A Novel Brain Image Processing Method for the Application of Detecting the GBM Disease Patterns in Anatomic Sections of T1-weighted 3D Magnetic Resonance Imaging

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***Abstract*—In this study, a novel brain image processing method is proposed to detect one of the most aggressive malignant primary brain tumors, the glioblastoma multiforme (GBM), using the minimum distance classifier (dGBM-MDC) for supporting clinical diagnosis system in anatomic sections of T1-weighted 3D magnetic resonance imaging (MRI). In the approach, we begin with the image conversion in the model of L* component in the L*a*b* space, which provides an image model of pixel values of colors. Then a small sample region of colors is selected in order to compute the average value in each pattern color before the image pattern classification with the MDC; the MDC is employed to classify each pixel by calculating the Euclidean distance between that pixel and each color marker of image patterns for image segmentation. We implement the proposed approach of the dGBM-MDC in the samples of three anatomic sections of a T1w 3D MRI (axial, sagittal and coronal cross-sections) on the real-time GBM-3D-Slicer datasets. The implementation results demonstrate the robustness and efficiency for the detection the GBM disease pattern as compared with manual slice-by-slice segmentation performance.**

***Keywords*—Image color conversion, segmentation, minimum distance rule, clinical decision support system, glioblastoma multiform , L*a*b* color, magnetic resonance imaging.**

I. INTRODUCTION

Most of brain tumors occur in the cerebral hemispheres and can develop in other parts of the brain such as the corpus callosum, brainstem or spinal cord. The cells of brain tumors could grow quickly, and could spread throughout the brain. Brain tumors in adults occupy the 13th place in frequency of all cancers, and due to their particularly poor prognosis in brain they are the fifth most common cause of cancer death in the under 65-year-old population (Weiner et al., 2013; Bagcı, et al., 2012; Szwarc, et al., 2010).

A glioblastoma multiforme (GBM) is one of the most common and most aggressive malignant primary brain tumors. The GBM could increases with age, and affect more men than women. It is reported that the incidence of the GBM is 2 to 3 per 100,000 people in the United States and Europe. The GBM accounts for 12% to 15% of all intracranial tumors and 50% to 60% of astrocytic tumors. In clinical, the treatments for the GBM patients typically include maximum safe resection, percutaneous radiation, chemotherapy and surgical operation. It is evident that the volume of GBM could provide an indicator of disease progression and, potentially, treatment outcomes for patients with the GBM. Clinical studies have shown that some modalities of biomarkers have been proved to be sensitive to the GBM in the detection, including the measure of the volume of GBM through magnetic resonance imaging (MRI). The patients with GBM may benefit from the detection of tumors in the early stage, in order to receive primary care or undergo clinical procedures to address the progressive symptoms (Egger et al., 2013; Iturria-Medina, et al., 2016; CBTC, 2015; Bauer, et al., 2013).

In medical community, the tumor volumes are computed in MRI scans generally on a manual slice-by-slice basis at regular intervals (Tohka, 2014; Egger et al., 2013; Huang et al., 2009). However, the huge amount of image data produced by imaging devices, for example, the MRI, makes the detection of potential diseases a burdensome task causing oversight errors in digital pathology images. Developments in computer vision and image processing algorithms in medical image interpretation have shown that the automatic detection methods for disease patterns can pursue the major objective of carrying out mass screening campaigns, acting as a fully automated system (Pepe et al., 2013; West et al., 2012).

Therefore, a robust method which could offer the analysis of GBM volume with systematic quantitative measurements in the anatomic sections of MRI is important in the detection of the GBM clinically. The challenge has been established. This study seeks to address the challenge for detecting the GBM in the samples of the three anatomic sections of a T1w 3D MRI on supporting the clinical decision-making systems.

II. METHOD

The transformation of a color image is very common in digital image processing for image pattern detection. The transformation model of images will provide a rich estimate of image pixel regions of colors for image segmentation process (Rafael, et al., 2008; Tong, et al., 2013).

Figure 1 shows the proposed method for detecting the GBM with the minimum distance classifier (dGBM-MDC) for supporting clinical diagnosis system. The proposed method of the dGBM-MDC mainly consists of the five steps, including the image conversion in the L* of the L*a*b* space, an image

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