Suggested Method for Medical Image Segmentation

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Abstract

The medical diagnosis in most cases of disease, particularly of tumors and fractures and inflation depends on the image taken to member of the body by medical imaging equipment such as MRI or X-ray or image scanning. Therefore, dealing with the medical image such as a process of amending the image or segmenting it may lead to influence the image which leads to an error in the diagnostic process. The method proposed here is to take a medical image with the extension (RGB) and use the K-means for the purpose of image segmentation and conversing of color space (RGB) to color space (HSV) for the segmented image and the original image, we identify or find the original edges of the image (Edge detection) by filters, and then subtracting image of color space (HSV) from the edges image of color space (HSV) by comparing the output with the edge (threshold) to get a segmented image witch reveal member in more clearly for the purpose of using this image in subsequent operations such as feature extracting.

الخلاصة

يعتمد التشخيص الطبي في اغلب الحالات المرضية وخصوصاً منها الأورام و الكسور والتضخم على الصورة التي تاخذ للعضو من خلال اجهزة التصوير الطبية مثل الرنين المغناطيسي او اشعة X او صورة المفراس. لذلك فان العمل على الصورة الطبية مثل اجراء عملية تعديل الصورة او اجراء عملية تقسيم الصورة قد يؤدي الى التأثير على تفاصيل الصورة مما يؤدي الى خطأ في عملية التشخيص. ان الطريقة المقترحة هنا هي اخذ الصورة الطبية ذات الامتداد (RGB) والقيام باستخدام طريقة K-means لغرض اجراء التجزئة للصورة والقيام بتحويل الصورة من الفضاء اللوني (RGB) الى الفضاء اللوني (HSV) بالنسبة للصورة المجزئة والصورة الاصلية، نقوم بتحديد او ايجاد حواف الصورة الاصلية (Edge detection) بطريقة الفلاتر ، وبعدها تتم عملية طرح صورة الفضاء اللوني (HSV) من صورة الحواف ذات الفضاء اللوني (HSV) بطريقة مقارنة الناتج مع حافة (threshold) للحصول على صورة مجزئة تكشف العضو بصورة اكثر وضوحاً لغرض استخدام هذه الصورة في عمليات لاحقة مثل استخلاص الصفات.

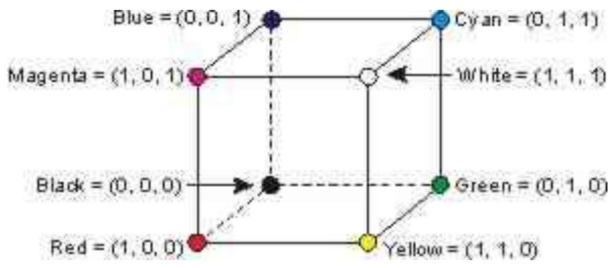
1. Introduction

Image segmentation is a fundamental process in many image, video, and computer vision applications. It is often used to partition an image into separate regions, which ideally correspond to different real world objects. Pixels in the region are similar to each other with respect to some characteristic property like color, intensity or texture. The goal of segmentation is to simplify the image representation into something that is more meaningful and easier to analyze (Erdem, *et al.*, 2004). It is a critical step towards on tent analysis and image understanding specially medical image segmentation, it is a challenging and high cost task. Many current problems in image-guided surgery, therapy evaluation and diagnostic tools strongly benefit from the result of the analyses of segmented images (Bowyer and Phillips, 1998). There are popular approaches used are: threshold techniques, edge-based technique, region based techniques Threshold based techniques are often called as histogram-based methods. which make decision on local pixel information are effective only when the intensity levels are far outside the range of levels in the background. Edge-based techniques are use the boundaries of regions to segment the image and detect abrupt changes in intensity (discontinuities) Region-based approaches are use similarity among pixels to find different regions. K-means algorithm is one such region based method used to segment the image (Vanzella and Torre, 2006). (RGB) color spaces widely used throughout computer graphics and images, all of the color spaces can be derived from the RGB information supplied by devices such as cameras, scanner, MRI device, and CT medical images (Wang, and Siskind, 2003).

