Augmenting 3D, T1-Weighted, Magnetization-Prepared Rapid Acquisition with Gradient-Echo (MP-RAGE) Sequenced MRIs Through Gaussian Filters and Skull Stripping for Alzheimer's Disease Diagnosis via 3D CNNs

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Alzheimer's Disease is a progressive neurodegenerative disease that results in memory loss and a general cognitive decline, afflicting approximately 45 million people worldwide with the rate expected to sharply increase in the near future. There currently exists many proposed methods of applying neural networks for the early diagnosis of Alzheimer's Disease, with different models accounting for longitudinal data, for 3D and 2D data, and for different modalities. The existing research has established the potential for neural network application with magnetic resonance imaging (MRI) for early diagnosis; however, there exists no standardized method for preprocessing the MRI scans, with each paper utilizing a different software with different levels of processing. Thus, this study evaluates neural network efficiency, when trained on a single dataset with three different levels of preprocessing with the Statistic Parametric Mapping 12 software, to identify an optimal methodology. This paper utilized a basic supervised 3D convolutional neural network with a binary classification system (normal control (NC) vs Alzheimer's Disease (AD)). After extensive quantitative analysis and comparing the neural network accuracy for different preprocessing models, we were able to determine preprocessing is a necessary step for MRI scans, increasing accuracy on average by 8.235%. In addition, utilizing the Gaussian Filter for the MRIs resulted in an increase in accuracy by 2.25%, attesting to the merits and potential applicability of this preprocessing method. To validate the contributions of this study, this paper utilized data collected through the Alzheimer's Disease Neuroimaging Initiative.

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