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ENHANCEMENT OF LUNG CANCER NODULES IN CHEST X-RAY USING MORPHOLOGICAL TRANSFORMATION FUNCTION

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ABSTRACT

This paper examines the ability of morphological transformation function (MTF) techniques in enhancing the lung nodules in chest x-ray images. Three images of chest x-ray with lung cancer nodules were selected using convenience sampling and retrieved retrospectively in a softcopy format from the free medical online databases. The MTF techniques were performed using the MATLAB software. The images were labelled as Set A (reference image) and Set B (test Image). The Peak Signal-to-Noise Ratio (PSNR) was computed for image quality assessment. In addition, the images were subjectively assessed using the Visual Grading Analysis (VGA). The results show that mean value of PSNR is higher for Set B (21.81) as compared to Set A (21.76). In addition, from the VGA analysis it is found that Set B allows enhancement of image quality and allows correct identification of lung nodules location. In conclusion, the MTF technique potentially give better image quality and delineation of lung nodules in chest x-ray images.

Keywords: chest x-ray, lung cancer, morphological transformation function, peak signal-to-noise ratio

1. INTRODUCTION

Lung cancer remains to be the leading cause of cancer mortality worldwide. In both developing and developed countries, over the past four decades, survival rates have only improved slightly with most of lung cancer being diagnosed at late stages [1]. Likewise, in Malaysia the 5-year survival rate only stood at 9% (95% CI: 8.4-9.7) while the 5-year relative survival rate is only 11% (95% CI: 10.3-11.9) [2]. In order to improve lung cancer prognosis, the options are either to get early diagnosis, potentially allowing curative intervention or to improve treatment. General x-ray examination remains the first-in-line test performed before proceeding with specialized modalities such as computed tomography (CT scan). General x-ray is used to acquire the chest image due to its fast image acquisition and the least expensive diagnostic modality. In the United Kingdom (UK), the National Institute for Health and Care Excellence (NICE) guidelines recommended urgent chest x-ray for patient with any persistent symptoms that might indicate lung cancer, as an effort to improve survival rate [1]. Chest x-ray may help in depicting lung nodules, hilar mass or pneumonia among others. However, 90% of cases of lung cancer misdiagnosis occurred on misinterpretation of chest radiographs [3]. It may be due to the difficulties of differentiating lesion in the lung from respiratory vessels, structures of the mediastinal, bone, and other complex structures of organs on radiographs of the chest [3]. In addition, it is mentioned that nodules are difficult to be detected by x-ray due to its variability in sizes, significant distinction of image density, low contrast, and the location of the nodules at complicated region such as hilum and ribs [4]. Moreover, the increased amount of work on the interpretation of digit images can be a potential cause of interpretation errors in distinguishing subtle lesion. Therefore, this study aims to enhance visualization of lung nodules in the chest x-ray images using digital image processing namely morphological transformation function (MTF) techniques.

2. METHODS

2.1. Sample

This is a cross-sectional study whereby three images of chest x-ray with lung cancer nodules were selected retrospectively from the free medical online databases. These images were selected using convenience sampling. Computed radiography (CR) images of chest x-ray with confirmed lung cancer nodules, sizes in range of 1cm to 3cm and in a format of Joint Photographic Experts Group (JPEG) and Portable Network Graphic (PNG) were included in this study.

2.2. Data Collection and Analysis

The selected images was labelled as Set A (Reference Images) which are A1, A2 and A3. Next, these images underwent post processing using MTF techniques and labelled as Set B (Test Images). Set B consists of images labelled as B4, B5 and B6. The MTF techniques were performed using MATLAB software. Objective and subjective assessment of image quality was performed on these images.Both sets of images were assessed objectively using Peak-Signal-to-Ratio (PSNR). The PSNR measures the reconstruction quality of images with higher value PSNR generally signifies the reconstructed image is of higher attribute than the reference image. Next, subjective assessment was done using Visual Grading Analysis (VGA) by comparing Set A and Set B images. One certified radiographer with a minimum of 8 years of working experienced evaluated the images subjectively. Furthermore, the assessor need to indicate the existence and location of the lung nodules by placing the letter P.

3. FINDINGS

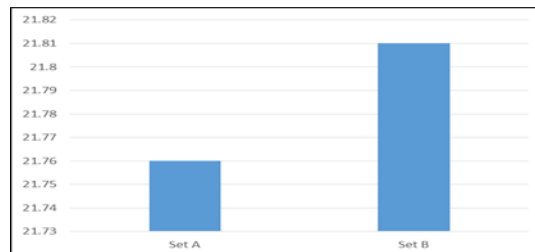### 3.1. Objective Assessment of Image Quality

Figure 1. Mean of PSNR for MTF

Objective assessment on image quality was performed by calculating the PSNR values of chest x-ray images. Figure 1 demonstrates the mean value of PSNR for Set A and Set B (reference and test image respectively) are 21.76 and 21.81 respectively. It shows that the mean value increase after post processing using MTF technique. Higher PSNR values indicates that the images had been enhanced using the MTF. MTF can be used to enhance the image since it is in the feature-built enhancement group [5].

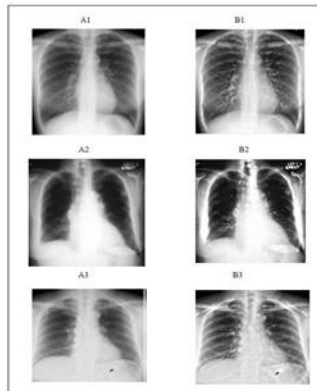### 3.2. Subjective Assessment of Image Quality

Figure 2. Set A (Reference Image) and Set B (Test Image)

Subjective assessment of images in Figure 2 was performed by the radiographer using VGA. Based on the radiographer's assessment, Set B depicts better image quality as compared to Set A. For the localization of lung nodules based on the chest x-ray images, Set A and Set B enable 66.7% and 100% of correct nodules identification respectively. This suggest better nodules depiction using MTF technique which may reduce likelihood of misdiagnosis.

4. CONCLUSION

In conclusion, the study had shown that image processing technique using MATLAB software can improved image quality. The MTF has the potential to be used as post processing technique of chest x-ray images to get better depiction of lung nodules. For future study, it is recommended to use images with DICOM format to avoid compression of images prior to post processing using MATLAB software.

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