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An Efficient Supervised Learning Technique for Tumour Detection and Analysis from MR Image Data Set

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ABSTRACT

Image mining plays a vital role in image analysis. It is a sub field of data mining technique and mainly focuses on knowledge discovery from image data sets. An Image mining technique uses mainly three major steps, image segmentation, detection and finally extraction of of information. In medical field image analysis for a medical image set such as MRI image data set, are always challenging for the researchers because medical image mining needs more accuracy in the mining results. Existing image mining methods encounters with several issues such as poor accuracy, higher detection time, and inaccurate tumour growth rate. In this research work we are presenting an efficient supervised learning method for tumour detection and analysis from MR image dataset. Proposed supervised learning method uses hybrid method. Initial it uses existing BWT method for data pre-processing and segmentation than later apply SVM+ PCA with object labelling method to extract final results for tumour image such as tumour size, type, growth rate. Existing BWT method with SVM and proposed BWT with SVM+ PCA are implemented over simulator MATLAB and various performance measuring parameters are calculated and experimental results analysis clearly shows that proposed method performs outstanding over existing BWT with SVM tumour detection method.

Keywords : MRI, BWT, SVM, Object labeling, PCA, Brain Tumour

I. INTRODUCTION

Image mining is a subfield of data mining process. It basically deals with knowledge discovery from image data set. Image segmentation holds a vital position in the region of clinical photograph processing. Segmentation may be used to discover a tumour from MRI photo [2].

A brain tumour can be broadly classified as number one brain tumour (a tumour originates in the mind) and secondary mind tumour (unfold to mind from elsewhere inside the body thru metastasis). Primary mind tumours do no longer spread to other body elements and can be malignant or benign and secondary mind tumours are constantly malignant. A malignant tumour is extra dangerous and lifestyles threatening than a benign tumour. The detection of a malignant tumour is greater difficulty than a benign tumor [3]. In this research work we are presenting an efficient supervised learning method for tumour detection and analysis from MR image dataset. Proposed supervised learning method uses hybrid method. This complete paper is organized in following chapters: Introduction, MR image mining, existing methods, Problem statement, proposed solution, Result analysis. Conclusions & future works.

II. MR IMAGE MINING

Image mining may be an important technique that is employed to mine data squarely from the image. Image segmentation is that the primary introduces image mining. Image mining is solely associate degree expansion of information mining within the field of image process.

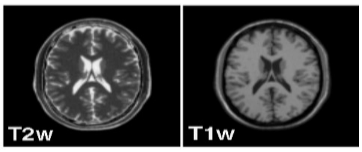


Figure 1. MR Images

Image mining handles with the hidden knowledge extraction, image knowledge association and extra patterns that don't seem to be clearly accumulated in the pictures [1]. Mining of medical MR images is called as MR image mining [3].

III. EXISTING METHODS

Nilesh Bhaskarrao Bahadure et al. 2017, worked on "Image Analysis for MRI Based Brain Tumour Detection and Feature Extraction Using Biologically Inspired BWT and SVM". As per researcher [1] the segmentation, detection, and extraction of infected tumour vicinity from magnetic resonance (MR) photos are a primary subject, however, a tedious and time taking mission achieved by way of radiologists or medical experts, and their accuracy depends on their experience handiest.

Vasupradha Vijay et al. 2016 worked on "Automated Brain Tumour Segmentation and Detection in MRI using Enhanced Darwinian Particle Swarm Optimization (EDPSO)". As per Vasupradha [2], scientific image segmentation is the most difficult problems inside the research subject of MRI scan analysis.

Deepa et al. 2016 worked on "Review of Brain Tumour Detection from MRI Images". According to Deepa [3], these days photograph processing performs an important role in the scientific area and scientific imaging is a developing and challenging subject.

Kamil Dimililer et al. 2016 worked on "Effect of image enhancement on MRI brain images with neural networks". As per Kamil [4] given that human frame's trendy control metabolism stops, vintage cells do no longer die and those bizarre cells form a mass of tissue called a tumour.

Asra Aslam et al. 2015 worked on "Improved Edge Detection Algorithm for Brain Tumour Segmentation". As per Asra [5], photograph segmentation is used to split gadgets from the historical past, and for this reason, it has proved to be a powerful tool in biomedical imaging. In this paper, an advanced edge Detection algorithm for mind-tumor segmentation is offered.

Shweta Kharya et al. 2012 worked on "Using data mining techniques for diagnosis and prognosis of cancer disease". As per Shweta [6] breast cancer is one in all the leading cancers for ladies in developed countries as well as India. It is the second most typical explanation for cancer death in girls. The high incidence of carcinoma in girls has increased considerably within the last years.

