

Thrombus Detection Using Image Processing

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Abstract: The powerful tool for increasing the reliability and reproducibility of disease diagnostics is image processing. In the hands of pathologists, image processing provides quantitative data to specialists from histological images which supplement the qualitative data. This project proposes the method for analyzing digitized images of MRI and detects the diseases which can cause the Heart Attack. The proposed work presents the method for detecting the disease like thrombus related to heart. Methods presented in this proposed work for detection of thrombus include steps like preprocessing, segmentation, feature extraction. At first the noise is been removed using Median Filter. Image is segmented using Region Growing method to detect the affected region. From this segmented region, the features are extracted using Histogram of Oriented Gradients (HOG) and Speeded up Robust Features (SURF).

Keywords: Medical image processing, Thrombus, HOG, SURF, Region Growing

1. INTRODUCTION

One of the significant organs in our body is Heart. In the event that the task of a heart isn't legitimate, at that point it will influence the other body portions of human, for example, mind, Kidney and so forth. It is just a siphon, which siphons blood all through the body. On the off chance that the dissemination of blood in the body is wasteful, at that point the organs endures, in the event that the heart quits working out and out, at that point demise may happen inside minutes. Life is totally reliant upon the productive working of heart. The term coronary illness alludes to the malady of heart and the vein framework inside it. The Heart sickness is brought about by plaque developing along the internal dividers of the supply routes of blood and which limits the conduits and decreases the blood stream to heart. Heart disease can be detected by the diagnostic imaging modalities such as CT scan and MRI. Both of the modalities have advantage in detecting depending on the location type and the purpose of examination needed. To diagnosis the Heart disease is a difficult tasks. In the existing work, Heart disease is detected using the Echocardiography and Data Mining Technique[1-9]. In the present work, Detection of Thrombus is carried out using Image processing technique[10-19]. Thrombus is the unwanted portion of muscle or clot present in the inner region of the heart.

Median Filter is used to remove noise by preserving edges[20-37]. Region Growing method is used to segment the region of interest effectively[38-44]. Features are extracted using HOG and SURF[45-60].

This paper is organized as follows: Section 2 presents the Methodology. In Section 3 shows the result and discussion. Section 4 presents the conclusion.

2. METHODOLOGY

In this section Preprocessing, Segmentation and Feature extraction is proposed. In Fig 2.1 shows the flow diagram and Fig 2.2 shows the block diagram of proposed diagram.

A. Preprocessing

^[2]In image processing, preprocessing is the first step used to remove noise. Median filter is used in the proposed work. The median filter is a nonlinear digital filtering technique often used to remove noise from an image or signal. It preserves edges while removing noise.

$$y[m,n] = \text{median}\{x[i,j], (i,j) \in \omega\} \quad (1)$$

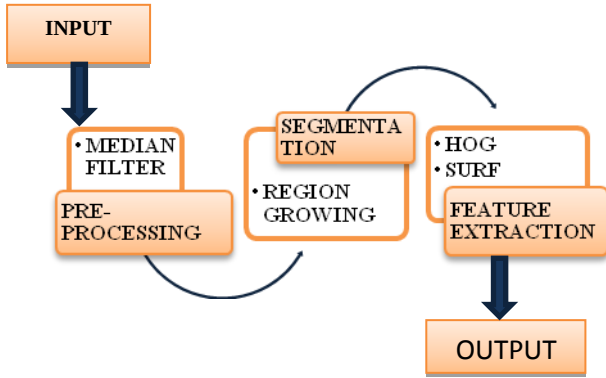


Figure 2.1. Block Diagram

B. Segmentation

^[5]Image segmentation is the process that subdivides an image into its constituent parts or objects. In the proposed work, Region growing method is proposed in the segmentation process. Region growing is a simple region-based image segmentation method. In this work, ^[4] Seeded region growing method is used. The first step involved in seeded region growing is to select a set of seed points. The step of this method is as follow;

$$U_{i=1}^L R_i = L \quad (2)$$

Here, L is total number of regions.

R_i is the connected region, $i=1,2,\dots,n$, where n is the number of regions.

$$R_i \cap R_j = \text{NULL for all } i \neq j \quad (3)$$

This method correctly separates the regions that have same properties.

