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Sandeep Kumar · Harish Sharma ·
K. Balachandran · Joong Hoon Kim ·
Jagdish Chand Bansal
Editors

Third Congress on Intelligent Systems

Proceedings of CIS 2022, Volume 2

Springer

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Preface

This book contains outstanding research papers as the proceedings of the 3rd Congress on Intelligent Systems (CIS 2022), held on September 05–06, 2022, at CHRIST (Deemed to be University), Bangalore, India, under the technical sponsorship of the Soft Computing Research Society, India. The conference is conceived as a platform for disseminating and exchanging ideas, concepts, and results of researchers from academia and industry to develop a comprehensive understanding of the challenges of the advancements of intelligence in computational viewpoints. This book will help in strengthening congenial networking between academia and industry. We have tried our best to enrich the quality of the CIS 2022 through the stringent and careful peer-review process. This book presents novel contributions to Intelligent Systems and serves as reference material for advanced research.

We have tried our best to enrich the quality of the CIS 2022 through a stringent and careful peer-review process. CIS 2022 received many technical contributed articles from distinguished participants from home and abroad. CIS 2022 received 729 research submissions from 45 different countries, viz., Algeria, Australia, Bangladesh, Belgium, Brazil, Bulgaria, Colombia, Cote d'Ivoire, Czechia, Egypt, Ethiopia, Fiji, Finland, Germany, Greece, India, Indonesia, Iran, Iraq, Ireland, Italy, Japan, Kenya, Latvia, Malaysia, Mexico, Morocco, Nigeria, Oman, Peru, Philippines, Poland, Romania, Russia, Saudi Arabia, Serbia, Slovakia, South Africa, Spain, Turkmenistan, Ukraine, United Kingdom, United States, Uzbekistan, and Vietnam. After a very stringent peer-reviewing process, only 120 high-quality papers were finally accepted for presentation and the final proceedings.

This book presents second volume of 60 research papers data science and applications and serves as reference material for advanced research.

Bengaluru, India — Sandeep Kumar
Kota, India — Harish Sharma
Bengaluru, India — K. Balachandran
Seoul, Korea (Republic of) — Joong Hoon Kim
New Delhi, India — Jagdish Chand Bansal

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Dr. Harish Sharma is an associate professor at Rajasthan Technical University, Kota, in the Computer Science and Engineering Department. He has worked at Vardhaman Mahaveer Open University, Kota, and Government Engineering College, Jhalawar. He received his B.Tech. and M.Tech. degrees in Computer Engineering from Government Engineering College, Kota, and Rajasthan Technical University, Kota, in 2003 and 2009, respectively. He obtained his Ph.D. from ABV—Indian Institute of Information Technology and Management Gwalior, India. He is a secretary and one of the founder members of the Soft Computing Research Society of India. He is a lifetime member of the Cryptology Research Society of India, ISI, Kolkata. He is an associate editor of *The International Journal of Swarm Intelligence (IJSI)* published by Inderscience. He has also edited special issues of the many reputed journals like *Memetic Computing Journal of Experimental and Theoretical Artificial Intelligence Evolutionary Intelligence* etc. His primary area of interest is nature-inspired optimization techniques. He has contributed to more than 105 papers published in various international journals and conferences.

Dr. K. Balachandran is currently a professor and head of CSE at CHRIST (Deemed to be University), Bengaluru, India. He has 38 years of experience in research, academia, and industry. He served as a senior scientific officer in the Research and Development Unit of the Department of Atomic Energy for 20 years. His research interest includes data mining, artificial neural networks, soft computing, and artificial intelligence. He has published more than 50 articles in well-known SCI-/SCOPUS-indexed international journals and conferences and attended several national and international conferences and workshops. He has authored/edited four books in the area of computer science.

