ABSTRACT

Cataract is a leading cause of blindness and can be detected through digital image analysis. This study aims to detect cataracts by classifying digital eye images into normal and cataract categories using CataractNet, a lightweight Convolutional Neural Network (CNN) architecture. The initial dataset consisted of 612 digital camera images, which was expanded to 2,564 images through data augmentation. The preprocessing stage included resizing, normalization, and augmentation, while training was carried out using the Adam optimizer with hyperparameter configurations obtained through grid search. Model performance was evaluated using a confusion matrix. The results show that CataractNet with data augmentation achieved an accuracy of 96.77%, precision of 100%, recall of 93.55%, specificity of 100%, and an F1-score of 96.67%. In comparison, the model without augmentation achieved only 91.94% accuracy. These findings indicate that data augmentation and hyperparameter optimization play a crucial role in improving training stability and enhancing model generalization. A small number of cataract images were misclassified as normal due to low opacity levels. Future research is recommended to expand dataset diversity and incorporate additional augmentation techniques, such as contrast enhancement, to improve the model's adaptability to various image conditions.

Keywords: *Cataract, CataractNet, Convolutional Neural Network (CNN), Data Augmentation, Digital Image*

ABSTRAK

Katarak merupakan penyebab utama kebutaan yang dapat dideteksi melalui analisis citra digital. Penelitian ini bertujuan mendeteksi katarak dengan cara mengklasifikasikan citra digital mata normal dan katarak menggunakan model *CataractNet* yang merupakan arsitektur *Convolutional Neural Network* (CNN) ringan. Dataset awal terdiri dari 612 citra digital kamera yang diperluas menjadi 2.564 citra melalui proses augmentasi. Tahapan *preprocessing* meliputi *resize*, normalisasi, dan augmentasi data, sementara pelatihan dilakukan menggunakan Adam *optimizer* dengan konfigurasi *hyperparameter* yang diperoleh melalui *grid search*. Evaluasi performa model dilakukan menggunakan *confusion matrix*. Hasil penelitian menunjukkan bahwa model *CataractNet* dengan augmentasi data mampu mencapai akurasi 96,77%, *precision* 100%, *recall* 93,55%, *specificity* 100%, dan F1-*score* 96,67%. Sebagai perbandingan, model tanpa augmentasi hanya mencapai akurasi 91,94%. Ini membuktikan bahwa augmentasi data dan optimasi *hyperparameter* berperan penting dalam meningkatkan stabilitas pelatihan dan kemampuan generalisasi model. Masih terdapat beberapa dataset katarak yang terdeteksi normal dikarenakan tingkat kekeruhan rendah. Penelitian selanjutnya disarankan untuk memperluas variasi dataset, serta menambahkan variasi augmentasi dengan menerapkan teknik peningkatan kontras agar model lebih adaptif terhadap kondisi citra yang beragam.

Kata kunci: Augmentasi Data, *CataractNet,* Citra Digital, *Convolutional Neural Network* (CNN), Katarak