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TEXTUREFEATUREABSTRACTIONBASEDONASSESSMENTOFHOGANDGLDMFEATURESFORDIAGNOSINGBRAINABNORMALITIESINMRIIMAGES

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Texture Feature Abstraction based on Assessment of HOG and GLDM Features for Diagnosing Brain Abnormalities in MRI Images

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Abstract- The brain tumors are increasing rapidly among the younger generation. The survival of the subject can gradually be increased if the tumors are detected at early stages. Magnetic Resonance Imaging (MRI) is an important technique in detecting the tumors. The images are corrupted by random unwanted information, complicating the automatic feature extraction and the analysis of clinical data. Many methods are existing in present day to remove the unwanted information from the images. Automatic classification is essential because it reduces the cause of human error and where the accuracy is not affected. The work emphasizes on removal of noises from the MRI using the hybrid KSL technique which is the combination of Kernel, Sobel and low pass filter. Features are the properties which describe the whole image. Features from these images are extracted using shape, texture and intensity based techniques. The feature extracted are HOG and GLDM.

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I. Introduction

Imaging technique in biomedical field has helped the doctors in depicting the inner parts of the body for easier diagnosis. It also has helped doctors to make keyhole surgeries for reaching the particular interior parts without really opening too much of the body. X-ray is a beam produced by a tube which contains X-ray by sending through the body. This had helped doctors in investigating the subject very detailed manner. But the drawback from this was when the subject was x-rayed many times there was some side-effects. CT scanner, Ultrasound and Magnetic Resonance Imaging have overcome x-ray imaging by making easier way for doctors. Technique of imaging using ultra-sound utilizes high frequency band sound waves which will be in terms of megahertz range that are reflected in imaging. The technique is usually diagnosis of fetus in pregnant women. It can be used to image the breast, muscles, tendons, abdominal organs, heart, arteries and veins. But it provides less information when compared to techniques such as CT or MRI. Powerful magnetic fields and radio waves which produce detailed interior information of body are used in Magnetic resonance imaging technique. MRI is one of the improvised technique in medical imaging which has proven to be a successful tool in the realizing the human brain. The abundant information provided by this concerning of the soft tissue and anatomy of brain has improved the quality of diagnosis and its treatment.

The not involving the introduction of instruments into the body is the important advantage of this technique. MRI scan is not only meant for brain also utilized for examining any part of the body including the injuries due to sports, problems related to musculoskeletal, vessels of heart and blood can be analyzed. Internal organs, brain and spinal cord and bones and joints. Results obtained can be provide ample amount of information for treatment, planning for further and shows how effective the previous treatment was. MRI scan include a special methods that ensures extra information to physician. An intracranial neoplasm (brain tumor) happens when undesirable cells form within the brain. There are mainly malignant or cancerous tumors and benign tumors or noncancerous tumors. Malignant tumors are the tumors which are caused due to inflammation in other parts of the body. In malignant, primary tumors which start within the brain and secondary tumors which will be spreading from other body parts known as brain metastasis tumors. Benign tumors are tumor cells which grow in brain. They grow very slow where as malignant cells grow very rapidly. Brain tumors has the symptoms determined on the amount of the brain involved. Some of the symptoms are headaches, problem with vision, seizures, vomiting and mental changes. Cause of most brain tumors is usually unknown. The common type in children is a malignant medulloblastoma. Anticonvulsant medication used for treatment of seizures. Primary brain tumors originate in your brain. They can develop from the brain cells, nerve cells and glands.

II. Background Study

a) Preprocessing

Removing noise from signal or image is the main aim of pre-processing. Photography field uses Pre-processing because an image is degraded which needs to be enhanced so that it will printed as required. Getting back a high quality magnetic resonance image medical for diagnosing is crucial where it injures the subject more if the machines are passing high level

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Magnetic resonance sound for taking an image. Noise will be introduced to image at the time acquisition or during the transmission. The corruption rate in an image is decided by its quantification. Noises sources for an image are:

i. Environmental conditions may affect the sensors which are used for imaging.
ii. Inadequate light levels and sensor temperature produce the unwanted information in an image.
iii. Transmission channel interruption cause noise generation.

b) Feature Extraction

Dimensionality reduction is known as feature extraction. When input is large enough to be processed by an algorithm and it is having an impression to emphasize the quality redundant. This input information will be made to appear into a decreased few features. Features extracted are picked up and expected features set will extract the appropriate information from the input which will perform the desired task being reduced instead of the full size input.

