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A Review on Various Thresholding Technique for Image Segmentation

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ABSTRACT: Image thresholding is used to provide a representation of an image in a simplest form which requires less space. This representation is called segmented image and the process is image segmentation.This paper presents an extensive review of thresholding techniques for image segmentation. It reviews variety of thresholding techniques which includes local, global and dynamic thresholding techniques.This paper includes the drawbacks and advantages of various threshold computing methods, color image threshold and optimized multi-level thresholding. The study concludes that the adaptive threshold technique is best among various threshold techniques. However it is also incapable of detecting weak edges.

Keywords: image Segmentation, Thresholding, Global Thresholding, Local thresholding, Multi-level thresholding, optimized multi-level thresholding, Adaptive thresholding

I. INTRODUCTION

To understand an image, it has to be divided into different parts called objects which can be easily identified and depicts some meaningful information. This division process is called image segmentation and thresholding is one of the popular techniques for image segmentation. Image thresholding works on the principle of pixel classification. It divides an image into segments depending upon the pixel attributes. This techniques applies on each pixel and by comparing it to a specific threshold value decides whether the picture belongs to an object or background. For gray images, the segmentation is carry out on the basis of image gray levels where the brighter part of an image is object and darker is background. The objects and background of gray level images can be easily identified, but the process becomes more complicated for color or textured images. So, for color and textured images requires much more attention and processing to get segmented[1].The thresholding is also affected by the noise and artefacts present in image. Usually some preprocessing steps are applied to reduce the noise and artefacts effects.

Thresholding is mainly classified into three local, global and dynamic categories depending upon the functional dependencies of the threshold operator T. When T depends only on the gray value of pixel, it will be global. When T depends upon the gray value as well as the local property of pixel, then the threshold value is called local threshold. Whereas, if threshold value depends on pixel grey value, local property and on its position also, then the threshold is called dynamic threshold[2]. Weszka (1978) presented a survey on threshold techniques which concluded that many different threshold approaches are possible and the more sophisticated threshold selection methods can be developed[2].

II. LITERATURE REVIEW

2.1 Global Threshold technique

Earlier, only few types of segmentation techniques were known and most commonly used were preprocessing and thresholding or combination of both [3].The global threshold selection has been aid with the use of local properties of image. Values of local property can be used to improve the histogram as well as to directly compute the global threshold. Thus, global threshold selection techniques based on local propertiesare divided into two categories: histogram improvement methods and methods that computes threshold. The histogram improvement methods tried to improve the histograms of the images so that the threshold selection process could make easy whereas the threshold computing methods tried to include a local property of image to compute the optimal threshold value.

a. Histogram improvement an Threshold Computation

Doyle(1962) proposed a “p-tile” global threshold technique for segmenting images having dark objects and light background [4]. The threshold value of the proposed method depending upon the area of object and not suitable for the images having unknown object areas. To overcome this drawback a histogram based threshold selection technique was proposed. Prewitt and Mendelson called it mode method [5]. This method involves smoothing of histogram, finding modes and then select the threshold at the minima between the modes. This method is suitable for gray level images but does not work well where the object and background are not clearly separated by a deep valley.Weszka t al. (1974) overcomes the problems of locating valleys in images having multiple peaks of unequal sizes. They described a method which selects a threshold value from a histogram of only those points which take on high values under a digital Laplacian operation [6]. Mason et al. (1975) described a method which computed weighted histogram that makes valleys deeper and peaks sharper and higher. This method facilitates the use of mode method to select the threshold value easily [7]. The global threshold value totally depends upon the histogram of the image. Hence, many methods are introduced to improve the histograms, so that the threshold value can be computed easily and efficiently. Some of the methods were reviewed by Weszka and Rosenfeld(1977) [8]. Ahuja and Rosenfeld (1978) used concurrences matrices alternative to histogram modification for threshold selection. In this method elements near the diagonal corresponds to pairs of neighboring elements which have almost similar grey levels and such elements are likely to be interior of the objects.. Thus histogram of these elements have deep valleys which makes threshold selection easy [9].Wu et al. (1982) demonstrated a quad-tree method to improve the histogram of grey images. This method yields histograms having sharper peaks and deep valleys which makes the threshold selection easy [10] . Rosenfeld and Torre (1983) depicted that the histogram's concavity structure make threshold selection for the images having unclear peaks and valleys in histogram. Concavity structure can be extracted using convex hull. This method gives good results but sensitive to noise[11].

