Deep Learning Project: Identifying Pneumonia diagnosis by CNN Classifier

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X-ray-based pneumonia diagnosis remains a monumental challenge even for trained and experienced clinicians

15% of all deaths of children under

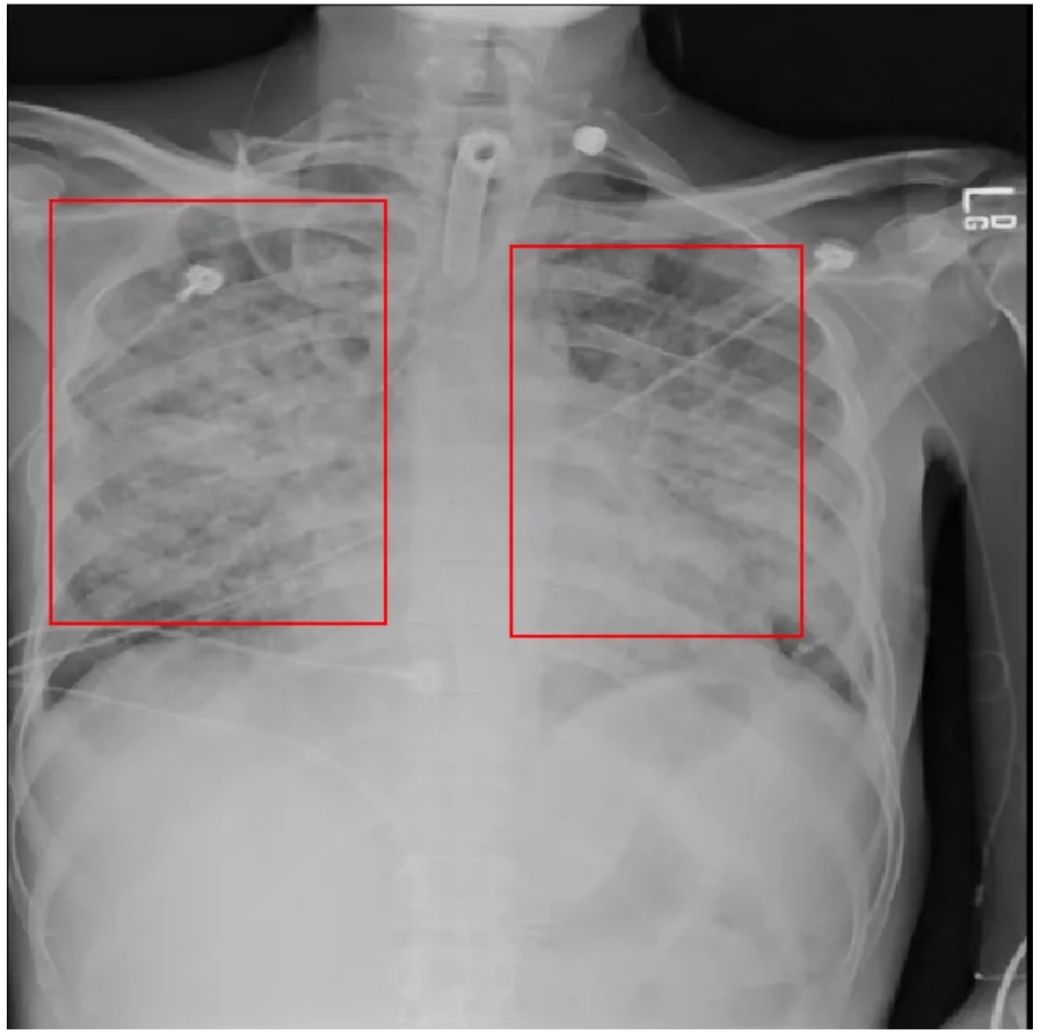
5 years old internationally, are accounted for by pneumonia.

920,000 children under the age of 5 died from the disease in 2015.

While common, accurately diagnosing pneumonia is difficult. It requires review of a chest radiograph (CXR) by highly trained specialists and confirmation through clinical history, vital signs and laboratory exams.

Chest Radiographs Basics

* Black = Air
* White = Bone
* Grey = Tissue or Fluid



Deep learning helps detect potential pneumonia cases

Current Problem

Clinicians are **faced with reading high volumes of images** every shift. Being tired or distracted clinicians can **miss important details in image**

The diagnosis of pneumonia on CXR is complicated due to other conditions in the lungs such as fluid overload (pulmonary edema), bleeding, etc

