



Contents lists available at ScienceDirect

Materials Today: Proceedings

journal homepage: www.elsevier.com/locate/matpr

CBIR algorithm development using RGB histogram-based block contour method to improve the retrieval performance

Manasa K. Chigateri^a, Savita Sonoli^b

^a VTU Research Centre, ECE Dept., RYMEC, Ballari & Asst. Prof., Dept of E&CE, RYMEC, Cantonment, Ballari 583104, Karnataka, India

^b Dept. of Electronics & Communication Engg., Rao Bahadur Y. Mahabaleswarappa Engineering College, Cantonment, Ballari 583104, India

ARTICLE INFO

Article history:
Available online xxx

Keywords:

CBIR
Image
Feature
Database
Query
Extraction
Histogram
HSV
Retrieval
Contents

ABSTRACT

In this research paper, CBIR algorithm development using RGB histogram-based block contour method to improve the retrieval performance is presented along with the simulation results. CBIR to extract the visual content of an image automatically like color, texture, size, direction, distance, nearness or its shape using HSV colour RGB histogram & block contour methods is proposed here in this paper. The work presented in this paper is a new methodology of the picture retrievals by the combination of different parameters of the query image with the help of RGB histograms & the block contours. Simulations are carried out in the Matlab environment and the simulation results are observed. The CBIR based system is going to be tested using different types of test images for varieties & finally the nearest test outcomes will be got & be tabulated neatly. Here, in this proposed work using different sizes of the blocks & the no. of characteristics & the time obtained for extracting those realistic parameters could be found out & also other parameters such as the recalling, precision, characteristics were calculated and compared with existing systems. The precision and recall are used to calculate the performance of the designed system. The results presented gives precision values & the values of the recall parameter of the developed & existing CBIR systems, which shows the efficacy of the proposed methodology that is superior. Here, the observation is – the developed methodology will be highly unique, its performance will be more superior to the existing systems. Finally, to conclude, it could be iterated that this contributory work was developed to show about the RGB histogram & block contour concept involvement to extract the different features of the images and carry out the performance of system (retrieval). Finally, the results of the simulation gives the improved performance of the system (retrieval) over the others, thus showing the profoundness or the effectiveness of the research work done.

© 2021 Elsevier Ltd. All rights reserved.

Selection and peer-review under responsibility of the scientific committee of the International Virtual Conference on Sustainable Materials (IVCSM-2k20).

1. Introduction

CBIR, i.e., Content based Image retrieval could also be interpreted as a technique that is going to improvise the precision of the picture's search process which will enhance the image searching accuracy. A no. of authors had worked on the IP concepts which are dependent on the CBIR systems, which uses different techniques such as colour, texture, direction, orientation, gray scale and shape. By processing this, feature vector will be obtained & finally the process of comparing will be completed. In certain areas, for ex., in the search engines & in the patents, the CBIR method can be utilized registration, face detection etc [26]–[30]. For security purposes, the CBIR method could be utilized. To provide protection, it can do the encrypting process & the decrypting of the imaging

process of the pictures. In conjunction with the CBIR, another process called as the stenography can generate some algorithms that will make the information highly secured. Only by referring to the picture contents, can CBIR can support in many areas of applications [13]. Many authors have produced survey or reviews papers on CBIR, few of them in [29] & [30] could be seen, where a huge amount of literature on this topic could be found, In this context, we make a sincere attempt into the same.

“C B I R”, which is also called as the query by image content is the applying of imaging methodologies for the picture extractions, i.e., the question of performing the search process for different digital pics in big data bases [1]. Owing to the dramatic rise in storage and network infrastructures, the use of digital pics has grown exponentially over the last few couple of years. In fact, the techno-

<https://doi.org/10.1016/j.matpr.2021.03.198>

2214-7853/© 2021 Elsevier Ltd. All rights reserved.

Selection and peer-review under responsibility of the scientific committee of the International Virtual Conference on Sustainable Materials (IVCSM-2k20).

logical changes have led the professional users to use, store and manipulate the remotely stored images [2]. The concept of the IR - the Information Retrievaling system comprises of the location & the retrieval performance of the relevant informative concepts of the pictures or the documents, for ex., the keywords or an instance as a repository question [3].

2. Organization of the paper

A brief introductory note about the related work is given in the section I. Section III gives the algorithm development along with the mathematical modes that has been used in its development. The proposed architectural layout of the CBIR process is depicted in section IV followed by the important features of the proposed algorithm developed in the Matlab environment in section V. The performance evaluation of CBIR process is displayed in section VI followed by the results of the simulation in section VII. The paper concludes with the conclusions in section VIII followed by the references.

