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An Enhanced Framework for Content Based Medical Image Retrieval using Deep Neural Network

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Abstract: ***As the technology growth fuelled by low cost tech in the areas of compute, storage the need for faster retrieval and processing of data is becoming paramount for organizations. The medical domain predominantly for medical image processing with large size is critical for making life critical decisions. Healthcare community relies upon technologies for faster and accurate retrieval of images. Traditional, existing problem of efficient and similar medical image retrieval from huge image repository are reduced by Content Based Image Retrieval (CBIR) . The major challenging is an semantic gap in CBIR system among low and high level image features. This paper proposed, enhanced framework for content based medical image retrieval using DNN to overcome the semantic gap problem. It is outlines the steps which can be leveraged to search the historic medical image repository with the help of image features to retrieve closely relevant historic image for faster decision making from huge volume of database. The proposed system is assessed by inquisitive amount of images and the performance efficiency is calculated by precision and recall evaluation metrics. Experimental results obtained the retrieval accuracy is 79% based on precision and recall and this approach is preformed very effectively for image retrieval performance.***

Keywords: CBIR, DICOM, DNN, Semantic gap

I. INTRODUCTION

The Medical Images plays the essential role in radiology department for diagnosis and treatment purpose. In the field of diagnostic radiology, the role of Digital Imaging and Communications in Medicine (DICOM) images plays a very vital role in patient diagnosis. DICOM Standard which was developed by American College of Radiology—National Electrical Manufacturers (W. Dean Bidgood, 1997). DICOM the popular medical image standard has its own set of constraints in terms of faster processing. In addition to incipiently digital methods are generated the different type of DICOM images by using various kind of imaging devices like CT, MRI, Ultrasound (USG), PET-CT,..etc. DICOM standards helps in quickly retrieving the images over networks to print, store it offline, interpretation of the image using Meta data etc., with appropriate signal interpretations by PACS.

Especially when there need of radiologist & physician to correlate the image with historic images for faster understanding of medical conditions of the patients and diagnose the patient. The typical retrieval process in DICOM viewer software would be based on only patient details like patient ID from DICOM Image repository. The traditional medical retrieval systems are provides only simple text based retrievals proficiencies. Typically, the CBIR (Malar Selvi1, 2012) of images are dealt through the essential ingredients of the image such as color and its movements. The movement of the color in the image arrived through the histogram of the images across the channels. S. . (Khan, 2016) There is also need to consider other aspects such as Mean, Skeins around the amount of the color in the image. At times an image attribute such as Kurtosis also used which outlines the color distribution across the image. Typically, these are the factors used during the CBIR. The architecture diagram of CBIR system shows in figure1. The CBIR systems (Adnan Qayyum, 2017) encompass the two phases. The first phase is offline phase, extracted the pre processed image features from the massive amount of image dataset and creates a local feature database. Second Phase name called online phase, extracted the pre processed particular query image features and similarity measures are calculated between query image features and trained image features from database .

II. RELATED WORKS

When it comes to lookup of previous history in the huge volume of DICOM archives we might need to resort to CBIR (Content Based Image Retrieval). As technology grows in a fast pace environment there is inherent need for the radio logistics to have quick inference and comparison of the DICOM image based on history. This also calls for intelligent pre-processing of the DICOM images.

Geometric and image segmentation-based image retrieval algorithm has been discussed here (Amol Bhagat, 2013). Though the system was heavily relying up on the geometric aspects of the images it also presented an approach for web-based image retrieval system using oracle as data store.

Combining the meta data and composite image features is recommended in (Ceyhun Burak Akgül, 2010). In healthcare field has been set as more important for beneficial. This would be very effective when the medical descriptors appropriately handled in the image(s) to augment this recommendation.

IBM QBIC(Query by Image Content) system has been used for image based retrieval. This is based on certain image properties. This has been developed as commercial product and its available now it's part of different IBM product offerings. (M. Flickner, 1995).

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Different state-of-the-art approaches for querying and visual retrieval based on semantic annotations were discussed by (Alexandra La Cruz, 2012). This paper presents a framework called ANISE for medical image annotation. This was benchmarked against portrait the medical images, organ parts segmentation.

