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Binarization of Black/Green Board Data Captured by Mobile

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Abstract: This paper deals with the binarization of mobile captured images from the black/green board images in which text is segment from the degraded images of the black/green board and get the 92.589% accuracy. In proposed technique first apply the enhancement technique to eliminate the distortion in background of given image. After enhancement image is segmented in 3x3 parts and computed locally threshold value. Binarization is the active area of research in academic because it is the important phase of the pre-processing in the field of pattern recognition and the rate of recognition is highly dependent on the accuracy of binarization.

Keywords: Binarization, thresholding, Precision

I. INTRODUCTION

Binarization is the process of converting grey scale image to purely a black and white image which is known as digitized image. This field is mainly applied in the field of segmentation, biometrics pattern recognition and so on. In segmentation field the objects are located on the image are segmented from the image [1]. This segmentation concept is used for binarization of mobile captured images. The big challenge is to binarize the images under luminous intensity variation. To binarize these mobile captured images global thresholding method is not used because they binarize the one part more dark and lost the information. So resolve this binarization we briefly study the binarization techniques and literature survey.

This paper is structured as follow: section two describes literature survey of various papers in the field of binarization, Section three describes the various binarization techniques, Section fourth describe the database, Section Fifth describe the proposed method and section Sixth describes the various results.

II. LITERATURE SURVEY

This section deals with the various works done by various authors in the field of binarization. Some piece of work is reviewed and analysed by me that is described as under:

Anoop Mukhar[2] Develop the two novel algorithms for the thresholding. In his method the image histogram is used for computation of thresholding value. The optimal value of threshold is determined on the bases of average mean value. **M.valizadeh, M.komeili[3]** Proposed algorithm involves two stages. In the first stage extract the some part of the character and estimate the grey level foreground and background pixels. In the second stage, apply the binarization method based on the estimation. **Bolan Su, Shijian Lu [4]** proposed a self-training learning algorithm for document image binarization. Based on reported binarization methods, the proposed framework first divides document image pixels into three categories, namely, foreground pixels, background pixels and uncertain pixels. A classifier is then trained by learning from the document image pixels in the foreground and background categories. Finally, the uncertain pixels are classified using the learned pixel classifier. **Yi Wang Bin Fang [5]** proposed the adaptive binarization for the character segmentation of the license plate. In their proposed method first they image pass through the no of filters like average filter, Gaussian filter and median filter to eliminate the light intensity effect. At last covert the grey scale image into binary image by the local threshold value obtained from the convolved image. **ChiMa [6]** describes the multi-threshold dynamic binarization algorithm for bill images. The algorithm can be used those bill images where intensity variation is too much. The algorithm is suitable for scanning small and large scales of text images or others. The experiment result shows that the improved algorithm has a good anti-noise capability. However, although the algorithm can much reduce the interference of noise, the noise pixels cannot be completely eliminated. Therefore, the algorithm still needs to be further improved.

III. BINARIZATON TECHNIQUES

From the literature survey we find that Binarization is the technique to digitize the image. The Binarization Method converts the grey scale image (0 up to 256 gray levels) in to black and white image (0 or 1). In every binarization method a particular threshold value is calculated by an algorithm and that threshold value is used to convert the grey scale image into binary image.

$$g(x, y) = \begin{cases} 1 & \text{if } f(x, y) \geq T \\ 0 & \text{otherwise} \end{cases}$$

In this equation $g(x,y)$ is transformed image, $f(x,y)$ is a transformation function and T is a threshold value. To more understand the binarization see the block diagram fig no 2[7].

