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Riddler's Thresholding Algorithm for DNA Image Using ISODATA Modified Algorithm

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ABSTRACT

In areas such as compuer vision and image processing,image thresholding has been and still is a relevant research area due to its wide spread usage and application.This paper try to undertake on image thresholding techniques on human DNA. The DNA image is used to identify the genetic disorderness. The microeletronic scope captured the uncleared image and it is too difficult to understand. This work try to analysis the content of DNA image. Medical image processing techniques are apply on DNA image. Variuos preprocessing techniques are performed like median filter, wiener filter, contrast stretching and riddler's modified thresholding algorithm for thresholding the DNA image. In this paper proposed riddler thresholding modified algorithm to find the solution for median value using metrics. In future, the work done by this paper helps to do the segmentation on human DNA images

Keywords:- Image Thresholding, median filter, wiener filter, contrast stretching, Riddler's algorithm, Quality metrics, DNA image.

I. INTRODUCTION

In computer vision an image segmentation process is a partitioning of an image into those distinct regions. It is based on detect that an image is like line, region, edge. The segmentation is subdividing the objects because easy to be solved the problem. image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain visual characteristics. The result of image segmentation is a set of segments that collectively cover the entire image, or a set of contours extracted from the image.

Medical imaging is the technique and process of creating visual representations of the interior of a body for clinical analysis and medical intervention, as well as visual representation of the function of some organs or tissues (physiology). Medical imaging seeks to reveal internal structures hidden by the skin and bones, as well as to diagnose and treated as disease. In Riddler-clustering technique, image is segmented into two clusters as background and foreground using the initial threshold value. The Median filter is a nonlinear digital filtering technique, often used to remove noise. Contrast is the difference in luminance or colour that makes an object (or its representation in an image or display) distinguishable. Wiener filter The wiener filter is filter a used to produce an estimate of a desired or target random process by linear time-invariant filtering of an observed noisy process, assuming known stationary signal and noise spectra, and additive noise. The wiener filter minimizes the mean square error between the estimated random process and the desired process. we are using the wiener filter blurring method so the output image is filter the noise image. by using threshold on images the threshold is a gray scale image convert into the binary images. In this paper used an Optimal thresholding selects a threshold value that is statistically optimal and some quality metrics are compared that modified riddler's algorithm . This outline of this paper is as follows.

In this paper Section 2 contain the Image Segmentation under the subsection are Thresholding, Edge detection and Region based techniques are explained. Section 3 described the proposed work contain the Preprocessing methods are Median filter, Wiener filter, Contrast stretching, Riddler's calvard. Section 4 discussed the Result and Discussion. Section 5 described the conclusion section 6 described the future enhancement.

II. IMAGE SEGMENTATION

An image segmentation process is a partitioning of an image into those distinct regions. It is based on detect that an image is like line, region, edge. The

segmentation is subdividing the objects because easy to be solved the problem.

The partitioning of an image is based on pixel oriented. The pixel is called as picture element. All pixels must be assigned to region. Each pixel must belong to a single region only. Each region must be uniform. Any merged pair of adjacent regions must be non-uniform. Each region must be a connected set of pixels.

Segmentation is generally the first stage in any attempt to analyze or interpret an image automatically. Segmentation bridges the gap between

- Low-level image processing and
- High-level image processing.

Some kinds of segmentation technique will be found in any application involving the detection, recognition, and measurement of objects in images. The goal of image segmentation is the representation of an image into something that is more meaningful and easy to analysis. Some boundaries are used for example of lines, curves etc .Because locate to the object of an image.

The result of image segmentations is a set of segments that collectively cover the entire image or a set of counters extracted from the image .Each pixel based on such as colour, intensity or texture. The simplest method of image segmentation is thresholding method. This method is based on a clip-level (or a threshold value) to turn a gray-scale image into a binary image. It is called as balanced histogram thresholding[1].

