A Brief Review on Different Image Segmentation Technique

Saroj Kumari [1] , Priyanka Kumari[2] , Dr. Piyush Ranjan [3], Dr. Priyanka Srivastava [4]

[1]Jharkhand Rai University, Raja Ulatu, Namkum,
Ranchi, 834010, India
[2.] Sarla Birla University, Mahilong, Ranchi, 835222
Corresponding Email Id: jusasep@gmail.com

ABSTRACT

Image segmentation has come out as an essential tool for image processing. An image possesses various properties like the arrangement of an object, light, shadow, depth, and various other factors. Image segmentation encompasses the splitting of an image into multiple homogenous segments with comparable properties. Hence, these multiple segments provide effective pattern recognition during image processing. To date, different image segmentation techniques have been developed. Each technique applies different algorithms specific to the image. The effectiveness of the techniques depends highly on the properties of an image. This article provides a comparative overview of six different image segmentation techniques and summarizes the advantages and disadvantages of each technique.

Key Words: Image Segmentation, edge-based segmentation, thresholds segmentation, Artificial Neural Network segmentation, fuzzy setsegmentation, partial differential equation.

Introduction

The segmentation or segmentation of images is the significant and testing segment in the space of image handling. In practical application, all aspects of an image are not taken into consideration. However, in numerous space segmentations, they are assumed to be an essential part of the handlingof images [52]. This interaction is the reason for thecomprehension and examination of image acknowledgments [1].
The fundamental motivation driving the segmentation of imagesis to distribute images into various locales.

Each portion addresses specific sorts of data aspixels, shading, and surface to name a few that isolate the edges of any image as its regions consequently. The strategy for segmentation separates every pixel of an image from its different areas [2] [3].

There are distinctive sorts of images, for example,range images (profundity image), atomic attractive reverberation images, light powerimage, warm image and so forth Light power is exceptionally normal to these in our day-by- day information [4] [33]. These are the fundamental utilization of image Separation ordivision: Object discovery andacknowledgment, video observation or examination, Automatic traffic signal, and content-based image recovery [5].

Different techniques of image Segmentation There are various kinds of image segmentationtechniques. The absolute generally significantand normally utilized procedures are as per thefollowing which are shown in Fig. 1 [37] [38].
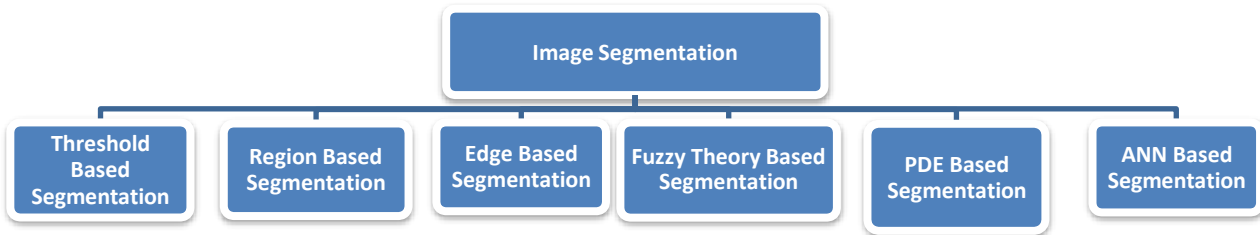
Fig.1**:** Different Image Segmentation Techniques

Threshold-Based Segmentation: Limit segmentation is the most widely recognized and least difficult type of image segmentation procedure. It straightforwardly separates the image dark scale data handling dependent on the dim worth of various targets[47]. There are twokinds of limit segmentation: Local edge strategy and Global edge technique [6].

The neighborhood edge chooses numerous segmentation edges and has the various targets and foundation by different edges when it partitions while the worldwide limits partition the image into two distinct districts oftarget and foundation by a solitary edge[26][27].

Counting this, there are many similar unique edge techniques such as the least mistake strategy, likelihood unwinding technique,second saving strategy [48], entropy-based edgetechnique, straightforward factual 'strategies, fuzzy set technique, etc

The advantage of this technique is that estimation is less complex and quicker for example straightforward calculations canlikewise be created to register these.

