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# Artificial intelligence systems for doctors training

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# Artificial intelligence systems for doctors training

**E A Druzhinina[1], V G Nikitaev[1], A N Pronichev[1], I P Shabalova[2], V Yu Selchuk[1], V V Dmitrieva[1], E V Polyakov[1], T V Dzhangirova[1], S A Mozerov[1]**

[1]National Research Nuclear University MEPhI (Moscow Engineering Physics Institute), Kashirskoe shosse 31, 115409, Moscow, Russia.
[2]Russian Medical Academy of Continuous Professional Education of the Ministry of Healthcare of the Russian Federation, Barrikadnaya str., 2/1, 125993, Moscow, Russia

E-mail: VGNikitayev@mephi.ru

**Abstract.** One of the most effective solutions of oncology problems is creation of artificial intelligence medical systems. Intelligent medical system is a collaboration product of doctors and IT specialists. This article reveals an approach to the creation of educational intelligent systems using the example of an intellectual teaching system for the cytological diagnosis of breast diseases. These systems are based on many years of doctor's practice and improve the quality of training for new doctors.

## 1. Introduction

According to the Ministry of Health for 2018 the leading localizations in the total (both sexes) structure of cancer incidence are: skin (12.6%, with melanoma - 14.4%), mammary gland (11.5%), trachea, bronchi, lung ( 10.1%), colon (6.8%), prostate gland (6.6%), stomach (6.0%), rectum, rectosigmoid compound, anus (4.9%), lymphatic and hematopoietic tissue (4.7%), the body of the uterus (4.2%), kidney (4.0%), pancreas (3.0%), cervix (2.8%), bladder (2.8%) , ovary (2.4%).
It takes about 10-15 years after graduation to prepare a highly qualified specialist in the field of morphology.

The most rapidly developing systems in oncology are intelligent medical systems based on pattern recognition, knowledge bases, and expert technologies. Complexes of artificial intelligence in the general case include clinical, research, training, information and telemedicine systems. Such systems act as support systems during making medical decisions and improve the quality of diagnosis and treatment.

The purpose of this work is the development of artificial intelligence systems for doctors training as an example of cytological diagnosis of diseases of the breast.

## 2. Interdisciplinary education strategy of doctors in the field of artificial intelligence

The strategy of interdisciplinary education of doctors in the field of artificial intelligence includes the following stages: division of doctors into three categories (according to the level of their interaction with intellectual systems: a doctor-user, a doctor-researcher, a doctor-developer), development of a system of requirements for the doctors training, implementation of the requirements to the doctors training. [1]

An intelligent training system was created as a part of the implementation phase of the requirements for the doctors training. The educational system is based on a clinical system that represents the expert knowledge of doctors. This system allows to train young doctors of various categories using artificial intelligence technologies.

## 3. The intellectual teaching system for cytological diagnosis of breast diseases.

The conceptual model of the intellectual teaching system as a result of interdisciplinary work is presented in Figure 1.

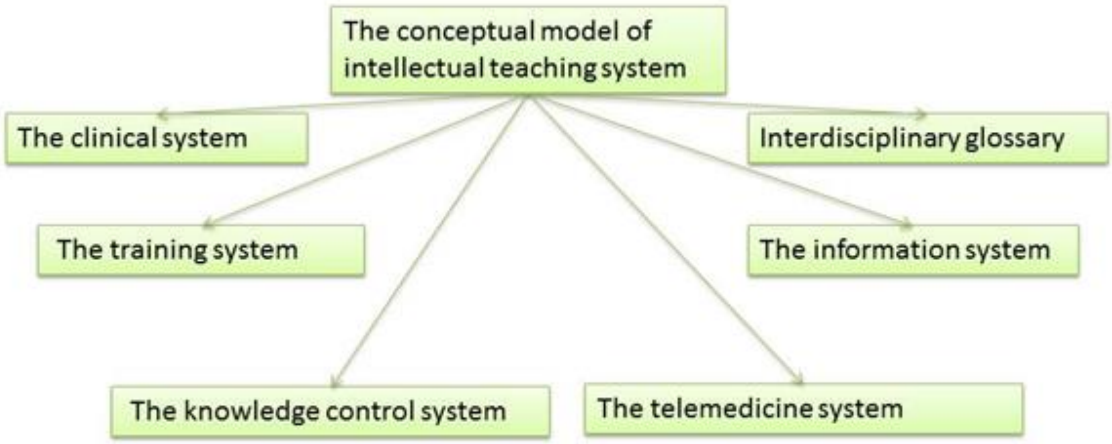


**Figure 1.** The conceptual model of an intellectual teaching system.

A model of a clinical system focused on the educational activities and being a part of the computer training system for cytological diagnosis of breast diseases is illustrated in Figure 2.

