A SURVEY ON PULMONARY FIBROSIS PROGRESSION USING DEEP LEARNING

Ms. Shubhangi mahule [1], R.Shalini [2], P.Narmada [3], Ayesha Siddiqa [4], B.Anil Kumar [5]

[1] *Associate Professor, Department of Computer Science and Engineering, ACE Engineering College, Hyderabad, Telangana, India*

[2,3,4,5] *IV BTech Students, Department of Computer Science and Engineering, ACE Engineering College, Hyderabad, Telangana, India*

ABSTRACT

The progressive lung scarring known as pulmonary fibrosis has no known cause and no known cure. The normal can suffer from scar tissue. slowly, which makes it challenging for oxygen to enter the bloodstream. Doctors have no way of predicting what will happen or where a person would fall on that continuum, which ranges from long-term healing to rapid deterioration. When exercising or walking, low oxygen levels can make it difficult to breathe, which can lead to complications like lung cancer, pulmonary hypertension, and pneumothorax. The survey analysis presented in this paper is based on deep learning methodologies and can aid in the diagnosis of interstitial lung disease. In our suggested system, we are using Multiple Quantile Regression, EfficientNets. The. We use one of the EfficientNets models that is categorized B0-B7 based on the number of layers, for severity estimation. Future work will focus on creating an EfficientNets that can be installed on any computer station and used in locations other than academic institutions.

Keywords: Pulmonary fibrosis, scarring of lungs, Forced Vital capacity, severity estimation, Efficientnets, Computed Tomography, Transfer learning, magnetic resonance imaging.

INTRODUCTION

One of the risky diseases is pulmonary fibrosis, a condition marked by lung scar tissue. Pulmonary fibrosis is caused in humans, but what does that actually mean? Fibrosis, which comes from the words pulmonary (lung) and fibrosis (scar tissue), technically refers to the thickening or scarring of tissue. The thin, delicate walls of the lungs' air sacs thicken, harden, and scar due to this disorder, also known as fibrosis. How you breathe and absorb oxygen into your blood is impacted by this disease. Scarring stiffens the architecture of the lung, making it less efficient at supplying oxygen to the bloodstream. Due to the prolonged underuse of the muscles throughout the body, the patient may have a decreased capacity for exercise and may become more easily exhausted. There is no known cure for pulmonary fibrosis. Although current treatments aim to stop further lung scarring, lessen symptoms, and keep you active and healthy, lung scarring that has already taken place cannot be reversed. Many times, general coughs go unnoticed because people dismiss them as minor problems, but by the time they are recognized, they have developed into a serious illness. Neglecting the problem and viewing it as minor in the beginning is the main issue for many patients suffering from because the damage done is irreversible. Even doctors are unable to foresee the early stages of pulmonary fibrosis. Every person with pulmonary fibrosis has a different experience living with the illness.

By displaying how the air sack walls thicken and stiffen over time, a Computed Tomography (CT) scan of the lungs over time can detect the presence of pulmonary fibrosis. A spirometer can measure Forced Vital Capacities, or how much air must be forcibly expelled after taking a deep breath, to quantify the shortness of breath that is a symptom of this condition. In order to establish a diagnosis and maintain the patient's health, it is possible to use these numbers to accurately assess the severity of a disease, understand the patient's condition, and place him on the severity spectrum.

LITERATURE SURVEY

A. C. Best, J. Meng, A. M. Lynchet [1]: The presence of pulmonary fibrosis can be determined over time using a Computed Tomography (CT) scan of the lungs, which demonstrates how the air sack walls get thicker and more rigid over time. The author examined serial changes in quantitative computed tomographic indexes over a 12-month period in patients with idiopathic pulmonary fibrosis (IPF) and described how these changes were related to pulmonary function test results, visual CT scoring, and quantitative computed tomographic indexes as predictors of mortality.

A spirometer can be used to quantify the condition's symptom of shortness of breath, known as Forced Vital Capacities 1 (FVC), which is the amount of air that must be forcibly expelled after taking a deep breath. These figures can be used to accurately assess the severity of a disease, comprehend the patient's condition, and place the patient on the severity spectrum so that a diagnosis can be made and the patient's health can be preserved.

