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Assistance of pneumoconiosis diagnostics process with x-ray image coloring using Matlab application

Introduction

X-ray imaging is still among most popular diagnostic methods. One reason may be that this method enables the collection of key information regarding patient's health condition. Yet not in all cases it is viable to diagnose the patient with only one examination and then subsequent x-rays should be instituted. This action is of course not without negative effect on the patient, for more x-rays mean more detrimental radiation to human body.

The author of this paper intends to assist the diagnostic process of making decisions during x-ray images analysis. The present publication is an attempt at providing a broader look at methods regarding the detection of calcifications and fibroses using x-ray images colour saturation (these changes are observed among others in pneumoconiosis and asbestosis). In the course of research Matlab application with colormapeditor library has been used.

Data and methods

The research has been conducted on 50 x-ray images in posteroanterior projection. Colormapeditor library has been used – which is one of Matlab application libraries. It enables colouring of shade tones. X-ray images are of monochromatic type, which means they consist of gray layers grouped in levels ranging from 0 to 255 where 0 is black and 255 is white.

One affliction that has been researched is coalworker's lung (pneumoconiosis). This respiratory system disease is caused by long exposure to dusts of both organic and non-organic origin (such as coal, silicon, talc, asbestos) which are inhaled with air. Anthracosis is in turn a variety of pneumoconiosis. It is known as occupational miner's disease. The following image depicts lungs of a black coal miner who suffers from pneumoconiosis (Fig. 1).

Anthracosis is characterized by focal fibrosis of lung tissue. It is caused by inhaling the mining dust. It shares many similarities with silicosis. Caplan's syndrome

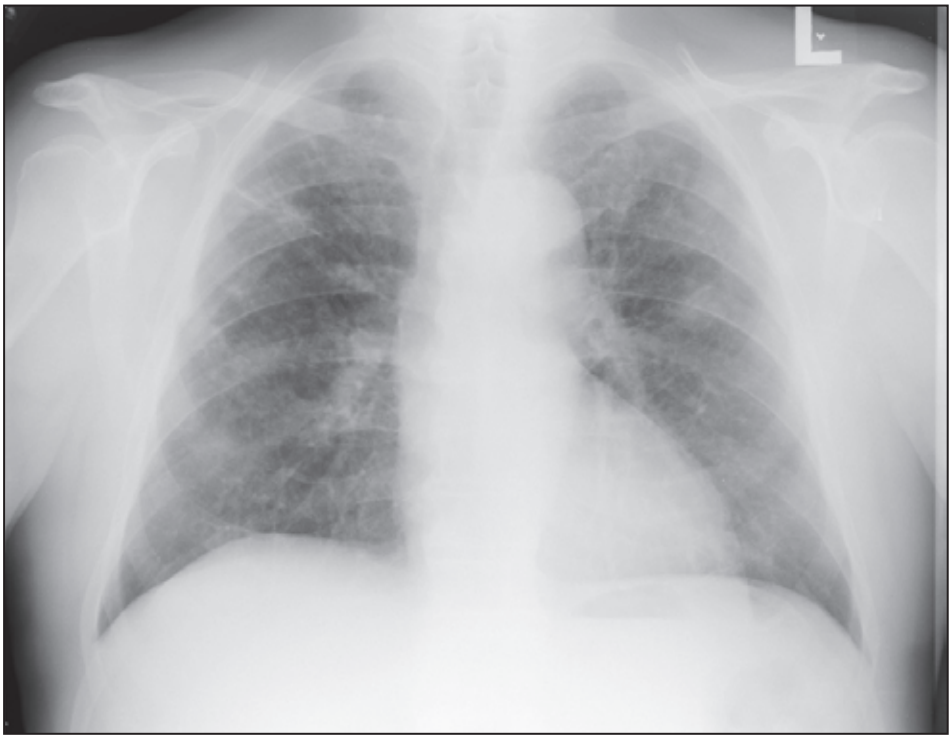

Fig. 1. Anthracosis (black coal mine)

is a particular variety of this disease and it can lead to lung fibrosis and loss of lungs flexibility. Pneumoconiosis diagnosis is based mainly on radiology. At an early stage a general lung picture may not differ at all from normal or may show only slight changes in peribronchial image. Gradually, a specific reticulum appears – a result of lymph vessel occupation.