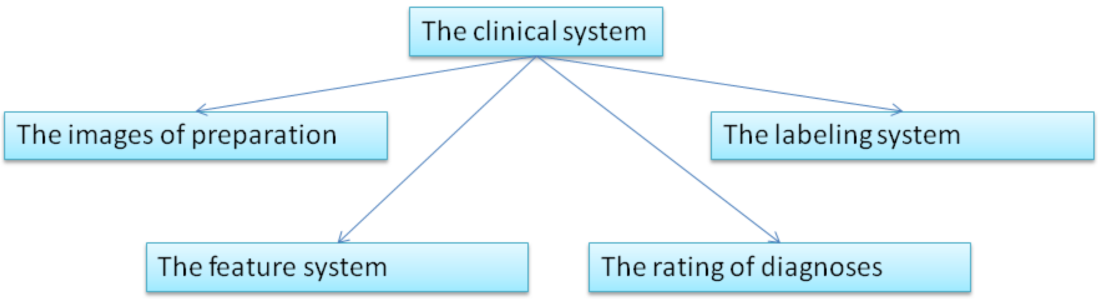


**Figure 2.** Model of the clinical system.

The expert downloads digital cytological images to the input of the clinical system which are described by the expert with using of the feature system. Also tagged images are loaded. The significant for recognition [2] areas on them are highlighted with coloured elements (ellipses and pointers with corresponding signatures) according to an expert opinion. Nosology is selected in the feature system during the images describing for subsequent rating of diagnoses. Then all the considered images and their descriptions are sent to the knowledge base.

The rating of diagnoses represents the distribution of diagnoses with an adjusted feature system.

The labelling system is a selection procedure of the most obvious and significant group of images from the series for training a young doctor carried out by an experienced doctor. The expert highlights the areas he's interested in on the selected images with the use of graphic editors and makes notes about highlighted areas affiliation in accordance with the developed feature system. Further such tagged images are loaded into the system with a “tagged” mark in the additional field of the table. Thus each image loaded into the teaching system has its own description in it in accordance with the feature system.

The feature system contains two groups. The first group is the place of the image in the system. This group contains the attributes of the image: the number (identifier) of the image and the number (identifier) of the patient. A patient database is formed during the work with the system. Various necessary data about the patient are filled in the database. Each patient is assigned an identifier for the privacy. The second group are signs of cytological description of the image including nosology (see Figure 3).

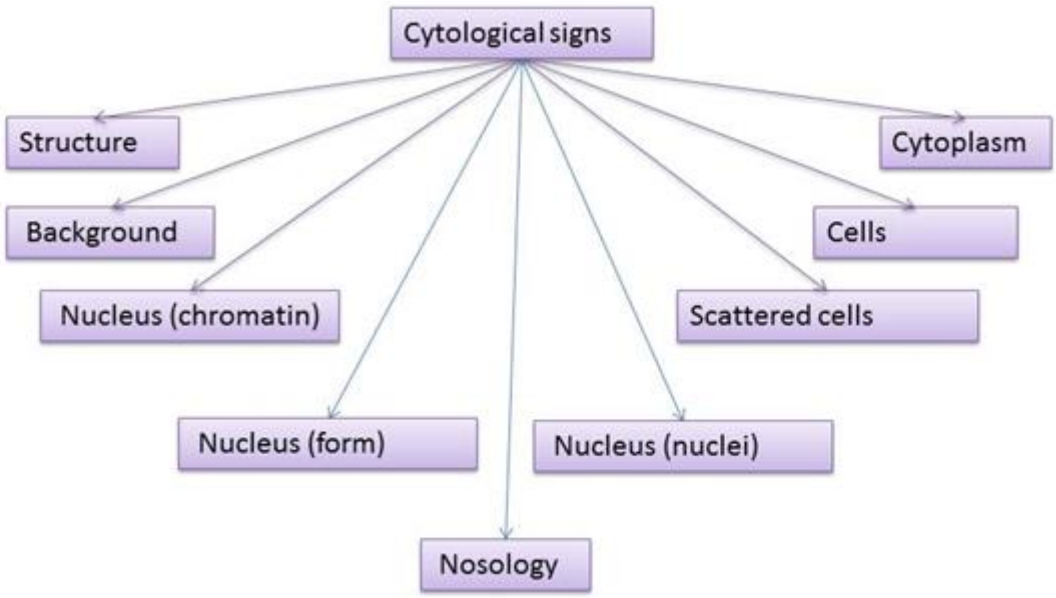


**Figure 3.** Signs of cytological image description.

The feature system considered here is developed in collaboration with medical specialists.