The inconvenience of this procedure is that it is difficult to set up cautious results for Image segmentation issues.

Region-Based Segmentation: In this method, we segment similar images into different regions having similar features. It directly determines the region [7]. There are basically two types of region-based segmentation:

Region Growing Method: It is a technique thatbundles pixels or sub-divisions into a bigger area which relies upon specific rules. It compares the existing region with neighboringpixels having similar characteristics like grey scale, color, shape, texture, etc [8].
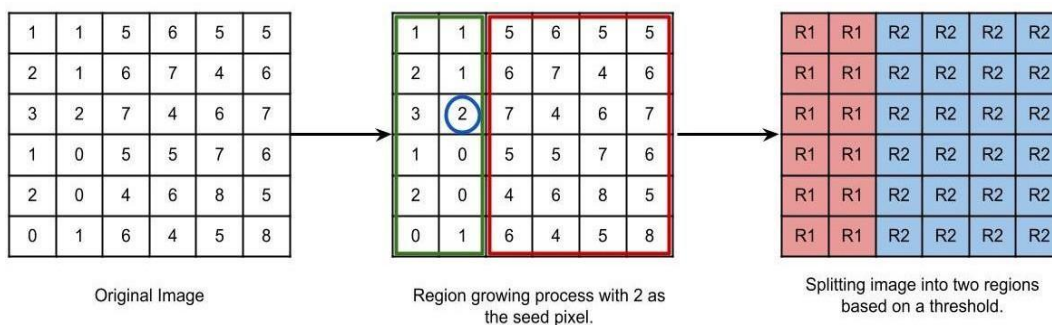

Fig.2: Region growing workflow

Region Splitting and Merging: In this framework, the whole image is taken as a solitary district and further withdrawn into thesets of free locales. The locale consolidating process is in district parting [24]. This Consolidating process is utilized after each split and thinkingabout adjoining areas and then, at that point, combine them which have comparativeelements (like dim scale, difference, etc).
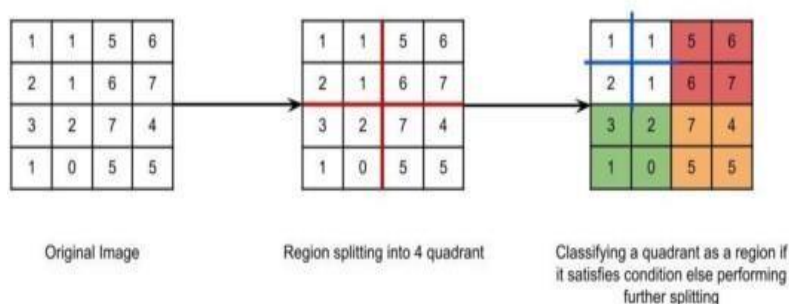

Fig.3: Region splitting and merging workflow

Edge Based Segmentation: It is notable strategy for images handling all alone. This technique is focused on the fast difference in power worth of the image (single worth doesn't give great data about edges) [34] . Aboveall, they decrease the clamor of the image andthen, at that point, play out the segmentation [9]. It is the foremost improvement for the image segmentation process. It confined the image to the majority of things and their experiences [31][32]. It partitions the image by seeing the pixels or grouping of the image. There are two sorts of edge-based division: Gray Histogram and Gradient Histogram [10] [11].

Fuzzy Theory-Based Segmentation: It is utilized to examine an image and give exact information from any image. Dim scale image can undoubtedly change over into fuzzy imageby utilizing a fuzzification work (for eliminatingcommotion) [35]. The disparate morphological activity (Fuzzy K-implies and Fuzzy C-implies utilized in image handling) can be joined with fuzzy techniques to procure better outcomes.

