DETEKSI DINI ABNORMALITAS SEL DARAH PUTIH MENGGUNAKAN ATTENTIVE CNN DENGAN CLASS WEIGHT DAN FOCAL LOSS

TESIS

Diajukan sebagai salah satu syarat untuk memperoleh gelar

Magister Komputer (M.Kom)

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Fakultas Teknologi Informasi

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Jakarta

2025

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Demikian pernyataan ini saya buat dengan sebenarnya.

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Judul Tesis	:	Deteksi Dini Abnormalitas Sel Darah Putih Menggunakan *Attentive CNN* Dengan *Class Weight* Dan *Focal Loss*

Telah dipertahankan pada periode 2025-1 dihadapan dewan penguji dan diterima sebagai bagian persyaratan yang diperlukan untuk memperoleh gelar Magister Komputer (M.Kom) pada Program Studi Ilmu Komputer (S2) Fakultas Teknologi Informasi Universitas Nusa Mandiri.

Jakarta, 11 Agustus 2025

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No	Tanggal Bimbingan	Pokok Bahasan	Paraf Dosen Pembimbing
1.	08 April 2025	Pengajuan Judul dan membahas terkait dataset serta membandingkan Metode *CNN* and *Transfer Learning*	
2.	22 April 2025	- Konsep klasifikasi yang digunakan - Model *Transfer Leraning* + *Attention Mechanism*	
3.	03 Mei 2025	Explorasi dan Evaluasi dataset yang digunakan	
4.	14 Mei 2025	Evaluasi *dataset* yang digunakan dan metode yang digunakan	
5.	31 Mei 2025	Explorasi dan implementasi *tuning Transfer Learning*	
6.	14 Juni 2025	Explorasi dan implementasi *tuning Transfer Learning*	
7.	28 Juni 2025	Explorasi dan implementasi *tuning Transfer Learning*	
8.	5 Juli 2025	Evaluasi dan analisis hasil eksperimen	
9.	17 Juli 2025	Pemeriksaan menyeluruh terhadap draft laporan	

Catatan untuk Dosen Pembimbing.
Bimbingan Tesis

- Dimulai pada tanggal : 09 April 2025
- Diakhiri pada tanggal : 30 Juli 2025
- Jumlah pertemuan bimbingan : 9 (Sembilan) kali bimbingan

Disetujui oleh,

Dosen Pembimbing

Prof. Dr. Eng.. Hilman Ferdinandus Pardede, S.T., M. Eng.

KATA PENGANTAR

Puji syukur alhamdullillah, penulis panjatkan kehadirat Allah, SWT, yang telahmelimpahkan rahmat dan karunia-Nya, sehingga pada akhirnya penulis dapat menyelesaikan laporan tesis ini tepat pada waktunya. Dimana laporan tesis ini penulis sajikan dalam bentuk buku yang sederhana. Adapun judul tesis, yang penulis ambil sebagai berikut "Deteksi Dini Abnormalitas Sel Darah Putih Menggunakan *Attentive CNN* Dengan *Class Weight* Dan *Focal Loss*".

Tujuan penulisan laporan tesis ini dibuat sebagai salah satu syarat untuk mendapatkan gelar Magister Komputer (M.Kom) pada Program Studi Ilmu Komputer (S2) Fakultas Teknologi Informasi Universitas Nusa Mandiri.

Laporan Tesis ini diambil berdasarkan hasil penelitian atau riset mengenai deteksi dan klasifikasi sel darah putih dengan algoritma *Machine Learning* dan *Deep Learning*. Penulis juga mencari dan menganalisa berbagai macam sumber referensi, baik dalam bentuk jurnal ilmiah, buku-buku literatur, internet, dll yang terkait dengan pembahasan pada laporan tesis ini.

