IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 2, February 2021
Impact Factor: 4.819

Fetal Contour Extraction Using Level Set Image Segmentation Approach

Dr. R. S. Jaiswal
Assistant Professor, Department of Computer Science and Engineering
College of Engineering and Technology, Akola, Maharashtra

Abstract: *This paper deals with phase of designing a new hybrid approach of segmentation. The brief description of proposed scheme is presented, followed by the design. The chapter begins with the introduction followed by discussion of experimental results. The proposed segmentation approach is followed by its evaluation and comparisons with existing methods.*

Keywords: Fetal Contour

I. INTRODUCTION

Two important segmentation techniques include global region-based and local region-based methods. There is another method of combining the two methods which leads to hybrid segmentation system such as piece-wise smooth (PS) models, selective binary and Gaussian filtering regularized level set etc. to overcome the shortcomings such as computational complicity, the inability to change curve topology, inability to deal with boundary concavities, inability to deal with intensity inhomogeneity of segmentation methods and improve segmentation performance and accuracy. More accurate segmentation can be achieved by combination of algorithms than a single algorithm as one particular algorithm can overcome disadvantages of another algorithm. Hybrid segmentation techniques are based on the idea that more correct result can be obtained if combination of algorithms is done. The quality of segmentation can be improved.

1.1 Existing Hybrid Segmentation Approach

In order to overcome the drawbacks and combine the merit of different methods, hybrid segmentation approach is used. [Lankton et. al., 2007] They presented a gradient descent flow based on a novel energy functional which is capable of producing robust and accurate segmentations of medical images. It is a hybridization of local geodesic active contours and global region-based active contours. In order to find significant local minima, delineate object borders despite noise, poor edge information and heterogeneous intensity profiles combination of these two methods can be done. To accomplish this, a cost function is constructed. The analysis of interior and exterior means in a local neighborhood around each point on the curve is done. Results were demonstrated by comparing this algorithm with standard techniques using medical and synthetic images to demonstrate the proposed method's robustness and accuracy as compared to both edge-based and region-based alone.

The hybrid models either combine region (local and/or global) or edge information or both local and global intensity information in their energy formulations. [Zhang et al., 2010] proposed a method which combines the advantages of edge-based and region-based active contours by defining a SPF (signed pressure force) function based on global means. In order to regularize level set, a Gaussian kernel is adapted. [Oh et. al., 2014] formulated a hybrid method which combines global region information and geodesic edge term to prevent boundary leakage problem.

[Soomro et. al., 2016, Soomro et. al., 2017] proposed a region-based active contour methods in the context of local and global intensity information. Local and global intensity information is integrated in their energy formulations of these methods. The movement of contour is driven by Global force and local force captures the inhomogeneities across the regions.

[Soomro et. al., 2018] presented an image segmentation method based on edge scaled energy functional which uses local and global information for intensity inhomogeneous image segmentation. Initially global intensity term is integrated with a geodesic edge term to produce a preliminary rough segmentation result. Result of first stage is given as input to second stage by integrating local intensity term with geodesic edge term to get final segmentation result. The second stage precisely achieves desirable segmentation result for inhomogeneous image segmentation due to the

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 2, February 2021
Impact Factor: 4.819

suitable initialization from the first stage. Two stage segmentation approach increases the accuracy and also eliminates the problem of initial contour existed in traditional local segmentation methods. The energy function uses both global and local terms incorporated with compacted geodesic edge term. To avoid re-initialization, a Gaussian kernel is adapted .The experimentation were carried out on Multimodal Brain Tumor Image Segmentation Benchmark (BRATS) 2015 and PH^2 skin lesion database.

1.2 Proposed Hybrid Segmentation Approach

The proposed hybrid segmentation approach combines two different methods, global region-based method and local region-based method. The development of hybrid region-based segmentation approach tries to improve the performance of hybrid segmentation systems. Inspired by the work of [Soomro et. al., 2018], a hybrid segmentation algorithm which aims to blend the benefits of global and local region-based approaches to improve the quality of segmentation is proposed. It is a two-stage method which uses local and global intensity information. A rough segmentation result is obtained using proposed global region-based approach. It takes global image intensities inside and outside of contour. So it is initialization insensitive. It is fast and stable with homogeneous regions. All homogeneous regions and spurious boundaries in an image are captured using this method and coarse segmentation result is obtained. This result is given as input to second stage to obtain final segmentation result. The first stage is unable to capture objects with intensity inhomogeneity as it uses global image information across the regions. So it is extended to local region-based active contour method. The second stage precisely achieves desirable segmentation result. Thus proposed segmentation approach increases the accuracy and also eliminates the problem of contour initialization.

