A PERFORMANCE AWARE CONTENT BASED IMAGE RETRIEVAL (CBIR) TECHNIQUE

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Abstract: The increased pace in the digital media has gained lot of buzz in modern technology for images and videos storage. The digital images contain important information and its processing is a biggest task. Also, storing and retrieving these large sized digital image leads to higher response time which causes performance degradation. Further detection and examining of the image content is a major concern. Hence, this manuscript introduces a performance aware CBIR technique. Here, Chest X-ray image retrieval is performed by considering similarity score. The X-ray image is subjected to the ground truth divisions based on discrete wavelet transform (DWT) and Bhattacharya coefficient for image retrieval. To analyze the image contents, a grey-level co-occurrence matrix (GLCM) based technique is incorporated with CBIR that gives texture of histopathological image with specific pair of pixel values. The study computes the GLCM contrast and correlation values to retrieve the histopathological image. These proposed technique helps to improve the retrieval performance and analyze the similarity factors of the database images. This performance aware CBIR technique offers better feature extraction and accurate image retrieval than existing techniques.

Key words: Image detection, CBIR, GLCM, DWT.

1. INTRODUCTION

Early image retrieval systems depended on literary explanation of images. By utilizing content depictions, images can be organized by topical or syntactic grouping to rearrange route and skimming on the premise of standard Boolean inquiries. It was very much conceded that a more refined and direct technique to show and record optical data would be based upon the basic attributes of the images themselves. CBIR is actualized utilizing the optical constituents of an images, for

example, shape, shading, spatial format, and surface to show and record the images. In CBIR, the visual parameters of the images are eliminated and can be represented through multi-dimensional vectors. These vectors form the stable database for the images. In order to perform the image retrieval, the contents of the image are considered as features. The use of CBIR technique can differentiate the similarity features of the image in terms of vector representation. The similarity among the component vectors of the query image and database images are considered to retrieve matching images by using features indexing. The indexing plan gives a productive way to deal with look at the images database.

One of the essential issues in CBIR is powerful indexing and speedier images retrieval on the premise of optical attributes. Since the element vectors of images have a tendency to have high dimensionality and consequently, they are not appropriate for ordinary indexing structures, measurement decrease is generally done before setting up a successful indexing plan. PCA is additionally one of the strategies generally utilized for measurement diminishment. In this strategy we directly delineate information to a direction space, so that the tomahawks are adjusted to mirror the most extreme varieties in the information. Thus, the manuscript introduces a performance aware CBIR technique to enhance retrieval performance of medical image. Finally, the categorization of manuscript is performed as; review of literature (Section-2), problem description (Section-3), proposed CBIR technique (Section-4), results analysis (Section-5) and conclusion (section-6).

2. LITERATURE SURVEY

The existing works addressing different CBIR based technique for image processing. A work of Rosu et al., [1], presented a CBIR technique for remote sensing (high-resolution) images. The author has compared the texture discrimination feature with existing research and found more effective in terms of performance enhancement. In Zheng et al., [2] a breast cancer diagnosis mechanism is presented by considering whole slide images (WSI) for CBIR based retrieval. In Huang et al., [3] have considered security threats over CBIR and introduced a Privacy protection mechanism. The mechanism composed of different stages of protection like private query, feedback and local retrieval stages. The mechanism found more effective in privacy protection of CBIR technique. To integrate contour and colour information, Lakovidov et al., [4] have presented an image descriptor for CBIR technique. The descriptor scheme is effective and found more specifically it does not require data training for parameter adjustment.

The available CBIR techniques need decoded input images and it leads to higher computational complexity for large scale CBIR data. Hence, Byju et al., [5] have introduced a CBIR system that achieves image description and accurate image retrieval in partially decoded images. The CBIR technique for WSI database and query interest image is given in Zheng et al., [6]. Every WSI is encoded as matrix of

binary code and outcomes with better retrieval performance. The work of Xia et al., [7] have given a privacy aware CBIR technique that offers data owner to use the CBIR service over the cloud without revealing the image content to the server. The outcomes suggests that the security and efficiency is enhanced that existing technique.

