# SEGMENTATION STRATEGIES IN THE FIELD OF MRI IMAGES: A COMPREHENSIVE ANALYSIS

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**ABSTRACT**

With the advancement of technology, it almost becomes apparent that user requires information on the go. Health related problems are common and users do not possess much time in order to tackle the issue related to health. On the go information is required to the user to monitor their health. Digital image processing works towards this aspect and provides the mechanisms known as segmentation of MRI images to provide user on the go information about health related issues. MRI images are prone to noise hence handling MRI image with pre-processing phase is critical. This paper presents comprehensive analysis of techniques used to operate on image and classify the diseases based on abnormality detection. Phases associated with disease detection are also discussed and parameter optimized in existing work is elaborated. These parameters can be considered for improvement in future endeavours.

***Keywords***- Image processing, Segmentation, disease detection, Noise

## I. INTRODUCTION

(Miah 2015)Image processing applied to field of health care is always vital since this mechanism can provide on the go information to the users. Like any other digital media, MRI images can be prone to noise. Hence noise handling mechanisms must be incorporated with the image processing phases to extract information out of available resources. (Singh & Aman 2013) Noise within the image can occur due to variety of reasons. The source of noise could be sensor, camera or malfunction of circuit. Noises introduced due to this problem are categorised as

### *1.1 Salt and Pepper Noise*

(Leavline et al. 2013)Salt and pepper noise is also known as impulse noise. This noise introduces white dots within the image and image clarity is lost. To solve the problems of salt and pepper noise, median filtering is commonly used.

### *1.2 Gaussian noise*

(Ma et al. 2007)Gaussian noise is introduced due to thermal or heat emitted through devise used to capture the image. The medium through which image is transferred could also cause the problem. Contrast related problem occurs due to this type of noise. Gaussian filtering mechanism is used to tackle the issues of Gaussian noise.

### *1.3 Shot Noise*

(Djidjou et al. 2014)This noise occurs due to malfunction of sensors. The sensor failure hence result this kind of noise that occurs in the darker regions of the image. Adaptive median filtering could be used to tackle such a noise.

### *1.4 Anisotropic Noise*

(Khirade 2015)This noise appears within the image through the orientation of image. In other words if image is scaled then such noise appears within the image.

The noise removal is generally accomplished within pre-processing phase. After the pre-processing phase, generally segmentation takes place. Segmentation is used to divide the image into segments through which critical and non critical regions are identified. The last step in image processing to determine the problem in images is classification. In this process actual problem present within the image is identified. Rest of the paper is organised as under: section 2 describes the phases of image segmentation and classification, section 3 gives the literature survey, section 4 gives the comparison

table and problem definition, section 5 present the conclusion and future scope and last section gives the references.

## II. PHASES ASSOSIATED WITH IMAGE SEGMENTATION

Image segmentation is the mechanism in which image is partitioned into segments. The objective is to transform the image into more meaningful parts which can be easy to analyse. In health care environment image is generally transformed into gray scale levels at first place. From the gray scale image, image is partitioned into black and white regions. Black regions indicate non critical parts and white regions indicate critical parts. In general the parts associated with segmentation are listed as under

### *1.1 Pre-Processing*

(Singla 2016)This phase is critical in case image is prone to noise. The corruption within the image hinders the result. Pre-processing ensures the removal of noise and hence segmentation can be performed with accuracy. Pre-processing hence is associated with the filters. Commonly encountered noise in MRI images is salt and pepper noise and to tackle that noise, median filter is needed. Pre-processing can also be incorporated with the contrast enhancement strategies. Once the clarity of image is improved first phase terminates.

### *1.2 Segmentation*

(Raju et al. 2013)It is the process of driving the necessary region from entire image. (Nagarajan 2011)The image segmentation generally requires conversion from any image to gray scale image. The image parts which are critical are converted to white region and unnecessary part is converted to black region. The analysis of whitish region is done only. Thus the process of segmentation will reduce the image into critical segments that can be easily analysed.

### *1.3 Classification*

(Naraei et al. 2016)The classification process identifies the problems within the segmented regions. Classification accuracy is depicted by comparing the actual result with the simulation result. Training set is generated from the dataset.(Qayyum et al. n.d.) From the training set image is selected. The training set is that in which image problems are already detected. The result obtained from the segmented image is then compared against the result obtained from the simulation. Error approximation is obtained by comparing the result obtained from the simulation against the actual result.

The process of segmentation is critical in the analysis of diseases within the image. Without segmentation simulation time considerably increases and prediction accuracy also decreases. Next section describes the literature survey.

