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DETECTION OF MRI BRAIN TUMOR USING CLOWN FISH ALGORITHM & SVM CLASSIFIER

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Abstract— **One of the major causes of death among people is brain tumor. The methodologies used in this process are preprocessing, segmentation, feature extraction, classification. In case of preprocessing, the median filter is used. For segmentation, a new sophisticated clown fish queuing and optimization algorithm for the segmentation of the brain tumor is proposed. The algorithm is based on the queuing characteristics of the clown fish. From this, feature is extracted from the detected tumor. Then the Classification is done, which is an important part to differentiate between normal patient and a patient who has tumor in brain. For classification the Support Vector Machine (SVM) classifier is used. SVM classifiers trained by combining samples from several patients .While training an image we classify the tumor as benign & malignant. Finally the characteristic of tested image is compared to the trained image, from which the type of tumor is detected.**

Keywords--- Magnetic Resonance Imaging (MRI), clown fish algorithm, feature extraction, SVM classifier.

I. INTRODUCTION

Brain is a complex organ since it contains more than 10 billion working brain cells. A **brain tumor** or **intracranial neoplasm** occurs when abnormal cells form within the brain. Brain Tumor is a life threatening disease .The two major classification of tumor are Benign Tumor and Malignant Tumor. Benign Tumor is a non-cancerous cell. It does not cause death or serious injury. Malignant Tumor is a cancerous cell. This malignant tumor tends to grow and spread in a rapid and uncontrolled way that can cause death. Some research shows that people affected by brain tumor died due to their inaccurate detection. Computed Tomography (CT), Magnetic Resonance Imaging (MRI), Positron Emission Tomography (PET), Single Positron Emission Computed Tomography (SPECT) is some of the imaging technique used majorly to identify diseases. MRI scan is more comfortable than any other scans. It will not affect the human body because it does not practice any radiations.MRI plays an important role in assessing pathological conditions of the ankle, foot and brain. Using these scanners doctors are able to easily visualize and locate the particular portion or area where the disease is being affected and finally to detect them some methodologies are processed. Huang Z, Chen Y., An Improved Artificial Fish Swarm Algorithm based on Hybrid Behavior Selection. It is high dimensional function optimization & more powerful global exploration ability.

Murugavalli, Rajamani V., An improved implementation of brain tumor detection using segmentation based on neuro fuzzy technique. Detect various tissues like white matter, gray matter, cerebrospinal fluid and tumor. The K-means algorithm is an iterative technique that is used to partition an image into K clusters. K can be selected manually, randomly, or by a heuristic as explained by J. Selvakumar et al. In this paper the following methodologies are used, they are Preprocessing, image segmentation, feature extraction and then classification. For preprocessing the median filter is used. Following that, the image is segmented using clown fish queuing and optimization algorithm. The features are extracted from segmented image. Using SVM classifier, the type of tumor is detected.

II. PROPOSED METHODOLOGY

The Figure 1 represents the detection and classification of brain tumor.

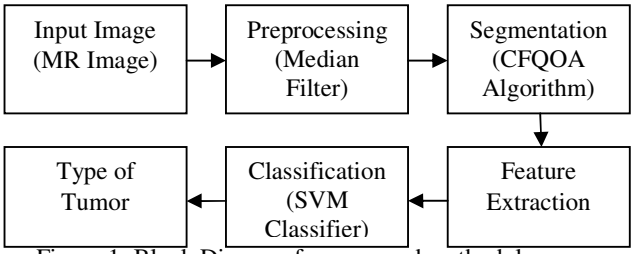

Figure 1: Block Diagram for proposed methodology.

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A. Preprocessing:

Preprocessing is the term for operations on images at the lowest level of abstraction. The aim of pre-processing is an improvement of an image data that suppresses undesired distortions or enhances some image features for further processing and analysis task. In this paper, median filter is used to preprocess an image. Median filtering is a non-linear technique used to reduce noises. Under certain condition, it maintains the edges while removing noise. It also involves the process of removing the film artifacts such as patient's name, age, and other details.

B. Segmentation:

In segmentation process, the clown fish queuing and optimization algorithm is used. The unique behavior of clown fish is that it always makes a relationship with sea anemones and are quite active. In other words, it gets benefits by living in anemones, by eating the leftovers from fish on the anemone and algae. The female clown fish are mostly dominant and large, it is denoted as alpha. The male fishes are small and denoted as beta. The remaining immature fishes are gamma. They develop into male fishes first; when they mature it becomes female. If the female fish are death, then the male fishes acquire female's position and the immature fishes will become new male fishes. Each and every fishes has certain behavior and they are prey, swarm, follow and switch, where they go in search for dominant positions and food consistence to survive. The prey behavior that tends to the food and swarm is moving towards the food. Remaining fishes follows towards and makes a queue. When this algorithm started to get operated the fishes will start moving into the image in the form of cells through simulation. This simulation happens till it finds food and position (i.e., minimum threshold). Since it undergoes queuing and switching process till it is optimized. At this point alpha becomes zero and beta becomes one, from this the tumor detected part will be white. This is the basic concept of this algorithm. The flow chart and equations are given below,

The position of dominant fishes "i" as Xi and normal fishes "j" as Xj. The distance as Euclidean,

$$dij = \|Xi - Xj\| \quad (1)$$

The visual distance is the distance between the location fishes, and the crowd factor (δ) is termed as the degree of freedom at which the fish moves. nf is the number of its fellow within the Visual.