Sakai, Nagao and Fujibayashi (1969) defined threshold values for images having multiple peaks, multiple thresholds are described for a single image depending on the properties of the different image areas. This threshold is called global threshold based on local property. Thus a good face detection method is developed but, it need some improvements in threshold selection, search methods etc [12]. Otsu (1979) found that till that time no threshold evaluating method has been proposed so that the optimal threshold value can be selected. So, an automatic optimal threshold selection method was proposed based on the global property of histogram. It maximizes separability of zeroth and first order cumulative moments of histogram[13]. Pun (1980) defined a new global function based on entropy of the histogram for threshold selection. This method automatically selects the threshold from histogram disrespect to the picture that is it does not depend upon the small variations in picture. The selected threshold performs a priori maximization of the posteriori known entropy of the resulting picture [14]. Pun (1981) used the derivation of entropic threshold and defined a new threshold selection method for images having irregular and various kinds of histograms. This method extracts the anisotropy coefficients from grey level histogram and then selects the threshold value [15]. Rosenfeld and Smith (1981) proposed a thresholding method using relaxation. Relaxation was first introduced by R. Southwell [16]. This method works for images having noise or unclear boundaries. In it the pixels are classified into dark and light categories based on the grey levels, then the values are adjusted the probabilities of each pixel based on the neighbour's pixel value. This process iterates so that the light pixels have high light probability value whereas dark has high dark probability values. Thus the threshold selection becomes easy [17]. Kohler (1981) proposed a multiple threshold method for image segmentation. It divided the method into two parts: first part selects the threshold value and the second part applies the relaxation on each selected threshold. The algorithm selects threshold so as to maximize the global average contrast of the edges detected by the initial threshold based on local edge information across the image. Then the relaxation process utilized both local edge information and similarity information to modify the segmented results. The proposed method gives very good results but it considers only single feature to segment the image [18].Deravi and Pal (1983) suggested two interaction measures to compute the threshold based on similar second order grey level statistics. This method works well even for images not having valleys in their histograms [19].This method has large space complexity.Wang and Haralick (1984) presented an automatic multi threshold technique for image segmentation. This recursive method was based on the local property to compute the threhold. The results are quite reasonable for different images [20]. Reddi et al. (1984) used the Otsu's method [13] and presented a fast search scheme for finding single and multiple

