A Novel Approach for Segmenting MRI images using Adaptive K-means Algorithm and Watershed Transform

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Abstract: *Image segmentation is basically a method used to split a picture into many segments. This process makes the image smooth and easy to calculate. Image Segmentation also enables to detect the regions of interest in a MRI image. The foremost purpose of this entire mechanism is to create an image more accurate and meaningful. This paper defines a novel technique in which image segmentation is performed using Adaptive K-means clustering along with ROI Saliency Map. In this approach, once the image is segmented, the clustering is carried on by way of considering that pixels nearby have a excessive chance of getting into the equal cluster. Accordingly, if a single pixel is mistakenly clustered, it can be corrected by looking at the neighboring pixels. A Region of interest (ROI) primarily based Image Segmentation that uses biologically prompted selective attention version. In this paper, we have also compared the proposed technique with Watershed Segmentation. Watershed transform works on grey-scale morphology. If the target regions have weak boundaries and low contrast levels, in that this algorithm can give closed contours. Finally Find Segmented Image and their result based on Accuracy, Mean, Standard Deviation and Entropy.*

Keywords-; *K-means , ROI ,Standard Deviation; Watershed Segmentation Entropy; accuracy;*

I. INTRODUCTION

Image Segmentation is a important part in Image Processing Field. The main objective of whole Image processing technique is to identify the image or object in deliberation simpler visually. Image Segmentation (IS) holds an important stand under image processing. Segmentation is essential part in medical imaging, and also vital part of facial extraction .

Medical Imaging is a important tool for diagnosis planning and treatment. Imaging modalities for instance digital mammography, Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) are good technique for Segmentation. Image segmentations are the technique to break a image into several non-overlap area which are equally exhausted the pixels and under the area are equal based on persuaded phenomena.[1].

Image segmentation is basically a primary and important task for more expedition in image processing field such as recognition, annotation of any object, Image understanding and etc. Much consideration had been laid on it but it remains an open and difficult setback owing to its diversity and complexity in all aspects. Traditional method are mostly depend on low-level cues, with which it is typical to segment out an object in its whole area, particularly complex ones. It was mentioned in Ref. [2] that such method cannot and should not aim to obtain a final and complete segmentation of an image which require higher level semantic data information and even application-dependent prior knowledge.

Cancer is a set of diseases that cause cells inside human body to change and raise the control. Several cancer cells ultimately shape a masses or lump named tumor is focus after the human body area wherever the tumor develop.

Breast cancer detection and analysis in its previous degree will increase the possibilities for a success remedy and whole improvement of the affected patient. Screening mammography is now the greatest radiological technique for premature recognition of breast cancer. It is an x-ray test of woman's breast that is asymptomatic. Mammography discovers approximately 80% to 90% of breast cancers disease. Abnormalities or masses recognition at previous stage is fairly feasible with the treatment of mammography. It is employed as a key tool for recognizing breast cancer [3].

There are Several Stages to breast Image Processing. The primary stage, breast image acquisition via mammography. The subsequent degrees are pre-processing photograph, , feature extraction(FE), Segmentation feature selection and classification. With technique digital mammography, characteristics calcification, bounded, speculated etc. masses may be diagnosed [4] .

In medical image system, the partition and segmentation of numerous cells is obligatory for the significant classification of numerous sicknesses. The accurate segmentation of tumor region from magnet resonated brain images is a crucial and problematical mission for the medical doctors. Several methods are anticipated for the automated partitioning of abnormal cells from magnetic resonating brain image. In this research article we endorse a stepped forward edition of two important Standard method. Watershed segmentation and fuzzy c means algorithm. Algorithms depend on clustering plays crucial function within the scientific Image Segmentation. Clustering is an unmanaged getting to know problem through which significant and beneficial entities were shaped together based on a few correspondence measures. Dissimilar entities are positioned in every other group. Selecting the starting Centroids is the most important issue related to fuzzy classification. Here we have proposed an accurate technique for the selection of initial Centroids depend on based totally on calculating histogram. Watershed technique is another broadly preferred algorithm used in the segmentation procedure of human organs. Over segmentation is one large problem in watershed technique. Using a marker within an image is on solution to this issue. Here we have represent an effective and efficient marker detection method depend on atlas approach.

