Scopus

## Documents

Sharma, N.[a] , Gupta, S.[a] , Gupta, D.[a] , Gupta, P.[b c] , Juneja, S.[d] , Shah, A.[d] , Shaikh, A.[e]

**UMobileNetV2 model for semantic segmentation of gastrointestinal tract in MRI scans**
(2024) *PLoS ONE*, 19 (5 May), art. no. e0302880, .

**DOI:** 10.1371/journal.pone.0302880

[a] Chitkara University Institute of Engineering and Technology, Chitkara University, Punjab, India
[b] University College Dublin, Dublin, Ireland
[c] Manipal University Jaipur, Jaipur, India
[d] International Islamic University, Kuala Lumpur, Malaysia
[e] Najran University, Najran, Saudi Arabia

**Abstract**
Gastrointestinal (GI) cancer is leading general tumour in the Gastrointestinal tract, which is fourth significant reason of tumour death in men and women. The common cure for GI cancer is radiation treatment, which contains directing a high-energy X-ray beam onto the tumor while avoiding healthy organs. To provide high dosages of X-rays, a system needs for accurately segmenting the GI tract organs. The study presents a UMobileNetV2 model for semantic segmentation of small and large intestine and stomach in MRI images of the GI tract. The model uses MobileNetV2 as an encoder in the contraction path and UNet layers as a decoder in the expansion path. The UW-Madison database, which contains MRI scans from 85 patients and 38,496 images, is used for evaluation. This automated technology has the capability to enhance the pace of cancer therapy by aiding the radio oncologist in the process of segmenting the organs of the GI tract. The UMobileNetV2 model is compared to three transfer learning models: Xception, ResNet 101, and NASNet mobile, which are used as encoders in UNet architecture. The model is analyzed using three distinct optimizers, i.e., Adam, RMS, and SGD. The UMobileNetV2 model with the combination of Adam optimizer outperforms all other transfer learning models. It obtains a dice coefficient of 0.8984, an IoU of 0.8697, and a validation loss of 0.1310, proving its ability to reliably segment the stomach and intestines in MRI images of gastrointestinal cancer patients. 

**Index Keywords**
Adam optimizer, Article, cancer patient, cancer radiotherapy, classification algorithm, computer model, convolutional neural network, data base, deep learning, gastrointestinal cancer, gastrointestinal tract, human, image analysis, image artifact, image segmentation, learning algorithm, NASNet mobile model, nuclear magnetic resonance imaging, prediction, residual neural network, ResNet101 model, semantics, transfer of learning, UMobileNetV2 model, validation process, X ray analysis, Xception model, diagnostic imaging, female, gastrointestinal tumor, image processing, male, pathology, procedures, semantics, stomach; Female, Gastrointestinal Neoplasms, Gastrointestinal Tract, Humans, Image Processing, Computer-Assisted, Magnetic Resonance Imaging, Male, Semantics, Stomach

**References**

- Mittal, M., Goyal, L. M., Kaur, S., Kaur, I., Verma, A., Hemanth, D. J.
  **Deep learning based enhanced tumor segmentation approach for MR brain images**
  (2019) *Applied Soft Computing*, 78, pp. 346-354.

- Sharif, M. I., Li, J. P., Khan, M. A., Saleem, M. A.
  **Active Deep neural Network Features Selection for Segmentation and Recognition of Brain Tumors using MRI Images**
  (2019) *Pattern Recognition Letters*,

- Khan, M. A., Sharif, M., Akram, T., Bukhari, S. A. C., Nayak, R. S.
  **Developed Newton-Raphson Based Deep Features Selection Framework for Skin Lesion Recognition**
  (2019) *Pattern Recognition Letters*,

- Hemanth, D. J., Anitha, J., Mittal, M.
  **Diabetic retinopathy diagnosis from retinal images using modified Hopfield neural network**

(2018) *Journal of medical systems*, 42, p. 247.
PMID: 30382410

- Khan, M. A., Rubab, S., Kashif, A., Sharif, M. I., Muhammad, N., Shah, J. H.
**Lungs Cancer Classification from CT Images: An Integrated Design of Contrast based Classical Features Fusion and Selection**
(2019) *Pattern Recognition Letters*,

- Khan, M. A., Sharif, M., Akram, T., Yasmin, M., Nayak, R. S.
**Stomach Deformities Recognition Using RankBased Deep Features Selection**
(2019) *Journal of medical systems*, 43, p. 329.
PMID: 31676931

- Khan, M. A., Khan, M. A., Ahmed, F.
**Gastrointestinal diseases segmentation and classification based on duo-deep architectures**
(2020) *Pattern Recognition Letters*, 131, pp. 193-204.

