

REFERENCES

- [1] A. N. Izzati, "Evaluasi Teknik Penyimpanan Kacang Kedelai dalam Upaya Peningkatan Kualitas Kacang Kedelai Produksi Dalam Negeri," *J. Sci. Food Agric.*, vol. 1, pp. 11–26, 2024, doi: 10.61511/josfa.v1i1.2024.522.
- [2] I. Unaizahroya, "Meracik peluang: Bisnis kreatif olahan kedelai yang mendunia," *Buletin Teknologi & Inovasi Pertanian*, pp. 15–20, Aug. 31, 2025.
- [3] D. Yogatama and Supatman, "Klasifikasi kedelai GMO dan NON-GMO menggunakan metode *convolutional neural network*," *Jurnal Sains Informatika Terapan*, vol. 4, pp. 163–170, Jun. 2025, doi: 10.62357/jsit.v4i2.582.
- [4] E. R. Septiana, F. A. Fiolana, and D. Erwanto, "Klasifikasi kualitas citra kedelai hitam (Malika) menggunakan metode *k-nearest neighbor*," *JEECOM*, vol. 4, no. 2, pp. 79–86, Oct. 2022, doi: 10.33650/jeecom.v4i2.4469.
- [5] C. Liu *et al.*, "*Detection of surface defects in soybean seeds based on improved YOLOv9*," *Sci. Rep.*, vol. 15, no. 1, Dec. 2025, doi: 10.1038/s41598-025-92429-3.
- [6] N. Wijaya and Jacky, "*Comparison of accuracy rate for soybean type using backpropagation*," *Jurnal Pekommas*, vol. 6, pp. 23–31, Oct. 2021, doi: 10.30818/jpkm.2021.2060204.
- [7] G. D. Kızılloluk and M. Akın, "*A hybrid approach based on convolutional neural networks and machine learning for soybean seed quality classification*," in *2025 9th International Artificial Intelligence and Data Processing Symposium (IDAP)*, IEEE, Sep. 2025, pp. 1–4. doi: 10.1109/IDAP68205.2025.11222306.
- [8] G. Rolando, S. T. Moraglio, A. caratti, C. Cordero, G. Borreani, and L. Tavella, "*Quantitative and qualitative damage caused by Halyomorpha halys (Hemiptera: Pentatomidae) on soybean crop at different growth stages*," *Crop Protection*, vol. 187, pp. 1–1, Oct. 2024, doi: 10.1016/j.cropro.2024.106987.
- [9] Md. B. Rahman, A. Tulsi, and A. Momin, "*Spectral-spatial fusion for soybean quality evaluation using hyperspectral imaging*," *AgriEngineering*, vol. 7, pp. 1–19, Sep. 2025, doi: 10.3390/agriengineering7090274.
- [10] Y. Gulzar, "*Enhancing soybean classification with modified inception model: A transfer learning approach*," *Emir. J. Food Agric.*, vol. 36, pp. 1–9, Apr. 2024, doi: 10.3897/ejfa.2024.122928.

- [11] S. Jitanan and P. Chimlek, “Quality grading of soybean seeds using image analysis,” *International Journal of Electrical and Computer Engineering*, vol. 9, no. 5, pp. 3495–3503, Oct. 2019, doi: 10.11591/ijece.v9i5.pp3495-3503.
- [12] S. Saki and M. Soori, “Artificial intelligence, machine learning and deep learning in advanced transportation systems: A review,” *Multimodal Transportation*, pp. 1–25, Mar. 2025, doi: 10.1016/j.multra.2025.100242.
- [13] X. He, J. Jin, Y. jiang, and D. Li, “A lightweight convolutional neural network-based feature extractor for visible images,” *Computer Vision and Image Understanding*, vol. 249, pp. 1–13, 2024, doi: 10.1016/j.cviu.2024.104157.
- [14] R. Al Husan and T. M. Kusuma, “Klasifikasi biji kedelai menggunakan convolutional neural network (CNN) pada model EfficientNet-B0,” *Jurnal Teknologi Informasi dan Ilmu Komputer (JTIK)*, vol. 12, no. 6, pp. 1261–1269, Dec. 2025, doi: 10.25126/jtiik.2025126.
- [15] N. Zhang, Enxu. Zhang, and F. Li, “A soybean classification method based on data balance and deep learning,” *Applied Sciences (Switzerland)*, vol. 13, pp. 1–14, 2023, doi: 10.3390/app13116425.
- [16] R. Maheshwari, A. Sharma, J. P. Meena, and S. K. Nagar, “Optimized deep learning architecture with EfficientNet and MixUp & CutMix for robust plant disease classification,” in *2025 8th International Conference on Circuit, Power & Computing Technologies (ICCPCT)*, 2025, pp. 993–998. doi: 10.1109/ICCPCT65132.2025.11176735.
- [17] S. Rahayu and S. F. Romdoni, “Bayesian optimized pretrained CNNs for mango leaf disease classification: A comparative study,” *Jurnal Teknik Informatika (Jutif)*, vol. 6, no. 5, pp. 3051–3078, Oct. 2025, doi: 10.52436/1.jutif.2025.6.5.4967.
- [18] D. Shamia, R. Umapiya, M. L. M. Prasad, R. Chowdhury, P. Kumar, and K. Vishnupriya, “Enhancing skin cancer classification with MixUp data augmentation and EfficientNet,” *Journal Of Electronics, Electromedical Engineering, and Medical Informatics (JEEEMI)*, vol. 7, no. 2, pp. 557–566, Apr. 2025, doi: 10.35882/jeeemi.v7i2.703.
- [19] R. Mahendra, E. A. Laksana, and Sukenda, “Pendekatan transfer learning dengan InceptionResNetV2 dan augmentasi MixUp untuk peningkatan klasifikasi tumor otak,” *Jurnal Algoritma*, vol. 22, no. 1, pp. 161–172, May 2025, doi: 10.33364/algoritma/v.22-1.2194.

