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Curve Evolution Using Integration of Image Region and Edge Information To Detect Cyst

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Abstract: Image segmentation is very important to complete many image processing and computer vision tasks. It can be defined as a partitioning of the image into homogenous regions and semantic objects. One of the popular approaches to image segmentation is curve evolution and active contour models. The main aim of the paper is to segment the medical images to detect ultrasound cyst in order to aid telemedicine and to determine the edge information or regional properties or a combination of them. Curve evolution methods usually result in closed contours as opposed to disconnected edges resulting from filtering methods. Edge based active contours try to fit an initial closed contour to an edge function generated from the original image.

Key words: Integration, image, region, edge, information

INTRODUCTION

Telemedicine can be defined as the integration of telecommunication, information, human-machine interface and medical care technologies for the purpose of enhancing the delivery of health-care. This includes the transfer of basic patient information over computer networks which promote remote patient interviews and examination through videoconferencing. Telemedicine has been defined as the use of telecommunications to provide medical information and services[1].

Two different kinds of technology make up most of the telemedicine applications in use today. The first, called store and forward, is used for transferring digital images from one location to another. The other widely used technology, two-way interactive television (IATV), is used when a 'face-to-face' consultation is necessary. It is usually between the patient and their provider in one location and a specialist in another location. Videoconferencing equipment at both locations allows a 'real-time' consultation to take place. The technology has decreased in price and complexity over the past five years, and many programs now use desktop videoconferencing systems[1].

Image segmentation is a basic step in many image processing and computer vision tasks. Previous approaches to image segmentation include filtering-based methods to detect edges followed by edge linking, curve evolution and active contour models, region growing and merging, global optimization based on energy functions and Bayesian criteria, and graph partitioning and clustering[2]. Some of these methods seek to provide a unified framework that enables segmentation based on multiple heterogeneous attributes such as texture, color, and gray level intensity.

Curve evolution: One approach to image segmentation is via curve evolution techniques. In general, the goal of these techniques is to extract the boundaries (represented by closed curves) within an image[3].

Curve evolution has developed into an important tool and has been applied to a wide variety of problems such as smoothing of shapes, shape analysis and shape recovery. The underlying principle is the evolution of a simple closed curve whose points move in the direction of the normal with prescribed velocity. A fundamental limitation of the method as it stands is that it cannot deal with important image features such as triple points.

Curve evolution methods usually result in closed contours as opposed to disconnected edges resulting from filtering methods. However, their effectiveness in segmenting natural images that are rich in texture has not been clearly demonstrated. On the other hand some recent image segmentation methods have been successfully applied to a variety of images. Example for an edge-based method is the *edgeflow* technique, which uses a vector diffusion method to find edges[3,4].

Active Contours: Active contours or snakes are computer-generated curves that move within images to find object boundaries. They are often used in computer vision and image analysis to detect and locate objects, and to describe their shape. Snakes are widely used in many applications including edge detection, shape modeling segmentation and motion tracking.

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Properties of Curve Evolution: The curve evolution algorithm has the following properties which are listed below:

- It always leads to a convex polygon.
- It is rotation, scaling, reflection and translation invariant.
- It reduces the complexity of the shape.
- There is no blurring or dislocation of main features.
- It is stable to noisy deformations.
- It detects digital line segments in noisy images.
- A universal level of abstraction[4].

Justification of need: The detection and precise segmentation of specific objects is an important task in many computer vision and image analysis problems, particularly in medical domains. Existing methods such as template matching typically require excessive computation and user interaction, particularly if the desired objects have a variety of different shapes.

Quantitative analysis of digital images requires detection and segmentation of the borders of the objects of interest. In medical images, this segmentation has traditionally been done by human experts. Even with the aid of image processing software, manual segmentation is tedious and time consuming, especially in cases where a large number of objects must be specified. Although many new and sophisticated imaging techniques have been developed to circumvent these problems, the utility of existing analysis systems is limited by their narrow focus. Single-purpose systems developed for specific applications cannot be reused for other segmentation tasks, despite the fact that the systems frequently consists of the same general steps. While many commercial systems include segmentation capability, they typically rely heavily on user corrections to specify the exact border, a necessary step for precise morphological analysis. Thus the development of techniques to automatically and quickly segment an exact border is an important goal[5].

