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Implementation of CBIR based Image Authentication Algorithm

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Abstract: Content-based image retrieval, also known as query by image content is the application of computer vision techniques to the image retrieval problem, that is, the problem of searching for digital images in large databases. The design & development of image authentication algorithm based on quartic digital signature for a competent content based image retrieval system using block division with eigen features and supervised labeling is presented. Algorithms are developed using the mathematical models & the simulations are carried out in the Python environment to show the retrieving efficiency from the databases.

1. Introduction

In this approach, database image will be divided into small blocks of size 2 $m \times 2$ m where m will be 0 to n. From the small block system will extract the Eigen vector of 2 m values. These 2 m values are considered as features of each block. This process will be repeated for all blocks of an image and stored these features into the database with corresponding filename, location and label for the future comparing the features of query image. The compression will be considered as each block with range of ± 10%. The collection of images from compression result will be sorted. The zero compared value, image labeled text will be extracted and filtered the collection of images based on the label. The resultant list of images is considered and displayed on the GUI as the similarity images of a query image.

2. Existing Methods

Marakumbi Prakash R., Jayashree V. Khanapuri Various image authentication methods are being used to protect the images and information, and their communications. Virtual private network, firewall, encryption, cryptographic hash function such as digital signature, machine authentication code, manipulation detection code, and perceptual hashing are the examples of image authentication methods. Limitations of existing security like Firewall and virtual private network only protect the information up to the point of the internal networks. Encryption is an efficient tool for secure transmission, but when the sensitive data is decrypted, the information is not protected anymore. The drawback of cryptographic hash function is that it cannot locate where the images have been tampered. The major methods for authentication of an image are cryptographic, robust image hashing and watermarking authentications [1].

S.Rubini, R.Divya, G.Divyalakshmi and Mr T.M. Senthil Ganesan they studied the main components of a content based image retrieval system, including image feature representation, indexing, query processing, and query-image matching and user's interaction, while highlighting the current state of the art and the key-challenges. It has been acknowledged that it remains much room for potential improvement in the development of content based image retrieval system due to semantic gap between image similarity outcome and user's perception .Contributions of soft-computing approaches and natural language processing methods are especially required to narrow this gap. [1]

R Rajkumar and M V Sudhamani explain the retrieval based on combination of features and SNN. The experiments were carried out on the CBIR-50 dataset. The average precision value was 72.12%. In order to enhance the precision value from the earlier method, a deep learning approach, SNN was adopted. The result obtained for average precision for all the categories is 62.62% which is more than the existing works. The time taken for the top 100 similar images on is also recorded. The Siamese neural network is seen to give high precision results. But in case of new category of images gets added, then the model needs to be retrained along with new category and this consumes

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time for retraining. There is a scope to improve the network such that it can retrieve the new category of image by extracting features and also avoid the retraining phase. [2]

Kai Chu and Guang-Hai Liu they studied Feature extraction and representation is an important issue in CBIR and has a close relationship with human perception. Color and edge cues are visual search components for stimuli perception that can express meaningful characteristics of images or scenes. Representing image contents via extracting color and edge features based on feature integration theory is a challenging problem. To address this problem, a new and highly simple but efficient representation based on the multiintegration features model, called the MIFH, is proposed for CBIR using the feature integration theory. [3]

3. Development of the CBIR algorithm based on Quartic Digital signature approach

The 9-stepped CBIR algorithm which is used to retrieve the contents from the given test /query image is as follows.

Step 1: Consider a image $I(i, j)$ which has got a number of contents characterized as an object.

Step 2: Divide the whole image into non-overlapped blocks of size ($m \times n$) , one at a time, where m & n takes the values as (4 × 4), (8 × 8), (16 × 16), (32 × 32), (64 × 64), (128 × 128), (256 × 256).