Partial Differential Equation (PDE) Based Image Segmentation: It is a non-straight, cease, and quick method of segmentation [12].It models the level arrangement of strategy forthe gray image. It utilizes a dynamic shape or snake change model for the segmentation of the image. These are some of the notable strategies for PDA: Snake model, Level Set, andMumford Shah technique [13].
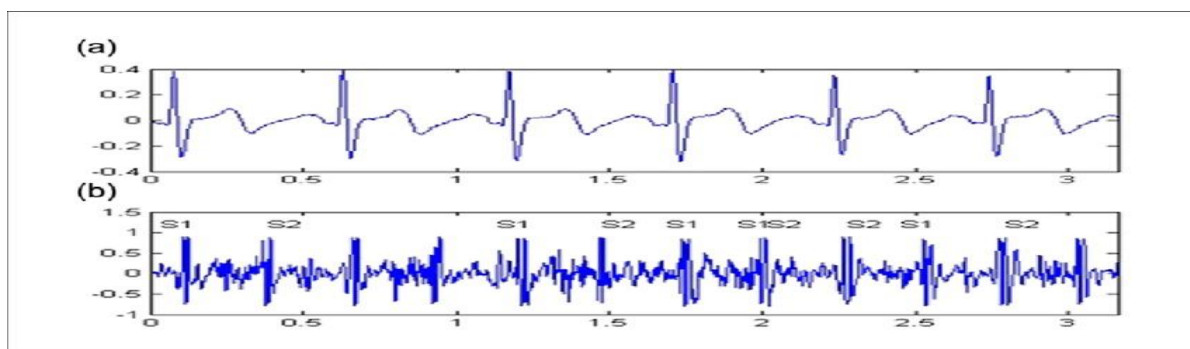

Fig. 4: Normal heart sound after filtering and normalization human brain for decision-making purposes and Artificial Neural Network-Based Segmentation**:** This method of segmentation works to stimulate the approaches of the is frequently used for the segmentation ofmedical images nowadays [14][15].
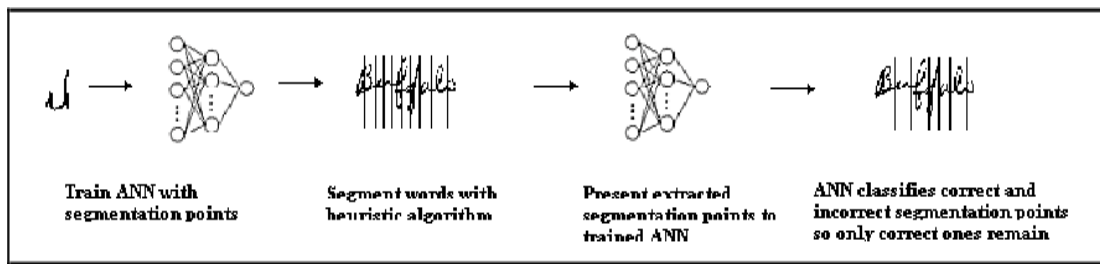
Fig. 5: Testing of offline handwriting Recognition using ANN Segmentation image. Coordinated ANN joins the data pixel Specifically, image is gotten and pre-managing is performed, later it, unite extraction is performed, while, ANN classifier [16] is used for surface methodology, Clustering is performed to limits establishment from sub- into two packs which give results. It passes on a superficial level strategy and division of image. Neural organization engineering [19] is for the most part utilized daily in 3D clinical image segmentation [52].

Literature Review: All fundamental image segmentation methods as of now being utilized by the scientists will be talked about in this part as given below:

Paper References	Year	Methodology Opted
[17]	2007	1 Proposed edge-based algorithm which calculate the edge of every pixel.
[18]	2010	2 Proposed threshold and fast marching method for medical images.
[20]	2010	3 Proposed optimal threshold and genetics to enhance image acquisition.
[21]	2012	4 Proposed multilevel threshold using wavelet mutation.
[22]	2007	5 Proposed unsupervised based gray features.
[23]	2008	6 Proposed region based on a clustering algorithm.
[25]	2010	7 Proposed new method using region growing method.
[28]	1991	8 In light of region and edge detection strategy. It is a hybrid method.
[29]	2008	9 Proposed new method comprises region and edge-based algorithm.
[30]	2012	10 Proposed on K-mean image method and edge detection method.
[36]	2009	11 Proposed new morphological fuzzy algorithm based on fusion segmentation.
[39]	2012	12 Proposed fuzzy object model to segment the MRI image.
[40]	2012	13 Proposed a new fuzzy method to segment the image.
[41]	2004	14 Proposed a new method for medical images which also contain fuzzy techniques.
[42]	2008	15 Proposed non-linear cease PDE for the gray image.
[44]	2011	16 Proposed new method for color image.

