

**Pengenalan Emosi Berbasis EEG Tinjauan Terbaru dari Dataset
dan Metode**

Tugas Akhir

Diajukan Untuk Memenuhi
Persyaratan Guna Meraih Gelar Sarjana
Informatika Universitas Muhammadiyah Malang



Muhammad Aulanas Bitaqwa

(201910370311149)

Data Science

**PROGRAM STUDI INFORMATIKA
FAKULTAS TEKNIK
UNIVERSITAS MUHAMMADIYAH MALANG**

2024

LEMBAR PERSETUJUAN

Pengenalan Emosi Berbasis EEG Tinjauan Terbaru dari Dataset dan Metode

TUGAS AKHIR

**Sebagai Persyaratan Guna Meraih Gelar Sarjana Strata 1
Informatika Universitas Muhammadiyah Malang**



Menyetujui,
Malang, 25 Maret 2024

Dosen Pembimbing 1



Hariyady S.Kom, MT.
NIP. 10816120588PNS.

Dosen Pembimbing 2



Wildan Suharso S.Kom., M.Kom
NIP. 10817030596PNS.

LEMBAR PENGESAHAN

Pengenalan Emosi Berbasis EEG Tinjauan Terbaru dari Dataset dan Metode Tugas Akhir

Sebagai Persyaratan Guna Meraih Gelar Sarjana Strata 1
Teknik Informatika Universitas Muhammadiyah Malang

Disusun Oleh:

Muhammad Aulanas Bitaqwa

201910370311149

Tugas Akhir ini telah diuji dan dinyatakan lulus melalui sidang majelis penguji
pada tanggal 25 Maret 2024

Menyetujui,

Dosen Penguji 1



Ir Denar Regata Akbi S.Kom., M.Kom.

NIP. 10816120591PNS.

Dosen Penguji 2



Hardianto Wibowo S.Kom., MT.

NIP. 10816120592PNS.

Mengetahui,
Ketua Jurusan Informatika



Ir. Galih Wasis Wicaksono S.kom. M.Cs.

NIP. 10814100541PNS.

LEMBAR PERNYATAAN

Yang bertanda tangan dibawah ini :

Nama : Muhammad Aulanas Bitaqwa
Tempat, Tanggal Lahir : 05 November 2000
NIM : 201910370311149
Fakultas / Jurusan : Teknik / Informatika

Dengan ini saya menyatakan bahwa Tugas Akhir dengan judul “**Pengenalan Emosi Berbasis EEG Tinjauan Terbaru dari Dataset dan Metode**” beserta seluruh isinya adalah karya saya sendiri dan bukan merupakan karya tulis orang lain, baik sebagian maupun keseluruhan, kecuali dalam bentuk kutipan yang telah disebutkan sumbernya.

Demikian surat pernyataan ini saya buat dengan sebenar-benarnya. Apabila kemudian ditemukan adanya pelanggaran terhadap etika keilmuan dalam karya saya ini atau ada klaim dari pihak lain terhadap keaslian karya saya ini maka saya siap menanggung segala bentuk resiko / sanksi yang berlaku.

Mengetahui,

Malang, 25 Maret 2024

Dosen Pembimbing

Yang Membuat Pernyataan



Hariyady, S.Kom, M.T
NIDN. 0717067307

Muhammad Aulanas Bitaqwa

KATA PENGANTAR

Alhamdulillah rabbil 'alamin, dengan memanjatkan puji dan syukur kehadirat Allah SWT yang telah melimpahkan rahmat dan hidayah-Nya. tak lupa shalawat serta salam kepada junjungan Nabi Besar Muhammad SAW, sehingga skripsi berjudul “Pengenalan Emosi Berbasis EEG Tinjauan Terbaru dari Dataset dan Metode” dapat terselesaikan.

Tugas akhir ini ditulis dalam rangka memenuhi syarat untuk memperoleh gelar sarjana komputer bagi mahasiswa program S1 pada studi Teknik Informatika Universitas Muhammadiyah Malang. Penulis menyadari bahwa tugas akhir ini masih banyak terdapat kekurangan, oleh sebab itu penulis mengharapkan kritik dan saran yang bersifat membangun dari semua pihak demi kesempurnaan tugas akhir ini.

