International Research Journal of Education and Technology
Peer Reviewed Journal
ISSN 2581-7795

AUTOMATED DETECTION OF LUNG DISEASE USING CHEST X-RAYS

[1]Puviyarasu Sakthivel [2]Krishnan Murugan [3]Manikandan Ganesan [4]Manu Raju

[1,2,3,4] Department of Electronics and Communication Engineering

[1,2,3,4] Bannari Amman Institute of Technology, Sathyamangalam, Erode, Tamil Nadu, India

ABSTRACT

The burgeoning field of medical imaging is witnessing a remarkable stride with the advent of automated techniques for lung disease detection through the meticulous analysis of chest X-rays. This project meticulously navigates a comprehensive literature landscape, culminating in the adept implementation of an advanced system. This system harnesses the power of Convolutional Neural Networks (CNNs), pushing the boundaries of diagnostic precision and operational efficiency. The diseases under scrutiny include Bacterial Pneumonia, Corona Virus Disease, Normal cases, Tuberculosis, and Viral Pneumonia.

Beyond the intricacies of deep learning, the project ventures into the realm of user interaction by seamlessly integrating Flask, a Python web framework. This addition transcends mere functionality by architecting a user-friendly graphical interface, tailored to the discerning needs of healthcare professionals. This innovative amalgamation of cutting-edge neural network methodologies and an intuitively designed interface not only promises but stands poised to revolutionize the landscape of lung disease diagnosis.

INTRODUCTION

The field of medical imaging has undergone a profound transformation with the integration of advanced technologies, particularly in the realm of automated diagnosis. Amidst these strides, the detection of lung diseases stands as a pivotal frontier, offering the promise of heightened accuracy and efficiency. In this context, our project emerges as a beacon of innovation, poised to redefine the landscape of lung disease diagnosis.

Chest X-rays, a cornerstone of diagnostic imaging, become the focal point of our exploration. The conventional paradigms of interpretation are transcended as we delve into the realm of automated analysis, leveraging the potency of Convolutional Neural Network

(CNNs). Through an exhaustive survey of the existing literature, we navigate the intricate nuances of lung disease pathology to create a robust system capable of identifying conditions such as Bacterial Pneumonia, Corona Virus Disease, Normal cases, Tuberculosis, and Viral Pneumonia.

Beyond the confines of algorithmic intricacies, our project extends its reach into user-centric design. The integration of Flask, a Python web framework, becomes the bridge between advanced deep learning methodologies and a user-friendly graphical interface. Tailored to the discerning needs of healthcare professionals, this interface not only enhances accessibility but also promises to streamline the diagnostic workflow.

As we embark on this journey, the fusion of cutting-edge technology and user- centric design holds the potential to usher in a new era in lung disease diagnosis. Our project stands as a testament to the symbiotic relationship between artificial intelligence and human interaction, charting a course towards a future where accuracy, efficiency, and user experience converge seamlessly in the pursuit of improved healthcare outcomes.

EXISTING SYSTEM

Several pioneering systems have been developed to automate the detection of lung diseases from chest X-rays, showcasing the transformative potential of deep learning in medical imaging. Among these, CheXNet, a radiologist-level pneumonia detection system, has demonstrated remarkable success [1]. Another noteworthy example is COVID-Net, designed specifically for identifying COVID-19 cases through chest X-ray images, reflecting the adaptability of deep learning models to emerging health challenges [2]. Additionally, the comprehensive work by Rajpurkar et al. has extended the capabilities of automated diagnostic tools, encompassing various lung pathologies [3].

PROPOSED SYSTEM

The proposed system aims to push the boundaries of automated diagnosis in the field of lung diseases, leveraging state-of-the-art technology to enhance accuracy, efficiency, and accessibility in healthcare. Employing advanced deep learning techniques, particularly Convolutional Neural Networks (CNNs), this system seeks to surpass existing limitations and provide a comprehensive solution for detecting a spectrum of lung pathologies, including Bacterial Pneumonia, Corona Virus Disease, Normal cases, Tuberculosis, and Viral Pneumonia.

International Research Journal of Education and Technology
Peer Reviewed Journal
ISSN 2581-7795

DATA FLOW DIAGRAM

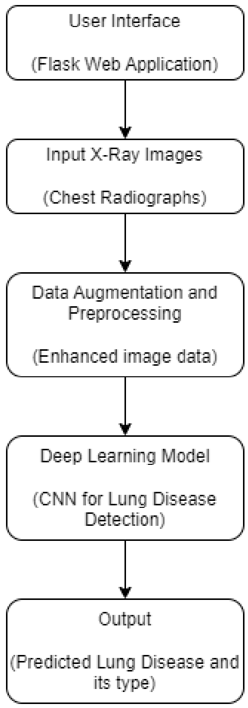


Figure 1: Data Flow Diagram

The above figure represents the dataflow diagram of our project.