- El Nawar, R., Yeung, J., Labreuche, J., Chadenat, M. L., Duong, D. L., De Malherbe, M.
**MRI-based predictors of hemorrhagic transformation in patients with stroke treated by intravenous thrombolysis**
(2019) *Frontiers in neurology*, 10, p. 897.
PMID: 31507511

- Alnazer, I., Falou, O., Urruty, T., Bourdon, P., Guillevin, C., Naudin, M.
**Usefulness of Functional MRI Textures in the Evaluation of Renal Function**
(2021) *2021 Sixth International Conference on Advances in Biomedical Engineering (ICABME)*, pp. 34-38.
(October) –). IEEE

- Salame, H., Issa, M., Nicolas, G., Haddad, J., Hadad, M. M., Farhat, F. S.
**A rare case of a ruptured metastatic hepatic lesion from a jejunal gastrointestinal stromal tumor (GIST) treated by arterial embolization**
(2018) *The American Journal of Case Reports*, 19, p. 1480.
PMID: 30542049

- Berzin, T. M., Parasa, S., Wallace, M. B., Gross, S. A., Repici, A., Sharma, P.
**Position statement on priorities for artificial intelligence in GI endoscopy: a report by the ASGE Task Force**
(2020) *Gastrointestinal Endoscopy*, 92 (4), pp. 951-959.
PMID: 32565188

- van Ginneken, B., Schaefer-Prokop, C. M., Prokop, M.
**Computer-aided diagnosis: how to move from the laboratory to the clinic**
(2011) *Radiology*, 261 (3), pp. 719-732.
PMID: 22095995

- Agushaka, J. O., Ezugwu, A. E., Abualigah, L.
**Dwarf mongoose optimization algorithm**
(2022) *Computer methods in applied mechanics and engineering*, 391, p. 114570.

- Abualigah, L., Yousri, D., Abd Elaziz, M., Ewees, A. A., Al-Qaness, M. A., Gandomi, A. H.
**Aquila optimizer: a novel meta-heuristic optimization algorithm**
(2021) *Computers & Industrial Engineering*, 157, p. 107250.

- Cogan, T., Cogan, M., Tamil, L.
**MAPGI: accurate identification of anatomical landmarks and diseased tissue in the gastrointestinal tract using deep learning**
(2019) *Computers in biology and medicine*, 111, p. 103351.

- Sharif, M., Attique Khan, M., Rashid, M., Yasmin, M., Afza, F., Tanik, U. J.
  **Deep CNN and geometric features-based gastrointestinal tract diseases detection and classification from wireless capsule endoscopy images**
  (2021) *Journal of Experimental & Theoretical Artificial Intelligence*, 33 (4), pp. 577-599.

- Gamage, C., Wijesinghe, I., Chitraranjan, C., Perera, I.
  **GI-Net: anomalies classification in the gastrointestinal tract through endoscopic imagery with deep learning**
  (2019) *2019 Moratuwa Engineering Research Conference (Mercon)*, pp. 66-71.
  (July) –).IEEE

- Diamantis, D. E., Zacharia, A. E., Iakovidis, D. K., Koulaouzidis, A.
  **Towards the substitution of real with artificially generated endoscopic images for CNN training**
  (2019) *2019 IEEE 19th International Conference on Bioinformatics and Bioengineering (BIBE)*, pp. 519-524.
  (October) –). IEEE

- Öztürk, Ş., Özkaya, U.
  **Gastrointestinal tract classification using improved LSTM-based CNN**
  (2020) *Multimedia Tools and Applications*, 79 (39), pp. 28825-28840.