Penyelesaian skripsi ini tidak lepas dari dukungan dan bantuan berbagai pihak, baik secara langsung maupun tidak langsung. Oleh karena itu, pada kesempatan ini penulis dengan segala kerendahan hati mengucapkan terima kasih dan penghargaan yang sebesar-besarnya kepada:

1. Allah SWT yang selalu memberikan kemudahan dan kesabaran dalam mengerjakan tugas akhir ini.
2. Orang Tua Tercinta saya Bapak Much. Nurudin dan Ibu saya Wiwin Widiati, Adik saya Marchia Risqi Dwi Putri, Serta Diana Mufidah dan juga keluarga besar saya. Terima kasih atas segala dukungan, motivasi, dan nasehat yang terus menerus tiada henti.
3. Dosen pembimbing saya, Bapak Hariyady, S.Kom, MT. dan Bapak Wildan Suharso, S.Kom., M.Kom yang sudah bersedia dan meluangkan waktunya untuk membimbing dan memberi masukan terkait tugas akhir ini.

4. Terimakasih untuk kerabat, saudara serta teman seperjuangan saya Abdul Hamid, Haris Maulidin Munandar, Arga Andiko, Bayu Agung Setyawan, Yudha Budi Rahmansyah dan lainnya yang tak bisa saya sebutkan satu per satu. Terima kasih atas dukungan kalian.
5. Terimakasih juga untuk semua teman – teman INFOKOM UMM saya Pak Ruslan, S.Pd, Tagar Al aziz S.T, Moch Dimas Rewin S.Kom, Novi Ardi Subrata, A.Md lainnya yang tidak bisa saya sebutkan satu per satu. Terima kasih atas dukungan kalian.

Malang, 20 Desember 2023

Penulis



DAFTAR ISI

HALAMAN JUDUL	
LEMBAR PERSETUJUAN	ii
LEMBAR PENGESAHAN	iii
LEMBAR PERNYATAAN	iv
ABSTRAK	v
ABSTRACT	vi
KATA PENGANTAR	vii
DAFTAR ISI	ix
DAFTAR GAMBAR	xi
DAFTAR TABEL	xii
BAB I PENDAHULUAN	1
1.1 Latar Belakang	1
1.2 Rumusan Masalah	2
1.3 Tujuan Penelitian	2
1.4 Cakupan Masalah	2
1.5 Sistematika Penulisan	3
BAB II TINJAUAN PUSTAKA	4
2.1 Metodologi Pencarian Literatur	4
2.2 Kriteria Inklusi	4
2.3 Elektroensefalografi (EEG)	4
2.4 Tinjauan Literatur Sistematis	5
2.5 Machine Learning	5
BAB III METODE PENELITIAN	7
3.1 Metodologi Pencarian Literatur	7
3.2 Dataset untuk pengenalan emosi berbasis EEG	8
3.3 Model Emosi	12
3.4 Ekstraksi Fitur	13
3.5 Pemrosesan sinyal	13
3.6 Algoritma Machine Learning	14
3.7 Hasil Analisis	14
BAB IV HASIL DAN PEMBAHASAN	15

4.1 Implementasi	15
4.2 Implementasi metode	16
4.3 Feature Extraction Methods	17
4.4 Implementasi Machine Learning	18
4.5 Performance Metrics	20
4.6 Applications.....	20
BAB V KESIMPULAN DAN SARAN	22
5.1 Kesimpulan.....	22
DAFTAR PUSTAKA.....	24



DAFTAR GAMBAR

Gambar 1 Prosedur Penyaringan dan pemilihan artikel7



DAFTAR TABEL

Tabel 1 Ringkasan Dataset Pengenalan Emosi Berbasis EEG	10
Tabel 2. Metode dan Teknik Pembelajaran Mesin untuk Pengenalan Emosi Berbasis EEG	15



