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| **Reference Number** | 7.1.01/SPP/33 |
| **Title of the Project** | Classification and Analysis of Medical Scans |
| **Name of the College & Department** | K S School of Engineering and Management, Department of Computer Science and Engineering |


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## Key words

*Machine Learning, Image processing, CT Scan, X-Ray, DICOM images, Deep Learning, Python.*


## Introduction

Machine Learning has phenomenal applications in the field of Medical Sciences, where technology and medicine go hand in hand, machine learning has been making major strides in today's modern world of medicine, and has proved to be effective. This project aims at developing and implementing a Machine Learning model that loads, visualizes, analyzes medical imageries, specifically CT Scans and X-Rays. This project as a result will contribute towards increasing the efficiency of diagnosis of doctors, thus increasing the overall outcome for the patients. The first aspect of the project includes volumetric segmentation of the CT imageries, and visualizing CT scans from a 2 Dimensional DICOM image to a 3 Dimensional plot, which as a result gives the medical professional a deeper insight into the CT scan of a particular person, thus increasing their level of efficiency during diagnosis. As medical professionals such as doctors, go through hundreds of CT imageries per day, their level of efficiency sometimes decreases based on numerous factors, but giving the doctors a deeper insight into the imageries will not only enhance their level of perception into the imagery, but also give them a better insight for their diagnosis. The second aspect of the project includes a binary classification model that aims at classifying a set of X-Rays into Pneumonia and Normal. This aspect of the project aims at classifying the images in a manner of Pneumonia and Normal,

and the performance of the model is evaluated using various factors. The dataset of the X-Rays is differentiated based on whether the person has Pneumonia or if it is Normal, and the dataset is extracted from The Cancer Imaging Archive (TCIA) and Mendely's Data.

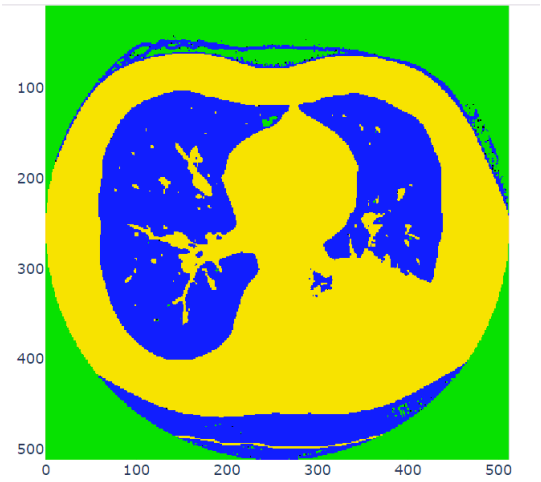
## Objectives

1. To design and develop a Machine Learning model that can load, evaluate, segment and visualize a normal 2 Dimensional DICOM imagery onto a 3 Dimensional Plot.
2. To visualize and segment CT images giving the medical professional a deeper insight into the imagery, and also increasing their perception into the image.
3. To load, analyze, train and develop a Machine Learning model that classifies the X-Ray imageries as Pneumonia or Normal.

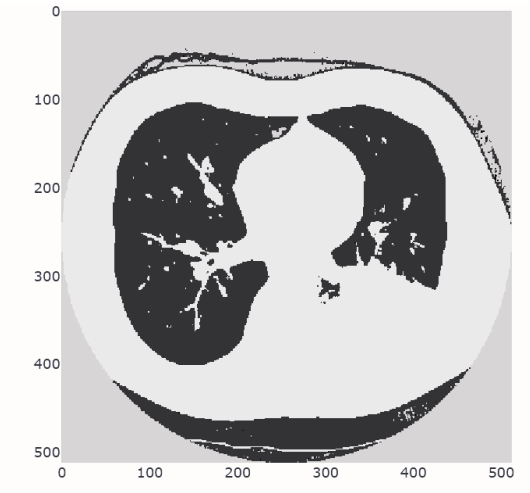
## Methodology

The dataset involves CT scans and X-Rays of an identified person. The CT scans are in the form of DICOM images extracted from TCIA| (The Cancer Imaging Archive) and the X-Rays are JPEG images which are extracted from Mendeley's Data. 12. The CT scans are visualized and analyzed with a volumetric segmentation approach to obtain a Segmented 3D visualization from a 2D DICOM image. With a CNN approach, the Chest X-Rays are visualized, analyzed, and classified as Pneumonia or Normal.


