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Content Based Image Retrieval using Convolutional neural network and SVM

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ABSTRACT
One of the most interesting and rapidly growing search fields in the last decade has been content-based image retrieval. Image retrieval is the process of obtaining and describing images from a huge database. Images are extracted and then matched to obtain the image. Many feature descriptors have been developed, however their effectiveness is influenced by a variety of factors. This study proposes a new technique for CBIR based on deep learning-based feature extraction and support vector machine-based base similarity matching. In the proposed method, a pre-train convolutional neural network (CNN) is utilised to extract robust features from images, and SVM is used for similarity matching.. Publically available Corel dataset is used for the evaluation of performance of the proposed method and experimental analysis of the proposed approach is simulated on MATLAB2017a toolbox which comprises the various functions to simulate it. Propose method gives 97.27 % accuracy, which is significance improvement with compare to existing methods.

Keywords
Content based image retrieval (CBIR), Features extraction, Deep learning, Convolutional neural network, Similarity matching, SVM.

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I. INTRODUCTION

The development like the Internet and the accessibility of image capturing strategy similarly as digital cameras, image scanners, and the extent from digital image collected works are growing Speedily. There are two frameworks: text-basedand content-based. The text-based come up to be clever toward be real traced reverse toward 1970s. In such system, the images are physically based database management system (DBMS) toward accomplish image retrieval. There are two disadvantages via resources of this approach. The initial is

that a substantial intensity concerning human labor is essential for labor-intensive explanation. The second is the footnote wrongness suitable to the objectivity from human being perception [1-3]. "Content-based" means that the examiner analyzes the contents of the image toward a certain extent than the metadata such as keywords, tags, or imagery associated during the image. The expression "content" within this context strength refers toward colors, shapes, textures; otherwise any additional information by way of the intention about container is resulting related the image itself [4][5].The image relevance within CBIR is evaluated with the features extorted through image analysis. The progression of manually explaining images by entering keywords or metadata inside a great database by human can be time consuming, or possibly may not capture the desired keywords that describe the images. Also, the assessment of the effectiveness of keyword image search is subjective and has not been all around characterized. So utilization of this system can seriously save the expense of large scale image database development. This retrieval technique utilized considering images retrieval stay on content of an image. The techniques, algorithms and tools that are utilized inside this technique, originate from the field like as signal processing, statistics, pattern recognition, data mining along with PC vision.Color, texture with shape is the primary characteristic of Images. The performance from a CBIR system has two significant steps. The first stair is analyzing every feature concerning the image and in place of it in conditions of numerical standards. When additional and more features are analyzed, an improved illustration related the image preserve be obtained. Every about the color, texture, shape features represents a dissimilar stage about the image. CBIR aim on the way to extend techniques used for extracting similar images from an image database on the basis of mechanically determined image features. Given an input query image, we extract its features and measure the similarity (distance) of features connecting the query image and images inside the database. The framework returns comparative image as per the similarity positioning.

The current CBIR systems can be separated into two classes. One depends on over all features, and the

other depends on local features. The previous one manages the entire image and concentrates global features.

