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Vertebrae Segmentation Techniques for Spinal Medical Images

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***Abstract*: Accurate localization and segmentation of the spine from medical images plays an important role in CAD (Computer Aided Diagnoses) as it used for many clinical tasks to diagnose many diseases like degenerative disc disease, kyphosis, scoliosis and spondylolisthesis. Besides it can be used as an input to the classification process. The bone structures in medical images have high contrast but the vertebrae identification is considered a challenging task due to many difficulties like the unclear boundaries of the vertebrae, the abnormal spine curves and complex structure of the vertebrae. In order to achieve an accurate, efficient and automated spine segmentation and detection from medical images, there are several techniques. This paper analyzes and review the different vertebrae segmentation techniques. The spine segmentation task divides into three main stages: initial spine skeleton detection, vertebrae segmentation of the spine while the third stage is designed to enhance the results of the vertebrae segmentation. After segmentation process classification is done. In this paper segmentation process is comprised of three algorithms and they are k-means segmentation algorithm, otsu's segmentation algorithm and fuzzy-c-means segmentation algorithm. Feature extraction is done by the help of this segmentation algorithms. Finally, the extracted image is given as input to the classification process and finally the output is classified. This paper presents different algorithms for each stage as each algorithm is supported by one or more paper which explain the algorithm.**

***Keywords*: Classification, Computer aided diagnosis, Medical images, Segmentation, Spine segmentation, Vertebrae segmentation**

1. Introduction

During the past few decades, the importance of the medical images has increased significantly. It is considered as an important tool to visualize the interior body, reveal internal structures and achieve information about the human body to be able to diagnose and treat diseases. There are different types of medical images such as ultrasound, Computed Tomography (CT) scans and Magnetic Resonance Images (MRI). Each type of them used for specific purpose. Medical Ultrasound used to visualize the soft tissues in real time. CT images use the combination of many X-ray to demonstrate and make 3D images of body organs. MRI is used to provide detailed images of ligaments and cartilage which are not visible using other medical images types. CT provides accurate 3D images of the spinal anatomy. The medical image processing has attracted more and more attention from computer science experts. As, it has many applications such as visualization, segmentation and registration. Medical image segmentation plays a fundamental rule in medical image processing. It is known as the problem of partitioning the medical image into meaningful parts. It is used for many purposes such as understanding image content, extracting the important features of the image, searching and mining in the medical image, detecting boundaries within medical images and obtaining further diagnoses insight. Due to many challenges like the large amount of data, wrong manual steps in taking medical images and the requested high accuracy, the medical image.

2. Objectives

The main objective is to produce higher accuracy image. In proposed method the accuracy is increased more than the existing method for clear view and tumor is detected.

3. Block diagram

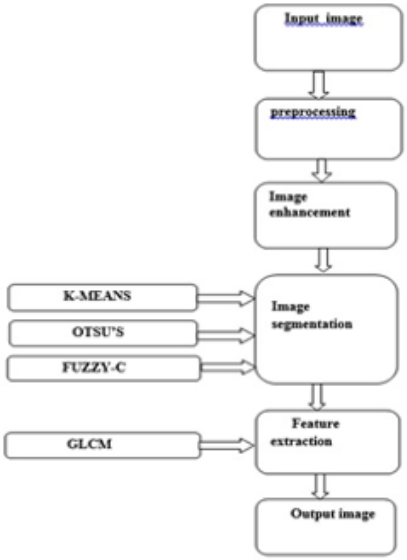

Fig. 1. Block diagram segmentation process

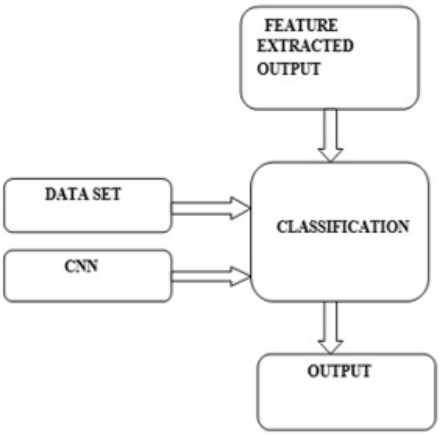

Fig. 2. Block diagram of classification process

4. Methodology

Preprocessing is done for input image and image segmentation is done. The segmentation process consists of three different segmentation algorithms. These algorithms are used to detect the tumor in spinal chord by comparing the three different accuracies that is generated in segmentation process. By using segmentation algorithms output we do feature extraction. For feature extraction we use GLCM (gray level co-occurence matrix) as extraction algorithm. The extracted image is given as input to classification process. In classification we use CNN (convolutional neural network) algorithm to classify image and finally the state of the disease is found.

5. Components


Fig. 3. Pentium IV processor

Pentium IV processor: Pentium IV is a brand by intel for an entire series of single-core CPUs for desktops, laptops and entry-level servers. The processors were shipped from November 20, 2000, until August 8, 2008. All Pentium 4 CPUs are based on the NetBurst architecture. The Pentium 4 WILLAMETTE (180 nm) introduced SSE2, while the PRESCOTT (90 nm) introduced SSE3. Later versions introduced Hyper-Threading Technology (HTT). The first Pentium 4-branded processor to implement 64-bit was the Prescott (90 nm) (February 2004), but this feature was not enabled. Intel subsequently began selling 64-bit Pentium 4s using the "E0" revision of the Prescotts, being sold on the OEM market as the Pentium 4, model F. The E0 revision also adds execute Disable (XD) (Intel's name for the NX bit) to Intel 64. Intel's official launch of Intel 64 (under the name EM64T at that time) in mainstream desktop processors was the N0 stepping Prescott-2M. Intel also marketed a version of their low-end Celeron processors based on the NetBurst micro architecture (often referred to as Celeron 4), and a high-end dersivative, Xeon, intended for multi socket servers and workstations. complemented by the dual-core -brands Pentium-D and Pentium Extreme Edition.

MATLAB R2018a: MATLAB (matrix laboratory) is a multi-paradigm numerical computing environment and proprietery programming language developed by MathWorks. MATLAB allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages, including C, C ++, Java, Fortron and Python.Although MATLAB is intended primarily for numerical computing, an optional toolbox uses the MuPAD symbolic engine, allowing access to symbolic computing abilities. An additional package, Simulink, adds graphical multi-domain simulation and model-based design for dynamic and embedded systems.As of 2018, MATLAB has more than 3 million users worldwide. MATLAB users come from various backgrounds of engineering, science, and economicsThe MATLAB application is built around the MATLAB scripting language. Common usage of the MATLAB application involves using the Command Window as an interactive mathematical shell or executing text files containing MATLAB code. When creating a MATLAB function, the name of the file should match the name of the first function in the file. Valid function names begin with an alphabetic character, and can contain letters, numbers, or underscores. Functions are often case sensitive. MATLAB supports elements of lambda calculus by introducing function handles, or function references, which are implemented either in .m files or anonymous nested functions.

6. Advantages

- Time consuming process for detecting the vertebrate
- More accuracy.
- High efficiency.

A. Disadvantages

- The software installation process is tedious

B. Future scope

There are various types of enhancement techniques used to increase the contrast of the CT images. The images can also be extracted in 3-D by using other complex algorithms.

7. Conclusion

Vertebrae segmentation techniques for spinal medical images is implemented and the output is generated. Detection of tumor is done by using segmentation and classification algorithm and the feature is extracted. This proposed system is designed to produce higher accuracy and very efficient in terms of detection.

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