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Alzheimer's Detection Based on Segmentation of MRI Image

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Abstract

In recent years, digital medical imaging technology has opened its door to the community. In this paper we provide a software solution for detecting the brain abnormalities for detection of Alzheimer's disease. The proposed algorithm is to produce a 3D representation of the brain from the MRI slices. This method is more accurate and reliable. MRI slices undergo different processes such as de-noising, segmentation, slice-o-matic (3D construction), and calculation of residual volume of brain parts. It uses the grey to white matter ratio for determining if the person is affected by Alzheimer's disease.

1. Introduction

One of the most complex and integral parts of the human body is the brain. It is the centre of the human nervous system. It is made up of more than 100 Billion of nerves that communicate in trillions of connections called synapses. The important functions of the brain includes thinking and voluntary movements, responsible for coordination and balance, creative visualization, executive planning, language and math, memory and learning and emotional responses.

As brain is the centre of the nervous system any abnormal behaviour or functioning of it may cause total collapse of the entire body functionalities. Such an abnormality may lead to Alzheimer's disease. It is a common form of dementia. It causes problems with memory, thinking and behaviour. Alzheimer's is an irreversible neurodegenerative dementia that occurs frequently in elder adults about 65. There is no cure available presently for this disease. But

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Researchers are making effort to find appropriate treatment for this dementia which can improve the quality of life for both the patients and their families. Therefore the development of an automatic Alzheimer's detection (AD) is economically desirable. More than 5 millions of Americans have Alzheimer's disease and it is expected to increase up to 16 million people by 2050. It is one among the top 10 disease in America which causes death.

Brain consists of about 100 billion nerve cells and each nerve cell is connected to the other nerve cells and thus forming a communication network. As one ages the brain develops plaques and tangles. They are first developed in the brain an area involved in the memory and eventually spreads out to the other parts of the brain. These plaques and tangles disable or block the communication among the nerve cells and distress its function and eventually the cells will die. The distraction and the death of the nerve cells cause memory failure, personality changes, problems in carrying out daily activities and other symptoms of Alzheimer's disease.

The analysis of the neuroimaging data has achieved much attraction recent years, which provide early and accurate detection of Alzheimer's disease. Alzheimer's disease is widely studied from Magnetic Resonance Imaging (MRI) data, captured by MRI scanner and creates the pictures of scanned tissue. Nowadays, the software programs available made it easy for the computation of the grey matter in the human brain automatically. Presently, Voxel Based Morphometry (VBM) is used for the clinical procedure with less execution time [1]. The main advantage of VBM is that it is not biased to any particular structure but it can be applied to any part of the brain [2]. The software used for the clinical diagnosis of the Alzheimer's disease in Japan are the stand alone VBM software and voxel based specific regional analysis system for Alzheimer's disease. Alzheimer's detection is possible by grey matter volume loss in the mild cognitive impairment group compared to normal aged person[3].AD is widely study from MRI data using fractal based [4].[5], independent component analysis based [6], advanced local binary pattern of brain [7]. Even from MRI data earlier detection of AD is possible [8].

The neuroanatomical configurations and the difference in the structure of the individual brains may cause overlooking of the structural alterations by visual inspection [9]. Moreover the visual inspection is very difficult to identify the minute changes in the human brain. MRI 3D segmentation of brain help physician to view more information in new perception of AD [10].

This paper uses the Magnetic Resonance Imaging (MRI) for detecting the abnormalities in the brain. The best acquisition of the brain can be obtained from the MRI because of its high contrast, excellent spatial resolution and high availability. Here the input is taken as the MRI image and it is processed for diagnosis. The objective of this paper is to reconstruct the brain in 3D format and then find the grey and white volume. If the ratio of grey volume to white volume exceeds certain threshold, then it is detected as an abnormality.

2. Material and Methods

2.1. Magnetic Resonance Imaging

The MRI, or nuclear magnetic resonance imaging (NMRI) is a non-invasive medical imaging technique which is used in radiology to visualize the internal structure and function of the body. MRI is used especially in musculoskeletal neurological (brain), oncological (cancer), and cardiovascular imaging. Here a powerful magnetic field, computer and a radio frequency pulse are used to produce detailed picture of soft tissues, organs, bones and other internal body structures. The traditional MRI unit is a large tube which is cylindrically shaped surrounded by a circular magnet. Unlike computed tomography (CT) scans and conventional X-rays, MRI does not utilize ionizing radiation. A powerful magnetic field will align he nuclear magnetizing of hydrogen atoms of water in the body, while the patient is in the scanner without causing any chemical reaction in the body. Certain amount of energy will be emitted as the hydrogen atoms return to their usual alignment. The energy emitted will depend on the type of body tissue. This energy will be captured by the MR scanner and create he picture of the scanned tissue based on the information. MRI is considered as a new technology. Earlier this technique was known as NMRI. The word nuclear was associated with ionizing radiation exposure; it is now referred to as MRI. The term NMRI is still used by scientists, to define the non-medical devices operating on the same principles.

2.2. Wavelet Transform

There are several methods for de-noising the image. For the analysis of abrupt changes in an image a new method called wavelets is used which is localized in time and frequency. Wavelets are rapidly decaying wave like oscillations