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Review of Techniques Used To Detect Problems Using MRI Images

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Abstract- **Digital image processing provides graphical mode for detection and prevention of diseases with the collaboration of machine learning. Machine learning contains legion of mechanisms that can work upon the feature extracted from the image. This paper performs analysis of techniques associated with disease detection using filtering and machine learning such as SVM, Regression analysis, random forest and MSVM. In addition detailed procedure followed for classification of MRI image for cancer detection. Parameters considered for evaluation in each research is also discussed in this paper. Comparative analysis of various techniques can be used to choose best possible technique for future endeavours.**

Index Terms- Digital image processing, SVM, Regression analysis, random forest, MSVM.

I INTRODUCTION

Cancer is prime reason for death among humans in modern era. Detection of cancer at early stage is critical for curing such a disease. Technology thereby play critical role in detection and prevention of such a deadly disease.[1] Digital image processing is a field dealing with analysis of MRI images for detection of diseases. Image clarity enhancement mechanisms are researched over and included within the libraries of image processing toolbox to enhance clarity for better detection of any anomaly present within the image. [2]Clarity within the image is required due to noise that can appear within the image. To tackle the issue of noise, filters are present that are employed on the image which is required to be checked for noise.

After noise handling[3] is done, feature extraction process takes place. Feature extraction is the process of extracting the necessary characteristics used to identify critical diseases. [4]Noise handling mechanisms involve median filtering, Gaussian filtering, shot noise filtering , universal filtering etc. [5]After MRI image noise handling once complete, image enhancement mechanisms are used to introduce brightness within the area of interest.

Segmentation [6]procedure is used to separate critical region from entire image. After segmentation procedure, feature extraction from the critical region is deployed. These features are matched against the training set features. In case match occurs, corresponding label from training set is fetched and classification result is produced.

Rest of the paper is organised as follows: section 2 described the detailed process followed for image pre-processing, segmentation and classification, section 3 describes the metrics, section 4 describes the comparative study of techniques discussed in section 2. Section 5 gives conclusion and future scope and last section gives the references.

II.DETAILED STEPS USED TO DETECT ANOMALIES WITHIN THE IMAGE

This section discusses various mechanism employed in image data mining. For this purpose first of all pre-processing mechanism is used.

A. Image pre-processing

Image pre-processing [7], [8]mechanism is deployed to determine noise if any from within the image. image enhancement along with the image noise handling mechanisms are key steps within the image pre-processing mechanisms. Noise and noise handling mechanisms are discussed as under

1) Noise and Noise handling mechanisms

Noise[9], [10] is the distortion that corrupts the image. Noise in medical image is an issue and required tackling mechanisms. Noise is of distinct categories and introduced due to capturing mechanisms, transmission mechanisms and due to environmental conditions.

a) Salt and Pepper Noise
[11], [12][13]This type of noise is introduced as the pixel intensity value goes beyond the threshold value. Threshold value for a given pixel is in between 0 to 255. As the pixel intensity value exceeded this threshold value, white dots introduced within the image causing distortion.

b) Gaussian Noise
It is likewise called as electronic noise since it arises in intensifiers or indicators. Gaussian noise caused by common sources, for example, warm vibration of particles and discrete nature of radiation of warm questions. [14], [15]Gaussian noise for the most part irritates the dark esteems I n computerized pictures. That is the reason Gaussian noise show basically outlined and attributes by Its PDF or standardizes histogram as for dim esteem.

c) Shot Noise
The presence of this noise is seen because of the factual idea of electromagnetic waves, for example, x-beams, unmistakable lights and gamma beams. [10], [16]The x-beam a d gamma beam sources radiated number of photons per unit time. These beams are infused in patient's body from its source, in therapeutic x beams and gamma beams imaging frameworks. These sources are having irregular variance of photons. Result accumulated picture has spatial and worldly irregularity. This noise is likewise called as quantum (photon) noise or shot noise.

