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# Comparative Analysis of FIG and PSO For Classifying Brain Diseases.

**Manjula K[1]* , Monisha A[2], Reshma K[3], Swetha P[4], and Vijayarekha K[5].**

[1,2,3,4]School of Computing, SRC,SASTRA University,Kumbakonam, India.
[5]School of EEE,SASTRA University, Thanjavur, India.

**ABSTRACT**

The medical CT brain disease image types are to be identified using its features such as textural features (BHOG, LBP) and statistical features (Wavelet, CVH). **T**he feature selection process is used to extract the optimal features of CT images. The CT brain disease images can be classified based on the selection of the optimal features using various algorithms. It improves the performance of the classification process. In this paper, CT images for brain diseases are classified by using feature selection algorithms such as Fisher Criterion and Genetic Optimization and Particle Swarm Optimization. The K-NN classifier is used for classifying the brain disease images based on the selected features. The type of brain disease is found using both the algorithms (FIG+KNN and PSO+KNN). Both the algorithms are compared by using its performance measures such as Specificity and Accuracy then the optimal one is found. It is proven that the feature selection algorithm PSO using K-NN gives better classification than that of FIG using K-NN.

**Keywords**- K-NN Classifier, Fisher Criterion and Genetic Optimization, Particle Swarm Optimization, Brain disease image

***Corresponding author***

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## INTRODUCTION

The medical field plays an important role in this world. In order to protect the life of patients' from the critical diseases, the day to day improvements are being considered periodically. A CT (computed tomography) scan is used to take detailed pictures of inner structures of the body. The Computed Tomography (CT) scan can provide valuable information in the diagnosis of brain diseases. CT images can use to get detailed information of the inside of the body. To recognize the signs of brain diseases, FIG and PSO algorithms can be used and then they are compared to each other to find its performance. In these algorithms, two types of features are extracted such as statistical and textural features. For this four Feature Extraction processes such as B-HOG, Wavelet, LBP and CVH Feature Extraction are used to remove the redundant features and to transform into reduced set of features. Feature selection process is for selecting a specific feature set from an image. Two feature Selection processes such as FIG and PSO to select the best features from the set of features. For classification purpose K-NN( K – Nearest Neighbors) classifier is used. Finally Feature Selection process FIG and PSO are compared to each other to find the best one by using its performance measures such as Sensitivity, Sensitivity and Accuracy. In this paper, Section II described about the recent literatures; Section III deals with the proposed methods FIG and PSO. The results are given in Section IV. Section-V deals with conclusions.

### Literature Survey:

The authors [1, 2, 3, 4] proposed that Genetic algorithm (GA) is developed to find the most optimized solution for a given problem .And they have finally concluded that the genetic algorithm improves the computational speed of estimating the fittest solution. Fisher criterion algorithm is applied to obtain the fittest solutions so that it reduces the dimensionality of the image. The authors [5,6] proposed one of the classification algorithm known as k-Nearest-Neighbours (k-NN). The 'k' value is set automatically. It is varied from data to data and then it is optimal by means of classification accuracy. The construction of the model reduces the dependency on k and makes classification quicker.

The authors [7, 8, 9, 10, 11] proposed that a heuristic search algorithm PSO which provides a number of ways to solve the real world problems in an efficient way. It is applied to multi-objective problems. Because of less number of function evaluations, It is computationally efficient than that of Genetic Algorithm. The author [12] proposed that brain health is important for quality of life. They analyzed and found Alzheimer's disease using MRI. The author [13] proposed the CBIR using Nearest Neighbour and Hybrid KNNSVM to analyse Magnetic Resonance Images from the large database. The authors [14] used sketch based image retrieval using information content of orientation.

