BRAIN TUMOR DETECTION AND CLASSIFICATION USING PSO AND SVM CLASSIFIER

Under the guidance of:

Deepak P

Asst prof.

Team Members:

Vishruth M(4NN16CS059)

Adithya Reddy B(4NN16CS003)

Anoop Kushalappa(4NN16CS011)

Abhay P Naik(4NN16CS001)

Abstract

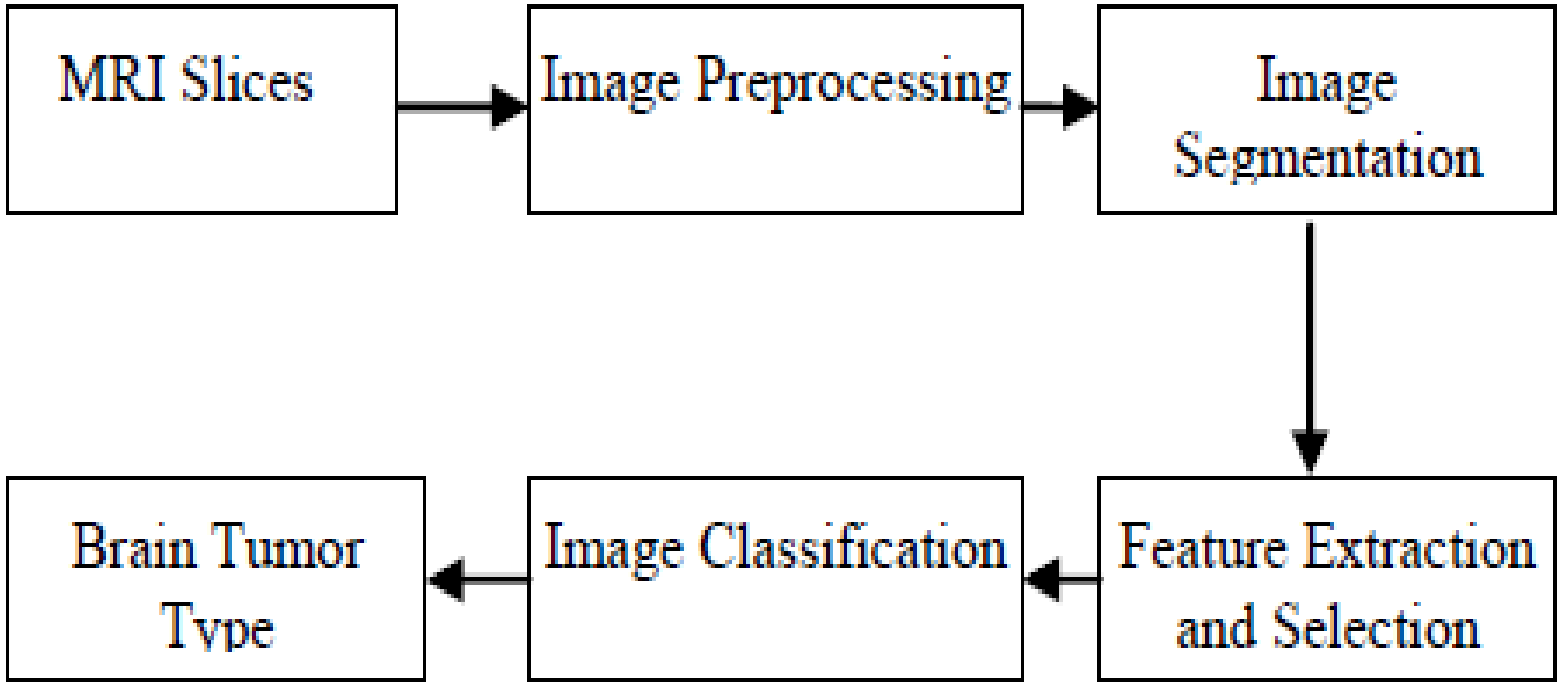
- Medical image processing is the very significant process for any disease diagnosis now a days. MRI is usually used to detect the presence of tumor and its type.
- The process which is followed in classification of brain tumor is very complicated. There are various steps for the medical image processing like image segmentation, image extraction and image classification.
- A machine learning model is developed by using the Particle Swarm Optimization(PSO) algorithm for feature selection and then Support Vector Machine(SVM) classifier is used to classify the type of tumor in present brain MRI images.

