

best model to analyze the COVID-19 Chest X-ray images dataset with an average of 94.70% accuracy. Therefore, this method is expected to generate higher accuracy so future studies with wider databases can provide better results for analyzing diverse ailments.

ACKNOWLEDGMENT

The University of Indonesia financially supported this research with a PUTI 2022 grant scheme.

REFERENCES

- [1] Adam Jacobi, Michael Chung, Adam Bernheim, Corey Eber. "Portable chest X-ray in coronavirus disease-19 (COVID-19): A pictorial review". 2020. *Clinical Imaging*. Vol. 64, pp. 35–42. doi: 10.1016/j.clinimag.2020.04.001.
- [2] Aras M. Ismael, Abdulkadir Şengür. "Deep learning approaches for COVID-19 detection based on chest X-ray images." 2021. *Expert Systems with Applications*. Vol. 164, p. 114054. doi: 10.1016/j.eswa.2020.114054.
- [3] Abbas, A., Abdelsamea, M.M. & Gaber, M.M. "Classification of COVID-19 in chest X-ray images using DeTraC deep convolutional neural network." 2021. *Applied Intelligence*. Vol. 51, pp. 854–864. doi: 10.1007/s10489-020-01829-7.
- [4] Wang, L., Lin, Z.Q. & Wong, A. "COVID-Net: a tailored deep convolutional neural network design for detection of COVID-19 cases from chest X-ray images". 2020. *Scientific Reports*. Vol. 10, p. 19549. doi: 10.1038/s41598-020-76550-z.
- [5] Shervin Minaee, Rahele Kafieh, Milan Sonka, Shakib Yazdani, Ghazaleh Jamalipour Soufi. "Deep-COVID: Predicting COVID-19 from chest X-ray images using deep transfer learning". 2020. *Medical Image Analysis*. Vol. 65, p. 101794. doi: 10.1016/j.media.2020.101794.
- [6] Jain, R., Gupta, M., Taneja, S. "Deep learning based detection and analysis of COVID-19 on chest X-ray images". 2021. *Applied Intelligence*. Vol. 51, pp. 1690–1700, doi: 10.1007/s10489-020-01902-1.
- [7] Borghesi, A., Maroldi, R. "COVID-19 outbreak in Italy: experimental chest X-ray scoring system for quantifying and monitoring disease progression". 2020. *La Radiologia medica*. Vol. 125, pp. 509–513. doi: 10.1007/s11547-020-01200-3.
- [8] Ni Zhang, Yi-Xin Cai, Yong-Yong Wang, Yi-Tao Tian, Xiao-Li Wang, Benjamin Badami. "Skin cancer diagnosis based on optimized convolutional neural network". 2020. *Artificial Intelligence in Medicine*. Vol. 102, p. 101756, doi: 10.1016/j.artmed.2019.101756.
- [9] Fang, X., Liu, W., Ai, J. "Forecasting incidence of infectious diarrhea using random forest in Jiangsu Province, China". 2020. *BMC Infectious Diseases*. Vol. 20, p. 222. doi: 10.1186/s12879-020-4930-2.
- [10] Yang, L., Wu, H., Jin, X. "Study of cardiovascular disease prediction model based on random forest in eastern China". 2020. *Scientific Reports*. Vol. 10, p. 5245, doi: 10.1038/s41598-020-62133-5.
- [11] Yao, P., Wu, H., Gao, B. "Fully hardware-implemented memristor convolutional neural network". 2020. *Nature*. Vol. 577, pp. 641–646, doi: 10.1038/s41586-020-1942-4.
- [12] M.V. Valueva, N.N. Nagornov, P.A. Lyakhov, G.V. Valuev, N.I. Chervyakov. "Application of the residue number system to reduce hardware costs of the convolutional neural network implementation". 2020. *Mathematics and Computers in Simulation*. Vol. 177, pp. 232–243, doi: 10.1016/j.matcom.2020.04.031.
- [13] Zhiqiang Geng, Yanhui Zhang, Chengfei Li, Yongming Han, Yunfei Cui, Bin Yu. "Energy optimization and prediction modeling of petrochemical industries: An improved convolutional neural network based on cross-feature". 2020. *Energi*. Vol. 194, p. 116851, doi: 10.1016/j.energy.2019.116851.
- [14] Wei Wang, Yiyang Hu, Ting Zou, Hongmei Liu, Jin Wang, Xin Wang. "A New Image Classification Approach via Improved MobileNet Models with Local Receptive Field Expansion in Shallow Layers". 2020. *Computational Intelligence and Neuroscience*. Vol. 2020, p. 817-849, doi: 10.1155/2020/8817849.
- [15] Yu Zhang, Yu Liu, Peng Sun, Han Yan, Xiaolin Zhao, Li Zhang. "IFCNN: A general image fusion framework based on convolutional neural network". 2020. *Information Fusion*. Vol. 54, pp. 99-118, doi: 10.1016/j.inffus.2019.07.011.
- [16] Dhillon, A., Verma, G.K. "Convolutional neural network: a review of models, methodologies and applications to object detection. 2020. *Progress in Artificial Intelligence*. Vol. 9, pp. 85–112 doi: 10.1007/s13748-019-00203-0.