Using the Matlab application with it's colormapeditor library a monochromatic x-ray image has been transformed into a colorful picture. Tones of gray from the range of 0 to 255 have been changed into particular colors. A coloring effect has been achieved on particular tones of gray.

Results and discussion

A number of 50 x-ray images has been used in the course of this research, all of them in posteroanterior projection. A pneumoconiosis affliction was under examination while the aim of the coloring was to provide data on ailment development. The picture mentioned below has been transformed with Matlab's library colormapeditor (Fig. 2).

Given lung image presents lungs of a person suffering from Coalworker's pneumoconiosis (Fig. 1). By dint of coloring reticular changes in both left and right lung can be observed. Affliction has progressed and reached advanced stage judging by the developed calcifications in upper parts of the lungs.

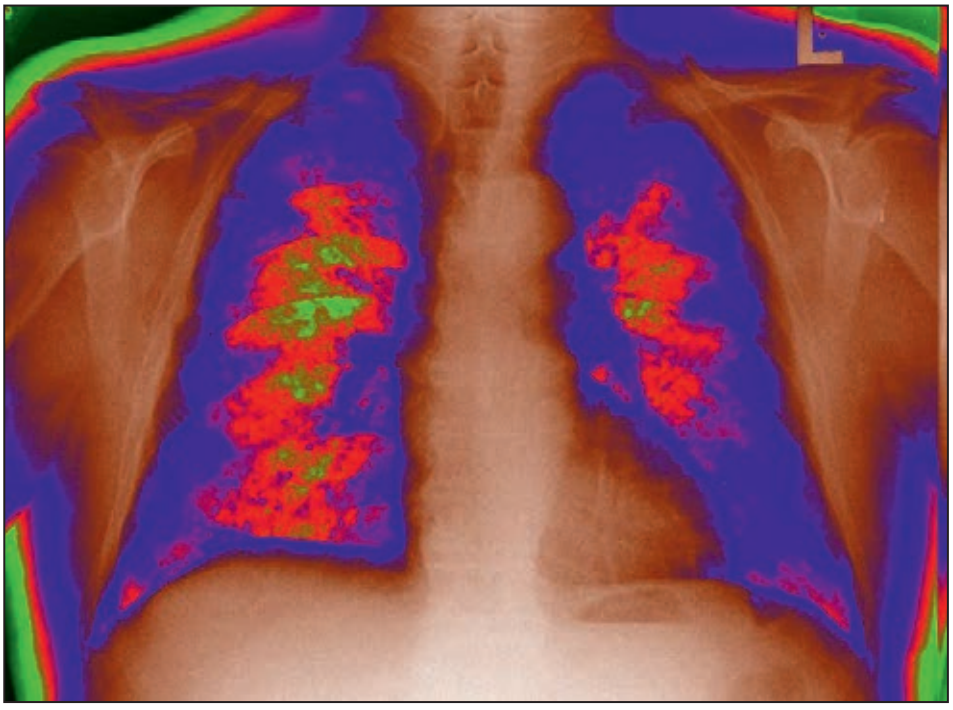

Fig. 2. Coloring of x-ray image

Apart from the calcifications the coloring reveals also tuberculosis nodules in the lung zones. For the sake of a better visibility they have been marked with black colour (Fig. 3).

This result has been achieved on the basis of imparting values to tones of gray from the range between 1 and 256 (where 1 is completely black and 256 comes as completely white). This scale of colors, implemented in colormapeditor library is different from the generally accepted systems (starting with 0). The values of colors have been determined in the following order: 1 – black, 50 – green, 100 – red, 150 – blue, 200 – brown, 256 – white. This arrangement resulted in a greater contrast allowing for simpler recognition of pneumoconiosis changes on the x-ray image.

