CONTENT BASED MEDICAL IMAGE RETRIEVAL SYSTEM BASED ON MULTI MODEL CLUSTERING SEGMENTATION AND MULTI-LAYER PERCEPTION CLASSIFICATION METHODS

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Abstract

Content-based Medical Image Retrieval (CBMIR) has been active in the research field over the past few years. A CBMIR system recovery's performance depends largely on some aspects, the nature of which has been studied in detail for decades. Although different strategies have been proposed, it is still one of the most challenging issues in current CBMIR research. This is mainly due to the so-called "semantic gap" between the device and the high-resolution image-low pixel capture. Today's medical images in daily practice have been increasingly created on the scale of millions. Recovering medical images from huge classifications is difficult, so it rises to the Content-Based Medical Image Retrieval System (CBMIR) system. In existing systems, images are first retrieved and then classified. Also, the retrieval rate obtained by the existing method is not ideal. Therefore in this work, a Clustering Segmentation and Multilevel Tetrolet Feature Extraction strategies are proposed to overcome the existing work drawbacks. The simulation of the proposed work is developed using Matlab simulation software. The predictive result for this work has encouraged performance, and the method is cost-effective compared to the purposes described in the literature. In terms of performance measurements, i.e., Accuracy, Precision and Recall.

Key Words: Content-Based Medical Image Retrieval, Clustering Segmentation, Multi-Level Tetrolet Feature Extraction, precision, accuracy and recall

1. Research Background

In recent years, fundamental examinations have been directed for CBIR by taking a gander at various viewpoints like feature fusion, spatial data and semantic translations [1]. Color is defined as one of the broadest vision features with an image of the frontal area and base. This is resolved as enthusiastic to the interpretation of the picture and the reversal in [2]. In [3, 4], image comprehension depends on the Edge Orientation Difference Histogram (EODH). The proposed study is resolved on a scale, turn invariant and juxtaposition. In the Mixed Scale, Invariant Feature Transform (SIFT) scatter the codebook using EODH is clearer.

In [5], the component of color and surface is a convincing technical reconstruction of the image in introducing the organization and the search process. Color by combining the two functions makes the proposed study stronger far. According to [6], there are flaws in the picture in terms of scale and perspective. The quantized RGB color space is used to deliver the color. Simultaneously, the level is set with the model's help, along with separate colors and levels provided for the current screen life. As shown in [7, 8], the sieve conductor's invariance-scale characteristics and the conductor become better current CBIR conduction and better conduction than the independent use of the sieve conductor.

Ongoing progress in image retrieval has been diverted to checking the use of binary descriptors for convergence, as they are computational representations. This is manifested in the display of [9], Local Binary Pattern (LBP) and SIFT method of hybrid upgrade picture restoration [10, 11]. The blend of the two features is picked as SIFT performs poorly in noise establishment, and LBP is represented vigorously for this circumstance [12]. As shown by [13], the early fusion with typically weighted grouping is energetic for picture healing as it keeps up equality in feature vector depiction.

The research model is introduced in [14]. This research model relies on the image arrangement structure. Simultaneously, it relies on the color and Haar transform characteristics and the image through a separator's application. Research using ratio recycling is not the same. In the past, it was based on a sequential method (preparation of test models) [15]. The primary need in any image restoration process is to sort the images in terms of outward appearance [16] and comparable nearby images. CBIR's basic idea is to go to the image relative to the image to have a warehouse query and similar coordination procedures from separate measurements.

2. Proposed CBIR System

In the medical field, digital images are increasingly being used for production, diagnosis and treatment. The rapid expansion of digital image medicine has forced an efficient content-based image recovery system to recover medical images in question-like appearance. Doctors can provide significant assistance in medical care and research through such organizations. Therefore in this work, a Clustering Segmentation and Multilevel Tetrolet Feature Extraction strategies are proposed to overcome the existing work drawbacks. Figure 1 shows the block diagram of the proposed method. The simulation of the proposed work is developed using Matlab simulation software. The predictive results for this work support performance and are a cost-effective method compared to the literature methods. In terms of performance measurement, i.e., Accuracy, Precision, and Recall, this proposed method has proven efficient.