[43]	2010	16. Proposed a new model for de-noising the image.
[45]	2007	17. Proposed fast-learning ANN color image separation method.
[46]	2010	18. Proposed new algorithm based on neural network and texture taxonomy.
[49]	2010	19. Proposed new method for color image and based on neural network.
[50]	2011	20. Proposed image texture classification method based on ANN.
[53]	2018	21. Proposed two graph-based methods (graph cuts and graph search)for medical images.
[54]	2015	22. Proposed comparative study of threshold and fuzzy-basedalgorithm.
[55]	2019	23. Proposed hybrid method for medical image segmentation.

Comparison of different image segmentation techniques

Table 1 describes the comparison between different segmentation techniques, its advantages and its disadvantages [51] [52].

Table 1: Comparison of Various Segmentation Techniques

Segmentation Technique	Method Description	Advantages	Disadvantages
Threshold Technique	Requires that the histogram of an image has different apexes, each contrasting with an area.	It doesn't require earlier data of the image. Also, it has less computational intricacy.	Doesn't function admirably for an image with no conspicuous pinnacles or with wide and level valleys.
Region-Based Technique	Bunch Pixels into homogeneous districts. Counting region creating, region separating, region merging or their blend.	Work best when the area homogeneity measure is not difficult to depict. Theyare more commotion- protected than the edge divulgence approach.	Are usually progressive and expensive both in computational time and memory.
Edge Detection Technique	In view of the discovery of brokenness, regular attempts to find focus on many sudden changes in gray level.	Edge recognition method is the way human sees articles and capacities outstandingly for images having extraordinary separation between locales.	Doesn't function admirably with imagesin which the edges arebadly characterized orthere are such a large number of edges.
Fuzzy Technique	Apply fuzzy operators, properties, mathematics and also, derivation rules, give a method for dealing with the vulnerability intrinsicin an assortment of issues because of	Fuzzy enrollment capacity can be used to address thelevel of specific properties or phonetic articulation, and fuzzy If-Than rules can be used to perform harsh derivation.	1) The assurance of fuzzy participation is definitely not an inconsequential work. 2) The calculation associated with fuzzy methodologies could be concentrated.

	uncertainty rather than irregularity.		
Partial Differential Equation	PDE utilizes a dynamic shape model for division reasons.	quickest strategy, best for time basic applications.	more computational complexity
Artificial Neural Network Technique	Utilizing neural organizations to perform arrangement.	No compelling reason to compose a confounded program. Can completely use the equal idea of neural network.	Training time is long.

Conclusion

Here, in this article, we have discussed the six unique sorts of image segmentation methods for image processing. After analyzing and evaluating the six diverse image segmentationmethods, it seems futile to restrict the ideal segmentation result to a single segmentation strategy. As image segmentation is dependenton numerous viewpoints such as surface, force, shading, pixel, picture content, and so forth, it is smarter to utilize half-breed (blend of at least two) image segmentation methods for the better consequence of tackling image segmentation issues. This very well explains the complexity of the Image segmentation process as it requires a balanced blend of numerous applications.

References

1 *Haralick, R. M., & Shapiro, L. G. (1985). Image segmentation techniques. Computer vision, graphics, and image processing, 29(1), 100-132..*

2 *Sharif, M., Mohsin, S., Jamal, M. J., & Raza, M. (2010). Illumination normalization preprocessing for face recognition. In 2010 the 2nd conference on environmental science and information application technology (Vol. 2, pp. 44-47). IEEE.*

3 *Yasmin, M., Sharif, M., Masood, S., Raza, M., & Mohsin, S. (2012). Brain image enhancement-A survey. World Applied Sciences Journal, 17(9), 1192-1204.*

