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Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

DAFTAR PUSTAKA

Abu Bakar, B.B. dan Osman, M.S., 2013, Acclimations of Petri net theory in real-time system for hybrid plant, *2013 Science and Information Conference*, 2013 hlm. 244–248,

Ahmed, H. dan Nandi, A.K., 2020, *Condition monitoring with vibration signals: Compressive sampling and learning algorithms for rotating machines*, John Wiley & Sons.

Ajanalkar, S., Birajdar, S., Rajput, K., Fegade, R., Maslekar, D. dan Raul, A., 2025, Advanced machine learning models for early detection of helical gear faults, *International Journal on Interactive Design and Manufacturing*, [Online] tersedia di DOI:10.1007/s12008-025-02301-x.

Alam, N.M.F.H.N.B., Khalif, K.M.N.K., Jaini, N.I., Bakar, A.S.A. dan Abdullah, L., 2021, *Defuzzification of Intuitionistic Z-Numbers for Fuzzy Multi Criteria Decision Making*, [Online] 879–887, tersedia di DOI:10.1007/978-3-030-85577-2_101.

Aliev, R.A. dan Tserkovny, A., 2020, *Fuzzy Logic for Incidence Geometry*, [Online] 49–85, tersedia di DOI:10.1007/978-3-030-31041-7_4.

Allam, E., Elbab, H.F., Hady, M.A. dan Abouel-Seoud, S., 2010, Vibration Control of Active Vehicle Suspension System Using Fuzzy Logic Algorithm, *Fuzzy Information and Engineering*, [Online] 2 (4), 361–387, tersedia di DOI:10.1007/s12543-010-0056-3.

Altay, A. dan Kayakutlu, G., 2011, Fuzzy cognitive mapping in factor elimination: A case study for innovative power and risks, *Procedia Computer Science*, [Online], 2011 hlm. 1111–1119, tersedia di DOI:10.1016/j.procs.2010.12.181.

Alves, K.S.T.R., de Jesus, C.D. dan de Aguiar, E.P., 2024, A new Takagi–Sugeno–Kang model to time series forecasting, *Engineering Applications of Artificial Intelligence*, [Online] 133, tersedia di DOI:10.1016/j.engappai.2024.108155.

Alzarrad, A. dan Fonseca, D., 2018, *A New Model to Improve Project Time-Cost Trade-Off in Uncertain Environments*, [Online] tersedia di DOI:10.5772/intechopen.74022.

UNIVERSITAS GADJAH MADA
OPTIMASI SISTEM KLASIFIKASI REAL-TIME KONDISI RODA GIGI KONVEYOR PADA FPGA BERDAYA RENDAH BERBASIS SISTEM INFERENSI FUZZY INTEGER
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Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Amarnath, M. dan Lee, S.-K., 2015, Assessment of surface contact fatigue failure in a spur geared system based on the tribological and vibration parameter analysis, *Measurement*, [Online] 7632–44, tersedia di DOI:https://doi.org/10.1016/j.measurement.2015.08.020.

Analog Device, 2015, ADXL345 - 3-Axis, ±2 g/±4 g/±8 g/±16 g Digital Accelerometer, [Online], tersedia di *https://www.analog.com/en/products/adxl345.html*, diakses 8 September 2025.

Ansaf, H., Ansaf, B.K. dan Al-Samahi, S.S., 2021, A Neuro-Fuzzy Technique for the Modeling of B-Glucosidase Activity From Agaricus Bisporus, *Biochem*, [Online] 1 (3), 159–173, tersedia di DOI:10.3390/biochem1030013.

Aravindhan, S., Shyamalagowri, M., Karthika, J. dan Rajan, C., 2025, Causal Neuromorphic Graph Learning with Physics-Informed Micro-Twins for Explainable Wind Turbine Fault Diagnosis, *SSRG International Journal of Electrical and Electronics Engineering*, [Online] 12 (12), 140–150, tersedia di DOI:10.14445/23488379/IJEEE-V12I12P111.

Arroyo, J., Arrabé, C.V. dan Gonzalez, J., 2021, IceStudio Visual Editor for Open FPGA Boards, [Online], tersedia di *https://github.com/FPGAwars/icestudio*, diakses 20 Juli 2023.

Attur, S.S. dan Harikumar, M.E., 2022, Detection of Alzheimer's Disease using Fuzzy Inference System, *Proceedings - 4th International Conference on Smart Systems and Inventive Technology, ICSSIT 2022*, [Online], 2022 hlm. 1235 – 1241, tersedia di DOI:10.1109/ICSSIT53264.2022.9716523.

Azhar, A.M.N., 2024, Study Program Selection Recommendation System Using the Fuzzy Inference System Mamdani, *Jurnal Sistem Cerdas*, [Online] 7 (1), 13–25, tersedia di DOI:10.37396/jsc.v7i1.384.

Azizi, M. dan Zhou, A., 2024, Optimized machine learning approach for structural response prediction using wolf-bird optimizer, *Structures*, [Online] 65, tersedia di DOI:10.1016/j.istruc.2024.106691.

Bahrami, M., Javadikia, H. dan Ebrahimi, E., 2018, Intelligent Prediction of Fault Severity of Tractor's Gearbox by Time-domain and Frequency-domain (FFT

UNIVERSITAS GADJAH MADA
OPTIMASI SISTEM KLASIFIKASI REAL-TIME KONDISI RODA GIGI KONVEYOR PADA FPGA BERDAYA RENDAH BERBASIS SISTEM INFERENSI FUZZY INTEGER
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Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

phase angle and PSD) Statistics Analysis and ANFIS, *Journal of Mechanical Engineering*, [Online] 47 (1), 51–61, tersedia di DOI:10.3329/jme.v47i1.35421.

Barlybayev, A., Zhetkenbay, L., Karimov, D. dan Yergesh, B., 2023, Development neuro-fuzzy model to predict the stocks of companies in the electric vehicle industry, *Eastern-European Journal of Enterprise Technologies*, [Online] 4 (4 (124)), 72–87, tersedia di DOI:10.15587/1729-4061.2023.281138.

Barrón-Romero, César dan Hernández-Zavala, Antonio, 2020, Hardware implementation of an α - level based binary search and shifting fuzzifier (α - BSSF), *Journal of Intelligent & Fuzzy Systems*, [Online] 39 (5), 6671–6685, tersedia di DOI:10.3233/JIFS-190291.

Bartels, J., Hagihara, A., Minati, L., Tokgoz, K.K. dan Ito, H., 2023, An Integer-Only Resource-Minimized RNN on FPGA for Low-Frequency Sensors in Edge-AI, *IEEE Sensors Journal*, [Online] 23 (15), 17784–17793, tersedia di DOI:10.1109/JSEN.2023.3286580.

Bartels, J., Tokgoz, K.K., A, S., Fukawa, M., Otsubo, S., Li, C., Rachi, I., Takeda, K.-I., Minati, L. dan Ito, H., 2022, TinyCowNet: Memory- and Power-Minimized RNNs Implementable on Tiny Edge Devices for Lifelong Cow Behavior Distribution Estimation, *IEEE Access*, [Online] 1032706–32727, tersedia di DOI:10.1109/ACCESS.2022.3156278.

Barth, A., Cohen, K. dan Ma, O., 2021, *A Fuzzy Logic Approach for Spacecraft Landing Site Selection*, [Online] 1–13, tersedia di DOI:10.1007/978-3-030-82099-2_1.

Barzen, B.L.C., Reais-Parsi, A., Hung, E., Kang, M., Mishchenko, A., Greene, J.W. dan Wawrzynek, J., 2023, Narrowing the Synthesis Gap: Academic FPGA Synthesis is Catching Up With the Industry, *2023 Design, Automation & Test in Europe Conference & Exhibition (DATE)*, [Online], 2023 hlm. 1–6, tersedia di DOI:10.23919/DATE56975.2023.10137310.

Becking, D., Dreyer, M., Samek, W., Müller, K. dan Lapuschkin, S., 2022, *ECQ$^{\text {X}}$: Explainability-Driven Quantization For Low-Bit*

UNIVERSITAS GADJAH MADA
OPTIMASI SISTEM KLASIFIKASI REAL-TIME KONDISI RODA GIGI KONVEYOR PADA FPGA BERDAYA RENDAH BERBASIS SISTEM INFERENSI FUZZY INTEGER
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Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

And Sparse DNNs, [Online] 271–296, tersedia di DOI:10.1007/978-3-031-04083-2_14.

Berg, 2024, Gear Teeth Surface Wear: Causes, Detection & Prevention,

Bertolotti, I.C., 2005, *Real-time embedded operating systems: Standards and perspectives*, [Online]. tersedia di DOI:10.1201/9781420038163.

Bharathkumar, K., Paolini, C. dan Sarkar, M., 2020, FPGA-based Edge Inferencing for Fall Detection, *2020 IEEE Global Humanitarian Technology Conference (GHTC)*, [Online], 2020 hlm. 1–8, tersedia di DOI:10.1109/GHTC46280.2020.9342948.

Bhushan, C.M., Koppuravuri, P., Prasanthi, N., Gazi, F., Hussain, M.M., Abdussami, M., Devi, A.A. dan Faizi, J., 2025, Deploying TinyML for energy-efficient object detection and communication in low-power edge AI systems, *Scientific Reports*, [Online] 15 (1), 44299, tersedia di DOI:10.1038/s41598-025-27818-9.

