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MONKEYPOX DETECTION USING DEEP LEARNING MODELS AND EXPLAINABLE AI

Monkeypox (Mpox) is a viral disease that spread rapidly and caused a significant global outbreak in 2022 and 2023, which consequently led to increased public health concern. This increase necessitates the development of accurate and rapid diagnostic tools to support clinical decision-making and containment strategies. This study aims to implement a robust, privacy-preserving, racially fair, and explainable Deep Learning framework integrated with Federated Learning for early and accurate Mpox detection.

This study addresses the central research question: Can deep learning models, enhanced with explainability and fairness considerations, provide an accurate, interpretable, and scalable framework for Mpox detection across diverse skin tones?

The primary aim was to implement a robust, privacy-preserving, racially fair, and explainable Deep Learning framework integrated with Federated Learning for early and accurate Mpox detection. The specific objectives included (i) implementing a Deep Learning model using Transfer Learning on diverse skin lesion datasets to accurately classify Mpox and (ii) integrating and evaluating Explainable AI techniques such as Grad-CAM and LIME to improve transparency and trustworthiness of the model's predictions.

The methodology involved training and evaluating five models, Densenet201, ResNet152V2, CNN, Xception-Net, and InceptionNet, using an HSV color space augmentation function to change image color properties systematically to increase image diversity. Data were split using a 70:20:10 ratio for training, validation, and testing. In order to manage the computational demands of training deep neural networks on large and diverse datasets, the experiments were conducted using high-performance computing resources, such as GPU acceleration and parallelized training strategies. Model performance was assessed with standard metrics. Grad-CAM and LIME were applied to enhance interpretability, while confusion matrices illustrated classification performance across all classes. Findings revealed that Xception achieved the best results, with an accuracy of 99%, precision of 0.99, sensitivity and specificity of 1.0, and an AUC-ROC of 1.0. DenseNet201 and CNN models also performed competitively, with accuracy above 94%.

The potential impact of this research lies in providing a foundation for scalable, explainable, and clinically applicable diagnostic tools for Mpox. Using high-performance computing advantages, such as parallel training and distributed learning, ensures that the framework can be deployed across large-scale datasets and resource-constrained environments. By addressing fairness in skin tone variations and incorporating federated learning for data privacy, this framework contributes to advancing equitable and trustworthy AI-driven healthcare solutions.

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Yes

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