IV. PROBLEM STATEMENT

In medical image process, segmentation of MR pictures of the brain may be a difficult and difficult task as a result of the adult male pictures are related to the artifacts. Applicable and correct segmentation technique is critical in before neoplasm detection and classification of abnormalities. Segmentation in image process is observed the technique of isolating a picture into reciprocally exclusive regions. It is applied so as to spot objects of interest and also edges or boundaries in pictures. The presence of artifacts, obscure or simulate the pathology.

The main difficulty in image segmentation method is that the selection of a correct technique for a specific quite image dataset. There's not usually accepted technique for brain imaging image segmentation. Image mining techniques are widely used in medical image processing such as tumour detection from MR images.

A Brain tumour is associate degree abnormal growth of cells inside the bone. Ordinarily, the growth can grow from the cells of the brain, blood vessels, nerves that emerge from the brain. There are a unit 2 kinds of growth which are- benign (non-cancerous) and malignant (cancerous) tumors. Various image mining techniques are widely used for processing of MR images. Existing image mining techniques have following issues-

- ✓ Accuracy in region and size detection
- ✓ Total detection time
- ✓ Detection rate % or growth rate %

V. PROPOSED SOLUTION

In this research work, we are presenting an efficient supervised learning method for tumour detection and analysis from MR image dataset. Proposed supervised learning method uses a hybrid method. Initially, it uses existing BWT method for data pre-processing and segmentation than later apply SVM+ PCA with object labelling method to extract final results for tumour image such as tumour size, type, growth rate. Existing BWT method with SVM and proposed BWT with SVM+ PCA are implemented over simulator MATLAB and various performance measuring parameters are calculated.

5.1 Proposed algorithm- Proposed Hybrid Brain tumour detection method for MR images

Input- Image set (Tumour image and normal image)
Output- Tumour detected (Tumour area in pixel, detection time and accuracy %)
Step 1- Take in input image I1 from image data set I
Step 2- (Apply Pre-processing)
2.1 - Noise Removal (Median Filter)
2.2- Contrast Enhancement (Sigmoid Function)
Step 3- Skull Striping (Elimination of non-brain tissues)
3.1 Convert Image into Gray Scale
3.2 Convert Image into Binary (By Thresholding)
3.3 Search number of connected objects
3.4 Find Mask by assigning 1 to inside and 0 to the outside (Tumour Region)
3.5 Find Mask by assigning 1 to inside and 0 to the outside (Tumour Region)
Step 4 Object labeling (label different objects within the image)
4.1 Take the Binary output of skull image
4.2 Label different object within the image
Step 5 Segmentation (BWT)
5.1 Segmentation of abnormal brain tissues and normal tissues such as gray matter (GM), white matter (WM), and cerebrospinal fluid (CSF).
Step 6 Morphological Pha
6.1 Erosion operation of morphology is employed to eliminate white pixel
6.2 Eroded regions and the original image are both divided into two equal regions
6.3 The black pixel region extracted from the erode operation is counted as a brain MR image mask
Step 7 Feature extractions-
7.1 Forward selection method apply
Step 8 Feature Selection and reduction (by PCA)
8.1 Apply PCA for feature selection reduction
Step 9 Apply SVM Classification
9.1 Classify images in Normal and Abnormal
Step 10 Tumour area detected (In pixel)
Step 11 Stop

5.2 Working of proposed method

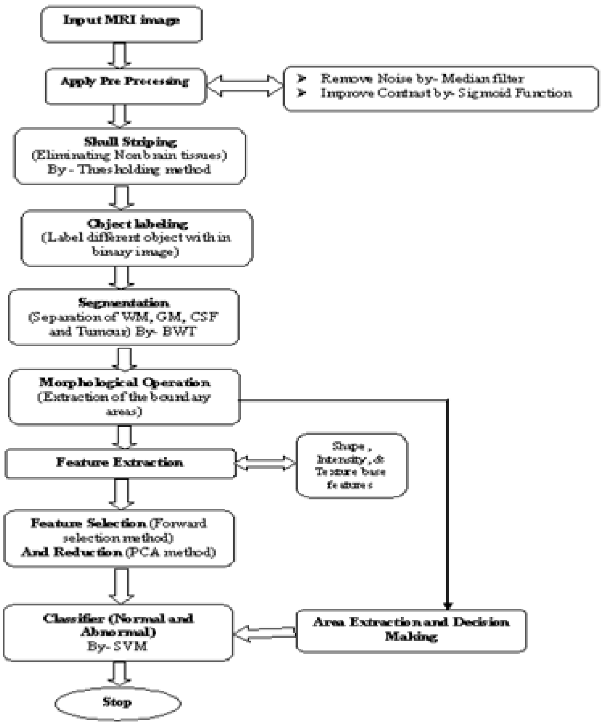


Figure 2. Working of proposed method

VI. RESULT ANALYSIS

Existing BWT method with SVM and proposed BWT with SVM+PCA methods are implemented over simulator MATLAB and various performance measuring parameters are calculated such as accuracy %, detection time, precision and detection rate %.