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threshold value. A continuous probability function was introduced to calculate maximum interclass variance for threshold selection. The proposed method gives better results than Otsu' method [21]. Kapur (1985) found that there are some drawbacks in the algorithms suggested by Pun. It stated that there is some algebraic mistake in[14] and second algorithm[15] does not give always satisfactory results. So, to overcome these shortcomings a new entropy based algorithm is introduced. This algorithm derived two probability distributions from original grey level distribution of the image. The total entropy of the image is then maximized togive threshold value and good segmentation results [22]. The definition of entropy does not include the spatial information. So, the images with similar histograms results in same entropic value and same threshold, which is not acceptable.Tsai (1985) proposed a threshold selection method based on the moment preserving principle. Threshold values are computed deterministically in such a way that the moments of an input picture is preserved in the output picture. This can recovers an ideal image from a blurred image. This method can automatically and deterministically select multiple thresholds without iteration or search [23]. Kitler et al. (1985) presented a threshold selection method based on the statistics of the image. This method uses sum of different statistics of image for threshold selection instead of analysis of histogram of image. This method is robust to noise and gives satisfactory results[24]. Kittler et al. (1986) proposed an efficient solution to the problem of minimum error threshold. Image is represented in the form of histogram which, can be viewed as an estimate of the probability density function of mixture population consists grey levels of object and background pixels. Hence, they introduced an iterative search of minimum error threshold and a minimizing criterion function to select the optimal or minimum threshold [25]. Ye and Danielsson (1988) studied [25] and found that minimizing a criterion function method is a robust whereas the iterative search of minimum error threshold method is faster but depend upon the initial value. So, to improve the second method they used the initial threshold selection method introduced by Ridler [26]. The proposed method gives good result as the minimizing criterion function as well as speed also increased [27]. Cho et al. improved the Kittler and Illingworth's minimum error thresholding method [25] by correcting the biased estimates of variance of model distributions. This improvement generates the bimodal histograms which ultimately leads to good threshold selection. The proposed method was more robust as well as computationally expensive [28]. Pal and Pal (1989) introduced two new definitions of entropy called entropy of order and the conditional entropy. Two algorithms are proposed, one consists of entropy of order and probability of co-occurrence of pixel intensities which takes into consideration spatial information of image whereas another algorithm based on conditional entropy. The proposed algorithms good results but the study does not include the effect of noise [29]. Wong and Sahoo (1989) presented a threshold selection algorithm based on the maximum entropy principle. This method uses both spatial as well as grey level information of an image. It does not require prior information about the image. The optimal threshold value is determined by maximizing a posterior entropy according to some features of image. This method provides good results but cannot applied to color images [30].Snyder et al. (1990) proposed a new method for the selection of optimal threshold. The method used the tree annealing method to find the minimum error threshold. This method is suitable for multimodal images. Although it require more space but avoids local minima as well as easy to use [31]. Brink (1992) proposed a new method, which is refinement of [32] that extends the [22]. Abutaleb (1989) extends the one dimensional entropy concept of Kapur et al.(1985) into 2-dimensional concept. Then Brink refines this concept by maximizing the smaller two entropies instead of maximizing the sum of the two entropies of the object class and background class. The proposed method gives good results but fails when there is uneven illumination [33]. Li and Lee (1993) proposed a minimum cross entropy method for segmenting an image. This method selects the threshold which minimizes the cross entropy between the threshold image and original image. For the image having no prior information, the minimum cross entropy method gives the most unbiased results [34]. Chen et al. (1994) proposed a fast 2-d entropic method for threshold selection. The computation complexity can be reduced to O(L8/3) for an image with L gray levels [35]. Then, Gong et al. (1998) proposed a recursive algorithm for 2D entropic thresholding to reduce the computation complexity from O (L4) to O (L2). However, it is still inefficient to apply this algorithm to 1D multilevel thresholding selection, due to their computation of threshold without taking advantage of the recursive structure of entropy measures [36]. Yen et al. (1995) found that the earlier multi-thresholding approaches suffer from two disadvantages: the classification number of grey value are difficult to classify and large computational time is required to select threshold.

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To overcome these problems, a new maximum correlation criterion is defined and a cost function is calculated. By minimizing the cost function the classification number can be classified and the threshold value can be determined automatically[37].Cheriet et al. (1998) presented recursive approach an extension of Otsu's method to segment only the document images. This is a recursive approach that segments the lowest intensity object at each iteration leaving the darkest object in digitized image. Results of the images depicts that the proposed method is very effective and efficient [38]. Xue et al. (1999) proposed a minimum error threshold for SAR images based on Rayleigh distribution. They studied Gaussian distribution with equal deviation, Gaussian distribution with distinct distribution and Poisson distribution and found that these have some weaknesses. The Gaussian distribution dispersed from negative to positive co-ordinates, which does not satisfy real situation whereas Poisson distribution has equal mean and deviation, which does not fit the image property. This method uses mixed model of Rayleigh shifted distribution to increase the precision of approximation. This method is not suitable for non-SAR images. But when compared to Otsu and other minimum error threshold methods it gives comparatively good results for SAR images[39]. Liao et al. (2001) proposed a fast and efficient algorithm along with look up table for 1-d image thresholding which is improvement over Otsu's method.

The proposed method requires less computational time and provides good segmentation results [40]. Sahoo and Arora (2004) proposed a two-dimensional threshold selection method based on Renyi's entropy of order and uses two-dimensional histogram to choose an optimal threshold value. This method of thresholding comprises global thresholding method of [37] and the two-dimensional version of the entropic correlation method introduced in [32]. Experimental results shows that proposed method gives good results but suffers from high computational cost [41]. Arifin and Asano (2006) presented a new gray level thresholding algorithm based on the cluster similarity measurement to control the selection of the threshold value. The similarity measure uses two criteria which produces two clusters, then these clusters are used to calculate optimum threshold. The proposed method is efficient and can be extended for multi-thresholding [42]. Xie et al. (2008) presented an undistorted fast recursion method and a distorted optimal search strategy for low signal to noise ratio images. The search strategy uses entropy function proposed in [43], it calculates 2-D maximum entropy threshold by using subtraction which utilizes less computational time. The search strategy is distorted therefore; the method gives good results only if the pixels of a region are homogeneous [44]. Sheeba and manikandan (2014) performed a comparative study between four grey image thresholding methods namely, Between class variance (Otsu's), Total class variance (Hou's), Posterior maximum entropy (kapur's) and Minimum error Thresholding are performed for image segmentation and found that Posterior maximum entropy method gives better result than the other methods [45].

