INFORMATICS INSTITUTE OF TECHNOLOGY

In Collaboration with

UNIVERSITY OF WESTMINSTER

BrainGuard: Unified Approach for MRI-Based Detection of Brain Diseases Using Mixture of Experts

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Submitted in partial fulfilment of the requirements for the BEng in Software Engineering degree at the University of Westminster.

April 2025

ABSTRACT

Problem: This research presents a unified deep learning framework for detecting the different brain disorders like tumors, stroke, and dementia from 224 x 224 image size. The framework can operate without additional datasets or data augmentation. The research also examines other approaches including Mixture of Experts and attention-based models that pairwise the computational burden between models to improve both accuracy and efficiency. Further improvement of the attention mechanisms in CNN results in higher diagnostic accuracy and places the model as a potential candidate for clinical use.

Methodology: The approach that is used in the proposed solution is the Mixture of Experts architecture, where EfficientNet, DenseNet, and ResNet trained backbones are used for training. The expert models in the system were trained on a set of images and were selected to identify features related to a given disease. The Mixture of expert architecture was extended with a Gating Network, that is, the input image is forwarded to several expert models. The features are extracted from the image in parallel and each of the experts provide a score considering the analysis. The Gating Network then joins these scores, but it only uses the most important features of the scoring system. The use of this methodology assists in increasing the generality of the model in medical conditions through utilizing the most relevant information from the expert models.

Initial Results: The model was also able to accurately distinguish between intricate class differences as well as complex patterns regarding several neurological disorders. With the same dataset, having 1000 images per class, it reached a classification accuracy of 96.11%, precision of 96.15%, recall of 96.11% and F1-score of 96.09%. This fact that such a generalization is achieved even without data augmentation hints at the benefits of this approach for real-world clinical use where the volume of data is large, and the time required to process it is scarce.