Content Based Image Retrieval Using Statistical Features and Neural Network

Harkirat Kaur[1], Baljit Singh Khehra[2]
[1, 2] Department of CSE
[1, 2] BBSBEC, Fatehgarh Sahib

Abstract- *With the development of the Internet, and the availability of image capturing devices such as image scanners, the size of digital image collection is rising quickly. A well-organized image searching, browsing and retrieval tools are essential for users from different domains, including remote sensing, crime prevention, publishing, medicine, architecture, etc. Therefore, several general purpose image retrieval systems have been exploited. In CBIR, images are indexed by their visual content. Content based image retrieval consists of two parts: feature extraction/indexing and retrieval part. The techniques which are used to extract features of an image are called feature extraction techniques. The choice of features plays a significant role in image retrieval. Some of the features used are color, texture and shape. Combination of these features provides better performance than single feature. Here we have proposed a combination of statistical features and deep neural network which has improved the performance of the system which is shown in the results.*

I. INTRODUCTION

Image retrieval on the basis of image features, textures and color has become one of the most researched areas in the field of computer vision. The major utilization of all the techniques used to retrieve images based on content relies on how well the features are being extracted. With advances in feature extraction methods, the field is getting more and more sophisticated. Given an image database, we are interested in finding relevant images for a given query image. The "relevant" images are visually and semantically similar to the query image. Traditionally, retrieval was done by utilizing meta-data associated with the image. This meta-data includes image name, textual description associated with the image, time at which the picture was taken etc. But in a large image database, manually assigning labels/tags for each image is impossible. Further the meta-data associated with the image may be noisy, leading to incorrect retrieval. This motivates the use of content based retrieval systems.

Content based retrieval systems utilize "image content" to find similarity between the images. The "image content" refers to color, textures objects, shapes etc., present in the image. For the retrieval system to be scalable, the main challenge is to find a representation for the image which

1. Is robust to geometric transformations
2. Consumes less memory per image
3. Requires less computation for computing similarity between two images

The first property is required for robust image retrieval. The second property is necessary for storing the image representation of the entire database in RAM of the computer, to avoid costly disc accesses. The third property is necessary for online retrieval. Whenever a new image is added to the database we must able to quickly compute the distance of the new image with other images in the database. Recently proposed method called, Vector of Locally Aggregated Descriptors(VLAD) satisfies these properties and has been shown to be suitable for large image databases. In this thesis, we improve upon the existing Color Mean feature extraction approach by using HMMD color algorithm before aggregation and using feature fusion for fusing complementary information in images. Further, we propose an approach which uses features obtained from a pre-trained convolutional neural network for constructing compact image representation. In order to make use of the vast amount of data on the World Wide Web, efficient and effective techniques to retrieve the information based on its content are required to be developed. Among the various media types, images are one of the most important sources of information. It is not only the most widely used media type besides text, but also one of the most widely used bases for representing and retrieving videos and other multimedia information. Despite the extensive research effort, the retrieval techniques used in CBIR systems lag behind the corresponding techniques in today's best techniques available.

At the early stage of CBIR, research primarily focused on exploring various feature representations, hoping to find a "best" representation for each feature. It is interesting to look back toward the beginning and see which of the original ideas have blossomed, which haven't, and which were made obsolete by the changing landscape of computing. Many programs and tools have been developed to formulate and execute queries based on the visual or audio content and to help browsing large multimedia repositories. Answers to many questions with respect to speed, semantic descriptors or objective image interpretations are still unanswered. The work

presented here gives a brief review of the research carried out in this field and also the proposed techniques that will help improve the system.

II. RELATED WORK

Varish and pal, [1] proposed a method, Content based image retrieval (CBIR), in which the process of retrieval of similar images from the database is proceeded on the basis of visual content of the given query image. In this paper, the authors have obtainable a CBIR technique using color based feature. Since color can be considered as one of the important features of the image data, so importance is given to all three colors, i.e. red, green and blue, is given during the image retrieving process. In this CBIR technique, firstly we have constructed three probability histograms i.e histogram is constructed for each color component and later the histograms are divided into various numbers of major bins and similarly from each bin, several statistical values like standard deviation, skewness and kurtosis are computed. The calculated statistical values are used as extract the features of the image data. The processing cost of the existing CBIR technique is considerably low. The experiment on technique has been performed on the standard image databases and reasonable results have been achieved.

