International Journal of Applied Engineering Research ISSN 0973-4562 Volume 13, Number 8 (2018) pp. 5766-5771

Statistical Feature Based Image Classification and Retrieval Using Trained Neural Classifiers

[1]Meenakshi Garg, [2]Manisha Malhotra and [3]Harpal Singh

[1]Research Scholar, [2]Associate Professor, [3]Professor
[1,2] University Institute of Computing, Chandigarh University, Mohali, India.
Electronics and Communication Engineering Department, CGC Landran, Punjab, India.

Abstract:

Content Based Image Retrieval (CBIR) has been one of the widely used approaches for sniffing & fetching out images from large image database. Nowadays, innumerous approaches have been staged to enhance the CBIR performance. The CBIR have a affinity to retrieve images depending on their graphical content. CBIR shuts down several issues which are linked with the existing ways of retrieving images by keywords. Most existing CBIR techniques are based on the images of color, text documents, informative charts, and shape. The work in this experiment have been performed using performance evaluation of the proposed method using COREL database with Deep Neural Network classifier for categorizing the images. The proposed approach here involves an efficient statistical feature extraction with 3 moments i.e. standard deviation, skewness & kurtosis and further classification of the images on the basis of these features using Deep Neural Network (DNN). The classifiers help categorize the images according to the data set. The precision values has been calculated and compared according to the retrieved images from the datasets and the results have been shown in graphical and tabular manner.

Keywords: Image retrieval, classifiers, ANN, feature extraction.

INTRODUCTION

In text-based retrieval, images are considered or indexed using keywords, subject titles or codes. The word "content" might refer to shapes, colors, textures, or some information which can be inherited from the picture itself. Thus, efforts are in the CBIR arena has started to involve manmade design which tried achieving the needs of consumer to perform the exact search. CBIR is important because founds that rely surely on metadata have dependent on fixed quality and completeness. These keywords become the norms to search and retrieve images. The space between the feature vector of the requested image and therefore the feature information is computed in terms of the distances. Future step is that the match exists. Text-based is not homogeneous system because different consumers use different keywords to search according to their awareness and understanding. The consumer can even offers the feedback whether or not the results are as expected and this mechanism is termed connectedness feedback. In off-line, the system extracts visual options like color, shape, texture, and abstraction info etc of every image within the info and stores them during a completely different info at intervals the system known as feature info. Kato to define the tests on image automatic retrieval from a database that centered on shapes and colors present. The word "content-based image retrieval" looks to have recognized in 1992, used by T. Finally, the system positions the images so returns the results that closely measure most, of like the requested image. In on-line retrieval, the consumer will submit a question example so as to retrieve the required pictures. A basic content-based image retrieval system is divided into off-line and on-line. The measure of the feature information is incredibly little as compared to the image data. This means the addition of these query methods are allow to queries, descriptive semantics, which may include consumer's feedback that can include systems or artificial learning that should be able to understand consumer's satisfaction level.

In a specific, picture regions are obtained by an object to be founded in an order to define the shape, and known segmentation methods combine with low-level color detection and region-growing of texture features or merge and split processes. texts or attributes in binary images or explicit margins of target objects in airborne or space images, etc.). CBIR uses two large clusters of contour or shape descriptors, namely, contour-based and region-based, signifying either an outer boundary (or contour) or an entire region. In the region based approaches, all pixels came with shape, which are achieved into account to attain the representation of shape. Color is that the feature that makes the thing identification method terribly straightforward and is stable in contrast to direction variations, dimension of image and background complexness. The common region techniques use the moment definer to define the shape. The color house is employed for the specification of the colors. The object's shape performs a critical role in retrieving for alike objects (e.g. To extract the color possibilities from the content of a picture, a correct color house and a good color descriptor need to be determined. It is seen in world that humans usually distinguish things supported their color. This can be the rationale that color is usually wont to differentiate pictures in content-based image retrieval. After dividing the objects, their contours have to be defined, indexed, and matched. There square measure numerous color areas developed like RGB, HSV, CIE L*a*b for completely various needs and different functions. Shape from an image is quite a powerful representation as it characterizes the geometry of the object.

For the people, the texture correlates to a spatially repetitive, specific, structure of the planes are surfaces formed by repetition a specific element or numerous elements in individual relative spatial positions. There is no appropriate definition of texture in the area of image processing. Normally, the repetition includes nearer orientation, variations of scale or optical and geometric features of the elements. These texture properties are visible patterns in a picture which have properties of the uniformity do not result from the appearance of only a one color or intensity. The reason for available texture definitions that are based on the features described from the image and texture analysis methods.

