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Unet network-based liver tumor segmentation system

Chenxin Xing

Collage of Computer Science and Technology, Changchun Normal University, Changchun, Jilin, 130032, China

Abstract: *In recent years, with the development of artificial intelligence, computer and other technologies and the increase of people's demand for computer-aided diagnosis technology, computer-aided diagnosis technology has been developed greatly, among which Unet network-based liver tumor segmentation technology is a typical representative of computer-aided diagnosis technology. However, the research of Unet network-based liver tumor segmentation technology is not very mature, and there are still some aspects that do not meet the market demand. Therefore, in this paper, we propose a proposal of Unet network-based liver tumor segmentation technology based on the existing computer-aided diagnosis technology and related research in the market, combined with the market demand. Under the market demand of computer-aided diagnosis and treatment, an accurate and practical liver tumor segmentation system is designed to improve the shortcomings of the commercially available liver tumor segmentation systems.*

Keywords: *Computer-aided diagnosis, treatment technology*

1. Introduction

A system needs to be generated according to the actual market demand and implementability, and computer-aided diagnosis system can well meet the reference that doctors need for judging the condition. Although there are many computer-aided diagnosis systems at this stage, the current computer-aided diagnosis system only serves a few people, and the innovation of its technology and the accuracy of its auxiliary diagnosis can still be improved. In this paper, we mainly analyze the liver tumor segmentation system based on Unet network, and propose several designs of the liver tumor segmentation system based on Unet network for its advantages and disadvantages with other computer-aided diagnosis technologies in the market, and give a specific implementation plan.

2. Analysis of the advantages and disadvantages of contemporary liver tumor segmentation systems

The common features of liver tumor segmentation systems in the current market are analyzed, and some of their shortcomings and aspects that can be improved can be found based on technology, accuracy and practicality.

2.1 Advantages of liver tumor segmentation system in the current market

Nowadays, liver tumor segmentation systems on the market are using liver CT images for processing generally have the following three advantages. Usually computer-aided diagnosis in medical imaging is divided into three steps: the first step is to extract the lesion from the normal structure; the second step is the quantification of image features; the third step is to process the data and draw conclusions [1].

Because the computer can fully use the image information for accurate quantitative calculation, remove the subjectivity of human, avoid the "many different" diagnostic results caused by differences in personal knowledge and experience; so its results are fuzzy and definite, it makes the diagnosis more accurate and more scientific. With the development of modern high technology, computer-aided diagnosis will be integrated with image processing and PACS system, which will become easier to operate and more accurate, and its clinical application will be further expanded. CT images can clearly reflect the internal anatomical structure of human tissues and the nature of lesions, and can accurately locate the tumor. The third point is that at this stage, most of the commercially available liver use FCN network for segmentation of liver tumor CT images. the FCN network proposes a jump structure in making classification prediction is to combine semantic information from deep (coarse layer) and

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appearance from shallow (fine layer), which is trained by several different enhancement stages to fuse the features of different stages to achieve more accurate segmentation task [2].

2.2 Deficiencies of liver tumor segmentation systems on the market at this stage

At present, the liver tumor segmentation system on the market is complicated to operate and requires repeated training before use, and the segmentation results also have certain errors, and the segmentation results only provide reference value for doctors and are oriented to fewer groups. The system that meets the market demand and has a wide audience can be quickly accepted by the market, which is also in line with the original design intention of the Unet network-based liver tumor segmentation system, and the system will add more functions needed by the public according to the actual demand. Minimize redundant functions and superfluous operations.

Due to the limitations, in most cases, physicians still make judgments based on morphological information provided by modern imaging and their own clinical experience. Due to individual patient differences and the limitations of the physician's observation of imaging information, sometimes errors or mistakes in judgment may occur.

At this stage, FCN network is mostly used in the market to segment liver tumor CT maps. FCN network proposes a jump structure, which is trained by several different enhancement stages to fuse the features of different stages to achieve a more accurate segmentation task. However, the sampling work of FCN is relatively simple, and only one deconvolution operation is used, after which the convolution structure is not followed, while in the jump connection part FCN uses the add operation, and the segmentation results have errors. This system uses Unet network segmentation technique using stacking operation to make the segmentation results more accurate.

When patients have had multiple examinations and their conditions keep changing, it becomes difficult for both doctors and patients and patients' families to organize the laboratory materials and CT images. Although some hospitals have launched electronic medical records, the hospital management system does not distinguish between these records and some hospitals have a time limit for the management of electronic medical records, which cannot be viewed after six months to a year of medical records. For today's fast-paced life, there is no need for people to waste their time on organizing and keeping medical records. Obviously, for this, the current computer-aided diagnosis and treatment system cannot organize and save the cases. This requires the liver tumor segmentation system based on Unet network to record the changes of patients' conditions and organize their medical records according to time, and this system uses a database to store various information related to patients' conditions to realize the organization of medical records.