DICOM Image retrieval related challenges has been outlined by (Gunjanbhai Patel, 2012) apart from typical PACS or RIS. In this various medical imaging platforms and software which are meant for DICOM Image Management discussed. It suggested for cloud based approach for retrieval and simplified infrastructure availability.

e-Sushrut Chhavi is a solution which providing Query/Retrieve facility in the image archiving solutions(B. K. Sahu and R. Verma, 2011). For better accuracy and faster retrieval from archive repository and the server extracted the some information from identified image.

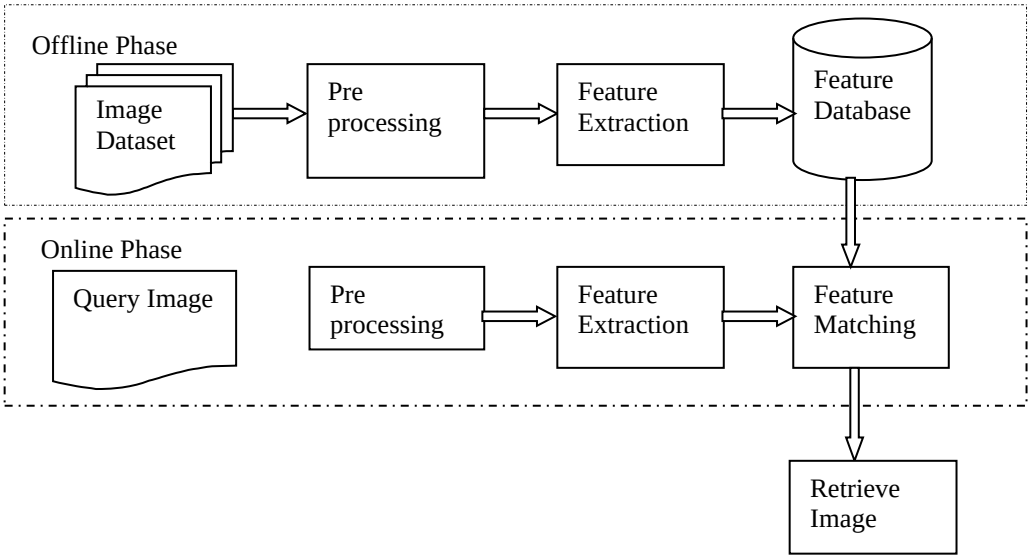

Fig 1. Block diagram for CBIR

III. DEEP NEURAL NETWORK

Deep learning is being applied as a supervised learning mechanism (Alexander, 2018,). Deep neural networks afford a superior scalability to extract features. (Joseph, 2018) This capability helps to learn from the training images for better classification and improving the overall labeled data. DNN contain three layers namely input, hidden that are not accessible from the outside world and output layer (Kim P, 2017). More than two Multi layered hidden layers which attempts to give better results are called deep neural network. This could be outlined as provided in the sample block diagram below in fig 2.By establishing multiple layers similar to the neurons being used in our brain we can form Neuron as a node and connection of neurons as weighted sum. (Zaharchuk, G , 2018) This is typically stored in the form of weights and bias. In figure 3 shows the deep neural network architecture for medical images. The first layer interconnected with more than one hidden layers. The second layers is connected to the third layer namely output layer and it is shown in architectural diagram.

