ABSTRACT

- MRI and CT scans are crucial in medical diagnostics, but acquiring both is expensive, time-consuming, and exposes patients to radiation.
- Generative AI Solution: AI-driven image synthesis enables MRI-to-CT translation, reducing the need for additional scans while maintaining anatomical accuracy.
- Advanced neural networks learn complex mappings between MRI and CT images, optimizing loss functions to minimize differences while preserving clinical features.
- AI-generated CT scans closely resemble real ones, benefiting radiation-free imaging, radiotherapy planning, and medical analysis.
- Research aims to improve model robustness, reduce artifacts, enhance generalization, and integrate uncertainty estimation for reliable clinical deployment.

SYSTEM STUDY

- MRI and CT scans serve distinct diagnostic purposes, but obtaining both can be costly and expose patients to radiation.
- AI models learn to synthesize CT images from MRI scans, enabling cross-modal image translation without requiring additional scans.
- Advanced neural networks, such as GANs and transformers, map MRI features to CT-equivalent representations while preserving anatomical accuracy.
- Models are trained on paired MRI-CT datasets, using loss functions to minimize discrepancies and ensure high-fidelity synthetic CT generation.
- This technology enhances radiation-free imaging, supports radiotherapy planning, and improves medical diagnostics with cost-effective AI-driven solutions.

MODULE DETAILS

- Data Preprocessing Module – Collects and preprocesses MRI-CT paired datasets, including normalization, augmentation, and alignment to enhance model training.

- Generative AI Model Module – Implements deep learning architectures (GANs, transformers, or CNNs) to learn and synthesize CT images from MRI scans while maintaining anatomical accuracy.
- Loss Function and Optimization Module – Uses loss functions like Mean Squared Error (MSE), Structural Similarity Index (SSIM), and adversarial loss to refine image synthesis quality.
- Evaluation and Validation Module – Compares synthetic CT images with real ones using quantitative metrics (PSNR, SSIM) and qualitative assessments by medical experts.
- User Interface and Integration Module – Develops a system for healthcare professionals to input MRI scans, visualize synthetic CT outputs, and integrate results into clinical workflows.

EXISTING SYSTEM

- MRI and CT scans are used separately for medical diagnosis.
- Patients often need to undergo both scans for comprehensive assessment.
- CT scans expose patients to ionizing radiation, posing potential health risks.
- The process is time-consuming and expensive, requiring specialized equipment.
- Image alignment issues can arise due to variations in scanning conditions.

DISADVANTAGES:

- Dual Modality Requirement – MRI and CT scans are separately required for comprehensive diagnosis, increasing time and cost.
- Radiation Exposure – CT scans expose patients to ionizing radiation, posing health risks with repeated scans.
- Resource Intensive – Obtaining both scans requires expensive equipment and specialized medical staff.
- Limited Accessibility – Not all healthcare centers have access to both MRI and CT imaging, delaying diagnosis and treatment.
- Data Inconsistencies – Variations in patient positioning and scanning conditions can cause misalignment between MRI and CT images.

PROPOSED SYSTEM

- Uses Generative AI to synthesize CT images from MRI scans.
- Eliminates the need for additional CT scans, reducing patient burden.
- Provides radiation-free imaging, ensuring a safer diagnostic process.
- Enhances efficiency by reducing costs and accelerating diagnosis.
- Ensures anatomical accuracy and consistency in medical imaging.

ADVANTAGES:

- AI-Based MRI-to-CT Synthesis – Uses Generative AI to generate synthetic CT scans from MRI images, eliminating the need for additional CT scans.
- Radiation-Free Imaging – Reduces patient exposure to harmful ionizing radiation, ensuring safer diagnostics.
- Cost-Effective Solution – Lowers the financial burden on healthcare facilities by minimizing the need for dual imaging.
- Faster Diagnosis and Treatment – Accelerates medical workflows by providing instant CT-like images from MRI scans.
- Improved Image Quality and Consistency – AI ensures anatomically accurate and high-fidelity synthetic CT scans, reducing inconsistencies in traditional methods.

TOOLS DETAILS

Platform: Google colab
Language : Python
Operating system : Windows 10 or above