S Danielle, Kangg zang [2]: The reliability and interpretability of clinical-decision support algorithms for medical imaging are problematic. As a result, the author developed a diagnostic tool based on a deep-learning framework for the screening of patients with widespread, curable retinal diseases that can cause blindness. With the help of transfer learning, which is used in this framework, a neural network can be trained with a smaller amount of data than with traditional methods. When using a dataset of optical coherence tomography images, this method can classify age-related macular degeneration and diabetic macular edema with performance that is on par with human experts. By highlighting the regions that the neural network has identified, it can also offer a more transparent and understandable diagnosis.

Ho-fung chan [3]: The author assessed the reproducibility of these metrics and their correlation with existing clinical measures of IPF disease severity in order to determine whether microstructural imaging metrics from in-vivo hyperpolarized 3He DW MRI are sensitive to longitudinal changes in a cohort of participants with IPF. Idiopathic pulmonary fibrosis lungs had higher hyperpolarized helium 3 diffusion-weighted MRI metrics, and airway mean diffusive length scale estimates from diffusion models were sensitive to longitudinal change.

Alexander wong, jack lu, mahmood famouri [4] For the purpose of predicting the progression of authors developed An algorithm called Fibrosis-Net uses chest computed tomography (CT) data to identify pulmonary fibrosis. They deliberately created We develop a customised network design for estimating forced vital capacity (FVC) using a patient's CT scan, initial spirometry test, and clinical metadata.To create

a solid architectural design for a CT lung analysis, design research is necessary. In order to study the Fibrosis-Net decision-making process and affirm that forecasts are supported by relevant visual cues in CT images, they ultimately developed a performance validation strategy driven by explainability.

Zabir al nazi, fazla rabi, Sumit Saha and Amirul Islam [5] Scarring of the lung tissue results in a decrease of lung function and is a symptom of the restrictive interstitial lung disease known as idiopathic pulmonary fibrosis (IPF). Forced Vital Capacity, or FVC is used to measure the decline in lung function, but it is still difficult to accurately predict how IPF will progress. The authors presented Fibro-CoSANet, an unique end-to-end multi-modal learning-based solution, to deal with this issue and forecast the drop in FVC. Frameworks for convolutional neural networks with stacking attention layers, Fibro-CoSANet makes use of computed tomography images and demographic data.

Fabian heinman, Gerald birk, Tanja schoenberger,Birgit steinstofer [6] The The often utilised readouts from histopathological tissue grading are arduous, require highly qualified individuals, and contain inherent variability. Convolutional neural networks with deep learning have recently made advancements that make it possible to automate such scoring tasks. Masson trichrome was used to stain lung tissue samples taken from mice with a variety of fibrotic and inflammatory conditions. Whole slide scans were obtained, divided Using customised CNNs, the larger tiles were then divided into smaller ones and categorised as either having inflammation or Ashcroft fibrosis. Following instruction, the Ashcroft fibrosis CNN had a 79.5% accuracy rate and the inflammation CNN had an 80% accuracy rate.

Anju Yadav, Rahul Saxena, Ayush kumar, tarandeep singh walia, Atef Zaguia, s f Mustafa kamal [7] In order using the patient's computed tomography (CT) scan and patient metadata, one can forecast the progression of the disease, this study suggests a deep learning-based FVC-Net architecture. The input to the model combines the metadata and the image score calculated based on the level of honeycombing for a patient identified using segmented lung images. To get the final output, input is then fed into a 3-layer net. Performance of the proposed FVC-Net model with regard to a cohort from the pulmonary fibrosis progression dataset is contrasted with a number of current state-of-the-art deep learning-based models.

Andria dovel, juon kang [8] The author created prognostic models by using machine learning on microbial EV metagenomes, which were extracted from patient serum and coded by their cumulative taxonomic hierarchy diagnostic models for COPD, asthma, and lung cancer. With substantial features at the genus and phylum levels and mean AUC values ranging from 0.93 to 0.99, all models had similar characteristics demonstrated high predictive strength. A generalized linear model (GLM) without feature selection, a GLM with feature selection, a gradient boosting machine (GBM), an artificial neural network (ANN), and a GBM ANN ensemble model were five machine learning (ML) techniques that were used to analyze the control and disease group samples for asthma, COPD, and lung cancer.

