A Feed-Forward Neural Network and Euclidean Distance based approach to CBIR using Image Queries

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Abstract— A content based image retrieval system is developed as an efficient, accurate and fast image retrieval system, where the user will give an image as input to get the similar images as output. The similar images are fetched from the class to which the query image belongs. Similar images are decided on the basis of the visual similarity of query image to the retrieved images. The visual features are extracted using the color and texture features of the images present in the database. These features are used to train the feed forward neural network which decides on the class of the query image during testing. The distance between query image and database images of the identified class are calculated. Among these images, 10 images with least distance values are selected and displayed as output. This application will reduce time and retrieval complexity as compared to other existing approaches or applications.

Key words: CBIR, Discrete Wavelet Transform, Feed Forward Back Propagation Neural Network, Euclidean Distance

I. INTRODUCTION

In earlier days, image retrieval was done based on text annotation. The meaning of annotation stands for the explanation or comment added to a text or diagram. Such image retrieval systems were known as text based image retrieval (TBIR) system. In this form of system the images are in the database were stored along with the description of the image in the form of text. When an image was to be searched in the database in order to fetch similar images, the search was carried out in the form of automatic or manual annotation of images. The similar images were searched from the database based on the keywords provided to that image in the form of explanation. Since all images cannot be described clearly with single fixed statement or group of words, the results were not accurate and produced irrelevant results. The search was done manually so it took time to search each and every image according to the keywords. As the number of images was increased in the text annotation database, the time required to search similar image was also increased. To overcome this use of content based image retrieval (CBIR) is in vogue.

Content based image retrieval is widely used due to its widespread use in video and image data in digital form. CBIR is a technology that helps to organise pictures based on their visual content. The key characteristic of CBIR is less computational complexity and its high retrieval efficiency. The easy way to match images is finding any image and then matching it against other images from a collection which is created as database. It is the easy way for matching rather than textual description, because, textual description fails to capture every perfect detail about the image. CBIR solves the problem of retrieving images from large databases. In CBIR color features are mostly used because they can be easily extracted when compared to the shape and texture features.

When an image is given as input to the system, color moments and discrete wavelet transform features are extracted. These features are used t train the neural network to identify 18 classes of images. The neural network then classifies an image into one amongst these classes. The class identification is used to narrow the database system. The Euclidean distance of the query image with the images in database is computed and the distance is designed to output the 10 least distance images from the class. Thus providing a methodology to extract similar images from a large database. The proposed approach hence uses a hierarchical methodology for CBIR and the results are satisfactory.

This paper is organized into five sections. Section 1 deals with introduction. Section 2 deals with literature survey. Section 3 deals with proposed solution. Section 4 deals with the testing and analysis of the result. Section 5 deals with the conclusions and future avenues.

II. LITERATURE REVIEW

The section of the paper explains the work done in the recent years in development of the system for image preprocessing, image segmentation, feature extraction and about neural network classifier. Manjigao et al. (2012) proposed content based image retrieval using two visual features. Here, the RGB image is converted into HSV image. The features of the database images are calculated and stored in an array. Hemachandran et al. (2012) proposed content based retrieval system using color and texture features, where wavelet transformation and color histogram are used to extract features of an image. This system fetches images faster on Wang image database. Muller et al (2004) proposed content based image retrieval in medical applications for clinical benefits. In medical field, digital images produced are used for the diagnostics and therapy for patient. The access to such large repository is done by patient identification, which is still a complex issue but reduced significantly. M. Sifuzzaman et al (2009) proposed wavelet as a solution for the problems in engineering, mathematics, physics etc., and also the improved version of Fourier transform. Fourier transform can only analyse signal components when it is stationary, whereas wavelet transform analyse the components of non-stationary signal. Arvind Nagathan (2014) proposed "CBIR using feed forward back propagation neural network" for global image properties. Feed forward back propagation neural network (FFBP) proceeds in both direction forward and backward direction. Output computation is done in forward direction. Error computation is done in backward direction. Katarzyna et al. (2009) proposed human emotions in order to search an image from the database. In this paper, it is examined on how useful an artificial neural network is for labelling the