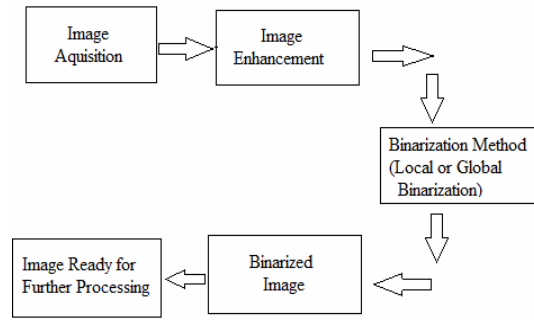


Fig. 1: Block Diagram of Binarization

For the binarization the several method are used which can classify into categories local thresholding method and global thresholding method. The global thresholding method consider the whole image to compute the thresholding value and local thresholding method divide the image into several regions and compute the threshold value for each region. The global thresholding method are Otsu, Kilter and Illingworth Method, Yanni and Horne Method etc and the local thresholding method are Niblack, Sauvola, adaptive and Bernsen etc.

A. Otsu Method In image processing, **Otsu's** thresholding method is used for automatic binarization level decision, based on the shape of the histogram. Otsu's thresholding method involves iterating through all the possible threshold values and calculating a measure of spread for the pixel levels each side of the threshold, i.e. the pixels that either falls in foreground or background. The aim is to find the threshold value where the sum of foreground and background spreads is at its minimum [8].

B. Kilter and Illingworth Method The kilter method [5] is used mixture of Gaussian distribution to find threshold value. In kilter Method the t is threshold that is used to segment the image into two parts background and foreground, both of the parts modelled by Gaussian distribution, $p_B(t)$ and $p_F(t)$, the $p_{mix}(t)$ mixture of these two Gaussian distribution.

$$p_{mix}(t) = \alpha p_B(t) + (1 - \alpha) p_F(t)$$

Where α is determined by the portions of background and foreground in the image.

C. Yanni and Horne Method

Yanni and Horne method [9] initializes the midpoint of two peaks of image histogram which is defined as:

$$g_{mid} = (g_{max} + g_{min})/2$$

g_{mid} is the midpoint of the highest and lowest peak point. The midpoint is updated using the mean of the two peaks on the right and left sides of the initial midpoint which can be written as:

$$g_{mid} = (g_{peak1} + g_{peak2})/2$$

Where g_{mid} is updated midpoint and g_{peak1} and g_{peak2} are the mean values of left and right.

D. Niblack method [5] the threshold value for the local area under the window is calculated pixel wise. The calculation of the threshold value is depending upon the local mean and standard deviation of window area. The threshold value is finding using following equation.

$$T_{Niblack} = m + k * s$$

$$T_{Niblack} = m + k \sqrt{\frac{1}{NP} \sum (p_i - m)^2}$$

E. Sauvola Method

The Sauvola algorithm [9] is a modified form of Niblack algorithm. It gives more performance than Niblack under such conditions as light variation on document image, light texture etc. In the Sauvola modification, the binarization is given by:

$$T_{Sauvola} = m * (1 - k * (1 - \frac{s}{R}))$$

IV. DATABASE

Database of grey scale images is prepared by capturing the images from various black boards with different orientation by using mobile camera. In this data I have collected different 50 images. Some part of database is shown in fig no1.

