Middle-East Journal of Scientific Research 23 (6): 1076-1084, 2015
ISSN 1990-9233

DOI: 10.5829/idosi.mejsr.2015.23.06.93182

Certain Investigation on Pathologies in Brain Images Using MRI Slicing

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Abstract: Medical imaging is used to diagnose or examine the internal organs affected by a particular disease. Diagnostic technologies are usually responsible for acquiring medical images of high efficiency and quality. Magnetic Resonance Imaging (MRI) is used for studying the diagnostic work up, for surgery and monitoring treatments. To visualize internal structures of the body, radiology is used in the MRI.The image nuclei of atoms useMagnetic Resonance Imaging (MRI) inside the body. MRI is generally mostcommonly used since it provides more detailed information about tumor such as its type, position and size. In this paper the analysis of MRI medical image is done in order to diagnose the pathologies present in the internal structure of the human body. It involves a series of steps like pre-processing, which includes filtering and morphological operation to remove the noise and to enhance the contrast of the image respectively. Followed by pixel identification, thresholding and segmentation using edge detection method is done. In order to identify the position of the pathology MRI slicing is done. As an enhancement work wavelet transform is implemented on brain image.

Key words: MRI · NMR · Tumor · Pathologies · Top hat and bottom hat transform morphological operation

INTRODUCTION

Medical image processing produce’s quality images of the human body parts. When treating brain tumors, anatomical information to examine human brain development MRI imaging is often used [1]. Magnetic Resonance Imaging provides detailed information about brain tumour [2], cellular structure and vascular information, where it an important tool for the easily diagnosis, treatment and monitoring of the any disease in our brain. The neurosurgical applications of MRI [3] are mostly used to maximize tumour resection while it is used to avoiding damage to normal brain tissue. Brain Image Segmentation and tumor detection is a complex and challenging parts in the Medical Image Processing.

Brain tumor, a notorious disease, has affected and distraught many lives. Life-threatening brain tumors begin from a single cell that has undergone a chromosomal or genetic mutation that affected its protein balance, increasing its capacity for mitotic division or decreasing the suppression mechanism for cell division. As the malignant cell loses its normal function, it starts to abnormally divide much faster than the surrounding normal tissues. A small mass of malignant cells results from that single dividing cell and starts to attack adjacent normal tissue and to threaten the affected brain [4].

The most common symptoms are Headaches, Seizures, Nausea and vomiting are not diseases, but they are one of the symptoms of brain tumor, Mental or Personality Changes can range from problems to severe intellectual problems and confusion, Focal symptoms includes ringing, decreased sensation, paralysis, difficulty in walking or double vision. Diagnosing brain tumors by imaging techniques includes scan is a brain internal structures photograph. A specific machine takes a scan. Using technology of computer, the brain is photographed from various angles to form a scanned image.

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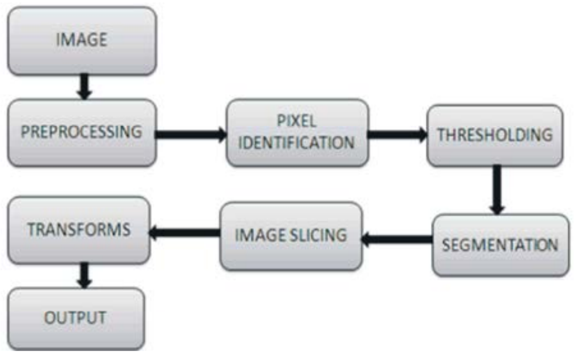

Fig. 1: Steps in detection of brain tumor

Preprocessing: Preprocessing images remove slow-frequency background noise and normalize the intensity of the single particles images, removing reflections and masking portions in images. In Image preprocessing data images are enhancedprior to computational processing which includes the conversion to gray scale by removing salt and pepper noise. Conversion process causes some data loss. It is better to do histogram equalize on each color (R,G,B) before converting it to gray scale,this makes more sense and the drawback here is that the histogram is equalized 3 times. The result is not affected even when the picture is resized.

