Radiology Report Generation from Chest X-ray Image

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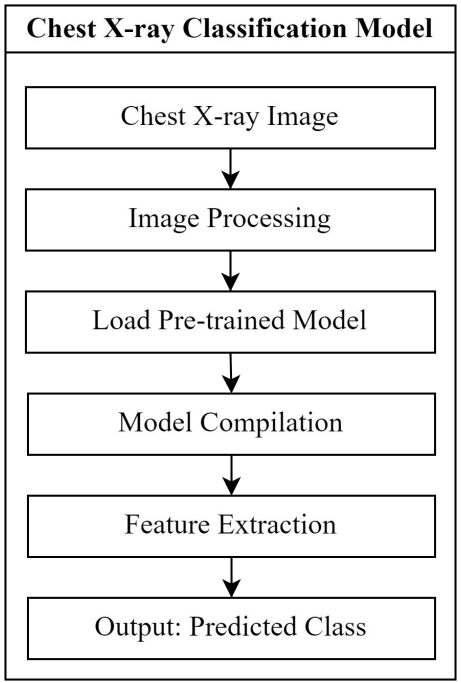
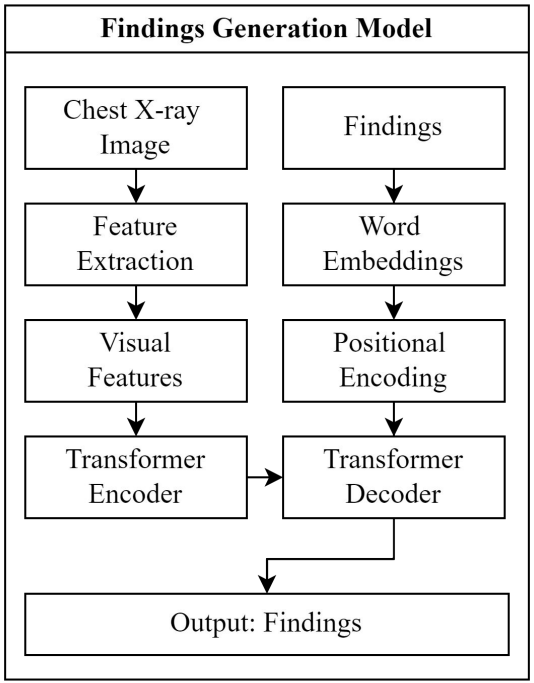
Presentation Outline

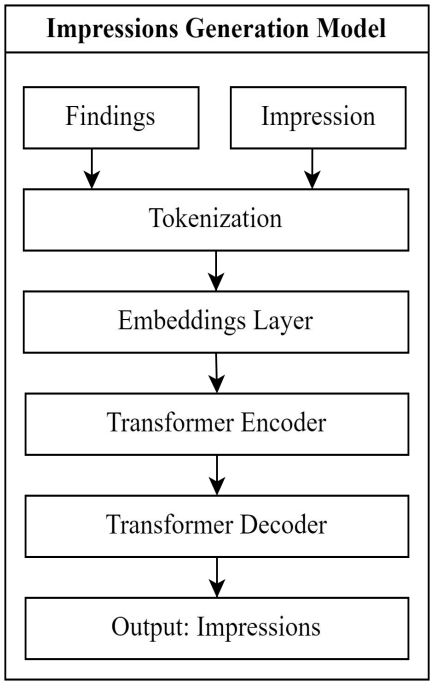
- Methodology
- Results
- Discussion
- Remaining Tasks