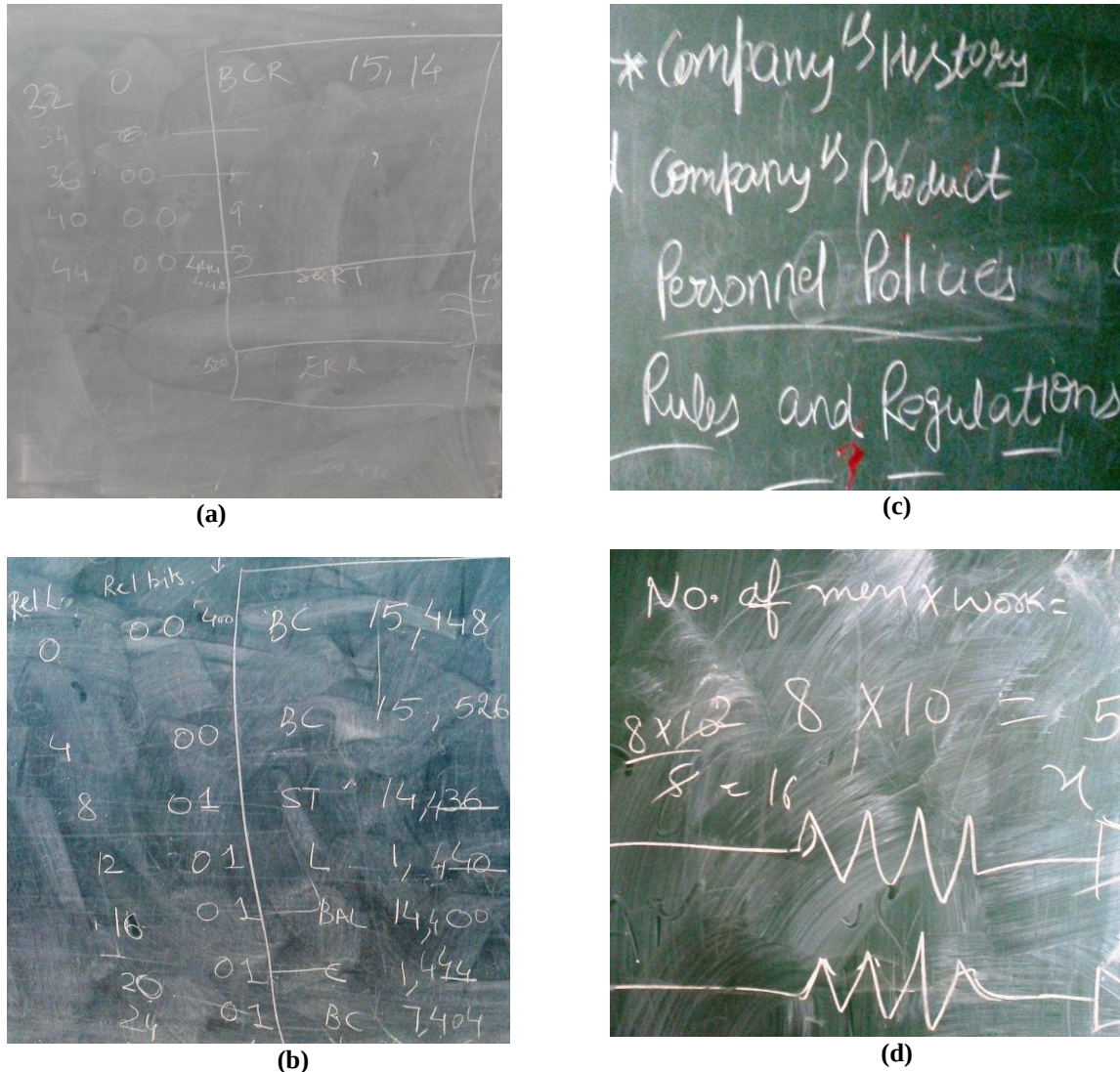


Fig. 2: Some Part of Database

V. PROPOSED WORK

In this method, we take variable sized images from different black/green boards which are captured by mobile camera. First of all image enhancement technique is applied on input image and then image is divided into 3x3 parts. After that threshold value is computed for each part by using OTSU method and binarized all these segmented parts by using corresponding threshold values. After that the parts of image are joined.

Algorithm

Step 1:

Capture the image of black board using mobile camera.

Step 2:

Apply image enhancement technique on input image.

Step 3:

Apply 3x3 partition method on enhanced image.

Step4:

Now apply OTSU method by using following steps

4.1 Separate the pixels into two clusters according to the threshold.

$$q1(t) = \sum_{i=1}^t p(i) \quad \text{and} \quad q2(t) = \sum_{i=t+1}^I p(i)$$

P represents the image histogram.

4.2 Find the mean of each cluster.

$$\mu1(t) = \sum_{j=1}^t \frac{ip(i)}{q1(t)} \quad \text{and}$$

$$\mu2(t) = \sum_{j=t+1}^I \frac{ip(i)}{q2(t)}$$

4.3 Calculate the individual class variance.

$$\sigma_1^2(t) = \sum_{i=1}^t [i - \mu1(t)]^2 \frac{p(i)}{q1(t)}$$

and

$$\sigma_2^2(t) = \sum_{i=t+1}^I [i - \mu2(t)]^2 \frac{p(i)}{q2(t)}$$

4.4 Square the difference between the means.

$$\sigma_b^2(t) = \sigma^2 - \sigma_w^2(t) \\ = q1(t)[1 - q1(t)] [\mu1(t) - \mu2(t)]^2$$

Finally, this expression can safely be maximized and the solution is **t** that is maximizing $\sigma_b^2(t)$

Step5:

Repeat the step 4 for each part of the image.