Extracted features from an image are the properties that elaborates the full image. The aim is to reduce the original information set by measuring certain features. Generally feature extraction can be classified as Shape based, Texture based and Intensity based. Circularity, shape, irregularity, area, perimeter etc. are the commonly used shape features. Intensity features are mean, median intensity, variance, standard variance, skewness and kurtosis. Commonly used texture features are contrast, sum of square variance, correlation, entropy, energy, homogeneity. Wavelet transform is used in the modern feature extraction method for MRI as the WT supplies localization in both spatial and spectral domains. Wavelet transform can be decomposed into different levels. Middle frequencies information is provided by decomposition coefficients. These information has excellent usage for image segmentation. The features extracted from wavelet coefficients are combined and applied as input to the segmentation stage. The work mainly concentrates on extracting the features like histogram of gradient and grey level difference method.

III. Methodology

A system comprises of pre-processing of input image, feature extraction and segmentation of the image. The block diagram representation for various steps carried out in this work is depicted in the Figure 1.

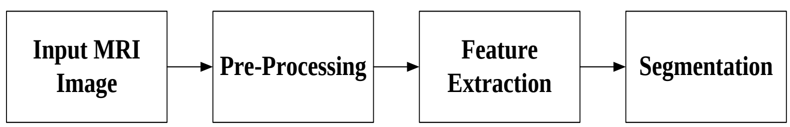

Fig.1: Block diagram of Proposed Methodology

a) Image Acquisition

The input MRI image is acquired by using MRI scan technology. The image acquisition is a difficult task as the image needed from the scanner is of an important organ of the body and once if it is damaged curing those damages is difficult. The user positions his body on the scanner. The user will go through high magnetic resonance imaging so that the machine captures the image in a proper manner. Then collect the images through the help of MRI scanning centers. The scanner produces the images 5mm slice thickness whose resolution varies from 256X256 to 958X958. One of the T2 weighted brain MRI image (normal and abnormal) considered in the database.

b) Brain MRI Image Preprocessing

The MRI image can be seen as a combination of many noises such as salt and pepper, speckle noise, Rican noise, Gaussian and so on. To improvise the information present in the image and remove associated noises pre-processing techniques are used. In this proposed algorithm we use a hybrid technique known as KSL technique. KSL filtering algorithm is the combination of kernel, sobel and low pass filter. Kernel filter is applied on to the MRI image, where kernel matrix is applied to each pixel in the image. Various kernel filters are used to remove different types of noises. This provides LPF and HPF using a kernel. Next pass the output obtained through sobel filter which does the work of 2-D spatial gradient measurement on an image.

Filtered image obtained from the sobel output is passed through LPF which is best suited for smoothing of an image. This retains the low frequency information present in an image. The KSL filtering technique for MRI is implemented using Matlab and tested for different kind of images. Kernel matrix is applied to each and every matrix pixel. The kernel has multiplication factors for multiplying to the pixel and its neighbors. As all the values present in the image will be multiplied and each value change with the sum of the products. These filters provide low and high-pass filtered outputs.

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$$\begin{pmatrix} a & b & c \\ d & e & f \\ g & h & i \end{pmatrix} * \begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{pmatrix} * \begin{bmatrix} 2 & 2 \end{bmatrix} = (i*1)+(h*2)+(g*3)+(f*4)+(e*5)+(d*6)+(c*7)+(b*8)+(a*9) \quad (1)$$

The Sobel operator does the operation on a 2-D gradient of spatial measurement of an image. Usually it finds the closest gradient magnitude at every point in an input gray-scale image. The edge detector has a pair of 3*3 convolution masks where one is used to estimate the gradient columns and the other one is used to estimate the gradient of rows. Always convolution mask is smaller than the actual image. The mask has moved on the image, influencing a square of pixels at each time. The Sobel masks are shown

$$G_x = \begin{pmatrix} -1 & 0 & +1 \\ -2 & 0 & +2 \\ -1 & 0 & +2 \end{pmatrix} \quad (2)$$

$$G_y = \begin{pmatrix} +1 & +2 & +1 \\ 0 & 0 & 0 \\ -1 & -2 & -1 \end{pmatrix} \quad (3)$$

The calculation of the gradient is done by:

$$|G| = \sqrt{G_x^2 + G_y^2} \quad (4)$$

The closest Magnitude can be estimated as:

$$|G| = |G_x| + |G_y| \quad (6)$$

A low pass filter is frequently used as smoothing methods. An image is blended by reducing the dissimilarities between pixel values by providing the average values of nearby pixels. In low pass filters all the high frequencies are being removed off by retaining the low frequencies. An example

$$A = \begin{pmatrix} \frac{-1}{16} & \frac{-1}{8} & \frac{-1}{16} \\ \frac{-1}{8} & \frac{3}{4} & \frac{-1}{8} \\ \frac{-1}{16} & \frac{-1}{8} & \frac{-1}{8} \end{pmatrix} \quad (7)$$