- [17] Derek A. Pisner, David M. Schnyer. "Chapter 6 - Support vector machine." 2020. *Machine Learning: Methods and Applications to Brain Disorders*. pp. 101-121, doi: 10.1016/B978-0-12-815739-8.00006-7.
- [18] Jair Cervantes, Farid Garcia-Lamont, Lisbeth Rodríguez-Mazahua, Asdrubal Lopez. "A comprehensive survey on support vector machine classification: Applications, challenges and trends". 2020. *Neurocomputing*. Vol. 408, pp. 189-215, doi: 10.1016/j.neucom.2019.10.118.
- [19] Dou, J., Yunus, A.P., Bui, D.T. "Improved landslide assessment using support vector machine with bagging, boosting, and stacking ensemble machine learning framework in a mountainous watershed, Japan". 2020. *Landslides*. Vol. 17, pp. 641–658, doi: 10.1007/s10346-019-01286-5.
- [20] Fazil Kaytez. "A hybrid approach based on autoregressive integrated moving average and least-square support vector machine for long-term forecasting of net electricity consumption". 2020. *Energi*. Vol. 197, p. 117-200, doi: 10.1016/j.energy.2020.117200.
- [21] Melgani, Farid & Bruzzone, Lorenzo. "Classification of Hyperspectral Remote Sensing Images with Support Vector Machines". 2004. *Geoscience and Remote Sensing*. IEEE Transactions. Vol. 42, pp. 1778–1790, doi: 10.1109/TGRS.2004.831865.
- [22] Onuwa Okwuashi, Christopher E. Ndehedehe. "Deep support vector machine for hyperspectral image classification". 2020. *Pattern Recognition*. Vol. 103, p. 107-298, doi: 10.1016/j.patcog.2020.107298.
- [23] Mingjing Wang, Huiling Chen. "Chaotic multi-swarm whale optimizer boosted support vector machine for medical diagnosis". 2020. *Applied Soft Computing*. Vol. 88, p. 105946, doi: 10.1016/j.asoc.2019.105946.
- [24] Yanyu Chen, Wenzhe Zheng, Wenbo Li, Yimiao Huang. "Large group activity security risk assessment and risk early warning based on random forest algorithm". 2021. *Pattern Recognition Letters*. Vol. 144, pp. 1–5, doi: 10.1016/j.patrec.2021.01.008.
- [25] Rakesh Katuwal, P.N. Suganthan, Le Zhang. "Heterogeneous oblique random forest". 2020. *Pattern Recognition*. Vol. 99, p. 107078, doi: 10.1016/j.patcog.2019.107078.
- [26] Emma Izquierdo-Verdiguier, Raúl Zurita-Milla. "An evaluation of Guided Regularized Random Forest for classification and regression tasks in remote sensing." 2020. *International Journal of Applied Earth Observation and Geoinformation*. Vol. 88, p. 102051, doi: 10.1016/j.jag.2020.102051.
- [27] Moor, Lieven & Luitel, Prabesh & Sercu, Piet & Vanpée, Rosanne. "Subjectivity in Sovereign Credit Ratings". 2017. *SSRN Electronic Journal*, doi: 10.2139/ssrn.2934287.
- [28] Wengang Zhang, Chongzhi Wu, Haiyi Zhong, Yongqin Li, Lin Wang. "Prediction of undrained shear strength using extreme gradient boosting and random forest based on Bayesian optimization". 2021. *Geoscience Frontiers*. Vol. 12, Issue 1, pp. 469–477, doi: 10.1016/j.gsf.2020.03.007.
- [29] Ding-Xuan Zhou. "Theory of deep convolutional neural networks: Downsampling." 2020. *Neural Networks*. Vol. 124, pp. 319-327, doi: 10.1016/j.neunet.2020.01.018.
- [30] Xianwei Jiang, Bo Hu, Suresh Chandra Satapathy, Shui-Hua Wang, Yu-Dong Zhang. "Fingerspelling Identification for Chinese Sign Language via AlexNet-Based Transfer Learning and Adam Optimizer". 2020. *Scientific Programming*. Vol. 2020, p. 3291426, doi: 10.1155/2020/3291426.
- [31] J.-K. Fang, C.-M. Fong, P. Yang, C.-K. Hung, W.-L. Lu and C.-W. Chang. "AdaGrad Gradient Descent Method for AI Image Management." 2020. *IEEE International Conference on Consumer Electronics – Taiwan*. pp. 1–2, doi: 10.1109/ICCE-Taiwan49838.2020.9258085.
- [32] Kamsing, P., Torteeka, P. & Yooyen, S. An enhanced learning algorithm with a particle filter-based gradient descent optimizer method. 2020. *Neural Computing & Applications*. Vol. 32, pp. 12789–12800, doi: 10.1007/s00521-020-04726-9.
- [33] Jianfeng Xu, Yuanjian Zhang, Duoqian Miao. "Three-way confusion matrix for classification: A measure driven view". 2020. *Information Sciences*. Vol. 507, pp. 772–794, doi: 10.1016/j.ins.2019.06.064.