

Documents

Rashid, M.M.^a, Alam, M.S.^{a b}, Haque, M.A.^b, Ali, M.Y.^c, Yvette, S.^d

Effect of different modalities of facial images for diagnosis of ASD by deep neural network
(2024) *AIP Conference Proceedings*, 3161 (1), art. no. 020121, .

DOI: 10.1063/5.0229865

^a International Islamic University Malaysia, Jln Gombak, Kuala Lumpur, 53100, Malaysia

^b Northern University Bangladesh, Askona, Dhaka, Bangladesh

^c Mechanical Engineering Programme Area, Universiti Teknologi Brunei, Jalan Tungku Link Gadong, Bandar Seri Begawan, BE1410, Brunei Darussalam

^d Asia Pacific University, Jalan Teknologi 5, Taman Teknologi Malaysia, Kuala Lumpur, 57000, Malaysia

Abstract

This research aims to explore the potential of various facial image types in diagnosing Autism Spectrum Disorder (ASD) through the application of deep learning neural networks. It delves into how deep learning algorithms perform with different facial image modalities, especially 2D and 3D, while addressing specific challenges associated with each. The methodology includes training deep learning models on distinct datasets and conducting an in-depth analysis of their accuracy and performance metrics. Significantly, the ResNet50V2 model recorded a 96.9% accuracy rate on the 2D dataset, and the Xception model achieved an 84.4% accuracy rate on the 3D dataset. These findings emphasize the strong capability of deep learning neural networks in making accurate ASD diagnoses from facial images. Nonetheless, the research reveals a stronger proficiency in handling 2D over 3D images, suggesting a need for more comprehensive 3D dataset training to improve three-dimensional image processing. Through evaluating the efficacy of different image modalities, this investigation enriches the field's knowledge base, highlights the necessity for robust dataset development, and charts a course for future studies to advance the precision and practicality of ASD diagnosis via deep learning approaches. © 2024 Author(s).

References

- Manoharan, A., Sooriamoorthy, D., Begam, K.M., Aparow, V.R.
(2023) *Journal of Energy Storage*, 72.
- Sooriamoorthy, D., Shanmugam, S.A., Juman, M.A.
(2021) *Biomedical Signal Processing and Control*, 68.
- Khodatars, M., Shoeibi, A., Sadeghi, D., Ghaasemi, N., Jafari, M., Moridian, P., Khadem, A., Berk, M.
(2021) *Comput. Biol. Med.*, 139.
- Alkahtani, H., Aldhyani, T.H.H., Alzahrani, M.Y.
(2023) *Appl. Sci.*, 13, p. 4855.
- Alam, M.S., Rashid, M.M., Roy, R., Faizabadi, A.R., Gupta, K.D., Ahsan, M.M.
(2022) *Bioeng.*, 9, p. 710.
- Saranya, A., Anandan, R.
(2022) *Intell. Autom. Soft Comput.*, 33, pp. 1167-1182.
- Zheng, Y., Liu, L.
(2022) *Proc. Int. Conf. Intell. Educ. Intell. Res.*, pp. 266-271.
- Lu, A., Perkowski, M.
(2021) *Brain Sci.*, 11, p. 1446.
- Ramesh, S., Tan, C.Y., Hamdi, M., Sopyan, I., Teng, W.D.
(2007) *Proceedings of SPIE, Vol. 6423: International Conference on Smart Materials and Nanotechnology in Engineering*, Shanyi Du et al. SPIE Digital Library, USA, Nov

