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Bone Fracture Detection with Deep Learning and Ensemble of CNN Models in X-Ray Images

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Abstract: *Bone fracture detection plays a pivotal role in timely and accurate medical diagnosis, especially in trauma and orthopedic care. Leveraging advancements in deep learning, this work presents an automated approach to bone fracture classification using multi-modal imaging data. A comparative evaluation of state-of-the-art convolutional neural network architectures, including ResNet50, VGG16, EfficientNet, Xception, and NASNetMobile, was conducted to identify optimal models for fracture detection. An ensemble strategy combining Xception and NASNetMobile was also implemented to enhance classification performance. Models were trained and validated using a specialized Bone Fracture Classification dataset, incorporating diverse image modalities and anatomical variations. Preprocessing steps included normalization and augmentation to ensure generalizability and robustness. Performance was assessed using standard metrics such as accuracy, precision, recall, and F1-score. Results demonstrate that the ensemble model significantly outperforms individual models, achieving an accuracy, precision, recall, and F1-score of 95.8%. NASNetMobile and Xception also delivered high accuracy at 91.5% and 88.7%, respectively. These findings indicate the effectiveness of ensemble deep learning architectures in improving fracture detection accuracy in medical imaging applications*

Keywords: Bone Fracture Detection, Deep Learning, X-ray Imaging, CNN, ResNet50, VGG16, EfficientNet, Xception, NasNetMobile, Grad-CAM Image Classification, Flask, Medical AI, Ensemble Learning

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