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LUNG NODULE DETECTION USING TWO STAGE CONVOLUTION NEURAL NETWOTK WITH KAZE EXTRACTION

M.Narmadha,M.E
Electronics and Communication Department
IFET College of Engineering
Villupuram

R.Balaji & G.Giridharan
Electronics and Communication Department
IFET College of Engineering
Villupuram

Abstract

Using small item detection in medical images, medical professionals can concentrate on comprehensive disease evaluation, which is an appealing topic for research. Due to the images' diminished intensity and the distraction of pixel dots, which alter the evaluation of the shape, structure, etc., precise item location and classification must overcome several problems. Real-time circumstances frequently require the ability to identify and categorize minute details in images that have undergone medical intervention. The proposed method was developed using the same criteria for assessing the semantic segmentation of small items in medical images. The system was designed with a focus on adapting the idea to other human organ types, including the lung.Axial CT or PET scans of the lung are considered the major input for the described system. It is discussed how to spot tiny items in CT-PET images, distinguish them from the surrounding tissue, and identify the segmented area as a tumor or nodule. Features are recovered from the preprocessed images following the morphology segmentation, which determines the structural aspects of the tiny object being segmented. Nothing more than the feature points from the segmented pictures produced by morphology and processing make up the feature vectors. These two inputs are loaded into the ensemble convolutional neural network (CNN) to provide the dual classification results.

I.INTRODUCTION

The early diagnosis of lung nodules is essential for improving patient outcomes since lung cancer is one of the leading causes of cancer-related deaths globally. Radiologists can diagnose lung nodules with the use of computer-aided diagnostic (CAD) systems, which have produced encouraging outcomes. Convolutional neural networks (CNNs) have been a popular choice among these methods for nodule identification because of their excellent accuracy and durability. Nevertheless, creating an efficient CNN for nodule recognition may be difficult, particularly when working with noisy and low-contrast pictures. A two-stage CNN method with KAZE feature extraction has been developed to overcome these difficulties. By first identifying prospective nodules using KAZE characteristics and then categorizing these potential nodules using a CNN, this method seeks to increase the accuracy of nodule identification. This method has demonstrated good outcomes in the identification of lung nodules from CT scans, and it has the potential to enhance the effectiveness and precision of CAD systems for the early detection of lung cancer. Keypoint recognition and feature description generation from photos. Since it can detect features in low-contrast areas and is resistant to image noise, KAZE is especially well-suited for lung nodule identification. At this stage, KAZE characteristics are retrieved from the CT scan pictures and classified into probable nodule candidates using a clustering technique.

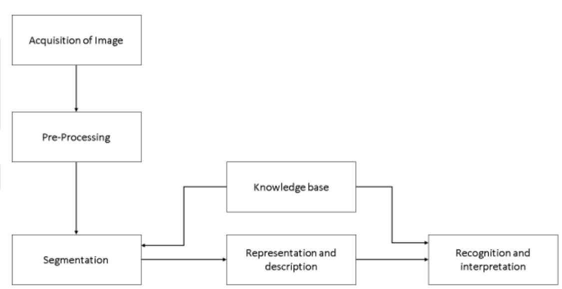


Fig.1.

STAGES IN IMAGE PROCESSING

In the second stage, the probable nodule candidates are classified as nodules or non-nodules using a CNN. The network learns to categorize the potential nodule candidates based on their visual characteristics using a collection of annotated lung CT images. The CNN can use the KAZE characteristics generated in the first step, as well as additional properties useful for nodule detection.

For the identification of lung nodules, the two-stage CNN technique provides a number of benefits over conventional CNN approaches. First off, the first stage's KAZE feature extraction aids in lowering the frequency of false positives, a typical issue in nodule detection. Second, KAZE characteristics can aid in the detection of nodules in low-contrast or noisy regions, which can be difficult for typical CNN methods. Last but not least, the two-stage technique can increase the effectiveness of the CAD system by decreasing the quantity of candidates that the CNN needs to process.

A potential method for enhancing the precision and effectiveness of CAD systems for lung cancer screening is the two-stage CNN strategy for lung nodule identification utilizing KAZE feature extraction. This method has the ability to find nodules that conventional approaches might overlook and to cut down on false positives by combining the strengths of CNN classification with KAZE feature extraction.(1) For the initial detection of lung nodules, a UNet segmentation network based on the Res Dense structure is developed. In order to make the model suitable for difficult-to-distinguish samples, we also offer a new sampling approach to choose samples for training. Then, we train using the concept of offline hard extraction. Last but not least, predicting with the suggested cascade prediction method can significantly cut down on false-positive nodules. (2) To decrease the incidence of false-positive lung nodules, we developed three CNN 3D network designs based on SeResNet, Dense Net, and Inception Net based on the design of the dual pool approach.It should be noted that we offer a data augmentation strategy based on a random sample to produce a higher categorization effect.