Methodology

- **System Architecture [1]**

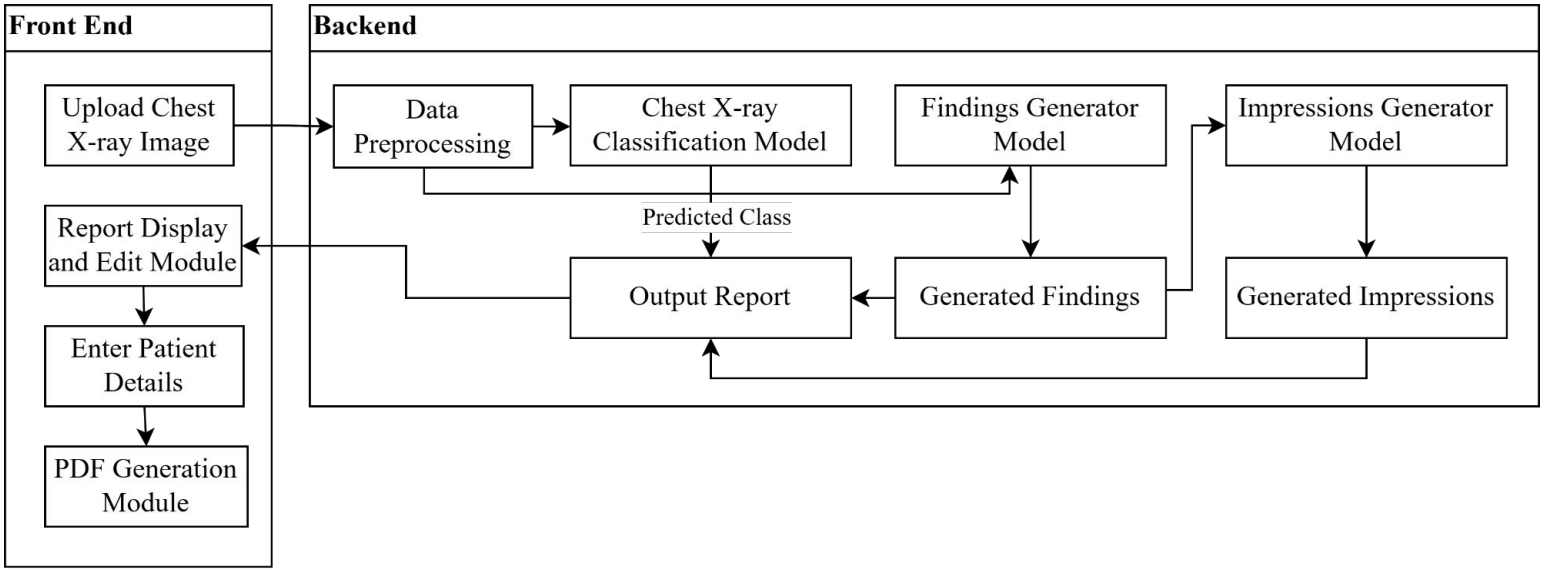






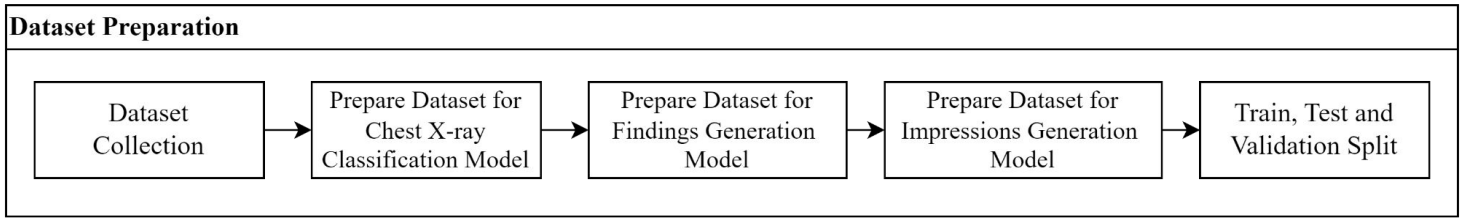
Methodology [Cont.]

- **System Architecture [2]**



Methodology [Cont.]

- **Dataset Preparation**
  - Dataset Collection
  - Prepare Dataset for Chest X-ray Classification Model
  - Prepare Dataset for Findings Generation Model
  - Prepare Dataset for Impressions Generation Model
  - Train, Test, and Validation Split



Methodology [Cont.]

- **Machine Learning Models [1]**
  - **Chest X-ray Classification Model**
    - Data Augmentation (Rotation, Horizontal Flip, Zoom)
    - Image Preprocessing (Resizing, Normalization)
    - Load Pre-trained Model (ResNet101, DenseNet121)
    - Model is compiled with appropriate loss functions, optimizers and evaluation metrics
    - Extract relevant features
    - Predicted class is given as output
    - Training and Fine-tuning

Methodology [Cont.]