For performance analysis of existing method and proposed method are tested on total 100 MRI 3-D images in which 35 images are normal and 65 are abnormal images. These images are collected from open MRI online dataset (https://openfmri.org/dataset/). These all the Images are based on T-2 W MRI type.

6.1 Confusion matrix-A confusion matrix has been created for an existing and proposed method. Confusion matrix shows all the possible prediction results. In confusion matrix, possible outcomes of a two-classes (normal and abnormal) prediction are represented as True Positive (or TP), True Negative (or TN), False Positive (or FP) and False Negative (or FN). Here images have two category normal images and abnormal images. TP, TN, FP, and FN can be defined as –

- TP= True positive shows the total number of abnormal images which has been correctly classified by the classifier.
- TN= True negative shows the total number of normal images which has been correctly classified by the classifier.
- FP= False positive shows the total number of normal images which has been classified as abnormal by the classifier.
- FN= False negative shows the total number of abnormal images which has been classified as normal by the classifier.

Table 1. Confusion Matrix

Expected Outcome	Actual		Row Data Total
Positive Results	TP	FP	TP+FP
Negative Results	FN	TN	FN+TN
Column Data Total	TP+FN	FP+TN	TP+FP+ FN+TN

6.2 Simulation parameters and Results- Following parameters are calculated for existing and proposed methods-

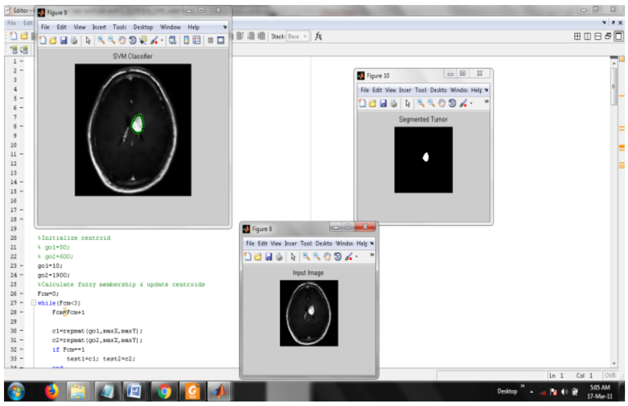


Figure 3. Simulation results

6.2.1 Precision-Precision can be defined as the ration of abnormal images with correct results.

Precision = (TP/ TP+FP

6.2.2 Accuracy-Accuracy can be defined as the ratio of test results which are accurate.

Accuracy = {(TN + TP) / (TN + TP+FN+ FP)}

6.2.3 Specificity- Specificity can be defined as the ratio of the finding all the normal images from all the normal cases.

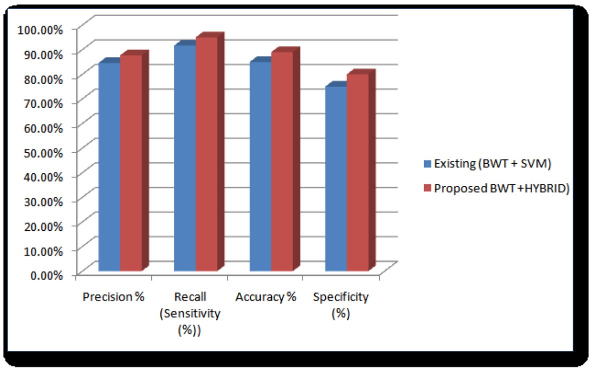
Specificity= (TN/ TN+FP)

6.2.4 Recall- Recall or sensitivity can be defined as the probability of the test finding the abnormal case among all the abnormal cases.

Recall= TP/ TP+ FN

Table 2. Comparisons of Accuracy % Results for existing and proposed Method

Parameters	Existing (BWT + SVM)	Proposed BWT +HYBRID)
True Positive	55	57
True Negative	30	32
False Positive	10	8
False Negative	5	3
Precision %	84.61%	87.69%
Recall (Sensitivity (%	91.66 %	95 %
Accuracy %	85 %	89 %
Specificity (%)	75 %	80 %



Graph 1. Comparisons of Accuracy % Results for existing and proposed Method

Result Influence- The above Table 6.2.1 and Graph 6.2.1 shows simulation results of accuracy % calculated for existing and proposed a method. Experimental results clearly show that proposed method has better precision %

