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A NOVEL METHOD FOR THE DETECTION OF LUNG NODULE IN CHEST CT IMAGES USING VECTOR QUANTIZATION

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Abstract: Computer-aided detection (CAD) of lung nodules is critical to assisting radiologists in early identification of lung cancer from computed tomography (CT) scans. This paper proposes a novel CADe system based on a hierarchical vector quantization (VQ) scheme. This method is Compared with the commonly-used simple thresholding approach, high-level VQ yields a more accurate segmentation of the lungs from the chest volume. In identifying initial nodule candidates (INCs) within the lungs, low-level VQ proves to be effective for INCs detection and segmentation, as well as computationally efficient compared to existing approaches. False-positive (FP) reduction is conducted via rule-based filtering operations in combination with a feature-based support vector machine classifier. This system was validated on 205 patient. Experimental results demonstrated that our CADe system obtained an overall sensitivity of 82.7% at a specificity of 4 FPs/scan. The outperformance demonstrates its potential for fast and adaptive detection of lung nodules via CT imaging.

Index Terms: Computed Tomography(CT), Computer Aided detection(CAD), Segmentation, Lung nodules.

I. INTRODUCTION

Detection of pulmonary nodules has a crucial effect on the diagnosis of lung cancer, but the detection is a nontrivial task, not only because the appearance of pulmonary nodules varies a wide range, but also because nodule densities have low contrast against adjacent vessel segments and other lung tissues. Computed tomography (CT) has been shown as the most popular imaging modality for nodule detection, because it has the ability to provide reliable image textures for the detection of small nodules. The goal is to detect the cancer nodule at a early stage.

CADe systems consist of three stages: 1) image preprocessing, 2) initial nodule candidates (INCs) identification, and 3) false positive (FP) reduction.

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A. Preprocessing

In the preprocessing stage, the system aims to largely reduce the search space to the lungs, where a segmentation of the lungs from the entire chest volume is usually required. Because of the high image contrast between lung fields and the surrounding body tissue, image intensity-based simple thresholding is effective, and is currently the most commonly used technique for lung segmentation. This work proposes an adaptive solution to mitigate the difficulty of threshold method in lung segmentation.

B. INCs Detection

After defining the search space (i.e., the lung volume), INCs detection is the next step to build a CADe system. Various INCs detection techniques have been extensively studied in recent years, such as than multiple thresholding nodule enhancement filtering mathematical morphology and genetic algorithm template matching among many others. The most commonly used multiple thresholding approach aims to find connected components of similar image gray-values. Though intensity-based thresholding methods are computationally cheaper other pattern-recognition techniques for the detection of INCs.

C. FP reduction

The last step to complete a CADe system is to evaluate its performance for FP reduction. In this project it is a powerful tool to judge the performance of a classification system. This work takes the advantages of the rule-based filtering operation and the supervised learning for FP reduction. Inspired by our previous work we have proposed a hierarchical vector quantization (VQ) approach to address the preprocessing and INCs detection issues in an adaptive manner, aiming to overcome the drawbacks of global thresholding methods. Compared with the existing approaches, the hierarchical VQ can be an alternative with either comparable detection performance and less computational cost, or comparable cost and better detection performance.

Expert rules are learned from prior knowledge of true nodules annotated by the radiologists, while the classification rule for SVM is learned from two-dimensional (2-D) and three-dimensional (3-D) features extracted from the labelled subset. Inspired by our previous work, we have proposed a hierarchical vector quantization (VQ) approach to address the preprocessing and INCs detection issues in an adaptive manner, aiming to overcome the drawbacks of global thresholding methods. Compared with the existing approaches, the hierarchical VQ can be an alternative with either comparable detection performance and less computational cost, or comparable cost and better detection performance.

II. EXISTING SYSTEM

Lung cancer is one of the most common cancer-related deaths. Although attention has been paid to early stage predictions and diagnoses, prognosis remains very poor. This problem can be approached by

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developing more discriminative diagnosis methods. In this paper a computer-aided diagnosis is proposed to solve the problem of classification of solitary pulmonary nodules in chest x-ray images for diagnosis of early-stage lung cancer in x-ray lung images.

