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PULMONARY FIBROSIS PREDICTION

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Abstract:
Imagine that at some point, you started breathing shallowly and with constant effort. It took several months for you to be officially diagnosed with pulmonary fibrosis, a lung scarring-related condition for which there is no recognized cause or treatment. You would want to be aware of your prognosis if something happened to you. This is where a concerning illness can become overwhelming for the patient: results might vary from stable long-term conditions to rapidly declining health, and it can be difficult for physicians to predict a patient's potential place on this spectrum. Even with access to a chest CT scan, current treatments for fibrotic lung illnesses are challenging. Furthermore, there are problems planning clinical studies due to the wide range of possible outcomes. Ultimately, individuals experience severe anxiety due to the illness's opaque nature, in addition to symptoms associated with fibrosis. With the help of this initiative, we hope to forecast how much a patient's lung function will deteriorate in response to a lung CT scan. We will use a spirometer to measure the amount of air that is inhaled and expelled in order to evaluate how well lung function is sustained. Using the image, metadata, and baseline FVC as input, the goal is to create a prediction using machine learning algorithms. If it is successful, patients with this incurable lung illness and their families will have a better understanding of their prognosis when they receive their initial diagnosis. Enhancing severity identification might also hasten the clinical development of new medicines and have a positive effect on treatment trial design.

Keywords: Prognosis, Fibrosis, Severity, Disease, Lung, Diagnosed

Introduction:
Lung scarring causes the condition pulmonary fibrosis, which has no known origin or treatment. In these situations, the patient anticipates the illness's outcome. That's where a concerning illness gets daunting for the patient: results can vary from steady improvement over time to sharp decline, but physicians aren't always able to predict a patient's potential place on this spectrum. Treatment for fibrotic lung diseases is challenging with current techniques, even when a chest CT scan is available. Furthermore, the wide range of possible outcomes causes problems when it comes to planning clinical trials. Ultimately, patients experience severe anxiety due to the disease's unclear course of development, in addition to symptoms associated with fibrosis. We are using machine learning approaches to help with this prediction, which might be very beneficial to clinicians as well as patients. Our datasets were gathered via the Open Source Imaging Consortium (OSIC), a collaborative initiative involving academics, industry, and philanthropy that operates on a not-for-profit basis. The organization facilitates swift progress in the battle against fibrosing interstitial lung diseases (ILDs), emphysematous disorders, and idiopathic pulmonary fibrosis (IPF). Its goal is to bring together global radiologists, physicians, and computational scientists to advanceimaging-based therapies.
In this study, we will forecast a patient's degree of lung function decline based on a CT scan of their lungs. The output from a spirometer, which measures the volume of air inhaled and expelled, will be used to determine lung function supported output. Using the image, metadata, and baseline FVC as input, the goal is to create a prediction using machine learning algorithms.

Literature Survey:

The Veracity and Dependability of Social Networks as a Source for Patient-

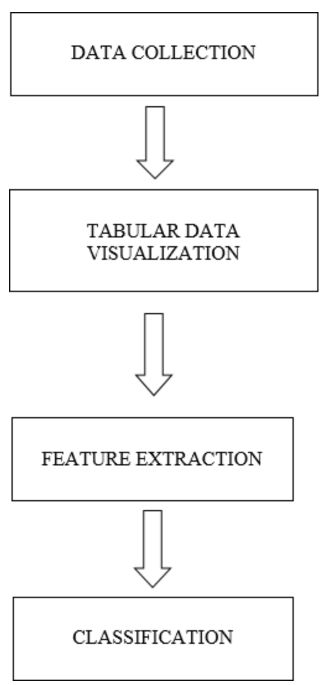
Reported Outcomes with Idiopathic Pulmonary Fibrosis

There are an estimated five million patients with the interstitial lung disease idiopathic pulmonary fibrosis (IPF) worldwide. With a median patient survival period of three to five years and progressive respiratory failure, this disease affects 150,000 patients in the US and causes 40,000 deaths yearly. Idiopathic pulmonary fibrosis (IPF) is still classified as a rare disease even though its death rate in the US is comparable to that of breast cancer. In order to create patient- reported outcomes instruments for IPF patients in the United States over a ten-year period, this study assesses the validity and reliability of social network data.

