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# AN EFFICIENT CLASSIFICATION SCHEME BASED ON COMMON REFLEX FUZZY MIN-MAX NEURAL NETWORK FOR BRAIN TUMOR DETECTION

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**Abstract:** Brain tumor is most dangerous disease among the cancerous diseases. The chances of the death in brain tumor are more as compared to other diseases. To stay away from the chances of death in the early detection of brain tumor is necessary. Nowadays Brain tumor detection and classification is one of the most active research areas in medical image processing field. Detection of the brain tumor manually by doctors was very difficult and time consuming process. To avoid the misclassification and to minimize the time, automatically brain tumor detection and classification is necessary. So, in this work, a common Reflex Fuzzy Min-Max (RFMM) neural network classification scheme is proposed for brain tumor detection. Initially, the input image is pre-processed to remove poison noise as well as active contour is used for edge detection to improve the detection result. Then, tumor region are segmented by Glow-worm Swarm based Clustering (GSC) scheme. After that, the geometric and texture features are extracted. Finally, the RFMM neural network is classified the MRI (DICOM) image into normal or abnormal image. The simulation results show that this RFMM neural network obtained better accuracy compared than existing Support Vector Machine (SVM) algorithm.

***Keywords:*** Brain tumor, MRI (DICOM) image, texture, geometric, neural network, classification.

## 1. INTRODUCTION

Tumour is one of the foremost reason for death in economically developed countries and second important reason for death in developing countries. Tumour accepted medically as a malignant neoplasm, which is an extensive group of a mixture of diseases, all concerning unregulated cell growth. In cancer, cells break up and breed widely, forming malignant tumours, and raid nearby parts of the body. The cancer may also expand to more distant parts of the body through the lymphatic system or bloodstream. Not all tumours are cancerous. Benign tumors do not produce wildly ,do not attack neighboring tissues, and do not spread throughout the body.

Tumor is usually treated with chemotherapy, radiation therapy and surgery. The chances of surviving the disease vary greatly by the type and location of the Tumour and the extent of disease at the start of treatment. On the other hand, Tumors can have an effect on people of all ages, and few types of Tumors are most common in children, the risk of developing Tumor generally increases with age. In 2008, Tumor caused about 13% of human deaths worldwide (7.9 million). Rates are rising as more people live to an old age and as mass lifestyle changes occur in the developing world (Jemal et al 2011). More than 70% of cancer deaths occurs at the low- and middle- income countries. Deaths as of cancer worldwide are projected to continue rising, with an estimated 11.5 million deaths in 2030.

Brain tumor is one of the primary reasons for the rise in mortality among children and adults. A tumor is a group of tissue that propagates out of control of the normal forces that regulate growth. Brain tumors occurs when a type of cell changes from its normal character and grows and then multiplies in an abnormal way.

MRI is used to detect the presence and absence of tumors. MRI produce much greater variation between the various soft tissues of the body than computed tomography (CT) does, making it peculiarly useful in neurological (brain), oncological, musculoskeletal, cardiovascular and (cancer) imaging. It's not like a CT scan. It benefits no ionizing radiation, but uses a powerful magnetic field to adjust the nuclear magnetization of (usually) hydrogen atoms in water in the body.

### 1.1.Categories of Brain Tumor:

a) Primary brain tumor

A Primary brain tumor is one that originates in the brain itself. Although, these t y p e s o f brain tumors frequently shed cancerous cells to other places in the central nervous system (the brain or spine), they rarely spread to other parts of the body. Primary brain tumors are named due to its cell types, from which they are originated.

b) Secondary brain tumor (metastatic)

A secondary brain tumors occurs when cancer cells spread toward the brain from a primary cancer to other parts of the body. Secondary tumors are on the subject of three times more common than primary tumors of the brain. Secondary brain tumors take their origin from tumor cells which spread to the brain from another location in the body.

c) Benign tumor

A tumor (solid neoplasm) having self-limiting growth does not conquer other tissues or metastasis. A benign tumor does not contain any cancer cells and usually, once removed, does not reappear. Most benign brain tumors have clear borders, meaning they do not invade surrounding tissues. These tumors might cause symptoms related to cancerous tumors because of their size and location in the brain (Francis Ali- Osman 2005).

d) Malignant tumor

Malignant brain tumors contain cancer cells. Malignant brain tumors are usually rapid growing and conquer surrounding tissues. It very hardly spread to other areas of the body, but may recur after treatment. At times, brain tumors which are not cancer are called malignant because of their size and location, and also the damage they do with the vital functions of the brain.