II. SEGMENTATION

It is a important technique to fetch information from composite medical image. It has large area in medical field . The important Concept of Segmentation divide a image in uniform manner and focus on Region of interest in Object. It is basically depend on neighbor pixel and exhausted Area are uniform a predefine condition. Partition and Segmentation depend on separate a image into significant elements for additional, consequential in a upper level emergence of the pixels as foreground objects and the background. It is frequently identify in medical image, for example Magnetic Resonance image and X-ray radiography. Such as, the force in uniform in magnetic Resonance image frequently seems as intensity adjustments across the image, which develop from radio-frequency (RF) coils. Therefore the consequential forces of same tissue differ by areas in the Image. The Magnetic Resonance image noise is Rican scattered and may affect much the performances of Classification algorithm. Magnetic Resonance image and Breast cancer image partition and Segmentation depending on Self-systematize Map Network Magnet Resonance Image is a higher medical imaging method giving good data information about the human soft tissue anatomy. Intend of Magnetic Resonance (MR) image segmentation is to exactly identify the main tissue arrangements in these image volumes.

This is a novel approach and this unsupervised magnet resonance image segmentation approach is depend on self systematize feature. Image segmentation is usually occupied to bounded in image and position object. The output of image segmentation is a compilation of background that cooperatively occupied the whole image, or a collection of contours taken out from the image. [6].

Watershed Transform

It is algebraically morphology. Watershed technique was developed Lantuejoul and diagablein 1977[30]. The Watershed is a Strong area-depend Image Segmentation Technique. Beucher and Lantuejoul have created Watershed Transform. This technique has been developing superior results and is most commonly have studied in Image Segmentation. The In image the pixel value of each point stands for the every local minimum value, elevation of that point, and its closed area are called as the borders of the basin and collection basin form the watershed Technique[11]. Basically, the watershed function comprises of more areas occupied from where a water droplet could flow towards different minima. The immersion process have simulated from the heights of local minima. The stage of water rises in every basin and whilst two basins meet, a watershed is created among them.[7]

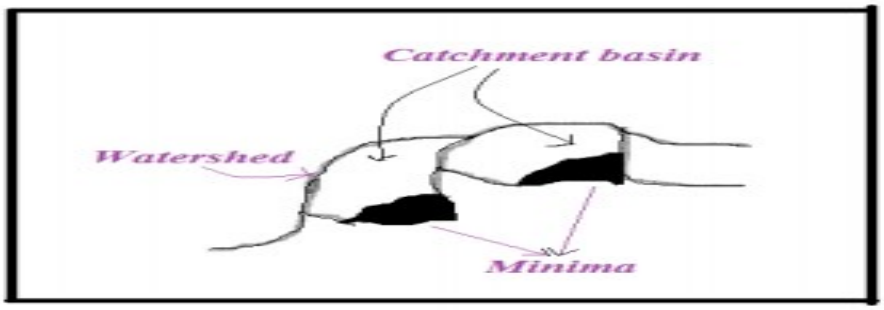


Fig. 1. Watershed Segmentation technique describe in two dimensions

The algebraically concept of watershed technique. Let M_jj=1 to R be the another regional minima of an input two dimensional image f (x,y). let us suppose that C (M_j) be the group of points in a catchment basin included with the local minimal M_j. Z[n] represent the set of points (p,q) of the two dimension image in which f (p,q) < n. algebraically we can represent following Equation

$$Z[n] = \{(p,q) \mid f(p,q) < n\}$$

Where Z(n) is denoted group of position
Z[n] is a group of position address of the two dimensional image f (x,y) lying below the plane f (x,y) = n. max and min indicate the maximum and minimum key value of two dimensional function f(x,y). Initially flooding start limit n = max + 1 to n = min + 1 . Let $C_n(M_j)$ represent the group of co-ordinates in the catchment basin included with minimum M_j that are flooded at next part n. $C_n(M_j)$ represent as a binary image presented by mathematically.

$$C\,n\,(M\,j) = \begin{cases} 1, & If\ (x,y)\varepsilon\ C\ (Mj) and\ (x,y)\varepsilon\ Z[n] \\ 0, & otherwise \end{cases} \quad (5)$$