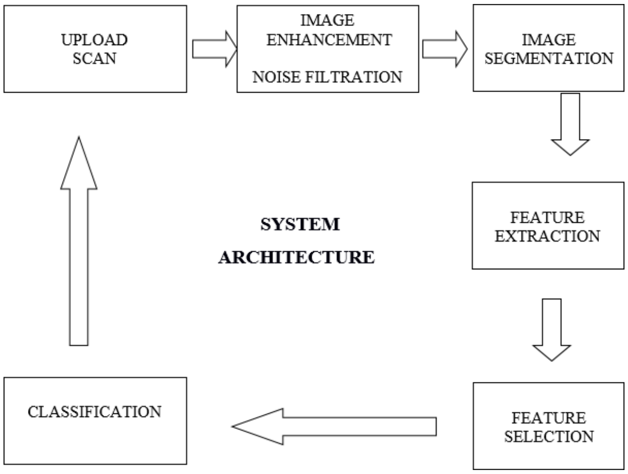
Computer-Aided Diagnosis of Pulmonary Fibrosis Using Deep Learning and CT The American Thoracic Society, the European Respiratory Society, and Wells1and Travis have all proposed uniform criteria and guidelines that are largely used in the differential diagnosis of idiopathicinterstitial pneumonias. The Fleischner Society's white paper recommendations have most recently updated this list. Radiologiststypically diagnose patients with usual interstitial pneumonia (UIP) by screening their high-resolution computed tomography (HRCT) for these patterns (typical UIP, probable UIP, indeterminate for UIP, and non-IPF). They collaborate with a clinicalboard of pneumonologists and histopathologists to make this diagnosis. Most of the time, more invasive techniques like transbronchial or surgical biopsies are needed for the definitive diagnosis if a pattern other than the usual or likely UIPpattern is found. Accurate pattern recognition on computed tomography (CT) scans is essential for the diagnosis andsubsequent management of patientssuffering from interstitial lung disease (ILD), and this importance increases when considering the recently suggested Fleischner Society guidelines.

Detection of Lung Cancer in CT Images using Image Processing
One of the most dangerous and common diseases that claims a great deal of lives each year is cancer. Lung cancer is the most common type of cancer with the highest death rate among all cancer types. Because computed tomography scans provide a detailed image of the tumor inside the body and track its growth, they are used to identify lung cancer. Despite being the preferred imaging modality, CT scans can be delayed in detecting lung cancer because of the potential for error in the visual interpretation of the scan results. As a result, image processing methods are frequently applied in the medical domain to identifylung tumors in their early stages.

Proposed System:
With this system, a CT scan of the patient's lungs will be used to estimate the degree of lung function decline. The output from a spirometer, which measures the volume of air inhaled and exhaled, will be used to determine lung function. The task is to predict something using machine learning techniques given the image, metadata, and baseline FVC as input.



(Fig Module 1 - Pulmonary fibrosis severity prediction using tabular data)



(Fig Module 2 - Pulmonary fibrosis severity prediction using image dataset)

Algorithm:

Step 1: User inputs CT scan on the application.

Step 2: The application pre-processes thedata.

Image enhancement layer:

a. Apply Contrast Limited Adaptive Histogram Equalization (CLAHE) to improve contrast and redistribute lightnessof image.

b. Apply Thresholding to replace pixels with black or white pixel based on predefined constant.

Image segmentation layer:

Use U-NET to categorize pixels as belonging to lungs, bordering lungs or noneof them.

Construct a segmented image.

$$f[x] * g[x] = \sum_{k=-\infty}^{\infty} f[k] \cdot g[x-k]$$

Step3: Extract and select features for pulmonary fibrosis as defined by medical experts (honeycomb lung).

(Fig Lungs CT Scan)

Step 4: Classify patient on the basis of severity of pulmonary fibrosis (less severe/more severe) using extracted feature, metadata and FVC. (Use Support Vector Machine for classification.)

Step 5: Display complete analysis and results on the application.

Results:

Here we predicted the “FVC” values for the following weeks but also displayed the “Confidence” score for each prediction.

These are the outputs of our tabular data which we have passed from different algorithm.

Final output of tabular data are as follows:

ML algorithm	CV Score	Accuracy
Bayesian Ridge	6.719061	99.83
Lasso	6.715907	99.84
LGBM Regressor	6.769326	99.81
Linear SVR	6.67863	99.83
Ridge	6.71917	99.83
Huber Regressor	6.672343	99.82

Conclusion:

Lung scarring is the cause of the disorder pulmonary fibrosis, which has no known cause and no known treatment. In these situations, the patient anticipates the illness's prognosis. We carried out operations on the textual data of different patients. We made use of Seaborn, a matplotlib-based Python data visualization library. It offers a sophisticated drawing interface for creating eye-catching and educational statistical graphics. The machine learning model will be further trained using this visualized data. The technique used to enhance, segment, and extract features from CT images works well. The images' impulse noise was successfully removed from them without causing any image blurring thanks to the median filtering technique. In this case, we forecasted the "FVC" values for the upcoming weeks while also showing the "Confidence" score for each forecast. Therefore, this suggested methodology aids in the precise and early detection of the severity of pulmonary fibrosis or the prediction of the disease's later stages.

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