PROBLEM STATEMENT

DEVELOPING AN APPLICATION FOR CLASSIFICATION AND DETECTION OF BRAIN TUMOR USING PSO AND SVM CLASSIFIER.

PROPOSED SYSTEM

- The proposed system can be used for early diagnosis and tumor type classification.
- The system made up of five phases. First phase is image pre-processing. The system uses brain MRI dataset which contains benign, malignant brain MRI images and it will used for training purpose.
- Second phase is segmentation by threshold segmentation. Then in next phase features can be extracted from brain MRI using feature vectors and then feature selection can be done with PSO(Particle Swarm Optimization).
- Final phase is classification using SVM.


MRI Slices
Image Preprocessing
Image Segmentation
Feature Extraction and Selection
Image Classification
Brain Tumor Type

SL.NO	TITLE	YEAR	AUTHOR	METHODOLOGY	MERITS	DEMERITS
01.	An efficient brain tumor detection methodology using k-means algorithm	2013	J Vijay, J Subhashani	K-means is the backbone of the papers methodology. k-means algorithm starts clustering by determining k initial points either at random or using some heuristic data, it then groups each image pixel under the central point it is closest to. Next it calculates new central points and repeat the former two steps.	Modification to k-means clustering method that makes it faster & more efficient. It is simple & less complex.	Since is unsupervised learning method it takes more time when compared to supervised clustering methods. Skull region Is not separated properly.
02.	Detection of Brain Tumor and Extraction of Features in MRI Images Using K-means Clustering and Morphological Operations	2019	Zuliani Zulkoffli, Talha Afzal Shariff	Firstly image is acquired then it Is subjected to pre-processing then k-means clustering algorithm is used to separate the images into 4 clusters of varying intensity levels, then the cluster with the tumor region is found then the tumor is extracted using morphological & region properties operation.	It has an average accuracy of 91.65% in detecting the tumor.	It has the robustness of only 60%,since in detects skull region in 11 out of 23 images

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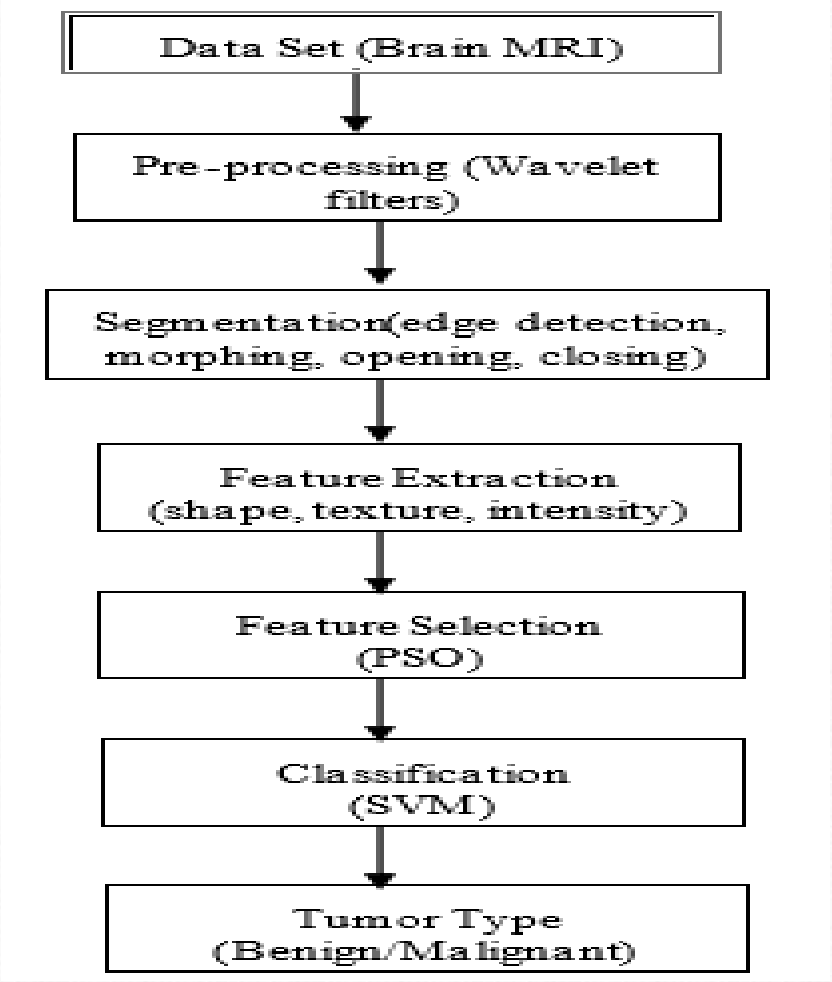
3.	An Intelligent System For Early Assesment And Classification of Brain Tumor	2018	Keerthana T.K, Shobha xavier,	This system works on medical image datatset using data mining technique. This system identifies the type of tumor by support vector machine, here we use genetic optimization algorithm for optimizing the features	This System will provide better accuracy with GA-SVM Classifier and will increase the decision making capacity.	A liitle Complicated System since it uses genetic algorithm to optimize weights and it takes more time for learning.
4.	Tumor Detection and Classification of MRI Brain Image using Different Wavelet Transforms and Support Vector Machines	2019	Mircea Gurbin , Mihaela Lascu , and Dan Lascu	Online Database of MRI Images containing Brain tumor is taken , Preprocessing, Training the SVMs (linear, kernel)Submit new MRI brains images (training sets) to the trained SVMs and output the obtained prediction.	This Binary SVM Model has a average accuracy of 92%.	A hybrid approach is recommended in solving properly the detection and classification problems in brain tumors.