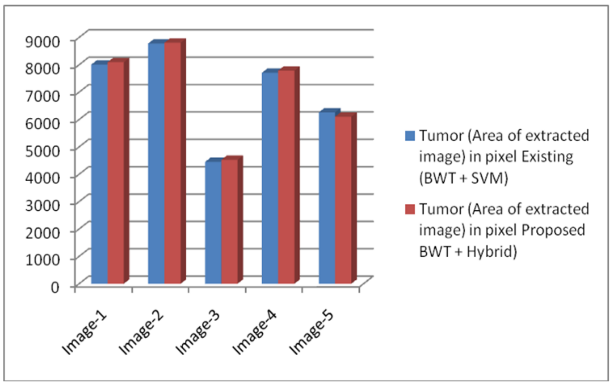
6.2.5 Detection area- For any image area or region can be calculated as the total number of vertical resolution, horizontal resolution and number of pixels of an image.

Detection area=Vr* Hr* Tp

Where Vr= Vertical resolution, Hr = Horizontal resolution, Tp= Number of a pixel in the infected area

Table 3. Detection area % for existing and proposed method

Images	Original Image Size	Actual Area in Pixel	Tumor (Area of the extracted image) in the pixel	
			Existing (BWT + SVM)	Proposed BWT + Hybrid)
Image-1	256*256	65536	8008	8095
Image-2	256*256	65536	8778	8806
Image-3	256*257	65792	4450	4526
Image-4	200*200	40000	7708	7788
Image-5	256*256	65536	6262	6103



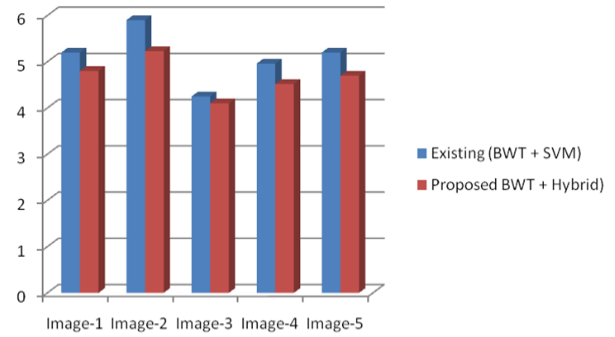
Graph 2. Detection area % for existing and proposed method

Result Influence-The above table 6.2.5 and Graph 6.2.5 shows tumour detection results in pixel for existing and proposed methods. The above results clearly show that proposed method has better detection area as compared to the existing method.

6.2.6 Detection time- This is the sum which requires detecting a tumour in MR images.

Table 4. Detection time for existing & proposed

Images	Original Image Size	Actual Area in Pixel	Tumor detection Time in seconds	
			Existing (BWT + SVM)	Proposed BWT + Hybrid)
Image-1	256*256	65536	5.2 s	4.8 s
Image-2	256*256	65536	5.9 s	5.23 s
Image-3	256*257	65792	4.25 s	4.1 s
Image-4	200*200	40000	4.96 s	4.52 s
Image-5	256*256	65536	5.2 s	4.7 s



Graph 3. Detection time for existing & proposed

6.3 Classifications accuracy-Tumour area detection is calculated for three data sets. Dataset -1 contains total 100 images (35 images normal and 65 abnormal), data set- 2 contains 150 images (70 normal images and 80 abnormal images) and data set-3 contains 200 images (69 normal images and 131 abnormal images. In first simulation results are calculated without applying feature extraction method for all three datasets (both methods existing and proposed). In the second phase of simulation again results are calculated after applying feature extraction method and following results calculated-

Table 5. Classifications accuracy

Dataset	Accuracy % Without Feature extraction method		Accuracy % With Feature extraction method	
	Existing (BWT + SVM)	Proposed BWT + Hybrid)	Existing (BWT + SVM)	Proposed BWT + Hybrid)
Data Set-1	80.25	85.2	84.2	89.3
Data Set-2	78.75	84.5	82.6	88.4
Data Set-3	81.4	85.66	83.7	89

Result Influence- The above table and graph 5.5.4 show simulation results for tumour detection accuracy % without applying feature extraction method (PCA) and with feature extraction method for three datasets. An experimental results clearly influence, that's proposed method have better results. Accuracy % increases after applying PCA feature extraction method.

VII. CONCLUSIONS & FUTURE WORKS

This research works presented an efficient supervised learning method for tumour detection and analysis from MR image dataset. Proposed supervised learning method uses a hybrid method. Initial it uses existing BWT method for data pre-processing and segmentation than later apply SVM+ PCA with object labelling method to extract final results for tumour image such as tumour size, type, growth rate. Experimental results clearly show proposed method have 3.56 % better accuracy as compared to the existing method. The proposed method also detect better tumour area % (5-8 %) in less time (4-6 % efficient) over existing method.

In future work, we will implement it with the real-time environment. Also, proposed method will be tested with various other methods.

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