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AUTOMATIC FLUOROGRAPHY SEGMENTATION METHOD BASED ON HISTOGRAM OF BRIGHTNESS SUBMISSION IN SLIDING WINDOW

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Abstract:

Improving diagnostic efficiency of pulmonary diseases is now a very urgent task. For the construction of automated systems of recognition and classification of radiographic images is necessary to perform the process of localization of pathological formations on chest fluorography. The correct choice of the method of segmentation for studying radiographic image segments provides quality and improves the accuracy of diagnostic decisions taken.

The article shows a block diagram of a device that implements a method for automatically segmenting chest fluorography. To construct algorithms detect pathological structures applied building of histogram of image brightness in a dedicated window. Determined graphics primitives that approximate brightness histogram of fluorography in optimum size analysis window. Based on the information generated parameter vector. Decision about belonging supplies parameter vector allocated to one of the classes is carried out by a trained multialternative classifier (two alternatives). As the window move on the image, it makes the final formation of a binary image.

Keywords: image segmentation, histogram of brightness, parameter vector.

Introduction

Currently, all the more interesting are medical diagnostic systems that allow a high diagnostic sensitivity for a short period of time to help doctor decide on the diagnosis and / or treatment of disease. These medical systems, in particular, X-ray diagnostic systems, which remain one of the most accessible diagnostic screening methods. However it is known that the X-ray examination of the probability of detection of tuberculosis is about 0.9, at the same time, the possibility to take a healthy person as patient - about 0.91. Therefore, the task of improving the diagnostic efficacy of lung disease currently remains highly relevant.

Modern medical technology place high demands on localization of pathological structures on radiographic images.

To classify the pathological formations on radiographs is necessary to select the field of light, and then break them into segments. The algorithms for automatic selection of light fields are described in [1, 2]. Highlighted lung field is divided into sections set indicating a certain segment of the lung.

The task of allocation morphological structures with pathological formations on the raster halftone images of chest fluorogram is reduced to the problem of separating the original image into pieces (segments), which differ in their semantic content [3,4]. An important aspect is choosing the right method of segmentation, because the quality of the diagnostic decisions depends on the quality of segmentation [5].

Known methods of image segmentation, for example, region-growing method, assumes to use the image pixels with the same or similar levels of brightness, which are neighbors, to build-up homogeneous field [6]. Then elementary regions having a common border, will merge, in accordance with various heuristic rules. The disadvantage of this method is the need for selecting the brightness threshold in an interactive mode, which does not allow to apply the method for the automated segmentation.

During the procedure of growing and merging areas, texture information is often used [7]. However, the use of texture information is limited to that for texture analysis are usually required to have already area larger than a single pixel. This condition is required to compute various attributes based on statistical data. In the case of addition of a single pixel in the field leads to ambiguity of decisions.

Proposed Method

An object of the proposed method is to improve the accuracy of allocation of segment boundaries halftone images of chest fluorography for patients with pneumonia, that is more in line allocated segments to the subjective perception of the doctor. This allows you to make better diagnostic decisions, as well as contributes to the degree of automation of the analysis process and classification chest fluorography [8].

Results and Discussion

This object is achieved by the fact that as a basis for constructing algorithms for the detection of pathological structures caused by pneumonia, it is advisable to apply the brightness histogram in a dedicated window. To evaluate the efficiency and effectiveness of the proposed method of determining the brightness histogram graphics primitives that approximate brightness histogram fluorogram in the analysis window. The size of the selected window is assumed to be 1% of the original image of chest fluorogram size. Based on the information generated parameter vector. Decision about belonging supplies parameter vector allocated to one of the classes is carried out by a trained multialternative classifier (two alternatives) configured to classify the brightness histogram, including morphological formation caused by pneumonia. After the decision on affiliation of the analyzed pixel to one of the classes implemented process binarization pixel chest fluorography corresponding to the window, which was determined by the brightness histogram. As the window move on the image, it makes the final formation of a binary image.