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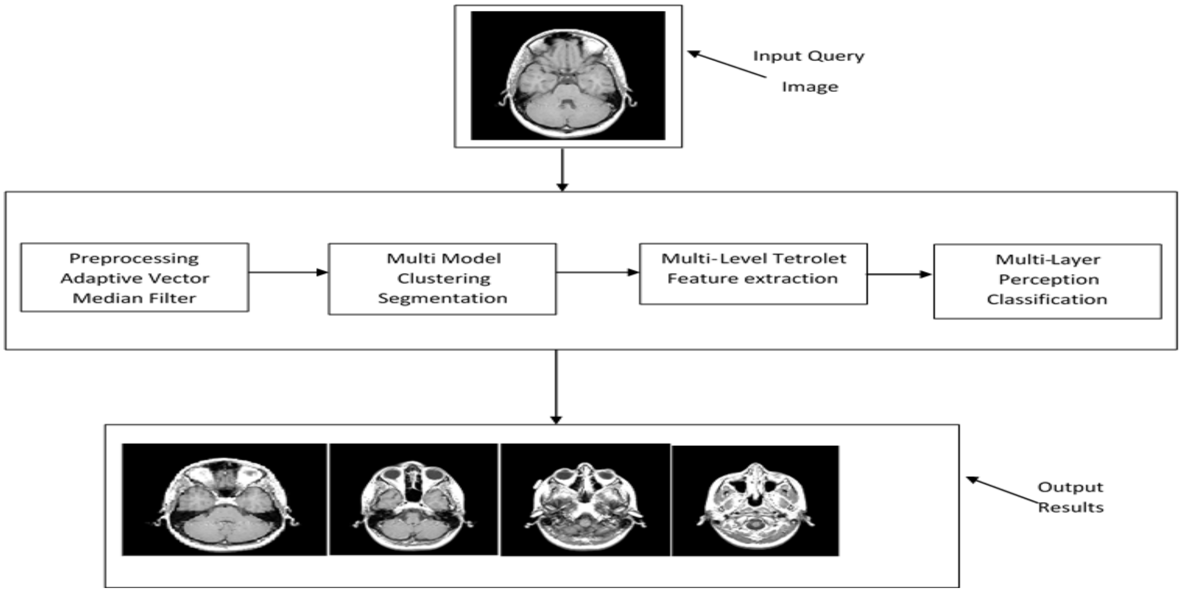

Figure 1. Block Diagram of Proposed System

2.1 Preprocessing Adaptive Vector Median Filter

The adaptive vector median filter structure is to empower the filter's adaptability to transform its size as it needs to be founded on the estimation of nearby noise thickness. The Adaptive vector median filter also permits neighborhood subtleties in the picture, which are to be safeguarded. The proposed adaptive vector median filtering technology is divided into two stages: noise identification and noise elimination. These two strategies are described in the attached subsections.

Stage 1: Noise detection is divided into two stages. The first stage is to distinguish between "noise pixels," The next one is to generally estimate the image's noise level.

Stage 2: Noise cancellation. In this stage, the filter information image f has generated a filtered image g.

The adaptive vector median filtering technique (x, y) is used to discover meters and is depicted by accompanying calculations. For each pixel area (x, y) and α (x, y) = 1 (for example, "noisy pixels"), perform the companion

