Overview of Segmentation X-Ray Medical Images Using Image Processing Technique

Wan Azani Mustafa¹, Nurshahira Mohd Salleh¹, Syed Zulkarnain Syed Idrus²,
Mohd Aminudin Jamlos¹, Mohamad Nur Khairul Hafizi Rohani³

¹Faculty of Engineering Technology, University of Malaysia Perlis, UniCITI Alam Campus, Sungei Chuchuh, 02100 Padang Besar, Perlis, Malaysia
²Center of Excellence Geopolymer and Green Technology, Universiti Malaysia Perlis, 01000 Kangar, Perlis, Malaysia.
³School of Electrical System Engineering, Universiti Malaysia Perlis, Pauh Putra Main Campus, 02600 Arau, Perlis, Malaysia

wanazani@unimap.edu.my

Abstract. Image processing techniques have been used in a wide variety of applications nowadays to enhance the quality of raw image data. Today, image segmentation or detection of x-ray medical imaging is very popular and challenges task in order to improve the diagnosis and analysis result. An x-ray image is one of the oldest photographic films that is mostly used in medical diagnosis and treatment. An x-ray image is a very useful modality for the physicians and doctors to determine and analyze the bone fracture, which is an important symptom used for diagnosis, but x-ray produces an only medium quality image, which will normally affect the information of the image. This article provides a review study of the medical image segmentation. Based on this study, the advantages and drawback each method clearly explained. This article presents an exhaustive review of these studies and suggests a direction for future developments in order to propose segmentation methods.

1. Introduction
Image segmentation is a famous technique in the image processing field because of the relevancy to many applications [1–3]. Image segmentation also an effective approach to separate objects from the background. Lots of segmentation applications have been introduced, such as document image analysis [4–6], medical image detection [7–10], object detection [11,12] and many more [13]. There are two groups of segmentation method which is the global segmentation and locally adaptive segmentation, and a hybrid segmentation which is the combination of the two segmentations. The global segmentation method used a single global threshold value for the whole image while the locally adaptive segmentation method calculates a threshold value for each pixel on the basic information contained in a neighbourhood of the pixel [14]. The example of a global segmentation method is by the Otsu threshold method [15], Fixed threshold [16], and Kittler and Illingworth's threshold method [17], while the local segmentation such as Niblack method [18,19], Wolf method [20] and Sauvola method [21].

In recent decades, segmentation on x-ray images has been one of the major interesting research subjects due to increasing the accuracy of diagnosis. An x-ray is an important tool for diagnosing medical conditions, especially bone fractures and implant. The common characteristics of an x-ray image are greyscaled colour space, high noise, low intensity, poor contrast, and weak boundary
representation, which will normally affect the information of the image [22]. The commonest diagnostic error in Accident and Emergency (A&E) units is that of missing fractures visible in X-ray images, usually because the doctors are inexperienced or not sufficiently expert. The most common missed are wrist fractures [23]. With limited information and low-quality image, segmentation and feature extraction of screw implant on x-ray image is a challenging task.

2. Literature Review

In the year 2015, Nida and Musbah have published a review study on image segmentation technique. According to them, image segmentation is the key points of the image processing technique [24]. There are several methods for image segmentation and that method was classified into two main categories which are the layer-based segmentation method and block-based segmentation method. Image segmentation, also known as labeling, is the process of dividing the individual elements of an image into a set of groups so that all elements in a group have a common property [25]. Figure 1 illustrated the flow chart of their study.

![Figure 1. Methods of Image Segmentation [24].](image)

With the same objective, Anjna and Kaur also describe a few segmentation techniques. Image segmentation is very practical for image compression or image recognition applications and they have discussed various image segmentation techniques in their paper [26]. The summary of the review was shown in table 1.

Table 1. Differences of Segmentation Technique [27].

| Method       | Description                  | Advantages                                      | Disadvantages                        |
|--------------|------------------------------|-------------------------------------------------|---------------------------------------|
| Thresholding | Use histogram peaks          | The method that is very simple and doesn’t require previous information | Very dependents on peaks, but spatial detail not to be considered |
| Edge-based method | Use discontinuity detection | Not much noise, easy to define similarity character | Not suitable for images with too many borders. |
| Region based | Use partitioning image       | Not much noise, easy to define similarity character | Expensive method |
| Clustering   | Use homogeneous clusters divisions | Convenient for the real problem | Not easy to define membership function |
Lalaoui et al. [28] found that segmentation of brain images by using Modified Expectation Maximization (MEM) algorithm is more effective and successful compared to the Fuzzy C-Means, K-Means and Mean Shifts (MS). It uses an intelligent way to reduce the number of iterations to quickly converge at the low time center for the segmented image. It shows that applying MEM clustering method can produce good segmentation results when applied to real and synthetic images. The advantages of this approach are reducing the number of iteration and execution time. Figure 2 shows a good performance of their method for brain real MR and synthetic images with intensity inhomogeneity. It demonstrates that Mean Shifts (MS) and MEM methods are better than the other method.

