APS360 PROJECT PROPOSAL

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1 INTRODUCTION

Pneumonia is an infection that inflames the alveoli in one or both lungs. The alveoli may be filled with fluid or pus (purulent material), resulting in cough with sputum or pus, fever, chills, and difficulty breathing(may, 2016). Each year, pneumonia affects about 450 million people globally (7 percents of the population) and results in about 4 million deaths(Ruuskanen et al., 2011). Nevertheless, pneumonia remains a leading cause of death in developing countries, and also among the very old, the very young, and the chronically ill(George, 2005).

The goal of our project is to develop a machine learning model that can diagnose Pneumonia from Chest X-Rays. The team will train the model using machine learning to improve its ability to recognize Pneumonia and keep its errors at a low level. The combination of ANN and CNN model will be used since it is most appropriate to recognize Pneumonia from Chest X-Rays.

By using this model, the Pneumonia can be diagnosed by AI rather than doctors, which means that a huge amount of doctor resources can be saved. This model will have a profound impact on human health since there will be more available doctor resources saved by this model that can rescue more other lives, especially in some developing countries faced serious doctor resources shortage.

2 ILLUSTRATION AND FIGURE

The purpose of the model is to classify chest X-rays into two classes, which are X-rays with pneumonia and without pneumonia. The team plans to use convolutional neural networks (CNN) as the network model to approach the model.

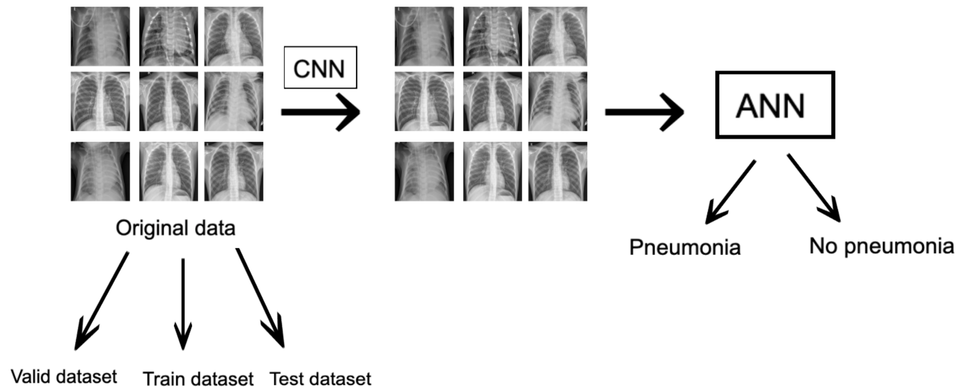

Figure 1: The visualization of the pneumonia detection model.

3 Background and Related Work

As mentioned in the previous section that Pneumonia is a serious health issue around the world, there is much research done in this area. Below are the highlights of the articles that the team learnt and got inspired from.

3.1 Related Work 1: Detection of pneumonia infection in lungs from chest X-ray images using deep convolutional neural network and content-based image retrieval techniques

This paper uses 7000 chest X-ray images to train the model by using VGG19Net based Pneumonia infection diagnosis, which shows a better performance than the other advanced models such as AlexNet, VGG16Net and InceptionV3Net (Rajasenbagam et al., 2021).

3.2 Related Work 2: COVID-19 Pneumonia Detection Using Optimized Deep Learning Techniques

This paper introduces a method of novel optimized deep learning approach to detect pneumonia of COVID-19. The article proposed a three-stage process, which contains image enhancement, Data Augmentation and transfer learning algorithms (Rahman et al., 2020).

4 Data processing

The team obtained chest X-ray images (anterior thorax and back) of selected pneumonia patients aged 1 to 5 years from Guangzhou Women's and Children's Medical Center by accessing the public data platform, Kaggle. The open-source dataset underwent an initial quality control screening to remove all low-quality or unreadable scans.(MOONEY, 2018)

5863 images are included into the dataset, which are divided into the training set, the validation set and the test set. Each set contains the chest X-ray images of healthy people and chest X-ray images of people with pneumonia.

By the research the team noticed that imaging abnormalities on X-ray images due to pneumonia "may present as confluent parenchymal (lobar or segmental) opacity or merely patchy opacity"(von Dadelszen)

A normal X-ray of the lungs images are clear and free of impurities. In pneumonia, the X-ray images of the lungs are blurred and have a flocculent appearance.

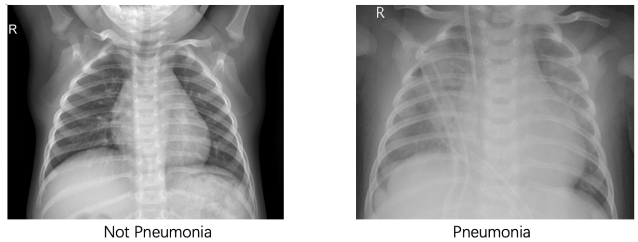

Figure 2: Chest X-ray images of healthy people and people with Pneumonia

Before loading the dataset into the model, although from the introduction of the dataset, all the images have been judged and screened by a total of five specialist doctors to confirm the correctness of their classification, the team cleaned up the dataset by excluding the images without obvious features of normal or pneumonic states.

