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Research Article

Brain Region Segmentation with CNN and Advanced Filtering usingGlobally Guided Image Filtering and NLM Filter

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Abstract—
In this paper, Brain Region segmentation is implemented in which from the MRI images brain region needs to be detected. This gives importance in MRI correction and diagnosis. Many researchers have worked on machine learning and deep learning technique using the image processing tools in MATLAB. The effort is done to achieve higher accuracy and lowest possible error. Brain Region Segmentation is amongst best research areas which gives tremendous scope of study and analysis for the scientists. Firstly, the brain region is segmented using convolutional neural network is implemented. As the new work novelty, the proposed technique is defined using globally guide image filtering and WLS filter is combined with convolutional neural network for the better accuracy in brain region segmentation. This technique improved more parameters such as sensitivity, specificity and mean square error. The combination of globally guided image filtering and WLS filter gives the interesting noise mitigation and smoothening function to the brain region image from MRI. The deep learning method is improvised by the use of filters GGIF, WLS and NLM combination and offers the better segmentation images as verified in results using MATLAB.

Keywords—MRI; Brain Region; Segmentation; GGIF; WLS; CNN

I. INTRODUCTION

The main broad area in this work is image processing using neural network and filtering techniques. In this work, Brain Region segmentation is implemented in which from the MRI images brain region needs detected. This gives importance in MRI correction and diagnosis. Many researchers have worked on machine learning and deep learning technique using the image processing tools in MATLAB. The effort is required to be done to achieve higher accuracy and lowest possible error. Brain Region Segmentation is amongst best research areas which gives tremendous scope of study and analysis for the scientists. Firstly, the brain region is segmented using convolutional neural network is implemented. As the new work novelty, the proposed technique can be defined using globally guide image filtering and WLS filter is combined with convolutional neural network for the better accuracy in brain region segmentation.

Image division empowers the area of articles and limit like bends, lines, and so forth in an image. [1] It additionally names every pixel in an image to such an extent that the pixel with same mark share certain attributes. [2] The resultant divided image comprises of a lot of portions which spread the whole image. [3] These MRI Scanned images are helpful in recognizing and distinguishing and grouping the tumor parts of the brain no problem at all. [4] Presently a day's the vast majority of the current strategies are human experience translation for image assessment which may bring about bogus recognizable proof of brain segmentation. [5] Computerized method for speaking to the images can make us location clear when contrasted with manual. [6]

Brain segmentation is the most usually happening threat among people, so investigation of brain segmentation is significant. [7] Clinical image processing is a blessing to individuals for preplanning their clinical medications. [8] The brain segmentation illness is a risky infection for human life-cycle since it develops as a prevailing malady in everywhere throughout the world. [9] Image pre-processing methods are utilized to improve the nature of an image before processing into

an application.In all image modalities commotions will be included during image procurement. Commotion will debase image and lessen quality. [10]

The MRI images are used in medical imaging for tumor diagnosis and brain tissue visualization. The expert radiologist does this manually, and it takes some time. [11-15] The conventional tumor MRI assessment approach is largely dependent on qualitative characteristics, such as tumor mass, growth pattern, etc. [16-19] In neuroimaging, for instances alignment of images, surface reconstruction, etc., Brain region segmentation is important. [20-22] The earlier approaches rely on qualitative characteristics and are very vulnerable to errors. Noise and errors must be minimized and easily defined, far less work must be performed for deep learning techniques to automatically identify a tumor, and there will be more areas to be explored. [23-26] The method of deep learning is somewhat different from the method of machine learning. The system of machine learning uses algorithms to enter input data, learn from the given data and make decisions based on knowledge or learning. [27-30] Deep learning has an unstructured or unlabeled capacity to learn from results. The algorithms in deep learning attempt to learn by using a process of extracting features, which differs greatly and renders the model completely automatic. [31-32]

Medical image technology has today been established as an invaluable medical instrument to meet the significant demand for medical image knowledge by displaying internal clinical examination organs. [33] This helps radiologists and physicians understand the disease accurately and facilitates medical practices for patients, improves their efficacy and making it affordable for the healthcare system. [34]

