DAFTAR PUSTAKA

[1] World Health Organization, “Cardiovascular diseases,” 31 Juli 2025. [Online]. Available: https://www.who.int/health-topics/cardiovascular-diseases

[2] G. Lippi, F. Sanchis-Gomar, and G. Cervellin, “Global epidemiology of atrial fibrillation: An increasing epidemic and public health challenge,” *Int. J. Stroke*, vol. 16, no. 2, pp. 217–221, 2021, doi: 10.1177/1747493019897870.

[3] P. M. Research, “Arrhythmia Market Share, Size, Trends, Industry Analysis Report, By Type (Supraventricular Tachycardias, Ventricular Arrhythmias, Bradyarrhythmias); By Site of Origin Atrial; By Test Equipment; By Region; Segment Forecast, 2022 - 2030,” p. 115, 2022, [Online]. Available: https://www.polarismarketresearch.com/industry-analysis/arrhythmia-market

[4] T. Vivekanandan, J. Jegan, D. Jagadeesan, Y. Sreeraman, N. C. S. N. Iyengar, and E. Purushotham, “Internet of Things Enabled Based Arrhythmia Classification using Dandelion Optimization Algorithm with Ensemble Learning,” *J. Intell. Syst. Internet Things*, vol. 11, no. 2, pp. 63–74, 2024, doi: 10.54216/JISIoT.110206.

[5] V. Krasteva, S. Ménétré, J. P. Didon, and I. Jekova, “Fully convolutional deep neural networks with optimized hyperparameters for detection of shockable and non-shockable rhythms,” *Sensors (Switzerland)*, vol. 20, no. 10, 2020, doi: 10.3390/s20102875.

[6] T. Joel and T. Sethukarasi, “Deep Siamese Domain Adaptation Convolutional Neural Network Optimized with Honey Badger Algorithm for Fetal Arrhythmia Detection and Classification from ECG Signals,” *Int. J. Pattern Recognit. Artif. Intell.*, vol. 38, no. 9, 2024, doi: 10.1142/S021800142452013X.

[7] G. Silva, P. Silva, G. Moreira, V. Freitas, J. Gertrudes, and E. Luz, “A Systematic Review of ECG Arrhythmia Classification: Adherence to

Standards, Fair Evaluation, and Embedded Feasibility," 2025, [Online]. Available: http://arxiv.org/abs/2503.07276

[8] J. Marc Overhage and D. McCallie, "Physician time spent using the electronic health record during outpatient encounters a descriptive study," *Ann. Intern. Med.*, vol. 172, no. 3, pp. 169–174, 2020, doi: 10.7326/M18-3684.

[9] A. H. Kashou *et al.*, "Exploring Factors Influencing ECG Interpretation Proficiency of Medical Professionals," *Curr. Probl. Cardiol.*, vol. 48, no. 10, 2023, doi: 10.1016/j.cpcardiol.2023.101865.

[10] D. A. Cook, S. Y. Oh, and M. V. Pusic, "Accuracy of Physicians' Electrocardiogram Interpretations: A Systematic Review and Meta-analysis," *JAMA Intern. Med.*, vol. 180, no. 11, pp. 1461–1471, 2020, doi: 10.1001/jamainternmed.2020.3989.

[11] Q. Liu *et al.*, "PSC-Net: Integration of Convolutional Neural Networks and transformers for Physiological Signal Classification," *Biomed. Signal Process. Control*, vol. 91, 2024, doi: 10.1016/j.bspc.2024.106040.

[12] H. Anu, S. Rathnakara, and S. Mallikarjunaswamy, "Enhanced ECG Signal Classification with CNN-LSTM Networks using Aquila Optimization," *Eng. Technol. Appl. Sci. Res.*, vol. 15, no. 3, pp. 23461–23466, 2025, doi: 10.48084/etasr.10492.

[13] K. K. Reddy C. *et al.*, "A multi-scale convolutional LSTM-dense network for robust cardiac arrhythmia classification from ECG signals," *Comput. Biol. Med.*, vol. 191, 2025, doi: 10.1016/j.compbiomed.2025.110121.