Lung nodules can be efficiently detected in MRI imaging techniques. Since MRI are really expensive and a low economic background denial people may not afford. clavicles in the chest radiographs (X-ray images) are suppressed with MTANN. Christo Ananth et al. [5] proposed a system, this system has concentrated on finding a fast and interactive segmentation method for liver and tumor segmentation. The main objective is to develop a technique so that lung nodules can be detected using X-ray imaging at an early stage. A multi resolution massive training artificial neural network (MTANN) is an image processing technique used for suppressing the contrast parameter of ribs and clavicles. The purpose is to develop the CADe with improved sensitivity and specificity by use of Virutal Dual Energy (VDE) chest radiographs.

Disadvantages

The existing methods are not faster and adaptive. The processing time of x-ray image is more and so it delay's the result of identification of pulmonary nodule. Accuracy as well as efficiency is low

III. PROPOSED SYSTEM

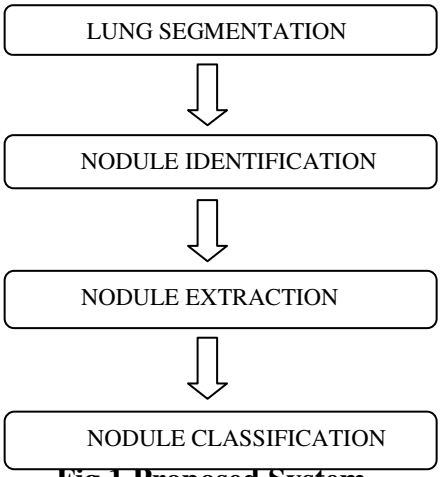

Fig 1.Proposed System

VQ was originally used for data compression in signal processing, and became popular in a variety of research fields such as speech recognition, face detection, image compression and allows for the modeling of probability density functions by the distribution of prototype vectors.

A. Segmentation

Image segmentation allows for the modeling of probability density functions by the distribution of prototype vectors. The general VQ framework evolves two processes the training process which determines the set of codebook vector according to the probability of the input data; and the encoding process which assigns input vectors to the codebook vectors.

Medical image segmentation is the key step toward quantifying the shape and

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volume of different types of tissues in a given image modality, which are used for 3D display and feature analysis to facilitate diagnosis and therapy. The main idea of VQ for image segmentation is to classify voxels based on their local intensity distribution rather than voxel-based intensities. Christo Ananth et al. [7] proposed a system, in which a predicate is defined for measuring the evidence for a boundary between two regions using Geodesic Graph-based representation of the image.

B. INCS Detection

A very important but difficult task in the CADe of lung nodules is the detection of INCs, which aims to search for suspicious 3-D objects as nodule candidates using specific strategies. This step is required to be characterized by a sensitivity that is as close to 100% as possible, in order to avoid setting a priori upper bound on the CADe system performance. Meanwhile, the INCs should minimize the number of FPs to ease the following FP reduction step. This section presents our hierarchical VQ scheme for automatic detection and segmentation of INCs.

C. Extraction

It is challenging to thoroughly separate nodules from attached structures due to their similar intensities, especially for the juxta-vascular nodules (the nodules attached to blood vessels). Since the thickness of blood vessels varies considerably (e.g., from small veins to large arteries), a 2-D morphological opening disk with radius of 1 up to 5 pixel was adopted to detach vessels at different degree. We can see that almost all of the nodules are within 3–30 mm in volume equivalent diameter, and the majority are small nodules with a size of less than 10 mm

D. Classification

A supervised learning strategy is carried out using the SVM classifier to further reduce FPs. Our feature-based SVM classifier relies on a series of features extracted from each of the remaining INC after rule-based filtering operation.

IV. RESULT

CAD systems are being developed to assist radiologists in the detection and diagnosis in order to decrease the errors. The experiments are performed on Lung cancer detection system with the help of real time lung images.The format of image is DICOM and original CT image is been preprocessed by several techniques of image processing and it is been segmentd by masking with original DICOM image.

