IOSR Journal of Applied Physics (IOSR-JAP)
e-ISSN: 2278-4861.Volume 8, Issue 2 Ver. I (Mar. - Apr. 2016), PP 29-31
www.iosrjournals

Image Segmentation Of CT Head Image To Define Tumour Using K-Means Clustering Algorithm

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Abstract : *Radiation Treatment Planning (RTP) is an essential part of radiation treatment to help the radiologist to deliver radiation effectively, precisely, and accurately. In RTP, the information of the location, the size, and the shape of the target, and the anatomical structure is very crucial. This information will affect the dose calculation of each treatment. Based on this issue, this research aims to design and develop a segmentation program to define organs boundaries correctly. The program began with the preprocessing which were consisted of grayscale and histogram equalization for contrast tissue image enhancement. The next step was the clustering process using K-Means clustering algorithm, which tried to make the partition of the data (CT image) into four groups by classifying the features into a single contiguous cluster. The separation process was then performed using the thresholding. By this research the abnormal brain (tumor) could be described within seconds (<1 minute) and the result was similar to those of the diagnostic radiologist. Hence, it can be concluded that this method is more effective than the manual one.*
Keywords: *ComputerTomography (CT), K-Means clustering, Tumour*

I. Introduction

Radiation Treatment Planning (RTP) is an essential part of radiation treatment to help radiologists provide radiation in the most effective, precise, and accurate way to maximize the radiation dose on the target and minimize the dose to the healthy parts of the body [1]. In RTP, the information of the location, the size, and the shape of the target, and the anatomical structure is very crucial. Segmentation method can be use to define organs boundaries correctly for the purpose of calculating the dose of each treatment [1]. Image segmentation is a critical job to split the image into separate regions where each region is homogenous and connected in space [2]. This method plays an important role in image processing because of errors at this level will affect the image analysis process at a more advanced level.

Segmentation techniques have been developed, the manual method [3], thresholding method [4], and the method of morphological operations [5]. It also has methods of unsupervised [6], [7] such as K-means clustering algorithm [8], the weighted K-means algorithm [9] and the method of Possibilistic Clustering Algorithm [10]. Implementation of a medical image segmentation that is really accurate undiscovered and still being developed [11]. Unsupervised segmentation technique that has been developed is the K-means clustering algorithm because it is simple, easy to implement, able to cluster large data, and able to handle data outliers and linear time complexity.

K-Means is one method of non-hierarchical clustering of data that seeks to partition the data into one or more clusters [12]. K-Means classifies objects into K clusters then finds the center and boundaries of the cluster through the iterative process. Proximity or similarity of an object with another object or the center of the cluster is computed using a distance function, generally using Euclidean distance. K-Means is able to minimize the average distance of each data to its cluster [13]. The purpose of the research is to design and develop segmentation program based on K-Means clustering algorithm with the input object is a head CT image.

II. Methods and Experimental

Image processing was done through pre-processing, the clustering process and separation of objects. Pre-processing to improve image quality used grayscaling and histogram equalization. Clustering process was done by classifying the characteristics of the CT image based on K-Means clustering, and it was shown in Figure 1. While the separation process was done by thresholding the image. Thresholding transformed grayscale image into a binary image based on a certain value which became the criterion.

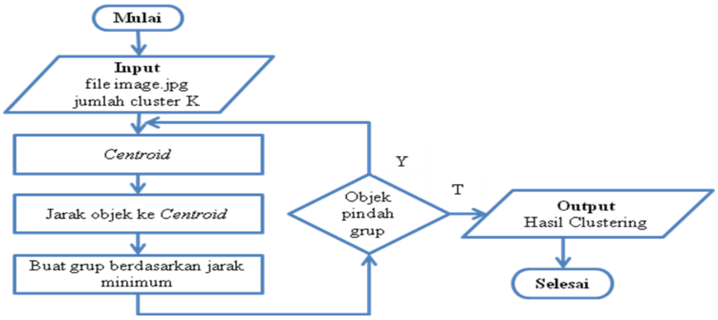


Fig. 1 Flowchart of K-Means Clustering

III. Results and Discussion

The result of image segmentation program design with K-Means clustering algorithm had been tested with the input data of a CT image of a human head. The image was automatically classified into 4 classes: class 1 for background and cerebrospinal fluid (CSF), class 2 for normal tissues (brain gray), class 3 for abnormal tissue, and class 4 for the bone. The segmentation process was done in detail and in quick time. The separation process of the clustering results was done to show a particular class that had been created. The analysis of time segmentation process was performed to determine whether these methods were effective to do and took a short amount of time (<1 min). The analysis was also performed to compare the results of the segmentation algorithm based on K-Means Clustering and based on the results of a radiologist with the manual method. The results of the testing program can be seen in Table 1.

Table 1 Results of Testing Segmentation Program

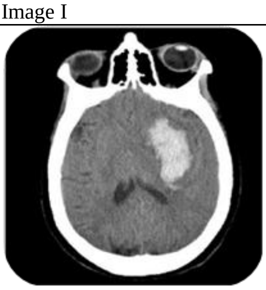
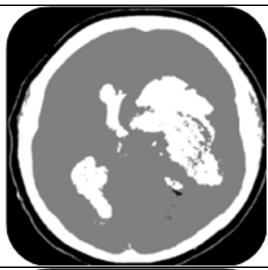
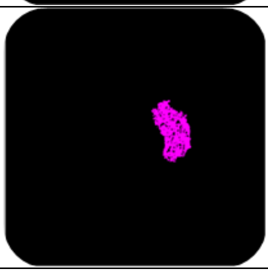
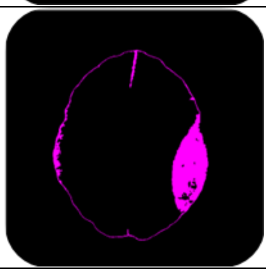
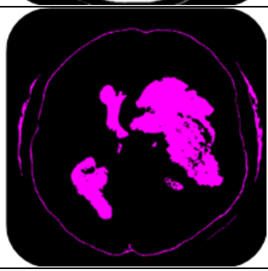
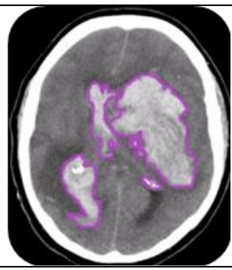
	Image I	Image II	Image III
Input image	 340x406x8b JPEG	 586x586x8b JPEG	 658x777x24b JPEG
Image of Clustering Results			
Image of Thresholding Results			
Processing Time (seconds)	3,17	4,55	5,79

Image of Radiologist Results			

IV. Conclusion

From this study it can be shown that the CT scan image segmentation program using K-Means clustering algorithm has successfully divided the slice of CT head image into four classes and managed to separate the abnormal part of the brain image in a very short time and the results are the same as the manual method. K-Means clustering algorithm is influenced by the number of cluster centers, the selection of initial cluster centers and the geometrical properties of the data.

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