[14] R. de T. Guerra, C. K. Yamaguchi, S. F. Stefenon, L. dos S. Coelho, and V. C. Mariani, "Deep Learning Approach for Automatic Heartbeat Classification," *Sensors*, vol. 25, no. 5, 2025, doi: 10.3390/s25051400.

[15] A. E. M. Atwa, E.-S. Atlam, A. Ahmed, M. A. Atwa, E. M. Abdelrahim, and A. I. Siam, "Interpretable Deep Learning Models for Arrhythmia Classification Based on ECG Signals Using PTB-X Dataset," *Diagnostics*, vol. 15, no. 15, p. 1950, 2025, doi: 10.3390/diagnostics15151950.

[16] M. Y. Ansari *et al.*, "A survey of transformers and large language models for

ECG diagnosis: advances, challenges, and future directions," *Artif. Intell. Rev.*, vol. 58, no. 9, 2025, doi: 10.1007/s10462-025-11259-x.

[17] S. Tahery, F. H. Akhlaghi, and T. Amirsoleimani, "HeartBERT: A Self-Supervised ECG Embedding Model for Efficient and Effective Medical Signal Analysis," 2025, [Online]. Available: https://anonymous.4open.science/r/HeartBert.

[18] S. Thapa, K. Howlader, S. Bhattacharjee, and W. Le, "MoRE: Multi-Modal Contrastive Pre-training with Transformers on X-Rays, ECGs, and Diagnostic Report," *Arxiv*, 2024.

[19] Y.-H. Kim, "One Report, Multifaceted Views: Multi-Expert Rewriting for ECG Interpretation".

[20] P. López-Úbeda, T. Martín-Noguerol, J. Escartín, and A. Luna, "Role of Natural Language Processing in Automatic Detection of Unexpected Findings in Radiology Reports: A Comparative Study of RoBERTa, CNN, and ChatGPT," *Acad. Radiol.*, vol. 31, no. 12, pp. 4833–4842, 2024, doi: 10.1016/j.acra.2024.07.057.

[21] D. Li *et al.*, "Joint extraction of Chinese medical entities and relations based on RoBERTa and single-module global pointer," *BMC Med. Inform. Decis. Mak.*, vol. 24, no. 1, 2024, doi: 10.1186/s12911-024-02577-1.

[22] F. Chen, S. M. A. Bokhari, K. Cato, G. Gürsoy, and S. Rossetti, "Examining the Generalizability of Pretrained De-identification Transformer Models on Narrative Nursing Notes," *Appl. Clin. Inform.*, vol. 15, no. 2, pp. 357–367, 2024, doi: 10.1055/a-2282-4340.

[23] E. H. Houssein, R. E. Mohamed, G. Hu, and A. A. Ali, "Adapting transformer-based language models for heart disease detection and risk factors extraction," *J. Big Data*, vol. 11, no. 1, 2024, doi: 10.1186/s40537-024-00903-y.

[24] A. H. Kashou, A. M. May, and P. A. Noseworthy, "Comparison of two artificial intelligence-augmented ECG approaches: Machine learning and deep learning," *J. Electrocardiol.*, vol. 79, pp. 75–80, 2023, doi: 10.1016/j.jelectrocard.2023.03.009.

[25] H. Taniguchi *et al.*, “Explainable artificial intelligence model for diagnosis of atrial fibrillation using holter electrocardiogram waveforms,” *Int. Heart J.*, vol. 62, no. 3, pp. 534–539, 2021, doi: 10.1536/ihj.21-094.

[26] M. A. Ahamed, K. A. Hasan, K. F. Monowar, N. Mashnoor, and M. A. Hossain, “ECG heartbeat classification using ensemble of efficient machine learning approaches on imbalanced datasets,” 2020. doi: 10.1109/ICAICT51780.2020.9333534.

