CovidVision: Advanced COVID-19 Detection from Lung X-rays with Deep Learning

Milestone 1: Project Initialization and Planning Phase

The project "COVID Vision: Detection of COVID with Chest X-rays using Deep Learning" aims to create a deep learning model for COVID-19 detection from chest X-ray images. We will leverage advanced architectures and transfer learning to enhance performance. Evaluation metrics like accuracy, sensitivity, and specificity will validate the model. The deployment phase will focus on a user-friendly interface and cloud integration. Risk management will address data availability and deployment challenges, aiming for high detection accuracy and reliability.

Activity 1: Define Problem Statement

The problem statement for "Detection of COVID with Chest X-rays using Deep Learning" addresses the need for an accurate tool to diagnose COVID-19 through chest X-rays. PCR tests are limited by availability and cost, while X-rays are more accessible but require expertise. This project aims to develop a deep learning model to autonomously detect COVID-19 patterns in X-rays, providing a rapid, reliable diagnostic tool for healthcare professionals to enhance COVID-19 screening.

Activity 2: Project Proposal (Proposed Solution)

The proposed solution involves developing a deep learning model to detect COVID-19 from chest X-ray images. Using techniques like convolutional neural networks (CNNs) and transfer learning, the goal is to create a model that accurately distinguishes COVID-19 from other respiratory conditions. This tool aims to automate and enhance diagnostics, providing healthcare professionals with a rapid, reliable solution for early COVID-19 detection and supporting public health efforts by reducing transmission rates.

Activity 3: Initial Project Planning

For "Detection of COVID with Chest X-rays using Deep Learning," we will define clear objectives, gather a diverse dataset of chest X-rays, and set up the infrastructure for model development. Our strategy involves selecting suitable deep learning architectures, like CNNs, and using transfer learning to optimize performance. We will establish milestones

for data acquisition, model development, evaluation metrics, and deployment, aiming to create a reliable, scalable tool for COVID-19 detection, aligned with project goals.

Milestone 2:Data Collection and Preprocessing Phase

Activity 1: Data Collection Plan & Raw Data Sources Identification

Our project aims to design and optimize a convolutional neural network (CNN) architecture using TensorFlow to classify chest X-ray images into three categories: COVID-19 positive, viral pneumonia (non-COVID), and normal cases. To achieve our objective, we will search for datasets related to chest X-rays for the detection of COVID-19, viral pneumonia, and normal cases. Our focus will be on identifying high-quality, diverse datasets that provide a sufficient number of images for each category to ensure robust model training and validation. The raw dataset for this project is obtained and downloaded from Kaggle, a popular platform for accessing a wide variety of datasets. The selected dataset includes a large number of chest X-ray images split into different categories from the Kaggle Dataset

Activity 2: Preprocessing Report

To ensure high-quality data and improve model performance, the images will undergo several preprocessing steps. These include resizing to [299, 299, 3] pixels, normalizing with a rescale factor of 1./255, and applying various data augmentation techniques. Specifically, we will use a zoom range of 0.2, shear range of 0.2, and shift ranges of 0.2 for both width and height. Additional preprocessing steps like denoising, contrast adjustment, edge detection, color space conversion, cropping, batch normalization, and whitening will also be employed to enhance data quality, promote model generalization, and improve convergence during neural network training. This comprehensive preprocessing pipeline is designed to ensure robust and efficient performance across various computer vision tasks.
The dataset includes:
- COVID images: 3,616 images
- Normal images: 10,192 images
- Lung opacity images: 6,012 images

This diverse and well-preprocessed dataset will support the development of a highly accurate and generalizable model.

Activity 3:Data Quality Report

During the data preprocessing phase, we faced an issue with dividing the dataset into training and testing sets. The initial dataset from Kaggle, consisting of 3,616 COVID-19 positive, 10,192 normal, and 6,012 lung opacity images, was meticulously reviewed for completeness, consistency, accuracy, and integrity. However, ensuring a balanced and representative split posed challenges due to class imbalances. Despite these hurdles, we successfully implemented strategies to maintain data quality and integrity, resulting in a robust dataset for training and testing our CNN model for chest X-ray classification.
Template Link: ***Covid Vision Data Collection and Preprocessing Templates***

Milestone 3: Model Development Phase

The Model Development Phase, involved selecting and fine-tuning the Xception architecture for COVID-19 detection using transfer learning. We pre-processed the X-ray dataset, applied data augmentation to enhance model robustness, and trained the model with optimal hyperparameters. The phase concluded with rigorous evaluation, ensuring the model achieved high accuracy and performance before moving to deployment.

