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A Multistage Approach to Improve Performance of Computer-Aided Detection of Pulmonary Embolisms Depicted on CT Images

Shraddha kokane[1], Swapnaja Kumbhar[2], Shweta Kutte[3], A. G. Patil[4]

[1,2,3,4] P.V.P.I.T. Budhgaon

[1,2,3,4] Dept. of Electronics and Telecommunication Engineering , Sangli , Maharashtra , India

Abstract—In the study, 20 computed tomography examinations with various lung diseases were selected, which include 44 verified PE lesions. The proposed CAD scheme consists of five basic steps: 1) lung segmentation; 2) PE candidate extraction using an intensity mask and tobogganing region growing; 3) PE candidate feature extraction;4) false-positive (FP) reduction using an artificial neural network(ANN); and 5) a multifeature-based k-nearest neighbor for positive/negative classification. In this study, we also investigated the following additional methods to improve CAD performance:1) grouping 2-D detected features into a single 3-D object; 2) selecting features with a genetic algorithm (GA); and 3) limiting the number of allowed suspicious lesions to be cued in one examination. The results showed that 1) CAD scheme using tobogganing, an ANN, and grouping method achieved the maximum detection sensitivity of 79.2%; 2) the maximum scoring method achieved the superior performance over other scoring fusion methods; 3) GA was able to delete "redundant" features and further improve CAD performance; and 4) limiting the maximum number of cued lesions in an examination reduced FP rate by 5.3 times. Combining these approaches, CAD scheme achieved 63.2% detection sensitivity with 18.4 FP lesions per examination.

Keywords - *Computer-aided detection (CAD), false positive (FP) reduction, feature selection , pulmonary embolism, tobogganing. genetic algorithm (GA).*

I. INTRODUCTION

A pulmonary embolism (PE) occurs when clots break off from the vein walls and travel through the heart to the pulmonary arteries. computed tomography angiography (CTA) has been established as a widely available first-line imaging test for diagnosing PE in clinical practice. Image processing techniques allow a large and complex set of quantitative measures to be derived from images, particularly in a research setting. Advances in image acquisition technology, computer vision systems, and new clinical/research queries are leading to increasing amounts of quantitative data being derived from medical images. Blood clots called deep vein thrombi often develop in the deep leg veins. CTA has advantages over both conventional pulmonary angiography and ventilation/ perfusion scans because of its low risk, direct imaging of the blood clot, high inter-observer agreement, high accuracy, and good correlation with patients' signs and symptoms. During the last several years, a number of research groups have developed CAD schemes for PE detection and reported preliminary testing results, often with very limited image datasets (i.e., <20 CT examinations).These schemes can be briefly categorized into two classes, namely, the vessel-segmentation-based scheme the lung-segmentation-based scheme . After those segmentations, CAD schemes typically search for the suspicious PE regions (lesions) based on the predefined range of the PE attenuation values in CT images . In the CAD schemes, various features (voxel intensity distribution of suspicious PE area and neighborhood, 3-D shape, 2-D shape, edge, and other morphological and textural features) are used to determine whether the candidate is likely representing a true positive (TP) or FP detection. We focused on investigating several approaches to 1) select optimal feature set for fast classification between TP and FP detections and 2) increase the overall performance of the CAD scheme.

II. FRAMEWORK OF PROJECT

In this proposed methodology ANN classifier, CAD system, Genetic algorithm for PE candidate detection mentioned. The first step of this method is the image capture. In that CT images are taken as input images. From the input images, 20 chest CT examinations are selected.

For the segmentation tobogganing algorithm is used. This algorithm is as works as- given image has each pixel determines its own direction to flow down by searching neighborest having lowest pixel value. Finally when direction of each pixel is determined, certain pixel became local minima.Feature extraction detected on the basis of Intensity based, Shape based and Boundary based.

After feature extraction for this study, we trained and implemented a feed-forward ANN to classify whether an initially detected and segmented candidate was a TP PE region or not. Then apply the ANN for removal of false detection. It is used for detection of TP and FP and for that scoring algorithm is used. This algorithm detects the affected part and for that different 15 samples are used.

To further improve True Positive and False Positive PE region classification, we applied a GA to preselect an optimal and non redundant feature set for a classifier By using genetic

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algorithm and group scoring method finding final result. In genetic algorithms K-NN is used for find out the nearest neighourhood pixels which is matched to the pulmonary embolism. In that genetic chromosomes are developed by using binary coded method is used.

A PE lesion typically appears on several 2-D images because it is formed as a clot in the arteries. We grouped 2-D PE candidates that overlapped on adjacent images as an independent PE lesion to build 3-D PE lesions. Although each 3-D lesion may consist of one to multiple 2-D regions, each with their own *k*-NN generated detection score, the 3-D lesion is regarded as a single PE lesion.