[27] A. Ravi Raja, P. Yesudasu, N. N. S. P. Revathi, P. R. L. Durga Prasad, K. Pujitha, and V. R. Prabha K, “A Review on Analysis of Cardiac Arrhythmia from Heart Beat Classification,” 2023. doi: 10.1109/ICEARS56392.2023.10085295.

[28] N. Anjum, K. A. Sathi, M. A. Hossain, and M. A. A. Dewan, “A Temporal Transformer-Based Fusion Framework for Morphological Arrhythmia Classification,” *Computers*, vol. 12, no. 3, 2023, doi: 10.3390/computers12030068.

[29] M. R. Thanka, S. P. Gandu, B. Manaswini, T. R. B. Snehitha, M. N. Reddy, and K. Nandini, “An Ensemble Approach for Cardiac Arrhythmia Detection using Multimodal Deep Learning,” 2023. doi: 10.1109/ICICT57646.2023.10134410.

[30] G. Michalopoulos, Y. Wang, H. Kaka, H. Chen, and A. Wong, “UmlsBERT: Clinical Domain Knowledge Augmentation of Contextual Embeddings Using the Unified Medical Language System Metathesaurus,” in *NAACL-HLT 2021 - 2021 Conference of the North American Chapter of the Association for Computational Linguistics: Human Language Technologies, Proceedings of the Conference*, 2021. doi: 10.18653/v1/2021.naacl-main.139.

[31] M. Najia and B. Faouzi, “An Enhanced Hybrid Model Combining CNN, BiLSTM, and Attention Mechanism for ECG Segment Classification,” *Biomed. Eng. Comput. Biol.*, vol. 16, 2025, doi: 10.1177/11795972251341051.

[32] M. A. Talukder, “A hybrid multiscale feature fusion model for enhanced

cardiovascular arrhythmia detection," *Results Eng.*, vol. 25, 2025, doi: 10.1016/j.rineng.2025.104244.

[33] W. P. Li, J. H. Chuah, G. J. Tan, C. Liu, and H.-N. Ting, "A progressive attention-based cross-modal fusion network for cardiovascular disease detection using synchronized electrocardiogram and phonocardiogram signals," *PeerJ Comput. Sci.*, vol. 11, p. e3038, 2025, doi: 10.7717/peerj-cs.3038.

[34] Y. He, C. Wang, S. Zhang, N. Li, Z. Li, and Z. Zeng, "KG-MTT-BERT: Knowledge Graph Enhanced BERT for Multi-Type Medical Text Classification," 2022, [Online]. Available: http://arxiv.org/abs/2210.03970

[35] P. Lam *et al.*, "LSTM-based Deep Neural Network With A Focus on Sentence Representation for Sequential Sentence Classification in Medical Scientific Abstracts," *Ann. Comput. Sci. Intell. Syst.*, no. 2024, pp. 219–224, 2024, doi: 10.15439/2024F5872.

[36] T. A. A. Abdullah *et al.*, "Sig-Lime: A Signal-Based Enhancement of Lime Explanation Technique," *IEEE Access*, vol. 12, pp. 52641–52658, 2024, doi: 10.1109/ACCESS.2024.3384277.

[37] A. S. Udawat and P. Singh, "An automated detection of atrial fibrillation from single-lead ECG using HRV features and machine learning," *J. Electrocardiol.*, vol. 75, pp. 70–81, 2022, doi: 10.1016/j.jelectrocard.2022.07.069.

[38] A. R. Garcia, S. B. Filipe, C. Fernandes, C. Estevão, and G. Ramos, "No 主観的健康感を中心とした在宅高齢者における 健康関連指標に関する共分散構造分析Title."

[39] M. H. Mazidi, M. Eshghi, and M. R. Raoufy, "Premature Ventricular Contraction (PVC) Detection System Based on Tunable Q-Factor Wavelet Transform," *J. Biomed. Phys. Eng.*, vol. 12, no. 1, pp. 61–74, 2022, doi: 10.31661/jbpe.v0i0.1235.

