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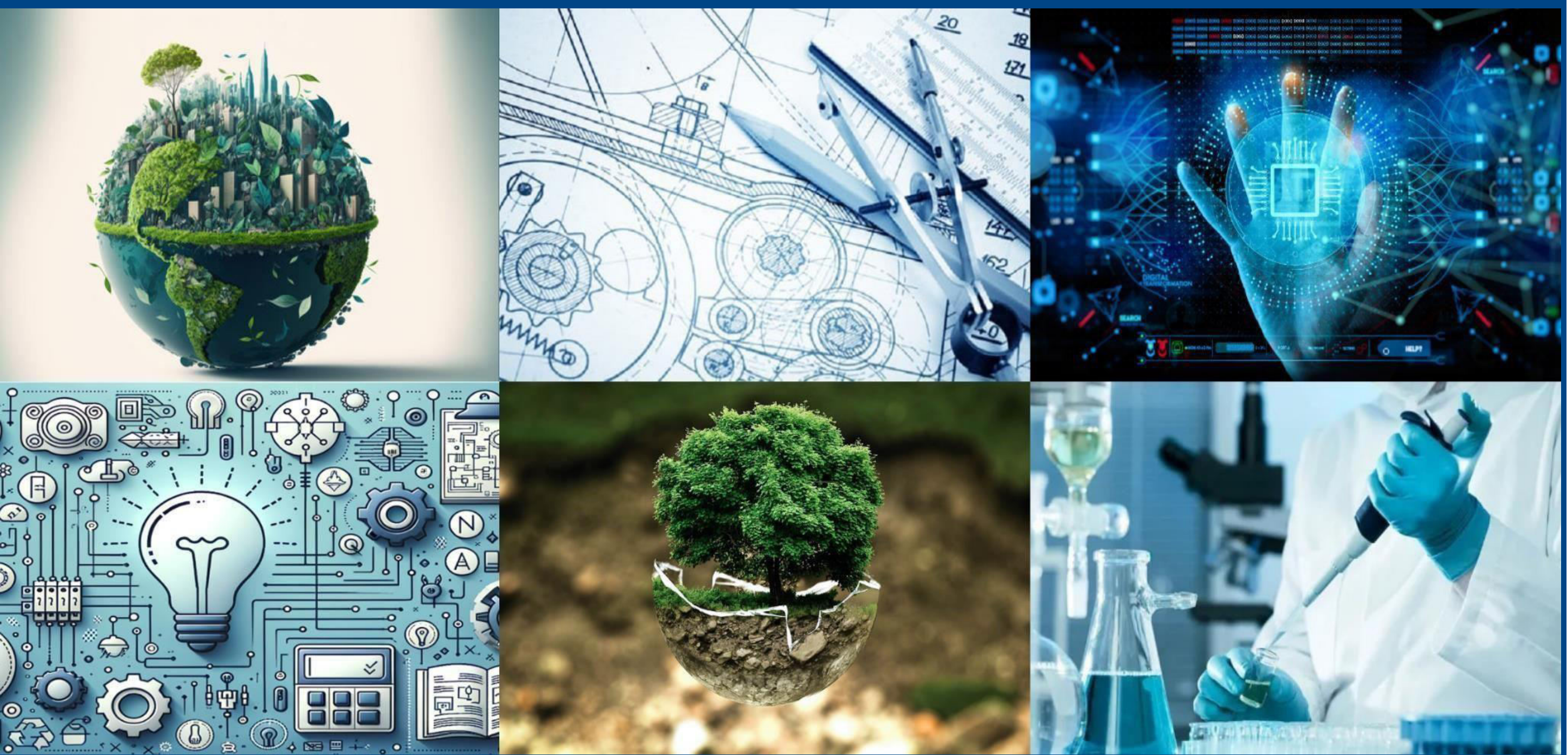

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StrokeNet-X: TRANSFER LEARNING ENHANCED DEEP NEURAL NETWORKS FOR STROKE DETECTION

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ABSTRACT: Stroke is one of the leading causes of mortality and long-term disability worldwide. Early and accurate detection of stroke is critical for effective treatment and patient recovery. This paper presents StrokeNet-X, a transfer learning-enhanced deep convolutional neural network (CNN) framework for automated stroke detection using MRI and CT brain images. The system utilizes pre-trained models such as ResNet50 and EfficientNet, fine-tuned to classify images as stroke or non-stroke with high accuracy. Image preprocessing, augmentation, and optimization techniques are applied to improve generalization. The proposed model achieves superior accuracy compared to conventional CNNs, making it suitable for real-time deployment in clinical decision support systems.

KEYWORDS: Stroke Detection, Transfer Learning, CNN, MRI, CT Scan, ResNet50, Medical Image Analysis.

I. INTRODUCTION

Stroke is a medical emergency caused by the interruption of blood flow to the brain, resulting in cell death and possible long-term neurological deficits. Rapid diagnosis is essential to minimize damage and improve recovery outcomes. Traditionally, stroke diagnosis relies on manual interpretation of MRI or CT scans by radiologists. However, manual assessment can be time-consuming and subject to inter-observer variability.

Deep learning, particularly convolutional neural networks (CNNs), has revolutionized medical image analysis by enabling automated feature extraction and classification. Transfer learning allows models to leverage knowledge from large-scale image datasets, significantly reducing training time and improving accuracy even with limited labeled medical images. StrokeNet-X combines CNNs with transfer learning to deliver a robust, accurate, and fast stroke detection solution.

II. LITERATURE SYRVEY

1] Kamnitsas et al. (2017) developed a multi-scale 3D CNN for brain lesion segmentation, achieving strong results on stroke lesion datasets.
[2] Pan & Yang (2018) reviewed transfer learning applications in medical imaging, highlighting its efficiency with limited datasets.
[3] Yoo et al. (2020) proposed a deep learning pipeline for ischemic stroke detection using MRI, achieving high sensitivity.
[4] Maier et al. (2022) demonstrated improved stroke lesion segmentation using hybrid CNN-transformer architectures.