### 1.2.Magnetic Resonance Image:

Currently, most of the medical imaging studies and finding are conducted by means of MRI, Positron Emission Tomography (PET) and Computed Tomography (CT) scan. An MRI scan is a radiology method that uses magnetism, radio waves, and a computer to produce images of human body structures. The MRI scanner having a tube surrounded by a massive circular magnet. The patient who needs the scanning is placed on a moveable bed which can pass through the magnet. The magnet creates a strong magnetic field that aligns the protons of hydrogen atoms, which then exposed to a beam of radio waves. This spins a variety of protons of the body, and produce a weak signal whic is detected by the receiver portion of MRI scanner. The receiver information is processed by a computer, and an image is created. The image as well as the resolution formed by MRI are quite detailed and can able to detect insignificant changes of structures within the body.A contrast agent like gadolinium can be used to increase the accuracy of the images (Joseph 2013).

An MRI scan can be used as an accurate method for disease

detection all over the body. At the top, trauma to the brain can be seen as bleeding or swelling. Other abnormalities often includes brain aneurysms, stroke, tumors of the brain, as well as tumors or inflammation of the spine. MRI scanners can produce 1500 images per second. Intra operative MRI can acquire high contrast images of soft tissue anatomy. It can also be acquired individually in as little as half a second per image.

a) Advantages of MRI

MRI does not make use of ionizing radiation, and is thus preferred over CT in children and patients requiring multiple imaging examinations. MRI is the modality of alternative to evaluate the brain morphology because it provides a superior soft-tissue contrast with flexible data acquisition protocols that highlights several different properties of the tissue. MRI illustrates anatomy in greater detail, and is more sensitive and specific is abnormalities within the brain itself. MRI scanning can be performed in any imaging plane without having to physically shift the patient. Frequently, surgery can be referred or more accurately directed after knowing the results of an MRI scan.

b) Drawbacks of MRI

The drawbacks are that they are very noisy and they can be affected by movement. So, they are not used for some mouth tumors. High static magnetic fields may induce nausea, vomiting, dizziness and headaches in humans.

**1.3.Computer-aided Diagnosis System:**

A Computer Aided Diagnosis (CAD) system has been developed for automatic detection of brain tumor through MRI. The CAD system can provide a better mechanism to identify the brain tumors than the conventional methods.

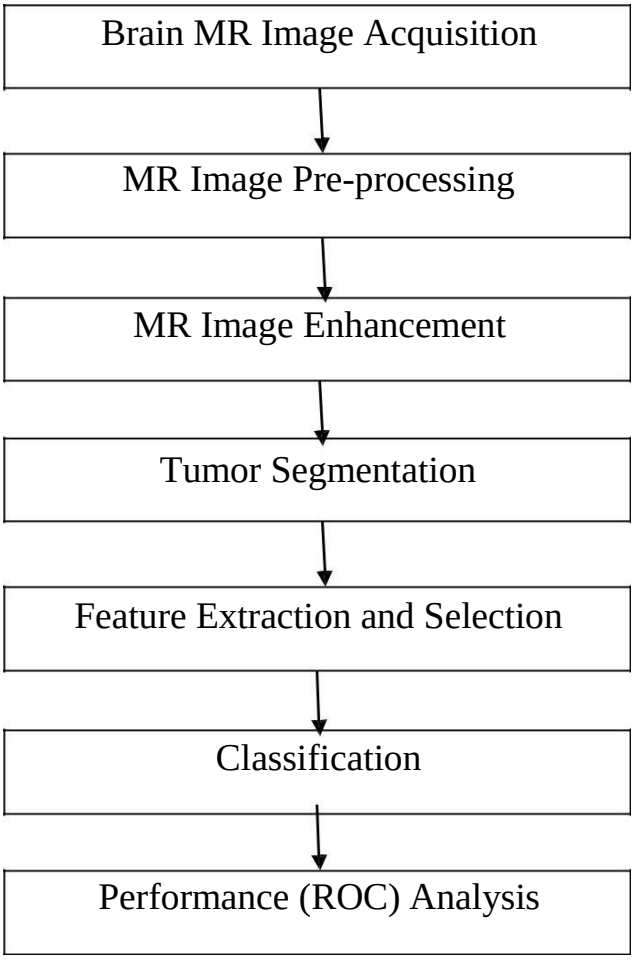


Figure 1.1 Flow diagram of CAD system

The first stage having brain image acquisition, preprocessing and enhancement. Second, stage consists of segmentation, feature extraction, classification, and performance analysis. Pre-processing and enhancement techniques are used to improve the detection of the suspicious regions in MRI.Pre-processing and enhancement methods remove film artifacts and high frequency components from the MR image. Segmentation describes the separation of the suspicious region from the background MRI using various optimization techniques. Textural features are extracted and selected from the suspicious region and then classified as normal or malignant.Finally a performance analysis is done for the proposed technique with the existing techniques.