- Lafraxo, S., El Ansari, M.
  **GastroNet: Abnormalities Recognition in Gastrointestinal Tract through Endoscopic Imagery using Deep Learning Techniques**
  (2020) *2020 8th International Conference on Wireless Networks and Mobile Communications (WINCOM)*, pp. 1-5.
  (October) –).IEEE

- Hmoud Al-Adhaileh, M., Mohammed Senan, E., Alsaade, W., Aldhyani, T. H., Alsharif, N., Abdullah Alqarni, A., Jadhav, M. E.
  **Deep learning algorithms for the detection and classification of gastrointestinal diseases**
  (2021) *Complexity*, p. 2021.

- Yogapriya, J., Chandran, V., Sumithra, M. G., Anitha, P., Jenopaul, P., Suresh GnanaDhas, C.
  **Gastrointestinal tract disease classification from wireless endoscopy images using a pre-trained deep learning model**
  (2021) *Computational and mathematical methods in medicine*, p. 2021.

- Öztürk, Ş., Özkaya, U
  **Residual LSTM layered CNN for classification of gastrointestinal tract diseases**
  (2021) *Journal of Biomedical Informatics*, 113, p. 103638.
  PMID: 33271341

- Montalbo, F. J. P.
  **Diagnosing gastrointestinal diseases from endoscopy images through a multifused CNN with auxiliary layers, alpha dropouts, and a fusion residual block**
  (2022) *Biomedical Signal Processing and Control*, 76, p. 103683.

- Kukreja, V.
  **Hybrid fuzzy AHP–TOPSIS approach to prioritizing solutions for inverse reinforcement learning**
  (2022) *Complex Intell. Syst*,

- Wang, S., Cong, Y., Zhu, H., Chen, X., Qu, L., Fan, H.
  **Multi-scale context-guided deep network for automated lesion segmentation with endoscopy images of the gastrointestinal tract**
  (2020) *IEEE Journal of Biomedical and Health Informatics*, 25 (2), pp. 514-525.

- Khan, M. A., Khan, M. A., Ahmed, F., Mittal, M., Goyal, L. M., Hemanth, D. J.
  **Gastrointestinal disease segmentation and classification based on duo-deep architectures**
  (2020) *Pattern Recognition Letters*, 131, pp. 193-204.

- Galdran, A., Carneiro, G., Ballester, M. A. G.
  **Double encoder-decoder networks for gastrointestinal polyp segmentation**
  (2021) *International Conference on Pattern Recognition*, pp. 293-307.
  (January) –). Springer, Cham

- Kukreja, V.
  **Sakshi Machine learning models for mathematical symbol recognition: A stem to stern literature analysis**
  (2022) *Multimed Tools Appl*, 81, pp. 28651-28687.

- Ronneberger, O., Fischer, P., Brox, T.
  **U-net: Convolutional networks for biomedical image segmentation**
  (2015) *International Conference on Medical image computing and computer-assisted intervention*, pp. 234-241.
  (October) –).Springer, Cham

-

-

- Oktay, O., Schlemper, J., Le Folgoc, L., Lee, M., Heinrich, M., Misawa, K.
  **Attention U-Net: Learning Where to Look for the Pancreas**
  (2018) *1st Conf. Med. Imaging with Deep Learn. (MIDL 2018)*,
  Amsterdam

- Sandler, M., Howard, A., Zhu, M., Zhmoginov, A., Chen, L. C.
  **Mobilenetv2: Inverted residuals and linear bottlenecks**
  (2018) *Proceedings of the IEEE conference on computer vision and pattern recognition*, pp. 4510-4520.

- Glorot, X., Bengio, Y.
  **Understanding the difficulty of training deep feedforward neural networks**
  (2010) *Proceedings of the thirteenth international conference on artificial intelligence and statistics*, pp. 249-256.
  (March) –). JMLR Workshop and Conference Proceedings

- Joseph, F. J. J., Nonsiri, S., Monsakul, A.
  **Keras and TensorFlow: A hands-on experience**
  (2021) *Advanced deep learning for engineers and scientists: A practical approach*, pp. 85-111.