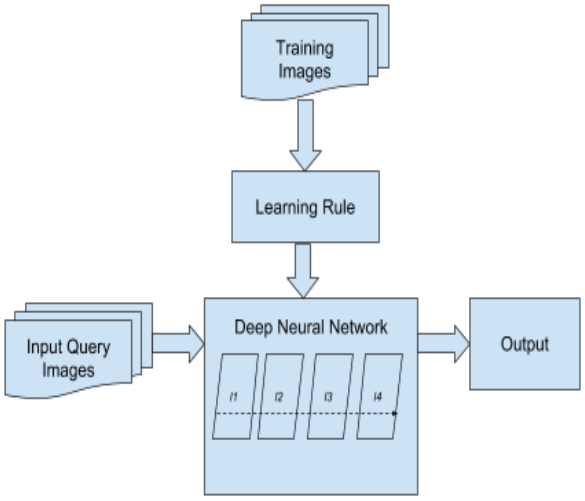

Fig 2. Block Diagram for DNN

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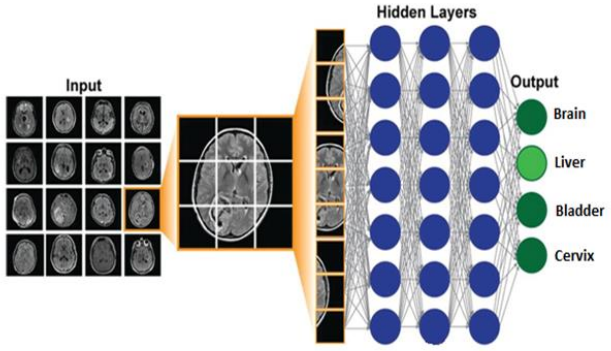

Fig 3. Deep Neural Network Architecture

IV. PROPOSED SYSTEM

In this proposed system, a classification determined the deep neural network framework for retrieval the similar images from the huge amount of medical image database. In figure 4 shows the proposed framework for proficient image retrieval. DNN is presently the most competent tool for vision systems. In this work restrain the three stages. The first stage is preprocessing performed by the image enhancement, RGB segmentation and Edge detection technique for medical image data set. Before preprocessing the medical images are resized, convert to the grayscale image and assigned the class label based on body organs. It is for improvement of the image data that suppress unwanted distortions or enhance some image features important for further processing. The second stage is represented as feature extraction, color and texture features are extracted from the preprocessing image data set. The Color features are the most intuitive and most apparent image features, which depicts much of the information from the image. In this work, HSV and color histogram technique are extracted the image low level color features. This technique is one of the most important features of an image and also a significant feature of perception of the retrieval process. The color features are extremely stable and robust which is compared among other low level features. A histogram is the widely used technique to extract color features. Texture features is a one more significant low level feature in the image and it is depict the image content. Here, gray level co-occurrence matrix (GLCM) was used to feature extraction of texture. Color features are not adequate to recognize image because different images may have similar histogram. The final stage develops the deep neural network model, which consists of an input, hidden and an output layers for classification purpose. This model conscientious for implementing requisite image retrieval functionality is deep neural network and its learning technique using back propagation algorithm. At first, this network is made to learn about features of the medical images from database. Finally after trained, this network is proficient to retrieve the exact and related images efficiently on its own.

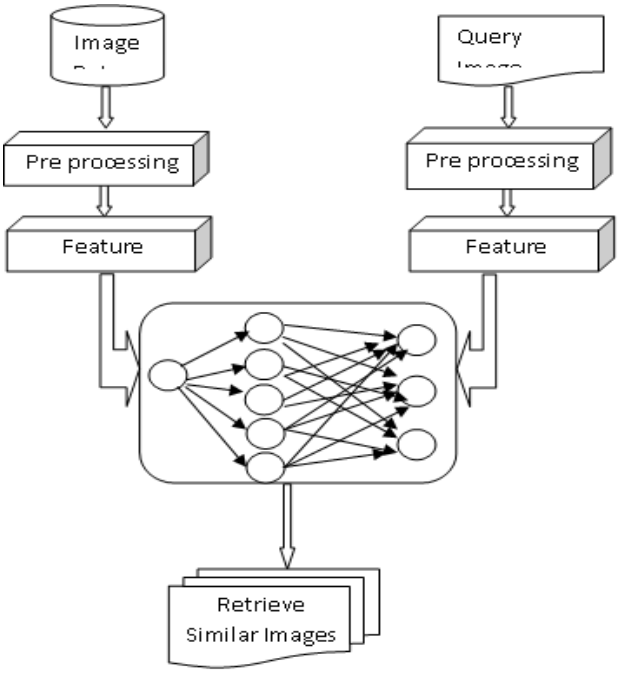

Fig 4. Proposed framework for CBMIR

V. EXPERIMENTAL RESULT

In this work, a popular and widely used MATLAB tool for developing and training the proposed deep neural network framework. In this proposed work has been downloaded the dataset from publically available medical image repository and classes were assigned based on the body organ from medical image metadata field e.g. bladder, lung, phantom...etc. It contain the 22 different classes are used in this proposed system. Each class the 200 images were taken and totally 4400 images are used for experimental work. The all medical image data set were in DICOM format and resized the image into 256x256 and covert to the gray scale image.