Bourechak, A., Zedadra, O., Kouahla, M.N., Guerrieri, A., Seridi, H. dan Fortino, G., 2023, At the Confluence of Artificial Intelligence and Edge Computing in IoT-Based Applications: A Review and New Perspectives. *Sensors*. [Online]. 23 (3). tersedia di DOI:10.3390/s23031639.

Buele, J., Ríos-Cando, P., Brito, G., Moreno-P., R. dan Salazar, F., 2020, *Temperature Controller Using the Takagi-Sugeno-Kang Fuzzy Inference System for an Industrial Heat Treatment Furnace*, [Online] 351–366, tersedia di DOI:10.1007/978-3-030-58817-5_27.

Cao, L., Cao, L., Guo, L., Liu, K. dan Ding, X., 2019, Reliability estimation for drive axle of wheel loader under extreme small sample, *Advances in Mechanical Engineering*, [Online] 11, tersedia di *https://api.semanticscholar.org/CorpusID:117421368*.

Cermenati, L., Malchiodi, D. dan Zanaboni, A.M., 2019, *Simultaneous Learning of Fuzzy Sets*, [Online] 167–175, tersedia di DOI:10.1007/978-981-13-8950-4_16.

Chen, J., Hong, S., He, W., Moon, J. dan Jun, S.-W., 2021, Eciton: Very Low-Power LSTM Neural Network Accelerator for Predictive Maintenance at the

UNIVERSITAS GADJAH MADA
OPTIMASI SISTEM KLASIFIKASI REAL-TIME KONDISI RODA GIGI KONVEYOR PADA FPGA BERDAYA RENDAH BERBASIS SISTEM INFERENSI FUZZY INTEGER
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Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Edge, *2021 31st International Conference on Field-Programmable Logic and Applications (FPL)*, [Online], 2021 hlm. 1–8, tersedia di DOI:10.1109/FPL53798.2021.00009.

Chen, J., Jun, S.-W., Hong, S., He, W. dan Moon, J., 2024, Eciton: Very Low-power Recurrent Neural Network Accelerator for Real-time Inference at the Edge, *ACM Trans. Reconfigurable Technol. Syst.*, [Online] 17 (1), tersedia di DOI:10.1145/3629979.

Chen, Y., Rao, M., Feng, K. dan Zuo, M.J., 2022, Physics-Informed LSTM hyperparameters selection for gearbox fault detection, *Mechanical Systems and Signal Processing*, [Online] 171108907, tersedia di DOI:https://doi.org/10.1016/j.ymssp.2022.108907.

Chen, Z., Yang, X. dan Cheng, X., 2020, Research on Fault Diagnosis Method of Gearbox Based on FPGA and LabVIEW, *IOP Conference Series: Materials Science and Engineering*, [Online], 30 Maret 2020 Institute of Physics Publishing., hlm. tersedia di DOI:10.1088/1757-899X/768/7/072096.

Cheng, X., Yang, X. dan Chen, Z., 2019, Research on FPGA filtering method of Gearbox fault signal, *IOP Conference Series: Materials Science and Engineering*, [Online], 15 April 2019 Institute of Physics Publishing., hlm. tersedia di DOI:10.1088/1757-899X/490/5/052024.

Chovatiya, V., Rutsch, G. dan Ecker, W., 2024, Addressing Fixed-Point Format Issues in FPGA Prototyping with an Open-Source Framework, *Design and Verification Conference and Exhibition*, Oktober 2024 Munich., hlm.

Christiansen, B., 2023, The Basics of Conveyor Maintenance, [Online], tersedia di *https://limblecmms.com/blog/conveyor-maintenance-plan/*, diakses 4 Januari 2024.

components101, 2020, ADXL345 Accelerometer Module, [Online], tersedia di *https://components101.com/modules/adxl345-accelerometer-module*, diakses 11 April 2025.

Contoli, C. dan Lattanzi, E., 2023, *Energy Efficiency Of Deep Learning Compression Techniques In Wearable Human Activity Recognition*, [Online] 102–113, tersedia di DOI:10.1007/978-3-031-34111-3_10.

UNIVERSITAS GADJAH MADA
OPTIMASI SISTEM KLASIFIKASI REAL-TIME KONDISI RODA GIGI KONVEYOR PADA FPGA BERDAYA RENDAH BERBASIS SISTEM INFERENSI FUZZY INTEGER
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Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Denaro, L.G. dan Lim, R., 2025, Analisis Deteksi Kerusakan Pada Jalan Aspal Menggunakan Deep Learning Untuk Mendukung Efisiensi Biaya Dan Waktu Dalam Pemantauan Berkelanjutan, *Jdip*, [Online] 3 (1), 16–25, tersedia di DOI:10.9744/jdip.3.1.16-25.

Dhanraj, J.A., Sangeethalakshmi, K., Kumar, T.S., Nagarajan, P. dan Bharathi, P.S., 2022, An Assessment on Condition Monitoring of Automobile Gearbox through Naïve Bayes Approach using Statistical Features, *2022 International Conference on Electronics and Renewable Systems (ICEARS)*, [Online], 2022 hlm. 656–661, tersedia di DOI:10.1109/ICEARS53579.2022.9752115.

Djagolado, M.W., Amirullah, A. dan Saidah, S., 2021, Pengembangan nominal aturan fuzzy pada metode fuzzy mamdani untuk menyeimbangkan beban tiga phasa pada saluran distribusi tegangan menengah, *Rekayasa*, [Online] 14 (3), 431–442, tersedia di DOI:10.21107/rekayasa.v14i3.10655.

Donzellini, G., Oneto, L., Ponta, D. dan Anguita, D., 2019, Introduction to FPGA and HDL Design, Giuliano Donzellini, Luca Oneto, Domenico Ponta, dan Davide Anguita (ed.), *Introduction to Digital Systems Design*, [Online], Springer International Publishing, Cham., hlm. 465–517, tersedia di DOI:10.1007/978-3-319-92804-3_9.

Du, X., Shi, X., Liu, P., Gai, J. dan Tan, J., 2023, Gear Fault Diagnosis Based on Improved Small Channel CNN under Attention Mechanism, *2023 5th International Conference on System Reliability and Safety Engineering, SRSE 2023*, [Online], 2023 Institute of Electrical and Electronics Engineers Inc., hlm. 250–257, tersedia di DOI:10.1109/SRSE59585.2023.10336077.

Duy, T.H. dan Van Cuong, N., 2014, Enhancement and FPGA implementation of ANFIS algorithm in digital image processing, *2014 IEEE 5th International Conference on Communications and Electronics, IEEE ICCE 2014*, [Online], 2014 hlm. 285 – 290, tersedia di DOI:10.1109/CCE.2014.6916716.

Dybała, J. dan Zimroz, R., 2014, Rolling bearing diagnosing method based on Empirical Mode Decomposition of machine vibration signal, *Applied Acoustics*, [Online] 77195–203, tersedia di DOI:https://doi.org/10.1016/j.apacoust.2013.09.001.

UNIVERSITAS GADJAH MADA
OPTIMASI SISTEM KLASIFIKASI REAL-TIME KONDISI RODA GIGI KONVEYOR PADA FPGA BERDAYA RENDAH BERBASIS SISTEM INFERENSI FUZZY INTEGER
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Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Electrobes, 2019, GY-291 ADXL345 3-Axis Digital Accelerometer Module, [Online], tersedia di *https://electrobes.com/product/gy-291-adxl345-3-axis-accelerometer-module/*, diakses 8 Agustus 2025.

Elisa, N., Li, J., Zuo, Z. dan Yang, L., 2018, *Dendritic Cell Algorithm With Fuzzy Inference System for Input Signal Generation*, [Online] 203–214, tersedia di DOI:10.1007/978-3-319-97982-3_17.

Erick, Y., 2022, Pengertian Conveyor: Fungsi, Jenis, Kegunaan, [Online], tersedia di *https://stellamariscollege.org/conveyor/*, diakses 16 September 2023.

Etxegarai, M., Camps, M., Echeverria, L., Ribalta, M., Bonada, F. dan Domingo, X., 2023, *Virtual Sensors for Smart Data Generation and Processing in AI-Driven Industrial Applications*, [Online] tersedia di DOI:10.5772/intechopen.106988.

F4PGA, 2022, Project X-Ray, [Online], tersedia di *https://f4pga.readthedocs.io/projects/prjxray/en/latest/index.html*, diakses 21 Januari 2023.

Feng, K., Borghesani, P., Smith, W.A., Randall, R.B., Chin, Z.Y., Ren, J. dan Peng, Z., 2019, Vibration-based updating of wear prediction for spur gears, *Wear*, [Online] 426–4271410–1415, tersedia di DOI:https://doi.org/10.1016/j.wear.2019.01.017.

Feng, K., Ji, J.C., Ni, Q. dan Beer, M., 2023, A review of vibration-based gear wear monitoring and prediction techniques, *Mechanical Systems and Signal Processing*, [Online] 182109605, tersedia di DOI:https://doi.org/10.1016/j.ymssp.2022.109605.

Ferhi, L.A., Amar, M.B., Choubani, F. dan Bouallègue, R., 2024, Enhancing Diagnostic Accuracy in Symptom-Based Health Checkers: A Comprehensive Machine Learning Approach With Clinical Vignettes and Benchmarking, *Frontiers in Artificial Intelligence*, [Online] 7, tersedia di DOI:10.3389/frai.2024.1397388.