In the area of medical imaging, the segmentation of images is very ubiquitous. Our nervous system's most essential component is the cortex. [35] It's very difficult to consider the nerves, along with its significance. Doctors can read the processing of the brain via MRI. There are many tissues in our bodies. Tissues are further split into cells and each cell has a distinct role in the nervous system. As the cells lose their capacity to regulate their development in our nervous system, they begin to expand or divide without direction. [36-40]

Brain segmentation is a field that has drawn huge numbers of researchers. In the diagnosis of many illnesses brain segmentation has possible uses. 1. Human brain images segmentation allows to analyses the variations in volumetry. The volumes of various cranial tissues in the brain are affected by multiple neurological diseases. [41-45] Diagnosis of neurosis diseases such as multiple sclerosis, stroke and Alzheimer' s disease is applied by segmentation and volume analysis. Diagnosis of these conditions requires a precise determination of white matter, grey matter and CSF volumetric modifications. [46] Segmentation helps determine the growth of the lesion and early tumor detection. Segmentation also supports surgical preparation. [47]

The skull removal procedure is an important field of research in applications of brain image processing. [48] In certain medical applications, it is an initial step in increasing the pace and precision of the diagnosis in many ways. Which excludes non-cerebral tissue from brain images such as the skull, scalp and dura. [49-50]

II. IMPLEMENTATION

Any simple information will be presented to explain this work such as a Globally Directed Image Filtering Procedure, which frees the brain fog from the feedback of MRI and refers to the GGIF picture that is then coupled with the WLS filter, which will increase the image flatness factor. The only CNN segmentation escape and the proprietary filter segmentation that enhances the CNN approach in the combined GGIF and WLS filters are compared in this article. 2 input picture tests are compared. It appears in Fig. 1 below.

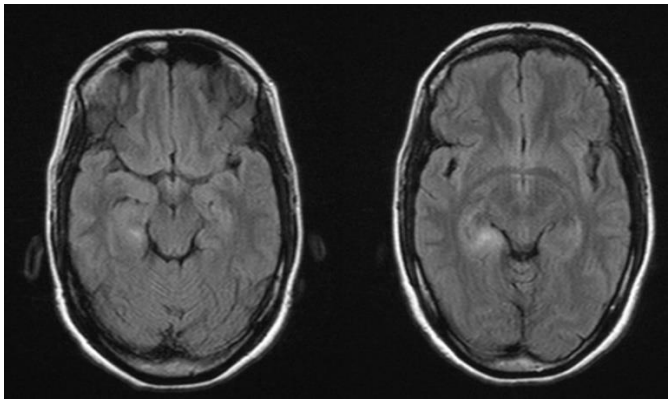

Fig. 1: testing inputs for result comparison of brain region segmentation [1]

III. GGIF WITH WLS:

This segment discusses the globally directed brain region and WLS (Weighted Lest Square) brain picture smoothening techniques for GGIF. Both of these functions are dependent on a number of equations that increase the nobility in the medical picture induced by MRI problems or other computer related errors. The two tasks have the potential and scope to enhance the handling of medical images. Guided image filtering is an old technology that has made it unique and stronger for the improvement of image processing with a certain extension of the worldwide feature. This technology has been used in paper [11] for the removal of images and improves the image and makes it seamless. In tandem with the CNN model, the spectrum continues to enhance brain area segmentation parameters. The reference paper [11] also takes up the equations.

IV. CONVOLUTIONAL NEURAL NETWORK ALGORITHM

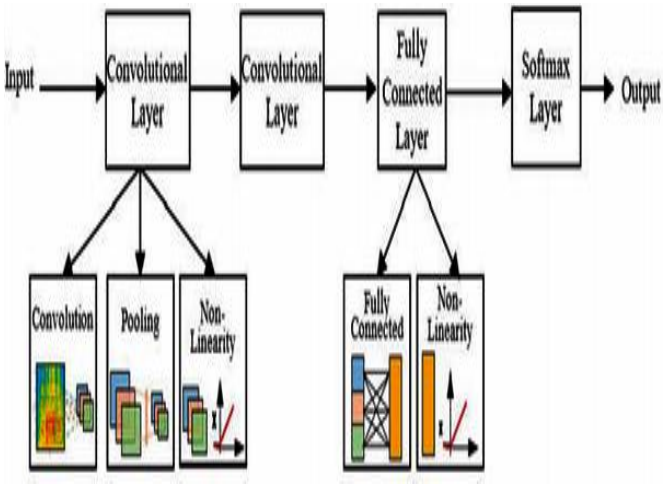

Fig. 2: Convolutional Neural Network Algorithm Block Diagram [1]

