

Brain Tumor & Skull Fracture Detection Using MATLAB

Shrawan Kumar¹, Nitesh Kumar²

^{1,2}Sagar Institute of Research Technology and Science, RGPV-Bhopal, India

Abstract: *In medical image processing it is the most challenging to detect the abnormalities found in the Human Brain like a Brain tumor and fracture in cranial or Skull fracture detection. This paper describes, and the proposed strategy to detect & extraction of such abnormalities brain tumor and fracture in the skull from the patients MRI scan images of the brain. This concept incorporates with some noise removal functions, segmentation, and Morphological operations which are the basic the basic concepts of the image processing. Detection and extraction of tumor and fracture from the MRI scan images of the brain are done by using MATLAB software.*

Keywords: MRI, Segmentation, Morphology, MATLAB.

1. Introduction

Abnormal growth of the tissues in the human brain is defined as the Brain tumor. Skull fracture is one of the major problems found for a human being. A brain tumor is an irregular mass of tissue in which cells produce exponentially and multiply uncontrollably, seemingly unchecked by the mechanism that controls normal cells. The human brain is one of the most complex organs of the body which has a various part within it, and each part has the distinct anatomical signature and function characteristics which are all together encapsulated within a mechanically strong bony structure, known as the skull. The skull bone of human is the most complicated part that supports the face and teeth and thus forms a protective cavity for the human brain, sensory organs, nerves system and blood vessels from any mechanical damage but allows the passage of air and food [1].

On the other hand, the brain is the interior most of the central nervous system. The location of tumors in the brain is one of the factors that can determine how a brain tumor affects an individual's functioning and what symptoms the tumor causes. For both the above cases either tumor detection or fracture detection magnetic resonance imager (MRI) is the commonly used device for the diagnosis[2]. Magnetic Resonance Imaging is a leading medical imaging technique used to compare high-quality images of the parts limited in the human body MRI imaging is often used when treating a brain tumor, skull fracture, ankle, and foot. From these very high-resolution images, we can derive detailed medical information to examine human brain development and discover abnormalities. Nowadays there are so many methodologies for classifying medical resonance images, which may be fuzzy methods, neural networks, at last, method knowledge-based techniques, shape methods, variation segmentation. Medical resonance imaging (MRI) consists of T1 weighted, T2 weighted and proton density (PD) weighted images are proposed by a system which integrates fuzzy based technique with multispectral analysis [3].

There are two basic steps used to detect Brain tumor and Skull Fracture, first is preprocessing and the second one is the post-processing, Pre-processing of MRI images is the primary stage in image analysis which performs image improvement and noise reduction techniques which is used for enhancing the image quality after that the MRI image is applied to the next stage which is called Post process, or this process is also known as secondary step, In this stage Morphological Operations are applied to detect the abnormalities like tumor and fracture in the image. The morphological operations are applied on some assumption about the size, shape and the location of the tumor or of the fracture, and at the end, the abnormalities are mapped on to the unique gray scale image with 255 intensity to more visible the tumor or fracture in the model [4]

2. Literature Review

Many of the researchers proposed so many methods, techniques and algorithms to detect brain tumor, skull fracture, stroke and other kinds of abnormalities in human brain using MRI. j. Vijay et al. proposed a method, in this method combine segmentation and K- means clustering and the results you unsupervised segmentation methods are better than supervised segmentation methods. This method can be applied to the minimal amount of data with a reliable result. The use of k- means clustering methods is fairly simple when it is compared with the fuzzy clustering method, but sometimes it fails give accurate result [5].

Deepthy Murthy et al. proposed a method for image acquisition, image preprocessing using Sobel filter, image enhancement using histogram equalization, in segmentation using thresholding and morphological operation and then the detection of tumor, but this method is not used for more images with more features which classifying the different type of tumor [6].

A.R.Kavita et al. proposed an effective modified region growing technique to detect the brain tumor in the human brain. They modify the region include comparative for modify region growing using both the feed forward neural

network (FFNN) and also the radial basis function (RBF) neural network. The magnetic resonance imaging (MRI), images data set taken from the publically available source contains 40 brain MRI images in which 20 brain images with tumor and 20 brain images without brain tumor [7].

