A HYBRID MODEL FOR IMAGE RETRIEVAL USING MULTISCALE FEATURES

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Abstract: *Information technology is a mandatory resource for day to day life of human beings. Digital image processing enters all the doors in processing an image and provides distinct resultant images. Even through its rapid growth various methods were developed to overcome various issues. But still it is floating issues in retrieval and recognition. In order to overcome such issues in this paper we presented a novel Multi scale method with the hybridization of Orientation and texture features using autocorrelation function. In this method the horizontal directionality and vertical directionality features are estimated and the orientation features. Extraction of all the features with the ACF in the generation of multi scale feature set. Finally, Retrieval and matching process is accomplished. Euclidean distance is considered for similarity measures and the performance is evaluated in terms of Precision and Recall. Compared to other existing models the proposed method gives better performance.*

Keywords: ACF, CBIR, MFE, Euclidean distance

1. INTRODUCTION

A digital image is an array of real or complex numbers represented by a finite number of bits. Digital image processing encompasses a broad range of hardware, software and theoretical under pining. This digitalized image can then be processed and displayed on a high resolution monitor. It involves the manipulation and interpretation of digital images. The central idea behind digital image processing is quite simple. The digital image is fed into a computer on pixel at a time.

The fundamental operation applied on the image databases are matching and determining whether the data is present or not. Matching is not expressive enough for multimedia data and database systems. It will move to systems in which the fundamental operation is similarity assessed. This reflects the preference in image retrieval of general users, who want to retrieve a number of similar images and then use them to iteratively refine their queries.

CBIR has two stages:

- *Pre-processing:* The image is first processed in order to extract the features, which describe its contents. The processing involves filtering, normalization, segmentation, and object identification. The output of this stage is a set of significant regions and objects.
- *Feature extraction:* Features such as shape, texture, color, etc. are used to describe the content of the image. Image features can be classified into primitives.

2. LITERATURE REVIEW

Reshma et al. [1] proposed an algorithm which incorporates the advantages of various other algorithms to improve the accuracy and performance of retrieval. The accuracy of color histogram based matching can be increased by using Color Coherence Vector (CCV) for successive refinement. The speed of shape based retrieval can be enhanced by considering approximate shape rather than the exact shape.

Anju et al. [2] described a novel technique for image recovery based on the integration of contour, texture, colour, edge and spatial features. Contour let decomposition is employed for the extraction of contour features such as energy and standard deviation. Directionality and anisotropy are the properties of contour let transformation that makes it an efficient technique. After feature extraction of query and database images, similarity measurement techniques such as Squared Euclidian and Manhattan distance were used to obtain the top N image matches.

Kekre et al.[3] discussed a image retrieval methods based on shape features extracted using gradient operators and slope magnitude technique with Block Truncation Coding (BTC).The shape features can be extracted using slope magnitude method applied on gradient of images taken in both horizontal and vertical directions.

Valtteri et al. [4] proposed Local Binary Pattern (LBP) texture feature as the source of image description. The first method divides the query and database images into equally sized blocks from which LBP histograms are extracted. Then the block histograms are compared using a relative L1 dissimilarity measure based on the Minkowski distances. The

second approach uses the image division on database images and calculates a single feature histogram for the query. It sums up the database histograms according to the size of the query image and finds the best match by exploiting a sliding search window.

Risvanaet al. [5] enhanced the approach referred when Local Tetra Pattern along with vertical, horizontal and diagonal directions and also adds the color feature. The Local Tetra Pattern encodes the images based on the direction of pixels that are calculated by horizontal and vertical derivatives and diagonal pixels for derivative calculation. The effectiveness of the proposed approach has been also analysed by combining it with the GT. Local Tetra Pattern encodes the relationship between center pixel and its neighbour pixels based on the directions that are calculated with the help of (n-1) order derivatives and so the combinations are more that makes easy searchable of images in the internet and the image labelling more proficient.

Mohd et al. [6] provides an overview of the functionality of content based image retrieval systems. Most systems use color and texture features, few systems use shape feature, and still less use layout features. Fuzzy logic has been used extensively in various areas to improve the performance of the system and to achieve better results in different applications.

3. PROPOSED METHODOLOGY

The proposed hybrid model with multiscale feature extraction is the combination of three techniques such as image enhancement filtering technique with Gaussian Median [GMF] Filter, Texture Based Features [TBF] and orientation model. Each technique constitute in the proposed model is used for different processes. Similarly the Gaussian Median Filter model is used for image enhancement and noise removal, TBF based technique is used for extraction of texture image in the generation of features and finally the orientation model is used to extract the rectangular image based features.

