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Strategies for Pulmonary Embolism Identification

Kavyamol James,[a] *Bijoy CP,*[b]*, Arya Somaraj*[c]

Mangalam College of Engineering Kottayam, Kerala, India
[a]kavyamoljams@gmail.com [b]bijoycp90@gmail.com [c]aryasomaraj1234@gmail.com

ABSTRACT :

A serious blockage in a lung artery is known as pulmonary embolism (PE), a potentially dangerous condition that re- quires prompt diagnosis and treatment. While CT imaging can be a helpful diagnostic tool for PE, analyzing a large number of images is labor-intensive and prone to human error. The medical imaging analysis field has changed significantly with the help of Deep Learning(DL) and Machine Learning techniques, primarily Convolutional Neural Networks (CNN),which is used for auto- mated disease detection. With the help of a thorough overview, this paper provides a methodical analysis of recent advancements in medical image processing for the identification of PE. In order to close the knowledge gap between research and practice, this study offers a framework that addresses both conventional and state-of-the-art methods.

INTRODUCTION :

When artificial intelligence (AI) predictive approaches are used instead of solely relying on human expertise, auto diagnosis is made possible and detection mistakes are decreased. Furthermore, neural networks have significantly changed the course of AI technology. Lung illness is widespread worldwide. These comprise pneumonia, asthma, fibrosis, TB, and chronic obstructive pulmonary disease, among others. For lung disease, a prompt diagnosis is crucial. For this reason, numerous models for machine learning and image processing have been created. Lung disease prediction uses many of the DL techniques, such as convolutional neural network (CNN), capsule network, vanilla neural network and visual geometry group based neural network .

The clots of blood from various parts of the body move to the lungs and block a pulmonary artery are the cause of pulmonary embolisms (PE).[3]. It is a component of a more serious illness called Deep Vein Thrombosis (DVT), which make clot form in vein . A blood clot called DVT typically forms in the arms, legs, or other veins Every year, between 3 to 6 million Americans are affected by PE and DVT and 15- 30 percentage pass away within three months of diagnosis. The death rate might reach 25 percentage. CT pulmonary angiography(CTPA) is often used to identify this condition .The application of deep learning to computer-aided CTPA diagnosis (CAD) of PE shows considerable potential[2]. However, the deep learning literature presents a multitude of competing approaches for a particular problem, which greatly complicates the process of developing a CAD PE system[1]. One drawback of the older computer-aided CTPA diagnosis methods and some current DL-based models is also require training data that are heavily annotated, where each individual emboli is marked manually or segmented. For their own model development, individual hospitals or research teams might not be able to produce large size of annotated training data. Overfitting, a situation where the model perform too well on training data and when applied to new data its performance decreases rapidly, can be brought on by small datasets. A number of regularization techniques, including as early pausing and dropout, can be employed to mitigate overfitting to some degree.

The fundamental when it comes to distorted image orientation, such as tilted or rotated images, CNN performs poorly. We will now use CT scans to identify pulmonary embolism. Predicting if a pulmonary embolism is present in the CT scans is the task. The Semantic Image Segmentation problem is what this one is. A doctor using the models will be able to diagnose a pulmonary embolism. One uncommon side effect of PE is pneumothorax. PE can be predicted from CT images using Deep Learning algorithms[3].

LITERATURE REVIEW :

Over the past years, the field of Pulmonary Embolism detection has seen incredible growth. Carefully examined the application of deep learning techniques in detecting PE in the table 1. The problem of pulmonary embolism can be effectively resolved with computer-aided diagnostics. Using AI approaches, this paper offers and discusses a work on
pulmonary embolism. The use of CTPAs for automatic PE detection has been the subject of numerous research, with encouraging outcome[1].

TABLE 1. Literature review Comparison

Sl.No	METHODOLOGY	RESEARCH CONTRIBUTION	RESEARCH GAP

[1]	A CNN-LSTM network based on two-stage attention	Obtaining on the test set an area under the receiver operating characteristic curve (AUC) of 0.95 for identifying the existence of PE in the investigation.	Bilateral PE, it is possible to see that some discriminative regions do not exactly correspond to PE regions.
[2]	More Accurate Faster R-CNN (MA Faster R- CNN).	Improve the detection efficiency, false detection and missed detection effectively	cannot identify the precise location of a pulmonary embolism. SSIM = 0.88, PSNR = 25.00.
[3]	The U-Net-based ResD-Unet network architecture.	This enhances boundary segmentation definition and properly segments the pulmonary arteries in lung CT images.	The segmentation outcomes are similar to those obtained through manual segmentation.
[4]	A deep neural network made up of two components: a network to handle the entire CT- PAs and a convolutional neural network architecture known as InceptionResNet V2 .	Both stack- and slice-based levels it perform too well .	A small, poorly labeled training set could nonetheless yield the desired results and it can only be used by small research groups and individual hospital
[5]	Enhanced Inception- Residual Convolutional Neural Network.	EIRCNN significantly lowers the number of false-positive .	Classification accuracy of the proposed deep learning can also be supported by incorporating additional strategies in the data pre-processing step.