- Auwal, S.T., Ramesh, S., Yusof, F., Manladan, S.M.
(2018) *J. Adv. Manuf. Tech.*, 97, pp. 1071-1098.
- Ramesh, S., Meenaloshini, S., Tan, C.Y., Chew, W.J.K., Teng, W.D.
(2008) *Ceram. Int.*, 34, pp. 1603-1608.
- Manladan, S.M., Yusof, F., Ramesh, S., Fadzil, M.
(2016) *Int. J. Adv. Manuf. Tech.*, 86, pp. 1805-1825.
- Ramesh, S., Natasha, A.N., Tan, C.Y., Bang, L.T., Niakan, A., Purbolaksono, J., Chandran, H., Teng, W.D.
(2015) *Ceram. Int.*, 41, pp. 10434-10441.
- Ramesh, S., Tan, C.Y., Peralta, C.L., Teng, W.D.
(2007) *Sci. Tech. Adv. Mater.*, 8, pp. 257-263.
- Tan, C.Y., Yaghoubi, A., Ramesh, S., Adzila, S., Purbolaksono, J., Hassan, M.A., Kutty, M.G.
(2013) *Ceram. Int.*, 39, pp. 8979-8983.
- Duraisamy, N., Numan, A., Ramesh, K., Choi, K.-H., Ramesh, S., Ramesh, S.
(2015) *Mater. Letts.*, 161, pp. 694-697.
- Bowen, C., Ramesh, S., Gill, C., Lawson, S.
(1998) *J. Mater. Sci.*, 33, pp. 5103-5110.
- Manladan, S.M., Yusof, F., Ramesh, S., Zhang, Y., Luo, Z., Ling, Z.
(2017) *J. Mater. Proc. Tech.*, 250, pp. 45-54.
- Ramesh, S., Zulkifli, N., Tan, C.Y., Wong, Y.H., Tarlochan, F., Ramesh, S., Teng, W.D., Sarhan, A.A.D.
(2018) *Ceram. Int.*, 44, pp. 8922-8927.
- Gunathilake, T.M.S.U., Ching, Y.C., Chuah, C.H., Illias, H.A., Ching, K.Y., Singh, R., Nai-Shang, L.
(2018) *Int. J. Biological Macromolecules*, 118, pp. 1055-1064.
- Francis, K.A., Liew, C.-W., Ramesh, S., Ramesh, K., Ramesh, S.
(2016) *Ionics*, 22, pp. 919-925.
- Ramesh, S., Amiriyani, M., Meenaloshini, S., Tolouei, R., Hamdi, M., Pruboloksono, J., Teng, W.D.
(2011) *Ceram. Int.*, 37, pp. 3583-3590.
- Jais, A.A., Ali, S.A.M., Anwar, M., Somalu, M.R., Muchtar, A., Isahak, W.N.R.W., Tan, C.Y., Brandon, N.P.
(2017) *Ceram. Int.*, 43, pp. 8119-8125.
- Misran, H., Singh, R., Yarmo, M.A.
(2008) *Microporous and Mesoporous Mater.*, 112, pp. 243-253.
- Barzani, M.M., Sarhan, A.A.D., Farahany, S., Ramesh, S., Maher, I.
(2015) *Measurement*, 62, pp. 170-178.
- Yeo, W.H., Fry, A.T., Purbolaksono, J., Ramesh, S., Inayat-Hussain, J.I., Liew, H.L., Hamdi, M.
(2014) *J. Supercritical Fluids*, 92, pp. 215-222.
- Ching, Y.C., Gunathilake, T.M.S.U., Chuah, C.H., Ching, K.Y., Singh, R., Liou, N.-S.
(2019) *Cellulose*, 26, pp. 5467-5481.

- Yee, Y.Y., Ching, Y.C., Rozali, S., Hashim, N.A., Ramesh, S.
(2016) *BioResources*, 11, pp. 2269-2286.
- Ramesh, S., Gill, C.
(2001) *Ceram. Int.*, 27, pp. 705-711.
- Pai, Y.S., Yap, H.J., Singh, R.
(2015) *Proc. Inst. Mech. Eng. Part B J. Eng. Manuf.*, 229, pp. 1029-1045.
- Ramesh, S., Tan, C.Y., Yeo, W.H., Tolouei, R., Amiriyani, M., Sopyan, I., Teng, W.D.
(2011) *Ceram. Int.*, 37, pp. 599-606.
- Sutharsini, U., Thanihachelvan, M., Ting, C.H., Ramesh, S., Tan, C.Y., Chandran, H., Sarhan, A.A.D., Urriés, I.
(2017) *Ceram. Int.*, 43, pp. 7594-7599.
- Tan, C.Y., Singh, R., Teh, Y.C., Tan, Y.M., Yap, B.K.
(2015) *Int. J. Appl. Ceram. Tech.*, 12, pp. 223-227.
- Afshar-Mohajer, M., Yaghoubi, A., Ramesh, S., Bushroa, A.R., Chin, K.M.C., Tin, C.C., Chiu, W.S.
(2014) *Appl. Surf. Sci.*, 307, pp. 1-6.
- Wen, B., Musa, S.N., Onn, C.C., Ramesh, S., Liang, L., Wang, W., Ma, K.
(2020) *Building and Environment*, 185.
- Rahim, A.A.A., Musa, S.N., Ramesh, S., Lim, M.K.
(2020) *Proc. Inst. Mech. Eng. Part L J. Mater. Design and Appl.*, 234, pp. 1032-1059.
- Alkhatib, S.E., Tarlochan, F., Mehboob, H., Singh, R., Kadirgama, K., Harun, W.S.B.W.
(2019) *Artificial Organs*, 43, pp. E152-E164.
- Zavareh, M.A., Sarhan, A.A.D.M., Karimzadeh, R., Singh, R.S.A.I.K.
(2018) *Ceram. Int.*, 44, pp. 5967-5975.
- Sugumaran, T., Silvaraj, D.S., Saidi, N.M., Farhana, N.K., Ramesh, S., Ramesh, K., Ramesh, S.
(2019) *Ionics*, 25, pp. 763-771.
- Chee, H.A., Singh, R.S.K., Lee, K.S.
(2021) *Journal of Ceramic Processing Research*, 22, pp. 289-295.
- Chee, H.A., Singh, R.S.K., Lee, K.S.
(2020) *Journal of Ceramic Processing Research*, 21, pp. 495-500.
- Cheong, A.C.H.
(2020) *International Journal of Advanced Science and Technology*, 29 (1), pp. 111-128.
- Ramesh, S., Khan, M.M., Chee, H.A., Wong, Y.H., Ganesan, P., Kutty, M.G., Niakan, A.
(2016) *Ceramics International*, 42, pp. 17620-17625.
- Ramesh, S., Chew, W.J.K., Chee, H.A., Tan, C.Y.
Sintering behaviour and properties of flyash-doped zirconia
(2017) *Materials Science Forum*, 894, pp. 85-88.
Trans Tech Publications Ltd
- Matcha, B.N., Sivanesan, S., Ng, K.C.
Modelling road traffic congestion at urban merge section under mixed traffic conditions
(2021) *Proceedings of the Institution of Civil Engineers-Transport*, pp. 1-17.
edited by Thomas Telford Ltd

