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BIOMARKERS

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Developing topics

Explainable deep learning models for dementia identification via magnetic resonance imaging

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Abstract

Background: Today, to diagnose dementia, clinicians evaluate cognitive tests performed by patients and briefly analyze brain imaging data to look for biomarkers. While valuable information is present in MRI scans, these latter remain challenging to analyze and interpret. Artificial intelligence models have shown promising results to improve the current practice by supporting practitioners in the evaluation of imaging data. Nonetheless, the majority of developed statistical models are more often than not black-box systems that issue predictions without any clear interpretability, hindering their practical applications.

Methods: We propose an interpretable method based on deep learning that works on minimally preprocessed T1-weighted 3D scans of the brain. Relying on FullGrad [1], we can dissect the predictions of the model given an input scan. Once the model is trained, it can not only give an automated diagnostic but also generate a heatmap highlighting the regions of the brain that our model points to be responsible for its prediction of dementia. To ensure practicality, we integrate our model in a convenient app that can smoothly be run from a browser, as shown in the attached screenshot.

Results: We trained and evaluated our model on the OASIS dataset [2]. The specific explanation obtained by our model points at well-known biomarkers, notably by highlighting the voxels of the hippocampus of patients with dementia. Interestingly, as it can be seen in the second annex, we notice that across individuals, our model focuses more on the voxels located in the right hippocampus.

Conclusions: In this study, we show how machine learning can identify dementia patients using MRI images while ensuring interpretable decisions of the models. Our tools, including the bespoke "explainer" viewer overlaid on each patient's brain, will enable the development of better and more reliable machine-learning based diagnostics and nurture the trust of practitioners in computer-aided diagnostics. Furthermore, this will help to discover currently unknown biomarkers and thus lead to a better understanding of the disease. References: 1) Full-Gradient Representation for Neural Network Visualization, Suraj Srinivas, Francois Fleuret, 2) OASIS-3: Longitudinal Neuroimaging, Clinical, and Cognitive Dataset for Normal Aging and Alzheimer Disease, Pamela J LaMontagne.

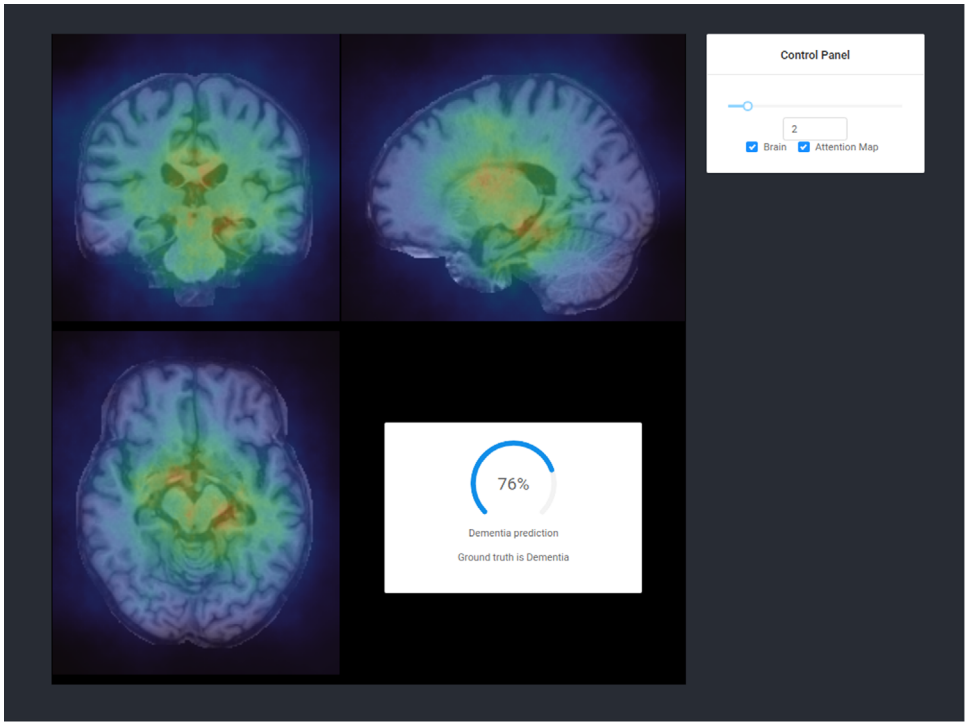

FIGURE 1

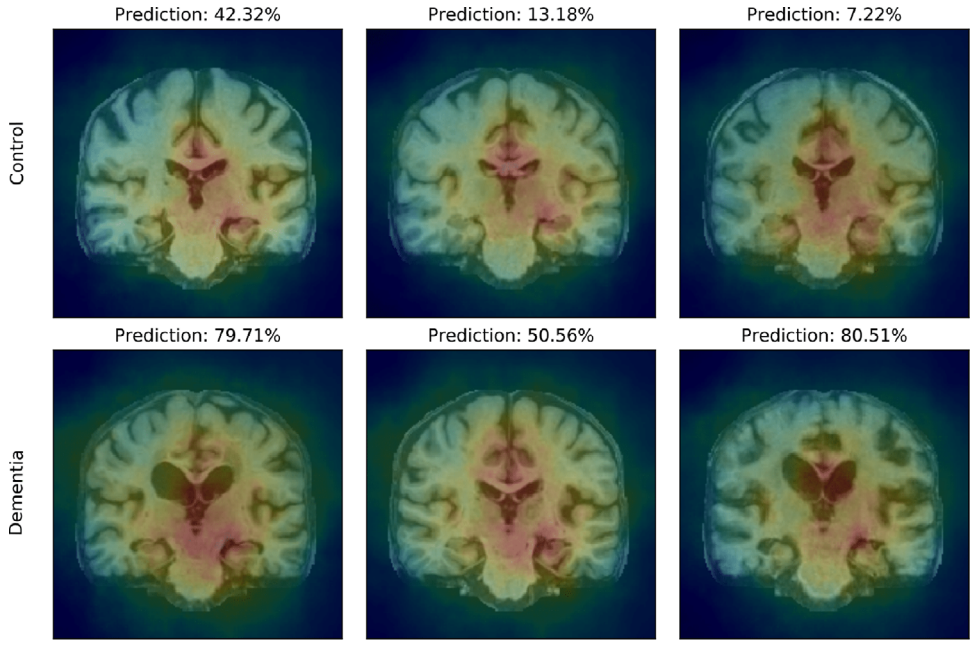

FIGURE 2