Singha and Hemachandran, [2] discussed on the topic, Content Based Image Retrieval using Color and Texture, This paper presents the content based image retrieval, in which the features like color and texture are defined, called Wavelet Based Color Histogram Image Retrieval(WBCHIR).The color and texture features are extracted through the wavelet transformations and the color histogram. The combination of the above various features is robust to translation and scaling of the objects in an image. The discussed system is a capable and faster retrieval method to test on a WANG image database, which contains 1000 general-purpose color images. The performance of this method has been evaluated by comparing the results with the existing systems.

Erande and Badadapure[3] proposed study on image retrieval technique which is based on the two steps in CBIR, first is Feature extraction and second is Similarity measurement. An extensive set of experiments has been conducted to show that the new algorithm can improve the retrieval accuracy. In our project DML and ANN algorithms are used to measure the similarity between images. The experiment also indicates that the new algorithm (ANN) is more effective and more efficient than alternative algorithm. Results obtained using ANN are more accurate as compared to DML algorithm. Also relevance feedback mechanism is used which improves the retrieval accuracy. In Results obtained using DML in first iteration 9 images are similar to query image. But after second iteration 2 images are similar to query. So rate of wrong result is reduced in second iteration results. So relevance feedback improves retrieval accuracy.

Singh and Rajput[4] proposed a new CBIR system that will calculate more accurate results as compare to various other developed systems. This system uses the soft system. Image recovery system evaluates the similarity of each image in its data build up to a query image in terms of the various visual features and provides the image with preferred range of similarity. To extract features according to the data set which Auto calculates the feature weight by the neural network and develop and put into practice an efficient feature extraction of NN and SVM. The precision and recall graph in gui is prescribed accordingly as per according to the retrieved contents of the images from the datasets of the database. It is also used to apply the back propagation or feed forward algorithm for the neural network classification and also to calculate cross relationship and apply weakening model for the feature matching.

Kushwah and Agrawal[5] discussed that the content-based image retrieval (CBIR) is a new but widely adopted method for finding images from the image database. Since, the network and development of multimedia technologies are becoming more popular, users are not much satisfied with the traditional information retrieval methods. So, the content based image retrieval (CBIR) is becoming a source of exaction and fast retrieval of the images from the database. Since nowadays, various techniques have been developed in order to improve the performance of CBIR. In this CBIR technique, image retrieval system inputs the query image and retrieves the relevant similar images accordingly by using the spatial coordinates which further uses the k means clustering algorithm for its segmentation and hence the image is retrieved.

Patel and Yerpude [6] proposed the algorithm, which basically uses two parameters i.e precision and recall for its evaluation. This algorithm works on the images of Wang database. With the advancement of Internet and Multimedia social networking technologies, the usage of such multimedia contents like images ,video, audio etc are increased rapidly. So, there was the need to manage the retrieval of such vast data accordingly in an effective manner. Hence to carry out management & retrieval, an effective technique was required. This technique presented by this paper is a novel technique, used for the efficient retrieval of the required images from the large database of the image known as Content Based Image Retrieval (CBIR) system. Since from past many years, many techniques have been proposed for the same, But if the performance of those techniques is measured with respect to

time, many of the techniques suffers from efficient retrieval accuracy. Hence, this paper introduces a method which uses the histogram and the color edge of an image with haar wavelet transform for the resourceful retrieval of similar images from the image database along with query image.

Mohamadzadeh and Farsi [7] suggested that Since,accuracy and the speed of image retrieval are still the parameters of the preference of CBIR ,but, the main task of various CBIR techniques of image retrieval systems is to perform the functions to assess, retrieve and characterize the image retrieval, according to the users demand. However, this study proposed a method based on iterative discrete wavelet transform and sparse representation. For the evaluate and comparison of the applicability of the feature-based sparse representation for an image retrieval technique, the precision at average normalized and percent recall modified retrieval rank are used as quantitative metrics. The experimental results prove that the proposed method provides better output as comparison to other methods.