Mstep is the maximum step of the fish moving; Step is a random positive number within Mstep;

$$S = \{Xi / \|Xi - X j\| < Visual\} \quad (2)$$

is the set of fish j exploring area at the present position.

Y=f(X) is the fitness function for reaching the dominant position.

$$Prey(Xi) = Xi + step(Xj - Xi)/(\|Xj - Xi\|) \text{ if } Yj > Yi, \quad (3)$$

$$= Xi + step, \text{ else,}$$

$$Swarm(Xi) = Xi + step(Xc - Xi)/(\|Xc - Xi\|),$$

if ,Yc/fish_no> crowd factor = prey(Xi)

Where; $Xc = \Sigma_{x = crowdfactor} Xj/fish\_no$ (4)

Else, Follow (Xi) = Xi + step(Xmax-Xi)/(||Xmax-Xi||)

If, Ymax/fish_no>crowdfactor (5)

Else, prey(Xi) where Ymax = max{f(Xj)|Xj} (6)

The total number of fishes assigned is 50.Thus, the MR image is segmented and the tumor is detected.

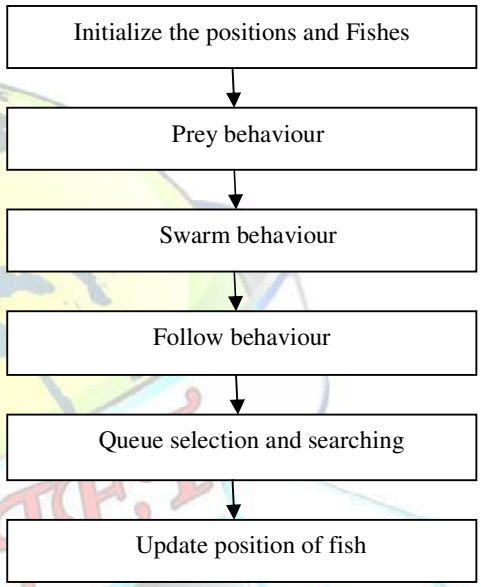

Figure: 2 Flow Chart for CFQOA.

C. Feature extraction:

Feature extraction is the process of transforming the input data into a set of features which can be represented as input data. From the segmented MRI brain images, the feature will be extracted. This feature extraction involves to describe the large set of data accurately, by reducing the amount of data. The following features are extracted from the segmented image.

1. Symmetrical.
2. Texture.
3. Gray scale.

Thus features are extracted using the following parameters which comes under those three categories are mean,standarddeviation,skewness,variance,kurtosis,entropy,energy,RMS,correlation,IDM,contrast,homogeneity.

D. Support Vector Machine (SVM) classifier:

The segmentation results are obtained for the purpose of classifying benign and malignant tumors. In order to

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classify the type of tumor as benign or malignant, we applied SVM. Support vector machine algorithm depends on the structural risk minimization principle SVM is a systematic technique for two class problems. The SVM classifier is used in many research areas because it gives high performance in pattern recognition and image processing tasks. SVM is most likely used in problems with small training dataset and high dimensional feature space. Like neural networks, SVM needs two stages; training and testing. The SVM can be trained by features given as an input to its learning algorithm. During training, the SVM finds the suitable margins between two classes. Features are named according to class associative with specific class. SVM belong to a family of generalized linear classification. A special property of SVM is SVM simultaneously minimize the empirical classification error and maximize the geometric margin.SVM does not suffer from the small size of training dataset and obtains optimum outcome for practical problem since its decision surface is specified by the inner product of training data which enables the transformation of data to a high dimensional feature space. SVM called Maximum Margin Classifiers.SVM is based on the Structural risk Minimization (SRM). SVM map input vector to a higher dimensional space where a maximal separating hyper plane is constructed. The feature space can be defined by kernel function K(x, y). [9] proposed a system in which this study presented the implementation of two fully automatic liver and tumors segmentation techniques and their comparative assessment. The described adaptive initialization method enabled fully automatic liver surface segmentation with both GVF active contour and graph-cut techniques, demonstrating the feasibility of two different approaches.