A. Thresholding

Threshold is one of the widely methods used for image segmentation. It is useful in discriminating foreground from the background. By selecting an adequate threshold value T, the gray level image can be converted to binary image. The binary image should contain all of the essential information about the position and shape of the objects of interest (foreground)[3]. The advantage of obtaining first a binary image is that it reduces the complexity of the data and simplifies the process of recognition and classification. The most common way to convert a gray-level image to a binary image is to select a single threshold value (T). Then all the gray level values below this T will be classified as black (0), and those above T will be white (1). Image segmentation is a definition of splitting an image into a set of different regions. Thresholding is a special type of image segmentation. An arbitrary image is segmented into its background and foreground by choosing the optimum threshold value. If the gray-level or brightness of the pixel in an image is greater than the threshold value, then it is a foreground pixel or otherwise it is a background pixel as shown in equation

$$f(i, j)=\begin{cases} 0 \ for \ g(i,j) \leq T \\ 1 \ for \ g(i,j) > T \end{cases}$$

Where f(i, j) is the binarized image and (i, j) is the pixel coordinate[4]. In binary images, there are two groups or clusters, so thresholding methods rely on generating clusters the result of an image using Optimal thresholding selects a threshold value that is statistically optimal, based on the contents of the image Algorithm, due to Calvard and Riddler's.

B. Edge detection techniques

The edge representation of an image significantly reduces the quantity of data to be processed, yet it retains essential information regarding the shapes of objects in the scene. The major property of the edge detection technique is its ability to extract the exact edge line with good orientation as well as more literature about edge detection has been available in the past three decades [5].

C. Region based techniques

The region based segmentation is partitioning of an image into similar/homogenous areas of connected pixels through the application of homogeneity/similarity criteria among candidate sets of pixels. Each of the pixels in a region is similar with respect to some computed or characteristics property such as colour, intensity and/or texture [6].

III. DNA Image

Deoxyribonucleic acid, DNA, is the fundamental building block for an organism's genetic makeup. A DNA sequence is made up of four chemical bases, also referred to as nucleotides: Adenine (A), Guanine (G), Cytosine (C) and Thymine (T) located in the nucleus cell nucleus. Each living organism's genome is determined by the unique combinations of the four bases whose sequence encodes the information needed for building and maintaining a living organism [2].

III. Proposed work

A. Preprocessing

Median filter

The Median filter is a nonlinear digital filtering technique, often used to remove noise. Median filtering is very widely used in digital image processing because under certain conditions, it preserves edges whilst removing noise. The main idea of the median filter is to run through the signal entry by entry, replacing each entry with the median of neighbouring entries. Note that if the window has an odd number of entries, then the median is simple

to define: it is just the middle value after all the entries in the window are sorted numerically. For an even number of entries, there is more than one possible median. The median filter is a robust filter. Median filters are widely used as smoothers for image processing, as well as in signal process and time series processing.

An image containing salt-and-pepper noise will have dark pixels in bright regions and bright pixels in dark regions. This type of noise can be caused by dead pixels, Analog to digital converter errors, bit errors in transmission, etc. This can be eliminated in large part by using dark frame subtraction and by the interpolating around dark/bright pixels[7].

To demonstrate, using a window size of three with one entry immediately preceding and following each entry, a median filter will be applied to the following simple 1D signal: x = [2 80 6 3] So, the median filtered output signal y will be: y[1] = Median[2 2 80] = 2 y[2] = Median[2 80 6] = Median[2 6 80] = 6 y[3] = Median[80 6 3] = Media

n[3 6 80] = 6 y[4] = Median[6 3 3] = Median[3 3 6] = 3 i.e. y = [2 6 6 3].

Wiener filter

The wiener filter is filter a used to produce an estimate of a desired or target random process by linear time-invariant filtering of an observed noisy process, assuming known stationary signal and noise spectra, and additive noise. The wiener filter minimizes the mean square error between the estimated random process and the desired process. we are using the wiener filter blurring method so the output image is filter the noise image[8].

Contrast stretching

Contrast is the difference in luminance or colour that makes an object (or its representation in an image or display) distinguishable. In visual perception of the real world, contrast is determined by the colour and brightness of the object. The human visible system is more sensitive to contrast the absolute luminance, we can perceives the world similarly regardless of the large change in illumination over the day or from place to place. The maximum contrast of an image the contrast ratio or dynamic range[9].

