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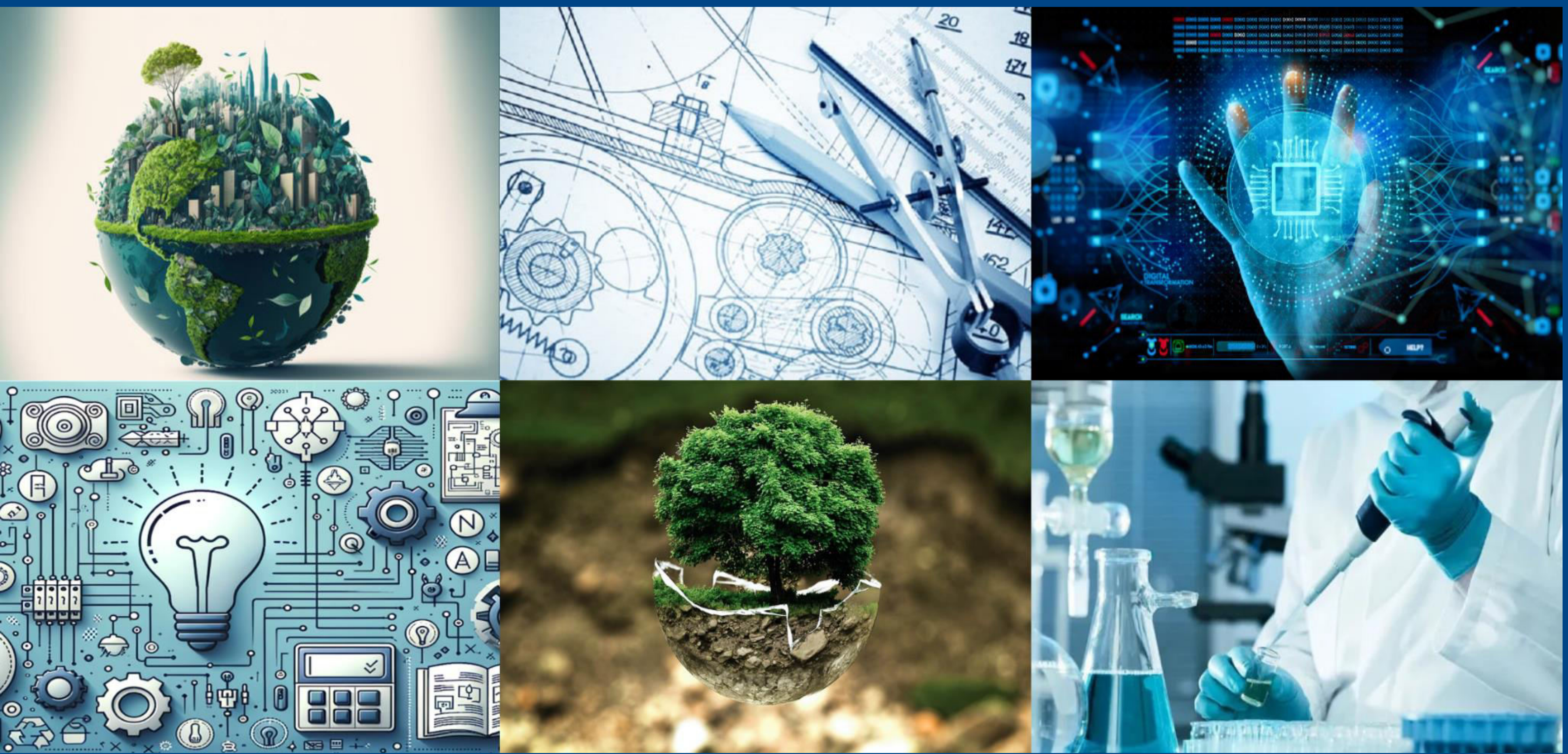

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International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

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# Lung Cancer Detection using Deep Learning