There is a great use of content-based image retrieval in applications such as fashion, graphic designers, medical diagnosis, geographical information, publishing and advertising, crime prevention, etc. Various regional and national newspaper publishers need to maintain their libraries of multiple photographs, or use them on the Reuters, Press Association and other agencies. Electronic techniques of access and storage are showing along with developments and designs in automated techniques of production of the newspaper, that greatly improve the accuracy and speed of the retrieval process. In hospitals, decision making process requires the medical practitioner to search and review similar X-ray or scanned images of a patient before giving any solution. In crime prevention, police needs to confirm the face of a criminal by matching his image features with the images in the database. The most important application is the Web. Now, various experimental and commercial CBIR systems are available, and several search engines are tied with CBIR facilities, example Alta Vista, Google and Yahoo. To record the finished projects photos are used in architecture, including exterior and interior shots of creating as well specific features of design. In architecture, photographs are used in architecture to record interior and exterior shots of buildings, design features and to record finished projects. In teaching, visual content is very helpful in giving knowledge to educational industry. In the commerce department, there is need to find out about the trademarks whether they exist in database before using them.

RELATED WORK

In last decades, various research works have been developed and many techniques have been proposed but most of the approaches deal with the accuracy problem. The comparison results and retrieval performance are discussed. Aman Chadha, Sushmit Mallik et al [1] proposed the CBIR system which is used to help consumers to recover related images relied on their contents. The proposed technique gives the way to detect the images in huge databases by utilizing the unique descriptors from a trained image. CBIR technology generates full use of picture content features like, texture, color, and shape, etc. which are extracted and analyzed to take the effective retrieval. CBIR technique systems greatly enhanced the speed and accuracy of returned information. Moreover, their complexity in terms of amount which is required retrieval computational cost and coefficient is present. The proposed algorithm in Patel, dileshwer et al. [2] is calculated with two parameters i.e. is precision and images of Wang database. proposed an approach for image retrieval from very large image database. In this paper, novel technique has been presented which uses histogram and color edge of an image with wavelet transform. Juho Kannalaet al [3] in their work presented a method for making image descriptors that effectively encode the data and also appropriate for histogram based representation. The result analysis indicates the accuracy in texture recognition tasks compared to the state-of-the-art. This proposed approach is inspired with some other descriptors that give binary codes like local phase quantization and local binary pattern and thus it is depending on the statistics of natural images and enhances its modeling capacity. The proposed approach calculates the binary code for every pixel by using linear projecting. With the increasing of available bandwidth the rapid developments are contained in memory, processor, and saved technologies or the variation of image and video data in a digital form, this create the CBIR technique which has crucial alternative to the traditional image searching, these CBIR technique systems greatly enhanced the speed and accuracy of returned information. In [4] author proposed that a content-based picture retrieval application for computer vision schemes to the picture returning problem of finding for digital photos in huge databases. which are extracted and analyzed to take the effective retrieval. The color space of HSV is closer to human the understanding of colors, so it provides better results in various CBIR systems. CBIR technology generates full use of picture content features like, texture, color, and shape, etc. In these spectral transforms and descriptors based moments, like Fourier descriptors (FD) and Zernike moments are proved to be good choices for normal shape applications. In this work image may be divided into two equal parts as serve as local descriptors of color and texture. From the above survey, it is concluded that for efficient and invariant image retrieval, low level features invariant to geometric transformations, and robust under various types of noises are needed. Moreover, their complexity in terms of amount which is required retrieval computational cost and coefficient is present. In order to check the applicability of the proposed method, accuracy and average normalized modified retrieval rank has been act as quantitative metrics. Jing-Yu Yang et al. [10] proposed that neuron biological and psychophysical studies indicate that human visibility system is more responsive to edge orientation and color. During the mentioned descriptors which are the most crucial shape descriptors, that haven't evaluated opposite to the each other. It describes the uniform of color difference b/w edge and colors orientations wrap on rich type of visual data and information. The comparison results and retrieval performance are discussed. Image recovery system is used to estimate the image similarity of every image only in terms of visual features. In this study, feed forward algorithm has been applied for neural network. Also, this paper provides a detailed review of the works carried out, in reducing the semantic gap between the low level features and the high level semantic concepts. A new method of matching scheme has been presented based on the most similar highest priority (MSHP) principle. This novel approach provides precise results among other developed system. It is more helpful information and works as an vital

