IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Brain Region Segmentation using Hybrid Filtering and Deep Learning Algorithm

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***Abstract*— The division of brain region shapes in three measurements is basic for the investigation of various brain structures, and progressed approaches are arising constantly inside the field of neurosciences. With the improvement of high-goal miniature optical imaging, entire brain pictures can be procured at the cell level. Be that as it may, brain regions in tiny pictures are collected by discrete neurons with hazy limits, the unpredictable and variable highlights of brain regions make it trying to precisely fragment brain regions. Manual division is a solid strategy, yet is ridiculous to apply for an enormous scope. in this method, a filter named as globally guided filter is combined with the deep learning method which is CNN known as convolutional neural network. The accuracy and mean square error are mainly improved in this method according to input images given.**

Keywords*— *Brain; image processing; region; segmentation; cnn

I. INTRODUCTION

In the course of the most recent couple of many years, the quick advancement of noninvasive brain imaging innovations has opened new skylines in investigating and considering the brain life systems and capacity. [1] Gigantic advancement in getting to brain injury and investigating brain life structures has been made utilizing attractive reverberation imaging (MRI). [2] The advances in brain MR imaging have likewise furnished huge measure of information with an undeniably elevated level of value. [3] The investigation of these huge and complex MRI datasets has become a monotonous and complex assignment for clinicians, who need to physically remove significant data. This manual investigation is regularly tedious and inclined to blunders because of different between or intraoperation changeability considers. [4] These troubles in brain MRI information investigation required innovations in mechanized strategies to improve infection finding and testing. [5] These days, electronic techniques for MR picture division, enrollment, and perception have been broadly used to help specialists in subjective finding. [6] General Segmentation procedure coordinating at least two methods which is productively giving preferred outcomes over the division calculations working alone. This is all conceivable in the field of Picture Processing, dominatingly in the region of clinical picture division [8, 9 and [10-15]. Picture division implies isolating the articles from the foundation. Picture division goes about as a heart to the grouping strategy. The, proposed framework predominantly centered around clinical imaging to separate region and particularly in MRI pictures. It has high-goal and exact situating of delicate and hard tissues, and is particularly reasonable for the finding of brain tumor. So, this sort of imaging is more reasonable to recognize the brain injuries or edge detection.

II. IMPLEMENTATION

For understanding the proposed work, some basic details are provided such as Globally Guided Image filtering technique makes the image of brain fog free from the MRI input and is referred to as the GGIF image which is then combined WLS filter, the purpose for which is to improve the smoothening factor of the image. Here, in this thesis, a comparison is made of exiting only CNN based segmentation, and filter based proposed segmentation which improves the CNN method in combination base of GGIF and WLS filter. Comparison is made on 2 input image tests. Which are shown below in Fig.1.

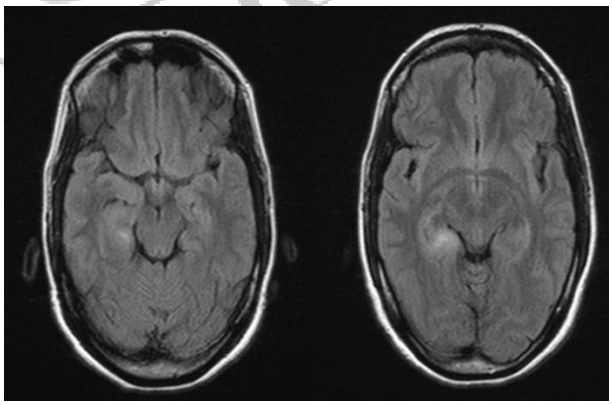

Fig. 1: testing inputs for result comparison of brain region segmentation [1]

This section explains the GGIF Globally Guided Image Filtering Technique for Brain Region Segmentation and WLS (Weighted Least Square) for Brain image smoothening function. Both of these functions are based on a set of equations which improves the fogginess in the medical image which may be caused due to the handling issues of the MRI scanner or any machine related errors. The two functions have the capability and better scope in the improvement in medical image processing related areas. Guided image filtering is well known old technique, in which a certain addition of the global function makes it unique and better for the image processing-based enhancement. In paper [16], this technique has been used for

image dehazing and gives better improvements and smoothened image. The scope of which is continued in combination with the CNN model to improve the parameters in brain region segmentation. Further the equations are taken from the reference paper [16].