Murala*et.al.* [8] discussed a new algorithm for content-based image retrieval application which uses the directional local extreme patterns. The link between the referred pixel and its surrounding neighbors is determined by the standard (LBP) local binary pattern, this is done by comparing the various gray-level values of the image. The proposed method is differ from the basic existing LBP in the sense that it only extracts the directional edge information based on local extrema in 0◦, 45◦, 90◦, and 135◦ directions in an image. Performance is compared with various patterns like LBP, block-based LBP (BLK_LBP), center-symmetric local binary pattern(CS-LBP), local edge patterns for segmentation (LEPSEG),local edge patterns for image retrieval (LEPINV), and other existing transform domain methods by conducting four experiments on benchmark databases viz. Corel (DB1) and Bro-data's (DB2) databases. The results evaluated after being tested shows relevance in terms of their evaluation measures in comparison to other existing methods on individual databases.

III. PROPOSED METHODOLOGY

DEEP NEURAL NETWORK

In behavioral sciences, also as in most biological sciences, applied mathematics analyses victimization ancient algorithms don't invariably result in a satisfactory answer, notably in classification analysis. Current classification strategies suppose constant quantity or non-parametric variable analyses: discriminant analysis, cluster analyses, etc.

These strategies square measure typically rather inefficient once the information square measure nonlinearly distributed, even once variable transformation. Therefore, here we tend to propose a classification technique, supported the principles of deep neural networks. Throughout the eighties, the utilization of the NN developed explosively within the areas of word recognition

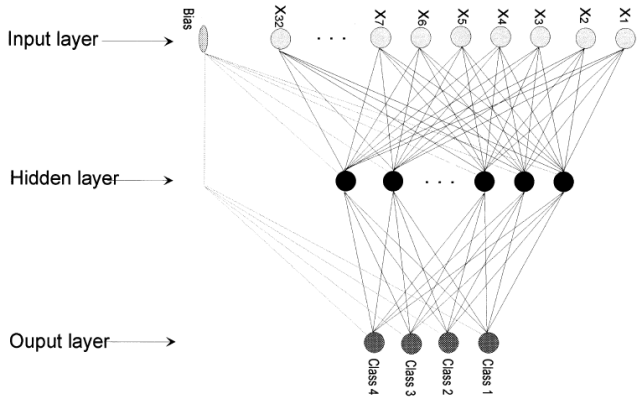


Fig. 1. Structure of a neural network used in the experiments

Waibel et al., 1989; Lefebvre et al., 1990), and character or image recognition (Belliustin et al., 1991; physicist et al., 1990; Tirakis et al., 1990; Omatu et al., 1990; Fukushima and Wake, 1990; Iwata et al., 1990). Yet, solely some applications were associated with the biological sciences. In hydrobiology models, compared to multiple correlations, NN clearly improved prediction performance

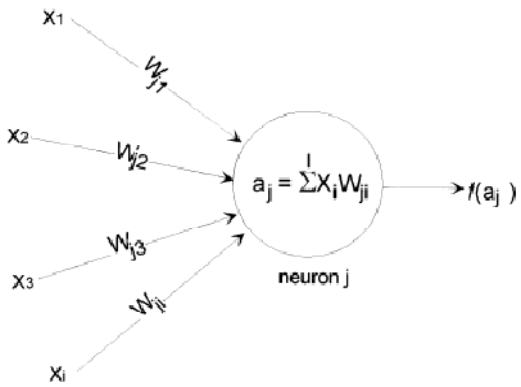


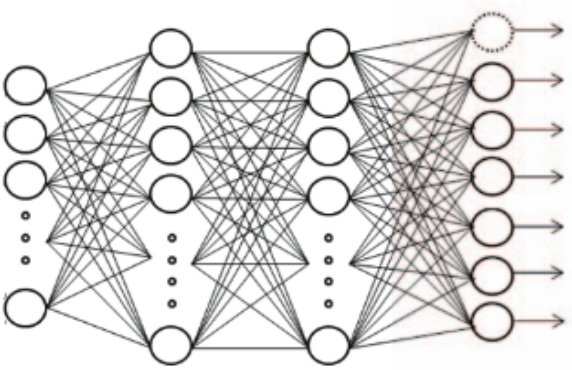
Fig. 2. Detail of one neuron

For classification functions, NN are used for the analysis of macromolecule structure, the classification of seaweeds (Smits et al., 1992), and therefore the recognition of impulsive noises in marine mammals (Nicolas et al., 1989). During this paper, NN square measure accustomed discriminate the vocalizations of 4 male Damadama, deer (Mammalia, Cer6idae), throughout the rutting amount.

