Date of Publication: 30 June 2017 | Volume 5, Issue 2 | Pages: 31-34

Investigating Image Processing Techniques for Detection of Color Images

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ABSTRACT: Image processing plays an important role in analyzing the medical images. Color Image detection and segmentation is the most challenging and time consuming task in medical image processing. Magnetic Resonance Imaging (MRI) is an advanced medical imaging technique to analyze internal structure of the body. This technique is efficient for de noising of MRI and effectively preserves the relevant edge feature and removes the noisy coefficients. The reconstructed MRI data has high Peak signal to noise ratio (PSNR) as compared to the classical wavelet domain de noising approaches. After segmentation, the classification of tumor into malignant and benign is a difficult task due to variation in tumor tissue characteristics like gray level intensities, shape, and size. This paper focuses on highlighting the strengths and limitations of the earlier proposed classification techniques. The paper provides an insight into the reviewed literature to reveal new aspects of research.

Keywords: Magnetic Resonance Imaging (MRI), Image processing, De-Nosing, Segmentation.

1. INTRODUCTION

Noise reduction in digital images, despite many years active research, still remains a challenging problem. The rapid proliferation of portable image capturing devices, combined with the miniaturization of the imaging sensors and increasing data throughput capacity of communication channels, results in the need to create novel fast and efficient de noising algorithms.

Color images are very often corrupted by impulsive noise, which is introduced into the image by faulty pixels in the camera sensors, transmission errors in noisy channels, poor lighting conditions and aging of the storage material [1] The suppression of the disturbances introduced by the impulsive noise is indispensable for the success of further stages of the image processing pipeline. The images used for experimentation purposes in this thesis are all gray-scale images. They contain no color information. They represent the brightness of the image. This image contains 8 bits/pixel data, which means it can have up to 256 (0-255) different brightness levels. A 0'represents black and '255' denotes white. In between values from 1 to 254 represent the different gray levels. As they contain the intensity information, they are also referred to as intensity images. Color images are considered as three band monochrome images, where each band is of a different color. Each band provides the brightness information of the corresponding spectral band. Typical color images are red, green and blue images and are also referred to as RGB images. This is a 24 bits/pixel image.

The main aim of image processing application is to abstract important attributes from the image data, from which a descriptive, interpretative, or reasonable prospect can be obtained by the machine. There are several image processing techniques such as histogram equalization, image segmentation, image enhancement, image restoration, image compression, morphological operation, feature selection and extraction and classification.

2. LITERATURE REVIEW

A. Kharrat et al.[2] In their paper presented a method for automated diagnosis, based on classification of human brain MR images. The proposed approach consists of five stages: In the first stage, 2D Discrete Wavelet Transform and Spatial Gray Level Dependence Matrix (DWT-SGLDM) is used for feature extraction. In the second stage, for feature selection Simulated Annealing (SA) is applied to reduce features size. The next stage uses Stratified K-fold Cross Validation to avoid over fitting. In the fourth stage to optimize SVM parameters, GA-SVM model is used. Finally SVM is used to construct the classifier.

The method obtained 95.6522% classification accuracy on the T2-weighted brain MRI image datasets.
This system could further be used for image classification with difference in pathological conditions, types and disease status.

Ramya and *Sasirekha*[3] in their paper proposed a segmentation algorithm to detect tumor in 2D brain MR images. The proposed system constitutes of three phases: image denoising, skull removal and segmentation. Noise removal is done by using fourth order partial differential equation. Skull removal is done by using two main morphological operators, erosion and dilation. Region growing segmentation is achieved by means of seed point selection.

The accuracy of this method is high compared to watershed segmentation algorithm.
Its future work includes classification of tumor stages by using Support Vector Machine (SVM) classifier or Neural Network classifier and tumor size calculation for better analysis of tumor.

