CHAPTER VI

CLASSIFICATION
CHAPTER 6

CLASSIFICATION

6.1 PREFACE

This Chapter deals with similarity between proposed segmented algorithms and Radiologist report. In this thesis, the proposed techniques block based non rigid registration, PSO with FCM, HPACO with FCM are used to detect the tumor region. The tumor Spatial Similarity Measure and Gray Level Similarity Measure similarity of the above techniques is measured with Radiologist report. The major objective of this thesis is to extract suspicious region from background tissue from MRI.

The PSO algorithm consists of three steps, namely

1. Generating particles,
2. Velocity update and

Here, a particle refers to a kernel in the entire brain image that changes its Spatial Similarity Measure from one move (iteration) to another based on velocity updates.

PSO which is computationally very efficient optimization technique is proposed for brain tumor image segmentation. The proposed method is relatively simple, reliable, and efficient. The efficiency was compared with HPACO. HPACO provides better performance comparing with PSO. HPACO can be concluded that the proposed approach has lower tumor value and lesser execution time. There is a decrease beyond 80% in both the values when compared to any other existing approach.
This method based on Average intensity measure for blocks of both normal and target image was calculated and compared. If there is any abnormality found in the normal image then it is stored in segmented database. Otherwise it is stored in normal database. In the following table, block 1 to block 4 of both source and target image does not have difference in average intensity but in block 5 to block 8 it has different values. Those values are stored in segmented database.

### 6.2 RELATED WORK

The Role of Classifier is an important one in implementation of Automatic System. This system is used to detect brain tumor tissues from MRI brain images. Several authors have suggested various techniques for classification, Rahmalan et al. performed a method on Self organizing Map for classifying features into a range of density [79]. MAO et al designed a classification method using Recursive feature elimination based on Support Vector Machine (SVM RFE) for gene selection and classification, which are integrated into a consistent framework [18]. Azadeh et al. designed Artificial Neural Networks (ANN)-Multilayer perceptron neural network for classify the image features [10,11].

Chin et al. represented Support Vector Machine used for trained by multiple feature vectors based on n-peptide comSpatial Similarity Measures and it tried to find the separating hyper plane with the largest distance [24,88].
Chikhl et al. specified techniques such as Support Vector Machine (SVM), Penalty Parameter based Support Vector Machine (PSVM) for assigning different weights to each class such that the training algorithm learns the decision surface according to the relative importance of data points in the training data [23]. Fadi et al. classified a glioma tumors using Brain electrical activity mapping [44]. Devos et al. specified techniques on Linear Discriminant Analysis (LDA), Least Squares Support Vector Machine (LS-SVM) for classifying linear, non linear, low and high grade tumors [31,32]. Guido et al. Presented a classification on Voxel and Geometric Model [12,41,51,88,91].

New CAD System is developed for verification and comparison of brain tumor detection algorithm. PSO and HPACO automatically determine the optimal threshold value of given image to select the initial cluster seed point then the clustering algorithm Fuzzy C Means calculates the adaptive threshold for the brain tumor segmentation. The results are compared with the existing approaches. Computational result indicates that the Particle Swarm Optimization algorithm improves the performances of the segmentation and can find the optimum solution faster than the other two methods.

The execution time for different segmentation techniques, HPACO with Fuzzy C Means require more time than the proposed PSO with Fuzzy C Means. The weight vector value obtained for the proposed method is less compared to the existing results. The input features for the segmentation process are mean, median, and standard deviations.
The variation of the total number of tumor Gray Level Similarity Measures detected of an image with various segmentation techniques. The value of the tumor cells detected with our proposed implementation is about 2215 for the HPACO with FCM but the value of the tumor Gray Level Similarity Measure detected for the PSO with FCM is only 2313. The increase in the value of the detected tumor cells is due to the abstraction level and FCM clustering process.

In image processing, execution time is an important parameter to analyze any image in general and medical image in particular. The execution time for the HPACO with FCM is 61.39 seconds and PSO with FCM is 100.03 seconds. The increase in the execution time for the proposed implementation is due to the layer by layer abstraction level and FCM clustering techniques.

The similarity between segmented results using various segmented algorithm with the Radiologist tumor identification report as per the hospital database is used to classify the images. The HPACO with Fuzzy and PSO with Fuzzy algorithms are used to identify tumor Spatial Similarity Measure and Gray Level Similarity Measure similarities are measured with Radiologist report. The true positive detection rate and the number of false positive detection rate at various thresholds of the images are used to measure the algorithm’s performance. These rates are represented using Free-Response Receiver Operating Characteristic (FROC) curve.
Proposed block based technique, PSO and HPACO with fuzzy based segmentation, HPACO technique provides better values. The accuracy of the brain tumor segmentation process is compared with the existing methods. The Average classification error of HPACO is 0.008% and the accuracy is 95.16% and tumor detection is 99.87%.

The average classification error is reduced when the number of sample is increased. The results have provided substantial evidence that for brain tumor segmentation of HPACO algorithm performed well.

