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Binarization of Ancient Tamil Scripts From Stone Inscriptions

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ABSTRACT

Tamil character recognition is one of the most difficult tasks in the pattern recognition system. There are lots of difficult things which can be solved through image processing technique, separating each character, recognizing character fonts and writing styles used in different centuries. Many researchers try to apply many techniques for breaking through the complex problem of Tamil character recognition. Currently there are widely available digital image processing algorithm and implementation that are able to detect characters from raw images. In character recognition system most of the applications use grey/binary images since processing color images is computationally high. Such images may also contain non-uniform background so it is difficult to extract the images without performing preprocessing. In this research paper an attempt has been done to analyses the various approaches and challenges in recognitions of Tamil characters and issues related to recognitions method that can convert color image into binary form.

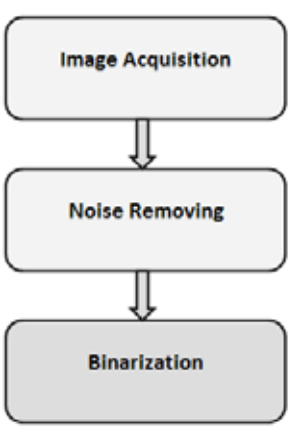
KEYWORDS : Binarization, Tamil character recognition, Gray scale, image processing

I. Introduction

Image Binarization is the process of separation of pixel values into dual collection, black as foreground and white as background. A binary image is a digital image that has first two feasible values meant for every pixel. Normally, two colors are used for a binary image i.e black and white however any two colors can be used. The color used for the objects in the image is the foreground color white the rest of the image is the background color.

Binary images frequently occur in image processing as mask or as the outcome of some operations as segmentation and Thresholding. Binarization is one of the most important pre-processing steps which consist to separate foreground and background. It converts a grayscale image into a binary image.

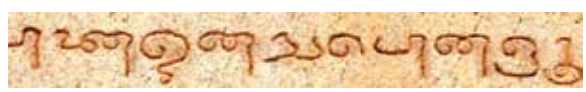
Steps in Binarization:



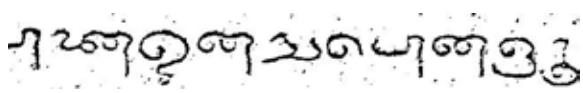
To create rigors and productive report picture Binarization method converts the grey scale image (0 up to 256 gray levels) into a black and white (0 or1) which have the capacity to handle great effects. The high quality binarized image can give more accuracy in character recognition as compared original image because noise is present in the original image. In fact problem is that which Binarization algorithm is appropriate for all images.

This is especially true in the case of historical images with variation in contrast and illumination. Generally they can be classified into three major types global Binarization, local Binarization, hybrid Binarization method and dynamic Thresholding Binarization.

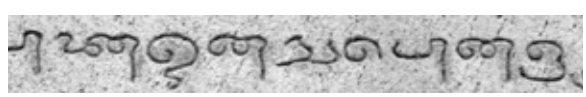
Input Image:



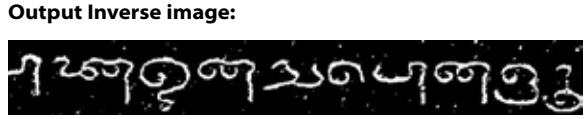
Output binary image:



Output grayscale image:



Output Inverse image:



A. Global Binarization

Global Binarization computes an optimal threshold for the entire image; these techniques need few computations and can work well in simple cases. But fails in complex backgrounds, such as non-uniform color and poor illuminated backgrounds. These methods are usually not suitable for degraded document images because they do not have a clear pattern that separates foreground and background. It is better for calculate the threshold values for the entire grey scale images. They are probably the faster algorithms. We found global Binarization algorithm based on 1. Classification procedures 2. Histogram 3. Clustering 4. Entropy 5. Gaussian distributions

1. Otsu [otsu 1979] calculates a global threshold by accepting the existence of two classes, foreground and background, and choosing the threshold that minimizes the interclass variance of the Thresholded black and white pixels. Reddi et al [Reddi et al 1984] technique can be considered as an expansion of Otsu technique for the multithresholding case. In this work they have used it's a global Thresholding technique. Its goal is the maximization of the interclass variance. Improved integrated function algorithm (IIFA) [Trier and Taxt 1995] applies a gradient like operator, defines as he activity A(x,y), which is the absolute sum of approximated derivatives for both scan and rater directions taken over a small area, on the image. A three level

label image with pixel levels '+' '-' and '0' is produced. All '+' marked regions are labeled print, and '-'marked regions are labeled background a '0' marked region is labeled print if a majority of the pixels with 4-connected are '+' marked otherwise it is labeled background.

