MONKEYPOX DETECTION USING DEEP LEARNING MODELS AND EXPLAINABLE AI

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ABSTRACT

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, XceptionNet, 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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