2).Filtering Mechanisms
The noise dealing with frameworks are used as a piece of demand to deal with the commotion show inside the picture. Diverse separating instruments are open to ensure smoothening of picture. These frameworks are discussed in this segment.

a) Median Filter
This channel is used as a piece of demand to deal with salt and pepper noise or inspiration commotion. [17], [18]The middle channel empty pixels which are energized past certain limit level. The overhauled or balanced interpretation of middle channel is used as a piece of demand to deal with salt and pepper noise(SAP). It is a non coordinate channel which is extensively used in view of slightest computational multifaceted nature. [19], [20]The unpredictability factor makes its ideal to deal with starting circumstances of SAP from inside the picture. Run time window length one dimensional middle channel similarly exists which is used as a piece of demand to deal with hardware usage of middle channel.

b) Mean Filter
The nature of the picture is basic parameter which is used to judge whether picture is adequately talented for use or not. [21], [22]The mean channel is one such picture improvement procedure which is used to redesign the normal for the picture. The high thickness drive commotion can be dealt with by the use of mean channel. The weighted entire of the adjoining pixel is used to enhance the pixel. The thickness of the pixel is improved as uproarious pixel is supplanted by pixel acquired from weighted mean pixel. Image corruption is typical issue that exist inside the picture. The upgrade of the picture can be expert by the use of nonlinear channel. Mean channel is the answer for this issue. Alone mean channel may not deal with noise totally. Remembering the ultimate objective to decide the issue feathery strategies are met with the mean channel. This will outline soft mean channel.

3) Image Enhancement Mechanism
The clearness of picture is appealing in restorative pictures. The clearness of picture is lost as a result of wide assortment of reasons. One of the normal reasons could be temperature or medium through which picture is transmitted.[10], [23] The picture in PC framework is spoken to fit as a fiddle. These bits can be defiled in the midst of the transmission of picture. With a particular true objective to decide the issue differentiate improvement methodologies are required. One such system to update the differentiation is histogram evening out. The histogram indistinguishable quality system relies upon repeat of pixel occurring inside the picture. The complexity is basic parameter in order to scrutinize the data successfully from the picture.

B. *Machine Learning and Segmentation of MRI Image*
[24], [25]Machine learning is the mechanism of making the machine takes a automated decision once it is being trained. Training given to the machine id categorised into two categories: **Supervised**

Learning and Unsupervised learning. Supervised learning mechanism provides training and is limited to the images presented or already stored within the dataset. In other words only limited decisions are accommodated within supervised learning.[25], [26] Training process needs to be performed again and again in case new images have to be cooperated within such system. Unsupervised learning on the other hand is followed in case number of images participating in the system is uncertain. Training is required at the beginning for creating a system for decision making. In case new images are to be checked then no training for all the images is required. Hence, in large datasets unsupervised learning is preferred. For machine learning and segmentation following techniques are used

Artificial Neural Network (ANN): [27]After component extraction is done, the learning database pictures are arranged by utilizing neural system. These component vectors are considered as neurons in ANN. The yield of the neuron is the capacity of weighted aggregate of the sources of info. The back proliferation calculation altered SOM; Multiclass Support vector machines can be utilized.

Backbone Propagation Neural Network (BPNN): [28]BPNN calculation is utilized as a part of a repetitive system. Once prepared, the neural system weights are settled and can be utilized to register yield esteems for new question pictures which are absent in the learning database.

Support Vector Machine (SVM): [29], [30]A help vector machine develops a hyper-plane or set of hyper-planes in a high-or interminable dimensional space, which can be utilized for order, relapse, or other tasks. SVM is regulated learning model with related learning calculations that dissect information and perceive designs, utilized for grouping and relapse investigation. Given an arrangement of preparing cases, each set apart to belong to one of two classifications, a SVM preparing calculation manufactures a model that doles out new cases into one class or the other, making it a non - probabilistic paired straight classifier.

C. *Classification*

[31], [32]This process identifies the disease if any from within the MRI image inputted. Classification is on the basis of classes. Classes could be any number of diseases that can be diagnosed from within the MRI image. Classification thus, is the final result of all the steps performed in previous sections. In case, classification is accurate then classification accuracy is high otherwise it is low. The prime objective of most of the classification mechanisms is to enhance classification accuracy.

