Clinical intelligent system for the diagnosis of prostate cancer

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Abstract. A software clinical intelligent system for the diagnosis of prostate cancer is discussed. The system provides assistance to the doctor in the histological diagnosis. The system has the mode of operation of an expert doctor to fill the knowledge base of the system, the mode of assistance to the diagnostician (pathologist) in the formation of requests to the system, the mode of support in decision-making based on the formation of a rating list of possible diagnoses for the case under study, the training mode.

1. Introduction
Correct and timely diagnosis of prostate cancer allows to develop an optimal treatment plan, which increases the chances of winning over the disease.

The difficulty in diagnosing prostate cancer is that the malignant tumor in the initial stages can occur without noticeable symptoms [1-3].

The purpose of this work is to increase the efficiency of histological diagnosis of prostate cancer by creating a clinical intelligent system for the diagnosis of prostate cancer.

2. Clinical intelligent system for diagnosis of prostate cancer
The developed intellectual system of prostate cancer diagnosis provides four modes of operation [4-5]. The first mode is the work of the expert: the images are loaded into the system, on them the expert doctor finds signs characteristic of certain diseases, and performs a text description of the observed picture. The possibility of graphical image markup is provided for the trainee to correctly interpret the description of the image made by the expert. In this case, the expert physician applies to the image graphic lines that either surround the described area in the image, or point to the object under study (in the form of an arrow, the end of which points to the object). Several types of marking lines - "arrow", "ellipse", "rectangle", "arbitrary line" (for objects with complex shape) are provided for the convenience of marking the doctor-expert. The color of the marking lines is selected from the color palette in order to be able to select different objects in one diagnosis (or objects with different diagnoses) in different colors, while maintaining visibility depending on the color of the image area. The image description formed in this way and the image itself are stored in the knowledge base [6-9].
Examples of marking on the image of a microscopic preparation of the prostate gland to indicate the normal secretory cell and the acinus of the folded form are shown in Figure 1 and Figure 2.

**Figure 1.** Marking an image of a microscopic prostate preparation to indicate a normal secretory cell (marked with a green arrow).

The second mode of operation of the system is the diagnostic mode (the pathologist loads the image of the histological preparation of the patient into the system, the system searches for similar images in the knowledge base, and returns the list of recommended diagnoses based on the similar images found in the knowledge base).

**Figure 2.** Marking of the image of a microscopic preparation of the prostate gland to indicate the acinus of the folded form (marked with a green line).
The third mode of assistance to the diagnostician allows you to establish a diagnosis by visual comparison of images.

The fourth mode of training allows to produce training and assess the quality of learning material.

Characteristic signs of the disease (objects) and their properties (attributes) are noted in order to create a reference knowledge base for the implementation of training procedures on each image of the histological preparation [10]. Thus, we obtain the following main categories of data involved in the description of the image, and the relationship between them (Figure 3).

![Figure 3. The main categories of data involved in the description of the image, and the relationships between them.](image)

This model should be specified so that each object of the corresponding category could be identified. Below are the elements of the model.

1) patient: to identify him/her, it is necessary to know his/her card number, name and date of birth.

2) Preparation of the patient: it is necessary to know which patient it was obtained, and the number of the slide.

3) Image: it is necessary to know the number of the slide for which the image was obtained, the name of the image, the date of its loading into the system and the scale at which it was obtained.

4) Objects on the image: the image on which the object is marked, the name of the object - a sign of the disease which corresponds to the image.

5) features of the object in the image: its location in the image (coordinates), marking parameters (color).

6) the Reference names of diagnoses and symptoms.

3. Conclusion

The paper describes a clinical intelligent system for the diagnosis of prostate cancer in the histological study of prostate drugs. The system provides for work in four modes, allows on the basis of the knowledge base filled by experienced specialists to train diagnosticians (pathologists) and helps them to make decisions regarding the diagnosis.

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