In fig. 2, CNN algorithms are shown in a block diagram, first input images are provided with a concentrated application, and then coevolutionary layers are formed that produce the completely connected layer by encoder method and, finally, the output prediction is implemented by SoftMax. Both pictures are qualified and checked in the same way. The presented work utilizes MATLAB's semantic segment feature to simplify CNN collection. No special workout is required, it converts automatically through the loaded neural network.

V. FINAL PROPOSED ALGORITHM & FLOWCHART

The algorithm of the proposed work is given below step by step:
Step 1: Input of the testing image, through MATLAB interface.
Step 2: Applying GGIF on testing Image
Step 3: Applying WLS filter to smoothen image of MRI
Step 4: Conversion to gray scale

Step 5: Apply NLM non local mean filter
Step 6: Apply semanticseg deep learning method for CNN implementation
Step 7: Final Segmentation
Step 8: Accuracy, MSE, Sensitivity and Specificity Calculation
Step 9: Comparison of the performance metrics
The flowchart of GGIF and CNN combined proposed work is shown in Fig. 3:

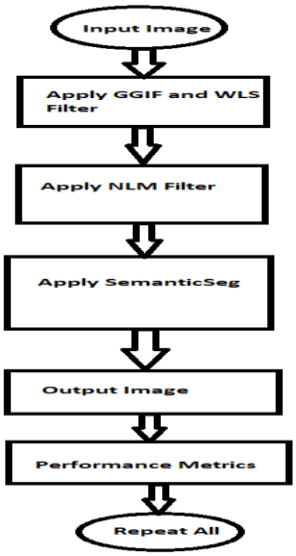

Fig. 3: GGIF and CNN brain region segmentation flowchart for proposed method

VI. RESULTS:

The performance metrics observed in this are:
Accuracy
Sensitivity
Specificity
And Mean Square Error
Result screenshot is shown below:

Figure 4: Result observations

In this section, the screens for the two inputs for the proposed work which includes GGIF, WLS and CNN together is shown in Fig. 5 and Fig. 6.

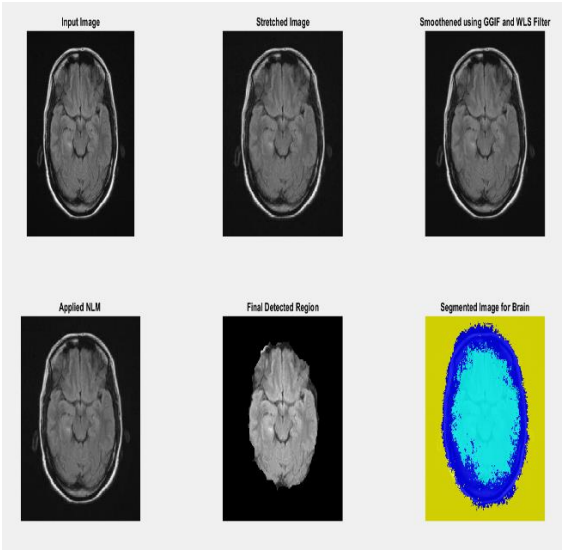

Fig. 5: Proposed Output, GGIF based CNN for Brain Region Segmentation for input 1

