Brain Tumor Detection and Skull Fracture Detection using Morphological Operators in MATLAB

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Abstract— This paper presents a technique for the detection of brain tumor and skull fracture from magnetic resonance imaging (MRI). The MRI is basically used in the biomedical to detect, analyze and visualize finer details in the internal structure of the human body. This methodology is basically used to detect the differences in the tissues which have a far better technique as compared to computed tomography (CT). So this method makes this technique a very special one for brain tumor and skull fracture detection. Computed tomography (CT) images which are used to ascertain the difference in tissues density and magnetic resonance imaging (MRI) provides an excellent contrast between various tissues of the body. In this present methodology, preprocessing includes image resizing, conversion to gray, image enhanced in the way that finer details are improved and the noise level removed from the specimen image. In this methodology, the technique is using threshold segmentation, threshold segmentation is one of the simplest segmentation methods which is using for the improves the quality of result. The input gray scale image is converts in a binary format. Here we use one more segmentation method watershed segmentation; watershed segmentation is one of the most appropriate methods to group pixels of an image on the basis of their intensities. The main purpose of morphological operation is to separate the tumor parts and the fracture parts of the image. Now only the tumor and fracture portion of the images is visible, shown as white color and bubble, with the help of edge detection.

Keywords: MRI, Threshold Segmentation, Median Filter, Morphological Operator, Skeleton and Edge Detection

I. INTRODUCTION

Brain, skull heart and lungs and so on are the most censorious part of the human body. And after that, all parts of the human body are controlled by the brain cells. Subsequently, brain is a crucial organ of the body and these organs of the brain are surrounded by the skull. We can say brain and skull are the two most important parts of the human body. These days, brain tumor is an intense ailment among youngster and grown up. Brain tumor is most fatal and recalcitrant disease in the human body. A skull fracture is any kind of break in the cranial bone, also known as skull. There are many types of skull fracture, but only one major cause , an impact or a blow to the head that's enough to break the skull or cranial . An injury in to the brain can also accompany the fracture, but that's not always the case. In both the cases, an accurate detection of size and location of brain tumor and skull fracture plays a vital role in the diagnosis of tumor and fracture. An efficient algorithm is proposed for tumor and fracture detection based on segmentation and morphological operators. first of all quality of scanned image enhanced by using median filter which can removes the noise from the input image and then morphological operators erosion and dilation are applied to detect the tumor or fracture in the scanned image. Accurate measurements in the brain or cranial diagnosis are quite difficult because of diverse shapes, size and appearance of the tumor or fracture. Tumors can grow abruptly causing defects the neighboring tissues and also it affects the healthy tissues. Similarly a fracture in cranial can affects the tissues of the brain. Then we will develop a technique of 3D segmentation of a brain tumor and skull fracture by using segmentation in conjunction with morphological operators.

II. TYPES OF BRAIN TUMOR

A word tumor is nothing but a synonym for a word neoplasm which is formed by, an abnormal grow of cells tumor is something totally different from the cancer. There are common types of tumor and they are as follows:

1) Benign:
2) Pre-malignant:
3) Malignant(last stage of tumor causes the cancer).[1]

A. Benign:

A benign tumor is one of which, does not expand in an abrupt way, it does not affect its neighboring healthy tissues and also does not expands to non-adjacent tissues. Moles are the very common example of the benign tumors.

B. Pre-malignant:

This kind of tumor is not yet cancerous but appears to be developing the property of cancer. This stage of tumor considered as a disease, if not properly treated it may lead to cancer. That's why premalignant tumor is a precancerous stage.

