Conference Paper

Method of Myelogram Analysis in Leukocyte Recognition Systems

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Annotation

An approach for the formation of a myelogram was proposed. It is based on digital image processing and pattern recognition. It is used in automated analysis of blood smears and bone marrow. The proposed approach is implemented in an automated recognition system of blood cells. The effectiveness of the proposed approach was evaluated.

Keywords: Computer microscopy, image processing, segmentation, blood cells recognition, acute leukemia

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1. Introduction

Acute leukemia diagnosis is based on the study of morphological features of leukemic cells in the peripheral blood and aspirates of the bone marrow[1-2].

Confirmation of the diagnosis of acute leukemia is based on the data of puncture aspiration bone marrow biopsy. This research is required in the study of blood diseases. In most cases you can establish the correct diagnosis with results of this research.

The study is carried out by using a light microscope. The preparations of peripheral blood and bone marrow are fixed and stained by the method of May-Grunwald-Romanovsky. The percentage of the different types of white blood cells among 100 white blood cells are counted in study of peripheral blood cells. The myelogram is calculated in the analysis of bone marrow - the percentage of various types of nucleated cells in the bone marrow (usually examines 200-500 cells). There are 8 lines of hematopoiesis in the bone marrow [3].

Traditional microscopic studies with leukocyte count is difficult, tedious, time-consuming, and it requires mental and physical stress.

Blood smears and bone marrow aspirates microscopic analysis errors are depended on the experience and qualifications of a physician of clinical laboratory diagnostics. These errors are reached 30 -40% [4-5].

Application of methods of clarifying the morphological characteristic of lymphoid elements is of considerable interest up to the present time.

Computer microscopy with using a multispectral camera is better able to study the structure of nuclear chromatin threads and allows to objectify the data obtained in the form of a numeric index in comparison with visual microscopy[1-2].

At the present stage of development the digital image processing systems have lack of required level of diagnostic efficiency and reliability of automatic analysis of blood smears, they have not classification stability [6].

The work is dedicated to the creation of a program complex of the automated classification of leukocytes of the bone marrow.

2. Materials and methods

As objects of the measurements were made by image of leukocytes is obtained with preparations of the bone marrow fixed and stained by the method of May-Grunwald-Romanovsky. The diagnosis of acute lukemia was determined on the basis of morphological, cytochemical and immunophenotypic studies.

Three myelogram were selected as referencing verification method.

A information processing method in the automatic recognition included the following stages: image acquisition (automated Olympus BX43 microscope with camera Imperx IPX-4M1ST-GCFB, BMP format to save the images, color-coded RGB24 more than 16 million colors) (Figure 1), segmentation of white blood cells (method histogram-based approach methods watershed transformation and distance and the filtration distance), description (as features used morphological characteristics), classification (classifier based on k-means algorithm, as one of the easiest, and at the same time is powerful enough methods)[7-8].

3. Results and discussion

The developed program complex allows to segment blood cells from preparations of bone marrow, to count the characteristics of the leukocyte, to count myelogram in the preparation of bone marrow.

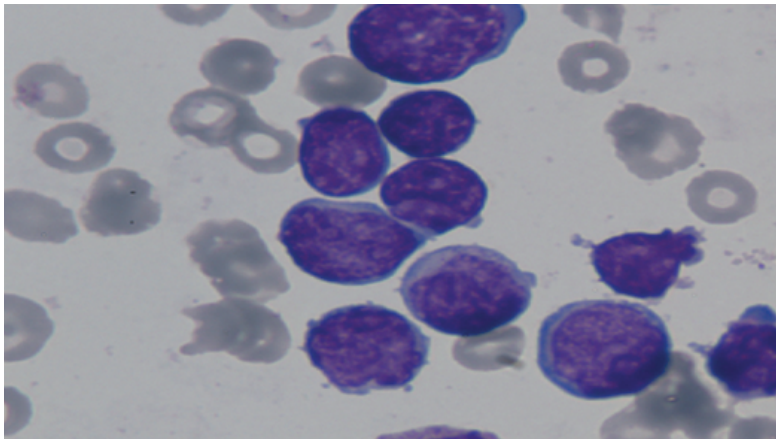

Figure 1: Example of white blood cells image in the system.

The implementation is executed in the environment 3.2.82 QTCreator in C++ using Qt 5.4, the Database SQLite was used to store the results of measurements.

The program allows to save the calculated characteristics for the selected cells in the file format ".csv", to classify sample cells, view the recognized cells [9-12].

The program interface for detected cells is shown in Figure 2.