The experimentation was carried out on ultrasound images obtained from authorized radiologist. The points inside and outside the object are modeled using the mean intensities of the local regions at each point on the true edge of an object. The resulting flow is more robust to image noise, capable of finding significant local minima and partitioning the image without making global assumptions about its makeup. The steps for fetal contour extraction using proposed approach are described below:

Step 1: Read the image from a file.
Step 2: Apply anisotropic diffusion to facilitate the segmentation.
Step 3: Level set function is initialized.
Step 4: Mean values of exterior and interior region are calculated.
Step 5: Value of speed function is computed.
Step 6: Minimization of energy is carried out.
Step 7: Curve is evolved
Step 8: The side length of the square window selected by the V(x, y) function is initialized.
Step 9: Output from step 7 is used as a input.
Step 10: Mean values of exterior and interior region are calculated.
Step 11: Value of speed function is computed.
Step 12: Minimization of energy is carried out.
Step 13: Curve is evolved
Step 14: Find Circular region or object in image.
Step 15: Compute new binary image with small, round object in it.
Step 16: Remove noise and other particles from final image using morphological operations.
Step 17: Show measurements and report.

Ultrasound images dataset is used for experimentation purpose. Ultrasound images from authorized radiologist are used. Mean square error, Peak Signal to Noise Ratio, Correlation, Structural Similarity index, Dice Similarity Coefficient and Jaccard Similarity Coefficient are the parameters used for comparing proposed model with the available model present in the literature. Sufficient medical images were tested and after testing, result shows improvement in quality and efficiency of segmentation as compared to existing approaches.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 2, February 2021
Impact Factor: 4.819

II. EXPERIMENTAL EVALUATION

The values of **Structural Similarity Index,** Correlation, Jaccard Similarity Coefficient, Dice similarity coefficient, Peak Signal to Noise Ratio, Mean Square Error are evaluated for Proposed Hybrid method for different images. The images are taken from authorized sonography center.

The result of the evaluated values of **Structural Similarity Index,** Correlation, Jaccard Similarity Coefficient, Dice similarity coefficient, Peak Signal to Noise Ratio and Mean Square Error for some of the images are represented in the table and the comparison graph. The method is implemented by coding the algorithm in global_local_hybrid.m in Matlab language.

	Structural Similarity	Correlation	MSE	PSNR	Dice	Jaccard
Existing Global Method	0.9593	0.9583	4.498	41.634	1.736	0.8681
Proposed Global Region-based Method	0.9683	0.9592	1.259	47.164	1.869	0.9349
Existing Local Method	0.9319	0.8930	2.689	43.867	1.595	0.7975
Proposed Local Region-based Method	0.9431	0.9018	2.946	43.473	1.649	0.8247
Proposed Hybrid Method	0.9897	0.9915	1.486	46.444	1.895	0.9475

Table: Parameters of 1st image after application of Existing Global Method, Proposed Global Region-based Method, Existing Local Method, Proposed Local Region-based Method and Proposed Hybrid Method.

	Structural Similarity	Correlation	MSE	PSNR	Dice	Jaccard
Existing Global Method	0.7031	0.8064	47.197	31.426	1.107	0.5539
Proposed Global Region-based Method	0.7474	0.8404	30.226	33.361	1.732	0.8658
Existing Local Method	0.6774	0.7784	25.666	34.071	1.495	0.7476
Proposed Local Region-based Method	0.7319	0.8245	25.617	34.079	1.729	0.8647
Proposed Hybrid Method	0.7499	0.7669	31.227	33.219	1.762	0.8808

Table: Parameters Of 2nd image after application of Existing Global Method, Proposed Global Region-based Method, Existing Local Method, Proposed Local Region-based Method and Proposed Hybrid Method.

	Structural Similarity	Correlation	MSE	PSNR	Dice	Jaccard
Existing Global Method	0.9719	0.9669	1.5273	46.326	1.876	0.9378
Proposed Global Region-based Method	0.9719	0.9669	1.5272	46.326	1.876	0.9378

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 2, February 2021
Impact Factor: 4.819

Existing Local Method	0.9156	0.9335	1.5843	46.166	1.533	0.7667
Proposed Local Region-based Method	0.9485	0.9549	1.5065	46.385	1.705	0.8527
Proposed Hybrid Method	0.9865	0.9883	1.7438	45.749	1.879	0.9397

Table: Parameters Of 3rd image after application of Existing Global Method, Proposed Global Region-based Method, Existing Local Method, Proposed Local Region-based Method and Proposed Hybrid Method.