The performances of the proposed work are evaluated based on the precision and recall performance matrix.

$$Precision = \frac{TruePositive(TP)}{TruePositive + FalsePositive(FP)}$$

$$Recall = \frac{TruePositive}{TruePositive + FalseNegative(FN)}$$

$$Accuracy = \frac{TP + TN}{TP + TN + FP + FN}$$

Where, True Positive which denote the number of images correctly identified from the training database based on the query class image, True Negative which is represents the no of images exactly identified but it is not belong to class of query image, False Positive denotes the number of images not from query image class are identified and FN is false negative represent the no of images identified by class of query image but are not correctly classified.

In this work obtained the retrieval accuracy result is 79% based on precision and recall.

Subsequent to the given input image is preprocessed by using the image enhancement technique, RGB segment, image edge detection and output are observed as follows in figure 5. Though the above said image analysis aspects are directly having visual changes for human(s) to interpret, we need to use the appropriate measures of attributes to have comparison of the existing images for ease of retrieval which is achieved through the Mean value, Histogram Analysis, etc.,. In figure 6 shows the query image analysis data values are namely deviation, maximum pixel , entropy and standard deviation. In figure 7 shows the query image mean value based on number of instance and value of instance occurred. In figure 8 shows the retrieval result of giving bladder class query image and red box indicates the wrongly identified image from the medical image repository.

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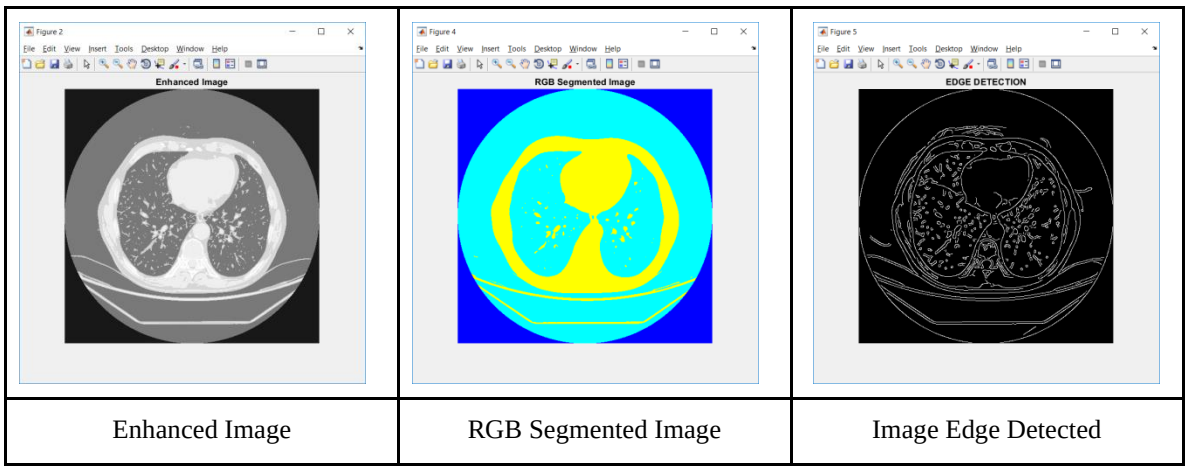


