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A Novel Approach for Edge Detection of Angiogram Images Using Classical Image Processing Technique

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Abstract:* The Blood vessels of the human body can be visualized using many medical imaging methods such as X-ray, Computed Tomography (CT), and Magnetic Resonance (MR). In medical image processing, blood vessels need to be extracted clearly and properly from a noisy background, drift image intensity, and low contrast pose. Angiography is a procedure widely used for the observation of the blood vessels in medical research, where the angiogram area covered by vessels and/or the vessel length is required. For this purpose we need vessel enhancement and segmentation. Segmentation is a process of partitioning a given image into several non-overlapping regions. Edge detection is an important task and in the literature, complex algorithms have been modelled for the detection of the edges of the blood vessels. In this paper, the edges of the vessels in the angiogram image are detected using the proposed algorithm which is done using the classical image processing techniques. This involves the Pre- processing step, where the noise is removed using a simple filter and Histogram equalization technique, instead of the Canny edge Detector. The proposed algorithm is not complicated but accurate and involves very simple steps.

***Keywords:* Image Edge Detection, Image Segmentation, Computational Modelling.**

I. INTRODUCTION

Segmentation plays a vital role in the detection of blood vessels in an angiogram image. It is a process of partitioning an angiogram into several non-overlapping regions. Thus it is used to extract the vascular and background regions. Based on the partitioning results, surfaces of vasculatures can be extracted, modelled, manipulated, measured and visualized. Hence it is used to detect the various vascular diseases. Therefore, developing reliable and robust image segmentation methods for angiography has been the priority and by the other research groups.

In computer vision, image segmentation is the process of partitioning a digital image into multiple segments (sets of pixels, also known as super pixels). The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze. Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. More precisely, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain characteristics.

II. PROBLEM IDENTIFICATION

The Blood vessels of the human body can be visualized using many medical imaging methods such as X-ray, Computed Tomography (CT), and Magnetic Resonance (MR). In medical image processing, blood vessels need to be extracted clearly and properly from a noisy background, drift image intensity, and low contrast pose. Angiography is a procedure widely used for the observation of the blood vessels in medical research, where the angiogram area covered by vessels and/or the vessel length is required. For this purpose we need vessel enhancement and segmentation. Segmentation is a process of partitioning a given image into several non-overlapping regions. Edge detection is an important task and in the literature, complex algorithms have been modelled for the detection of the edges of the blood vessels. In this paper, the edges of the vessels in the angiogram image are detected using the proposed algorithm which is done using the classical image processing techniques. This involves the Pre-processing step, where the noise is removed using a simple filter and Histogram equalization technique, instead of the Canny edge Detector. The proposed algorithm is not complicated but accurate and involves very simple steps.

III. DIFFERENT EDGE DETECTION METHODOLOGIES

A viewpoint dependent edge may change as the viewpoint changes, and typically reflects the geometry of the scene, such as objects occluding one another. A typical edge might for instance be the border between a block of red colour and a block of yellow. In contrast a line (as can be extracted by a ridge detector) can be a small number of pixels of a different colour on an otherwise background. For a line, there may therefore usually be one edge on each side of the line.

Edge detection makes use of differential operators to detect changes in the gradients of the grey levels. It is divided into two main categories**:**

Fig: 1. Types of Edge Detector

IV. DIFFERENTIAL GEOMETRIC FORMULATION

A more refined approach to obtain edges with sub-pixel accuracy is done by using the differential edge detection, where the requirement of non-maximum suppression is formulated in terms of second- and third-order derivatives computed from a scale-space representation, proposed by Lindeberg in the year 1998.

A. Parameters:

The Canny algorithm contains a number of adjustable parameters, which can affect the computation time and effectiveness of the algorithm.

- The size of the Gaussian filter used in the first stage directly affects the results of the canny algorithm. Smaller filter cause less blurring, and allow detection of small, sharp lines.
- A larger filter causes more blurring, smearing out the value of a given pixel over a larger area of the image. Larger blurring radii are more useful for detecting larger, smoother edges, for instance, the edge of a rainbow.
- Thresholds: the use of two thresholds with hysteresis allows more flexibility than in a single threshold approach, but the general problems of thresholding approaches still apply.
- A threshold set too high can miss important information. On the other hand, a threshold set too low will falsely identify irrelevant information like noise as important.
- It is difficult to give a generic threshold that works well on all images. No tried and tested approach to this problem yet exists.