R.Braakman et al. suggested the data sheet of depressed skull fracture of 225 consecutive cases; the author is also given the idea about the treatment, symptoms, and diagnosis of 225 patients who have depressed type of skull fracture [8].

3. Proposed Methodology

In the detection of abnormalities in brain either brain tumor or skull fracture, the proposed algorithm has two stages, first is the preprocessing of given MRI image and after that segmentation and then perform a morphological operation which nothing but stage two. Steps of the proposed algorithm are as follows:-

- 1) First of all, give an MRI image of the brain as input.
- 2) Now convert it into a grayscale image.
- 3) A grayscale image is applied to the high pass filter for noise removal.
- 4) The output of the high pass filter is now applied to the medium filter to enhance the quality of the image.
- 5) Compute the threshold segmentation.
- 6) Compute the watershed segmentation.
- 7) Compute morphological operation.
- 8) Finally, the output will be an abnormality.

1) Gray scale

Magnetic resonance images can be acquired on the computer when a patient is fully scanned by the MRI machine. We can acquire an MRI image of any part of the body which is under test or desired. In general, when we see MRI images on a computer, the images look like black & white images. In analog practice, grayscale imaging is sometimes called "black and white," but technically this is a misnomer. In true the black and white image is also known as halftone, the only possible shade is pure black and pure snowy. The illusion of gray covering in a halftone image is found by rendering the image as a grid of black dots on a black background or vice-versa. With the size of individual dots determining the seeming lightness of the gray in their locality. The halftone technique is usually used for printing photographs in daily newspapers and as MRI image is taken on computer then, in case of transmitted light or the image on a computer show, the brightness level of the Red(R), Green(G) and Blue(B) each components are signified as a number from decimal 0 to 255 or binary 00000000 to 11111111. Pixel in Red-green-blue(RGB) grayscale image, the lightness of the grayscale is straight proportional to the number representing the illumination levels of the primary colors. Black is represented as $R=G=B=0$ or $R=G=B=00000000$ and white color is represented by $R=G=B=11111111$. Because there is 8 bit binary representation of the gray level, this imaging method is called 8-bit gray scale. Gray scale image is a range of shades of gray without apparent color, the darkest likely shade is black, which is the total nonappearance of transmitted or reflected light, and the lightest possible shade is white the show or reflection of light at all noticeable

wavelengths. So because of the above reasons first we have to convert our MRI image to pre-processed in gray scale image.

2) High Pass Filter

After grey scaling of snapshot is given as an enter to excessive move filter. A high cross filter is general for most sharpening approaches. An snapshot is sharpened when the contrasts is superior between adjoining areas with some variation in brightness or darkness. A high pass filter tends to keep the high-frequency understanding within an photograph reducing or disposing of the low-frequency knowledge. While the kernel array of excessive cross filter is designed to broaden the brightness of the core pixel relative to neighboring pixels. The kernel array in general comprises a single constructive price at the core, which is utterly surrounded by bad values.

3) Median filter

In digital signal processing, it's most likely desirable to be equipped to perform to some form of noise discount on an photo or sign. The median filter is a nonlinear digital filtering manner, which is used to eliminate noise, such noise discount is a average pre-processing step to improve the exceptional of outcome of the later processing (for illustration facet detection). The median filtering is very largely utilized in digital snapshot processing due to the fact below certain conditions; it preserves the brink at the same time eliminating noise.

The main logic of the median filter is to run through the signal entry, replacing each entry with the median of the neighboring entries. The pattern of the neighbors is called as "Window," which slides entry by entry over the entire signal. For one dimensional (1 D) signals, the most obvious window is just the first few preceding the following entries, whereas for 2 D or higher dimensional signals such as images more complex window pattern are possible such as "box or "cross" patterns. The main point is that if the window has an odd number of the entries, then the median is simple to define: it is just the middle value after all entries in the window are sorted numerically for an even number of entries, there are more than one possible median. The median filter enhances the quality of the MRI images.

4) Threshold segmentation

The very most straightforward method of image segmentation is called the threshold methods. The basically threshold segmentation is based on a clip-level(or a threshold value) to turn a grayscale image into a binary image.

