

REFERENCES

- Abadi, A.D. et al. (2022) 'Detection of Cyclists' Crossing Intentions for Autonomous Vehicles', Digest of Technical Papers - IEEE International Conference on Consumer Electronics, 2022-January. Available at: <https://doi.org/10.1109/ICCE53296.2022.9730559>.
- Asmaa, O., Mokhtar, K. and Abdelaziz, O. (2013) 'Road traffic density estimation using microscopic and macroscopic parameters', Image and Vision Computing, 31(11), pp. 887–894. Available at: <https://doi.org/10.1016/j.imavis.2013.09.006>.
- Balcilar, M. and Sönmez, A.C. (2008) 'Extracting vehicle density from background estimation using Kalman filter', 2008 23rd International Symposium on Computer and Information Sciences, ISCIS 2008, pp. 1–5. Available at: <https://doi.org/10.1109/ISCIS.2008.4717950>.
- Bedi, A.K., Sunkaria, R.K. and Randhawa, S.K. (2018) 'Local Binary Pattern Variants A Review', 2012(3), pp. 1–6.
- Burghouts, G.J. and Geusebroek, J.M. (2009) 'Material-specific adaptation of color invariant features', Pattern Recognition Letters, 30(3), pp. 306–313. Available at: <https://doi.org/10.1016/j.patrec.2008.10.005>.
- Cai, Y. et al. (2020) 'A Novel Improved Local Binary Pattern and Its Application to the Fault Diagnosis of Diesel Engine', Shock and Vibration, 2020. Available at: <https://doi.org/10.1155/2020/9830162>.
- Chan, A.B. and Vasconcelos, N. (2005) 'Classification and Retrieval of Traffic Video Using Auto-Regressive Stochastic Processes', in IEEE Intelligent Vehicles Symposium, Proceedings. Las Vegas, NV, USA, pp. 771–776. Available at: <https://doi.org/10.1109/IVS.2005.1505198>.
- Chen, Y.L. et al. (2011) 'A real-time vision system for nighttime vehicle detection and traffic surveillance', IEEE Transactions on Industrial Electronics, 58(5), pp. 2030–2044. Available at: <https://doi.org/10.1109/TIE.2010.2055771>.
- Dinani, M.A., Ahmadi, P. and Gholampour, I. (2015) 'Efficient Feature Extraction for Highway Traffic Density Classification', in Iranian Conference on Machine Vision and Image Processing, MVIP. Tehran, Iran, pp. 14–19. Available at: <https://doi.org/10.1109/IranianMVIP.2015.7397494>.
- Evan, T. and Jing, C. (2007) 'Vehicular traffic density estimation via statistical methods with automated state learning', 2007 IEEE Conference on Advanced Video and Signal Based Surveillance, AVSS 2007 Proceedings, (October 2007), pp. 164–169. Available at: <https://doi.org/10.1109/AVSS.2007.4425304>.
- Fritz, M. et al. (2004) 'THE KTH-TIPS database'.
- Garg, K. et al. (2016) 'Real-time Road Traffic Density Estimation using Block

- Variance', 2016 IEEE Winter Conference on Applications of Computer Vision, WACV 2016 [Preprint]. Available at: <https://doi.org/10.1109/WACV.2016.7477607>.
- De Goma, J.C. et al. (2019) 'Vehicular Obstruction Detection in the Zebra Lane Using Computer Vision', 2019 IEEE 6th International Conference on Industrial Engineering and Applications, ICIEA 2019, pp. 362–366. Available at: <https://doi.org/10.1109/IEA.2019.8715022>.
- Gonzalez, R.C. and Woods, R.E. (2008) 'Digital Image Processing Third Edition Pearson', p. 954.
- Guo, Z., Zhang, L. and Zhang, D. (2010) 'A completed modeling of local binary pattern operator for texture classification', IEEE Transactions on Image Processing, 19(6), pp. 1657–1663. Available at: <https://doi.org/10.1109/TIP.2010.2044957>.
- Gupta, A. et al. (2020) 'Real-time video monitoring of vehicular traffic and adaptive signal change using Raspberry Pi', 2020 IEEE Students' Conference on Engineering and Systems, SCES 2020, pp. 0–4. Available at: <https://doi.org/10.1109/SCES50439.2020.9236731>.
- Harjoko, A. et al. (2023) 'Traffic Density Estimation Based on Block Occupancy Classification', Innovative Computing, Information and Control Express Letters, 17(11), pp. 1187–1194. Available at: <https://doi.org/10.24507/icicel.17.11.1187>.
- Hoang, V.D., Le, M.H. and Jo, K.H. (2014) 'Hybrid cascade boosting machine using variant scale blocks based HOG features for pedestrian detection', Neurocomputing, 135, pp. 357–366. Available at: <https://doi.org/10.1016/j.neucom.2013.12.017>.
- Kulkarni, A.P. and Baligar, V.P. (2020) 'Real Time Vehicle Detection, Tracking and Counting Using Raspberry-Pi', 2nd International Conference on Innovative Mechanisms for Industry Applications, ICIMIA 2020 - Conference Proceedings, (Icimia), pp. 603–607. Available at: <https://doi.org/10.1109/ICIMIA48430.2020.9074944>.
- Kurniawan, F., Sajati, H. and Dinaryanto, O. (2016) 'Adaptive Traffic Controller Based On Pre-Timed System', TELKOMNIKA (Telecommunication Computing Electronics and Control), 14(1), pp. 56–63. Available at: <https://doi.org/10.12928/telkomnika.v14i1.2798>.
- Kurniawan, F., Sajati, H. and Dinaryanto, O. (2017) 'Image Processing Technique for Traffic Density Estimation', International Journal of Engineering and Technology, 9(2), pp. 1496–1503. Available at: <https://doi.org/10.21817/ijet/2017/v9i2/170902117>.
- Li, J. (2015) QMUL Junction 2. Available at: http://www.eecs.qmul.ac.uk/~sgg/QMUL_Junction_Datasets/Junction2/Junction2.html (Accessed: 8 April 2023).
- Li, Z. et al. (2012) 'Scale- and rotation-invariant local binary pattern using scale-adaptive texton and subuniform-based circular shift', IEEE Transactions on Image Processing, 21(4), pp. 2130–2140. Available at: <https://doi.org/10.1109/TIP.2011.2173697>.
- Li, Z., Tan, E. and Chen, J. (2008) 'On traffic density estimation with a boosted