Prof. Joong Hoon Kim a faculty of Korea University in the School of Civil, Environmental and Architectural Engineering, obtained his Ph.D. from the University of Texas at Austin in 1992 with the thesis "Optimal replacement/rehabilitation model for water distribution systems." His major areas of interest include optimal design and management of water distribution systems, application of optimization techniques to various engineering problems, and development and application of evolutionary algorithms. His publication includes *A New Heuristic Optimization Algorithm: Harmony Search* Simulation, February 2001, Vol. 76, pp 60–68, which has been cited over 6,700 times by other journals of diverse research areas. His keynote speeches include "Optimization Algorithms as Tools for Hydrological Science" in the Annual Meeting of Asia Oceania Geosciences Society held in Brisbane, Australia, in June of 2013, *Recent Advances in Harmony Search Algorithm* in the 4th Global Congress on Intelligent Systems (GCIS 2013) held in Hong Kong, China, in December of 2013, and "Improving the convergence of Harmony Search Algorithm and its variants" in the 4th International Conference on Soft Computing For Problem Solving (SOCPROS 2014) held in Silchar India, in December of 2014. He hosted the 1st, 2nd, and 6th Conference of International Conference on Harmony Search Algorithm (ICHSA) in 2013, 2014, and 2022. He also hosted the 12th International Conference on Hydroinformatics (HIC 2016). Also, he has been serving as an Honorary Chair of Congress on Intelligent Systems (CIS 2020, 2021, and 2022).

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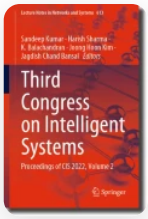

Third Congress on Intelligent Systems

(CIS 2022)

Archana Ingle, Mani Roja, Manoj Sankhe & Deepak Patkar

Part of the book series: Lecture Notes in Networks and Systems ((LNNS,volume 613))

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Congress on Intelligent Systems

Abstract

Brain and other nervous system cancer are the 10th major reason for morbidity. It is highly required to exactly locate the boundaries and tumor area before the treatment such as chemotherapy or brain surgery to resume a normal life. This paper discusses

different traditional segmentation techniques and various deep learning approaches incorporating convolutional neural networks (CNN). An automatic tumor segmentation and classification model are implemented for four different classes with U-shaped encoder–decoder architecture. Architecture performance is measured and compared with the best available models using various standard metrics like accuracy, sensitivity, specificity, Dice similarity coefficient (DSC), and mean intersection over union (MIoU) on different datasets with freely available resources. The implemented architecture outperforms various existing algorithms in comparison with accuracy and sensitivity metrics.

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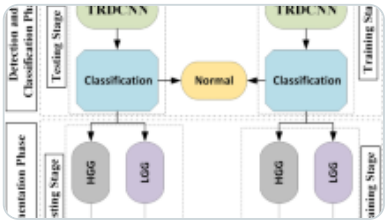

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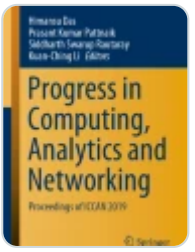

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References

1. https://indianexpress.com/article/lifestyle/health/world-brain-tumour-day-2020-symptoms-cause-treatment-6448213/. Last Accessed 31 July 2022

2. Hebli A, Gupta S (2016) Brain tumor detection using image processing: a survey. In: Proceedings of 65th IRF international conference, 20th November 2016, Pune, India. ISBN: 978-93-86291-38-7

Google Scholar

3. Swamy S, Kulkarni P (2015) Image processing for identifying brain tumor using intelligent system. Int J Innovative Res Sci Eng Technol 4(11). ISSN (Online): 2319-8753; ISSN (Print): 2347-6710

Google Scholar

4. Tahir M, Iqbal A, Khan A (2016) A review paper of various filters for noise removal in MRI brain image. Int J Innovative Res Comput Commun Eng 4(12). ISSN (Online): 2320-9801; ISSN (Print): 2320-9798

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5. Thakur N, Khan N, Sharma S (2021) A comparative analysis of edge-preserving approaches for image filtering. In: Intelligent learning for computer vision, CIS 2020, vol 61. Springer

