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Explainable MRI-Based Diagnosis of Diverse Brain Conditions Using Ensemble Learning

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Abstract : Magnetic Resonance Imaging (MRI) is essential for the differential diagnosis of brain diseases, with deep learning methods showing promise for enhancing diagnostic accuracy. This study develops an ensemble learning model incorporating DenseNet121, EfficientNetB1, and ResNet50 architectures for the accurate classification of diverse brain conditions, including glioma, meningioma, pituitary tumors, and multiple sclerosis (MS). The model is trained on publicly available MRI datasets, utilizing Gradient-weighted Class Activation Mapping (Grad-CAM) to increase interpretability by highlighting crucial image regions, thereby enhancing transparency in AI-assisted diagnostics. The ensemble model achieved a notable classification accuracy of 99.84%, demonstrating its reliability in distinguishing multiple brain conditions. Grad-CAM visualizations further support the model's decision-making, fostering trust in clinical applications. This approach offers a valuable tool for MRI-based diagnosis, emphasizing both accuracy and interpretability in neuroimaging. Future research will expand to larger, diverse datasets to ensure robustness across varied clinical settings.

Keywords : brain tumor, ensemble learning, explainability, grad-cam, glioma, interpretability, meningioma, multiple sclerosis, pituitary, XAI
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