Database:In the medical world, to ingress the real medical images like MRI, PET or CT scan and to resume a research are a very complicated because of privacy problem and heavy technical deadlocks. The objective of this study is to compare the DICOM image sample sets for evaluation and make effective classification.

## II. EXISITING SYSTEM

Support Vector Machine (SVM) is an algorithm that was developed for pattern classification. It is applied to various optimization problems such as regression and the data classification. The data points are identified as being positive or negative, and the problem is to find a hyper-plane that separates the data points by a maximal margin.

SVM is a useful technique for data classification. It is easier to classify the data and it involves testing for some data instances. The objective of SVM is to produce a model which predicts target value of data instances in the testing set which are given only the attributes. The steps within SVM classification involves the identification as if familiarly connected to the identified classes called as feature selection or feature extraction. The objective is to find classifier with largest margin between closest positive and negatively labeled support vectors. Normal vector for optimal separating hyper plane $w_{opt}$ is found using a quadratic optimization procedure.

In existing system, Support Vector Machine (SVM) based classifier with Berkeley Wavelet Transformation (BWT) based brain tumor segmentation has been presented.

The experimental results achieved accuracy, specificity, and sensitivity.

Disadvantage: The classification accuracy was not good and it has taken high training time for process the image. So, the performance was not good.

Most common disadvantage of non-parametric techniques such as SVMs is the lack of transparency of results. SVMs could not represent the score of all companies as a simple parametric function of the financial ratios, since its dimension perhaps very high. It can a linear combination of single financial ratios or it may have an additional simple functional form. The weights of the financial ratios are not constant. Thus the marginal contribution of each financial ratio to the score is changeable. Using Gaussian kernel, every company has its own weights according to the difference between the value of their own financial ratios and those of the support vectors of the training data sample.

## III.PROPOSED SYSTEM

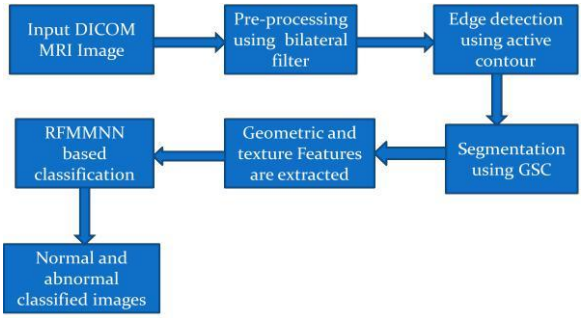


Figure 3. Proposed block diagram representation

### 3.1. PRE-PROCESSING:

Pre-processing using bilateral filter to remove the poison noises without reduces the sharpness of the images. Then, the edge has been deducted by using active contour scheme to improve the segmentation process. Here, the level set active contour method has been used. The level set method is a numerical technique that is used to track the interfaces and shapes. In level set method, the contours are set as zero level set of higher dimensional function, known as level set function. Initially, geometrical shaped contours are set and after a number of iteration the contours spread over the

vision of interest or the edges of the object boundaries.

Pre-processing indicates that the same tissue type may have a different scale of signal intensities for different images.

### 3.2.EDGE DETECTION USING ACTIVE CONTOUR

Active contour models are mainly intended for image segmentation, allows a contour to deform iteratively and then detachment an image into different regions.

Active contour models have been extensively applied to image segmentation. The basic idea of active contour is to use a deformable model and let it evolves in each iteration to minimize a given energy function.

### 3.3.GLOW-WORM SWARM BASED CLUSTERING (GSC) SCHEME BASED SEGMENTATION

To separate the tumor region from the image the segmentation process has been carried out. Here, the clustering concept has been implemented for separation process. Two classes are considered such as normal region and tumor region. The Glowworm Swarm Optimization (GSO) scheme has been implemented for this clustering process to separate the regions.

