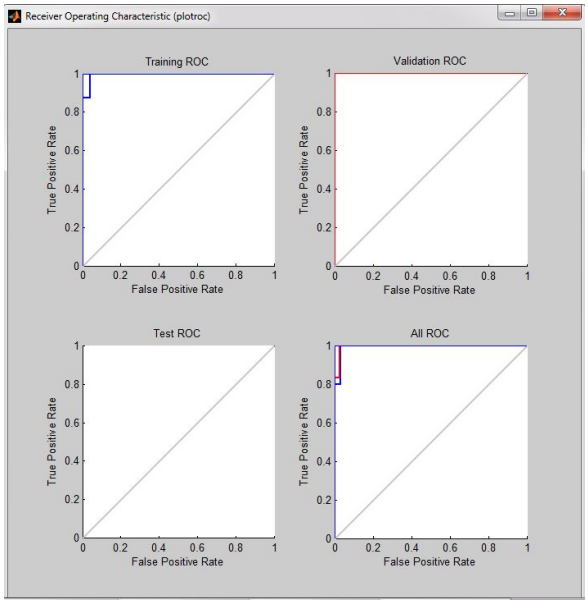

Figure 5: Experimental graph

The performance plot is a graph of number of epochs versus the Mean Square Error (MSE) as in figure 4. The number of epochs we have chosen is 2000 and the MSE measures the average of the squares of the errors i.e., the difference between the two training epochs. The graph shows the best training performance at epoch number 1995.

Also, the regression plot for training process is shown in Figure 5. The regression plot gives the relationship between the input parameters (target, '0' to '1') and the output parameters given by,

output= (learning rate x target) + bias

The circles at target '1' indicate the output parameters i.e., image classes. The graph shows that the regression of about 87% is achieved.

To check performance of a CBIR system precision rate and recall rate are calculated.

$$precision = \frac{N_{A(q)}}{N_{R(q)}}$$

$$recall = \frac{N_{A(q)}}{N_t}$$

Where $N_{R(q)}$ are the query images, $N_{R(q)}$ is the number of images retrieved, and N_t represents the total number of relevant images available in the database.

For comparison, tables of retrieval precision and recall values for each class of image is being shown.

TABLE I: PRECISION VALUES FOR EACH CLASS

Category ID	Category	Precision
01	Animal	0.80
02	Person	0.90
03	Scene	0.86
04	Flower	0.92

TABLE II: RECALL VALUES FOR EACH CLASS

Category ID	Category	Precision
01	Animal	0.72
02	Person	0.80
03	Scene	0.75
04	Flower	0.85

It is found that retrieval precision for different classes vary from 85% to 92%. So an average precision is found to be 88%. Also recall rate for different classes vary from 70% to 86%, so an average precision comes to be 78%.

VI. CONCLUSION

In this work perceptron based content based image retrieval technique is worked upon. Database are first transformed into HSV format and then resized. It is found out that use of perceptron has improved the recall rate and also reduces retrieval time.

On the basis of experimental performed average retrieval precision of 88% is obtained and average recall rate of 78% is obtained

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