International Journal of Innovative Research in Computer and Communication Engineering

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | Impact Factor: 7.488 |

||Volume 8, Issue 7, July 2020||

An Analysis of Different Image Segmentation Techniques in Fruit Image

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ABSTRACT: In the recent trend, the domain of image processing plays a crucial role in modern real-time applications. Such image processing techniques help to achieve better solutions for the digitized image. Several methods look like an image processing tool. The segmentation of images is a vital process in evaluating and extracting data from images. Along with the different strategies of image processing, segmentation hasbeen used to identify edges, to a threshold, to grow areas, and to separate the images. There are varied bunch techniques utilized, the first widely used of K-means algorithmic program and fuzzy C-means algorithmic program regenerate to double values.The Otsu method requires a gray level histogram to be calculated before running, while K does not allow a gray level histogram to calculate before running. All methods produce good segmentation results, but K is better than Otsu. The Otsu approach takes comparatively longer and raises algorithm complexity.Comparative measures based on Index of Similarity (IS) and Coefficient Tanimoto (TC).

KEYWORDS: Image Processing, Image Segmentation,Clustering,Otsu's Method, Thresholding, K-means Clustering (KMC), Fuzzy c-means (FVM).

I. INTRODUCTION

Image processing (IP) is a technology to translate and operate an image into digital form to obtain an improved image or retrieve useful information from the image. It's a signal processing method. The procedure has taken as an image, and then powerful algos are implemented, and effects may be images, data, or related features. By image segmentation, processing stages begin, segmentation of images, compression of the image, etc. For other implementations, it is also the basic square, such as pattern recognition, object identification, etc. Images are usually processed by way of automated image processing, although additional methods such as optical or analog are necessary. This study focuses on conventional methods that have been developed by them. Imaging is the processing of images (which offers the input data in any case)—image editing techniques separation or standard signal processing procedures of the discrete color planes of an image. Photos are often known to be 3D signals. There are few papers describing techniques for image processing [1].

Image segmentation (IS) is the production of image compression in the first or front level. The segmentation process' output is the result that is segmented by its size, good shape, and the best connectivity. Segmentation applies to the recognition process as well as the separation of the surface of the structural units and digital image regions. Segmentation may depend on several features that may be either color or texture contained in the image. Image segmentation in the field of image processing is one of the emerging trends. It has uncovered satellite imagery technologies, medical applications, etc.. Image segmentation allows us to analyze the items of sub-regions individually in the segment. Satellite images mechanically detector buildings have multiple uses, ranging from the tracking of human activity in remote regions to an evaluation of the surfaces necessary to install solar panels on top of buildings. The primary stage in the processing and retrieval of photographs is image segmentation. Along with the different strategies of image processing, segmentation is used to identify boundaries, to a threshold, to expand areas, and to separate the images [2].

Clustering is an essential strategy used to extend a sensor network's life by reducing power consumption. By forming clusters, a sensor network can be scalable. The cluster chief is also called the cluster head (CH). Sensors of a group can choose a CH, or the network builder can pre-assign the CH. Various clustering algorithms for scalability and effective

communication have explicitly developed. The cluster-based routing method is often used to perform energy-efficient WSN routing. Higher energy nodes (cluster heads) can be utilized in the hierarchical architecture to process and send information while the sensing can play with low energy nodes. Some of the clustering algorithms are LEACH, PEGASI, TEEN, and APTEEN. The most crucial technique in energy efficiency is clustering. The sensor nodes are organized in groups called clusters in this technique [3].

Fuzzy clustering is an image segmentation strategy in which each data point may be more than one cluster or partition. Several of the data points is allocated membership grades. Such membership scores reflect the extent of involvement, showing increasing cluster data points. Thus, cluster points at the edge with a lesser membership value show that cluster participates in a lesser degree than the central cluster point. Technically, the use of a fuzzy range gives an incorrect class membership function—the main components of soft computation in the control of large natural data collection problems. The core premise in fuzzy clusters is that the data is not distinctively split into a cluster collection. The data points for each of the clusters are given membership values, and dynamic clustering algorithms allow the clusters to become their natural types. [4].

K-means (KM) image segmentation algo is a sort of supervised algo that segments areas of interest. The picture is first extended in the K-means method for segmentation to acquire a well-qualified image for segmentation. In K-mean data collection, the k number of data groups is classified. 2 key isolated steps are in the K-means method. The rising point of cluster nearest to the middle from corresponding data points is determined in the first step in centroids in the second phase [5].

