Artificial Neural Network Based Image Retrieval Using Ripplet-II Transform and Color Histogram

Ms. Ashwini S. Aher[1], Mr. Kishor N. Shedge[2]
Department of Computer Engineering
[1,2], SVIT College of Engineering, Chincholi, Nashik, India

Abstract- *In last few decades, Content Based Image Retrieval System (CBIR) is an emerging field to retrieve relevant images from a database. It utilizes the visual contents of an image for the local and global features. Local feature includes spatial domain which presents the significance of the image as well as the index of an image. Global feature includes shape descriptors, contour representations and texture features. Segmentation process is required in global feature extraction technique. It is a challenging task to simulate visual information in CBIR system. CBIR strategy combines the local and global features to deal with the low level information. In this system, proposed new CBIR technique to fuse color and texture features. Color Histogram (CH) is used to extract a color information. Ripplet-II transform provide the freedom in parameter settings, which can be optimized for specific problems. Ripplet-II transform can be used for feature extraction due to its efficiency in representing edges and textures. ANN is used for better classification result. The features are created for each image and stored as a feature vector in the database. We evaluated our work using Corel l-k dataset. To examine the accuracy with the other proposed systems, precision and recall methods are used that provides competitive and efficient result. The experimental results show that our proposed method outperforms with existing CBIR systems.*

Keywords- CBIR, Color Histogram, Ripplet, features extraction, ANN

I. INTRODUCTION

Over the last few decades, the tremendous growth in quantity of images stored in digital form, have raised many demanding issues in digital data management and retrieval paradigm. Recently, Content Based Image Retrieval (CBIR) system has emerged as an effective solution to address some of these issues efficiently. CBIR is the task of retrieving relevant images from a large image database (DB) by measuring similarities between the query image and database images, based on automatically derived features like color, texture, shape etc. The performance of a CBIR system strongly depends both on the availability of suitable features for proper representation of the semantic aspects of the images automatically, and also the effectiveness of the used similarity measure. High retrieval efficiency and less computational complexity are the desired characteristics of an effective CBIR system. CBIR system overcomes the problems of text based image retrieval because manual annotation is not used in this system. Image retrieval system is based on a feature extraction technique. Features are extracted from the query image then similarity measure is used to find the most similar image from a database. Feature extraction technique is classified into two categories, local and global features. Local feature technique includes color, shape and texture features used for object identification and recognition. Recognition is a process to identify objects such as recognizing a person or identification of the existing objects of an image. This process used in many applications like toll booth monitoring, factory automation, and security surveillance.

Global feature techniques are used to retrieve object classification and object detection in image. These are shape, texture and local feature descriptor of an image. It describes the whole image and segmentation process is applied to find the appropriate features.

II. LITERATURE SURVEY

In 2018, Atif Nazir, Rehan Ashraf, Taiha Hamdani and Nouman Ali described image retrieval technique. In this paper, new CBIR technique to fuse color and texture features. Color Histogram (CH) is used to extract a color information. Texture features are extracted by Discrete Wavelet Transform (DWT) and Edge Histogram Descriptor (EDH).

In 2017, Syed Muhammad Anwar, Fozia Arshad, Muhammad Majid image characterization system. In this paper, a fast wavelet based medical image retrieval system is proposed that can aid physicians in the identification or analysis of medical images. The image signature is calculated using kurtosis and standard deviation as features.

In 2016, Anju Jose Tom, Ajan Manohar proposes a compression method for medical images by representing singularities along arbitrarily shaped curves without sacrificing the amount of compression. This method uses a recently introduced family of directional transforms called Ripplet transform.

In 2016, Pravin Karde, Pradnya Vikhar discusses the concept and scope of content based image retrieval system. In this paper the basic CBIR system is developed by combining features like color moments, color correlogram and Gabor texture features along with edge histogram descriptor.

In 2016, S.Banuchitra, Dr.K.Kungumaraj, survey some of the technical aspects of content based image retrieval techniques. And also discuss the advantages and disadvantages
of CBIR methodology

Sr No	Author Name	Title of Paper	Year of Publication	Publisher
1	Atif Nazir	Content Based Image Retrieval System by using HSV Color Histogram, Discrete Wavelet Transform and Edge Histogram Descriptor	2018	IEEE
2	Syed Muhammad Anwar	Fast Wavelet based Image Characterization for Content based Medical Image Retrieval	2017	IEEE
3	Anju Jose Tom	Ripplet Transform Type II for Medical Image Compression	2016	IJIRCCE
4	Pravin Karde	Improved CBIR System using Edge Histogram Descriptor (EHD) and Support Vector Machine (SVM)	2016	IEEE
5	S.Banuchitra	A Comprehensive Survey of Content Based Image Retrieval Techniques	2016	IJECS

Table 1. List of Reference Papers

III. PROPOSED SYSTEM

The overall working flow is shown in Figure 1 and proposed research has been included three main techniques as HSV color histogram, edge histogram descriptor and Ripplet II transform. CBIR is basically a two-step process which is Feature Extraction and Image Matching (also known as feature matching). Feature Extraction is the process to extract image features to a distinguishable extent. Information extracted from images such as color, texture and shape are known as feature vectors. The extraction process is done on both query images and images in the database. Image matching involves using the features of both images and comparing them to search for similar features of the images in the database.