Filtering: In the Transmission of images over channels, Images are corrupted by salt and pepper noise, due to faulty communications. Noise means any unwanted signal. One person's signal is another one's noise. Noise is not always bad. The noise originates from Sensor. The types of noises are amplifier noise,quantization noise, salt-and-pepper noise, Shot noise, film grain and anisotropic noise. Wiener filters are optimum linear filters in which linear estimation of a desired signal sequence from another related sequence is done.

Signal-To-Noise Ratio: Peak Signal-to-Noise Ratio (PSNR) is the ratio between the maximum power of a signal and the power of corrupting noise. PSNR is expressed in logarithmic decibel scale.The quality of reconstruction of lossy compression codec's (e.g. image compression) PSNR is most commonly used to measure. PSNR is an approximation to human perception of reconstruction quality. Given a noise-free m×n monochrome image I and its noisy approximation K. PSNR is most easily defined via the mean squared error (MSE) are defined as:

$$MSE = \frac{1}{\min} \sum_{i=0}^{m-1} X \sum_{j=0}^{n-1} [I(i,j) - K(i,j)]2 \quad (1)$$

The PSNR is defined as:

$$PSNR = 20.\log10(MAX_I)-10.\log10(MSE) \quad (2)$$

where, MAX_I is the maximum pixel value of the image, linear PCM with B bits/sample, MAX_I is 2^B-1. PSNR forlossy image and video compression were between 30 and 50 dB.

Morphological Operations: Morphological operators interact with other image known as structure element and transform the original image into another image. Morphology provides a systematic approach to analyse. Mathematical morphology is generally based on set theory. The shapes of any objects in a binary image are normally represented by object membership set functions. Objects are connected areas of pixels with value 1, the background pixels have value0.

Histogram Equalization: Histogram equalization harmonizes the image luminosity level distribution in that each of the histogram levels tends to increase the contrast level towards the same number of pixels. This is normally used to maximize the image luminance. Histogram equalization is a method in image processing of contrast adjustment using the image's histogram. This method usually increases the global contrast of many images.

Top Hat and Bottom Hat Transform: Top hat transform is used to extracts small elements. There are two types of top-hat transform namely white top-hat transform and black top-hat transform. The difference between the input images and its opening by some structuring element is known as white top-hat transform. The black top-hat transform is defined dually as the difference between the closing and the input image.

Bottom-Hat class provides functionality for subtracting original image from a morphologically closed version of a binary or gray-scale image and can be used to extract intensity in the desired image. To do a bottom hat transformation, it takes a couple of steps using Vision.

Thresholding: Thresholding is the simplest method of image segmentation. From a Grayscale image, thresholding can be used to create binary images. In many applications ofimage processing, the gray levels of pixels belonging to the object are quite different from the gray levels of the pixels.

Segmentation: Image segmentationdivide's a digital image into various segments. It is used to change the representation of an image and easier to analyse in easier form [5]. It also locates objects and boundaries (lines, curves, etc.) in any digital images.

Canny Edge Detector: The Canny edge detector is an edge detection operator that uses a multi-stage algorithm to detect a wide range of edges in images. The algorithm should mark as many real edges in the image as possible, good localization – edges marked should be as close as possible to the edge in the real image, minimal response.

MRI Slicing: Magnetic Resonance Imaging (MRI) is the detailed images of the body's structures and organs, without the use of X-rays. A computer converts signals from the MRI scan and in produces clear cross-sectional images the body parts that has been scanned. Each slice which is taken from the body area has been scanned and numerous images are created which clearly used to know the features of any part of the body. The images that produced by MRI [6] can be compared to a sliced loaf of bread.

