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FEATURES OF MEDICAL IMAGE PROCESSING

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Abstract. *The work is devoted to design digital images processing methods, algorithms and software for medical diagnostic. One of the main directions in this area is the improvement of computational methods to increase the efficiency of the diagnostically process. The methods of digital processing and analysis of medical diagnostically images are described. The main principles of design, main issues of imaging processing and structure of actual tomography visualization software are proposed and are discussed. The main medical-technical requirements for processing and visualization software are proposed and considered. The methods of image processing based on a priori information and context-oriented approach, taking into account the specifics of the source data. Improvement of the software product should be based on its use in medical practice. The perspective areas are intellectual processing and image analysis based on information technologies that support diagnostic decision-making.*

Keywords: *image processing, information technologies, medical diagnostic,*

Introduction. In connection with the improvement of electronic and computer technologies, there has been a rapid development of methods and tools for analyzing diagnostic images. At the same time, one of the main directions in this area is the improvement of computational methods for increasing the efficiency of the survey [1-3]. The main tasks are: reducing invasiveness, raising awareness and reducing the total cost of the survey. Currently, an increasing role in the diagnosis of pathologies of internal organs is assigned to tomographic examination methods: spiral x-ray computer and magnetic resonance imaging, which allows to reconstruct volumetric structures along a set of parallel sections [2-4]. The output data obtained as a result of such studies of a patient's tomographic examination are the result of a complex mathematical treatment, on which the quality of diagnostics largely depends. The analysis of diagnostic images is also used in microscopic methods, cytomorphological and histological studies, capillaroscopy, and in the processing of thermal imaging data [5]. Therefore, it is advisable to analyze the stages of the process of image formation and transformation in modern diagnostic systems, reflect the circle of unsolved problems, as well as form the main medical and technical requirements for the corresponding software.

The essence of the work. The process of diagnostic examination of the patient can be divided into several stages. The first of these is the stage of choosing a diagnostic method, which depends on the patient's condition, the availability of research methods and the prospects for treatment. The main quality indicators in this case are accuracy, sensitivity and specificity, as applied to the diagnosed pathology. The main problem is to minimize the number of mistakenly chosen visualization methods and exclude the optional research that delays the diagnosis process. When choosing methods, the clinician needs to thoroughly know the technical capabilities of the equipment and the physical principles of the formation of diagnostic images, to provide information on which diagnostic conclusions are based on the visualization of the examination results. For this purpose, it seems expedient to develop virtual training systems that allow one to study the capabilities of the corresponding real-world systems using phantom models [6, 7].

Traditionally, diagnostic images have been used exclusively for diagnostics. However, with the advent of powerful graphic workstations and computer-assisted surgical robots, a new direction has emerged - surgery, based on images that are used to navigate a surgical instrument [8-10]. For this purpose, methods of computer planning are used, which allows virtual simulation of the course of surgical intervention based on a reconstructed model of the operating environment, according to which the search for the optimal trajectory from the point of view of minimal invasiveness can be carried out.

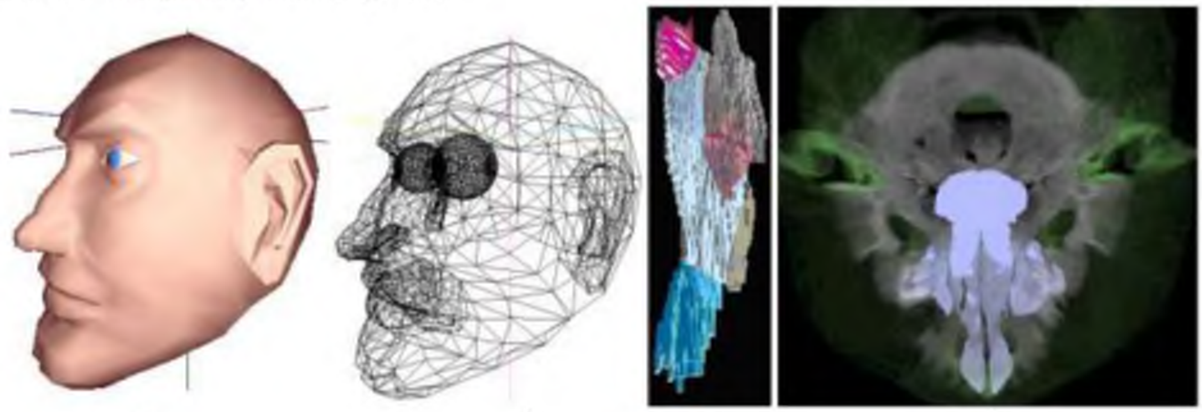
An important step is also a realistic multi-view visualization of diagnostic data, allowing you to directly display anatomical structures with high accuracy and information. maximum possible.

