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Content Based Medical Image Retrieval for Diagnosing Lung Diseases Using CT Imaging Sign- A Survey

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ABSTRACT - *Content Based Medical Image Retrieval (CBMIR) is the digital image searching problem in large databases that make use of the contents of the images. CBMIR play major role in medical application for retrieving CT images and to diagnosis the abnormal lung tissues in the CT images in a more accurate way. Nowadays, lung cancer is one of the most dangerous disease with least to high death ratio in the world. Content Based Medical Image Retrieval (CBMIR) system could help the radiologists to examine the patient CT image to assist retrieve the more accurately by retrieving the similar pulmonary nodules by using the query nodules. CBMIR system is to retrieve similar nodules from large chest CT image database for a given query nodule.*

Recently, image processing techniques are widely used in several medical areas for image improvement in before detection and treatment stages, where the time factor is very important to discover the abnormality issues in target images, especially in various cancers such as lung cancer, breast cancer, etc. The proposed method on the retrieval of the Common CT Imaging Signs of Lung Diseases (CISLs) is achieved not only better retrieval results but also the satisfactory computation efficiency.

***Keywords**:* Medical image retrieval, Content based image retrieval, Lung CT images, image processing, Common CT Imaging Signs of Lung Diseases (CISLs)

1. INTRODUCTION

Lung diseases are one of the most common causes of death and disability worldwide [1]. Since CT imaging can provide the necessary information for displaying whether the lung tissue is normal or abnormal, it is used by radiologists as a basis to recognize the lung diseases [2]. However, it is labor-consuming or even difficult for radiologists, especially for junior ones, to detect diseases by analyzing CT scans. Lung cancer is mainly serious health problem in all larger than the world**.** It is second most common cancer [3] in both men and women. Lung cancer would calculate approximately report for about 13% of all cancer diagnosis and 28% for all cancer deaths. The survival rate of lung cancer is 4 To 5 years and there having only 15% is surviving if lung cancer is diagnosed at its primary stage. This rate is increases to 49% while it is still localized and recognized and medical images support in clinical decisions. There is rapid development of medical science and technology which produces more and more digital medical imaging techniques.

A content-based image retrieval (CBIR) system could assist the radiologists using the examples of similar nodules. The visual information content in the retrieved nodules could help the radiologists to interpret the equivalent query nodule and its clinical management (biopsy and follow-up scan). Large number of lung CT images are generated by hospitals and clinics every day, and the images are stored in picture archival and communication system (PACS). The images stored in the PACS system could be used for the development of CBIR system and CBIR-based computer-aided diagnosis (CAD) system.

The mechanism on CBIR system of pulmonary nodules measured a representative slice of the nodule [4, 5] instead of the whole nodule. Moreover, the prior mechanism depends on radiologists for manual segmentation of nodules. The retrieval system with minimal user intervention is preferred for clinical use. The performance of retrieval system is also important for its applicability. The aim of the present system is to reduce the user intervention as well as to improve the accuracy of retrieval. If we can provide relevant past cases to radiologists, the diagnosis efficiency and accuracy can be improved. This problem can be addressed by using the content-based medical image retrieval (CBMIR) technique. Based on the survey a new method is to be proposed for lung cancer detection and prediction that help to identify the lung cancer in its early stage and also to predict the lung cancer. Therefore the survival rate of patient will increase.

Objectives of the proposed system are as follows:

- To reduce the number of rules for testing.
- To reduce the time and cost necessary for various excessive Medical Tests.
- To increase the accuracy of performance of Lung Cancer Prediction and finding System.

- Use less number of attributes for prediction of Cancer.
- Early stage discovery of cancer.
- Increasing the survivability of the patient more than 5 years.

2. CONTENT BASED MEDICAL IMAGE RETRIEVAL SYSTEM

The technique is Content Based Medical Image Retrieval (CBMIR).The most widely used method in Medical Image Retrieval are Text Based Image Retrieval and Content Based Image Retrieval. Text Based Image Retrieval method is used for keywords and it requires time consuming. Content Based Image Retrieval method is used for color, shape, texture and any other information of an image. Among these two methods Content Based Image Retrieval is best suited for medical image retrieval. CBMIR is one of the outstanding areas in Computer vision and Image Processing. The main aim of CBMIR method is efficiently retrieve the images. Thus, in the proposed CBMIR method, not only combine the visual and semantic information together to overcome their limitation, but also utilize the fundamental structure of the database for a better retrieval performance.

