Purpose:Marker-based registration, needed especially when there is no sufficient bony anatomy for adequate match, plays an important role in the image guided radiation therapy (IGRT) systems, of which the accuracy of registration greatly depends on that of the location of the markers embed. Since the manual marker detection has many limits for its time consuming and labor intensive, it is essential to enable an automatic detection of makers to help to cut down the human error in registration as well as to get a speed-up of the registration process, making IGRT systems more efficient.

Methods: In this study, we present a simple and efficient clustering method based on the k-means clustering algorithm, which we call threshold-based clustering. This method is established in three procedures. First, we got a set of segmented 3D CT images using binary thresholding method since the value of the markers is far different from that of the CT images. Second, the calculation was done by comparing the spacial distance between every two possible marker candidates to make marker points with similar intensity clustered. Finally, the centers of markers can be obtained after a given number of iteration time which can be changed according to the prior estimated number of markers.

Results:This method has been tested on 46 CT slices with a size of 512*512. Markers were successfully identified in at least 99.00%. It took less than a second to detect three markers with the average location accuracy of 0.56mm compared to 1.50mm for the conventional manual technique.

Conclusions:It has been testified that the method proposed can accurately detect the location of the markers within 3D CT images. Our results demonstrate the subvoxel accuracy can be achieved completely automatically which makes the method well suited for clinical applications.