C. Malignant:

Malignancy is made up of , mal means bad and gins means fire, is the type of tumor, that grow worse with the passage of time and finally results in the death of a person . Malignant is basically a medical term that describes , a serve processing brain tumor cells have high proteiniceous fluid which has very high level density and hence high intensity, therefore water shade segmentation is the most appropriate tool to classify tumors and high intensity tissues of the brain . The segmentation of an MRI image entails the division or separation of the image in to region of similar attributes. Segmentation of the brain tumor from MRI is an important but time consuming task performed by the medical experts.
The digital image processing community has developed various segmentation methods. Four of them most common methods are:

- Amplitude thresholding
- Texture thresholding
- Template thresholding
- Region – Growing thresholding

It is very for detecting tumors and nercotic tissues. These type of algorithms are used for dividing brain image in to the three basic catagories:

- Pixel based

- Region or texture based
- Structural based

III. TYPES OF SKULL FRACTURE

A skull fracture is nothing but, break in the skull bone. There are four major types of skull fractures, including the following:

1) Linear Skull fracture: This is the most common type of skull fracture found. In the linear fracture, there is break in the bone, but does not move or penetrate in the bone. These kinds of patients may be observed in the hospital for a few amount of time, and can usually resume normal within few days. Usually there is no need of intervention.
2) Depressed skull fracture: This type of fracture may be seen with or without a cut in the scalp. In this type of the fracture, part of the skull is actually sunken from the trauma. This type of skull fracture may require surgical interventions, depending on the severity, to help correct the deformity.
3) Diastatic Skull fracture: this type of fracture that occurs along the suture line in the skull. In this type of fracture, the normal suture lines are widened. This fracture is more often seen in new born and older infants.
4) Basilar Skull Fracture: The basilar skull fractures are the most serious type of skull fracture, and involves a break in the bone at the base of the skull. The patients with this type of fracture frequently have bruises around their eyes and bruise behind their ear. These patients are usually requires close observation in the hospital.[3]

IV. PROPOSED METHODOLOGY

One of the main causes for increasing mortality among children's and adults is the brain tumor or skull fracture. It has been concluded from the research of most of the developed countries that number of peoples suffering and dying from these kind of dangerous disease has been increased to year by year during few decades. The national brain tumor foundation (NBTF) for research in US estimates the death of 13000 patients while 29000 undergoes primary brain tumor diagnosis. These high mortality rates of brain tumor greatly increase the importance of the brain tumor detection accurately. Hence the magnetic resonance imaging (MRI), 3D, Image Segmentation , Watershed and the Morphological operators (Erosion and Dilation) are the fundamental tools for the tumor detection on the other hand Skeleton and Edge detection is used for Skull fracture detection.[6]

Following are the steps using for Tumor detection and Skull fracture detection:

A. Image acquisition:

Images are obtained from MRI scan and these scanned images are obtained are displayed in to a two dimensional matrices having pixels as its elements, and these matrices are depends on matrix size and its field of view. Now the images are stored in Image file and displayed as a gray scale image. The entries of this gray scale are ranking from 0 to 255, where 0 shows total black color and 255 shows pure white color. Total entries between these ranges vary in intensity from black to white.

B. Pre-processing:

In this stage, image is enhanced in the way that finer details and they can give the best possible results. This stage consists following sub Stages:

1) Text Removal:

In this stage all the unwanted text noise will be removed from the scanned image.

2) Noise Removal:

In this stage many filters are used to remove the noise from the images. To remove the noise from the image we use median filter.

3) Image Sharping:

This stage will help us to detect the boundary of tumor as well as fracture of the skull; it will also help to enhance the quality of image. The sharping of the image is very necessity to extract the accurate result; generally a high pass filter is used for this purpose.

C. Post processing:

After preprocessing the image goes to post processing for extraction of the data or information like, Tumor and fracture. There are various stages in post processing we are using for the detection purpose. Those are following:

1) Segmentation:

segmentation of image is based on the division of the image in to regions. And this division is done on the basis of similar attributes. Similarities are spreads out in to groups. The main purpose of segmentation is extraction of the important features from the image, from which information can be easily perceived. Segmentation from magnetic resonance imaging images is an interesting but challenging task in the field of medical imaging [7].