In addition to the organization and preservation of medical records, intelligent recording of changes in patients' conditions is also an important module. The intelligent recording of the condition has to be considered in a comprehensive way and it has to meet the doctor's need to judge the condition. For different patients to be combined with age, other medical history and other aspects, and then according to the diagnosis of different doctors who previously diagnosed the condition to meet the needs of doctors, patients and their families. For this, the computer-aided diagnosis and treatment systems on the market nowadays are not well thought out and do not have perfect functions. Therefore, a more scientific and reasonable intelligent record of changes in the condition is needed. This system adopts the form of animation to process the segmentation results of liver CT into dynamic changes and intelligently record the changes of patients' conditions.

At present, most of the liver tumor patients in China are middle-aged and elderly people over 50 years old. Although the network and smart phones are gradually popularized in modern society, considering that middle-aged and elderly people are not easy to learn new system software, the operation of liver tumor segmentation system needs to be simple and clear to meet the needs of doctors' auxiliary diagnosis and also to meet the needs of patients and their families about the changes of patients' conditions. This inevitably takes into account each patient's acceptance of his or her condition. To address this issue, firstly, the common computer-aided diagnosis system is lacking in this related function; secondly, the hospital's auxiliary diagnosis and treatment system cannot well consider the patient's acceptance of his or her condition. This requires the Unet network-based liver tumor segmentation system to consider the patient's acceptability, require identity verification when logging into this system, and to a certain extent, slowly guide the patient to accept it through cooperation with the patient's family instead of telling them all at once.

The security of the system needs to be considered along with the organization of the records and the

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preservation of patient information. Computer-aided diagnosis systems need to keep patient information confidential, which requires designers to fully consider possible problems and corresponding countermeasures.

3. Unet network-based liver tumor segmentation system

3.1 Using image segmentation technology

Image segmentation technique is the technique and process of dividing an image into several specific regions with unique properties and presenting the target of interest. It is a key step from image processing to image analysis. It is important for disease diagnosis, image-guided surgery, and medical data visualization, providing a reliable basis for clinical diagnosis and pathology research. The image segmentation technique used in this system is based on Unet network, a CNN-based image segmentation network, which is mainly used for medical image segmentation. This type of method can locate abnormal regions of liver tissue using deep-level features of medical images, and segment medical images precisely using shallow-level features and obtain results. As shown in the Figure 1:

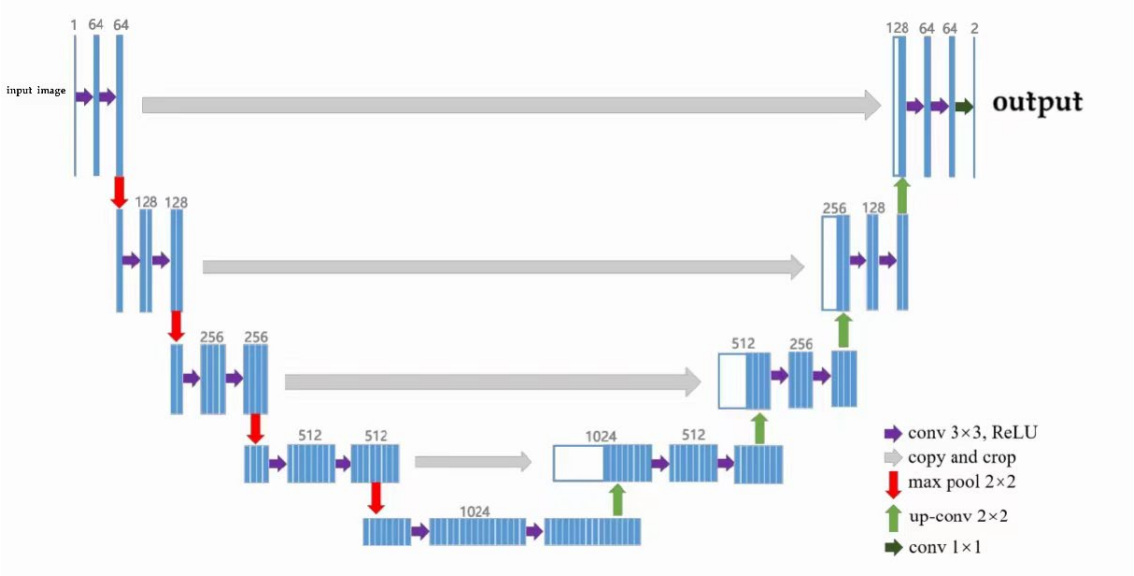

Figure 1: Neural network

3.2 Multi-phase CT liver tumor segmentation using dual-channel cascaded U-Nets (DC-CUNets) based method

A two-stage U-Net segmentation network was designed to segment the liver using the first-stage U-Net, and then the segmented liver region of interest was fed into the second-stage U-Net network to segment the liver tumor. Secondly, since the enhanced CT contains multiple sets of scanned images at different time periods after the intravenous contrast injection to the patient, considering that different sets of images contain different image features, this system designs two-channel U-Nets to learn the image features in the arterial phase and venous phase CT respectively, and achieves the two-channel feature fusion by feature cascading to improve the segmentation accuracy of the overall liver tumor.

