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A Review on Global Binarization Algorithms for Degraded Document Images

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Abstract

Several algorithms have previously been proposed for improving the thresholding of degraded document images. No algorithm can solve all types of problems, but some algorithms are better than others for specific situations.

This article reviews global binarization algorithms for improving degraded document images, thus indicating their differences and similarities, and also their advantages and disadvantages. They have been classified into three groups, which are global thresholding, local thresholding and hybrid thresholding. In total, 7 image global threshold binarization algorithms are summarized.

Keywords: *Digital image processing, digitization, thresholding technique.*

1. Introduction

As stated by Khashman and Sekeroglu (2007), "One of the simplest and yet efficient image processing techniques which can be used to separate foreground and background layers of document images is thresholding." Normally, document image analysis uses thresholding as a standard algorithm to change the gray document images to binary form. Document image binarization is very important for old papers to be digitized into digital data.

The degraded document images contain unwanted noises, uneven illumination (shadows), skewed pages, ink seeping, strains, and smear. No standard algorithm performs the best in all degraded document images.

This article reviews the global binarization algorithms for degraded scan images. Ridler and Calvard (1978) developed an algorithm to optimize the process of changing a gray-level image to a bimodal image while retaining the appropriate possible illumination of the image.

Otsu (1979) found a classical algorithm in image binarization which helps reducing a gray-level image to a binary image for classifying foreground and background with a global threshold. He proposed an algorithm that can be applied iteratively to a grayscale histogram of an image for generating threshold candidates.

Pun (1980, 1981) proposed an optimal criterion for image thresholding. This criterion was corrected and improved by Kapur *et al*. (1985). They revised and improved Pun's algorithm by assuming two probability distributions for objects and background as well as maximizing the entropy of the image to obtain the optimal threshold.

Kittler and Illingworth (1986) proposed a minimum error thresholding algorithm that minimizes the probability of classification error by fitting error expression. It is assumed that the image can be characterized by a mixture of two Gaussians distributions of object and background pixels.

Fan *et al*. (1996) proposed a fast entropic technique to obtain a global threshold automatically by reducing complexity in computation.

Portes de Albuquerque *et al*. (2004) proposed an entropic thresholding algorithm that was customized from non-extensive Tsallis entropy concept.

Xiao *et al*. (2008) proposed an entropic thresholding algorithm based on the gray-level spatial correlation (GLSC) histogram. They revised and extended Kapur *et al*.'s algorithm (Kapur *et al*. 1985).