II. IMAGE PROCESSING

Image processing relates to the creation of visual images. The image produced on the web is called the image. The digital image consists of metric or topological images; the edge is for image processing, and the edge of the crack is used for structure formation between pixels. The border is an area-related global one, but the borders are local image property. Image analysis algos examine a virtual memory data bin and its surroundings. The machine then sees the image through a keyhole. Knowledge and currently planning are the basis for high-level processing. This process imitates the ability of people to make decisions based on the information in the image. The degree of degradation can be measured by utilizing quality [6].

Figure 1**:**Image Captured By A Camera

A. BENEFITS OF IMAGE PROCESSING

- Visualization allows us to recognize non-visual objects.
- Image editing is quicker and more affordable.
- Free of noise.
- Shape and restore images-To create a better image.
- Pictures from the archive can be quickly accessed.

B. DIFFERENT TYPES OF IP TECHNIQUES

1. Image Enhancement (IE)

IE is an approach to explain image effects by changing the data from the initial images and make them more desirable for show or study. It assists in noise removal, sharpening, or enhancing an image so that key features can be easily identified.

2. Image Restoration

The technique called image restoration is used to restore the transparent image from a distorted or corrupted image. Blurry / Corruption is induced by distracting, distorted, or misfocus images. Blurring happens by creating an optimal lens width reduction caused by the incomplete mechanism of image formation.

3. Image Compression

Image compression reduces bytes in an image file devoid of degrading image quality to the image clearer. Reduce the scale of data to store more images in a specified disk or memory space.

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4. Image Segmentation

Segmentation or partitioning of a unique image inno. of regions by such identified pixels for image processing depicts the features of object detection and the regular picture and unknown boundary estimation.

5. Image Recognition

The methodology for image recognition involves classification/identification and detection of features as video artifacts or pictures. The identification system compares images from the database by actual image, and if fit can be made, further method execution may take place in real-time.

6. Image Smoothing

By using this smoothing technique, noise can be from the picture. The image that includes noisy details like lines, clusters, sprouts, and stains by using a smoothing technique to filter the noisy data away. This operates based on the low pass filter, which helps minimize the major gap between pixels by measuring the near pixel value. [7-10].

III. IMAGE SEGMENTATION

We must provide an image to conclude the segmentation. Images could be black, white, or colored images. Colored pictures are due to the level of grey. Color in the image varies with the difference of gray level contrast. Object representation is a challenging process of image processing, aimed at collecting details that correlate to IS-based image data, attributes estimation, object view. The results of IS depend very much on the precise measurement of the feature. The IS method can be performed that separates the picture in its entirety and eliminates the point of concern. The

processing of IS, however,segmentation outcomes will annoy other image analysis stages [11].

A. CLASSIFICATION OF SEGMENTATION TECHNIQUES

1. Segmentation by Edge Detection

The edge detection way is a critical step in the process of IS. The image is divided into the target and its context. Divide the image through the edge detection method by analyzing the intensity change or pixels.

2. Segmentation by Thresholding

Segmented image a few of the most natural solutions to the image is based on intensity levels, so it is referred to as the threshold. Both globally and locally, thresholding can take place. Global threshold distinguishes objects,or field pixels use a binary picture section partition as opposed to the threshold value selected.

3. Segmentation by Region-based

Pixels from the same item are sorted for segmentation in this methodology. With regional segmentation, the thresholding technique is effective. The segmentation region observed should be removed. In comparison, region-dependent segmentation is called similarity, primarily focused segmentation.

4. Segmentation by Feature

Formed clustering: The clustering of a team organization method followed the characteristics. A set of pixels, which are part of a single area and are mostly from specific areas, typically contains a number—information Clump like cluster analysis, automatic classification, taxonomy in segmentation.

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5. Segmenting by K Means Clustering

k suggests that clump algorithmics are the fourth segmentation method employed in this work. Based on their content, images can be grouped. Various bunch methods are used, with most commonly used K-means algoandFCM algos regenerating into double values.

6. PDE Based Image Segmentation

In image treating and especially in IS, PDE (Partial Differential Equations) equations or PDE models are commonly used. We utilize active contour models for segmentation. Dynamic contour models and serpents turn the issue of segmentation into PDE.