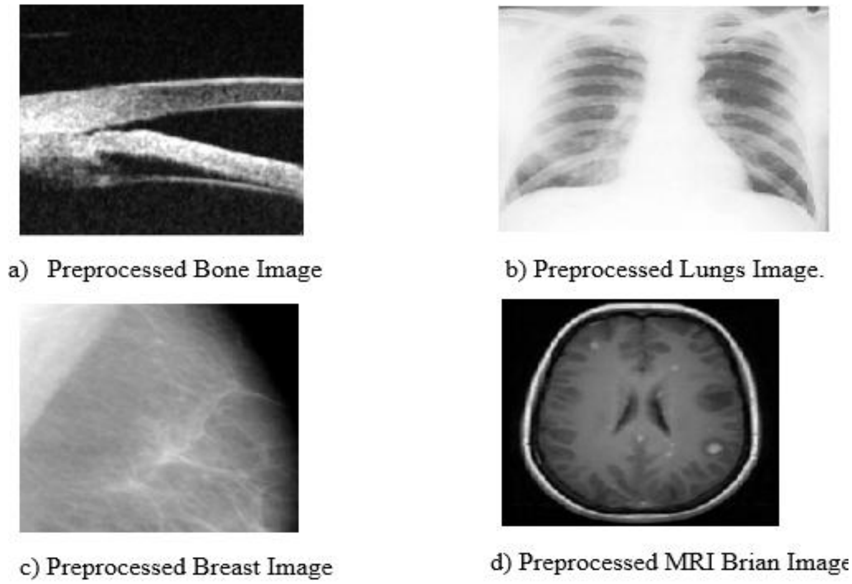

Figure.2. Result of Preprocessing images

The simulation result of the proposed adaptive vector median filter-based preprocessing is shown in Figure 2.

2.2 Multi Scale-Invariant Clustering Segmentation

The process of image segmentation is mainly influenced by two factors: feature presentation and segmentation approach. The proposed unsupervised invariant clustering method requires computing the Euclidean distance between all the input data points and Gaussian kernel for measuring density $\rho_i$of the data point i. Here, density $\rho_i$represents the points distribution nearby the data point i. The cluster centers have been enclosed using lower density and comparatively large distances from higher density points (Rodriguez *et al.*, 2014). The distance δ_i is measured by calculating the minimum distance d_{ij}among point i and the set of points j with higher density. Hence, the distance δ_i is computed using Equation 4.4.

$$\delta_i = \begin{cases} \min_j(d_{ij})\ if\ \rho_j > \rho_i \\ \max_j(d_{ij})\ if\ \rho_i\ is\ the\ highest\ density \end{cases} \qquad (1)$$

Where ρ_i , ρ_j represents the density of point i and j and δ_i is the distance.

2.2.1 MSIC Segmentation Algorithm

The following steps show the MSIC segmentation algorithm.

Input: Fused image

Output: Number of clusters

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Step 1: Read the image and obtain the representation of the input image in three color channels.

Step 2: Finding the cluster centers

2.1) Compute the density ρ and separation measure δ by using Equation (1) and Equation (2) correspondingly.

$$\rho_i = \sum_j exp^{-\frac{d_{ij}^2}{d_c^2}} \qquad (2)$$

Where d_{ij} represents Euclidean distance among data point i and j and $d_c$represents cutoff distance.

2.2) Selection of cluster centers by considering the data points with high density (ρ) and considerable distance (δ).

2.3) Assign the cluster number.

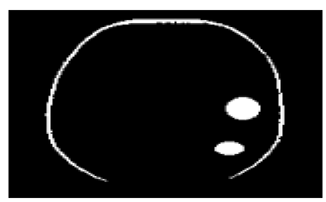
Step 4: Assign the remaining data points to the clusters.

Step 5: Complete the final segmentation based on the labels marked through the previous step.

a) Segmented Bone Image

b) Segmented Lungs Image.

c) Segmented Breast Image



d) Segmented MRI Brian Image

Figure 3: Result of Segmentation

The result of segmentation is shown in Figure 3. As we have already seen, it is rather advantageous to use different sets of features on both of these levels, rather than one set of features global rules.

2.3 Multilevel Tetrolet Feature Extraction

Multilevel Tetrolet Feature (MTF) Extraction works with the property of shape. MTF is caught as far as the edge image of each image's grayscale likeness in the database. MTF portrayal is a significantly advanced fit as a fiddle investigation and matching framework. After the shape is found and sectioned from an image, a portrayal method is utilized to describe it proficiently. The multifaceted nature and the presentation of the resulting steps fit as contrivance investigation frameworks to a great extent subject to the invariance, heartiness, steadiness, and uniqueness of the applied shape portrayal strategy

Whereas MTF is applied to a 1D shape limit. Due to the spatial and frequency restriction property of the wavelet basis capacities, wavelet descriptors are more effective in speaking to and depicting shapes than Fourier descriptors and moments. The algorithm steps of Multilevel Tetrolet Feature extraction are as per the following.