III. METRICS CONSIDERED FOR SEGMENTATION AND CLASSIFICATION OF MRI IMAGES

Metrics decide the efficiency of technique being used for segmentation and classification. These metrics are described as follows:

MSE: [33]MSE indicates mean square error. For the accurate segmentation and classification this metrics should be minimised. Formula to calculate MSE is as under

$$MSE = \sqrt{(X_a^2 - X_{ma}^2)}$$

Here X_a is the actual value and X_{ma} is the approximate value of features.

PSNR: [34]it is peak signal to noise ratio. For the effective classification, this value should be high. The formula to evaluate PSNR is given as under

$$PSNR = 10.\log_{10}\left(\frac{Max_i^2}{MSE}\right)$$

Max_i is the maximum value of the pixel within the MRI image and MSE is the mean square error.

TP and FP: [35][36]This is a part of confusion matrix. TP indicates true positive value and FP indicates false positive rate. For the accurate classification, TP must be high and FP must be low.

IV. COMPARISON OF TECHNIQUES USED IN MRI PRE-PROCESSING, IMAGE SEGMENTATION AND CLASSIFICATION

Noise and its impact on MRI images is described through comparative table as under

Noise	Description
Gaussian Noise	Gaussian noise is a factual noise. It is equitably disseminated over the signal. It is a noteworthy piece of "read noise" of a picture sensor i.e. of the consistent noise level in dull zones of the picture. The portability density function (PDF) of Gaussian noise is equivalent to that of the typical appropriation, otherwise called Gaussian conveyance. It is normally utilized as added substance repetitive sound give

	added substance white Gaussian noise (AWGN).
Salt-pepper Noise	Fat-tail circulated or implusive noise is now and again called salt and pepper noise or spike noise. A picture containing salt and pepper noise will have dim pixels (dark specks or pepper) in bright pixel and splendid pixels (white dabs or salt) in dim area. A compelling strategy to evacuate this sort of noise includes the utilization of middle channel, morphological channel or a contra harmonic median channel.
Shot noise	The presence of this noise is seen because of the statistical idea of electromagnetic waves, for example, x-beams, obvious lights and gamma beams. The x-beam and gamma beam sources radiated number of photons per unit time. These beams are infused in patient's body from its source, in therapeutic x beams and gamma beams imaging frameworks. These sources are having arbitrary variance of photons. Result assembled picture has spatial and fleeting arbitrariness. This noise is likewise called as quantum (photon) noise or shot noise

Table 1: Noise and its description

Noise handling mechanisms and type of noise handled by filters is presented as follows

Filtering Technique	Effects	Parameters	Advantage	Disadvantage
Median Filter	It remove the outlier without reducing the sharpness of image	PSNR MSE	Useful to enhance edges.	drawback of Median Filtering is blurring the image in process
Mean Filter	Grain noise has been improved	Entropy	used to suppress the small details in an image and also bridge the small gaps exist in the lines or curves	Does not smooth the image
Contrast Enhancement Scheme	Enhances the colour of the image to remove noise	Sharpness Contrast	Useful for removing of noise that is present due to color	Only work with the colour components
Particle Filter	Handles blur in the image	smoothness	Smooth the image	Computes estimate based results

Table 2: Comparison of Filtering mechanisms

Merits and demerits associated with segmentation and classification strategies is presented as under

Technique	Advantage	Disadvantage
SVM	Simple geometric interpretation and a sparse solution. Robust, when sample has some bias.	Slow training. Difficult to Understand for classification large support vector
K-means Clustering	Simpler classifier as exclusion of any training process. Applicable in case of a small not trained dataset.	More training samples More speed of computing distances sensitive to irrelevant inputs so expensive testing every time.
Metric Evaluation	Convergence rate is better	Work on limited values

Table 3: Comparison of Segmentation and classification strategies

V. CONCLUSION AND FUTURE SCOPE

MRI images are used to diagnose the disease if any within the image. To detect the disease effectively, image is required to be filtered. For this purpose, filtering mechanism is utilised. Feature extraction is used to detect the characteristics that have to matched with the trained image features. Classes and corresponding labels are already defined, the matched features thus gives the disease detected. The process is known as classification. MRI image segmentation and classification is critical and hence effective technique from machine learning and segmentation is required for fast classification of disease.