3.3 The problem to be solved by the liver tumor segmentation system in Unet network

The system is mainly used in the medical field. The original U-Net has a limited network depth and limited capability for feature extraction, while directly increasing the number of hidden layers not only brings complex network parameters, but also leads to overfitting of network training for segmentation tasks with small data sets such as medical image segmentation. In order to optimize the network training process, two depth bottleneck structures are proposed to replace the convolutional layers in the original U-Net shrinkage path to improve the network depth and reduce the network training parameters. The depth bottleneck structure is fused with liver segmentation U-Net and multi-scale dual-channel liver tumor segmentation U-Nets, and multi-scale DC-CUNets based on the depth bottleneck structure are implemented in this paper [3].

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3.4 Easy-to-use operation design

The system will try to reduce the honor function and more than operation according to the actual demand, the design of the function, each core module only retains the core function. For example, the image segmentation function is only designed with picture selection window, image analysis button and image processing result window to operate in the most intuitive way. The system can meet the functions required by the market, although only the core functions are retained, which are very easy for middle-aged and elderly people. The system is also designed with an intelligent reminder function, which allows users to set a reminder for the next examination time according to the medical prescription [4].

3.5 Fully consider the value of the system to society

The system will cooperate with including hospitals, government, industry associations, etc. Based on the patient's medical history, the patient's liver CT images will be collected and put into a special database to encrypt the patient's information to protect the patient's privacy while providing assistance for later system training and case studies by related institutions [5].

3.6 Safety and preventive measures design

Considering the different degrees of acceptance of patients, and under the premise of protecting patients' privacy, this system is designed with separable functions. Many young people work in the field and cannot be with the elderly every moment, this system sets up associated accounts, so that young people in the field can check the changes of their parents' condition remotely at any time, helping children to realize remote understanding of their parents' health status. In addition, some children do not want their parents to know the specifics of their condition, the system sets up a management mode where children can set the visible content of their parents and make different choices for different situations.

4. Conclusion

For computer-aided diagnosis technology design should be repeated to consider its rationality, and simple to use products will be rapidly promoted in the market. The design and development of this system uses image segmentation, database and other technologies to realize intelligent auxiliary diagnosis of liver tumor, which can meet the need of doctors for computer-aided diagnosis and the need of patients and their families for the change of condition and finishing and preservation, fully considering the needs of different audience groups, and can meet the market needs to the greatest extent. As shown in the Figure 2:

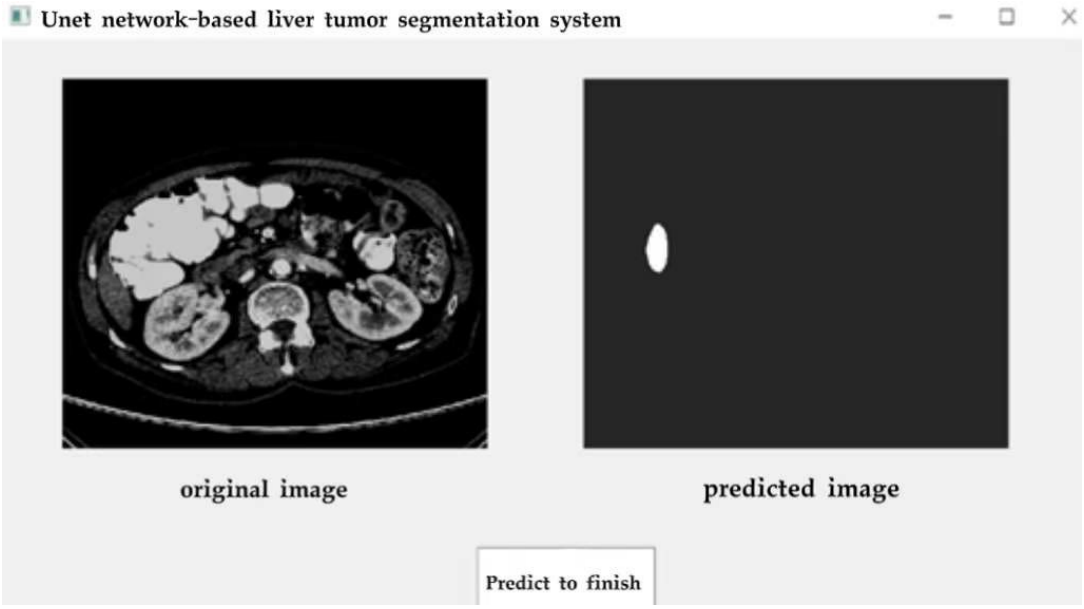

Figure 2: System interface

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