Development and Implementation of an Automated Hemorrhage Detection System using Watershed Segmentation and Active Contour Techniques

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ABSTRACT
The visual representations of the inner parts of body along with functions of the organs or tissues are called as Medical Imaging. This is of critical importance for early diagnosis and treatment. The images obtained by various techniques such as Magnetic Resonant Imaging (MRI), Computed Tomography (CT) are processed for medical assistance and treatment. First step is image preprocessing. After preprocessing, morphological operations are done. This transformed image undergoes watershed segmentation and Active contour process. The result thus will be fed to a classifier for detecting the presence of hemorrhage.

Keywords: *Diagnosis, Brain hemorrhage, Computed Tomography (CT), Magnetic Resonance Imaging (MRI), Watershed Segmentation, Active contour.*

INTRODUCTION

The brain's anatomical structure is very complicated. In recent years the anatomical study of human body and the treatment of different kinds of disease in distinct parts of the body show potential advancement depending on the medical imaging technology. Medical imaging techniques play a crucial role for capturing the bleeding in or around the brain and determine the type of hemorrhage. Images are captured by different devices using different modalities such as Computed Tomography (CT) Scan, Magnetic Resonance Imaging (MRI).In order to predict the exact presence of hemorrhage medical images require further processing. Therefore, watershed algorithm and active contour is proposed in this paper. The proposed system employs CT images. The scanned image is pre-processed to remove the unwanted noises. Pre-processing follows a series of operations eliminating the unwanted distortions and to enhance certain properties of the image.

Morphological operations are a set of nonlinear operations corresponding to the shape or morphology for the structuring element in an image. These operations apply a structuring element to the input image to obtain the output image. The basic objective of these operations is to remove any imperfections present in the image. Erosion and dilation are the most common operations. This image is then segmented for further processing. Watershed segmentation aims at isolating the watershed lines/ridges such that using markers the region of interest can be highlighted. The concept of marker based approach is used to resolve this segmentation problem. Once there is a presence of hemorrhage, it can be classified for the types making it a multiclassification problem. The system is trained for various datasets of Brain CT images with and without hemorrhage.

RELATED WORKS

The literature on brain segmentation from MRI information is intensive and soft methods square measure well analyzed In Spence offers imaging brain segmentation.

We are going figure on MRI with the 3 strategies conferred this paper. This theorem classification is to spot the distribution of various materials in MRI volumetrical datasets of the brain. during this approach, voxels square measure allowed to contain quite one material and data from neighboring pixels is incorporated into the classification method

Pham and blue blood extended the standard FCM to deal with homogeneities mister acquisition way. PDI was introduced by Shihab that projected a brand new objective perform and contribution by dividing it by a price representing the strength of it for mister brain pictures was initial projected by Wells et al. in Wells used EM rule to at the same time estimate the classification of the image and a corrupting bias field characteristic to mister imaging. Segmentation method. In contrast to literature on brain segmentation for magnetic resonance imaging, the literature on brain segmentation on CT information is comparatively distributed. The foremost common approaches use active contours, thresholding and region growing. But all of those strategies need manual input. In, Hu et al. segmental brain matter from 3D CT pictures by initial applying Fuzzy C-means and thresholding to 2nd slices of the amount to make 2nd masks, and then propagating the 2nd masks between neighboring slices. A technique for automatic CT brain segmentation of neural structure brain hemorrhage (ICH) is projected by Loncaric and Kovacevic in 5 regions of interest (background, skull, brain, ICH and calcifications) were segmental employing a combination of KMeans cluster and neural networks.

PREPROCESSING

Re-sizing: Then the grayscale image is being resized to 256x256 pixels. It is done so that all images follow a uniform criteria for easier processing.

Grayscale Conversion: The image (CT) of brain is converted to grayscale. This transformation is done to eliminate the colors and to make it suitable for future processing.

Edge Detection: It involves the detection of edges to work out the boundary or to verify the presence of hemorrhage. Smart edge detector with mathematician filter is employed for this purpose.

Edge Highlighting: The edges are made to contrast in the grayscale image so that it is easy for morphological operations and segmentation.

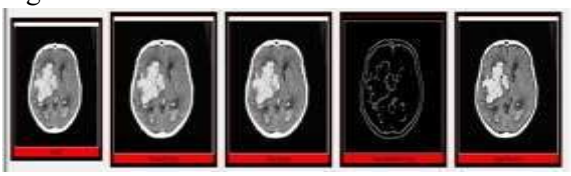

Fig.2:-*Preprocessing modules*

PROPOSED METHODOLGY

This system consists of four major modules. Figure 1 displays the flow between these modules.

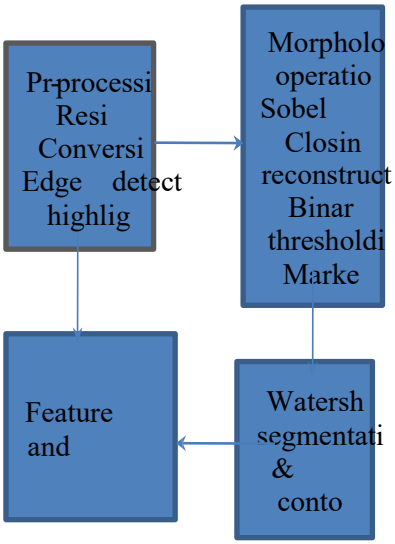

Fig.1:-*Flow chart of process*

MORPHOLOGICAL OPERATIONS

Sobel operator is used to find the elevation map using the gradients. **Closing Reconstruction**:

- It is a sequential process of dilation followed by erosion. Erosion is the process

where the image is compressed such that small holes on the foreground are filled.

- Binary thresholding is done to remove the unwanted highlighted regions from the sobel image.
- Markers are found by superimposing sobel and threshold image to form the background and hemmorhage region.