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:

1. The architecture for Deep neural Network can be shown as:



Deep neural network architecture

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

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

3. In the function, z=Wx , where x is the input vector and W is the weight parameter.
4. 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.

VI. RESULTS

Figure 4.1: Retrieved images of peoples using HMMD features based on Query Image. 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 4.2: Retrieved Images of bus of the query image. 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 4.3: Results for retrieved image of buildings using HMMD 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.

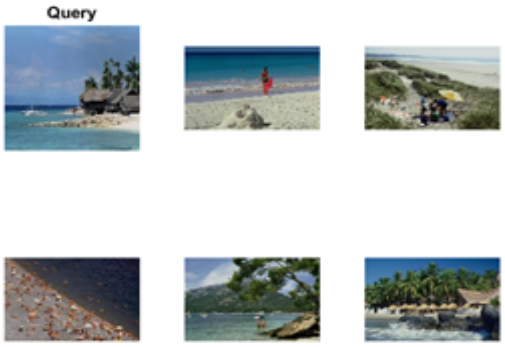


Figure 4.7: Results for beach image query using HMMD Feature. The primary image retrieved is same because the question image. This shows the effectiveness of the method which can then be quantified in terms of Precision and Recall and the results can be mentioned in the form of graphs and a comparison result or graph can be displayed.

V. CONCLUSION

Content based image retrieval is a demanding method of capturing significant images from a large storage space. Though this area has been explore for decades, no technique has achieved the accuracy of human visual perception in distinguishing images. Whatsoever the size and content of the image database is, a human being can easily recognize images of same category. Overall the performance of content based image retrieval depends on features, feature extraction techniques, similarity measures and the size of database. Several feature extraction techniques have been developed to the task of image retrieval. Further, it is proved that by combining different features, the performance can be increased. 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 is giving desired results. Further, 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. 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.

REFERENCES

[1] N.Varish and A.kumar pal, “Content-based image retrieval using statistical features of colour histogram,”IEEE Transactions,vol.22,no.15,pp.978-1-4673-6823,2015.

[2] M.Singha and K.Hemachandran, "Content Based Image Retrieval using Color and Texture,"vol.3, no.1,pp.39-57, 2012.

[3] V.Y Erandeand P.R.Badadapure, " Content Based Image Retrieval using Neural Network ,"vol. 4, no.5, pp. 571-575, 2013.

[4] S. Singh and .R Rajput,"Content Based Image Retrieval using SVM, NN and KNN Classification,"International Journal of Advanced Research in Computer and Communication Engineering, vol. 4, no.2,pp.549-552, 2015.

[5] V.Kushwahand A. Agrawal. "Study on Query Based Clustering Technique for Content Based Image Retrieval," International Journal of Research in Engineering & Advanced Technology, vol. 2, no.8,pp.1-6, 2014.

[6] D.Patel and A.Yerpude. "Content Based Image Retrieval using Color Edge Detection and Haar Wavelet Transform," International Research Journal of Engineering and Technology, vol.02, no.7,pp.1906-1911,2015.

[7] S.Mohamadzadeh and H. Farsi. "Content-based image retrieval system viasparse representation." IET, vol.10,pp.1-8,2015.

[8] S. Murala , R. P. Maheshwari and R. Balasubramanian. “Directional local extrema patterns: a new descriptor for content based image retrieval content-based image retrieval system via sparse representation,”vol. 28, no.2–5, pp.1-8, 2012.

[9] J. Yue ,Z.Li , L. Liu and Z. Fu," Content-based image retrieval using color and texture fused features," vol. 54, no.3–4, pp.1121–1127,2011.

[10] S.Murala, R. P. Maheshwari, Member, IEEE, and R. Balasubramanian, *Member, IEEE* ," Local Tetra Patterns: A New Feature Descriptor forContent-Based Image Retrieval "IEEE transactions on image processing, vol. 21, no. 5, 2012.

[11] J. Wan, D.Wang, C.H Steven. Hoi, P. Wu,Jianke Zhu, Y.Zhang, J. Li, "Deep Learning for Content-Based Image Retrieval,"international conference on Multimedia,vol. 28, no.1–4, pp. 157-166, 2014.