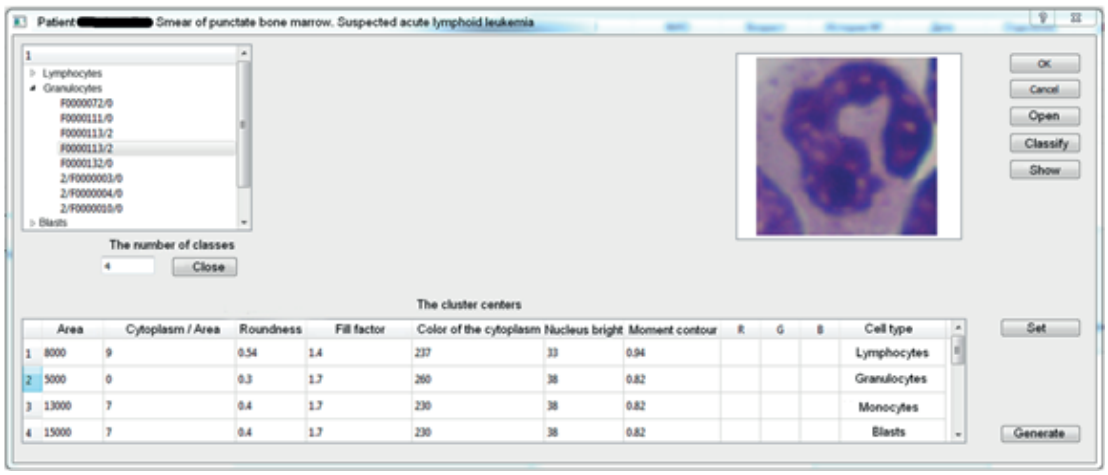

Figure 2: The interface for classification and viewing of recognized cells.

The proposed solution allows to display the selected cell and all other cells on the same image from the original image Figure 3.

In the case of incorrect classification, the user can change the type of recognized cells.

Example of a comparison myelogram deemed by expert and software is presented in Figure 4.

The centers and the radii of the clusters were chosen empirically in the classification procedure. 4 classes were selected: lymphocytes, granulocytes, monocytes, blasts.

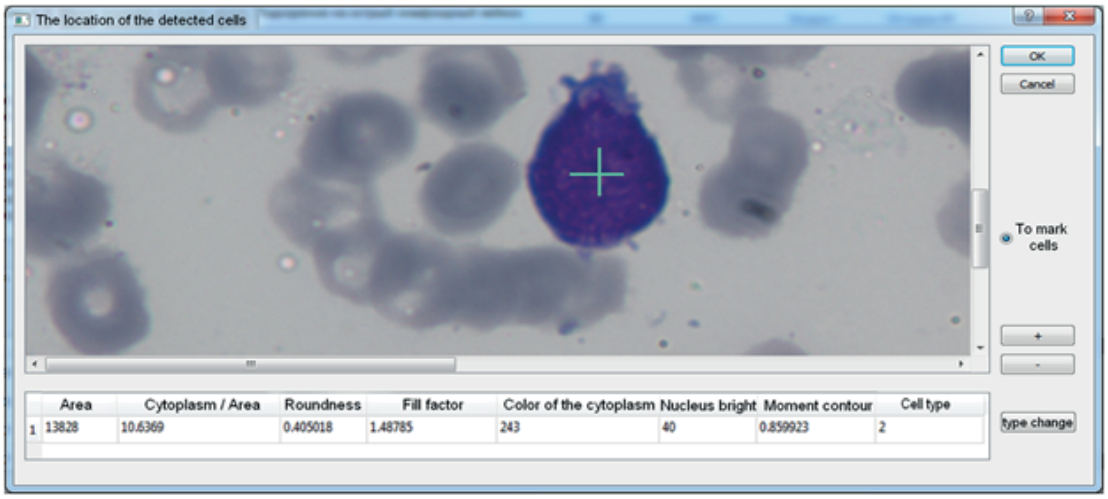

Figure 3: The interface for viewing cell parameters.

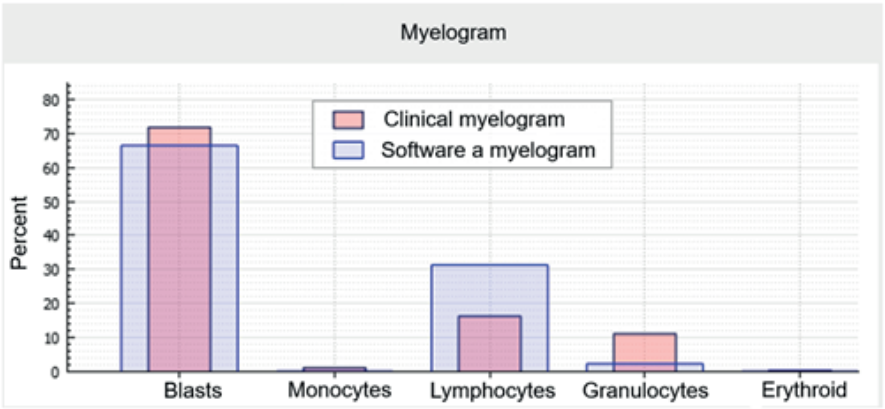

Figure 4: Example of a comparison myelogram built by expert and software.

The following myelogram figures were obtained after results processing: 66.5 – blasts, 0 – Monocytes, 31.3 – lymphocytes, 2.2 – granulocytes (patient A); 64.0 – blasts, 0 – Monocytes, 11.3 – lymphocytes, 24.6 – granulocytes (patient B).

The proposed approach to constructing the myelogram coincides with the calculated expert by 87%.

4. Conclusions

The proposed method of classification and recognition of samples of blood cells allows for quantitative analysis and to count the blood cells.

Planned step for further research is improving of the leukocytes recognition accuracy on images of bone marrow samples.

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