DAFTAR PUSTAKA

- [1] J. Li, S. Li, J. Pan, and F. Wang, "Cross-Subject EEG Emotion Recognition With Self-Organized Graph Neural Network," *Front. Neurosci.*, vol. 15, p. 611653, 2021, doi: 10.3389/fnins.2021.611653.
- [2] N. Murali Krishna *et al.*, "An Efficient Mixture Model Approach in Brain-Machine Interface Systems for Extracting the Psychological Status of Mentally Impaired Persons Using EEG Signals," *IEEE Access*, vol. 7, pp. 77905–77914, 2019, doi: 10.1109/ACCESS.2019.2922047.
- [3] C. Tang, Y. Li, and B. Chen, "Comparison of cross-subject EEG emotion recognition algorithms in the BCI Controlled Robot Contest in World Robot Contest 2021," *Brain Sci. Adv.*, vol. 8, no. 2, pp. 142–152, 2022, doi: 10.26599/bsa.2022.9050013.
- [4] Y. Dan, J. Tao, J. Fu, and D. Zhou, "Possibilistic Clustering-Promoting Semi-Supervised Learning for EEG-Based Emotion Recognition," *Front. Neurosci.*, vol. 15, p. 690044, 2021, doi: 10.3389/fnins.2021.690044.
- [5] H. Hua, W. Tang, X. Xu, D. D. Feng, and L. Shu, "Flexible multi-layer semi-dry electrode for scalp EEG measurements at hairy sites," *Micromachines*, vol. 10, no. 8, p. 518, 2019, doi: 10.3390/mi10080518.
- [6] T. Emsawas, T. Morita, T. Kimura, K. I. Fukui, and M. Numao, "Multi-Kernel Temporal and Spatial Convolution for EEG-Based Emotion Classification," *Sensors*, vol. 22, no. 21, p. 8250, 2022, doi: 10.3390/s22218250.
- [7] G. Yang, R. Jiao, H. Jiang, and T. Zhang, "Ground truth dataset for EEG-based emotion recognition with visual indication," *IEEE Access*, vol. 8, pp. 188503–188514, 2020, doi: 10.1109/ACCESS.2020.3030680.
- [8] S. Park and M. Whang, "Special Issue 'Emotion Intelligence Based on Smart Sensing,'" *Sensors*, vol. 23, no. 3, p. 1098, 2023, doi: 10.3390/s23031098.
- [9] R. Yuvaraj, A. Baranwal, A. A. Prince, M. Murugappan, and J. S. Mohammed, "Emotion Recognition from Spatio-Temporal Representation of EEG Signals via 3D-CNN with Ensemble Learning Techniques," *Brain Sci.*, vol. 13, no. 4, 2023, doi: 10.3390/brainsci13040685.