3. Algorithm development

It might not be sufficient to scan and retrieve image pics by using text contents, since the image may be represented in diverse manners. Hence, to throw a light into this chosen research topic, we are carrying out an integrated analysis of HSV color histogram characteristics with contour based concepts could be used for improving the retrieval system's performance in CBIR [5 38]. A brief survey, i.e., an insight into the integrated analysis of HSV color histogram characteristics with shape-based edge detection to improve the retrieval system performance in content-based image retrievals w.r.t. the image processing point of view is being presented w.r.t. the work done by various researchers across the globe [6 37]. The work done by them was studied, lacunas observed & the problem was defined with a good objective to be solved. In this section, CBIR algorithm Development using RGB histogram based block contour method to improve the retrieval performance is presented along with the simulation results developed in the Matlab environment [7]. Brief in-depth step by step approach for achieving this goal is depicted in the future paragraphs [8 39].

The contributory work developed in this paper discusses about the RGB histogram & block contour concepts which are used to extract the different properties of the pics & then carry out the working characteristics of the system of retrivals [9]. Using GLCM as just a statistical method, the features are then extracted. The contrast, power, entropy and homogeneity are regarded as texture characteristics here. Here, the whole image is partitioned into no. of fixed block of sizes of (8×8) , (4×4) , (16×16) , (32×32) , (64×64) , (128×128) and (256×256) non overlapping blocks and either of these sizes can be used for extracting the feature parameters of the picture [10 40].

The threshold of the each block, is then determined as the average of the image pixels, the no. of pixels below the value of the threshold and the no. of pels which are above the value of the threshold. Then, the mean was measured and considered as characteristics of these upper & lower values. For all the blocks, this procedure is iterated for extracting the characteristics of the entire picture. The shape is extracted using RGB, the 3rd visual characteristic property of an picture. histogram & block contours. Finally, some simulations are carried out on the chosen pic data base for a no. of types of the images which are stored in the C drive. The results of simulation predicts that improved acts w.r.t. the improved performance of the retrieval framework over the others [1112].

A question picture is sent to the system in the proposed CBIR retrieval process and the image features can be extracted. The characteristics of the test image are contrasted with all the image features in the data base using the Euclidean distance measure methods. To calculate the similarity between both the query and all the other photos utilizing the mathematical equation, the CBIR coefficients are used. [1314]

$$\text{Distance}_{(Q,D)} = w_1 S_{color} + w_2 S_{texture}$$

where the parameter Q is called as the test photo & the parameter D is called as the data base picture, S_{color} will be the gray levels characteristics scores & $S_{texture}$ is the feature of the texture scores which are got after the application of the Euclidean distance metric concepts. The weight values are defined by w_1 as 0.70, & then the parameter w_2 as 0.30 for the betterment of the performance characteristics on a number of trail procedures [1516].

4. Algorithm development

The retrieval system's proposed architecture is as shown in the Fig. No. 1. This comprises of multiple blocks, such as extraction of features, image repository, data bases, measure of similarity, and Interface of the Graphical Users. The images obtained from a standard data base are processed for function extraction and retrieval uses in the Photographic Repository. The data base stores the names of the files & the features of the pictures extracted by different methods in the Image Functional Data base [1718]. Sample functions are retained in the data base after the standard data base has been exported. This framework does the task of accepting the user's test/query image or displaying the resulting images. The feature extraction and similarity measurement modules are used in the FE process to remove the features from the images and find a similarity between the data base images & the query images [1920].

5. Important features of the proposed algorithm developed in Matlab environment

The retrieval system's proposed architecture is as shown in the Fig. No. 1. This comprises of multiple blocks, Figs. 1

In this section, the important features of the proposed algo that is developed in the Matlab environment is presented in a nutshell.

- Color Features : using Histogram
- Red Channel Histograms : 60 bins
- Green Channel Histograms : 60 bins
- Blue Channel Histograms : 60 bins
- Object Features : Using Contours
- Area of the Contour
- Perimeter of the Contour
- Contour Nearness Approximating
- Aspect's Ratio
- Extant
- Solidity
- Architecture:
- Distance Equation : $w_1 S_{color} + w_2 S_{object}$
- where $w_1 = 70\%$ and $w_2 = 30\%$
- Database:
- COREL database images are used to test the system, 5 K and 10 K size images set
- image.very.jpg image dataset,
- Image URL \rightarrow 10000 images
- Result : Image contents retrieved.