Non-brain tissue has to be eliminated from the MRI images which is performed by skull stripping methods. Non-brain tissues which are removed is a basic step in the processing of brain MR images. This process by default includes some intensity normalization, spatial normalization, and repositioning of the brain, but to a certain extent those can be switched off. The actual skull stripping is a modified version of the BET algorithm, expanding a spherical surface iteratively until it envelopes the brain. The output can be a skull stripped (masked) brain, the mask itself or different surface formats. Skull-Strip is called by a set of other functions. Therefore no separate block for skull-stripping but options can be adjusted as parts of the respective blocks. It increases the speed and accuracy of diagnosis which is the preceding step in various medical applications. It's been know that removes non-cerebral tissues such a skull, scalp, and dura which will from images of brain. S3 is named after algorithm simple skull stripping which depends on brain anatomy and intensity of image characteristics. It uses intensity adaptive thresholding which helps in increased robustness, morphological operations of the magnetic resonance (MR) images. The value of the threshold is evaluated by adaptively knowledge based in brain MR images database. The performance of S3 algorithm is used to estimate the similarities with three popular algorithms known as brain extraction tool, brain surface extractor, and robust brain extraction using standard validity indices.

c) Brain MRI Image Feature Extraction

Analysis of the texture of an image is the main role in the medical image segmentation. The basic principles is the use of characteristics regarding text, image and background objects. Features are removed in this processes to identify image, text and background objects by the help of various techniques. Few techniques used for excluding the features from the image are depending on shape of the subject, textures and the intensity based. The simple and straight forward statistical features are used to distinguish objects from one another. Principles depends on observing the image pixel colors for example pixels lighter than from background in gray scale images indicate characteristic pattern of the brain tissues. Intensity of the image having high values the WM, pixels of lesser values are GM and pixels with least values are CSF.

- Histogram of Gradients

Object detection in computer vision and image processing are mainly defined through histogram of gradient. The high intensity features are extracted by this method. Dense means that it extracts features for region of interest and all locations in the image as reflected to only the local neighborhood of key-points like SIFT. This technique counts the availability of gradient orientation of an image in localized portions. This is similar to shape contexts edge orientation histograms. It is uniformly spaced cells of dense grid and this ensures overlapping local contrast for normalization. It will obtains the information of the region by capturing the gradients. It

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can be done through making the image into small parts. Each cell which are divided has a particular number of gradient orientation bins. Pixels are bi-linearly interpolated to reduce aliasing. Pixel vote for its orientation bin and for the neighboring orientation bins. Distances of pixels from the centre decides the weights. Depending on the energy across the blocks histograms are normalized. Usually each step size has a cell where in each cell has 4 blocks .Therefore these define four different version of histogram.

- Gray Level Difference Method (GLDM)

The GLDM depends on the availability of two pixels which are having difference in grey level. They are separated by specific displacement is δ.

$$\delta = (\Delta i,\ \Delta j) \tag{8}$$

Let $S(i,j) = |S(i,j) - S(i+\Delta i, j+\Delta j)|$ (9)

Consider difference = 2, d = 1 and angle = 00 the element in the matrix is assigned the value of 13 as M (2) = 13. The algorithm of GLDM is as shown.

a) Segmented Image, (d) distance and direction
b) Read the Segmented Image (ROI)
c) Iterative process for each pixel block window size 7X7
d) Select the pixel with passing through parameters d
e) Construct the 255 5 matrix in S
f) If the selected pixel and consecutive pixels are same, then the position of the selected pixel and d will be replaced by the count in the GLDM matrix
g) Repeat the steps 2-6

In the process of texture analysis usually Haralick features are extracted and from those set, algorithms select the reduced features. The statistical texture features of a digital mammogram or the digital image are extracted using this technique. Contrast can be defined as the difference between the high and low intensity levels of the image. The measure of homogeneity of the image is angular second moment. Entropy is correlated to energy. Measure of inverse difference moment is the distribution of elements in the GLDM in diagonal form. Gray level difference method be defined by g (n, m). For any given displacement

$$\delta = (\Delta n,\ \Delta m) \tag{10}$$

Where, Δn and Δm are integers

$$g\delta(n,\ m) = \ |g(n,m) - g(n+\Delta n,\ m+\Delta m)| \tag{11}$$

d) Brain MRI Image Segmentation

Neural networks are the networks which are constructed and are used to implement human brain. The main aim of this network is to create a computational device for looking after the brain to perform many tasks faster than the traditional systems. ANN does various tasks as matching of pattern and classification, optimization function, quantization of vector. ANN is an effective information processing system which is similar as biological neural network characteristics. ANN possesses large number of nodes and neurons. These are inter connected to each other. These neurons and nodes have the capability of modeling the networks of the original brain manages it.