DATA FLOW EXPLANATION

The provided block diagram illustrates the key components and flow of interactions in a proposed system for the automated detection of lung diseases using chest X-rays. Here's a brief explanation of each heading:

User Interface (Flask Web App):

- The entry point for healthcare professionals to interact with the system.
- Implemented as a Flask web application, providing a user-friendly interface for inputting chest X-ray images.

Input X-ray Images:

- Chest radiographs are the raw input to the system.
- These images serve as the basis for automated analysis to identify various lung diseases.

Data Augmentation & Preprocessing:

- Enhances the training dataset through data augmentation techniques.
- Ensures proper preprocessing of input images to improve the model's ability to generalize across diverse cases.

Deep Learning Model (CNN):

- The core of the system is a Convolutional Neural Network (CNN).
- Responsible for learning complex patterns in chest X-ray images to accurately predict different lung diseases.

Interpretability & Explainability:

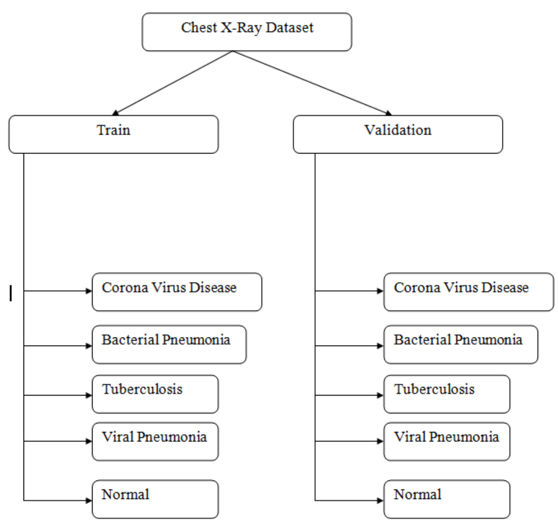
- Incorporates visualization and explanation tools.
- Aids healthcare professionals in understanding and trusting the model's diagnostic decisions, addressing the interpretability challenge associated with deep learning models.

International Research Journal of Education and Technology
Peer Reviewed Journal
ISSN 2581-7795

Diagnostic Outcomes:

- The system produces predicted outcomes, indicating the presence or absence of specific lung diseases.
- These outcomes provide valuable information to healthcare professionals for further analysis and decision- making.

DATASET STRUCTURE



In the context of a chest X-ray dataset used for training and validation in an automated lung disease detection system, the dataset structure typically involves a division into training and validation sets. This structure is crucial for training machine learning models effectively and evaluating their performance. Let's break down the components of this dataset structure:

Chest X-Ray Dataset:

The dataset consists of a collection of chest X-ray images, each representing a radiographic view of a patient's chest. These images serve as the primary input data for training and validating the machine learning model.

Training Set:

The training set is a subset of the chest X-ray dataset used for training the machine learning model. It is the portion of the data on which the model learns to recognize patterns and features associated with different lung diseases.

Purpose: To teach the model to generalize from examples, identifying common patterns across a variety of chest X-ray images.

Size: Typically, the training set is the largest subset, as it needs to expose the model to a diverse range of examples for effective learning.

Validation Set:

The validation set is a separate subset of the chest X-ray dataset used for evaluating the model's performance during the training process. It helps assess how well the model generalizes to new, unseen data.

Purpose: To provide an unbiased evaluation of the model's performance and detect issues like overfitting or underfitting.

International Research Journal of Education and Technology
Peer Reviewed Journal
ISSN 2581-7795

Size: Smaller compared to the training set, the validation set is used iteratively during training to tune hyperparameters and assess the model's generalization ability.

Labeling:

Each chest X-ray image in both the training and validation sets is associated with a label indicating the presence or absence of specific lung diseases. Labels may include categories such as Bacterial Pneumonia, Corona Virus Disease, Normal, Tuberculosis, and Viral Pneumonia.

Purpose: To train the model to associate visual patterns in X-ray images with specific disease categories, enabling it to make accurate predictions during real-world use.

Data Balance:

The dataset is curated to maintain a balance in the distribution of images across different disease categories. This helps prevent biases in model training, ensuring that the model learns equally from each class.