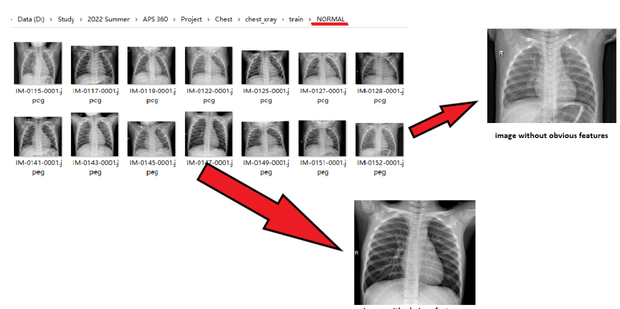

Figure 3: Chest X-ray images of healthy people

In the formatting stage, the team decided to first resize all the pictures they have cleaned from the previous stage to a standard size. Converting all images to the same size would help the model to easily get these images being loaded and forward processing. In our dataset, the images have a size around 1500 *1400 which is relatively enormous. If the team proceeds to apply some filters with the Convolution Neural Network in later steps, processing images with this amount of pixels would be time consuming for the model to recognize. Therefore, the team decides to format all the images we have after clean to a considerably smaller size (100*100). As the dataset is divided into two categories we would label pictures for chests that have pneumonia as 1, pictures for normal chests as 0. After the steps we took in cleaning and formatting the images. Our datasets are prepared to proceed to the model training stage.

5 ARCHITECTURE

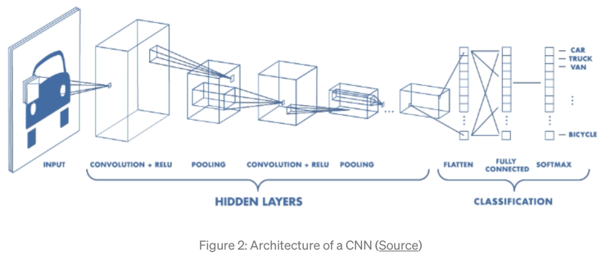

Figure 4: Architecture of A CNN(Agrawal, 2021)

In this project, there are two categories (pneumonia/healthy) of 3D images of chest X-ray in the database with different features. In order to obtain the correct spatial features related to the lung state from the input images, the team will use the CNN algorithm that applies kernels through each convolutional layer to extract the lung features, the arrangement, and the relationship between these features. Each pooling layer in the algorithm intercepts the parts of the image that have valid information, simplifying the pixel metrics of the image.

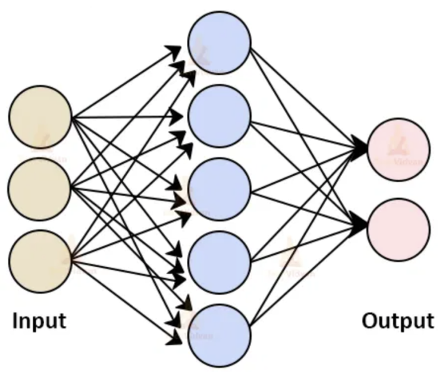

Figure 5: Architecture of AN ANN(Mishra, 2020)

The second algorithm that will be used by the team is the ANN algorithm, where the images will be extracted as input after the simplification of the CNN, avoiding the drawback of the ANN being too complex in terms of trainable parameters when converting a 2D image to an 1D image in the case of a large image size. The outputs will be set into 1 if the chest X-ray belongs to a patient with pneumonia or 0 if the chest X-ray belongs to a healthy person.

6 BASELINE MODEL

The baseline model for this project will be the ANN model. All the chest X-ray images will be converted into an 1D column vector and be input into the ANN model. A couple of layers will be processed by the ANN model to output two values as the result of machine learning: 1 for pneumonia and 0 for no pneumonia.

7 ETHICAL CONSIDERATIONS

In the process of data collection, the chest X - ray images that the team uses may contain personal information that some patients do not want to be public. Therefore, one of the ethical considerations could be whether the database the team uses protects the privacy of the patients, while ensuring the research's validity. In order to minimize the ethical concerns in the research paper, the team tries to access the database through Kaggle.com, which is a subsidiary of Google LLC and can be considered as a relatively reliable source.

8 Project Plan

Table 1: Project Plan

Report Parts	**Student Names**				**Deadlines**
	Ariana Lin	Rosalind Wang	Haobo Wang	Muchen Liu	
Introduction				✓	June 4
Illustration/figure	✓				June 4
Background and Related Work	✓				June 4
Data processing		✓	✓		June 4
Architecture	✓	✓	✓	✓	June 5
Baseline Model	✓	✓	✓	✓	June 5
Ethical Considerations	✓				June 5
Project plan			✓	✓	June 4
Risk Register		✓			June 5
Link to Colab Notebook				✓	June 5
References	✓	✓	✓	✓	June 5
Overall Review	✓	✓	✓	✓	June 5

Meeting time: 6p.m. (2 days a week through Zoom)
Group chat platform: WeChat
Internal Deadline: One the day before the real deadline.
Task allocation: The group will clearly divide the task into different parts and distribute them equally to different group members. To ensure that members do not overlap when writing reports or coding, the roles of the different sections are clearly labelled to ensure that group members only have to complete the corresponding content.

9 Risk Register

Do not change any aspects of the formatting parameters in the style files. In particular, do not modify the width or length of the rectangle the text should fit into, and do not change font sizes (except perhaps in the

9.1 Team member drops the class (Likelihood: Medium)

If a team member abandons a lesson, the whole team will ask him/her to report on his/her progress, doubts, uncertainties, etc. Once we have a full picture of the current situation we will reassign his/her tasks to other members.

9.2 Disagreement between teammates (Likelihood: Medium)

The group will discuss and agree on the task before doing it. If there is a disagreement between the group members during the discussion, then a vote will be taken. If the conflict escalates, the group member with the problem will be separated and discussed with the rest of the group to try to resolve the problem and conflict after reconciliation.

9.3 LOSS OF DOCUMENTS (LIKELIHOOD: LOW)

After a certain period of time, each group member will download the latest report and database in case of missing issues.

10 LINK TO COLAB NOTEBOOK

https://colab.research.google.com/drive/1fl9xno2NnzIQbWjo9uV111ABvOPhKa9h?usp=sharing

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Peter von Dadelszen.