Single layered is defined by taking an element to be processed and combining it with other processing element. A layer indicates a stage going stage by stage means input stage and output stage are linked with each other. These lined environments leads to formation of various network architectures. When a layer of the processing nodes is formed the inputs can be connected to these nodes with different weights, resulting in series of outputs one single node. This is called single layered feed forward network. A multi-layered is defined by the connection of several layers. The input layer receives the input and has no function as of buffering the input signal. The output layered generates the output of the network called the hidden layers. The hidden layers are the inner layers to the network. This has no contact with external environment. The layers may vary from zero to N numbers.

IV. Experimental Results

Pre-processing is concerned with predominantly decreasing any variability in the input. The input image for processing is read and shown in Figure 2.

Fig. 2: Input Brain MRI Image

The work proposes a novel filtering approach called as KSL filter which is effective over the Impulse (Salt and Pepper) noise commonly present within brain MRI images. The input MRI Image is first pre-processed by filtering it in three stages namely KSL filtering technique as mentioned earlier. First kernel performs the convolution operation then sobel detects the edges. After detecting the edge the high frequency noise is removed out by passing it through low-pass filter. Figure 3 shows the test image and filtered image using Kernel filter and Figure 4 shows filter output of sobel and Low-Pass filter.

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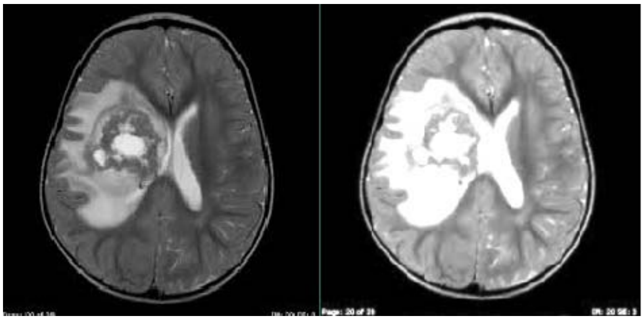

Fig. 3: Query Image and Kernel Filtered Applied image

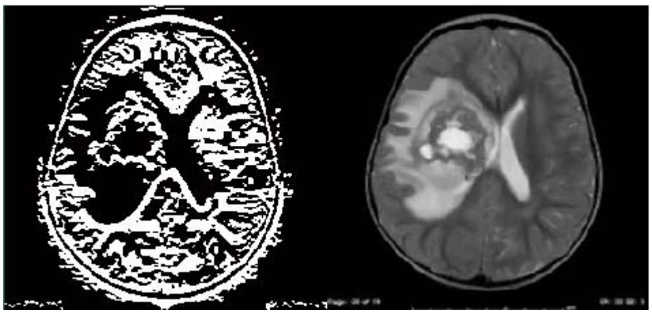

Fig. 4: Sobel Filtered and Low pass Filtered image

The different noise removal algorithms are tested and simulated. Denoising process is carried out for five set of brain MRI images using the different standard impulse lessening filters such as Median mesh (filter), and proposed filtering approach called as Kernel Sobel Low-pass filter. The Table 2 indicates the comparative analysis of performances of different denoising algorithms evaluated using statistical noise parameters such as PSNR, SNR, SSI and MSE.

Table 2: Comparison Analysis of noise removal techniques

Test Images	SNR (KSL)	SNR (MEDIAN)	PSNR (KSL)	PSNR (MEDIAN)
Image 1	26.90	8.19	36.79	28.60
Image 2	30.96	31.23	38.84	29.07
Image 3	28.51	14.63	36.36	29.31
Image 4	22.67	16.59	33.46	30.70
Image 5	25.03	5.18	31.82	28.90

After noise removal the next step is brain image segmentation. But for segmentation of brain image the skull stripping process is a preliminary step. Removal of non-cerebral tissues of the brain is essentially termed as Skull Stripping. The non-cerebral tissues are normally bright and may hamper the segmentation process because MRI images contains patient label (Film Artifacts), noise like salt and pepper noise and skull regions. Hence the direct usage of brain MRI images without skull stripping as a main preprocessing step will affects the accuracy of both segmentation and classification process. Therefore it is necessary to remove the skull region which is not required in the detection of abnormalities. Since morphological operations is said to give better results than tracking algorithms morphological operations based skull stripping algorithm is explored in this work. Related to the methodology we proposes a pivotal scheme which is to create a mask of the brain which is free from non-cerebral tissues and multiply with the original image to obtain the resultant image free from skull region. The images obtained after opening operation, creation of mask and after skull removal for brain MRI images are as in Figure 5 and the features extracted from the images are HOG and GLDM are as shown in Table 3.

