Brain Tumor Classification Using MobileNetV2 and Transfer Learning

1. Literature Review

Brain tumor classification is a critical task in medical imaging. Traditional machine learning algorithms often depend on handcrafted features, which can be insufficient for high-accuracy predictions. Deep learning models, especially convolutional neural networks (CNNs), have demonstrated superior performance in image-based classification tasks due to their ability to learn hierarchical features.

Transfer learning is particularly beneficial in medical imaging where labeled data is limited. Pre-trained models like MobileNetV2, trained on large datasets such as ImageNet, can be fine-tuned for domain-specific applications, including brain tumor detection.

2. Proposed Algorithm / Methodology

We propose a deep learning-based approach utilizing MobileNetV2 for feature extraction, followed by a custom classification head for brain tumor classification.

Steps:
1. Data Collection & Preprocessing: Dataset split into training and validation sets. Images resized to 224x224 and normalized.
2. Data Augmentation: Techniques such as rotation, zoom, and flipping applied to improve generalization.
3. Model Architecture: Base: MobileNetV2 (with ImageNet weights, without top layers). Added layers: GlobalAveragePooling, Dense(128, ReLU), and Dense(Softmax).
4. Training: Categorical crossentropy loss with Adam optimizer. Trained over 10 epochs.
5. Evaluation: Accuracy, loss, and confusion matrix visualized.

3. Results & Analysis

Accuracy:
The model achieved a validation accuracy of over 86.58%

Loss:
Final validation loss was 0.3418

Confusion Matrix:
The confusion matrix shows that the model is effectively distinguishing between tumor types. Misclassifications are minimal, indicating good generalization.

Plots:
- Accuracy Plot – Confirms consistent improvement over epochs.
- Loss Plot – Confirms steady reduction in training/validation loss.

4. Advantages of MobileNetV2

- Lightweight and fast.
- Suitable for deployment in real-time or resource-constrained environments.
- Outperforms traditional CNNs in speed while maintaining accuracy.

5. Limitations

- Performance may degrade on unseen types of tumors not present in the training data.
- Interpretability of deep learning predictions is still an open challenge in medical AI.

6. Future Scope

- Expand dataset with more tumor types.
- Implement Grad-CAM for explainability.
- Explore ensemble learning by combining MobileNetV2 with other models.