- Chollet, F.
  **Xception: Deep learning with depthwise separable convolutions**
  (2017) *Proceedings of the IEEE conference on computer vision and pattern recognition*, pp. 1251-1258.

- Ghosal, P., Nandanwar, L., Kanchan, S., Bhadra, A., Chakraborty, J., Nandi, D.
  **Brain tumor classification using ResNet-101 based squeeze and excitation deep neural network**
  (2019) *2019 Second International Conference on Advanced Computational and Communication Paradigms (ICACCP)*, pp. 1-6.
  (February) –). IEEE

- Saxen, F., Werner, P., Handrich, S., Othman, E., Dinges, L., Al-Hamadi, A.
  **Face attribute detection with mobilenetv2 and nasnet-mobile**
  (2019) *2019 11th International Symposium on Image and Signal Processing and Analysis*

*(ISPA)*, pp. 176-180.
(September) –). IEEE

- **DP Kingma, JL Ba, Adam: A method for stochastic optimization**
(2015) *3rd Int. Conf. Learn. Represent. ICLR 2015—Conf. Track Proc*, pp. 1-15.

- Zhang, Z.
**Improved adam optimizer for deep neural networks**
(2018) *2018 IEEE/ACM 26th International Symposium on Quality of Service (IWQoS)*, pp. 1-2.
(June) –).IEEE

- Keskar, N. S., Socher, R.
(2017) *Improving generalization performance by switching from adam to sgd*,
arXiv preprint arXiv:1712.07628

- Ye, R., Wang, R., Guo, Y., Chen, L.
**SIA-Unet: A Unet with Sequence Information for Gastrointestinal Tract Segmentation**
(2022) *Pacific Rim International Conference on Artificial Intelligence*, pp. 316-326.
Springer: Cham

- Nemani, P., Vollala, S.
(2022) *Medical Image Segmentation Using LeViT-UNet++: A Case Study on GI Tract Data*,
arXiv [cs.NE]

- Chou, A., Li, W., Roman, E.
**GI Tract Image Segmentation with U-Net and Mask R-CNN**
*Image Segmentation with U-Net and Mask R-CNN*,

- Niu, H., Lin, Y.
**SER-UNet: A Network for Gastrointestinal Image Segmentation**
(2022) *Proceedings of the Proceedings of the 2022 2nd International Conference on Control and Intelligent Robotics*,
ACM: New York, NY, USA

- Georgescu, M. I., Ionescu, R. T., Miron, A. I.
(2022) *Diversity-Promoting Ensemble for Medical Image Segmentation*,
arXiv preprint arXiv:2210.12388

- Sharma, N, Gupta, S, Koundal, D, Alyami, S, Alshahrani, H, Asiri, Y
**U-Net Model with Transfer Learning Model as a Backbone for Segmentation of Gastrointestinal Tract**
(2023) *Bioengineering (Basel)*, 10 (1), p. 119.
Jan 14; PMID: 36671690

- Sharma, N., Gupta, S., Rajab, A., Elmagzoub, M. A., Rajab, K., Shaikh, A.
**Semantic Segmentation of Gastrointestinal Tract in MRI Scans Using PSPNet Model With ResNet34 Feature Encoding Network**
(2023) *IEEE Access*, 11, pp. 132532-132543.

- Sharma, N, Gupta, S, Reshan, MSA, Sulaiman, A, Alshahrani, H, Shaikh, A.
**EfficientNetB0 cum FPN Based Semantic Segmentation of Gastrointestinal Tract Organs in MRI Scans**
(2023) *Diagnostics (Basel)*, 13 (14), p. 2399.
Jul 18; PMID: 37510142

**Correspondence Address**
Gupta P.; University College DublinIreland; email: punit.gupta@ucd.ie

**Publisher:** Public Library of Science

**ISSN:** 19326203
**CODEN:** POLNC
**PubMed ID:** 38718092
**Language of Original Document:** English
**Abbreviated Source Title:** PLoS ONE
2-s2.0-85192598451
**Document Type:** Article
**Publication Stage:** Final
**Source:** Scopus