The Glow worm Swarm Optimization (GSO) algorithm Glow worm swarm optimization (GSO) [14] is the first swarm intelligence algorithm used for optimizing multimodal functions with equal or distinct objective function values. Initially the swarm of N glow worms (g1....gn) are scattered in the search space. Each glow worm gi releases the bio luminescence substance, luciferin Li to make itself visible for other glow worms within its vision range. The vision range for each glow worm varies depending on the amount of luciferin released. All the glow worms searches for their neighbors within their vision range and then move towards the brighter glow worm within their neighbor set. The best neighbor with higher luciferin value has been selected using the probabilistic mechanism. In each iteration, the position of the glow worm changes and the luciferin value gets updated. At the end, most of the glow worms group together to make the compact clusters in the search space at multiple optimal solutions. The GSO algorithm has got many significant features over other swarm intelligence algorithms. It is capable of capturing the multiple local optima of any multimodal function. The vision range for local neighborhood is dynamic which can be effectively used for realistic scenario. The strength of optimization and dynamic nature of the glow worms inspired us to apply the GSO to find the optimal solution for clustering the multimedia documents.

### 3.4.FEATURE EXTRACTION

From the segmented region, the geometric and texture features are extracted to improve the DICOM image classification. The shape has been given the geometrical information and it contains the features like centroid, Eccentricity, area, perimeter, circularity, shape index, solidity, orientation and euler number. The texture feature has been the given Grey Level Co-occurrence Matrix (GLCM) information's. The energy, entropy, covariance, mean, homogeneity features has been extracted.

### 3.5.CLASSIFICATION BASED ON REFLEX FUZZY MIN-MAX NEURAL NETWORK

Fuzzy min max (FMM) model is a combination of both fuzzy sets and neural networks for classification. It uses hyper box structure for pattern classification thst consisting of min and max points of opposite corners of hyper box. To handle overlapping region of hyper boxes during classification is a crucial role. There are various types of FMM models were described during learning phase the hyper boxes are expanded until almost the whole pattern space is covered. At the end of learning phase, there

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is no overlapping hyper boxes that belong to different classes. The maximum expansion of these hyper boxes is controlled by the expansion parameter θ which is used for expansion.

## IV. IMPLEMENTATION AND RESULTS

The proposed algorithms were tested on DICOM image sample sets for evaluation in brain tumour diagnosis. The experimental aims to verify the performance improvement of SVM and proposed RFMMNN in learning granular data, study the effect of variation of granularity of test data on classification performance.

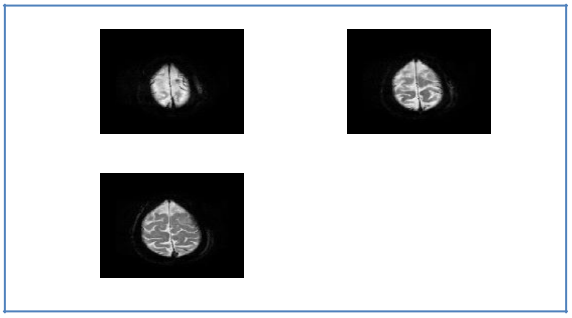

Figure 4.1 Input image.

As shown in the figure 4.1, the input brain images are collected from dataset. It is controlled initially by the pre processing stage with the help of the bilateral filter. Bilateral filter is a non-linear filter. It prevents averaging across image edges, while averaging within smooth regions of the image hence, it is edge-preserving. Also, Bilateral filters are non-iterative. It is shown in the figure 4.2.

