SVM Employed Accurate and Efficient Fusion Based Image Retrieval Model

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Abstract: *In this paper, an accurate image retrieval system is proposed based on the fusion of features. The complete system is framed by the combination of color and texture techniques i. e. color moment and Local binary pattern respectively. To make the framed system more efficient Support vector machine is applied as a classifier on the fused feature vector. The system is named as CT - SVM. These experiments are performed on benchmark dataset i. e. Corel - 1K. The results are calculated for the proposed system and the obtained results for CT - SVM system shows an appreciable improvement in terms of average precision that is 90% in case of Corel - 1K dataset.*

Keywords: Color moment CM local binary pattern LBP, Support vector machine SVM

1. Introduction

As the size of image database is increasing day by day, the issue of managing, storing and retrieving these images from huge databases has also become a big concern. So, there is a great need of framing the systems which can deal with these types of databases [1] [2]. CBIR i. e. Content based image retrieval system is a great solution to this problem. Basically these systems help in indexing and retrieving of images automatically using visual features of the images [3].

The two important and main steps of any image retrieval system is feature extraction and similarity measurement. It has various applications in divergent areas and mostly employed in the field of medicine for the diagnosis of medical diseases [4]. With the help of CBIR systems, the medical professional can easily search the similar image from large store house of medical images which are X - ray images, CT scan, MRI, ultrasound images etc and can identify the disease readily [5] [6]. These systems are successfully being used for the purpose for crime prevention by identifying the sketch or fingerprints of the criminals from their stored databases. Many of the CBIR applications are real time applications which are very much beneficial to the users [7].

In this manuscript, a system is framed using the best techniques and a classifier and the proposed system is named as CT - SVM model.

2. Proposed Work

For framing the hybrid image retrieval system CM technique is selected out of various other color analyzers. The reason for selecting the technique is shown in Table 1.

Table 1: Relative analysis of various color descriptors

Technique	Advantages	Disadvantages
Color Histogram	Invariant to rotation and provide both global and local color feature information [8] [9]	Do not provide spatial information, sensitive to noise
Color Auto Correlogram	Provides spatial information	Sensitive to noise and rotation
Dominant Color Descriptor	Scalable, Invariant to rotation [10]	Not so accurate, takes more time and also do not provide spatial information
Color Moment	Provides spatial information, robust, scalable and very fast. [11] [12]	Not able to describe colors when difference is very less.

Now the CM technique is fused with all the texture descriptors via the process of normalization to find out the best hybrid combination. Normalization is a technique which brings all the variables that are used in the dataset to the common range.

In order to carry out the experiments, Corel - 1K standard benchmark dataset of CBIR containing natural heterogeneous images is taken [13] [14]. Most decisive parameters of CBIR system i. e., Average precision, recall are computed for different fused models and for the calculation of similarity Euclidean distance is used. The average precision value of CM with different texture techniques is shown in Table 2 by taking every image of the dataset as the query image.

Table 2: Average value of all parameters (%) when CM is fused with different texture techniques

Combination Techniques	Precision	Recall
CM Fused with LBP	82.5	18
CM Fused with DWT	79.5	16
CM Fused with Gabor	73	13
CM Fused with GLCM	76	15
CM Fused with Curvelet	69	12