Penulis menyadari bahwa tanpa bimbingan dan dukungan dari semua pihak dalam pembuatan laporan tesis ini, maka penulis tidak dapat menyelesaikan laporan tesis ini tepat pada waktunya. Untuk itu pada kesempatan ini penulis menyampaikan ucapan terimakasih kepada:

1. Rektor Universitas Nusa Mandiri
2. Wakil Rektor I Bidang Akademik Universitas Nusa Mandiri
3. Dekan Fakultas Teknologi Informasi Universitas Nusa Mandiri
4. Ketua Program Studi Ilmu Komputer (S2)
5. Bapak Prof. Dr. Eng.. Hilman Ferdinandus Pardede, S.T., M. Eng. selaku dosen pembimbing yang telah menyediakan waktu, pikiran dan tenaga dalam membimbing penulis dalam menyelesaikan tesis ini.
6. Orang tua tercinta yang telah memberikan dukungan material dan moral kepada penulis
7. Seluruh Dosen Program Studi Ilmu Komputer (S2) Fakultas Teknologi Informasi Universitas Nusa Mandiri yang telah memberikan pelajaran yang berarti bagi penulis selama menempuh studi

8. Seluruh staf di lingkungan Universitas Nusa Mandiri yang telah melayani penulis dengan baik selama kuliah

Serta semua pihak yang terlalu banyak untuk penulis sebutkan satu persatu sehingga terwujudnya penulisan laporan tesis ini. Penulis menyadari bahwa penulisan laporan tesis ini masih jauh sekali dari sempurna, untuk itu penulis mohon kritik dan saran yang bersifat membangun demi kesempurnaan penulisan karya ilmiah di masa yang akan datang.

Akhir kata semoga laporan tesis ini dapat bermanfaat bagi penulis khususnya dan bagi para pembaca yang berminat pada umumnya.

Jakarta, 11 Agustus 2025

Penulis

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ABSTRAK

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Judul Tesi	:	Deteksi Dini Abnormalitas Sel Darah Putih Menggunakan *Attentive CNN* Dengan *Class Weight* Dan *Focal Loss*

Deteksi dini sel darah putih (WBC) abnormal, seperti leukemia, penting untuk mendukung diagnosis hematology yang akurat. Namun, identifikasi manual melalui citra mikroskopis memakan waktu relative lama dan terkendala oleh tingginya kemiripan morfologi antar sel, sehingga menyulitkan identifikasi secara konsisten. Penelitian ini mengembangkan model klasifikasi WBC berbasis *Deep Learning* dengan penanganan ketidakseimbangan data dan penerapan *Attention Mechanism.* Model menggunakan *backbone* ResNet50 dan EfficientNetB0 dengan teknik balancing *Class Weighting* dan *Focal Loss* serta *Block Attention* CBAM untuk menyoroti fitur morfologi sel. Data diambil dari *Munich University Hospital* dengan tahap segmentasi ROI, augmentasi dan evaluasi akurasi, *F1-Score* serta *confusion matrix*. Hasil menunjukkan akurasi model ResNet50 mencapai 95.86% dengan *Macro F1-Score* 75.15%, serta peningkatan deteksi pada kelas abnormal. Pendekatan ini mendukung pengembangan sistem klasifikasi otomatis berbasis citra digital untuk diagnosis hematology yang lebih cepat dan andal.

Kata Kunci:

Abnormalitas Sel Darah Putih, Klasifikasi Citra, *Deep Learning, Balancing, Attention Mechanism*

ABSTRACT

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Study of Program	:	Computer Science
Faculty	:	Information Technology
Levels	:	Master's Degree (S2)
Concentration	:	Artificial Intelligence and Blockchain
Title	:	Early Detection of White Blood Cell Abnormality Using Attentive CNN With Class Weight and Focal Loss

Early detection of abnormal white blood cells (WBCs), such as in leukemia, is crucial for supporting accurate hematological diagnosis. However, manual identification through microscopic images is relatively time-consuming and constrained by the high morphological similarity between cell, making it difficult to identify consistently. This study develops a deep learning-based WBC classification model that addresses data imbalance and incorporates an attention mechanism. The model utilizes ResNet50 and EfficientNetB0 backbones, employing Class Weighting and Focal Loss for balancing, as well as the CBAM attention block to emphasize relevant cellular morphological features. The dataset was obtained from Munich University Hospital and underwent ROI segmentation, data augmentation, and evaluation using accuracy, F1-score, and confusion matrix. Results show that the ResNet50 model achieved an accuracy of 95,86% with a macro F1-score 75.15%, demonstrating improved detection performance for abnormal classes. This approach contributes to the development of reliable and efficient image-based automatic classification systems for hematological diagnostics.

Keywords:

White Blood Cell Abnormalities, Image Classification, Deep Learning, Data Balancing, Attention Mechanism

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