

문자 스타일에 따른 문자 분할

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Machine-Printed Character Segmentation according to Font Style

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Abstract An identification of a font allows that an OCR system can perform font-specific processes, which consist of various mono-font segmentation tools and recognizers. According to the font styles, character segmentation method should be applied differently. Touching characters in slant style cannot be segmented vertically but segmented on a slant. This paper proposes that touching characters in italic style can be segmented vertically after slant normalization.

1. Introduction

An identification of a font allows an OCR system consisting of various mono-font recognizers. Mono-font reading system that works well in a single font can achieve a high accuracy due to *a priori* regularity known to the OCR system. For example, an OCR-A font-specific recognizer achieves the highest performance in the rates of recognition. After the font is identified, the multiple font system is switched to a mono-font state and the problem is essentially reduced to a mono-font process. In other words, an OCR system can perform font-specific processes, which consist of various mono-font segmentation tools and recognizers. This would reduce the confusion caused by training on many fonts and would effectively reduce the recognition problem

to choosing the correct class from one font rather than from many fonts. There are hundreds of fonts in English, so we cannot make hundreds of segmentation tools and recognizers. However, we can group fonts into several font groups, and make several font-specific segmentation tools and recognizers. For example, an OCR system consists of a serif font-specific recognizer, a sans-serif font-specific recognizer, a typewriter font-specific recognizer, and an italic style-specific recognizer. According to the result of a font classifier, one of font-specific segmentation tools and one of font-specific recognizers are applied to an input word. Figure 1 shows an OCR system that consists of various mono-font segmentation tools and recognizers.

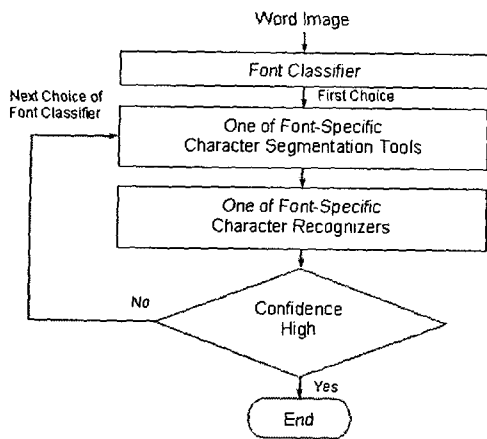


Figure 1. Font-specific character segmentation and recognition

2. Font-specific character segmentation

An identification of a font allows the design of specific segmentation tool. For example, in Figure 2 the word is in upright style. It can be segmented vertically. Besides, it is in Courier that is fixed pitch font. That means all characters have the same width. The width can be deduced from a single character of correctly segmented characters, and then the pattern can be cut at the equidistant positions. In Figure 3, the word is in slant style. It cannot be segmented vertically but segmented on a slant. According to the font styles, character segmentation method should be applied differently. The font styles changes the structure of a character in a font. For example, the structures of an "m (upright)" and an "m (slant)" are different.

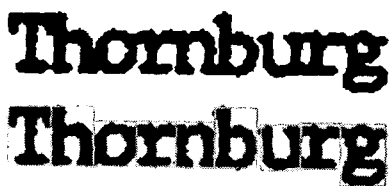


Figure 2. Touching characters in upright style



Figure 3. Touching characters in italic style

3. Font-style classification

The vertical projection profile is defined as followings; when image function $I(x, y)$ takes on two values (say, black and white), the vertical projection profile is obtained by counting the black pixels in the vertical direction.

Vertical projection profile(P_v) : sum of black pixels perpendicular to the x -axis.

$$P_v(x) = \sum_y I(x, y)$$

(1)



(a)



(b)

Figure 4. (a) The vertical projection profile of touching characters in upright style, (b) The vertical projection profile of touching characters in italic style.

Figure 4(a) shows the vertical projection profile of touching characters in upright style. Figure 4(b) shows the vertical projection profile of

touching characters in italic style. We can observe from the vertical projection profile that characters in upright style are characterized by a set of upright and tall peaks. For characters in italic style the peaks are less tall, rounded and larger. Font style can be identified by the analysis of the vertical projection profile[1].

4. Slant Normalization

Slant normalization estimates the average slant angle of component characters and then correct the slant uniformly under the assumption that each word is printed with a constant slant. Kim and Govindaraju have proposed slant correction techniques where the average slant angle is estimated from the angles of extracted vertical strokes[2]. Figure 5 shows the slant normalization of some words. Touching characters also can be slant normalized and be segmented vertically as shown in Figure 6.

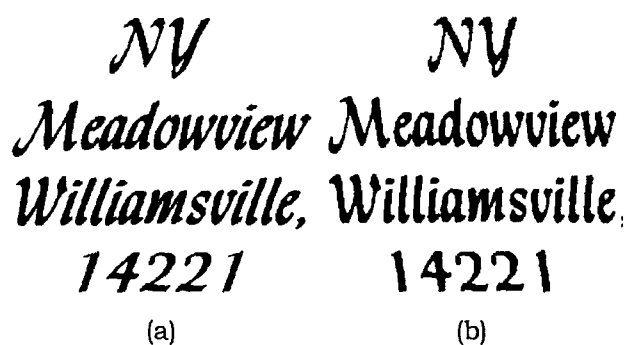


Figure 5. Slant normalization: (a) before slant normalization (b) after slant normalization



Figure 6. Slant normalized touching characters can be segmented vertically

4. Conclusion

Touching characters in upright style can be segmented vertically. However, touching characters in italic style can not be segmented vertically but be segmented on a slant. It is quite a difficult and time consuming job to find the slanted segmented path in touching characters. This paper proposed that touching characters in italic style can be segmented vertically after slant normalization. Touching characters in italic style that had been failed in character segmentation were successfully segmented by the proposed method.

5. References

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