role in picture understanding and analysis. In [9], CBIR method has been proposed using color, texture and shape information to attain high efficiency. And then it will return the image with similarity, the feature weight based on the neural network is used to evaluate the efficient feature extraction. Based on the current trends, the open research issues include algorithms for feature extraction, that are robust under various geometric transformations, noise and various lighting conditions, recognizing the semantic concepts present in the image, automatic segmentation of the different semantic concepts in the image, effective learning of the high level semantic concepts, etc. In the scale space curvature descriptor performs the evaluated size and shape descriptors when it has compared with the Core Experiment of MPEG-7. In comparison with other approaches, proposed technique gives better performance. Although, for your knowledge, several articles had been distributed on how to run the uniform color difference between edge orientations and colors to picture retrieval and display. The various datasets and the performance measures used in analyzing the efficiency of CBIR systems are also presented. Rajam, I [5] presented a novel technique depend on the sparse representation and iterative discrete wavelet transform has been presented in this paper. A discussion of invariant image retrieval under various geometric transformations is also made. In Felci et al [6] this paper discusses the various methodologies used for extracting the salient low level features and various distance measures to find the similarity between images. To obtain an efficient CBIR framework, one must choose the components of the CBIR in a balanced manner, and this paper helps in analyzing all the components of the CBIR framework. Shrivastava, Nishant et al [7] proposed an evaluation of MPEG-7 size descriptors the effectiveness of Fourier descriptors and Zernike moments that was confirmed with experimental conclusion. In [8] content based image retrieval system has been presented based on the image recovery system.

PROPOSED METHODOLOGY

A. Training the network

The back propagation technique in such as supervised learning because the network is trained with the expected reply: replies. Every iteration modifies the association weights so as to reduce the error of the reply (expected value-estimated value). Adjustment of the weights, layer by layer, is calculated from the output layer back to the input layer. This correction is created by:

$$\Delta W_{ji} = \eta \delta_j f(a_i)$$

Where DWji is that the adjustment of weight between neurons j and somatic cell i from the previous layer; f(ai) is that the output of somatic cell i, h is that the learning rate, and dj depends on the layer. For the output layer, dj is:

$$\delta_j = (Y_j - \hat{Y}_j) f'_i(a_j)$$

Where Yj is that the mean ('observed value') and Y. j is that the current output worth ('estimated value') of somatic cell j. For the hidden layer, dj is:

$$\delta_j = f'_j(a_j) \sum_{k=1}^{K} \delta_k W_{kj}$$

Where, K is the variety of neurons within the next layer. The learning rate plays a very important role in training. once this rate is low, the convergence of the burden to AN optimum is extremely slow, once the speed is just too high, the network will oscillate, or a lot of seriously it will bog down during a native minimum (Gallant, 1993). to cut back these issues, a momentum term a is employed and DWji becomes:

$$\Delta W_{ji} = \eta \delta_j f(a_i) + \alpha \Delta W_{ji}^{\text{Prev}}$$

Where, DWjiPrev denotes the correction within the previous iteration. In our study, at the start a zero.7 and h 0.01, then they're changed in line with the importance of the error by the subsequent algorithm:

If present–error\previous–error * one.04

$$\eta = \eta * 0.75,$$
$$\alpha = 0,$$
$$\eta = \eta * 1.05,$$
$$\alpha = 0.95,$$

The coaching, performed on representative information set, runs till the total square of errors (SSE) is minimized:

$$\text{SSE} = \frac{1}{2} \sum_{p=1}^{P} \sum_{j=1}^{N} (Y_{pj} - \hat{Y}_{pj})^2$$

Where: Ypj is that the expected output worth, Y. pj is that the calculable worth by the network, j 1…N is that the variety of records and p 1…P is that the variety of neurons within the output layer.

B. Testing

Once trained, the performance of the network should be tested. As in discriminate analysis, a primary indication is given by the proportion of correct classifications of the coaching set records. All the same, the performance of the network with a take a look at set (set of comparable information unused throughout training) is a lot of relevant.

In the take a look at step, the computer file square measure fed into the network and therefore the desired values square measure compared to the network's output values. The agreement or disagreement of the results so offer a sign of the performance of the trained network.

Algorithm 1

Step 1: Image is obtained from training dataset.

Step 2: Calculate the R, G B value from image

Step 3: Calculate the histogram and probability histogram value from image

Step 4: Divide the probability histogram into 10 bins and for each bin calculate the standard deviation, skewness and kurtosis

Step 5: Features of image is extracted and save it in training file.

Step 6: If this image is the last image, then preprocess the training file and train the classifier, otherwise go to step 1.