year	Technology/Methodology used	pros	cons
2008	Serial evaluation of quantitative Computed Tomography [CT] measures can show disease progression .	Provide detailed information to diagnose and evaluate many conditions.	It is challenging to predict the disease's course solely from the analysis of CT scans, which complicates the prognosis.
2018	Histological scoring of lung fibrosis and inflammation using deep neural networks in the mouse model system.	These findings show how deep learning can standardize and automate time-consuming and expensive scoring tasks.	Exploding gradient.
2018	Identification of Treatable Diseases and Medical Diagnosis by Image-Based Deep Learning (Transfer learning).	This tool might help hasten the diagnosis and referral of these treatable conditions, enabling earlier treatment and better clinical outcomes.	Issue of negative transfer, this only works if initial and target problems are indistinguishable for first round of training to be relevant.
2019	MRI with inhaled hyperpolarized helium used to assess IPF	provides non invasive and quantitative assessment of microstructural acinar changes in the lungs.	-
2021	Fibro-CoSANet: a convolutional self-attention network for predicting the prognosis of lung fibroids.	The design of networks to increase the prognostic precision of IPF may be aided by this network.	-
2021	Using Chest CT Images, Individualized Prediction of Pulmonary Fibrosis Progression Using Deep Convolutional Neural Network.	when making predictions when making predictions, demonstrates sound judgement.	class imbalance, overfitting.
2022	Assessment of dietary effects using information from circulating microbial extracellular vesicles, machine learning algorithms for risk assessment of lung cancer, COPD, and asthma	overcomes the limitations caused by overfitting by doing cross-validation.	-
2022	Using deep learning and honeycombing, FVC-NET provides an automated diagnosis and prognosis prediction for lung fibrosis.	modified Laplace Log-likelihood score (MLL) score of FVC-Net surpasses EN, EQR, LR, and RF, considered most optimal.	Methodology is slightly complex

CONCLUSION AND FUTURE SCOPE

The project's goal is to determine the severity of pulmonary fibrosis, a lung scarring condition that is frequently challenging to predict, even by medical professionals. Determining the patients with rapid progression is crucial due to the unpredictable nature of the progression and the brief median survival of 2–6 years. The objective is to assess how predictable pulmonary fibrosis progression using deep learning techniques.

Future work will focus on creating an EfficientNets that can be installed on any computer station and used in locations other than academic institutions.

ACKNOWLEDGEMENT

We would like to express our gratitude to our guide Ms.Shubhangi Mahule and project coordinator Mrs.Soppari Kavitha for their continuous support and guidance. Also, we are extremely grateful to Dr. M.V.VIJAYA SARADHI, Head of the Department of Computer Science and Engineering, Ace Engineering College for his support and invaluable time.

REFERENCES

[1] A. C. Best, J. Meng, A. M. Lynchet al., “Idiopathic pulmonary fibrosis: physiologic tests, quantitative CT indexes, and CT visual scores as predictors of mortality”,Radiology, vol. 246, no. 3, pp. 935–940, 2008.

[2] “Identification of Treatable Diseases and Medical Diagnosis by Image-Based Deep Learning”, S Danielle, Kangg zang et al.cell. 2018.

[3] “Diffusion-weighted MRI assessment of airway microstructure in IPF patients who have inhaled hyperpolarized helium “ , Ho-fung chan etal., Radiology, 2019.

[4] “An Individualized Deep Convolutional Neural Network for Pulmonary Fibrosis Progression Prediction From Chest CT Images”. Alexander wong, jack lu, mahmood famouri, National center for biotechnology information, 2021.

[5] “Fibro-CoSANet: a convolutional self-attention network for predicting the prognosis of lung fibroids”. Zabir al nazi, fazla rabi, Amirul islam, sumit saha, National library of medicine 2021.

[6] “Deep neural network based histological scoring of lung fibrosis and inflammation in the mouse model system”, Fabian heinman, Gerald birk, Tanja schoenberger,Birgit steinstofer, Plos one, 2018.

[7] “FVC-NET: An Automated Diagnosis of Pulmonary Fibrosis Progression Prediction Using Honeycombing and Deep Learning”, Anju Yadav, Rahul Saxena, Ayush kumar, tarandeep singh walia, Atef Zaguia, s f Mustafa kamal., Hindawi Computational Intelligence and Neuroscience, 2022.

[8] “Assessment of dietary effects using machine learning algorithms for risk assessment of lung cancer, COPD, and asthma using data from circulating microbial extracellular vesicles”, Andria dovel, juon kang., Laboratory and molecular medicine, 2022.