C[n] is denoted the union of the flooded catchment

$$C[n] = U_{i=1}^{R}\ Cn\ (mj) \quad (6)$$

$$C [max + 1] = U_{i=1}^{R} C (Mj) \quad (7)$$

Equation of watershed segmentation represent that C [n-1] is a subgroup of C [n] and C [n] is resepresent the subset of Z(n). here C [n-1] is a subgroup of Z [n]. For created the watershed lines, we begin Z [min + 1] = Z [min + 1]. The group of rules then recursively finds C [n] from C [n-1]. The algebraically of C [n] from C [n1] as follows. Here H is indicate be the set of connected additives in Z [n]. Then for each connected component h ϵ H[n], here 3 outcomes

1. h ∩ C [n-1]i
2. s empty.
3. C [n-1] ∩ h consist one joint component of C [n-1]
4. C [n-1] ∩ h consist more than one combined element of C [n-1]

Watershed Transform is basically used to differentiate unseparated entities in an image. It usually finds "watershed ridge lines" and "catchment basins" in a image by assuming it as a flat surface where light pixels are high and dark pixels are low. This transform works good if it can mark or find background locations and foreground objects.

Marker controlled watershed segmentation follow the steps:

- Computing the segmentation function.
- Finding the foreground marks
- Computing the background marks
- Modifying the segmentation function so as the background marker location and foreground objects only has minima
- Computing the watershed transform of the modifying the segmentation technique.

III. ADAPTIVE K-MEANS CLUSTERING

In this research paper we will use adaptive k mean segmentation scheme to segment breast magnet resonance image to diagnose breast cancer in women. two important features are clarified in the segmentation Process circularity and brightness. These features are used because more circular and brighter objects are basically recognized as breast cancer. Adaptive k mean clustering is consist of two main phase ,first one Initialization Phase and second one Adaptive Segmentation Phase .

1. **Initialization phase**: It is based on image clustering technique with k mean function .K mean function depend on number iterations(n=10), and goodness function are create. It is former iteration technique and depend on projected. Adaptive segmentation technique .

2. **Adaptive segmentation phase**: Partition of image clustering and breast cancer are executed .K mean clustering is depend on number of n iteration (n=10) starting from the end iteration in the initialization Phase .. This manner occupied of many sub-methods: feature-based evaluation technique ,feature-based calculation, new facilities making method, and item choice.

These two phases are clarified in the sub sequent section with the steps involved and the feature characteristics for each phase

Initialization phase

1. initialization phase is a first phase of adaptive segmentation algorithm when we will apply adaptive segmentation scheme for n iterations. We will calculate new midpoint to build the primary novel cluster

The goodness functions have calculated as the mean circularity of whole resulting objects. The circularity ratio is the fraction of the contour area to the Circle are a with uniform perimeter, which is expressed mathematically as:

$$\text{fcirc} = \frac{4*\pi*A}{p^2}$$

A and P are denote the entity area in that order . If fcirc result is 1 than it is denoted circle and less than one it is denoted any other shape.. The area is calculated by using the sum of pixels in all divided clusters. The formula of goodness function is given below .

$$\text{GOODNESS} = \frac{\sum_{i=1}^{M} fcirc_i * A_i}{\sum_{i=1}^{M} A_i}$$

Ai is the ith object area and fcirci is Circularity ratio of ith object When the object area is multiplied through object circularity ratio to increase the large object values and decrease small object values.

2. Adaptive phase segmentation:

Adaptive Segmentation phase technique depend on center of the project algorithm . In this First stage, the k-means technique is functional for a new n iterations beginning from the prior iteration (initialization phase). K mean clustering is depend on number of n iteration (n=10) starting from the end iteration in the initialization Phase .The feature-technique calculation method is used to recompute goodness by above Eq. ,.This calculation is apply to calculate the accurate present goodness with previous goodness iteration. After the Compression we have found if the present goodness is accurate, than the novel goodness value is less to the former value goodness , in this case the existing situation have taken and the prior outcomes have destroyed.

IV. ROI SEGMENTATION ANALYSIS AND IMPROVEMENT

Basically there are numerous ways to division Region of interest. The major ways comprise feature point, human interaction and visual attention device segmentations. Feature point segmentation scheme is applied among them only to the imaging having definite features. Subjective factors influences the human interaction method. Besides it has a low efficiency, as a large library not good for PACS [9].

