Accurate Brain Tumor Detection Using CNN

# Project Objective:

The main objective of this project is to develop an AI-powered system that can automatically classify brain stroke conditions using medical imaging (CT/MRI scans).

The system aims to assist medical professionals in early detection and diagnosis of strokes, potentially improving response time and patient outcomes.

## Target Audience & Stakeholders:

Target Audience:

Radiologists and neurologists

Hospital diagnostic departments

Medical students and researchers in AI healthcare

*Stakeholders*:

Project development team (students)

Supervising professors

Hospital partners (if any)

End users (doctors, technicians)

Methodology:

#### Data Acquisition

* + MRI Dataset Collection: Gather brain MRI scans from patients, including those with brain tumor and MS
  + Public Databases: Use BRATS (tumors), MSSEG (MS lesions), or clinical images.

##### Preprocessing

* + Noise Reduction: Apply filters to remove noise.
  + Normalization: Standardize pixel intensities.
  + Skull Stripping: Remove non-brain tissues.
  + Data Augmentation: Enhance dataset with transformations.

##### Segmentation

* + Tumor and MS Lesion Detection using deep networks (U-Net, V-Net).

###### Feature Extraction

* + CNN-based feature learning for spatial/textural patterns.
  + Optional handcrafted features: shape, intensity, etc.

Classification

* + Use CNNs (ResNet, DenseNet) to classify:
    - Tumor types
    - MS presence
    - Overlapping patterns

1. MS-Tumor Correlation Analysis
   * Analyze spatial/clinical relationships between tumor and MS lesions.
2. Evaluation Metrics
   * Accuracy, Sensitivity, Specificity

- Precision, F1 Score, Dice Coefficient, AUC-ROC

- 8. Diagnosis Output

* + Tumor & MS detection results
  + Correlation analysis & visualizations

# Requirements

Functional Requirements

1. The system shall allow the user to upload brain CT or MRI images through a user-friendly interface.
2. The system shall validate the uploaded image format (e.g., JPEG, PNG) and reject unsupported or corrupted files.
3. The system shall process the image using a trained deep learning model and return the classification result.
4. The result shall include the predicted stroke type (e.g., Normal, Ischemic, Hemorrhagic) and a confidence score.
5. The user shall be able to view a summary of previously classified images and their results.
6. The system shall allow users to download classification results as a PDF report.
7. Admin users shall be able to monitor and manage the uploaded images and results (e.g., delete or reclassify).

Non-Functional Requirements

1. The classification model shall achieve at least 85% accuracy on unseen test data to ensure reliability.
2. The system shall provide feedback within 5 seconds after image submission for a smooth user experience.
3. The application interface shall be responsive and compatible with modern browsers (Chrome, Firefox).
4. The system shall maintain user privacy and ensure that uploaded medical images are not shared or stored without consent.
5. The application shall be designed to run both as a local desktop tool (offline mode) and as a web-based platform.
6. Error messages and user feedback shall be clear, informative, and guide the user in resolving issues.

Domain Requirements

1. The classification model shall be trained on a balanced dataset containing real medical brain images from diverse patient demographics.
2. The system shall clearly state that it is a decision support tool and not a substitute for professional medical diagnosis.
3. The classification result must include a timestamp and unique ID for traceability in case of medical review.
4. The system must reject non-brain-related medical images and notify the user accordingly.
5. The system should follow basic principles of medical ethics: transparency, explainability, and data security.

# UML Digrams

https://drive.google.com/drive/folders/1xP46-Okq1fgoWr8Zwq54PbAhBYJmSr8O