2) Threshold segmentation:

This segmentation method is one the simplest method. First of all the input gray scale is converted in to a binary format. The method is based on the threshold value which will convert gray scale image in to the binary image format. The main goal of threshold segmentation is to select the threshold value. [7],[9]

3) Watershed Segmentation:

Watershed segmentation is also one of the best segmentation methods to group pixels of an image on the basis of their intensities. Pixels, falling under similar intensities are grouped together. Watershed segmentation is a good segmentation technique for dividing a MRI image to separate the tumor from the image. [4]

4) Morphological Operators:

Morphological operators applied after watershed segmentation, some of the commands used in morphing are given below:

a) Strel:

This command is used for creating the morphological element. A most essential part of the morphological dilation and erosion operators is the structuring element used to probe the input image. A structuring element is a set of matrix that identifies the pixel in the image which is processed and defines the neighborhood used in the processing of each pixel. We can choose a structuring element the same size and shape as the objects want to process in the input image. Flat and non-flat structuring elements are mainly used. Flat structuring element is a binary valued neighborhood, either 2-

D or multidimensional, in which the true pixels are included in the morphological computation and the false pixels are not.

b) Dilation and Erosion:

The most common and popular morphological operations are dilation and erosion. The operator dilation adds pixels to the boundaries of object in an image, while the erosion remove that pixels on object boundaries. The number of pixels added or removed from the objects in the specimen image depends upon the shape and size of the structuring element used to process the image. In the morphological operations such as dilation and erosion operations, the state of any given pixel in the output image is determined by applying a rule to the corresponding pixel and its neighbors in the input image. The rules used to process the pixels defines the operation as a dilation or an erosion,

Rules for dilation and erosion:

Dilation: A morphological dilation makes objects more visible and fills in small holes in the objects.

Erosion: A morphological erosion removes islands and small objects so that only substantive objects remain.

V. ALGORITHM

Proposed algorithm for tumor detection

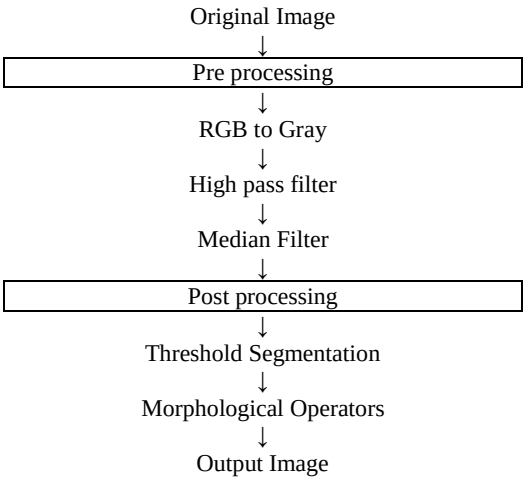
1) Step 1: init(input_image);
2) Step2 : img←input_image;
3) Step3 : img_pre←preprocessing(img);
4) Step4 : img_seg←segmentation(img);
5) Step5 : img_morph←morphologi(img_seg);
6) Step6 : img_output←output(img_morpg);
7) Step7 : return(img_output);
8) Step8 : end;

Proposed algorithm for skull fracture detection

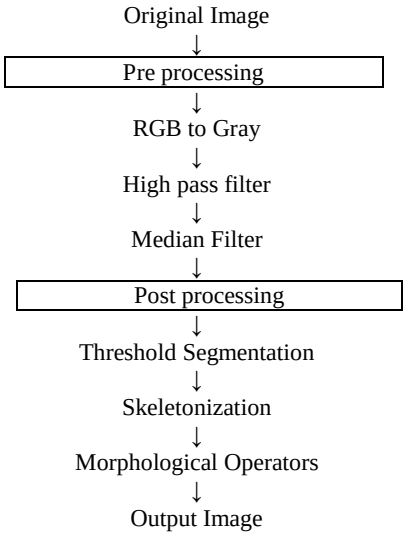
1) Step 1: init(input_image);
2) Step2 : img←input_image;
3) Step3 : img_pre←preprocessing(img);
4) Step4 : img_seg←segmentation(img);
5) Step5 : img_skelt←skeltonization(img_seg);
6) Step6 : img_endp←find_skel_ends(img_morph);
7) Step7 : feature[ ]←feature_extraction(img_endp);
8) Step8 : return (feature []);
9) Step9 : end;

VI. FLOW-DIAGRAM

A. *Block Diagram of Brain Tumor:*



B. *Block Diagram of skull fracture detection*



VII. EXPERIMENTAL OUTCOMES

A. *Outcomes for Brain Tumor*

The very first stage in then detection of brain tumor is pre-processing; it consists of several stages like RGB to gray conversion, filtering the image after conversion to get the best possible and enhanced image.