Figure 1 is a block diagram of a device implementing the method developed automatic segmentation chest fluorography.

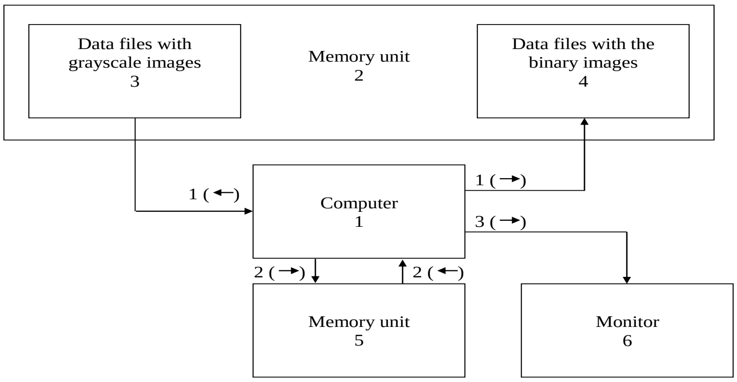


Figure 1. Block diagram of the device that implements a method for automatically segmenting chest fluorography.

The device consists of: 1 PC; monitor 6; and two memory blocks 2 and 5. The memory unit 2 in turn comprises a memory unit 3 for storing files fluorogram halftone images, which is connected to the first input of the computer 1. The memory unit 4, contained in the storage unit 2 is specialized for storing data files with segmented images (binary images). This unit is connected to the first output of the computer 1. The memory unit 5 is defined for storing software segmentation fluorogram halftone images, and is connected to the second input and second output of the computer 1. The monitor 6 has a connection to the third output of the computer 1.

The developed method for automatic segmentation of chest fluorogram is realized according to the diagram shown in Figure 2.

In unit 1 have to enter into the computer the original pixel raster grayscale image of chest fluorogram, which has vertical size $N1$ and $N1$ horizontal. Unit 2 implements a partition of the original image in the cell, such as the size $0{,}01 \cdot N1 \times 0{,}01 \cdot N2$ in which the luminance histogram are determined. Units 3 and 4 are formed by scanning the image vertically and horizontally. Unit 5 realizes the compunting of histogram image fragments falling within a window. Unit 6 forms the parameter vector designed for the classification of the pixel being the center of the window within which the calculated histogram. The parameter vector is determined based on the brightness histogram in window by graphics primitives that may be implemented, for example, based on the Hough transform, spline interpolation, Fourier - descriptors, chain code, rectangle approximation.

The unit 7 implements parameter vector. In this work, a classifier based on neural networks of direct distribution. As a basic principle of training the classifier algorithm implemented in the back-propagation [9]. It should be emphasized that a distinguishing feature of the neural network configuration algorithm is that the first neural network is adjusted on test specimens simulating pneumonia. Then, in the second configuration stage with real samples of fluorogram fragments with pneumonia, if necessary, it implements the correction of weighting coefficients of the neural network. Figure 3 is a chart that allows you to create parameter vector based on the approximation of the histogram of brightness rectangular window of the same width. Unit 1 loads the histogram of the current window. In unit 2 is determined the maximum value of the histogram. Unit 3 calculates a minimum value, wherein the threshold filtering is used at 10% of maximum value. Unit 4 forms a dynamic range of the histogram after filtering threshold. In Unit 5 sets the width of the rectangles approximating the histogram. In Unit 6 determines the brightness of the pixel in the current window. In Unit 7 calculates feature value. Blocks 8-10 implements procedures to prepare for the calculation of the following features.

Images for creating test patterns in the simulation of pneumonia and associated histogram are shown in Figure 4. Initial test images formed in fragments chest fluorography (Figure 4a). To simulate the sub-picture image with pneumonia fragments were subjected pathology without low-pass filtering using a two-dimensional Fourier transform. Figure 4b presents the model image with the disease and its histogram.