In Xiang et al., [8], a deep hashing and multi-task learning based CBIR technique is introduced and it is found more significant than existing techniques of CBIR. The work of Arai et al., [9] have presented a CBIR technique for clinical brain images by adapting pseudo-scanner standardization and out forms better image retrieval. To identify the impact of visual saliency in CBIR, Wei et al., [10] have conducted quantitative and qualitative analysis. The performance is enhanced during retrieval over public datasets. Another work of Andres et al., [11] have given traditional Neural Network (NN) based CBIR and found effective than existing technique.

In Liu et al., [12], a large-scale mammogram database is used for CBIR and the given CBIR technique offers effective retrieval for clinical images. The use of CBIR for brain MRI image is found in Swati et al., [13] and achieves lower pre-processing time and effective results on CBIR over cross validation concerns. Further, Khan et al. [14] have elaborated the texture descriptor for image retrieval and achieved highest average precision from texture orientation and magnitude to retrieve. A work of Ferreira et al., [15] have described an encryption mechanism incorporated with CBIR to enhance security in retrieval. The outcomes have suggested that incorporation of encryption mechanism offers secure and efficient retrieval.

A supervised deep learning approach is given in Rossi et al., [16] that handles the Multiview and multimodal MRI image retrieval. The approach achieves improved retrieval performance than existing system. The work focusing on object level regions is observed in Brogan et al., [17] and introduced a spatial verification for retrieving. The system outcomes with accurate and better retrieval by using image key points obtained from image index. In Ahmed and Malebary [18], two expansion approaches are used to enhance CBIR precision than existing approaches. Similarly, other researches like Liu et al., [19] have introduced secure CBIR for mobile users, Ilida and Kiya [20] given privacy preserve CBIR, Kang et al., [21] have given Preserving Hashing for SIFT Feature in retrieval, Ma et al., [22] presented Breast Histopathological Image Retrieval, Erfankhah et al., [23] expressed Binary Patterns for Retrieval of Histopathology Images, Chaudhuri et al., [24] proposed remote sensing image retrieval and D'Angelo et al., [25] have presented eddy current testing (ECT) based CBIR.

3. PROBLEM DESCRIPTION

The researches in image processing with CBIR has gained lot of interest for feature extraction, disease diagnosis of unannotated image database. Also, upon the area of interest of the database image is difficult to retrieve. Another concern of

CBIR take place when the database being referred to comprises of images of an unequivocally confined space. One generally examined use of this multifaceted nature is retrieval of trademark images, principally in light of various shape highlights as the absence of foundation empowers programmed division of these images. Also, recovering significant images from expansive and element accumulations of incidental images is major concern. The essential issue in CBIR is the gap between the abnormal state semantic ideas utilized by people to comprehend images content and the low-level visual components extricated from images and utilized by a PC to record the images in a database. From recent work analysis it is observed that, existing works are lacking with comparative analysis, rare consideration of precision and medical images for retrieval. Thus, the problem is that "a performance aware CBIR technique is necessary". The novelty of the proposed CBIR technique is:

- The Chest X-ray image is subjected to the ground truth divisions based on discrete wavelet transform (DWT).
- To extract horizontal, vertical and diagonal properties from DWT.
- Introduce Bhattacharya coefficient for image retrieval.
- Chest X-ray image retrieval is performed by considering similarity score.
- To develop a scalable digital image retrieval using CBIR method to handle intelligently with huge histopathological digital images.
- To develop GLCM based image retrieval by GLCM contrast and correlation.

Finally, to extracting similarity features of database image matching to query image.