In the year 2016, Bishali and Santanu have made an analysis of various edge detection methods for x-ray images. They do research on Canny, Sobel, Prewitt, Roberts, Zero cross and Log operators edge detection method. The finding of these methods was evaluated, compared and analyzed through the mathematical equation of quality metric, mean and standard deviation. And they have concluded from their findings that Zero Cross and LOG edge detection method give the best results on the X-ray images [29]. The samples of the resulting images were shown in table 2.

Table 2. Figures of various Edge-Detection Method Testing [29].
In another study, Goh et al. [30] have done research in performance analysis Otsu performance. They analysed the image thresholding method of Otsu algorithm based on its feasibility, consistency and performance analysis. Besides, the aim of this research also revealed that the image parameters such as level of intensity between object and background, object size, object position and noise would affect Otsu threshold performance but it is not affected by the location of the object on image plant [30]. Then, a new method using soft thresholding for medical image segmentation by applying the...
simplest configuration of a soft-decision thresholding method was studied by Fernández et al. [31]. It’s based on relating each pixel in the image to the different regions via a membership function, rather than through hard decisions and to changing the probabilistic point of view of the histogram of the image by a membership-related. Image threshold is a simple and direct approach to extract different regions from an image [32]. According to an investigation by Senthilkumaran and Vaithegi, they have found that Niblack algorithm is better than Souvola algorithm based on the removal of background noise. This experimented was tested on medical images such as MRI brain and bone x-ray. The performance is measured using statical parameters which are Jaccard Similarity Coefficient and Peak Signal to Noise Ratio (PSNR) [33]. The details of the performance approach are presented in Table 3.

Table 3. Comparison between Niblack and Sauvola Method and performance evaluation [33].

| Niblack Method | Sauvola Method | PNSR | Jaccard |
|---------------|---------------|------|--------|
| ![MRI brain image] | ![MRI brain image] | 58.9606 | 52.0983 | 0.5218 | 0.2771 |
| ![MRI bone x-ray image] | ![MRI bone x-ray image] | 54.2790 | 52.3042 | 0.3324 | 0.2117 |
| ![MRI bone x-ray image] | ![MRI bone x-ray image] | 55.0773 | 52.5917 | 0.4460 | 0.2689 |
| ![MRI bone x-ray image] | ![MRI bone x-ray image] | 68.6692 | 54.2790 | 0.4074 | 0.2050 |
Ng et al. [34] mention the significant relationship method between k-means clustering and watershed algorithm. The idea is incorporated the K-means clustering algorithm with the improved watershed segmentation algorithm. It addresses the drawbacks of the conventional watershed algorithm, which include over-segmentation and sensitivity to noise. The experimental results have shown (figure 3) that the suggested method using K-means clustering to obtain a primary segmentation of MR images before applying the improved watershed segmentation to them is effective. By reducing the amount of over-segmentation, they obtain a segmentation map which is more representative of the various anatomies in the medical image.

![Figure 3. Comparing segmentation maps obtained using the proposed methodology against those obtained using conventional methodology: (a) 93% fewer partitions (b) 94% fewer partitions [34].](image)

In 2018, a new medical image segmentation for cancer by using fuzzy entropy with a level set algorithm was proposed by Maolood et al. [35]. The analysis is conducted by experimented on breast cancer images. The results of the experiment show that the compact constraint of the proposed method exerts various effects on different degrees of compactness as shown in figure 4. The searching and scanning have started to find the ground truth (GT) regions of cancer by decreasing and increasing the parameter value of the mask (M), as demonstrated in figure 4. These processes continue pixel by pixel on the medical image until the nearest GT boundary of cancer. The level set method creates a red initial curve around the cancer region because this method is sensitive to this process, as displayed in figure 4. The experimental images illustrated optimization steps of iterations until achieving the optimum solution which summarizes the performance of the FELs thresholding method, which is calculated for sensitivity, precision, specificity, and accuracy measures, for each medical image [35].
Figure 4. Fuzzy entropy with the level set segmentation of ultrasound breast cancer: (a) Original ultrasound image with cancer, (b) is searching to find cancer to region, (c) find cancer and segmented after 130 iterations, (d) is initialization by thresholding for extracted the cancer region [35].

3. Conclusion

Image segmentation is a part of image processing. Segmentation is defined as the process of segmenting an image into different sections which are usually used for the digital image to find patterns and some other relevant information. The objective of image segmentation is to separate pixel values into a couple of groups, black as foreground and white as background. This paper was to overcome the shortcoming of the previous method, and even after developing a method, there still some flaws in the algorithm, there still unwanted noise, non-uniform illumination, poor quality, low contrast and etc. So, in the future, there will be an image segmentation that can overcome all the shortcoming and can solve the problems from the previous methods. In the future, others image segmentation method like the clustering can be studied and applied for medical image detection.

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