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Research Neural Network to Recognize Blood Cells

Nikitaev V.G., Nagornov O.V., Pronichev A.N., Ovcharova V.S., Polyakov E.V., Zaytsev S.M., and Dmitrieva V.V.

National Research Nuclear University MEPhI (Moscow Engineering Physics Institute), Kashirskoe shosse 31, 115409, Moscow, Russia

Annotation

The work investigates a neural network classifier for the differential diagnosis of acute lymphoblastic leukaemia and lymphomas. Specialized software was developed for research. The accuracy characteristics of the recognition of red blood cells were obtained in studies, it allows to judge about the possibility of using neural networks for classification of blood cells.

Keywords: neural network, digital image processing, blood cells detection, acute lymphoblastic leukemia.

Corresponding Author:
V. Nikitaev
VGNikitayev@mephi.ru

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1. Introduction

Diagnosis of acute lymphoblastic leukemia and their variants based on morphological, cytochemical and immunophenotypic characterization of leukemic cells in the pool. Using light microscopy plays an important role in accurate estimate of the number of parameters of blasts: the shape and size of cells, shape of nuclei, features of the structure of chromatin.

A comparative study of blasts in different variants of acute lymphoblastic leukemia with the help of modern high technologies will allow to expand our knowledge of the biology of leukemic cells and to identify possible patterns in differences in the nuclear structure of blasts in different types of acute lymphoblastic leukemia [1-2].

One approach is the use of neural networks for the classification of blood cells.

With the use of neural networks in the diagnosis of acute leukemia dataset from the database of images of blood cells (Acute Lymphoblastic Leukemia Image Database for Image Processing - ALL-IDB) achieved an error in 97,22% for 108 test images. Obtained good data for a small number of images illustrate the need for further research on the definition of variant cancer with increasing sample size[3].

At present, researches on new algorithms for training neural networks are carried out to improve existing algorithms and to solve the remaining unsolved problems in the field of neural networks.

The aim of this work is research of possibilities of neural network classifier for the differential diagnosis of acute lymphoblastic leukemia.

2. Materials and methods

Studies were carried out on stained smears of peripheral blood and bone marrow. Morphocytochemical and immunophenotypic studies were conducted in the laboratory of immunology of hematopoiesis of N.N. Blokhin Russian Cancer Research Center.

Images were obtained by the system of computer microscopy (automated Olympus BX43 microscope with camera Imperx IPX-4M1ST-GCFB). Images were saved in BMP format, color-coded RGB24 (~16 million colors).

7943 images of leukocytes were received. Among them - 1029 from donors, 2415 from patients with T- acute lymphoblastic leukemia, 3004 cells with B-acute lymphoblastic leukemia, 1495 patients with follicular lymphoma.

Spatial and chromatic regularity in the chromatin structure of the nuclei of blood cells were studied according to the obtained images with the calculation of textural features (matrix of spatial adjacency, run-length matrix, wavelet characteristics) to component color models XYZ, HSL, Lab, Luv, LCH, HLS, HSV, YUV, YIQ, YCbCr, CMY. As a result, the statistical characteristics of images of cells in a matrix were formed and saved in data files of type "*.csv"[4-9].

3. Results and discussion

System of classification of blood cells was designed as result of work. It based on neural classifier written in C++ in the QtCreator environment 4.2.2, with the Compiler MinGW (32bit).

The program interface is shown in Figure 1.

The program with using of the library in "Fast Artificial Neural Network Library (FANN)" was developed to conduct the study a neural network classifier [10].

As the activation function was chosen sigmoidal function.

This neural network contains two hidden layers, each of which has 2000 hidden neurons.

Output neurons are in the output layer of the neural network. They have each responsible for a certain state. Thus, in the output layer has 4 output neurons for each of the States ("Normal", "follicular lymphoma", "T- Acute Lymphoblastic Leukemia ", "B- Acute Lymphoblastic Leukemia").

