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Brain Tumor Detection from MRI Images using Multilevel Wavelets

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Abstract: ***A brain tumor in humans is caused by abnormal cell growth persisting in the brain. It is a life-threatening disease toa human being. Early detection of the tumor is the best way for a patient entering into the adverse condition of the disease. Image segmentation is the popular field in image processing to differentiate between tumor cells and normal cells. The tumor can be detected using the technique called segmentation in the field of image processing which can accurately be identified using MRI images in the field of medical images. The tumor affected region and the size of the tumor can be identified with the assistance of radiologic evaluations. Magnetic resonance imaging is a fast-growing tool in recently used to detect the defected part of the body. Principal Component Analysis (PCA) is mainly used for analysing the components from the image. Extracting components relevant to tumor detection is performed using mutual information extraction (MIE). It provides better accuracy in classifying the traumatic brain injury from the MRI images. The proposed system, Multi-atlas segmentation is done on sample digital images with tumor.***

Index Terms: Image processing, Brain tumor, Biopsy, Image enhancement, Multi-atlas segmentation.

I. INTRODUCTION

In recent years, image processing plays an important role in real-time applications. There are few steps and number of techniques to achieve better results in image processing which includes enhancing the clarity of an image, dealing with noisy images, classification of images, and compressing the original image so as to reduce the storage space. There are a number of researches in progress in digital image processing steps which includes feature extraction, restoration, and image enhancements. Image processing is a technique to extract information by transforming an image into digital form and doing manipulation over it. The output of image processing will be an image or it is characteristics related to project information of the considered. Image processing techniques is a process of altering an existing image into a clear readable format. Mostly images are treated as two- dimensional signals and for manipulation signal-processing techniques are applied. Image processing has a broad spectrum and applications such as remote sensing images via satellites and other spacecraft can be used to predict the material and resources available on the land. Image-based analysis research software like MATLAB, WINGRASS, and ArcGIS, Mathcad used to process images and to make an analysis on it.

MATLAB is a product of Works, a multi-paradigm numerical computing environment and proprietary programming language. When images are dealing as two- dimensional data, this matrix laboratory is a useful tool for making analysis over images.The medical image is also taken for analysis which processed on the basis of visual representation of the human body. Medical image processing is capable to view the internal structure of the hidden organs covered by skins and bones to predict the exact cause of the disease for further treatment procedure. The biological image is obtained from radiology which uses technologies like X-ray, radiography, magnetic resonance imaging medical ultrasonography and endoscopy.Image processing plays a vital role in Robotics vision in which automated vision keeps on being dealt with including distinctive techniques for handling, dissecting, understanding and navigating. Optical Character Recognition (OCR) is another area of image processing which is the mechanical or electronic transformation of pictures, written by hand or printed content into a machine- readable format. Sources like OCR has performed scanned document, a photo of a document. Image analysis is helpful in medical field to save time and cost. Medical images are captured using advanced sensors, CT scan, and ultrasound, MRI images in which image processing techniques are reconstructed and modelled in the processing

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of 2D images to create 3D images. Image processing software assists to modify the appearance of the images to make them as for how they visible to the human eye. Temporal and spatial techniques are used to detect the characteristics of tumor and other ailments in an MRI. It is also possible to find the diameter, volume, and vasculature of a tumor and flow of blood or other fluid. Medical images are used for both, diagnosis and therapeutic purposes. It is the most powerful resource that effectively cares for our patients. X-ray, ultrasound, computer aided tomography is mostly used to identify diseases. In order to obtain relevant information from the test image, the combination strategies of PCA and LDA feature extraction method is used to obtain the transformation of input image to reduced set of features.by using multi-atlas technique the exact injury area is detected.

II. LITERATURE REVIEW

K. Sumithra, et. al., explained about image restoration, image enhancement, image segmentation, image recognition techniques briefly and also provided a clear view of applications used in image processing.

Nida M. Zaitoun,et. al., described the image segmentation using a number of variance decision

Ana Ferrazetal, et. al., presented a prototype for the pretransfusion testing, specially dedicated for emergency situations. The prototype is characterized by its portability, efficiency and fast results. It was the first developed prototype. Based on its characteristics it was possible to model a final prototype that introduced significant improvements (Kiran et al., 2015).