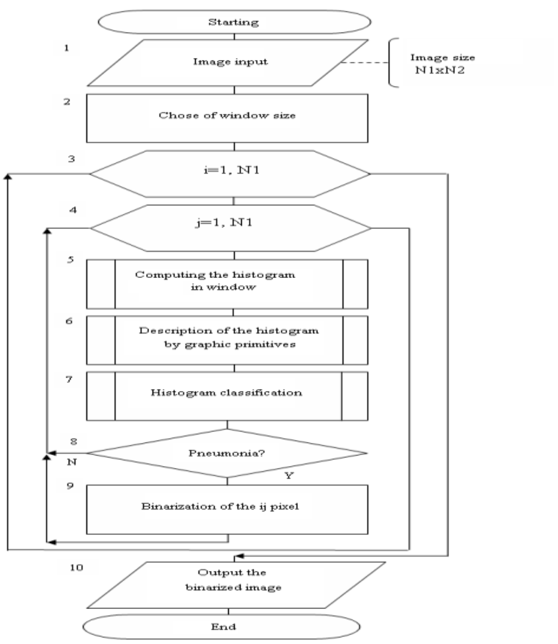


Figure 2. Scheme of the algorithm that implements a method for automatically segmenting chest fluorography.

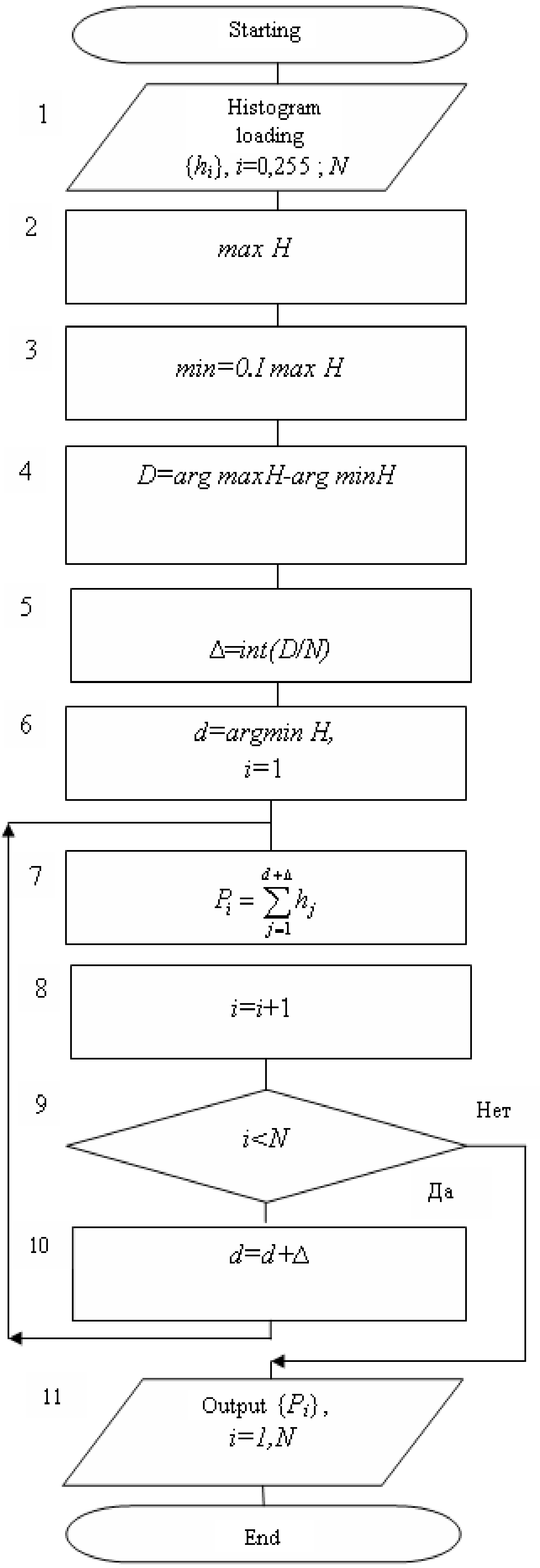
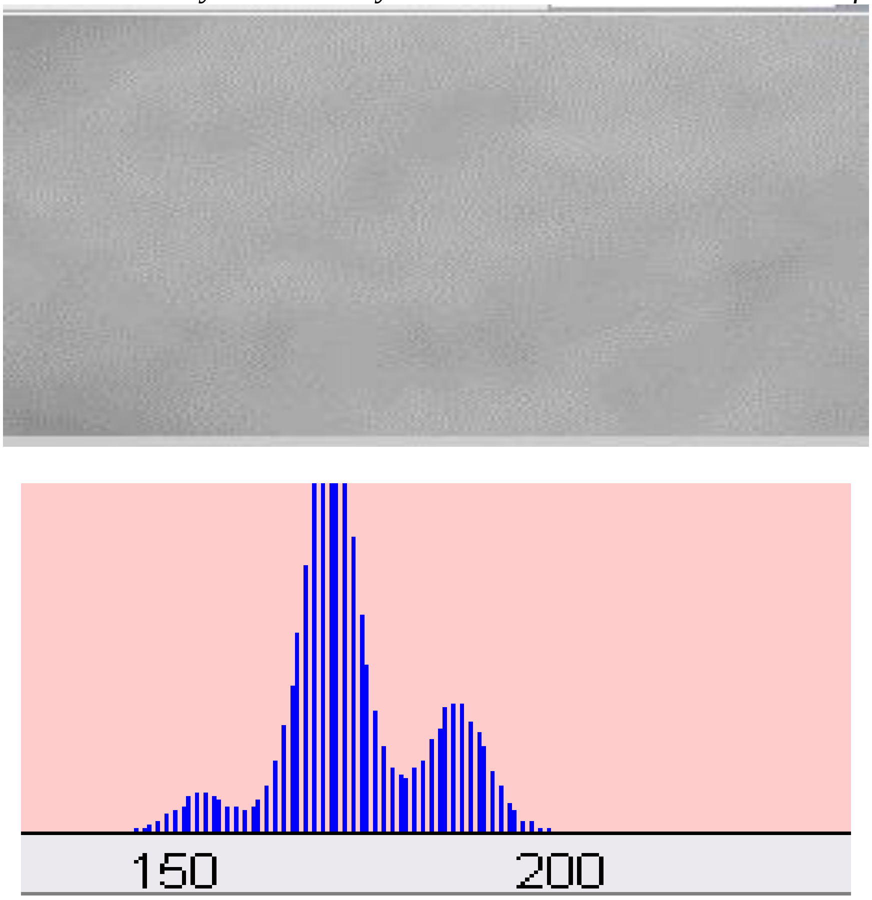
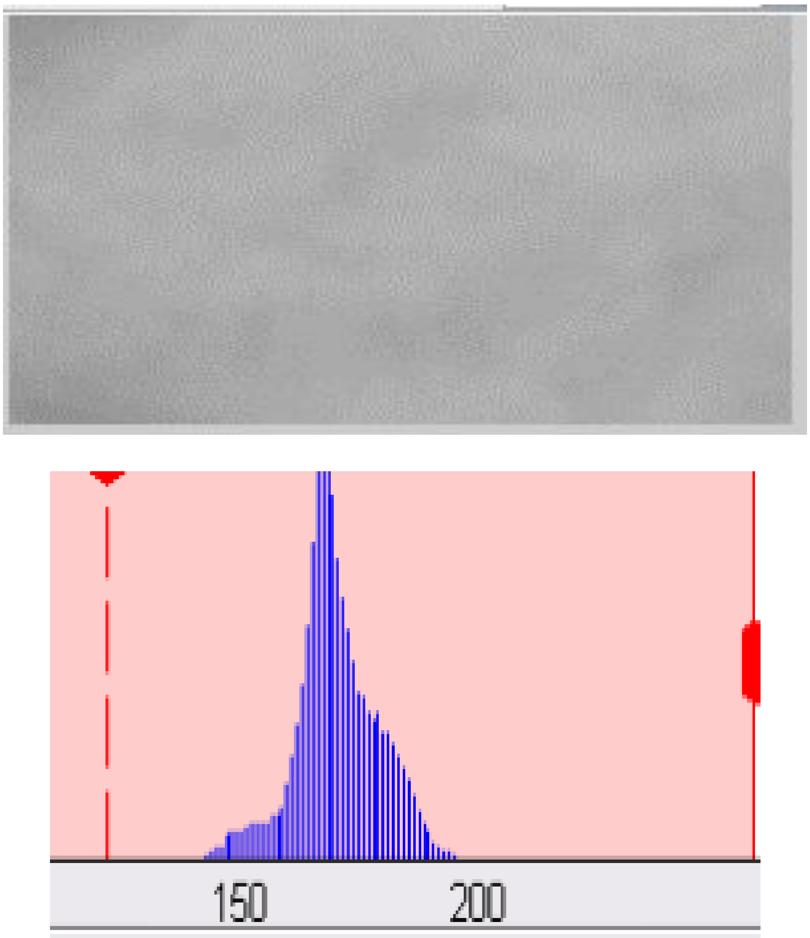