Purpose: To create a balanced and representative dataset that facilitates the development of a robust and unbiased lung disease detection model.

Randomization:

The order of images in both the training and validation sets is often randomized to prevent the model from learning spurious patterns based on the sequence of data.

Purpose: To ensure that the model generalizes well to new, unseen data, regardless of the order in which it encounters examples.

Hence, the dataset structure for chest X-ray images involves a thoughtful division into training and validation sets, each with specific roles in training and evaluating the performance of the automated lung disease detection model. The labeled images, balanced distribution, and randomization contribute to the robustness and generalization ability of the model.

PROJECT IMPLEMENTATION RESULTS

The below figure represents the UI which is made by the flask. This UI has an option to select the chest X-Ray image for the detection of lung disease.

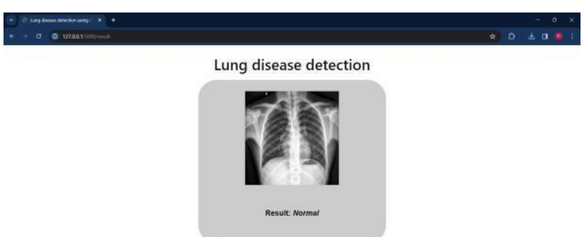
International Research Journal of Education and Technology
Peer Reviewed Journal
ISSN 2581-7795

Different Types of Disease Detection:

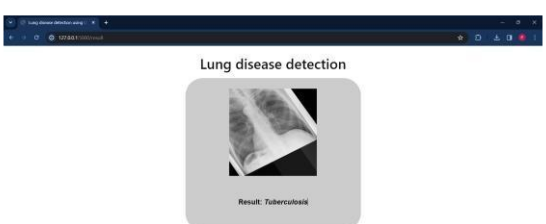
1. Corona Virus Detection

2. Bacterial Pneumonia

3. Normal Lung



4. Tuberculosis



5. Viral Pneumonia

CONCLUSION:

In the pursuit of advancing automated lung disease detection through chest X-ray analysis, the proposed system represents a significant leap forward. By leveraging cutting-edge technologies such as Convolutional Neural Networks (CNNs) and integrating a user- friendly interface, the system aims to revolutionize the landscape of respiratory health diagnostics.

The foundation of the system lies in its robust dataset structure, meticulously organized into training and validation sets. This dataset, comprising diverse chest X-ray images annotated with specific disease labels, serves as the cornerstone for training a powerful machine learning model. The balanced distribution of data across disease categories, thoughtful randomization, and careful labeling contribute to the model's ability to generalize effectively and make accurate predictions across various scenarios.

The user interface, implemented through a Flask web application, provides healthcare professionals with a seamless and intuitive platform for interacting with the system. This interface not only streamlines the process of inputting X-ray images but also enhances user experience, fostering trust in the automated diagnostic outcomes.

Interpretability and explainability have been prioritized in the system's design. Visualization and explanation tools accompany the deep learning model, addressing the inherent challenges associated with understanding complex decisions made by neural networks. This empowers healthcare professionals to confidently incorporate automated predictions into their diagnostic workflows.

Continuous learning mechanisms and regular updates further ensure the system's adaptability to emerging diseases. By keeping the model parameters current, the proposed system remains at the forefront of diagnostic capabilities, poised to tackle evolving challenges in respiratory health.

In conclusion, the amalgamation of advanced deep learning techniques, a thoughtful dataset structure, and a user-centric design positions the proposed system as a promising contender in the realm of automated lung disease detection. As it undergoes further refinement and validation, this system holds the potential to significantly impact healthcare practices, fostering more accurate and efficient diagnoses for improved patient outcomes.

REFERENCES

[1] Rajpurkar, P., Irvin, J., Zhu, K., Yang, B., Mehta, H., Duan, T., ... & Ng, A. Y. (2017). CheXNet: Radiologist-Level Pneumonia Detection on Chest X-Rays with Deep Learning. arXiv preprint arXiv:1711.05225.

[2] Wang, L., Lin, Z. Q., Wong, A., & Covid- Net Team. (2020). COVID-Net: A tailored deep convolutional neural network design for detection of COVID-19 cases from chest X-ray images. Scientific Reports, 10(1), 1-12.

[3] Rajpurkar, P., Irvin, J., Ball, R. L., Zhu, K., Yang, B., Mehta, H., ... & Ng, A. Y. (2018). Deep learning for chest radiograph diagnosis: A retrospective comparison of the CheXNeXt algorithm to practicing radiologists. PLoS medicine, 15(11), e1002686.