Many methods have been proposed to detect and segment 2D shapes, the most common of which is template matching. However, its slow speed has prevented its wide spread use. Another technique is based on global feature vectors. But such global techniques are unable to recognize objects that are partially visible. The Hough Transform (HT) is useful for shape analysis in noisy, occluded and multiple-object environments. However, its main drawbacks are its substantial computational and storage requirements that become especially acute when object orientation and scale have to be considered. Significant improvements in speed and memory storage are needed for efficient use of the HT for shape and object recognition. The size of the parameter space must be reduced significantly to save storage and to minimize the associated search task.

PROPOSED WORK

- Segmentation of medical images is done and the cyst is diagnosed and detected.
- Better segmentation results are obtained by using curve evolution method rather than the conventional method.
- The image-region properties or the edge information of the cyst is determined which could be sent over the computer networks. This region-of-interest (ROI) could be examined by the medical practitioners or physicians who are at a remote location and gives appropriate medical prescriptions or treatment recommendations.

This results in decreased time and increased accuracy for repetitive segmentation problems, as system performance improves with continued use. The effectiveness of the resulting system is demonstrated on a medical diagnosis task using cystological images.

SOFTWARE MODULES

The following are the modules into which the project has been divided into

- Gray scale conversion
- Marking minutiae-points
- Storing the detected cyst image under appropriate set
- Extraction of edge information or image region properties from the detected cyst.

Gray scale conversion: The gray scale conversion avoids the problems arising due to skin color and other color differences. Hence, after conversion, the available image will be in the 8 bit color mode. i.e. 2^8 =256 color intensity.

Marking minutiae-points: The gray scaled image is now subjected to fix the data points called minutiae. These points are technically referred as pixels. Any arbitrary point is taken (Preferably centre point). The image is scanned along x-axis to determine the change of intensities. The minutiae points are marked whenever there is a change in the intensity levels. Similarly it is done along y-axis. Now, presence of each minutiae is represented as dark colored pixel.

Storing the detected cyst image under appropriate set: Collecting more data or record is useless unless we store these data or records in an optimal manner. So the image in which the region-of-interest is determined is stored in a file.

Extraction of edge information or image region properties from the detected cyst: Each and every minutiae location which are identified by their respective pixel co-ordinates.e.g.(x1,y1)are stored in a log file.

IMPLEMENTATION

The digital image is first converted to gray scale. The gray scaled image is now subjected to fix the data points called minutiae. Now, presence of each minutiae is represented as dark colored pixel. The detected cyst image is then stored under appropriate set. The edge information i.e., the minutiae locations of the detected cyst is stored in the log file.

GRAY SCALE CONVERSION

Gray scale conversion is one of the simplest image enhancement techniques. The gray scale conversion avoids the problems arising due to skin color and other color differences. Hence, after conversion, the available image will be in the 8 bit color mode. i.e. 2^8 =256 color intensity.

Gray scale conversion can be performed using the following function.

y = f (x)

where

x: original input data
y: converted output data
a. Linear conversion
y = ax + b
a: gain, b: offset

Contrast stretch is one of linear conversion as follows.

MARKING MINUTIAE-POINTS

The next module is marking minutiae-points. The gray scaled image is now subjected to fix the data points called minutiae. These points are technically referred as pixels. Any arbitrary point is taken (Preferably centre point). The image is scanned along x-axis to determine the change of intensities. The minutiae points are marked whenever there is a change in the intensity levels. Similarly it is done along y-axis. Now, presence of each minutiae is represented as dark colored pixel.

Since, the image is represented as series of rows and columns of pixels, the identification of pixel follows the following procedure.

Minutiae representing Pixel Identification Algorithm: Procedure to be followed

- Start
- Initializing pointer P
- Get the value for M, N. i.e., no of rows and columns that are used to represent the entire image.
- For every M value where.1 <= M <= M

i.e. For (m=1; m <= M; m++)

- For every nj value, where 1 <= nj <= N
- Check the Pixel intensity value
  if (Pixel intensity value > 127)
- // Get the co-ordinates of the pixel

eg: (mi,nj)

Store or write the co-ordinate value (mi,nj) in a file continuously

- Store the values
- Increment nj Value by 1 or 2
- Increment mi value by 1 or 2
- Close /stop

STORING THE DETECTED CYST IMAGE UNDER APPROPRIATE SET

Storing the image data as files : In the First step, each and every minutiae locations which are identified by their respective pixel co-ordinates eg: (x1, y1) or (mi, nj) are stored in a file and saved.