Computed Tomography (CT) image

There are multiple techniques available for diagnosis of the lung cancer [7] including MRI, PET, X-ray, but the CT scan image is considered as one of the best method which gives detailed description about lung nodules. It has low noise and less distortion and gives improved clarity than other images, thereby easily calculate and estimate texture feature of image.

Dataset

Lung image dataset is attained from NIH/NCI (national informative health/ national cancer imaging) organization (LIDC) lung image dataset consortium that provides lung computed tomography image which is available on the web cancer [8] imaging archive site. It is publically available and easily accessible.

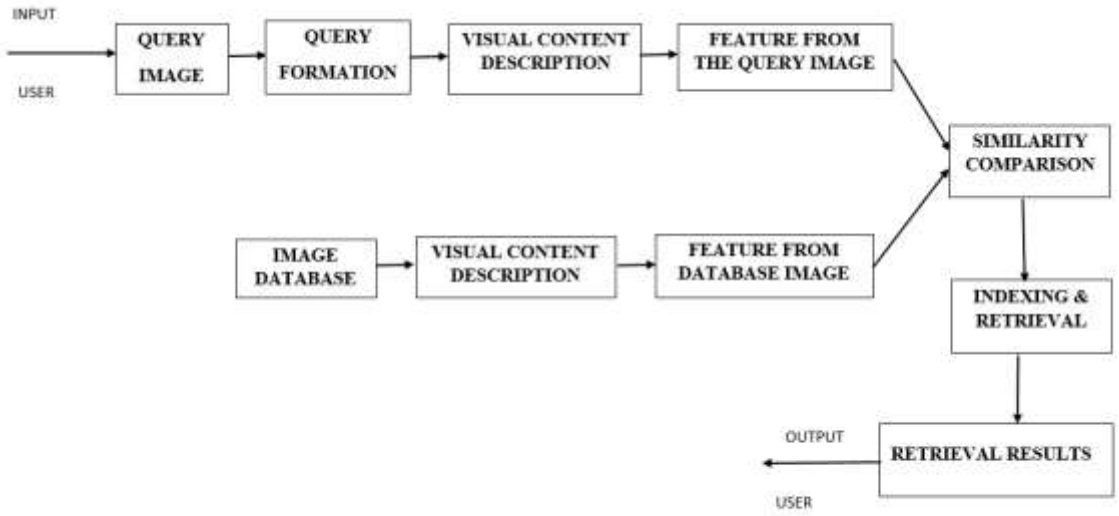

FIGURE 1: CONTENT BASED IMAGE RETRIEVAL

As shown in figure 1 the user gives input as an image to the retrieval system. Then the features of images are extracted for both the query image and the images in the database. The similarity measurement is applied to the retrieval system which computes the distance between the query image and the database images.

3. LITERATURE SURVEY

INTRODUCTION

The Content Based Medical Image Retrieval (CBMIR) is the recently using technique for the retrieval of Common CT Imaging Signs of Lung Diseases (CISLs). There are various method used in CBMIR for early detection of lung diseases. Here in this chapter we present a survey about Content Based Medical Image Retrieval technique for the retrieval of CISLs.

SURVEY

[i] Ling Ma, Xiabi Liu, Yan Gao, Yanfeng Zhao, Xinming Zhao, Chunwu Zhou, "A new method of content based medical image retrieval and its applications to CT imaging sign retrieval", - (2017) 148-158 [9]

New technique of content based medical image retrieval through considering fused, context-sensitive similarity. At first, they fuse the semantic and visual similarities between the query image and each image in the database as their Pairwise similarities. Then, weighted graph is created whose nodes are correspond to the images and edges determine their Pairwise similarities. By using the shortest path algorithm over the weighted graph, it achieve a new similarity measure, context-sensitive similarity measure, among the query image and each database image to complete the retrieval process. Usually, the fused Pairwise similarity is used to narrow down the semantic gap for obtaining a more correct Pairwise similarity measure, and spread it on the intrinsic data manifold to achieve the context-sensitive similarity for a better recovery performance. The proposed technique is calculate on the retrieval of the Common CT Imaging Signs of Lung Diseases (CISLs) and achieved not only better retrieval results but also the satisfactory computation efficiency.