	Structural Similarity	**Correlation**	**MSE**	**PSNR**	**Dice**	**Jaccard**
Existing Global Method	0.7959	0.2991	24.139	34.338	1.343	0.6712
Proposed Global Region-based Method	0.8790	0.9032	24.734	34.232	0.729	0.3648
Existing Local Method	0.9708	0.9596	1.2032	47.362	1.837	0.9183
Proposed Local Region-based Method	0.9212	0.8641	4.9686	41.202	1.455	0.7273
Proposed Hybrid Method	0.9322	0.8130	5.0718	41.113	1.533	0.7666

Table: Parameters Of 4th image after application of Existing Global Method, Proposed Global Region-based Method, Existing Local Method, Proposed Local Region-based Method and Proposed Hybrid Method.

	Structural Similarity	**Correlation**	**MSE**	**PSNR**	**Dice**	**Jaccard**
Existing Global Method	0.8246	0.7483	32.802	33.006	0.843	0.4214
Proposed Global Region-based Method	0.9289	0.8596	4.3732	41.757	1.760	0.8800
Existing Local Method	0.9322	0.8731	2.5793	44.049	1.749	0.8746
Proposed Local Region-based Method	0.9465	0.9016	1.9129	45.348	1.808	0.9038
Proposed Hybrid Method	0.9709	0.9466	1.6347	46.030	1.891	0.9453

Table: Parameters Of 5th image after application of Existing Global Method, Proposed Global Region-based Method, Existing Local Method, Proposed Local Region-based Method and Proposed Hybrid Method.

After averaging the values, we get

	Structural Similarity	**Correlation**	**MSE**	**PSNR**	**Dice**	**Jaccard**
Existing Global Method	0.8676	0.8766	22.152	37.325	1.258	0.6292
Proposed	0.9175	0.9171	7.7176	43.194	1.815	0.9074

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 2, February 2021
Impact Factor: 4.819

Global Region-based Method						
Existing Local Method	0.8757	0.8684	7.4976	41.871	1.566	0.7827
Proposed Local Region-based Method	0.9004	0.8792	7.4108	42.079	1.685	0.8425
Proposed Hybrid Method	0.9370	0.9363	7.5189	43.568	1.856	0.9281

Table: Parameters after averaging

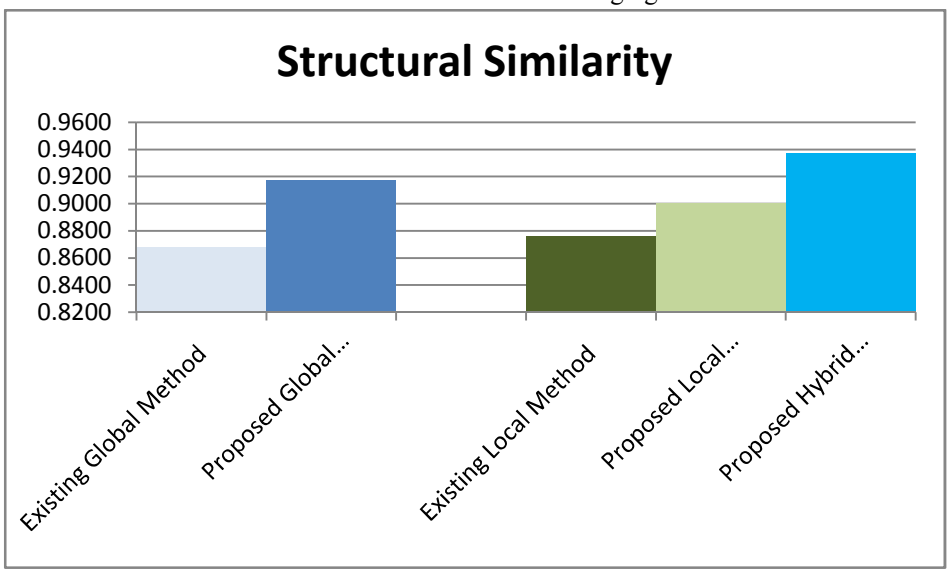


Figure: Structural Similarity Comparison for Existing Global Method, Proposed Global Region-based, Existing Local Method, Proposed Local Region-based model, Proposed Hybrid Method.