Step6:

Join each and every part of image.

Flow chart of the proposed work: flow chart of the proposed work represents the flow of data from input to output through various stages of the algorithm.

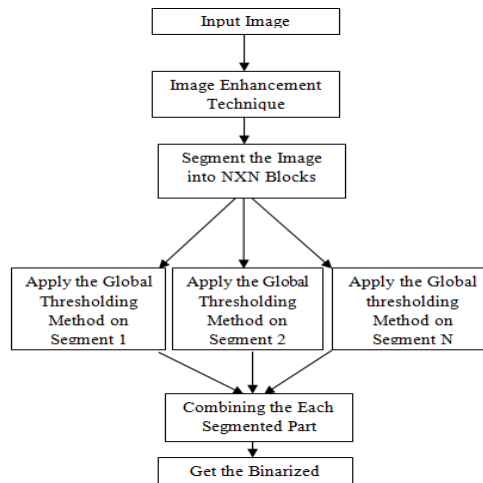
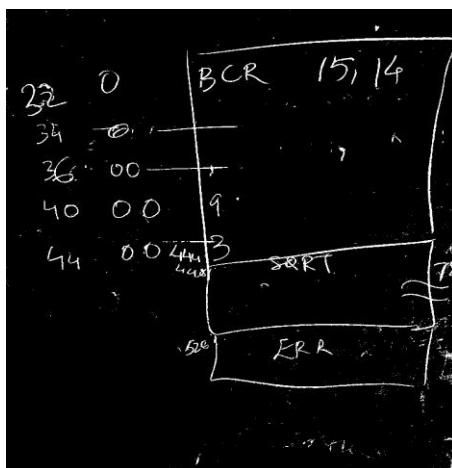


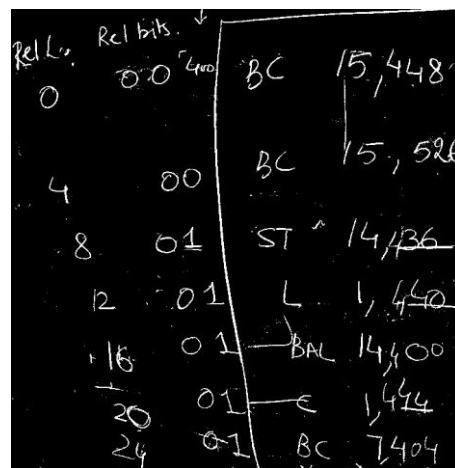
Fig. 3: Flow chart of proposed work

VI. RESULTS AND DISCUSSION

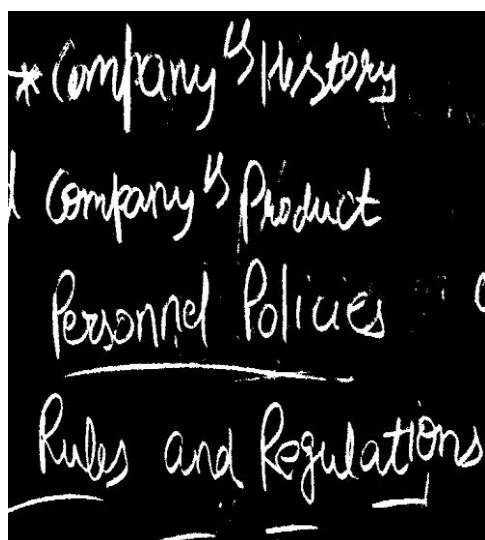
Results of some part of database used by proposed method is illustrated by following figures.