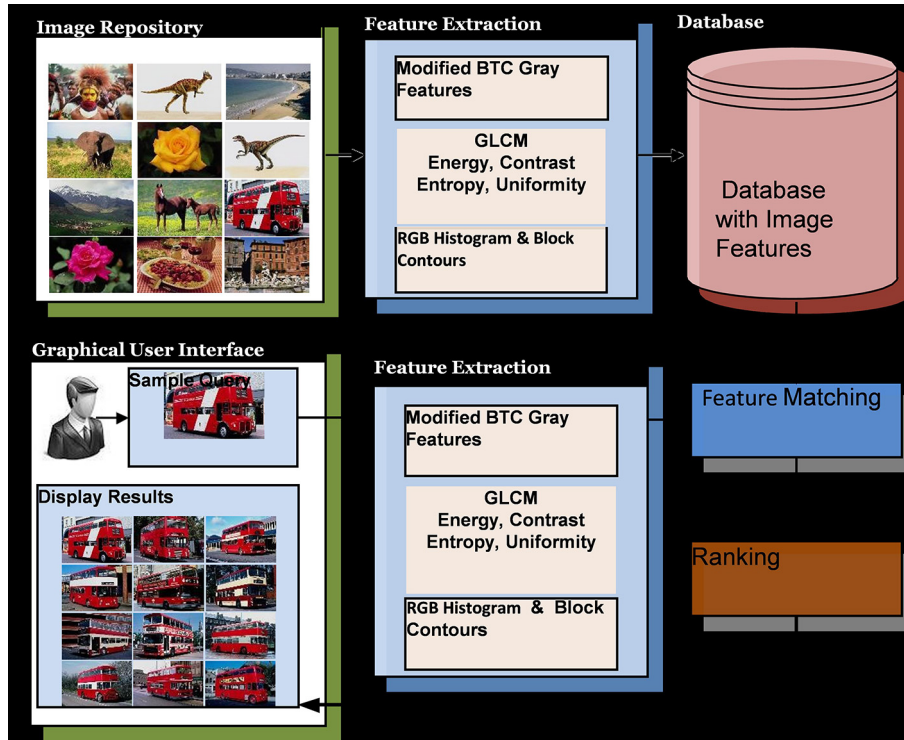


Fig. 1.

Table 1

Performance characteristics of the image retrieval process : Precision.

Class	Proposed	Purohitet.al. [35]	Manimalet.al. [34]	Chuenet.al. [31]	Jhanwaret.al. [32]	Hung andDai's [33]
BUILDINGS	0.823	0.7312	0.710	0.562	0.374	0.411
BUS	0.805	0.7823	0.920	0.683	0.453	0.424
BUTTERFLY	0.811	0.8700	0.620	0.888	0.741	0.852
DINO	0.94	0.9900	0.970	0.992	0.915	0.587
ELEPHANT	0.691	0.6725	0.860	0.658	0.304	0.426
FLOWER	0.622	0.6925	0.760	0.733	0.369	0.427
FOOD	0.783	0.8522	0.770	0.891	0.852	0.898
HORSE	0.812	0.7600	0.870	0.803	0.568	0.589
MOUNTAIN	0.784	0.7512	0.490	0.522	0.293	0.268
SUNSET	0.735	0.6502	0.620	0.54	0.398	0.446
Average	0.7806	0.7752	0.762	0.727	0.527	0.533

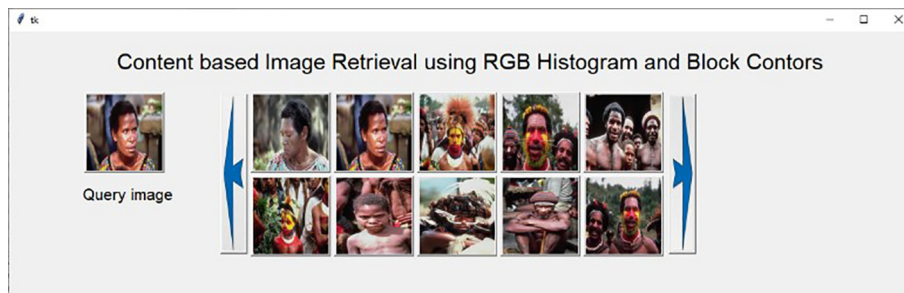


Fig. 2.

6. Performance evaluation of the CBIR process

The system is evaluated for various block sizes of (4–4), (8–8), (16–16), (32–32), (64–64), (128–128) and (256–256) with new features to evaluate the output assessment. When the size of the block

sets varies, as seen in Figs, 3–15, the no. of features extracted from the pictures varies. Accuracy and recall values were determined on the basis of the resulting images to measure the o/p w.r.t. the different block size, respectively, shown in Tables 1 and 2. The findings from the results of the simulation indicates that if block size

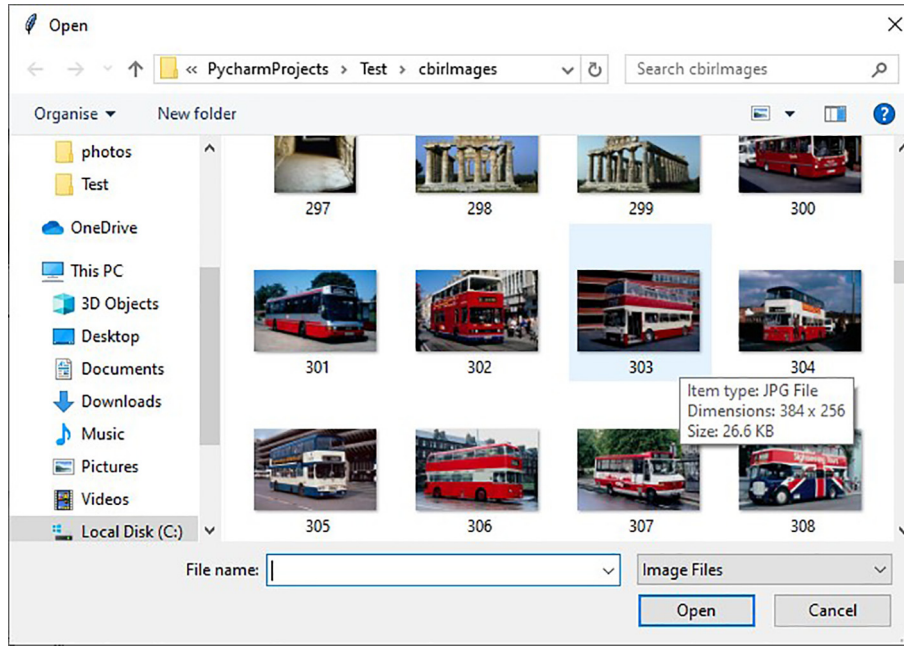


Fig. 3.

