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RESEARCH ARTICLE

Extraction of Defected Area of Medical Images Using Affine Transform

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ABSTRACT:* *In medical imaging, image registration is a vital problem. It has many potential applications in clinical diagnosis. It is a process of aligning two images into a common coordinate system thus aligning them in order to monitor subtle changes between the two. It is necessary to register multiple images of the same scene acquired by different sensors, or images taken by the same sensor but at different times for many image-processing applications. Mathematical modelling techniques are used to correct the geometric errors like translation, scaling and rotation of the input image to that of the reference image, so that these images can be used in various applications like change detection, image fusion etc. In the conventional methods, these errors are corrected by taking control points over the image and these points are used to establish the mathematical model which is used to detect the changes. The objective of this paper is, by increasing the accuracy level of the registration, implementation and evaluating a registration algorithm to correct the geometric errors of the input image with respect to the reference image and performing an segmentation on registered image to detect the changes in a image.

***KEYWORDS:* Image registration, affine transform, image segmentation, watershed method, change detection**

I. Introduction

For remote sensing application image registration is a fundamental image processing technique. Image registration is the process of an automatic or manual procedure which tries to find corresponding points between two images and spatially align them to minimize a desired error, i.e. a consistent distance measure between two images. It determines the geometric transformation between two images. It also determines the geometric transformation between two images. In various computer vision applications, registration process is needed, such as stereo depth perception, motion analysis, change detection, object localization and object recognition.

Image Registration process requires two inputs, one is reference image and another one is the image to be registered. This process produces one output, which is termed as registered image. Registration of an image is an indispensable pre-processing tool in order to integrate different kinds of sensor data and different temporal data in integrating multitemoral and multi-source images. Image registration is used in medical imaging, cartography, remote sensing, and other applications that rely on obtaining precise information from images—for example, detecting tumors from MRI scans or discovering from satellite images how an area became flooded.

Intensity Based Approach

In intensity based approach, to estimate mapping function image intensity value of a whole image is used. The main idea is to search iteratively for the geometric transformation that, when applied to the moving image, optimizes i.e. minimizes or maximizes a similarity measure, also known as the cost function. The optimizer has the function of defining the search strategy. The similarity measure is computed in the overlapped regions of the input images and is related to voxel intensity.

Feature Based Approach

In feature based approach, extracts the feature points and by using those extracted feature points only, mapping function is calculated. In the feature based registration methodologies there are two main approaches to search for the optimal transformation after the feature segmentation process in the input images

- Using some criterion the matching among features is established e.g. based on geometrical, physical or statistical properties. Then, the geometric transformation is established based on the matching found. Then, the "corresponding costs" which are the "distances" between the descriptors of the possible point pairs, and the similarity measure between the input images is usually given by the sum of all the "corresponding costs" established.
- Based on the optimization of a similarity measure between the features extracted from the input images the matching and the transformation are defined concurrently. However, in this case, the features extracted are used to define the registration result, rather than the original intensity images.

II. Image Registration Methodology

As it is mentioned above, image registration is widely used in medical imaging, remote sensing, computer vision etc. In general, its applications can be divided into four main groups according to the manner of the image acquisition:

Different viewpoints (multiview analysis): In this images of the same scene are acquired from different viewpoints [4].

Examples of applications: Remote sensing mosaicing of images of the surveyed area. Computer vision—shape recovery [4].

Different times (multitemporal analysis): In this mages of the same scene are acquired at different times, often on regular basis, and possibly under different conditions. The aim of this is to evaluate and find changes in the scene which appeared between the consecutive images acquisitions [4].

Examples of applications: Remote sensing Medical imaging [4].

Different sensors (multimodal analysis): In this mages of the same scene are acquired by different sensors. The aim of this is to integrate the information obtained from different source streams to gain more complex and detailed scene representation [4].

Examples of applications: Remote sensing, Medical imaging. Results can be applied, for instance, in radiotherapy and nuclear medicine.

In the proposed method, first image registration is performed for the input images using affine transform. Then segmentation is done using watershed segmentation method to detect the changes in defected image compared with normal image.

Block diagram of proposed method is shown in Fig 1.