4. PROPOSED CBIR TECHNIQUE

The manuscript aims to introduce a performance aware CBIR technique to enhance medical image retrieval performance (as shown in Figure.1). For Chest X-ray images, a sophisticated computerised lung division system introduced. The proposed system composed of three stages, initially a CBIR choose a small group of Chest X-ray images which are same as patient X-ray images. These images are pre-processed to retrieve by subjecting to discrete wavelet transform (DWT). The 2D-DWT helps to extract the low frequency coefficient features of image and are categorized as Low Frequency (LL) sub band image, Horizontal features (LH) of query image, Vertical features (HL) of query image and Diagonal feature (HH) of query image. Further, horizontal and vertical features summation is performed for better analysis. Later, horizontal and vertical projection is performed for all column pixels of query image within the column and horizontal pixels of query image along the horizontal axis respectively. Further, the Bhattacharya coefficient to retrieve the query image. The inclusion of Bhattacharya coefficient helps to pattern and contrast matching of the image for similarity among the trained and query image. The similarity value of all the images is computed and are sorted to get best matching image. Finally, the images are retrieved at high accuracy. The architecture (Figure.1) considers both Bhattacharyya and GLCM based CBIR and is mentioned for better

understanding purpose. The study has not considered any processing power in CBIR, however the power may vary with feature extraction process. The study has compared with two different benchmarked works in [26] (Bhattacharya distance based CBIR) and (GLCM based CBIR) [27].

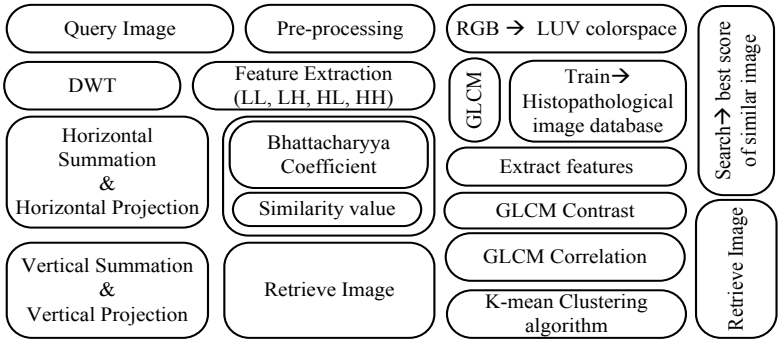


Fig. 1. Architecture of Proposed CBIR Technique

To find the matched image and retrieve using GLCM approach, a query image is taken as an input. Then the image is converted into RGB to LUV image. From the extracted LUV image, Luminance (L) image is considered for analysis and is used to calculate the GLCM contrast and correlation. After obtaining the GLCM contrast and correlation coefficients. The histopathological database images are trained to extract the GLCM features. Further, to classify the trained image with query image, a K-means clustering algorithm is utilized. The features matching with the query images are sorted out by using GLCM algorithm and obtained the similar images matching to the query image. The below part explains the algorithms implemented for proposed CBIR technique.

Algorithm for CBIR using DWT and Bhattacharyya Coefficient

Input → Query image
Output→ Retrieved images
Start
Step-1: Choose→ Query image (X-ray image)
Step-2: Apply→ Haar DWT on Query image
Step-3: Extract features → DWT coefficients (LL, LH, HL, HH)
Step-4: Perform → horizontal summation (Row wise) & projection
Step-5: Perform→ vertical summation (Column wise) & projection
Step-6: Retrieve → data base images
Step-7: Compute→ Similarity value (Bhattacharya coefficient)
Step-8: Collect → similar retrieved image
End

The algorithm for CBIR using DWT and Bhattacharyya coefficient is initialized with selection of Query image (Step-1) i.e., chest X-ray image from database and resized it for analysis. Further, hear DWT technique (Step-2) is applied on query image to extract image features Low Frequency (LL) sub band image, Horizontal

features (LH), Vertical features (HL) and Diagonal feature (HH) (Step-3). Later, horizontal Further, horizontal and vertical features summation is performed for better analysis. Later, horizontal and vertical projection is performed for all column pixels of query image within the column and horizontal pixels of query image along the horizontal axis respectively (Step 4 & 5). In order to retrieve images from database Bhattacharyya coefficient is applied which gives the similarity value is computed for all database images (Step 6 & 7). Finally, top retrieved image is collected to display (Step-8).

