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Digital image of a blood smear as an object for research

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Abstract:

Analysis is the basis of diagnosis in medical practice. For these purposes, one important source is digital images. Based on this, we look at the digital image of the blood smear. These data allow us to consider the possibility of diagnosing various diseases. Particular attention in the work is paid to certain methods of digital image analysis. The choice of such methods is based on the analysis task. The article presents examples of digital images of a blood smear and the results of their processing.

Key words: Medicine, Diagnostics, Digital image, Red blood cells, White blood cells, Plasma, Blood smear

Introduction

Analysis is one of the stages in the decision-making procedure. Therefore, the key aspect is not only the study of primary data, but also obtaining additional information. This is especially important in critical areas and situations, which include medicine. Timely analysis of medical data is the basis for effective diagnosis and prevention of disease development [1], [2].

To analyze medical data, various primary data can be used, among which digital medical images should be highlighted [3]-[7]. This array of data allows you to make a better analysis and obtain the most reliable results. Among the tools for such analysis, various methods and approaches to digital image processing should be highlighted [8]-

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[14]. The choice and use of such tools depends on the subject of analysis, object of research.

Among the various medical images, we highlight the digital image of a blood smear. Such a study provides both a general clinical picture and the ability to prevent the development of various diseases. This determines the relevance of this work and its practical significance.

Related works

The images of a blood smear, as well as general issues of blood analysis [15]-[17], are one of the key objects of research in the works of many authors.

N. Abbas, D. Mohamad, A. H. Abdullah, T. Saba, M. Al-Rodhaan, and A. Al-Dhelaan solve the problem of segmenting leukocyte nuclei in digital images [18]. This is important for classifying white blood cells in order to identify disorders caused by a particular type of leukemia. This paper proposes a method that improves the accuracy and efficiency of such segmentation. This has been confirmed by a number of experiments.

E. Gering and C. T. Atkinson are exploring the possibility of counting nucleated red blood cells using digital image analysis [19]. This is necessary to identify parasites inside the nuclei of red blood cells. At the same time, the problem of automating this process is solved. The article proposes a method that is based on a sharp increase in contrast for a uniform size of the region of interest. This improves the efficiency of core counting.

The study by authors V. D. Dvanesh, P. S. Lakshmi, K. Reddy and A. S. Vasavi solves the general problem of counting blood cells using digital image processing [20]. It is equally important to determine the number of red blood cells and leukocytes. For these purposes, various digital image processing techniques are used. In particular, an important tool is the circular Hough transforms [20].

F. Sadeghian, Z. Seman, A. R. Ramli, B. H. Abdul Kahar and M. I. Saripan review a general scheme for leukocyte segmentation using digital image processing [21]. The purpose of such segmentation is to isolate the nucleus and cytoplasm. The basis of the general segmentation scheme is made up of different digital image processing algorithms.

H. A. Nugroho, M. S. Wibawa, N. A. Setiawan, E. E. H. Murhandarwati and R. L. B. Buana use digital processing methods to identify Plasmodium falciparum and

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Plasmodium vivax [22]. In particular, the authors propose an approach to determining the types and stages of development of these research objects. Adaptive k-means clustering, k-nearest neighbor and support vector machine are used for these purposes.

The study [23] discusses the automatic detection and classification of malaria parasite species in a blood smear. The proposed approach is based on a series of digital image processing algorithms that come from light microscopes used in endemic regions. This allows parasite species to be classified as Pf or Pv based on chromatin size distribution [23].

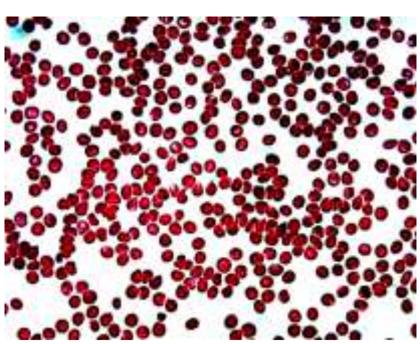
N. Ritter and J. Cooper are exploring the possibility of solving the problem of segmentation and identification of cell boundaries [24]. This is important for accurately determining the components of a blood smear and their subsequent classification. First, the authors review a blood cell segmentation algorithm for images obtained from peripheral blood smear slides. This approach allows you to automate the counting of blood cells and identify points within each object.

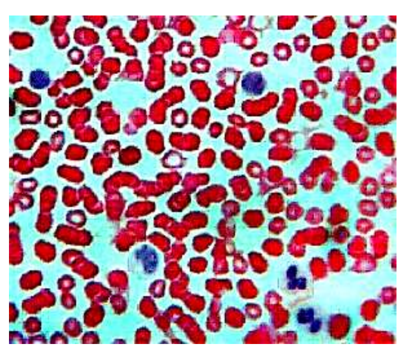
F. I. Sholeh studies algorithms for segmenting leukocytes from blood smear images [25]. The possibility of using such algorithms in real time is being considered.