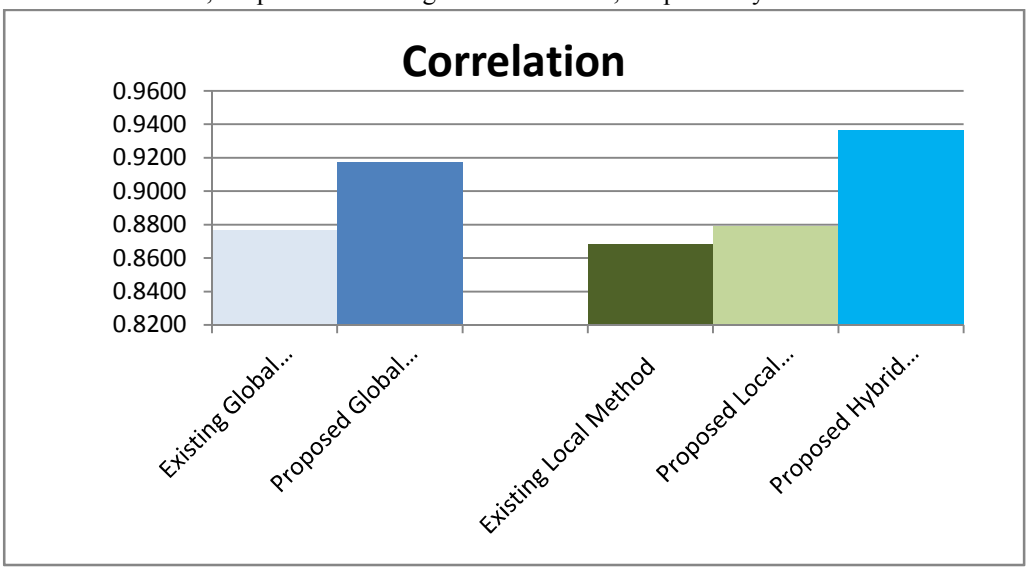


Figure: Correlation Comparison for Existing Global Method, Proposed Global Region-based, Existing Local Method, Proposed Local Region-based model, Proposed Hybrid Method.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 2, February 2021
Impact Factor: 4.819

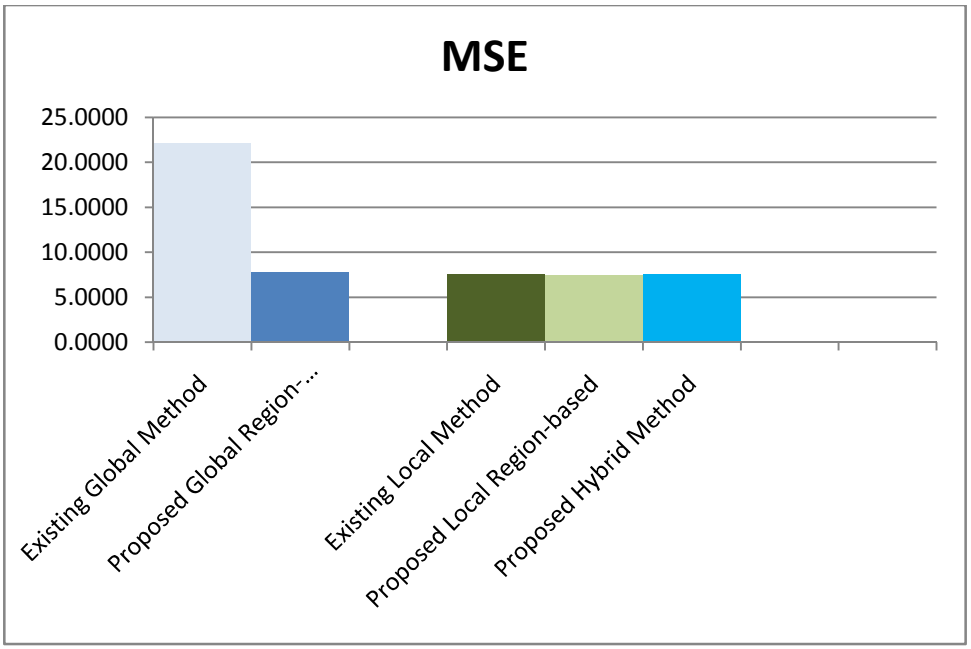


Figure: Mean Square Error Comparison for Existing Global Method, Proposed Global Region-based, Existing Local Method, Proposed Local Region-based model, Proposed Hybrid Method.

