Comparative Study on Segmentation Techniques Using Fruit Images

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Abstract- *Segmentation is a process of dividing an image into distinct regions with the aim to extracts object of interest from the background. The traditional thresholding , clustering and transformation segmentation techniques that were widely used are Otsu and K-means and watershed. Segmentation of image plays an crucial act in pragmatic applications such as medical science. Thresholding is an important technique for image segmentation. Among all segmentation method, Otsu method is one of the most standout methods for image thresholding. Clustering is one of the methods used for segmentation. Both Otsu and K-means methods produce good quality of segmented areas under natural environment . the objective of this paper is to compare segmentation techniques between Otsu, K-means and watershed techniques on fruit images to find out which provides a best result based on segmentation metrics.*

Keywords- Otsu thresholding, Watershed transformation, K-Means Clustering, Fruit images

I. INTRODUCTION

Due to onset computer technology image processing techniques have been increasingly important in a wide variety of applications.Digital analysis of images is an exciting research area that requires a synergy between technical,engineering and medical and various other disciplines.Digital image processing plays an outstanding errand in day by day life application such as natural images,medical images,satellite images and so forth.Image segmentation is a vintage subject in the field of image processing and also is a hotspot and hub of image processing techniques.Segmentation of the fluctuated segments among the particles is to a great degree crucial to restorative call. Image segmentation is a vintage subject in the field of image processing and also is a hotspot and hub of image processing techniques. Watershed transformation is a region-based method under the classical method of segmentation.. This technique depends on the grayscale scientific morphology and it is utilized for multi component images. Clustering is a technique for gathering information objects into various groups,such that comparative information objects have a place with a similar gathering and unique information items to various groups.. Current research increasing interest in digital image searching, classification, identification, management and storage. K-means clustering is a key technique in pixel-based methods. Because pixel-based methods based on K-means clustering are simple and the computational complexity is relatively low compared with other region-based or edge-based methods, the application is more practicable. The segmentation process was performed by using thresholding method, Otsu which produces the limit esteem which was consequently actualized on the fruit images with the expect to isolate the damaged part.

1.1 RELATED WORK

Due to beginning Computer innovation picture preparing procedures have been progressively essential in a wide assortment of utilizations [6].In earlier years, a few kinds of image analysis technique are utilize to analyze the agricultural images such as fruits and vegetables, for recognition and classification purposes. Fruits are real wellspring of vitality, vitamins, fiber plant chemicals and supplements. So filling up on these fruit can help in weight reduction or wellbeing administration [9].Image segmentation is the crucial piece of image analysis process. The segmentation process for images with confounded structure is a standout amongst the most troublesome issues in image processing and has been a dynamic territory of research for a very long while[1].Image segmentation is the vital part of image analysis process. The segmentation process for images with complicated structure is one of the most difficult problems in image processing and has been an active area of research for several decades [8]. Thresholding is an important technique in image segmentation applications. The basic idea of thresholding is to select an optimal gray-level threshold value for separating objects of interest in an image from the background based on their gray-level distribution[5].Image segmentation needs to segment the object from the background to read the image properly and identify the content of the image carefully, segmentation is necessary to interpretation of an image. For image segmentation Multilevel Thresholding method uses the Otsu's method to segment the

image.[3]. Thresholding is an important technique for image segmentation.Otsu method is one of the most successful methods for image thresholding. The objective function of Otsu method is equivalent to that of Kmeans method in multilevel thresholding . They are both based on a same criterion that minimizes the within-class variance[4].The Otsu thresholding is a searching method of an optimal threshold value obtained by using discriminating criteria to maximize the distribution result of the two classes on the grayness level. This method was done to minimize the total weights of some variants in the class of the background and foreground pixels to obtain the optimal threshold[10]. K-means algorithm was used to evaluate the impact of clustering using centroid initialization, distance measures, and split methods. The experiments were performed using breast cancer dataset[2].The clustering techniques are the most important part of the data analysis and k-means is the oldest and popular clustering technique used. Clustering is a process of grouping data objects into disjointed clusters so that the data in the same cluster are similar, but data belonging to different cluster differ. A cluster is a collection of data object that are similar to one another are in same cluster and dissimilar to the objects are in other clusters[11].K-means clustering is suitable for image segmentation as the number of clusters is usually known for images of particular regions of the fruit images[7].