Figure 3. Scheme of the algorithm for generating the parameter vector.



a)

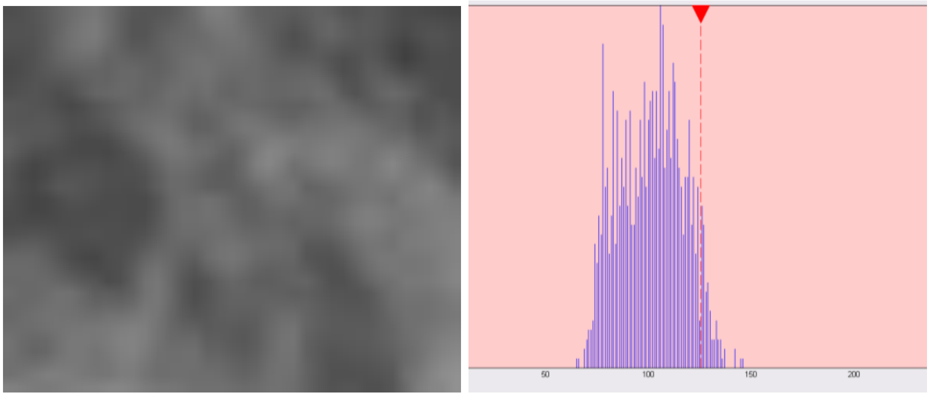


b)

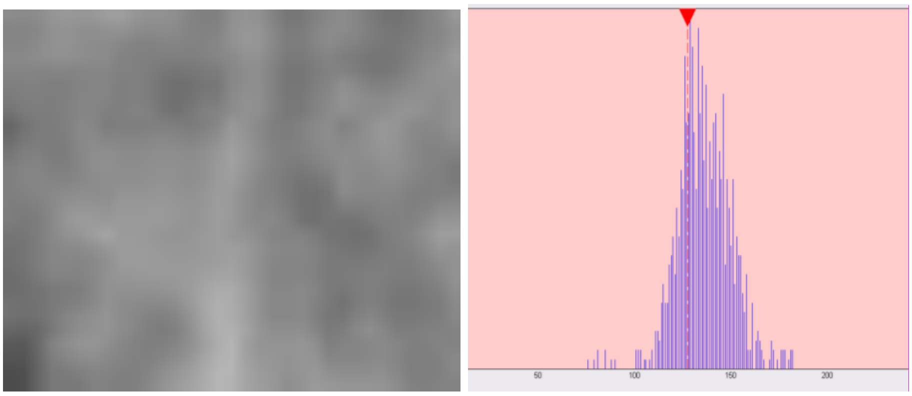
Figure 4. Windows with analysis and brightness histogram of fluorogram: window without pathology - a; Model of window with the pathology resulting from frequency filtering window without pathology - b