2.4 MULTI-LAYER PERCEPTION CLASSIFICATION

Multi-Layer Perception has developed as a significant technique for classification. It is a computational model that has the appearance of a human neural network. The engineering of an MLP is prepared to do any surmised work, and hence, MLP is a good decision when the capacity to be educated isn't known ahead of time. Multi-Layer Perception networks are information-driven and self-versatile techniques to alter themselves to the information, with no definite determination of practical or distributional with the fundamental model. The architecture of MLP is shown in Figure 4. The MLP is given, the contribution is taken as I_P and Is. The object of each knot is given to each knot from the shell layer.

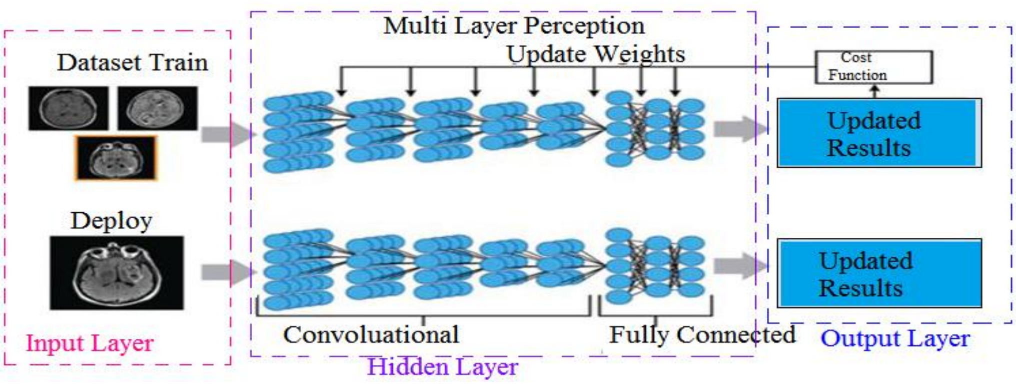


Figure 4. The architecture of the Multi-Layer Perception network

Figure 4 shows the examples given to understand this in a simplified way so that the reference image is derived based on the "Multi-Layer **Perception** Network." MLP network models are fully integrated layers of aggregation, except for the three components: convolutional, pooling, and fully connected layers. The following steps are performed in the MLP process:

2.4.1 Multi-Layer Perception network algorithm

Step1: Input query medical image.

Step 2: The Feature extraction process involves using the terolet feature extraction.

Step3: To train the extracted features to the input layer of MLP

Step6: Compare function with Euclidean distance (ED)/Canberra distance (CD) technology to query medical images from the database.

Step 7: Initialize a random number with a small weight in the hidden output layer and

$$w_{ij} = a, w_{jk} = a \qquad -1 <= a <= 1 \ \ldots 32)$$

Step 8: Fix the DI = (-1, 1) for normal and d2 = (1, -1) for abnormal

Step 9: Compute the difference between actual and error value

Output y_o and Y_i.

Step 10: Calculate the error term δj

$$\delta_j = y_j(1 - y_j)(d_j - y_j) \ \ldots (4)$$

δj in hidden layer as

$$\delta_j = y_j(1 - y_j) \sum_j \delta_k w_{kj} \ \ldots (5)$$

Step 11: Repeat the training cycle from step 2

The proposed work is to decide the nearest coordinate for the given input image from the non-applicable pictures. Accuracy is a small amount of accurately anticipated questioned clinical pictures to all projected clinical photos. The proposed system is assessed by following execution metrics for CBMIR

$$\text{Precision (Pr)} = \frac{\text{TPp}}{\text{TPp+FPp}} \ \ldots (6)$$

$$\text{Recall (Re)} = \frac{\text{TPp}}{\text{TNp+FNp}} \ \ldots (7)$$

$$\text{F}_{\text{measure}} = 2 * \frac{\text{Pr}*\text{Rel}}{\text{Pr+Rel}} \ldots (8)$$

Where

TPp = True Positive TNp = True Negative

FPp = False Positive FNp = False Negative

3. RESULTS AND DISCUSSION

The simulation results and performance analysis of the proposed content-based medical image retrieval system are discussed in this section. The simulation of the proposed work is developed using Matlab simulation software. The predictive result for this work encourages performance, and the method is cost-effective compared to the methods described in the literature. In terms of performance measurements, i.e., Accuracy, Precision, and Recall, the proposed method has proved efficient.