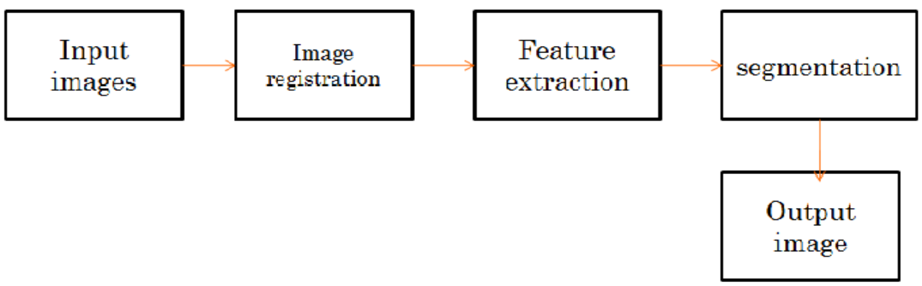

Fig 1: Block diagram of proposed method

Registration of image requires two inputs images for the process, one is a reference image and another one is an image to be registered. Registration process produces one out, which is termed as registered image. Here we are considering one input as a normal liver CT image and another one is a defected liver CT image

Affine Transformation

Transformation modifies the spatial relationship between pixels in an image and mapping pixel locations in an input image to new locations in an output image.

Here are some spatial transformation types:

Affine: Transformation that can include translation, rotation, scaling, and shearing. Straight lines remain straight, and parallel lines remain parallel, but rectangles might become parallelograms.

Projective: Transformation in which straight lines remain straight but parallel lines converge toward vanishing points.

Box: Special case of an affine transformation where each dimension is shifted and scaled independently.

Composite: Composition of two or more transformations.

Affine transformations are more general than rigid and can therefore tolerate more complicated distortions while still maintaining some nice mathematical properties [1].
A transformation T is linear if [1].

$$T(X1+x2) = T(X1) + T(X2)$$

And for every constant c,

$$CT(X) = T\ (CX).$$

A transformation is called affine transform, if T(X) +T (0) are linear. Affine transformations are linear in the sense that they map straight lines into straight lines. affine transformation is The most commonly used registration transformation which is sufficient to match two images of a scene taken from the same viewing angle but from a different position, i.e., the camera can be moved, and it can be rotated around its optical axis, This affine transformation is composed of the Cartesian operations of a scaling, a rotation, and a translation [1].

Segmentation

Image segmentation is used to extracting relevant information from the input images [6]. This information can be simply established by sets of areas, volumes, surfaces, points, edges, medial axes, lines, contours, etc., or descriptors on the objects represented in the images, such as distances, lengths, angles, moments or shape signatures or even more complex structures containing information about the objects, such as skeletons or diagrams in the images, graphs, [6]. Here, for segmentation we are using a watershed segmentation method [6].
Watershed segmentation is one of the most commonly used segmentation method. Use of watershed transformation based image segmentation has proved to be an efficient method provided that the main drawback of this technique is suppressed.[3] This drawback consists in the over segmentation produced by the watershed transformation if it is directly applied on the image which is need to be segmented[3]. A watershed transformation technique worked on the gradient of that image which is to be segmented was employed to reduce the over segmentation of the watershed algorithm. But the result is over segmentation image if only when we use the watershed algorithm with the gradient of raw data image without clustering method [2]. The solution for preventing this over segmentation is well know and has been widely used in various examples. It consists in a prior selection of the objects or regions to be extracted in an image [3].

To get rid over segmentation, merging method based on edge strengths and mean gray values were used. The watershed segmentation algorithm can segment image into several homogeneous regions which have the similar or same gray levels. To perform the meaningful segmentation of image, regions of different gray levels should be merged if the regions are from the same object [2]. The watershed segmentation generates the spatially homogeneous regions which are over segmented. But the objective of this work is to obtain one closed boundary per actual region in the final segmentation results of the image under the study [2].

As mentioned above, watershed transform was executed on the gradient image. The gradient defined the first partial derivative of an image and contains a measurement for the change of gray levels. The gradient values (G (x, y)) of the initial segmented image were obtained using firstly the approximation of the gradient operator in x, y directions (Equation 1) as two 3x3 masks [2].