Step 3: Calculate the threshold as the mean of each block using the Eqn. (1) as

$$M_i = \frac{1}{(n \times m)} \sum_{i=1}^{n} \sum_{j=1}^{m} I(i, j) \tag{1}$$

Where, i is the i^{th} block of size (m×n)

Step 4: Calculate the upper & lower counts w.r.t. the threshold values using the Eqn. (2) as

$$BM_k(i, j) = \begin{cases} 0 & if\ I_k(i, j) \geq M_k \\ 1 & if\ I_k(i, j) < M_k \end{cases} \tag{2}$$

where k is the *kth* block & $i = 1, 2, 3, \ldots, n$ and $j = 1, 2, 3, \ldots, m$.

Step 5: Calculate the upper mean using the Eqns. (3) as

$$UM_i = \frac{1}{\sum_{i=1}^{n} \sum_{j=1}^{m} BM_k} \sum_{i=1}^{n} \sum_{j=1}^{m} BM_k(i, j)\ I_k(i, j) \tag{3}$$

Step 6: Calculate the lower mean using the Eqns. (4) as

$$LM_i = \frac{1}{\left(mn - \sum_{i=1}^{n} \sum_{j=1}^{m} BM_k \right)} \sum_{i=1}^{n} \sum_{j=1}^{m} \{1 - BM_k(i, j)\}\ I_k(i, j)$$

----------(4)

Step 7: Store these values as the features of each block.

Step 8: Repeat this process for all the blocks till it reaches n & m values.

Step 9: The calculated upper mean & lower mean are stored in the database for the later use.

3.1 Important features of the proposed algorithm developed.

The important features he proposed algorithm developed in the Python environment are –

- Red Channel Histograms: 60 bins;
- Green Channel Histograms: 60 bins;

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• Blue Channel Histograms: 60 bins;
• Object Features: Using Contours;
• Contour Area (Contour Perimeter, Contour Approximation, Aspect Ratio, Extent, Solidity) ;
• Architecture – (Distance Equation: w1Scolor + w2Sboject, where *w*1 = 70% and *w*2=30%) ;
• Result: Image contents retrieved;
• Database – (COREL database images are used to test the system, 5K & 10K size images set,
• image.very.jpg image dataset, url : www-db.stanford.edu/~wangz/image.vary.jpg.tar →10000 images).

4. **Results and Discussions**

In this section, the results of simulation along with their justifications are presented both qualitatively as well as quantitatively. All the numerical computational results are neatly tabulated in the form of tables from Tables 1 to 4, the narrative of teach table contents are as follows. The Table 1 gives the number of image features, while the Table 2 gives the time to compute features & the number of bytes required to store features of an image. While the performance characteristics of image retrieval process with the precision parameters of (16 × 16) only is shown in the Table 3. Similarly, the performance characteristics of the image retrieval process for the recall parameters of (16 × 16) only are given in the table4. Finally, the table 5 gives the performance characteristics showing the accuracy & the F_Score from which one can come to know the effectiveness of the simulated outputs. CBIR simulation results using the block division with eigen values method for different types of query image such as Buildings, Bus, Human Beings, Dino, Elephant, Flower, Food, Horse, Mountain, Sunset, etc… are taken into consideration for the simulation study. Some of obtained results were displayed below.