1.2 MOTIVATION AND JUSTIFICATION

Otsu thresholding depends on the difference of pixel force it is the technique which emphasizes through all the conceivable edge esteems it is one of the better edge determination strategy formedical pictures as for consistency and shape measures. The otsu strategy motivatesthis look into work for its simplicity of computations consistency and effectiveness.K implies bunching has favorable position of best execution procedure under segmentation.the k implies grouping rouses this exploration work in view of its simplicity of simple,fast and productivity and gives best outcome when thought about through time precision than alternate calculations and k implies additionally functions admirably with extensive number of informational indexes Watershed change has been utilized for multi segment pictures and it is simple,intuitive and can be parallelized.In watershed change the subsequent limits shape shut and associated regions,the limits of the subsequent districts dependably compares to forms which show up in the picture as evident shapes of objects.So defended to work in Otsu and Watershed and k means division.

1.3 OUTLINE OF THE PAPER

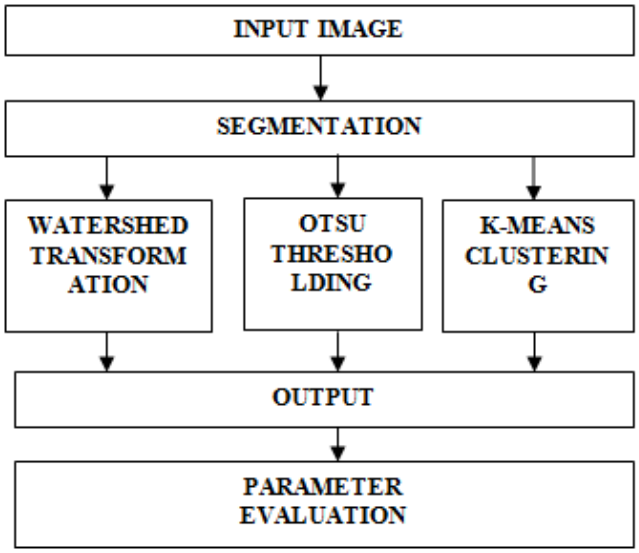


Fig 1.1 Outline of the Paper

1.4 ORGANIZATION OF THE WORK:

The paper is planned as follows, Methodology which includes the Watershed transformation, Otsu thresholding ,K-Means clustering are presented in section II, Experimental results are shown in section III, Performance analysis is also discussed in section IV, Conclusion is presented in section V.

II. METHODOLOGY

2.1 WATERSHED TRANSFORMATION:

Watershed segmentation (watershed transformation) is a district based method. This procedure relies upon the grayscale numerical morphology and it is used for multi section pictures. Naturally, the watershed calculation can be thought of as a scene that is flooded by water. At each point, the stature of the scene speaks to the pixel's force. The watershed change figures the picture districts which speak to the bowls dishes and zone constrains (the ridgelines). The picture slant is used as commitment of the change, with the ultimate objective that beyond what many would consider possible are orchestrated at high point centers A Watershed division process begins at some common minima Mi esteem finds the most decreased motivations behind the zone into where the water streams. . By evaluating appropriate partition, the district is segregated into zones Ωi which has advancement from the relating slightest Mi by adding to Ωi, again and again, unlabeled spotlights on the outer furthest reaches of Ωi. A point is added to region Ωi If its partition from the region is more diminutive than those from various regions. The strategy

is reiterated until the moment that no remaining unlabeled concentrations are those of the watershed line. In utilization, with a particular true objective to get a thin-watershed line, a point is added to the zone Ωi despite when its detachment from the region levels with those from some extraordinary areas. Hence, there is no point that has a place with the watershed line. This sort of strategy is amazingly direct and instinctual and has extraordinary properties, which make it important for some picture division applications. Regardless, it has diverse weights, for instance, completed division and poor at recognizing dainty structures and structures with low banner to-fuss extent

2.2 OTSU THRESHOLDING:

It is fundamental in picture preparing to pick a palatable point of confinement of dim level for expelling objects from their experience. Otsu is a modified utmost assurance zone based division strategy. Otsu procedure is a kind of overall thresholding in which it depends just on diminish estimation of the photo. Otsu system was proposed by Scholar Otsu in 1979. Which is comprehensively used in light of the fact that it is direct and convincing? The Otsu system requires enrolling a diminish level histogram before running. Nevertheless, by virtue of the one-dimensional which simply consider the dim level information, it doesn't give better division result. Along these lines, for that two dimensional Otsu computation was proposed which tackles both dull level point of confinement of each pixel and furthermore its Spatial relationship information inside the territory. This computation can gain adequate division comes to fruition when it is associated with the uproarious pictures. Otsu's procedure is ordinary in finding the perfect motivating force for as far as possible. It relies upon the interclass variance intensification..