The above figure illustrates the methodology with respect to the volumetric segmentation of the CT images. The machine learning model is designed by training the model to load the data, this is accomplished by creating a directory path link, directly from Kaggle and importing the data onto the environment. We then identify the images with the name, age and sex of the patient to prevent any duplicate images being loaded. The model is then trained to segregate (Volumetric Segmentation) using HU values, and giving different color contrast to each of the segmented aspects of the CT scan as shown below in the figure.

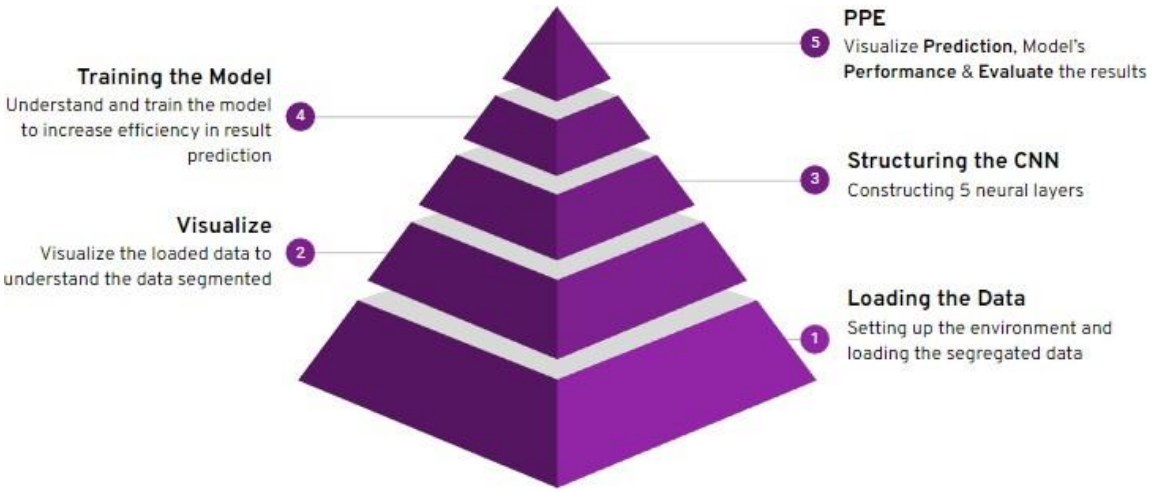



Using RGB colors




Converting it to grayscale

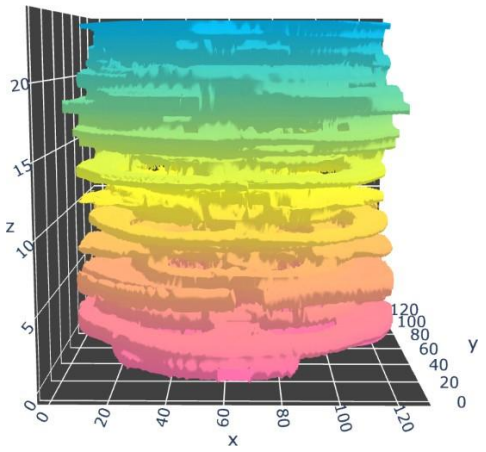
The next aspect of the project involves a binary classification model to classify the X-ray images based on whether the person has Pneumonia or is Normal. The model has the same approach as the segmentation of CT Scans but has significant changes when coming to the CNN approach and the evaluation factors while evaluating the model's performance.