Therefore, the importance of digital blood smear image analysis should be noted. In this case, it is possible to use various methods of image analysis, which is largely determined by the type of the original image.

Image of a blood smear as an object of study

First of all, we note that a blood smear is a complex object that includes blood plasma, leukocytes, red blood cells and platelets. Depending on the problem that needs to be solved, we can provide various digital images of the blood smear. Figure 1 shows examples of blood smear images.





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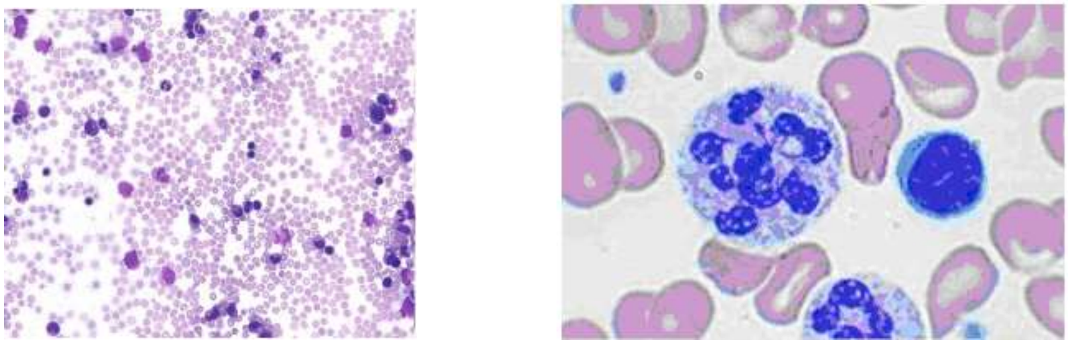
a) b)



c) d)

Figure 1: Some examples of digital blood smear images

We see blood smears of different colors, different in intensity of individual elements of the smear and their texture. The simplest is the smear in Figure 1a. The most complex images are those presented in Figure 1c and Figure 1d. In Figure 1c we see the different components of a blood smear, and in Figure 1d we see complex images of blood cells.

Some examples of blood smear image analysis

As noted earlier, different blood smear images require different digital processing techniques. This also correlates with the task that is posed to researchers.

Consider the data in Figure 1a. We see that the same type of blood smear cells are represented here. These cells clearly stand out against the general background and have approximately the same geometric dimensions. Let us apply the threshold limiting method according to the Otsu method to this image. The result is presented in Figure 2.

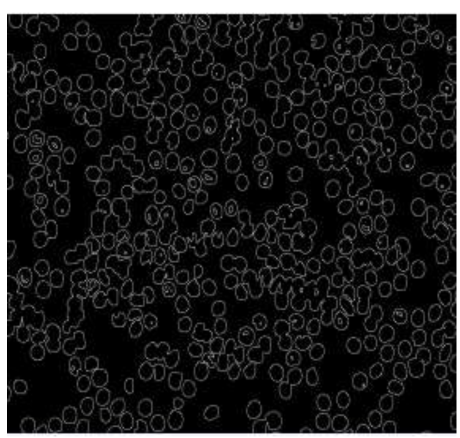


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Figure 2: Result of cell outline extraction for blood smear in Figure 1a

The processed image shows the outlines of individual cells in the blood smear. The program allows you to calculate their total number in the amount of 394 cells.

By changing the initial threshold values, we can achieve more accurate identification of cell boundaries in a blood smear. We can also apply preprocessing techniques to the digital raw blood smear image [6]. This will also improve the quality and efficiency of identifying cell boundaries and will be the basis for their further analysis.

Similar manipulations can be done with the data in Figure 1b. This drawing is similar to the previous drawing. Thus, in the simplest case, a combination of preliminary image processing methods with edge extraction methods can be used. This allows you to construct a simple procedure for counting cells in a blood smear.

More difficult to analyze are the blood smear images in Figure 1c and Figure 1d.

First, let's look at the processing procedure for Figure 1c. We will use color segmentation based on the k-means method [26]. To do this, first of all, consider the brightness histogram of Figure 1c (see Figure 3).

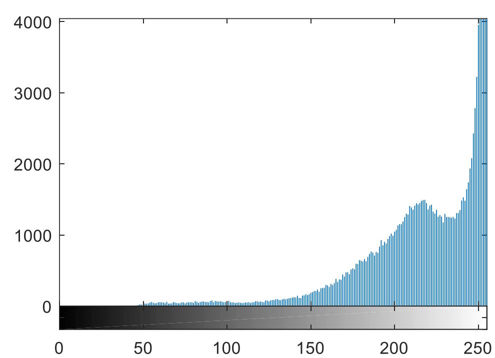

Figure 3: Histogram of brightness values for the data in Figure 1c

We see three levels of change in values on the histogram. Therefore, we will consider three possible clusters for the data in Figure 1c (see Figure 4).

