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An Efficient Approach to Content Based Image Retrieval

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Abstract: Content-based image retrieval (CBIR) is image retrieval approach which allows the user to extract an image from a large database depending upon a user specific query. An efficient and effective image retrieval performance is achieved by choosing the best transform and classification techniques. Currently available transform techniques such as Fourier Transform, Cosine Transform, and Wavelet Transform suffer from discontinuities such as edges in images. To overcome this problem, a technique called Ripplet Transform (RT) has been implemented along with the neural network based classifier called Multilayered perceptron (MLP) for finding an effective retrieval of image. Classification using multilayered perceptron (MLP) with the Manhattan Distance measure showed varying experimental results for dimensions of Images. The performance of various Transform is compared to find the of particular wavelet function for image retrieval.

Keywords: Content-based image retrieval (CBIR), Ripplet transforms (RT), Multilayered Perceptron (MLP), Edge Histogram Descriptor, Feature Vector, Similarity Check.

I. INTRODUCTION

In recent years, advances in data storage and image acquisition technologies have led to huge databases. In order to deal with these datas and to efficiently manage these collections, it is necessary to develop an efficient retrieval system [1]. Knowledge discovery and business insight from operational data and retrieving similar images from large databases have been powerful weapons to take Competitive advantages in the modern business world [2]. The explosive growth of the internet and the wide use of digital content necessitate the development of effective ways of managing the visual information by its content and have increased the need for efficient image retrieval procedure [3].Computational data processing from different perspective represents from data mining with goal of extracting implicit and interesting samples, trends and other information are more necessary in educational, industrial and other scientific research areas[4].

In Content Based Image Retrieval(CBIR) system the images can be retrieved from a large database based on the visual content of images. The visual content of an image is analysed in terms of low-level features extracted from the image [8]. These low level features include color, shape and texture . There are several transform techniques implemented for the feature extraction process. But the transform techniques like Fourier Transform(FT) and Wavelet Transform(WT) suffer from discontinuities such as edges and contours in images[9].

In order to overcome the limitations of the conventional transforms an effective method called Ripplet transform(RT) has been implemented for feature extraction[1]. In order to improve the performance of retrieval of images and to decrease the computational complexities a neural network based classification tool called Multilayer perceptron (MLP) has been applied. This classification technique is used for the classification of images depending upon the features. Once the classification is over ,Manhattan similarity measure is used to retrieve and display images based on the distance values. The main objective of the system is to check the effectiveness of Ripplet Transform(RT) with different neural network based classification tools with a point to determine an efficient technique for the Content based Image Retrieval.

II. PROPOSED ALGORITHM

a) Ripplet Transform(RT)

The conventional transform technique like Fourier Transform(FT) ,Cosine Transform, Wavelet Transform(WT) suffer from discontinuities such as contours and edges in images. To address this problem, Jun XU et al. Proposed a new MGA (Multigeometric analysis) tool called Ripplet Transform (RT) [1][5]. RT is capable of representing images or 2D signals at different directions and different scales. RT provides a new tight frame with sparse representation for images with discontinuities alonget curves [6]. RT could be represented as Continuous Ripplet (CRT) and discrete Ripplet transform (DRT)

b) Multilayered Perceptron(MLP)

Multilayer perceptron (MLP) network is a feed forward artificial neural network model that maps set of input datas onto a set of appropriate output. A MLP consists of multiple layers of nodes in a directed graph, with each layer fully connected to the next one The network consists of a set of source nodes forming the input layer, one or more hidden layers of computation nodes, and an output layer of nodes. The input signal propagates through the network layer-by-layer [7]. Each node in one layer connects with a certain weight Wij to every node in the following layer. Learning

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algorithms like back propagation can be used to train the network [1].

In order to increase the accuracy and to reduce the search space, the proposed CBIR system uses a MLP-Neural Network based classifier with feed forward back propagation algorithm for training the network which consists of three layers [1]. The learning network consist of certain number of nodes in the input layer and in the output layer .The signal-flow of such a network with one hidden layer is shown in below.

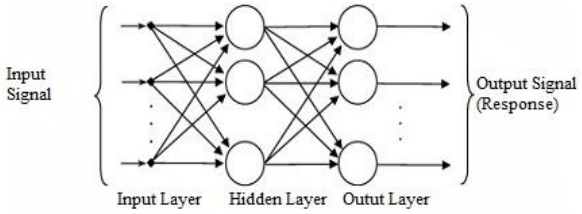

Fig. Signal flow graph of Multilayered perceptron (MLP).

c) **Manhattan Distance Measure**

Manhattan Distance Measure Manhattan distance is also known as city block distance.It represents the distance between two points in an image. The "closer" the instances to each other, the larger will be the similarity value. The Manhattan distance, lit, between two vectors p,q in an n-dimensional real vector space is the sum of the lengths of the projections of the line segment between the points onto the coordinate axes. It is given by the equation,

$$d_1(\mathbf{p},\mathbf{q}) = \|\mathbf{p}-\mathbf{q}\|_1 = \sum_{i=1}^{n} |p_i - q_i|,$$

Where p and q are vectors. The distance depends on the rotation of the coordinate system, but does not depend on its reflection about a coordinate axis or its translation. It is more commonly used than Euclidean distance because of the accuracy in high dimensional space[6].