First of all input image is shown here, Fig1. Shows input image which has brain tumor

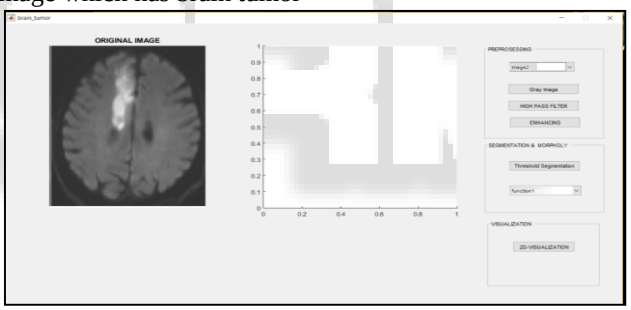


Fig. 1: Input image

Now the specimen image or we can say the input image is first of all converted in to gray image Fig 2. Shows the gray image of the input image, after that Removal is applied on the input image, All unwanted text noise and other noise is removed in this stage Fig 3 and Fig 4 Shows the filtered and enhanced result of given input image

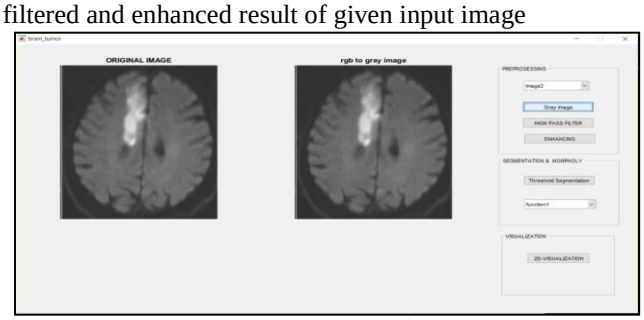


Fig. 2: Input image is converted in to Gray image

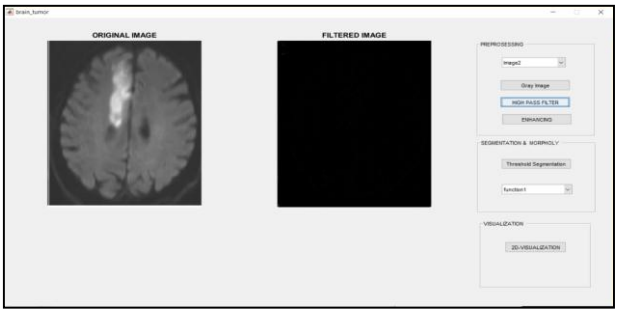


Fig. 3: Filtered image

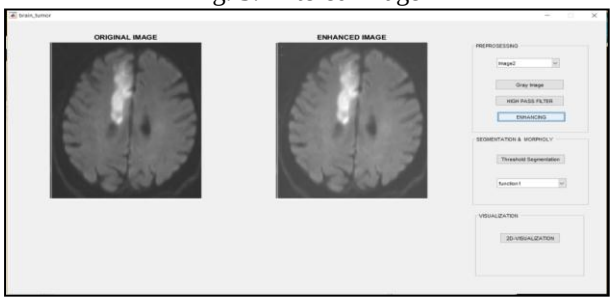


Fig. 4: Enhanced image

After completion of Pre-processing of the image further move for post-processing, in this stage, it consists mainly the segmentation of image and Morphological operators. Now after enhancing the input image it passes through the process of image segmentation in this stage we got the segmented image of input image. Fig 5.Shows the Segmented image of specimen image.