Step 7: Use Deep Neural Network for classification of images and training the neurons:

The architecture for Deep neural Network can be shown as:

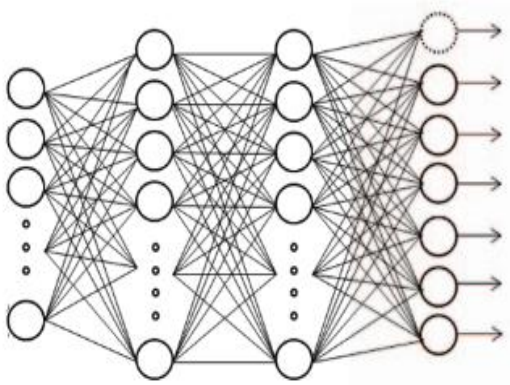

Figure 1: Deep neural network architecture

1. The activation function of hidden units is the logistic sigmoid

$$g(z) = \frac{1}{1+exp(-z)}.$$

2. In the function, z=Wx , where x is the input vector and W is the weight parameter.
3. The output is given by:

$$h_W(x_i) = \begin{bmatrix} p(y_i = 1|\, x_i; W) \\ p(y_i = 2|\, x_i; W) \\ \vdots \\ p(y_i = m|\, x_i; W) \end{bmatrix} = \frac{1}{\sum_{j=1}^{m} e^{W_j^T x_i}} \begin{bmatrix} e^{W_1^T x_i} \\ e^{W_2^T x_i} \\ \vdots \\ e^{W_m^T x_i} \end{bmatrix}$$

Algorithm 2

Step 1: Now, image is obtained from testing data set.

Step 2: Extract the feature of image.

Step 3: Apply the features as input to the trained classifier, using the equation

$$h_W(x_i) = \begin{bmatrix} p(y_i = 1|\, x_i; W) \\ p(y_i = 2|\, x_i; W) \\ \vdots \\ p(y_i = m|\, x_i; W) \end{bmatrix} = \frac{1}{\sum_{j=1}^{m} e^{W_j^T x_i}} \begin{bmatrix} e^{W_1^T x_i} \\ e^{W_2^T x_i} \\ \vdots \\ e^{W_m^T x_i} \end{bmatrix}$$

Step 4: Find the class to which the image belongs using the output of the classifier

Step 5: Pick random images from the selected category.

RESULTS

The following performance metrics are considered in analyzing the performance of content-based image retrieval

(i)Precision: Precision is used for evaluation of most CBIR systems. Precision is the fraction of returned images that are relevant to the query image. If we denote T as the set of returned images and R as the set of all images relevant to the query image, then precision is given by:

Precision = |T∩R| / |T|

(ii) Recall: Recall is the fraction of returned relevant images with respect to the total number of relevant images in the dataset.

Recall = |T∩R| / |R|

The numbers of relevant images are computed and the precision and recall in each number of retrieved images for all query images are obtained. We next consider the average of these precisions and recalls for each number of retrieved images as the precision and recall of each method for each number of retrieved images. The distance is computed between the feature vectors of the query image and the feature vectors stored in the dataset using Euclidian distance. Sort the images according to distances with the smallest distance first. The number of images returned is six in number fixed by the code.

The retrieved pictures in the results show that the photographs are relevant to the specified or the question image. The performance metrics in terms of confusion matrix has been planned for the one thousand image Corel dataset [11] that shows that there's a scope of improvement within the existing algorithmic program. The results show a brand new methodology is needed so as to enhance the relevance of the retrieved pictures. The projected work is meant for the development within the retrieval method on the grounds of quantitative and qualitative information.

Figure 2: Retrieved images of peoples using STATISTICAL features based on Query Image.

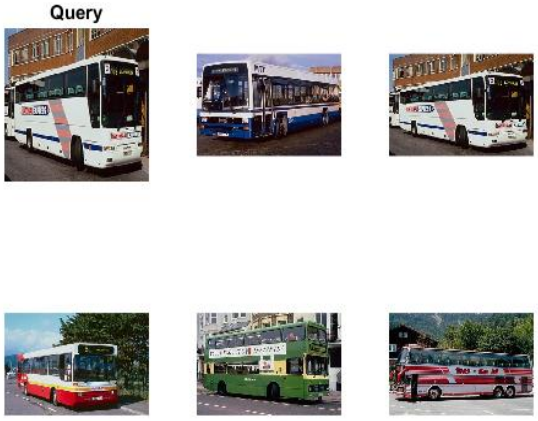

Figure 3: Retrieved Images of bus of the query image.