The output of the image after applying canny edge detector can be seen in the below figure.

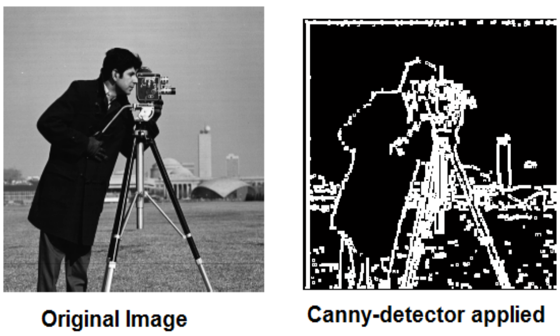

Fig: 2. Canny Edge Detector

V. CLASSICAL IMAGE PROCESSING ALGORITHM

- Step 1: Read the given angiogram image, and convert it into a matrix form where each pixel value is in the range from 0-255.
- Step 2: Apply median filtering to remove noise.
- Step 3: Take Histogram of the given input image.
- Step4: Obtain a uniform histogram using histogram equalization or linearization technique
- Step 5: Repeat the above process again.
- Step 6: 2D FIR filter is used to detect the edges of the angiogram image.

In first the input image is pre-processed using median filter to remove noise and then the histogram of the input angiogram image is obtained. Then by a technique called histogram equalization, uniform histogram is obtained. Again, the histogram of the histogram equalized image is obtained. Finally, the edges of the vessel from the given angiogram image is obtained.

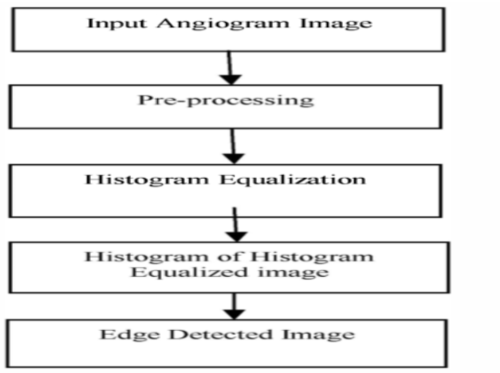

Fig: 3. Flow Diagram

Thus, the above mentioned algorithm is used to detect the edges of the vessel from the given angiogram image.

VI. RESULTS AND ANALYSIS

These results are analyzed by basic outline of some really fundamental commands and techniques in MATLAB. This is not a replacement for the MATLAB online tutorial or help pages- take advantage of those! They're great resources and a lot nicer than they were when I learned MATLAB. This should only be taken as a guide of where to start.

MATLAB is a flexible, extensible software package that allows for the quick, efficient manipulation and visualization of datasets, among its many uses. It is widely used in the oceanographic community, and will serve you well regardless of what field you go into, when it comes to dealing with data.

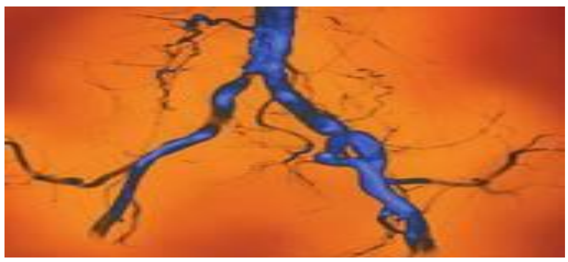

Fig. 4. RGB Image

This chapter gives the complete illustration about the performance evaluation of the proposed approach. The proposed approach was tested over various images like RGB and gray angiogram images and the respective figures obtained are shown below.

The above figure shows original RGB angiogram image. This image was given as an input image for the proposed approach.