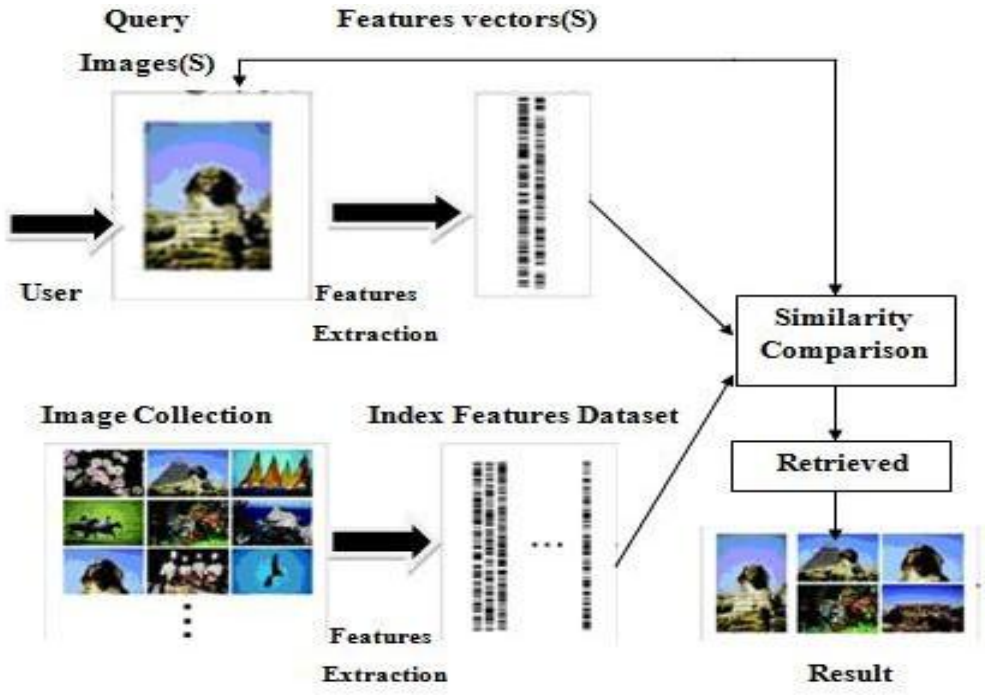

Figure 1. Content based image retrieval (CBIR)

The last one fragments the image into a few areas and extract. Region features respectively. Localized CBIR utilizes region as the essential building blocks for features extraction and similarity measurements,
which is near human perception and has been turned out to be more effective as far as retrieved performances [6].
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extend techniques used for extracting similar images from an image database on the basis of mechanically determined Image features. Given an input query image, we extract its features and measure the similarity
Distance) of features connecting the query image and images inside the database. The framework returns comparative image as per the similarity positioning.

II. RELATED WORK

J. Yu et al. [7], proposed a method to remove the semantic gap between low level and high level feature by using the bag-of-features model. S. Somnugpong and K. Khiewwan [8], in work authers combined the color correlograms and edge direction histogram. EDH gives the geometry information for the different color in the same image. Nazir, Atif, et al.[9], authors has used three descriptor for feature extraction. For the color feature they have used color histogram and two