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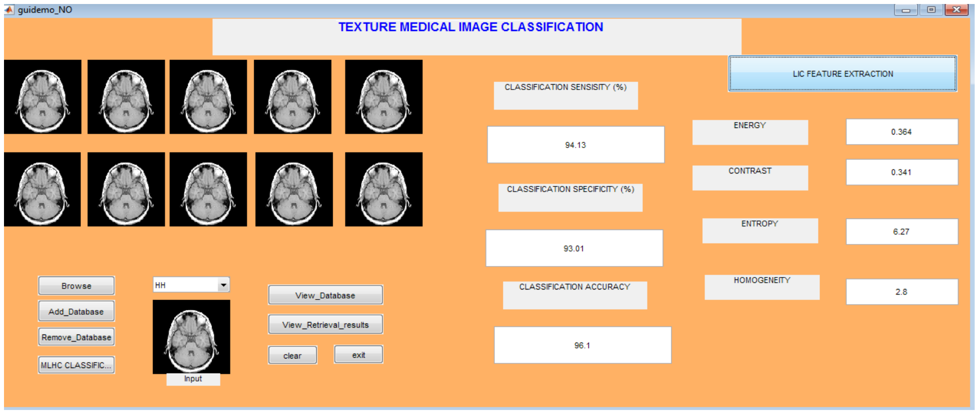
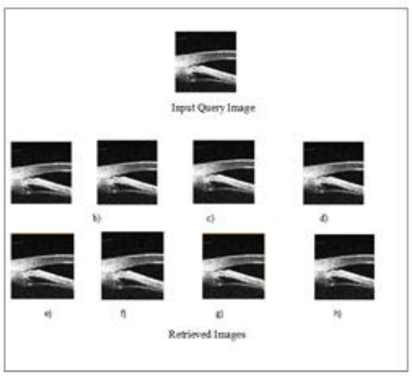
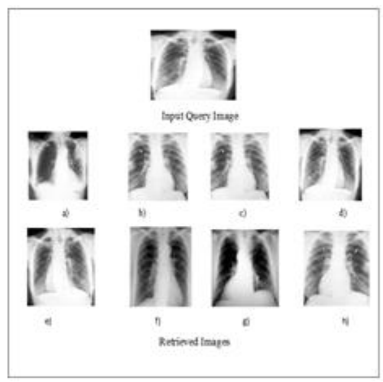


Figure 5. Graphical User Interface screen of Proposed System

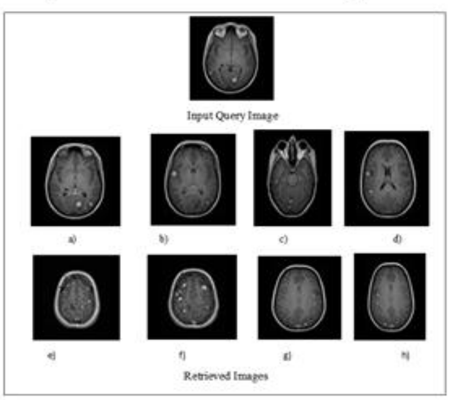
Multilevel Tetrolet Feature Extraction and Multi-Layer Perception network classifier based simulation result of Graphical User Interface screen for the medical image retrieval system is shown in Figure 5.