## METHODOLOGY

Region of Interest (ROI) in the Brain CT images is obtained and the features are extracted from those regions. The four different features such as B-HOG features, Wavelet features, LBP features and CVH features have been extracted from the images. B-HOG and LBP are texture based features whereas Wavelet and CVH are spatial features. In LBP (Local Binary Pattern) the central point is to be identified and then it is to be tested whether the adjacent points are greater than or less than the central point.The wavelet based features are extracted by splitting images using wavelets in the levels.The Bag of visual words and Histogram of Oriented Gradients (BHOG) extracted by count occurrences of gradient orientation in localized portions of an image. CVH feature means Histogram of CT value and it is extracted by computing the Histogram of CT values over each ROI.

The combination of the spectral and the spatial features are more effective in the identification of the diseases in the images. The extracted features are large in number and hence the best features are selected from the extracted features. For the selection of the best features, Fisher Criterion based Genetic Optimization (FIG) and Particle Swarm Optimization (PSO) algorithms have been used.

### Fisher Criterion and Genetic Optimization (FIG):

Fisher criterion is used in the place of the objective functions in genetic optimization algorithm. Figure 1 shows the process of FIG. In FIG, Mutation and Crossover operations are the basic steps in the genetic

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algorithm. In the crossover step the new population of genes are initialized by modifying the previous population of genes. After the crossover step mutation step is employed. In the crossover step child chromosomes are created. After the mutation and the crossover step the stopping condition is verified and the process is repeated till the stopping condition is reached.

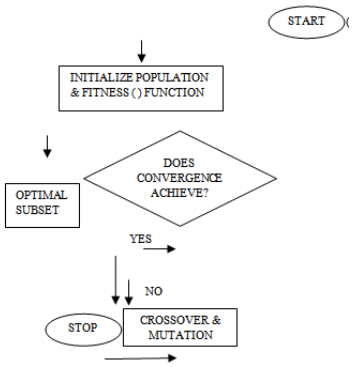


**Fig 1: Fig Process**

**Particular Swarm Optimization (PSO):**

The algorithm PSO is also used in the field of digital image processing and pattern recognition. This algorithm uses a population (known as swarm) of candidate solutions (known as particles). By using the particles own best known position in the search - space as well as the entire swarm's best known position; these particles are guided to move around in the search-space. The movements of the swarm will be guided whenever the improved positions are being found. Until reaching optimal solution, this process will be repeated. Figure 2 displays the process of PSO algorithm.

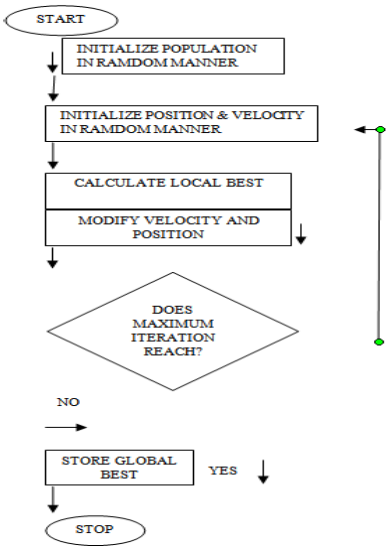


**Fig 2: Pso Process**

Finally from FIG and PSO, the features are selected and then classified using k-NN classifiers.

**k-NN classifier and Performance Analysis:**

K-Nearest Neighbour classifier is used for classification and regression. Its classification performance can be improved through supervised learning. The performance analysis is for analysing the performance of the process. The performance of the process is measured based on the performance metrics like Accuracy and Specificity. These can be calculated using the following specifications:

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Accuracy= (PT+NT) / (PF+NT) + (PT+NF)
Specificity= NT / (PF+NT)

Where Positively True (PT) means correct identification; Positively False (PF) means incorrect identification; Negatively True (NT) means correct rejection and Negatively False (NF) denotes incorrect rejection.