S. E. El-Khamy et al.[4] In their paper presented a combination of Fuzzy C-Mean (FCM) and conformed threshold. The proposed system consists of five stages: the first stage is preprocessing which enhances the intensity of input MR brain

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image for next stages. The second stage is calculation of the number of clusters for FCM input by applying a rectangular window for image histogram. The third stage is finding the clusters center using FCM. The fourth stage is the brain tumor segmentation using conformed threshold value. The final stage is tumor detection from the segmented image.
This method shows better correctness and decreases the processing time by 80% compared to the global threshold segmentation technique, but the completeness is better in global threshold method than the proposed method.
Its future work includes calculation of the diameter of the tumor in 3D MR brain image for treatment planning with high accuracy.

N. Mathur et al.[5] In their paper presented a fuzzy based edge detection using K-means clustering method. The K-means clustering approach is used in generating various groups which are then input to the mamdani fuzzy inference system. This results in the formation of the threshold parameter to be then fed into the classical sobel edge detector which enhances its edge detection capability using the fuzzy logic.

The result shows that fuzzy based k-means clustering increases the performance of classical sobel edge detector along with retaining much relevant information.
Its future work includes the application of proposed method on other edge detectors.

S. Khare et al.[6]. In this paper they proposed a new algorithm for the detection of brain tumor using MRI. The proposed method is implemented using Genetic Algorithm (GA), Curve Fitting and SVM. GA is used to create image segments. The segments obtained after applying GA might be losing some information in their neighboring segments. Curve fitting is applied to properly segment the image without the loss of information. After segmenting the image, features are extracted from the segments. SVM is then used to classify these extracted features. The classified data then helps in determining the tumor using the extracted features.
This method is 16.39% accurate and 9.53% precise then the method using Mahalanobis distance.

A.Lakshmi et al.[7]. In this paper they provided the brain MR image segmentation process which makes the brain tumor diagnosis and analysis easier. The proposed system consists of two main steps: preprocessing and segmentation. Preprocessing step involves three methods. First method is noise removal using curvelet transform, second one is artifact removal and the third method is skull removal using mathematical morphology. After preprocessing, segmentation is done using spatial FCM.

The results presented in the paper are preliminary and quantitative validation on more accuracy and stability of method is still necessary.
Its future work includes image segmentation, classification and performance analysis.

Selkar and *Thakare*[8] in their paper presented watershed and thresholding algorithm for brain tumor detection and segmentation. The system consists of three stages. Firstly quality of the scanned image is enhanced by removing noise. Secondly thresholding and watershed segmentation is applied to get a high intensity portion called tumor from the whole image. Finally for boundary extraction and to find the size of tumor, edge detection operator is applied.

The result shows efficient tumor detection by using thresholding algorithm rather than watershed algorithm and canny edge operator gives efficient boundary extraction results rather than prewitt and Robert operator.

A. Kharrat et al.[9] In their paper presented an automatic brain tumor segmentation method in MR images. The proposed method constitutes four steps – The first step is image pre-processing. The second step involves feature extraction via the wavelet transform-spatial gray level dependence matrix (WT-SGLDM). In the third step dimensionality reduction is done using GA and the final step involves classification of reduced features using SVM.

The result shows that the proposed method outperforms manual segmentation with Match Percent (MP) measure equal to 97.08% for the malignant and 98.89% for the benign tumors. The proposed approach outperforms the FCM algorithm with an accuracy rate of 99.69% and 99.36% for benign and malignant tumors respectively and the specificity rate of 99.64% and 99.71% for malignant and benign tumors respectively.

Beham and *Gurulakshmi*[10]. In this paper they presented a K-means clustering algorithm and Morphological Image Processing. The proposed method consists of three steps: The first step is image enhancement in which outer elliptical shaped object is removed. The second step is morphological process, carried out to extract the required region. The final step is the segmentation using K-means clustering algorithm.
This unsupervised method is efficient and less error sensitive and can be applied to minimal amount of data with reliable results compared to supervised methods.