An experienced doctor can create his own knowledge base using the filling module in the presented intellectual training system. The interface of the knowledge base filling module is shown in Figure 4. Images are loaded and described according to the formed classification with the use of the created reference data tables matching to the feature system [3]. An example of the reference table is shown in Fig.5. Each image is not necessarily described according to all signs of Fig.3. It depends on the scale of the image. Some signs are clearly visible with high enlargement. The others are difficult to identify.

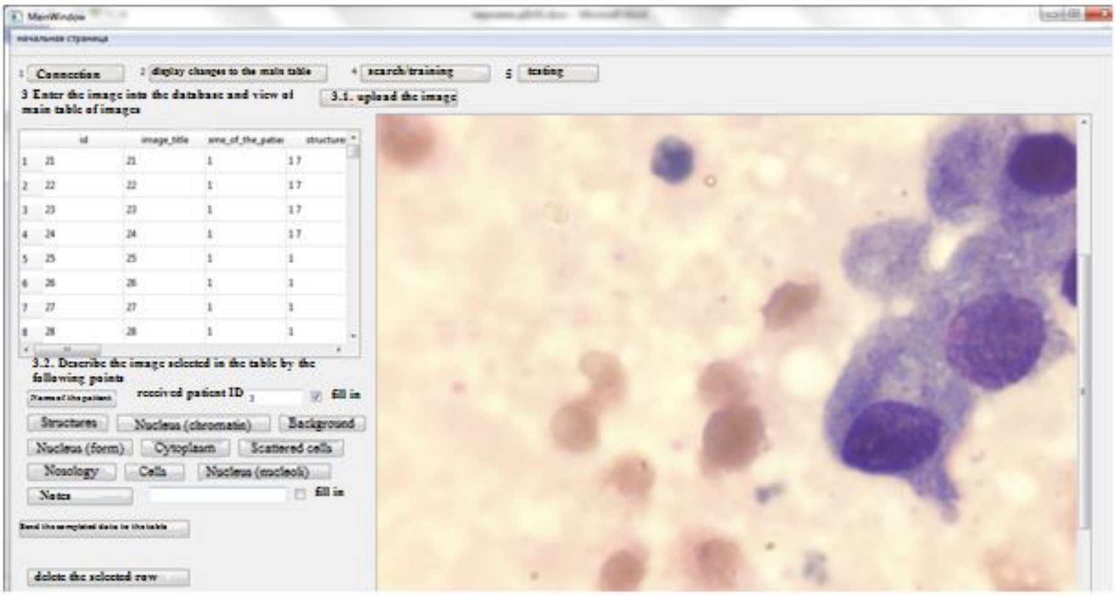


**Figure 4.** Interface of the knowledge base filling module - for downloading and describing images with the use of reference tables.