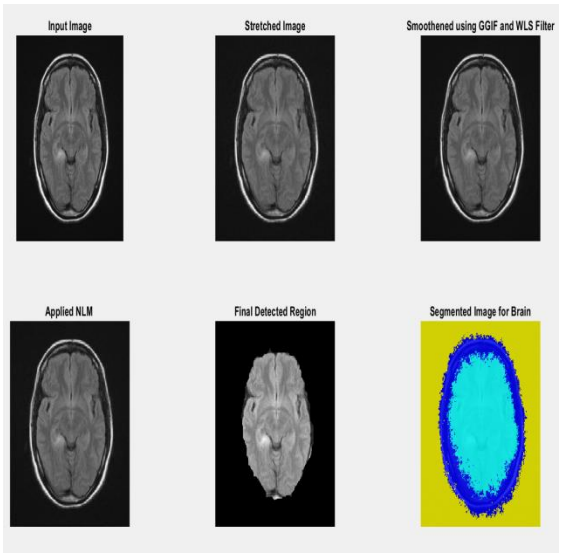

Fig. 6: Proposed Output for GGIF based CNN Brain Region Segmentation for input 2

Table 1: Tabulated Results for Image 1

Image 1	Brain Region Segmentation using CNN	Brain Region Segmentation using CNN and GGIF(Proposed)
Accuracy(%)	96.35	96.51
Sensitivity(%)	95.45	95.63
Specificity(%)	96.77	96.91
Mean Square Error	1.36E-04	1.32E-04

Table 1 and table 2 shows the results obtained comparing existing and proposed work for brain region segmentation with and without GGIF and WLS filter.

Table 2: Tabulated Results for Image 2

Image 2	Brain Region Segmentation using CNN	Brain Region Segmentation using CNN and GGIF(Proposed)
Accuracy(%)	96.78	97.09
Sensitivity(%)	95.86	95.6
Specificity(%)	97.23	97.82
Mean Square Error	1.34E-04	1.30E-04

In Fig. 7 to Fig. 10, results for Accuracy, sen, spec, and MSE are shown which shows in all the parameters GGIF based CNN for brain region segmentation is better than the existing one for image input 1.

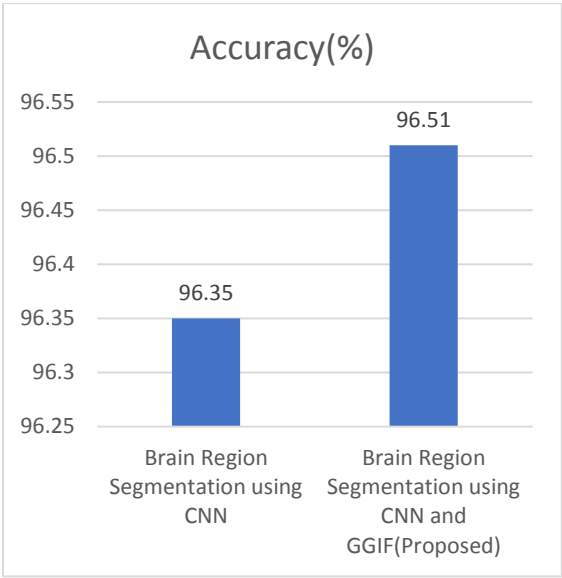

Fig. 7: Accuracy Output Image 1

In fig 7, it is seen that for input image 1 the accuracy is improved with use of GGIF Filter with CNN.

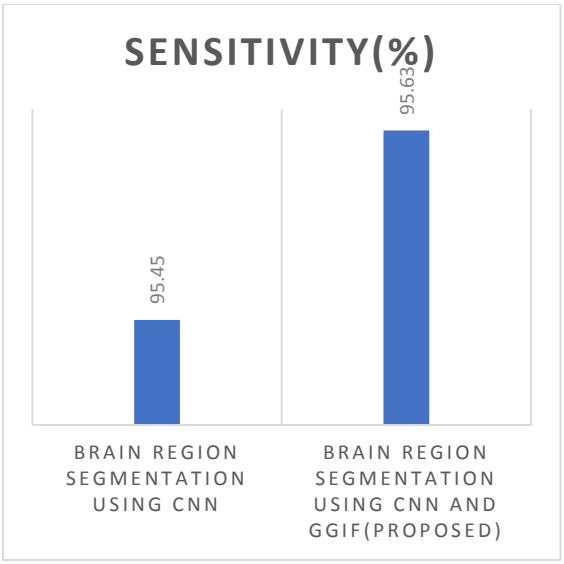

Fig. 8: Sensitivity Output Image 1

In fig. 8 the sensitivity is improved for the proposed work CNN and GGIF. It gives a noise free segmentation of the process.