- Sivakumar, S., Alexander, C.H.C., Teow, H.L., Ali, M.Y., Ramesh, S.
Two-Stage Sintering of Zirconia Toughened Alumina Composite (ZTA) Doped with Copper Oxide
(2023) *Proceeding of 5th International Conference on Advances in Manufacturing and Materials Engineering: ICAMME 2022*, pp. 661-667.
Springer Nature Singapore
- Sivakumar, S., Alexander, C.H.C., Teow, H.L., Ali, M.Y., Ramesh, S.
Effect of Zirconia Doping on the Sintering and Mechanical Properties of Hydroxyapatite Bioceramic
(2023) *Proceeding of 5th International Conference on Advances in Manufacturing and Materials Engineering: ICAMME 2022*, pp. 147-153.
Springer Nature Singapore
- Sekar, V., Noum, S.Y.E., Putra, A., Sivanesan, S., Chin, K.C., Wong, Y.S., Kassim, D.H.
(2021) *Sound Vib*, 55, p. 4.
- Teow, H.L., Sivanesan, S.K., Noum, S.Y.E.
Effect of Fe₂O₃ on the densification behaviour and mechanical properties of zirconia-toughened alumina (ZTA) composites prepared by two-stage sintering
(2020) *AIP Conference Proceedings*, 2233.
- Soosai, A., Sivanesan, S., Muniandy, S., Loong, T.H.
Influence of Zirconia Content to the Mechanical Behaviour of Alumina Zirconia Composite Prepared via Colloidal Meth
(2021) *International Conference and Exhibition on Sustainable Energy and Advanced Materials*, pp. 124-132.
edited by Springer Nature Singapore (Springer Nature Singapore, Singapore)
- Muniandy, S., Soosai, A., Loong, T.H., Sivanesan, S.K.
Effect of Sintering Temperature and Low Weight Percentage of Zirconia in Hydroxyapatite-Zirconia Composite on Mechanical Properties for Biomedical Application
(2021) *International Conference and Exhibition on Sustainable Energy and Advanced Materials*, pp. 133-140.
edited by Springer Nature Singapore (Springer Nature Singapore, Singapore)
- Faizabadi, A.R., Zaki, H.F.M., Abidin, Z.Z., Husman, M.A., Hashim, N.N.W.N.
(2023) *J. Integr. Adv. Eng.*, 3, pp. 37-46.
- Faizabadi, A.R., Zaki, H.F.B.M., Abidin, Z.B.Z., Hashim, N.N.W.N., Bin Husman, M.A.
(2022) *IEEE Access*, 10, pp. 76168-76184.
- Ghosh, T., Palash, M.I.A., Yousuf, M.A., Hamid, M.A., Monowar, M.M., Alassafi, M.O.
(2023) *Mathematics*, 11, p. 2633.

Correspondence Address

Alam M.S.; International Islamic University Malaysia, Jln Gombak, Malaysia; email: alam.s@live.iium.edu.my

Editors: Nataraj C., Sivanesan S.K., Yong L.C., Cheong A.C.H., Perumal S.K.S., Thiruchelvam V.

Publisher: American Institute of Physics

Conference name: 5th International Conference on Sustainable Innovation in Engineering and Technology 2023, SIET 2023

Conference date: 16 August 2023

Conference code: 202231

ISSN: 0094243X

Language of Original Document: English

Abbreviated Source Title: AIP Conf. Proc.

2-s2.0-85204013065

Document Type: Conference Paper

Publication Stage: Final

Source: Scopus

ELSEVIER

Copyright © 2024 Elsevier B.V. All rights reserved. Scopus® is a registered trademark of Elsevier B.V.

 **RELX Group™**