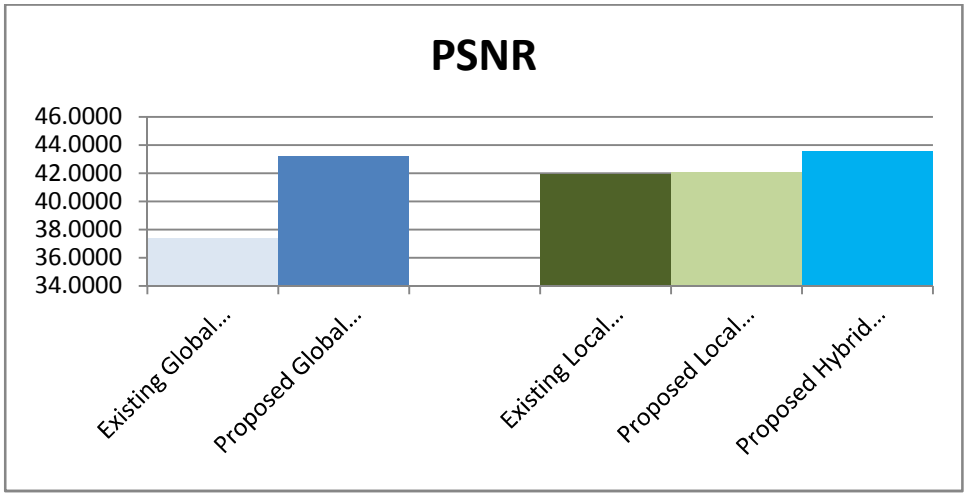


Figure: Peak Signal to Noise Ratio Comparison for Existing Global Method, Proposed Global Region-based, Existing Local Method, Proposed Local Region-based model, Proposed Hybrid Method.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 2, February 2021
Impact Factor: 4.819

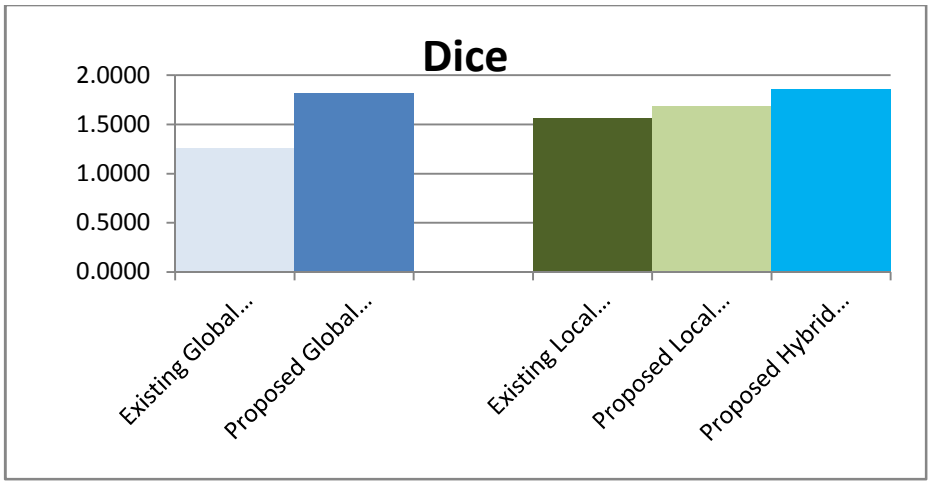


Figure: Dice Similarity Coefficient Comparison for Existing Global Method, Proposed Global Region-based, Existing Local Method, Proposed Local Region-based model, Proposed Hybrid Method.

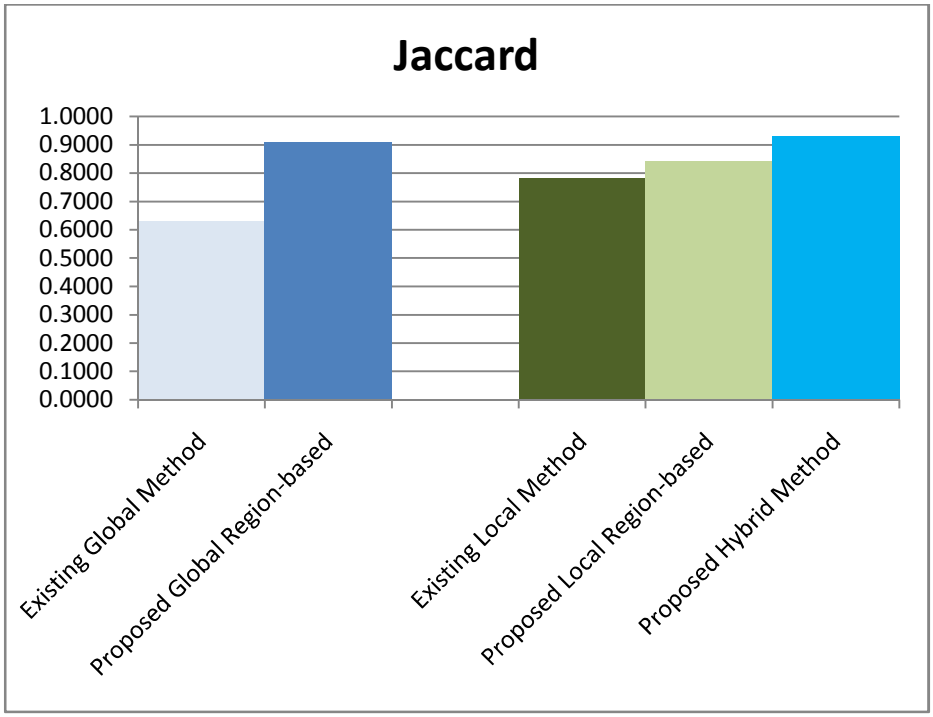


Figure: Jaccard Similarity Coefficient Comparison for Existing Global Method, Proposed Global Region-based, Existing Local Method, Proposed Local Region-based model, Proposed Hybrid Method.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 2, February 2021
Impact Factor: 4.819

