ENHANCING TUBERCULOSIS DIAGNOSIS IN SRI LANKA: A DEEP LEARNING APPROACH WITH CHEST X-RAY IMAGES

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Abstract: Tuberculosis (TB) is a severe and potentially life-threatening global health concern. Due to limited access to advanced diagnostic technologies, early detection of this disease can be challenging. Early detection is vital for effective treatment and prevention. However, traditional TB diagnostic methods often exhibit suboptimal sensitivity and specificity, especially in resource-constrained regions like Sri Lanka. This poses significant difficulties for healthcare practitioners in diagnosing and managing the disease effectively. In this research study, our primary objective was to develop a computer-aided diagnosis system through deep learning models for the early detection of pulmonary tuberculosis using chest X-ray images. To achieve this, we utilized a dataset comprising 270 chest X-ray images, including 171 normal cases and 99 pulmonary tuberculosis cases, obtained from Trincomalee General Hospital with all necessary ethical approvals. Our approach involved training 12 deep learning classification models, employing a 5-fold cross-validation methodology. Among these models, DenseNet121 emerged as the top-performing model, achieving an impressive average precision of 92.42%, an average recall of 93.91%, an average F1 score of 93.03%, and an average accuracy of 91.48%. Intrigued by the model's decision-making process, we further explored gradient-based localization techniques to pinpoint the precise regions within the chest X-ray images that were most indicative of tuberculosis. By identifying these key distinctive regions, we aim to provide clinicians with valuable insights that can enhance the accuracy of tuberculosis diagnosis. These findings strongly suggest that our model holds the potential to serve as an effective tool for early pulmonary tuberculosis diagnosis, a critical step in reducing the disease's transmission and improving patient outcomes.

Keywords: 5-Fold cross-validation, DenseNet121, Gradient-based localization, Pulmonary tuberculosis