2.2 Optimized Multi-level thresholding Techniques

Zahara et al. (2005) and Fan and Lin (2007) reported that Otsu and Gaussian distribution method is good for bi-level thresholding but computationally expensive for multi-thresholding. So, an optimization method should be introduced that can reduce its computational cost. In 2005 a hybrid NM-PSO-Otsu method is proposed that uses Nelder-Mead simplex search for local search and Particle Swarm Optimization for global search. The method is found effective and efficient when compared to Otsu method [46]. Again in 2007, a hybrid multi-level thresholding method proposed, that uses PSO-EM methods. In this method, Particle Swarm Optimization carries out global search and expectation maximization updates the best particle, which leads the remaining particles to seek optimal solution in search space [47]. Both methods [46] and [47]successfully avoid the local minima and easily minimize the objective function Gaussian curve fitting for multi-level thresholding. Although it is found that PSO-EM converges much faster than NM-PSO and PSO-EM is better. However, it is found that the PSO-EM method does not give quality results when applied to RAM image. Huang et al. (2005) proposed a new method of thresholding based on the pyramid data structure manipulation and the adaptively selected window size according to Lorentz information measure. The proposed method effectively and efficiently segment the images having uneven light distribution but not applicable for multithresholding [48].Zhang and Liu (2006) reported a new method for underwater image segmentation. This method overcome the complex computation problem of maximum entropy method. For this, an optimization method PSO is used. The threshold values are obtained using Particle Swarm Optimization method where fitness function is maximum entropy method. The threshold values are obtained effectively with high efficiency [49]. Yin (2007) found that the minimum cross entropy thresholding is time consuming for complex images i.e. multilevel threshold. So, to efficiently find out the multilevel threshold for a complex image, a recursive method to reduce the order of magnitude of minimum cross entropy method is proposed. To optimize the results the PSO is used. Whereas Zhao et al. (2007) found that PSO method stuck in sub optimal threshold and used quantum PSO to optimize the results. Experiment shows that the proposed QPSO method overcome the PSO shortcomings and suitable for real world images [50][51]. Ye et al. (2008) proposed a threshold selection method based on an optimization principle called Particle swarm Optimization (PSO). This method calculates the fitness of each particle or pixel and determines the local and global best positions. Then positions are updated and process continues until an optimal solution is achieved or maximum number of iterations are executed. The proposed algorithm successfully find the optimal solution. However, this method has a drawback that it requires the prior knowledge of number of thresholds [52]. Hammouche et al. (2008) proposed a multilevel thresholding method that not only calculate the threshold value but also determine the appropriate number of thresholds. This method uses genetic algorithm with wavelet transform.. Experiments shows the efficiency of proposed method [53].Huang (2009) proposed a new fast two-stage algorithm to improve the efficiency of Otsu's method. The runtime of proposed method is less than the Otsu's method but efficiency is equal [54]. Horng (2010) found that the maximum entropy thresholding method is most widely used for multilevel threshold selection, but having high computational cost. To optimize this a new multilevel threshold selection method based on Honey Bee mating is proposed. When compared to other methods it is found that the results are good and computational cost is relatively low [55]. Then, Horng (2011) proposed another maximum entropy thresholding algorithm that uses Artificial Bee Colony algorithm that simulates the behavior of honey bees foraging. It works efficiently than his previous method [56]. Al-Amri et al. (2010) presented a comparative study of various thresholding techniques such as Mean method, P-tile method, Histogram Dependent Technique (HDT), Edge Maximization Technique (EMT) and visual Technique. Experimental study done on all these techniques and the results show that the histogram dependent technique and edge maximization technique gives best results [57]. Abdulaah et al. (2012) proposed an image segmentation algorithm that produces good quality segmentation results of natural images. This method uses the Otsu method with inverse technique that efficiently segment natural images. When compared to conventional