7. ANN Based Image Segmentation

ANN, each neuron is mapped on a NN to match the pixel of the image. The neural network image is equipped using activity samples, or a relation between neurons is then discovered, i.e., pixels. Fresh images from the qualified camera are then segmented.

8. Fuzzy Theory-Based IS

With the purpose of analyzing images andgives precise details from an image, the theory of the fuzzy set is applied. That minimizes image noise;a Fuzzy function may also be used. achieve better performance by various morphological operations may be coupled with the floated process. Fuzzy k-means andFCM are typically used in IP processes.

IV. CLUSTERING

Clustering or analyzing the cluster can be viewed as a method for data reduction that generates subgroups handled rather than single datasets. Typically, the classification of a vast number of data into relevant categories or groups based on similarity among data was described as the mechanism used for organizing/classification them. Clusters are classes of identical results focused on shared traits and distinct from results in other clusters. Clustering, though, is an unsupervised learning method since it hasn't been applied to the clusters until the implementation. High-quality classification requires achieving a high intracluster relation and low intercluster similarity [13].

A. SEGMENTATION BY CLUSTERING

Clustering is to divide the community (data points) into a no. of groups to make data points of one group more identical to those of the other categories. These classes are referred to as clusters. The clustering algo k-means is commonly used. The generation of a boundary often causes loss of information during the segmentation of images [14].

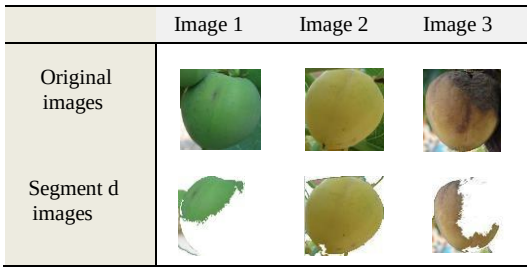

Figure 2: Original and Segmented Images

V. FUZZY-C MEANS CLUSTERING

At FCM, membership value is allocated to every data item, showing the degree of which it belongs. All membership values should be added for each data point.

The middle of the cluster is determined with FCM:

- Select several clusters.
- Learning-based coefficients to each cluster level arbitrarily.

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- The algo should repeat until fusion is completed (i.e., the change of coefficient should not exceed the sensitivity threshold value among two phases):
- Each cluster's center equations.
- Calculate the coefficient in the cluster for increasing data points.

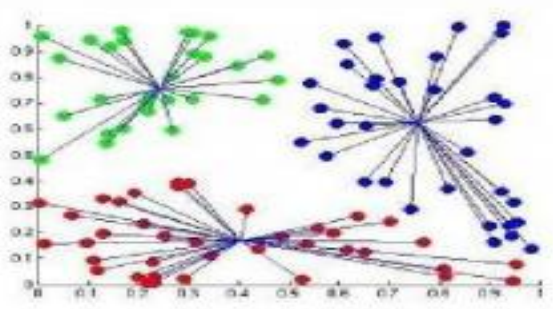

Figure3:FCM clustering

FCM is a standard method of clustering data elements effectively and reliably into various classes. It uses a fuzzy advance to assign data to several clusters.

A. ADAPTIVE FUZZY K-MEANS (AFKM)

AFKM has frequently used methods for dividing various images. KMand FCM rules are assimilated with this approach to improve the outcome of segmentation. This work proposed a combination of algos utilizing FCM and genetic algos (GA) to accomplish several exact regions by segmenting on a natural picture. The method does not require the initial number of the initialization cluster [15].

VI. K-MEANS METHOD IN SEGMENTATION

K-means refers to the number of clusters specified in a given number of single clusters. "K."Cluster to which an observation is attributed is calculated by multiple distance estimation. This algo strives to minimize measurement between the cluster's center and observation by assigning monitoring to a cluster and terminate the loop if the smallest distance measurement is reached.

	Image 1	Image 2	Image 3
Original images			
Segmented sub-images			

Figure 4: Segmentation of Sub-images

Fig revealed that individual segmented sections of the category were not adequately identified because the regions of concern were improperly filled with black pixels. Solve the limit by an inverse process has been added. Throughout this phase, it was modified to white if the region of a pixel of concern was black. The sub-images were then recomposed for the entire entity to create a segmented image.

A. ADVANTAGES OF K-MEANS

- Easy and durable
- If there are multiple factors, K-means would be better computerized than hierarchy if we hold k smalls.
- Unless the clusters are globular, K-means generate clusters tighter than hierarchy
- Equal to k-medoid.