Feriadi, I., Riva'i, M., Aswin, F., Pramono, E. dan Putra, N.I., 2025, Pengembangan Model Condition-Based Monitoring Multi-Parameter Untuk Deteksi Dini Potensi Kerusakan Pompa Sentrifugal Pada Sistem Distribusi Air Bersih,

UNIVERSITAS GADJAH MADA
OPTIMASI SISTEM KLASIFIKASI REAL-TIME KONDISI RODA GIGI KONVEYOR PADA FPGA BERDAYA RENDAH BERBASIS SISTEM INFERENSI FUZZY INTEGER
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Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

JPNMB, [Online] 1 (9), 1785–1793, tersedia di DOI:10.59837/jpnmb.v1i9.336.

Fithri Prima, Hasan Alizar, Wisnel dan Sultan Fauzi Kesogihan R., 2025, A case study on risk analysis of machine breakdown using the FMEA method, *E3S Web Conf.*, [Online] 60412001, tersedia di DOI:10.1051/e3sconf/202560412001.

Frangieh, T., Stroop, R., Athanas, P. dan Cervero, T., 2012, *A Modular-Based Assembly Framework for Autonomous Reconfigurable Systems*, [Online], hlm. 314–319, tersedia di DOI:10.1007/978-3-642-28365-9_26.

Fu, G., Wei, Q., Yang, Y. dan Li, B., 2022, IoT-based gearbox fault diagnosis for quayside container cranes, *2022 International Symposium on Sensing and Instrumentation in 5G and IoT Era, ISSI 2022*, [Online], 2022 Institute of Electrical and Electronics Engineers Inc., hlm. 18–23, tersedia di DOI:10.1109/ISSI55442.2022.9963173.

Gharghory, S.M., El-Dib, D.A. dan Mahmoud, M., 2016, Low power fuzzy control system for adjusting the blood glucose level, *Proceedings of the International Conference on Microelectronics, ICM*, [Online], 2016 hlm. 333 – 336, tersedia di DOI:10.1109/ICM.2016.7847883.

Giffari, F. dan Prasetyawan, Y., 2020, Perancangan Aktivitas Perawatan pada Conveyor System Batu Bara dengan Metode Risk Based Maintenance (RBM) dan Reliability Centered Maintenance II (Studi Kasus: PLTU Tenayan Raya), *Jurnal Teknik ITS*, [Online] 9 (2), tersedia di DOI:10.12962/j23373539.v9i2.56031.

Guan, S., Hui, V., Štiglic, G., Constantino, R.E., Lee, Y.J. dan Wong, A.K.C., 2025, Classifying the Information Needs of Survivors of Domestic Violence in Online Health Communities Using Large Language Models: Prediction Model Development and Evaluation Study, *Journal of Medical Internet Research*, [Online] 27e65397, tersedia di DOI:10.2196/65397.

Guccione, S., Levi, D. dan Sundararajan, P., 1999, JBits: A Java-based interface for reconfigurable computing, *2nd annual military and aerospace applications of*

UNIVERSITAS GADJAH MADA
OPTIMASI SISTEM KLASIFIKASI REAL-TIME KONDISI RODA GIGI KONVEYOR PADA FPGA BERDAYA RENDAH BERBASIS SISTEM INFERENSI FUZZY INTEGER
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Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

programmable devices and technologies conference (MAPLD), 1999 hlm. 1–9,

Habbouche, H., Benkedjouh, T., Amirat, Y. dan Benbouzid, M., 2025, Fault Detection in Gearboxes Using Fisher Criterion and Adaptive Neuro-Fuzzy Inference, *Machines*, [Online] 13 (6), tersedia di DOI:10.3390/machines13060447.

Haj Mohamad, T., Abbasi, A., Kim, E. dan Nataraj, C., 2021, Application of Deep CNN-LSTM Network to Gear Fault Diagnostics, *2021 IEEE International Conference on Prognostics and Health Management (ICPHM)*, [Online], 2021 hlm. 1–6, tersedia di DOI:10.1109/ICPHM51084.2021.9486591.

Hakim, S.J.S. dan Razak, H.A., 2012, Damage identification using experimental modal analysis and adaptive neuro-fuzzy interface system (ANFIS), *Conference Proceedings of the Society for Experimental Mechanics Series*, [Online], 2012 hlm. 399 – 405, tersedia di DOI:10.1007/978-1-4614-2425-3_37.

Hasib-Al-Rashid, Manjunath, N.K., Paneliya, H., Hosseini, M., Hairston, W.D. dan Mohsenin, T., 2020, A Low-Power LSTM Processor for Multi-Channel Brain EEG Artifact Detection, *2020 21st International Symposium on Quality Electronic Design (ISQED)*, [Online], Maret 2020 IEEE., hlm. 105–110, tersedia di DOI:10.1109/ISQED48828.2020.9137056.

Higgins, L.R., Mobley, R.K. dan Wikoff, D., 2008, *Maintenance engineering handbook*, McGraw-Hill Education.

Hoang, N.-P., Nguyen, T.-D., Nguyen, T.-H., Pham, D.-H., Nguyen, P.-D. dan Nguyen, T.-V.-H., 2025, A Data-Driven Framework for Fault Diagnostics in Gearbox Health Monitoring Under Non-Stationary Conditions, *Processes*, [Online] 13 (6), tersedia di DOI:10.3390/pr13061663.

Hoshino, Y., Rathnayake, N., Dang, T.L. dan Rathnayake, U., 2024, *Cascaded-Anfis and Its Successful Real-World Applications*, [Online] tersedia di DOI:10.5772/intechopen.1006491.

Hu, C., Smith, W.A., Randall, R.B. dan Peng, Z., 2016, Development of a gear vibration indicator and its application in gear wear monitoring, *Mechanical*

UNIVERSITAS GADJAH MADA
OPTIMASI SISTEM KLASIFIKASI REAL-TIME KONDISI RODA GIGI KONVEYOR PADA FPGA BERDAYA RENDAH BERBASIS SISTEM INFERENSI FUZZY INTEGER
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Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Systems and Signal Processing, [Online] 76–77319–336, tersedia di DOI:https://doi.org/10.1016/j.ymssp.2016.01.018.

Huda, S., 2017, Circuits, Architectures, and CAD for Low-Power FPGAs, *Tesis*, University of Toronto.

Humaira, H., Rasyidah, R. dan Rahmayuni, I., 2019, Designing mamdani fuzzy inference systems for decision support systems, *Proceedings of ICAITI 2019 - 2nd International Conference on Applied Information Technology and Innovation: Exploring the Future Technology of Applied Information Technology and Innovation*, [Online], 2019 hlm. 111 – 115, tersedia di DOI:10.1109/ICAITI48442.2019.8982153.

Hutahaean, R.Y. dan Antonius, D., 2022, STUDI KASUS IDENTIFIKASI KERUSAKKAN MESIN BERDASARKAN SINYAL GETARAN, *Jurnal Rekayasa Mesin*, 13 (2), 305–318,

Ibrahim, A.M., Lawan, S.M., Abdulkadir, R.A., Shuaibu, N.S., Uzair, M., Indabawa, M.G., Ibrahim, M. dan Aliyu, A.M., 2024, *Solar Radiation Prediction Using an Improved Adaptive Neuro-Fuzzy Inference System (ANFIS) Optimization Ensemble*, [Online] tersedia di DOI:10.5772/intechopen.1003891.

IEEE SA, 2018, IEEE Standard for Sensor Performance Parameter Definitions,

Iida, M., 2018, What Is an FPGA?, Hideharu Amano (ed.), *Principles and Structures of FPGAs*, [Online], Springer Singapore, Singapore., hlm. 23–45, tersedia di DOI:10.1007/978-981-13-0824-6_2.

Imani, M.B., Zadeh, M.H., Khan, L. dan Nourani, M., 2017, A Scalable Spark-Based Fault Diagnosis Platform for Gearbox Fault Diagnosis in Wind Farms, *2017 IEEE International Conference on Information Reuse and Integration (IRI)*, [Online], 2017 hlm. 100–107, tersedia di DOI:10.1109/IRI.2017.32.

intel, 2025, Cyclone® 10 LP FPGA Product Table,

intel, 2023, Intel® FPGA Product Catalog - version 23.1, [Online], tersedia di *https://www.intel.com/content/www/us/en/content-details/730595/intel-fpga-product-catalog.html*, diakses 8 September 2023.

UNIVERSITAS GADJAH MADA
OPTIMASI SISTEM KLASIFIKASI REAL-TIME KONDISI RODA GIGI KONVEYOR PADA FPGA BERDAYA RENDAH BERBASIS SISTEM INFERENSI FUZZY INTEGER
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Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Inturi, V., Shreyas, N. dan Sabareesh, G.R., 2021, Anfis-Based Defect Severity Prediction on a Multi-Stage Gearbox Operating Under Fluctuating Speeds, *Neural Processing Letters*, [Online] 53 (5), 3445–3466, tersedia di DOI:10.1007/s11063-021-10557-z.

Ismail, M., Shang, C. dan Shen, Q., 2021, *Towards a Framework for Interpretation of CNN Results With ANFIS*, [Online] 153–166, tersedia di DOI:10.1007/978-3-030-87094-2_14.

