2D TO 3D MEDICAL IMAGE COLORIZATION

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Introduction:

Medical imaging is an essential part of modern healthcare systems, especially for analyzing internal structures of the human body. Among various imaging techniques, Magnetic Resonance Imaging (MRI) is widely used because it provides detailed information about soft tissues. However, MRI data is usually available as multiple grayscale 2D slices. Understanding these slices individually makes it difficult to visualize the complete 3D structure of the brain.

In order to improve interpretation, this project focuses on converting ordered 2D MRI slices into a structured 3D volume. Additionally, pseudo-colorization is applied using deep learning techniques to enhance visibility and contrast between regions. Although MRI images do not have natural color, pseudo-color helps in better visualization and understanding.

The final system generates orthogonal views (axial, coronal, sagittal) and an interactive 3D brain model, making it easier to analyze spatial relationships.

Figure 1: Proposed Pipeline

[MRI Input Slices] → [Preprocessing (Resize & Normalize)] → [U-Net Deep Learning Model] → [Pseudo-Colorized Output] → [Slice Stacking] → [3D Volume Reconstruction] → [Orthogonal Views Extraction] → [3D Rotatable Brain Visualization]

Objectives:

• To preprocess MRI slices and prepare them for model input.
• To apply deep learning techniques for pseudo-colorization.
• To reconstruct a 3D volume from 2D slices.
• To generate orthogonal medical views.
• To develop an interactive 3D visualization model.

Methodology:

1. The project follows a systematic pipeline. Initially, MRI slices are collected from the BraTS dataset and arranged in sequence. Preprocessing is performed to resize images and normalize pixel values.
2. A U-Net based deep learning model is then applied to generate pseudo-color images from grayscale slices. This model preserves structural information while enhancing visual clarity.
3. The colorized slices are stacked to form a 3D volume. Orthogonal views are extracted from this volume to simulate real medical visualization.
4. Finally, 3D rendering techniques are used to create a rotatable brain model. Additional processing such as thresholding and smoothing improves visualization quality.

Result and Conclusion:

1. The system successfully generates pseudo-colorized MRI slices and reconstructs a 3D brain model. The outputs provide improved visualization compared to original grayscale images.
2. Orthogonal views help in understanding the internal structure in different planes, while the 3D model provides better spatial perception. This project demonstrates the effectiveness of combining deep learning and 3D reconstruction for medical image visualization.

References:

[1] O. Ronneberger et al., U-Net, MICCAI 2015.
[2] R. Zhang et al., Colorful Image Colorization, ECCV 2016.
[3] F. Menze et al., BraTS Dataset, IEEE 2015.

Future Scope:

• Use advanced models like GANs for improved colorization.
• Integrate segmentation for tumor detection.
• Develop web-based visualization tools.
• Extend system to CT and X-ray imaging.