III. IMPLEMENTATION SCREENSHOTS

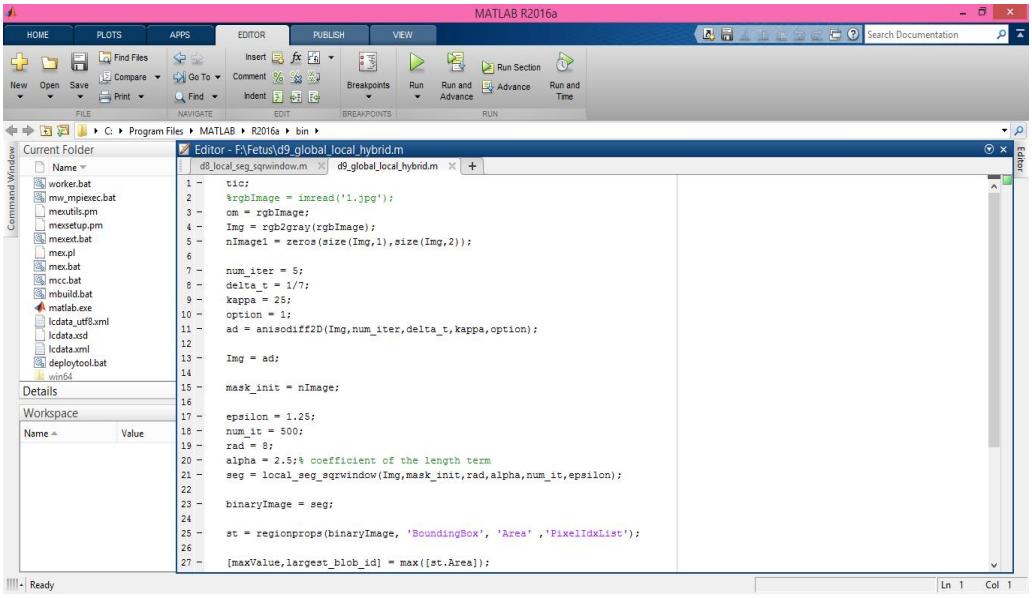


Figure: Screenshot for Module Implementation of Proposed Hybrid method.

Result after application of algorithm on 1st input image is shown below in figure a & b.

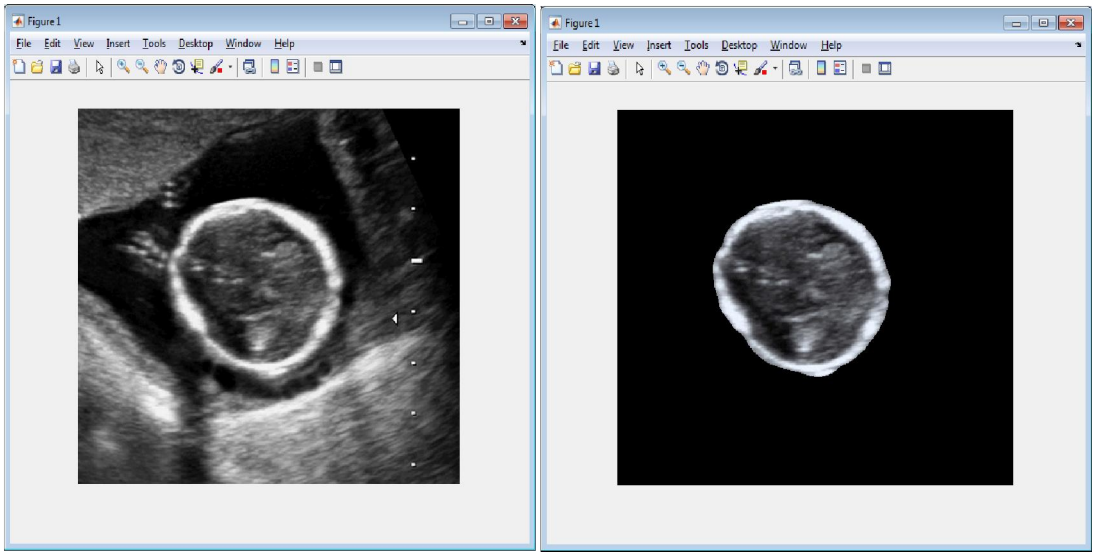


Figure: a) Input Image b) Result of Proposed Hybrid Method

Result after application of algorithm on 2nd input image is shown below in figure a & b.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 2, February 2021
Impact Factor: 4.819