Algorithm for CBIR using GLCM and K-mean algorithm

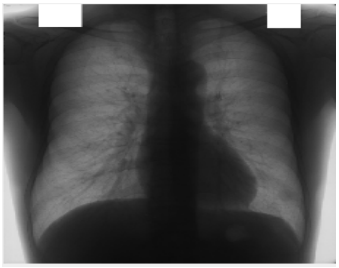
Input: Query image
Output: Matching images
Start
Step-1: Choose → Query image
Step-2: Convert→ RGB (Query image) to LUV color space
Step-3: Extract → Luminance (L) value from LUV
Step-4: Apply → GLCM based CBIR over (L)
Step-5: Compute→ Contrast and Correlation value
Step-6: Train (Database) using K-mean algorithm
Step-7: Search → matched image
End

Bhattacharyya distance and relative entropy are both divergences i.e., both always take non-negative values, with a value of zero if and only if the two distributions are identical. However, neither is a true distance metric, which must additionally satisfy the triangle inequality (which neither measure does) and be symmetric. Bhattacharyya distance is symmetric ($B(p,q)=B(q,p)$), whereas relative entropy is not ($R(p\|q)\neq R(q\|p)$). The meaning of $R(p\|q)$ is different than $R(q\|p)$, and it matters a great deal which one we use. As relative entropy is not symmetrical in identifying similarity between two images, the proposed approach doesnot considered relative entropy. The algorithm for CBIR using GLCM is initiated by considering one of the histopathological images as query image (Step-1). The same image is subjected to LUV conversion from RGB for multispectral image color (Step-2). Further, the luminance (L) value from the LUV color space is extracted for better analysis of retrieval (Step-3). Then, GLCM algorithm is applied to 'L' image for computation of GLCM contrast and correlation (Step 4 & 5). Later, the histopathological image database is trained by applying K-mean algorithm (a unsupervised algorithm) for retrieval purpose. The K-mean algorithm does the segmentation of the interest area from the background (Step-6). Finally, search the matched image respect to matched image (Step-7).

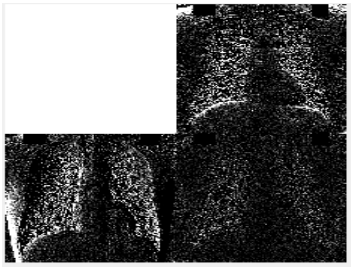
5. RESULTS AND DISCUSSION

The proposed CBIR technique is designed by using MATLAB for medical images. There are two different algorithms are introduced where a) Bhattacharyya

coefficient and DWT techniques are used and b) GLCM algorithm and K-mean algorithm. Two set of databases are used for the analysis of CBIR one is chest radiological image and histopathological image. The outcomes are retrieved for CBIR based on its features similarity and extracted the matched image. The following image is selected from chest X-ray database as query image (Figure.2 (a)) and DWT is applied and its coefficient is given in Figure.2 (b).



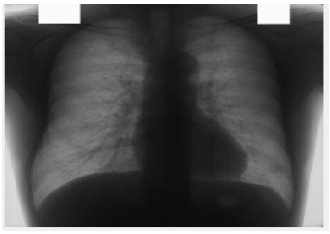
(a) Input image



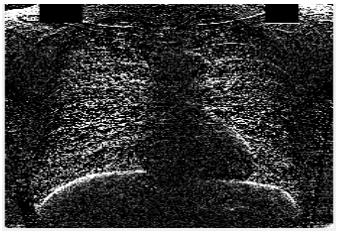
(b) DWT coefficient

Fig. 2. Query image

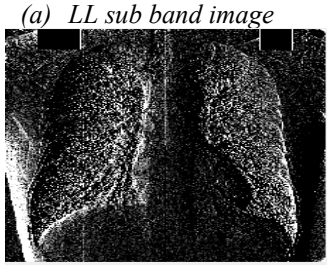
The extracted features from the query image are Low Frequency (LL) sub band image, Horizontal features (LH), Vertical features (HL) and Diagonal feature (HH) are given in Figure.3.