Otsu method and K-means clustering, the proposed method gives amazing results [58]. Zhiwei et al. (2012) gave a novel approach to segment images using 2-d thresholding and artificial fish swarm algorithm. This approach uses spatial information to segment an image. It segments the image with the best position of artificial fishes swarm. The results shows that the proposed method efficiently calculate the optimal threshold value [59]. Cai et al. (2014) proposed a new iterative triclass thresholding technique based on the Otsu's method. This method classify the image into three classes instead of two by using Otsu's thresholding method. The two classes are true background and foreground and third is to-be determined (TBD) class. Then repeatedly Otsu method is applied on TBD class until each pixel belongs to two classes i.e. pixel either in background or foreground class. Thus, a high quality segmented image is achieved. The results shows that this is effective and efficient segmentation method [60]. Bdioui et al. (2014) proposed an entropy based thresholding method for color image segmentation. The method uses discriminator color criterion to find out the suitable color space and then entropy based threshold based technique is applied. The results shows that the proposed method gives better results when compared to K-means [61]. Dhieb et al. (2014) proposed a global 2-d maximum entropy based image segmentation algorithm. The conventional entropy method trapped in local maximum entropy that is overcome by this method by using Particle Swarm Optimization method. This optimization method increase the efficiency of proposed method [62]. Sandeli and Batouche (2014) presented a new method for image segmentation by multilevel thresholding based on generalized island model (GIM). This GIM model constitute of three metaheuristics called Particle Swarm Optimization (PSO), Genetic Algorithm (GA) and Artificial Bee Colony (ABC). It helps the method to not stuck in local minima. The proposed method outperforms other methods and give effective results [63].Devi et al. (2015) gave an iterative thresholding based on 2D improved Otsu method using a novel threshold value recognition function which is used to find the optimum threshold value in different types of histograms and separate it into two classes. For the two classes separated by the above threshold value, mean values are computed. Based on the threshold value and the two mean values, the histogram of an image is divided iteratively into three regions, namely, the Foreground (FG) region, Background (BG) region and To-Be-Processed (TBP) region. Again for that TBP region, the process is repeated iteratively until the stable values are not found. Finally, all the previously determined foreground regions are combined separately and the background regions are combined separately to give the segmented image. The experimental results show that the proposed method performs well in detecting the objects and has better anti-noise performance compared with the existing methods [64]. Tuba et al. (2015) found that the multilevel thresholding includes an exhaustive search for optimal threshold selection. The number of possible values for threshold grows exponentially and it prevents the exhaustive search. To solve this problem a swarm intelligence technique called firework algorithm is adopted for multilevel image thresholding. It uses Kapur's entropy function as its objective function. On comparing with other swarm optimization methods, it is found that proposed method gives better results [65]. Sharma et al. (2016) stated that the fireworks algorithm used to maximize two functions called Otsu and Kapur. In this paper fireworks algorithm is used for multilevel thresholding and Otsu criterion is used as fitness function. Experimental results shows that the proposed method outperforms the method proposed in [65]. The segmentation quality of proposed method is very good [66]. Banerjee et al. (2016) proposed a region based triple thresholding method for image segmentation. It segments grey images using three threshold values; one global and two local threshold. Based on these threshold values image is divided into four regions having different intensity values. The proposed method segments images efficiently and detects all the regions in an image [67]. Win and Chomchuay (2017) proposed a method to segment cell nuclei in pleural fluid. In this method, the image is preprocessed using median filter and then the enhanced image is converted to l*a*b color space. The cell nuclei is segmented using Otsu method and morphological operations are applied to remove noise and to reconstruct into color-segmented image. the proposed method gives very good results [68].