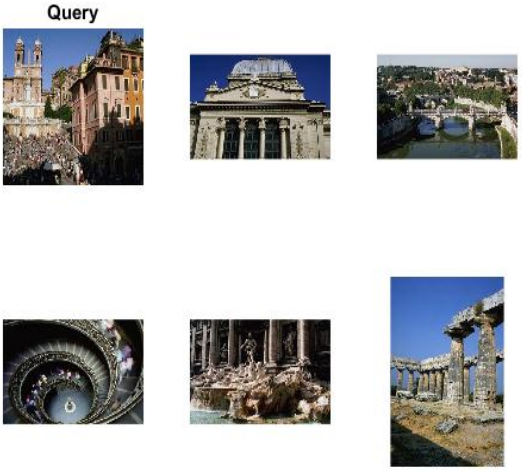

Figure 4: Results for retrieved image of buildings using STATISTICAL feature.

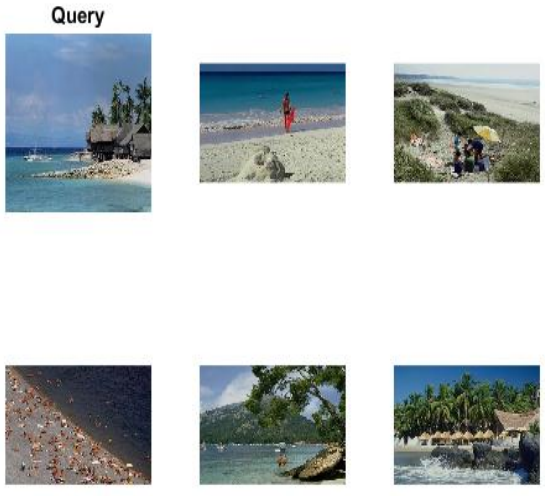

Figure 5: Results for beach image query using STATISTICAL Feature.

The primary image retrieved is same because the question image. This shows the effectiveness of the method which can then be quantified in terms of Precision and Recall and the results can be mentioned in the form of graphs and a comparison result or graph can be displayed.

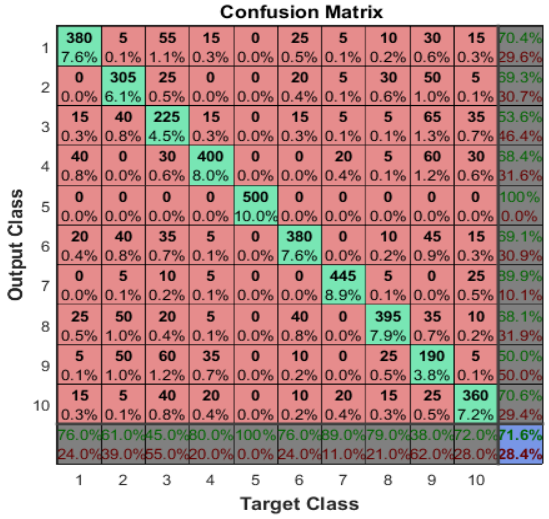

Figure 6: Confusion matrix for Deep Neural Network

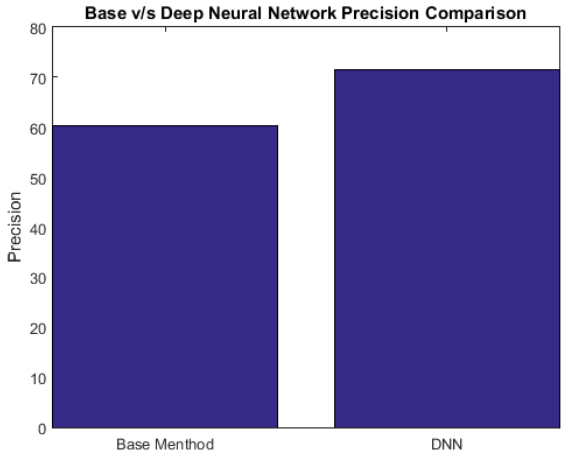

Figure 7: Precision Bar graph

CONCLUSION

Overall the performance of content based image retrieval depends on features, feature extraction techniques, similarity measures and the size of database. Still, this is not the required image and hence there is a scope of improvement in the existing algorithm future work consists of using some other color space or improved texture extraction technique. Content based image retrieval is a challenging method of capturing relevant images from a large storage space. Whatever the size and content of the image database is, a human being can easily recognize images of same category. Several feature extraction techniques have been developed to the task of image retrieval. We have performed performance evaluation

of the proposed method using and Deep Neural Network classifier with COREL database for determining the classification rate .It is observed that the proposed methods are relatively giving improved results. Further, it is observed that in some cases there will be irrelevant images with the result of query image in some cases these irrelevant images are totally different from query image on basis of color and shape. Although this area has been explored for decades, no technique has achieved the accuracy of human visual perception in distinguishing images.

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