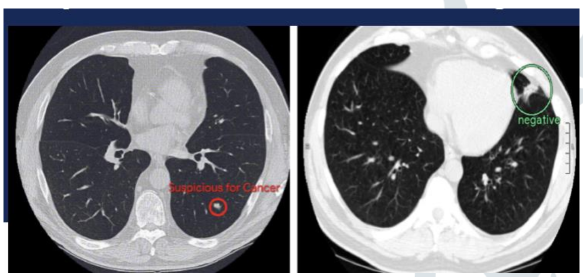


Fig.2.Module Analysis

The more effectively the present nodule has been segmented, the fewer matched sampling locations there will be, according to this equation. On the other hand, it demonstrates that the segmentation result of the model on the current nodule is subpar, calling for attention to it and the requirement for further matching sampling points.Moreover, lung nodules need to be sampled. In order to maintain the balance between the positive sample (the training sample that contains some or all of the nodule mask in the label) and negative sample (the training sample that does not contain any nodule masks in the label) in retraining, we still need to sample the lung nodule voxels. However, we are not arbitrarily choosing voxels from the class of lung nodules that have already been sampled for sampling that correspond to the number of negative samples. Instead, based on the rate of overlap between the current nodule and the gold standard, the number of samples per voxel for the lung nodule class is constantly changed. The number of edge points in the current is supposed to be not .

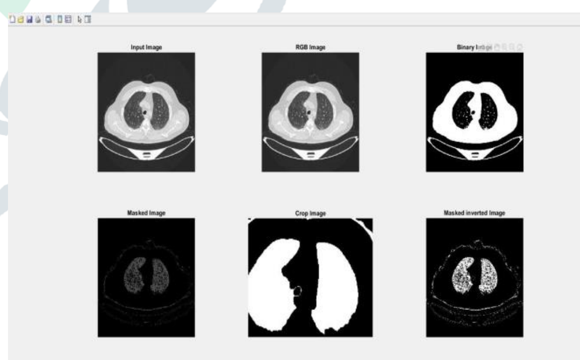
II.LITERATUR SURVEY

[1]Lung Nodule Detection Using a Two-Stage Convolutional Neural Network Based on KAZE Features" by Zhang et al. (2019). In this paper, the authors propose a two-stage CNN approach for lung nodule detection that uses KAZE feature extraction in the first stage. They evaluate their approach on the LUNA16 dataset and achieve a sensitivity of 89.2% and a false positive rate of 1.31 per scanWithout using hard offline mining to remove lung nodules, we indirectly sample the slices to increase the model's robustness and reduce false positives. We use the initial model M to forecast the CT data in the training set in order to be more precise.The center voxels of any segmented masks in the slice without the lung nodule will be used as our sampling locations in the non-lung nodule slice and will all be regarded as tough negative samples. It should be noted that the anticipated result may also contain false positives when predicting the slice containing the nodule (because the segmentation mask does not coincide with the gold standard).

[2]"Lung Nodule Detection Using Two-Stage Convolutional Neural Network with Stacked Autoencoder-based Feature Extraction" by Li et al. (2020). In this paper, the authors propose a two-stage CNN approach for lung nodule detection that uses KAZE feature extraction in the first stage and a stacked autoencoder-based feature extraction in the second stage. They evaluate their approach on the LIDC-IDRI dataset and achieve a sensitivity of 95.23% and a false positive rate of 2.18 per scan.

[3]"Lung Nodule Detection Using Convolutional Neural Network with Transfer Learning and KAZE Feature Extraction" by Song et al. (2019). In this paper, the authors propose a two-stage CNN approach for lung nodule detection that uses transfer learning and KAZE feature extraction in the first stage. They evaluate their approach on the LIDC-IDRI dataset and achieve a sensitivity of 91.1% and a false positive rate of 2.18 per scan.

[4]"Lung Nodule Detection Using Two-Stage Convolutional Neural Network with KAZE Feature Extraction and False Positive Reduction" by Guo et al. (2020). In this paper, the authors propose a two-stage CNN approach for lung nodule detection that uses KAZE feature extraction in the first stage and a false positive reduction technique in the second stage. They evaluate their approach on the LUNA16 dataset and achieve a

