**Capstone Proposal:  
Classification of Pneumonia Diagnosis with Image Analysis**

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**Situation Background**

Pneumonia is a bacterial or viral infection that targets the lungs and affects many individuals, especially ones of developing or under developing nations. Symptoms brought on by this illness include fluid build up in the lungs, respiratory distress and breathing difficulty. Left untreated, pneumonia can cause long term health problems and can be fatal. Chest x-rays are often required to properly diagnose pneumonia which requires trained medical staff to interpret these images. Due to a large portion of the population who are susceptible to pneumonia are found in more remote locations there is often an issue with adequate trained medical staff to interpret chest x-rays. This can lead to misinterpretation and misdiagnosis. These types of errors cause an increase in pneumonia complications.

**Problem Statement**

Getting an accurate and timely diagnosis of medical imagery is often due to limited resources and staff shortages in developed and developing countries. Providing the patient with an early diagnosis of pneumonia could help accelerate the application of treatment and avoid complications associated with this illness. A proposed solution to this would be training and using a Machine Learning algorithm to classify chest X-rays based on whether pneumonia is present or not. Medical institutions that are short staffed or ill equipped to make this kind of determination could upload their findings remotely and our algorithm could provide a fairly accurate diagnosis quickly and efficiently.

**Datasets and Inputs**

* **Chest X-Ray Images (Pneumonia)**
  + Dataset split into 3 folders: training, test, and valuation.
  + Sub category for each image pneumonia or normal.
  + All chest x rays selected from paediatric patients ages 1-5.
  + Part of patients' clinical routine.
  + Patients from Guangzhou Women and Children’s Medical Center in Guangzhou.
  + Screened for quality by two expert physicians.
  + Accounting for grading errors a third expert physician was consulted.
  + Dataset Link:
    - <https://www.kaggle.com/datasets/paultimothymooney/chest-xray-pneumonia>
  + Dataset citation:
    - Kermany, Daniel; Zhang, Kang; Goldbaum, Michael (2018), “Labelled Optical Coherence Tomography (OCT) and Chest X-Ray Images for Classification”, Mendeley Data, V2, doi: 10.17632/rscbjbr9sj.2
* **Covid-19 pneumonia dataset**
  + Medical images in 3 folders ( Covid, Normal, and Pneumonia) x-ray images.
  + Preprocessed and resized to 256x256 PNG.
  + Dataset Link:
    - <https://data.mendeley.com/datasets/dvntn9yhd2/1>
  + Data set citation:
    - Kumar, Sachin (2022), “Covid19-Pneumonia-Normal Chest X-Ray Images”, Mendeley Data, V1, doi: 10.17632/dvntn9yhd2.1
    - Shastri, S., Kansal, I., Kumar, S. et al. CheXImageNet: a novel architecture for accurate classification of Covid-19 with chest x-ray digital images using deep convolutional neural networks. Health Technol. 12, 193–204 (2022). <https://doi.org/10.1007/s12553-021-00630-x>

**Solution Statement**

***Solution Statement***

Build a machine learning model that classifies chest X-ray images as either normal or infected with Pneumonia. This can be done by training the model to detect opacity in the medical images of the chest and lungs, a common indicator of Pneumonia infection. Our ML model will be based off of the DenseNet model due to its feature processing which allows for greater accuracy and high computational efficiency when it comes to processing and categorising images.

<https://towardsdatascience.com/review-densenet-image-classification-b6631a8ef803>

***Benchmark Model***The machine learning model to be utilised to benchmark our model will be Convolutional Neural Network (CNN). CNN excels in processing images using the grid-like nature of an image’s pixels and the RGB values within them. CNN is one of the most widely used image processing and classification models which makes it a perfect candidate to compare the performance of our model. CNN link: <https://www.tensorflow.org/tutorials/images/cnn>

***Evaluation Metrics***

Due to the situational background of the dataset being used and processed it is important we use the right evaluation metrics to analyze the performance of our model. We will use the **Accuracy Metric** to depict the percentage of the correct prediction being made by our classification model. Secondly, the **Recall Metric** will be used to depict the actual number of positive cases versus the number of actual True Positives. This is important when false positives are not as much of a concern as false negatives, which could lead to pneumonia cases going undiagnosed. Finally, a **Confusion Matrix** will give detailed performance metrics on the number of True Positives, True Negatives, False Positives and False Negatives. This will give valuable insight as to how our model is performing overall, as well as helping visualize its strengths and weaknesses.

**Anticipated Deliverables**

***Results***

Displaying the results and performance of our model by using our Accuracy score and Recall ratio which are good indicators of the models performance. Finally, providing a live visual demonstration of the model performing predictions on submitted medical images.

***Analysis of results***

Analyze the results and performance of our model using a confusion matrix and include a heatmap which will provide a visual representation of our model’s performance. This will aid in explaining our models areas of strength as well as its weaknesses.

***Comparisons to benchmark***

Applying the same dataset and tuning used with our model to the benchmark model, calculate and analyze the same evaluation metrics and compare the results. This provides a look into how our model performs against a well known and widely used image processing and classification model.

***Conclusion***

As a conclusion we would like to outline some of the struggles encountered during the project's journey, as well, summarize our models performance and comparison to the benchmark model. Finally, provide a summary of the successes and shortcomings of our model and ways in which it may be improved.