images with emotional keywords based on visual features only. Here, emotions of an image are decided based on the arrangement of eyes and lips. A single image can have many emotions depending on the person face and his current situation. Ryszard et al. (2013) proposed a review on the feature extraction method for CBIR and biometric system. Here CBIR is defined as the process of retrieving desired or similar images from the large collection or database on the basis of features that can be automatically extracted. When a query image is selected, its feature vector is created and it is compared with the feature vector stored in the database one by one. The images with smallest feature distance are retrieved as similar image. The nearest neighbour classifier is used to find the distance between the query image and the images in the database. Sudarshan Nandy et al (2012) proposed the back propagation algorithm in order to optimize the feed forward neural network. Here, they are using and improving the already existing artificial bee colony algorithm. Artificial bee colony algorithm is a nature inspired meta-heuristic algorithm and is based on the technique called as back propagation neural network. The analysis of the artificial bee colony is based on the correct classification rate and mean of squared error. V. Duraisamy, et al (2011) proposed the classification algorithm as gaussian fuzzy feed forward neural network. In order to extract the features of an image discrete cosine transform method is being used. Here, 180 brain MRI images are used as input to this application. Among 180 images 72 images are used for testing and remaining are used in order to test the system using neural network classifier. The results show that the accuracy obtained for classification process is around 95% of the designed system.

Though there are many approaches described in literation, the performances of rest of the systems degrade with the increase in system image database. Hence there is need for exploring an efficient hierarchical approach to CBIR. This paper presents answer worked is described in the next section.

III. PROPOSED APPROACH

The proposed solution provides for fast image retrieval employing content based image retrieval system using Wang database. These images are categorised into certain class based on homogeneous nature of the image. This proposed system takes the RGB color image and converts it into the computer readable HSV image. The HSV image is pre processed and segmented into sub parts. The segmented images are processed for extracting features. Color moments and discrete wavelet transform features of the image are extracted and stored in a feature vector. The features of all images are computed class wise and stored in separate matrices. The images in the database are used to train the neural network classifier.

After training, an image is passed to test. This image is pre processed and features are extracted to create a feature vector. This feature vector is input to neural network to determine to which class the query image belongs to. Later the distance between query image and the images from that class are computed. After calculating the distance the distance values, they are sorted in ascending order along with the indices and stored into a matrix. Finally 10 images with least distance values are fetched and corresponding images are displayed as similar images. The block diagram for the proposed approach is shown as below in fig 1. Each block is briefly explained in the following.

A. Image Database:

In this proposed system, Wang database is used, it consists of thousands of images. The images are categorised into 18 different classes, each class consist of minimum 50 images.

B. Preprocessing:

Preprocessing includes conversion of an image into HSV image and segmentation of an image. The RGB image is converted into HSV image. This conversion is done is done because human eyes can differentiate colors in an RGB image but it is hard for computer to read this RGB image. For ease of access RGB image is converted into HSV image. The image is also segmented into four sub images. Segmentation is done for more meaningful representation of an image. Each sub-image is subjected to feature extraction process.

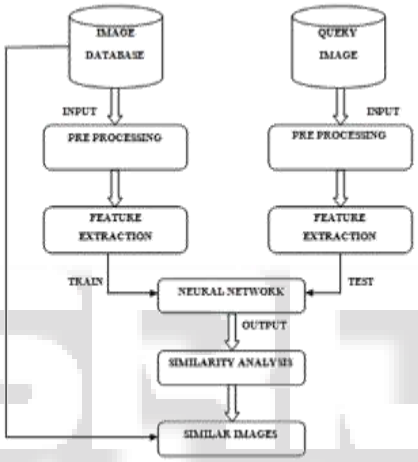

Fig. 1: block diagram for system designed

C. Feature Extraction:

Database images are classified into 18 different classes. Color moments and discrete wavelet transform features are extracted from each classified class and stored in matrix. Color moment gives two: mean and standard deviation feature of an image. Discrete wavelet transform gives four coefficients values for an image. Combining these two seventy two feature values are extracted for an image. When an input is passed same seventy values are extracted from it to determine the image class in the database. Later the features re compared with the class features against the input image features to fetch similar images.