- SVM classifier', Proceedings - Digital Image Computing: Techniques and Applications, DICTA 2008, pp. 117–123. Available at: <https://doi.org/10.1109/DICTA.2008.30>.
- Liao, S., Law, M.W.K. and Chung, A.C.S. (2016) 'Median Robust Extended Local Binary Pattern for Texture Classification', Image Rochester NY, 18(5), pp. 1107–1118.
- Liu, L. et al. (2012) 'Extended local binary patterns for texture classification', Image and Vision Computing, 30(2), pp. 86–99. Available at: <https://doi.org/10.1016/j.imavis.2012.01.001>.
- Malhi, M.H. et al. (2011) 'Vision based intelligent traffic management system', Proceedings - 2011 9th International Conference on Frontiers of Information Technology, FIT 2011, pp. 137–141. Available at: <https://doi.org/10.1109/FIT.2011.33>.
- Mallikarjuna, P. et al. (2006) 'THE KTH-TIPS2 database', pp. 1–10.
- Mehboob, F. et al. (2016) 'Traffic Flow Estimation from Road Surveillance', Proceedings - 2015 IEEE International Symposium on Multimedia, ISM 2015, pp. 605–608. Available at: <https://doi.org/10.1109/ISM.2015.14>.
- Menon, A. and Omman, B. (2018) 'Detection and Recognition of Multiple License Plate from Still Images', 2018 International Conference on Circuits and Systems in Digital Enterprise Technology, ICCSDET 2018 [Preprint]. Available at: <https://doi.org/10.1109/ICCSDET.2018.8821138>.
- Mittal, U. and Chawla, P. (2023) 'Vehicle detection and traffic density estimation using ensemble of deep learning models', Multimedia Tools and Applications, 82(7), pp. 10397–10419. Available at: <https://doi.org/10.1007/s11042-022-13659-5>.
- Moranduzzo, T. and Melgani, F. (2014) 'Car speed estimation method for UAV images', International Geoscience and Remote Sensing Symposium (IGARSS), pp. 4942–4945. Available at: <https://doi.org/10.1109/IGARSS.2014.6947604>.
- Nguyen, D.L., Putro, M.D. and Jo, K.H. (2022) 'Driver Behaviors Recognizer Based on Light-weight Architecture and Attention Mechanism', IEEE Access, 10(June), pp. 71019–71029. Available at: <https://doi.org/10.1109/ACCESS.2022.3187185>.
- Ojala, T., Pietikäinen, M. and Harwood, D. (1994) 'Performance Evaluation of Texture Measures with Classification Based on Kullback Discrimination of Distributions', in Proceedings of 12th International Conference on Pattern Recognition. IEEE. Available at: <https://doi.org/10.1109/ICPR.1994.576366>.
- Ojala, T., Pietikäinen, M. and Mäenpää, T. (2002) 'Multiresolution gray scale and rotation invariant texture classification with local binary patterns', Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), 1842, pp. 404–420. Available at: https://doi.org/10.1007/3-540-45054-8_27.
- Pan, X., Guo, Y. and Men, A. (2010) 'Traffic surveillance system for vehicle flow detection', ICCMS 2010 - 2010 International Conference on Computer Modeling and Simulation, 1, pp. 314–318. Available at: <https://doi.org/10.1109/ICCMS.2010.75>.