6.3 CLASSIFICATION OF BRAIN TUMORS

The true positive detection rate and the number of false positive detection rate are used to measure the algorithm’s performance. An overlap means that at least 80% of the region extracted lies within the circle indicating a true abnormality as determined by KMCH Radiologist Report database.

For example, Patient MRI image the tumor containing in X coordinate Gray Level Similarity Measure is from 110 to 144 and y coordinate Gray Level Similarity Measure is from 140 to 170 in this area 1925 Gray Level Similarity Measures are affected by tumor.

The Segmented image by HPACO Containing in X coordinate Gray Level Similarity Measure is from 111 to 144 and y coordinate Gray Level Similarity Measure is from 141 to 171 in this area 1950 Gray Level Similarity Measures are affected by tumor. Compared to the KMCH Report with the HPACO segmented Report, results from the proposed method overlaps 98.71% of the specified region and this image is classified as true positive image.
Suppose the overlap is less than 80% of the specified region, and then the image is considered as false positive image. In this thesis, the true positive is considered only at 80% of overlap occurs. All other regions extracted by the algorithm are labeled as false positives.

In general, it is expected that the true positive detection rate in an FROC curve will continue to increase or remain constant as the number of false positives increase. In this case the true positive rate actually drops at certain points. If the threshold value is low true detections may become merged with false positive regions. The exact true positive and false positive rates are given in table shows false positive rates for the set of 120 patient images as affected for the brain tumor cases, the technique is only able to extract a very small fraction of the clusters.

6.4 SPATIAL AND GRAY LEVEL SIMILARITY MEASURE

The performance of intelligent system is best described in terms of their Spatial and Gray Level similarity measure accuracy, quantifying their performance related to false positive and false negative instances. These metrics are based on the consideration that a test point always falls into one of the following four categories

- False Positives (FP)
- False Negative (FN)
- True Positive (TP)
- True Negative(TN)
Table 6.1 Radiologist report and Algorithms

<table>
<thead>
<tr>
<th></th>
<th>Radiologist</th>
<th>Algorithms</th>
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<tbody>
<tr>
<td>TP</td>
<td>✓</td>
<td>X</td>
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<tr>
<td>TN</td>
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<td>FP</td>
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<td>FN</td>
<td>X</td>
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If TP and FN means both the Radiologist report and Algorithms will fall correct in finding the Gray Level Similarity Measure and Spatial Similarity Measure Similarity. If means TN and FP means both the Radiologist report and Algorithms will fall wrong in finding the Gray Level Similarity Measure and Spatial Similarity Measure Similarity

6.4.1 GRAY LEVEL SIMILARITY MEASURE

To compare the radiologists identified report tumor region Gray Level Similarity Measure with proposed segmented algorithm detect the tumor region Gray Level Similarity Measure to find the accuracy of the Gray Level Similarity Measure similarity accuracy, the ratio between our proposed techniques find out the number of segmented Gray Level Similarity Measure and number of Gray Level Similarity Measures identified in the radiologist report
6.4.2 SPATIAL SIMILARITY MEASURE

To calculate similarity between the radiologists identified report tumor region Gray Level Similarity Measure Spatial Similarity Measure with proposed segmented algorithm detect the tumor region Spatial Similarity Measure to find the accuracy of the Spatial Similarity Measure similarity. The ratio between the starting and ending Spatial Similarity Measure of X and Y with radius of radiolisit report identified region into our proposed algorithm segmented region.

6.4.3 OVERALL SIMILARITY

Overall Accuracy = the combination of gray level similarity accuracy and spatial similarity accuracy.

The HPACO with Fuzzy and PSO with Fuzzy algorithms are used to identify tumor Spatial Similarity Measure and Gray Level Similarity Measure similarities are measured with Radiologist report. The true positive detection rate and the number of false positive detection rate at various thresholds of the images are used to measure the algorithm’s performance. These rates are represented using Free-Response Receiver Operating Characteristic (FROC) curve. The number of Gray Level Similarity Measures affected by the tumor cells is calculated and the results have been compared with the existing results. The proposed HPACO with fuzzy based segmentation technique provides better values. The accuracy of the brain tumor segmentation process is compared with the existing methods. The percentage detection of tissues like tumor is 99.87%.
A. **Error Rate**

The Success of this approach to identify the number of tumor Gray Level Similarity Measure in terms are

- Gray Level Similarity Measure Error Rate
- Spatial Similarity Measure Error Rate

Gray Level Similarity Measure Error Rate is the tumor Gray Level Similarity Measure accuracy less than 80% is rejected as a True Negative. Spatial Similarity Measure Error Rate is the tumor Spatial Similarity Measure with minimum of 50%.

**6.5 SUMMARY**

In the thesis, the lowest error Rate is 20%. The PSO with FCM configuration is compared with HPACO with FCM. The Lowest Error Rate in the accuracy percentage and the error rate of different algorithms are calculated and shown above. HPACO gives the best accuracy comparing with other optimization techniques. Overall accuracy of tumor Gray Level Similarity Measure using HPACO is 95.16%.