Wavelet Transform: A wavelet is a special function used to give time – frequency transformation. It can assign with a frequency range to each scale component. Then the scale component can be viewed with a resolution that matches the scale. A wavelet transform is the representation by only change in the time extension, but not in its shape. This transforms have advantages over Fourier transforms for representing functions that have sharp peaks and for accurately used to producing the finite, non-periodic and non-stationarysignals. DWT is used for data compressionof a signal which is already sampled and the CWT for the signal analysis, where DWT is commonly used in engineering and computer applications and the CWT in scientific research. Wavelet transform is found to be the efficient one when compared with various transforms in existence which is used for transform data, then encodes the transformed data where mainly used in compression. JPEG 2000 is implemented as an image compression standard, which uses orthogonal wavelets. It means that although the frame is over complete, it is a tight frame.

RESULTS AND DISCUSSION

Filtering

Weiner Filter and Median Filter: Weiner filtering is also called as Least Mean Square (LMS) Filtering is one used to minimize the mean square error between original and approximated images. Where it is used to improve direct inverse filtering. It is also used in restoration of an image. Median filter is a non-linear filter which is used to remove lines and provides less blurring than linear filters. They are effectively reducing impulse noise (Salt and Pepper noise), random noise and Gaussian noise.

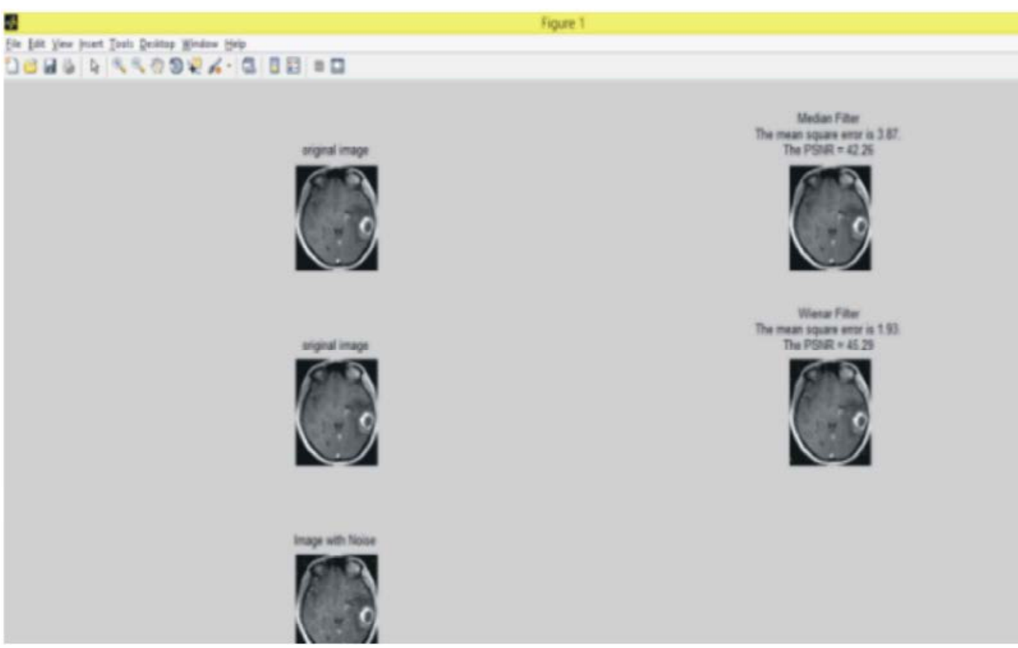

Fig. 2: Wiener and Median Filter output

Wiener filter
PSNR Value: 45.29
MSE Value: 1.93
Median filter
PSNR Value: 42.2
MSE Value: 3.87

From the results of PSNR and MSE values of median filter and wiener filter it is clear that the wiener filter gives best results.