**Dr. Ammi Reddy[1], V. Gayatri Sri Priya[2], S.Harini[3]**

Professor, Department of ECE, Vasireddy Venkatadri Institute of Technology, Nambur, Guntur, A.P., India[1]

Undergraduate students, Department of ECE, Vasireddy Venkatadri Institute of Technology, Nambur, Guntur, A.P., India[2-3]

**ABSTRACT:** Lung cancer is one of the leading causes of cancer-related deaths worldwide, primarily due to late-stage detection. Early and accurate diagnosis of lung cancer is critical for improving survival rates. In recent years, advancements in deep learning have enabled significant progress in medical image analysis, offering a powerful tool for automated and precise detection of lung cancer from imaging data. This study presents a deep learning-based approach for the detection of lung cancer using convolutional neural networks (CNNs) and advanced image preprocessing techniques. We leverage a large dataset of computed tomography (CT) scans, applying preprocessing steps like normalization and segmentation to enhance feature extraction. Deep learning is an emergent and influential method which is used for feature learning and pattern recognition. we have compared several deep neural networks for recognition of pulmonary cancer. Our model was trained on labeled CT images, with particular attention to detecting nodules and distinguishing malignant from benign lesions. By using a CNN architecture optimized for lung nodule classification, the model achieved high accuracy in predicting the presence of lung cancer, outperforming traditional image processing methods and prior machine learning approaches. The results demonstrate that deep learning can facilitate accurate, non invasive lung cancer screening, potentially aiding radiologists in early diagnosis and reducing the burden on healthcare systems.

**KEYWORDS:**Matlab2024a, CNN, Parameter Analysis, Segmentation,

## I. INTRODUCTION

The early detection of lung nodules with Computer-Aided Diagnosis (CAD) schemes is especially significant for the analysis and recovery of lung cancer patients. Though, classifying huge numbers of CT images is very hard and time consuming for radiologists. Therefore, the automatic recognition of lung nodules is important field for research and significantly enhances the effectiveness of pulmonary nodule detection frameworks. Common symptoms of lung cancer include coughing, sore throat, chest pain, fatigue, chest infection, hemoptysis, and weight loss. Excessive delay in detecting or triggering lung cancer cases could cause the patient's affliction. Automatic diagnosis of malignant/benign character of pulmonary nodules is typically the most important goals of CAD schemes and it is done on feature extraction in order to decide every time there is analytical indecision and disparity. Conventional CAD systems usually involve a number of image processing steps and then perform categorization job for detection of tumor or abrasion. The malignant/benign character of the training CT images can be can simply identified by the annotator without the need for particular drawing of the tumour margins on the training dataset. So, we are presenting our study which concentrates on CAD Schemes based on deep learning techniques. In this regard, the movement in medicine toward CAD systems, which is due to a quantitative analysis of CT lung images, can improve CT image analysis, diagnosis of the disease, detection of small cancerous nodules and reduce diagnostic time. Performance of traditional CAD systems depends a lot on the intermediary outcomes of the image processing steps for consistent features. In many CAD schemes, additional issues may be integration and selection of extracted features. The malignant/benign character of the training CT images can be can simply identified by the annotator without the need for particular drawing of the tumor margins on the training dataset. There are many automatic diagnosis systems based on traditional systems, as research area based on deep leaning techniques are less explored, so we are presenting our study which concentrates on CAD Schemes based on deep learning techniques. The CAD systems and the steps to access lung CT databases are described. In the next step, the diagnosis of the nodules and their classification described. Finally, the existing challenges are discussed. In the survey, we have attempted to present comprehensive but brief and easy to understand content, while highlighting the concept. From our study, we can see that from the perspective of CAD for lung cancer detection, Deep

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learning techniques have not been that much explored. In this paper, automated detection systems dependent on different types of deep learning architectures are analysed. Lung nodules can be classified as benign or malignant pulmonary nodules with the application of these networks to the CT images with some modification. In this paper, we compare the conventional CAD systems with the CAD methods established on Deep Learning technique. • We have addressed several the advantages and disadvantages of the existing algorithms for pulmonary cancer detection. • Several automated detection systems for pulmonary nodules with deep learning architectures are compared for in the paper. In this regard, the movement in medicine toward CAD systems, which is due to a quantitative analysis of CT lung images, can improve CT image analysis (which may contain pulmonary nodules), diagnosis of the disease, detection of small cancerous nodules (which with much difficulty can be detected by a physician) and reduce diagnostic time.