B. DISADVANTAGES

- Analysis of the consistency of developed clusters is challenging.
- A fixed number of clusters will make determining what K will be difficult.

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- Will not interact well with on-globular clusters.
- In the final clusters, various initial partitions can result.

K-means are used to compare multiple pixels or to group-specific pixels or data sets. Since K-means operate on a spherical cluster, which is ideal for broad data sets, it is efficient, flexible to change. K-means approach to ISn is fast and effective in measurement expense relative to other segmentation approaches. One of the main drawbacks of the K-means method is its standardized outcome, whichleads to the effects of similar scale clusters, although details are of different proportions. In K-media value of k that must be determined in the original step of the algorithm is difficult to predict. [5].

A. OTSU AND K-MEANS METHOD

This says that the objective function of the Otsu method in multi-level levels is similar to that of K means process. Both are focused on the same standards, which reduce the gap among classes. The Otsu method works even on regional scales, though K is local. The Otsu method needs to be determined before running the gray level histogram, whereas K requires a gray level histogram not to be computed before running. Both methods yield strong segmentation performance, but K is better than Otsu. [16].

VII. THRESHOLDING

Partition the image in different types of segments. Thresholding is a vital approach. The thresholding method applies to the mechanism from which the appropriate threshold value is selected, such that the bifurcation can be rendered if the image dependent on it and optical image analysis on gray-level distribution can be carried out. The histogram of the image plays a significant role in the creation of algos in image threshold algos.

In comparison, thresholding is classified into the following two groups:

A. Global thresholding

Global thresholding means that the T threshold is derived purely by concentrating the grayscale image-level value or only relates pixel features.

B. Local thresholding

If a threshold value T is focused on gray level and local pixel properties defined as the Local thresholding protocol, Local threshold specifies that. Local thresholding The different thresholds from the respective segmented regions of the picture will be selected in this way [3].

VIII. OTSU'S THRESHOLDING

The Otsu method is a useful threshold selection method and is accessible for its rare time consumption. The thresholding process of Otsu includes iterating over the total possible threshold value as well as determining the typical structure of the entire pixel level for both sides of the threshold. The key goal is to measure the threshold value in places where it is minimally feasible to incorporate foreground and background spreads. Nevertheless, Otsu's method uses a thorough analysis to determine parameters to extend the variance within the class. While the algorithm delivers adequate segmentation results when performed under noisy limitations. The time limit for multi-level threshold selection increases as the number of classes in an image increases as well.

A. LIMITATIONS

If the histogram retains a bimodal distribution as well as a deep but sharp valley links two peaks, the histogram does not have a bimodality more such that the area of the object is low in comparison to the context area. Also, if the difference in object and background intensity is high as compared with the mean difference or the image gets corrupted by noise constraints, the sharp valley of the histogram of gray levels is perverted. [17]

IX. LITERATURE SURVEY

Yogesh, Ali, I., and Ahmed, A. (2018) This paper provides another approach for the segmentation of color images.It is the HFCM method, indicating the HSV - FCM method, abbreviated to the proposed form. A new technique known as TsNKM used the proposed approach to perform color-dependent segmentation on an image in which a colored sample image is transformed into a LAB image.A new series of operations are presented with a typical LAB value of LAB

image to obtain a segmented fruit image. A suggested HFCM approach was carried out in various fruits samples, and comparing tests with TsNKM was reported with higher indexes of similarity than the TsNKM. Thus the proposed solution can be applied in multiple areas such as automatic harvesting, fruit detection overlapping, or the extraction of information on fruit set.

Divya, P., and Anusudha, K. (2018) Segmentation is mainly aimed at depicting or converting the image into the simplest form for further processing. IS is commonly used for viewing angles of objects or limits. For segments of the defeated regions in leaves, the present method employs threshold and histogram techniques. Thresholding is segmentation methods used to segment image by fixing a threshold value,anda histogram is a method applied to collect image data. Defected image is divided into eight clusters in KM segmentation based on its strength as well as its iteration phase. The next approach is the Otsu one used by automated thresholding processes to segment the file. The threshold value is modified each cycle in phase, depending on the mean and variance value, andthe average variance value is generally known as a threshold value. Then, compared to obtainable methods in defect recognition with precision, the proposed method provides better segmentation results.