Jaen-Cuellar, A.Y., Trejo-Hernández, M., Osornio-Rios, R.A. dan Antonino-Daviu, J.A., 2023, Gear Wear Detection Based on Statistic Features and Heuristic Scheme by Using Data Fusion of Current and Vibration Signals, *Energies*, [Online] 16 (2), tersedia di DOI:10.3390/en16020948.

Jassbi, J.J., Serra, P.J.A., Ribeiro, R.A. dan Donati, A., 2006, A comparison of mandani and sugeno inference systems for a space fault detection application, *2006 World Automation Congress, WAC'06*, [Online], 2006 hlm. tersedia di DOI:10.1109/WAC.2006.376033.

Jee, K.-W., McShan, D.L. dan Fraass, B.A., 2007, Lexicographic ordering: Intuitive multicriteria optimization for IMRT, *Physics in Medicine and Biology*, [Online] 52 (7), 1845–1861, tersedia di DOI:10.1088/0031-9155/52/7/006.

Jesús Arroyo Torrens dan Juan González, 2022, Apio: Open source ecosystem for open FPGA boards, [Online], tersedia di *https://github.com/FPGAwars/apio*, diakses 26 Januari 2023.

Jeung, S. dan Kwon, J.-W., 2025, A Robust Multivariate Time Series Classification Approach Based on Topological Data Analysis for Channel Fault Tolerance, *Sensors*, [Online] 25 (9), 2709, tersedia di DOI:10.3390/s25092709.

J.R. Davis, 2005, Chapter 13: Gear Failure Modes and Analysis , *Gear Materials, Properties, and Manufacture*, hlm. 257–291,

Jward, 2020, ZD AC gear motor (90mm), 5IK40GN-C / 5GN 15K , Ac Induction motor, [Online], tersedia di *https://www.jwardtech.com/en/product/AC-gear-motor.html*, diakses 10 April 2026.

Kang, S., Moon, J. dan Jun, S.-W., 2020, FPGA-Accelerated Time Series Mining on Low-Power IoT Devices, *2020 IEEE 31st International Conference on*

UNIVERSITAS GADJAH MADA
OPTIMASI SISTEM KLASIFIKASI REAL-TIME KONDISI RODA GIGI KONVEYOR PADA FPGA BERDAYA RENDAH BERBASIS SISTEM INFERENSI FUZZY INTEGER
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Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Application-specific Systems, Architectures and Processors (ASAP), [Online], 2020 hlm. 33–36, tersedia di DOI:10.1109/ASAP49362.2020.00015.

Kannan, R., 2016, Low complexity sensor: Fusion solution for accurate estimation of gravity and linear acceleration, *Multisensor Attitude Estimation: Fundamental Concepts and Applications*, [Online], hlm. 199–217, tersedia di DOI:10.1201/9781315368795.

Karaduman, G., Kiliç, İ., Tasar, B. dan Yaman, O., 2025, GearDetectionNET: Detection of Gearbox Faults Under Different Load Conditions via 1D-CNN Architecture, *Journal of Vibration Engineering and Technologies*, [Online] 13 (7), tersedia di DOI:10.1007/s42417-025-02085-0.

Kgatwe, C.K., Madushele, N., Olatunji, O.O. dan Adedeji, P.A., 2022, A Survey of Fuzzy Logic Systems in Condition Monitoring of Conveyor Gearbox, *2022 IEEE 13th International Conference on Mechanical and Intelligent Manufacturing Technologies (ICMIMT)*, [Online], 2022 hlm. 240–246, tersedia di DOI:10.1109/ICMIMT55556.2022.9845269.

Khairuddin, S.H., Hasan, M.H., Hashmani, M.A. dan Azam, M.H., 2021, Generating Clustering-Based Interval Fuzzy Type-2 Triangular and Trapezoidal Membership Functions: A Structured Literature Review, *Symmetry*, [Online] 13 (2), tersedia di DOI:10.3390/sym13020239.

Kisabo, A.B., Osheku, C.A., Lanre, A.M.A. dan Adebimpe, A.F., 2011, Fuzzy logic control for an expendable launch vehicle autopilot, *European Journal of Scientific Research*, [Online] 59 (2), 226 – 240, tersedia di *https://www.scopus.com/inward/record.uri?eid=2-s2.0-80052981945&partnerID=40&md5=d4877d632cba2ff29eccc1ed6628e7cb*.

Kishore, K., Sharma, A. dan Mukhopadhyay, G., 2020, Failure Analysis of a Gearbox of a Conveyor Belt, *Journal of Failure Analysis and Prevention*, [Online] 20 (4), 1237–1243, tersedia di DOI:10.1007/s11668-020-00928-4.

Klippel, E., Oliveira, R.A.R., Maslov, D., Bianchi, A.G.C., Delabrida, S.E. dan Garrocho, C.T.B., 2022, Embedded Edge Artificial Intelligence for Longitudinal Rip Detection in Conveyor Belt Applied at the Industrial Mining

UNIVERSITAS
GADJAH MADA
OPTIMASI SISTEM KLASIFIKASI REAL-TIME KONDISI RODA GIGI KONVEYOR PADA FPGA BERDAYA RENDAH BERBASIS SISTEM INFERENSI FUZZY INTEGER
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Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Environment, *SN Computer Science*, [Online] 3 (4), 280, tersedia di DOI:10.1007/s42979-022-01169-y.

Koçak, İ., Bayramoğlu, S.E., Sayın, N. dan Thalib, L., 2025, Detection of Plus Disease in Retinopathy of Prematurity Using Deep Learning Models: Evaluating Vision Transformers and ResNet Architectures, *International Journal of Imaging Systems and Technology*, [Online] 35 (5), tersedia di DOI:10.1002/ima.70174.

Koch, D., Dao, N., Healy, B., Yu, J. dan Attwood, A., 2021, FABulous: An Embedded FPGA Framework, *The 2021 ACM/SIGDA International Symposium on Field-Programmable Gate Arrays*, FPGA '21, [Online], 2021 Association for Computing Machinery, New York, NY, USA., hlm. 45–56, tersedia di DOI:10.1145/3431920.3439302.

Kreß, F., Serdyuk, A., Kobsar, D., Hotfilter, T., Hoefer, J., Harbaum, T. dan Becker, J., 2024, LOTTA: An FPGA-based Low-Power Temporal Convolutional Network Hardware Accelerator, *2024 IEEE 37th International System-on-Chip Conference (SOCC)*, [Online], 2024 hlm. 126–131, tersedia di DOI:10.1109/SOCC62300.2024.10737863.

Kuzin, E.G., Gerike, B.L., Drozdenko, Y. V, Lupiy, M.G. dan Grigoryeva, N. V, 2017, Diagnostics of Technical Condition of Gear Units of Belt Conveyors for the Aggregate of Methods of Nondestructive Testing, *IOP Conference Series: Materials Science and Engineering*, [Online] 253 (1), 12013, tersedia di DOI:10.1088/1757-899X/253/1/012013.

Laplante, P.A. dan Ovaska, S.J., 2012, *Real-Time Systems Design and Analysis: Tools for the Practitioner, Fourth Edition.*

Lattice, 2025, iCE40 LP/HX Family Data Sheet. *https://www.latticesemi.com/view_document?document_id=49312*.

Lattice, 2023a, iCE40 LP/HX Low-Power, High-Performance FPGA with Small BGA package for the thinnest devices, [Online], tersedia di *iCE40 LP/HX Low-Power, High-Performance FPGA with Small BGA package for the thinnest devices*, diakses 30 Oktober 2025.

UNIVERSITAS GADJAH MADA
OPTIMASI SISTEM KLASIFIKASI REAL-TIME KONDISI RODA GIGI KONVEYOR PADA FPGA BERDAYA RENDAH BERBASIS SISTEM INFERENSI FUZZY INTEGER
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Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Lattice, 2023b, iCE40 Ultra / Ultra Lite Industry-Leading Small Footprint, Low Power FPGA for High Volume Applications, [Online], tersedia di *https://www.latticesemi.com/en/Products/FPGAandCPLD/iCE40Ultra*, diakses 30 Oktober 2025.

Lattice, 2023c, iCE40 UltraPlus, ML/AI Low Power FPGA, [Online], tersedia di *https://www.latticesemi.com/en/Products/FPGAandCPLD/iCE40UltraPlus*, diakses 13 September 2023.

Lattice, t.t., What is an FPGA?, [Online], tersedia di *https://www.latticesemi.com/What-is-an-FPGA*, diakses 13 September 2023.

Lee, E.A. dan Seshia, S.A., 2017, *Introduction to embedded systems : a cyber-physical systems approach*, 2 edisi.

Li, J., Chao, F. dan Yang, L., 2019a, *A Study of TSK Inference Approaches for Control Problems*, [Online] 195–207, tersedia di DOI:10.1007/978-3-030-27538-9_17.

Li, X., Li, J., Zhao, C., Qu, Y. dan He, D., 2019b, Early Gear Pitting Fault Diagnosis Based on Bi-directional LSTM, *2019 Prognostics and System Health Management Conference (PHM-Qingdao)*, [Online], 2019 hlm. 1–5, tersedia di DOI:10.1109/PHM-Qingdao46334.2019.8942949.

Li, X., Sun, J., Gu, J., Pu, M. dan Wu, G., 2022, *Tuning ANFIS Using a Simplified Sparrow Search Algorithm*, [Online] tersedia di DOI:10.3233/atde220091.