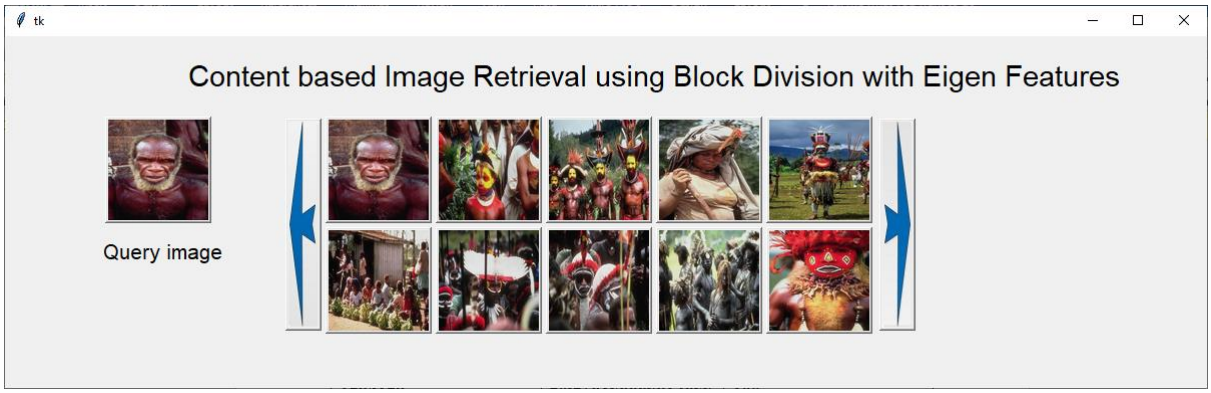

Fig. 1 : CBIR using block division & Eigen features for image – 1 (Page 1), human being content found in the database

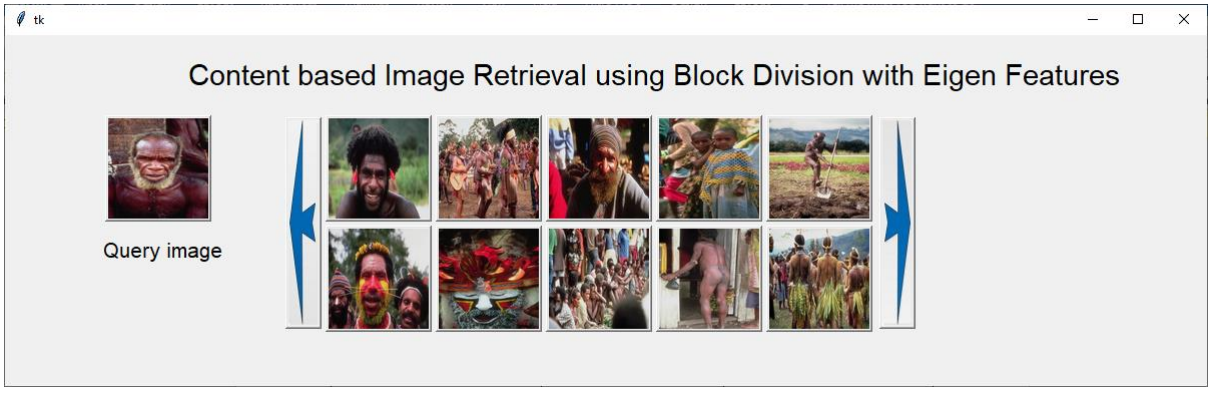

Fig. 2 : CBIR using block division & Eigen features for image – 1 (Page 3), human being content not found in the database

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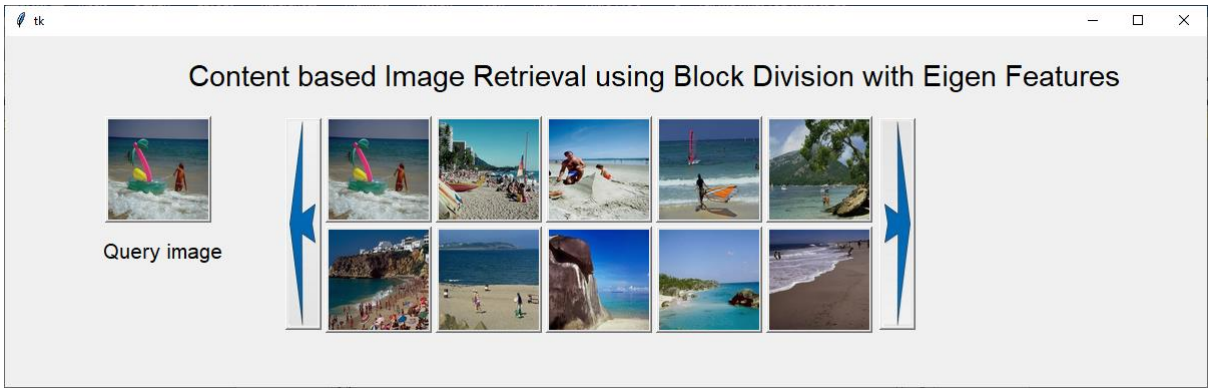

