Prospects for the development of intellectual diagnosis of prostate cancer

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Abstract.To date, the world's pressing problem is the problem of timely diagnosis of cancer, allowing the patient to avoid severe complex treatment, to survive and lead his usual way of life. The article discusses the prospects for the development of intellectual diagnosis of prostate cancer. The final decision on such a diagnosis of the patient is made on the basis of the histological analysis of the tumor tissue preparation. However, at the moment there is a shortage of qualified specialists-pathologists. Hence the need to create training histological diagnosis systems to disseminate the knowledge of specialists, as well as expert systems and intelligent systems to support medical decision-making.
This article considers the project of development of an expert system of histological diagnosis of prostate cancer. This intelligent system will allow experienced histologists to transfer their knowledge to younger specialists. It is assumed that this knowledge will be processed by the system in such a way that doctors will be able to quickly make a decision on the diagnosis of patients.

1. Introduction

Every year 500 thousand patients with oncological pathology are registered in Russia [1]. It's known that the detection of malignant tumors in the early stages in 95% of cases there is a complete recovery of cancer patients. The analysis of the main problems of diagnosis of prostate cancer was carried out, among which the following can be highlighted:

1) methods of finger rectal examination, transrectal ultrasound scanning are inaccurate, their accuracy is about 50% [2];

2) a number of prostate diseases have cancer-like symptoms;

3) the most difficult task of diagnosis is to determine the degree of differentiation of the tumor (this is what determines the tactics of treatment);

4) prostate cancer is characterized by a wide variety of histological structures;

5) lack of qualified pathologists.

On the part of medical workers, various operational (in the sense of the process) solutions to these problems are offered. Among them, such as the use of a combination of several diagnostic methods, the preparation of methods and algorithms for diagnosis.

In addition, technical specialists, together with medical personnel, carry out various developments aimed at improving the quality of research aimed at diagnosing prostate cancer. This includes improving the accuracy of medical equipment (tomographs, microscopes, etc.), as well as designing and developing information systems to support decision-making in the diagnosis of prostate cancer.

Based on the results of the analysis of existing works [3], [4] in this area, it was concluded that most of the existing expert decision support systems are based on clinical data. Thus, the development

of an expert decision support system based on histological analysis data is extremely relevant, as it has no known analogues.

2. Approach to solving diagnostic problems

One of the solutions to the problems of diagnosis is the creation of an intelligent decision support system in the histological diagnosis of prostate cancer. Ideally – it is a system that supports two modes of operation:

- self-study (images are loaded into the system, on them a specialist doctor marks out the characteristic features of certain diseases, then the image data, their marking and information about the marking is stored in the knowledge base),
- support for diagnosis (pathologist loads into the system the image of the histological preparation of the patient, the system searches for similar images in the knowledge base, and the output returns a list of recommended diagnoses based on similar images found in the knowledge base).

The most difficult and time-consuming task in this case is the problem of recognition to find similar images, therefore, taking into account the current capabilities, it is proposed in the study to identify characteristic objects in a manual format without automation, that is, the training mode of the system is implemented in accordance with the above.

The marking of images in the training mode of the system should allow to allocate objects characteristic for the diagnosis. Therefore, the system should implement the following drawing capabilities:

- drawing geometric shapes: ellipse (for rounded objects, such as visible nucleoli), rectangle, arrow (for point objects), and polygon (for objects with complex shapes) - allows you to quickly and accurately mark specific objects;
- color selection on the color palette to be able to select different objects (or objects with different diagnoses) in different colors, maintaining visibility depending on the color of the image area;
- the ability to change the scale of the image due to the different size characteristic of different features;
- the ability to choose the line thickness depending on the size of the object, as well as the scale of the image.

One of the priority areas of Informatization in Oncology are systems to support medical decision-making, which are multimedia training complexes using knowledge bases, expert systems, network systems. The development of such systems is a complex interdisciplinary task that combines the tasks of medicine, education and information technology (as shown in Figure 1).