V. LITERATURE SURVEY

[10] In This paper basically modifies the rules in the microscopic photographs for cell segmentation for stained specimen. The elaborated method basically sum up GVF for watershed algorithm and deco volutes color for ihc separation marker. In microscopic images conventional watershed often occurs which is highly sensitive to noise. Image analysis is further enabled and over segmentation (80-90% cells perfectly segmented) is reduced by suggested method.

[11]In this Research paper, in order to segmentation an image in separated regions although the contrast is poor, watershed algorithm is used. Therefore this method helps in achieving 925 of accuracy.

[12] In this research paper, K means clustering is performed for magnet resonance image segmentation. Basic Concept of Magnetic Resonance Image area supported partition that can considerably differentiate between regular and irregular tissue. Magnetic resonance Image doesn't require contact to radiation. Magnetic Resonance Imaging can be an important and useful technique to help for detection of disease, or to pursue disease progress. At the procedure ending the tumor is taken out of the magnetic Resonance image and its exact position and the form also recognize. The area of the tumor is focus relying upon the amount of area detect from the cluster.

[13] In this paper, an enhanced watershed segmentation algorithm is described which basically for the partitioning of the image target objects makes use of RBF Neural Networks. For defining object regions, instead of making use of catchment basin minima, the algorithm developed throughout this work deploys RBF neural networks to identify the end boundaries of the segmentation clusters which are formed from the watersheds have created in the image histogram topography. The parameters such as widths, centers which are basically known as RBF initial parameters are repeatedly place over the histogram peaks and minima respectively. Experimental results of this leaning technique make it viable for different applications of gray scale image classifications.

[14]K-means technique is basically used to categorize the tumor level based upon count of pixel values in the mammogram Images. Further the tumor level has been analyzed and classified. In this anticipated work identifies tumor level based on the pixel count as well as it also detects the tumor in the former phase itself.

[15]Breast cancer is the main reason of death among women. Untimely detection implement on X-ray mammography is the key to improve breast cancer diagnosis. So as to enhance radiologists diagnostic presentation, many CAD processes had been discovered to enhance

the recognition of primary identification of this disease. In this proposed paper, an effort is built to extend an technique of adaptive k-means clustering for breast image segmentation for the micro calcifications recognition and computer based decision system for untimely recognition of breast cancer

VI. PROPOSED WORK

Proposed Algorithm

1. Read Image with N * N size.
2. Choose gray or color image, then change color image into gray image.
3. Take the size of row, column and dimensions of an image.
4. Initialize the adaptive K-means for segmentation:
5. Call k-means segmentation for n iterations.
6. Set the cluster label matrix is also called boundary.
7. Calculate an easy approximation of object's perimeter.
8. Compute the object perimeter using an equation:

$$Perimeter = \sum \sqrt{\sum (\Delta \times \Delta)^2}$$

Where $\Delta^2 = diff(Boundary)$

9. For each connected object (i) do
10. Find the ratio of object circularity (i) using formula:

$$Circ_{ratio} = \frac{4 \times \pi \times Area}{Perimeter^2}$$

11. End for
12. Compute the goodness using Eqn.:

$$Goodness = \frac{\sum_{j=1}^{N} Circ_{ratio_j} \times Area_j}{\sum_{j=1}^{N} Area_j}$$

Where jth is the object to N (number of object). The object's circularity ratio is multiplied through object area for maximizing values of large objects and minimizes values of small objects.

13. Again Call K-means for new centers using the last iteration clustering result.
14. Compute the goodness using Step 12.
15. If the new goodness<= previous goodness then
16. Save the new goodness
17. Save the clustering result
18. Else
19. Find the novel center generation algorithm.
20. End if
21. Until an amount of iterations N is get or goodness does not change occur.
22. For each connected object (i) do
23. Find the circularity ratio of object (i) using formula:

$$Circ_{ratio} = \frac{4 \times \pi \times Area}{Perimeter^2}$$

24. If $Circ_{ratio}$ (i) is not close to 1then

25. Delete object(i)
26. Else
27. Store the results
28. End if
29. End for
30. Initialize ROI saliency map for binary image.
31. Apply binary erosion on binary image.
32. Find the regional maximum peak value by saliency map.
33. Set discard threshold value to 0.2 find the label matrix of binary image.
34. Calculate average saliency on the basis of mean intensity of an object using region prop function.
35. Update average scale (y) using minimum (m) and maximum (M) value of mean intensity by formula:
36. If M-m>eps
37. y=x
38. Else
39. Estimate the value of y using Eqn.

$$y = \frac{(b-a) \times (x-m)}{M-m} + a$$

Where b=1, a=0, x is previous average scale

40. End if
41. Determine the index (idx) element if average saliency> discard threshold.
42. If ~is empty(idx)
43. Store results
44. End if
45. End if
46. DISPLAY Segmented Image, Mean, Standard Deviation, Entropy, and Accuracy.