## RESULTS AND DISCUSSION

CT Brain images are taken as the input. The dataset consists of Brain images with different type of diseases. The ROI is selected from the CT Brain images because the other regions may contain some unwanted information. Figure 3 shows the input image then its cropped image is shown in figure 4.The four different types of features are extracted. For the selection of the best features from the extracted features Fisher criterion and genetic optimization (FIG) and Particular Swarm Optimization (PSO) is employed. The selected features are then classified using K-NN classifiers in order to find the disease in the brain images. Figure 5 shows the classification of given (fabry disease) image using FIG+KNN and PSO+KNN algorithms. The performance of the process is measured based on the performance metrics like Accuracy and Specificity. The performance is analysed using its performance metrics and the same is represented graphically using Figure 6. The performance of these two algorithms measured for seven different brain disease images and tabulated in Table 1. The performance measured indicates that PSO gives good result than FIG.

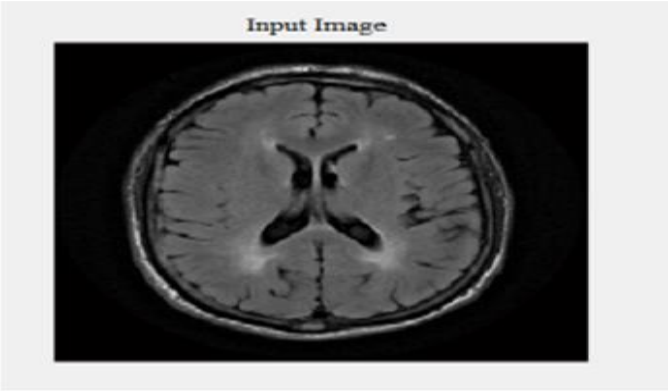


**Fig 3: Input Image**

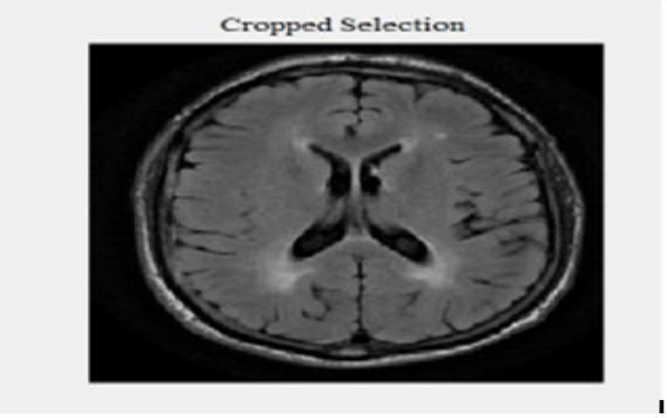


**Fig 4: Cropped image**

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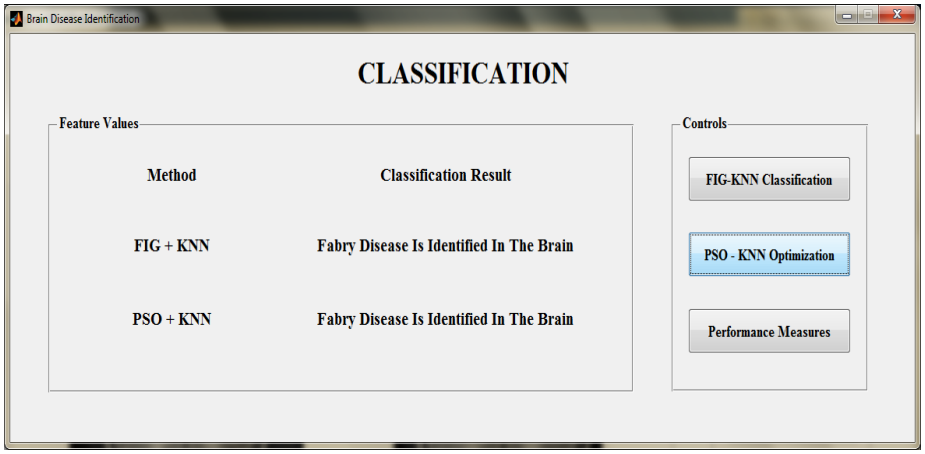