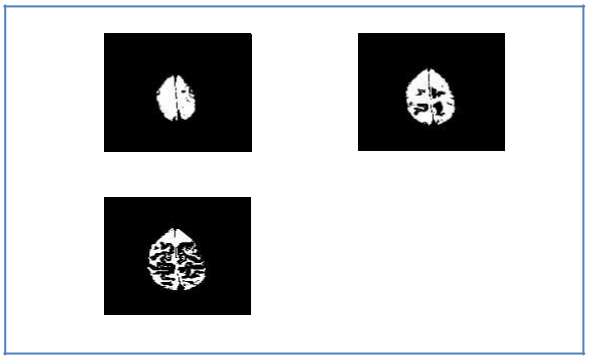

Figure 4.2 Pre-processed and edge detected images

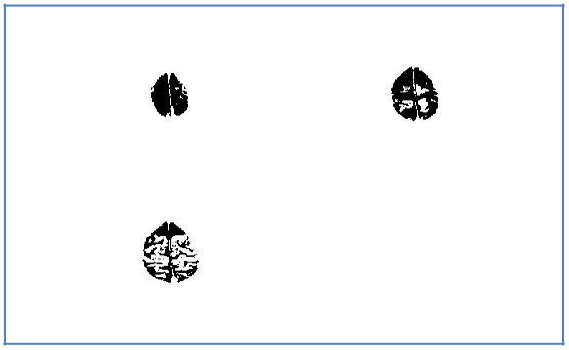

Fig 4.3: Segmented images

The pre-processed image is moved to the next level for segmenting. Here the Glowworm Swarm Optimization (GSO) is used. As shown in the figure 4.3, the image is processed and segmented. The segmented image is extracted with the help of the artificial neural network. The best classification algorithm is considered for processing the extracted image, it is shown in the figure 4.5.

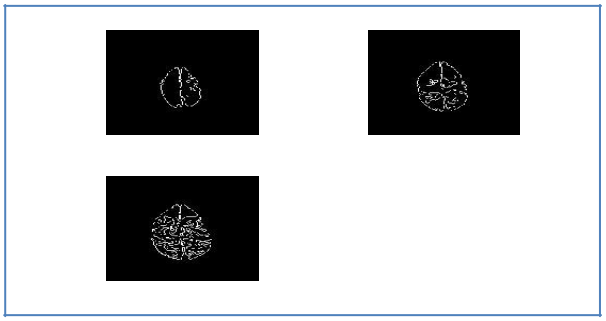

Fig 4.4: Feature extracted images

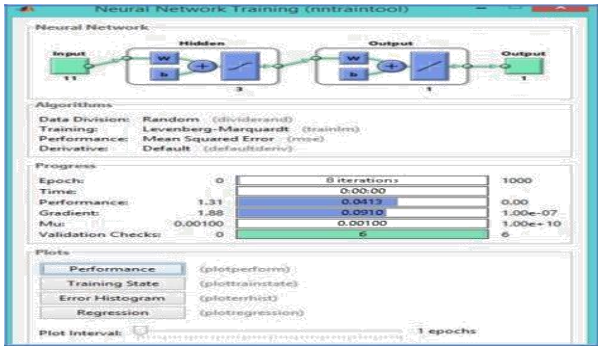


Fig 4.5: Neural network based classification

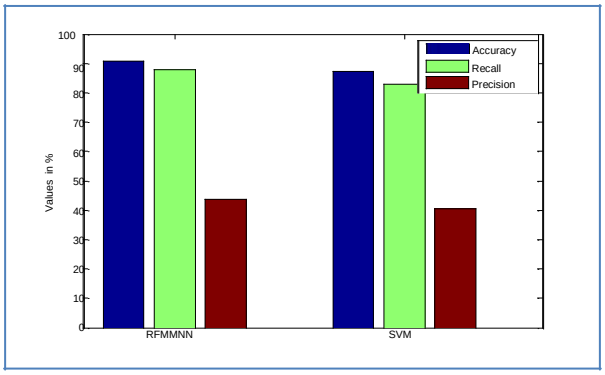


Fig 4.6: Performance comparison for proposed RFMMNN and existing SVM classification schemes

Fig 4.6 shows the graphical representation performance comparison between proposed RFMMNN and existing SVM classification schemes. It demonstrates that the proposed scheme attained high accuracy of 90.23% compared than SVM due to the efficient segmentation and feature extraction.

## V. CONCLUSION & FUTURE WORKS

### 5.1. Conclusion

The research work presented with a bi-lateral filter based pre-processing stage; Glow-worm Swarm Optimization based segmentation, a novel algorithm RFMMNN for classification of brain tumors is proposed. In this method, pre-processing was done by bilateral filter since it was optimal in flat parts of the image. The de-noised images were given as the input to edge detection. Then texture features like contrast, correlation, homogeneity and energy were extracted using the gray level co-occurrence matrix method. The extracted features are then specified to RFMMNN classifier. Using this algorithm one can segment the brain tumors accurately from an MR brain image. Finally, the classification done and the experimental results shows the proposed RFMMNN attained better accuracy, precision and recall compared than existing SVM.

### 5.2.Future work

The proposed segmentation algorithm focuses on two dimensional anatomical structures. It can also be extended to three dimensional volumetric structures. As the intensity and orientation based segmentation method is capable of extracting the features of the medical images accurately, it can also be applied to the fusion image. As the online service is used for the detection of a brain cancer type, the research can be extended to other brain cancer types and location also.

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