## II. LITERATURE SURVEY

**TOPIC:** A Lightweight Multi-section CNN for Lung Nodule Classification and Malignancy Estimation.
**AUTHOR'S:** Pranjal Sahu , Dantong Yu, Mallesham Dasari , Fei Hou , and Hong Qin.

**DESCRIPTION:**
The size and shape of a nodule are the essential indicators of malignancy in lung cancer diagnosis. However, effectively capturing the nodule's structural information from CT scans in a Computer-aided system is a challenging task. Unlike previous models which proposed computationally intensive deep ensemble models or 3D CNN models, we propose a lightweight, multiple view sampling based Multi-section CNN architecture. The model obtains a nodule's cross-sections from multiple view angles and encodes the nodule's volumetric information into a compact representation by aggregating information from its different cross-sections via a view pooling layer. The compact feature is subsequently used for the task of nodule classification. The method does not require nodule's spatial annotation and works directly on the crosssections generated from volume enclosing the nodule. We evaluated the proposed method on LIDC-IDRI dataset. It achieved state-of-the-art performance with a mean 93.18% classification accuracy. The architecture could also be used to select the representative cross-sections determining nodule's malignancy which facilitates in the interpretation of results. Because of being lightweight the model could be ported to mobile devices which brings the power of AI driven application directly into practitioner's hand.

**TOPIC:** Automatic recognition of 3D GGO CT imaging signs through the fusion of hybrid resampling and layer-wise fine-tuning CNNs.
**AUTHOR'S:** Guanghui Han, Xiabi Liu, Guangyuan Zheng, Murong Wang, Shan Huang.

**DESCRIPTION:**
Ground-glass opacity (GGO) is a common CT imaging sign on high-resolution CT, which means the lesion is more likely to be malignant compared to common solid lung nodules. The automatic recognition of GGO CT imaging signs is of great importance for early diagnosis and possible cure of lung cancers. The present GGO recognition methods employ traditional low-level features and system performance improves slowly. Considering the high-performance of CNN model in computer vision field, we proposed an automatic recognition method of 3D GGO CT imaging signs through the fusion of hybrid resampling and layerwise fine-tuning CNN models in this paper. Our hybrid resampling is performed on multi-views and multi-receptive fields, which reduces the risk of missing small or large GGOs by adopting representative sampling panels and processing GGOs with multiple scales simultaneously. The layer-wise fine-tuning strategy has the ability to obtain the optimal fine-tuning model. Multi-CNN models fusion strategy obtains better performance than any single trained model. We evaluated our method on the GGO nodule samples in publicly available LIDC-IDRI dataset of chest CT scans. The experimental results show that our method yields excellent results with 96.64% sensitivity, 71.43% specificity, and 0.83 F1 score. Our method is a promising approach to apply deep learning method to computer-aided analysis of specific CT imaging signs with insufficient labeled images.

**TOPIC:** Identification of pulmonary nodules via CT images with hierarchical fully convolutional networks.
**AUTHOR'S:** Genlang Chen, Jiajian Zhang, Deyun Zhuo, Yuning Pan, Chaoyi Pang.

