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Detection of Pulmonary Tuberculosis in Chest X-Ray Images Using CNN-VGG19: Evidence from a Local Indonesian Clinical Dataset

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Abstract

*Pulmonary tuberculosis (TB) remains a major public health challenge, especially in developing countries where early and accurate diagnosis is critical. Although deep learning models have shown promising performance in TB detection using chest X-ray (CXR) images, most studies rely on large-scale public datasets that may not adequately represent the variability and limitations of real-world clinical data. This study aimed to evaluate the robustness and generalization capabilities of the CNN-VGG19 architecture when applied to small-scale clinical datasets. The dataset consisted of 434 CXR images collected from Haji Makassar Hospital, Indonesia, and categorized into tuberculosis, pleural effusion, and normal classes. A transfer learning approach was applied, and model performance was evaluated using analyses of accuracy, precision, recall, F1 score, and confusion matrices, with comparisons to ResNet50 and InceptionV3 under identical experimental conditions. The results showed that CNN-VGG19 achieved an accuracy of 0.8807 and a macro F1 score of 0.8800, outperforming the comparative models. These findings suggest that CNN-VGG19 provides stable performance in a data-constrained environment and highlight the impact of class overlap on classification performance.***Keywords-*** Carbon trading, Multi-objective optimization (MOO), Multi-criteria decision making (MCDM), Particle swarm optimization – Self-organizing maps (PSOM), Machine learning.