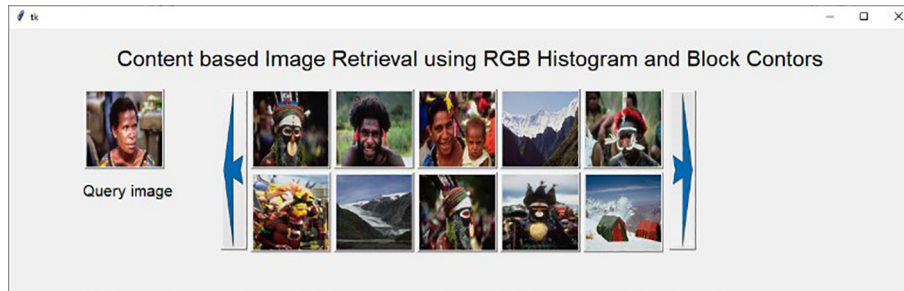


Fig. 4.

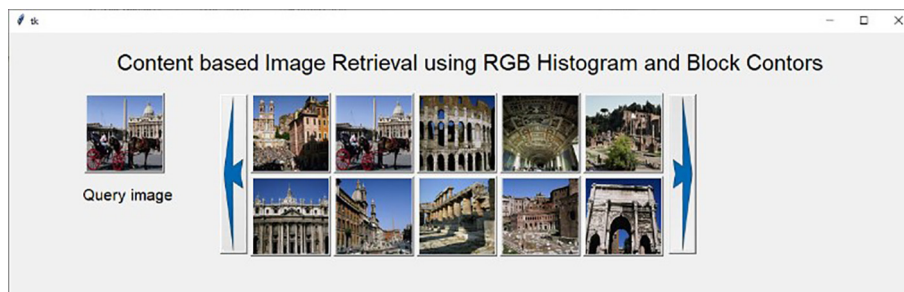


Fig. 5.

is smaller, but computational cost will increase abruptly, the accuracy will be greater. In Figs. 3 to 15, the overall average accuracy and recall values are shown for each blocks of all types of categories [21]-[24].

The proposed RGB based histogram & block contour approach in improving the performance of the CBIR system is developed as .m file along with its sub-routines using different tool boxes available in the Matlab environment. The developed .m files are run and the test question picture is inputted to the algorithm after which the image retrieval process is initiated and the results are observed (Figs. 2 to 15) [2528].

7. Simulation results

Simulations were carried out in the Matlab environment & the developed program was run, simulation results were observed and finally justifications were done and compared with the work done by other authors. The Fig. 2 shows sample images taken from the C drive as the query images to the algorithm. The Figs. 3 to 15 gives the query image and its resultant images for different types of queries such as man / man, monument / monument, dinosaur / dinosaur, elephant / elephant, horse/horse, scene/scene. The simulation is repeated for Buildings, Bus, Butterfly, Elephant, Dinosaur,

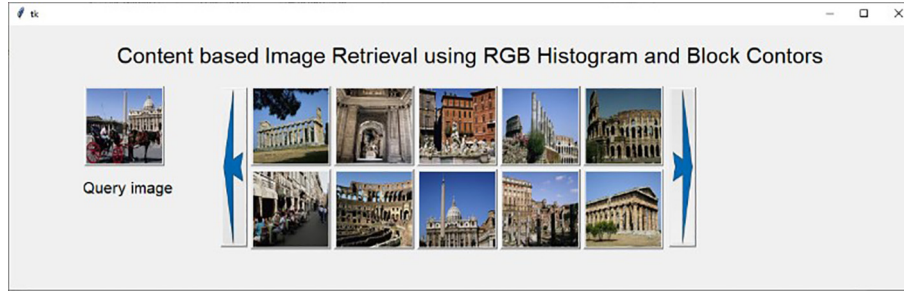


Fig. 6.

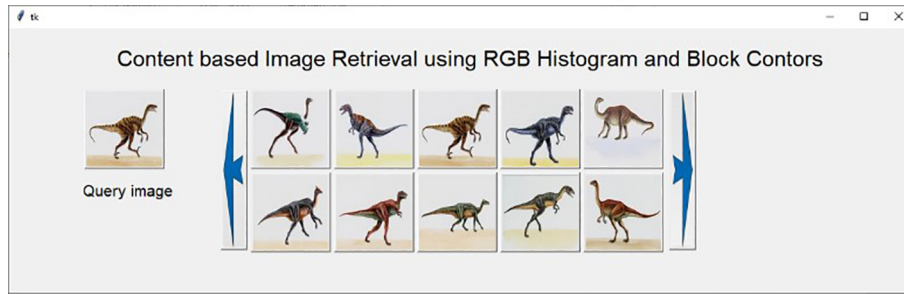


Fig. 7.