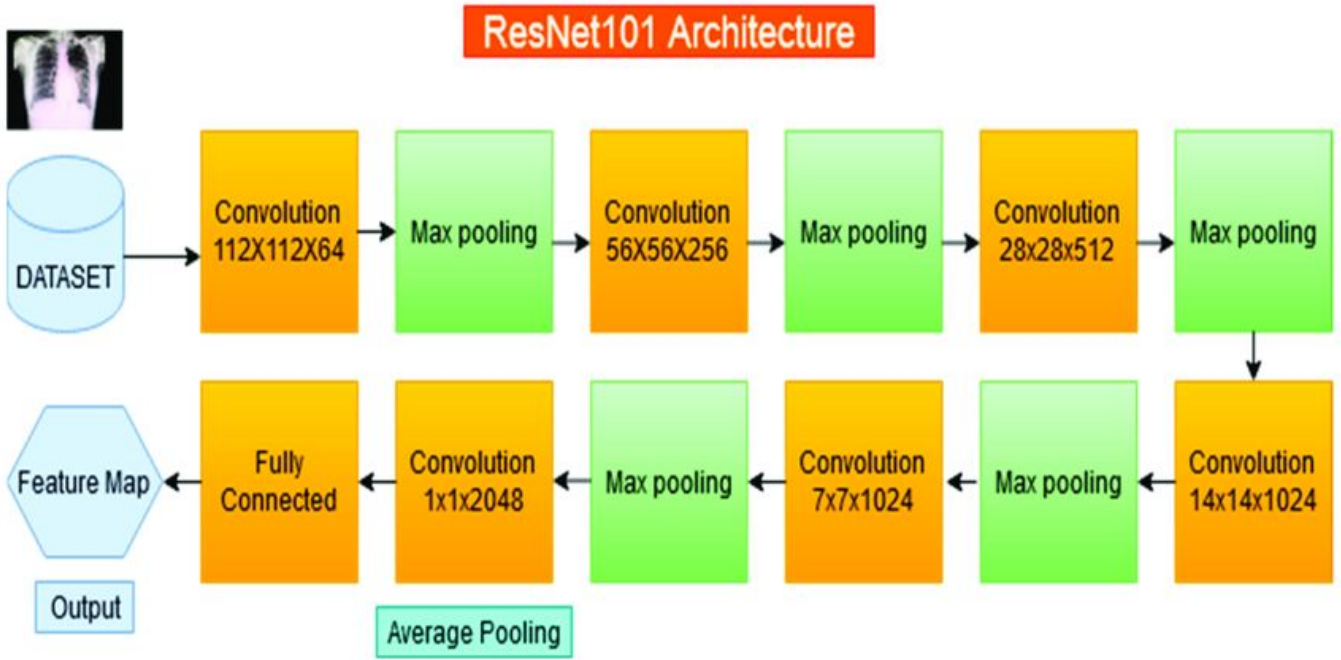
- **Machine Learning Models [2]**
  - **Findings Generation Model**
    - CNN or ViT for visual features extraction
    - Feed into transformer encoder
    - Convert findings text into embeddings
    - Process the features and findings
    - Output detailed text finding
    - Training and Fine-tuning
    - Model evaluation and testing

Methodology [Cont.]

- **Machine Learning Models [3]**
  - **Impressions Generation Model**
    - Tokenize findings
    - Convert into embeddings
    - Process embeddings
    - Generate high-level impressions
    - Output summarized impressions
    - Training and Fine-tuning
    - Model evaluation and testing