Enhanced Image	RGB Segmented Image	Image Edge Detected

Fig 5.Query image pre processing

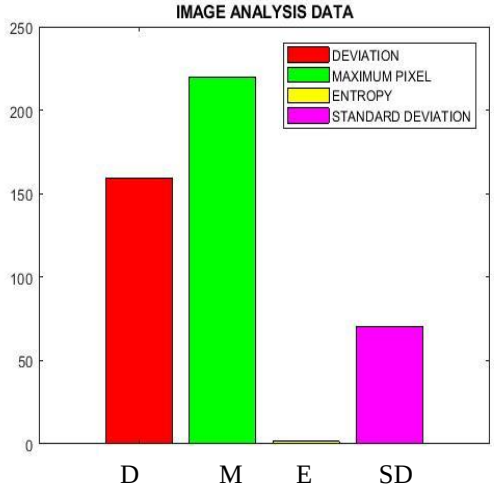


Fig 6. Image Analysis Data

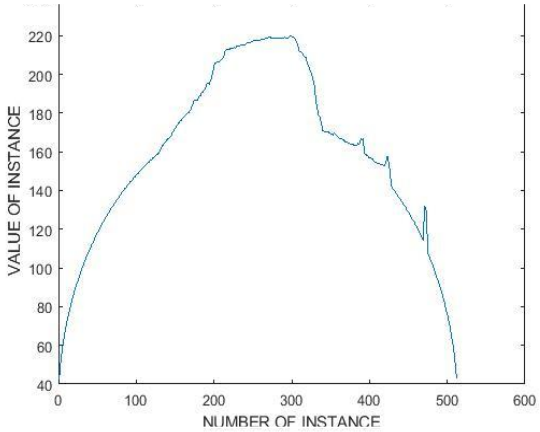
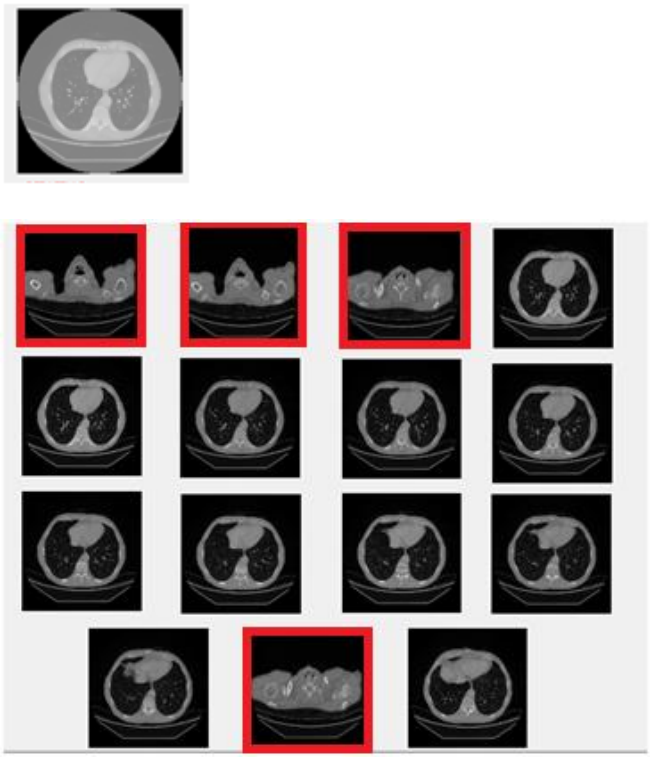


Fig 7. Query image mean value



(a)

(b)

Fig 8. Retrieval Result for Bladder Class (a) Query Image, (b) Retrieved Images

VI. CONCLUSION

This paper has developed the content based medical image retrieval using deep neural network. The different type of preprocessing is applied for enhance the image features for further processing . The color features extraction is used to extract the local image features and texture feature extraction gives us information on the structural arrangement of surface and object on the image. The developed deep neural net work has significantly enhanced there call rate and also reduced the retrieval time, due to its highly proficient and exact classification capability. Also, the back propagation algorithm has improved the retrieval precision due to its capability of reducing the error during training process itself. The experimental results of the proposed method have obtained the substantial development in retrieval performance. Further, include applying different deep learning concept to the content based image retrieval system considering more abstract level, low-level image descriptors and highly efficient, which might prove to be more accurate result and improve the accuracy in efficient manner.