Lin, J., Hong, H., Song, W., Jiang, C. dan Lu, C., 2025, Power System Adaptive Robust Dynamic State Estimation Based on Hybrid Measurements; [基于混合量测的电力系统自适应抗差动态状态估计方法], *Diangong Jishu Xuebao/Transactions of China Electrotechnical Society*, [Online] 40 (15), 4694–4707 and 4721, tersedia di DOI:10.19595/j.cnki.1000-6753.tces.241387.

López-Balcázar, C.A., Hernández, J., Ramírez-López, F. dan García-Balcázar, G.G., 2025, Verilog-based logical design of CubeSat ACS based in fuzzy inference systems focused on trapezoidal membership functions, *Journal of*

UNIVERSITAS GADJAH MADA
OPTIMASI SISTEM KLASIFIKASI REAL-TIME KONDISI RODA GIGI KONVEYOR PADA FPGA BERDAYA RENDAH BERBASIS SISTEM INFERENSI FUZZY INTEGER
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Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Physics: Conference Series, [Online] 2946 (1), 012004, tersedia di DOI:10.1088/1742-6596/2946/1/012004.

López-Pérez, D. dan Antonino-Daviu, J., 2016, Detection of mechanical faults in induction machines with infrared thermography: Field cases, *IECON 2016 - 42nd Annual Conference of the IEEE Industrial Electronics Society*, [Online], 2016 hlm. 7107–7112, tersedia di DOI:10.1109/IECON.2016.7793604.

Lv, Y., Liu, Y., Li, S., Liu, J. dan Wang, T., 2025, Enhancing marine shaft generator reliability through intelligent fault diagnosis of gearbox bearings via improved Bidirectional LSTM, *Ocean Engineering*, [Online] 337, tersedia di DOI:10.1016/j.oceaneng.2025.121860.

Mackenzie, A., 2008, Validation of correction methods for the non-linear response of digital radiography systems, *British Journal of Radiology*, [Online] 81 (964), 341 – 345, tersedia di DOI:10.1259/bjr/57141560.

Macmann, O., Cohen, K. dan Cazaurang, F., 2021, *Fuzzy-Flatness Hybrid Fault-Tolerant Control*, [Online] 265–277, tersedia di DOI:10.1007/978-3-030-82099-2_24.

Magyari, A. dan Chen, Y., 2022, Review of State-of-the-Art FPGA Applications in IoT Networks. *Sensors*. [Online]. 22 (19). tersedia di DOI:10.3390/s22197496.

Mahdi, A. dan Suryani, E., 2025, Predictive Maintenance Trafo Distribusi Menggunakan Machine Learning Untuk Meningkatkan Keakuratan Pengambilan Keputusan, *Syntax Literate Jurnal Ilmiah Indonesia*, [Online] 10 (4), 3680–3693, tersedia di DOI:10.36418/syntax-literate.v10i4.57853.

Maia, D.H. dan Khuman, A.S., 2021, *A Mamdani Fuzzy Logic Inference System to Estimate Project Cost*, [Online] 145–163, tersedia di DOI:10.1007/978-3-030-66474-9_10.

Marmor, Y.N., Gadrich, T. dan Bashkansky, E., 2021, Accuracy of multi-experts' prioritization under Mallows' model of errors creation, *Quality Engineering*, [Online] 33 (2), 286–299, tersedia di DOI:10.1080/08982112.2020.1830419.

Martinetti, A., van Dongen, L.A.M. dan Romano, R., 2016, Beyond Accidents: A Back-Analysis on Conveyor Belt Injury for a Better Design for Maintenance

UNIVERSITAS GADJAH MADA
OPTIMASI SISTEM KLASIFIKASI REAL-TIME KONDISI RODA GIGI KONVEYOR PADA FPGA BERDAYA RENDAH BERBASIS SISTEM INFERENSI FUZZY INTEGER
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Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Operations, *American Journal of Applied Sciences*, [Online] 141–12, tersedia di DOI:10.3844/ajassp.2017.1.12.

Matania, O., Bachar, L., Bechhoefer, E. dan Bortman, J., 2024, Signal Processing for the Condition-Based Maintenance of Rotating Machines via Vibration Analysis: A Tutorial, *Sensors*, [Online] 24 (2), tersedia di DOI:10.3390/s24020454.

Matsui, T., Yukawa, C., Nagai, Y., Toyoshima, K., Hirata, A. dan Oda, T., 2022, FPGA Implementation of a Interval Type-2 Fuzzy Inference Based Wildfire Monitoring System, *2022 IEEE 11th Global Conference on Consumer Electronics (GCCE)*, [Online], 2022 hlm. 876–877, tersedia di DOI:10.1109/GCCE56475.2022.10014188.

Mayo, S.A., Cai, Z. dan Imtiaz, R., 2025, A Comprehensive Approach to Gear Fault Classification Leveraging Vibration Data and Neural Networks, *2025 IEEE International Conference on Prognostics and Health Management, ICPHM 2025*, [Online], 2025 Institute of Electrical and Electronics Engineers Inc., hlm. tersedia di DOI:10.1109/ICPHM65385.2025.11062050.

Medeiros, A., Cardoso, R., Júnior, J.O. dan Alves, S.M., 2024, Failure Analysis of Gear Using Continuous Wavelet Transform Applied in the Context of Wind Turbines, *Proceedings of the Institution of Mechanical Engineers Part J Journal of Engineering Tribology*, [Online] 238 (7), 860–868, tersedia di DOI:10.1177/13506501241235726.

Menard, D., Caffarena, G., Lopez, J.A., Novo, D. dan Sentieys, O., 2019, Fixed-point refinement of digital signal processing systems, *Digitally Enhanced Mixed Signal Systems*, HAL open science., hlm.

Ménard, D., Caffarena, G., Martín, J.A.L., Novo, D. dan Sentieys, O., 2018, *Analysis of Finite Word-Length Effects in Fixed-Point Systems*, [Online] 1063–1101, tersedia di DOI:10.1007/978-3-319-91734-4_29.

Meng, Y., 2005, An agent-based reconfigurable system-on-chip architecture for real-time systems, *Second International Conference on Embedded Software and Systems (ICESS'05)*, [Online], 2005 hlm. 8 pp.-, tersedia di DOI:10.1109/ICESS.2005.21.

UNIVERSITAS GADJAH MADA
OPTIMASI SISTEM KLASIFIKASI REAL-TIME KONDISI RODA GIGI KONVEYOR PADA FPGA BERDAYA RENDAH BERBASIS SISTEM INFERENSI FUZZY INTEGER
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Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

microchip, t.t., Low-Power FPGAs, [Online], tersedia di *https://www.microchip.com/en-us/products/fpgas-and-plds/low-power*, diakses 13 September 2023.

mk, 2020, What is a Conveyor System?, [Online], tersedia di *https://www.mknorthamerica.com/Blog/what-is-a-conveyor-system/*, diakses 14 September 2023.

Mobley, R.K., 2002, *An introduction to predictive maintenance*, Elsevier.

Mosavi, M.R., Ayatollahi, A. dan Afrakhteh, S., 2021, An efficient method for classifying motor imagery using CPSO-trained ANFIS prediction, *Evolving Systems*, [Online] 12 (2), 319 – 336, tersedia di DOI:10.1007/s12530-019-09280-x.

Mucha, W., 2020, Comparison of Machine Learning Algorithms for Structure State Prediction in Operational Load Monitoring, *Sensors*, [Online] 20 (24), tersedia di DOI:10.3390/s20247087.

Muhammad, T., Chang, S. dan Chang, J.-Y., 2025, *Approved Fault Detection in Spur Gear Transmission Systems Using Vibration Analysis and Definite Integral-Based Damage Assessment*, [Online] tersedia di DOI:10.21203/rs.3.rs-6604883/v1.

Muharom, D. dan Okdinawati, L., 2024, Failure Prediction Models using Vibration Data Motor and Gearbox: A Case Research in The Mining Industry PT Angsana Coal, *Asian Journal of Engineering, Social and Health*, [Online] 3 (11), tersedia di DOI:doi.org/10.46799/ajesh.v3i11.474.

Naimi, M. dan Tahayori, H., 2020, Centroid of polygonal fuzzy sets, *Applied Soft Computing*, [Online] 95106519, tersedia di DOI:https://doi.org/10.1016/j.asoc.2020.106519.

Narendiranath Babu, T., Kothari, A.J., Rama Prabha, D., Mokashe, R., Kagita, K.B. dan Raj Kumar, E., 2024, A comparative study on ML algorithms and ANN on fault diagnosis of a two-stage helical gearbox, *Journal of Intelligent and Fuzzy Systems*, [Online] 46 (4), 9819–9840, tersedia di DOI:10.3233/JIFS-233602.

UNIVERSITAS
GADJAH MADA
OPTIMASI SISTEM KLASIFIKASI REAL-TIME KONDISI RODA GIGI KONVEYOR PADA FPGA BERDAYA RENDAH BERBASIS SISTEM INFERENSI FUZZY INTEGER
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Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Nasrul, T.I., Amri dan Sayuti, M., 2024, Application of Fuzzy Mamdani Method to Predict the Number of Blood Bags Based on Demand and Supply Data Using Matlab, *International Journal of Engineering, Science and Information Technology*, [Online] 4 (4), 29–37, tersedia di DOI:10.52088/ijesty.v4i4.567.