Sun, S.,et al. [2016]The core work in this paper is the means for the segmentation of images. Predicated on a traditional IS clustering somewhat for the accuracy of the image segmentation, a kind of C-based, fuzzy control is proposed. Methods firstly for clustering, fast-based IS algorithms use fuzzy C-means for clustering image segmentation algorithms. The experimental findings reveal that the clustering algorithm, stronger segmentation than the standard clustering algorithm for the aggregation of images, optimizes the efficiency of the same assumptions.

Sammouda, R., et al. [2015]In infrared images of the prostate, we use the IS process to segment or extract the area of cancer. This paper discusses as well as compares two methods for the segmentation of images: algos of K-means as well as FCM algo. The two-algo extracted cancer clusters are evaluated by student t and it was found that in the exact shape of tumors K-mean is more accurate than FCM.

Wang, L., and Zhang, G. (2015) Through combining the image segments into the final image cluster, the image cluster ensemble is an effective image method. The image processing improves the accuracy and reliability of the conventional single cluster algorithm. The study utilizes KM or Nyström Spectral Clustering to develop a modern partitioned image algorithm named the Cluster Ensemble algorithm. The computational complexity of the algorithm is small. It adopts a structure for a cluster ensemble. This procedure uses a KM algo to generate a range of segmentation tests.

Harrabi, R., and Ben Braiek, E. [2014]Itroduced a new method for the segment of color images based on a modified methodology from FCM and various color spaces that aims to include details in The FCM technology, A degree is used to recognizethe most important elements of color spaces used in the first stage of segmentation. The second step is to group these different data into uniform regions with the help of FCM something. A comparison analysis vs. current methods is proposed to test the accuracy of the classification procedure. The experimental findings on color images for medical or consistency show that different colored regions combined with the regular FCM image segmentation algorithm are superior.

Linju Lu et al. [2012] A new algo is suggested to improve the efficiency of MR image segmentation, based on kernel FCM (KFCM) algos and KNN algo. The statistically gray image-level histogram is being used in the algo to speed up algo in the KFCM algorithm. Also, KNN algos based on kernel methods often consider spatial details of the image. Increasing pixel is mapped to a high-dimensional function space utilizing kernel methods to conduct the FCM algo as well as the KNN algo. Studies show that the proposed algo for image segmentation is effective or efficient.

X. COMPARATIVE ANALYSIS

In this phase, the different methods are based on clustering to segment defects in fruit images. The image is processed with bilateral filters during the preprocessing period, to reduce the influence of noise or texture information. Medianfiltersare used to remove noise from an image or signal. Experimental results suggest that the algorithms can segment the defects more accurately.

1 Tanimoto Coefficient (TC)

TC uses as a measure of similarity, the association between the cross-section set as well as the union set. Within this equation, the numbers of attributes in each object (a, b) are seen as a logical equation. C is the crossing set in this case. The amount of the foreground pixels TC correctly measures the similarity of segmented images, varying from 0 to 1.

2 Similarity Index (SI)

It is an alert metric that quantifies degradation * of image quality arising from processing, for example, compression or data transmission losses. It is an actual comparison metric that allows for a reference image and an image processed into two models with the same image capture. It presents the standard compression of the processed image.It can be accessed, for instance, by saving a JPEG reference image (at any level of quality) then reading the picture back.It also varies from o to 1.

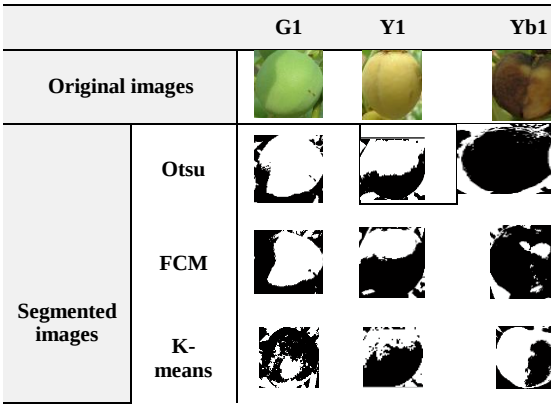

Figure 5: Original and Segmented Images

	Original images	Segmented images	SI	TC
Green mangoes teen			0.854	0.982
Yellow mango			0.899	0.837
Yellow-brown pomegranate			0.921	0.969
Red chili			0.970	0.968
Purple mangosteen			0.938	0.978
Black plum			0.772	0.703

Figure 6:IS of different Fruits using different Segmentationtechniques.