Performance Analysis: To obtain more accurate pairwise similarity and to achieve better retrieval result using shortest path algorithm.

[ii] Ashis Kumar Dhara, Sudipta Mukhopadhyay, Anirvan Dutta Mandeep Garg, Niranjan Khandelwal: "Content-Based Image Retrieval System for Pulmonary Nodules: Assisting Radiologists in Self-Learning and Diagnosis of Lung Cancer", February 2017, Volume 30, pp 63–77 [10]

The Visual information of related nodules could assist the budding radiologists in self learning. Content-Based Image Retrieval (CBIR) system for pulmonary nodules, pragmatic in lung CT images. The report CBIR systems of pulmonary nodules cannot be put into accomplishment as radiologists need to draw the boundary of nodules during query formation and feature database creation. In the intended retrieval system, the pulmonary nodules are segmented using a semi-automated technique, which require a seed point on the nodule from the end-user. The participation of radiologists in feature database creation is also condensed, as only a seed point is expected from radiologists instead of manual delineation of the boundary of the nodules. The performance of the retrieval system depends on the correctness of the segmentation technique. Several 3D features are explored to develop the performance of the proposed retrieval system. For efficient representation of the nodules in the feature space, a set of relevant shape and texture features are considered. The actual Performance of the proposed CBIR-based CAD system is related to the performance of the CAD system using support vector machine.

Performance Analysis: The CAD system is to reduce user intervention as well as to improve accuracy of retrieval.

[iii] Neha Malviya, Dr. Naveen Choudhary, Kalpana Jain: "Content Based Medical Image Retrieval and Clustering Based Segmentation to Diagnose Lung Cancer", ISSN 0973-6107 Volume 10, Number 6 (2017) pp. 1577-1594 [11]

Lung cancer is most severe health problem in the world which causes multiple deaths every year. There are different technique available for diagnosis of the lung cancer such as CT image, MRI image, X-Ray Image etc. but the CT scan image provide larger detail about multiple organs of lungs. Henceforth today the medical images are produced more and more in their daily activities which are millions in size. Retrieving medical images from the large gathering is a challenging task, thus it emerges content based medical image retrieval system (CBMIR) system. The retrieval system intended cluster based segmentation for diagnoses of the lung cancer. Fundamentally it has three phases. First is segmentation for segment out the lung image into exacting regions, second phase describe the texture feature extraction of lung regions and third is clustering which is used to classify and arranged into images in particular cluster which is further better the speed and exactness of system by retrieving images. It analysis and measures the performance in terms of precision and recall with respect to time. The content based medical image retrieval system with clustering can evaluate the fast image retrieval system. Matlab image processing tool box with workspace is used with 500 real time lung CT scan images for testing and implementing proposed the CBMIR system.

Performance Analysis: Its simple and efficient approach for searching and retrieving lung CT images from large image dataset.

[iv] Wafaa Alakwaa, Mohammad Nassef, Amr Badr: "Lung Cancer Detection and Classification with 3D Convolutional Neural Network (3D-CNN)", (IJACSA) International Journal of Advanced Computer Science and Applications, Vol. 8, No. 8, 2017 [12]

A computer-aided diagnosis (CAD) system for lung cancer classification of CT scans with unmarked nodules, a dataset from the Kaggle Data Science Bowl, 2017. Thresholding used as a primary segmentation method to segment out lung tissue from the rest of the CT scan. Thresholding produced the next best lung segmentation. The first method is directly feed the segmented CT scans into 3D CNNs for classification, but this proved to be inadequate. Instead, a modified U-Net trained on LUNA16 data (CT scans with labeled nodules) was used to first

detect nodule candidates in the Kaggle CT scans. The U-Net nodule detection created many false positives, so regions of CTs with segmented lungs where the most likely nodule candidates were located as determined by the U-Net output were fed into 3D Convolutional Neural Networks (CNNs) to ultimately categorize the CT scan as positive or negative for lung cancer. The deep 3D CNN models performed the best on the test set. The whole state-of-the-art performance AUC of 0.83, considering use of less labeled data than most state of- the-art CAD systems.