Google Scholar

6. Aslama A, Khan E, Beg M (2015) Improved edge detection algorithm for brain tumor segmentation. Procedia Comput Sci 58:430–437. Elsevier Science Direct

Google Scholar

7. Ilhan U, Ilhan A (2017) Brain tumor segmentation based on a new threshold approach. Procedia Comput Sci 120:580–587

Article Google Scholar

8. Chaudhari A, Choudhari V, Kulkarni J (2017) Automatic brain MR image tumor detection using region growing 5(12). ISSN (p): 2347-6982

Google Scholar

9. Alam M et al (2019) Automatic human brain tumor detection in MRI Image using template-based K means and improved fuzzy C means clustering algorithm. Big Data Cogn Comput 3:27

Article Google Scholar

10. Yamashita R, Nishio M, Do R, Togashi K (2018) Convolutional neural networks: an overview and application in radiology 9(4):611–629. Springer

Google Scholar

11. Febrianto D, Soesanti I, Nugroho H (2020) Convolutional neural network for brain tumor detection. IOP Conf Ser: Mater Sci Eng 771:012031

Google Scholar

12. Akkus Z et al (2017) Deep learning for brain MRI segmentation: state of the art and future directions. J Digit Imaging 30:449–459. https://doi.org/10.1007/s10278-017-9983-4

Article Google Scholar

13. Havaei M et al (2016) Brain tumor segmentation with deep neural networks. https://doi.org/10.1016/j.media.2016.05.004. Elsevier. 1361-8415/© 2016

14. Pereira S, Oliveira A, Alves V, Silva C (2016) Brain tumor segmentation using convolutional neural networks in MRI images. IEEE Trans Med Imaging 35

Google Scholar

15. Lakshmi A (2017) Thesis: performance analysis of brain tumor segmentation and classification

Google Scholar

16. Dong H et al (2017) Automatic brain tumor detection and segmentation using U-Net based fully convolutional networks. In: Communications in computer and

information science medical image understanding and analysis, pp 506–517

Google Scholar

17. Hasan S, Linte C (2018) A modified U-Net convolutional network featuring a nearest-neighbor Re-sampling-based elastic-transformation for brain tissue characterization and segmentation. IEEE. 978-1-7281-0255-9/18/$31.00 © 2018

Google Scholar

18. Anaraki A, Ayati M, Kazemi F (2018) Magnetic resonance imaging-based brain tumor grades classification and grading via convolutional neural networks and genetic algorithms. https://doi.org/10.1016/j.bbe.2018.10.004. Published by Elsevier. ISSN: 0208-5216/© 2018

19. Sultan H, Alem N, Al-Atabany W (2019) Multi-classification of brain tumor images using deep neural network. IEEE Access 7

Google Scholar

20. Jijja A, Rai D (2019) Efficient MRI segmentation and detection of brain tumor using convolutional neural network. IJACSA 10(4)

Google Scholar

21. Shelke S, Mohod S (2019) Semi-automated brain tumor segmentation and detection from MRI. IRJET 06(01). e-ISSN: 2395-0056; p-ISSN: 2395-0072

Google Scholar

22. Afshar P, Plataniotis K, Mohammadi A (2019) Capsule networks for brain tumor classification based on MRI images and coarse tumor boundaries. In: ICASSP. IEEE, p 1368. 978-1-5386-4658-8/18/$31.00©2019

Google Scholar

23. Mehrotra R, Ansari M, Agrawal R, Anand R (2020) A transfer learning approach for AI-based classification of brain tumors. https://doi.org/10.1016/j.mlwa.2020.100003. Published by Elsevier Ltd. ISSN: 2666-8270/©

24. https://www.kaggle.com/datasets/awsaf49/brats2020-training-data. Last Accessed 05 Feb 2022

25. Ronneberger O, Fischer P, Brox T (2015) U-Net: convolutional networks for biomedical image segmentation. In: Navab N et al. (eds) MICCAI 2015, Part III, LNCS 9351. Springer International Publishing, Switzerland, pp 234–241. https://doi.org/10.1007/978-3-319-24574-4_28

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