- [20] J. Smucny, G. Shi, T. A. Lesh, C. S. Carter, and I. Davidson, “Data augmentation with MixUp: Enhancing performance of a functional neuroimaging-based prognostic deep learning classifier in recent onset psychosis,” *Neuroimage Clin.*, vol. 36, pp. 1–8, 2022, doi: 10.1016/j.nicl.2022.103214.
- [21] J. Sanjaya and M. Ayub, “Augmentasi data pengenalan citra mobil menggunakan pendekatan random crop, rotate, dan MixUp,” *Jurnal Teknik Informatika dan Sistem Informasi*, vol. 6, no. 2, pp. 311–323, Aug. 2020, doi: 10.28932/jutisi.v6i2.2688.
- [22] X. Jiang *et al.*, “PlantCaFo: An efficient few-shot plant disease recognition method based on foundation models,” *Plant Phenomics*, vol. 7, pp. 1–12, 2025, doi: 10.1016/j.plaphe.2025.100024.
- [23] H. Lee, Y. S. Park, S. Yang, H. Lee, T. J. Park, and D. Yeo, “A deep learning-based crop disease diagnosis method using multimodal MixUp augmentation,” *Applied Sciences (Switzerland)*, vol. 14, no. 10, May 2024, doi: 10.3390/app14104322.
- [24] Y. A. Abdillah and Kursini, “Corn leaf disease classification optimization using ResNet50 architecture utilizing Bayesian optimization,” *Journal of Electrical Engineering and Computer (JEECOM)*, vol. 7, no. 1, pp. 8–15, Apr. 2025, doi: 10.33650/jeeecom.v4i2.
- [25] M. I. F. Nurzula and C. Fatichah, “Optimasi Hyperparameter pada Convolutional Neural Network untuk Klasifikasi Jenis Penyakit Kanker Kulit menggunakan Bayesian Optimization,” *ILKOMNIKA: Journal of Computer Science and Applied Informatics E*, vol. 7, no. 1, pp. 146–157, Apr. 2025, doi: 10.28926/ilkomnika.v7i1.690.
- [26] A. Nikitin, I. Fastovets, D. Shadrin, M. Puklchik, and I. Oseledets, “Bayesian optimization for seed germination,” *Plant Methods*, no. 1, pp. 1–10, 2019, doi: 10.1186/s13007-019-0422-z.
- [27] S. E. Arman, S. Rahman, and S. A. Deowan, “COVIDXception-Net: A Bayesian Optimization-Based Deep Learning Approach to Diagnose COVID-19 from X-Ray Images,” *SN Comput. Sci.*, vol. 3, no. 2, Mar. 2022, doi: 10.1007/s42979-021-00980-3.