[12] A. Talib, M.Mahmuddin, HHusni, Loay E. George, "A weighted dominant color descriptor for content-based image retrieval,"Journal of Visual Communication and Image Representation,vol. 82, no.6–9, pp.345-360,2012.

[13] A.Kumar ,J. Kim , W.Cai , M. Fulham and D.Feng, "Content-Based Medical Image Retrieval: A Survey of Applications to Multidimensional and Multimodality Data,"Journal of digital imaging, vol. 54, no.3–4, pp.1025-1039,2015.

[14] X. Y. Wang, Y. 1. Yong, and H. Y. Yang, "An effective image retrieval scheme using color, texture and shape features," Computer Standards & Interfaces, vol. 33, no. 1, pp. 59-68,2011.

[15] G. H. Liu, and 1. Y. Yang, "Content-based image retrieval using color difference histogram," Pattern Recognition, vol. 46, no. 1, pp. 188-198, 2013.

[16] M. J. Swain and D.H. Ballard, "Color indexing," International Journal of Computer Vision, vol. 7, no. 1, pp. 11-32, 1991.

[17] M. Kokare, B. N. Chatterji, and P. K. Biswas. "A survey on current content based image retrieval methods. " IETE Journal of Research, vol. 48 no. 3-4, pp. 261-271, 2002.

[18] Li. Jia, and 1. Z. Wang, "Automatic Linguistic Indexing of pictures by a statistical modeling approach," Pattern Analysis and Machine Intelligence, IEEE Transactions, vol. 25, no. 9, pp. 1075-1088, 2003.

[19] M. Kokare, B. N. Chatterji, and P. K. Biswas. "A survey on current content based image retrieval methods," IETE Journal of Research, vol. 48 no.3-4, pp. 261-271, 2002.

[20] L.Ying, D.Zhang, Lu. Guojun, Ma. Wei-Ying."A survey of content-based image retrieval with high-level semantics," Pattern Recognition,vol. 40, no. 1, pp. 262-282,2007.

[21] A. W. M. Smeulders, M. Worring, S. Santini and A. Gupta, and R. Jain, "Content-based image retrieval at the end of the early years," IEEE Transaction, vol. 22, no. 12, pp. 1349-1380,2000.

[22] A. Vailaya, A. T. Figueiredo, A. K. Jain, and H. 1.Zhang, "Image classification for content-based indexing," IEEE Transaction on image processing, vol. 10, no.I, pp. 117-130, 2001.

[23] N. Alajlana, I.E., Rube, M.S. Kamel and G. Freeman, "Shape retrieval using triangle-area representation and dynamic space warping," IEEE pattern recognition, vol. 40, no. 7, pp. 1911-1920,2007.

[24] M. Chahookiand N. Charkari, "Shape retrieval based on manifold learning by fusion of dissimilarity measures," Image Processing lET, vol. 6, no. 4, pp. 327-336,2012.

[25] Y. Chen and J. Z. Wang, "A Region-Based Fuzzy Feature Matching Approach to Content Based Image Retrieval", IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 24, no.9,pp. 1252-1267, 2002.

[26] M. B. Rao, B. P. Rao, and A. Govardhan, "Content based Image Retrieval System basedon Dominant Color and Texture Features,"International Journal of Computer Applications, vol. 18, no.6, pp-0975-8887, 2011.

[27] J. M. Fuertes, M. Lucena, N. P. D. L Blanca and J. C. Martinez, "A Scheme of Color Image Retrievalfrom Databases," IEEE pattern recognition, vol. 22, no. 3, pp-323-337, 2001.

[28] Natsev, A.Rastogi, R.Shim, 'WALRUS: a similarity retrievalalgorithm for image databases', IEEE Trans., no.3, pp. 301–316, 2004.

[29] G. V. D. Wouwer, P. Scheunders and D. V. Dyck, "Statistical texture characterization from discretewavelet representation", IEEE Transactions on Image Processing, vol.8, pp.592–598, 1999.

[30] R. Datta, D. Joshi, J. Li and J. Z. Wang, "Image retrieval: Ideas, influences, and trends of the newage", ACM computing Survey, vol.40, no.2, pp.1-60, 2008