B. Riddler's calvard Algorithm

In Riddler's-clustering technique, image is segmented into two clusters as background and foreground using the initial threshold value . One cluster C_1 corresponds to the pixels that are higher than the threshold value and C_2 corresponds to the pixels that are equal or less than the threshold value. Means of foreground and background clusters are showed as m_f and m_b , respectively, and they are defined

Mathematically as:

$$m_f(T_n)=\sum_{g=0}^{Tn} gp(g)$$

$$m_b(T_n)=\sum_{g=Tn+1}^{L-1} gp(g)$$

In these expressions, g is the gray level values that is defined as g={0,1,2,.....,L-1} and p(g) is the probability mass function (PMF) of the gray level g . PMF is calculated from the histogram of the image by normalizing it to the total number of samples . A new threshold value T_{n+1} is calculated by averaging the m_f and m_b as:

$$T_{n+1}=\frac{m_f(T_n)+m_b(T_n)}{2}$$

This operations are repeated until the difference $|T_n-T_{n+1}|$ is lower than specified value ε.

Riddler's Segmentation method was one of the first iterative schemes based on two-class Gaussian mixture models. At iteration, a new threshold is established using the average of the foreground and background class means and apply the modified ISODATA thresholding algorithm. This modified ISODATA thresholding algorithm are used to calculate the median of the values.

T. W. Ridler and E. S. Calvard presented a method of picture thresholding in . The principle of this method is to evaluate the unique threshold T for any image with a two-class histogram, by assuming the threshold to be[10]:

ISODATA thresholding algorithm

INPUT:image∈$R^{w.h}$

OUTPUT:image∈$R^{w.h}$

Procedure

1. **for** i=0 **to** w.h **do** (size of the image (mxn))

2.// Calculate the probability distribution of gray levels

P(**image**(i)+1)=p(**image**(i)+1)+1;

end

3. //Normalize the values

P=P/(f*c);

4. **for** i=1 **to** 256 **do**

5. //zero and first order accumulations

ω(i)= ω(i-1)+P(i);

μ(i)= μ(i-1)+(i-1)*P(i);

end

6. **Th_{old}**=μ_T=μ(256);

7. **while(Th_{new}!=Th_{old} and n<count)**

//Iterative algorithm are used

Th_{old}=Th_{new};

// Calculate the average of the threshold the image

Th_{new}=$\frac{\mu_{Th_{old}>image}+\mu_{Th_{old}<image}}{2}$;

n++;