Graph:

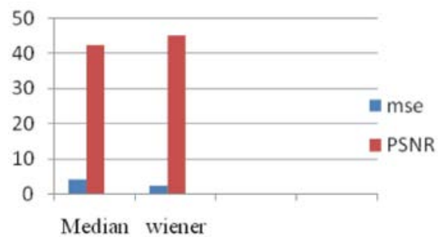

Fig. 3: Graph for the wiener filter and medianfilter

Morphological Operations
Top Hat and Bottomhat Transform:
Top hat and Bottomhat transform

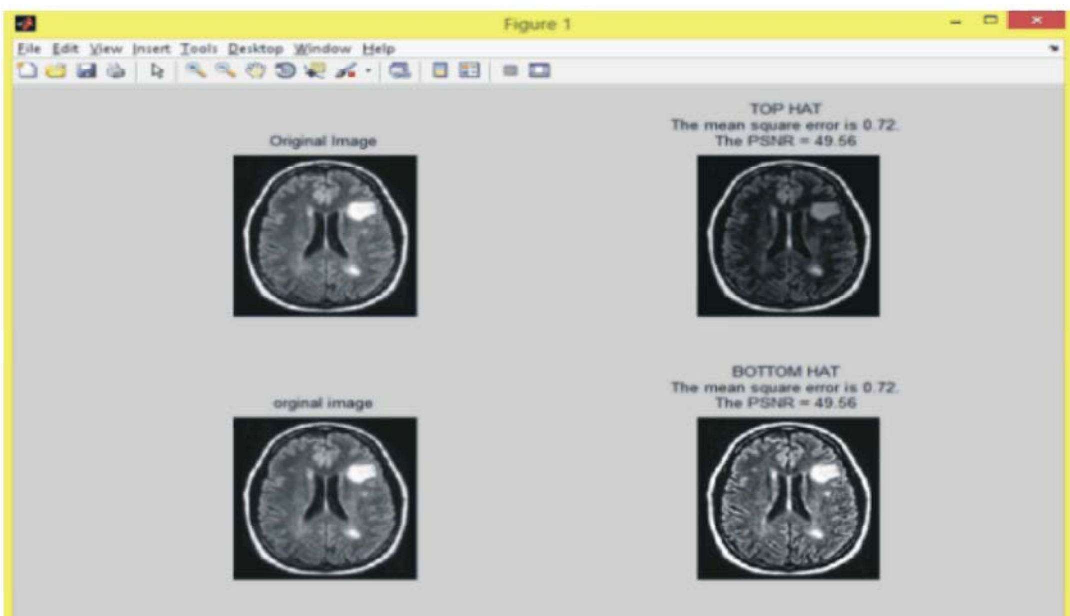

Fig. 4: Top hat and Bottom hat transform output

Top hat and Bottom hat transform:
PSNR Value: 49.56
MSE Value: 0.72
HISTOGRAM EQUALIZATION

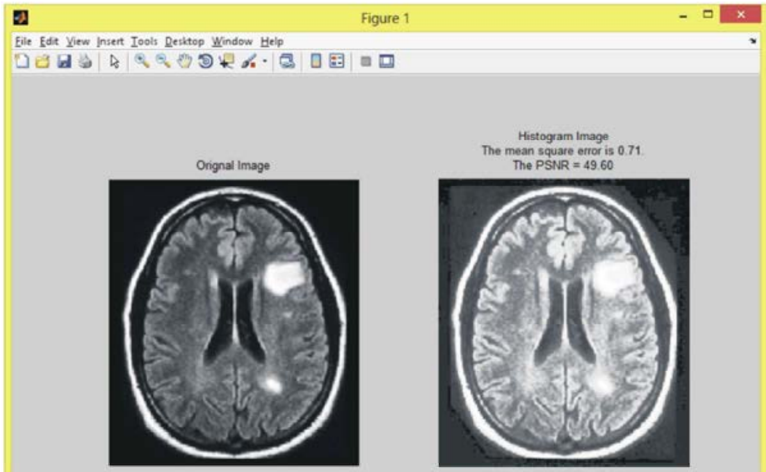

Fig. 5: Histogram Equalization Output

PSNR Value: 49.60

MSE Value: 0.71

From the PSNR and MSE values it is clear that the histogram equalisation gives better results compared to tophat and bottomhat transform.