D. Classification

Uses feed forward neural network classifier. The neural network is trained and further tested using images. When an image is passed as an input, the neural network correctly determines to which class the image belongs to and displays similar images from the class. Euclidean distance is used to calculate the distance between the query image and the images in the detected class.The calculated distance is stored in a vector which is sorted in ascending order along with the index number. The images with least distance values are fetched and displayed. The similar images are displayed along with distance values as shown in fig 3. Another figure,

fig 4 shows to which categorised class the query image belongs.

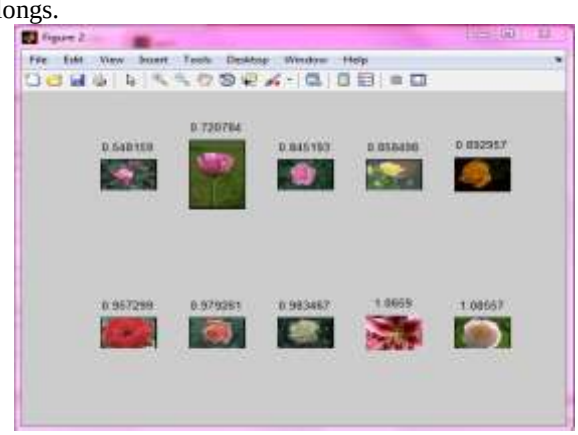

Fig 3: Output of Similar Images

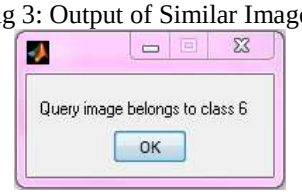

Fig 4: Output of Query Image Class

IV. Testing and Analysis

The neural network is tested with many numbers of images in order to check for correct output. For testing, 30 images from each class are taken one after other to check for correct output. The image taken for testing is first segmented into parts as sub-images. Features are extracted for each sub-image and feature vector is created. This feature vector is fed to the neural network, which identifies the class of the input query image. Further the distance between the query image to image belonging to a class is captured. Ten least distance images are output which is near to the query image.

When an input is passed, the neural network determines its class among the classified database. This image is compared with all the images in the class, the distance between them is computed and stored in a matrix. The below table, table 1 shows the number of images used to test from each class and the correctly identified images and incorrectly identified images. The table also shows the minimum and maximum distance measured for the input images.

Query Image Class	No. Of Image	Class Identified Correctly	Class Identified Wrongly	Least Similarity Value (distance)	Max Similarity Value (distance)
1	30	30	0	0.9491	3.2961
2	30	30	0	1.8378	3.3263
3	30	30	0	1.0644	3.0228
4	30	30	0	0.6340	2.1723
5	30	30	0	0.7876	2.9682
6	30	30	0	1.0088	2.1986
7	30	30	0	1.0906	2.8784
8	30	30	0	0.8488	3.3641
9	30	30	0	0.8366	2.2660
10	30	30	0	2.4799	4.0212
11	30	30	0	0.7082	2.8069
12	30	30	0	0.8017	2.2338
13	30	30	0	1.9081	3.2668
14	30	30	0	1.7770	3.1168
15	30	30	0	1.7494	3.0488
16	30	30	0	1.8178	4.2411
17	30	30	0	1.1193	2.3813
18	30	30	0	1.6084	3.8381

Table 1: Recognition of Database Images

V. Conclusion and Future Work

This paper presents a new the CBIR system that retrieves images based on visual features such as color, shape and texture of an image. In this work, color and texture features are used as visual features.

This system promises fast, efficient and accurate retrieval of similar images with less computational time as compared to other retrieval systems. Firstly the query image is processed and its class (from among the predefined classes) is identified using a feed forward neural network. Later the euclidean distance of the query image with all the image in the class found ten least distant image and displayed. The performance of the system is satisfactory as briefly explained in the previous section.

This Additional features may be explored for making system more robust.

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