

**Final Year Project Proposal**

(Batch: Fall 2020)

**Classification of X-ray images for Pneumonia and Covid-19 using deep learning model**

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Table of Contents

[**Abstract** 3](#_Toc146027719)

[**Introduction** 4](#_Toc146027720)

[**Background and Problem Identification** 4](#_Toc146027721)

[**Project Description** 5](#_Toc146027722)

[**Project Objectives and Goals** 5](#_Toc146027723)

[**Develop Deep Learning Models** 5](#_Toc146027724)

[**Dataset Preparation** 6](#_Toc146027725)

[**Web Interface Development** 6](#_Toc146027726)

[**Performance Evaluation** 6](#_Toc146027727)

[**Accessibility and Usability** 6](#_Toc146027728)

[**Documentation and Knowledge Sharing** 6](#_Toc146027729)

[**Future Enhancements** 7](#_Toc146027730)

[**Proposed Methodology** 7](#_Toc146027731)

[**Project Deliverable and Milestones** 7](#_Toc146027732)

[**Individual Tasks** 8](#_Toc146027733)

[**Tools and Technologies** 8](#_Toc146027734)

[**CONTRIBUTION AND IMPACT ON SOCIETY** 9](#_Toc146027735)

[**Conclusion** 9](#_Toc146027736)

[**References** 9](#_Toc146027737)

# **Abstract**

Respiratory diseases, particularly pneumonia and COVID-19, continue to pose significant public health challenges worldwide. Rapid and accurate diagnosis is crucial for effective patient management and disease control. This project aims to develop and evaluate deep learning models for the automated classification of chest X-ray images into three categories: pneumonia, COVID-19, and normal cases. The publicly available "COVID-19+PNEUMONIA+NORMAL Chest X-Ray Image Dataset" from Kaggle will be utilized for training and testing the models ([Kumar et al., 2022](#_ENREF_3); [Shastri et al.](#_ENREF_5)).

In addition to model development, we will create a user-friendly web interface that allows physician to upload chest X-ray images. This interface will enable easy access to our diagnostic tool, making it accessible to healthcare professionals and the general public.

Convolutional Neural Networks (CNNs), data augmentation, transfer learning, and attention mechanisms will be employed to enhance model performance and interpretability. The models will undergo rigorous evaluation using various performance metrics.

This project has the potential to contribute significantly to X-ray image analysis by providing a reliable and accessible tool for the early detection and differentiation of pneumonia and COVID-19 from chest X-ray images.

# **Introduction**

As of UNICEF’s report of 2018([United Nations International Children's Emergency Fund, 2019](#_ENREF_6)), Estimated number of pneumonia-related deaths in children under five are 58,000 making Pakistan the number third in the list after Nigeria and India. The Express Tribune claims that 92,000 children die from pneumonia every year in Pakistan and it accounts for approximately 20% of childhood deaths worldwide. Though Pneumonia is the most common chest/lung’s disease the Covid-19; also, a chest/lung’s disease, caused more than six million deaths worldwide ([World Health Organization, 2023-09-14](#_ENREF_7)) and 30,656 deaths in Pakistan([Organization, 2023](#_ENREF_4)). However, it is assumed that deaths could be lesser if the disease could have been detected earlier.

The disease detection from X-ray images is an emerging technology in the field of medical sciences, but classification of Chest X-ray images as either affected by Pneumonia, Covid-19 or some other disease is a daunting task as it requires expertise and domain knowledge too([Ibrahim, Ozsoz, Serte, Al-Turjman, & Yakoi, 2021](#_ENREF_2)). In short, classification of X-ray images is a task that demands the skills of a thoroughly-trained radiologist with years of experience. The groundbreaking impacts of AI have revolutionized every aspect of our life including health sciences as its contribution in this application of Classification of X-ray images for Pneumonia and Covid-19. Instead of engaging a patient, physician and radiologist in several meetings, a physician simply suggests for Radiological Examination(X-ray) and a Deep Learning trained model would automatically classify the images showing the problem. It reduces the timing headache for the physician as well as replaces the radiologist’s burdensome job.