Graph:

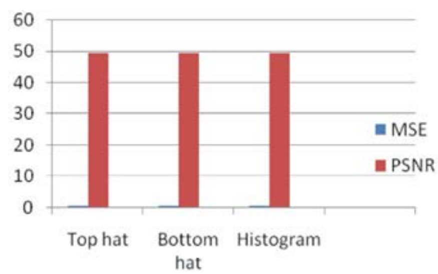

Fig. 6: Graph for top hat, bottom hat transform and histogram equalization

Pixel Identification: The value of each pixel in a image is shown in Fig. 7, where the intensity of each pixel is calculated.

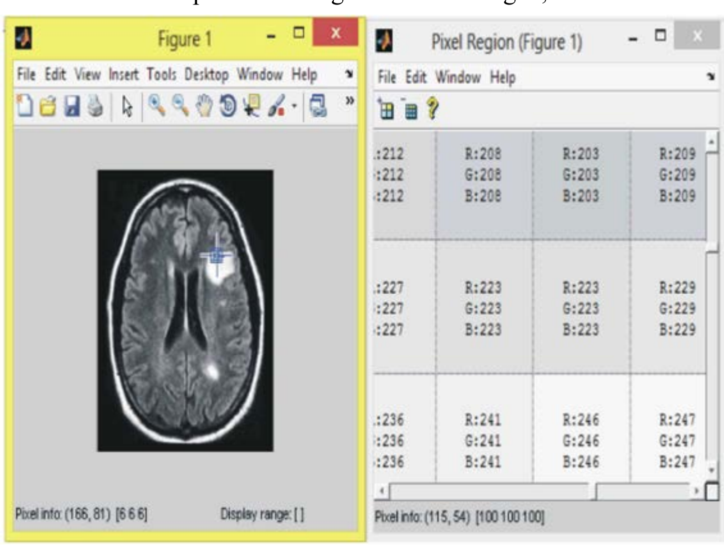

Fig. 7: Pixel Identification

THRESHOLDING

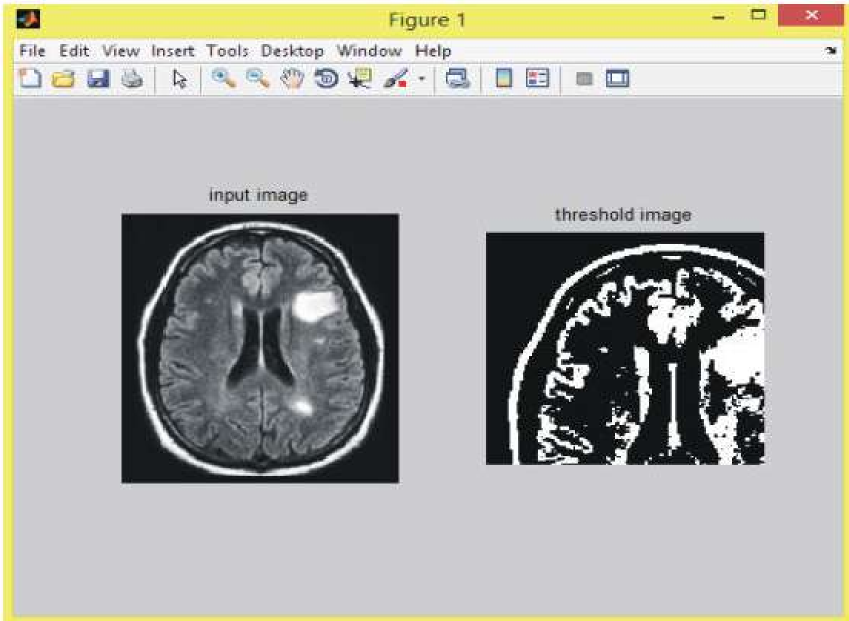

Fig. 8: Thresholding

Here the binarizationofthe image is done.

Segmentation: The performance between the sobel and canny edge detector is shown in Fig. 9.