- [28] P. Qin, T. Wang, and Y. Luo, “A review on plant-based proteins from soybean: Health benefits and soy product development,” *J. Agric. Food Res.*, vol. 7, pp. 1–8, Jan. 2022, doi: 10.1016/j.jafr.2021.100265.
- [29] W. Lin *et al.*, “Soybean image dataset for classification,” *Data Brief*, vol. 6, pp. 1–7, 2023, doi: 10.17632/v6vzvfszj6.6.
- [30] A. Sable, P. Singh, A. Kaur, M. Driss, and W. Boulila, “Quantifying Soybean Defects: A Computational Approach to Seed Classification Using Deep Learning Techniques,” *Agronomy*, vol. 14, pp. 1–18, 2024, doi: 10.3390/agronomy14061098.
- [31] H. A. Fatan, T. Widiari, and Sudarno, “Klasifikasi Kualitas Kopi Arabika Dengan Metode Random Forest Dan K-Nearest Neighbor Pada Imbalanced Dataset,” *Jurnal Gaussian*, vol. 14, no. 1, pp. 107–117, Jun. 2025, doi: 10.14710/j.gauss.14.1.107-117.
- [32] E. M. Lemes and H. C. R. M. Catão, “Soybean Seed Coat Cracks and Green Seeds Predisposing Conditions, Identification and Management,” Mar. 12, 2024, *Multidisciplinary Digital Publishing Institute (MDPI)*. doi: 10.3390/seeds3010011.
- [33] M. F. Naufal and S. F. Kusuma, “Analisis perbandingan algoritma machine learning dan deep learning untuk klasifikasi citra sistem isyarat bahasa Indonesia (SIBI),” *Jurnal Teknologi Informasi dan Ilmu Komputer (JTIIK)*, vol. 10, pp. 873–881, 2023, doi: 10.25126/jtiik.2023106828.
- [34] N. O. M. Salim and A. K. Mohammed, “Comparative analysis of classical machine learning and deep learning methods for fruit image recognition and classification,” *Traitement du Signal*, vol. 41, no. 3, pp. 1331–1343, Jun. 2024, doi: 10.18280/ts.410322.
- [35] Md. J. U. Chowdhury, Z. I. Mou, R. Arfin, and S. Kibria, “Plant Leaf Disease Detection and Classification Using Deep Learning: A Review and A Proposed System on Bangladesh’s Perspective,” *International Journal of Science and Business*, no. 1, pp. 193–204, 2023, doi: 10.58970/IJSB.2214.
- [36] C. Xu, J. Wu, F. Zhang, J. Freer, Z. Zhang, and Y. Cheng, “A deep image classification model based on prior feature knowledge embedding and application in medical diagnosis,” *Sci. Rep.*, vol. 14, no. 1, Dec. 2024, doi: 10.1038/s41598-024-63818-x.

- [37] K. Velarati, C. A. Sari, and E. H. Rachmawanto, “A comparison of convolutional neural network (CNN) and transfer learning MobileNetV2 performance on spices image classification,” *Journal of Applied Informatics and Computing (JAIC)*, vol. 8, no. 2, pp. 413–420, Dec. 2024, doi: 10.30871/jaic.v8i2.8622.
- [38] M. Tan and Q. V. Le, “EfficientNet: Rethinking model scaling for convolutional neural networks,” Sep. 2020, doi: doi.org/10.48550/arXiv.1905.11946.
- [39] A. Barnawi *et al.*, “A systematic analysis of deep learning methods and potential attacks in internet-of-things surfaces,” *Neural Comput. Appl.*, vol. 35, pp. 1–16, Jan. 2023, doi: 10.1007/s00521-023-08634-6.
- [40] I. D. Mienye and T. G. Swart, “A comprehensive review of deep learning: Architectures, recent advances, and applications,” *Information (Switzerland)*, vol. 15, no. 12, pp. 1–45, Dec. 2024, doi: 10.3390/info15120755.
- [41] H. Pratap, M. S. Guru Prasad, P. Agarwal, A. Bhardwaj, A. Mehra, and S. Mathpati, “SoyNet: Deep learning approaches for automated soybean seed quality assessment,” *IEE- 2nd International Conference on Advancement in Computation and Computer Technologies, InCACCT 2024*, pp. 613–617, 2024, doi: 10.1109/InCACCT61598.2024.10551180.
- [42] L. Alzubaidi *et al.*, “Review of deep learning: Concepts, CNN architectures, challenges, applications, future directions,” *J. Big Data*, vol. 8, pp. 1–74, Mar. 2021, doi: 10.1186/s40537-021-00444-8.
- [43] R. Sigitta, R. Saputra, and F. Fathulloh, “Deteksi penyakit tomat melalui citra daun menggunakan metode convolutional neural network,” *AVITEC*, vol. 5, p. 43, Jan. 2023, doi: 10.28989/avitec.v5i1.1404.
- [44] M. K. Raj, N. A. Abinesh, G. Bhuvanesh, and S. Bhuvaneshwaran, “Hand cricket game using CNN squeeze network,” *IJARCCCE*, vol. 12, Jan. 2023, doi: 10.17148/IJARCCCE.2023.12588.
- [45] O. Citra, R. Rachmawati, A. Ridho Barakbah, and T. Karlita, “Comparison of activation functions in feature extraction layer using sharpening filters,” *Journal of Applied Engineering and Technological Science*, vol. 6, no. 2, pp. 1254–1267, Jan. 2025, doi: 10.37385/jaets.v6i2.5895.
- [46] A. Pratama, T. Sugiharto, and P. Novantara, “Klasifikasi jenis tanaman alpukat berdasarkan bentuk daun menggunakan algoritma CNN,” *Jurnal Computer*