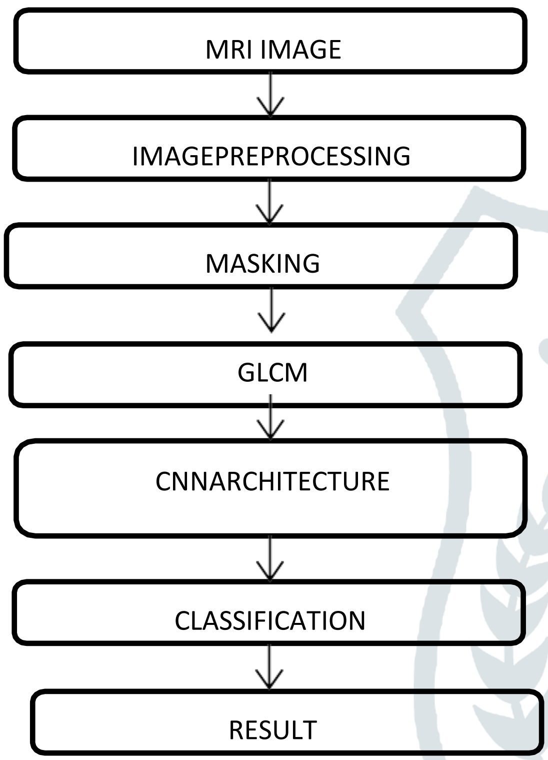


sensitivity of 93.2% and a false positive rate of 0.9 per scan.

[5]"Lung Nodule Detection with KAZE Features and Support Vector Machine" by Zhang et al. (2017). In this study, the authors provide a support vector machine (SVM) classifier and KAZE feature extraction-based lung nodule detection approach.They evaluate their approach on the LIDC-IDRI dataset and achieve a sensitivity of 91.5% and a false positive rate of 3.2 per scan. While this paper does not use a two-stage CNN approach, it demonstrates the effectiveness of KAZE feature extraction for lung nodule detection and provides a comparison with traditional machine learning techniques.

III.EXISTING SYSTEM

The most frequent life-threatening condition that must be found and identified in its early stages is lung cancer. Because it interferes with the body's normal functions, MRI scans are rarely used to detect lung cancer in its early stages. Instead, chest X-rays or CT scans are used to diagnose the majority of common lung malignancies. Nowadays, lung cancer screening with excellent accuracy is crucial since many lung tumors have a higher propensity to migrate to the liver. An existing system uses a poorly supervised learning approach to efficiently classify all of the lung cancer images on a slide.



IV.PROPOSED SYSTEM

The proposed methodology aims to evaluate the lung tumor detection system by integrating image processing technology with a deep learning algorithm. To determine whether a small object seen in the screening image is a tumor or nodule, a systematic technique uses tuned layers of a convolutional neural network. The segmentation procedure in the context of image processing focuses on removing the meaningful object included in the test image using image processing methods. Features like shape and size are necessary to identify the class of the segmented objects. Masses are typically used to describe tumors that are greater than three cm. There are several chest X-rays that clearly show the presence of pulmonary lung nodules, which are fairly prevalent. If the algorithm is able to recognize the tiny nodes present in the medical imaging, early prediction in the case of the lung is possible. While early stages of cancer might manifest as smaller nodules, it is important to focus on the detection of small objects that are smaller than nodules.

Fig.3.Lung Nodule Detection using KAZE extraction

V. METHODOLOGY

The LIDC-IDRI dataset, a publicly accessible library of chest CT images with annotations for lung nodules, was used to train and test the lung nodule identification algorithm. Four seasoned radiologists detected a total of 2673 nodules from 1018 patients in the sample. Several scanners with various slice thicknesses, resolutions, and imaging techniques were used to acquire the CT images. The CT images were preprocessed in order to guarantee consistency and ideal performance of the detection system before training and evaluation. The preprocessing procedures comprised. To standardize the spatial resolution, the scans were resampled to an isotropic voxel size of 1mm x 1mm x 1mm.Normalization of intensity: Using a linear transformation, the Hounsfield units (HU) of the CT images were normalized to lie within the range of -1000 to 1000.

Lung segmentation: To separate the lung areas from the surrounding structures in the CT images, a region-growing algorithm was used. Annotation for nodules: Binary masks were created using the LIDC-IDRI database's ground truth nodule locations and sizes. After that, the binary masks and preprocessed CT images served as the inputs for the two-stage CNN method with KAZE feature extraction for lung nodule detection.The feature extraction technique known as KAZE (Kanade-Lucas-Tomasi with Zernike moments) combines the KLT (Kanade-Lucas-Tomasi) algorithm with Zernike moments, a group of orthogonal polynomials used in image analysis. The KAZE characteristics are useful for lung nodule identification in CT scans because they are resistant to image rotation, scale, and illumination variationsIn this work, the OpenCV package was used to extract KAZE features from the preprocessed CT images. The steps of the KAZE algorithm are as follows:

Details of the KAZE feature extraction process

Scale-space construction: By repeatedly applying a Gaussian filter to the picture at various scales, a Gaussian pyramid is created. KAZE feature recognition process involves applying a Laplacian of Gaussian (LOG) filter to the picture at each scale and spotting local maxima to find key points in the scale-space pyramid.