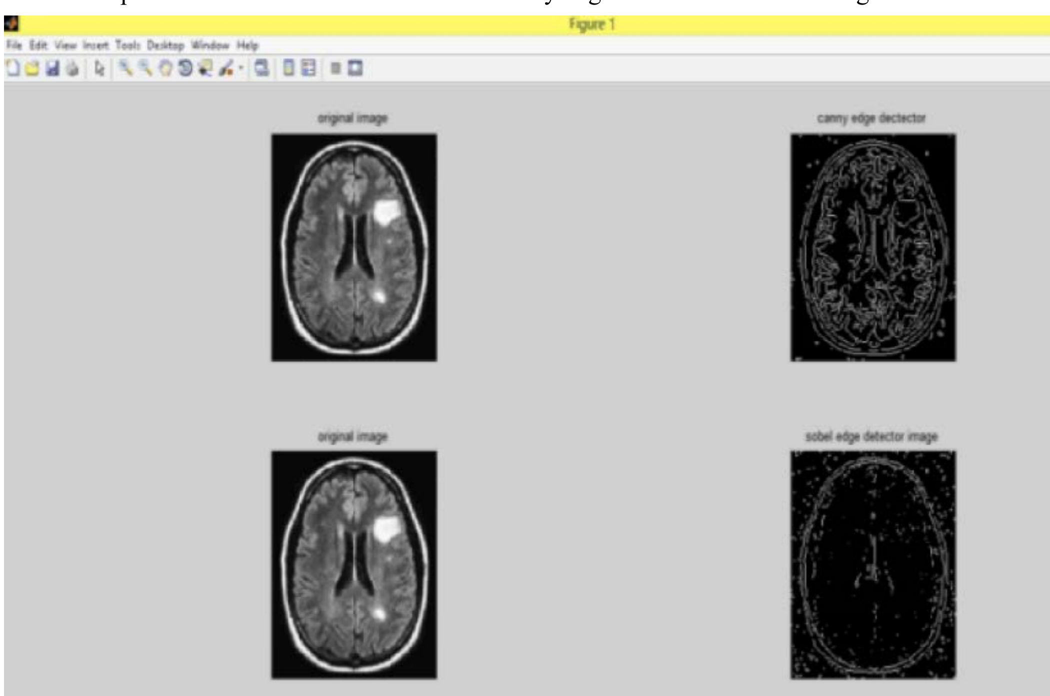

Fig. 9: Canny and Sobel Edge detector

Canny edge detector preserves more edges compared to that of the sobel edge detector.

Slicing: Slicing of the MRI image is done to identify the tumor.

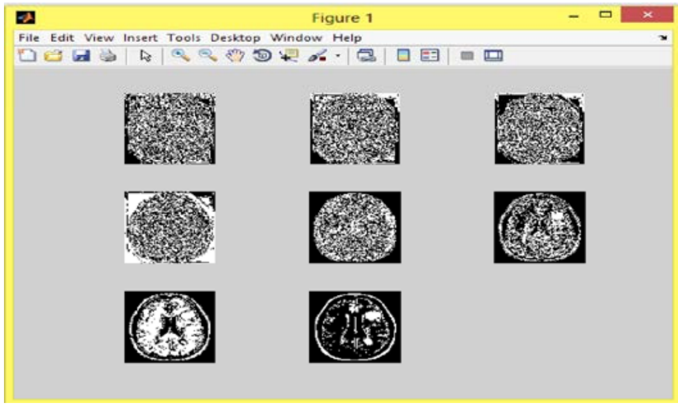

Fig. 10: Slicing

Here the position of the pathology is identified using 2D slicing.