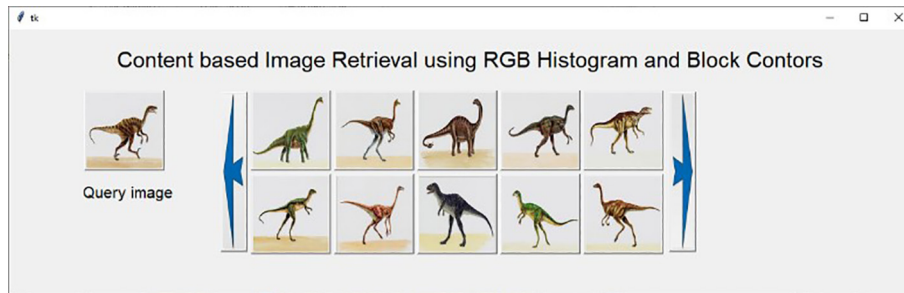


Fig. 8.

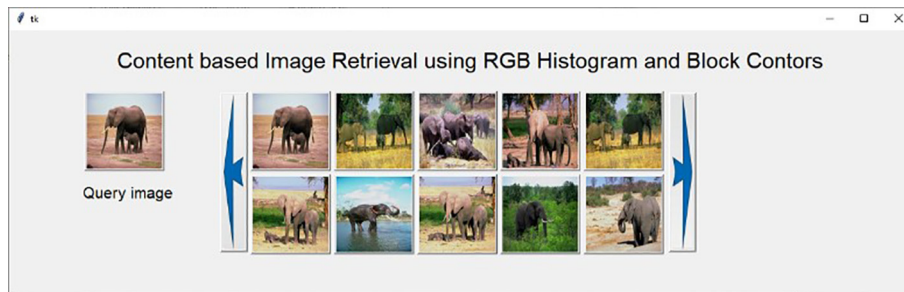


Fig. 9.

Flower, Horse, Food, Horse & the Mountain [2932]. The results are tabulated in the form of a quantitative table as shown in Tables 1 & 2 respectively, where the first table shows the performance characteristics of the image retrieval process w.r.t. precision & the second table shows the performance characteristics of the image retrieval process w.r.t. the recall parameter [3336].

8. Conclusions

This contributory work presented a novel method of image retrieval by combining different features of the query image with the help of RGB histograms & the block contours. These systems are tested with various query images for each category and corre-

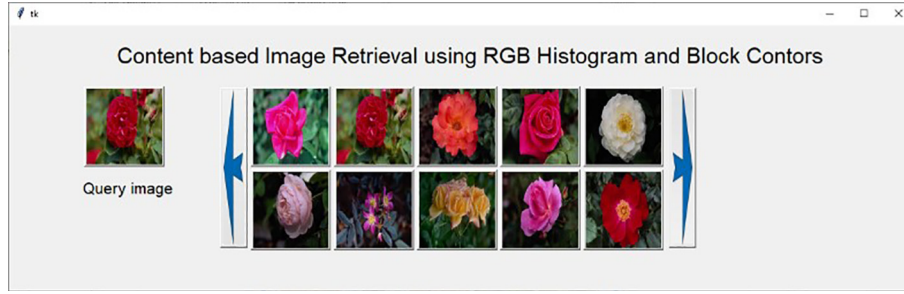


Fig. 10.

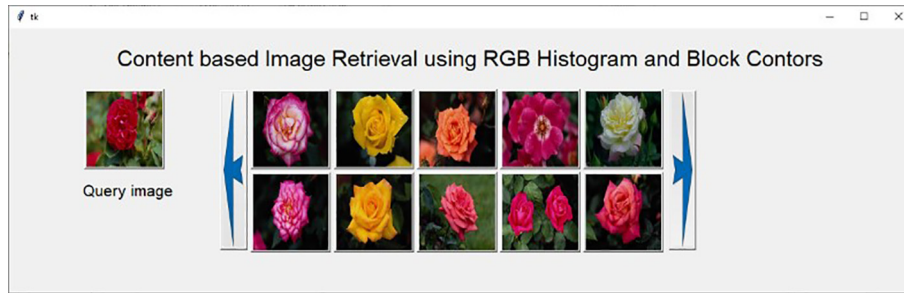


Fig. 11.