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**DESCRIPTION:**
Lung cancer is one of the most diagnosable forms of cancer worldwide. The early diagnoses of pulmonary nodules in computed tomography (CT) chest scans are crucial for potential patients. Recent researches have showed that the methods based on deep learning have made a significant progress for the medical diagnoses. However, the achievements on identification of pulmonary nodules are not yet satisfactory enough to be adopted in clinical practice. It is largely caused by either the existence of many false positives or the heavy time of processing. With the development of fully convolutional networks (FCNs), in this study, we proposed a new method of identifying the pulmonary nodules. The method segments the suspected nodules from their environments and then removes the false positives. Especially, it optimizes the network architecture for the identification of nodules rapidly and accurately. In order to remove the false positives, the suspected nodules are reduced using the 2D models. Furthermore, according to the significant differences between nodules and nonnodules in 3D shapes, the false positives are eliminated by integrating into the 3D models and classified via 3D CNNs. The experiments on 1000 patients indicate that our proposed method achieved 97.78% sensitivity rate for segmentation and 90.1% accuracy rate for detection. The maximum response time was less than 30 s and the average time was about 15 s.

**TOPIC:** Using Double Convolution Neural Network for Lung Cancer Stage Detection.
**AUTHOR'S:** Jakimovski, Goran & Davcev, Danco.

**DESCRIPTION:**
Recently, deep learning is used with convolutional Neural Networks for image classification and figure recognition. In our research, we used Computed Tomography (CT) scans to train a double convolutional Deep Neural Network (CDNN) and a regular CDNN. These topologies were tested against lung cancer images to determine the Tx cancer stage in which these topologies can detect the possibility of lung cancer. The first step was to pre-classify the CT images from the initial dataset so that the training of the CDNN could be focused. Next, we built the double Convolution deep Neural Network with max pooling to perform a more thorough search. Finally, we used CT scans of different Tx cancer stages of lung cancer to determine the Tx stage in which the CDNN would detect possibility of lung cancer. We tested the regular CDNN against our double CDNN. Using this algorithm, doctors will have additional help in early lung cancer detection and early treatment. After extensive training with 100 epochs, we obtained the highest accuracy of 0.9962, whereas the regular CDNN obtained only 0.876 accuracy.

## III. PROPOSED METHODOLOGY

The proposed model aims to address the limitations of existing models by incorporating the following elements: Multi-Stage Deep Learning Pipeline.

**Stage 1**: Preprocessing and Augmentation • The first step is acquisition of CT images from accessible databases like LIDC, LIDC-IDRI, ELCAP. • Second step is preprocessing of Lung CT image in order to enhance the image and to remove unnecessary noises. Some of the commonly used preprocessing techniques are Adaptive Median Filter, Alpha-Trimmed Mean Filter, Gaussian Filter. • Normalize and segment lung regions using U-Net or similar models.

**Stage 2:** Nodule Detection and Segmentation . Third step is segmentation of the preprocessed CT image using a standard segmentation technique like thresholding technique, Markov random field, region growing, watershed and histogram based segmentation. • The fourth step is analysis, in which during feature extraction, some of the extracted features are for example area, perimeter, eccentricity, centroid, diameter.

**Stage 3:** Nodule Classification and Risk Assessment • The fifth step is the classification phase, where nodule and non-nodule structure are distinguished on the basis of CT images. • Classification algorithms are used for recognition and classification of malignant nodules for which the algorithms use extracted features for training features and the trained model is used for the sorting succeeded by system valuation. • The resultant models have superior specificity, sensitivity and accuracy. Commonly used methods for classification are SVM, Neural Networks, CNN and ANN. 5 • Recognition of lung cancer in the early hours, Emre Dandil proposed a novel CAD system. They have used principal component analysis (PCA) to reduce number of features and probabilistic neural network (PNN) to classify benign/malignant nodules.