[40] F. Lin *et al.*, "Artificial-intelligence-based risk prediction and mechanism discovery for atrial fibrillation using heart beat-to-beat intervals," *Med*, vol. 5, no. 5, pp. 414-431.e5, 2024, doi: 10.1016/j.medj.2024.02.006.

[41] J. Zheng *et al.*, “A High Precision Machine Learning-Enabled System for Predicting Idiopathic Ventricular Arrhythmia Origins,” *Front. Cardiovasc. Med.*, vol. 9, 2022, doi: 10.3389/fcvm.2022.809027.

[42] C. Chen, Z. Hua, R. Zhang, G. Liu, and W. Wen, “Automated arrhythmia classification based on a combination network of CNN and LSTM,” *Biomed. Signal Process. Control*, vol. 57, 2020, doi: 10.1016/j.bspc.2019.101819.

[43] T. Pokaprakarn, R. R. Kitzmiller, J. Randall Moorman, D. E. Lake, A. K. Krishnamurthy, and M. R. Kosorok, “Sequence to Sequence ECG Cardiac Rhythm Classification Using Convolutional Recurrent Neural Networks,” *IEEE J. Biomed. Heal. Informatics*, vol. 26, no. 2, pp. 572–580, 2022, doi: 10.1109/JBHI.2021.3098662.

[44] M. Wang, S. Rahardja, P. Fränti, and S. Rahardja, “Single-lead ECG recordings modeling for end-to-end recognition of atrial fibrillation with dual-path RNN,” *Biomed. Signal Process. Control*, vol. 79, 2023, doi: 10.1016/j.bspc.2022.104067.

[45] Y. C. Wang *et al.*, “Current Advancement in Diagnosing Atrial Fibrillation by Utilizing Wearable Devices and Artificial Intelligence: A Review Study,” 2022. doi: 10.3390/diagnostics12030689.

[46] “แนวทางเวชปฏิ บั ติ สำหรั บดู แลผู ้ ป่ วยภาวะหั วใจเต้ นผิ ดจั งหวะ ชนิ ด atrial fibrillation (AF) ในประเทศไทย จั ดทำโดย • ชมรมช่ างไฟฟ้ าหั วใจ • สมาคมแพทย์ โรคหั วใจแห่ งประเทศไทยในพระบรมราชู ปถั มภ์.” [Online]. Available: https://www.news-medical.net/health/Atrial-Fibrillation-%28AF%29.aspx

[47] S. Hamza and Y. Ben Ayed, “An integration of features for person identification based on the PQRST fragments of ECG signals,” *Signal, Image Video Process.*, vol. 16, no. 8, pp. 2037–2043, 2022, doi: 10.1007/s11760-022-02165-8.

[48] W. W. Chen, C. C. Tseng, C. C. Huang, and H. H. S. Lu, “Improving deep-learning electrocardiogram classification with an effective coloring method,” *Artif. Intell. Med.*, vol. 149, 2024, doi: 10.1016/j.artmed.2024.102809.

