Analysis of Cancer Detection Techniques within Stomach

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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 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

Keywords: 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.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[1].Clarity within the image is required due to noise that can appear within the image[2].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 handlingis done, feature extraction process takes place.Feature extraction is the process of extracting the necessary characteristics used to identify critical diseases[3].Noise handling mechanisms involve median filtering, Gaussian filtering, shot noise filtering , universal filtering etc[4].After MRI image noise handling once complete, image enhancement mechanisms are used to introduce brightness within the area of interest[5]. Segmentation procedure is used to separate critical region from entire image[6].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,section3 describes the metrics,section 4describes the comparative study of techniques discussed in section 2. Section 5 gives conclusion and future scope and last section gives the references.

1.1 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.

Image Pre-processing

Image pre-processing mechanism is deployed to determine noise if any from within the image.[7][8]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

Noise and Noise handling mechanisms

Noise is the distortion that corrupts the image.[9][10]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.

Salt and Pepper Noise

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.[11][12][13]

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. Gaussian noise for the most part irritates the dark esteems in computerized pictures.That is the reason Gaussian noise show basically outlined and attributes by Its PDF or standardizes histogram as for dim esteem.[14][15]

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.

1.2 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.

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.

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.

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.

Machine Learning and Segmentation of MRI Image

Machine learning is the mechanism of making the machine takes a automated decision once it is being trained.[24][25]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.

1.3 Machine learning and segmentation following techniques are used

Artificial Neural Network (ANN): 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.[27]

Backbone Propagation Neural Network (BPNN): 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.[28]

Support Vector Machine (SVM): 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.[29][30]

1.4 Classification

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.[31][32]

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: MSE indicates mean square error.For the accurate segmentation and classification this metrics should be minimized.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.[33]

PSNR: 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. [34]

TP and FP: 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.[35][36]

2.Comparison of techniques Used In MRI Pre-Processing, Image Segmentation and Classification

Table 1. Noise and its description

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 2. Comparison of Filtering mechanisms

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

II. CONCLUSIONS 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.

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