

ABSTRAK

Leukemia merupakan penyakit keganasan darah yang berfokus pada gangguan pembentukan sel di sumsum tulang dan limfosit. Di antara berbagai jenisnya, *Acute Lymphoblastic Leukemia* (ALL) menjadi varian yang paling sering menyerang anak-anak, yang ditandai dengan proliferasi sel limfoblas abnormal yang menghambat produksi sel darah sehat. Metode diagnosis konvensional melalui pengamatan mikroskopis hingga kini masih memiliki keterbatasan, terutama terkait durasi analisis yang lama serta adanya subjektivitas atau variasi penilaian antar tenaga medis. Penelitian ini mengusulkan solusi berbasis kecerdasan buatan menggunakan arsitektur *Transfer Learning* EfficientNetB3 dengan integrasi bobot pelatih ImageNet yang telah disesuaikan melalui proses *fine-tuning*. Untuk menjamin transparansi sistem, metode *Explainable Artificial Intelligence* (XAI) diterapkan guna memvisualisasikan area sel yang paling krusial dalam proses pengambilan keputusan klasifikasi.

Hasil evaluasi menunjukkan bahwa model mencapai performa yang sangat tinggi dengan akurasi 99,23% dan presisi 99,23%. Berdasarkan pengujian matrixs fungsional XAI, metode Score-CAM menunjukkan tingkat keandalan paling optimal dengan nilai deletion rata-rata terendah sebesar 35,55% dan insertion rata-rata sebesar 48,23%. Capaian ini menegaskan bahwa fitur-fitur morfologi yang diidentifikasi oleh model memiliki relevansi klinis yang kuat terhadap karakteristik sel limfoblas, sehingga sistem ini layak dipertimbangkan sebagai alat bantu pendukung keputusan bagi tenaga medis dalam diagnosis ALL.

Kata Kunci: Leukemia Limfoblasik Akut, Klasifikasi Citra, *Transfer Learning*, EfficientNetB3, Explainable Artificial Intelligence, *Grad-CAM*, *Grad-CAM++*, Score-CAM.

ABSTRACT

Leukemia is a malignant blood disease that focuses on disorders in the formation of cells in the bone marrow and lymphocytes. Among the various types, Acute Lymphoblastic Leukemia (ALL) is the variant that most commonly affects children, characterized by the proliferation of abnormal lymphoblast cells that inhibit the production of healthy blood cells. Conventional diagnostic methods through microscopic observation still have limitations, particularly regarding the lengthy analysis time and the subjectivity or variation in assessment among medical personnel. This study proposes an artificial intelligence-based solution using the Transfer Learning EfficientNetB3 architecture with the integration of ImageNet training weights that have been adjusted through a fine-tuning process. To ensure system transparency, the Explainable Artificial Intelligence (XAI) method is applied to visualize the most crucial cell areas in the classification decision-making process.

The evaluation results show that the model achieves very high performance with an accuracy of 99.23% and a precision of 99.23%. Based on the XAI functional matrix testing, the Score-CAM method shows the most optimal reliability level with the lowest average deletion value of 35.55% and an average insertion of 48.23%. This achievement confirms that the morphological features identified by the model have strong clinical relevance to lymphoblast cell characteristics, making this system worthy of consideration as a decision support tool for medical personnel in ALL diagnosis.

Keywords: Acute Lymphoblastic Leukemia, Image Classification, Transfer Learning, EfficientNetB3, Explainable Artificial Intelligence, Grad-CAM, Grad-CAM++, Score-CAM.