The study of thresholding methods for image segmentation found that there are variety of thresholding selection methods present in literature. The most commonly thresholding is divided into two categories local and global thresholds. The thresholding is very simple and effective method for image segmentation. The entropy based and Otsu method are popular methods for threshold selection. The Otsu method is simple and work with a global threshold values due to its low sensitivity to dark areas. Otsu method does not require prior knowledge on the shape of the histogram. Entropy based methods are also very good in segmentation of grey images. However, both does not work well for complex images hence some optimization techniques are used with these methods to achieve effective results.Threshold based segmentation methods can effectively separate objects from the background. The conventional Otsu's method can achieve good result only when the histogram of an image has two distinct peaks.

2.3 Color image thresholding

The thresholding is among the most popular techniques for segmenting grey level images. The peaks and valleys of grey images are easily identified and objects and background are separated efficiently. In the case of colored images, the images are more complex and one has to identify different parts of the scene by considering different histograms of different colors. The noise in image leads to unequal histogram peaks and valleys which makes the segmentation difficult. To overcome this difficulty some smoothing methods are adopted.

Celenk and Haag (1998) introduced athresholding method for color images. Conventionally, thresholding operates on the single color component where the values of other two components are ignored. So, to improve the performance of thresholding, instead of one here three RGB components are considered independently. Thebest thresholds are selected by optimizing the within-group variance or directed divergence measure for Red, Green and Blue distributions separately. Then the three results are combined with a predicate logic function to get optimal threshold value [69].

2.4 Local threshold Technique

Global threshold works well only for images having a histogram in which two modes are separated by a deep valley. A fixed threshold cannot give appropriate results for images having uneven background and poor illumination or having multiple objects and complex boundaries. To handle this kind of images, there is a need of threshold value that varies over different image regions. Hence, local threshold technique is introduced, which includes some local properties of pixels along with their grey values.

Bartz(1969) introduced a local threshold technique for OCR system. An OCR system deals

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with a range of print quality distortions over a single document. So, the local threshold technique is assigned to adapt with different types of print quality distortions. They combine the four threshold operators to select threshold value that can be applied locally [70]. Wolfe (1969) applied two threshold operator on analog grey levels of neighborhood pixels to detect the variations in a single character [71]. Panda (1977) suggested a method which applies threshold depends on both the edge value and grey value of a pixel [72]. Panda (1978) determined two threshold values one for low gradient pixels and another for high gradient [73]. Kirby and Rosenfled (1979) presented a threshold selection method based on grey value as well as local average value. This method is an alternative approach to [8, 9] that uses local average value and produce better results [74]. Sahoo, Wilkins and Yeager (1997) introduced a new entropic thresholding method based on Renyi's Entropy principle. It uses two probability distributions of original image and involves the maximum entropy sum method and the entropic correlation method. This method incorporates information from the grey level histogram as well as local information embedded in weights. So, it gives better results than maximum entropy and entropic correlation method[75]. Sahoo and Arora (2004) enhanced this method as 2-dimensional entropy [41].

Kim and Lee (2015) proposed an improved adaptive thresholding 3D segmentation algorithm, which can perform medical volume segmentation very effectively. The improved adaptive thresholding segmentation algorithm checks bimodality of every region and by applying the Otsu adaptive threshold value only at the region of bimodal histogram distribution, to make the segmentation process very stable and yield a good result [76]. Kim et al. (2016) proposed a sensitive two stage adaptive thresholding method for medical image segmentation. At first stage the conventional adaptive thresholding done, that results marked object voxels. Then at second stage, carry out thresholding method one more time from the results of previous results. By this method, weak objects can be detected without the influence of nearby strong objects. By doing this, can get more detail object which cannot be detected by conventional one [77].

2.5 Dynamic Threshold Technique

The global and local threshold techniques do not work well for the images having multiple and unequal grey values distribution.Chow and Kaneko(1971) suggested a dynamic threshold selection method that used the interpolation technique at each point to remove false edges and give accurate edge detection results [78]. Chow and Kaneko(1972) found that for low quality images global threshold did not separate objects from the background. So, the threshold should be selected dynamically according to the local characteristics and consequently may vary from point to point. The dynamic threshold based on the statistical distribution of intensity over pixels [79]. This method is totally depends upon the histogram of image and it is difficult to obtain bimodality in histograms. Yanowitz and Bruckstein (1989) proposed a new segmentation method that uses the gradient of object boundaries as well as the location and grey values to select a threshold. Then these values are interpolated to get a noise free results. The proposed method gives very good results [80][81].

III. CONCLUSIONS

The global threshold selection method involves the interpretation of histogram of image.The image is represented as grey level density histogram. The minimum or valleyof histogram of image is considered as threshold value, which is not always as straightforward and simple. Because histogram gives only the first order statistical information not semantic information as well as it is difficult to select the criteria for threshold selection when histogram is not clearly bimodal.

The segmented image obtained from thresholding has the advantages of smaller storage space, fast processing speed and ease in manipulation, compared with gray level image which usually contains 256 levels. Therefore, thresholding techniques have drawn a lot of attention during the past 20 years.Adaptive thresholding segmentation is very efficient and simple segmentation method. However, it cannot detect weak objects near the strong objects.Finally, the lack of objective measures to assess the performance of various thresholding algorithms, and the difficulty of extensive testing in a task-oriented environment, have been other major handicaps.

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