The key of this segmentation is to select the threshold value (or values when multiple-level are selected). There is some popular methods are used in industry including the maximum entropy methods, otsu's method (maximum variance), and K-means clustering can also be used. In computer idea, segmentation is the process of partitioning a digital image into the multiple segments (sets of pixels, also known as superpixels). Segmentation aims to simplify and or change the representation of an image into something that is more meaningful and easier to analyze[9]. Image segmentation is

generally used to locate an object and boundaries (lines, curves, etc.) in images. The results of the image segmentation is a set of segments that collectively cover the entire image or is a set of contours extracted from the image for example edge detection. Each of the pixels in a region is similar concerning some characteristics or computed property such as color, intensity or texture. Adjacent regions are significantly different from some characteristics when applied to a stack of the image, typical in medical imaging the resulting contours after image segmentation can be used to develop 3D reconstruction with the help of interpolation algorithm like marching cubes.

5) Watershed segmentation

A gray image may be seen as a topographic relief, where the gray level of a pixel is interpreted as its attitude in the relief. A drop of the water falling on a topographic relief flows along a path to finally reach a local minimum. Watershed of a relief corresponding to the limits of the adjacent attachment basins of the drop of the water. In digital image processing, different watershed lines may be computed.

In graphs, some may be defined on the nodes, on edges or the hybrid lines (on both nodes and edges). Watershed may also be defined in the continuous domain. There are many different algorithms to compute watersheds. In 90's one of the most common watershed algorithms was introduced by F. Meyer's. the algorithm works on grayscale images, during the successive flooding of the gray value relief, watersheds with adjacent catchment basins are constructed, and this flooding process is performed on the gradient image i.e., the basins should emerge along the edges, generally this will lead to an over-segmentation of the image, especially for the noisy image material, e.g., material CT scan data. Either the image must be preprocessed, or the regions must be merge by similarity criteria afterward. The following steps follow in Meyer's flooding watershed Algorithms

- A set of the markers, pixel where the flooding shall start are chosen. Each one is given a different label.
- The neighboring pixels of every marked subject have an interest in the priority queue with a priority stage similar to the gray level of the pixel.
- The pixel with the higher priority level is extracted from the priority queue. If the neighbor of the extracted pixel that has already been labeled all the same label, then the pixel is labeled with their tag.
- All in marked neighbors that are not yet in the priority queue are again put into the priority queue.
- Step 3 until the priority queue is empty. The nonlabeled pixels are watershed lines.

6) Morphological operation

The morphological operation works on the process of set theory and is simple to use. The main objective of the morphological operation is to remove the imperfection in the structure of the image. For enhancement purpose when images are processed while performing some operations like thresholding, it is the chance for distortion of the image due to noise. As a result, imperfection exists in the structure of the image. The main goal of the morphological operation is

to remove this imperfection, that mainly affects the shape and texture of the images. So it is but obvious that morphological operation can be very useful image segmentation as the process directly deals with the shape extraction in an image. Most of the morphological operation used here is a combination of two processes, dilation, and erosion. Such operation uses a small matrix structure called a structuring element. The structuring elements are small sets in the matrix form or a sub-image used to interact with the image to be processed, and the precise detail can be obtained by choosing suitable structuring elements.

A morphological operation on a binary image creates a new binary image in which the pixel has a non zero value only if the test is successful at the location in the input image. The structuring element is a binary image, i.e. the small matrix of pixels, each pixel with a value of zero or one:

- The matrix sizes specify the size of the structuring element.
- The pattern of zero and one specifies the shape of the structuring element.

Origin of the structuring element usually one of its pixel, although generally, the origin can be outside the structuring element.

7) Skeleton

The procedure to reduce all objects in an image to lines, without changing the essential structure of the image, use the function basket. The above process is known as skeletonization. It is the most powerful tool in the MATLAB, is used for the fracture extraction from MRI, either skull fracture or any other fracture in the human body.