- [10] P. Jemioło *et al.*, “Datasets for Automated Affect and Emotion Recognition from Cardiovascular Signals Using Artificial Intelligence— A Systematic Review,” *Sensors*, vol. 22, no. 7, p. 2538, 2022, doi: 10.3390/s22072538.
- [11] H. C. Li, T. Pan, M. H. Lee, and H. W. Chiu, “Make patient consultation warmer: A clinical application for speech emotion recognition,” *Appl. Sci.*, vol. 11, no. 11, p. 4782, 2021, doi: 10.3390/app11114782.
- [12] Y. Chen, R. Chang, and J. Guo, “Effects of Data Augmentation Method Borderline-SMOTE on Emotion Recognition of EEG Signals Based on Convolutional Neural Network,” *IEEE Access*, vol. 9, pp. 47491–47502, 2021, doi: 10.1109/ACCESS.2021.3068316.
- [13] Z. Tian, D. Huang, S. Zhou, Z. Zhao, and D. Jiang, “Personality first in emotion: A deep neural network based on electroencephalogram channel attention for cross-subject emotion recognition,” *R. Soc. Open Sci.*, vol. 8, no. 8, p. 201976, 2021, doi: 10.1098/rsos.201976.
- [14] A. R. Elshenaway and S. K. Guirguis, “Adaptive Thresholds of EEG Brain Signals for IoT Devices Authentication,” *IEEE Access*, vol. 9, pp. 100294–100307, 2021, doi: 10.1109/ACCESS.2021.3093391.
- [15] A. Mishra, A. Singh, and A. Ujlayan, “A Pragmatic Approach for EEG-based Affect Classification,” *Int. J. Intell. Syst. Appl. Eng.*, vol. 9, no. 4, pp. 165–170, 2021, doi: 10.18201/IJISAE.2021473635.
- [16] J. Dai, X. Xi, G. Li, and T. Wang, “EEG-Based Emotion Classification Using Improved Cross-Connected Convolutional Neural Network,” *Brain Sci.*, vol. 12, no. 8, p. 977, 2022, doi: 10.3390/brainsci12080977.
- [17] Q. Zhong, Y. Zhu, D. Cai, L. Xiao, and H. Zhang, “Electroencephalogram Access for Emotion Recognition Based on a Deep Hybrid Network,” *Front. Hum. Neurosci.*, vol. 14, p. 589001, 2020, doi: 10.3389/fnhum.2020.589001.
- [18] A. S. Abdulbaqi, M. T. Younis, Y. T. Younus, and A. J. Obaid, “A hybrid technique for eeg signals evaluation and classification as a step towards to neurological and cerebral disorders diagnosis,” *Int. J. Nonlinear Anal. Appl.*, vol. 13, no. 1, pp. 773–781, 2022, doi: 10.22075/IJNAA.2022.5590.
- [19] L. Pagiling, Y. D. N. H, M. G. Noor, and I. Galugu, “Klasifikasi Sinyal EEG Menggunakan Algoritma Random Forest dan SVM pada Area Motor

- Cortex,” vol. 05, no. 03, pp. 33–38, 2020.
- [20] E. Peters *et al.*, “Machine learning of high dimensional data on a noisy quantum processor,” *npj Quantum Inf.*, vol. 7, no. 1, pp. 3–7, 2021, doi: 10.1038/s41534-021-00498-9.
- [21] Mustaqeem, M. Sajjad, and S. Kwon, “Clustering-Based Speech Emotion Recognition by Incorporating Learned Features and Deep BiLSTM,” *IEEE Access*, vol. 8, pp. 79861–79875, 2020, doi: 10.1109/ACCESS.2020.2990405.
- [22] M. Kopańska, A. Banaś-Ząbczyk, A. Łagowska, B. Kuduk, and J. Szczygielski, “Changes in eeg recordings in covid-19 patients as a basis for more accurate qeeg diagnostics and eeg neurofeedback therapy: A systematic review,” *J. Clin. Med.*, vol. 10, no. 6, pp. 1–12, 2021, doi: 10.3390/jcm10061300.
- [23] H. S. A. Hamatta *et al.*, “Genetic Algorithm-Based Human Mental Stress Detection and Alerting in Internet of Things,” *Comput. Intell. Neurosci.*, vol. 2022, p. 4086213, 2022, doi: 10.1155/2022/4086213.
- [24] F. E. Cabrera, P. Sánchez-Núñez, G. Vaccaro, J. I. Peláez, and J. Escudero, “Impact of visual design elements and principles in human electroencephalogram brain activity assessed with spectral methods and convolutional neural networks,” *Sensors*, vol. 21, no. 14, Jul. 2021, doi: 10.3390/s21144695.
- [25] Y. Luo *et al.*, “EEG-Based Emotion Classification Using Spiking Neural Networks,” *IEEE Access*, vol. 8, pp. 46007–46016, 2020, doi: 10.1109/ACCESS.2020.2978163.
- [26] C. Torres-Valencia, Á. Orozco, D. Cárdenas-Peña, A. Álvarez-Meza, and M. Álvarez, “A discriminative multi-output gaussian processes scheme for brain electrical activity analysis,” *Appl. Sci.*, vol. 10, no. 19, pp. 1–15, 2020, doi: 10.3390/app10196765.
- [27] L. A. Barradas-Chacón, C. Brunner, and S. C. Wriessnegger, “Stylized faces enhance ERP features used for the detection of emotional responses,” *Front. Hum. Neurosci.*, vol. 17, p. 1160800, 2023, doi: 10.3389/fnhum.2023.1160800.
- [28] X. Zeng *et al.*, “Affection of facial artifacts caused by micro-expressions on