[49] L. Krause, “What Is Ventricular Tachycardia? Symptoms, Causes, and

More." [Online]. Available: https://www.healthline.com/
[50] R. Gao *et al.*, "Time-distanced gates in long short-term memory networks," *Med. Image Anal.*, 2020, doi: 10.1016/j.media.2020.101785.
[51] B. Tutuko *et al.*, "DAE-ConvBiLSTM: End-to-end learning single-lead electrocardiogram signal for heart abnormalities detection," *PLoS One*, vol. 17, no. 12 December, 2022, doi: 10.1371/journal.pone.0277932.
[52] S. Dhyani, A. Kumar, and S. Choudhury, "Analysis of ECG-based arrhythmia detection system using machine learning," *MethodsX*, vol. 10, 2023, doi: 10.1016/j.mex.2023.102195.
[53] S. Boulkaboul, S. Bouchama, S. Kasser, and B. A. S. Ali, "D-Resnet: Deep Resnet based approach for ECG classification," *Control Eng. Appl. Informatics*, vol. 26, no. 1, pp. 64–71, 2024, doi: 10.61416/ceai.v26i1.8816.
[54] R. K. Hughes *et al.*, "Apical Ischemia Is a Universal Feature of Apical Hypertrophic Cardiomyopathy," *Circ. Cardiovasc. Imaging*, vol. 16, no. 3, pp. 251–259, 2023, doi: 10.1161/CIRCIMAGING.122.014907.
[55] Q. ul ain Mastoi *et al.*, "Machine learning-data mining integrated approach for premature ventricular contraction prediction," *Neural Comput. Appl.*, vol. 33, no. 18, pp. 11703–11719, 2021, doi: 10.1007/s00521-021-05820-2.
[56] L. R. Liu *et al.*, "An Arrhythmia classification approach via deep learning using single-lead ECG without QRS wave detection," *Heliyon*, vol. 10, no. 5, 2024, doi: 10.1016/j.heliyon.2024.e27200.
[57] F. Bahlke *et al.*, "First clinical data on artificial intelligence-guided catheter ablation in long-standing persistent atrial fibrillation," *J. Cardiovasc. Electrophysiol.*, vol. 35, no. 3, pp. 406–414, 2024, doi: 10.1111/jce.16184.
[58] H. A. Huillcen Baca, A. Muñoz Del Carpio Toia, J. A. Sulla Torres, R. Cusirramos Montesinos, L. A. Contreras Salas, and S. C. Correa Herrera, "Detection of Arrhythmias Using Heart Rate Signals from Smartwatches," *Appl. Sci.*, vol. 14, no. 16, 2024, doi: 10.3390/app14167233.
[59] T. Yamane, M. Kimura, and M. Morita, "Application of Nine-Axis Accelerometer-Based Recognition of Daily Activities in Clinical Examination," *Phys. Act. Heal.*, vol. 8, no. 1, pp. 29–46, 2024, doi:

10.5334/paah.313.

[60] D. Al-Shammary, M. Noaman Kadhim, A. M. Mahdi, A. Ibaida, and K. Ahmed, “Efficient ECG classification based on Chi-square distance for arrhythmia detection,” *J. Electron. Sci. Technol.*, vol. 22, no. 2, 2024, doi: 10.1016/j.jnlest.2024.100249.

[61] W. Wu, Y. Huang, and X. Wu, “SRT: Improved transformer-based model for classification of 2D heartbeat images,” *Biomed. Signal Process. Control*, vol. 88, 2024, doi: 10.1016/j.bspc.2023.105017.

[62] M. Ebrahimpoor, M. Taghizadeh, M. H. Fatehi, O. Mahdiyar, and J. Jamali, “Premature Ventricular Contractions Detection by Multi-Domain Feature Extraction and Auto-Encoder-based Feature Reduction,” *Circuits, Syst. Signal Process.*, vol. 43, no. 5, pp. 3279–3296, 2024, doi: 10.1007/s00034-024-02613-5.

[63] Z. Yang *et al.*, “A coordinated adaptive multiscale enhanced spatio-temporal fusion network for multi-lead electrocardiogram arrhythmia detection,” *Sci. Rep.*, vol. 14, no. 1, 2024, doi: 10.1038/s41598-024-71700-z.

[64] A. Anbarasi and T. Ravi, “Detection and classification of arrhythmia type using hybrid model of LSTM with convolutional neural network,” *Appl. Nanosci.*, vol. 13, no. 5, pp. 3435–3445, 2023, doi: 10.1007/s13204-022-02368-y.

[65] S. Allabun, “An Intelligent Learning Approach for Improving ECG Signal Classification and Arrhythmia Analysis,” *Int. J. Adv. Comput. Sci. Appl.*, vol. 15, no. 4, pp. 319–326, 2024, doi: 10.14569/IJACSA.2024.0150433.

[66] S. Nithya, M. Mary Shanthi Rani, and V. Sivakumar, “Classification of Cardiovascular Arrhythmia Using Deep Learning Techniques: A Review,” *EAI Endorsed Trans. Pervasive Heal. Technol.*, vol. 10, 2024, doi: 10.4108/eetpht.10.6421.