From the below Fig.1 shows the overall process flow of the proposed model with a multiscale feature set which are generates based on the texture features are detected and orientation features such as rectangular area of images. These features are concatenated with each other in the generation of hybrid feature set. The overall structure of the process flow is represented in the following Fig.1.

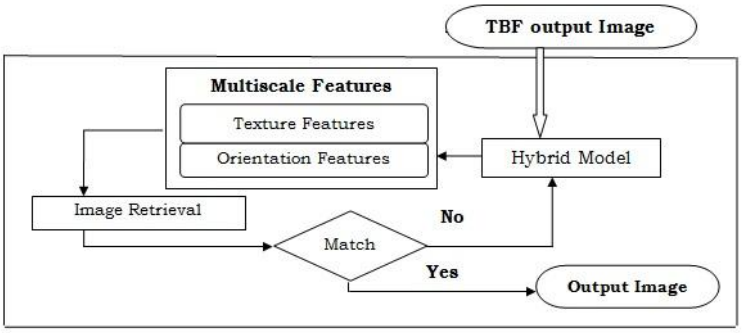

Fig 1. Process flow of Multiscale Feature

The proposed model comprised of three features such as Orientation, Texture and Directionality features are extracted in the generation of feature set.

3.1. ORIENTATION FEATURE

The auto correlation coefficients that range from 0 to 1 are computed for (a,b) directions with the positional difference (p,q) of each block using the following equation 5.6.

$$C_{ff}(p,q) = \frac{n^2 \sum_{a=1}^{n-p} \sum_{b=1}^{n-q} f(a,b) * f(a+p,b+q)}{[n-p][n-q] \sum_{a=1}^{n} \sum_{b=1}^{n} f^2(a,b)} \quad \ldots (1)$$

Where $P \leq n/2$ and $q \leq n/2$ and n is the size of the K^{th} block.

3.1.1. HORIZONTAL DIRECTIONALITY

In the proposed model, the texture horizontal directionality of each block of size (n x n) is computed by applying $q = 0$ in the equation (1). The auto correlation coefficients on horizontal directionality, (C_{HCF}) is modeled and represented as:

$$C_{HCF}(p,0) = \frac{n^2 \sum_{a=1}^{n-p} \sum_{b=1}^{n} f(a,b) * f(a+p,b)}{[n-p][n] \sum_{a=1}^{n} \sum_{b=1}^{n} f^2(a,b)} \quad \ldots (2)$$

3.1.2. VERTICAL DIRECTIONALITY

In the proposed model, the texture vertical directionality of each block of size (n x n) is computed by applying p = 0 in the equation (1). The auto correlation coefficients on vertical directionality is modelled and represented as:

$$C_{VCF}(0,q) = \frac{n^2 \sum_{a=1}^{n} \sum_{b=1}^{n-q} f(a,b) * f(a,b+q)}{[n][n-q] \sum_{a=1}^{n} \sum_{b=1}^{n} f^2(a,b)} \quad \ldots (3)$$

3.1.3.GENERATION OF FEATURE SET WITH ORIENTATION

Finally the feature database is established to store the feature set of all the images available in IDB. The orientation features are generated with each feature set blocks. Here, multiscale feature set generation are considered for the retrieval represented as below

$$\mathbf{F}_{\mathrm{ORI}}(\mathbf{I}) = \{\mathbf{F}_{\mathrm{HCF}}, \mathbf{F}_{\mathrm{VCF}}, \mathbf{F}_{\mathrm{s}}\} \quad \ldots (4)$$

The following images are considered to illustrate the computation of autocorrelation features. The feature vector of images is computed by with varying p and q values and also the image as a single block.

3.2. GENERATION OF TEXTURE BASED FEATURE

The establish a feature set of texture image retrieval as presented in equation 5

$$F_{TBF} = \{F_E, F_C, F_E, F_H\} \quad \ldots (5)$$

The auto correlation function, the feature set F_{Tex} of the input image is established and the graphical representation of the feature set presented as below:

$$F_{Tex} = \{F_1, F_2, \ldots\ldots, F_k\} \quad \ldots (6)$$

Where F_1,F_2 and F_k denotes auto correlation feature vector of K^{th} block.