Analysis of similar histograms of various fluorography showed that in the absence of pathological changes in the selected window, the histogram has a multimodal form. In the presence of low-pass filtering the luminance modality of histogram disappears, while the histogram becomes a shape close to a triangle.

After adjustment of the classifier on the test patterns (figure 4) carried out a test check of the classifier on real images with pneumonia. Real pieces of pneumonia fluorogram for patient with abnormal formations and without a corresponding histograms are shown in figure 5.



a)



b)

Figure 5. Windows of analysis and brightness histogram of fluorography: Picture window with no pathology - a; picture window in the presence of pneumonia - b

From these fragments of images creates the control sample to test the image classifier. If the error obtained in the control sample (Figure 5) is satisfactory, then the second neural network configuration step is performed. Otherwise, is executed the correction weights of the neural network based on back propagation method by using the control sample as the training [9].

Real pneumonia fluorography before processing and after processing the developed method, shown in Figure 6.

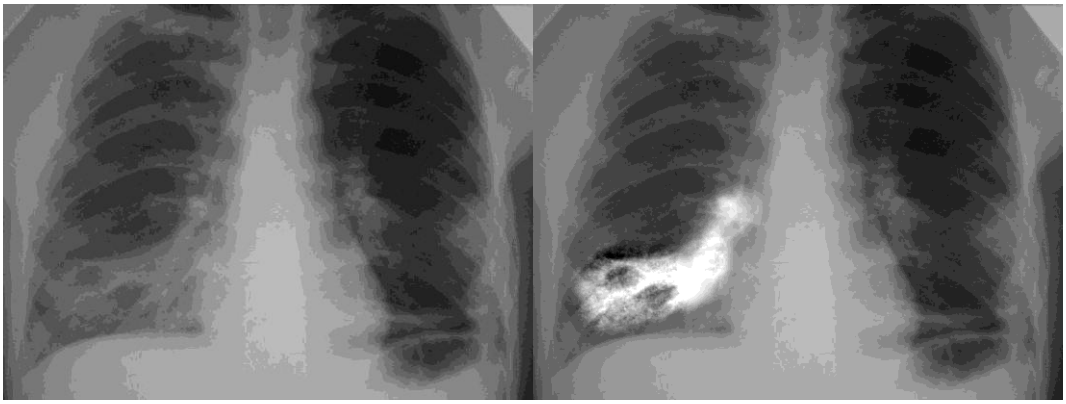


Figure 6. Lungs fluorography with pneumonia in left - ; on the right - after the processing of the proposed method

An analysis of the experimental results when processing images for the diagnosis of lung diseases photofluorogram pneumonia demonstrates the effectiveness of the proposed method.

Conclusions

Was developed a method for automatically segmenting chest fluorography patients with pneumonia, is to construct a histogram of image brightness in the selected window and the subsequent analysis of histograms. The method differs from the prior art in that for allocation of pixels corresponding to the abnormal formation caused by disease "pneumonia", define the brightness histogram graphics primitives in a dedicated window. Moreover, the size of the selected window is 1% of the original image size fluorogram chest. Then, based on the data generated vector of informative signs prescribed dimension. Decision about belonging supplies parameter vector allocated to one of the classes is carried out by a trained multialternative classifier (two alternatives) configured to classify the brightness histogram. As the window move on the image, it makes the final formation of a binary image.

Acknowledgments

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