- Science and Information Technology (CoSciTech)*, vol. 6, no. 2, pp. 120–128, Jul. 2025, doi: 10.37859/coscitech.v6i2.9474.
- [47] T. A. Zuraiyah, S. Maryana, and A. Kohar, “Automatic door access model based on face recognition using convolutional neural network,” *MATRIK: Jurnal Manajemen, Teknik Informatika dan Rekayasa Komputer*, vol. 22, no. 1, pp. 241–258, Nov. 2022, doi: 10.30812/matrik.v22i1.2350.
- [48] M. Krichen, “Convolutional neural networks: A survey,” *Computers*, vol. 12, no. 8, pp. 1–41, Jul. 2023, doi: 10.3390/computers12080151.
- [49] S. Wulandari, Y. I. Mukti, and T. Susanti, “Optimalisasi prediksi penyakit stroke menggunakan algoritma *deep learning*,” *Jurnal Mahasiswa Teknik Informatika (JATI)*, vol. 8, no. 2, pp. 1826–1833, 2024, doi: 10.36040/jati.v8i2.9256.
- [50] M. N. Razali, N. Arbaiy, P. Lin, and S. Ismail, “Optimizing multiclass classification Using Convolutional neural networks with class weights and early stopping for imbalanced datasets,” *Electronics (Switzerland)*, vol. 14, pp. 1–14, 2025, doi: 10.3390/electronics14040705.
- [51] A. A. Abd El-Aziz, M. A. Mahmood, and S. A. El-Ghany, “EfficientNet-B3-based automated deep learning framework for multiclass endoscopic bladder tissue classification,” *Diagnostics*, vol. 15, no. 19, Oct. 2025, doi: 10.3390/diagnostics15192515.
- [52] H. Ali, N. Shifa, R. Benlamri, A. A. Farooque, and R. Yaqub, “A fine-tuned EfficientNet-B0 convolutional neural network for accurate and efficient classification of apple leaf diseases,” *Sci. Rep.*, vol. 15, no. 1, Dec. 2025, doi: 10.1038/s41598-025-04479-2.
- [53] M. P. Mathew, “A comparative deep learning framework for grape leaf disease classification using EfficientNetB0, InceptionV3, and Xception,” *Discover Applied Sciences*, vol. 7, no. 10, Oct. 2025, doi: 10.1007/s42452-025-07457-5.
- [54] R. S. Sandhya Devi, V. R. Vijay Kumar, and P. Sivakumar, “EfficientNetV2 model for plant disease classification and pest recognition,” *Computer Systems Science and Engineering*, vol. 45, no. 2, pp. 2249–2263, 2023, doi: 10.32604/csse.2023.032231.
- [55] A. Rayhan, R. Hidayat, and R. Afyenni, “Perbandingan akurasi EfficientNetV2 dan MobileNetV2 pada klasifikasi makanan tradisional Indonesia,” *Journal Cerita*, vol. 10, no. 2, pp. 124–127, Aug. 2024, doi: 10.33050/cerita.v10i2.3326.