end

8. **for** i=0 **to** w.h **do** //size of the image

//applying threshold

If(image(i)>Th)then

$image_{th}$(i)=0

else

$image_{th}$(i)=1

end

end

9. return{$image_{th}$}

IV. RESULT AND DISCUSSION

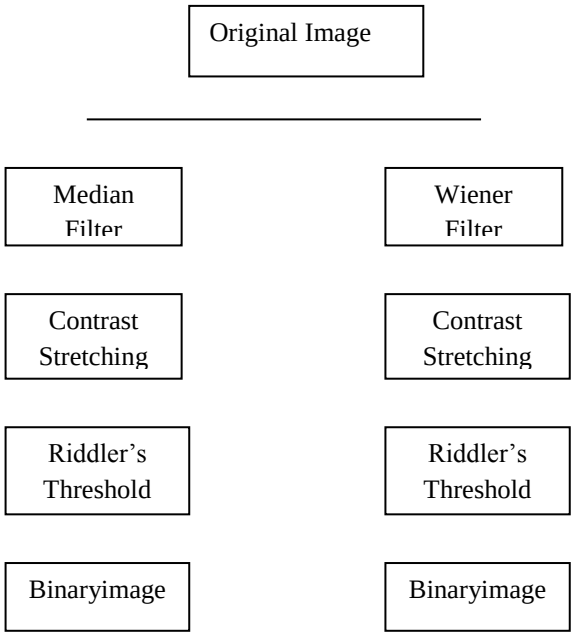

Figure2.Proposed work

The simulation using MATLAB tool to find the result. As shown in Figure 1, display the output of varies techniques applied to DNA image using MATLAB tool. Here the first columns contain set original DNA images, the second columns contain the DNA median filter image, the third column contains the median filter images apply on contrast stretching DNA image ,the fourth column contains the contrast image apply on riddler algorithm image. the fifth column contains the wiener filter DNA image. The sixth column contains the wiener filter result apply on contrast stretching. The seventh column contains the contrast stretching result apply to riddler's algorithm using thresholding.

