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Notice for the PhD Viva-Voce Examination

Mr Nidhin Raju (Registration Number: 1981307), PhD scholar at the School of Sciences, CHRIST (Deemed to be University), Bangalore will defend his PhD thesis at the public viva-voce examination on Friday, 24 May 2024 at 11.00 am in Room No. 044, Ground Floor, R & D Block, CHRIST (Deemed to be University), Bengaluru - 560029.

Title of the Thesis	:	**Artificial Intelligence Based Computational Framework for Identification and Classification of Interstitial Lung Diseases Using HRCT Images**
Discipline	:	**Computer Science**
External Examiner (Outside Karnataka)	:	**Dr A Michael Alphonse** Associate Professor Department of Mathematics Birla Institute of Technology and Science Pilani, Hyderabad Campus Jawahar Nagar, Hyderabad – 500078 Telangana
External Examiner (Within Karnataka)	:	**Dr Pethuru Raj** Chief Architect and Vice President Edge AI Division Reliance Jio Platforms Ltd Bengaluru – 560103 Karnataka
Supervisor	:	**Dr Peter Augustin D** Professor Department of Computer Science School of Sciences CHRIST (Deemed to be University) Bengaluru – 560029 Karnataka

The members of the Research Advisory Committee of the Scholar, the faculty members of the Department and the School, interested experts and research scholars of all the branches of research are cordially invited to attend this open viva-voce examination.

Registrar

Place: Bengaluru
Date: 18 May 2024

ABSTRACT

Interstitial Lung Diseases (ILDs) refer to a wide array of respiratory disorders characterised via infection and scarring of the lung's interstitial tissue. These conditions affect the space within the air sacs, compromising the lungs' ability to expand and contract properly. ILDs manifest with a range of symptoms, including persistent cough, shortness of breath, and fatigue. Diagnosis of ILDs often involves imaging methods, mainly High-Resolution Computed Tomography (HRCT), to assess lung abnormalities. ILDs can have lasting effects on respiratory function, leading to progressive fibrosis. The primary obstacle in identifying ILDs lies in the diverse array of symptoms they present, making it challenging to distinguish them from other pulmonary disorders. The HRCT is a commonly employed method in ILD diagnosis. These images provide a detailed depiction of lung tissue, revealing its size, shape, and any notable abnormalities or changes. Moreover, HRCT plays a crucial role in monitoring disease progression over time. Deep Learning (DL) excels in detecting patterns in intricate medical images that may pose challenges for traditional methods. Moreover, DL algorithms exhibit the ability to identify subtle changes in medical images indicative of pathology, and they can automate object detection tasks. The application of DL in medical contexts can enrich the precision and rapidity of diagnoses. In this research aimed at improving the accuracy of artificial intelligence AI-based ILD identification, we harnessed the benefits of deep learning, employing full-training, Transfer Learning (TL), and ensemble voting techniques. Our approach involved the construction of three Convolutional Neural Networks (CNNs) from scratch for ILD detection. Additionally, we customized models named InceptionV3, VGG16, MobileNetV2, VGG19, and ResNet50 for both full-training and TL strategies.

This comprehensive methodology aimed to take benefits of DL architectures to enhance the precision of ILD identification in medical imaging. Both the first dataset consisting of HRCT images and the second dataset comprising Chest X-ray were employed in our study. However, during the initial training phase of the TL models, we utilized pre-trained ImageNet weights. To enhance performance, modifications were made to the classification layers of all five models for both TL and full-training processes. To further improve training outcomes, a soft-voting ensemble approach was employed. The ensemble, combining the predictions of all three newly developed CNN models (ILDNetV1, ILDNetV2 and ILDNetV3), and ILDNetV1 achieved the highest test accuracy at 98.14%. Additionally, we incorporated machine learning (ML) models, including Logistic Regression, BayesNet, RandomForest, Multilayer Perceptron (MLP), and J48, using statistical measurements derived from HRCT images. Our study introduces a novel AI-based system for predicting ILD categories. This system demonstrated superior performance on unseen data by leveraging the results from the newly constructed CNNs, transfer learning, and ML models. This comprehensive approach holds promise for advancing ILD category prediction, providing a more robust and accurate tool for medical diagnosis and decision-making.

Keywords: ILD, HRCT, Deep Learning, Ensemble, Multi-label Classification

Publications:

1. **Nidhin Raju**, D. Peter Augustine, and H. B. Anita. "A Novel Deep Learning Approach for Identifying Interstitial Lung Diseases from HRCT Images" SN Computer Science 4.2 (2022): 132. [Status: Published, Scopus Indexed: Q1]
2. **Nidhin Raju** and D. Peter Augustine "An Efficient Deep Learning approach for Identifying Interstitial Lung Diseases using HRCT images" International Journal of Computational Science and Engineering [Status: Published, Scopus Indexed: Q3]
3. **Nidhin Raju** and D. Peter Augustine "Reduce Overfitting and Improve Deep Learning Models Performance in Medical Image Classification" Machine Intelligence Computer Vision and Natural Language Processing, Taylor and Francis Gratis [Status: Published, Scopus Indexed]
4. **Nidhin Raju**, D. Peter Augustine, and Chandra J " A Novel Artificial Intelligence System for the Prediction of Interstitial Lung Disease" SN Computer Science [Status: Published, Scopus Indexed: Q1]