III.PROPOSED ALGORITHM

In the proposed method, the image samples are labeled and stored in a database. Then their features based on RT are extracted for the training of a MLP network[1]. The exact configuration of the MLP is selected on trial and error basis, based on the error rate of the output classification. The block diagram of the proposed CBIR system is shown below. The user gives the query image to the system. Ripplet Transform based features are extracted for this particular query image.

These features, class identification of the query image is carried out by the selected MLP based pre-classification block. Once the classification of the query image is over, the system computes the similarities between the query image and all the images in the partitioned database by using the Manhattan distance. The system retrieves the similar matching images from the partitioned database and Presents them to the user.

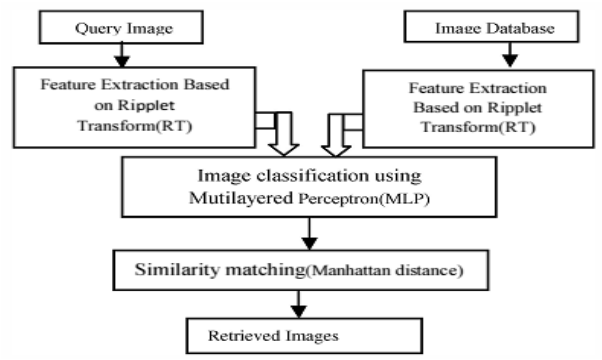

Fig. Block diagram of proposed image retrieval system.

The matching process then retrieves those images whose features match most closely to that of the query image.

Training the Algorithm

The Training process extracts the image features to a distinguishable extent and prepares a database of feature vectors. These feature vectors are obtained by the wavelet transform and then applying EHD on selected wavelet coefficients. The overall training process is shown in figure2. The main steps of training algorithm as follow:

Step 1: Input image (I) of size M×N.
Step2: Resize image (I) in a size where both M and N are divisible by four due to requirement of EHD.
Step 3: Take 2 Level Discrete Wavelet Transform of the input image (I).
Step 4: The two-level DWT gives the four matrices cA2, cH 2, cV2 and cD2 of wavelet coefficients at level 2.
Step5: Calculate Edge Histogram of the approximation coefficients cA2 and detailed coefficients cH2 and cV2 while leaving detail coefficients cD2 as it mainly contains noisy details rather than the meaningful information. The EHD give85 information points as 80 points obtained from standard bins 5 additional points obtained by global bin.
Therefore, the length of the feature vector (fv) is 85 for one wavelet coefficient matrix and overall length of feature vector forcA2, cH2 and cV2 is 85 3=255.
Step 7: Calculate feature vector (fv) for each image in the database and arrange all these feature vectors in a database. The size of database is,

Number of Images (Rows) ×255(Column)

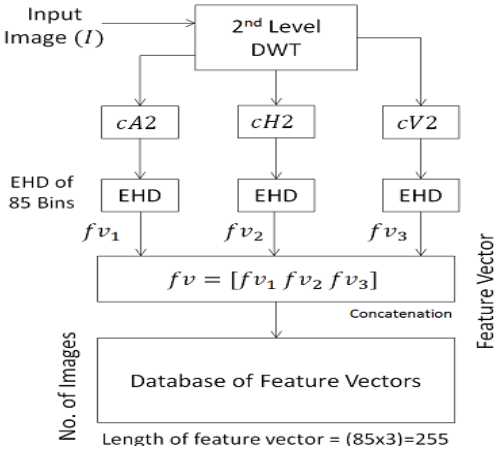

Fig. Training process for proposed scheme.

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IV. CONCLUSION AND FUTURE WORK

Feature extraction based on Ripplet Transform was found to produce an accurate retrieval producing a good multi-resolution analysis. It provides a hierarchical representation of images which results in an effective approximation of images from coarse granularity to fme granularity. In this paper, a content based image retrieval algorithm is presented for texture and shape based features. Edge Histogram Descriptor (EHD) are utilized to obtain better efficiency in image retrieval. The image retrieval performance could be further improved by using Ripplet Transform with another neural network based classification technique called Radial Basis Function(RBF) for different Fundus images containing Diabetic Retinopathy.

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