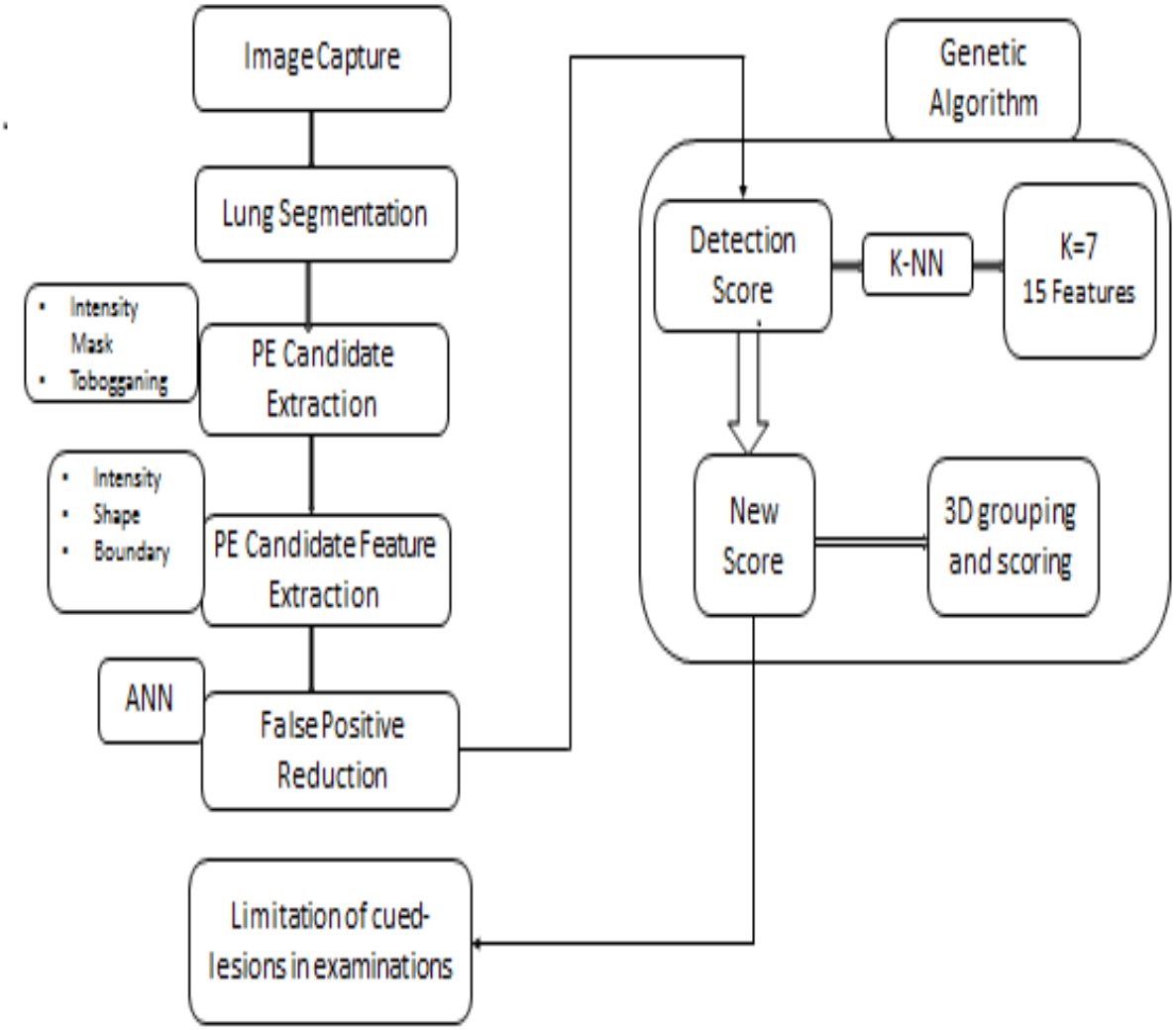

Fig.1.Functional block diagram of system

III. FLOW CHART

First we call the JPG image and display the CT image .The image is converted to thresholding. Here adaptive thresholding is used for the edge detection. If the image is equals to gray then display the binary otherwise it display the CT image. Variable J stores negation of the image which is used for water shading image. This process is used for intensity masking which is removes the spacing of he boundaries. It also defines GA algorithms. GA algorithm.

Then the image is to be big masked for the displaying cancer spot using GA algorithms. If image equals to false then image is big masked otherwise the image goes to the intensity process. Big masked image displays as a cancer spot. We take constant 1 for the region filling of cancer spot. And for the edge detection. ANN algorithm detects the pulmonary embolism .If the image having cancer the then it displays as the true positive else displays false positive. ANN determines region number, max and min centroid region, perimeter of cancer region .