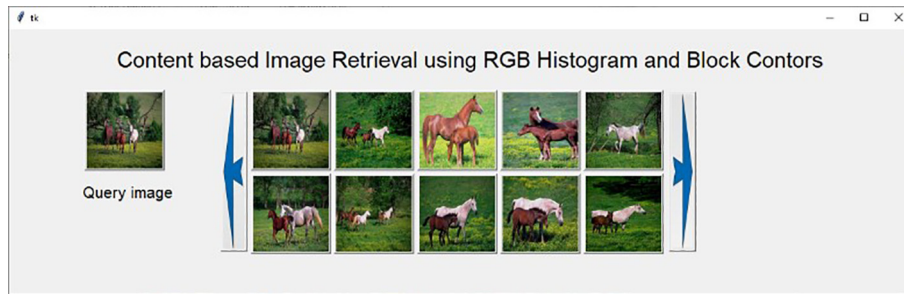


Fig. 12.

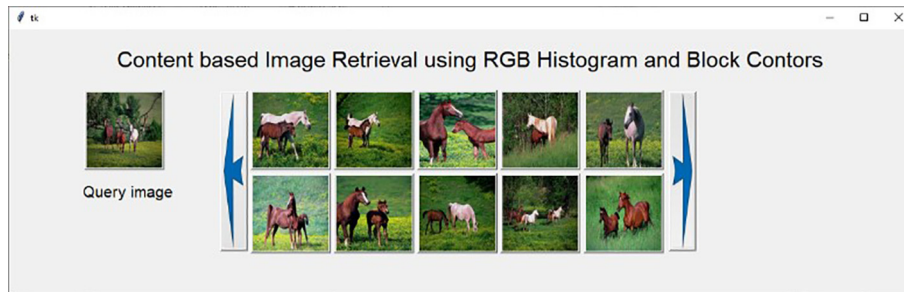


Fig. 13.

sponding results were tabulated. Here, in this proposed work with the variation in the size of the blocks & the no. of feature parameters & the time that is required for extracting the image features, which could be found out & also the recall & precision parametric characteristics could be calculated and compared with existing systems. The precision and recall are used to calculate the performance of the designed system. Tables 1 & 2 shows the recall / precision values of the proposed and existing CBIR systems, which

shows the efficacy of the proposed methodology that is superior. The assumption here is that the efficiency of the system proposed is superior to the current schemes. Finally, to conclude, it could be iterated that this contributory work was developed to show about the RGB histogram & block contour concept involvement to extract the different features of the images and carry out the performance of the framework of retrievals. The simulation results indicate that the retrieval system has better efficiency over all the others.

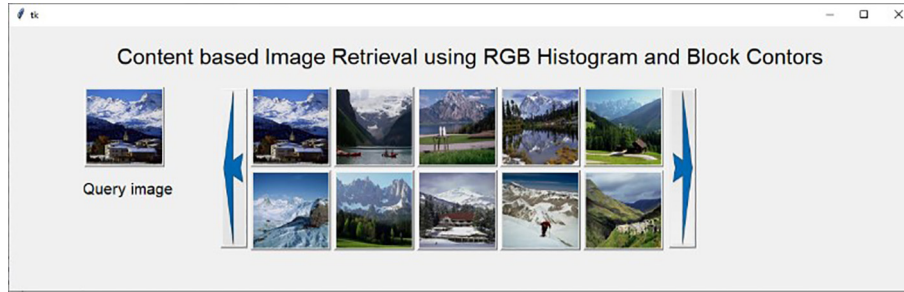


Fig. 14.

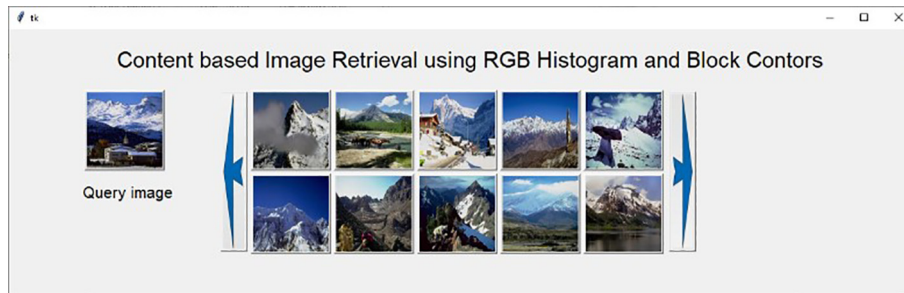


Fig. 15.

Table 2

Performance characteristics of the image retrieval process : Recall.

Class	Proposed	Purohitet.al. [35]	Chuenet.al. [31]	Jhanwaret.al. [32]	Hung and Dai's [33]
BUILDINGS	0.765	0.662	0.174	0.127	0.132
BUS	0.755	0.721	0.141	0.115	0.126
BUTTERFLY	0.6	0.559	0.121	0.092	0.099
DINO	0.977	0.978	0.101	0.072	0.104
ELEPHANT	0.544	0.559	0.149	0.132	0.119
FLOWER	0.735	0.715	0.132	0.129	0.122
FOOD	0.593	0.584	0.112	0.087	0.093
HORSE	0.743	0.773	0.134	0.102	0.103
MOUNTAIN	0.593	0.621	0.213	0.135	0.152
SUNSET	0.689	0.633	0.192	0.121	0.113
Average	0.6994	0.6805	0.146	0.111	0.116

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgement

The research work was helped by VTU Research Centre, Dept. of Electronics & Communication Engg., Rao Bahadur Y Mahabaleswarappa Engineering College (RYMEC), Ballari, Karnataka and Visvesvaraya Technological University, Belagavi, Karnataka.