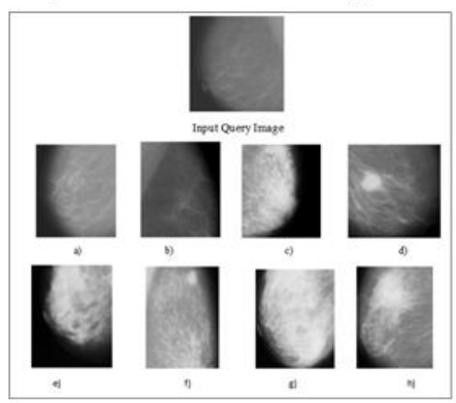
a) CBIR Result of Bone Image



b) CBIR Result of Cheast Image



c) CBIR Result of Brain Image



d) CBIR Result of Mammogram

Figure 6. Result of Proposed Image Retrvial

The retrieved simulation results of the proposed CBMIR system are shown in Figure 6.

Table 1. Performance analysis of the proposed system with existing methods

S.no	Parameters	SVM [Kabbur et.al 2016]	ANN[Kabbur et al. 2016]	Proposed Multi-Layer Perception (MLP)
1	Precision (%)	93.02	94.56	97.99
2	Recall (%)	89.03	90.89	95.49
3	F-measure (%)	12.63	10.30	3.46
4	Accuracy (%)	94.98	96.59	99.13

Table 1 discusses the Performance analysis of the proposed content-based medical image retrieval system with existing content-based medical image retrieval methods.

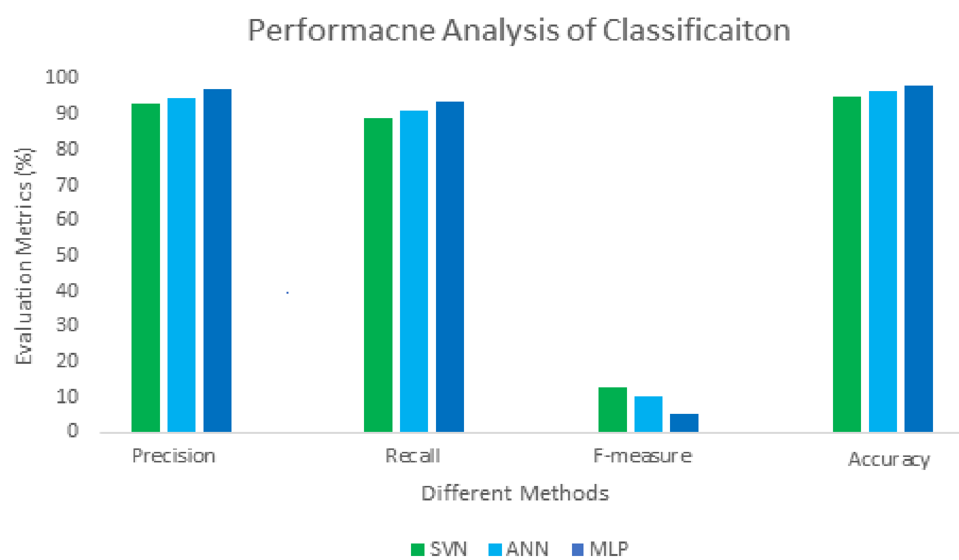


Figure 7. Overall Performance Analysis

Figure 7 discusses the Performance analysis of the proposed content-based medical image retrieval system. This analysis shows the proposed methods give good results while compared with existing methods. For example, the overall precision, recall, F-measure and accuracy of the proposed system are 97.99%, 95.49%, 3.46% and 99.13%, respectively.

4. CONCLUSION

This work has proposed novel techniques for content-based medical image retrieval systems, namely Multilevel Tetrolet Feature Extraction and Multi-Layer Perception network classifier. Numerous calculations, structures, and frameworks have been contemplated and created to help search and peruse through massive multimedia databases dependent on content. In light of clinical imaging's significance, there is expanding enthusiasm exhibited by informatics analysts and doctors to create CBIR algorithms, just as models for clinical image applications. The proposed cluster segmentation and Multilevel

Tetrolet Feature Extraction strategies have been introduced to overcome the existing drawbacks. The simulation of the proposed work is developed using Matlab simulation software. As compared with existing methods, the proposed method has proved to be efficient based on the performance metrics, namely precision, recall, F-measure and accuracy. For example, the overall precision, recall, F-measure and accuracy of the proposed system are 97.99%, 95.49%, 3.46% and 99.13%, respectively.