Ngudiyono, N. dan Sulistyowati, T., 2022, *Application of the Adaptive Neuro Fuzzy Inference System (ANFIS) to Predict Ultimate Bearing Capacity of Footing on Granular Soil*, [Online] 3–14, tersedia di DOI:10.2991/978-94-6463-088-6_2.

Nguyen, C.D., Ahmad, Z. dan Kim, J., 2021, Gearbox Fault Identification Framework Based on Novel Localized Adaptive Denoising Technique, Wavelet-Based Vibration Imaging, and Deep Convolutional Neural Network, *Applied Sciences*, [Online] 11 (16), 7575, tersedia di DOI:10.3390/app11167575.

Ninoslav, Z. dan Bajrić, R., 2020, Gearbox faults feature selection and severity classification using machine learning, *Eksploatacja i Niezawodność – Maintenance and Reliability*, [Online] 22 (4), 748–756, tersedia di DOI:10.17531/ein.2020.4.19.

Oh, S.W., Lee, C. dan You, W., 2019, Gear Reducer Fault Diagnosis Using Learning Model for Spectral Density of Acoustic Signal, *2019 International Conference on Information and Communication Technology Convergence (ICTC)*, [Online], 2019 hlm. 1027–1029, tersedia di DOI:10.1109/ICTC46691.2019.8939913.

Oliveira, D.N., De Lima Henn, G.A. dan Da Mota Almeida, O., 2010, Design and implementation of a Mamdani fuzzy inference system on an FPGA using VHDL, *Annual Conference of the North American Fuzzy Information Processing Society - NAFIPS*, [Online], 2010 hlm. tersedia di DOI:10.1109/NAFIPS.2010.5548190.

ONYX Insight, 2025, Gear Fracture, [Online], tersedia di *https://onyxinsight.com/resources-support/failure-atlas/fracture-gear-failure/*, diakses 11 April 2026.

UNIVERSITAS
GADJAH MADA
OPTIMASI SISTEM KLASIFIKASI REAL-TIME KONDISI RODA GIGI KONVEYOR PADA FPGA BERDAYA RENDAH BERBASIS SISTEM INFERENSI FUZZY INTEGER
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Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Özger, M., 2009, Comparison of fuzzy inference systems for streamflow prediction, *Hydrological Sciences Journal*, [Online] 54 (2), 261 – 273, tersedia di DOI:10.1623/hysj.54.2.261.

Pan, S.-J., Tsai, M.-L., Chen, C.-L., Lin, P.T. dan Lee, H.-Y., 2023, Investigation of Machine Learning Methods for Predictive Maintenance of the Ultra-High-Pressure Reactor in a Polyethylene-Vinyl Acetate Production Process, *Electronics*, [Online] 12 (3), tersedia di DOI:10.3390/electronics12030580.

PCB Piezotronics, t.t., Introduction to MEMS Accelerometers, [Online], tersedia di *https://www.pcb.com/resources/technical-information/mems-accelerometers*, diakses 24 September 2025.

Prasetio, B.H., Maulana, R. dan Syauqy, D., 2017, *Desain Sistem Digital: Menggunakan FPGA dan VHDL Teori dan Aplikasi*, Universitas Brawijaya Press.

Qian, C., Ling, T. dan Schiele, G., 2023, Enhancing Energy-Efficiency by Solving the Throughput Bottleneck of LSTM Cells for Embedded FPGAs, Irena Koprinska, Paolo Mignone, Riccardo Guidotti, Szymon Jaroszewicz, dkk. (ed.), *Machine Learning and Principles and Practice of Knowledge Discovery in Databases*, 2023 Springer Nature Switzerland, Cham., hlm. 594–605,

Rajab, S., 2019, Handling interpretability issues in ANFIS using rule base simplification and constrained learning, *Fuzzy Sets and Systems*, [Online] 36836 – 58, tersedia di DOI:10.1016/j.fss.2018.11.010.

Rathnayake, N., Dang, T.L. dan Hoshino, Y., 2021, A Novel Optimization Algorithm: Cascaded Adaptive Neuro-Fuzzy Inference System, *International Journal of Fuzzy Systems*, [Online] 23 (7), 1955 – 1971, tersedia di DOI:10.1007/s40815-021-01076-z.

Ravenslofty, L., 2022, Mistral - A Cyclone V bitstream library, [Online], tersedia di *https://github.com/Ravenslofty/mistral*, diakses 30 Januari 2023.

Razzaq, A., Sani, S.R. dan Ye, A.G., 2021, Designing efficient FPGA tiles for power-constrained ultra-low-power applications, *Integration*, [Online] 78124–134, tersedia di DOI:https://doi.org/10.1016/j.vlsi.2021.02.004.

UNIVERSITAS GADJAH MADA
OPTIMASI SISTEM KLASIFIKASI REAL-TIME KONDISI RODA GIGI KONVEYOR PADA FPGA BERDAYA RENDAH BERBASIS SISTEM INFERENSI FUZZY INTEGER
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Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Ricci, S., Caputo, S. dan Mucchi, L., 2023, FPGA-Based Pulse Compressor for Ultra Low Latency Visible Light Communications, *Electronics*, [Online] 12 (2), 364, tersedia di DOI:10.3390/electronics12020364.

Riebesehl, J., Heebøll, H.R., Razumov, A., Galili, M. dan Zibar, D., 2024, Digital signal processing techniques for noise characterization of lasers and optical frequency combs: A tutorial, *APL Photonics*, [Online] 9 (8), tersedia di DOI:10.1063/5.0212592.

Rizvi, S., Mitchell, J., Razaque, A., Rizvi, M.R. dan Williams, I., 2020, A fuzzy inference system (FIS) to evaluate the security readiness of cloud service providers, *Journal of Cloud Computing*, [Online] 9 (1), 42, tersedia di DOI:10.1186/s13677-020-00192-9.

Roubos, H., Setnes, M. dan Abonyi, J., 2001, Learning Fuzzy Classification Rules from Data, Robert John dan Ralph Birkenhead (ed.), *Developments in Soft Computing*, 2001 Physica-Verlag HD, Heidelberg., hlm. 108–115,

Roukhami, M., Lazarescu, M.T., Gregoretti, F., Lahbib, Y. dan Mami, A., 2019, Very Low Power Neural Network FPGA Accelerators for Tag-Less Remote Person Identification Using Capacitive Sensors, *IEEE Access*, [Online] 7102217–102231, tersedia di DOI:10.1109/ACCESS.2019.2931392.

Runkler, T.A., Coupland, S., John, R. dan Chen, C., 2017, *Interval Type–2 Defuzzification Using Uncertainty Weights*, [Online] 47–59, tersedia di DOI:10.1007/978-3-319-67789-7_4.

Saadatmorad, M., Jafari-Talookolaei, R., Pashaei, M.-H., Khatir, S. dan Wahab, M.A., 2021, *Adaptive Network-Based Fuzzy Inference for Damage Detection in Rectangular Laminated Composite Plates Using Vibrational Data*, [Online] 179–196, tersedia di DOI:10.1007/978-981-16-7216-3_14.

Saatchi, R., 2024, Fuzzy Logic Concepts, Developments and Implementation, *Information*, [Online] 15 (10), tersedia di DOI:10.3390/info15100656.

Salleh, M.N.M., Talpur, N. dan Hussain, K., 2017, Adaptive neuro-fuzzy inference system: Overview, strengths, limitations, and solutions, *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence*

UNIVERSITAS
GADJAH MADA
OPTIMASI SISTEM KLASIFIKASI REAL-TIME KONDISI RODA GIGI KONVEYOR PADA FPGA BERDAYA RENDAH BERBASIS SISTEM INFERENSI FUZZY INTEGER
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Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

and Lecture Notes in Bioinformatics), [Online] 10387 LNCS527 – 535, tersedia di DOI:10.1007/978-3-319-61845-6_52.

Salman, S.M., Papadopoulos, A.V., Mubeen, S. dan Nolte, T., 2023, Evaluating Dispatching and Scheduling Strategies for Firm Real-Time Jobs in Edge Computing, *IECON 2023- 49th Annual Conference of the IEEE Industrial Electronics Society*, [Online], 2023 hlm. 1–6, tersedia di DOI:10.1109/IECON51785.2023.10312523.

Sang, G.M., Xu, L., Vrieze, P. d. dan Bai, Y., 2020, *Towards Predictive Maintenance for Flexible Manufacturing Using FIWARE*, [Online] 17–28, tersedia di DOI:10.1007/978-3-030-49165-9_2.

Santoso, F., Garratt, M.A. dan Anavatti, S.G., 2016, Adaptive Neuro-Fuzzy Inference System identification for the dynamics of the AR.Drone Quadcopter, *2016 International Conference on Sustainable Energy Engineering and Application (ICSEEA)*, [Online], 2016 hlm. 55–60, tersedia di DOI:10.1109/ICSEEA.2016.7873567.

Sarjito, A., 2025, Optimalisasi Pemeliharaan Permesinan Kapal Berbasis Artificial Intelligence Sesuai Peraturan Pemerintah No. 31 Tahun 2021 Tentang Penyelenggaraan Bidang Pelayaran, *Saintara Jurnal Ilmiah Ilmu-Ilmu Maritim*, [Online] 9 (1), 20–30, tersedia di DOI:10.52475/saintara.v9i1.368.