References

- [1] K.J. Avneet Kaur, Chhabra, A Comprehensive Survey of Modern Content Based Image Retrieval Techniques, *Int. Jour. of Comp. Sci. & Info. Technologies* 5 (5) (2014) 6127–6129.
- [2] Srikanth Redrourthu, K. Annapurani, "Time Comparison of Various Feature Extraction of Content Based Image Retrieval", *IJCST- Int. Jour. of Comp. Sci. & Info. Technologies* 5 (2) (2014) 2518–2523.
- [3] Neelima Bagri, Punit Kumar Johari, "A Comparative Study on Feature Extraction using Texture and Shape for Content Based Image Retrieval", *Int. Jour. of Adv. Scie. & Tech.*, Vol. 80, ISSN: 2005-4238, pp. 41-52, 2015.
- [5] Ahmad Alzu'bi, Abbas Amira, Naeem Ramzan, Semantic content-based image retrieval: A comprehensive study, *J. Vis. Commun. Image, R.* 32 (2015) 20–54.
- [6] Mukul Majhi and Sushila Maheshkar, "Privacy Preserving in CBIR Using Color and Texture Features", *Fourth IEEE Int. Conf. on parallel, Distributed & grid computing (PDG)*, Wagnaghat, India, pp. 276-281, 2016.
- [7] Jayant Mankar, Anjulata Sahu, Kanchan Harode, Megha Pawase, NishaTitarmare, Rima Karad bhajne, Soumya Katti, "CBIR Based on Color and Texture Features using DCT and DWT", *Int. Jour. of Engg. & Adv. Res. Tech.* (IJEART) ISSN: 2454-9290, Volume-2, Issue-4, April 2016.
- [8] Arun Singh Chouhan, Prabhleen Kaur, Saroj Bala, Literature Survey on Latest trends in Content Based Image Retrieval (CBIR) Applications by Indian Authors in year 2015, *Int. Jour. of Computer Trends & Tech. (IJCTT) – Vo. 31 No. 2* (2016) Jan.
- [9] Reeta Janet Jessy I, Mrs. N. Bindu M.E., N. Rajkumar, "Color Co-Occurrence and Bit Pattern Feature Based CBIR", *Int. Jour. of Scientific & Engg. Res.*, Volume 7, Issue 3, March-2016.
- [10] Rajkumar Jain, Punit Kumar Johari, "An Improved Approach of CBIR using Color Based HSV Quantization and Shape Based Edge Detection Algorithm", *IEEE Int. Conf. Recent Trends In Electronics Info. Communication Tech.*, May 20-21, 2016, India.
- [11] Kratika Sharma and Sanjeev Jain, "Performance Measurement of CBIR Systems Based on different Techniques and Global Features", *IJCSNT*, Vol. 5, No. 1, 2016.
- [12] Vidya Kalpavriksha, Laxmi Kullur, "A Comprehensive Survey of Techniques / Methods for Content Based Image Retrieval System", *IJSTE – Int. Jour. of Sci. Tech. & Engg.* 3 (11) (May 2017).
- [13] Avaniish Tiwari, Anurag Jain, A Collaborative Approach to Enhance CBIR Performance using DCT, DST and Kekre's Transform, *Int. Jour. of Comp. Applications* 114 (18) (Mar. 2015) 6–10.