Wavelet Transform:

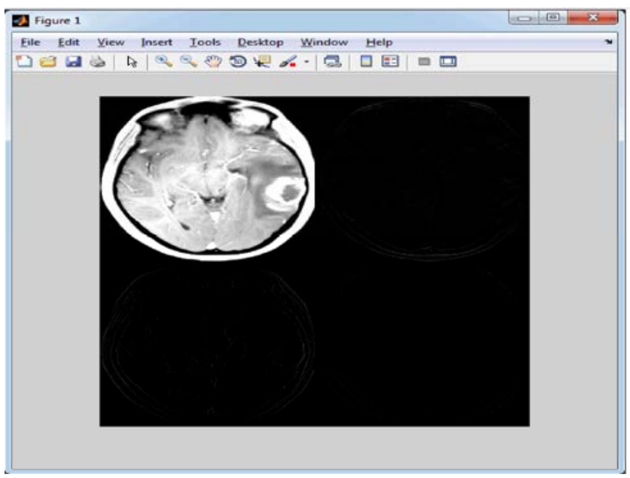

Fig. 11: The image displays the pathology

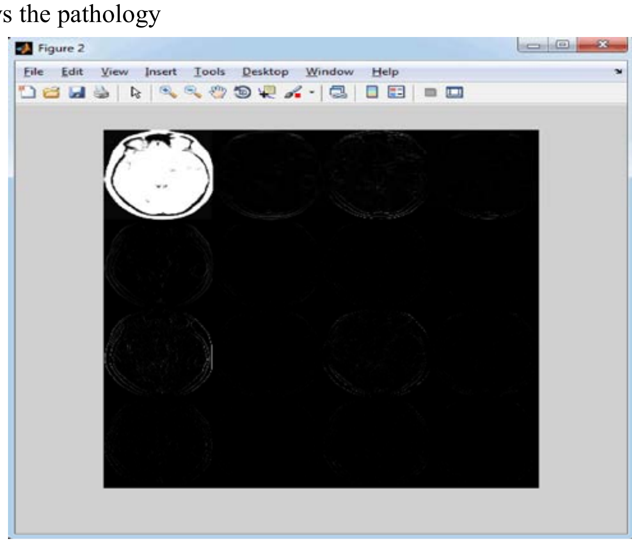

Fig. 12: First daubuchie filter output in wavelet transform

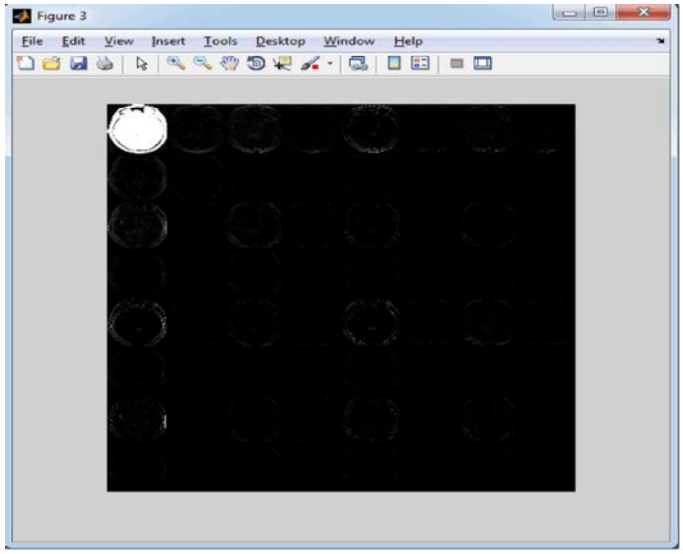

Fig. 13: Second daubuchiefilteroutput in wavelet transforms

The results show the image of the pathology, outputs of the first and second daubuchie filter.

CONCLUSION

In this paper the preprocessing of the brain images such as filtering, morphological operation are performance orders to remove the noises that are produced at the time of scanning. The median filter has shown best result by removing the noise and preserving the edges when compared to that of the wiener filter by analyzing its PSNR and MSE values. In morphological operation, histogram equalization has given a best result by increasing the contrast of the image when compared with the traditional tophat and bottom hat transform. Then pixel identification gives a clear view of the intensity of each pixel i.e., the value of RGB of each pixel, by consuming lesser time with high efficiency. Then bi-linearization is done by the thresholding method. Next segmentation has achieved its perfection by using the canny edge detection algorithm, which preserves the edges of the original image by giving less preference to noises, when compared with that of the sobel edge detector. Then slicing is done to exactly locate the position of pathology in brain images.

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