3.3 GENERATION OF FEATURE SET WITH PROPOSED METHODOLOGY

The representation of the multiscale feature set is presented as follows.

$$F_{MFE} = \{F_{TBF}, F_{Tex}, F_{ORI}\} \quad \ldots (7)$$

Where $\{F_{TBF}\}$ the texture based feature set is represented in the equation 6, $\{F_{Tex}\}$ the feature set with texture feet is represented in the equation

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4. SIMILARITY AND PERFORMANCE MEASURES

4.1 PRECISION

Precision measures the fraction of retrieved images that are relevant to a specific query and is analogous to positive predictive value.

$$P = \frac{\text{No. of relevant images retrieved}}{\text{Total no. of images Retrieved}} \quad \ldots (8)$$

4.2 RECALL

Recall measures the fraction of all the relevant images in a collection that are retrieved by a specific query and similar to the concept of sensitivity. Here, recall is the number of figure captions that were indexed by a concept divided by the number of captions in which the concept was actually present.

$$R = \frac{\text{No. of relevant images retrieved}}{\text{Total no. of relevant images in DB}} \quad \ldots (9)$$

5. ALGORITHMS

5.1 ALGORITHM – I

// Generating feature sets //

Input: Input image size from IDB
Output: Feature database
Begin
Step 1: *Read an image from the image database (IDB) of size M×N.*
Step 2: *Divide the input image into non-overlapping blocks of size n x n*
Step 3: *Call* ***procedure ori _ feature ( )***
Step 4: *Call* ***procedure auto_ corr ( )***
Step 5: *Repeat* ***Step1*** *through* ***Step4*** *for all the images in* ***IDB****.*
Step 6: *Establish feature database set.*
End

5.2 ALGORITHM – II

//Retrieving top *m* relevant images corresponding to the target image//

Input **:** Target Image
Output **:** Resultant Image
Begin
Step 1: *Select the target image of size M×N and divide into blocks.*
Step 2: *Repeat* ***Step3*** *and* ***Step 4*** *in algorithm I.*
Step 3: *Compute the SVM distance classifier between the target image and the image set for matching 5*
Step 4: *Compute the Precision and Recall using the equation 8 and equation 9.*
Step 5: *Stop*
End

// Procedure Orientation Feature//

Procedure ori_ feature ( )
Begin
Step 1: *Identify the input image with rectangular grid.*
Step 2: *Establish the horizontal feature matrix with the auto correlation features of the input image*
Step 3: *Establish the vertical feature matrix with the auto correlation features of the input image*
Step 4: *Calculate rectangular based general features*
Step 5: *Calculate the feature set of input image*
Step 6: *Repeat* ***Step2*** *through* ***Step5*** *for all the input images and find the rectangular feature vectors.*
Step 7: *Return*
End

//Procedure auto correlation //

Procedure auto_corr ()
{
Step 1: *Read an input image from the image database.*
Step 2: *Compute the positional difference*
Step3: *Establish feature Matrix with the auto correlation features for all the k sub regions of the input image*
Step 4: *Return*
}

6. EXPERIMENTATION AND RESULTS

To validate the effectiveness of the proposed image retrieval system, experimentation is performed with the images in the COREL image database that contains various 2-D monochrome images of different classes and images in Brodatz texture image database. The total images are grouped into 10 different classes of images. Some of these images of the respective classes are shown in Fig.6.1.


a. Flower


b.Horse

Fig.6.1 Sample Images

Each image in the IDB is subjected to the above mentioned extraction process with the proposed model. The proposed model coefficients are obtained as described in section. The procedure auto_corr( ), procedure ori_feature( ) are applied. Then the extraction of entire process is done using the values of equation 5.36.The proposed algorithm 5.1 is applied on the image from the selected image database for the experimentation. The image 103_2 is considered as the input image. Initially the texture features are extracted to generate feature sets. The resultant of texture feature set is generated for the input image 103_2 and then establish a feature set of face image retrieval mentioned in equation 7.

$$F_{MFE} = \{F_E, F_C, F_E, F_H, F_1, F_2, F_{VK}, F_{HK}, F_K, F_{ORI}\}$$

After the execution of step 3, each image in the IDB is subjected to the above mentioned texture extraction process with the auto correlation model. The image under analysis is partitioned into *k* blocks, each block of size. Then the auto correlated coefficients are described and the procedure auto_corr is applied. Finally the resultants of orientation feature set are generated for the input image.