2. Color Spaces

A color space is a mathematical representation of a set of color. The three most popular color models are RGB (used in computer graphics), YIQ, YUV, or YCbCr (used in video systems) and CMYK (used in color printing). However, none of these color space are directly related to the intuitive notions of hue, saturation, and brightness. This resulted in the temporary pursuit of other models, such as HIS and HSV, to simplify programming, processing, and end-user manipulation (Gonzalez, *et al*, 2004)

2.1- The RGB color space The RGB color space is the best-known and most widely used color model. In RGB each color is represented by 3 values red (R), green (G) and blue (B), positioned along the axes of the Cartesian coordinate system. The values of RGB are assumed to be in the range of [0,1] or in some cases in the range of [0-255]. This way black is represented as (0, 0, 0), white is represented as (1, 1, 1) or (255, 255, 255). These black and the white colors are represented by 2 of the opposite corner of the cube that can be defined by the R, G, B axes of the Cartesian coordinate systems. Other corners of the cube represent the red, green, blue, cyan, magenta and yellow colors. Grayscale colors are represented with identical R, G, B components.

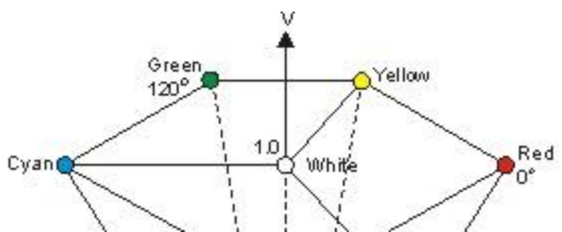


Fig(1) RGB color space

Because the RGB color space is widely used in monitors, digital cameras, it is the most important color space in image processing (Sangwine and Horne, 1998).

2.2- The HSV Color Space

The HSV color space is very similar to the HIS color space. In HSV every color is represented by three components Hue (H), Saturation (S) and Value (V). The following figure shows how this color model represents each color in a six sided pyramid form.



The Hue component describes the color itself in the form of an angle between [0,360] degrees. 0 degree mean red, 120 means green 240 means blue. 60 degrees is yellow, 300 degrees is magenta. The Saturation component signals how much the color is polluted with white color. The range of the S component is [0,1].Black has a V coordinate of 0. At this point the values of H and S are irrelevant. The point S=0, V=1 is white. Intermediate values of V for S=0 (on the center line) are the grays. When S=0 value of H is irrelevant (called by convention undefined). When S is not zero, H is relevant. For example pure red is at H=0, S=1, V=1. The formula that converts from RGB to HSV or back is more complicated than with other color models, therefore we will not elaborate on the detailed specifics involved in this process (Diepold and Oelbaum, 2004).

3. Edge detection

Edge detection is a fundamental tool used in most image processing applications to obtain information from the frames before feature extraction and object segmentation. This process detects outlines of an object and boundaries between objects and the background in the image. An edge detection filter is also used to improve the appearance of blurred or low-pass filtered pixels streams. The basic edge detection operator is a matrix area gradient operation that determines the level of variance between different pixels. The edge detection operator is calculated by forming a matrix centered on a pixel chosen as the center of the matrix area. If the value of this matrix area is above a given threshold, then the middle pixel is classified as an edge. Examples of gradient-based edge detectors are Roberts, Prewitt, and Sobel operators. All the gradient-based algorithms have kernel operators that calculate the strength of the slope in directions that are orthogonal to each other, generally horizontal and vertical. Later, the contributions of the different components of the slopes are combined to give the total value of the edge strength. The Prewitt operator measures two components: the vertical edge component is calculated with kernel Kx and the horizontal edge component is calculated with kernel Ky, |Kx| + |Ky| gives an indication of the intensity of the gradient in the current pixel (Umbaugh, 1998).

$$Kx = \begin{bmatrix} -1 & 0 & 1 \\ -1 & 0 & 1 \\ -1 & 0 & 1 \end{bmatrix} \qquad Ky = \begin{bmatrix} -1 & -1 & -1 \\ 0 & 0 & 0 \\ 1 & 1 & 1 \end{bmatrix}$$