There are many kernel functions in SVM, so how to select a good kernel function is also a research issue. However for general purposes there are some popular kernel functions (a). Linear kernel (b).Polynomial kernel (c).RBF kernel (d).Sigmoid kernel In these popular kernel functions, RBF is the main kernel function because of following reasons :

1. The RBF kernel nonlinearly maps samples into a higher dimensional space unlike to linear kernel.
2. The RBF kernel has less hyper parameters than the polynomial kernel.
3. The RBF kernel has less numerical difficulties.

III. ALGORITHM FOR PROPOSED METHODOLOGY

i. Load the input image.
ii. Preprocess the input image using median filter.
iii. Initialize the number of fishes.
iv. The movement of the fish is defined in terms of crowd factor (i.e., speed of the fishes).
v. Map the input MR image I and the binary of the input image J.
vi. Provide directions for the fish to move.
vii. Use the formulas of prey, step, swarm, follow and update its value.
viii. Detect the gradient and threshold of the image.
ix. Find the step of the fishes and then update its position.
x. The detected tumor image should be further processed to determine its features.
xi. From the segmented tumor image the following parameters such as mean ,standard deviation, entropy,RMS,variances,smoothness,kurtosis,skewness,IDM,contrst,correlation,energy,homogeneity are used for feature extraction.
xii. The output obtained from the feature extraction is given as the input to the SVM classifier.
xiii. The several data sets are trained and is classified as benign and malignant.
xiv. While testing an MR brain image, the extracted features from the image will be compared to the trained data.
xv. Finally the tumor is classified as benign or malignant.

IV. RESULTS AND DISCUSSION

In this paper, the brain tumor is detected and classified using clown fish queuing and optimization algorithm for segmentation and SVM classifier for classification. Thus the results are produced using MATLAB2013a in windows 8 OS and worked under Pentium processor.

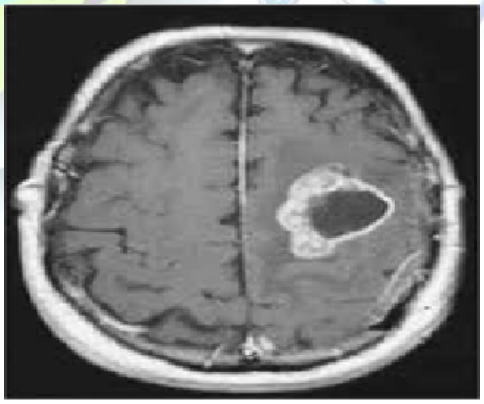

Figure: 3 Input MR image .

The figure 3 the MR brain tumor image is provided as the input acquisition.

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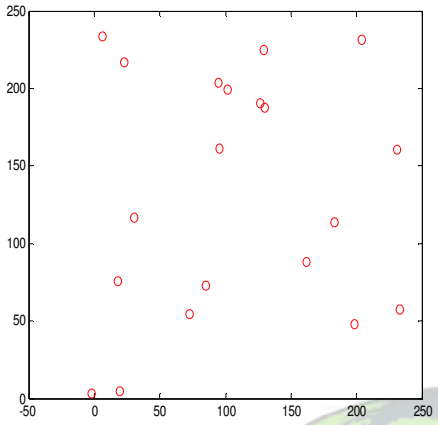

Figure :4 Movement of fishes from Input Image.

In figure 4, once the algorithm gets operated,the movement of fishes happens by simulation in the input image.

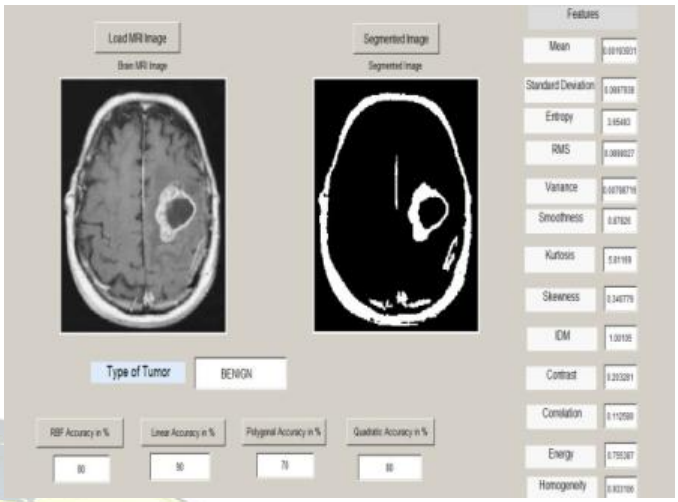

Figure :6 Classified output using SVM classifier.

In figure 6, the features are extracted from the segmented image and is classified.

Figure: 5 Segmented image using CFQOA.

In figure 5, the input MR image is segmented using clown fish queuing and optimization algorithm from which the tumor is detected.

