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APPLICATION OF ARTIFICIAL INTELLIGENCE FOR CELL CULTURE DETECTION AND ANALYSIS

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In vitro cell culture research is an important method of biological and medical experiments. Cell cultures are used to study cell physiology, model diseases, tissue engineering, and develop new drugs and evaluate their effects [1].

One type of cell culture analysis is morphometric analysis, which is the process of quantifying the shape, size, and structure of cells. Traditional methods of morphometric analysis include manual measurement of a large number of cells, which requires a significant amount of time and effort. This is a laborious process, prone to errors due to the human factor. To speed up and automate the morphometry process, digital processing methods based on segmentation of cell culture images are used, in which an area with interesting characteristics is highlighted in the image. In this case, with cells. Image segmentation methods are divided into: classical and modern. An example of a classic method is the watershed algorithm, which is based on modeling the spread of markers across a gradient image. This method is effective when there are clear boundaries between objects, but it can produce incorrect results in the case of overlapping cells or uneven lighting during image acquisition. Modern methods are based on the use of neural networks. An example is a convolutional neural network based on the selection of features of a segmented image. At the same time, the neural network approach requires a lot of computing power.

Working with a neural network has a sequence:

1. Database preparation. It includes obtaining digital images of the studied cells at various stages of growth and identifying their morphometric properties to develop requirements for a set of characteristics and parameters to be detected and analyzed by software, as well as their sub-

sequent annotation. Data markup is performed manually by experts or using semi-automatic methods.

2. Choosing or creating the neural network architecture. At this stage, it is determined which neural network architecture will be used to solve the task. The choice depends on the complexity of the images and computing power. U-Net, AlexNet or VGGNet can be used for cell detection. U-Net is often used for biomedical image segmentation. AlexNet is simpler and may be suitable for classification tasks rather than segmentation. VGGNet provides deeper feature extraction but requires more computing power [2].

3. Training. It occurs by the method of backpropagation of the error obtained when comparing the results of neural network segmentation and the initial annotation of images. After that, the weights of the features are adjusted to increase the accuracy of cell segmentation.

4. Testing. After training, the neural network is tested on new cell culture images that it has not seen before, which helps to assess the stability of the method. For additional information, the following indicators are used: Accuracy, F1-Score, Recall, mean average precision.

5. Usage and implementation. After obtaining good metrics at the testing stage, the developed application based on the use of neural network algorithms can be implemented in laboratory practice to assist researchers in automating the analysis of cellular cultures and improving the accuracy of diagnostics [3].

The use of neural network algorithms for the detection and analysis of cell cultures makes it possible to speed up data processing and improve the accuracy of research by minimizing errors.

References

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