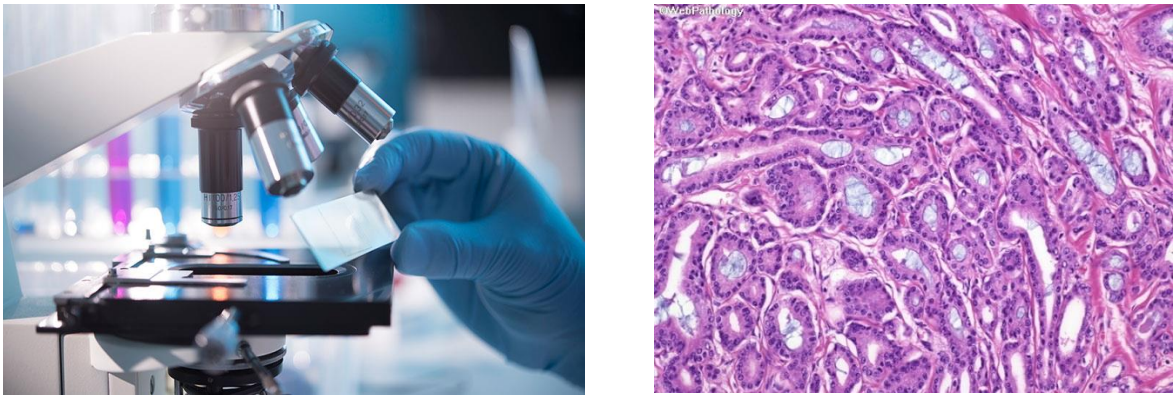


Figure 1. Histological preparation for the diagnosis of prostate cancer.

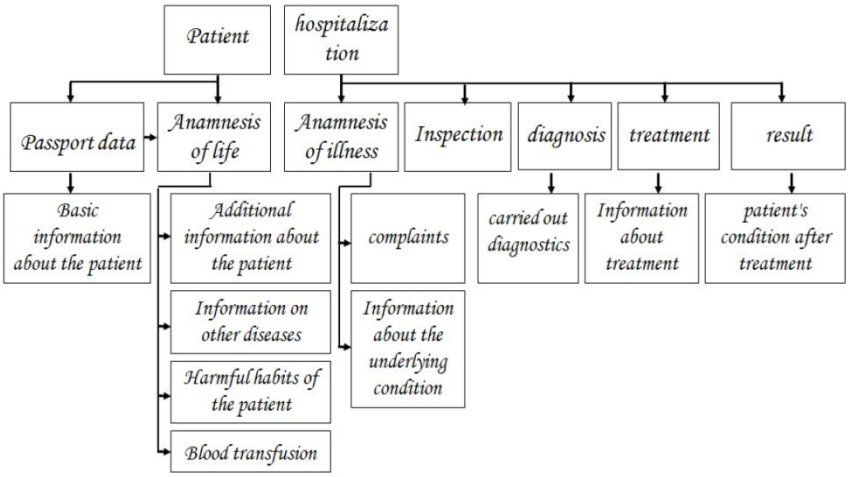
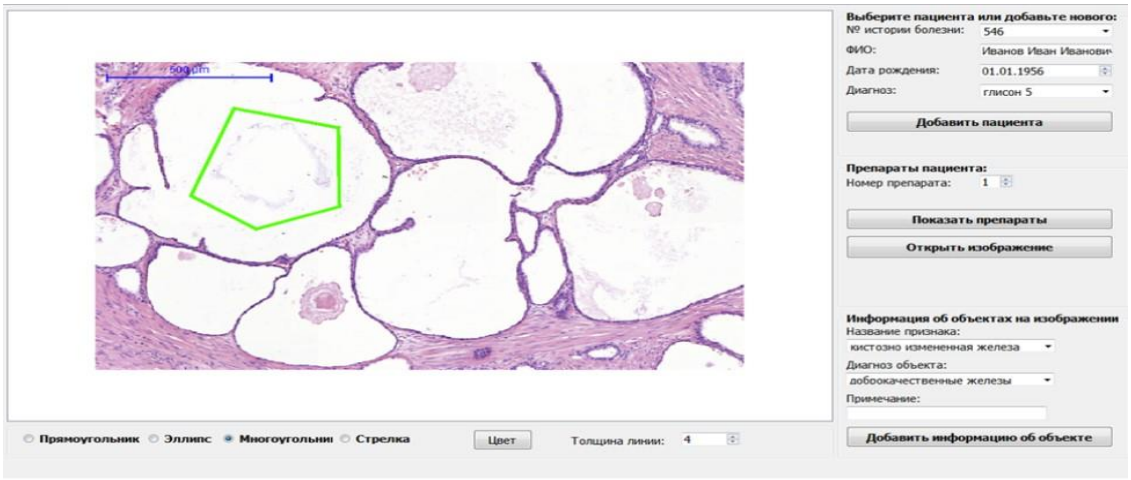