Satria, B., Radillah, T., Tambunan, L. dan Iqbal, M., 2021, Implementasi metode fuzzy sugeno untuk prediksi penentuan porsi dana pembangunan perumahan, *JSAI (Journal Scientific and Applied Informatics)*, [Online] 4 (1), 75–84, tersedia di DOI:10.36085/jsai.v4i1.1330.

Satrijo, D., Suprihanto, A., Kurdi, O., Wibowo, D.B., Haryadi, G.D., Umardani, Y., Rozi, K. dan Pratomo, M.F.A., 2021, Penggunaan metode Reliability-Centered Maintenance untuk menjaga keandalan material belt conveyor, *Jurnal Material Teknologi Proses: Warta Kemajuan Bidang Material Teknik Teknologi Proses*, [Online] 2 (1), 1, tersedia di DOI:10.22146/jmtp.66163.

Sawicki, A., Walendziuk, W. dan Idzkowski, A., 2016, The gravitational acceleration components elimination from the accelerometer measurement

UNIVERSITAS
GADJAH MADA
OPTIMASI SISTEM KLASIFIKASI REAL-TIME KONDISI RODA GIGI KONVEYOR PADA FPGA BERDAYA RENDAH BERBASIS SISTEM INFERENSI FUZZY INTEGER
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Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

data, *Proceedings of SPIE - The International Society for Optical Engineering*, [Online], 2016 hlm. tersedia di DOI:10.1117/12.2248631.

Schmalensee, L. v., 2023, How to Generate Accurate Continuous Thermal Regimes From Sparse but Regular Temperature Measurements, *Methods in Ecology and Evolution*, [Online] 14 (5), 1208–1216, tersedia di DOI:10.1111/2041-210x.14092.

Seed, C., 2019, Arachne-pnr, [Online], tersedia di *https://github.com/YosysHQ/arachne-pnr*, diakses 30 April 2023.

Selvachandran, G., Quek, S.G., Lan, L.T.H., Son, L.H., Giang, N.L., Ding, W., Abdel-Basset, M. dan de Albuquerque, V.H.C., 2021, A New Design of Mamdani Complex Fuzzy Inference System for Multiattribute Decision Making Problems, *IEEE Transactions on Fuzzy Systems*, [Online] 29 (4), 716–730, tersedia di DOI:10.1109/TFUZZ.2019.2961350.

Seng, K.P., Lee, P.J. dan Ang, L.M., 2021, Embedded Intelligence on FPGA: Survey, Applications and Challenges, *Electronics*, [Online] 10 (8), 895, tersedia di DOI:10.3390/electronics10080895.

Sezer, E., Romero, D., Guedea, F., Macchi, M. dan Emmanouilidis, C., 2018, An Industry 4.0-Enabled Low Cost Predictive Maintenance Approach for SMEs, *2018 IEEE International Conference on Engineering, Technology and Innovation (ICE/ITMC)*, [Online], 2018 hlm. 1–8, tersedia di DOI:10.1109/ICE.2018.8436307.

Shah, D., Hung, E., Wolf, C., Bazanski, S., Gisselquist, D. dan Milanovic, M., 2019, Yosys+nextpnr: An open source framework from verilog to bitstream for commercial FPGAS, *Proceedings - 27th IEEE International Symposium on Field-Programmable Custom Computing Machines, FCCM 2019*, [Online], 1 April 2019 Institute of Electrical and Electronics Engineers Inc., hlm. 1–4, tersedia di DOI:10.1109/FCCM.2019.00010.

Shah, M., t.t., Project Oxide - documenting Lattice's 28nm "Nexus" FPGA parts, [Online], tersedia di *https://github.com/gatecat/prjoxide*, diakses 30 Januari 2023.

UNIVERSITAS GADJAH MADA
OPTIMASI SISTEM KLASIFIKASI REAL-TIME KONDISI RODA GIGI KONVEYOR PADA FPGA BERDAYA RENDAH BERBASIS SISTEM INFERENSI FUZZY INTEGER
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Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Silicon Blue, 2008, ULTRA LOW-POWER iCE FPGAs. *https://www.latticesemi.com/~/media/LatticeSemi/Documents/ApplicationNotes/UZ/UltraLow-PoweriCEFPGAs.PDF?document_id=44648*. [Online]. tersedia di *https://www.latticesemi.com/~/media/LatticeSemi/Documents/ApplicationNotes/UZ/UltraLow-PoweriCEFPGAs.PDF?document_id=44648*, diakses 13 September 2023.

Sonawane, P. dan Chandrasekaran, M., 2018, Investigation of gear pitting defect using vibration characteristics in a single-stage gearbox, *International Journal of Electrical Engineering Education*, [Online] 57002072091881383, tersedia di DOI:10.1177/0020720918813837.

Soni, R.K., Steiner, N. dan French, M., 2013, Open-Source Bitstream Generation, *2013 IEEE 21st Annual International Symposium on Field-Programmable Custom Computing Machines*, [Online], April 2013 IEEE., hlm. 105–112, tersedia di DOI:10.1109/FCCM.2013.45.

Soubervielle-Montalvo, C., Perez-Cham, O.E., Puente, C., González-Galván, E.J., Olague, G., Aguirre-Salado, C.A., Cuevas-Tello, J.C. dan Ontañón-García, L.J., 2022, Design of a Low-Power Embedded System Based on a SoC-FPGA and the Honeybee Search Algorithm for Real-Time Video Tracking, *Sensors*, [Online] 22 (3), 1280, tersedia di DOI:10.3390/s22031280.

Stanojević, B., 2023, Empiric Solutions to Full Fuzzy Linear Programming Problems Using the Generalized “Min” Operator, *Mathematics*, [Online] 11 (23), 4864, tersedia di DOI:10.3390/math11234864.

Starzhinskii, V.E., Soliterman, Yu.L., Goman, A.M. dan Osipenko, S.A., 2008, Forms of damage to gear wheels: Typology and recommendations on prevention, *Journal of Friction and Wear*, [Online] 29 (5), 340–353, tersedia di DOI:10.3103/S1068366608050048.

Steiner, N., Wood, A., Shojaei, H., Couch, J., Athanas, P. dan French, M., 2011, Torc: towards an open-source tool flow, *Proceedings of the 19th ACM/SIGDA international symposium on Field programmable gate arrays*, [Online], 27

UNIVERSITAS GADJAH MADA
OPTIMASI SISTEM KLASIFIKASI REAL-TIME KONDISI RODA GIGI KONVEYOR PADA FPGA BERDAYA RENDAH BERBASIS SISTEM INFERENSI FUZZY INTEGER
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Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Februari 2011 ACM, New York, NY, USA., hlm. 41–44, tersedia di DOI:10.1145/1950413.1950425.

STMicroelectronics, 2016, MEMS digital output motion sensor: ultra-low-power high-performance 3-axis "nano" accelerometer. *STMicroelectronics*. [Online]. tersedia di *https://www.st.com/resource/en/datasheet/lis3dh.pdf*, diakses 24 September 2025.

Sun, W., Giusca, C. dan Lancaster, A., 2017, *Surface texture measurements of gear surfaces using stylus instruments.* [Online]. tersedia di *https://eprintspublications.npl.co.uk/7643/*.

Sun, X., Ding, H., Li, N., Dong, X., Sun, J. dan Zheng, G., 2025, Intelligent Fault Diagnosis Method for Shearer Rocker Gear Based on Swin Transformer and Multiscale Convolution Parallel Integration, *IEEE Transactions on Instrumentation and Measurement*, [Online] 74, tersedia di DOI:10.1109/TIM.2025.3551002.

Sun, Z. dan Wang, Y., 2022, A Deep Fuzzy Clustering Network for Gearbox Health Assessment, *2022 Global Reliability and Prognostics and Health Management (PHM-Yantai)*, [Online], 2022 hlm. 1–4, tersedia di DOI:10.1109/PHM-Yantai55411.2022.9941922.

Szermer, M., Zając, P., Amrozik, P., Maj, C., Jankowski, M., Jabłoński, G., Kiełbik, R., Nazdrowicz, J., Napieralska, M. dan Sakowicz, B., 2021, A Capacitive 3-Axis MEMS Accelerometer for Medipost: A Portable System Dedicated to Monitoring Imbalance Disorders, *Sensors*, [Online] 21 (10), tersedia di DOI:10.3390/s21103564.

Talpur, N., Salleh, M.N.M. dan Hussain, K., 2017, An investigation of membership functions on performance of ANFIS for solving classification problems, *IOP Conference Series: Materials Science and Engineering*, [Online], 2017 hlm. tersedia di DOI:10.1088/1757-899X/226/1/012103.

Tamilselvi, V. dan Ahalya, T., 2024, *Fuzzy Logic Controller in Cog and Mamdani Method*, [Online] 111–122, tersedia di DOI:10.58532/v3bjcm1p1ch11.

Tariq, O.B., Shan, J., Floros, G., Sotiriou, C., Casu, M.R., Lazarescu, M.T. dan Lavagno, L., 2021, High-Level Annotation of Routing Congestion for Xilinx

UNIVERSITAS GADJAH MADA
OPTIMASI SISTEM KLASIFIKASI REAL-TIME KONDISI RODA GIGI KONVEYOR PADA FPGA BERDAYA RENDAH BERBASIS SISTEM INFERENSI FUZZY INTEGER
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Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Vivado HLS Designs, *Ieee Access*, [Online] 954286–54297, tersedia di DOI:10.1109/access.2021.3067453.