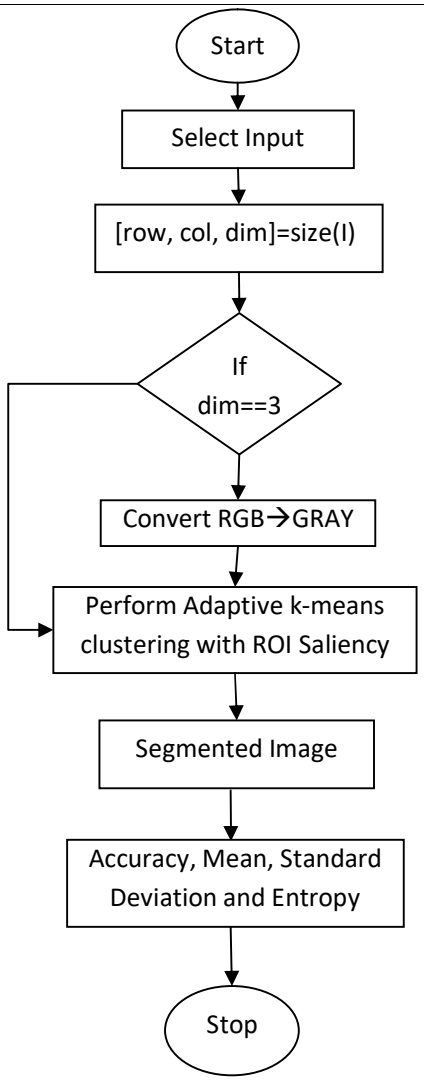
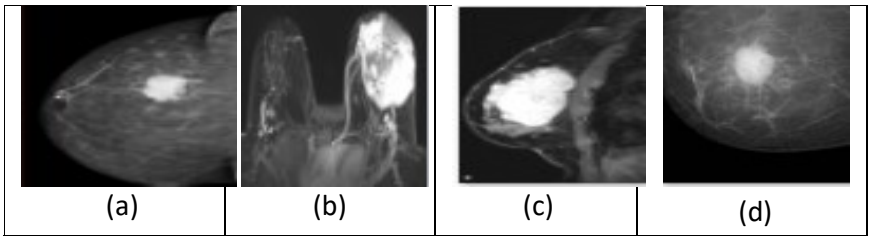