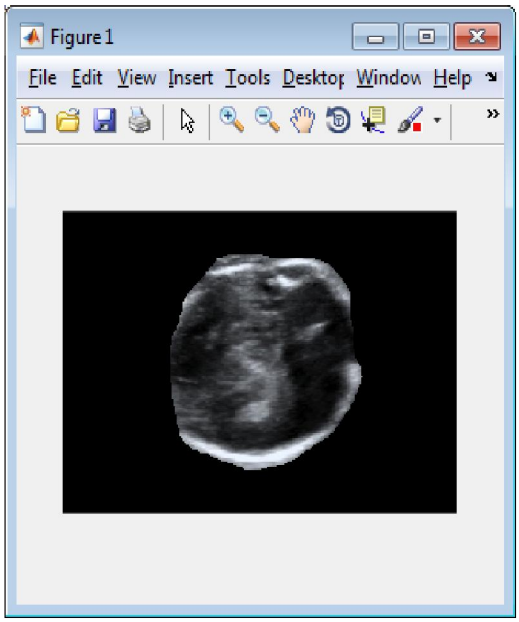
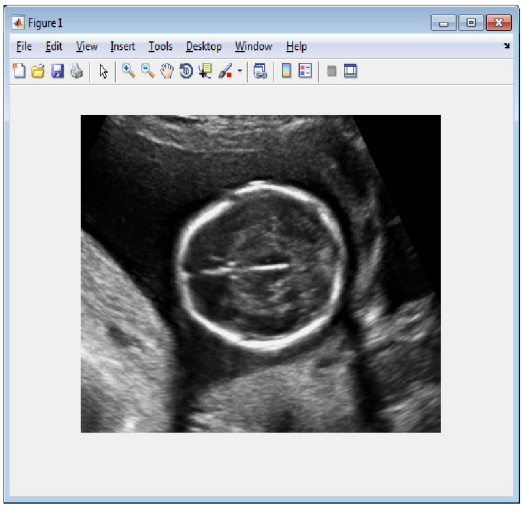


Figure: a) Input Image b) Result of Proposed Hybrid Method

Result after application of algorithms on 3rd input image is shown below in figure a &b.



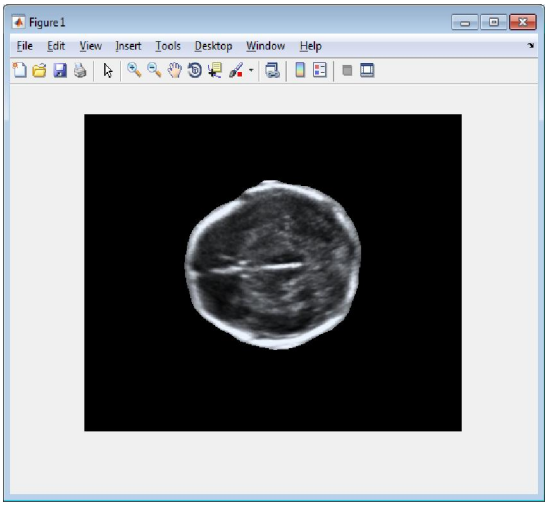
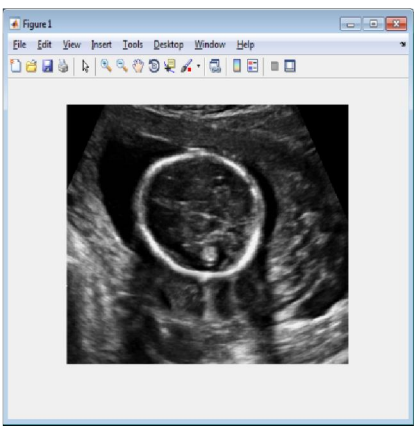


Figure: a) Input Image b) Result of Proposed Hybrid Method

Result after application of algorithms on 4th input image is shown below in figure a & b.