2. Histogram peaks [Prewitt and Mendelson 1966] is the most commonly used global Thresholding technique and it is based on histogram analysis. It assumes a bimodal histogram. The histogram is smoothed (using the three point mean filter) iteratively until it has only two local maxima. Black percentage [Doyle 1962] is a parametric algorithm that assumes that the percentage of black pixels is known (p). The histogram is used and the threshold is set to the highest gray level which maps at least (100-p)% of the pixels into the background category. Here we set p=5. Ramesh et al. [Ramesh et al 1995] use a simple functional approximation to the PMF consisting of a two –step function. Thus the sum of squares between a bi-level function and the histogram is minimized, and the solution of Tis obtained by iterative search: Rosenfeld and kak [Rosenfeld and kak 1982] select global threshold from the histogram of 2D image. They assume that gray values of each object are possible to cluster around a peak of the histogram od 2D image and try to compute the location of valley or peaks directly from the histogram

3. K-means [Jain and Dubes 1988] is a clustering-based method, where the gray-level samples are clustered in two parts as background and foreground using the corresponding clustering algorithm. Similarly Frzzy c-means [Duda an dHart 1973] is a fuzzy clustering approach that the gray-scale values are clustered into tw fuzzy classes corresponding to background and foreground pixels.

4. Pun [Pun 1980] considers the gray-level histogram as a G-symbol source, where all the symbols are statistically independent. The ratio of the posteriori entropy as a function of the threshold to that of the source entropy. Yen et at [Yen 1995] define the entropic correlation and obtain the threshold that maximizes it.

5. Kittler and Illingworth [Kittler and Illingworth 1985] present an algorithm that is based on the fitting of the mixture of Gaussian distributions and it transforms the Binarization problem to a minimum-error Gaussian density fitting problem. Similarly, Lloyd's [Lloyd 1985] technique considers equal variance Gaussian density functions, and minimizes the total misclassification error via an iterative search. Finally, Riddler and Calvard [Ridler and Calvard1978] by iterative Thresholding advanced one of the first iterative schemes based on two-class Gaussian mixture models. At iteration n, a new threshold T is established using the average of the foreground and background class means. Abdenour Sehad et al.(2013) has present a capable scheme for binarization of ancient and degraded document images, grounded on texture qualities. The suggested technique is an adaptive threshould- based. It has been calculated by using a descriptor centered on a co-occurrence matrix.

B. Local Binarization

A. Local Binarization has different thresholds for different target pixels depending on their neighborhood/ local information. Calculate different threshold values depending on the local regions of the image. Generally these are sensitive to background noises due to large variance in case of poor illuminated degradation. Binarization algorithm based on clustering procedure, local variation, entropy, neighborhood information, Otsu's method. More specially,

1. The Kohonen SOM [papamarkos and Atsalakis 2000] neural network can be used for general gray-scale reduction. Specifically, gray-scale feeds the Kohonen SOM neural network classifier, and after training, the neurons of the output competition layer define the gray-level classes. If we define that the output layer has only two neurons then we perform bilevel clustering.

2. Niblack [Niblack 1986] calculates a local threshold for each pixel that depends on the local mean value and the local standard deviation in the neighborhood of the pixel, but using a more complicate formula. Bernsen [Bernsen 1986] uses also local thresholding, calculating the mean value of the maximum and minimum values within a window around the pixel. When the difference of the two values is bigger than a threshold the pixel is part of the foreground, otherwise the pixel is considered as background and takes a default value.

3. Abutaleb [Abutaleb 1989] uses a local technique that considers the joint entropy of two related random variables, namely, the image gray value at a pixel , and the average gray value of a neighborhood centered at that pixel.Pemdpcl [Brink and Pendock 1996] suggest a modification of Abutaleb's technique by redefining class entropies and finding the threshold as the value that maximum the minimum of the foreground and background entropies. A local technique similar to previous ones is also considered from Kapur et al. [Kapur et al 1985] the maximization of the entropy of the thresholded image is interpreted as indicative of maximum information transfer. The image foreground and background are considered as two different signal sources, so that when the sum of the two class entropies reaches its maximum, the image is said to be optimally thresholded.

4. Palumbo at al. [Palumbo et al 1986] local algorithm consists in measuring the local contrast of five 3 X 3 neighboorhoods organized in a center-surround scheme.[Parker 1991] local method first detects edges and then that area between edges is filled. First for the eight connected neighborhood of each pixel the negative of the brightest neighbor, Dis found. Then it is broken up to regions r X r, and each region, the sample mean and standard deviations are calculated.

[Gatos et al 2006] local method claims to deal with degradations which occur due to shadows, non-uniform illumination, low contrast, large signal-dependent noise, smear and strain.

5. Liu and Li [Liu and Li 1993] proposed a 2-D Otsu thresholding method, which claim to perform much better than the 1-D Otsu method does, when images are corrupted by noise. Their method calculates the local average gray level within a limited window. [Vonikakis et al. [Vonikakis et al 2008] presents a local method whose main objective is to adopt the characteristics of the OFFF ganglion cells of the Human Visual System (HVS) and employ them in the text Binarization process.

B. Hybrid Binarization combines global and local Thresholding. It consists of carrying out a global Thresholding to classify a part of the background of the document image and keep only the part containing the foreground. It refined the image obtained by the image in order to obtain a sharper result by applying an adaptive Thresholding.

C. Dynamic Binarization defines the threshold of a pixel with the grey-level values of its own and neighboring pixels and the coordinate of the pixel. This Binarization method is commonly used for the bad quality images, especially the images with single peak histogram. However owing to the dynamic threshold the method has high computation complexity and slow speed.

CONCLUSION

The main objective of this paper is to evaluate the short comings of algorithms for degraded image Binarization. Global thresholding method is better approach for calculate the threshold values of a grey scale images but it doesn't give good results for colored image and under intensity. For such kinds of images local thresholding methods can be used like as Sauvola, Niblavk etc.

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