M.A. Aswathy, et. al.,made a study to point out the recent developments in breast cancer detection and classification. It gave an outlook on efficiency, authenticity, and accuracy of different techniques. Digital mammography was extensively used for early detection of cancer. The biopsy was the most accurate imaging method. Due to its adverse effects on the human body.

Mahmud,et. al.,described in modern-days photography and other industries employed the digital image processing. Most of the research had to improve the prevailing issues of digital images. Recognition of characters helped in capturing the best matching the photographs and images. In modern days photography and digital image processing were used by many industries.

Donna Giri, et. al., (2013) proposed the automated diagnosis of Coronary Artery Disease affected patients using combination strategies of feature extraction methodology. The proposed approach is based on the decomposition of heart rate signals in order to detect the normal *and*Coronary Artery Diseaseconditions. They concluded that Independent Component Analysis (ICA) coupled with Gaussian Mixture Model (GMM) classifier combination resulted in highest accuracy for detectionof theabnormalities in heart diseases (Sumithra et al., March-2015).

VijendraPrasad,et. al., (2017) proposed the automated pathological brain detection system that allows the classification of brain abnormalities. The proposed scheme gave an efficient pathological brain detection system lies in the use of Simplified Pulse-Coupled Neural Network (SPCNN) for segmentation, Fast Discrete Curvelet Transform (FDCT) to extract curve like features, Principal Component Analysis (PCA) to reduce the features and finally Probabilistic Neural Network (PNN) for classification. They concluded that PNN was the simple network structure and faster learning method used to compare with the other classifiers.

Miguel Caixinha, et. al., (2017) proposed the automatic classification of cataract diseases based on ultrasound technique by using Machine Learning methodology. The proposed scheme used the acoustical parameters and backscattering signals obtained from porcine lenses with different cataract degrees are used for objective and automatic cataract classification. They concluded that the Support Vector Machine (SVM) shows the highest performance for classifying the cataract disease abnormalities (Singh et al., 2003).

Ramakrishnan, et. al., (2017) proposed the classification of brain tumor images by using combination strategies of Support Vector Machine approach along with Sequential Minimal Optimization (SVM-SMO) methodology. This algorithm was effectively employed to construct the hyperplane equation for statistical evaluation to reveal the huge margin for reducing the overshoot in dimensionality. They concluded that the linear kernel of SVM with SMO approaches gave a better accuracy classification between tumor and

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non-tumor images.

Tanvi Gupta, et. al., (2017) proposed the Classification of patients with tumor using Magnetic Resonance Imaging with volumetric Fluid Attenuated Inversion Recovery (MRI-FLAIR) acquisition. This method estimated the classification performance by using the linear kernel in SVM method for obtaining better accuracy than the neural network algorithm in brain tumor images. The proposed algorithm used the entire patient data set for a single sequence of classification within a short computation time (Wang et al., 2009).

AkhandaNandPathak, et. al., (2017) proposed the brain tumor classification using a multiclass SVM algorithm. The contribution of this work was to the integration of an efficient feature extraction tool and a robust classifier to perform accurate automated classification of a brain tumor in MRI images. They concluded that the highest classification accuracy is achieved for different types of tumor in the brain and less computation value. Due to the feature reduction based on the PCA (Yasmin et al., 2012).

III. METHODOLOGY

The traumatic hematoma usually consists of different densities in various regions of brain MRI images. In the proposed work, MRI images were considered and injured part of the images is segmented. Before segmenting the image, image pre-processing is done using CLAHE enhancement techniques. It is to be followed by the segmentation multiatlas technique and the results will be analyzed in terms of MSE, PSNR DSC values of the images in the next phase of the project. MRI images of test and trained images are considered for identification of hematomas.

3.1 IMAGE PRE-PROCESSING

The image preprocessing techniques are mainly processed to discard unnecessary items present in the images. Preprocessing mainly focuses on removing the noise present in the considered image. Conversion of the source image to grayscale representation is the important process in the preprocessing technique. In canny edge detection method is used for Different filter techniques are used for removing the noise present in the image.