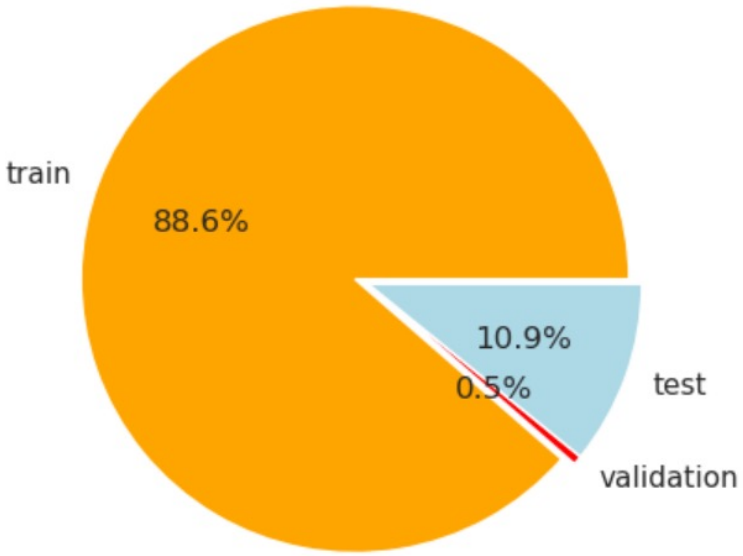
Model Benefits

Model Accuracy :
Automate initial detection (imaging screening) of potential pneumonia cases and **expedite their review**

Model Explainability :
Comparison of CXRs taken at different time points and **correlation with clinical symptoms** and history are **helpful in making the diagnosis**

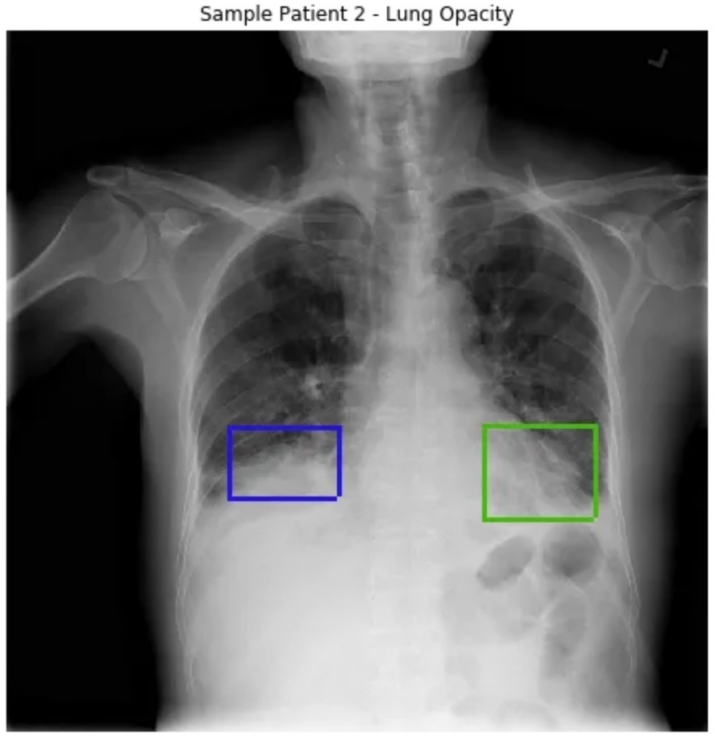
Chest xray Image data

Pie chart



Chest_xray Image Data
Num. Observations: 5.8K
No. of Features: 3
No. of Sub-Features: 2
Sample Features: train, test, validation
Sample Sub-Features: Normal, Pneumonia

Sample image Data



Pneumonia usually manifests as an area or areas of increased lung opacity on CXR.

Feature Engineering: CNN Layers

CNN Layers

Image data

↓

VGG16 Base Model

↓

flatten

↓

Dropout(30%)

↓

Dense (activation='relu')

↓

Dropout(20%)

↓

Dense (activation='sigmoid')

Regularization

	L2 Regularization	Dropout
Implementation	kernel_regularizer=l2(0.05)	Dropout(0.3->0.2)
Purpose	Encourage the weights to move towards zero but not exactly zero. This encourages the model to keep the weights small, making the model simpler and less likely to overfit on the training data	a dropout rate of 30% after the Flatten layer and 20% after a dense layer, the network becomes less sensitive to the specific weights of neurons

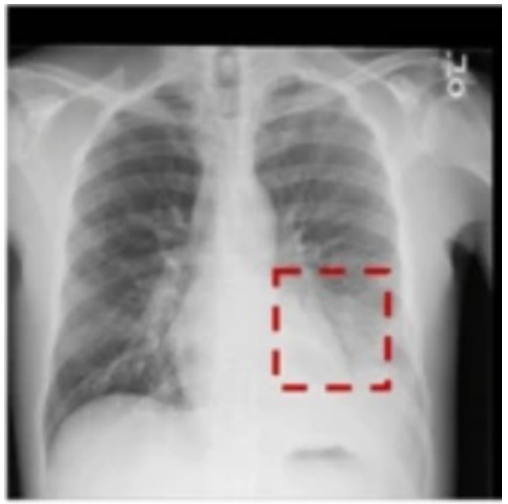
CNN Model scored 93.7% in accuracy, competent to diagnosis Pneumonia