4- K-Means Clustering

The K-means algorithm is an algorithm for identifying K groups/clusters of data points in multidimensional spaces. It is a fast and simple algorithm which has been used in many applications. The main idea of k means clustering is to define k centroids one for each cluster. These centroids should be placed carefully because different locations can cause different results. The next step is to take each pixel in the image and associate it to the nearest centroid. Thus the pixels are grouped into k clusters in the first step. At this point, we calculate k new centroids of the clusters resulting from the previous step. After finding the k new centroids, all the pixels in the image are assigned to their nearest centroid. The above steps are repeated until the centroids converge i.e. the centroids do not move anymore. The main objective of this algorithm is to minimize the squared error function V,

$$V = \sum_{i=1}^{k} \sum_{x_j \in S_i} (x_j - \mu_i)^2$$

where k is the number of clusters μi is the mean of the all the points in a cluster. Assume n sample feature vectors x1, x2……xn all from the same class. Assume k clusters. Let mi be the mean of the vectors in cluster (Bishop, C.,1995).

Algorithm

1. Place k points into the space represented by the objects that are being lustered. These points represent initial group centroids.
2. Assign each object to the group that has the closest centroid.
3. When all objects have been assigned, recalculate the positions of the k centroids.
4. Repeat steps 2 and 3 until the centroids no longer move (Komaraboina and Lakkakula,2006).

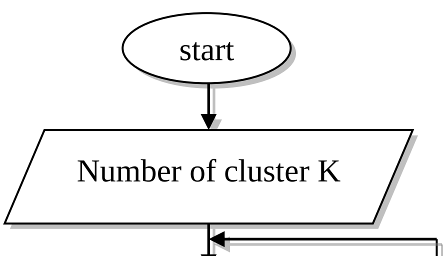


Image subtraction

Image subtraction can be used to segmented since not all the result remove the background from foreground information from images of identical scenes. The resulting image shows only the foreground objects of interest; the static background elements are eliminated. In the case of digital subtraction angiography, a baseline image is subtracted from one where blood vessels are enhanced with an X-ray-opaque liquid. The resulting image shows only the enhanced blood vessels without the obscuring background imagery. Image subtraction can be used in Illumination equalization is often used in biological sample imagery obtained from a microscope. A background image showing only the illumination non nomination inconsistencies (Umbaugh, 1998).