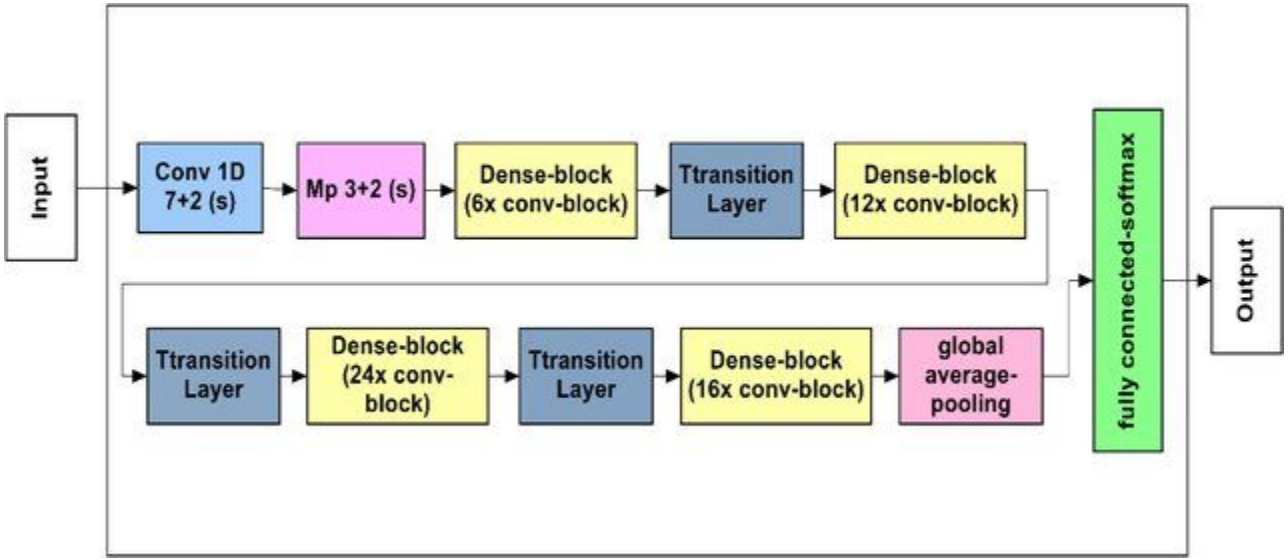
Methodology [Cont.]

- **Architecture of ResNet101**



Methodology [Cont.]

- **Architecture of DenseNet121**



Methodology [Cont.]

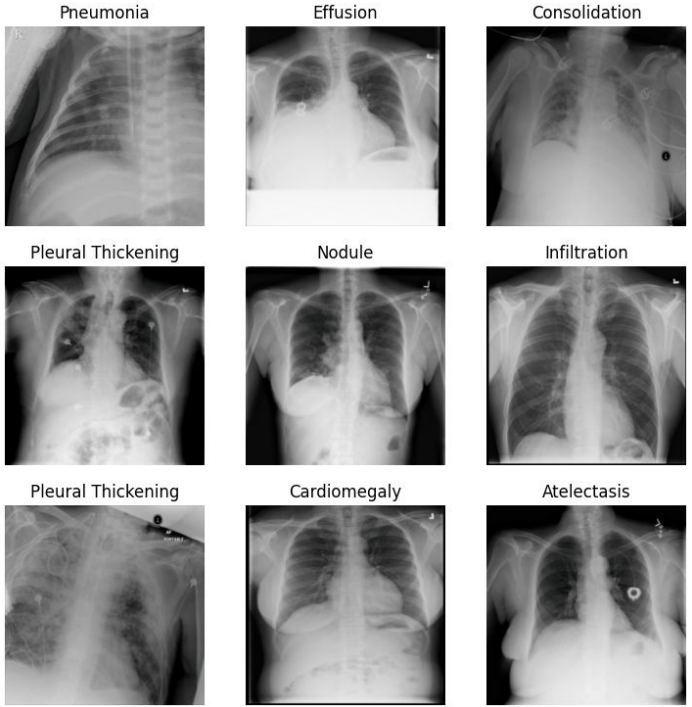
- **Datasets**

  For generating report from Chest X-ray image, the following set of data will be used:

  1. PhysioNet MIMIC-CXR
  2. Indiana University (IU) Chest X-ray
  3. NIH Chest X-rays

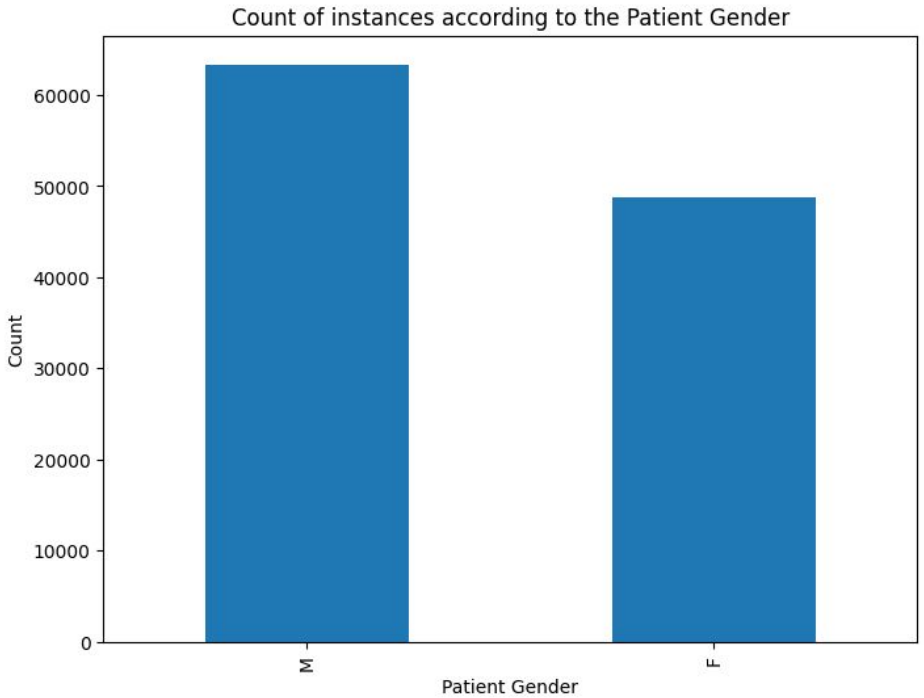
Methodology [Cont.]

- **Chest X-ray Images from Dataset**



Results [1]