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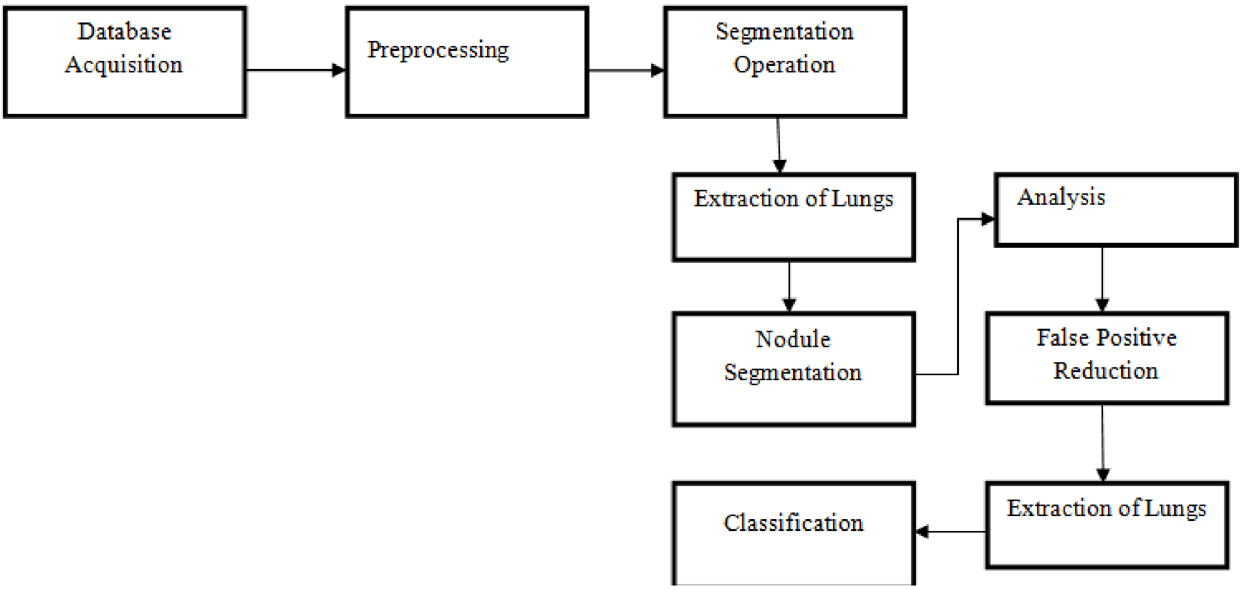


**Figure 1: Block diagram for proposed methodology.**

## IV. TESTING AND RESULTS

Lung cancer detection using deep learning in MATLAB has shown significant potential identification in processing and classification of lung detection. In this study, a convolutional neural network (CNN) model was trained on a dataset of lung cancer images, achieving high accuracy in detecting both benign(non-cancerous) and malignant(cancerous) nodules. The results suggest its potential application in assisting radiologists for early lung cancer diagnosis.