The method employed in the research enables, to a significant extent, to examine the development of a disease. Changes caused by a disease are quite well visible owing to imparting colors with high contrast to tones of gray. This method may impact the diagnosis process as pneumoconiosis at an early stage is not easily discerned from a normal healthy state on an x-ray image.

In a resultative picture (Fig. 2) green, blue, red as well as white and black were put to use. Values matching different tones of gray were imparted with specific colours. Achieved picture may prove to be more useful for diagnosis due to increased contrast between various parts of the lung.

A vital question needs to be asked – namely if the use of this proposed method should be of highest meaning for the diagnosis? As a matter of fact the answer is negative. A radiologist's opinion on particular case should play the biggest role in the process. This methodology ought to augment the diagnostic process rather than replace it.

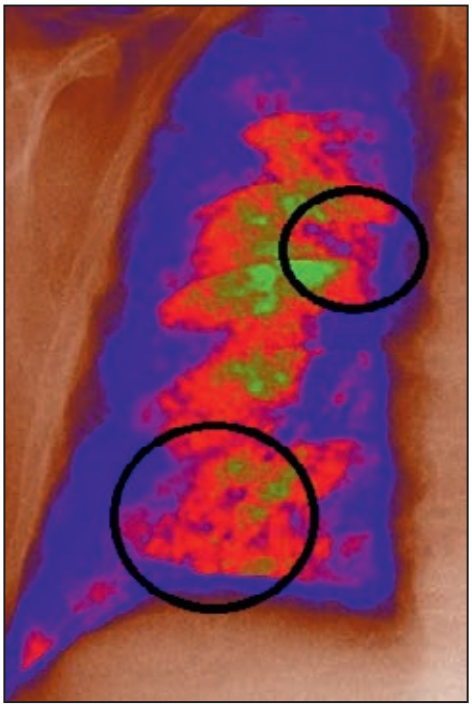

Fig. 3. Right lung with marked tuberculosis nodules

Conclusions

The research undertaken points out the usability of this methodology in the diagnostic process. X-ray image, which is a monochromatic picture, lacks detail ampleness. The same picture after the coloring process becomes in some manner an alternative image which can undergo further analysis by a specialist without the necessity of taking another x-ray image. In effect, the patient is not exposed to another amount of detrimental radiation. Transformed pictures may have an essential impact on the diagnostic process conducted by specialists. Fully automated process of coloring does not cause problems for doctors or radiologists who lack appropriate information regarding IT and image processing.

References

Corne J., Carroll M., Brown I., in., 2000. *Zdjęcia rentgenowskie klatki piersiowej*. Lublin, 70–76.
Dougherty G., 2009. Digital image processing for medical applications, 246–270.
Gonzalez R., Woods R., Eddins S., 2009. *Digital image processing. Using Matlab*, 318–360.
Pruszyński B., 2001. Radiologia diagnostyka obrazowa Rtg, TK,USG,MR i radioizotopy, 146–168.
Wróbel Z., Koprowski R., 2012. Praktyka przetwarzania obrazów z zadaniami w programie Matlab, 35–50.

Abstract

X-ray image is a picture of specific body part produced in tones of gray. Human chest area is a place where highest number of x-ray diagnosed afflictions occur. Adjusting selected ranges of gray tones by means of colour saturation results in obtaining a picture revealing afflictions, which might have been overlooked at early stages of development or their development is already more advanced that had been expected. There are objects easily discerned on a modified x-ray image such as calcifications, fibroses and present lung volume. Analysing images with pneumoconiosis may cause problems as this affliction at an early stage does not look very different than a normal, healthy state. By undergoing the process of colour saturation a monochromatic x-ray image gains more details and increased contrast between specified lung parts.

Key words: Matlab, pneumoconiosis, coloring, fibroses, calcifications

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