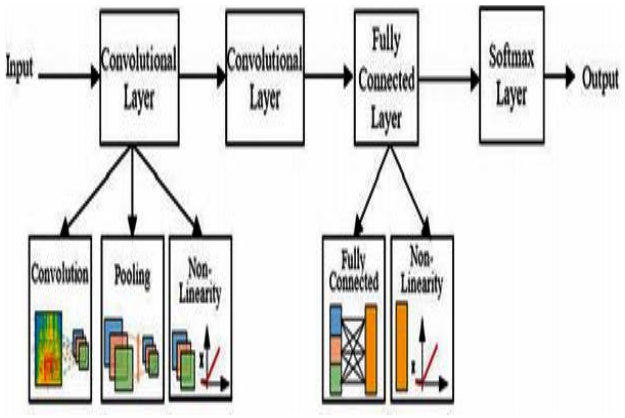

Fig. 2: Convolutional Neural Network Algorithm Block Diagram [3]

In figure 2, CNN algorithm is shown in a block diagram, firstly input images are given the accordingly convolutional is applied by pooling and convolutional layers are created, after which fully connected layer by encoder system is generated, at the end SoftMax layer is applied for output prediction. In a similar manner all images are trained and tested. In the work presented, semantic seg function of MATLAB is used which makes the work selection for CNN easier. In this special training is not required, it automatically converts through the loaded neural network.

III. RESULTS

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.3 to Fig.6, results for Accuracy, sen, spec, and MSE are shown which shows in all the parameters GGID CNN for brain region segmentation is better than the existing one for image input 1.