Fig1. Flow chart of Proposed scheme

VII. RESULT SIMULATION



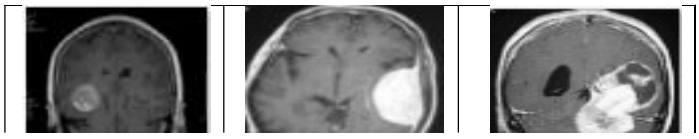


Fig 2. MRI Images used in the segmentation process

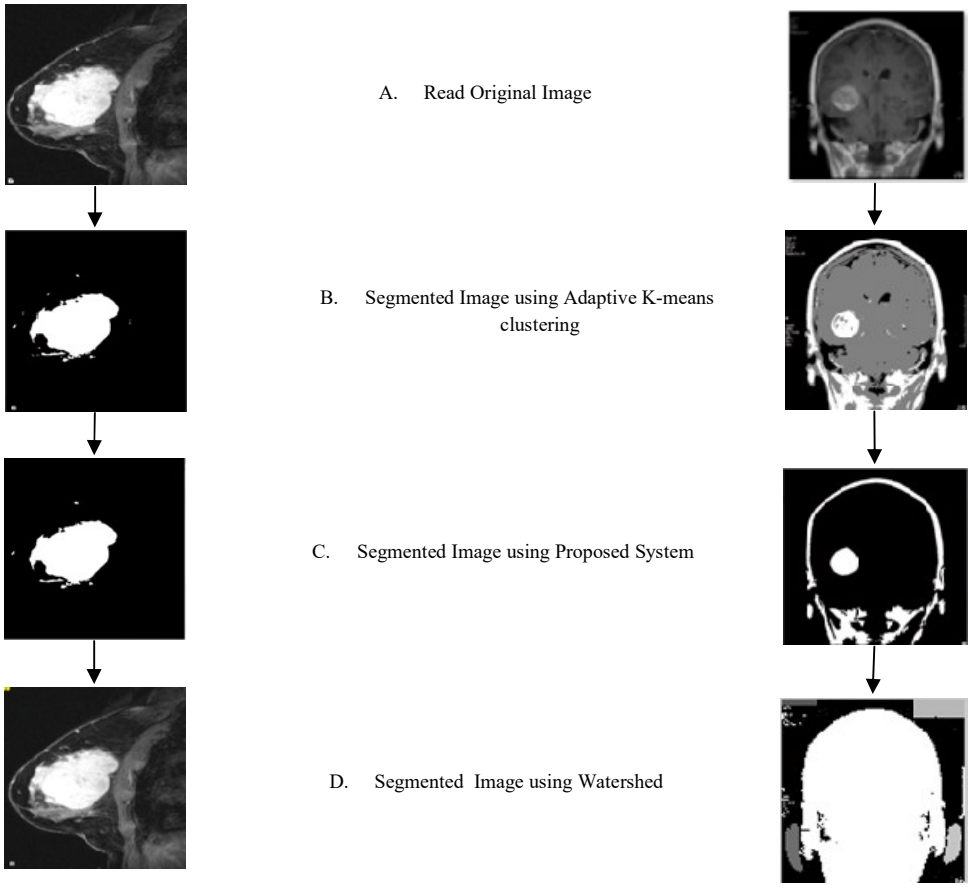


Fig.3 Step by step segmentation of MRI image

Image	Base System Result	Proposed System Result	Watershed System Result
(a)			
(b)			
(c)			

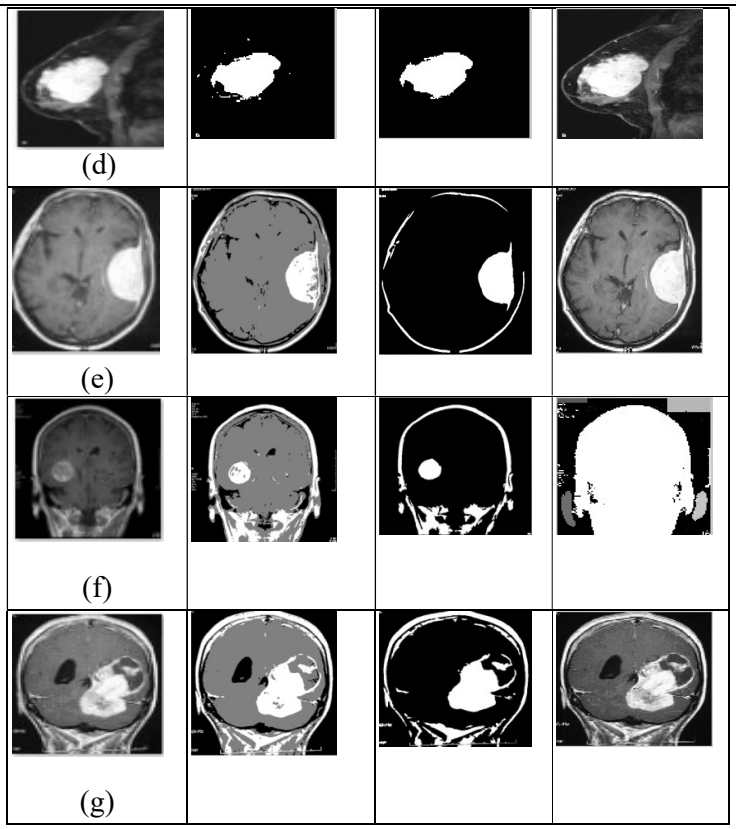


TABLE.1. SEGMENTED IMAGE USING BASE SYSTEM AND PROPOSED SYSTEM

Performance	Base System Result	Proposed System Result	Watershed System Result
PSNR	11.5524	29.7453	6.4903
STD	0.5629	0.1877	109.7082
ENT	0.2910	0.2263	0.9593
Mean	1.6878	0.0366	146.6509
Accuracy	52.413940	79.878616	35.142136