# **Background and Problem Identification**

In resource-limited areas, particularly in regions where access to skilled medical professionals is limited, the rapid and accurate diagnosis of respiratory diseases such as Pneumonia and Covid-19 poses a significant challenge. Radiological images, particularly X-ray images, serve as a crucial diagnostic tool in the early detection and monitoring of these diseases([Constantinou, Exarchos, Vrahatis, & Vlamos, 2023](#_ENREF_1)). However, the availability of trained radiologists to annotate these images is quite difficult, leading to delays in diagnosis and treatment, which can be life-threatening.

Furthermore, the traditional approach to image interpretation and disease diagnosis is manual, relying on the expertise of radiologists. This manual process is not only time-consuming but also susceptible to human error, particularly when radiologists are overburdened due to a high patient-to-physician ratio. Due to critical nature of respiratory illnesses and the impact of timely diagnosis on patient outcomes, there is an urgent need for automated solutions that can provide accurate and rapid diagnostic assistance.

Therefore, we aim at designing a system that would use CNN-a deep learning algorithm to classify the Chest X-ray Image as either Pneumonia affected, Covid-19 affected or none of these. Our user-friendly system will mitigate the need of expert radiologist and will assist in detection of respiratory diseases.

# **Project Description**

The core focus of the " Classification of X-ray images for Pneumonia and Covid-19 using deep learning model" initiative lies in devising an effective solution to address the challenges within the realm of diagnosing the respiratory disease from an X-ray image.

This endeavor is centered around the development of system endowed with the capacity to classify the X-ray image as Pneumonia affected, Covid-19 affected or normal. The principal intent behind this software is to bolster the process of image diagnosing. This system asks for image input through a web interface, the CNN model used for classification classifies that image and outputs the result.

This image interpretation alleviates the need of expert radiologist to annotate the X-ray image, facilitating both the patient and physician. Furthermore, the project takes pride in integrating Artificial Intelligence with Healthcare.

# **Project Objectives and Goals**

## **Develop Deep Learning Models**

The primary objective of this project is to design and train deep learning models capable of accurately classifying chest X-ray images into three categories: pneumonia, COVID-19, and normal cases. These models will leverage convolutional neural networks (CNNs) and various state-of-the-art techniques to achieve high classification performance.

## **Dataset Preparation**

Collect, and preprocess, the "COVID-19+PNEUMONIA+NORMAL Chest X-Ray Image Dataset" from Kaggle to create a comprehensive and balanced dataset for training and testing the deep learning models ([Kumar et al., 2022](#_ENREF_3); [Shastri et al.](#_ENREF_5)). Data preprocessing is essential to ensure that the models are exposed to high-quality, relevant training data.

## **Web Interface Development**

Create an intuitive and user-friendly web interface that allows users to upload chest X-ray images for classification. The interface should provide seamless integration with the trained models and deliver real-time results.

## **Performance Evaluation**

Thoroughly evaluate the developed models using appropriate metrics such as accuracy, precision, recall, and F1-score. Compare the models' performance to existing state-of-the-art methods to assess their effectiveness.

## **Accessibility and Usability**

Ensure that the web interface is accessible to both healthcare professionals and the general public. Prioritize user-friendliness, responsiveness, and security in the interface design.

## **Documentation and Knowledge Sharing**

Document the entire project, including model architectures, training processes, and web interface development. Share the knowledge and codebase with the research community through open-source repositories.

## **Future Enhancements**

Explore opportunities for future enhancements, such as extending the model's capabilities to detect additional respiratory diseases or incorporating real-time radiologist feedback to improve accuracy.

By achieving these objectives and goals, this project aims to provide a valuable tool for healthcare professionals and the public, contributing to early disease detection, improved patient outcomes, and better control of pneumonia and COVID-19.

