Chapter 9
Automated Brain Tumor Detection From Magnetic Resonance Imaging Using AI–PSO–Based Deep Learning Models

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ABSTRACT

The proposed methodology begins with optimizing deep CNN parameters using

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Particle Swarm Optimization (PSO) to find an optimal configuration that maximizes the network's performance. PSO aids in the exploration of the high-dimensional parameter space, optimizing CNN's convolutional layers for feature extraction. Subsequently, the CNN is employed to automatically extract hierarchical features from magnetic resonance imaging (MRI) scans, capturing intricate patterns indicative of automated brain tumor detection. Healthcare practitioners can use the AI-PSO-Based Deep Learning Models for automated detection and diagnosis purposes.

1. INTRODUCTION

The detection and accurate diagnosis of brain tumors are pivotal in the landscape of neurological medicine, significantly influencing treatment decisions and prognostic evaluations. Brain tumors, characterized by abnormal cell growth within or around the brain structure, can be classified broadly into primary (originating in the brain) and secondary (metastatic, originating elsewhere in the body). These tumors vary greatly in terms of malignancy, growth rate, and impact on surrounding neural tissues, making their detection and characterization a complex and nuanced task [**Ali, M. et al. (2022);Sivanantham, K. (2022)**].

Traditionally, brain tumor diagnosis relies heavily on imaging techniques such as Magnetic Resonance Imaging (MRI) and Computed Tomography (CT) scans. These imaging modalities provide detailed views of the brain's structure, enabling medical professionals to identify anomalous growths or changes in tissue density. However, the interpretation of these images is highly reliant on the expertise of radiologists and can be both time-consuming and subject to human error. Subtle nuances in tumor appearance, which could be crucial for diagnosis and treatment planning, might be overlooked or misinterpreted **[Ibrahim R et al. (2023);Krishna, T. G. et al. (2018);Kapoor, A., & Agarwal, R. (2021)].**

The advent of machine learning, and more specifically, deep learning, presents a transformative opportunity in medical imaging. Deep learning algorithms, particularly Convolutional Neural Networks (CNNs), have demonstrated remarkable success in image recognition tasks, outperforming traditional image processing methods in terms of both speed and accuracy. These algorithms can automatically learn hierarchical feature representations from vast amounts of data, making them particularly suited for the complex and varied data presented by brain scans **[Dixit, A., & Nanda, A. (2019, August)]**.

Brain tumor is one of the most diagnosed malignant tumors in persons of all ages, and tumor detection has been an active research topic in the modern years because of the high mortality rate. Detecting and classifying contaminated tumor locations using the Magnetic Resonance Imaging (MRI) is critical. Detecting the type of tumor

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