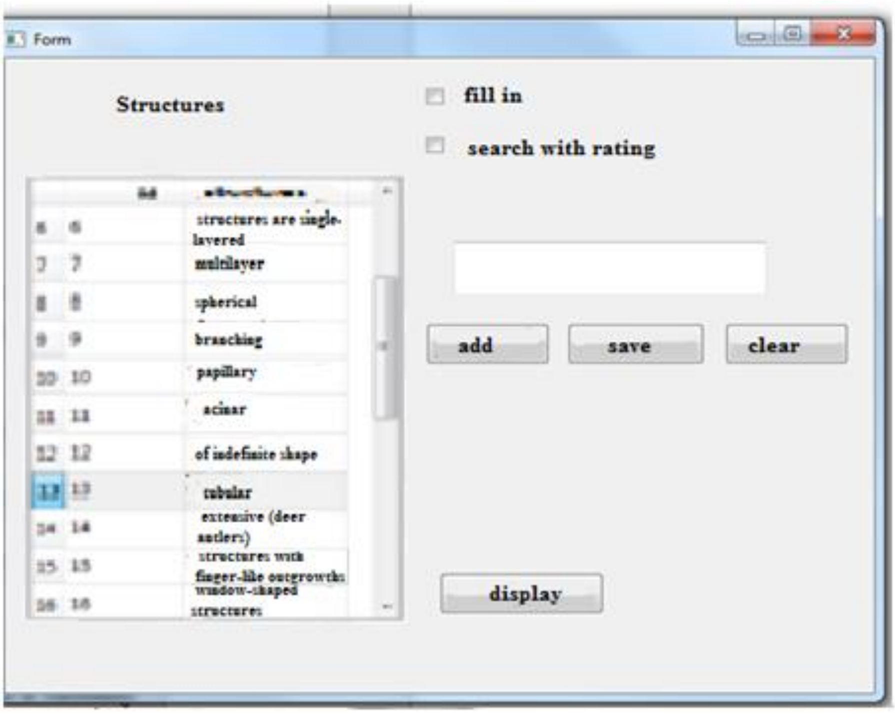


**Figure 5.** An example of a reference table for selecting an image description corresponding to a feature of a structure.

The studying doctor chooses the diagnoses and symptoms from the lists in the system of diagnostics training (Fig. 6). These diagnoses and symptoms can correspond to the images he's interested in. A selection of images with an adjusted symptoms and diagnoses from the knowledge base is performed on the basis of this information. At the same time the student is given the opportunity to view images in detail in the selection including images with the mark (relevant to the diagnosis). It is also possible for a doctor to view the distribution of recommended diagnoses (pie chart, fig. 7). It is possible to compare two images at the same time while watching a sample. Thus in contrast to the visual picture observed in the microscope the doctor learns to determine the diagnosis quickly with the help of an intelligent training system for cytological diagnosis of breast diseases paying attention to the objects important for its formulation.