Fig. 3 : CBIR using block division & Eigen features for image – 1 (Page 1), boat on the sea shore content found in the database content not found in the database

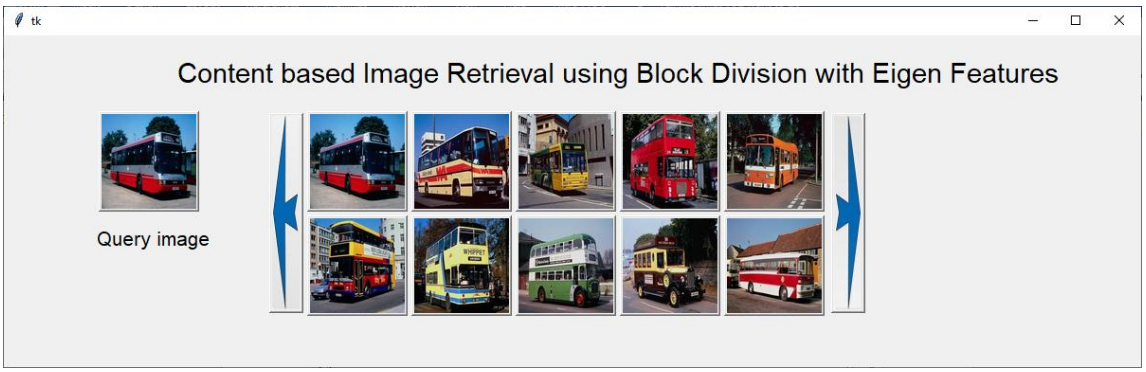

Fig. 4 : CBIR using block division & Eigen features for image – 1 (Page 1), red bus content found in the database

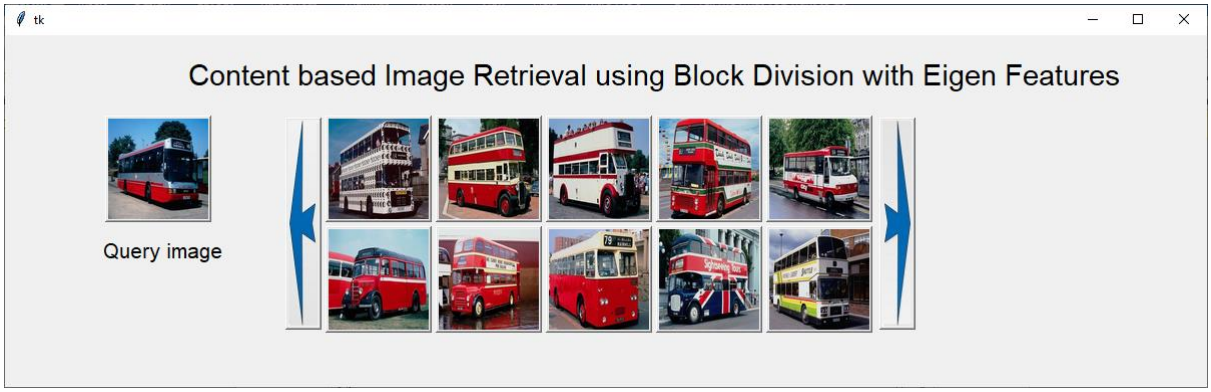

Fig. 5 : CBIR using block division & Eigen features for image – 1 (Page 5), red bus content not found in the database

Table 1: Number of image features

Block Size	No of blocks	No. of features
4 × 4	128	128 12288
8 × 8	64	3072
16 × 16	32	768
32 × 32	16	192
64 × 64	8	24
128 × 128	4	12