Tóth-Laufer, E., Rudas, I.J. dan Takács, M., 2014, Operator dependent variations of the mamdani-type inference system model to reduce the computational needs in real-time evaluation, *International Journal of Fuzzy Systems*, [Online] 16 (1), 57 – 72, tersedia di *https://www.scopus.com/inward/record.uri?eid=2-s2.0-84898954610&partnerID=40&md5=4117d9ec94a912e8e0482d1c0812a907*.

Trisanto, D., Rismawati, N., Mulya, M.F. dan Kurniadi, F.I., 2021, Modified Focal Loss in Imbalanced XGBoost for Credit Card Fraud Detection, *International Journal of Intelligent Engineering and Systems*, [Online] 14 (4), 350–358, tersedia di DOI:10.22266/ijies2021.0831.31.

Ultimate, 2025, Conveyor Types and Uses, [Online], tersedia di *https://www.ultimationinc.com/conveyor-technologies/conveyor-types/*, diakses 30 Oktober 2025.

Ultimation, 2019, Conveyor Types and Uses, [Online], tersedia di *https://www.ultimationinc.com/conveyor-technologies/conveyor-types/*, diakses 15 September 2023.

Uppalapati, S. dan Kaur, D., 2009, Design and implementation of a Mamdani fuzzy inference system on an FPGA, *Annual Conference of the North American Fuzzy Information Processing Society - NAFIPS*, [Online], 2009 hlm. tersedia di DOI:10.1109/NAFIPS.2009.5156408.

Uwimana, A., 2024, *Perspective Chapter: Macroeconomic Dynamics Through the Lens of the Adaptive Neuro-Fuzzy Inference System*, [Online] tersedia di DOI:10.5772/intechopen.1004041.

Vashishtha, S. dan Susan, S., 2022, Neuro-fuzzy network incorporating multiple lexicons for social sentiment analysis, *Soft Computing*, [Online] 26 (9), 4487–4507, tersedia di DOI:10.1007/s00500-021-06528-0.

UNIVERSITAS
GADJAH MADA
OPTIMASI SISTEM KLASIFIKASI REAL-TIME KONDISI RODA GIGI KONVEYOR PADA FPGA BERDAYA RENDAH BERBASIS SISTEM INFERENSI FUZZY INTEGER
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Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Verhagen, W.J. dan Oudkerk, T., 2020, *Use of Textual Elements to Improve Reliability Prediction for Aircraft Component Behavior*, [Online] tersedia di DOI:10.3233/atde200116.

Wan, J. dan McLoone, S., 2024, *Remaining Useful Life Estimation of Lenses for an Ion Beam Etching Tool in Semiconductor Manufacturing Using Deep Convolutional Neural Networks*, [Online] tersedia di DOI:10.3233/faia231177.

Wang, H., 2024, Raptor Codes With LT-LDPC Precoding Performance Analysis and FPGA Optimization, *Highlights in Science Engineering and Technology*, [Online] 9755–64, tersedia di DOI:10.54097/3x6yb210.

Wang, W., Galati, F.A. dan Szibbo, D., 2020, LSTM Residual Signal for Gear Tooth Crack Diagnosis, Andrew Ball, Len Gelman, dan B K N Rao (ed.), *Advances in Asset Management and Condition Monitoring*, 2020 Springer International Publishing, Cham., hlm. 1075–1090,

Wolf, C., 2020, nextpnr -- a portable FPGA place and route tool, [Online], tersedia di *https://github.com/YosysHQ/nextpnr*, diakses 26 April 2023.

Wolf, C., t.t., Project Trellis, [Online], tersedia di *https://github.com/YosysHQ/prjtrellis*, diakses 25 Juli 2023.

Wolf, C., 2016, Yosys Open SYnthesis Suite, [Online], tersedia di *https://github.com/YosysHQ/nextpnr*, diakses 26 Januari 2023.

Wolf, C. dan Lasser, M., t.t., Project IceStorm, [Online], tersedia di *http://bygone.clairexen.net/icestorm/*, diakses 20 Januari 2023.

Wu, Z., Wang, Z., Wei, H., Ren, J., Yuan, Y., Wang, T., Duan, W., Wei, H. dan Wang, S., 2022, Remaining useful life prediction for equipment based on RF-BiLSTM, *AIP Advances*, [Online] 12 (11), 115209, tersedia di DOI:10.1063/5.0125885.

Xilinx, 2023, FPGAs & 3D ICs, [Online], tersedia di *https://www.xilinx.com/products/silicon-devices/fpga.html*, diakses 8 September 2023.

UNIVERSITAS
GADJAH MADA
OPTIMASI SISTEM KLASIFIKASI REAL-TIME KONDISI RODA GIGI KONVEYOR PADA FPGA BERDAYA RENDAH BERBASIS SISTEM INFERENSI FUZZY INTEGER
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Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

xilinx, 2023, UltraFast Design Methodology Guide for FPGAs and SoCs (UG949), [Online], tersedia di *https://docs.xilinx.com/r/en-US/ug949-vivado-design-methodology*, diakses 6 September 2023.

Xilinx, 2020, XILINX 7 Series FPGAs Data Sheet: Overview,

Xu, C., Jiang, S., Luo, G., Sun, G., An, N., Huang, G. dan Liu, X., 2022, The Case for FPGA-Based Edge Computing, *IEEE Transactions on Mobile Computing*, [Online] 21 (7), 2610–2619, tersedia di DOI:10.1109/TMC.2020.3041781.

Yaïci, W. dan Entchev, E., 2016, Adaptive Neuro-Fuzzy Inference System modelling for performance prediction of solar thermal energy system, *Renewable Energy*, [Online] 86302–315, tersedia di DOI:https://doi.org/10.1016/j.renene.2015.08.028.

Yamamoto, K., Yamamoto, Y. dan Nagahara, M., 2023, Hypertracking and Hyperrejection: Control of Signals Beyond the Nyquist Frequency, *Ieee Transactions on Automatic Control*, [Online] 68 (10), 6232–6239, tersedia di DOI:10.1109/tac.2022.3230599.

Yan, H., Qin, Y., Xiang, S., Wang, Y. dan Chen, H., 2020, Long-term gear life prediction based on ordered neurons LSTM neural networks, *Measurement*, [Online] 165108205, tersedia di DOI:https://doi.org/10.1016/j.measurement.2020.108205.

Yang, W., Zimroz, R. dan Papaelias, M., 2022, Advances in Machine Condition Monitoring and Fault Diagnosis, *Electronics*, [Online] 11 (10), 1563, tersedia di DOI:10.3390/electronics11101563.

Yang, Z. dan Zhang, B., 2025, *Application of Deep Learning in Laboratory Equipment Failure Prediction and Maintenance*, [Online] tersedia di DOI:10.3233/atde250306.

yiehchen, 2019, Roda Gigi Spur, [Online], tersedia di *https://www.yiehchen.com/id/product/spur_gear.html*, diakses 10 April 2026.

Yusuf, H., Yang, K. dan Panoutsos, G., 2021, *Fuzzy Multi-Criteria Decision-Making: Example of an Explainable Classification Framework*, [Online] 15–26, tersedia di DOI:10.1007/978-3-030-87094-2_2.

UNIVERSITAS
GADJAH MADA
OPTIMASI SISTEM KLASIFIKASI REAL-TIME KONDISI RODA GIGI KONVEYOR PADA FPGA BERDAYA RENDAH BERBASIS SISTEM INFERENSI FUZZY INTEGER
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Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Zantvoort, K., Nacke, B., Görlich, D., Hornstein, S., Jacobi, C. dan Funk, B., 2024, Estimation of minimal data sets sizes for machine learning predictions in digital mental health interventions, *npj Digital Medicine*, [Online] 7 (1), 361, tersedia di DOI:10.1038/s41746-024-01360-w.

Zhao, S., Wang, P. dan Li, S., 2020, Study on the Fault Diagnosis Method of Scraper Conveyor Gear under Time-Varying Load Condition, *Applied Sciences*, [Online] 10 (15), tersedia di DOI:10.3390/app10155053.

Zhu, Y. dan Hou, K., 2024, Development and Implementation of an FPGA-Embedded Multimedia Remote Monitoring System for Information Technology Server Room Management, *International Journal of Digital Multimedia Broadcasting*, [Online] 20241–16, tersedia di DOI:10.1155/2024/4420578.

Zhu, Y., Li, Z., Li, C. dan Mao, Z., 2004, Research on clustering algorithm of fuzzy structure identification, *International Conference on Signal Processing Proceedings, ICSP*, [Online], 2004 hlm. 1483 – 1487, tersedia di *https://www.scopus.com/inward/record.uri?eid=2-s2.0-7744221169&partnerID=40&md5=7b4b7e7a8e3856fe9f2b34625d764d19*.

Zidar, J., Aleksi, I. dan Matić, T., 2023, Analysis of energy consumption for SPI and I2C communications in ultra-low power embedded systems, *2023 46th MIPRO ICT and Electronics Convention (MIPRO)*, [Online], 2023 hlm. 213–217, tersedia di DOI:10.23919/MIPRO57284.2023.10159889.

Zonta, T., da Costa, C.A., da Rosa Righi, R., de Lima, M.J., da Trindade, E.S. dan Li, G.P., 2020, Predictive maintenance in the Industry 4.0: A systematic literature review, *Computers & Industrial Engineering*, [Online] 150106889, tersedia di DOI:https://doi.org/10.1016/j.cie.2020.106889.