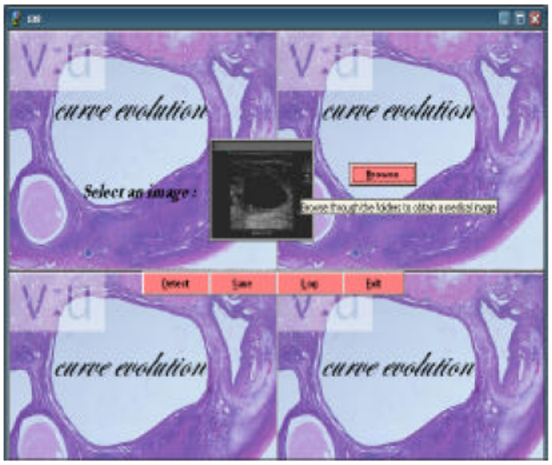
Getting Image data on text file: When a new image is under registration, the image is subjected to following process steps.

- Scanning image
- Gray scale conversion
- Noise reduction
- Minutiae Extraction

EXTRACTION OF EDGE INFORMATION OR IMAGE REGION PROPERTIES FROM THE DETECTED CYST

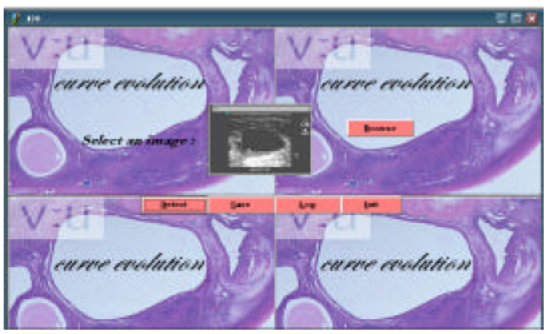
Each and every minutiae location which are identified by their respective pixel co-ordinates e.g. (x1, y1) or (mi, nj) are stored in a log file and saved.

RESULTS OF IMPLEMENTATION



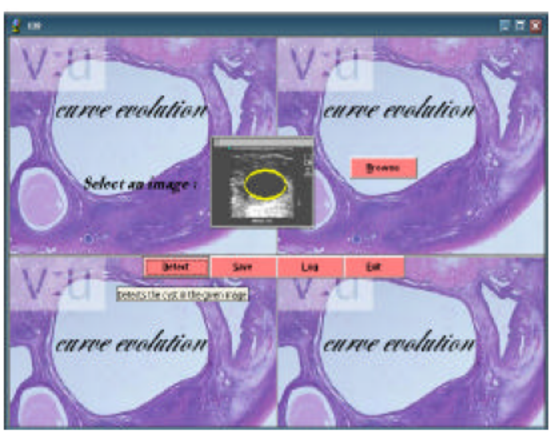
a) Original Image

GRAY SCALE CONVERSION



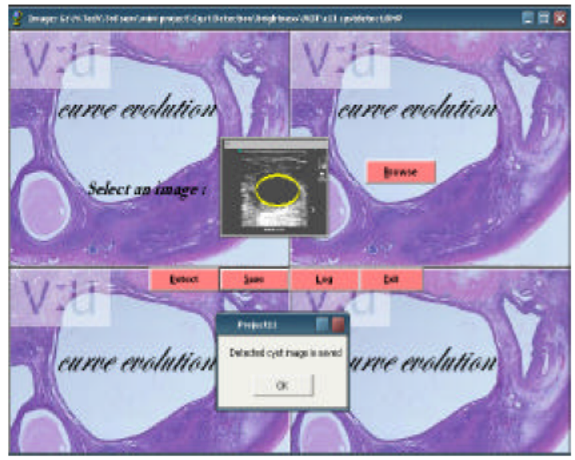
b) Gray scale conversion of the loaded image

MARKING MINUTIAE-POINTS



c) Marking minutiae-points and cyst detection

STORING THE SEGMENTED CYST IMAGE



d) Storing the detected cyst image under appropriate set

EXTRACTION OF EDGE INFORMATION

e) Extracting the properties of region-of-interest

CONCLUSIONS

The system developed competes with the real life situations. We have presented a semi-automated segmentation method using active contours framework with a variety of image features for the detection of the cyst obtained from ultra sound imaging and extract the edge information or image region properties which could be used in the knowledge based systems to give suitable medical recommendations in the absence of physicians. Based on the volume of cyst in the ultrasound image, the system recommendations are done.

- The project can be enhanced by integrating image region properties with edge information.
- A neural network learning module could be developed.

- When using neural networks for edge detection, the efficiency during the training can be improved. For this, the varied learning rate and the momentum can be applied instead of fixed values. In addition, instead of pixel-based inputs, if the texture-based inputs are fed into the fuzzy neural network, it will facilitate and determine the quality of an edge feature.

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