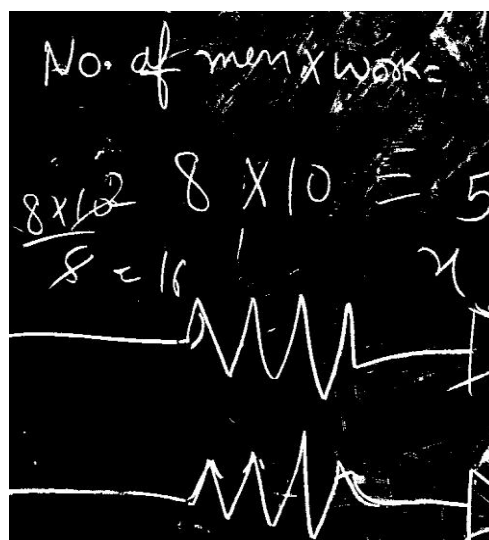
(a)



(b)



(c)



(d)

Fig. 4: Output of the proposed work.

Table 1: Comparison of Result with Other Algorithm

Input Images	Binarization Method	Performance Matrix			
		Accuracy	Precision	Recall	F1-Measure
Image1	OTSU	65.8116	0.0024	0.2135	0.0048
	NIBLACK	38.3789	0.0007	0.1076	0.0013
	SAUVOLA	11.0331	0.0001	0.0076	0.0001
	PROPOSED	93.6801	0.0310	0.5071	0.0584
Image2	OTSU	47.5670	0.0012	0.1124	0.0024
	NIBLACK	27.7701	0.0008	0.1066	0.0017
	SAUVOLA	8.6666	0.0001	0.0121	0.0002
	PROPOSED	93.1630	0.0490	0.5970	0.0905
Image3	OTSU	46.0895	0.0009	0.0691	0.0019
	NIBLACK	39.1333	0.0007	0.0601	0.0014
	SAUVOLA	20.7774	0.0001	0.0097	0.0002
	PROPOSED	88.8666	0.0328	0.5031	0.0615
Image4	OTSU	39.0293	0.0007	0.0931	0.0014
	NIBLACK	35.1364	0.0007	0.0967	0.0014
	SAUVOLA	15.8916	0.0001	0.0048	0.0001
	PROPOSED	87.8869	0.0145	0.3704	0.0279
Average Accuracy of total 50 images	OTSU	47.6243			
	NIBLACK	36.1046			
	SAUVOLA	29.1843			
	PROPOSED	92.589%			

The binarize images obtained by proposed method are shown in the section 5. To measure the performance of the algorithm the different matrix are used such as precision, Recall, F1-measure etc [10]. The true positive pixels are those pixels which are positive in truth image as well in obtained image. The false positive pixels are those pixels which are black in truth image but white in the obtained image. Similarly true negative pixels are those pixels are which are negative in true image as well in obtained image. The false negative pixels are those pixels which are white in truth image and black in obtained image.

True Positive

$$\text{Recall} = \frac{\text{True Positive}}{(\text{False Negative} + \text{True Positive})}$$

True Positive

$$\text{Precision} = \frac{\text{True Positive}}{\text{True Positive} + \text{False Positive}}$$

2. Recall. Precision

$$\text{F-Measure} = \frac{2 \times \text{Recall} \times \text{Precision}}{\text{Recall} + \text{Precision}}$$

Table 2: Comparison of Visual Inspected Result on Some More Database Images

Input Image	Otsu	Niblack	Sauvola	Proposed

VII. CONCLUSION

This paper has presented binarization of the blackboard images by mobile camera from different orientations and shows the better results as compared to the results shown by Otsu, Niblack and Sauvola when applied on the same black/green board images visually as well measured by using the evaluation metrics algorithms by measuring their performance by evaluation metrics. The accuracy obtained by using proposed algorithm is 92.589%. From the experimental result, we can infer that proposed method shows good result when compared with other methods. According to the results, proposed method had the best overall performance. This research paper will also act as a guide for the students, researchers in the field of binarization and the further scope can be imagined that the data written on walls, white boards number plates etc can be binarized.

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