ARTIFICIAL INTELLIGENCE-BASED METHOD FOR URINARY BLADDER CANCER DIAGNOSTIC

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Abstract: Bladder cancer is a disease that involves abnormal urinary bladder cell growth. The aim of this paper is to describe a diagnostic method of detecting bladder cancer using artificial intelligence. The first step was to obtain a sufficient image data set, which is achieved by using appropriate image pre-processing algorithms. These algorithms were created using digital filters and various statistical methods. The convolutional neural network model is being used for feature extraction and bladder cancer detection. Aforementioned image data set is divided into two parts which are used for training and testing convolutional neural network. Based on training and testing data the accuracy of neural network was investigated.

Introduction

Bladder cancer is a disease that involves abnormal urinary bladder cell growth. The aim of this paper is to describe a diagnostic method of detecting bladder cancer using artificial intelligence [1, 2]. Urinary bladder cancer diagnostic algorithm is based on tissue image classification. Images are obtained by biopsy of tissue in the area where a reasonable suspect of cancer is present. Example of such image is presented on Fig. 1.

Obtaining a sufficient image data set

For achieving better results, a larger data set is needed. This is achieved by adding impulsive noise to the image. After adding a random-positioned impulsive (salt and pepper) noise to all images in data set, a larger data set is obtained. Impulsive noise is achieved by adding a high or low value to random pixels. Example of such image is presented on Fig. 2.
Neural network based diagnostic algorithm

Neural network-based diagnostic is defined with image pixels value propagation through neural network [3, 4]. In this case an algorithm which differs from convolutional neural network is chosen. The base of this algorithm is image pre-scaling, rather than pixels pooling. To achieve image contour detection, image filters are applied. Output data are defined like 0 if the image presents healthy tissue, and 1 if the image presents cancer tissue. Image rescaling is achieved by using OpenCV python library and function resize. Function resize performs the geometric image transformation. Image edge detection is achieved by using Canny edge detector, as shown in Fig. 3.

For this purpose, a neural network with one hidden layer is proposed. In this step, the neural network is designed by using scikit-learn python library. The Rectified Linear Unit (ReLU) activation function and Adam optimizer were used. This neural network alongside image pre-editing algorithm gives results with 76% accuracy. Same results are achieved by using TensorFlow for neural network design.
Convolutional neural network-based approach

Python3 programming language and numerous libraries were used during the design of the convolutional neural network. Libraries that should be highlighted are Tensorflow and TF-Learn which are most commonly used for machine learning and because of which the process of building neural networks is considerably simplified. The convolutional neural network layers are made using the conv_2d, max_pool_2d and fully connected functions that can be used if the TFLearn library is installed. The constructed convolutional neural network consists of five convolutional layers, five pooling layers and two fully connected layers. The ReLU activation function and Adam optimizer were used. Such a network achieved accuracy that ranged from 95% to 98%. Figure 4 shows the results of the convolutional neural network where all images are correctly classified.

![Fig. 4 Results of the classification of the convolutional neural network](image)

Conclusion

In this paper is shown that convolutional neural network is the appropriate algorithm for urinary bladder cancer diagnostic. This approach achieves greater accuracy than the traditional approach. This algorithm can offer a possibility of implementing an application-based tool in urinary bladder cancer diagnostic.

References:


