growing, they added an additional constrain of "orientation". In the modified region growing, there are two thresholds; one is for the intensity and the other for orientation. Region is grown if only both constrains are met. For evaluation of the propose technique, spilt the original image into 4, 18 and 24 grids. Gridding results in smaller grids so that analysis can be carried out easily which is shown in figure 5.

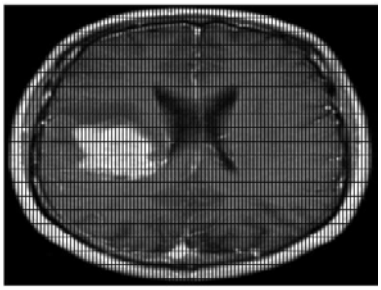

Figure 5: Gridded MRI Image

In this technique each of the grids is treated separately to which the region growing technique is applied. The initial step in region growing for the grid formed is to select a seed point for the grid. The initial region begins with the exact place of the seed. Also to find out the seed point of the grid histogram analysis is carried out. The histogram is found out for every pixel in the grid. As the image is a grey scale image, the values of this image is from 0 to 255. For every grid, the histogram value that comes most frequent is selected as the seed point pixel. From this, any one of the seed point pixel is taken as the seed point for the grid. After finding out the seed point, the region is grown from it. The neighboring pixels are compared with the seed point and if the neighbor pixel satisfies constrains, then the region is grown else it is not grown to that pixel. Figure 6 shows Normal Region Growing Segmented image.

Figure 6: Segmentation with Normal Region Growing method

From this matrix g, then get the orientation for each of the pixels. Suppose the pixel is having O_N and the orientation threshold is set as T_O,$\| O_P\text{-}O_N \| \leq T_O$ then the orientation constrain is met and satisfied. When both the intensity constraint and the orientation constraint are satisfied by a neighboring pixel, the region is grown to the neighbor pixel and the region grows. When $\| I_P – I_N \| \leq T_I$ AND $\| O_P\text{-}O_N \| \leq T_O$ then the neighbor pixel is added to the region. For every grid, the region is grown [1]. Figure 7 shows the Modified region Growing segmented image.

3.4 Feature Extraction

After finding out the regions for every grid, features are extracted from these regions. Normally in other techniques features are extracted from the pixels but in this technique features are extracted from the region. The extracted features include the area, orientation, mean, correlation and co-variance of the region

.

3.5 Final Classification

In-order to detect the presence of the tumour in the input MRI image, in this technique use the neural network classifier to classify the image into tumourous or not and its disease type also.

Figure 7: Segmentation with Proposed Modified Region growing method

The neural network consists of three layers which are input layer, hidden layer and the output layer. Initially the neural networks are trained by the features that are extracted in the previous step. For the training purpose, we have used about 30 MRI images of which 15 are normal and the other 15 are tumourous. The neural network is trained with features of these images. We have utilized Feed Forward Neural Network (FFNN) and Radial Basis Function (RBF) neural network for comparative analysis. The input MRI image is fed into the trained neural network after the pre-processing and modified region growing. The classifier compares the trained data with those of the input image feature data and classifies it into tumourous or normal.

4. Results

The performance of the technique is compared with the region growing algorithm to evaluate the sensitivity, specificity and accuracy

Table 1: Performance Evaluation of two methods

Evaluation Metrics		Training Dataset		Testing Datasheet	
		Region Growing	Modified Region Growing	Region Growing	Modified Region Growing
Input MRI Image Dataset	TP	9	10	7	10
	FP	2	0	3	1
	TN	4	5	4	4
	FN	0	0	1	0
	Sensitivity	100%	100%	70%	100%
	Accuracy	86%	100%	78%	93%

5. Conclusion

The technique consists of pre-processing, segmentation; feature extraction of the region and final classification.The normal region growing has the drawback of noise or variation of intensity which may result in over segmentation. To overcome this drawback an additional constrains of "orientation" is added in the modified region growing. By analyzing the results, the performance of the proposed technique has considerably improved the tumour detection compared with the region growing algorithm based MRI segmentation.

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