- [56] A. Swetapadma and A. Yadav b, “*Transfer learning-based EfficientNet method for transmission line insulator flaw detection,*” *e-Prime - Advances in Electrical Engineering, Electronics and Energy*, vol. 10, pp. 1–9, 2024, doi: 10.1016/j.prime.2024.100873.
- [57] C. Shorten and T. M. Khoshgoftaar, “*A survey on image data augmentation for deep learning,*” *J. Big Data*, vol. 6, pp. 1–48, 2019, doi: 10.1186/s40537-019-0197-0.
- [58] H. Zhang, M. Cisse, Y. N. Dauphin, and D. Lopez-Paz, “*mixup: Beyond empirical risk minimization,*” *Published as a conference paper at ICLR 2018*, pp. 1–13, 2018, doi: 10.48550/arXiv.1710.09412.
- [59] L. H. Li and R. Tanone, “*Improving robustness using MixUp and CutMix augmentation for corn leaf diseases classification based on ConvMixer architecture,*” *Journal of ICT Research and Applications*, vol. 17, no. 2, pp. 167–180, 2023, doi: 10.5614/ITBJ.ICT.RES.APPL.2023.17.2.3.
- [60] M. A. K. Raiaan *et al.*, “*A systematic review of hyperparameter optimization techniques in convolutional neural network,*” *Decision Analytics Journal*, vol. 11, pp. 1–32, Jun. 2024, doi: 10.1016/j.dajour.2024.100470.
- [61] I. H. Kartowisastro and J. Latupapua, “*A comparison of adaptive moment estimation (Adam) and RMSProp optimisation techniques for wildlife animal classification using convolutional neural networks,*” *Revue d’Intelligence Artificielle*, vol. 37, no. 4, pp. 1023–1030, Aug. 2023, doi: 10.18280/ria.370424.
- [62] J. Wu, X.-Y. Chen, H. Zhang, L.-D. Xiong, H. Lei, and S.-H. Deng, “*Hyperparameter optimization for machine learning models based on Bayesian optimization,*” *Journal of Electronic Science and Technology*, vol. 17, no. 1, pp. 26–40, 2019, doi: 10.11989/JEST.1674-862X.80904120.
- [63] W. Rohman, D. Erwanto, and I. Yanuartanti, “*Evaluasi kinerja CNN dengan optimizer RMSprop, Adam dan SGD dalam klasifikasi penyakit daun anggur,*” *Jurnal Teknik Elektro: Electronic Control, Telecommunication, Computer Information and Power System*, vol. 10, no. 1, pp. 91–104, Mar. 2025, doi: 10.30736/je-unisla.v10i1.1409.
- [64] R. Shen, G. Luo, and A. Su, “*Bayesian optimization for chemical synthesis in the era of artificial intelligence: Advances and applications,*” Sep. 01, 2025, *Multidisciplinary Digital Publishing Institute (MDPI)*. doi: doi.org/10.3390/pr13092687.

- [65] A. Jain *et al.*, “Bayesian optimized CNN ensemble for efficient potato blight detection using fuzzy image enhancement,” *Sci. Rep.*, vol. 15, no. 1, Dec. 2025, doi: 10.1038/s41598-025-15940-7.
- [66] R. Raju and T. M. Thasleema, “BO-CNN: A deep learning framework with Bayesian hyperparameter tuning for nutrient stress classification in *Piper nigrum*,” *Franklin Open*, vol. 13, Dec. 2025, doi: 10.1016/j.fraope.2025.100444.
- [67] V. Sefiana Putri and S. Basuki, “Explainable AI-driven convolution neural network for quality grading of soybean seed,” *Teknologi Informasi dan Komputer (ELTIKOM)*, vol. 176, no. 2, pp. 176–183, Dec. 2025, doi: 10.31961/eltikom.v9i2.1566.
- [68] M. Erdi, M. I. Mazdadi, R. A. Nugroho, A. Farmadi, T. H. Saragih, and H. A. A. Rozaq, “Prediction of life expectancy of lung cancer patients after thoracic surgery using decision tree algorithm and adaptive synthetic sampling,” *Jurnal Teknik Informatika (Jutif)*, vol. 6, no. 5, pp. 3456–3467, Oct. 2025, doi: 10.52436/1.jutif.2025.6.5.4724.
- [69] O. Rainio, J. Teuho, and R. Klén, “Evaluation metrics and statistical tests for machine learning,” *Sci. Rep.*, vol. 14, pp. 1–4, Mar. 2024, doi: 10.1038/s41598-024-56706-x.
- [70] S. B. Cho *et al.*, “Development of a CNN classifier with XAI to detect interpretable water stress in sweet potato using RGB images,” *Agric. Water Manag.*, vol. 321, pp. 1–4, 2025, doi: 10.1016/j.agwat.2025.109899.
- [71] F. L. Pakpahan, J. S. Sembiring, T. B. Abellista, and E. Indra, “Integration of YOLOv8 and FastAPI for early detection of nail diseases,” *Sinkron*, vol. 9, no. 2, pp. 978–986, 2025, doi: 10.33395/sinkron.v9i2.14796.