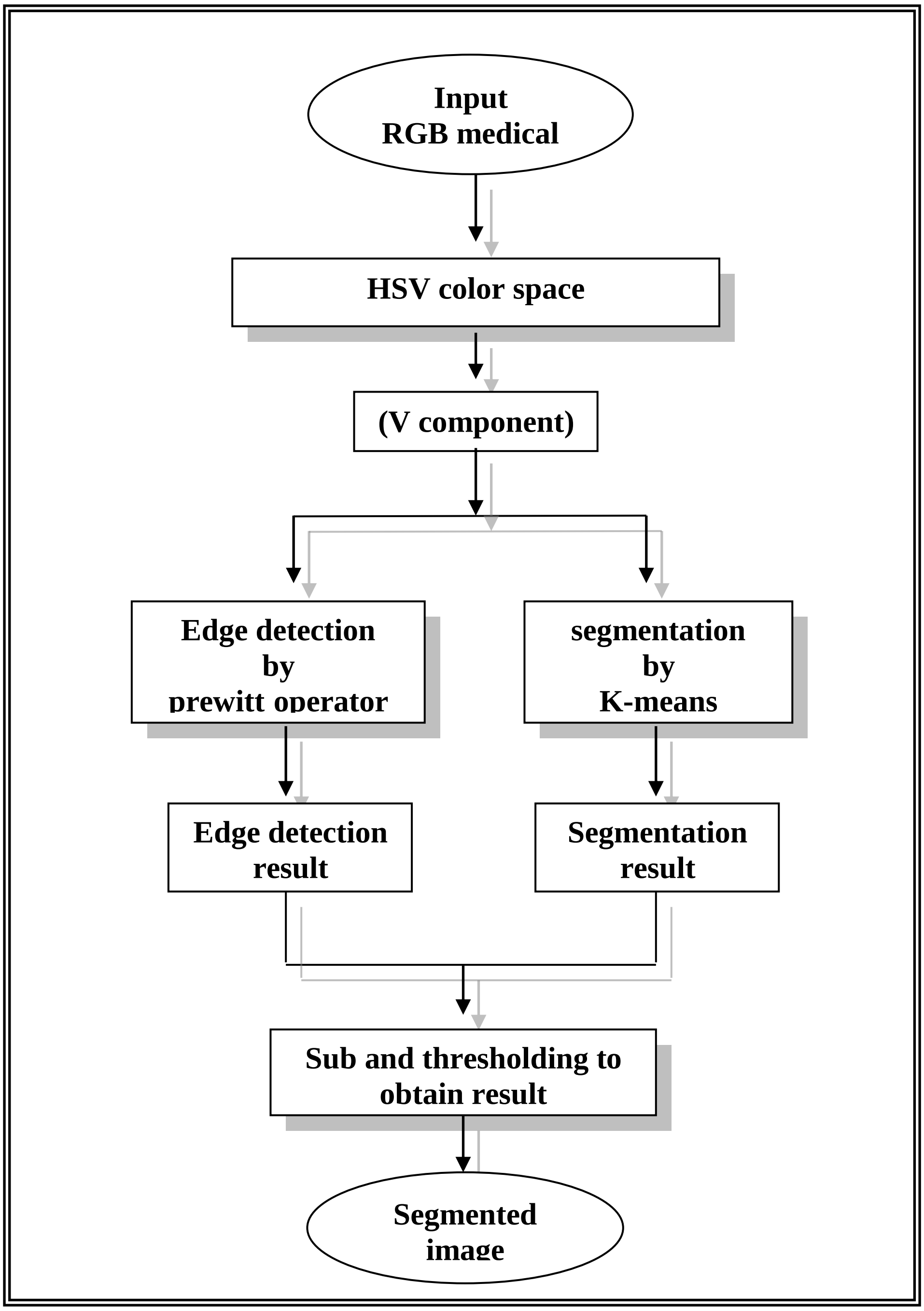


Fig (4) Flow chart for suggested method

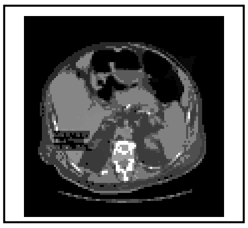
Experimental result

Original image

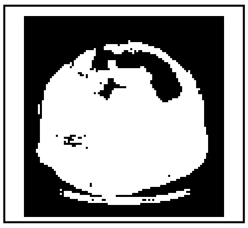
Edge detected image

Segmented image

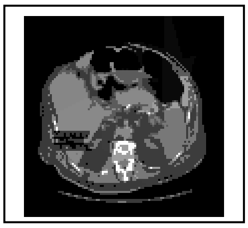
Result image



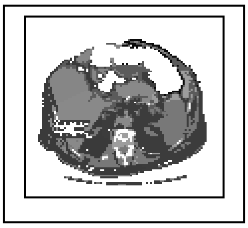
Original image



Edge detected image



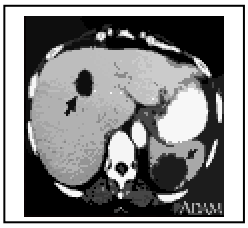
Segmented image



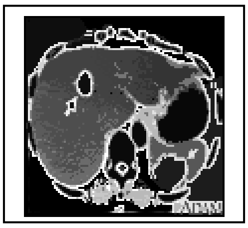
Result image

Original image

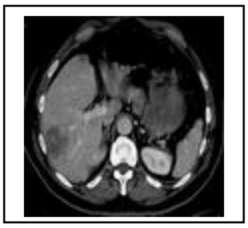
Edge detected image



Segmented image



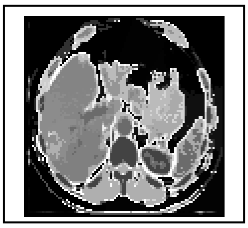
Result image



Original image

Edge detected image

Segmented image



Result image

Conclusion

1- Proposed method combines the advantages of K-means result and edge detection result where the edge of the object will be smooth after apply k-mean algorithm on the image and the prewitt operator will detect the object edge.
2- In the k-mean step the output depends largely on the initial cluster centroids and the number of clusters selected.
3- This algorithm work well when in the medical image average color of the two adjacent regions is quite different
4- Prewitt operator can detect the edge of the medical image easy.
5- The background of image omitted in some result.

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