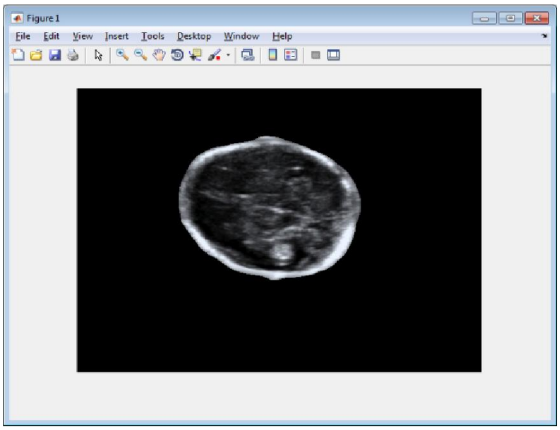


Figure: a) Input Image b) Result of Proposed Hybrid Method

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 2, February 2021
Impact Factor: 4.819

IV. SUMMARY AND DISCUSSION

The proposed hybrid approach is described and concluded as:

- Testing results for existing and proposed global region-based, local region-based, hybrid algorithms will be calculated and compared.
- Testing results shows that proposed hybrid algorithm performs well on different images.
- Evaluated values of Structural Similarity, Correlation, Mean Square Error, Peak Signal to Noise Ratio, Dice Similarity Coefficient, Jaccard Similarity Coefficient are compared for different images and found to be related with improved accuracy for existing and proposed methods.

Detailed analysis is done on different images to find out how proposed technique worked to produce optimal results.

REFERENCES

[1]. [Chiu et. al., 2010] Yun-Jen Chiu, Van-Truong Pham, Thi-Thao Tran and Kuo-Kai Shyu, "Evaluation of active contour on medical inhomogeneous image segmentation", in 3rd International Conference on Computer Science and Information Technology, DOI: 10.1109/ICCSIT.2010.5564101, pp.311 – 314, 2010.

[2]. [Fan et. al.,2010] Li-nan Fan,Dao-jing Li, Shen-shen Sun and Chao-hai Chang, "Applied Research on the Automatic Detection Of Lung Nodules ROI Based on Top-Hat & Gabor Filter", in Third International Symposium on Information Processing, DOI: 10.1109/ISIP.2010.70, pp. 533 – 536, 2010.

[3]. [Reddy et. al.,2011] G. Raghotham Reddy, K. Ramudu, P. Yugander and R. Rameshwar Rao, "Fast global region based minimization of satellite and medical imagery with geometric active contour and level set evolution on noisy images", in IEEE Recent Advances in Intelligent Computational Systems, DOI: 10.1109/RAICS.2011.6069400,pp.696 – 700, 2011.

[4]. [Gui et. al., 2011] Yufeng Gui, Zhaohui Zheng, Bichao Xu and Zhiling Zhang, "A split and merge algorithm based on grey theory", in Proceedings of 2011 IEEE International Conference on Grey Systems and Intelligent Services, DOI: 10.1109/GSIS.2011.6044047, pp. 469 – 472, 2011.

[5]. [Zhang et. al.,2011]Lime Zhang, Bo Wang, Zhongxuan Luo and Jielin Zhang, "Comparative study of C-V active contour model and subdivision for micro algae image segmentation", in International Conference on Electric Information and Control Engineering, DOI: 10.1109/ICEICE.2011.5778135, pp. 1241 – 1244, 2011.

[6]. [Izquierdo-Zaragoza et. al.,2011] J.L. Izquierdo-Zaragoza , M.C. Bastida-Jumilla, R. Verdu-Monedero, J. Morales-Sanchez and R. Berenguer-Vidal, "Segmentation of the carotid artery in ultrasound images using frequency-designed B-spline active contour", in IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP), DOI: 10.1109/ICASSP.2011.5946503,pp. 713 – 716, 2011.

[7]. [Tong-yao,2011]Wang Tong-yao, "The motion detection based on background difference method and active contour model", in 6th IEEE Joint International Information Technology and Artificial Intelligence Conference, DOI: 10.1109/ITAIC.2011.6030378, pp. 480 – 483, 2011.

[8]. [Koh et.al.,2011] Jaehan Koh, Peter D. Scott, Vipin Chaudhary and Gurmeet Dhillon, " An automatic segmentation method of the spinal canal from clinical MR images based on an attention model and an active contour model", in IEEE International Symposium on Biomedical Imaging: From Nano to Macro, DOI: 10.1109/ISBI.2011.5872677, pp.1467 – 1471, 2011.

[9]. [Artan et.al.,2011]Yusuf Artan , Masoom A. Haider and Imam Samil Yetik, "Graph-based active contours using shape priors for prostate segmentation with MRI", in IEEE International Symposium on Biomedical Imaging: From Nano to Macro, DOI: 10.1109/ISBI.2011.5872675, pp. 1459 – 1462, 2011.

[10]. [Vylder et. al., 2011] Jonas De Vylder, Jan Aelterman, Koen Douterloigne and Wilfried Philips, "A comparative study on the optimization of global optimum active contours", in 5th International Conference on Signal Processing and Communication Systems (ICSPCS), DOI: 10.1109/ICSPCS.2011.6140840,pp.1 – 10, 2011.