- [14] Xirong Li, Cees G.M. Snoek, Marcel Worring, Learning Social Tag Relevance by Neighbor Voting, *IEEE Trans. on Multimedia*, Nov. 11 (7) (2009) 1–10.
- [15] Moments Bo Fu, Jin Liu, XiuXiang Fan, Yi Quan, "A Hybrid Algorithm of Fast and Accurate Computing Zernike", Fourth Int. Conf. on Fuzzy Systems & Knowledge Discovery (FSKD 2007), IEEE Computer Society, Haikou, pp. 268–272, 2007.
- [16] Songhe Feng, Zheyun Feng, Rong Jin, Learning to Rank Image Tags With Limited Training Examples, *IEEE Trans. on Image Processing* 24 (4) (Apr. 2015) 1223–1234.
- [17] Md. Khalid Imam Rahman, M.A. Ansari, Amit Kumar Goel, An Efficient Indexing Algorithm for CBIR 2015 Communication Technology Ghaziabad, India 73 77
- [18] Harsha Vardhan, S.Visweswara Rao, "GLCM architecture for image extraction", Int. Jour. of Adv. Res. In Electronics & Com. Engg., IJARECE, Vol. 3, Issue 1, pp. 75–82, Jan. 2014.
- [19] Alireza Khotanzad And Yaw Hua Hong, "Invariant Image Recognition by Zernike Moments", *IEEE Trans. on Pattern Analysis & Machine Intelligence*, Vol. 12, No. 5, pp. 489–497, May 1990.
- [20] Purohit Shrinivasacharya, M.V. Dr, Sudhamani, "Retrieval of Images from WWW using Content Based Retrieval Techniques and Annotations", Ph.D. Thesis, VTU-Visvesvaraya Technological University, Institute of Technology, Bengaluru, Karnataka, Jun, 2015.
- [21] Simon Ximmeng Liao, "Image Analysis by Moments", Ph.D. Thesis, Dept. of Electrical & Computer Engg., The Univ. of Manitoba, Winnipeg Manitoba Canada, 1993.
- [22] Nagaraj B.G. & H.S. Jayanna, "Multilingual speaker identification", Ph.D. Thesis, Dept. of ECE, Siddaganga Inst. of Tech., Tumkur, Karnataka, India, May 2014.
- [23] Faouzi Alaya Cheikh, MUVIS: A System for Content-Based Image Retrieval M.S. Thesis, Tampere Univ. of Tech, Korkeakoulunkatu, Kampusareena, Tampere, Finland, 2004.
- [24] Yixin Chen, "A machine learning approach to content-based image indexing and retrieval", The Pennsylvania State Univ., The Graduate School, Dept. of Comp. Sci. & Engg., Ph.D. Thesis, Aug. (2003).
- [25] Yi Li, Linda G. Shapiro, "Object and Concept Recognition for Content-Based Image Retrieval", Ph.D. Thesis, Univ. of Washington, USA, 2005.
- [26] T. Dharani and I. L. Aroquiaraj, "A survey on content based image retrieval", Int. Conf. on Pattern Recognition, Informatics & Mobile Engg., Salem, Tamil Nadu, pp. 485–490, 2013.
- [27] Ying Liu, Dengsheng Zhang, Lu. Guojun, Wei-Ying Ma, A survey of content-based image retrieval with high-level semantics", *IEEE Transactions on Pattern Recognition* 40 (1) (Jan. 2007) 262–282.
- [28] C.-H. Lin, R.-T. Chen, Y.-K. Chan, A smart content-based image retrieval system based on color and texture feature, *Image and Vision Computing* 27 (6) (2009) 658–665.
- [29] N. Jhanwar, S. Chaudhuri, G. Seetharaman, B. Zavidovique, Content based image retrieval using motif cooccurrence matrix, *Image and Vision Computing* 22 (14) (2004) 1211–1220.
- [30] P.-W. Huang, S. Dai, Image retrieval by texture similarity, *Pattern recognition* 36 (3) (2003) 665–679.
- [31] Manimala Singha and K.Hemachandran, "Content Based Image Retrieval using Color and Texture", *Signal & Image Processing : An International Journal (SIPIJ)*, Vol.3, No.1, pp 39–57, February 2012.
- [32] Purohit Shrinivasacharya, M.V. Dr, Sudhamani, "Extraction of Texture with Wavelet Transforms and HSI Color Features Technique for Content Based Image Retrieval", *International Journal of Computer Information Systems* 12 (3) (2016) 1–28.
- [33] Lalith Agarwal, Anilpatidar, "Survey on Content Based Image Retrieval Techniques", *IJCSIT International Journal of Computer Science and Information Technologies*, Vol. 6, No. 5, ISSN 0975-9646, 4822–4824, 2015.
- [34] Khan W., Kumar S., Gupta N., and Khan N., "A Proposed Method for Image Retrieval using Histogram values and Texture Descriptor Analysis", *IJSCE*, ISSN: 231–2307, Volume-I Issue-II, May 2011.
- [35] Gulfishan Firdose Ahmed and Raju Barskar "A Study on Different Image Retrieval Techniques in Image Processing", *International Journal of Soft Computing and Engineering (IJSCE)*, ISSN: 2231–2307, Volume-1, Issue-4, September 2011.
- [36] Neha Sharma, Retrieval of Image by Combining the Histogram and HSV Features Along with Surf Algorithm, *International Journal of Engineering Trends and Technology* 4 (7) (July 2013).
- [37] Rajkumar Jain, Punit Kumar Johari "An Improved Approach of CBIR using Color Based HSV Quantization and Shape Based Edge Detection Algorithm", *IEEE International Conference on Recent Trends In Electronics Information Communication Technology*, May 20–21, 2016, India.

Further Reading

- [4] Bhoomika Gupta Shilky Shrivastava Manish Gupta, "Optimization of Image Retrieval by using HSV Color Space, Zernike Moment & DWT Technique", *IEEE Int. Conf. on Computational Intelligence & Computing Research (ICCIC)*, Madurai, pp. 1–5, 2015.
- [22] Michael Vorobyov, Shape Classification Using Zernike Moments, Ph.D. Thesis, Aug. (2011).
- [23] Ruba A.A. Salamah, Ibrahim S.I. Abuhaiba, Efficient Content Based Image Retrieval, *Islamic University – Gaza, Computer Engg. Dept., M.S. Thesis* (2010).
- [27] Mgr. Pavel Vacha, Ing. Michal Haindl, "Query by Pictorial Example", Charles Univ., Prague, Mathematics and Physics Dept. of Software Eng., Ph.D. Thesis, 2004