2.3 K-MEANS CLUSTERING:

The articulation "k-connotes" was first used by James MacQueen in 1967 , however the idea retreats to 1957.According to him: "The technique, which is called "k-infers", appears to give portions which are sensibly capable in the sentiment inside class distinction, affirmed to some connect by numerical examination and practical contribution. In like manner, the k-suggests framework is viably tweaked and is computationally proficient, with the objective that it is achievable to process generous cases on a propelled PC. In addition, the other is Likewise thought which laid out in introduction part of his work favorable circumstances of using K-connotes: "K-suggests count is one of first which a data master will use to inspect another enlightening file since it is algorithmically essential, modestly healthy and gives "adequate" answers over a wide combination of educational files." The K-infers computation is the most normally used partitional packing figuring since it can be easily realized and is the best one to the extent the execution time. The noteworthy issue with this figuring is that it is sensitive to the assurance of the hidden distribution and may meet to adjacent optima.We expect we have a couple of data point, D=(X1… Xn), first peruse this data centers, K starting centroid, where k is customer parameter, the amount of groups needed. Each point is then consigned to nearest centroid. For a few, we have to perceive get-together of data demonstrates and consign each point one social affair. The contemplation is to pick subjective pack centers, one for each gathering. The centroid of each bundle is then invigorated in perspective of techniques for each social event which consign as another centroid. We repeat undertaking and revived centroid until the point when the moment that no point changes, infers no point don't investigate from each gathering to another or indistinguishably, every centroid proceed as previously.

Method:

(i) Take input Image
(ii) Segment using Watershed, Otsu and k-means techniques.
(iii) Compare the segmented image
(iv) The experimented results are evaluated using metrics

III. EXPERIMENTAL RESULT

The table 3.1 shows the experimental results of the segmentation techniques. The original fruit images are tabulated and the segmented results of watershed transformation, otsu thresholding and k means clustering resultant images are been tabulated.

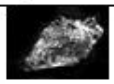
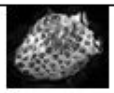
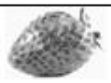
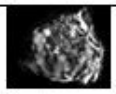
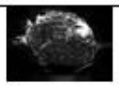
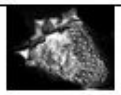
Images	Watershed segmentation	Otsu segmentation	K-Means clustering
IMAGE 1			
IMAGE2			
IMAGE3			
IMAGE4			
IMAGE5			

Table 3.1 Experimental results

IV. PERFORMANCE ANALYSIS

4.1 PERFORMANCE METRICS

PSNR-PEAK SIGNAL-TO-NOISE RATIO:

Peak Signal-to-Noise Ratio (PSNR) avoids this problem by scaling the MSE according to the image range:

Where *S* is the maximum pixel value. PSNR is measured in decibels (dB). The PSNR measure is also not ideal, but is in common use. Its main failing is that the signal strength is estimated as , rather than the actual signal strength for the image. PSNR is a good measure for comparing restoration results for the same image, but between-image comparisons of PSNR are meaningless. One image with 20 dB PSNR may look much better than another image with 30 dB PSNR. The PSNR (peak signal to noise ratio) is used to determine the degradation in the embedded image with respect to the host image. It is calculated by the formula as

$$PSNR = 10 \log10 (L2MSE)$$

MSE-MEAN SQUARE ERROR:

The MSE (mean square error)is defined as a average squared difference between a reference image and a distorted image.It is calculated by the formula given below

$$MSE=1XYX\Sigma i=1X\Sigma j=1(ci,-ei,)2$$

X and Y are height and width respectively of the image.The c (i, j) is the pixel value of the cover image and e (i, j) is the pixel value of the embed image.

