Medical Informatics

Medical Image Processing

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Detection of Pneumonia

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Introduction

- Finding ways to automate diagnostics from medical images, has continuously been one of the most interesting areas of software development.

- Pneumonia is an infection that inflames lungs' air sacs (alveoli). The air sacs may fill up with fluid or pus, causing symptoms such as a cough, fever, chills and trouble breathing.

- We will present a approach for detecting the presence of pneumonia in chest X-rays (CXR) by using only Image processing techniques. For this, we have worked on 52 analog chest CXRs pertaining to Normal and Pneumonia infected patients.

Methods

1. Resizing
2. Histogram Equalization
3. Thresholding (Otsu – Binary inverse)
4. Morphological operations (opening – closing)
5. Removing areas attached to the border
6. Median Filter
7. Classification

Results associated with images

- Resizing Method:

Image before resizing

Image after resizing

- The original images were having different size. We resized all the images to 800x800, using the ‘resize’ function of OpenCV.

Results associated with images

- Histogram Equalization Method:

Image before histogram equalization

Image after histogram equalization

- Histogram equalization is done to adjust image intensities so as to enhance contrast. The enhanced contrast aids in detection of the clouds. We used the ‘equalizeHist’ function available in OpenCV.

Results associated with images

- Thresholding Method:

Image before Otsu thresholding

Image after Otsu thresholding

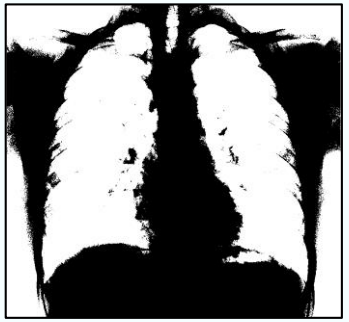


Image after Binary inverse thresholding

- Thresholding is done to segmenting the foreground (information) from the background (noise). For this purpose we have used Otsu thresholding and then we have used Binary inverse thresholding to inverse black and white.

Results associated with images

- Morphological operations:

Image before Morphological operations

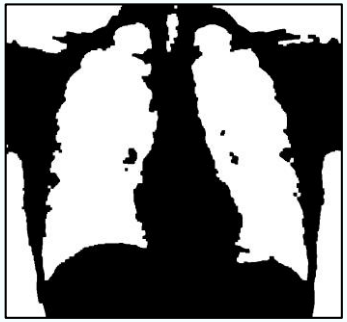


Image after Morphological operations
[Opening, then Closing]

- In Morphological operations: First we have applied kernel 7x7.
- Opening: to remove small objects, but keep original size (Opening = Erosion + Dilation)
- Closing: to fill holes, but keep original size (Closing = Dilation + Erosion)

Results associated with images

- Removing areas attached to the border Method:

Image before Removing

Image after Removing

- We remove areas attached to the border or convert it to black color to get the lung area with white only. We do this by using ‘copyMakeBorder’ function available in OpenCV to add 1 pixel white border and create zeros mask with 2 pixels larger in width and height and convert it to black using ‘floodFill’ function.

Results associated with images

- Median Filter Method:

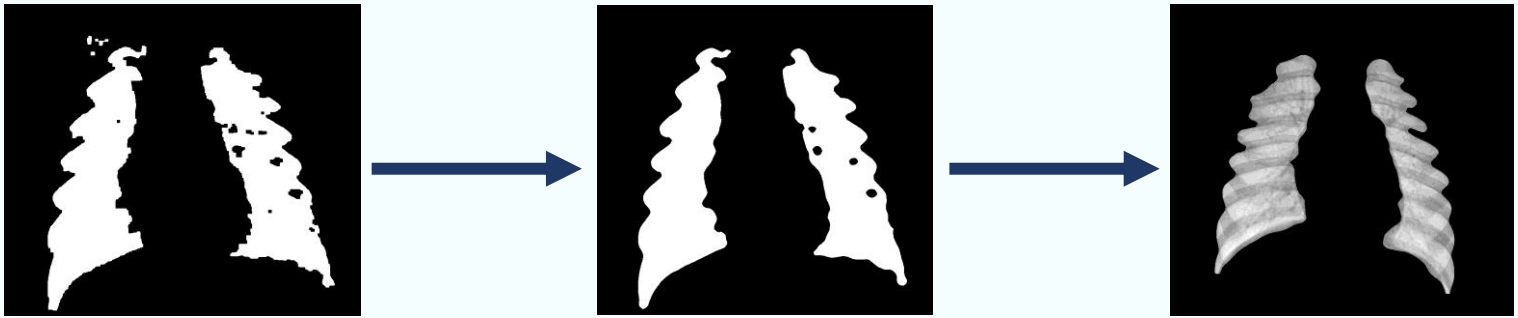


Image before Median Filter (A)