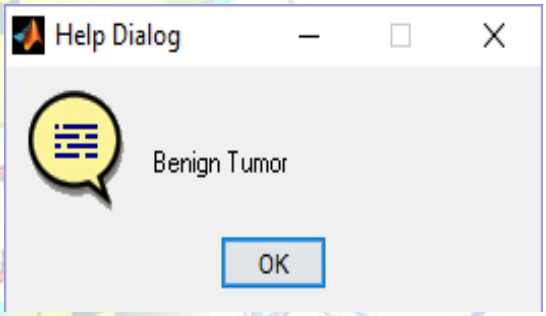

Figure :7 Type of tumor.

In figure 7, based on classified output the tumor type is detected as benign, which is an non cancerous cells.

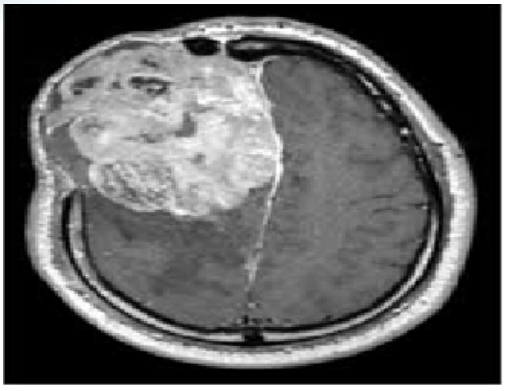

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Figure :8 Input MR image.

The figure 8 the MR brain tumor image is provided as the input acquisition.

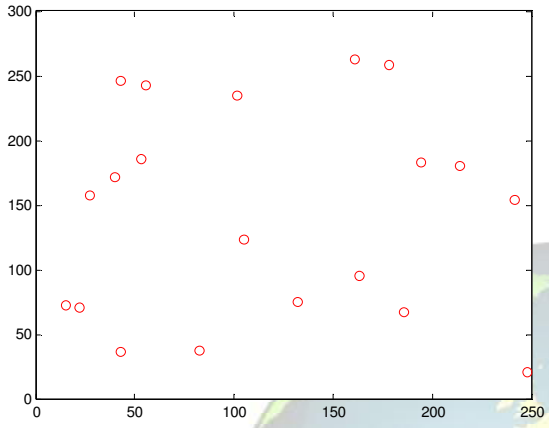

Figure :9 Movement of fishes from Input image.

In figure 9, once the algorithm gets operated,the movement of fishes happens by simulation in the input image.

Figure :10 Segmented Image using CFQOA.

In figure 10, the input MR image is segmented using clown fish queuing and optimization algorithm from which the tumor is detected.

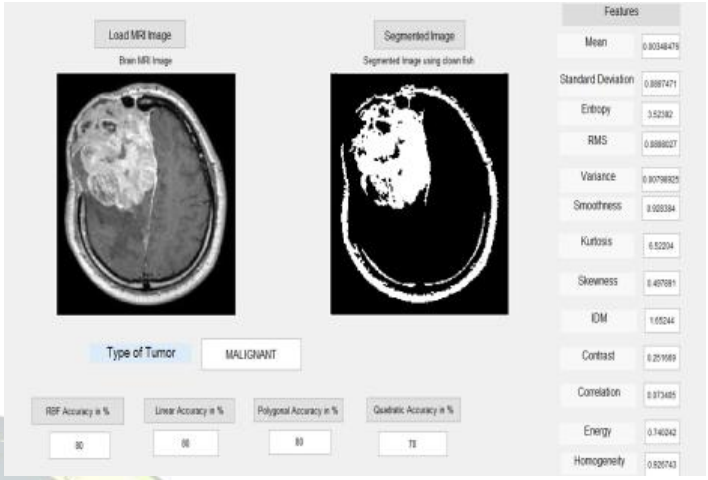

Figure :11 classified output using SVM classifier.

In figure 11, the features are extracted from the segmented image and is classified.

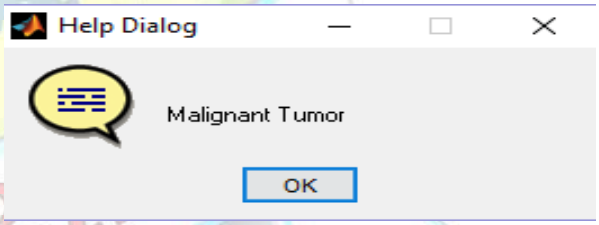

Figure :12 Tumor Type.

In figure 12, based on classified output the tumor type is detected as malignant, which is an cancerous cells.

V. CONCLUSION

This paper helps the doctor to detect the tumors exact progression. It is good, if caught at earlier stage. There is plenty of algorithms for segmentation, but in this paper the clown fish queuing and optimization algorithm is used for segmentation. For classification, the features extracted from the segmented image are further classified using SVM classifier. The tumor is detected and classified precisely.

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