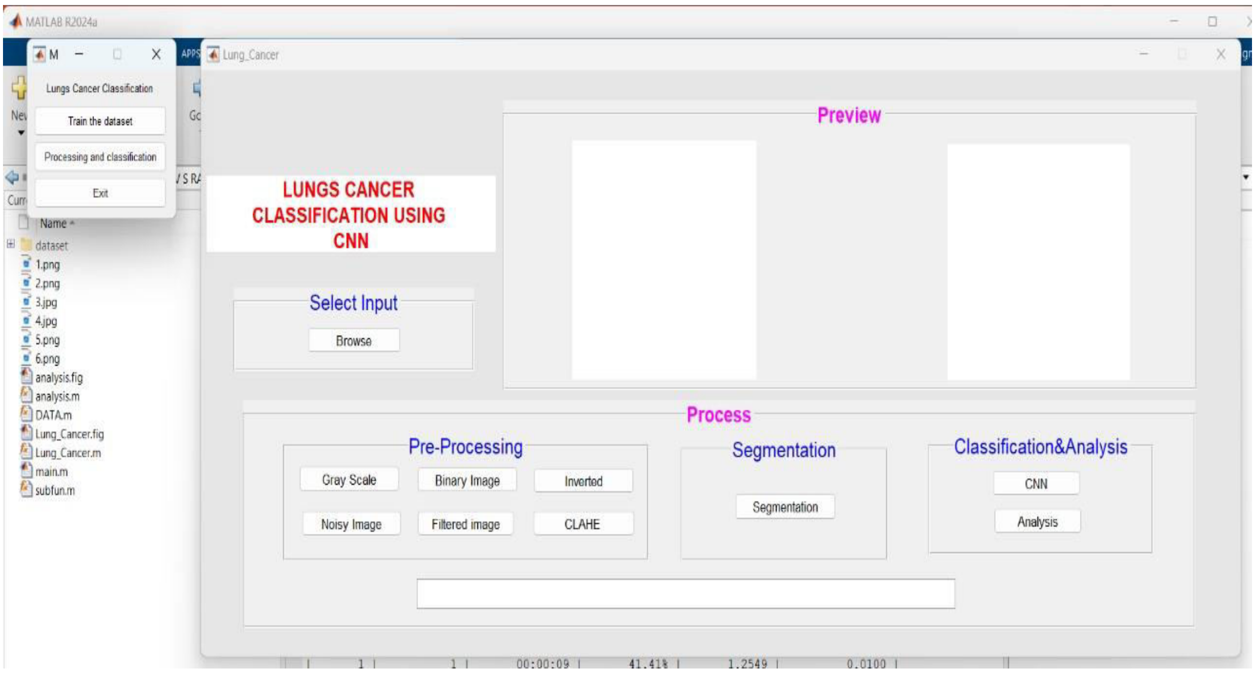


**Figure 2: Lung Cancer Classsification**

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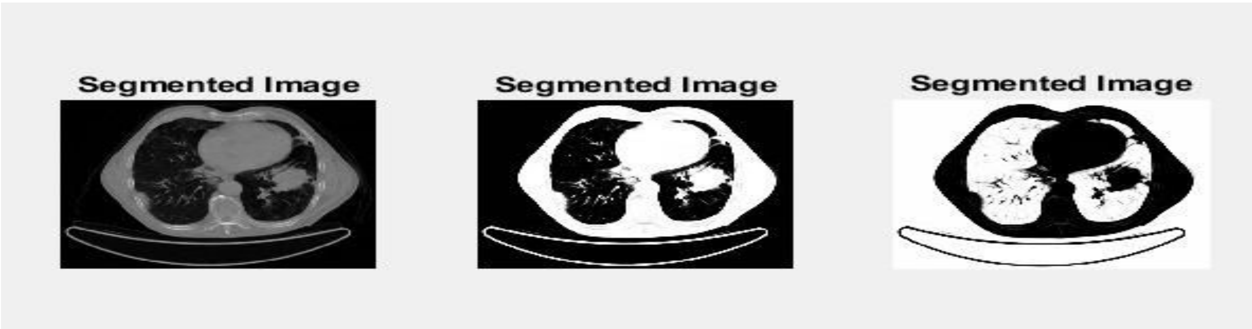