TABLE 2. EVALUATION MEASURE USING: BASE SYSTEM, PROPOSED SYSTEM AND WATERSHED SYSTEM ON IMAGE (A)

Performance	Base System Result	Proposed System Result	Watershed System Result
PSNR	8.0277	28.0293	Inf
STD	0.5403	0.2144	59.9042
ENT	0.3058	0.2792	0.5822

Mean	1.2403	0.0483	83.1567
Accuracy	68.740845	76.147079	0.118256

TABLE 3. EVALUATION MEASURE USING: BASE SYSTEM, PROPOSED SYSTEM AND WATERSHED SYSTEM ON IMAGE (B)

	Base System Result	Proposed System Result	Watershed System Result
PSNR	11.4564	29.7038	4.7557
STD	0.6773	0.3234	116.4261
ENT	0.5425	0.5256	0.9181
Mean	1.7015	0.1187	169.5360
Accuracy	53.176880	69.525909	41.156387

TABLE 4. EVALUATION MEASURE USING: BASE SYSTEM,PROPOSED SYSTEM AND PROPOSED SYSTEM ON IMAGE (F)

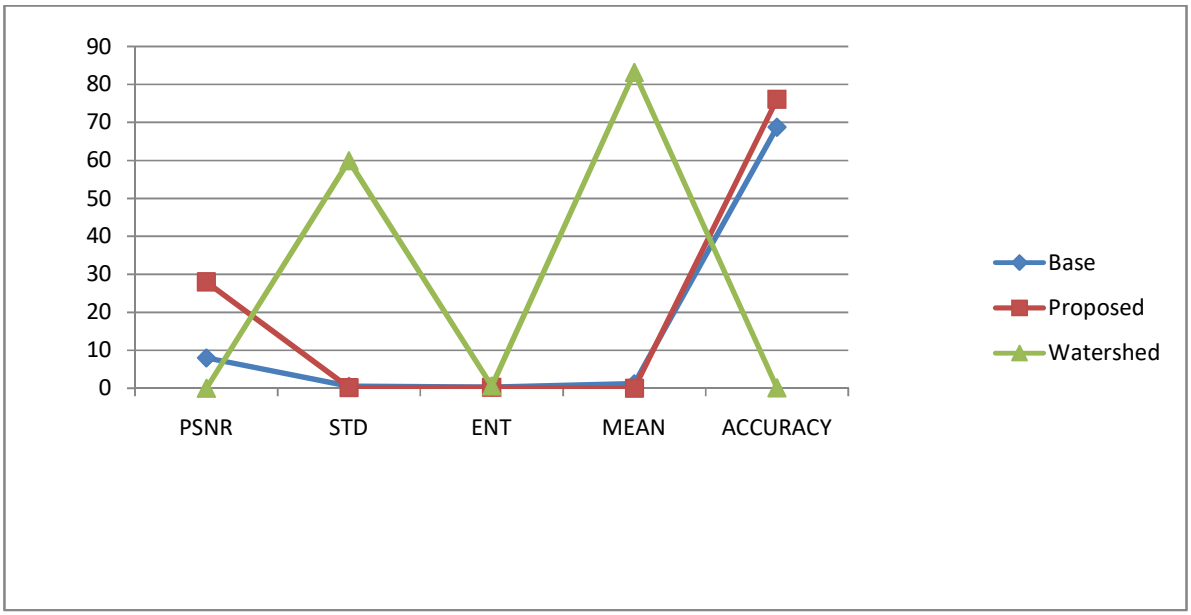


Fig. 3.Graph: Comparison of the parameters on Image (F)

VIII. CONCLUSION

We have implemented result based on PSNR, STD, ENT, Mean, Accuracy. This paper elaborates the whole technique in which an image is segmented using adaptive k-means algorithm along with Region of interest saliency map and comparison of the results with Watershed Segmentation algorithm. Watershed transform is the technique that is quite commonly used in Image Processing. In the segmented images it is clearly seen that, watershed technique developed over saturated images and hence reduce the overall clarity of the image. Image is developed by the anticipated method i.e. adaptive k means produces

more better images than that of watershed and traditional k-means and even the accuracy of the picture increases. Therefore it can be said that adaptive k-means along ROI saliency map has an edge over watershed segmentation. The proposed work is superior than the existing method.

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