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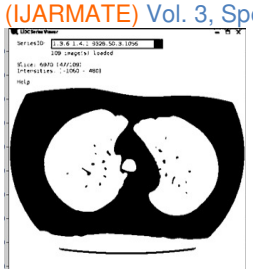

Fig 2 Original CT images, binary images

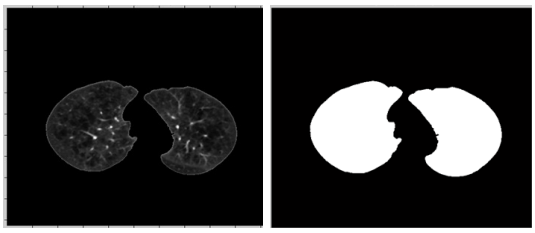

Fig 3 Lungs only Binary images, Lungs Only masked images

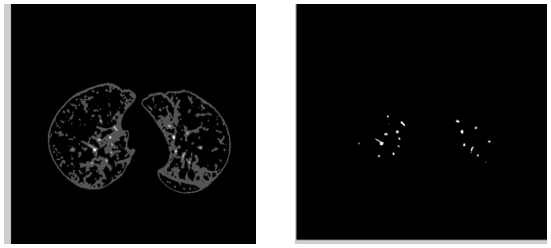

Fig 4 Low level VQ,low level nodule segmentation

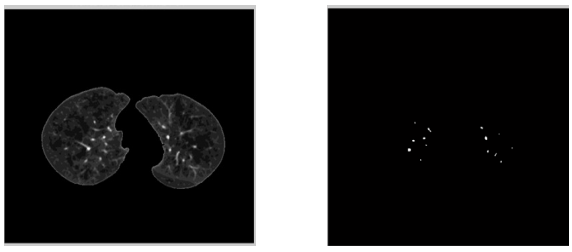

Fig 5 High level VQ,High level segmentation

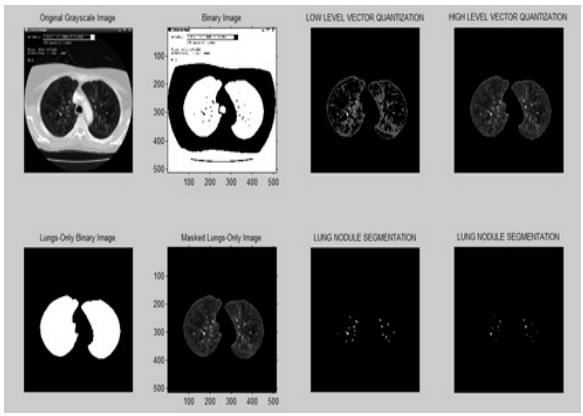

Fig 6 Normal lung CT images

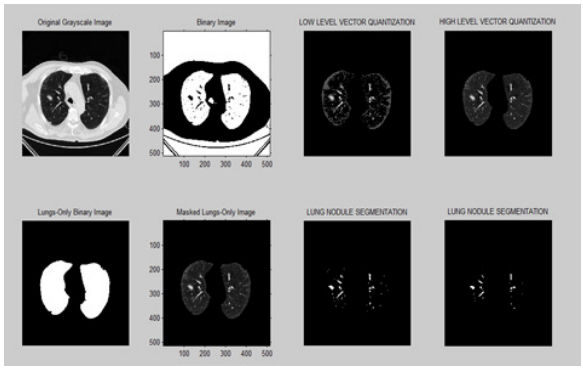

Fig 7 Abnormal lung CT images

V. CONCLUSION

In this paper A novel CADe system for fast and adaptive detection of pulmonary nodules in chest CT scans. Here we developed a hierarchical VQ scheme for INCs detection. The high-level VQ proves to be feasible to replace the commonly-used simple thresholding scheme for extraction of the lungs with higher accuracy, as well as comparable processing time and automation level. The following low-level VQ illustrates

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adequate detection power for non-GGO nodules, and is computationally more efficient than the state of-the-art approaches. The SVM classification results indicated that gradient features contributed the most against any of the other three groups of features (geometric, geometric, intensity, and Hessian features). automatic. The proposed hierarchical INCs detection approach is fast, adaptive, and fully automatic. The presented CADe system yields comparable detection accuracy and more computational efficiency than existing systems, which demonstrates the feasibility of our CADe system for clinical utility.

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