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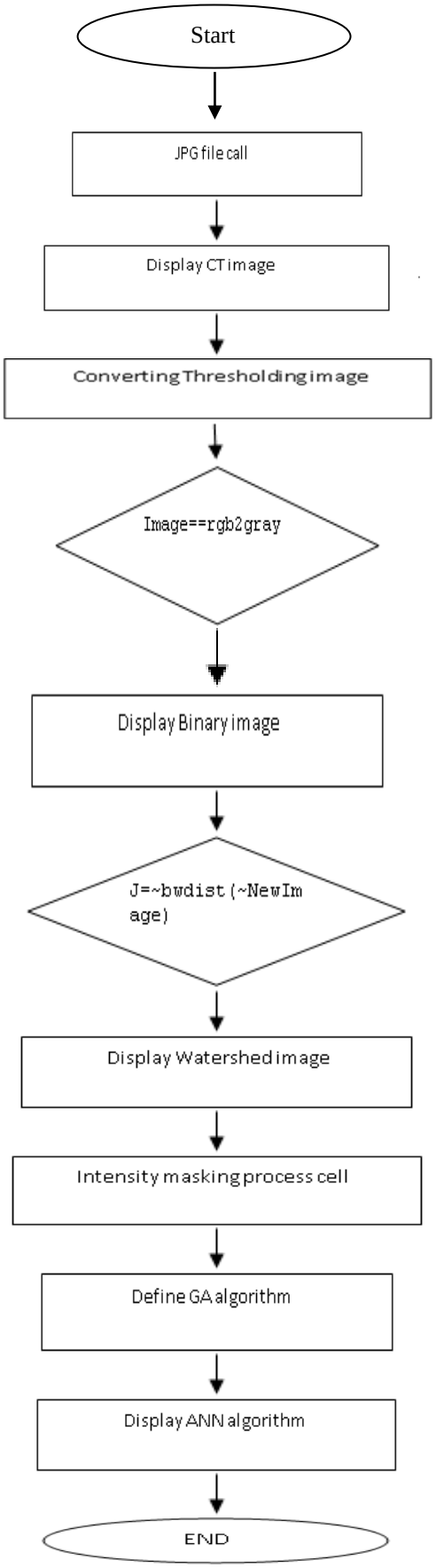
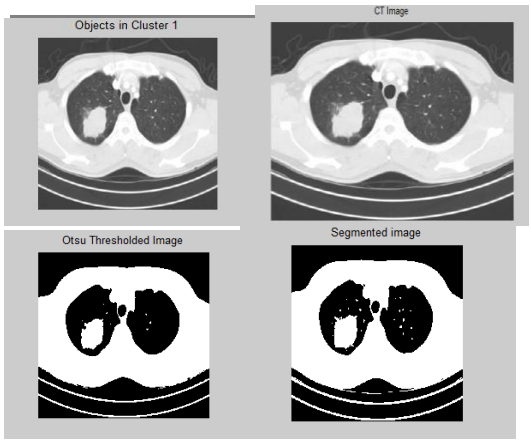
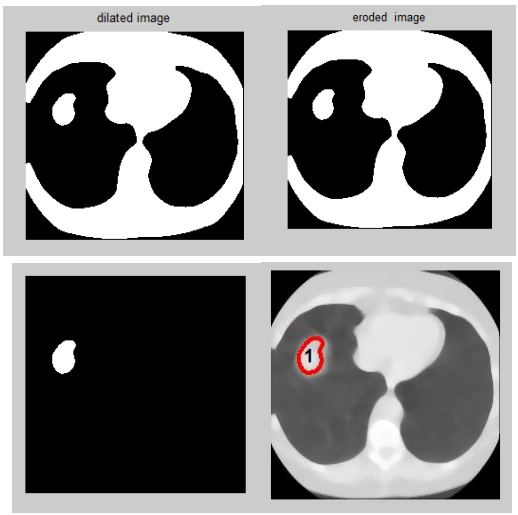


IV. RESULT

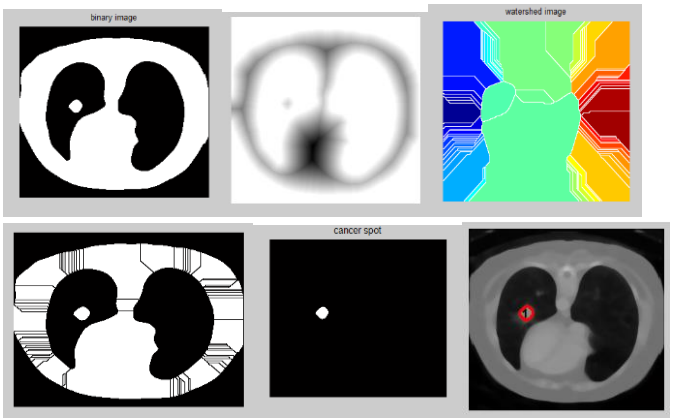
A. For generation of database



B. Using tobogganing algorithm and ANN



C. Using GA algorithm



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V. CONCLUSION

We developed and tested a new CAD scheme for detecting PEs depicted on CT images. To improve CAD performance(including both detection sensitivity and specificity), we investigated and tested a number of new scoring concepts or approaches. The study showed that 1) applying the maximum scoring-based grouping method; 2) using the optimal feature set selected by GA; and 3) implementing the criterion to limit the maximum number of detected PE lesions allowed to be cue in one examination could all contribute to the improvement of
CAD performance in PE detection.

VI. ACKNOWLEDGEMENT

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