C. Feature Extraction

Features are separated utilizing the HOG and SURF algorithm.[8] Histogram of situated slopes (HOG) is a component descriptor used to recognize objects. The portioned locale is isolated into little areas called cells, and for the pixels inside every phone, a histogram of inclination bearings is assembled. for x-direction:

$$g_x = \frac{\partial I}{\partial x} = f(x+l, y) - f(x-l, y) \quad (4)$$

for y-direction:

$$g_y = \frac{\partial I}{\partial y} = f(x, y+l) - f(x, y-l) \quad (5)$$

$$\text{Gradient magnitude: } (x,y) = (g_x^2 + g_y^2)^{1/2} \quad (6)$$

$$\text{Gradient orientation: } \theta(x,y) : \tan^{-1} \left(\frac{g_y}{g_x} \right) \quad (7)$$

Force over a bigger area of the picture is determined to improve exactness and after that utilizing this incentive to standardize all cells inside the square. Standardization

results give better invariance. Hoard descriptor requires the covers to register subsidiaries and slopes, geometry of part a picture into cells and gathering cells into a square, square covering, Normalization parameters.

^[9]Speeded up robust features (SURF) is a feature detector based on Hessian matrix. It is also based on multi scale space theory. The proposed SURF descriptor is based on similar properties and extracts the SURF descriptor from it.

$$S(x, y) = \sum_{i=0}^x \sum_{j=0}^y I(i, j) \quad (8)$$

Hessian matrix at point p and scale σ is given by;

$$H(p, \sigma) = \begin{pmatrix} L_{xx}(p, \sigma) & L_{xy}(p, \sigma) \\ L_{yx}(p, \sigma) & L_{yy}(p, \sigma) \end{pmatrix} \quad (9)$$

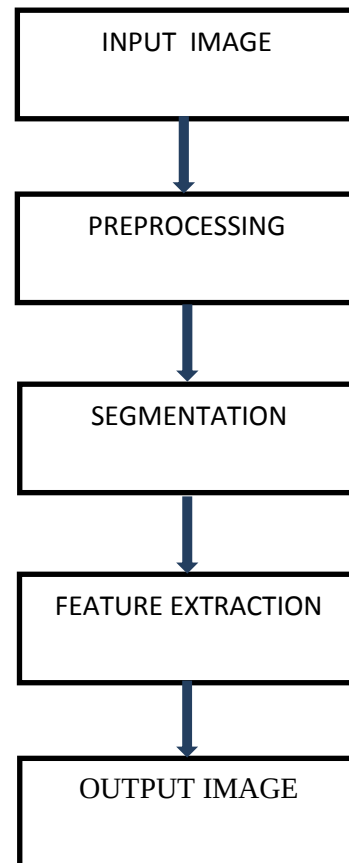


Figure 2.2. Flow Diagram

3. RESULT AND DISCUSSION

This section describes the Result and Discussion of the proposed work. Fig 3a shows the input image which is the MRI cross sectional image of Heart.

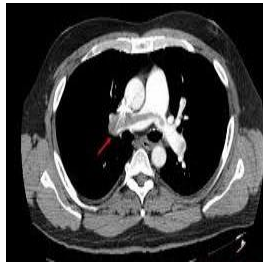


Figure 3a. Original image

A. Preprocessing Result

At first the noise is removed from the input MRI image. Median filter is applied to the input image to remove noise and also it preserves the edges while denoising the image. It is shown in the fig 3b.

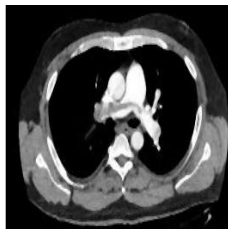


Figure 3b. Output of preprocessing using Median Filter

B. Segmentation Result

After preprocessing the image is further processed to detect the region of interest using Region Growing algorithm. This method separates the regions that have same properties. It is shown in the fig 3c.



Figure 3c. Output of Segmentation using Region Growing

C. Feature Extraction

After the detection of region of interest, the features are extracted from the region of interest. Histogram of Orientated Gradients (HOG) and Speeded up Robust Features (SURF) is applied to extract the features. These two extract the features of gradients and the point of interest of the image. The result of these two is shown in the fig 3d and fig 3e.

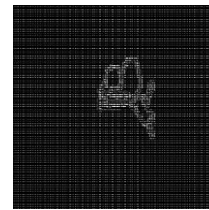


Figure 3d. Output of feature extraction using HOG

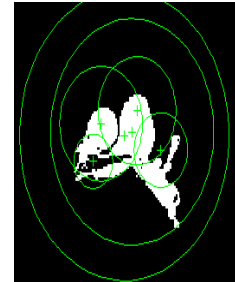


Figure 3e. Output of feature extraction using SURF

4. CONCLUSION

In this proposed approach, Thrombus detection is carried out in the image processing technique gives the result at high accuracy range. This process is done by MATLAB image processing. Morphological operation is used to detect the clotted region. It is easy to implement and reasonably fast. The HOG is modified form of the Histogram of gradient. It extracts the features based on the intensity variation in image. In this proposed work, the location of the clotted region has been determined based on the pixel value of the particular region. The location of the thrombus is detected efficiently using the above stated algorithm.

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