# **Proposed Methodology**

The proposed methodology for our system of Images classification for Pneumonia and Covid-19 using deep learning model is Waterfall due to its structured and sequential nature. The Waterfall approach aligns well with the development of X-ray image classification system. It has various advantages associated with it such as clear project phases, risk mitigation, meticulous documentation and quality assurance. These qualities make it particularly suitable for ensuring the accuracy, reliability, and compliance of the diagnostic tool in the healthcare domain.

# **Project Deliverable and Milestones**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Aug-23 | Sep-23 | Nov-23 | Dec-23 | Jan-23 | Feb-23 | Mar-23 | Apr-23 | May-23 |
| **Abstract** |  |  |  |  |  |  |  |  |  |
| **Proposal** |  |  |  |  |  |  |  |  |  |
| **SRS** |  |  |  |  |  |  |  |  |  |
| **Data-Preprocessing** |  |  |  |  |  |  |  |  |  |
| **Train Model** |  |  |  |  |  |  |  |  |  |
| **Evaluate Model** |  |  |  |  |  |  |  |  |  |
| **Front-end** |  |  |  |  |  |  |  |  |  |
| **API creation & Back-end** |  |  |  |  |  |  |  |  |  |
| **Integrate Model** |  |  |  |  |  |  |  |  |  |
| **Deployment** |  |  |  |  |  |  |  |  |  |

# **Individual Tasks**

|  |  |
| --- | --- |
| **Activity** | **Group Member(s)** |
| Proposal | Asad Ali, Muhammad Hussain, Um-e-Hani |
| SRS | Um-e-Hani |
| Data Pre-processing | Asad Ali, Muhammad Hussain |
| Train Model | Asad Ali |
| Evaluate Model | Muhammad Hussain, Um-e-Hani |
| Front-end | Um-e-Hani |
| API Creation and Back-end | Muhammad Hussain |
| Integrate Model | Asad Ali |
| Deploy Model | Asad Ali, Muhammad Hussain, Um-e-Hani |

# **Tools and Technologies**

**Jupiter Notebook, Spyder, Google Collab**

Jupiter Notebook will be initially used for data exploration and model prototyping, benefiting from its interactivity. Spyder will be employed for structured script development, especially during data preprocessing and model training phases. Google Collab will serve for resource-intensive model training, thanks to its cloud-based GPU/TPU access, while also enabling collaboration.

**Intellij**

Intellij will be used for backend development. The creation of APIs and other backend components or integrations will be done through Intellij. It can streamline coding, debugging, and project management tasks, enhancing the overall project efficiency and code quality.

**Visual Studio**

Visual Studio will be used for creating web interface. The overall frontend creation will be done through Visual Studio.

# **CONTRIBUTION AND IMPACT ON SOCIETY**

The development of deep learning models for automated chest X-ray image classification, which enables early diagnosis and discrimination of pneumonia and COVID-19, is the project's contribution to society. This development not only helps medical professionals diagnose patients quickly and accurately, but it also improves healthcare efficiency by lightening the workload of the medical personnel. The development of a user-friendly web interface broadens access to the diagnostic tool, promoting awareness and allowing people to evaluate their health. By offering useful insights and tools for medical picture analysis, the project also contributes to the more general domains of artificial intelligence in healthcare and pandemic preparedness, ultimately enhancing patient outcomes and public health. Moreover, we will try to enhance the accuracy of the model.

# **Conclusion**

This project will provide to learn, understand and apply the state-of-the-art techniques of deep learning for Classification of X-ray images for Pneumonia and Covid-19. The early diagnosis of pneumonia and COVID-19 will be possible after the successful development and evaluation of deep learning models for automated chest X-ray image classification. The user-friendly web interface will increase the accessibility, improving healthcare results and raising public awareness of health issues. This project demonstrates how AI-driven solutions could help with serious medical problems.

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