[v] Devinder Kumar, Alexander Wong, David A. Clausi: "Lung Nodule Classification Using Deep Features in CT Images", IEEE-2015 [13]

The CAD classifier system for classifying lung nodules as either malignant or benign. The planned system uses deep features extract from an autoencoder for annotations provide by up-to four radiologists for 157 patients to precisely create a strong depiction of nodules. Early detection of lung cancer can help in a sharp reduce in the lung cancer mortality rate, which accounts for more than 17% percent of the total cancer related deaths. A large number of cases are encountered by radiologists on a daily beginning for initial diagnosis. Computer-aided diagnosis (CAD) systems can assist radiologists by offering a second opinion and creation the complete process faster. The proposed CAD system which uses deep features extracted from an autoencoder to categorize lung nodules as either malignant or benign. They apply 4303 instances containing 4323 nodules from the National Cancer Institute Lung Image Database Consortium (LIDC) dataset to gain an overall accuracy of 75.01% with a sensitivity of 83.35% and false positive of 0.39patient over a 10 fold cross validation.

Performance Analysis: It shows an accuracy of 75% with a sensitivity of 83% and its help to create a strong representation of nodules.

[vi] Jinsa Kuruvilla, K. Gunavathi: "Lung cancer classification using neural networksfor CT images", COMPUTER METHODS AND PROGRAMS IN BIOMEDICINE 1 1 3 (2 0 1 4) 202–209 [14]

Computer aided classification method is discussed in computed tomography (CT) images of lungs developed using artificial neural network. The whole lung is segmented from the CT images and the parameters are considered from the segmented image. The statistical parameters like mean, standard deviation, skewness, kurtosis, fifth central moment and sixth central moment are used for classification. The classification procedure is done by feed forward and feed forward back propagation neural networks.compare to feed for-ward networks the feed forward back propagation network gives better classification. The parameter skewness gives the maximum classification exactness. A computer aided segmentation and classification technique is proposed. Morphological operations are used for segmentation and classification is done by different neural networks. The region of interest is the segmented single slices containing 2 lungs. The statistical parameters are used as features for classification. Compared to the statistical parameters like mean, standard deviation, kurtosis, fifth central moment and sixth central moment, skewness gives the maximum classification accuracy.

Performance Analysis: The segmented slices measured from sensitivity containing cancerous nodule is correctly classified as cancerous.

[vii] Dasu Vaman Ravi Prasad, "Lung cancer detection using image processing techniques", International journal of latest trends in engineering and technology. (2013) [15]

An image development method is developing for earlier disease finding and treatment stages; the time factor was taken in account to determine the abnormality issues in target images. Image quality and exactness is the core factors of this study, image quality assessment as well as enhancement stage where were adopted on low preprocessing techniques based on Gabor filter within Gaussian rules. The proposed technique is capable for segmentation principles to be a region of interest foundation for feature extraction obtaining. Relying on general features, a normality relationship is made. The main detected features for exact images correlation are pixels percentage and mask-labeling with high exactness and robust operation.

Performance Analysis: The image processing technique is used for image improvement in earlier detection and treatment stages.

[viii] N.G.YADAV, "Detection of Lung Nodule Using Content Based Medical Image Retrieval", International Journal of Electrical, Electronics and Data Communication, ISSN (p): 2320-2084, Volume-1, Issue-2, April-2013 [16]

It provides a computer aided diagnosis system for early detection of lung cancer. The chest computer tomography image is used in this paper. In the first phase of the proposed method, the lung region is extracted from the chest tomography image. The complexity in the early detection of lung cancer nodules is overcome in this paper. There are different method exists but none of those provide better accuracy of detection. This provide content based medical image retrieval Computer Aided Diagnosis System (CAD) for early detection of lung cancer nodules from the Chest Computer Tomography (CT) images. There are different phases occupied in the proposed CAD system.