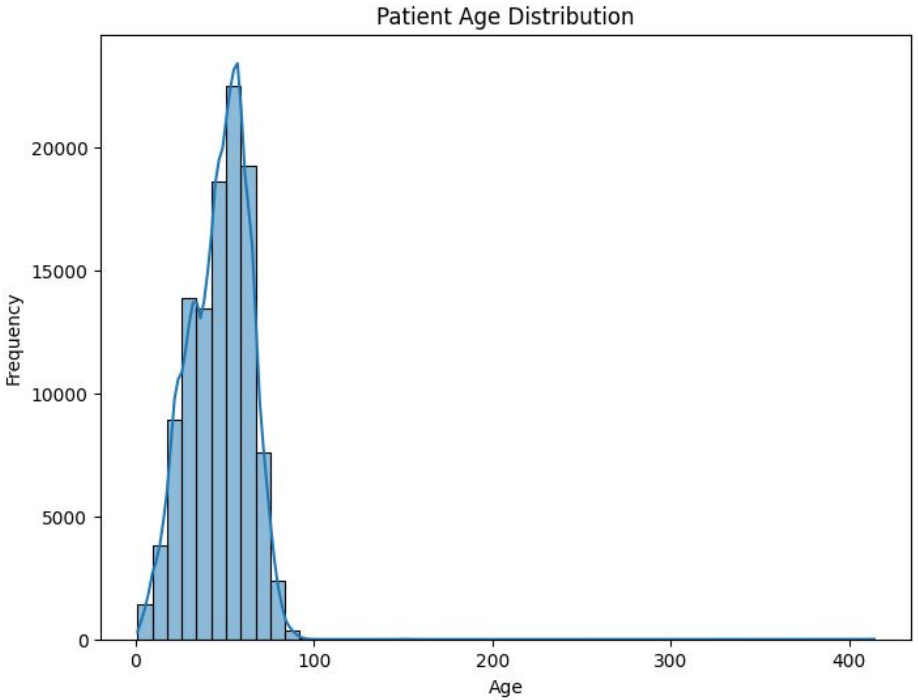
- **Exploratory Data Analysis**



Patient Gender	count
M	63340
F	48780

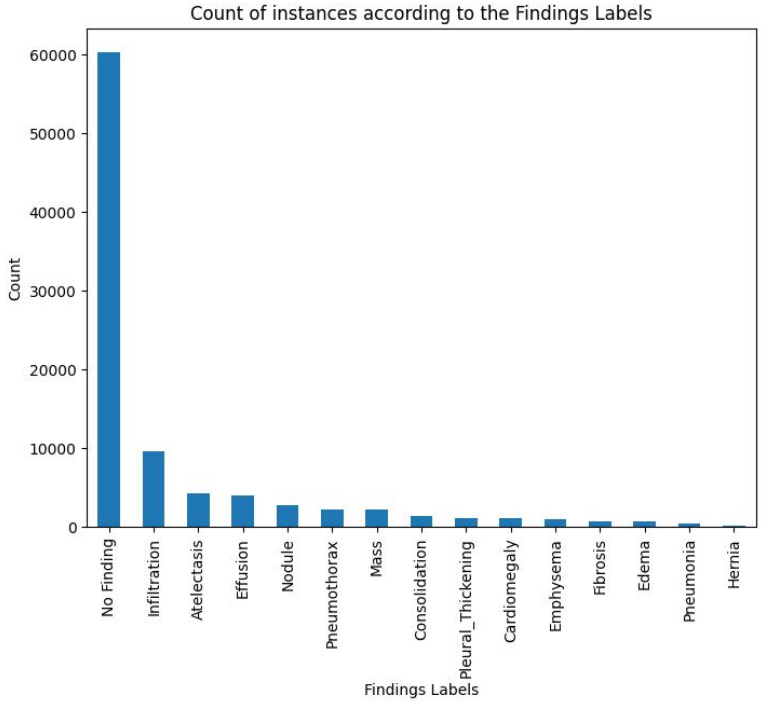
Results [2]

- **Exploratory Data Analysis (cont.)**



Results [3]

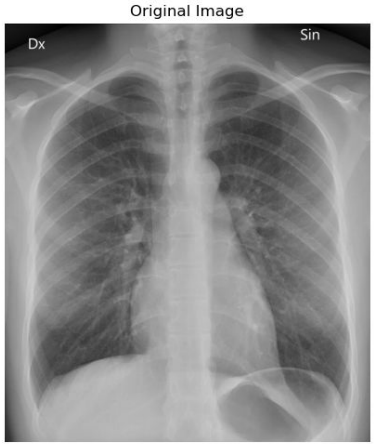
- **Exploratory Data Analysis (cont.)**

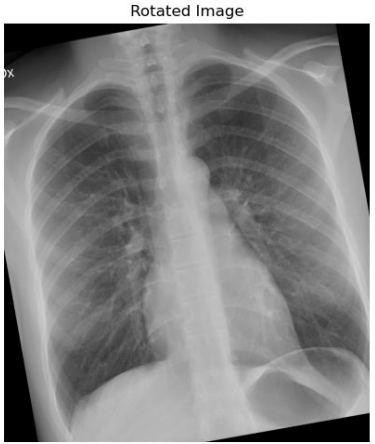


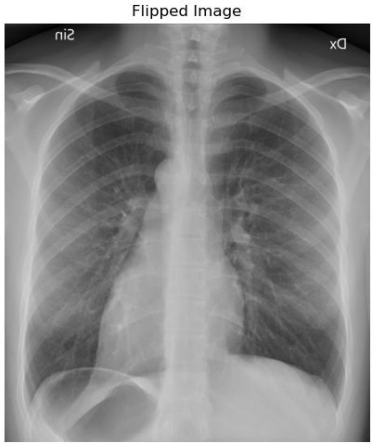
Finding Labels	count
No Finding	60353
Infiltration	9546
Atelectasis	4214
Effusion	3955
Nodule	2705
Pneumothorax	2193
Mass	2139
Consolidation	1310
Pleural_Thickening	1126
Cardiomegaly	1093
Emphysema	892
Fibrosis	727
Edema	627
Pneumonia	322
Hernia	110

Results [4]