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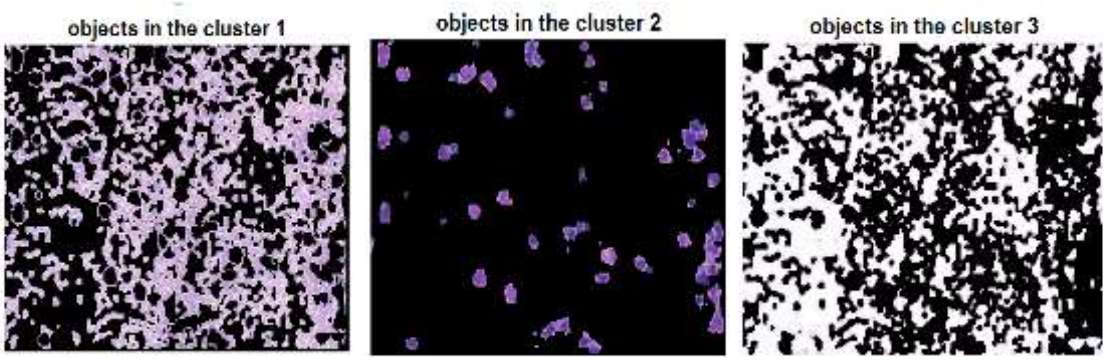

a) b) c)

Figure 4: Clustering for the data in Figure 1c

The first cluster displays many potential areas of interest where red blood cells are concentrated in the blood mask. These data require further processing to count such cells.

The second cluster displays leukocyte cells. This result is the clearest. Here you can see individual cells and count them.

The third cluster represents the areas of interest occupied by the plasma. This result is also satisfactory.

Now consider the data in Figure 1d. The main task of such an analysis is to highlight all the possible contours that we can see. For these purposes, we use the wavelet methodology [27]. The results of the corresponding processing are presented in Figure 5.

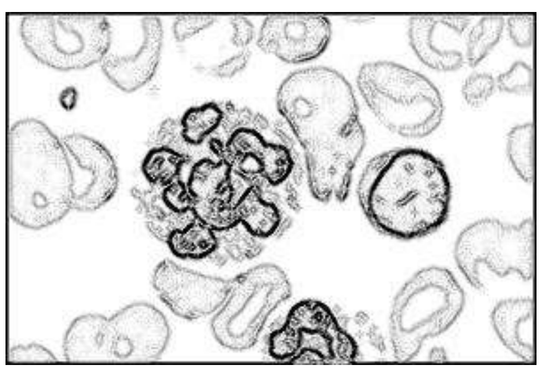

Figure 5: Contour extraction for blood smear image

We see a clear identification of individual contours, which allows for further analysis. In particular, this concerns the classification of leukocytes.

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Conclusion

Thus, the article discusses the main aspects of the analysis of a digital image of a blood smear as an object of study. Based on the analysis of literary sources, the importance of such a procedure for studying data is noted. Particular attention is paid to the choice of research methods based on the original blood smear image and the problems that need to be solved. The complexity of each stage of digital image analysis of a blood smear is noted. The results of various types of digital image processing of blood smears are presented.

References:

1. De Bruijne, M. (2016). Machine learning approaches in medical image analysis: From detection to diagnosis. Medical image analysis, 33, 94-97.
2. Younis, Y. S., & et al.. (2022). Early diagnosis of breast cancer using image processing techniques. Journal of Nanomaterials, 2022, 1-6.
3. Saw, S. N., & Ng, K. H. (2022). Current challenges of implementing artificial intelligence in medical imaging. Physica Medica, 100, 12-17.
4. Chen, H., & et al.. (2022). Explainable medical imaging AI needs human-centered design: guidelines and evidence from a systematic review. NPJ digital medicine, 5(1), 156.
5. Boboyorov Sardor Uchqun o‘g‘li, Lyubchenko Valentin, & Lyashenko Vyacheslav. (2023). Image Processing Techniques as a Tool for the Analysis of Liver Diseases. Journal of Universal Science Research, 1(8), 223–233.
6. Boboyorov Sardor Uchqun o‘g‘li, Lyubchenko Valentin, & Lyashenko Vyacheslav. (2023). Pre-processing of digital images to improve the efficiency of liver fat analysis. Multidisciplinary Journal of Science and Technology, 3(1), 107–114.
7. Gichoya, J. W., & et al.. (2022). AI recognition of patient race in medical imaging: a modelling study. The Lancet Digital Health, 4(6), e406-e414.
8. Lyashenko, V., & et al.. (2016). The Methodology of Image Processing in the Study of the Properties of Fiber as a Reinforcing Agent in Polymer Compositions. International Journal of Advanced Research in Computer Science, 7(1), 15-18.
9. Lyubchenko, V., & et al.. (2016). Digital image processing techniques for detection and diagnosis of fish diseases. International Journal of Advanced Research in Computer Science and Software Engineering, 6(7), 79-83.