- Pan, Z. et al. (2017) 'Feature based local binary pattern for rotation invariant texture classification', *Expert Systems with Applications*, 88, pp. 238–248. Available at: <https://doi.org/10.1016/j.eswa.2017.07.007>.
- Prasad, D. et al. (2019) 'HOG, LBP and SVM based Traffic Density Estimation at Intersection', in 2019 IEEE Pune Section International Conference, PuneCon 2019. Pune, India. Available at: <https://doi.org/10.1109/PuneCon46936.2019.9105731>.
- Putra, M.A. et al. (2025a) 'Confidence-Based Traffic Density Estimation Using Square Binary Patterns', *International Journal of Intelligent Engineering and Systems*, 18(1), pp. 291–303. Available at: <https://doi.org/10.22266/ijies2025.0229.21>.
- Putra, M.A. et al. (2025b) 'Square Binary Patterns: A Non-Circular Approach for Local Binary Patterns', *IAENG International Journal of Computer Science*, 52(6), pp. 1616–1626.
- Putra, M.A., Harjoko, A. and Wahyono (2022) 'Estimation of Traffic Density Using CNN with Simple Architecture', in *International Workshop on Intelligent Systems (IWIS) 2022*. Ulsan, South Korea: IEEE. Available at: <https://doi.org/10.1109/IWIS56333.2022.9920811>.
- Putra, M.A., Harjoko, A. and Wahyono (2025) 'A Systematic Review on Vision-Based Traffic Density Estimation for Intelligent Transportation Systems', *IET Intelligent Transport Systems*. John Wiley and Sons Inc. Available at: <https://doi.org/10.1049/itr2.70038>.
- Putra, M.A., Wahyono and Harjoko, A. (2025) 'SuroTex: Surrounding Texture Dataset', *Data in Brief*, 59, p. 111292. Available at: <https://doi.org/https://doi.org/10.1016/j.dib.2025.111292>.
- Qi, X. et al. (2013) 'Multi-scale joint encoding of local binary patterns for texture and material classification', *BMVC 2013 - Electronic Proceedings of the British Machine Vision Conference 2013 [Preprint]*, (September). Available at: <https://doi.org/10.5244/C.27.40>.
- Qi, Z. et al. (2019) 'A measurement method for vehicle queue length of intersection based on image processing', *2018 8th International Conference on Image Processing Theory, Tools and Applications, IPTA 2018 - Proceedings [Preprint]*. Available at: <https://doi.org/10.1109/IPTA.2018.8608140>.
- Qiao, Y. and Shi, Z. (2012) 'Traffic parameters detection using edge and texture', *Procedia Engineering*, 29, pp. 3858–3862. Available at: <https://doi.org/10.1016/j.proeng.2012.01.584>.
- Ridder, C., Munkelt, O. and Kirchner, H. (1995) 'Adaptive Background Estimation and Foreground Detection using Kalman Filtering', *Proceedings of the International Conference on Recent Advances in Mechatronics (ICRAM 1995)*, pp. 193–199.
- Russell, D. (2015a) QMUL Junction 1. Available at: http://www.eecs.qmul.ac.uk/~sgg/QMUL_Junction_Datasets/Junction/Junction.html (Accessed: 8 April 2023).
- Russell, D. (2015b) Roundabout Dataset. Available at: https://www.eecs.qmul.ac.uk/~sgg/QMUL_Junction_Datasets/Roundabout/Roundabout.html (Accessed: 22 December 2023).



- Sankaranarayanan, M., Mala, C. and Jain, S. (2024) 'Traffic Density Estimation for Traffic Management Applications Using Neural Networks', *International Journal of Intelligent Information Technologies*, 20(1). Available at: <https://doi.org/10.4018/IJIT.335494>.
- Song, Y. et al. (2024) 'A comprehensively improved local binary pattern framework for texture classification', *Multimedia Tools and Applications* [Preprint]. Available at: <https://doi.org/10.1007/s11042-024-19877-3>.
- Tan, X. and Triggs, B. (2010) 'Enhanced Local Texture Feature Sets for Recognition Under Difficult Lighting Conditions', *IEEE transactions on image processing*, 19(6), pp. 1635–1650. Available at: <https://doi.org/10.1109/TIP.2010.2042645>.
- Tangkocharoen, T. and Srisuphab, A. (2017) 'Vehicle detection on a pint-sized computer', in *2017 9th International Conference on Knowledge and Smart Technology: Crunching Information of Everything, KST 2017*. Chonburi, Thailand, pp. 40–44. Available at: <https://doi.org/10.1109/KST.2017.7886078>.
- Venu, N. (2023) 'Segmentation Analysis for Local Maximum Edge Binary Patterns using Medical Images', *IJFANS International Journal of Food and Nutritional Sciences*, 12(1). Available at: <https://www.researchgate.net/publication/361923631>.
- Wahyono, Filonenko, A. and Jo, K.H. (2015) 'Illegally parked vehicle detection using adaptive dual background model', *IECON 2015 - 41st Annual Conference of the IEEE Industrial Electronics Society*, pp. 2225–2228. Available at: <https://doi.org/10.1109/IECON.2015.7392432>.
- Wasantachai, T. et al. (2009) 'Traffic Density Estimation with On-line SVM Classifier', in *6th IEEE International Conference on Advanced Video and Signal Based Surveillance (AVSS)*. Genova, Italy, pp. 13–18. Available at: <https://doi.org/10.1109/AVSS.2009.43>.