In future modified MSVM can be used for segmentation and classification.

REFERENCES

[1] A. Noori, A. Al-jumaily, and A. Noori, "Comparing the Performance of Various Filters on Skin Cancer Images," Procedia - Procedia Comput. Sci., vol. 42, no. 02, pp. 32–37, 2014.

[2] A. Noori, A. Al-jumaily, and A. Noori, "The Beneficial Techniques in Preprocessing Step of Skin Cancer Detection System Comparing," Procedia - Procedia Comput. Sci., vol. 42, no. 02, pp. 25–31, 2014.

[3] P. Rao, N. A. Pereira, and R. Srinivasan, "Convolutional Neural Networks for Lung Cancer Screening in Computed Tomography (CT) Scans," pp. 489–493, 2016.

[4] P. Mehta and B. Shah, "Review on Techniques and Steps of Computer Aided Skin Cancer Diagnosis," Procedia - Procedia Comput. Sci., vol. 85, no. Cms, pp. 309–316, 2016.

[5] P. Yuvarani, "Image Denoising and Enhancement for Lung Cancer Detection using Soft Computing Technique," IEEE ACCESS, pp. 27–30, 2012.

[6] B. A. Miah, "Detection of Lung Cancer from CT Image Using Image Processing and Neural Network," no. May, pp. 21–23, 2015.

[7] B. V Kiranmayee, T. V Rajinikanth, and S. Nagini, "Enhancement of SVM based MRI Brain Image Classification using Pre-Processing Techniques," IEEE, vol. 9, no. August, pp. 1–7, 2016.

[8] A. Singh, "Analysis of Image Noise Removal Methodologies for High Density Impulse Noise," IEEE ACCESS, vol. 3, no. 6, pp. 659–665, 2014.

[9] G. B. Chittapur and B. S. Anami, "C OMPARISON AND ANALYSIS OF PHOTO IMAGE FORGERY DETECTION TECHNIQUES," IEEE ACCESS, no. 6, pp. 45–56, 2012.

[10] P. Singh, "A Comparative Study to Noise Models and Image Restoration Techniques," IEEE ACCESS, vol. 149, no. 1, pp. 18–27, 2016.

[11] A. H. Pilevar, S. Saien, M. Khandel, and B. Mansoori, "A new filter to remove salt and pepper noise in color images," Signal, Image Video Process., vol. 9, no. 4, pp. 779–786, 2015.

[12] E. J. Leavline, D. A. Antony, and G. Singh, "Salt and Pepper Noise Detection and Removal in Gray Scale Images : An Experimental Analysis," IEEE ACCESS, vol. 6, no. 5, pp. 343–352, 2013.

[13] P. S. J. Sree, P. Kumar, R. Siddavatam, and R. Verma, "Salt-and-pepper noise removal by adaptive median-based lifting filter using second-generation wavelets," Signal, Image Video Process., vol. 7, no. 1, pp. 111–118, Feb. 2011.

[14] P. Pandey, A. Bhan, M. K. Dutta, and C. M. Travieso, "Automatic Image Processing Based Dental Image Analysis Using Automatic Gaussian Fitting Energy and Level Sets," IEEE ACCESS, 2017.

[15] Y. Ma, D. Lin, B. Zhang, Q. Liu, and J. Gu, "A Novel Algorithm of Image Gaussian Noise Filtering based on PCNN Time Matrix," in 2007 IEEE International Conference on Signal Processing and Communications, 2007, pp. 1499–1502.

[16] T. K. Djidjou, D. A. Bevans, S. Li, and A. Rogachev, "Observation of Shot Noise in Phosphorescent Organic Light-Emitting Diodes," iEEE, vol. 61, no. 9, pp. 3252–3257, 2014.

[17] G. Wang, D. Li, W. Pan, and Z. Zang, "Modified switching median filter for impulse noise removal," Signal Processing, vol. 90, no. 12, pp. 3213–3218, 2010.