Gopal and *Karnan*[11].In this paper they presented a system to diagnose brain tumor through MRI using a hybrid image processing approach such as FCM with GA and Particle Swarm Optimization(PSO). The tumor detection is done in two phases. The first phase involves pre-processing and enhancement using the tracking algorithm to remove film artifacts and median filter to remove the high frequency components. The second phase involves segmentation and classification using GA with FCM and PSO with FCM.

PSO with FCM gives better classification accuracy 92.8% and average error rate 0.059% as compared to GA with FCM where classification accuracy rate is 89.6% and average error rate is 0.078%

TABLE 1: Comparison of Different Methods

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No.	Author	Year	Methods Used	Advantages	Limitations
1	A. Kharrat et al.	2016	DWT-SGLDM for feature extraction. Simulated Annealing (SA) to reduce features size. Stratified K-fold Cross Validation to avoid over fitting.GA-SVM to optimize SVM parameters. SVM to construct the classifier.	Minimum number of features to classify the normal brain and Pathological brain reduces the cost of classifier.	SA and GA need more computing time which increases as the number of generation increases.
2	Ramya and Sasirekha	2015	Image denoising: fourth order Partial Differential Equation (PDE). Skull Removal: Morphological Operators (erosion and dilation). Segmentation: Seed point selection based region growing segmentation.	Fourth order PDE removes noise effectively and favors better edge preservation. The accuracy of detection is high in comparison to watershed segmentation.	Initial seed point selection depends on user ability.
3	S. E. El-Khamy et al.	2015	Fuzzy C-Mean (FCM) and conformed threshold.	Better correctness and reduction in processing time compared to global threshold segmentation method.	Completeness result better in global threshold method than the proposed method.
4	N. Mathur et al.	2015	Fuzzy based sobel edge detection using K-means clustering method	Increases the performance of classical sobel edge detector along with retaining much relevant information.	Computational cost complexity is high
5	S. Khare et al.	2014	GA to create image segments. Curve fitting to properly segment the image without loss of information. SVM to classify extracted features.	More accurate and precise results than the method using Mahalanobis distance	Requires new training set whenever there is change in image database.
6	A. Lakshmi et al.	2014	Noise removal: curvelet transform Skull removal: mathematical morphology Segmentation: spatial FCM	Curvelet transform is an efficient noise removal method that considers both faint linear and curvy linear features.	Results presented are preliminary and requires clinical evaluation.
7	Selkar and Thakare	2014	Image enhancement: Noise removal Segmentation: Thresholding and watershed method Edge detection: Prewitt, Sobel, Canny edge detection operator	Thresholding algorithm detects tumor more efficiently than watershed algorithm and canny edge operator gives efficient boundary extraction results rather than prewitt and robert operator.	Threshold selection using histogram will be inefficient if the histogram peaks are not tall, narrow, and symmetric and separated by deep valley.
8	A. Kharrat et al.	2014	Image pre-processing, feature extraction via the wavelet tansform-spatial gray level dependence matrix (WT-SGLDM), dimensionality reduction using GA and classification of reduced features using SVM.	Using the optimal features, the method segments benign and malignant tumors with best classification accuracy.	Applicative where the parameters must be updated.
9	Beham and Gurulakshmi	2012	Image enhancement to remove outer elliptical shaped object. Morphological processing to extract the required region and K-means clustering segmentation method	Less error sensitive and can be applied to minimal amount of data with reliable results compared to supervised segmentation methods.	K-means clustering does not work well with non-globular cluster.
10	Gopal and Karnan	2010	Pre-processing and enhancement using the tracking algorithm and median filter. Segmentation and classification using with FCM.	PSO with FCM has lower classification error rate and execution time and better accuracy than GA with FCM.	Median filter removes noise to a great extent but at the cost of blurring the Images which in turn makes the edges invisible

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3. CONCLUSION

Image processing is widespread in biomedical image analysis and is vital for the study of anatomical structures, tissue volume computation, and diagnosis of abnormalities, pathology, treatment planning and computer-aided surgery. This is done to focus on the future developments of medical image processing in medicine and healthcare. This work will be extended to design new algorithm for detection of color images which will provide more efficient result than the existing methods in near future.

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