## III. LITERATURE SURVEY

Legions of work towards the segmentation of image are done. The segmentation procedures are varied from simple to complex. The complex image segmentation is preferred in case of multivariate images. The existing techniques associated with segmentation are described in this section.

### 3.1 SUPPORT VECTOR MACHINE AND ANN (ARTIFICIAL NEURAL NETWORK)

Skin lesion detection is mandatory at initial stage to keep away from deadly effects within human body. Death rate is increased considerably if detection is at 4th stage. Recovery rate is greatly intensified if it is detected at 2nd or early stage of lesion. SVM is one of the operative image processing segmentation strategy used to identify distinguished part from the original part. (Farooq et al. 2016)proposed precise segmentation methodology. Precise segmentation of the damaged area along with surrounding area is critical for accurate analysis and detection of lesion. Improved ALDS based on probabilistic approach is followed. Neural network decision theory is applied to diagnose the melanoma. The member ship function take decision melanoma if obtain value is within the range specified for particular member function.(Nazemi & Maleki 2014) recommends SVM+ANN to detect hands and body movement but is quite capable to diagnose lesion also. SVM+ANN is represented through following flowchart

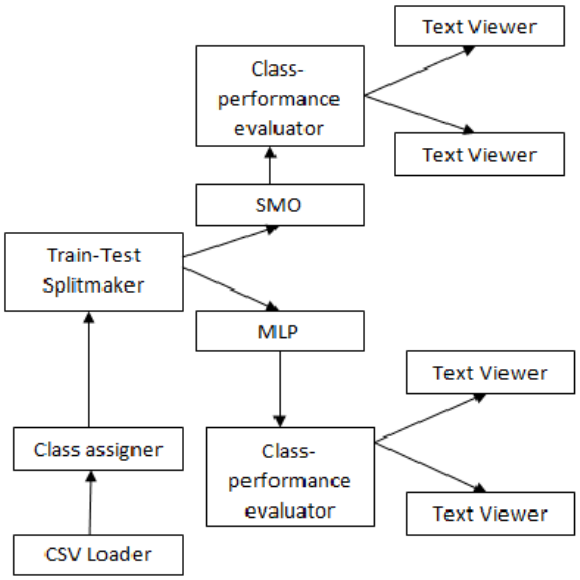

**Figure 2:** SVM and ANN Methodology

To reduce energy consumption active contour is used. The energy function used is listed as under

$$E_{Total} = \int_0^1 E_{int}(V(s) + E_{img}(V(s)) + E_{con}(V(s)) \quad (1)$$

$E_{total}$ is the total energy consumed during segmentation. $E_{int}$,$E_{img}$and $E_{con}$ are the energy consumed during image initialization, image processing and conversion respectively. V indicates the vector initialization during support vector machine working. As proposed by [9],In the initial observation results were not stable, hence similarity index was observed using following equation

$$SSIM = \frac{(2u_x u_y + c_1)(\sigma_{xy} + c_2)}{(u_x^2 + u_y^2 + c_1)(\sigma_x^2 + \sigma_y^2 + c_2)} \quad (2)$$

$U_x$ and $U_y$ indicates the membership functions whose range lies between 0 and 1. After this step feature extraction and comparison is performed using SVM and ANN techniques. Obtained results propose optimality of this technique.

### 3.2 SVM AND DEEP BELEIF NETWORK

Skin Lesion image detection process starts with feature extraction and then feature selection process. For this purpose segmentation is needed and classifiers are required to be trained. (Masood & Jumaily 2016) Proposed SVM and Deep belief network for detecting skin lesion. A test vector x is used for training purpose. Final classification through classification model is represented through the following function

$$F_{final} = sign(w.(f_i(x)_{k*i}) \quad (3)$$

The classifier includes deep learning architecture and exponential loss function used to improve seperability. Deep belief network is build using greedy layer wise unsupervised learning algorithm and parameter space of W is constructed by the use of unsupervised learning approach along with exponential loss function for fine tuning the classifier. Accuracy of the classifier is up to 95% hence is effective. Deep belief network is given as under

