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THE DIAGNOSTIC OF RETINAL DISEASES BY DINT OF CONVOLUTIONAL NEURAL NETWORKS

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Abstract. This article analyzes the method of using a convolutional neural network, which provides an increase in the efficiency of recognition and diagnosis of retinal diseases through layer-by-layer processing of the image of the human eye.

Introduction. There is a question of processing and recognition through images in the modern technologies. There are many techniques in the field of diagnosing diseases that can teach a computer to recognize, for example, a retinal disease in a patient. In this case, one of the best ways to diagnose possible violations by dint of neural networks. Convolutional neural networks allow to determine the disease with high accuracy [3].

The goal of the work. Increase the efficiency of diagnosing eye diseases using intelligent retinal image processing based on convolutional neural networks.

The main part of the work. There are so-called "classical neural networks" in the tasks, which related to neural networks. From the analysis of works and experiments it follows that when analyzing images of large dimension, the classical architecture of a neural network has the following drawbacks:

- the dimension of the neural network significantly increases [1];
- time and computational complexity of learning are increased;
- to increase the efficiency of the system it is necessary to use several neural networks, which increases the computational complexity of training.

Therefore, the so-called convolutional neural network (CNN) was chosen for image processing, because the CNN provides partial stability to change a scale, displacements, rotations, angle changes, and other interference and errors [1].

The CNN consists of couple of layers – subsample layers and convolutional layers, each of which consists of feature maps. For example, the first feature map is taught for seeking circles, the second is taught for seeking squares etc [2].

For the recognition of diseases of the retina of the eye it was developed the neural network, which consists of seven layers:

- Input layer sends an object image to the neural network. Layer size 40x40;
- The first layer is convolutional layer. It consists of six feature maps with size 40x40;
- The second layer is subsample. It consists of six feature maps too;
- The third layer is convolutional layer. It consists of 16 planes;
- The fourth layer is subsample. It consists of 16 planes too;
- The fifth layer is a fully connected layer that deals with the classification after data extraction.

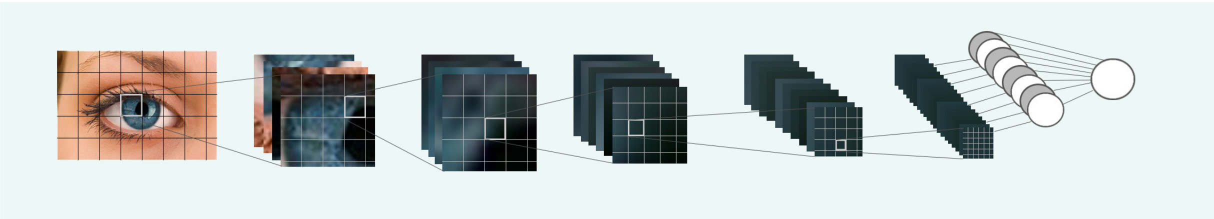

Figure 1 – The architecture of a convolutional neural network for highlighting the eye area.

As in the case of classical neural networks, the input of each element of the network receives a weighted sum - the scalar product between the input signal vector and the weight vector, which is then supplied as an argument to the activating function.

$$f(\alpha) = A\tan h(S\alpha), \qquad (1)$$

where $f(\alpha)$ – the desired value of the element, α – weighted sum of the previous layer signals, A – function amplitude, S – determines the position relative to the origin. This function is odd, with horizontal asymptotes $+A$ и $-A$.

The last sixth layer forms a signal with the help of the so-called "Radially Basic Function (RBF)" for each of the classes of the previous level [2]:

$$f(\alpha) = \sum_j \left(x_j - \omega_{ij}\right)^2, \qquad (2)$$

We use the formula of the neuron of the convolution layer [1]:

$$y_k^{(i,j)} = b_k + \sum_{s=1}^{K}\sum_{t=1}^{K} w_{k,s,t}\, x^{((i-1)+s,(j+t))}, \qquad (3)$$

where $y_k^{(i,j)}$ – neuron of the k-th plane of the convolution layer; b_k – neural displacement of the k-th plane; K – size of the receptive region of the neuron; $w_{k,s,t}$ – matrix of synaptic coefficients; x – outputs of neurons of the previous layer.

For the final correction of synaptic coefficients:

$w_{i,j}(t+1) = w_{i,j}(t) +$ HYPERLINK https://ru.wikipedia.org/wiki/%D0%AD%D1%82%D0%B0\o Эта η δ_p

, (4)

where η – coefficient of proportionality affecting the speed of learning.

Conclusions. To increase the efficiency of diagnosing diseases of the human eye with a hard background, it was suggested to use convolutional neural networks, because they are resistant to many positions of the object against the background of the camera.

A seven-layer convolutional neural network was developed that provides the detection and selection of the area of the eye with a hard background. Optimization of the structure of the developed neural networks was carried out, which made it possible to increase the efficiency of diagnosing eye diseases.

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