The loss** of the training set **decreases** continuously over epochs, whereas its **accuracy increases

*For validation data, **the lowest loss** for the test set happened at **epoch 6 at 0.1935**, while **the accuracy** was at its peak at **epoch 3 at 0.9375.***

AI aided Diagnosis of Xray images

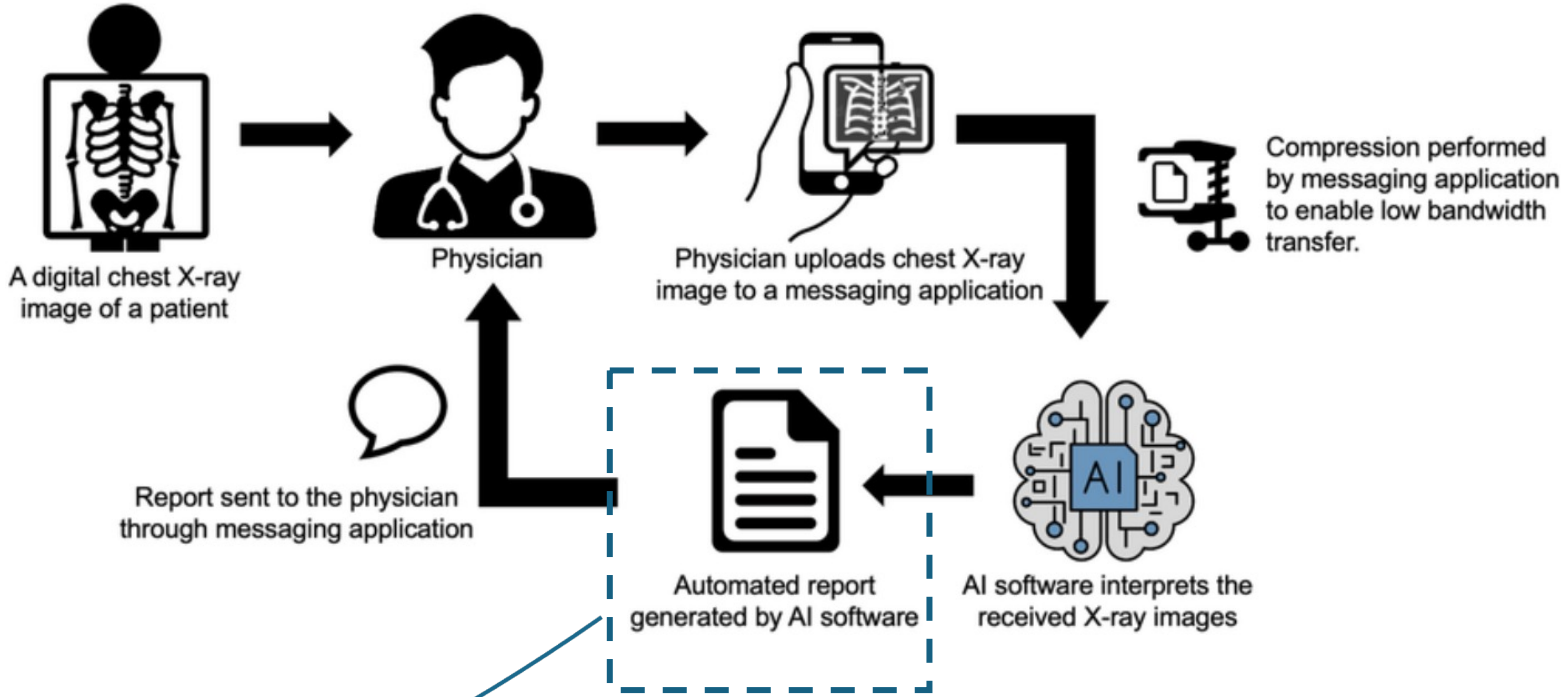
AI Report



Pneumonia

Example AI Report:
This image is 100.000 percent
P N E U M O N I A

Schematic drawing of an AI aided Diagnosis



Source

Future Work

$1.2M to acquire computational resources, high-quality data and operational runway for the next 6M

Data Improvement → **Model Tuning** → **Platform Design** → **Pilot Run**

- **Enhanced Data Collection**: Collect more varied data from different demographics and X-ray equipment to improve the robustness and applicability of the model

- **Experiment with Different Architectures**: Try different CNN architectures or newer models that might offer better performance or efficiency, like EfficientNet or ResNets

- **User-Friendly Interface**: Develop a more intuitive user interface for non-technical users, such as radiologists, to facilitate easier adoption of the technology

- **Integration with Hospital Systems**

- **Clinical Trial**: Conduct a pilot study in a clinical setting to gather real-world data on the model's performance and acceptance among healthcare professionals