WATERSHED SEGMENTATION

- The aim of the watershed transform is to search for regions of high intensity gradients or local maxima (watersheds) that divide neighbored local minima (basins).
- Watershed algorithm is efficient on gray scale images and hence the most used technique in medical image analysis.
- The watershed lines are identified, it may represent the edges of hemorrhage and this helps in diagnosis. Marker image is imposed on resized image to find the region of interest.

ACTIVE CONTOUR SEGMENTATION

- In computer vision, contour models describe the boundaries of shapes in an image. Snakes in particular are designed to solve problems where the approximate shape of the boundary is known.
- By being a deformable model, snakes can adapt to differences and noise in stereo matching and motion tracking. Additionally, the method can find

  Illusory contours in the image by ignoring missing boundary information.

  Compared to classical feature extraction techniques, snakes have multiple advantages:
- They autonomously and adaptively search for the minimum state.
- External image forces act upon the snake in an intuitive manner.
- Incorporating Gaussian smoothing in the image energy function introduces scale sensitivity.
- They can be used to track dynamic objects.

IMPLEMENTATION Canny Edge Detection with Gaussian Filter

- Edges that are weak and not connected to sturdy it's a time period edge detection formula
- Apply mathematician filter to sleek the image so as to get rid of the noise
- Realize the intensity gradients of the image Apply non-maximum suppression to urge eliminate spurious response to edge detection.

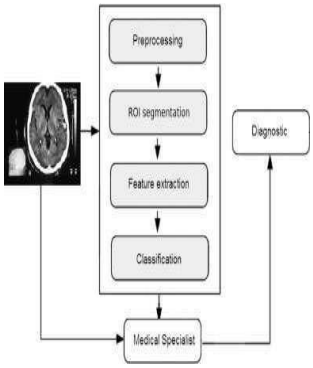

Fig.3:-*Functional Block Diagram*

- Apply double threshold to work out potential edges
- Track edge by hysteresis: terminate the detection of edges by suppressing all the opposite edges.

Sobel Operator

$$|G| = \sqrt{Gx^2 + Gy^2}$$

$$|G| = |G_x| + |G_y|$$

$$\theta = \arctan(Gy/Gx)$$

Algorithm Otsu Threshold

- Compute bar chart and possibilities of every strength
- Set up initial
- Step through all attainable thresholds • Desired threshold corresponds to the

most

$$\sigma_w^2(t) = \omega_0(t)\sigma_0^2(t) + \omega_1(t)\sigma_1^2(t)$$

Watershed-Transform Segmentation • Notice all-time low neighborhood of every element

- It should be threshold, edge or region primarily based
- Here we tend to use region primarily based algorithmic rule
- If element is on an upland and neighbor may be a native minimum there is also a trauma and metameric consequently.

1. Cipher a segmentation perform. This is often a picture whose dark regions area unit the objects you're making an attempt to section.
2. Cipher foreground markers. These area unit connected blobs of pixels inside every of the objects.
3. Cipher background markers. These area unit pixels that aren't a part of any object.
4. Segmentation perform so it solely has minima at the foreground and background marker locations.
5. Cipher watershed rework of changed segmentation perform.

- The gradient perform is taken into account as segmentation perform. Gradient is high at boundaries of object • Notice the foreground objects victimization distance perform • Equally notice the background image • Cipher the regional maxima in foreground region
- Perform needed morphological operations to get rid of unwanted dark regions
- Mark the background and victimization threshold confirm the watershed ridge lines. The desired region of interest area unit so obtained
- Pose the foreground threshold with maxima on the first image

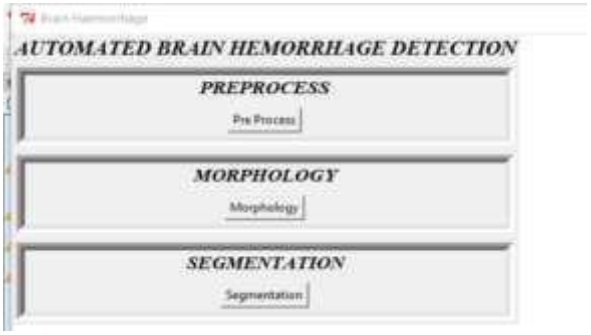

Fig.4:-*Steps involved in brain hemorrhage detection*

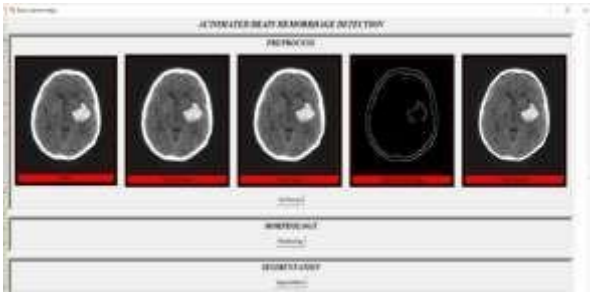

Fig.5:-*Preprocessing*

CONCLUSION

The hemorrhage detection system using the watershed algorithm and active contour could be used to detect brain hemorrhage better than the existing techniques. These results suggest that it is much accurate and can be used in real-time. The automated brain hemorrhage detection will be further undergoing classification to get more accurate results from the CT scan pictures.

FUTURE SCOPE

This segmentation model has expected twenty five pictures out of twenty seven with Associate in Nursing accuracy of 92.5%. The system can improve on coaching a lot of pictures for higher potency.

• As Associate in Nursing extension to the current segmentation consequent section involves classification. • If the hemorrhages square measure detected their options square measure extracted to search out its sort. • Victimisation the options, the image is being classified with any of the classifiers. It's analyzed for potency victimisation the options that square measure utilized in classification.

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