[67] R. H. Bemthuis, R. R. Govers, and A. Asadi, “A CRISP-DM-based Methodology for Assessing Agent-based Simulation Models using Process Mining,” *arXiv Prepr. arXiv2404.01114*, 2024, [Online]. Available: https://arxiv.org/abs/2404.01114%0Ahttps://arxiv.org/pdf/2404.01114

[68] M. Shayboun, C. Koch, and D. Kifokeris, “Learning from accidents: machine learning prototype development based on the CRISP-DM business understanding,” *Proc. Jt. CIB W099 W123 Annu. Int. Conf. 2021 Good Heal. Chang. Innov. Improv. wellbeing Constr.*, pp. 43–53, 2021, [Online]. Available: https://www.w099tg592020.com/uploads/1/3/0/5/130510093/cib_proceedings_2021_final.pdf

[69] H. M. Rai, J. Yoo, and S. Dashkevych, “GAN-SkipNet: A Solution for Data Imbalance in Cardiac Arrhythmia Detection Using Electrocardiogram Signals from a Benchmark Dataset,” *Mathematics*, vol. 12, no. 17, 2024, doi: 10.3390/math12172693.

[70] J. Cai, J. Song, and B. Peng, “Enhancing ECG Heartbeat classification with feature fusion neural networks and dynamic minority-biased batch weighting loss function,” *Physiol. Meas.*, vol. 45, no. 7, 2024, doi: 10.1088/1361-6579/ad5cc0.

[71] Y. Ju, J. L. S. Waugh, S. Singh, C. G. Rusin, A. B. Patel, and P. N. Jain, “A multimodal deep learning tool for detection of junctional ectopic tachycardia in children with congenital heart disease,” *Hear. Rhythm O2*, vol. 5, no. 7, pp. 452–459, 2024, doi: 10.1016/j.hroo.2024.04.014.

[72] K. Priyadharshini, A. Mathias, R. Santhana Krishnan, N. Kanthimathi, J. Relin Francis Raj, and P. Stella Rose Malar, “A Multi-Resolution Deep Learning Approach for IoT-Integrated Biomedical Signal Processing using CNN-LSTM,” 2025. doi: 10.1109/ICTMIM65579.2025.10988087.

[73] R. G. Franklin and B. Muthukumar, “Arrhythmia and disease classification based on deep learning techniques,” *Intell. Autom. Soft Comput.*, vol. 31, no. 2, pp. 835–851, 2022, doi: 10.32604/iasc.2022.019877.

[74] C. Luo, X. Li, and Y. Ye, “PFST-LSTM: A SpatioTemporal LSTM Model with Pseudoflow Prediction for Precipitation Nowcasting,” *IEEE J. Sel. Top. Appl. Earth Obs. Remote Sens.*, 2021, doi: 10.1109/JSTARS.2020.3040648.

[75] K. R. Febeena and C. Kurian, “MAB-Net: an enhanced MobileNet with attention and BiLSTM model for arrhythmia detection using

electrocardiogram signals," *Iran J. Comput. Sci.*, 2025, doi: 10.1007/s42044-025-00238-8.

[76] Y. Kaya, F. Kuncan, and R. Tekin, "A New Approach for Congestive Heart Failure and Arrhythmia Classification Using Angle Transformation with LSTM," *Arab. J. Sci. Eng.*, vol. 47, no. 8, pp. 10497–10513, 2022, doi: 10.1007/s13369-022-06617-8.

[77] K. P. Ajitha Gladis, A. Ahilan, N. Muthukumaran, and L. Jenifer, "ECG Arrhythmia Measurement and Classification for Portable Monitoring," *Meas. Sci. Rev.*, vol. 24, no. 4, pp. 118–128, 2024, doi: 10.2478/msr-2024-0017.