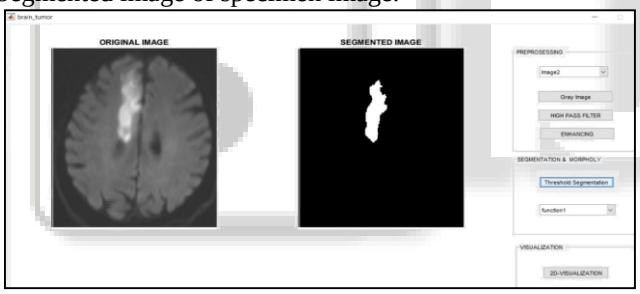


Fig. 5: Segmented Image

Now after getting the segmented image, the result is treated as an input to morphological operators here we use default structural elements to achieve the accurate and best result in the process of detection such dangerous disease brain tumor, in this process we use image dilation and image erosion Figure number 6, 7 and 8 shows the operations.

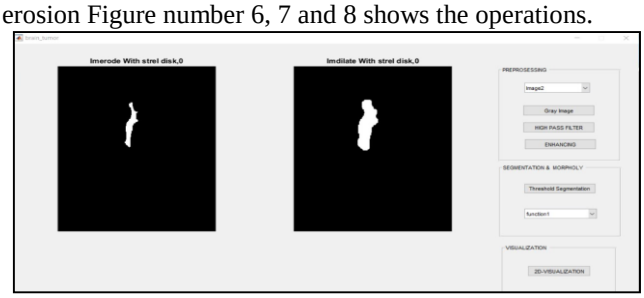


Fig. 6: Image erosion with structural element with disk, 0 also image dilation with the same structural element with disk, 0 functions 1

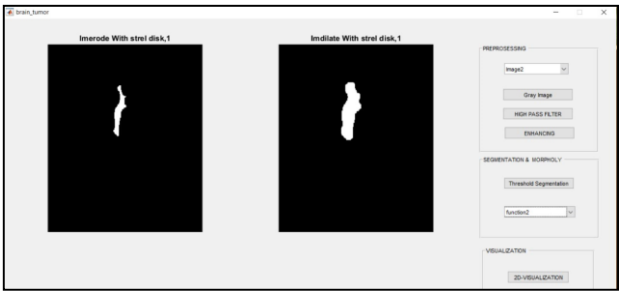


Fig. 7: Image erosion with structural element with disk, 1 also Image dilation with the same structural element with disk,1 function 2

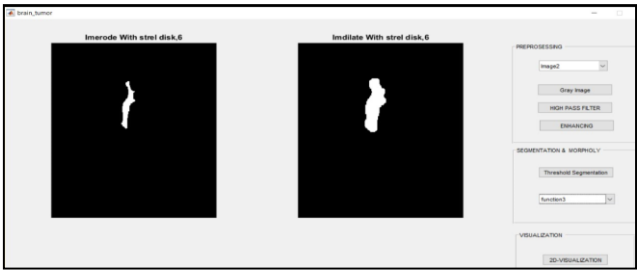


Fig. 8: Image erosion with structural element with disk,3 also image dilation with the same structural element with disk,3 function 3

And finally in Fig 9. We can clearly see the brain tumor in 2-D visualization, in this the specimen and final result can achieve. Fig 9. Shows the final result

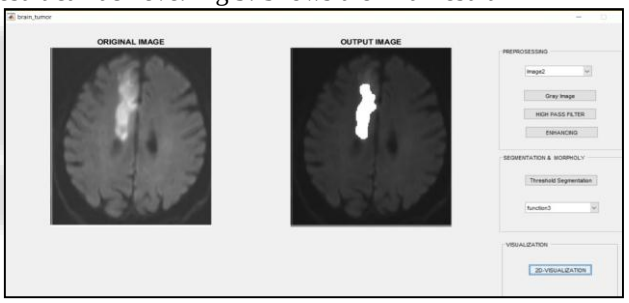


Fig. 9: Output image. High intensity part of brain is nothing but brain tumor.

B. Outcomes for Skull fracture

The very first stage in then detection of Skull fracture is pre-processing, it consists of several stages like RGB to gray conversion, filtering the image after conversion to get the best possible and enhanced image.