- electroencephalography signals,” Nov. 2022.
- [29] C. Athavipach, S. Pan-Ngum, and P. Israsena, “A wearable in-ear EEG device for emotion monitoring,” *Sensors (Switzerland)*, vol. 19, no. 18, p. 4014, 2019, doi: 10.3390/s19184014.
- [30] C. Gupta *et al.*, “Bringing machine learning to research on intellectual and developmental disabilities: taking inspiration from neurological diseases,” *J. Neurodev. Disord.*, vol. 14, no. 1, p. 28, 2022, doi: 10.1186/s11689-022-09438-w.
- [31] C. Qing, R. Qiao, X. Xu, and Y. Cheng, “Interpretable Emotion Recognition Using EEG Signals,” *IEEE Access*, vol. 7, pp. 94160–94170, 2019, doi: 10.1109/ACCESS.2019.2928691.
- [32] L. Yao, M. Wang, Y. Lu, H. Li, and X. Zhang, “Eeg-based emotion recognition by exploiting fused network entropy measures of complex networks across subjects,” *Entropy*, vol. 23, no. 8, p. 984, 2021, doi: 10.3390/e23080984.
- [33] X. Zhu, G. Liu, L. Zhao, W. Rong, J. Sun, and R. Liu, “Emotion Classification from Multi-Band Electroencephalogram Data Using Dynamic Simplifying Graph Convolutional Network and Channel Style Recalibration Module,” *Sensors*, vol. 23, no. 4, 2023, doi: 10.3390/s23041917.
- [34] S. R. Ashwini and H. C. Nagaraj, “Classification of eeg signal using eaca based approach at ssvep-bci,” *IAES Int. J. Artif. Intell.*, vol. 10, no. 3, pp. 717–726, 2021, doi: 10.11591/ijai.v10.i3.pp717-726.
- [35] A. Khosla, P. Khandnor, and T. Chand, “A novel method for EEG based automated eyes state classification using recurrence plots and machine learning approach,” *Concurr. Comput. Pract. Exp.*, vol. 34, no. 13, 2022, doi: 10.1002/cpe.6912.
- [36] Z. Zhao, Q. Liu, and F. Zhou, “Robust Lightweight Facial Expression Recognition Network with Label Distribution Training,” May 2021.
- [37] M. Arevalillo-Herráez, M. Cobos, S. Roger, and M. García-Pineda, “Combining inter-subject modeling with a subject-based data transformation to improve affect recognition from EEG signals,” *Sensors (Switzerland)*, vol. 19, no. 13, Jul. 2019, doi: 10.3390/s19132999.

