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Brain Tumor Diagnosis System Using Vision Transformers

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Background

Early diagnosis of brain tumors is critical, yet traditional workflows—spanning patient screening, lab tests, and MRI analysis—are often fragmented and slow. Recent deep learning advances, particularly Vision Transformers, offer a promising alternative for more accurate and scalable MRI image classification.

Research Question

Can a Vision Transformer model accurately classify MRI images for brain tumor diagnosis and be effectively deployed via a web-based application to support clinical decision-making?

MRI Image Upload (Input):
- The clinician uploads an MRI image via the web-based application.

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Data Preprocessing:
- The uploaded image is resized to 224×224 pixels and normalized (mean = 0.5, std = 0.5).

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Vision Transformer (ViT) Model:
- The preprocessed image is divided into 16×16 patches.
- Transformer layers process these patches and extract global features.
- A final MLP head outputs class probabilities.

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Output (Display):
- The system displays the predicted tumor class (glioma, meningioma, pituitary tumor, or no tumor) along with the confidence percentage.

Implications

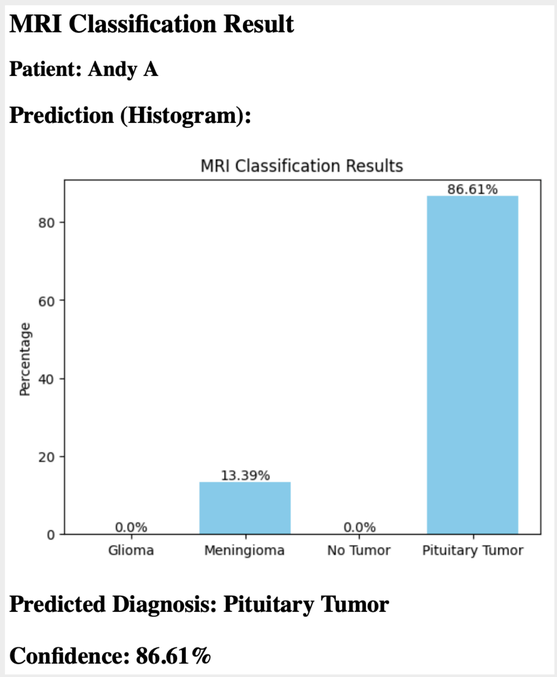
- **Enhanced Diagnostic Accuracy:** Earlier and more accurate tumor detection improves patient outcomes.
- **Streamlined Clinical Workflow:** Real-time, automated MRI analysis reduces delays and supports faster decision-making.
- **Increased Efficiency:** Automation minimizes radiologist workload and reduces misclassification rates.
- **Scalable AI Framework:** Establishes a robust platform for future integration of advanced diagnostic tools.

Materials & Methods

- **Programming:** Python 3.10, PyTorch (vit-pytorch), Jupyter Notebook
- **Hardware:** Apple Silicon (M3 Pro with GPU/MPS), AWS EC2 (p3.2xlarge)
- **Web & Deployment:** Flask, Docker, Gunicorn
- **Libraries:** scikit-learn, Matplotlib

aws

PyTorch



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