ISSN (E): 2181-4570 ResearchBib Impact Factor: 6,4 / 2023 SJIF(2023)-3,778 Volume-1, issue-10

10. Al-Sharo, Y. M., & et al.. (2021). Neural Networks As A Tool For Pattern Recognition of Fasteners. International Journal of Engineering Trends and Technology, 69(10), 151-160.

11. Lyashenko, V., Matarneh, R., & Kobylin, O. (2016). Contrast modification as a tool to study the structure of blood components. Journal of Environmental Science, Computer Science and Engineering & Technology, 5(3), 150-160.

12. Tahseen A. J. A., & et al.. (2023). Binarization Methods in Multimedia Systems when Recognizing License Plates of Cars. International Journal of Academic Engineering Research (IJAER), 7(2), 1-9.

13. Orobinskyi, P., & et al.. (2020). Comparative Characteristics of Filtration Methods in the Processing of Medical Images. American Journal of Engineering Research, 9(4), 20-25.

14. Attar, H., & et al.. (2022). Control System Development and Implementation of a CNC Laser Engraver for Environmental Use with Remote Imaging. Computational Intelligence and Neuroscience, 2022.

15. Babker, A. M., & Di Elnaim, E. O. (2020). Hematological changes during all trimesters in normal pregnancy. Journal of Drug Delivery and Therapeutics, 10(2), 1-4.

16. Babker, A. M. (2020). The role of Inherited Blood Coagulation Disorders in Recurrent Miscarriage Syndrome. Journal of Critical Reviews, 7(1), 16-20.

17. Eldour, A. A. A., & et al.. (2015). Red cell alloimmunization in blood transfusion dependent Patients with Sickle Cell Disease in El-Obied city, Sudan. IOSR Journal of Dental and Medical Sciences (IOSR-JDMS), 14(12), 137-141.

18. Abbas, N., & et al.. (2015). Nuclei segmentation of leukocytes in blood smear digital images. Pakistan journal of pharmaceutical sciences, 28(5), 1801-1806.

19. Gering, E., & Atkinson, C. T. (2004). A rapid method for counting nucleated erythrocytes on stained blood smears by digital image analysis. Journal of Parasitology, 90(4), 879-881.

20. Dvanesh, V. D., & et al.. (2018, March). Blood cell count using digital image processing. In 2018 International Conference on Current Trends towards Converging Technologies (ICCTCT) (pp. 1-7). IEEE.

ISSN (E): 2181-4570 ResearchBib Impact Factor: 6,4 / 2023 SJIF(2023)-3,778 Volume-1, issue-10

21. Sadeghian, F., & et al.. (2009). A framework for white blood cell segmentation in microscopic blood images using digital image processing. Biological procedures online, 11, 196-206.

22. Nugroho, H. A., & et al.. (2019). Identification of Plasmodium falciparum and Plasmodium vivax on digital image of thin blood films. Indonesian Journal of Electrical Engineering and Computer Science, 13(3), 933-944.

23. Kaewkamnerd, S., & et al.. (2012, December). An automatic device for detection and classification of malaria parasite species in thick blood film. In Bmc Bioinformatics (Vol. 13, No. 17, pp. 1-10). BioMed Central.

24. Ritter, N., & Cooper, J. (2007). Segmentation and border identification of cells in images of peripheral blood smear slides. In 30th Australasian Computer Science Conference, ACSC 2007.

25. Sholeh, F. I. (2013, September). White blood cell segmentation for fresh blood smear images. In 2013 International Conference on Advanced Computer Science and Information Systems (ICACSIS) (pp. 425-429). IEEE.

26. Boboyorov Sardor Uchqun o'g'li, Sinelnikova Tetiana, Zeleniy Oleksandr, & Lyashenko Vyacheslav. (2023). Color-aware digital image segmentation procedure as a tool for studying fatty liver disease. Journal of Universal Science Research, 1(9), 431–441.

27. Lyashenko, V., & et al.. (2021). Wavelet ideology as a universal tool for data processing and analysis: some application examples. International Journal of Academic Information Systems Research (IJAISR), 5(9), 25-30