[18] M. R. R. Varade, P. M. R. Dhotre, and M. A. B. Pahurkar, "A Survey on Various Median Filtering Techniques for Removal of Impulse Noise from Digital Images .," IEEE, vol. 2, no. 2, pp. 606–609, 2013.

[19] P. Singh and A. Aman, "Analytical analysis of image filtering techniques," Int. J. Eng. Innov. Technol., vol. 3, no. 4, pp. 29–32, 2013.

[20] E. A. Kumari, "A Survey on Filtering Technique for Denoising Images in Digital Image Processing," IEEE ACCESS, vol. 4, no. 8, pp. 612–614, 2014.

[21] C. Khare and K. K. Nagwanshi, "Image Restoration Technique with Non Linear Filters," IEEE, pp. 1–5, 2011.

[22] M. Saini, "A Hybrid Filtering Techniques for Noise Removal in Color Images," IEEE, vol. 5, no. 3, pp. 172–178, 2015.

[23] D. Bernstein, S. Diamond, and M. Morrow, "Blueprint for the Intercloud – Protocols and Formats for Cloud Computing Interoperability," IEEE, pp. 328–336, 2009.

[24] V. B. Kumar, "Dermatological Disease Detection Using Image Processing and Machine Learning," IEEE, pp. 88–93, 2016.

[25] A. Borji, S. Izadi, and L. Itti, "iLab-20M: A Large-Scale Controlled Object Dataset to Investigate Deep Learning," 2016 IEEE Conf. Comput. Vis. Pattern Recognit., pp. 2221–2230, 2016.

[26] M. Elad and M. Aharon, "Image denoising via sparse and redundant representations over learned dictionaries.," IEEE Trans. Image Process., vol. 15, no. 12, pp. 3736–45, 2006.

[27] A. Nazemi and A. Maleki, "Artificial neural network classifier in comparison with LDA and LS-SVM classifiers to recognize 52 hand postures and movements," Proc. 4th Int. Conf. Comput. Knowl. Eng. ICCKE 2014, pp. 18–22, 2014.

[28] B. J. Samajpati and S. D. Degadwala, "Hybrid Approach for Apple Fruit Diseases Detection and Classification Using Random Forest Classifier," IEEE, no. 2013, pp. 1015–1019, 2016.

[29] M. Satone and G. Kharate, "Feature Selection Using Genetic Algorithm for Face Recognition Based on PCA , Wavelet and SVM," IEEE, vol. 6, no. 1, pp. 39–52, 2014.

[30] J. Ram, "Ship Detection Based on SVM Using Color and Texture Features," IEEE, pp. 343–350, 2015.

[31] V. Ponomaryov, "Computer-aided detection system based on PCA/SVM for diagnosis of breast cancer lesions," 2015 Chil. Conf. Electr. Electron. Eng. Inf. Commun. Technol., pp. 429–436, 2015.

[32] J. C. Kavitha and A. Suruliandi, "Texture and color feature extraction for classification of melanoma using SVM," 2016 Int. Conf. Comput. Technol. Intell. Data Eng. ICCTIDE 2016, 2016.

[33] M. Mese and P. P. Vaidyanathan, "Optimal histogram modification with MSE metric," in 2001 IEEE International Conference on Acoustics, Speech, and Signal Processing. Proceedings (Cat. No.01CH37221), 2001, vol. 3, pp. 1665–1668.

[34] C. Chang-yanab, Z. Ji-xian, and L. Zheng-jun, "Study on methods of noise reduction in a stripped image," Int. Arch. Photogramm. Remote Sens. Spat. Inf. Sci., no. 1, pp. 2–5, 2008.

[35] V. S. H. Rao and M. N. Kumar, "A new intelligence-based approach for computer-aided diagnosis of Dengue fever.," IEEE Trans. Inf. Technol. Biomed., vol. 16, no. 1, pp. 112–8, Jan. 2012.

[36] G. Kaur, "An intelligent system for predicting and preventing MERS-CoV infection outbreak," J. Supercomput., 2015.