Detection of Brain Tumor in MRI Images, Using a Combination of Fuzzy C-Means and Thresholding

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ABSTRACT

The identification, segmentation, and detection of the infected area in brain tumor is a tedious and a time-consuming task. The different structures of the human body can be visualized by an image processing concept, an MRI. It is very difficult to visualize abnormal structures of the human brain using simple imaging techniques. An MRI technique contains many imaging modalities that scan and capture the internal structure of the human brain. This article concentrates on a noise removal technique, followed by improvement of medical images for a correct diagnosis using a balance contrast enhancement technique (BCET). Then, image segmentation is used. Finally, the Canny edge detection method is applied to detect the fine edges. The experiment results achieved nearly 98% accuracy in detecting the area of the tumor and normal brain regions in MRI images demonstrating the effectiveness of the proposed technique.

KEYWORDS

Balance Contrast Enhancement Technique (BCET), Canny Operator, Edge Detection, Image Segmentation, Magnetic Resonance Imaging (MRI) Images, Tumor Pathology

INTRODUCTION

Image processing techniques play an important role in the diagnostics and detection of diseases and monitoring the patients having these diseases. Digital image processing consists of algorithmic processes that transform one image into another in which certain information of interest is highlighted, and/or the information which is irrelevant to the application is attenuated or eliminated. The majority of hospitals use digital technology system to support their work because the system can bring users many benefits. The diagnosis result is dependent on the medical image because doctors often use the image to find out medical problems for patients. Based on the information from the image, especially object boundaries doctors will build a suitable treatment plan to save their lives. In fact, many patients are died by inaccuracy in diagnosis, which comes from a lack of information in the image because the image has not been processed effectively. And the edge detection is one of the important fundamental tools in image processing, particularly in the areas of feature detection and feature extraction, which aim at identifying points in a digital image at which the image has discontinuities (Cadena et al., 2017).

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A brain tumor is a collection of abnormal cells in the brain. A tumor may lead to cancer, which is a major leading cause of death and responsible for around 11% of all deaths worldwide. The cancer incidence rate is growing at an alarming rate in the world. So, detection of the tumor is very important in earlier stages. Diagnosing brain cancer begins with taking a thorough personal and family medical history, including symptoms and risk factors for brain cancer. The diagnostic process also includes completing a thorough physical and neurological exam. A neurological helps to evaluate the brain and nervous system and such functions as reflexes, sensation, movement, balance, alertness, coordination, vision, and hearing. Great knowledge and experience on radiology are required for accurate tumor detection in medical imaging. The brain tumor is a threat level depend upon the combination of factors like the type of tumor, its position, its size and its state of growth.

Magnetic Resonance Imaging (MRI) is an advanced medical imaging technique used to produce high-quality images of the parts contained in the human body MRI imaging is often used when treating brain tumors, ankle, and foot. MRI is an advanced medical imaging technique used to produce high-quality images of the parts contained in the human body MRI imaging is often used when treating brain tumors, ankle, and foot. MRI is attracting more and more attention to the brain tumor diagnosis in the clinical.

The authors have come across many works like detection of brain activation using conditional random field (CRF) (Wu, Chen, Zhao & Corso, 2014), early functional brain development with the data collected from the children during natural sleep (Redcay, Kennedy & Courchesne, 2007), and calculation and visualization of volumetric white affair property in diffusion tensor (DT) MRI (Kang, Herron, Turken & Woods, 2012). Extraction of texture places of the brain’s white matter (WM) and single cell detection (Leitea et al, 2016), topological visualization of human brain diffusion MRI (Schultz, Theisel & Seidel, 2007).

Brain tumor identification form magnetic resonance imaging (MRI) consists of several stages. Segmentation is known to be an essential but difficult step in medical imaging classification and analysis. The extraction of the brain tumor requires the separation of the brain MR images into two regions (Ain, Jaffar & Choi, 2014). One region contains the tumor cells of the brain and the second contains the normal brain cells (Abdel-Maksoud, Elmogy, & Al-Awadi, 2015). Sharma, Diwakar, and Choudhary (2012), Selvakumar, Lakshmi and Arivoli (2012) proposed Fuzzy C-Means (FCM) clustering method is often used for image segmentation. Zanaty (2012) proposed a methodology for brain tumor segmentation based on a hybrid type of approach, combining FCM, seed region growing, and similarity coefficient algorithm to measure segmented gray matter and white matter tissues from MR images. To solve the problem of the geometric image analysis, the allocation of linear and non-linear features (edges, borders, contours of the objects) the methods such as Sobel, Prewitt, Roberts, Cann and LoG (Canny, 1986; Stosis & Rutesic, 2018), and shearlet transform (Hauser, 2011) can be used.

The existing methods of tumor detection and evaluation are divided into region-based and contour-based methods. Region-based methods in (Dou, Ruan, Chen, Bloyet & Constans, 2007; Corso, Sharon & Yuille 2006) seek out clusters of pixels that share some measure of similarity. These methods reduce operator interaction by automating some aspects of applying low-level operations, such as threshold selection, histogram analysis, classification, etc. In general, these methods take advantage of only local information for each pixel and do not include the shape and boundary information. Many researchers use a wide range of techniques based on segmentation to solve the problem of localizing and analyzing the characteristics of a brain tumor. Verma (2017) conducted medical image segmentation based on morphological operators along with threshold selection. The work of Rajesh and Bhchalandra (2012) has been used morphological operations along with threshold and watershed segmentation, and Shah (2014) proposed a hybrid approach, which is a combination of the watershed method and the Canny edge detection method to detect the tumor boundaries in an MRI image for different cases of brain tumor. The main objective of this article is to create a trustworthy procedure detection of tumors of a multimodal MRI record based on segmentation.
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