AI for Chest X-ray

Proof of Concept Demonstration

Group 18

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Problem Statement & Purpose

Problem Statement

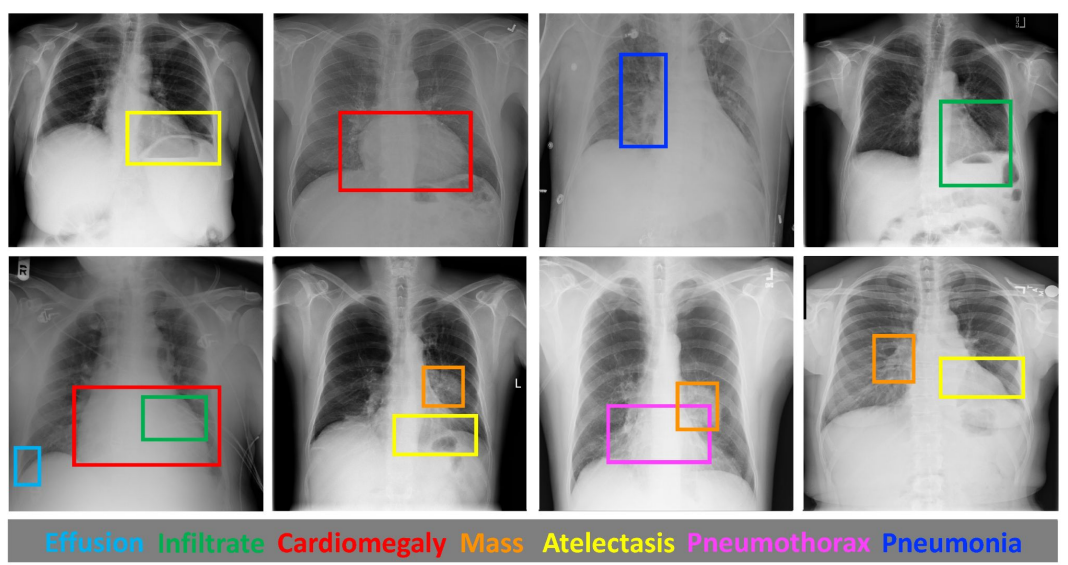
- Radiographers facilitate the imaging process for x-rays.
- Radiologists manually analyze x-rays to find any abnormalities, injuries or diseases.
- This can be very time consuming and like all things has the possibility of error.

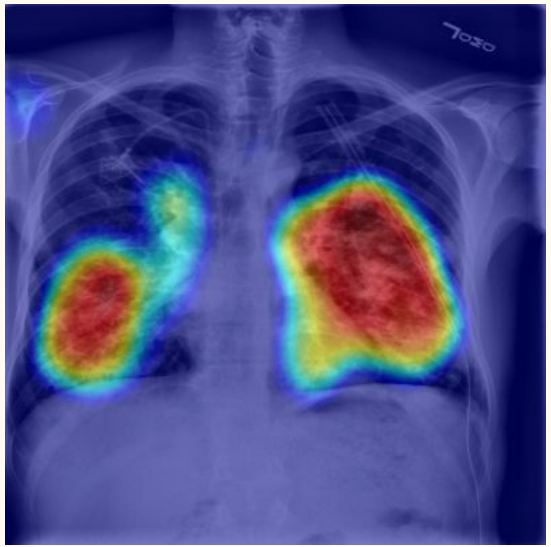
Overview of Project

- Project will help radiologists to identify common diseases in chest x-rays and the location of these diseases using visual mapping.
- Model checks for the following 5 diseases:
  - Atelectasis
  - Cardiomegaly
  - Consolidation
  - Edema
  - Pleural Effusion
- Project has a front-end website to allow radiologists to input x-ray images to the AI model and see output.
- Output includes patient information, disease probabilities and visual mappings on inputted x-ray image.

Key Features

- Providing probabilities for 5 key diseases
- Providing visual mapping on x-ray images to highlight areas of interest
- Help observe disease progression
- Save radiologists time
- Minimize disease identification errors





Stakeholders

Direct Stakeholders

- Radiologists: are medical doctors that specialize in diagnosing and treating injuries and diseases using medical imaging (radiology) procedures (exams/tests) such as X-rays among others.
    - This application will assist Radiologists in identifying diseases present in the inputted x-ray image by providing disease probabilities and the location of these diseases with the use of visual mapping and specific tags for the disease and location.