- [38] Arjun, A. S. Rajpoot, and M. R. Panicker, "Subject independent emotion recognition using EEG signals employing attention driven neural networks," *Biomed. Signal Process. Control*, vol. 75, 2022, doi: 10.1016/j.bspc.2022.103547.
- [39] H. A. Gonzalez, S. Muzaffar, J. Yoo, and I. M. Elfadel, "BioCNN: A Hardware Inference Engine for EEG-Based Emotion Detection," *IEEE Access*, vol. 8, pp. 140896–140914, 2020, doi: 10.1109/ACCESS.2020.3012900.
- [40] L. A. Martínez-Tejada, A. Puertas-González, N. Yoshimura, and Y. Koike, "Exploring EEG Characteristics to Identify Emotional Reactions under Videogame Scenarios," Mar. 2021.
- [41] P. Chumchu and K. Patil, "Dataset of cannabis seeds for machine learning applications," *Data Br.*, vol. 47, 2023, doi: 10.1016/j.dib.2023.108954.
- [42] K. Koyamada and T. Ito, "Seed specification for displaying a streamline in an irregular volume," *Eng. Comput.*, vol. 14, no. 1, pp. 73–80, 1998, doi: 10.1007/BF01198976.
- [43] A. Košir, G. Strle, and M. Meza, "Weak Ground Truth Determination of Continuous Human-Rated Data," Jan. 2021.
- [44] A. T. Adebisi and K. C. Veluvolu, "Brain network analysis for the discrimination of dementia disorders using electrophysiology signals: A systematic review," Mar. 2023.
- [45] W. Konlakorn, "MU Face Emotion Building a Large Dataset for Emotional Facial Expression in Psychological Domain," *In*.
- [46] A. Lopez-Rincon, "Emotion recognition using facial expressions in children using the NAO robot," *CONIELECOMP 2019 - 2019 International Conference on Electronics, Communications and Computers*. IEEE, pp. 146–153, 2019. doi: 10.1109/CONIELECOMP.2019.8673111.
- [47] P. Barros and A. Sciutti, "CIAO! A Contrastive Adaptation Mechanism for Non-Universal Facial Expression Recognition," *2022 10th Int. Conf. Affect. Comput. Intell. Interact. ACII 2022*, 2022, doi: 10.1109/ACII55700.2022.9953863.
- [48] A. V. Savchenko, "Facial expression and attributes recognition based on multi-task learning of lightweight neural networks," *SISY 2021 - IEEE 19th*

- Int. Symp. Intell. Syst. Informatics, Proc.*, pp. 119–124, 2021, doi: 10.1109/SISY52375.2021.9582508.
- [49] A. H. Farzaneh and X. Qi, “Discriminant distribution-agnostic loss for facial expression recognition in the wild,” in *IEEE Computer Society Conference on Computer Vision and Pattern Recognition Workshops*, vol. 2020-June, 2020, pp. 1631–1639. doi: 10.1109/CVPRW50498.2020.00211.
- [50] Q. Liu, J. Hao, and Y. Guo, “EEG Data Augmentation for Emotion Recognition with a Task-Driven GAN,” *Algorithms*, vol. 16, no. 2, Apr. 2023, doi: 10.3390/a16020118.
- [51] W. L. Zheng, W. Liu, Y. Lu, B. L. Lu, and A. Cichocki, “EmotionMeter: A Multimodal Framework for Recognizing Human Emotions,” *IEEE Trans. Cybern.*, vol. 49, no. 3, pp. 1110–1122, 2019, doi: 10.1109/TCYB.2018.2797176.
- [52] Z. Lan, Y. Liu, O. Sourina, L. Wang, R. Scherer, and G. Müller-Putz, “SAFE: An EEG dataset for stable affective feature selection,” *Adv. Eng. Informatics*, vol. 44, no. 101047, p. 101047, 2020, doi: 10.1016/j.aei.2020.101047.
- [53] S. Ehrlich, K. Agres, C. Guan, and G. Cheng, “A closed-loop, music-based brain-computer interface for emotion mediation,” Mar. 2019.
- [54] H. Jang *et al.*, “Recent advances in deep learning-based anomaly detection for industrial internet of things: A review,” *IEEE Internet Things J.*, vol. 8, no. 2, pp. 835–848, 2021, doi: 10.1109/JIOT.2020.3032386.
- [55] J. E. Pierce and J. Péron, “The basal ganglia and the cerebellum in human emotion,” *Soc. Cogn. Affect. Neurosci.*, vol. 15, no. 5, pp. 599–613, 2020, doi: 10.1093/scan/nsaa076.
- [56] Y. Zhang, H. Ma, X. Lv, and Q. Han, “Multimodal MRI Analysis of Brain Metabolism in Maintenance Hemodialysis Patients Based on Cognitive Computing,” *J. Healthc. Eng.*, vol. 2021, p. 7231658, 2021, doi: 10.1155/2021/7231658.
- [57] S. Madhavan, R. K. Tripathy, and R. B. Pachori, “Time-Frequency Domain Deep Convolutional Neural Network for the Classification of Focal and Non-Focal EEG Signals,” *IEEE Sens. J.*, vol. 20, no. 6, pp. 3078–3086, 2020, doi: 10.1109/JSEN.2019.2956072.