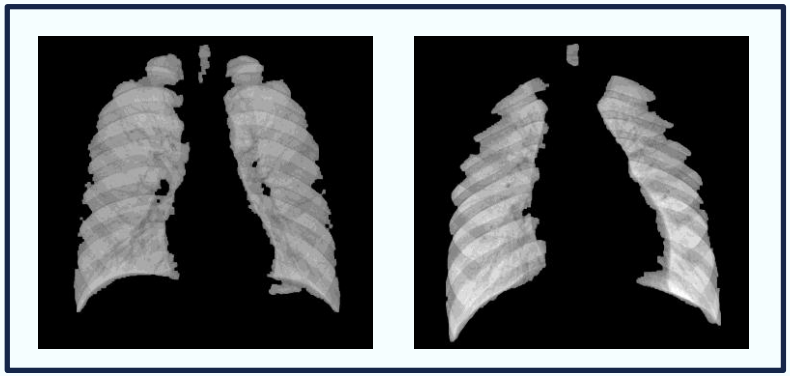
Image after Median Filter (B)

Image after multiplying (C)

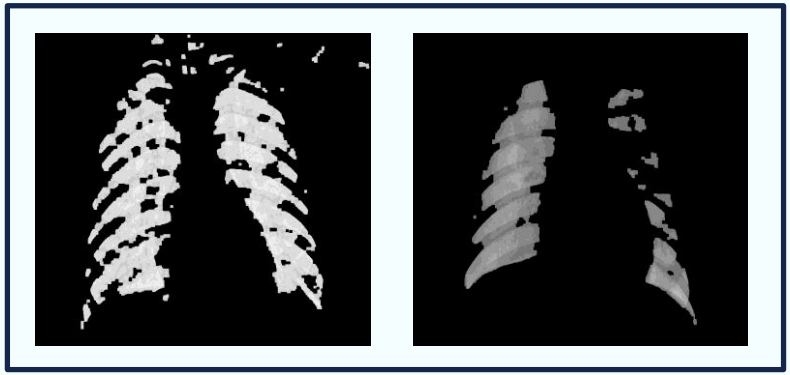
- We used median Filter with a size 21x21 to remove noise as shown in (B).
- After removing noise, we multiply the image(B) with the original image ‘resized image’ to get a clear and realistic view of the lungs (C).

Results associated with images

- Classification:



Normal lung region



Pneumonia affected lung region

- At the end, we have classified the images by number of labels using ‘connectedComponents’ function with 4 connectivity.
- After we get the number of labels for normal images, we discovered the labels of normal image in range between 3 and 6, but the labels of pneumonia are greater than 6.

Results

- Testing performed on 52 sample images: 25 Normal, 27 Pneumonia
- Confusion Matrix:

	Predicted as Normal	Predicted as Pneumonia
Actual Normal	**TN = 23**	**FP = 2**
Actual Pneumonia	**FN = 3**	**TP = 24**

- Accuracy = $\frac{TP + TN}{N}$ $\quad (N = TP + TN + FP + FN)$
- Accuracy = $\frac{24 + 23}{24 + 23 + 2 + 3} = 0.903 \times 100 = 90.3\ \%$

Conclusion

- Computer assisted detection of diseases from CXR are always very helpful at places where there is shortage of skilled radiologist.

- At this stage of the project, we have detected pneumonia by:
  - First, we got chest X-rays (CXR) images as input.
  - Then, we performed Otsu thresholding and inversed it using binary inverse thresholding.
  - Then, we did some morphological operations such as: opening and closing.
  - Then, we removed the areas attached to the border to get the lung area only.
  - Then, we applied median filter to remove noise.
  - Finally, we classified the images using number of labels method to get images as normal or pneumonia affected.

Thanks!