Fig. 5: Skull Striped Image

Table 3: Extracted HOG and GLCM Features

Test Images	Histogram of Gradients Features	Features from Gray Level Difference Method
Image 1	5720	24979
Image 2	10248	27571
Image 3	13949	29589
Image 4	16692	31292
Image 5	18974	32827
Image 6	21025	34345
Image 7	222839	35539
Image 8	24525	36760
Image 9	25910	37906
Image 10	27201	38935

V. Conclusion and Future Work

The tumor that is being spread widely have to be identified in prior stages. The tumor which is being captured by MRI scanner in MRI images will provide a wide range of information when compared with the other techniques such as CT scanner, X-ray Scanner. These images are first pre-processed to remove the noise as well as the skull region in the image. Segmentation process is performed to detect the tumor regions.

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Features such as GLDM, texture based, HOG is being performed to detect the tumor region.

References Références Referencias

1. D. S. K. Bandhyopadhyay and T. U. Paul, "Segmentation of brain mri image–a review," International Journal of Advanced Research in Computer Science and Software Engineering, vol. 2, no. 3, 2012.
2. A. Chinnu, "Mri brain tumor classification using svm and histogram based image segmentation," published in International Journal of Computer Science and Information Technologies, vol. 6, no. 2, pp. 1505–1508, 2015.
3. E.-S. A. El-Dahshan, H. M. Mohsen, K. Revett, and A.-B. M. Salem, "Computeraided diagnosis of human brain tumor through mri: A survey and a new algorithm," Expert systems with Applications, vol. 41, no. 11, pp. 5526–5545, 2014.
4. S. Gopinathan and S. Poornima, "Enhancement of images with speckle noise reduction using different filters," International Journal of Applied Science and Engineering Research, vol. 4, no. 3, pp. 333–352, 2015.
5. S. Nag, I. Kanta, and S. K. Roy, "A review of image segmentation methods on brain mri for detection of tumor and related abnormalities," International Journal of Advanced Research in Computer Science and Software engineering, vol. 4, pp. 1073 – 1095, 2014.
6. Rajeswari. S, and Theiva Jeyaselvi. K, "Support Vector Machine Classification for MRI Images", International Journal of Electronics and Computer Science Engineering, Vol. 1, No. 3, 1956, pp. 1534-1539.
7. D. Singh, and K. Kaur, "Classification of Abnormalities in Brain MRI Images Using GLCM, PCA and SVM", International Journal of Engineering and Advanced Technology, Vol. 1, No. 6, 2012, pp.243-248.
8. Sonali Patil and Dr. V. R. Udupi, "Preprocessing to be Considered for MR and CT Images Containing Tumors", IOSR Journal of Electrical and Electronics Engineering, Vol. 1, No. 4, 2012, pp.54-57.
9. P. Mohanaiah, P. Satyanarayana and L. GuruKumar "Image Texture Feature Extraction using GLCM Approach", International Journal of Scientific and Research Publication, Vol. 3, No. 5,2013, pp.1-5.
10. Fritz Albregtsen, "Statistical Texture Measures Computed From Gray Level Co Occurrence Matrices",Image Processing Laboratory, Department of Informatics, University of Oslo , 2008, pp.1-14.
11. R. Harclick, K. Shanmugam, I. Dinstein, "Texture Features For Image Classification", IEEE Transaction, vol3, No 6, 1973, pp.610-621.
12. N. Otsu, "A Threshold Selection Method from Gray-Level Histogram", IEEE Trans.on System Man Cybernetics, vol.9 1979, 9962-66.
13. M. M. Mokji and S.A.R. Abu Bakar, "Gray Level Co Occurrence Matrix Computation Based on Haar Wavelet", Computer Graphics, Imaging and Visualization, 2007.
14. Rosy Kumari, "SVM Classification An Approach on Detecting Abnormality in Brain MRI Images", International Journal of Engineering Research and Applications, Vol. 3, No. 4, 2013, pp.1686-1690

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