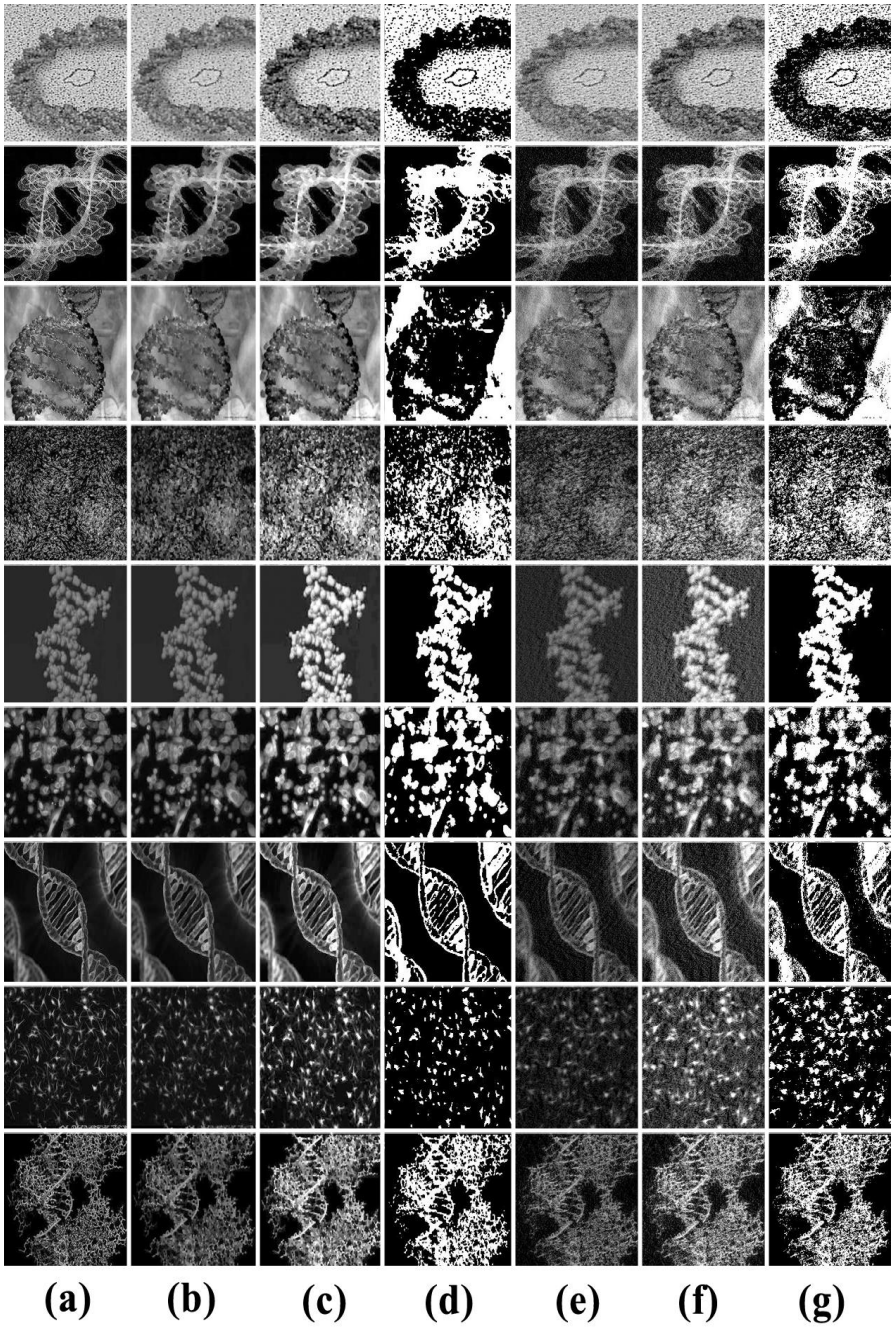

Figure 1: (a)original images on DNA(b)median filter (c)contrast stretching by median filter(d)riddler threshold median filter(e)wiener filter (f)contrast stretching by wiener filter(g)riddler threshold by wiener filter.

Performance Metrics for Simulation

Peak Signal to Noise Ratio (PSNR): It is the measure of quality of the image by comparing denoised image with original image. It is an expression used to depict the ratio of maximum possible power of image (signal) and the power of the corrupting noise that affects the quality of its representation.

Mean Square Error (MSE): It is the cumulative squared error between the final denoised image and the original image. This enables us to compare mathematically as to which method provides better results.

Mean Absolute Error (MAE): It is absolute error between the original image and the de-noised image. It represents the average value of introduced deviation per pixel with respect to original image.

Structural Similiarity Index Metric(SSIM): The structural similiarity(SSIM)index is a method for predicting the perceived quality of digital television and cinematic pictures,as well as other kinds of digital image and videos[11].

Table 1: Mean Absolute Error

IMAGES	MEDIAN RIDDLER'S	WIENER RIDDLER'S
Image1	0.5350	0.5328
Image2	0.8093	0.7768
Image3	0.5985	0.5625
Image4	0.5949	0.5879
Image5	0.8155	0.8384
Image6	0.6532	0.6970
Image7	0.7467	0.7877
Image8	0.8992	0.8755
Image9	0.6993	0.7371

Table 2: PSNR

IMAGES	MEDIAN RIDDLER'S	WIENER RIDDLER'S
Image1	5.1566	5.1969
Image2	2.7843	2.9767
Image3	3.9570	4.2851
Image4	5.6105	5.6767
Image5	1.8582	1.7403
Image6	3.6887	3.4133
Image7	2.7684	2.5450
Image8	2.1416	2.2859
Image9	4.0398	3.8081

Table 3: Mean Square Error

IMAGES	MEDIAN RIDDLER'S	WIENER RIDDLER'S
Image1	1.9834e+004	1.9651e+004
Image2	3.4249e+004	3.2765e+004
Image3	2.6144e+004	2.4242e+004
Image4	1.7866e+004	1.7596e+004
Image5	4.2390e+004	4.3556e+004
Image6	2.7811e+004	2.9631e+004
Image7	3.4375e+004	3.6189e+004
Image8	3.9712e+004	3.8414e+004
Image9	2.5651e+004	2.7057e+004

Table 4: SSIM

IMAGES	MEDIAN RIDDLER'S	WIENER RIDDLER'S
Image1	0.2889	0.3020
Image2	0.1589	0.2230
Image3	0.1621	0.1548
Image4	0.3428	0.3749
Image5	0.1847	0.1320
Image6	0.2145	0.1509
Image7	0.2555	0.1798
Image8	0.1036	0.1169
Image9	0.3510	0.3108