Feature extraction is the basis of content based image retrieval. In our system architecture we used Color Histogram (CH), which is used to extract color information. Texture features are extracted by Ripplet Transform and Edge Histogram Descriptor (EHD). The features are created for each image and stored as a feature vector in the database. ANN is used for better classification result.

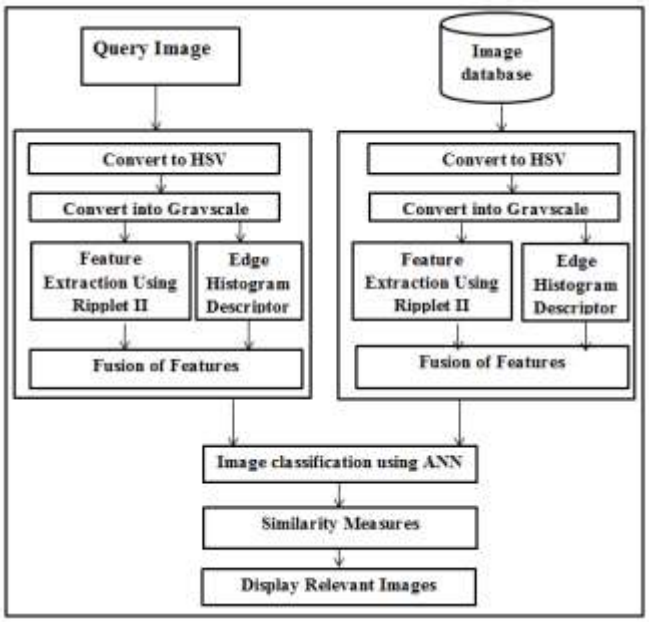

Figure 1. Proposed System Architecture

A. Color Histogram

In CBIR system color histogram is an effective approach to retrieve an image. The 3D image is potentially superior to 2-D images. In order to extract the color features, we primarily find the color space of an image which describes the array of a color. For example, in RGB color space there are three values in color components. In our proposed method we have used an HSV color space because hue and saturation are close to human visual system reported as. In image block, color quantization process shrinks the total number of different colors. RGB image can be easily transformed into HSV color space, by using this formula,

$$H = \cos^{-1}\frac{\frac{1}{2}[R-G]+[R-B]}{\sqrt{(R-G)^2-(G-B)(R-B)}}$$

$$S = 1-\left(\frac{3[\min(R,G,B]}{R+G+B}\right)$$

$$V = \left(\frac{R+G+B}{3}\right)$$

Here,

H represents hue, which is the prominent wavelength in the collection of waves.
S represents the saturation which represents the white light.
V represents values in color space which describes the intensity value in the image: range in between 0 and 1. Here 0 represent black and 1 represents a white color

B. Edge Histogram Descriptor

The edge histogram descriptor (EHD) is one of the widely used methods for shape detection. It basically represents the relative frequency of occurrence of 5 types of edges in each local area called a sub-image or image block. The sub-image is defined by partitioning the image space into 4x4 non-overlapping blocks. So, the partition of image definitely creates 16 equal-sized blocks regardless of the size of the original image. To define the characteristics of the image block, we then generate a histogram of edge distribution for each image block. The Edges of the image block are categorized into 5 types: vertical, horizontal, 45-degree diagonal, 135-degree diagonal and non-directional edges, as shown in Figure. Thus, the histogram for each image block represents the relative distribution of the 5 types of edges in the corresponding sub-image [6].

