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# Computer-aided Detection Of Pneumonia Using Deep Learning Techniques

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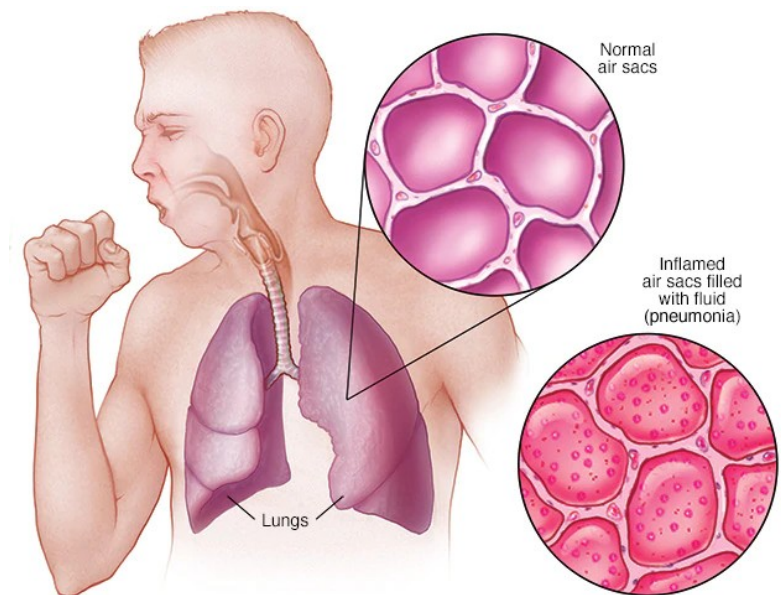
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*CMP3753M Project,*  
Proposal/Work in Progress Document.

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## Abstract

Pneumonia is swelling (inflammation) of the tissue in one or both of the lungs. It's usually caused by a bacterial or viral infection and can have fatal complications such as pleurisy or septicaemia (nhs.uk, 2019). Accurate automation of the diagnosis process will reduce human error and deliver reliable healthcare to resource scarce areas. Deep learning techniques will be used to automatically diagnose Pneumonia from a chest radiograph. The software will also output a modified image of the original radiograph, where the areas of the radiograph most suggestive of Pneumonia are highlighted.

## Introduction

According to two studies, patients were misdiagnosed with pneumonia at an alarming rate when they were readmitted to the hospital shortly after a previous hospitalization for the same illness (ScienceDaily, 2010). This led to overuse of antibiotics and increased health care costs. Since even expert physicians can make mistakes when examining chest radiographs. The involvement of a trained neural network that automatically flags suspicious chest x-rays will drastically reduce this chance of human error.

As mentioned before, image interpretation by a human expert is quite subjective, this could be because of fatigue, experience, or the quality of the radiograph. The software will ease the diagnosis process by returning a percentage of the likelihood of Pneumonia as well as an image highlighting areas that are most indicative of the lung condition.

If, for whatever reason, there is no medical expert present to analyse the radiograph, the output of this

software can still be examined by a non skilled practitioner to give them an idea of whether or not the patient has Pneumonia. Although this software will never be able to truly replace a trained professional.

In recent years, the field of Machine Learning (ML) has progressed rapidly. Deep learning approaches are considered to be state-of-the-art techniques for solving image classification problems such as this. The first Convolutional Neural Network was created in 1994 by Yann LeCun (Culurciello, 2019) and they are still in use today. However, due to the dramatic increase in computing power, this technique can now be applied to images. In the past, there has been many impressive results with the use of this technique.

## Aims and Objectives

The aim of this project is to determine whether or not a person has Pneumonia based on a chest radiograph using a Deep learning approach. The software should also output a modified image of this radiograph highlighting areas that are most indicative of Pneumonia.

The objectives needed to achieve this aim are listed below:

1. A suitable dataset must be sourced or built. The dataset must have enough images of normal/Pneumonia inflamed lungs. The dataset should be of a good quality and ideally should have been verified by trained Physicians.
2. A suitable model must be selected. After this, the architecture of the model needs to be defined.

3. Appropriate software must be identified to develop the project. This includes, the programming language, Integrated Development Environment, compiler, libraries, etc.
4. The software must then be integrated into a build-system and moved to a Git repository so changes can be properly tracked.
5. The previously selected model then needs to be developed.
6. After the model has been developed, the dataset must be randomly split up into a train and test dataset. It must be trained with images from the train dataset.
7. The model must then be tested using the test dataset. The images will be passed through the model and compared with the "ground truth" to see whether or not the model works. Ideally the model will be "good enough" to use in a medical environment.
8. Lastly, I will write up a technical guide as well as a report to analyze my findings.

### **Academic Literature**

"Antibiotic Timing and Errors in Diagnosing Pneumonia" by James A. Welker, DO; Michelle Huston, MD; Jack D. McCue (Welker, Huston and McCue, 2008), MD is an American paper published in 2008. The paper states that a "Time to first antibiotic dose (TFAD) of less than 4 hours has been made a core quality control measure in hospitals". The study concludes that reduction in the

required TFAD from 8 to 4 hours reduces the accuracy by which Emergency Department Physicians diagnose Pneumonia. These results complement the rationale of my study. If the chest x-rays were automatically scanned by a fully trained neural network the Physicians would have swift access to accurate results. This would decrease TFAD dramatically.

The next relevant piece of literature I consulted was "Deep Learning for Medical Image Processing: Overview, Challenges and Future" (Razzak, Naz and Zaib, 2017) by Muhammad Imran Razzak, Saeeda Naz and Ahmad Zaib. This paper discusses the challenges of using deep learning techniques for medical image processing. The paper also compares different architectures of Deep learning models which helped me conclude which one was optimal for my dataset. The paper concludes by mentioning the "tremendous performance of Deep learning" but recognizes that a drawback could be the "unavailability of large, annotated datasets", therefore I will need to ensure that the dataset I acquire is large enough to train the model without effecting the performance of the algorithm.

The next two pieces of literature I read were "Radiology of bacterial pneumonia" (Vilar, Domingo and Cogollos, 2004) by José Vilar, Maria Luisa Domingo and Jonathan Cogollos and "Imaging of community-acquired pneumonia" (Nambu et al., 2014) by Atsushi Nambu, Katsura Ozawa, Noriko Kobayashi, Masao Tago. Both of these studies analyze how Chest radiography is used to identify Pneumonia. Although not all of the information is important to me in these studies, the papers have taught me how to detect and characterize different types of Pneumonia from chest x-rays. The features

highlighted in these papers are the same features that my neural network needs to learn to be successful.

Another paper I read was "Classification of Malaria-Infected Cells Using Deep Convolutional Neural Networks" (Pan, Dong and Wu, 2018) by W. David Pan, Yuhang Dong and Dongsheng Wu. This paper is not related to Pneumonia, but it is still relevant to Computer-aided diagnosis. The study aims to classify Malaria-infected cells from images and they use the same class of deep neural networks that I am planning to use. The model was capable of achieving very high classification accuracies for automated diagnosis, which is promising.

## **Project Plan and Risk Analysis**

## **Review of Progress**

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