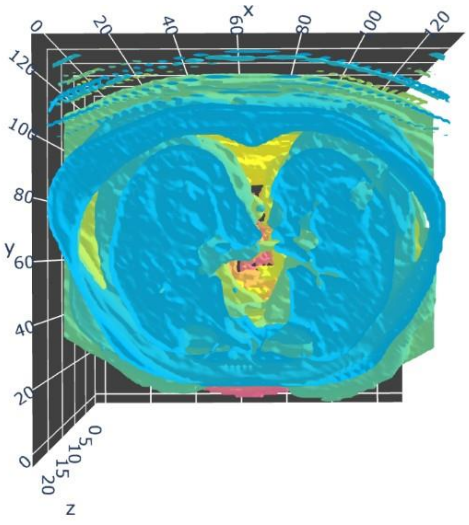

## Results and Conclusion

The expected, and the actual outcome of the project met the objectives listed out at the starting of the design and development phase. The volumetric segmentation was successfully

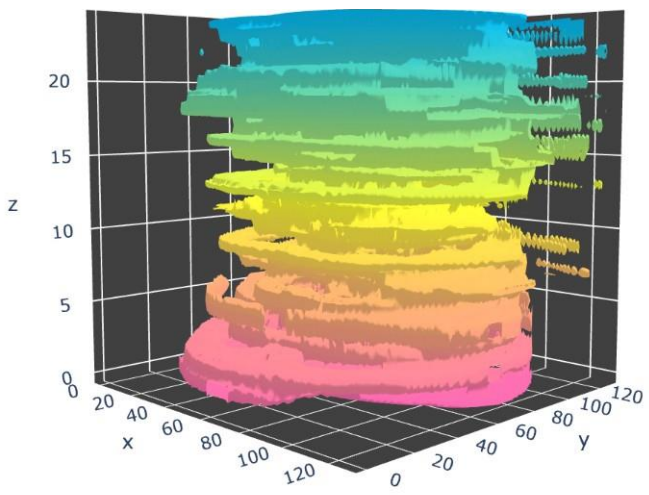
completed by using Hounsfield Units or HU values, and the 2 Dimensional DICOM image was plotted successfully onto the 3 Dimensional plot. The visualization outcome of the 3 Dimensional plot or visualization of the DICOM image is as shown below.




*The above figure illustrates the side-view of the visualized DICOM image.*




*The above figure illustrates the top-view of the visualized DICOM image*




*The above figure illustrates another side-view of the visualized DICOM image.*

For the binary classification of the X-rays part, the model has achieved an accuracy score of 98% as depicted in the image below.

```
[30]: loss, acc, prec, rec = model.evaluate(test_ds)
```

```
5/5 [==============================] - 18s 3s/step - loss: 0.8082 - accuracy: 0.7724 - precision: 0.7394 - recall: 0.9821
```

The model has successfully accomplished the objectives as listed earlier during the design phase of the project.

## What is the innovation in the project?

Machine Learning has played and has been bringing major strides in the world of medicine. As medicine and technology go hand in hand, machine learning has thus far been proved to be as competent as humans are making it one of the most sought after technologies responsible in today's constantly advancing world of medicine. The innovation of the project lies in the volumetric segmentation of the DICOM images, which gives the medical professional such as doctors, a deeper understanding and insight into a person's CT Scan. The natural outcome of the project is that, it increases the diagnostic efficiency of the medical professionals, as they sometimes look at hundreds of imageries per day and sometimes the diagnostic efficiency of the medical professional based on the patient's criticality might have an immense effect on their diagnosis.

## Scope for Future Work

Digital transformation is the new reality of the modern world's medical field. Besides industries which use ML models to scale their businesses and efficiency, such as manufacturing,

corporate, banking commerce, IT, medical domain has new challenges and it has more importance to address the evolving needs of this domain. This Machine Learning pipeline helps medical institutions and professionals, especially for doctors starting out their career in various ways, such as maintaining patient's profiles, analyzing the patient's diagnosis and giving out the best possible path for proceeding with the patient's diagnosis. The world is rapidly changing and technology has to meet the expectations of the medical industry. Doctors since ages have been dependent on technology to make better diagnosis, perform and assist them in operations, as well as to increase their efficiency. Some recent implementations have also shown, medical institutions have implemented robots to perform difficult operations. Thus, this project aims at increasing the diagnostic efficiency of the doctors which naturally leads to better diagnosis, as the project also aims at providing a deeper insight into the person's medical scans.