METHODOLOGY :

Based on the architecture of the framework for PE classification consisting of six stages and they are Data Collection, Data Processing, Data Augmentation, Data Segmentation , Feature Extraction, Classification, and Performance Analysis (fig .1).
Data collection is the process of gathering information from various sources. Pulmonary Embolism with RSNA- STR A number of datasets are frequently used globally for model training, including the CT (RSPECT) Dataset, FUMPE Dataset, CAD-PE Dataset, CTPA Pulmonary Embolism, CTPA Dataset, etc [4]. Image Conversion for Data Preprocessing, among the steps included in this procedure are the Dicom format is used for the datasets that were obtained. To enhance the images clarity and purity uses image conversion. The data has to be processed after being cropped. The lung item on the CT image is highlighted by the black background that is created by cropping but cropping causes variation in dimensions of image. So that scaling is used to standardize the dimensions of image. Additionally, grayscale used to ensures that grayscale of the image is consistent[1].[5]. The objective of augmentation is to generate more patterns that are similar from the data. This method improved the networks' capacity for generalization[4]. These are the various data augmentation methods. Mirroring, Rotations, Elastic Deformations, Zoom, Flip, Scaling and Shift are all examples of spatial augmentation. Color enhancement to adjust brightness, contrast, and gamma; noise enhancement to introduce Gaussian noise. Data segmentation is an important stage in the processing and analysis of images. On the chest CT images, it highlights the regions of interest (ROIs). Two examples of segmentation techniques include the traditional encoder-decoder model C-SE-ResUNet and the image segmentation approach U-Net. Feature Extraction in order to extract features, we must take into account the attributes that were evaluated. There are deep learning approaches like VGG19, DenseNet, AlexNet, Inception V3, ResNet and others, as well as features extraction techniques like Discrete Wavelet Transform(DET) ,Grey Level Co-occurrence

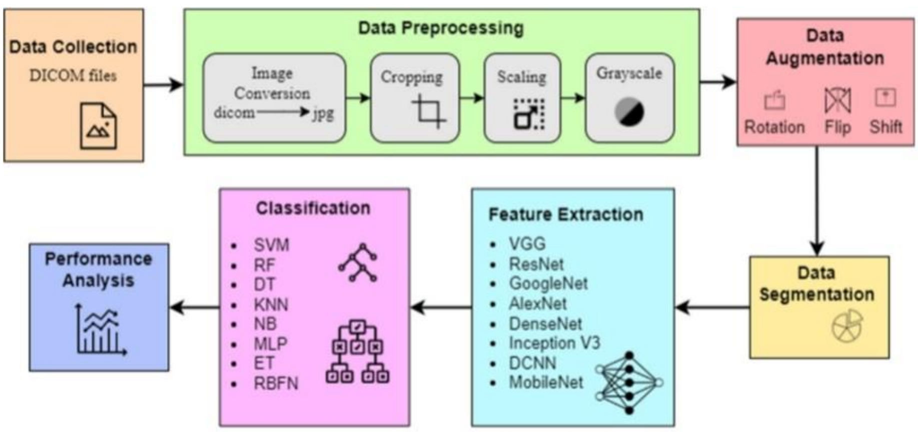

FIGURE 1. Framework for PE.

Matrix(GLCM) etc[2]. K Nearest Neighbor(KNN),Random Forest(RF) ,Decision Table(DT),Naïve Bayes(NB) and Multilayer Perceptron(MLP) classifiers are a few of the classification approaches used in machine learning classifiers. Performance Analysis is used determining the efficiency and effectiveness of a system[4].

This study compares densenet networks (DenseNet201, VGG19) with stacking attention networks (AttentionNet- 92 ,AttentionNet-56) and standard versus mixup data augmentation strategies. Despite providing significant improvements over the basic CNN, feature-wise attention extension and mixup data augmentation still outperform the stacked attention versions.ResNet50 model, which has integrated feature-wise attention layer and mixup enhanced data is used for training, had the best performance. It had a 95.57 accuracy rate.

CONCLUSION :

The problem of pulmonary embolism can be effectively resolved with computer-aided diagnostics. This work uses AI techniques to present and discuss a review of work on pulmonary embolism. The use of CTPAs for automatic PE detection has been the subject of numerous research, with encouraging outcomes. Studied a number of segmentation and diagnosis methods in order to offer a fresh approach for PE categorization. Among the flaws is the requirement for the system to make inaccurate predictions due to fractures. A variety of AI techniques were incorporated to enhance the models' functionality. Thus, these models are amenable to tuning to provide a common methodology for PE classification.

Future research in PE detection may focus on following research gap. They are Classification strategy, Factor analysis, Precise clinical models, Technological Advancement, Enhancement of CNN-based models. These are all recognized areas for future research, and finding answers to these would help clinicians concentrate on certain forms of PE and create individualized treatment plans for each.

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