[78] O. O'Donoghue, A. Shtedritski, J. Ginger, R. Abboud, A. E. Ghareeb, and S. G. Rodriques, "BioPlanner: Automatic Evaluation of LLMs on Protocol Planning in Biology," in *EMNLP 2023 - 2023 Conference on Empirical Methods in Natural Language Processing, Proceedings*, 2023. doi: 10.18653/v1/2023.emnlp-main.162.

[79] A. J. Prakash and M. Atef, "A lightweight deep learning approach for patient-specific electrocardiogram beat classification using local and long-term dependencies," *Eng. Appl. Artif. Intell.*, vol. 152, 2025, doi: 10.1016/j.engappai.2025.110754.

[80] S. Wang, S. Wang, Z. Liu, and Q. Zhang, "A role distinguishing Bert model for medical dialogue system in sustainable smart city," *Sustain. Energy Technol. Assessments*, 2023, doi: 10.1016/j.seta.2022.102896.

[81] C. N. Karaeng and D. A. Kristiyanti, "Multimodal Sentiment Analysis Approach Combining Transfer Learning and Generative AI of E-Commerce Product Reviews," *Proc. - 2025 4th Int. Conf. Electron. Represent. Algorithm Artif. Intell. Creat. Tomorrow's World Today, ICERA 2025*, pp. 215–220, 2025, doi: 10.1109/ICERA66156.2025.11087376.

[82] J. Huang *et al.*, "Research output of artificial intelligence in arrhythmia from 2004 to 2021: a bibliometric analysis," *J. Thorac. Dis.*, vol. 14, no. 5, pp. 1411–1427, 2022, doi: 10.21037/jtd-21-1767.

[83] S. Hu *et al.*, "Semi-Supervised Learning for Low-Cost Personalized

Obstructive Sleep Apnea Detection Using Unsupervised Deep Learning and Single-Lead Electrocardiogram," *IEEE J. Biomed. Heal. Informatics*, vol. 27, no. 11, pp. 5281–5292, 2023, doi: 10.1109/JBHI.2023.3304299.

[84] M. Gusev, "AI Cardiologist: Arrhythmia Detection by Transformer-Based Language Model," *Commun. Comput. Inf. Sci.*, vol. 2436 CCIS, pp. 223–237, 2025, doi: 10.1007/978-3-031-86162-8_16.

[85] R. Pashikanti, C. Y. Patil, and S. Amita Anirudhe, "An adaptive Marine Predator Optimization Algorithm (MPOA) integrated Gated Recurrent Neural Network (GRNN) classifier model for arrhythmia detection," *Biomed. Signal Process. Control*, vol. 94, 2024, doi: 10.1016/j.bspc.2024.106328.

[86] Y. Meng, L. Lin, Z. Qin, Y. Qu, Y. Qin, and Y. Li, "Biosignal Classification Based on Multi-Feature Multi-Dimensional WaveNet-LSTM Models," *J. Commun.*, vol. 17, no. 5, pp. 399–404, 2022, doi: 10.12720/jcm.17.5.399-404.

[87] R. B. Trivedi and S. R. Goyal, "Arrhythmia Detection by Analyzing ECGs Using Autoencoders and LSTM Networks," 2025. doi: 10.1007/978-981-96-2124-8_21.

[88] T. Bender *et al.*, "Analysis of a Deep Learning Model for 12-Lead ECG Classification Reveals Learned Features Similar to Diagnostic Criteria," *IEEE J. Biomed. Heal. Informatics*, vol. 28, no. 4, pp. 1848–1859, 2024, doi: 10.1109/JBHI.2023.3271858.

[89] Y. Jin *et al.*, "Cardiologist-level interpretable knowledge-fused deep neural network for automatic arrhythmia diagnosis," *Commun. Med.*, vol. 4, no. 1, 2024, doi: 10.1038/s43856-024-00464-4.

[90] M. Ramkumar, M. Alagarsamy, A. Balakumar, and S. Pradeep, "Ensemble classifier fostered detection of arrhythmia using ECG data," *Med. Biol. Eng. Comput.*, vol. 61, no. 9, pp. 2453–2466, 2023, doi: 10.1007/s11517-023-02839-6.