Version: RGB Colour

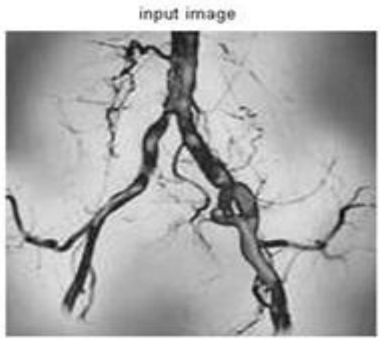

Fig. 5. Original Input Image

This is an image which is converted from RGB to gray scale for further processing steps. This is the first step involved.

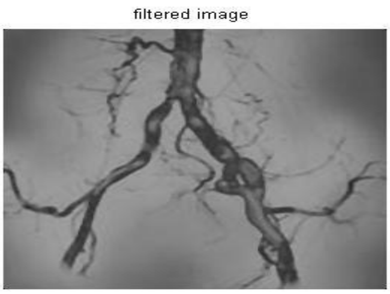

Fig. 6. Filtered Image

After first step the second step is pre-processing which involves filtering for smoothing the image and removes noise.

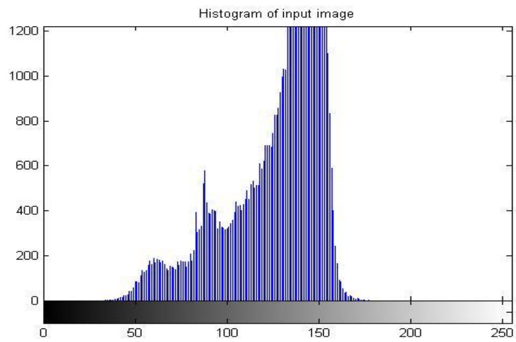

Fig. 7. Histogram of Input Image

The above image shows the histogram of the input image shown in fig.7. Histogram is defined as the probability of occurrence of an image with in the grayscale in the range of 0-255.

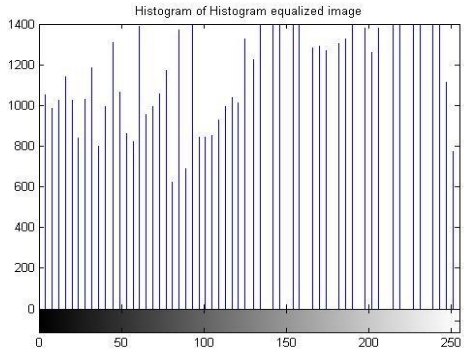

Fig. 8. Histogram of Histogram Equalized Image

Obtain a uniform histogram using histogram equalization or linearization technique. This involves the fourth `step of the proposed method. Hence we obtained the uniform histograms

Fig. 9. Histogram Image

The fig.9 shows the Histogram image after Histogram equalization or linearization technique.

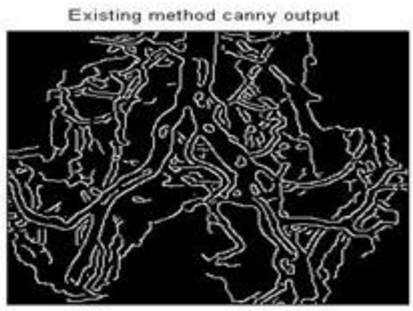

Fig 10. Existing Method Canny Output

This figure shows the output detection of edges of angiogram images using canny edge detection method which involves both blood vessels and blood tissues.

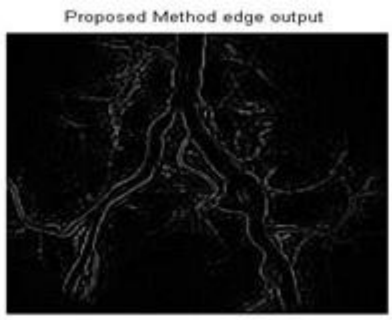

Fig. 11. Proposed Method Edge Output

The fig.11 shows the edge detection of angiogram images using classical image processing technique which involves clear visibility of blood vessels compared to existing canny edge detection method.

VII. CONCLUSION

In this paper, the proposed algorithm detects the edges of the blood vessel from the given angiogram image using the classical image processing techniques. The edges segmented are accurate and clear as compared to the canny edge detection and the steps involved to obtain the edges of the blood vessel are simple and easy to implement. The results provide that the proposed algorithm is effective and efficient in detecting the edges.

VIII. REFERENCES

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