Methodology

- Segmentation-Otsu Segmentation
- Feature Selection – Binary PSO algorithm
- Classification – Support Vector Machine(SVM)

Flow Chart


Data Set (Brain MRI)
Pre-processing (Wavelet filters)
Segmentation(edge detection, morphing, opening, closing)
Feature Extraction (shape, texture, intensity)
Feature Selection (PSO)
Classification (SVM)
Tumor Type (Benign/Malignant)

MRI SCANS

- MRI scans of brain are taken as the input for all training and testing purposes.
- The images are resized to 200 x200 px for processing.
- It is assumed that all the images given input to the system are either Benign (Non-cancerous) or Malignant (Cancerous).
- The images are separated into two labeled folders for training and testing purpose only.

Preprocessing

- After an MRI image is taken as input image it undergoes into various steps before passing it for image segmentation.

- First, we have to convert that image into grey scale image then we have remove noise or inhomogeneity from that grey scale image.

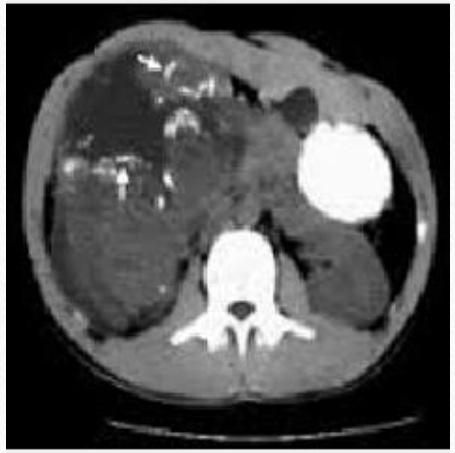
Segmentation

- Segmentation is the most crucial step in identification of Tumor.
- This step extracts the tumor from the MRI scans which is then sent for extracting features.
- Otsu segmentation algorithms that have been implemented

- Otsu’s thresholding is a non - linear operation that converts a grayscale image into a binary image where the two levels are assigned to pixel those that are below or above the specified threshold value.
- The algorithm assumes that the image contains two classes of pixels following bi-modal histogram:

  Foreground pixels

  Background pixels



Normal image

Segmented image

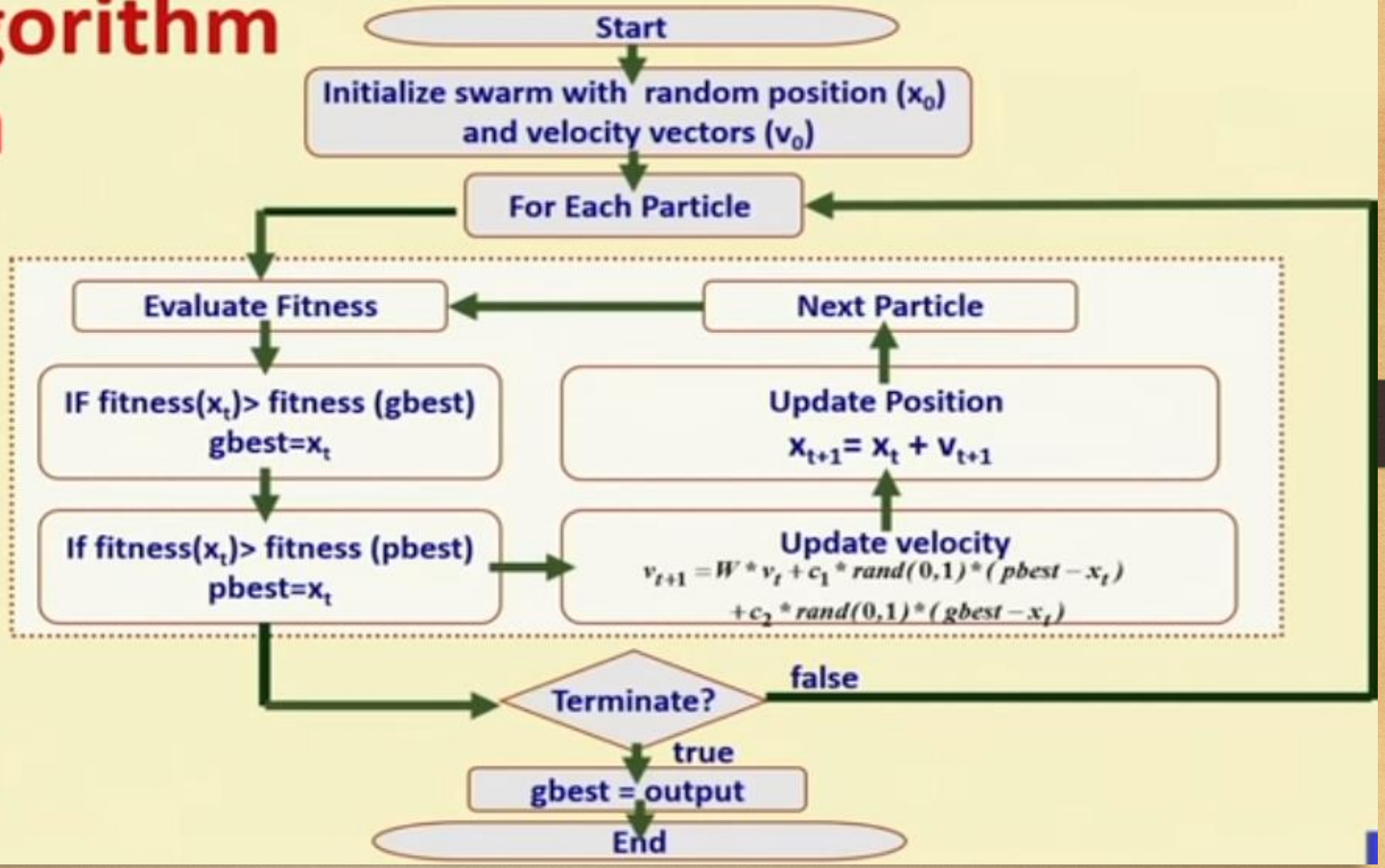
Feature Extraction

- DWT is used to extract coefficient of wavelets from brain MRI images.
- The wavelet localizes frequency information of signal function which was important for classification.
- This is required to calculate the Gray Level Co-occurrence Matrix
- GLCM considers the spatial relationship between the pixels
- Using this we extract 13 features such as contrast, correlation, energy, homogeneity etc.

Feature Selection

- Particle Swarm Optimization (PSO) algorithm is based on swarm intelligence.
- All particles have a fitness value evaluated by a fitness function and a velocity data.
- PSO algorithm starts with a group of random generated solutions (particles) and optimal solution is investigated iteratively.
- PSO gives the best segmentation results.