$U_x(i, j) = (2 + 4c)_{-1}\{u(i + 1, j) - u(i - 1, j) + c[u(i+1, j + 1) - u(i - 1, j + 1) + u(i + 1, j - 1) - u(i - 1, j - 1)]\}$

$U_y(i, j) = (2 + 4c)_{-1}\{u(i, j + 1) - u(i, j - 1) + c[u(i+1, j+1) - u(i + 1, j - 1) + u(i - 1, j+1) - u(i-1, j - 1)]\}$ … (1)

$$G(x,y) = \sqrt{(\frac{\partial f}{\partial x})^2 + (\frac{\partial f}{\partial y})^2} \qquad \text{………. (2)}$$

Where $c = (\sqrt{2} - 1) / (2 - \sqrt{2})$. Then the gradient image values (G (x, y)) were calculated using an above equation [2]. The gradient values on the border of input image are the same as in the inner pixels. This gradient image values are useful to calculate edge strength values as given in below equation.

$$x = \frac{\sum_{p \in Edge} \text{Gradient}(p)}{N}$$

Where Gradient (p) represents edge point’s gradient values which come from the gradient image for all pixels (p) on the edge between every two regions and N is the number of edge pixels [2].

III. Results

Real time liver image is selected for the experimental analysis. Here we are comparing the affected image with the normal image. First we are registering on defected image with normal using affine transform. The defected and normal images are shown in Fig 2.

The default registered image is shown in Fig 3. After proper rotation and translation, the final registered image is shown in Fig 4. After performing registration, watershed segmentation is done. Gradient magnitude and watershed transformation of gradient magnitude are shown in Fig 5 and 6 respectively. And the final output which shows the defected parts is shown in Fig 7. In the final output, defected parts are highlighted in gray color.

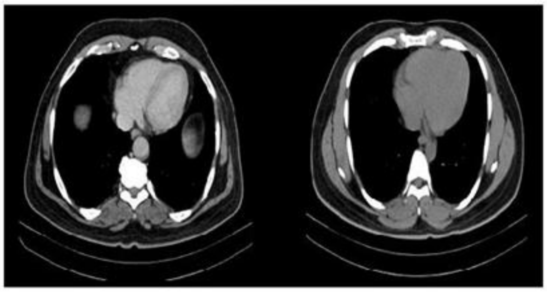

Fig 2: Defected and Normal Image

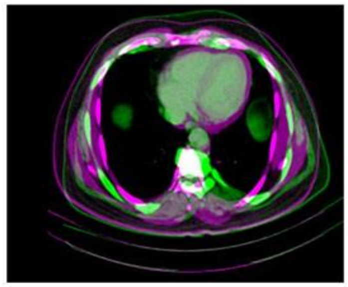

Fig 3: Default Registration

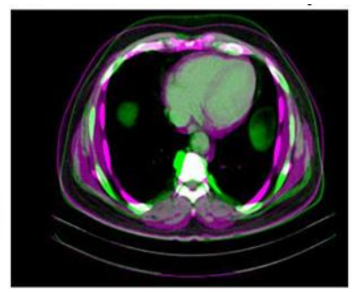

Fig 4: Final Registered Image

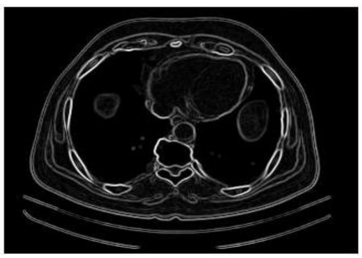

Fig 5: Gradient Magnitude Image

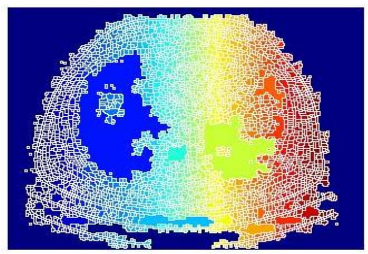

Fig 6: Watershed Transformation on Gradient Magnitude

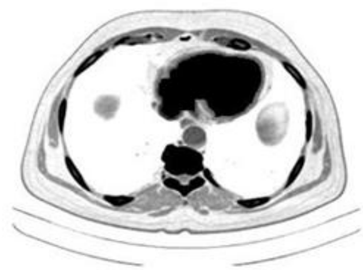

Fig 7: Change Detection Output Image

IV. Conclusion

Image registration is performed on the real time medical liver images by using an affine transformation which is more efficient one compare to all other registration algorithms by doing rotation and translation. So that the registration output is more suitable for next process compare to original input image. After registration is performed, segmentation is done using watershed segmentation method to find out the gradients of image and detect the changes in the defected medical image which is compared with normal medical image.

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