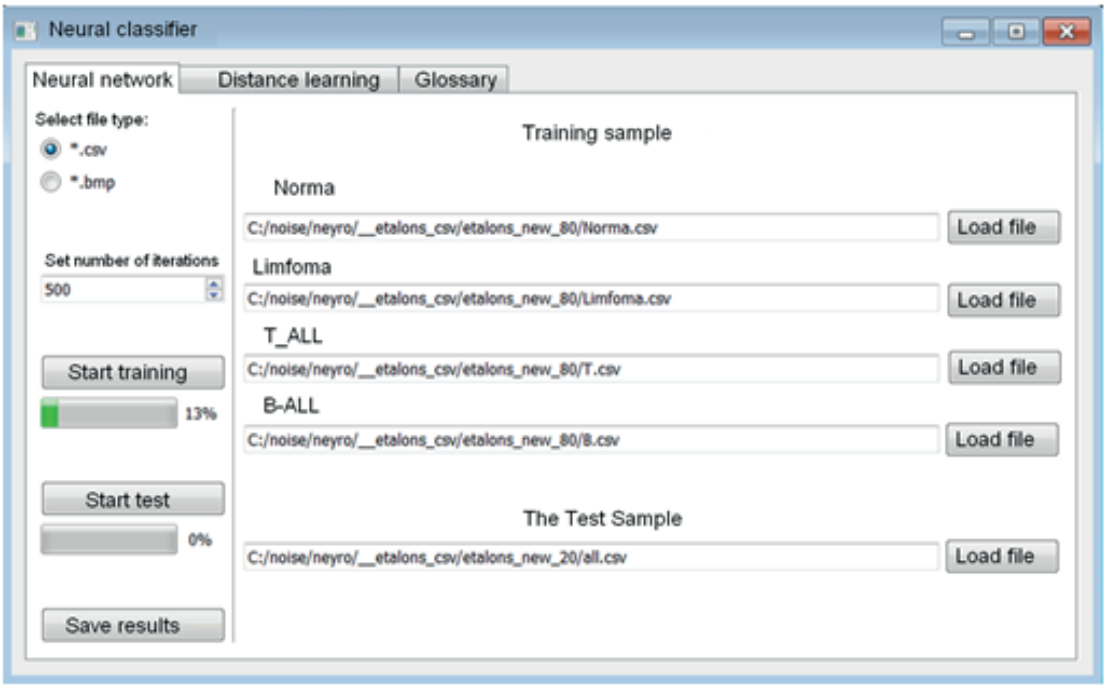

Figure 1: The process of images obtaining.

A file format of "csv" has used to test the system. Appropriate file was applied to each type of cells.

The original data file was divided into two parts: the training sample, with approximately 20% of the original data and the test sample, with approximately 80% of the original data.

Table 1 provides information on the number of images in the file format "csv" for each type of cells for the input data, training samples and test samples for testing the developed neural network classifier that takes a file format "*.csv".

At each stage of testing as test samples were submitted by the following sample:

- sample No. 1 containing only "Normal" cells,
- sample No. 2 containing only the "Lymphoma" cells
- sample No. 3, containing only "T- Acute Lymphoblastic Leukemia" cells
- sample No. 4 containing only the "B- Acute Lymphoblastic Leukemia" cells
- sample No. 5, containing all types of cells.

Table 1: information about the data for testing neural network classifier.

Cells type	the number of cells	training sample	test sample
Norma	1029	823	206
Limphoma	1495	1196	299
T- Acute Lymphoblastic Leukemia	2415	1932	483
B- Acute Lymphoblastic Leukemia	3004	2403	601
The total number	7943	6354	1589

Precision of neural network classifier at 250 training iterations for lymphoid cells was approximately ~ 77%,

4. Conclusions

In this paper, we propose a software solution for the classification of blood cells based on neural classifier. The obtained preliminary results allow to make conclusions, that neural networks may be applied in computer systems microscopy for lymphoid cells identification.

Further development of the system is in possibility of implementation of the neural classifier with greater precision of classification.

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