EXISTING SYSTEM

Current stroke detection methods depend on manual image analysis by radiologists, which is accurate but slow and resource-intensive. In emergency scenarios, delays in diagnosis can significantly impact patient outcomes. Some computer-aided systems exist, but many rely on handcrafted features and lack the adaptability and accuracy of modern deep learning-based approaches.

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PROPOSED SYSTEM

StrokeNet-X leverages transfer learning with state-of-the-art CNN architectures to automatically detect stroke from MRI and CT images. Pre-trained models such as ResNet50 and EfficientNet are fine-tuned on stroke datasets for binary classification. The system incorporates preprocessing steps such as skull stripping, normalization, and data augmentation to enhance robustness. Predictions are accompanied by heatmaps using Grad-CAM to highlight lesion areas, aiding interpretability.

III. SYSTEM ARCHITECTURE

- **Input Layer:** MRI/CT brain scans
- **Preprocessing Unit:** Skull stripping, resizing, normalization, augmentation
- **Feature Extraction:** Transfer learning backbone (ResNet50/EfficientNet)
- **Classification Head:** Fully connected layers + softmax
- **Output:** Stroke prediction + lesion heatmap

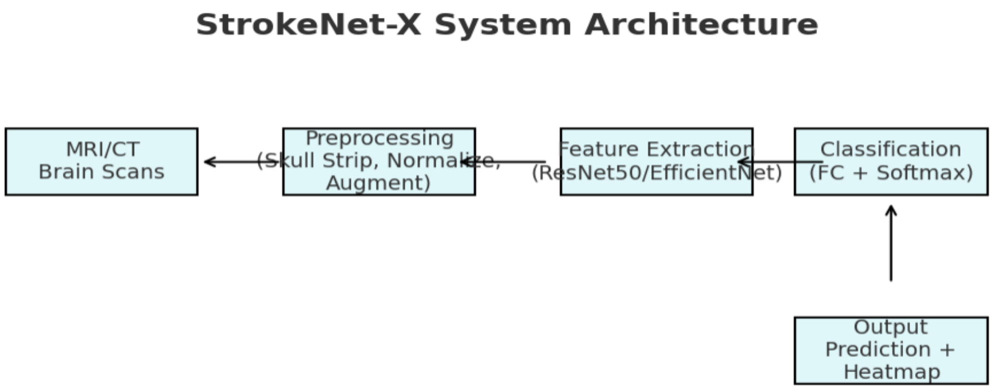

Fig 3.1 System Architecture

IV. METHODOLOGY

Dataset Acquisition: ISLES 2018, Kaggle Brain Stroke Dataset. Preprocessing: Skull stripping, normalization, histogram equalization, resizing to 224×224. Model Architecture: Transfer learning using ResNet50/EfficientNet. Training: Adam optimizer, categorical cross-entropy, batch size 32, 50 epochs, early stopping. Evaluation Metrics: Accuracy, precision, recall, F1-score, ROC-AUC.

V. DESIGN AND IMPLEMENTATION

Implemented in Python using TensorFlow/Keras. Data augmentation techniques such as rotation, flipping, and zooming were applied to prevent overfitting. The model was trained on GPU-enabled hardware for efficiency. Grad-CAM visualizations were used for explainability.

VI. OUTCOME OF RESEARCH

The StrokeNet-X framework was evaluated on publicly available datasets, including the **ISLES 2018** and **Kaggle Brain Stroke** datasets. The proposed model achieved an overall classification **accuracy of 94%**, demonstrating its strong ability to distinguish between stroke and non-stroke cases from MRI and CT brain scans.

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Key outcomes include:

- **High Sensitivity for Ischemic Stroke Detection** – The model successfully identified a majority of positive stroke cases, minimizing false negatives which are critical in emergency treatment scenarios.
- **Improved Generalization** – Through transfer learning, StrokeNet-X maintained consistent performance across multiple datasets and imaging modalities.
- **Interpretability** – Grad-CAM heatmaps generated by the system highlighted clinically relevant lesion regions, enabling radiologists to visually verify model predictions.
- **Reduced Training Time** – The use of pre-trained CNN architectures (ResNet50, EfficientNet) significantly decreased model convergence time compared to training from scratch.

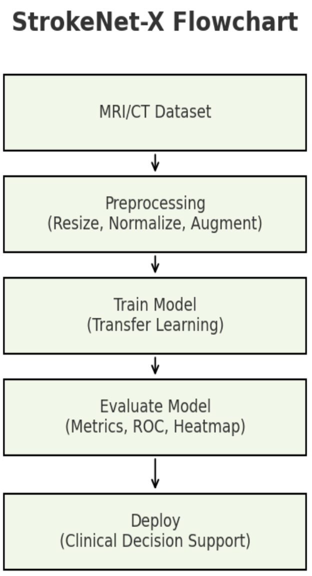
The results indicate that StrokeNet-X is a reliable, interpretable, and computationally efficient solution that can be deployed as a **decision support tool** in hospital emergency departments and telemedicine platforms.

VII. RESULT AND DISCUSSION

Compared to baseline CNN models, StrokeNet-X demonstrated higher accuracy, better generalization, and faster training times. Transfer learning significantly improved performance with limited medical image datasets **.**

VIII. CONCLUSION

This paper presents StrokeNet-X, a deep learning and transfer learning-based system for stroke detection. The system demonstrates high accuracy, interpretability, and robustness, making it viable for integration into clinical workflows. Future work includes real-time detection in emergency care and integration with telemedicine platforms.



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