

## PNEUMONIA DETECTION ALGORITHM

### A. DESCRIPTION

According to World Health Organization, pneumonia can be defined as a form of acute respiratory infection that affects the lungs [1]. This disease causes the patient's alveoli to be filled with pus and fluid leading to painful breathing and inadequate oxygen intake. Thus, early detection of pneumonia is necessary so that proper preventive action can be taken. Computer-Assisted Diagnosis (CAD) is one of the methods to detect the lung nodule on X-ray/CT-Scan images. In this project, the CAD was implemented using a pneumonia detection algorithm.

The main pneumonia detection algorithm was adopted from robotechnics' openCV\_Biomedical repository, YCAyca's Image\_Processing\_GUI repository for OpenCV image processing in QT and medaimane's qt-opencv-cpp-project for the QT5 GUI.

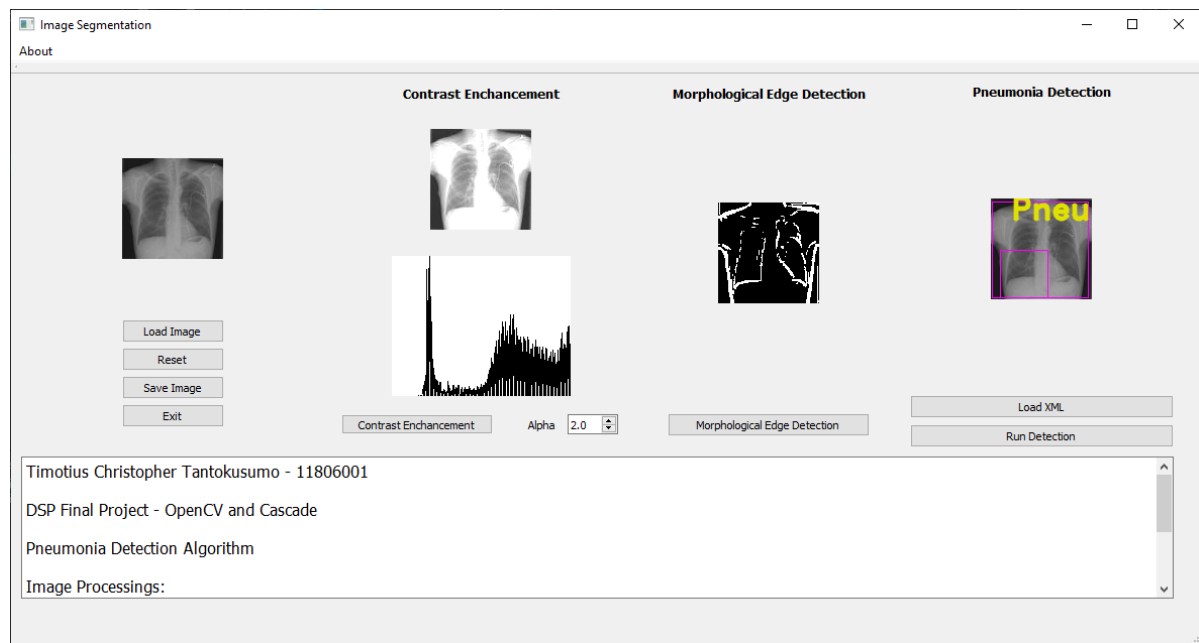


Figure 1. The GUI of the Pneumonia Detection Algorithm on QT5

The project's features that have been developed are:

1. OpenCV image processing such as contrast enhancement, morphological edge detection, and plotting histogram was implemented for image processing.
2. Converting the pneumonia detection algorithm from python into C++ so that the code is able to run in QT.

## **B. ALGORITHM**

The general algorithm of pneumonia detection:

1. The program is initiated and load a pulmonary x-ray image using the "Load Image" button and shown on the interface.
2. Afterward, the loaded image can be processed for contrast enchantment. The alpha (The contrast degree) can be adjusted using the spinbox with 0.5 single steps. The "Contrast Enhancement" button is pressed to process the image.
3. The enhanced image is shown on the interface and its intensity distributions are shown in the histogram underneath the enhanced image.
4. For further image processing, the "Morphological Edge Detection" button is clicked to detect the image edges.
5. To detect pneumonia on the x-ray image, the cascade or .xml file has to be loaded first by pressing the "Load XML" button.
6. Subsequently, the "Run Detection" button is clicked to run the pneumonia detection process.
7. The Morphological edge detected image and pneumonia detected image can be saved using the "Save Image" button.
8. Finally, the "Reset" button can be used to reset all of the processes and the "Exit" button to terminate the program.

The algorithm of Pneumonia Detection:

1. The cascade or .xml file (pneumonia-cascade.xml) is loaded into the program
2. The loaded image is converted between RGB/BGR and grayscale
3. Next, the image's contrast is improved to stretch out the intensity range (histogram equalization) so that the image becomes clearer.
4. DetectMultiScale function from CascadeClassifier OpenCV is used to detect the pneumonia.
5. The scaleFactor is set into 2, and the minNeighbours into 1
6. Finally, the image is shown with the rectangle marker to mark out pneumonia.