Activity 1: Initial Model Training Code, Model Validation and Evaluation Report

The initial model training involved using the Xception architecture with transfer learning. We employed data augmentation techniques to enhance generalization and trained the model with a 70-30 train-test split. The training code included setting up the Xception model, adding custom CNN dense layers, and configuring the optimizer and loss functions.

Activity 2: Model Selection Report

In the model selection report for future deep learning and computer vision projects, various architectures, such as CNNs or RNNs, will be evaluated. Factors such as performance, complexity, and computational requirements will be considered to determine the most suitable model for the task at hand.

Xception, which stands for "Extreme Inception," is an advanced convolutional neural network inspired by the Inception architecture. It enhances computational efficiency by replacing traditional Inception modules with depthwise separable convolutions. This approach allows Xception to capture complex patterns more effectively while reducing the number of parameters and computational load compared to earlier models like Inception V3. Images are typically resized to a standard input size of 299x299 pixels for Xception. To

further boost model performance, data augmentation techniques such as random rotation, flipping, and cropping are employed, increasing the diversity of training samples and enhancing the model's generalization ability.

Activity 3: Model Validation and Evaluation Report

The model was validated using a separate subset of the data to prevent overfitting. The evaluation metrics revealed a peak training accuracy of 82.86% and a validation accuracy of 79.08% at epoch 7. These metrics demonstrate the model's effectiveness in detecting COVID-19 from lung X-rays, indicating a robust performance suitable for practical deployment.

Template Link: ***Covid Vision Model Development Phase Templates***

Milestone 4: Model Optimization and Tuning Phase

The Model Optimization and Tuning Phase involves refining machine learning models for peak performance. It includes optimized model code, fine-tuning hyperparameters, comparing performance metrics, and justifying the final model selection for enhanced predictive accuracy and efficiency.

Activity 1: Hyperparameter Tuning Documentation

Hyperparameter tuning is a critical step in optimizing the performance of our COVID-19 detection model. By adjusting parameters such as learning rate, batch size, and the number of epochs, we aim to enhance the model's accuracy and efficiency. In our project, we experimented with various configurations, ultimately identifying the optimal settings that yielded the highest validation accuracy and minimized loss. This systematic tuning process significantly improved the robustness and reliability of our deep learning model.

Activity 2: Final Model Justification

The final model for COVID-19 detection was chosen based on its superior performance during hyperparameter tuning. By leveraging the Xception architecture and fine-tuning it with additional CNN dense layers, we achieved a balance between accuracy and computational efficiency. The model reached its highest accuracy at epoch 7, demonstrating robust performance with an accuracy of 82.86% on the training set and 79.08% on the validation set. This indicates the model's capability to generalize well to new data, making it a reliable tool for COVID-19 detection from lung X-rays.

Template Link: ***Covid Vision Model Optimization and Tuning Phase Templates***

Milestone 5: Project Files Submission and Documentation

The submission of all project files and comprehensive documentation to ensure transparency and reproducibility of our work. The complete codebase, including the Flask application, model training scripts, HTML templates, and the trained model, along with detailed instructions on how to set up and run the project, can be found in our GitHub repository. Please follow the link below to access all project materials:

CovidVision-Covid19-Detection-Using-Lung-X-Rays

This repository includes all necessary files and documentation to understand and replicate our COVID-19 detection application.

Milestone 6: Project Demonstration

The project is demonstrated to showcase its functionality and performance. For a comprehensive view of the project in action, including a walkthrough of the application, model predictions, and user interactions, please refer to the demonstration video available at the following Google Drive link:

CovidVision Demo

This video provides a detailed overview of how the COVID-19 detection app operates, illustrating the workflow from image upload to result display.