Research Proposal

Title: Real-Time Deep Learning Framework for Accurate Tumor Boundary Detection in Medical Imaging

1. Introduction
Tumor boundary detection is essential for accurate diagnosis, treatment planning, and surgical support. Manual segmentation is time-consuming and prone to human error. With the growth of Artificial Intelligence and deep learning, real-time tumor boundary detection has become feasible. This research proposes a real-time deep learning model to detect tumor boundaries with high accuracy using MRI, CT, and ultrasound imaging.

2. Problem Statement
Traditional tumor segmentation methods suffer from limitations such as low speed, poor performance on low-contrast images, and high dependency on expert radiologists. Existing AI models lack real-time performance required in surgeries and rapid diagnosis. Thus, a robust and fast deep learning-based solution is needed for real-time tumor boundary detection.

3. Objectives
1. To study existing tumor detection and segmentation approaches.
2. To design a deep learning architecture capable of real-time tumor boundary detection.
3. To evaluate U-Net, Mask R-CNN, and YOLO-based segmentation models.
4. To optimize the model for real-time clinical use.
5. To validate the proposed model on benchmark datasets.

4. Methodology
Data Collection: Use datasets such as BraTS, TCIA, and LiTS.
Preprocessing: Image normalization, noise reduction, and augmentation.
Model Development: Experiment with U-Net, U-Net++, Mask R-CNN, and YOLO-Seg.
Optimization: Model pruning, quantization, GPU acceleration.
Evaluation: Dice Score, IoU, Precision, Recall, and Frames Per Second (FPS).
Deployment: Build a real-time interface suitable for radiologists and surgeons.

5. Expected Outcomes
- A deep learning model capable of detecting tumor boundaries in real time.
- High segmentation accuracy even on complex or low-contrast images.
- Faster diagnosis and improved clinical workflow.
- Reduced human error in tumor boundary identification.

6. Significance of the Study
This research will assist radiologists in accurate diagnosis, help oncologists in treatment planning, and support surgeons by providing clear tumor margins during procedures. Real-time segmentation improves the speed and accuracy of critical medical decisions.

7. Conclusion
Real-time tumor boundary detection using deep learning can revolutionize medical imaging and surgical outcomes. The proposed system aims to deliver a reliable, fast, and accurate solution for clinical applications.

Keywords: Tumor Segmentation, Deep Learning, Medical Imaging, Real-Time Detection, U-Net, MRI, CT Scan.