4 *Knuttgen, H. G., Achten, E., Buisseret, T., Casteleyn, P. P., Luypaert, R., de Meirleir, D., ... & Verhaeve, E. (2012). Magnetic Resonance Imaging and Spectroscopy in sports medicine. Springer Science & Business Media.*

5 *S Angelina, S., Suresh, L. P., & Veni, S. K. (2012). Image segmentation based on genetic algorithm for region growth and region merging. In 2012 international conference on computing, electronics and electrical technologies (ICCEET) (pp.970-974). IEEE.*

6 *Davis, L. S., Rosenfeld, A., & Weszka, J. S. (1975). Region extraction by averaging and thresholding. IEEE transactions on systems, man, and cybernetics, (3), 383-388.*

7 *Khokher, M. R., Ghafoor, A., & Siddiqui, A. M. (2013). Image segmentation using multilevel graph cuts and graph development using fuzzy rule-based system. IET image processing, 7(3), 201-211.*

8 *Kang, W. X., Yang, Q. Q., & Liang, R. P. (2009). Comparative research on image segmentation algorithms. In 2009 First international workshop on education technology and computer science (Vol. 2, pp. 703-707). IEEE.*

9 *Yasmin, M., Mohsin, S., Irum, I., & Sharif, M. (2013). Content based image retrieval by shape, color and relevance feedback. Life Science Journal, 10(4s), 593-598..*

10 *Lakshmi, S., & Sankaranarayanan, D. V. (2010). A study of edge detection techniques for segmentation computing*

approaches. IJCA Special Issue on "Computer Aided Soft Computing Techniques for Imaging and Biomedical Applications" CASCT, 35-40.

11 *Al-Amri, S. S., Kalyankar, N. V., & Khamitkar, S. D. (2010). Image segmentation by using edge detection. International journal on computer science and engineering, 2(3), 804-807.*

12 *Xiao, J., Yi, B., Xu, L., & Xie, H. (2008). An image segmentation algorithm based on level set using discontinue PDE. In 2008 First International Conference on Intelligent Networks and Intelligent Systems (pp. 503-506). IEEE..*

13 *Jiang, X., Zhang, R., & Nie, S. (2009). Image segmentation based on PDEs model: A survey. In 2009 3rd International Conference on Bioinformatics and Biomedical Engineering (pp. 1-4). IEEE.*

14 *Senthilkumaran, N., & Rajesh, R. (2009). Image segmentation-a survey of soft computing approaches. In 2009 International Conference on Advances in Recent Technologies in Communication and Computing (pp. 844-846). IEEE.*

15 *CEDAR CD-ROM 1, Center of Excellence for Document Analysis and Recognition, StateUniversity of New York, Buffalo,* http://www.cedar.buffalo.edu/Databases/CD ROM1/ .

16 *Irum, I., Raza, M., & Sharif, M. (2012). Morphological techniques for medical images: A review. Research Journal of Applied Sciences, Engineering and Technology, 4(17), 2948-2962.*

17 *Zhu, S., Xia, X., Zhang, Q., & Belloulata, K. (2007). An image segmentation algorithm in image processing based on threshold segmentation. In 2007 third international IEEE conference on signal-image technologies and internet-based system (pp. 673-678). IEEE.*

18 *Xu, A., Wang, L., Feng, S., & Qu, Y. (2010). Threshold-based level set method of image segmentation. In Intelligent Networks and Intelligent Systems, International Workshop on (pp. 703-706). IEEE Computer Society.*

19 *M. Yasmin, M. Sharif, S. Masood, M. Raza, and S. Mohsin, (2012)."Brain image enhancement-A survey, " World Applied Sciences Journal, vol. 17, pp. 1192-1204.*

20 *Kaihua, W., & Tao, B. (2011). Optimal threshold image segmentation method based on genetic algorithm in wheel set online measurement. In 2011 Third International Conference on Measuring Technology and Mechatronics Automation (Vol. 2, pp. 799-802). IEEE.*

21 *Jiang, F., Frater, M. R., & Pickering, M. (2012). Threshold-based image segmentation through an improved particle swarm optimisation. In 2012 International Conference on Digital Image Computing Techniques and Applications (DICTA) (pp. 1-5). IEEE.*