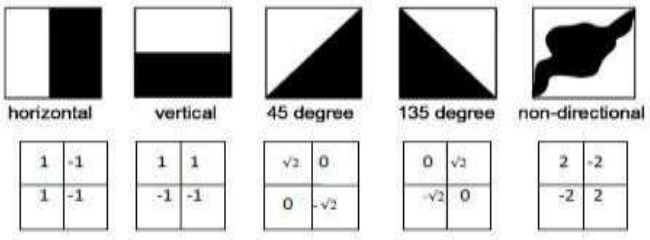

Figure 2. Five types of edges and corresponding filters

C. Ripplet-II Transform

Current image representation schemes have limited capability of representing 2D singularities (e.g., edges in an image). Wavelet transform has better performance in representing 1D singularities than Fourier transform. Recently invented ridgelet and curvelet transform achieve better performance in resolving 2D singularities than wavelet transform. To further improve the capability of representing 2D singularities, proposes a new transform called ripplet transform Type II (ripplet-II). The new transform is able to capture 2D singularities along a family of curves in images. In fact, ridgelet transform is a special case of ripplet-II transform with degree 1. Ripplet-II transform can be used for feature extraction due to its efficiency in representing edges and textures. Ripplet transform Type II (ripplet-II), which is based on generalized Radon transform. The generalized Radon transform converts curves to points. It creates peaks located at the corresponding curve parameters. Intuitively, our ripplet-II transform consists of two steps:

1) Use generalized Radon transform to convert singularities along curves into point singularities in generalized Radon domain.
2) Use wavelet transform to resolve point singularities in generalized Radon domain. Radon transform is widely applied to tomography. Classical Radon transform is defined in 2D space as the integral of an input 2D function over straight lines. Using this transform, four parameters, i.e scale, orientation, degree and translation can be tuned as required [3].

D. Artificial Neural Network

The ANN comprises of a single input layer, and a single output layer notwithstanding one or more hidden layers. All nodes are made out of neurons aside from the input layer. In CBIR, the retrieval of image is acquired with the proper training of a classifier using the collection of images in CBIR. The proposed CBIR system utilized the ANN classifier for the better classification or prediction of most similar images, so that the semantic gap gets reduced. Figure 4 shows the architecture of ANN. The process includes in the ABC based training of ANN for better classification accuracy.

E. Algorithm of Proposed System

Step 1: Apply the query image as input.
Step 2: Pre-processing on image and then convert into RGB to HSV.
Step 3: convert into Grayscale.
Step 4: Feature Extraction by using Ripplet II transform and Edge Histogram Descriptor (EHD)
Step 5: Combined the color, shape and texture feature vector into a single feature vector.
Step 6: Perform Image classification by using ANN.
Step 7: Apply similarity measurement Manhattan distance to compare the query image feature vector to database image feature vector.
Step 8: Display relevant images as a result.

IV. RSULT ANALYSIS AND PERFORMANCE ASSESMENT

This section represents the results of proposed system. For that used corel 1-k dataset.

Figure 3. Input Query Image

Figure 4. Top-10 Image Retrieval

We evaluate our proposed approach using Corel dataset. It is famous to evaluate performance

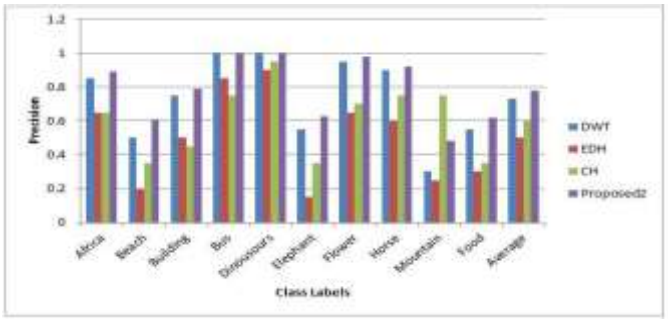

Figure 5. Comparison of Precision Graph With State Of The Art System

Performance of the system is calculated using two parameters that is precision and recall Precision P is derived as the ratio of the number of relevant images retrieved r by the total number of images retrieved n. Formula for Precision is,

$$p = \frac{Number\ of\ relevant\ image\ retrieval}{Totla\ Number\ of\ image\ retrieval}$$

Precision is used to find the accuracy of image retrieval. Recall R is the ratio of the number of related instances retrieved r by the total number of relevant instances m in the database, here instances referred to an image in the database.

$$R = \frac{\text{Number of relevant image retrieval}}{\text{Total number of relevant images in database}}$$

VI. CONCLUSION

CBIR is a fast developing technology with considerable potential. The area of content based image retrieval is a hybrid research area that requires knowledge of both computer vision and of database systems. There are various applications of CBIR in every fields of life like blood cell detection, archeology, criminal investigation, image search, social networking sites, forensic Labs, and satellite etc. A color and texture based image retrieval is explained in our work by using low level features with the combination of local and global features. Combining two or more features give a better result as compared to one feature because color and texture feature gives an efficient and appropriate result in the human visual system. Local features are extracted by edge histogram descriptor and global features are extracted by color histogram and ripplet transform type II. In our system, more appropriate color and texture features are used to form a feature vector and similarities are matched by manhattan distance. ANN based machine learning will train system to give more relevant results with less computation time.

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