REFERENCES

1. Kabbur, Mahabaleshwar. (2016). an Efficient Multiclass Medical Image CBIR System Based on Classification and Clustering. Journal of Intelligent Systems. 27. 10.1515/jisys-2016-0156.
2. Karthik, K., Kamath, S.S. A deep neural network model for content-based medical image retrieval with multi-view classification. *Vis Comput* (2020). https://doi.org/10.1007/s00371-020-01941-2
3. Kashif, M., Raja, G. & Shaukat, F. An Efficient Content-Based Image Retrieval System for the Diagnosis of Lung Diseases. *J Digit Imaging* (2020). https://doi.org/10.1007/s10278-020-00338-w
4. Renita, D.B., Christopher, C.S. Novel real time content-based medical image retrieval scheme with GWO-SVM. *Multimed Tools Appl* **79,** 17227–17243 (2020). https://doi.org/10.1007/s11042-019-07777-w
5. Sathiamoorthy, S., Natarajan, M. An efficient content-based image retrieval using enhanced multi-trend structure descriptor. *SN Appl. Sci.* **2,** 217 (2020). https://doi.org/10.1007/s42452-020-1941-y
6. Kavitha, P.K., Vidhya Saraswathi, P. Content-based satellite image retrieval system using fuzzy clustering. *J Ambient Intell Human Comput* (2020). https://doi.org/10.1007/s12652-020-02064-1
7. Nair, L.R., Subramaniam, K., PrasannaVenkatesan, G.K.D. *et al.* Essentiality for bridging the gap between low and semantic level features image retrieval systems: an overview. *J Ambient Intell Human Comput* (2020). https://doi.org/10.1007/s12652-020-02139-z
8. Giveki D, Soltanshahi MA, Montazer GA (2017) A new image feature descriptor for content-based image retrieval using scale-invariant feature transform and local derivative pattern. Optik 131:242–254
9. Murala S, Jonathan WQ (2014) Local mesh patterns versus local binary patterns: biomedical image indexing and retrieval. IEEE J Biomed Health Inf 18(3):929–938
10. ayaraj D, Sathiamoorthy S (2019) Computer-aided diagnosis system using watershed segmentation with exception-based classification model for Lung CT images. Int J Sci Technol Res (IJITEE) 8(4):46
11. Jayaraj D, Sathiamoorthy S (2019) Deep neural network based classifer model for lung cancer diagnosis and prediction system in healthcare informatics, intelligent data communication technologies and internet of things. Lect Notes Data Eng Commun Technol. https://doi.org/10.1007/978-3-030-34080-3

12. Ratyal N, Taj IA, Sajid M, Mahmood A, Razzaq S, Dar SH, Ali N, Usman M, Baig MJA, Mussadiq U (2019) Deeply learned pose invariant image analysis with applications in 3D face recognition. Math Probl Eng. https://doi.org/10.1155/2019/3547416
13. Dhara A. K., Mukhopadhyay S., Dutta A., Garg M., Khandelwal N.: Content-based image retrieval system for pulmonary nodules: Assisting radiologists in self-learning and diagnosis of lung cancer. Journal of digital imaging 30(1):63–77, 2017
14. Wei G., Cao H., Ma H., Qi S., Qian W., Ma Z.: Content-based image retrieval for lung nodule classification using texture features and learned distance metric. Journal of medical systems 42(1):13, 2018
15. Qayyum A., Anwar S. M., Awais M., Majid M.: Medical image retrieval using deep convolutional neural network. Neurocomputing 266:8–20, 2017
16. Ma, Ling & Liu, Xiabi & Gao, Yan & Zhao, Yanfeng & Zhao, Xinming & Zhou, Chunwu. (2017). A new method of content-based medical image retrieval and its applications to CT imaging sign retrieval. Journal of Biomedical Informatics. 66. 10.1016/j.jbi.2017.01.002.