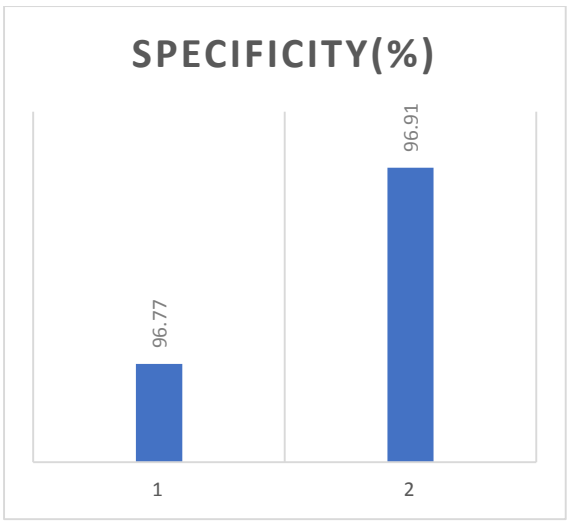

Fig. 9: Specificity Output Image 1

In fig. 9 the specificity which is basically the main measure of quality, the improved parameter is seen in case of our proposed work.

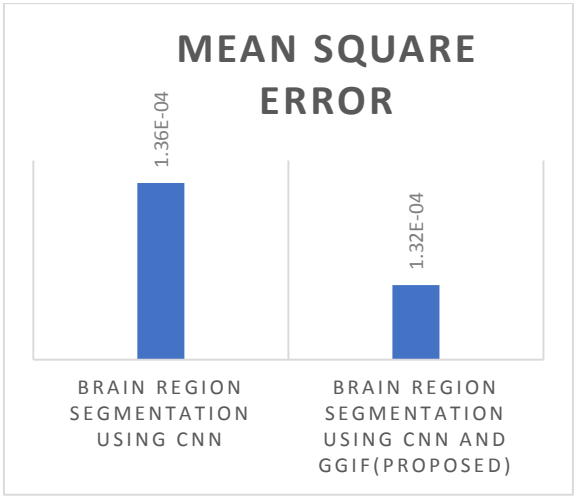

Fig. 10: Mean Square Error Output Image 1

In Fig. 11 to Fig. 14, results for Accuracy, sen, spec, and MSE are shown which shows in all the parameters GGIF CNN for brain region segmentation is better than the existing one for image input 2.

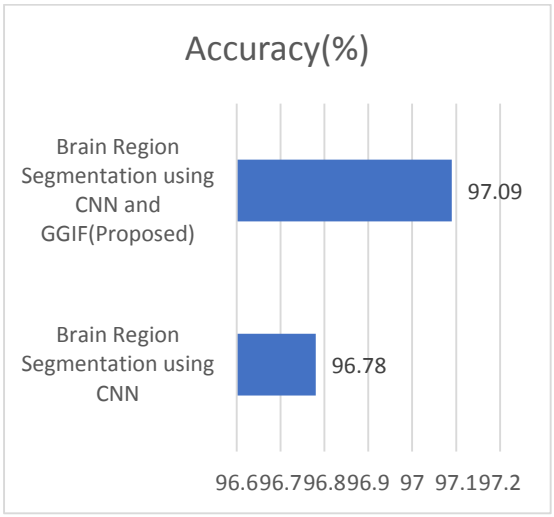

Fig. 11: Accuracy Output Image 2

In fig. 11, the input image 2 gives better accuracy result for the brain region segmentation.