Performance Analysis: CAD system provides early detection of lung cancer and efficiency is more than 80%.

[ix] Preeti Aggarwal, H K Sardana and Renu Vig: "Content Based Medical Image Retrieval Using Patient's Semantics with Proven Pathology for Lung Cancer Diagnosis", IET, 20-21 Sept. 2013 [17]

In lung cancer computer-aided diagnosis (CAD) systems, having an correct ground truth is critical and time consuming. Due to lack of ground truth and semantic information, lung CAD systems are not progressing in the manner these are supposed to. In this study, they have explored Lung Image Database Consortium (LIDC) database containing annotated pulmonary computed tomography (CT) scans, and they have used semantic and content-based image retrieval (CBIR) approach to exploit the partial amount of diagnostically labeled data in order to annotate unlabeled images with diagnoses. They evaluated the method by various combinations of lung nodule sets as queries and retrieves similar nodules from the diagnostically labeled dataset. In calculate the precision of this system Diagnosed dataset and computer-predicted malignancy data are used as ground truth for the undiagnosed query nodules.

Performance Analysis: CBMIR is an effective method for labelling undiagnosed images in order to improve the performance of CAD system.

[x] Xiabi Liu, Ling Ma, Li Song, Yanfeng Zhao, Xinming Zhao, Chunwu Zhou "Recognizing Common CT Imaging Signs of Lung Diseases through a New Feature Selection Method based on Fisher Criterion and Genetic Optimization", 2168-2194 (c) 2013 IEEE Journal of Biomedical and Health Informatics [18]

A new feature selection method based on FIsher criterion and Genetic optimization, called FIG for short, to tackle the CISL recognition problem. In our FIG feature selection method, the Fisher criterion is applied to calculate feature subsets, based on which a genetic optimization algorithm is developed to find out an optimal feature subset from the candidate features. They use the FIG method to select the features for the CISL recognition from various types of features, include bag-of-visual-words based on the Histogram of Oriented Gradients, the wavelet transform based features, the Local Binary Pattern and the CT Value Histogram. Then the selected features cooperate with each of five generally used classifiers including Support Vector Machine, Bagging, Naïve Bayes, k-Nearest Neighbor and AdaBoost to categorize the Regions of Interests (ROIs) in lung CT images into the CISL categories. In order to evaluate the proposed feature selection method and CISL recognition approach, we conducted the 5-fold cross validation experiments on a set of 511 ROIs captured from real lung CT images. For all the measured classifiers, our FIG method brought the better recognition performance than not only the full set of original features but also any single type of features. They further compare the FIG method with the feature selection technique based on classification Accuracy Rate and Genetic optimization. The advantages on computation effectiveness and efficiency of FIG over ARG are shown through experiments.

[xi] Preeti Aggarwal, Renu Vig, H K Sardana : "Semantic and Content-Based Medical Image Retrieval for Lung Cancer Diagnosis with the Inclusion of Expert Knowledge and Proven Pathology" proceedings of the 2013 IEEE Second International Conference on Image Information Processing (ICIIP-2013) [19]

In lung cancer computer-aided diagnosis (CAD) systems, having a correct ground truth is critical and time consuming. The contribution of this work consist of the growth of lung nodule database with proven pathology using content based image retrieval (CBIR) and algorithms for detection and classification of nodules. A study and analysis of 246 patients have been carried out for the detection of benign, malignant as well as metastasis nodules. The whole research work has been carried out using Lung Image Database Consortium (LIDC) database by National Cancer Institute (NCI), USA and achieved an average precision of 92.8% and mean average precision of 82% at recall 0.1. Finally, the validations have been carried out with the PGIMER, Chandigarh test cases and achieved an average precision of 88%. Experimental studies show that the proposed parameters and analysis improves the semantic performance while sinking the computational complexity, reading and analyzing all slices by physicians and retrieval time.