IS are nearly perfectly shaped and are filled with white pixels, most pixels in the interest area.

Table 1: SI and TC of different techniques

Techniques	Tanimoto Coefficient (TC)	Similarity Index (SI)
Otsu Thresholding	0.9530	0.5326
FCM	0.0303	0.0738
KMC median filter	0.0188	0.9034
KMCmedian filter, Bilateral Filter	0.9734	0.9534

The above table differentiates different image segmentation techniques. We equate two methods by their TCas well as the index of similarity. The image similarity was evaluated with SI as well as TC The images were segmented. SI or TC also calculates the resemblance of segmented images by correctly estimating the number of preliminary pixels. The value of SI, as well as TC, varies from 0 to 1 with different techniques, as shown in Figures 7 and 8. a higher value is like to 1, such that more top image quality is nearer to 1.

Table 2:SI andTC for Otsu, FCM, K-means

		Image 1	Image 2	Image 3
Similarity Index (SI)	Otsu	0.826	0.648	0.482
	FCM	0.778	0.529	0.144
	K-means	0.296	0.497	0.789
Tanimoto Coefficient (TC)	Otsu	0.757	0.480	0.318
	FCM	0.637	0.394	0.078
	K-means	0.174	0.388	0.652

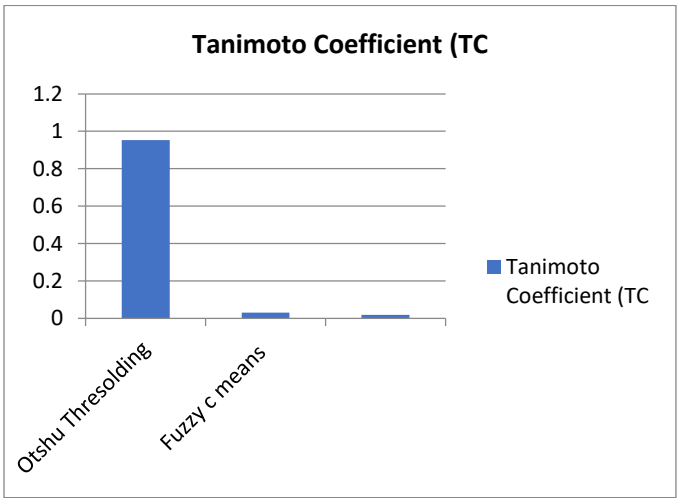

Figure 7: The Tanimoto Coefficient (TC) of different technique

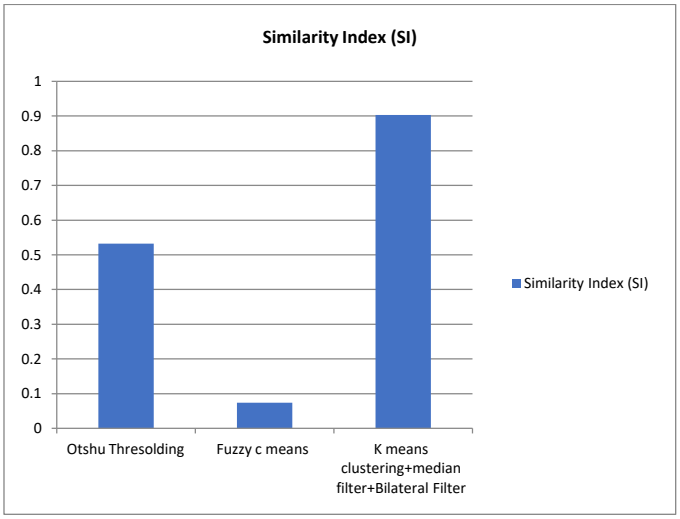

Figure 8: The Similarity Index (SI) of different technique

XI. CONCLUSION

The comparative survey describes different forms of image processing techniques, like image restorations, enhancement of the image, image segmentation, image recognition, or image restoration, which has been briefly discussed. The segmentation refers to the process by which digital image surfacesand regions correspond to structural units are identified and isolated.K-means IS algo is a sort of supervised algo which segments region of interest from context Thresholding is being used to division image vitally in various segment types of image. The Otsu approach for real-time images in terms of uniformity or measures of shape is one of the better threshold techniques.The time limit for multi-level threshold selection increases as the number of classes in an image increases as well.

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| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | Impact Factor: 7.488 |

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