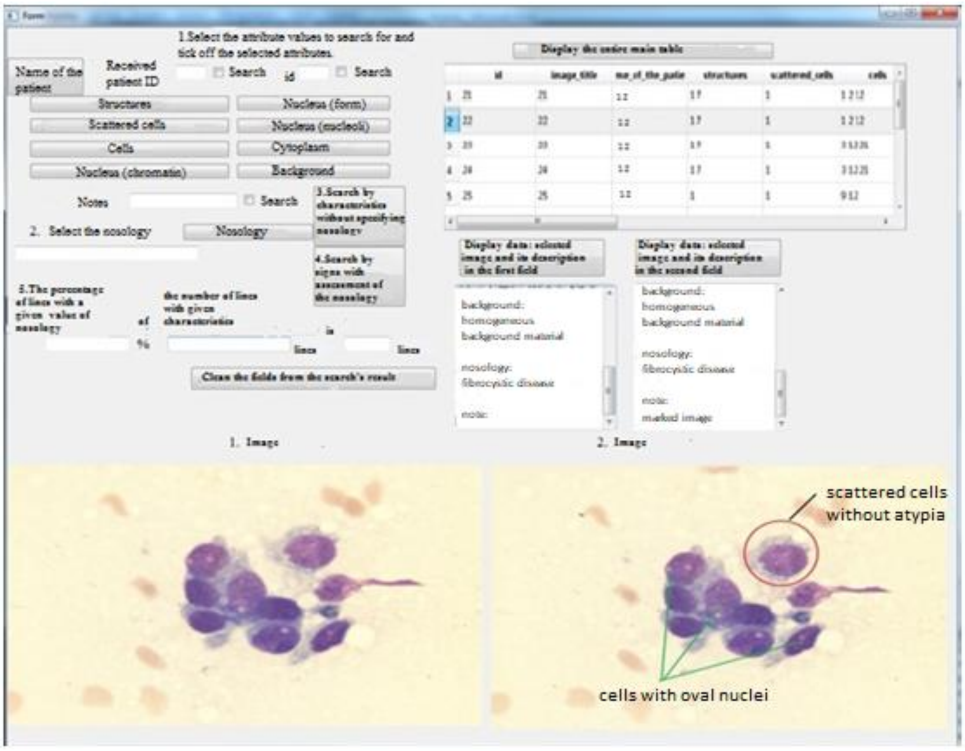


**Figure 6.** An example of a training system interface for image comparison.

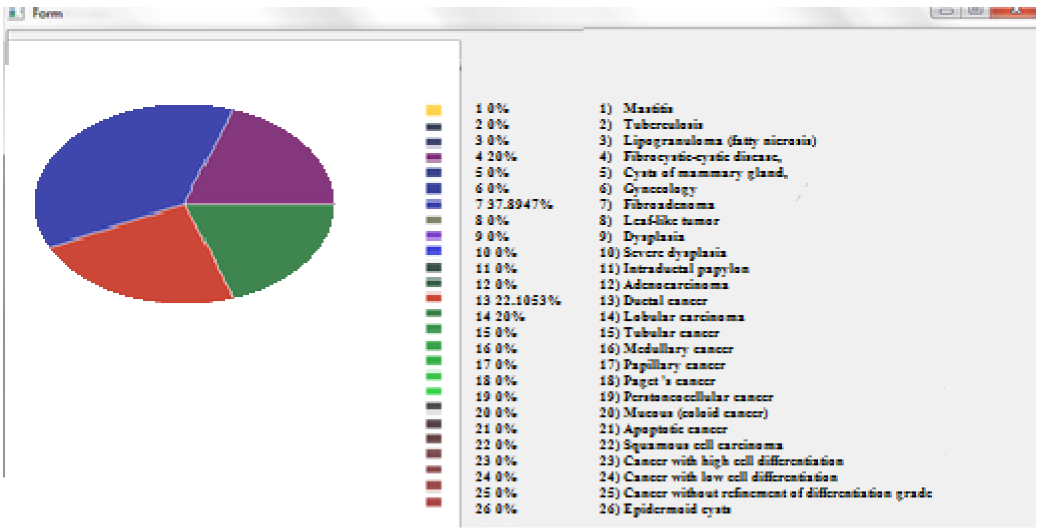


**Figure 7.** An example of a training system interface for images comparison and variants of nosology those are possible for adjusted values of features.

A trained physician is presented a series of shots of the drug for viewing in the system of knowledge control (it's offered to describe one image from the series). The tested doctor should select informative signs and their values using the reference tables of signs. The knowledge control system will compare the answer of the tested doctor with the expert opinion and will give an assessment and indicate the differences in answers. An example of the knowledge control system interface is shown in Fig.8.