TABLE – 1: COMPARSION OF EXISTING METHODS WITH ITS DISADVANTAGES

S.No	Authors	Title	Methods	Dataset	Disadvantages
1	Ling Maa, Xiabi Liu , Yan Gao ,Yanfeng Zhao , Xinming Zhao , Chunwu Zhou	A new method of content based medical image retrieval and its applications to CT imaging sign retrieval	Content Based Medical image retrieval,Fused Context Sensitive Similarity (FCSS)	LISS Database	To improve the retrieval efficiency. To perform the method on the multi-label CISLs.
2	Ashis Kumar Dhara , Sudipta Mukhopadhyay, Anirvan Dutta, Mandeep Garg, Niranjan Khandelwal	Content-Based Image Retrieval System for Pulmonary Nodules: Assisting Radiologists in Self-Learning and Diagnosis of Lung Cancer	CBIR based CAD Sysyem, Feature selection, Segmentation technique.	LIDC/IDRIData set	To improve the performance of segmentation pulmonary nodules, improvement of feature set, and learning based retrieval.
3	Neha Malviya, Dr. Naveen Choudhary, Kalpana Jain	Content Based Medical Image Retrieval and Clustering Based Segmentation to Diagnose Lung Cancer	CBMIR, Segmentation,k-means clustering, Hierarchical clustering, GLCM matrix	LIDC Database	To improve the speed and accuracy of system by retrieving images. The performance of CBMIR system enhances by combining various techniques for giving better performance.
4	Wafaa Alakwaa, Mohammad Nassef, Amr Badr	Lung Cancer Detection and Classification with 3D Convolutional Neural Network (3D-CNN)	Computer –aided diagnosis system, Deep learning, Convolutional neural networks, Segmentation.	LIDC Database	The initial lung segmentation as the watershed segmentation should be the immediate future work.
5	Devinder Kumar, Alexander Wong, David A. Clausi	Lung Nodule Classification Using Deep Features in CT Images	Computer –aided diagnosis system, Deep features	LIDC Database	To propose CAD system's capabilities by integrating the automatic detection of nodules module.
6	Jinsa Kuruvilla, K. Gunavathi	Lung cancer classification using neural networks for CT images	Computer aided segmentation and classification method	LIDC Database	Image classification is more accuracy.

7	Dasu Vaman Ravi Prasad	Lung Cancer Detection Using Image Processing Techniques	Image processing tehniques: Feature extraction, Image enhancement, Image segmentation	Available database	Improve the image quality and accuracy for better results.
8	N.G.YADAV	Detection of Lung nodule using Content Based Medical Image Retrieval	content based medical image retrieval Computer Aided Diagnosis System (CAD),Feature extraction, segmentation of lung region,SVM classifier	Available dataset	Only focus on local feature extraction methods
9	Preeti Aggarwal , HK Sardana and Renu Vig	Content Based Medical Image Retrieval Using Patient's Semantics with Proven Pathology for Lung cancer diagnosis	CBIR technique, Computer –aided diagnosis system	LIDC Database	To investigate different distance metrics for nodule similarity, identifying candidates with the CBIR expansion method.
10	Xiabi Liu, Ling Ma, Li Song, Yanfeng Zhao, Xinming Zhao, Chunwu Zhou	Recognizing Common CT Imaging Signs of Lung Diseases through a New Feature Selection Method based on Fisher Criterion and Genetic Optimization	Content based medical image retrieval (CBMIR) and Computer-aided diagnosis (CAD), Feature selection method is based on Fisher criterion and Genetic optimization (FIG)	Available database	Adding some image preprocessing steps to further improve the performance of CISLs.
11	Preeti Aggarwal, Renu Vig, H K Sardana	Semantic and Content-Based Medical Image Retrieval for Lung Cancer Diagnosis with the Inclusion of Expert Knowledge and Proven Pathology	Content Based Image Retrieval (CBIR), Computer Aided Diagnosis (CAD), Detection and classification algorithms of nodules.	LIDC Database	In proposed metastasis class assist the physicians in better and advanced classification of nodules.

4. CONCLUSION

Content Based Medical Image Retrieval is a simple and efficient approach for searching and recovering the lung CT images from the large medical image dataset. The various methods used in CBMIR for early detection of lung cancer with the pros and cons are discussed. Based on the survey CBMIR is an efficient method for retrieving images in a more accurate way with high quality image. A new method is yet to be proposed for early detection of lung cancer with less time to find the abnormality issues in the result an image.

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