Estimating feature orientation:

Each feature's orientation is determined by determining the dominating gradient direction in its immediate vicinity.

Extraction of the feature descriptor:

Each feature is given a feature descriptor by applying Zernike moments to the picture patch around it. The local texture and shape data of the patch are captured by the Zernike moments.

Data preparation: To reduce noise and normalize the image, lungs' CT images are gathered and pre processed.KAZE feature extraction is used to identify possible nodule candidates from the preprocessed pictures. The edges, corners, and blobs that the KAZE algorithm picks out in the image are used to identify probable nodules.Region suggestion: The KAZE feature extraction method produces a list of potential nodule-containing regions. The CNN is then fed information from these areas.

Convolutional neural network (CNN) training: To categorize the candidate regions as either nodules or non-nodules, a dataset of CT images is used to train a convolutional neural network (CNN). By modifying the weights, the CNN is tuned to minimize the loss function.

Nodule detection: The candidate regions discovered by the KAZE algorithm are subjected to the trained CNN in order to categorize them as nodules or non-nodules. A set of nodule detections with corresponding confidence scores make up the CNN's output.

Post-processing: To eliminate false positives and combine several detections into a single nodule, the nodule detections are filtered using a variety of post-processing approaches.

Evaluation: The model's effectiveness is measured using a variety of metrics, such as accuracy, sensitivity, specificity, and false-positive rate.

The two-stage CNN was then used to classify potential nodule candidates using the KAZE feature vectors.

Advantages:

Performance improvement: For the identification of lung nodules, the two-stage CNN strategy with KAZE feature extraction outperformed conventional CNN approaches. The method makes use of the advantages of both KAZE and CNNs, creating a more reliable and precise detection system.

Reduced false positives: By employing the KAZE features to filter out non-nodule areas before sending them to the CNN classifier, the two-stage technique lowered the amount of false positives. This lessens the requirement for extra post-processing stages and boosts the system's effectiveness.

Since KAZE characteristics are invariant to rotation, scaling, and illumination changes, they help the system generalize more effectively to other datasets and imaging techniques.

Limitations:

Computing complexity: Because the two-stage CNN technique with KAZE feature extraction includes an additional feature extraction phase, it requires more computation than typical CNN approaches. This could restrict how the technology can be used in real time.

Dataset bias: Because the LIDC-IDRI dataset utilised in this study mostly consisted of nodules seen by seasoned radiologists, it may not be entirely representative of all lung nodule cases. The approach's capacity to be applied to different datasets may be impacted by this.

Feature selection: Choosing the right parameters, such as the scale levels and feature descriptors, might affect how well KAZE features identify lung nodules. Some settings may need personal adjustment and subject-matter knowledge to be optimized.

Results:

Two-step CNN lung nodule detection using KAZE function is a computer vision project to detect lung nodules in CT scans. The project takes a two-step approach, the first step is a pre-processing step using KAZE feature extraction to identify potential candidate nodules. In the second step, candidate nodules are classified into nodules or non-nodules using a convolutional neural network (CNN).

This project aims to improve the accuracy and efficiency of lung nodule detection, an important step in the early diagnosis of lung cancer. Lung cancer is the leading cause of cancer-related death worldwide, and early detection can dramatically improve patient outcomes. Overall, the success of the project will be measured by its ability to accurately detect lung nodules and reduce the false positive rate. The project must also be evaluated in terms of speed and efficiency for clinical use.

Future scope

Improve the accuracy and efficiency of KAZE feature extraction technology: KAZE feature extraction is a crucial project step, and any improvement in this step can improve the overall performance of the project. Explore other feature extraction techniques: Although KAZE is effective, there may be other feature extraction techniques that might be better suited to detecting lung nodules, and exploring these. techniques can lead to further improvements.

Use Different CNN Architecture:
There are several CNN architectures available, and experimenting with different architectures can improve model performance.

Develop Stronger training datasets:
The accuracy and generalizability of a project depends on the quality and quantity of training data used. Developing more comprehensive and diverse datasets can improve project performance.

VI. CONCLUSION

A promising research that could help with lung cancer early detection is the two-step CNN lung nodule detection using the KAZE function. The project's objective is to swiftly and accurately identify lung nodules in CT images, and it includes a number of success indicators, such as accuracy, sensitivity, specificity, and false positive rate.

Despite the project's encouraging outcomes, there are still areas for growth and development. They include researching more feature extraction strategies, utilizing other CNN architectures, creating more potent training datasets, and incorporating additional medical imaging modalities.

The capacity to reliably identify lung nodules while lowering the false positive rate, as well as the project's actual clinical application in terms of speed and efficiency, will ultimately determine its success.

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