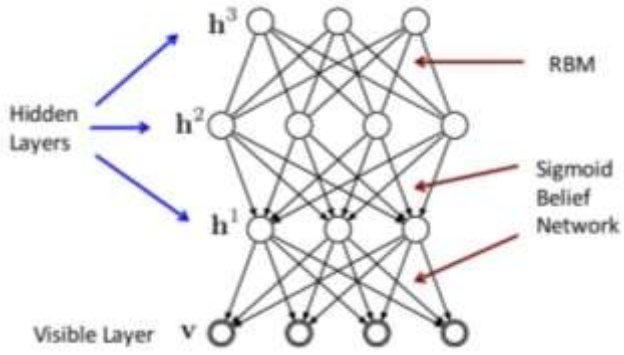


**Figure 3:** Deep Belief Network Working

### 3.3 SVM AND TEXTURE CLASSIFICATION

(Kavitha & Suruliandi 2016)give strategy to classify demography image into melanoma and non-melanoma images. Texture and colour features are extracted for analysing the same. (Asery et al. 2016; Qayyum et al. n.d.) Texture features of an image are extracted using GLCM. Colour histograms are efficient mechanism proposed to extract the colour features in three colour spaces with primary colour collaboration including RGB, HSV and OPP. Classification is generated using SVM(Support Vector Machine).(Ram 2015) Proposes ship detection using texture and SVM classification. Image is characterized into sub block to minimize the complexity of the image. Each block is processed separately and then joined together to form complete image. Supervised learning technique SVM is used for classification purpose.

### COMPARISON TABLE OF SEGMENTATION TECHNIQUES

Comparison table presents the quantitative analysis of parameters considered within the existing literature that can be used to enhance future work in terms of those parameters.

| Title | Technique | Parameters | Merits | Demerits |
|---|---|---|---|---|
| Detection of Lung Cancer from CT Image Using Image Processing and Neural Network(Miah 2015) | Neural network segmentation | Detection and error rate | Error rate is significantly reduced | Execution time is high that can be further reduced |
| Ship Detection Based on SVM Using Colour and Texture Features(Ram 2015) | Support Vector machine | False positive rate False Negative rate Accuracy | Accuracy is high and false positive rate is decreased | Entropy and classification accuracy can be further enhanced |

| | | | | |
|---|---|---|---|---|
| Detection of Lung Cancer using Gabor Filters and Watershed Segmentation Technique(Avinash n.d.) | Gabor filters and watershed segmentation | Classification accuracy MSE | MSE is decreased and accuracy is enhanced | Accuracy can further be enhanced by the use of improved segmentation procedure by neglecting the unnecessary region out of the image |
| Comparison Study of Segmentation Techniques for Brain Tumour Detection(Manju et al. 2013) | Multiple segmentation techniques | ------- | Comparative study is presented hence best possible strategy can be selected for future enhancement | No optimization parameters are presented |
| Abnormality Extraction of MRI Brain Images Using Region Growing Segmentation Techniques(Lal & Aju 2014) | Region growing segmentation | MSE PSNR | MSE is decreased and Peak signal to noise ratio is increased | Prediction accuracy is a problem that can be further enhanced |
| Study of Different Brain Tumour MRI Image Segmentation Techniques(Deshmukh 2014) | MRI image Segmentation using SVM | MSE Prediction Accuracy | MSE is reduced and accuracy is optimised | Limited area of brain MRI is used and general brain image set utilization is absent. |
| Global Image Segmentation Process for Noise Reduction by Using Median Filter(Kandpal & Ramola 2015) | Image segmentation with noise removal strategy | MSE Accuracy | MSE is reduced by the application of median filter | Specific noise that is salt and pepper noise is handled and this method going to fail in case of multiple noise |
| Retinal Area Detector from Scanning Laser Ophthalmoscope (SLO) Images for Diagnosing Retinal Diseases(Haleem et al. 2014) | Image segmentation for retinal disease detection | Prediction accuracy MSE | Accuracy and MSE is optimised | Pre-processing phase is absent hence image enhancement is not performed due to which prediction accuracy is not that high. |

Table 1: Comparison of various techniques of segmentation

## IV. PROBLEM DEFINATION

The existing literature constructed on segmentation to extract region of interest. Region of interest extraction reduces the image analysis region or in other words complexity of image analysis is considerably reduced. Image enhancement procedure considers only specific type of noise. In order to enhance the overall procedure, image enhancement must consider multiple noises filtering mechanism to form universal filtering. The parameters to be enhanced in future work includes

- Mean Square Error
- Peak Signal to noise ratio

## V. CONCLUSION

Segmentation procedure is critical in the analysis of defects present within the image. The pre-processing phase play a critical part in the process of segmentation since clarity within the image is introduced by the application of pre-processing. The existing literature is capable of handling singleton noise from within the presented image. The segmentation procedure suffers in case multiple noise sequences appear within the image. In order to tackle the situation universal filter implication in the image pre-processing phase can be proposed in future.

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