The values obtained are as follows with the multiscale feature set is as follows

$$F_{MFE} = \begin{Bmatrix} 0.9114 & 0.0178 & 0.0384 & 0.9638 & 0.9897 \\ 0.9022 & 7.4768e\text{-}004 & 0.0730 & 0.9780 & 1.0000\,1 \\ 0.9835 & 0.1371 & 0.0025 & 0.3298 & 0.9787 \\ 0.99047 & 0.98181 & 0.97520 & 0.99061 & 0.98678 \\ 0.98069 & 0.97486 & 0.98076 & 0.98033 & 0.97641 \\ 0.97221 & 0.97281 & 0.97370 & 0.97131 & 0.96846 \end{Bmatrix}$$

For the image retrieval the proposed model is applied and the retrieval results obtained are evaluated in terms of precision and recall presented in Table 6.1 and the retrieval of images for the target image 103_2 is shown in the following Fig.6.1.

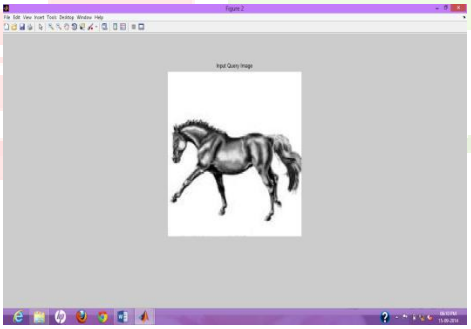

Fig.6.1 Horse Input image

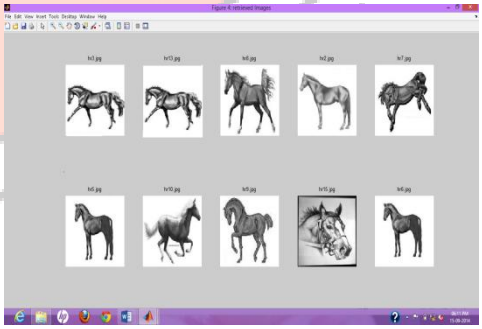

Fig.6.2. Resultant Image

In order to evaluate the performance of the proposed system with the existing system the precision and recall are computed with the selective image sets. The obtained results of the image with the proposed model is tabulated in the following Table 6.1 and the performance are evaluated with the existing the LBP and GLCM model.

Methods	Recognition
Local Binary Pattern [Zhen10]	62.93%
GLCM	68.10%
Texture Based Feature technique	75.96%
Proposed orientation model	81.65%

Table 6.1 Image Retrieval Rate

To test the performance of the images from 10 different classes have been considered. The performance of the proposed approach compared to the approaches such as LBP, GLCM and texture based feature technique is shown in Table 6.1. It is observed from the table that the proposed model has higher retrieval rate for all the images taken into consideration. The experimental results show that the proposed model produces the maximum accuracy. The pictorial representation of the experimentation and its performance evaluation are presented in the Fig.6.3

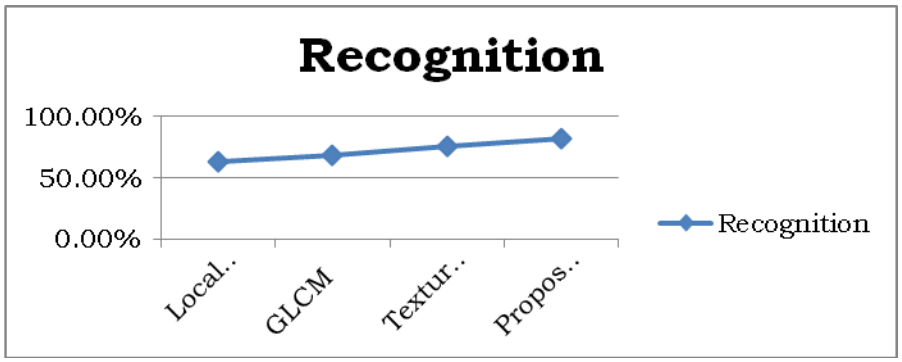

Fig.6.3 Performance evaluation of proposed FMBLBP

The precision and recall of the proposed method is presented in the following table. The performance of the existing schemes with precision and recall are also obtained. For easy comparison, they are also incorporated in the same Table 5.3.

7. CONCLUSION

In this paper, a hybrid model multiscale feature is proposed and applied for the image retrieval. The estimation features set are generated with the multiscale feature sets such as texture based feature and orientation features. The experimental result shows the efficiency of the proposed model. The images are close to the target image is retrieved from the image database based on their similarity. In order to achieve the better retrieval accuracy the proposed image retrieval has been tested with different images from various classes of images. The proposed technique is experimented and compared with existing LBP, GLCM and texture based features techniques. Compared to the existing model the proposed model gives better results and efficient for image retrieval.

8. REFERENCES

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