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Table 2 : Time to Compute features & no. of bytes required to store features of an image

Block Size	Time in seconds	No. of Bytes
4 × 4	282.11129236221313	131072
8 × 8	107.56176829338074	32768
16 × 16	50.809714555740356	8192
32 × 32	33.01567196846008	2048
64 × 64	27.03835153579712	512
128 × 128	20.276156663894653	128

Table 3 : Performance characteristics of image retrieval process : Precision (16 × 16) only

Class	Proposed 16 × 16	Hussain Dawood *et.al.* [36]	Purohit *et.al.* [35]	Manimala *et.al.* [34]	Chuen *et.al.* [31]	Jhanwar *et.al.* [32]	Hung and Dai's [33]
Buildings	0.781	0.8166	0.7312	0.710	0.562	0.374	0.411
Bus	0.841	0.8166	0.7823	0.920	0.683	0.453	0.424
Mens	0.811	0.8666	0.8700	0.620	0.888	0.741	0.852
Dino	1.00	1.00	0.9900	0.970	0.992	0.915	0.587
Elephant	0.821	0.7208	0.6725	0.860	0.658	0.304	0.426
Flower	0.845	0.8416	0.6925	0.760	0.733	0.369	0.427
Food	0.625	0.9291	0.8522	0.770	0.891	0.852	0.898
Horse	0.868	0.9416	0.7600	0.870	0.803	0.568	0.589
Mountain	0.793	0.50	0.7512	0.490	0.522	0.293	0.268
SUNSET	0.842	0.4208	0.6502	0.620	0.54	0.398	0.446
Average	0.8227	0.7854	0.7752	0.762	0.727	0.527	0.533

Table 4: Performance characteristics of image retrieval process: Recall (16 × 16) only.

Class	Proposed 16 × 16	Hussain Dawood *et.al.* [36]	Purohit *et.al.* [35]	Manimala *et.al.* [34]	Chuen *et.al.* [31]	Jhanwar *et.al.* [32]
Buildings	0.711	0.098	0.662	0.174	0.127	0.132
Bus	0.743	0.098	0.721	0.141	0.115	0.126
Men	0.711	0.104	0.559	0.121	0.092	0.099
Dino	1	0.12	0.978	0.101	0.072	0.104
Elephant	0.623	0.0865	0.559	0.149	0.132	0.119
Flower	0.791	0.101	0.715	0.132	0.129	0.122
Food	0.593	0.1115	0.584	0.112	0.087	0.093
Horse	0.833	0.113	0.773	0.134	0.102	0.103
Mountain	0.621	0.06	0.621	0.213	0.135	0.152
Sunset	0.723	0.505	0.633	0.192	0.121	0.113
Average	0.7349	0.0942	0.6805	0.146	0.111	0.116

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Table 5 : Performance characteristics showing the accuracy & the F_Score

Class	Accuracy (16 × 16)	F_Score (16 × 16)
Buildings	0.746	0.744358
Bus	0.792	0.788968
Mens	0.761	0.757715
Dino	1	1
Elephant	0.722	0.708425
Flower	0.818	0.817109
Food	0.609	0.60858
Horse	0.8505	0.85014
Mountain	0.707	0.696539
Sunset	0.7825	0.777976
Average	0.7788	0.776325

5. Conclusion

The precision and recall are used to calculate the performance of the designed system. Tables 1 & 5 shows the parametric values of the proposed and existing CBIR systems, which shows the efficacy of the proposed methodology that it is superior in nature. Here, the observation is that the performance of the proposed method is superior to the existing systems, which can be observed from the quantitative results presented in the tables in the simulation results. Finally, to conclude, it could be iterated that this contributory work was developed to show the use of block division methodology with eigen value incorporation to extract the different features of the secured images and carry out the performance of the retrieval system with good percentage retrievals.

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