22 *Karoui, I., Fablet, R., Boucher, J. M., & Augustin, J. M. (2007). Unsupervised region-based image segmentation using texture statistics and level-set methods. In 2007 IEEE International Symposium on Intelligent Signal Processing (pp. 1-5). IEEE.*

23 *Zhou, Y. M., Jiang, S. Y., & Yin, M. L. (2008). A region-based image segmentation method with mean-shift clustering algorithm. In 2008 Fifth International Conference on Fuzzy Systems and Knowledge Discovery (Vol. 2, pp. 366-370). IEEE.*

24 *Chen, G., Hu, T., Guo, X., & Meng, X. (2009). A fast region-based image segmentation based on least square method. In 2009 IEEE International Conference on Systems, Man and Cybernetics (pp. 972-977). IEEE.*

25 *Hua, Z., Li, Y., & Li, J. (2010). Image segmentation algorithm based on improved visual attention model and region growing. In 2010 6th International Conference on Wireless Communications Networking and Mobile Computing (WiCOM) (pp. 1-4). IEEE..*

26 Sharif, M., Mohsin, S., Jamal, M. J., Javed, M. Y., & Raza, M. (2011). Face recognition for disguised variations using gabor feature extraction. Australian Journal of Basic and Applied Sciences, 5(6), 1648-1656.

27 Sharif, M., Mohsin, S., Javed, M. Y., & Ali, M. A. (2012). Single Image Face Recognition Using Laplacian of Gaussian and Discrete Cosine Transforms. Int. Arab J. Inf. Technol., 9(6), 562-570.

28 Yu, X., & Yla-Jaaski, J. (1991). A new algorithm for image segmentation based on regio n growing and edge detection. In 1991 IEEE International Symposium on Circuits and Systems (ISCAS) (pp. 516-519). IEEE.

29 Monteir o, F. C., & Campilho, A. (2008). Watershed framework to region-based image segmentation. In 2008 19th International Conference on Pattern Recognition (pp. 1-4). IEEE.

30 Hameed, M., Sharif, M., Raza, M., Haider, S. W., & Iqbal, M. (2012). Framework for the comparison of classifiers for medical image segmentation with transform and moment based features. Research Journal of Recent Sciences, 2277, 2502.

31 Patil, R. V., & Jondhale, K. C. (2010). Edge based technique to estimate number of clusters in k-means color image segmentation. In 2010 3rd International Conference on Computer Science and Information Technology (Vol. 2, pp. 117-121). IEEE.

32 Islam, M. J., Basalamah, S., Ahmadi, M., & Sid-Ahmed, M. A. (2011). Capsule image segmentation in pharmaceutical applications using edge-based techniques. In 2011 IEEE International Conference on Electro/Information Technology (pp. 1-5). IEEE.

33 Sharif, M., Ali, M. A., Raza, M., & Mohsin, S. (2015). Face recognition using edge information and DCT. Sindh University Research Journal-SURJ (Science Series), 43(2).

34 Haider, W., Malik, M. S., Raza, M., Wahab, A., Khan, I. A., Zia, U., ... & Bashir, H. (2012). A hybrid method for edge continuity based on Pixel Neighbors Pattern Analysis (PNPA) for remote sensing satellite images. Int'l J. of Communications, Network and System Sciences, 5(29), 624-630.

35 Pednekar, A. S., & Kakadiaris, I. A. (2006). Image segmentation based on fuzzy connectedness using dynamic weights. IEEE Transactions on Image Processing, 15(6), 1555-1562.

36 Yucheng, L., & Yubin, L. (2009), May). An algorithm of image segmentation based on fuzzy mathematical morphology. In 2009 International Forum on Information Technology and Applications (Vol. 2, pp. 517-520). IEEE.

37 Haider, W., Sharif, M., & Raza, M. (2011). Achieving accuracy in early stage tumor identification systems based on image segmentation and 3D structure analysis. Computer Engineering and Intelligent Systems, 2(6), 96-102.