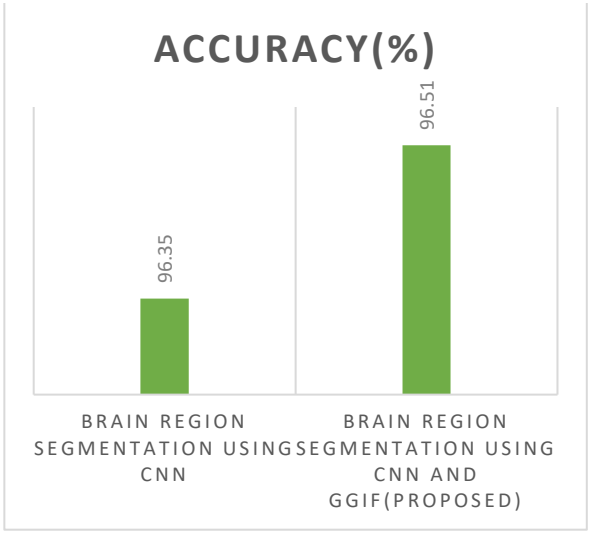

Fig.3: Accuracy Output Image 1

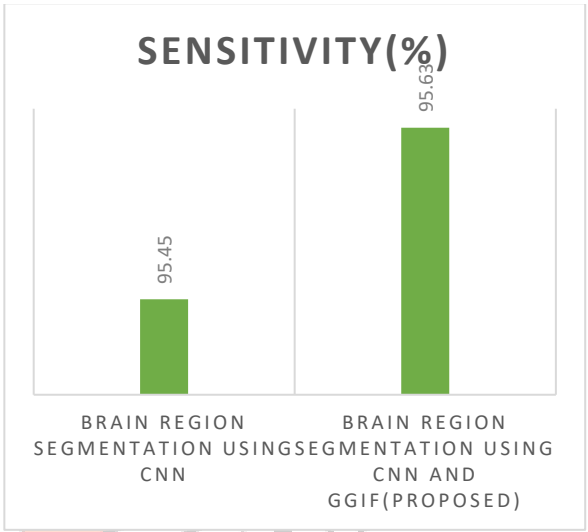

Fig.4: Sensitivity Output Image 1

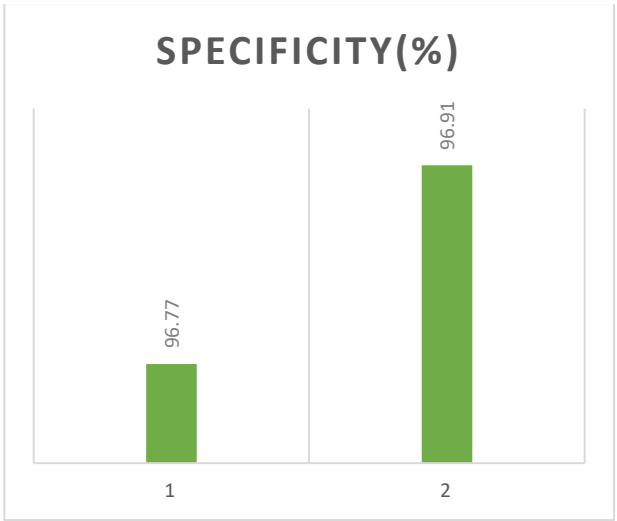

Fig.5: Specificity Output Image 1

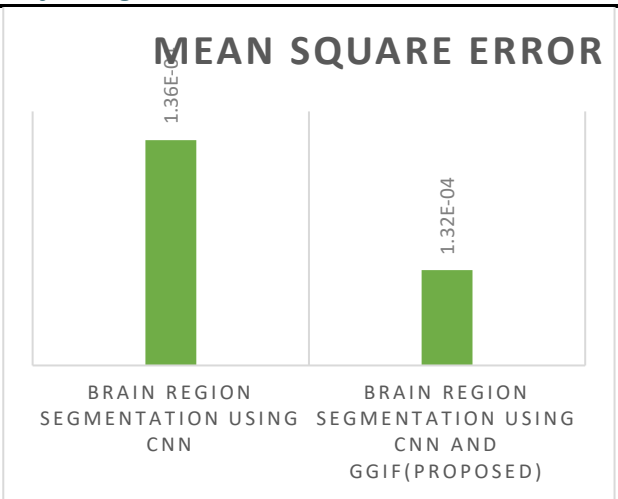

Fig.6: Mean Square Error Output Image 1

In Fig.7 to Fig.10, results for Accuracy, sen, spec, and MSE are shown which shows in all the parameters GGID CNN for brain region segmentation is better than the existing one for image input 2.