### C. TEST DISCUSSION

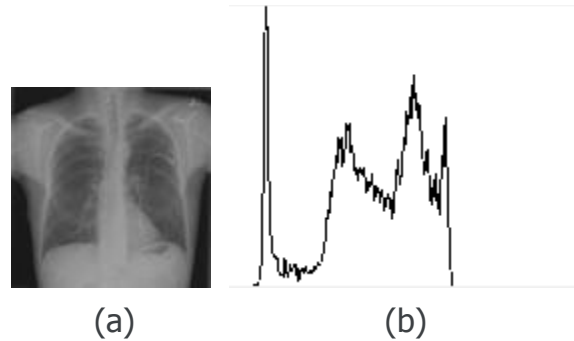


Figure 2. (a) Original Image with its (b) histogram

In this project, the histogram of the original image can be shown by adjusting the alpha of contrast enhancement into 1.

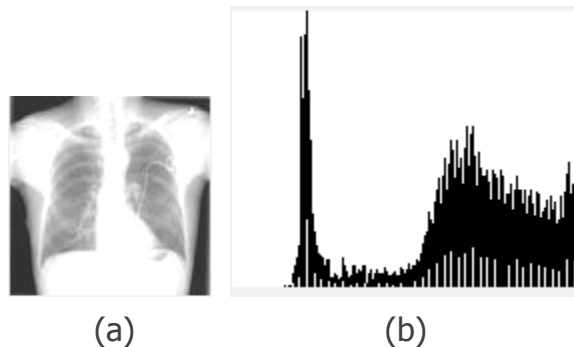


Figure 3. (a) Enhanced contrast image with its (b) histogram

The contrast enhancement image processing is used to increase the image contrast. The contrast level can be adjusted by altering the alpha value. Each step taken with the spinbox arrow are having a size of 0.5.



Figure 4. Morphological edge detection

The morphological edge detection is based on the contrast of the image. As a result, this image processing is dependent on contrast enhancement image processing. An appropriate contrast level is required for edge detection otherwise it will cause unable to detect the object's edges.

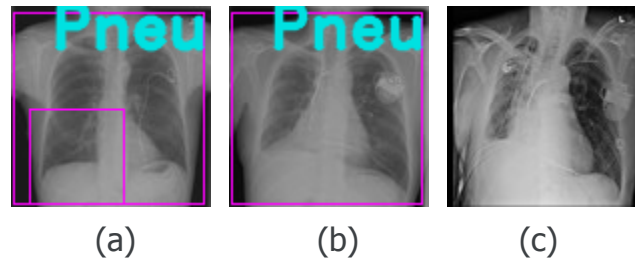


Figure 5. X-ray images with Pneumonia

In order to detect pneumonia on x-ray images, the cascading classifier was used in form of .xml format. Since the .xml file was directly taken from robotechnics' openCV\_Biomedical repository, the cascading classifier was unable to detect pneumonia on the preprocessed images. In this project, the scaleFactor is set into 2 to reduce image size with each scale and the minNeighbours adjusted into 1 to specify the degree of neighbors each candidate rectangle should have to retain pneumonia. However, the cascading classifier was unable to detect all x-ray images with pneumonia, this is shown in figure 5c. This may be due to the small size of the label, too large rectangle marker, or low accuracy of cascading classifier. Thus, further improvement is necessary in the future.

#### D. CONCLUSION

To sum up, the pneumonia detection algorithm is equipped with several image processing OpenCV and a pneumonia cascade classifier. However, the cascade classifier is still unable to detect pneumonia on the processed image of this program due to the .xml file. In addition, pneumonia detection is still lacking and further development regarding this matter is required for future applications.

This project's code can be found [here](#)

## E. REFERENCES

- [1]"Pneumonia", Who.int, 2021. [Online]. Available: <https://www.who.int/news-room/fact-sheets/detail/pneumonia>. [Accessed: 10-Jan- 2022].
- [2] Y. Aktaş, "A Comprehensive Guide to Image Processing: Using an OpenCV Tool", Medium, 2020. [Online]. Available: <https://towardsdatascience.com/image-processing-tool-a1b8fe66c957>. [Accessed: 15- Dec- 2021]
- [3] Y. Aktaş, "GitHub - YCAyca/Image\_Processing\_GUI", GitHub, 2021. [Online]. Available: [https://github.com/YCAyca/Image\\_Processing\\_GUI](https://github.com/YCAyca/Image_Processing_GUI). [Accessed: 15-Dec- 2021].
- [4] S. Chishti, "GitHub - robotechnics/openCV\_Biomedical", GitHub, 2018. [Online]. Available: [https://github.com/robotechnics/openCV\\_Biomedical](https://github.com/robotechnics/openCV_Biomedical). [Accessed: 10-Jan- 2022].
- [5] M. Skhairi, "GitHub - medaimane/qt-opencv-cpp-project", GitHub, 2019. [Online]. Available: <https://github.com/medaimane/qt-opencv-cpp-project>. [Accessed: 15- Dec- 2021].
- [6] "Face detection using haar cascade classifier", RIP Tutorial, n.d. [Online]. Available: <https://riptutorial.com/opencv/example/23226/face-detection-using-haar-cascade-classifier>. [Accessed: 10- Jan- 2021]