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An Effective Brain Tumor Detection System Using Extended Linear Boosting (ELB) Classification Algorithm

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ABSTRACT

Automated computer-aided soft computing methods are presently used to detect the tumor regions in brain images. In this paper, the tumor cells are detected in the brain Magnetic Resonance Imaging (MRI) using the Extended Linear Boosting (ELB) classification method as one type of soft computing process. This paper proposes an effective brain tumor detection and segmentation method using the ELB classification method. The Curvelet transform is applied on the source brain MRI image to convert the spatial domain pixels into multi-resolution pixel. The spectral and linear discriminate features are computed from the Curvelet transformed coefficient matrix. The dimensionality of the computed features is reduced using the PCA method and the optimized features are then classified using the ELB classification method. The performance evaluation metrics, sensitivity, specificity, accuracy and detection rate, are used in this paper to evaluate the performance of the proposed brain tumor detection and segmentation system.

KEYWORDS

Curvelet transform; Optimized features; Segmentation; Soft computing; Tumor cells

1. INTRODUCTION

The cells in the human brain may have different growth rate based on the size and location of the cells in the brain regions. The brain cells have normal and abnormal growth rates. The cells having normal growth rate are slowly developed in the brain regions without disturbing the surrounding cells [1]. The cells having abnormal growth rate are rapidly developed and multiplied in abrupt manner, which affects the other nearby cells in the brain regions. The cells having abnormal growth rate cells are called tumor cells. As per the recent research, there are around 120 types of tumor cells categorized into benign and malignant [2]. The benign cell is a biopsy cell and it does not lead to cancer. The malign cell is a cancerous cell and develops faster than the benign cells in the brain. The timely detection of these abnormal tumor cells in the brain region may help the radiologist to save the human life by giving proper treatments [3–7]. Figure 1(a) shows the benign case brain MRI image and Figure 1(b) shows the malignant case brain image.

The noninvasive modality methods are presently used to scan the internal regions of the brain [8,9]. These methods include Computer Tomography (CT), Magnetic Resonance Imaging (MRI) and Positron Emission Tomography (PET) based on the emitted radiation levels. The internal regions through the hard skull regions are not clearly visible in the CT modality method [10]. Hence, the MRI modality method is used which clearly detects both hard and soft tissues in the brain regions with less amount of radiation. The PET modality is rarely used due to their high level of emitted radiation [11]. Over the past decades, the manual tumor detection has been carried through radiologists or physicians. It is a very time-consuming and error probe method in the case of high population countries. To overcome such limitations in the manual tumor detection and segmentation process, automated computer-aided soft computing methods are presently used to detect the tumor regions [12]. In this paper, the tumor cells are detected in the brain MRI image using the ELB classification method as one type of soft computing process.

This paper is structured as the following sections. The conventional brain tumor detection and segmentation methods are depicted in Section 2, the proposed methodology for brain tumor detection system using ELB classification approach is explained in Section 3, the experimental results and their corresponding discussions are highlighted in Section 4. Section 5 highlights the main findings in this paper as conclusion.

2. LITERATURE SURVEY

Nasor *et al.* [4] used a patch-based clustering approach for the detection and segmentation of tumor regions in brain MRI images. K-means clustering technique was applied on the brain image to segment the abnormal