[91] S. EKEN, "Medical Data Analysis for Different Data Types," *Int. J. Comput. Exp. Sci. Eng.*, vol. 6, no. 3, pp. 138–144, 2020, doi:

10.22399/ijcesen.780174.
[92] A. Smajić, M. Grandits, and G. F. Ecker, "Using Jupyter Notebooks for re-training machine learning models," *J. Cheminform.*, vol. 14, no. 1, 2022, doi: 10.1186/s13321-022-00635-2.
[93] O. Mazumder *et al.*, "Computational Model for Therapy Optimization of Wearable Cardioverter Defibrillator: Shockable Rhythm Detection and Optimal Electrotherapy," *Front. Physiol.*, vol. 12, 2021, doi: 10.3389/fphys.2021.787180.
[94] F. J. Wesselius, M. S. van Schie, N. M. S. de Groot, and R. C. Hendriks, "An accurate and efficient method to train classifiers for atrial fibrillation detection in ECGs: Learning by asking better questions," *Comput. Biol. Med.*, vol. 143, 2022, doi: 10.1016/j.compbiomed.2022.105331.
[95] R. Feng *et al.*, "Engineering of Generative Artificial Intelligence and Natural Language Processing Models to Accurately Identify Arrhythmia Recurrence," *Circ. Arrhythmia Electrophysiol.*, vol. 18, no. 1, p. e013023, 2025, doi: 10.1161/CIRCEP.124.013023.
[96] J. Juliano, D. Ajeng, and J. Wiratama, "Enhancing Heart Disease Classification : A Comparative Analysis of SMOTE and Naïve Bayes on Imbalanced Data," vol. 9, no. September, pp. 2072–2079, 2025.
[97] N. Alamatsaz, L. Tabatabaei, M. Yazdchi, H. Payan, N. Alamatsaz, and F. Nasimi, "A lightweight hybrid CNN-LSTM explainable model for ECG-based arrhythmia detection," *Biomed. Signal Process. Control*, vol. 90, 2024, doi: 10.1016/j.bspc.2023.105884.
[98] A. Sun, W. Hong, J. Li, and J. Mao, "An Arrhythmia Classification Model Based on a CNN-LSTM-SE Algorithm," *Sensors*, vol. 24, no. 19, 2024, doi: 10.3390/s24196306.
[99] J. S. Bosma *et al.*, "The DRAGON benchmark for clinical NLP," *npj Digit. Med.*, vol. 8, no. 1, 2025, doi: 10.1038/s41746-025-01626-x.
[100] K. Yang *et al.*, "ECG-LM: Understanding Electrocardiogram with a Large Language Model," *Heal. Data Sci.*, vol. 5, 2025, doi: 10.34133/hds.0221.
[101] H. Chen, J. Zhan, Y. Guo, Y. Guan, and X. Liang, "Research and Design of

a CNN-LSTM-Based ECG Atrial Fibrillation Recognition System," 2025. doi: 10.1109/AINIT65432.2025.11035225.

[102] P. López-Úbeda, T. Martín-Noguerol, and A. Luna, "Automatic classification and prioritisation of actionable BI-RADS categories using natural language processing models," *Clin. Radiol.*, vol. 79, no. 1, pp. e1–e7, 2024, doi: 10.1016/j.crad.2023.09.009.

[103] H. Bleijendaal *et al.*, "Computer versus cardiologist: Is a machine learning algorithm able to outperform an expert in diagnosing a phospholamban p.Arg14del mutation on the electrocardiogram?," *Hear. Rhythm*, vol. 18, no. 1, pp. 79–87, 2021, doi: 10.1016/j.hrthm.2020.08.021.

[104] S. B. Gnanapirakasam and J. Manjula, "A Novel Approach for the Detection of Cardiovascular Abnormalities from Electrocardiogram and Phonocardiogram Signals Using Combined CNN-LSTM Techniques," *Trait. du Signal*, vol. 41, no. 6, pp. 3131–3142, 2024, doi: 10.18280/ts.410629.