Indirect Stakeholders

- Radiographers: are healthcare professionals who operate special scanning machines that make images for medical purposes.
    - Radiographers facilitate the imaging process for x-rays and upload the x-rays to hospital servers.
- Hospital Administrative Staff:
    - The hospital administrative staff will be sourcing the x-rays images from hospital servers and helping with other administrative details.
- Patient:
    - The patients treatment journey will be influenced by the findings of the chest x-ray AI model.

P0: Minimal Viable Product (MVP) Features

P0 (Minimum Viable Product)

- Front end website
- Pre-trained AI model-cross trained
- Identify 5 diseases and return disease tags with the following AOC:
    - Atelectasis 0.8
    - Cardiomegaly 0.85
    - Consolidation 0.85
    - Edema 0.85
    - Pleural Effusion 0.92
- Front end displays relevant patient information
- Simulated hopital server is used for storing x-ray images
- Ability for Radiologists to add comments on to findings

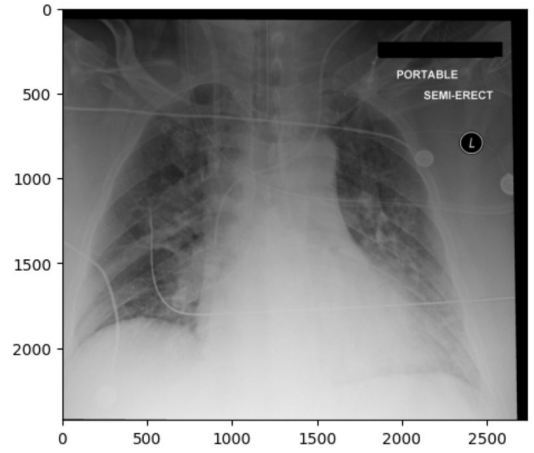
Demo

Workflow

1. User uploads image and submits
2. Backend receives image
3. Read Metadata from Image
4. Convert from DICOM to jpg
5. Run Pre-trained model on the image
6. Read the actual diseases from dataset
7. Convert combine step 4-6 output to Json
8. Return Json to front end and display to user

Study ID	58604118
Patient ID	00000005
Patient Name	Leno Branch
Patient Sex	F
Patient Birth Date	1983-04-17
Patient Current Age	40 years, 7 months, 0 days
Series Number	1
Acquisition Number	1
Acquisition Date	2001-05-17
Instance Number	1
View Position	AP
Patient Orientation	['L', 'F']
Patient Age at Time of Acquisition	18 years, 1 months, 0 days

Disease	Probability	Actual
Atelectasis	0.712985	0
Cardiomegaly	0.79886	0
Consolidation	0.543386	0
Edema	0.94632	1
Effusion	0.815571	0




```
{
    "Study_ID": "58604118",
    "Patient_ID": "00000005",
    "Patient_Name": "Leno Branch",
    "Patient_Sex": "F",
    "Patient_Birth_Date": "1983-04-17",
    "Patient_Current_Age": "40 years, 7 months, 0 days",
    "Series_Number": "1",
    "Acquisition_Number": "1",
    "Acquisition_Date": "2001-05-17",
    "Instance_Number": "1",
    "View_Position": "AP",
    "Patient_Orientation": "['L', 'F']",
    "Patient_Age_at_Time_of_Acquisition": "18 years, 1 months, 0 days",
    "Model_Atelectasis": 71.3,
    "Model_Cardiomegaly": 79.89,
    "Model_Consolidation": 54.34,
    "Model_Edema": 94.63,
    "Model_Effusion": 81.56,
    "Actual_Atelectasis": 0,
    "Actual_Cardiomegaly": 0,
    "Actual_Consolidation": 0,
    "Actual_Edema": 1,
    "Actual_Effusion": 0
}
```

Key Features Coming in the Future

P1: Next set of features that can be added to give the direct stakeholders an improved experience.

- The AI model used in the application will be created from scratch and trained by us.
- Highlight of regions of the x-ray affected by identified disease(s).
- The application should provide additional information for identified disease(s). This additional information includes descriptions of abnormalities, disease specification, and relevant measurements.

P2: Features that may be added at a later time, these requirements are not critical

- Disease tags will have an associated probability
- Secure way to push and pull files from the simulated hospital server on AWS.

P3: The requirements given a priority of P3 are nice to have, but not required.

- Model runs on past and present images to determine if condition is improving or getting worse
- Highlighting of regions should give probabilistic feedback
- Application will have 24/7/365 availability outside of very short maintenance.
- Application can be reformatted to meet all legal and industry standards so that it can be incorporated into a hospital's existing radiology workflow.