Figure 3: Segmented Image

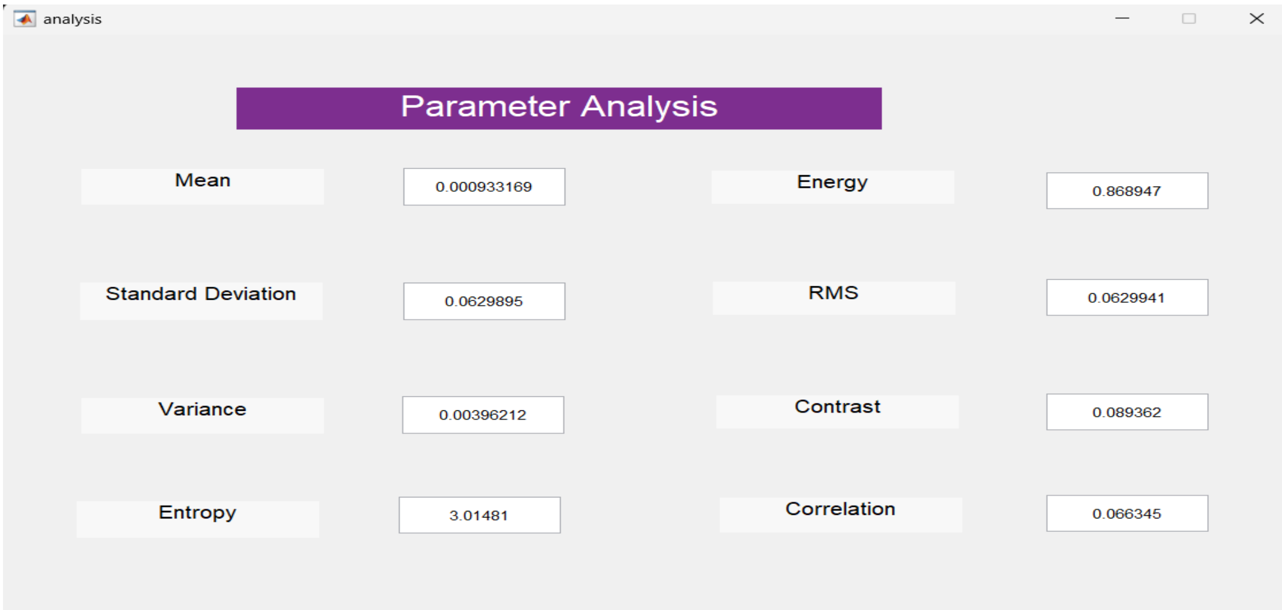


Figure 4: Parameter Analysis

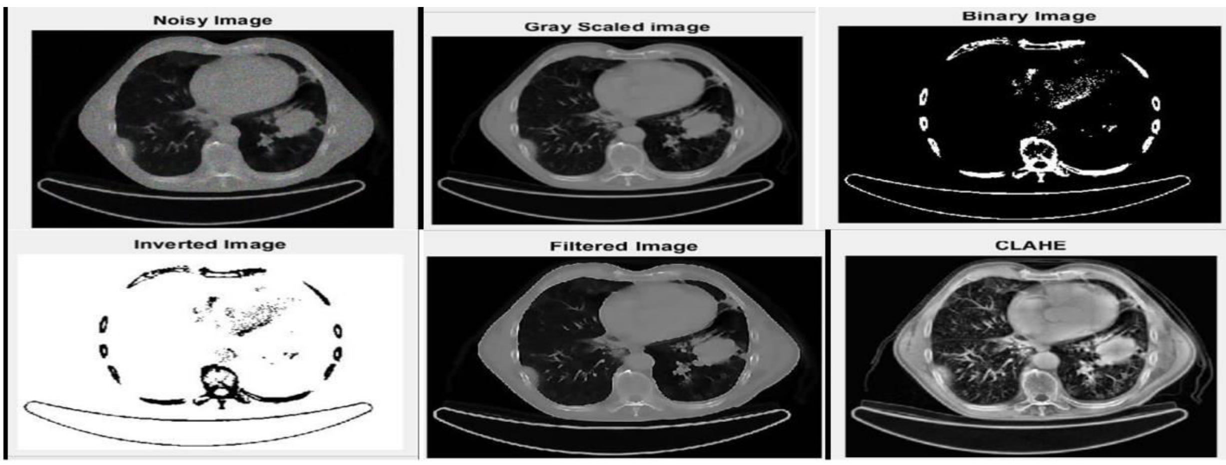


Figure 5: Preprocessing Of Images

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## V. CONCLUSION

[redacted]Deep learning has proven to be a powerful tool in the field of lung cancer detection, offering significant improvements in diagnostic accuracy and efficiency. By leveraging convolutional neural networks and other advanced algorithms, these systems provide reliable and consistent analysis of radiological images. The ability of deep learning models to identify lung nodules, differentiate between benign and malignant tumors, and reduce false positives enhances the decision-making process for medical professionals. Despite its numerous advantages, challenges such as data quality, model interpretability, and computational demands remain. 33 Addressing these issues through continued research and development will further enhance the effectiveness of deep learning-based detection systems. In conclusion, the integration of deep learning into lung cancer diagnostics represents a major advancement in medical imaging. As technology evolves, these systems will continue to support early detection, personalized treatment planning, and improved patient outcomes, ultimately contributing to the fight against lung cancer.

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