4. Algorithm

A. Proposed algorithm for tumor detection

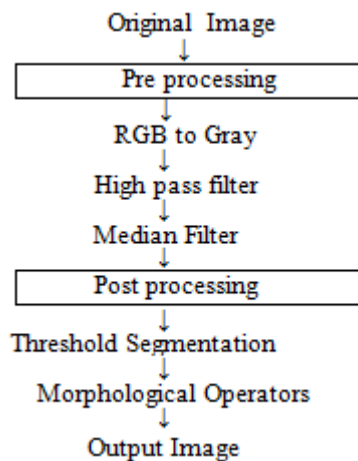
```
Step 1: init(input_image);
Step2: img←input_image;
Step3: img_pre←preprocessing(img);
Step4: img_seg←segmentation(img);
Step5: img_morph←morphology(img_seg);
Step6: img_output←output(img_morph);
Step7 : return(img_output);
Step8: end;
```

B. Proposed algorithm for skull fracture detection

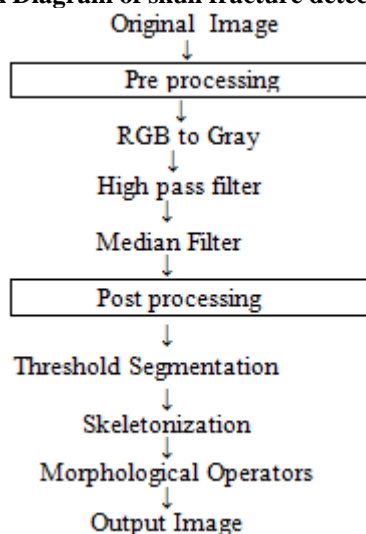
```
Step 1: init(input_image);
Step2: img←input_image;
Step3: img_pre←preprocessing(img);
Step4: img_seg←segmentation(img);
Step5: img_skelt←skeltonization(img_seg);
Step6: img_endp←find_skel_ends(img_morph);
Step7: feature []←feature_extraction(img_endp);
Step8: return (feature []);
Step9: end;
```

5. Flo-Diagram

A. Block diagram of Brain tumor:



B. Block Diagram of skull fracture detection



6. Conclusion

On the basis of above algorithm and methodology, Brain Tumor & Skull fracture Detection Using Bone lesions of the cranium base encompass a vast sort of benign and malignant lesions. CT and MR have a complementary role in refining the analysis and, specifically, in completely characterizing bony skull base lesions. Most by and large the cranium base is suffering from secondary bone lesions. Predominant bone tumors of the cranium base are infrequent, and their imaging elements are, overall, just like that noticeable elsewhere within the skeleton. Even when benign, tumors could recur when now not thoroughly removed. Consider that benign lesions can have an aggressive appearance and that malignant lesions can seem misleadingly benign. For that reason, radiologic-pathologic correlation is on the whole obligatory to arrive a final analysis

References

- [1] K. Prahlad Rao calvarial, Bone segmentation from medical images by image processing technique. Vol.4(12),Dec 2015
- [2] Miss Roopali R. Laddha & Dr. Siddharth A. Ladhake, Brain tumor detection using morphological operation. Vol.3,Issue.3, March-2014, ISSN 2319-4847

- [3] Mohamed Lamine Toure, Advance algorithm for brain segmentation using Fuzzy to Localize cancer and Epilepsy Region, Vol.2 ICEIE-2010
- [4] Rajesh C. Patil and Dr. A.S. Bhalechandar ,Brain tumor extraction from MRI images using MATLAB, Vol.2,Issue-1, ISSN:2277-9477
- [5] J. Vijay and J. Shubhashini, An efficient Brain tumor detection methodology using K-means clustering algorithm, International conference on communication and signal processing, April3-5,India, IEEE
- [6] Deepthy Murthy T.S. and G. sadashivappa, Brain tumor segmentation using thresholding, Morphological operations, and extraction of features of the tumor, ICAECC,2014.
- [7] A.R. kavitha and Ms. Kavin Rupa, An efficient approach for brain tumor detection based on modified region growing and neural network in MRI images.
- [8] R. Braakman , Depressed skull fracture: data,treatment and follow up in 225 consecutive cases. Journal of neurology,neurosurgery and psychology, 1972.
- [9] W. Gonzalez, Digital image processing, 2nd ed. Prentice Hall, year of publication 2008, page no.378