INTISARI

KLASIFIKASI CITRA *X-RAY* THORAKS PENYAKIT TUBERKULOSIS PARU MENGGUNAKAN *DEEP LEARNING CONVOLUTIONAL NEURAL NETWORK* (CNN)

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Deteksi penyakit tuberkulosis (TB) berbasis citra *X-Ray* thoraks masih merupakan metode deteksi awal yang biasa digunakan secara manual untuk mendeteksi TB oleh dokter ahli. Sementara itu, penerapan *artificial intelligence* (AI) khususnya *machine learning* (ML) telah berkembang sangat pesat. Dalam penelitian ini, klasifikasi positif dan negatif TB melalui citra *X-Ray* thoraks yang diperoleh dari *database* publik yang bersumber dari Belarus TB Portal, *National Library of Medicine* (NLM) dan *Radiological Society of North America* (RSNA) dengan total 4200 citra telah dianalisis menggunakan algoritma *deep learning convolutional neural network* (CNN). Pola citra *X-Ray* thoraks diekstrak berdasarkan kombinasi *pixel values*. Sementara itu, validasi *X-Ray* thoraks dilakukan berdasarkan analisis dokter ahli thoraks dan kardiologi dari *Qatar Hamad General Hospital*. Jumlah dataset yang digunakan dalam penelitian ini yaitu 3500 citra negatif TB dan 700 citra positif TB, *SMOTE-Tomek links* diterapkan sebagai teknik menyeimbangkan data *training* antara citra negatif TB dan positif TB. Model CNN berhasil memprediksi 349 citra negatif TB dari total 351 citra *testing* dan berhasil memprediksi 65 citra positif TB dari total 69 citra *testing*, sehingga memperoleh akurasi 98,6% sensitivitas 94,2% dan spesifisitas 99,4%. Dengan demikian, model CNN telah berhasil mengklasifikasi citra negatif TB dan positif TB melalui citra *X-Ray* thoraks dengan *hyperparameter* optimal learning rate 0,001 dan epsilon 0,01.

Kata kunci: Klasifikasi, tuberkulosis, citra *X-Ray*, *deep learning*, *machine learning*, *convolutional neural network*.

ABSTRACT

CLASSIFICATION OF CHEST X-RAY IMAGES OF PULMONARY TUBERCULOSIS DISEASE USING DEEP LEARNING CONVOLUTIONAL NEURAL NETWORK (CNN)

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The detection of tuberculosis (TB) based on chest X-Ray images is still a commonly used early detection method manually performed by expert physicians. Meanwhile, the application of artificial intelligence (AI), particularly machine learning (ML) has been rapidly advancing. In this study, the classification of positive and negative TB cases using chest X-Ray images obtained from public databases, namely the Belarus TB Portal, National Library of Medicine (NLM), and Radiological Society of North America (RSNA) was analyzed using a deep learning convolutional neural network (CNN) algorithm. Patterns in the chest X-Ray images were extracted based on the combination of pixel values. Validation of the chest X-Ray images was conducted through expert analysis by thoracic and cardiology specialists from Qatar Hamad General Hospital. The dataset used in this study consisted of 3,500 negative TB images and 700 positive TB images, with the SMOTE-Tomek technique applied to balance the training data between negative and positive TB images. The CNN model successfully predicted 349 negative TB images out of total 351 testing images and accurately predicted 65 positive TB images out of total 69 testing images, resulting in an accuracy 98.6%, sensitivity 94.2% and specificity 99.4%. Thus, the CNN model has successfully classified negative and positive TB images through thoracic X-Ray images with optimal hyperparameter learning rate 0.001 and epsilon 0.01.

Keywords: Classification, tuberculosis, X-Ray images, deep learning, machine learning, convolutional neural network.