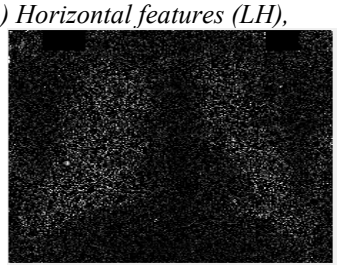
(a) LL sub band image



(b) Horizontal features (LH),



(c) Vertical features (HL)



(d) Diagonal feature (HH)

Fig. 3. Extracted features from query image

The similarity score or Bhattacharyya coefficient for all the database values are computed and analysed for retrieval (Figure.4). The top retrieved image or matched image are taken for visualization. The higher value of similarity score gives the appropriate retrieved image with query image.

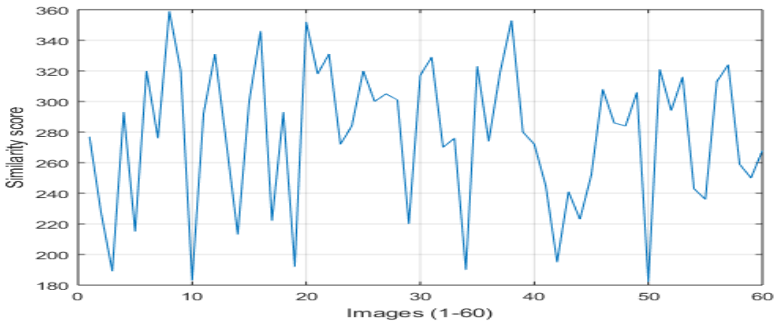
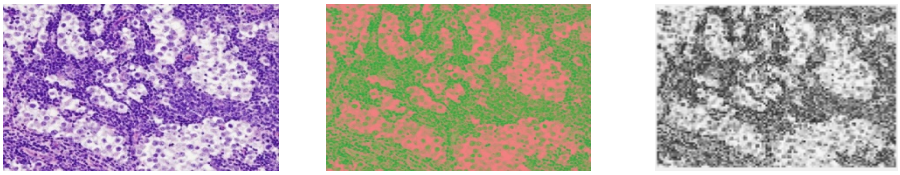


Fig. 4. Similarity value of retrieved image

From Figure.4, it is observed that image-8 is having highest similarity score of 359 while other images like image-20, image-37 are exhibits other similarity score of 352 and 353 respectively. Similarly, analysis for the feature matching of histopathological image is performed by selecting a query image from database as shown in Figure.5 (a). The respective LUV color space image is given in Figure.5 (b) and 5 (c) Luminance (L) image.



(a) *(b)* *(c)*

Fig. 5. (a) Input histopathological input image and (b) respecting LUV color space image and (Luminance image)

The computed GLCM contrast and correlation are given in Figure.6 which includes horizontal offset values of image alignment.

