Brain Tumor Detection System

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1 Introduction

The field of Medical Imaging has witnessed significant advancements in recent years, with the transformative benefits brought by machine learning. Machine learning has become integral to diagnostic models, helping doctors interpret results more efficiently. This project focuses on developing a brain tumor detection system using machine learning models and AI to help radiologists scan for brain tumors in less time and with more efficiency. Our model achieved a 97.17% accuracy rate in detecting brain tumor regions. One of the goals of this project was to build a website for uploading medical images and displaying results. The website, developed using Flask, advises users if a tumor is detected and provides information tailored to patients.

2 Detailed Project Description

The brain tumor detection system was developed and designed to identify the presence of brain tumors in medical images and show the results. This system used traditional machine learning models (Support Vector Machine and Random Forest) alongside deep learning using Convolutional Neural Networks to determine the best approach.

2.1 Dataset

In the data collection process, I chose a publicly available dataset from Kaggle (0,). The dataset consisted of medical images divided into two classes: "No Tumor" and "Yes Tumor." Each image was resized to 64x64 pixels and normalized to ensure consistent model inputs.

2.2 Data Preprocessing

All images in the dataset were resized to 64x64 pixels, and normalization ensured that all values remained between 0 and 1. Data augmentation was introduced to increase variability using rotation and flipping. Support Vector Machine (SVM) and Random Forest were used as baseline models.

2.3 Convolutional Neural Network

A CNN was built using convolutional, Max Pooling, batch normalization, and dropout layers. The model was trained using the Adam optimizer and cross-entropy loss function. Callbacks included learning rate reduction and early stopping to achieve the best accuracy and identify the optimal number of epochs. Model checkpointing was also utilized.

2.4 Evaluation

The CNN model achieved a test accuracy of 97.17%, demonstrating high accuracy and achieving the goal of reducing false positives and false negatives.

2.5 critical examination

The "Brain Tumor Detection System" highlights a machine learning-based solution for detecting brain tumors with a CNN model achieving 97.17%accuracy. Data Augmentation and choosing a limited augmentation data was essential to not go further beyond the limit of the dataset used in the project.

3 Web Application: Brain Tumor Detection System

One of the significant aspects of this project was the development of a web application using Flask, HTML, and CSS to make the brain tumor detection system model accessible and user-friendly. This application allows users to upload MRI images and receive diagnostic predictions based on the trained model, along with advice from AI using the OpenAI API key.

3.1 Image Uploading

A feature allows the user to click a button to upload an MRI image. The image is resized to 64x64 pixels and converted to grayscale to match the brain tumor detection system model's design. If a tumor is detected, the result is displayed on the website, and the user receives advice from AI using the OpenAI API.

4 Conclusion and Summary

The brain tumor detection system project successfully showcased how machine learning models can aid in medical diagnosis. The CNN demonstrated excellent performance in detecting tumors from MRI scans, providing valuable support for healthcare professionals. While challenges remain in model optimization and dataset diversity, this project serves as a foundation for future work.

5 References

Ahmed Hamada. (2020). *Brain Tumor Detection*. Kaggle. Retrieved from `https://www.kaggle.com/datasets/ahmedhamada0/brain-tumor-detection`