38 Shahzad, A., Sharif, M., Raza, M., & Hussain, K. (2008). Enhanced watershed image processing segmentation. Journal of Information & Communication Technology, 2(1), 01-09.

39 Kobashi, S., & Udupa, J. K. (2012). Fuzzy object model based fuzzy connectedness image segmentation of newborn brain MR images. In 2012 IEEE International Conference on Systems, Man, and Cybernetics (SMC) (pp. 1422-1427). IEEE.

40 Samet, R., Amrahov, Ş. E., & Ziroğlu, A. H. (2012). Fuzzy rule-based image segmentation technique for rock thin section images. In 2012 3rd International Conference on Image Processing Theory, Tools and Applications (IPTA) (pp. 402-406). IEEE.

41 Bueno, S. G., Martinez-Albala, A., & Cosfas, P. (2004). Fuzziness and PDE based models for the segmentation of medical image. In IEEE Symposium Conference Record Nuclear Science 2004. (Vol. 6, pp. 3777-3780). IEEE.

42 *Xiao, J., Yi, B., Xu, L., & Xie, H. (2008). An image segmentation algorithm based on level set using discontinue PDE. In 2008 First International Conference on Intelligent Networks and Intelligent Systems (pp. 503-506). IEEE*

43 *Zhang, F., Guo, S., & Qian, X. (2010). Segmentation for finger vein image based on PDEs denoising. In 2010 3rd International Conference on Biomedical Engineering and Informatics (Vol. 2, pp. 531-535). IEEE.*

44 *Yuan, C., & Liang, S. (2011). Segmentation of color image based on partial differential equations. In 2011 Fourth International Symposium on Computational Intelligence and Design (Vol. 2, pp. 238-240). IEEE.*

45 *Zhang, X., & Tay, A. L. (2007). Fast learning artificial neural network (FLANN) based color image segmentation in RGBSV cluster space. In 2007 International Joint Conference on Neural Networks (pp. 563-568). IEEE.*

46 *Zhao, W., Zhang, J., Li, P., & Li, Y. (2010). Study of image segmentation algorithm based on textural Features and neural network. In 2010 International Conference on Intelligent Computing and Cognitive Informatics (pp. 300-303). IEEE.*

47 *Sharif, M., Javed, M. Y., & Mohsin, S. (2012). Face recognition based on facial features. Research Journal of Applied Sciences, Engineering and Technology, 4(17), 2879-2886.*

48 *Yasmin, M., Sharif, M., & Mohsin, S. (2013). Neural networks in medical imaging applications: A survey. World Applied Sciences Journal, 22(1), 85-96.*

49 *Zhang, L., & Deng, X. (2010). The research of image segmentation based on improved neural network algorithm. In 2010 Sixth International Conference on Semantics, Knowledge and Grids (pp. 395-397). IEEE.*

50 *Ahmed, S. A., Dey, S., & Sarma, K. K. (2011). Image texture classification using artificial neural network (ANN). In 2011 2nd National Conference on Emerging Trends and Applications in Computer Science (pp. 14). IEEE.*

51 *Kumar, M. J., Kumar, D. G. R., & Reddy, R. V. K. (2014). Review on image segmentation techniques. International Journal of Scientific Research Engineering & Technology, 3(6), 993-997.*

52 *He, Y., Yang, D., Roth, H., Zhao, C., & Xu, D. (2021). Dints: Differentiable neural network topology search for 3d medical image segmentation. In Proceedings of the IEEE/CVF conference on computer vision and pattern recognition (pp. 5841-5850).*

53 *Chen, X., & Pan, L. (2018). A survey of graph cuts/graph search based medical image segmentation. IEEE reviews in biomedical engineering, 11, 112-124.*

54 *Singh, V., Gupta, S., & Saini, S. (2015). A methodological survey of image segmentation using soft computing techniques. In 2015 International Conference on Advances in Computer Engineering and Applications (pp. 419-422). IEEE.*

55 *Shaziya, H., Shyamala, K., & Zaheer, R. (2019). Comprehensive review of automatic lung segmentation techniques on pulmonary CT images. In 2019 Third International Conference on Inventive Systems and Control (ICISC) (pp. 540-545). IE*