2024 IEEE International Symposium on Smart Electronic Systems (iSES)

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Deep Learning for Brain Tumor Detection with FPGA Pathway

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Aniruddha Mallick ; Hriya Prasad ; Prasenjit Maji ; Subhabrata Banerjee ; Hemanta Kumar Mondal All Authors

Abstract:
Brain tumors, particularly gliomas, present significant challenges in medical science because of their high incidence, recurrence, and mortality rates. Perfect diagnosis using Magnetic Resonance Imaging (MRI) is crucial. Recent developement in deep learning, particularly in Convolutional Neural Networks (CNNs) and transfer learning models, have significantly enhanced the automation and accuracy of medical image analysis. This work proposes a comprehensive framework for classification of brain tumor using MRI data, integrating CNN, VGG16, and EfficientNetB0 models with a Field Programmable Gate Array (FPGA) implementation pathway. Our approach enhances the models' resilience and applicability using robust data augmentation methods, including geometrical transformation. Experimental results demonstrate that both CNN and EfficientNetB0 achieve classification accuracies exceeding 90%, showcasing their effectiveness in distinguishing between gliomas, meningiomas, and pituitary tumors. The FPGA-based accelerator significantly improves processing efficiency. This framework advances tumor classification and addresses computational challenges, paving the way for practical applications in medical diagnostics.

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I. Introduction

Brain tumors represent one of the most critical challenges in medical science due to their high incidence, recurrence, and mortality rates. Gliomas, in particular, are the most common malignant tumors originating from glial cells within the brain and spinal cord. Precise and prompt diagnosis is necessary for productive treatment and enhanced survival outcomes. MRI is the pr

and diagnosing brain tumors, offering precise images of brain structures and abnormalities. However, the Hand-drawn segmentation and classification of brain tumors from MRI images by radiologists is time-consuming and error-prone due to the increasing volume of

Authors

Aniruddha Mallick
Electronics and Commu. Engg., Institute of Engineering & Management, Kolkata, India

Hriya Prasad
Electronics and Commu. Engg., National Institute of Technology, Durgapur, India

Prasenjit Maji
Computer Science and Design, ECE, Dr. B. C. Roy Engineering College, NIT, Durgapur, Durgapur, India

Subhabrata Banerjee
Electronics and Communication Engineering, Institute of Engineering & Management, University of Engineering and Management, Kolkata, India

Hemanta Kumar Mondal
Electronics and Communication Engineering, National Institute of Technology, Durgapur, India

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