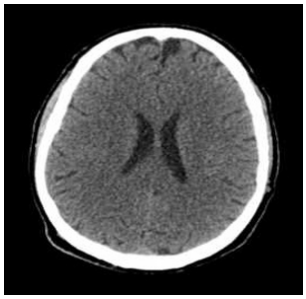

Fig 3.1 Grayscale image

3.2 EDGE DETECTION:

The edge detection is a basic characteristic method of the image. Edge is represented by the collection of pixels and it is present between the objects and background. It contains property, size, and shape. It is mainly helpful in describing the target object of the MRI image.It is to detect a wide range of edges in the MRI images. The first step is canny edge detection smooth the image and eliminates unwanted noise. It also finds the MRI images to gradient for highlighting the regions with high spatial derivation. To analyse the MRI images canny edge detector is used with the following information to extract MRI brain images.

Analysis of the MRI images depending on the intensities of the different regions and pixels of the brain images. This canny edge detection method is the most robust technique to check the abnormalities persist in the growth of the brain area from the MRI images.

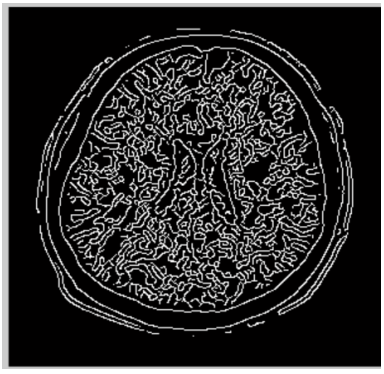

Fig 3.2 Target Edged Image

3.3 IMAGE ENHANCEMENT:

Image Enhancement is to obtain the improvement of information in medical images for human viewers to get a better accuracy. It

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accentuates or sharpens image features such as edges, boundaries, or contrast to make a graphic display more helpful for analysis. [5] discussed about the combination of Graph cut liver segmentation and Fuzzy with MPSO tumor segmentation algorithms. The system determines the elapsed time for the segmentation process. The accuracy of the proposed system is higher than the existing system. The algorithm has been successfully tested in multiple images where it has performed very well, resulting in good segmentation. It has taken high computation time for the graph cut processing algorithm. In future work, we can reduce the computation time and improves segmentation accuracy.

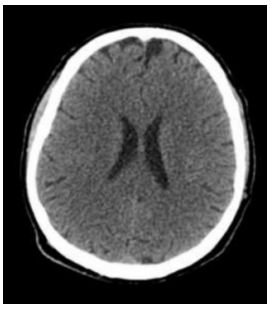

Fig 3.3 Original image

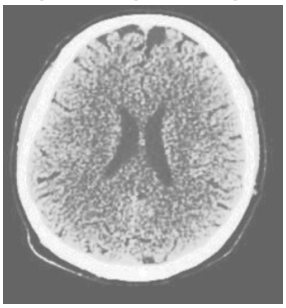

Fig 3.4 Enhanced image

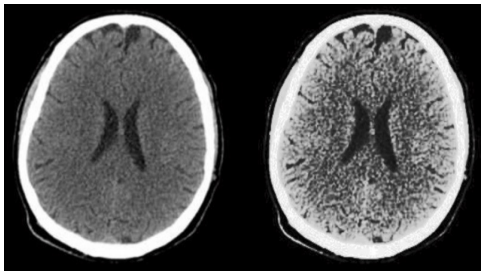

Fig 3.5 Enhanced Image pair

3.4 HISTOGRAM EQUALIZATION:

The popular technique for image enhancement is Histogram Equalization (HE). It is based on finding the distribution function for a given probability density function. After the transformation of density values, the image with increased dynamic range, high contrast and probability density function of the output will be displayed. The Mean Square Error (MSE), Peak Signal to Noise Ratio (PSNR) and Dice Similarity Coefficient (DSC) are calculated to estimate the performance between the original and enhanced images. The proposed system utilizes major steps, which includes: enhancement of the medical images, feature extraction, segmentation selection of relevant features, and finally classification to classify the tumor type.

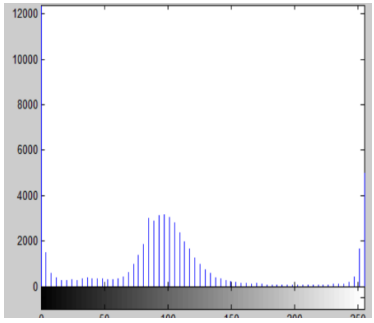

Fig 3.6 Original image histogram

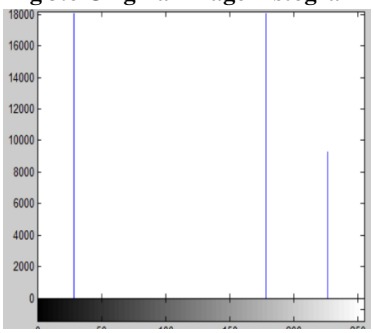

Fig 3.7 Enhanced image histogram

3.5 RGB SEGMENTATION:

The RGB color model is an additive color model in which red, green, and blue light are added together. RGB uses additive color mixing and is the basic color model used in television or any other medium that projects color with light. It is the basic color model used in computers and for web graphics, but it cannot be used for print production.