First of input image is shown here, Fig1. Shows input image which has skull fracture

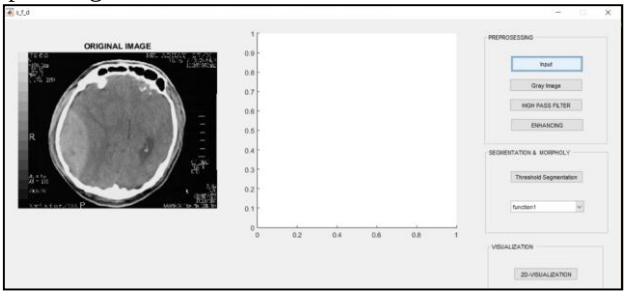


Fig. 1: Input image having Fracture

Now the specimen image or we can say the input image is first of all converted in to gray image Fig 2. Shows the gray image of the input image, after that Removal is applied on the input image, All unwanted text noise and other

noise is removed in this stage Fig 3 and Fig 4 Shows the filtered and enhanced result of given input image.

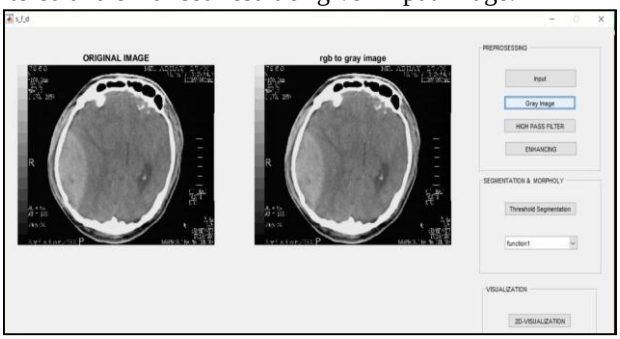


Fig. 2: Gray image

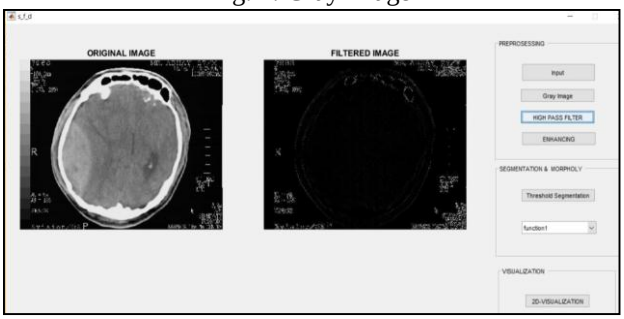


Fig. 3: Filtered Image

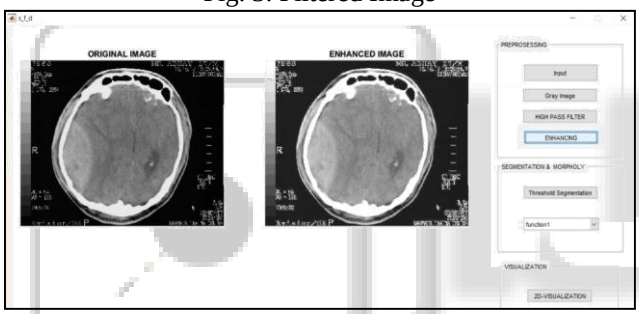


Fig. 4: Enhanced image

After completion of Pre-processing of the image further move for post-processing, in this stage, it consists mainly the segmentation of image and Morphological operators. Now after enhancing the input image it passes through the process of image segmentation in this stage we got the segmented image of input image. Fig 5. Shows the Segmented image of specimen image.

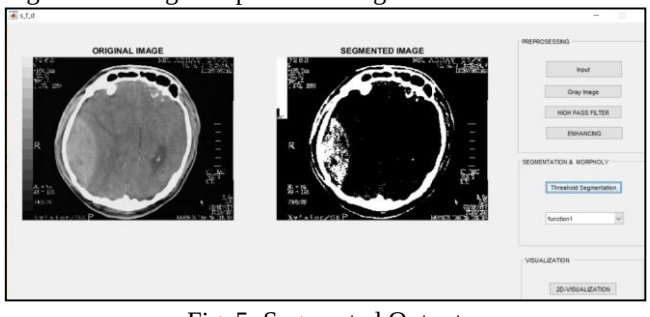


Fig. 5: Segmented Output

Now after getting the segmented image, the result is treated as an input to morphological operation here we use default structural elements to achieve the accurate and best result in the process of detection such dangerous problem skull fracture, in this process we use image dilation and image erosion Figure number 6,7 and 8 shows the such operations.