Figure 2. Structure of the knowledge base «Prostate cancer».



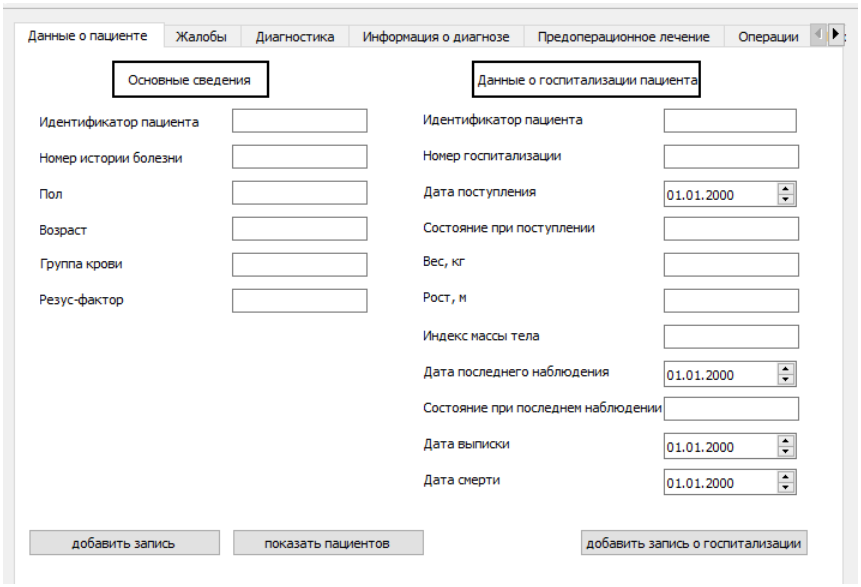


Figure 3. Alpha version of the system interface.

The decision support system for histological diagnosis of prostate cancer will accumulate the knowledge and experience of medical experts and information technology specialists. It is intended for interns and residents. An important stage in the development of the system was the design of a knowledge base that stores data on patients with prostate cancer. The structure of this knowledge base is shown in Figure 2.

The alpha version of the interface of the decision support system for histological diagnosis of prostate cancer is shown in Figure 3. The fields and interface structure have been developed in collaboration with practitioners to provide maximum clarity and convenience for health professionals who will use the system in the future, filling it with new data.

3. Conclusion

This system is under development and testing. It will allow to collect and store data of objective studies (examination, palpation, percussion, hearing), additional methods of research (clinical laboratory methods), special methods (MRI, CT, ultraechography, PET, radiological diagnosis, radioisotope diagnosis), instrumental methods (gastroscopy, laparoscopy), morphological methods and subjective methods of research (anamnesis of life, anamnesis of disease, patient complaints).

The system is developed using the C++ programming language with the use of cross-platform software development tools Qt-creator [5]. A relational database running MySQL has been developed to store research data.

The main advantage of the intellectual decision support system in the histological diagnosis of prostate cancer is the possibility of accumulation and transfer of knowledge to future specialists in the field of prostate cancer diagnosis.

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