PSO Algorithm Schema



- In BPSO, the velocity is still updated in the same fashion as in the standard PSO. However, variables xid ,pid and pgd can only have the values 0 or 1.
- So, velocity would indicate the probability of a particle in the position vector to take the value 1
- In BPSO, the position of the current particle is updated based on the probability value T (Vt) obtained from Sigmoid function.

$$x(t+1)=\begin{cases} 1 \text{ if } rand<S(v(t+1)) \\ 0 \text{ otherwise} \end{cases}$$

- where S(v(t)) is the Sigmoid function

$$S(v(t)) = 1/(1+\exp(-V(i,d)))$$

Classification

- This requires the system to train first using classified MRI scans and then based on trained data classify the test images.

- This step classifies the Brain Tumor MRI scan as:
    1. Benign (Non-Cancerous)
    2. Malignant (Cancerous)

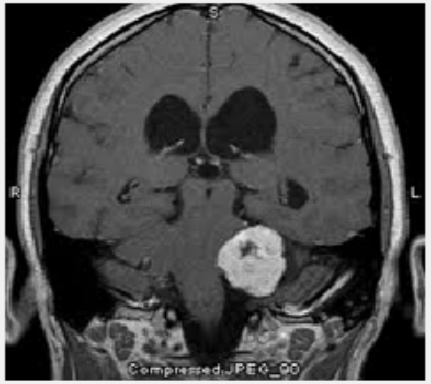
- SVM is the classification algorithm that have been implemented

Support Vector Machine(SVM)

- A SVM takes the set of feature vectors as input, generates a training model after scaling, selecting and validating, and generates a training model as the output.
- This training model is then used to classify the image as either benign or malignant based on the features generated from the selected features.
- The accuracy relies completely on the accuracy of features selected during data preparation stage.

RESULTS

INPUT IMAGE



SEGMENTED IMAGE

PREPARE DATA

LOAD BRAIN MRI IMAGE

DETECT TUMOUR

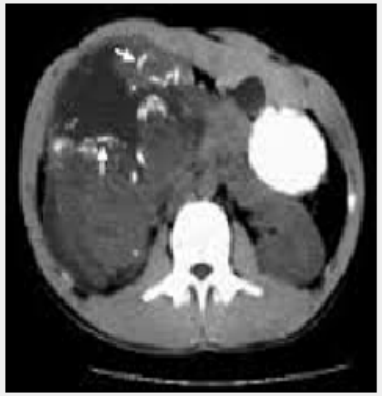
TUMOR TYPE: **BENIGN**

ACCURACY USING PSO **94.1176**

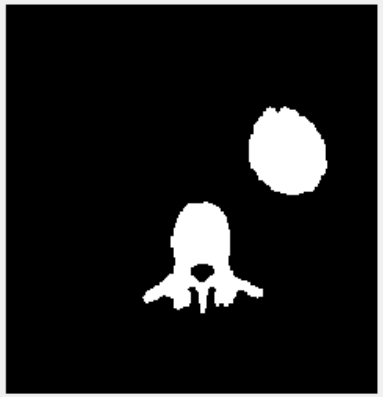
ACCURACY WITH SVM **78.5714**

ex3

INPUT IMAGE



SEGMENTED IMAGE



PREPARE DATA

LOAD BRAIN MRI IMAGE

DETECT TUMOUR

TUMOR TYPE: **MALIGNANT**

ACCURACY USING PSO **88.8889**

ACCURACY WITH SVM **78.5714**

CONCLUSION

- The main goal of medical image processing is to identify accurate and meaningful information using algorithms with minimum error possible.
- Brain tumor detection and classification through MRI images can be categorized into four different sections: pre-processing, image segmentation, feature extraction and image classification.
- It can be concluded that the algorithms and the parameters used in the proposed system are all meant to increase the efficiency of the system by achieving better results.

Future Enhancements

- Encouraged by these results, future work will involve the improvement of classification result and overall accuracy.
- To classify stages of tumor using tumor size.

References

[1] Zuliani Zulkoffli and Talha Afzal Shariff “Detection of Brain Tumor and Extraction of Features in MRI Images Using K-means Clustering and Morphological Operations” IEEE 2019

[2] Keerthana T K and Sobha xavier “An Intelligent System for Early Assessment and Classification of Brain Tumor” IEEE 2018

[3] Arun Kumar, Alaknanda Ashok and M. A. Ansari “Brain Tumor Classification Using Hybrid Model of PSO And SVM Classifier” IEEE 2018

[4] J Vijay and J Subhashani “An efficient brain tumor detection methodology using kmeans algorithm” IEEE 2013

THANK YOU