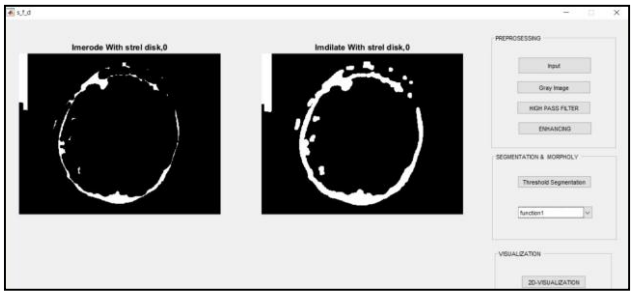


Fig. 6: Image erosion with structural element with disk,0 also image dilation with the same structural element with disk,0 function 1

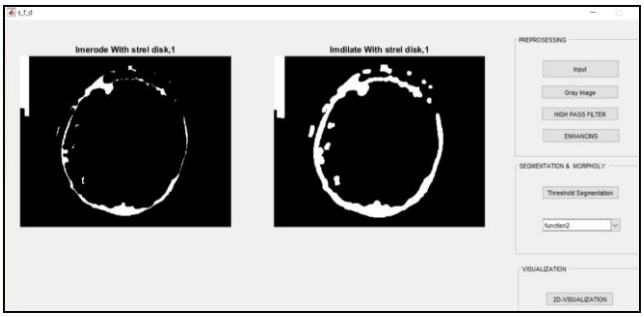


Fig. 7: Image erosion with structural element with disk, 1 also Image dilation with the same structural element with disk,1 function 2

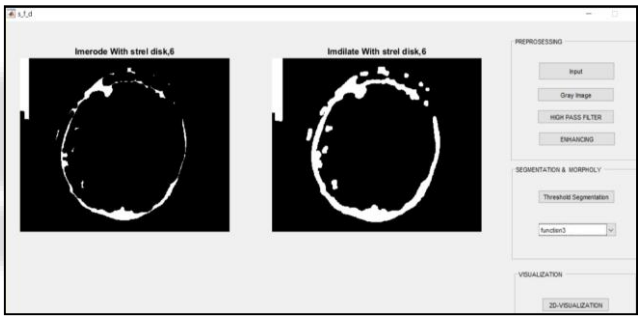


Fig. 8: Image erosion with structural element with disk,3 also image dilation with the same structural element with disk,3 function 3

And finally in Fig 9. we can clearly see the Skull fracture in 2-D visualization, in this the specimen and final result can achieve. Fig 9. Shows the final result with Skeleton and edge detection.

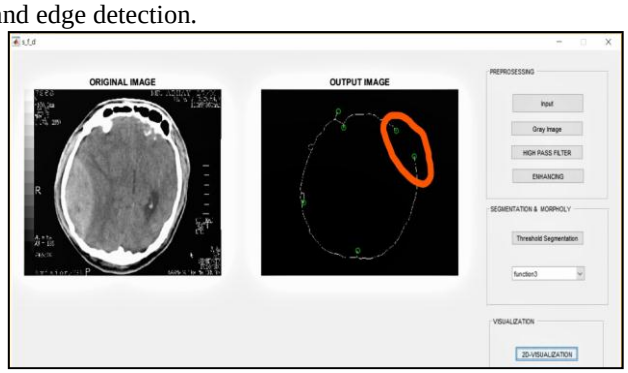


Fig. 9: Output image.

VIII. CONCLUSION

This research was conducted to detect the Brain tumor and Skull fracture detection using Medical imaging technique. The main technique is used noise removal and segmentation,

which is done using a method based on Threshold segmentation, Watershed segmentation, Morphological operators and Edge detection. The proposed segmentation method and morphological operators was experimented with MRI scanned images of human brain and skull: Thus locating tumor in the brain and fracture in the skull. Samples of human brains and skulls were taken, scanned using MRI process and then were processed through segmentation methods thus giving the best and efficient results.

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