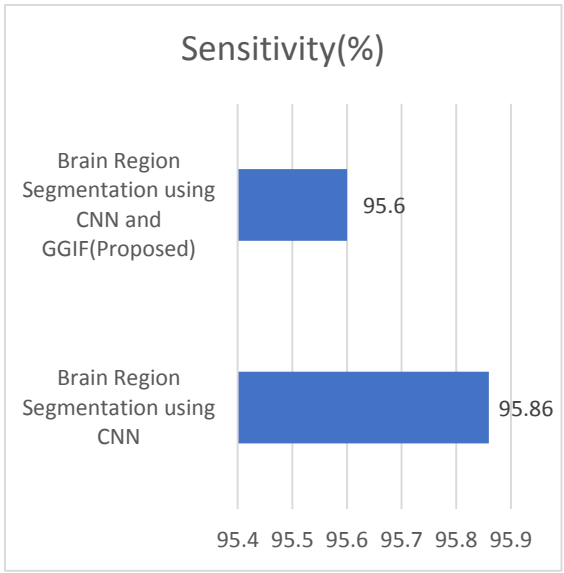

Fig. 12: Sensitivity Output Image 2

In fig. 12 sensitivity is almost same as in case of proposed and existing but the accuracy is improved better.

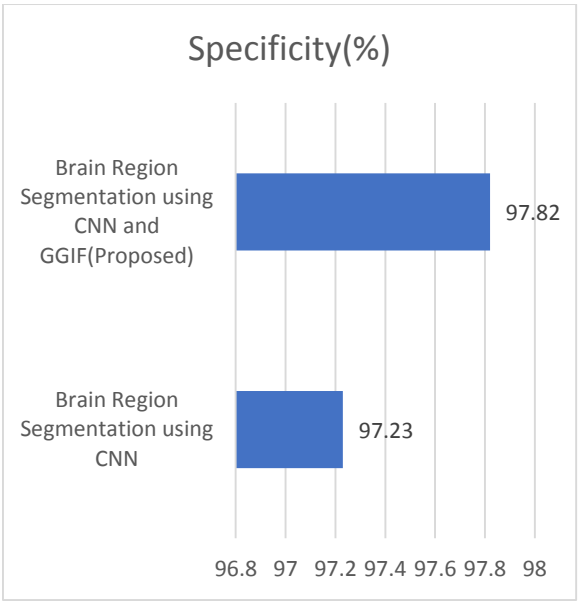

Fig. 13: Specificity Output Image 2

In fig. 13, specificity is improved in case of the input image 2.

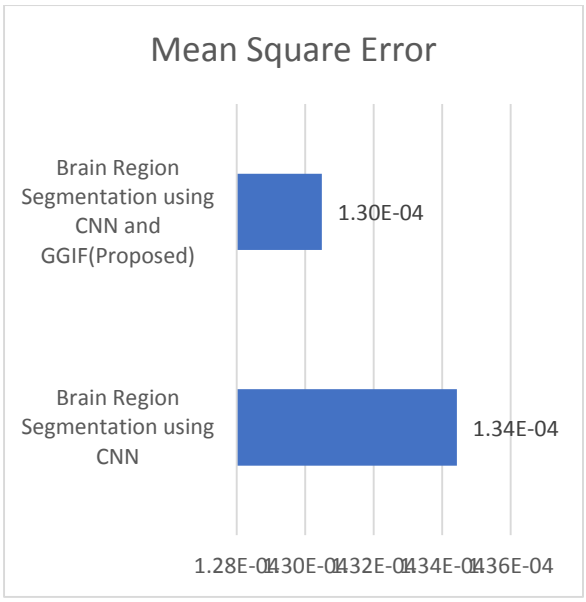

Fig. 14: Mean Square Error Output Image 2

In above fig. 14 the mean square error is improved a lot in proposed work.

VII. CONCLUSION

In this paper, a new method for brain region segmentation is proposed in which Globally guided image filter and Weighted Least square filter is combined for the brain region segmentation with semantic seg deep learning method, part of CNN convolutional neural network is implemented. The implementation and results are obtained using MRI input images for testing and given to MATLAB image processing tool. The results show that an accuracy of more than 97% is achieved, also specificity is more than 97.8 and sensitivity of 96.9% is achieved in the proposed work with lower mean square error in all the cases of the proposed method. The method design is novel when included with CNN as it gives interesting noise removal options in the field of biomedical image processing.

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