REFERENCES

1. Amol Bhagat, M. A. (2013). DICOM Image Retrieval Using Novel Geometric Moments and Image Segmentation Algorithm . *International Journal of Advanced Computer Research*, 37-46.
2. S.Malar Selvi1 and Mrs.C.Kavitha,, Content Based Medical Image Retrieval System (CBMIRS) Using Patch Based Representation, *IOSR Journal of Computer Engineering (IOSR-JCE) e-ISSN: 2278-0661, p-ISSN: 2278-8727 PP 24-36*
3. Arvind Nagathan, M. I. (July 2013). Content-Based Image Retrieval System using Feed-Forward Backpropagation Neural Network. *International Journal of Computer Science Engineering (IJCSE), 2*, 143-151.
4. Ceyhun Burak Akgül, D. L. (2010). Content-Based Image Retrieval in Radiology: Current Status and Future Directions. *Journal of Digital Imaging*, 208-222.
5. M. Flickner, H. S. (1995). Query by image and video content: the QBIC system. *Computer*, *28*(9), 23-32.
6. W. Dean Bidgood, J. M. (1997). Understanding and Using DICOM, the Data Interchange Standard for Biomedical Imaging. *Journal of American Medical Informatics Association*, 199–212.
7. Ziegler, S. E. (2012). Development of a Next-Generation Automated DICOM Processing System in a PACS-Less Research Environment. *Journal of Digital Imaging*, *25*(5), 670-677. Retrieved 12 25, 2018, from https://link.springer.com/article/10.1007/s10278-012-9482-6
8. Gunjanbhai Patel, DICOM Medical Image Management the challenges and solutions: Cloud as a Service (CaaS), IEEE Third International Conference on Computing, Communication and Networking Technologies (ICCCNT'12), Coimbatore, 2012, pp. 1-5.2012, DOI: 10.1109/ICCCNT.2012.6396083
9. B. K. Sahu and R. Verma, "DICOM search in medical image archive solution e-Sushrut Chhavi," *IEEE 2011 3rd International Conference on Electronics Computer Technology*, Kanyakumari,2011, pp. 256-260.doi: 10.1109/ICECTECH.2011.5942093
10. Alexandra La Cruz, Alexander Baranya, Maria-Esther Vidal, Medical Image Rendering and Description Driven by Semantic Annotations, Springer Berlin Heidelberg, Resource Discovery, 2013, pp.123-149
11. Adnan Qayyum, 2a*Syed Muhammad Anwar, 3bMuhammad Awais, 1aMuhammad Majid, “Medical Image Retrieval using Deep Convolutional Neural Network”, Elsiver, 2017
12. Alexander Selvikvåg Lundervold, Arvid Lundervold , An overview of deep learning in medical imaging focusing on MRI, Computer Vision and Pattern Recognition, 2018
13. Kim, P. (2017). MATLAB Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence(1st ed.). Berkely, CA, USA: Apress.
14. Zaharchuk, G., Gong, E., Wintermark, M., Rubin, D., & Langlotz, C. P. (2018). Deep Learning in Neuroradiology. American Journal of Neuroradiology. https://doi.org/10.3174/ajnr.A5543

15. S. . Khan and S. . Khan, "An Efficient Content based Image Retrieval: CBIR," International Journal of Computer Applications, vol. 152, no. 6, pp. 33-37, 2016
16. R. Joseph Manoj1 • M. D. Anto Praveena2 • K. Vijayakumar, An ACO–ANN based feature selection algorithm for big data, Cluster Computing , Springer, https://doi.org/10.1007/s10586-018-2550
17. K. Vijayakumar,C.Arun,Automated risk identification using NLP in cloud based development environments,J Ambient Intell Human Computing,DOI 10.1007/s12652-017-0503-7,Springer May 2017.
18. K. Vijayakumar, Arun C, "Integrated cloud-based risk assessment model for continuous integration", International Journal Reasoning-based Intelligent Systems, Vol. 10, Nos. 3/4, 2018.
19. K. Vijayakumar, S. Suchitra and P. Swathi Shri, "A secured cloud storage auditing with empirical outsourcing of key updates", International Journal Reasoning-based Intelligent Systems, *Vol. 11, No. 2, 2019.*

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