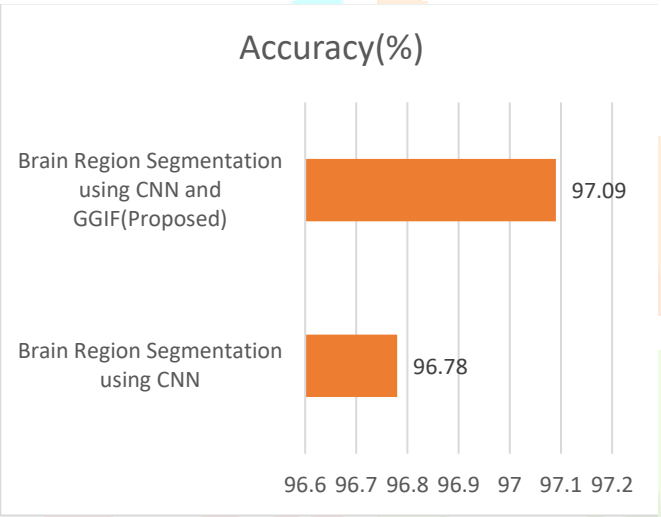

Fig.7: Accuracy Output Image 2

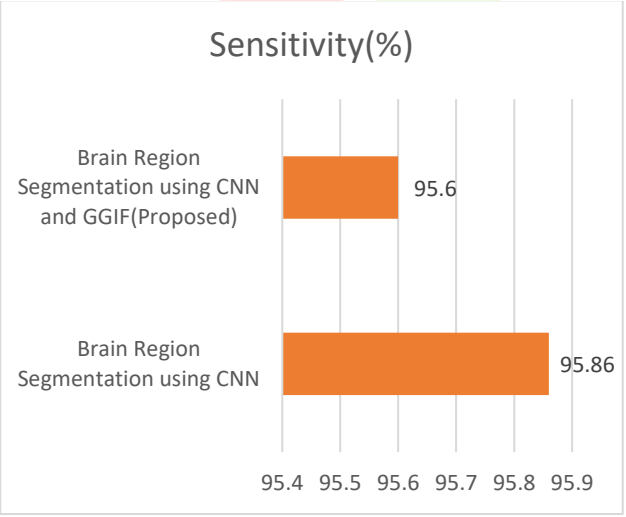

Fig.8: Sensitivity Output Image 2

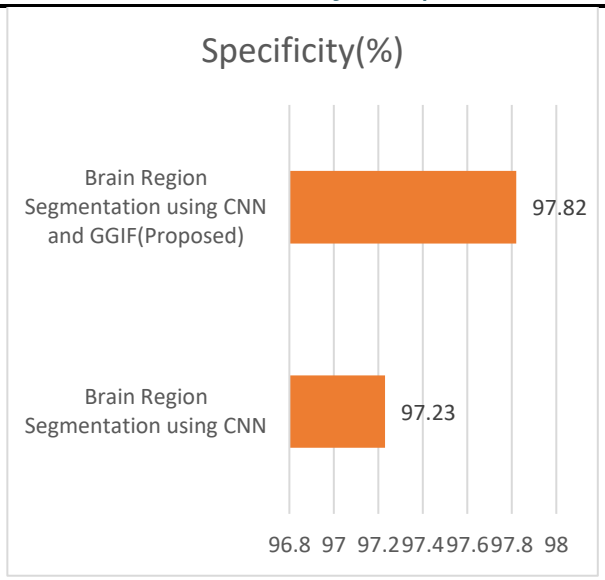

Fig.9: Specificity Output Image 2

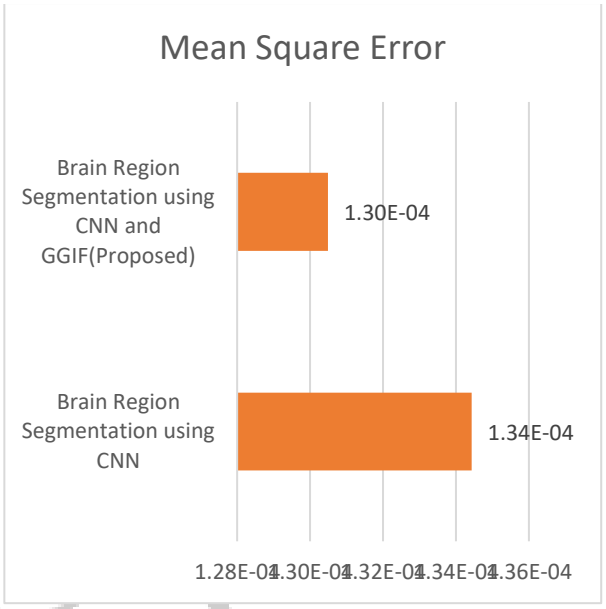

Fig.10: Mean Square Error Output Image 2

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IV. Conclusion

Picture division is the way toward apportioning a computerized picture into various regions. These regions are now and again called region of interest (ROI). The objective of the picture division is to disentangle and additionally change the portrayal of a picture into something that is more significant and simpler to break down. Clinical picture division is a significant errand for recognizable proof and area of tumors, conclusion, and PC guided a medical procedure and so forth in this manner a successful picture division is most extreme significant not just in distinguishing the area of infections in clinical pictures yet in addition similarly basic to notice the degree to which sicknesses spread across the ROI. In this paper, a new method is proposed which gives the combination of hybrid GGIF and CNN deep learning-based brain region output successfully as per the brain input images. The parameters are improved in the accuracy and mean square error.

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