- [58] S. Siuly, Y. Li, P. Wen, and O. F. Alcin, "SchizoGoogLeNet: The GoogLeNet-Based Deep Feature Extraction Design for Automatic Detection of Schizophrenia," *Comput. Intell. Neurosci.*, vol. 2022, p. 1992596, 2022, doi: 10.1155/2022/1992596.
- [59] Z. A. A. Alyasseri, A. T. Khader, M. A. Al-Betar, A. K. Abasi, and S. N. Makhadmeh, "EEG Signals Denoising Using Optimal Wavelet Transform Hybridized with Efficient Metaheuristic Methods," *IEEE Access*, vol. 8, pp. 10584–10605, 2020, doi: 10.1109/ACCESS.2019.2962658.
- [60] D. O. Nahmias, E. F. Civillico, and K. L. Kontson, "Deep learning and feature based medication classifications from EEG in a large clinical data set," *Sci. Rep.*, vol. 10, no. 1, p. 14206, 2020, doi: 10.1038/s41598-020-70569-y.
- [61] B. Hjorth, "The physical significance of time domain descriptors in EEG analysis," *Electroencephalogr. Clin. Neurophysiol.*, vol. 34, no. 3, pp. 321–325, 1973, doi: 10.1016/0013-4694(73)90260-5.
- [62] S. Morales and M. E. Bowers, "Time-frequency analysis methods and their application in developmental EEG data," *Dev. Cogn. Neurosci.*, vol. 54, 2022, doi: 10.1016/j.dcn.2022.101067.
- [63] J. M. Schoffelen and J. Gross, "Source connectivity analysis with MEG and EEG," *Hum. Brain Mapp.*, vol. 30, no. 6, pp. 1857–1865, 2009, doi: 10.1002/hbm.20745.
- [64] F. Van de Steen, L. Faes, E. Karahan, J. Songsiri, P. A. Valdes-Sosa, and D. Marinazzo, "Critical Comments on EEG Sensor Space Dynamical Connectivity Analysis," *Brain Topogr.*, vol. 32, no. 4, pp. 643–654, 2019, doi: 10.1007/s10548-016-0538-7.



UNIVERSITAS
MUHAMMADIYAH
MALANG



FAKULTAS TEKNIK

INFORMATIKA

informatika.umm.ac.id | informatika@umm.ac.id

FORM CEK PLAGIARISME LAPORAN TUGAS AKHIR

Nama Mahasiswa : Muhammad Aulanas Bitaqwa

NIM : 201910370311149

Judul TA : Pengenalan Emosi Berbasis EEG Tinjauan Terbaru dari Dataset

Hasil Cek Plagiarisme dengan Turnitin

No.	Komponen Pengecekan	Nilai Maksimal Plagiarisme (%)	Hasil Cek Plagiarisme (%) *
1.	Bab 1 – Pendahuluan	10 %	9 %
2.	Bab 2 – Daftar Pustaka	25 %	4 %
3.	Bab 3 – Analisis dan Perancangan	25 %	9 %
4.	Bab 4 – Implementasi dan Pengujian	15 %	0 %
5.	Bab 5 – Kesimpulan dan Saran	5 %	4 %
6.	Makalah Tugas Akhir	20 %	11 %

*) Hasil cek plagiarisme diisi oleh pemeriksa (staf TU)

*) Maksimal 5 kali (4 Kali sebelum ujian, 1 kali sesudah ujian)

Mengetahui,

Pemeriksa (Staff TU)



[Handwritten signature]



Kampus I

Jl. Bandung 1 Malang, Jawa Timur
P: +62 341 551 253 (Hunting)
F: +62 341 460 435

Kampus II

Jl. Bendungan Sutami No. 188 Malang, Jawa Timur
P: +62 341 551 149 (Hunting)
F: +62 341 582 060

Kampus III

Jl. Raya Tlogomas No. 248 Malang, Jawa Timur
P: +62 341 464 318 (Hunting)
F: +62 341 460 435
E: webmaster@umm.ac.id