TIME ACCURACY:

toc reads the elapsed time from the stopwatch timer started by the tic function. The function reads the internal time at the execution of the toc command, and displays the elapsed time since the most recent call to the tic function that had no output, in seconds

ENERGY:

Energy, the square sum of each matrix element, reflects the grayscale distribution homogeneity of images and texture crudeness. Same values of all co-occurrence matrix resulted in small energy profiles; on the contrary, high energy might be expected in case of unequal values among co-occurrence matrix values.

$$End,\theta=\sum i=1\sum j=1pd,\theta(i,j)^2$$

CONTRAST:

Contrast reflects the sharpness of images and the depth of texture grooves. Deeper texture grooves were associated with high contrast and better visual sharpness; on the contrary, low contrast led to shallow grooves and blurred images. Higher number of pixels with high difference in grayscale (e.g., contrast profile) is associated with higher values of contrast.

$$Contrastd,\theta=\sum i=1\sum j=1(i-j)2pd,\theta(i,j)$$

CORRELATION:

Correlation reflects the consistency of image texture

$$Correlationd,\theta=\sum i=1\sum j=1(i-\mu x)(j-\mu y)pd,\theta(i,j)/\sigma 2$$

HOMOGENITY:

Homogeneity reflects the homogeneity of image textures and scaled the local changes of image texture. High values of homogeneity denote the absence of intra-regional changes and locally homogenous distribution in image textures.

$$Homogeneityd,\theta=\sum i=1\sum j=1pd,\theta(i,j)/1+|i-j|$$

4.2 PERFORMANCE EVALUATION

[1] TECHNIQUES [2] [3]	[4] **[5] METRICS**	**[6] IMAGES** [7] 1	[8] 2	[9] 3	[10] 4	[11] 5
[12] WATERSHED TRANSFORMATION	[13] MSE	[14] 53.58	[15] 74.69	[16] 66.41	[17] 82.78	[18] 48.41
	[19] PSNR	[20] 13.54	[21] 10.66	[22] 11.68	[23] 9.771	[24] 14.43
	[25] ELAPSED [26] TIME	[27] 1.127	[28] 0.516	[29] 0.521	[30] 0.528	[31] 0.522
	[32] ENERGY	[33] 1.000	[34] 0.993	[35] 0.995	[36] 0.999	[37] 0.993
	[38] HOMOGENITY	[39] 1.000	[40] 0.997	[41] 0.998	[42] 1.000	[43] 0.997
	[44] CORRELATION	[45] -5.0886	[46] 0.058	[47] 0.130	[48] -1.525	[49] 0.1501
	[50] CONTRAST	[51] 4.984	[52] 0.156	[53] 0.095	[54] 0.001	[55] 0.139
[56] OTSU	[57] MSE	[58] 232	[59] 212	[60] 227	[61] 236	[62] 234
		.6	.3	.7	.1	.7
	[63] PSNR	[64] 24.49	[65] 24.89	[66] 24.59	[67] 24.43	[68] 24.45
	[69] ELAPSED [70] TIME	[71] 1.180	[72] 0.640	[73] 0.633	[74] 0.655	[75] 0.632
	[76] ENERGY	[77] 0.671	[78] 0.410	[79] 0.561	[80] 0.529	[81] 0.649
	[82] HOMOGENITY	[83] 0.908	[84] 0.830	[85] 0.892	[86] 0.889	[87] 0.904
	[88] CORRELATION	[89] 0.766	[90] 0.799	[91] 0.823	[92] 0.730	[93] 0.777
	[94] CONTRAST	[95] 1.008	[96] 1.595	[97] 0.846	[98] 0.949	[99] 1.029
[100] K-MEANS CLUSTERING	[101] MSE	[102] 1.54	[103] 1.71	[104] 18.59	[105] 4.58	[106] 3.57
	[107] PSNR	[108] 4.83	[109] 1.96	[110] 2.29	[111] 2.77	[112] 4.44
	[113] ELAPSED [114] TIME	[115] .322	[116] .325	[117] .317	[118] .323	[119] .317
	[120] ENERGY	[121] .64	[122] .37	[123] .49	[124] .44	[125] .54

		0	3	5	4	6
	[126] HOMOGENITY	[127].9448	[128].8880	[129].9396	[130].9923	[131].9928
	[132] CORRELATION	[133].9948	[134].8843	[135].9940	[136].9925	[137].9900
	[138] CONTRAST	[139].3003	[140].0993	[141].3958	[142].8995	[143].4004

Fig 4.1 Parameter Evaluation

V. CONCLUSION

The segmentation techniques of Otsu, Watershed and k-means compared for fruit images.The comparison is carried out using the performance metrics. By comparing these techniques k-means clustering gives the best result for fruit images.

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