**Fig 5: Classification**

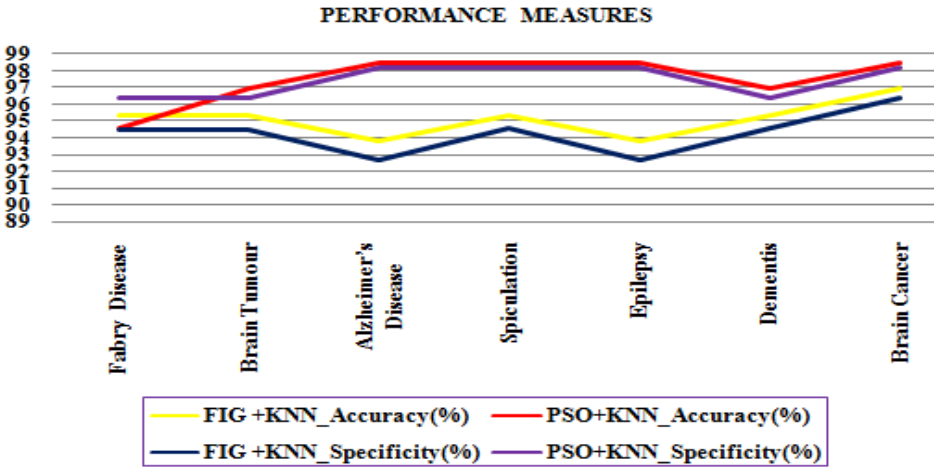
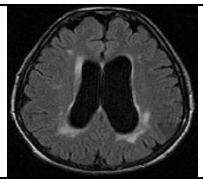
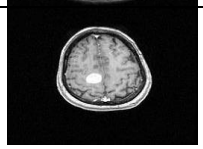
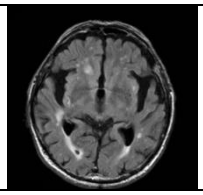



**Fig 6: Performance Measures**

| S.NO | Image | Image Name | FIG +KNN | | PSO+KNN | |
|---|---|---|---|---|---|---|
| | | | Accuracy(%) | Specificity(%) | Accuracy(%) | Specificity(%) |
| 1 |  | Fabry Disease | 95.3846 | 94.5454 | 94.5455 | 96.3636 |
| 2 |  | Brain Tumour | 95.3818 | 94.5094 | 96.9231 | 96.3636 |
| 3 |  | Alzheimer's Disease | 93.8462 | 92.7273 | 98.4615 | 98.1818 |

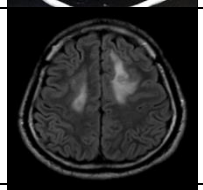
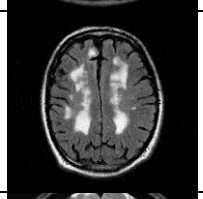
| | | | | | | |
|---|---|---|---|---|---|---|
| 4 |  | Spiculation | 95.3846 | 94.5455 | 98.4615 | 98.1818 |
| 5 |  | Epilepsy | 93.8462 | 92.7273 | 98.4615 | 98.1818 |
| 6 |  | Dementis | 95.3846 | 94.5455 | 96.9231 | 96.3636 |
| 7 |  | Brain Cancer | 96.9231 | 96.3636 | 98.4615 | 98.1818 |

**Table 1: Performance Measurement values brain diseases using FIG and PSO with KNN**

## CONCLUSION

In this paper, the efficient methods FIG and PSO for recognizing the brain disease have been proposed. By comparing FIG with K-NN and PSO with K-NN using its performance measures, it is proven that PSO recognizes the brain diseases better than that of FIG. The process can be further enhanced by combining the fisher criterion with other feature selection methodologies. The selection of the best features can be based on the application of the different objective functions in the feature selection process.

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