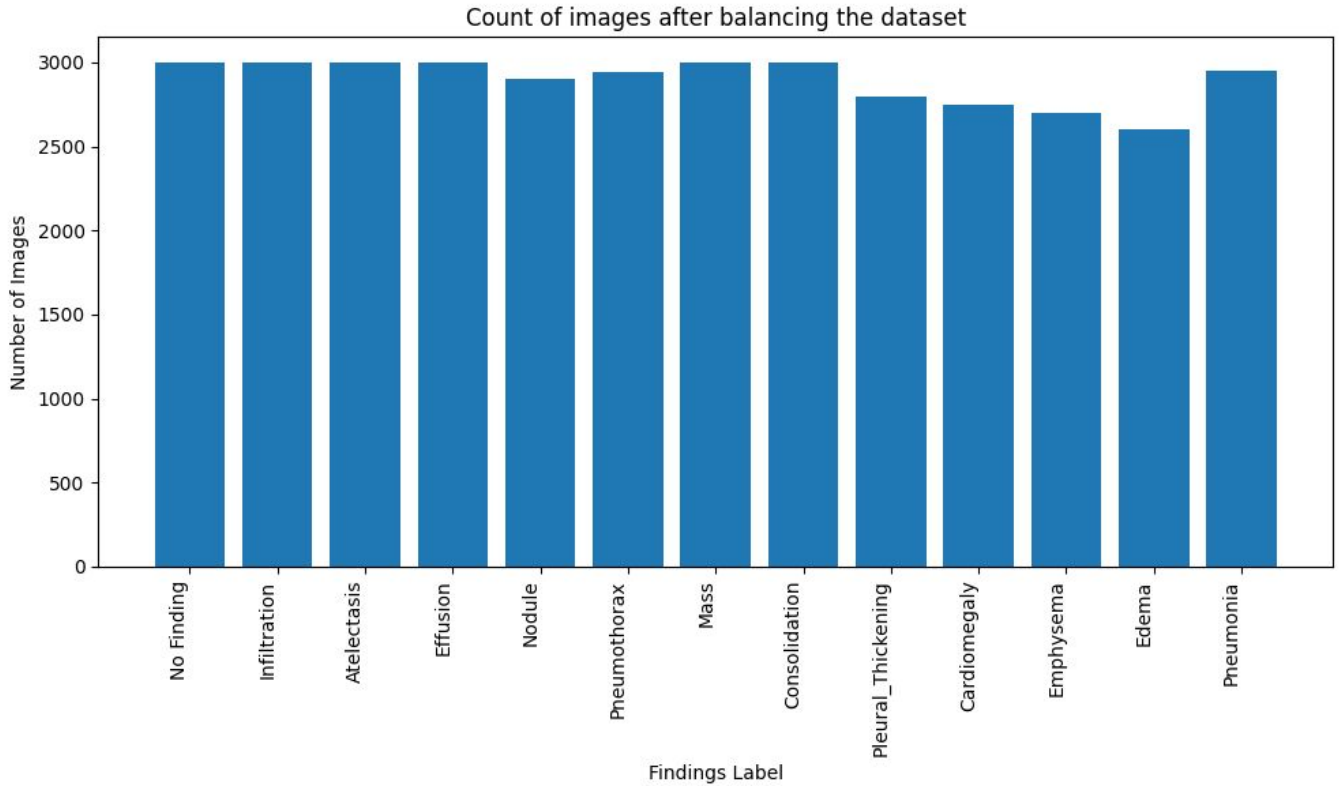
- **Augmented data**







Results [5]


Count of images after balancing the dataset
Number of Images
0
500
1000
1500
2000
2500
3000
No Finding
Infiltration
Atelectasis
Effusion
Nodule
Pneumothorax
Mass
Consolidation
Pleural_Thickening
Cardiomegaly
Emphysema
Edema
Pneumonia
Findings Label

Discussion

- Imbalance Dataset
- Lack of annotations in the dataset
- Very less variation in the dataset
- Challenge for creating a model that can detect very subtle changes in the X-ray images
- Detection of multiple disease from a single image

Remaining Tasks

- Training Chest X-ray Classification Model
- Development of User Interface
- Preparation of Dataset for Findings and Impression Generation Model
- Training Findings and Impression Generation Model
- Fine tuning the models

THANK YOU !!!