From the above table it is clearly visible that CM when fused with LBP gives the superior results. So in order to design hybrid system CM is fused with LBP technique. To make our system more accurate and to manage the big datasets efficiently SVM is incorporated in the fused system which acts as a classifier here. The block diagram of training and testing are shown below in Figure 1 and Figure 2.
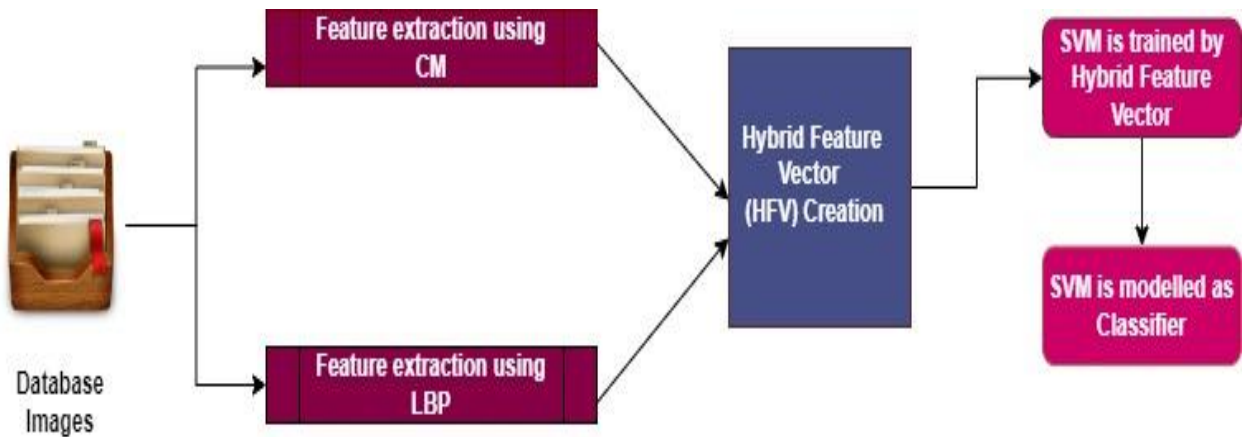
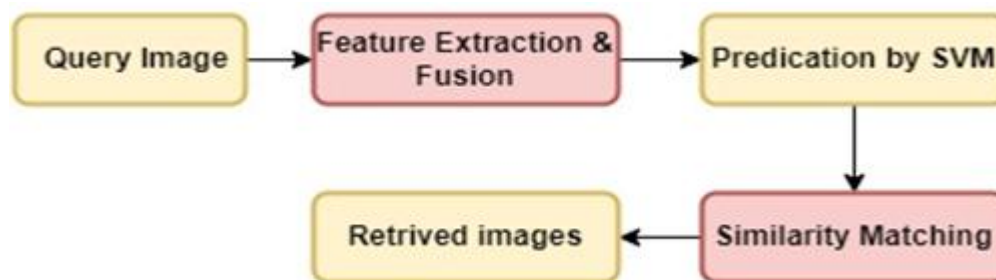**Figure 1:** Training phase of CT - SVM system

Figure 2: Testing phase of CT - SVM system

3. Experimental Set up and Results

For conducting the experiments standard CBIR dataset Corel - 1K is taken. This is one of the standard benchmark datasets for CBIR systems containing natural images. It contains diverse and heterogeneous type of images which are taken from the Corel photo gallery. The total database contains 10 different categories and each category has 100 images. The sample image from each category is shown in Figure 3.

Figure 3: Sample images of Corel - 1K database

3.1 Results

Results are computed by taking each image as query image from the dataset and similarity calculation is performed by using Euclidean distance metric. The model works in two phases. Firstly, average precision is computed after the formation of hybrid model (CT). In the next phase, precision value is obtained from the fusion and SVM classifier. All these results are tabulated in Table 3.

Table 3: Comparative analysis of hybrid CBIR system without and with SVM

Database	Semantic	Average Precision (%)	
		Fused features (CT)	CT - SVM
Corel - 1K	Cat 1: Africa	80	87
	Cat 2: Beaches	73	88
	Cat 3: Buildings	76	86
	Cat 4: Buses	90	100
	Cat 5: Dinosaur	100	100
	Cat 6: Elephant	74	85
	Cat 7: Flowers	84	92
	Cat 8: Horses	88	94
	Cat 9: Mountains	70	82
	Cat 10: Food	78	94
	Average Precision	81.3	90.8

From the Table 3, it is analysed that there is almost the improvement of 9% when SVM is amalgamated into the CT system. The precision value shows the significant rise i. e., 90.8% which is very high.

Time is also one of the most important criterions to judge the pursuance of any designed image retrieval system. The total time can be computed by feature extraction time and retrieval time. The retrieval time purely depends upon the distance metric used the feature extraction time depends upon the techniques that are used for extracting the features. Time analysis of the designed model is performed and is shown in Tables 4.

Table 4: Time analysis of CT - SVM system

Dataset	CT - SVM
Corel - 1K	Feature extraction time =260.4s
	SVM training time = 86.5s
	Testing time =1.2s

4. Conclusion

In this paper, the SVM based hybrid CBIR system is designed whose performance is much better when compared with simple hybrid CBIR system. The color and texture features of the images are extracted by color moment and LBP respectively which are finally combined by using appropriate weights to make an efficient system. After that to make system more accurate SVM is applied before the step of similarity measurement between query and database images which classifies the database images into multi classes so that the searching of query image is limited to particular class only and the framed system is known as CT - SVM system.

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