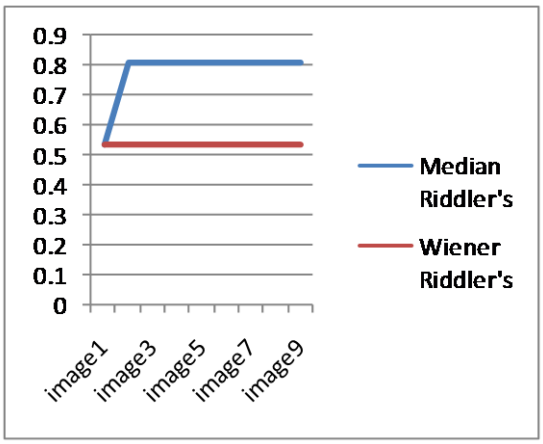

Figure3:comparison of mean absolute error results

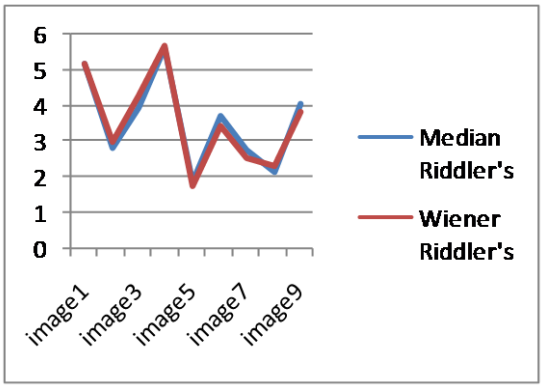

Figure4: comparison of Peak signal noise ratio results

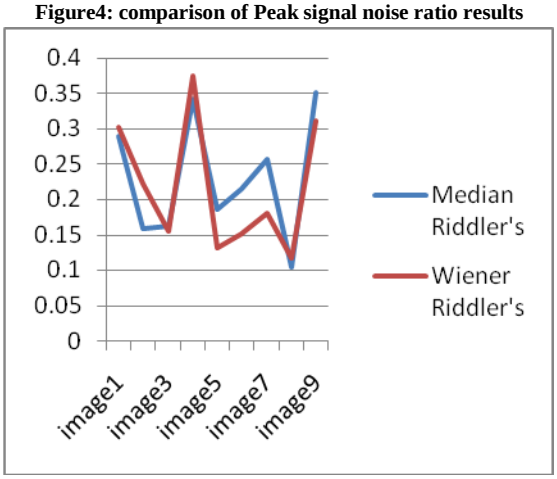

Figure5: comparison of SSIM results

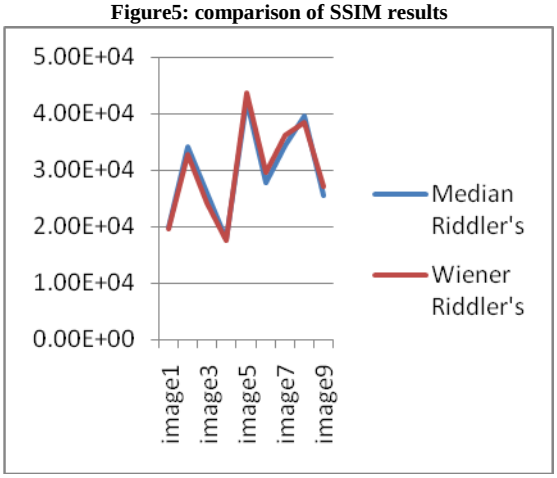

Figure6:comparison of mean square error results

IV. CONCLUSION

Here we discussed about an Image segmentation is often used to distinguish the foreground from the background. In this paper, the improved Riddler's thresholding algorithm has been proposed for medical image segmentation. This method performs better results than the other thresholding methods and produces suitable binary images,which can be further processing stages.the Riddler's thresholding algorithm is one of the very efficient methods to threshold gray images. However, its computation would become more complex. The experimental results show that the improved Riddler's thresholding method can be obtained easily with a better result of image thresholding. The focus of this paper is an attempt to study and perform Image Segmentation using Thresholding Techniques on DNA images with median filter as well as Salt and Pepper Noise, wiener filter, contrast stretching,Riddler's threshold modified algorithm using MATLAB version 7.10.0 (R2010a) software. Image quality measurement plays an important role in various image processing application. some metrics are used, so get the better result through show that the figures. Thresholding on an image and the results obtained in the experiment were studied thereby highlight the performance of this image segmentation technique.

VI. FUTURE ENHANCEMENT

In future this technique will be applied in medical images for diagnosis purpose and in DNA images for segmenting the objects.

- The propose a new filter for noise removal.
- To develop a new segmentation algorithm.
- To develop a common framework for an image segementation.
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