The results of the study. Consider the process of developing a software product for displaying intra-copy data, which can be divided into several stages:

- conceptual design, during which medical and technical requirements for the product being developed are formulated, a preliminary evaluation of the data processing strategy and the main features of the program is carried out;
- methodological development, which is used to justify and select methods and algorithms for the implementation of specific functions of the developed software;
- practical implementation, upon completion of which complete software modules and a test version of the software product are created;
- testing and debugging software, during which all identified flaws are eliminated and a complete final version of the software product is created with a set of relevant documentation.

Consider the basic medical and technical requirements for software products for data visualization: the interface module must implement the principles of working with the user (radiologist) interactively with maximum convenience and the absence of interface elements that are not used in the context of the task to be performed. The blocking of the main form with various interface elements and the presence of a large number of non-modal windows, as a rule, leads to a decrease in the efficiency of the interface. Additional functions of the software are support for interaction protocols with medical databases (local and remote), telemedicine functions, and work with specialized medical (DICOM) and standard (TIFF, BMP, etc.) graphic file formats. Data processing, in addition to improving the visual perception of images, should provide the possibility of a segmentation procedure – highlighting areas in the image that belong to structures with common properties, such as intensity, configuration, size, and location are chosen for tomographic images.

In the 3D-processing block, a reconstruction of three-dimensional data is performed using surface or volume representation methods. In the first case, the construction of surfaces is performed by lofting the contour sections of objects obtained as a result of 2D segmentation. To work with volumetric data, various voxel models (voxel - volume element) are used in information content, representing the display of space in the form of a three-dimensional raster [10]. Since tomographic images contain half-tone information about the intensity of individual pixels (and also the slice thickness is known), the primary model for the representation of volumetric data is a halftone voxel model containing information about the intensity in each volume element. The following are examples of 3D visualization of the surface of the head (fig. 1, a) based on the frame model on fig. 1b and mapping of the nasal cavity based on a segmented halftone voxel model (fig. 1, c) and a halftone voxel model in transparency mode (fig. 1, d).



a b c d

Fig. 1. Samples of 3D visualization: a) surface of the head, b) frame model of the head; c) segmented halftone voxel model of nasal cavity ; d) halftone voxel model of nasal cavity in transparency mode

The algorithmic basis of the software should be focused on the maximum degree of automation with the minimum number of parameters measured manually. Further improvement of the software product is carried out taking into account its use in medical practice.The software interface should model the user's logic, freeing him from a variety of routine operations. Additional information to the specialist is allowed to form specialized graphic G- and identification ID-buffers, which contain information about individual anatomical structures and their hierarchical relationships, taking into account the relationships and belonging to a particular area.

Conclusions. The initial diagnostic data generated as a result of the survey are subjected to preprocessing, segmentation, description and analysis procedures. At these stages, a histogram correction and filtering of images are performed to improve their visual perception, as well as segmentation, allowing to isolate diagnostically significant structures. Currently, there are no universal methods for automated image segmentation of bioobjects; therefore, most of the developed systems are based on a priori information and a context-oriented approach that takes into account the specifics of the source data. Automated analysis of segmented structures on the system of signs (geometric, color, etc.) allows you to inform the specialist for more information when making a diagnosis. Data transmission over a distance using telemedicine services and storage of digital archives of diagnostic data requires the development of image compression methods. The complexity of these methods lies in the impossibility of using standard algorithms for highly efficient compression of images with losses, due to the possibility of losing important diagnostic information. The problem of developing methods for compressing medical images should be solved on the basis of an integrated approach that takes into account the geometric and color characteristics of the objects being diagnosed. The promising areas are intellectual processing and image analysis based on information technologies that support diagnostic decision-making.

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