Region Analysis of Business Card Images Acquired in PDA Using DCT and Information Pixel Density

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Abstract. In this paper, we present a method of region analysis for business card images acquired in a PDA (personal digital assistant) using DCT and information pixel (IP) density. The proposed method consists of three parts: region segmentation, information region (IR) classification, and character region (CR) classification. In the region segmentation, an input business card image is partitioned into 8 × 8 blocks and the blocks are classified into information blocks (IBs) and background blocks (BBs) by a normalized DCT energy. The input image is then segmented into IRs and background regions (BRs) by region labeling on the classified blocks. In the IR classification, each IR is classified into CR or picture region (PR) by using a ratio of DCT energy of edges in horizontal and vertical directions to DCT energy of low frequency components and a density of IPs. In the CR classification, each CR is classified into large CR (LCR) or small CR (SCR) by using the density of IPs and an averaged run-length of IPs. Experimental results show that the proposed region analysis yields good performance for test images of several types of business cards acquired in a PDA under various surrounding conditions. In addition, error rates of the proposed method are shown to be 2.2–10.1% lower in region segmentation and 7.7% lower in IR classification than those of the conventional methods.

1 Introduction

Business cards have been widely used by career men as a means of an advertisement. Recently as one’s own p.r. is regarded as of great importance, the class of business card users is being extended to common people. Accordingly, people get more business cards of others and need efficient management of them instead of carrying all of them. Up to now people usually manage business cards by putting it in a book of business cards directly or making a note of its information in a memo pad. A hand-held PDA widely used in recent days can easily obtain an image of a business card by digitizing it with its built-in camera. It can also
recognize characters in an image and store the recognized characters. So such a management of the information of a business card using the PDA may be more efficient.

Business cards are generally composed of characters such as logotype, name, affiliation, address, phone number, e-mail address, etc., pictures such as photograph, symbol mark, line, etc., and background. So if a region analysis that divides a business card image into CRs, PRs, and BRs is performed, then any following processing for business card management may be much more efficient. Until now many region analysis methods have been proposed. Most of the methods are for document images [1]–[10]. In [4]–[6], a document image is first partitioned into blocks, the blocks are then classified into IBs containing characters or pictures and BBs using a block activity, and the image is finally divided into IRs and BRs. As a block activity, variance of a block [4], edge information in a block [5], or DCT energy in a block [6] is used. In addition, a document image is first binarized as IPs and BPs, and then divided into IRs and BRs using a run-length smoothing [1] or projection profiles of the binarized image [7]. Besides, an IR is classified into CRs and PRs by using adjacency of character strings [8], repetition of character strings [9], or distribution of IPs in its binarized region [10]. In [11], an extraction of text lines for business card images acquired in scanners has been proposed.

Since document images are usually acquired by high resolution scanners, they usually have regular illumination and intensity distributions in their local regions are nearly uniform. They also have many character strings of regular positions and pictures somewhat isolated from their adjacent characters. On the other hand, business card images acquired in a PDA with its built-in camera usually have lower resolution. In addition, they may often have irregular illumination and shadow due to acquisition under unstable hand-held situation. So their intensity distributions in local regions may not be uniform but severely varied. Moreover, they have low average density of characters and sizes of their characters may often vary in a few lines of irregular positions, and often have pictures lie close to their adjacent characters. Thus the performance of region analysis on business card images acquired in a PDA using the conventional region analysis methods for document images may be deteriorated. In this paper, we present a method of region analysis for business card images acquired in a PDA considering the characteristics of business card images.

2 Proposed Region Analysis

2.1 Region Segmentation Using DCT

In the region segmentation, an input image is first partitioned into blocks and the blocks are classified into IBs and BBs based on a block activity using DCT. We determine the block size as $8 \times 8$ by considering the averaged density and size of characters in business card images and define the block activity as the block energy with the absolute sum of low frequency DCT coefficients in the block. We also normalize the block energy by the RMS (root mean square) of