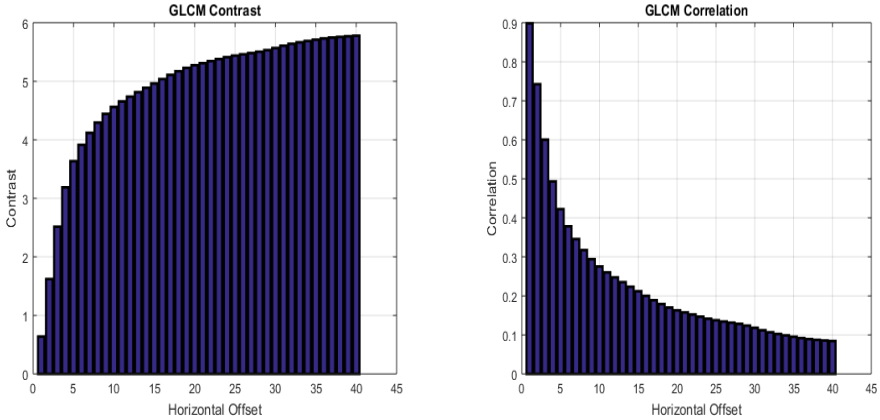


Fig. 6. GLCM contrast and correlation against horizontal offset

Finally, after training are retrieving the database images the feature similar images and non-similar images are given in Figure.7. The similarity score ranges from 0 to 1 where 14 images are similar to the query image.

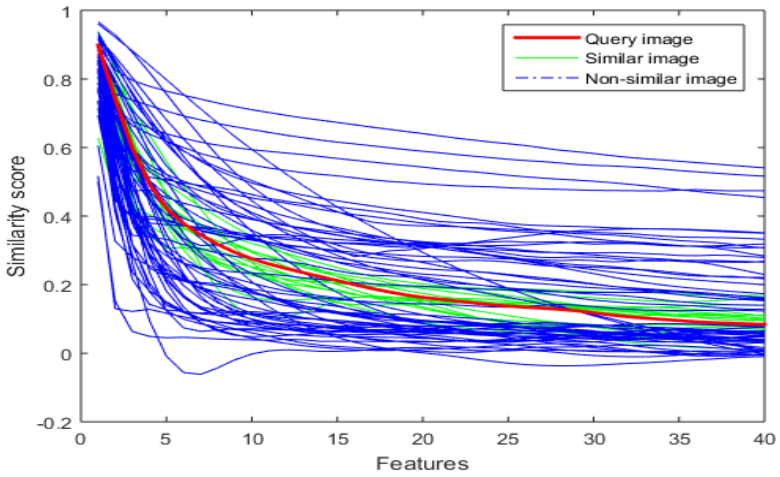


Fig. 7. Features matching images

The performance analysis of the proposed study is conducted by considering the recent work of Shivamurthy and Manjunatha [26] where it has achieved highest similarity score of 351. From the analysis it is observed that the proposed CBIR has highest similarity score.

Table 1. Similarity score analysis

Parameter/ Approach	***Highest Similarity Score***
Shivamurthy and Manjunatha [26]	*351*
Proposed CBIR Technique	*359*

Similarly, the proposed study is compared with Alnihoud [27] for precision (87%) and is given in table.2. From, the analysis it is observed that the proposed study has achieved 97% of precision which is higher than existing [27].

Table 2. Comparison of precision

Parameter/ Approach	***Precision***
Alnihoud [27]	*87%*
Proposed CBIR Technique	*97%*

6. CONCLUSION

The This paper introduces a performance aware CBIR technique to enhance medical image retrieval performance. Here, Chest X-ray image retrieval is performed by considering similarity score. The X-ray image is subjected to the ground truth divisions based on discrete wavelet transform (DWT) and Bhattacharya coefficient for image retrieval. To analyse the image contents, a GLCM based

technique is incorporated with CBIR that gives texture of histopathological image with specific pair of pixel values. The performance analysis of the proposed study is conducted by considering the recent work of Shivamurthy and Manjunatha [26] where it has achieved highest similarity score of 351. From the analysis it is observed that the proposed CBIR has highest similarity score. Similarly, the proposed study is compared with Alnihoud [27] for precision (87%) and is given in table.2. From, the analysis it is observed that the proposed study has achieved 97% of precision which is higher than existing [27].

The proposed technique can be a significant CBIR technique in medical image and feature extraction for disease analysis. The future study of the proposed work can be considered with different supervised techniques Support Vector Machine (SVM), fuzzy logic etc. Security aspect can be incorporated in the future works.

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