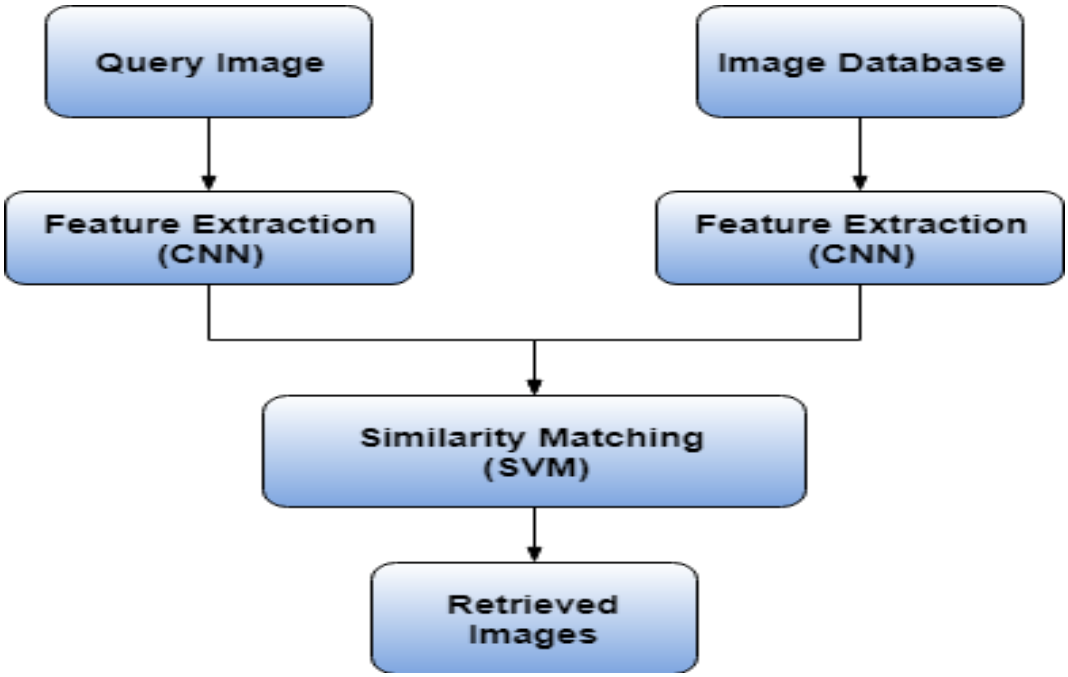

Figure2:BlockdiagramofproposedMethodology.

descriptors discrete wavelet transform and edge histogram is used for texture features. Pareek, Shreela, and HardwariLalMandoria [10].,in this work authers present the comparative study on the different descriptor such as Pattern (LBP); Local Derivative Pattern (LDP); Scale Invariant Feature Transform (SIFT); Bag of Features (BoF);WaveletTransform (WT) used in the CBIR.

III. Proposed Methodology

In this work we have proposed deep learning based features extraction and SVM for feature matching of query and template image.Bock diagram of proposed method is shown in the figure 2. In the following section describe the details of proposed method.The input image, including the training and inquiry stage, are all handled in this module. It is excessively the mostly basic in image retrieval. Convolutional neural network is used for the feature extraction from the images. Convolutional neural network is similar to the ordinary neural network but is cable to extract the deep feature from the images.

3.1 Convolutional Neural Network [11]

Convolution neural network is multilayer perception or feed forward network which consists of one input layer, one output layer and multiple hidden layers. CNN architecture is shown in the figure 3, containing input layer, convolutinal layer, pooling layer, RELU and fully connected layer (FC). These layers are repeated again and again until the network performance is not optimized.

1. Input Layer:
Input layer has input image pixel. In case of color image it contains 3 channels (RGB) as the input.
2. Convolutinal Layer (CONV):
This layer computes the convolution operation between the local region of the input image and filter.
3. Rectified Linear Unit (RELU):
This layer produces non negative values by using max (0, x) activation function on the each and every of the elements.
4. Pooling layer (POOL):
The main function of pooling layer is to perform down sampling by using max pooling. In the max pooling, largest value among the 3 by 3 windows is produces as the output.
5. Fully connected Layer (FC):
Fully connected is similar to the conventional neural network layer where all activations of previous layer are fully connected.

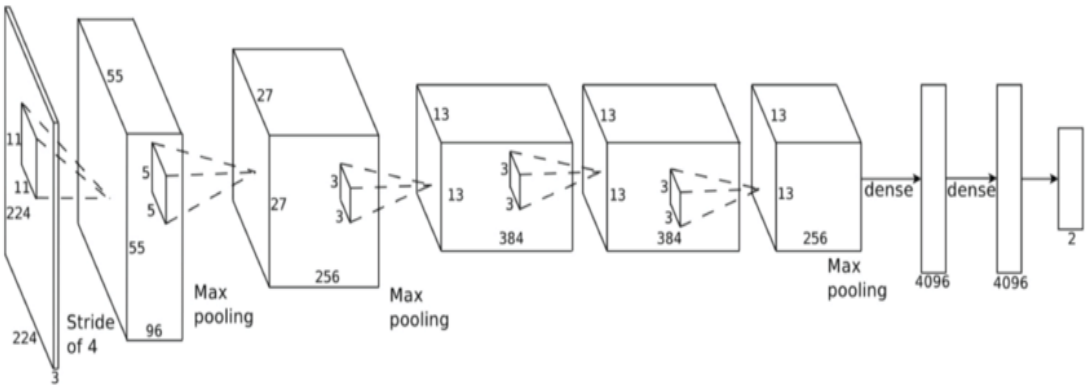

Figure 3. Convolutional Neural network Architecture

3.2 Similarity Matching

We have used support vector machine (SVM) [12] for calculating similarity score. First we have train the SVM by given training sample with their corresponding labels after
that train model is use to retrieve the images.
Steps that are used in our proposed methodology is describes in this section. In the proposed model CNN features are extracted from the images and given to the SVM perform the matching between the query image and database image if it matching score is meet the some threshold that image is retrieve. Main steps of proposed method are as follows:

3.3 Algorithm

Input: Query and database images
Output: Retrieved Images

Step 1: Read all images from database.
Step 2: Apply CNN and Extract feature from the FC7 layer.
Step 3: Stored all extracted features in a separate single file each.
Step 4: Now read query images.
Step 5: Applying features extraction from the CNN.
Step 6: After extract all the features from the images. Now we will apply similarity matching.
Step 7: Now applying SVM classifier.
Step 8: Display best match images as the result in term of retrieved images.

Table 2: Results of proposed method in terms of Precision, Recall, F-score and Accuracy

Category	Precision	Recall	F-Score	Accuracy (in %)
Africa	0.88	1.00	0.94	98.67
Beach	0.96	0.90	0.93	98.67
Building	0.97	0.97	0.97	99.33
Buses	1.00	1.00	1.00	100
Dinosaurs	1.00	0.97	0.98	99.67
Elephants	1.00	0.93	0.97	99.33
Flowers	1.00	1.00	1.00	100
Mountains	0.94	0.97	0.95	99.00
Food	1.00	1.00	1.00	100
Horses	1.00	1.00	1.00	100

IV .Experimental Results and Performances Analysis

A. Image Data Set

The coral dataset is very well-known image dataset for research purpose especially designed for Image retrieval system. In this experimental analysis dataset are used extremely huge capacity of images. In this analysis 0-999 (1000) images include be utilize which contained 10 classes existing into that set, and each classes have established 100 images out of coral dataset of thousands images.

Table 5.3: Comparison of the proposed method with existing methods in terms of precision

Category	J. Yu et al. [7]	S. Somnug et al. [8]	A.Nazir et al. [9]	S. Pareek et el. [10]	Proposed Research
Africa	0.57	0.676	0.85	0.31	**0.88**
Beach	0.58	0.598	0.5	0.44	**0.96**
Building	0.43	0.58	0.75	0.60	**0.97**
Bus	0.93	0.94	**1**	0.45	**1**
Dinosaur	0.98	0.998	**1**	**1**	**1**
Elephant	0.666	0.58	0.55	0.41	**1**
Flower	0.83	0.886	0.95	0.50	**1**
Horse	0.68	0.938	0.9	0.42	**1**
Mountain	0.46	0.478	0.3	0.40	**1**
Food	0.53	0.492	0.55	0.50	**0.94**
Average	0.65	0.725	0.735	0.50	**0.975**

B.Image Classification Results

This result analysis of classified images by proposed method is shown in the confusion matrix table 1. In which we can observed class by performance of the overall system.

In table 2 shows the performance of proposed method in terms of precision, recall, F- score and accuracy.

C.Performance comparisons with Existing Method

Here we have chosen only 10 categories of images and in table 5.2 shows precision, recall, F-score and accuracy of each class and the performance comparison with state of the art system is shown in the table2. As we can observed in the table proposed method outperform with compare to existing methods and it overall accuracy is 97.27%.

V. Conclusion

In this research work we have proposed deep learning based features extraction and Support Vector Machine (SVM) based method to retrieve the images. Convolutional neural network is recently most popular in the computer vision for pattern recognition and classification. In this work we have used pre-trained (Alexnet) CNN for the feature extraction from the images. CNN has amazing power to gives the robust and discriminating features. After extraction of the features, it has given to the support vector machine to perform the similarity matching between the query and database images. Proposed method gives the significantly improvement in terms of precision, recall, F-score and accuracy.

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