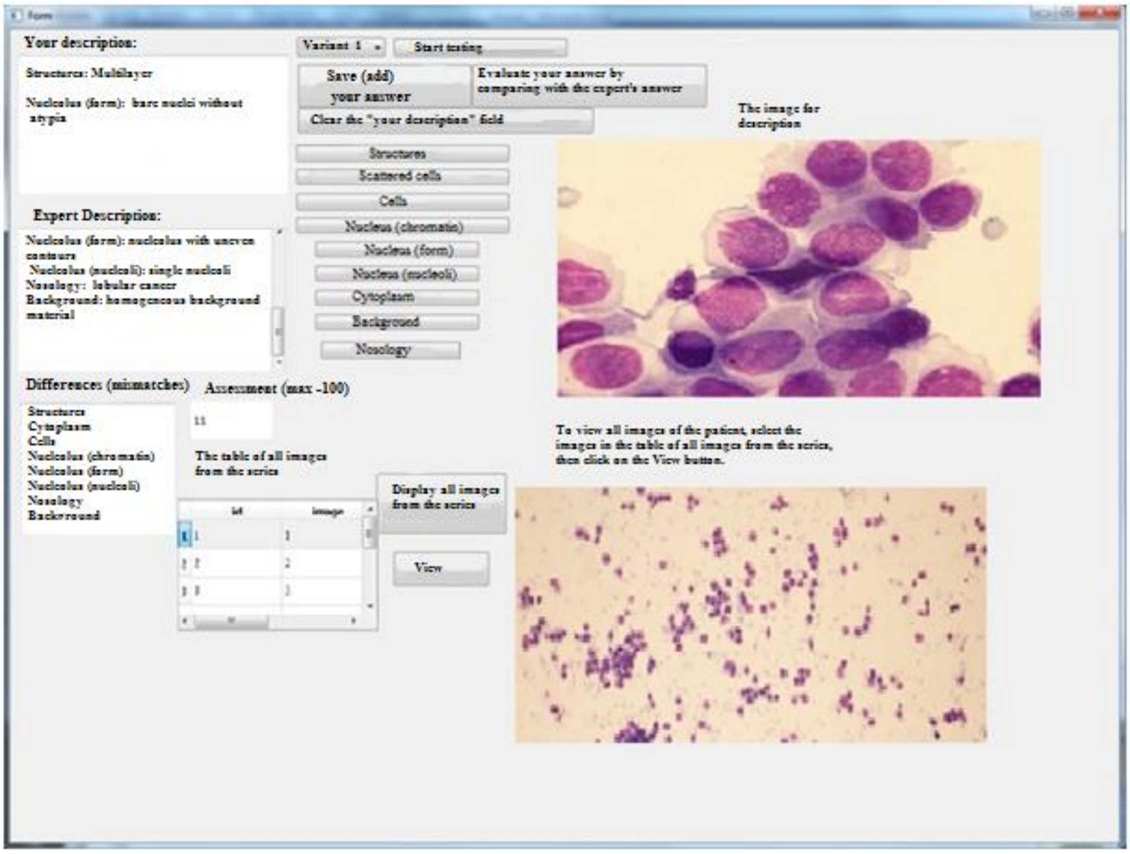


**Figure 8.** An example of the knowledge control system interface.

The knowledge base formed by an expert can be stored both on the local computer and on the server which makes it convenient for remote transmission.

## 4. Results

This approach to the interdisciplinary education of doctors in the field of artificial intelligence is fundamental and can be applied when creating training systems for various nosologies. In particular it was used to create an automated system for diagnosis skin melanoma. It is an example of the use of a labeling system in the description of structural elements in images of skin neoplasms below. [4]

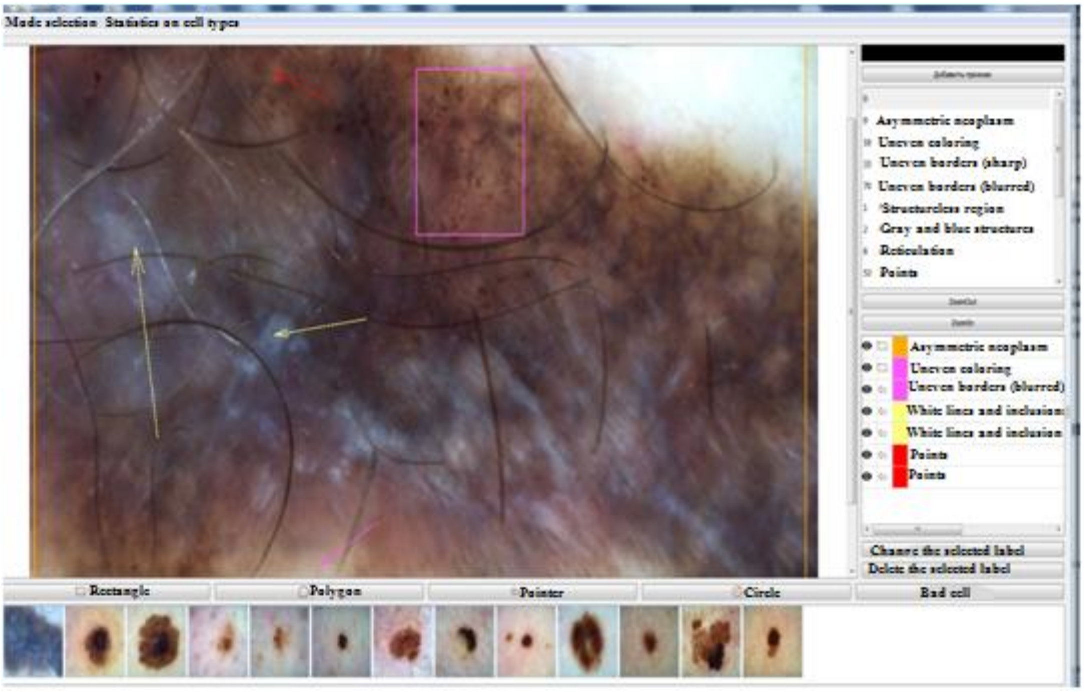


**Figure 9.** An example of labeling structural elements on dermatoscopic images of skin neoplasms.

## 5. Conclusion

This paper is devoted to the creation of artificial intelligence systems in the doctors training for example of cytological diagnosis of breast disease.

The following objects have been developed based on the previously formed strategy of interdisciplinary education of doctors in the field of artificial intelligence: a conceptual model of a teaching intellectual system; a system of signs of cytological description of images; a cytological knowledge base, including filling module; a training system with a rating of diagnoses; a knowledge control system.

The developed intellectual training system for cytological diagnosis of breast diseases is designed to accelerate learning process of young doctors, to quickly adapt them to the variability of cytological pictures and descriptions, to save time of the instructor (teacher) and to effectively integrate the achievements of artificial intelligence into medical practice.

## Acknowledgments

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