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# PROSPECTS FOR THE DEVELOPMENT OF MODERN SCIENCE AND PRACTICE

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## SEGMENTATION OF THE BLOOD VASCULAR SYSTEM OF THE EYE BY THE FUNDUS PHOTOGRAPHY

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Developments in signal processing and analysis have undergone tremendous expansion in recent decades. A particularly important area of application is medicine, which requires high-capacity software applications for both diagnosis and determination of optimal treatment methods [1].

A person receives about 80-90% of information through the visual system. Deterioration of vision can lead to a wide range of problems, as every day, social, psychological [1]. All this can even end in suicide. Among the causes of visual impairment are the circumstances associated with defects in the circulatory system of the human eye. Therefore, the development of methods for diagnosing medical information in the field of ophthalmology is an important task [1].

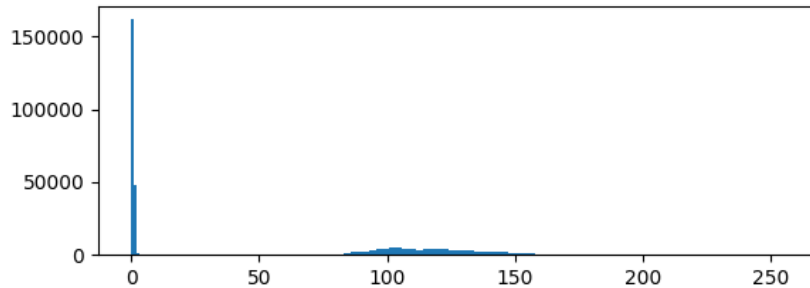
Depending on the nature of the input signal, we can distinguish the processing of both one-dimensional signals and two-dimensional (images). Images are one of the most important data sources for medical purposes [2-3]. This can be explained by the fact that the image can display the spatial features of the internal anatomy of the patient [2-4].

The fundus images are images of the rear of an eye. Fig. 1 demonstrates an example of such a type of image. As can be seen from the figure, the image of the fundus contains clearly defined blood vessels, which is invaluable information in the analysis of morphological parameters. Besides, quantitative indicators that can be obtained using methods of automated analysis can objectify the process of diagnosis.



**Figure 1 – A sample of fundus photography**

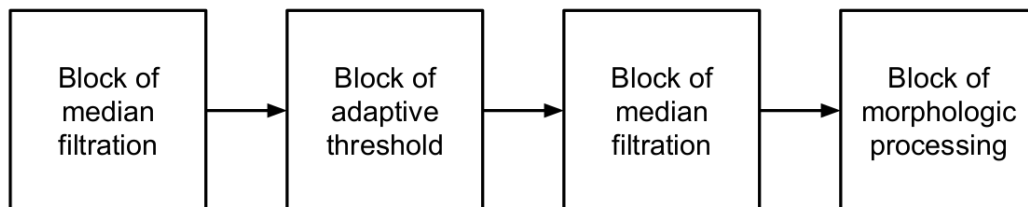
One of the most important steps in image processing is the segmentation process. Segmentation is the process of dividing an image into segments (superpixels). Depending on the application, segmentation can be performed for different ways. The most obvious method is based on the division of pixels depending on their intensity. Fig 2 shows developed histogram of the fundus image.



**Figure 2 – An example of histogram of fundus image**

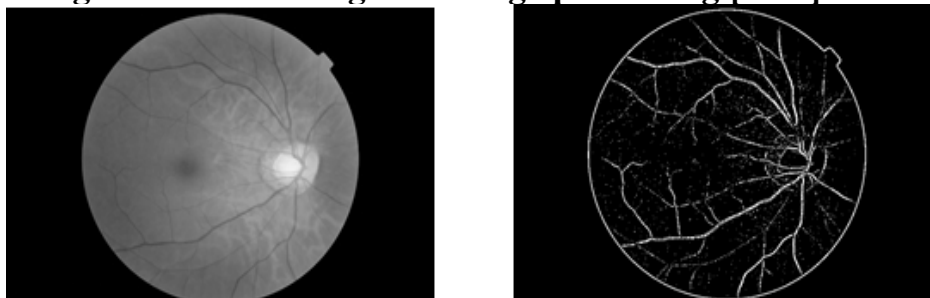
The histogram clearly shows that the image contains 2 groups of pixels. But meanwhile segmentation with a global threshold, for this type of images, does not allow eradicating the pixels of blood vessels. Therefore, the following module of blood vessel segmentation was developed (Fig. 3) [5-8].

It includes two blocks of median image filtering and one to direct segmentation. The second is performed after the segmentation process. For segmentation, adaptive segmentation is chosen, which is done with a threshold that is calculated not globally for the image, but locally for each square section under study. And the final chunk of morphological operations. This block should form more integral segments of super-pixels [5-13].



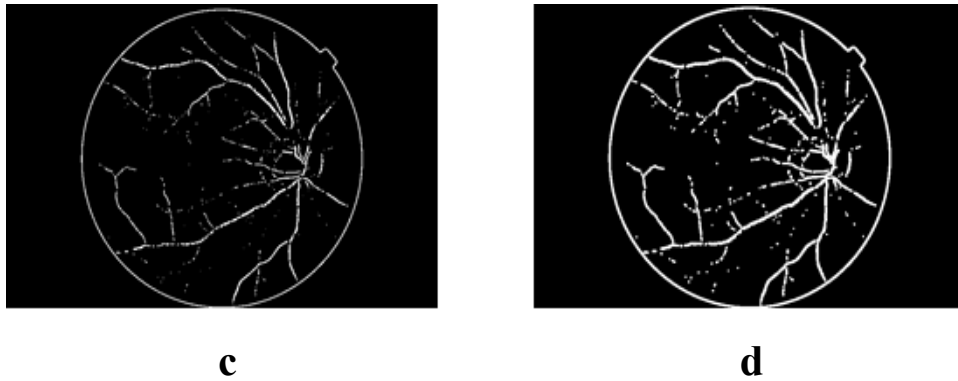
**Figure 3 – A block diagram of the developed software module for segmentation of vessels of the human eye on the fundus image**

**Fig. 4 shows the stages of image processing [2-13].**



**a**

**b**



**Figure 4 – Images at different stages of processing: a - input image after median filtration; b - image after adaptive threshold; c - segmented image after median filtration; d - segmented image after morphological operation**

The possibilities of using image processing and analysis methods for the segmentation of human eye vessels by fundus images were analyzed. The software module for determining the vessels of the human eye has been developed. The further stage of research is the use of a module to assess the structure of the circulatory system of the human eye.

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