This is an additive color system based on tri-chromatic theory. RGB is easy to

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implement but non– linear with visual perception. It is device dependent and specification of colors is semi–intuitive. [9] discussed that Biomedical and anatomical data are made simple to acquire because of progress accomplished in computerizing picture division. More research and work on it has improved more viability to the extent the subject is concerned. A few tech- niques are utilized for therapeutic picture division, for example, Clustering strategies, Thresholding technique, Classifier, Region Growing, Deformable Model, Markov Random Model and so forth. This work has for the most part centered consideration around Clustering techniques, particularly k-implies what's more, fluffy c-implies grouping calculations. These calculations were joined together to concoct another technique called fluffy k-c-implies bunching calculation, which has a superior outco- me as far as time usage. The calculations have been actualized and tried with Magnetic Resonance Image (MRI) pictures of Human cerebrum. The proposed strategy has expanded effectiveness and lessened emphasis when contrasted with different techniques. The nature of picture is assessed by figu- ring the proficiency as far as number of rounds and the time which the picture takes to make one emphasis. Results have been dissected and recorded. Some different strategies were surveyed and favorable circumstances and hindrances have been expressed as special to each. Terms which need to do with picture division have been characterized nearby with other grouping strategies.

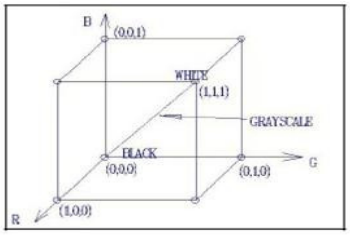

Fig 3.8 Secondary RGB colours

The secondary colors of RGB – cyan, magenta, and yellow – are formed by mixing two of the primary colors (red, green or blue) and excluding the third color. Red and green combine to make yellow, green and blue to make cyan, and blue and red form magenta. The combination of red, green, and blue in full intensity makes white. Red, green, and blue are the primary stimuli for human color perception and is the primary additive colors.

The RGB segmented figure of the query input as shown in the following image.

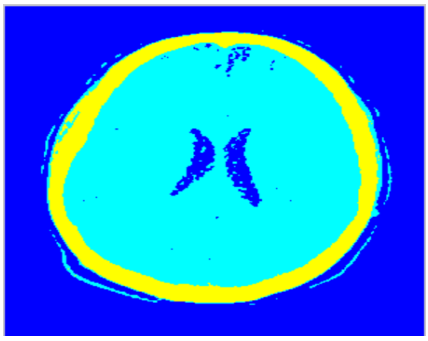

Fig 3.9 RGB enhanced image

IV FUTURE DEVELOPMENT

In the next phase of the project, feature extraction is done for collecting higher level information in images based upon the spatial or texture features. The texture analysis is an important parameter of human visual perception and machine learning system which is used effectively to improve the accuracy of the diagnosis system by selecting prominent features. It is essential to extract the relevant texture-based features due to the intricate structure of diversified tissues such as Gray matter, white matter and cerebrospinal fluid in the brain MRI images. To obtain relevant information from the input test image, the combination strategies of PCA feature extraction method is used to obtain the transformation of the input image to a reduced set of features. The proposed system provided better accuracy in classifying the traumatic brain injury MRI images. The accuracy is analysed in terms of MSE, PSNR and DSC values which are extracted from the brain MRI images. Multi-atlas segmentation used for layerization of every partition of the images. In this method poorly performing images gets discarded to obtain accurate

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segmentation results. In the atlas, selection strategy is important to obtain a segmentation of hematoma in brain injury images. For the selection of atlases, the mutual information between the target image and output image is calculated. The spatial domain fusion scheme uses the pixel average method to the input image and the selected atlas images. From the output Sum of Absolute Difference (SAD) method is used to find the measure of similarities in the input image to obtain the segmentation of hematoma.

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