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Estimation & Correction of Multiple Skew in Image Document

[1]Kashmira Santosh Kolhapur & [2] Mr. K. K. Pandyaji
Department of Electronics engineering, Padmabhooshan Vasantraodada Patil Institute of Technology, Budhgaon, Sangli, India.

Abstract*: This paper presents a method for estimation and correction of document image skew angle. The main idea of this method is based on the concept that any document has an object of rectangular shape such as text, lines, tables, figures. These objects can be restricted by rectangles. using extreme point properties to obtain the corners of rectangle which fits the largest connected component of document image. The angle of this rectangle represent angle of document skew. The experimental results show high performance of the algorithm in detecting the angle of skew for a variety of documents with different levels of complexity.*

1. Introduction

In today's world the field of image processing brings out the idea of automatic assembling and processing of the observed information most of the documents are exist in printed form. But if they are needed to be changed into electric form, it has to be done through scanning. Document scanning is widely used for various applications. When we scan the document it may not be feed properly into scanner by using hand placement or automatic document feed, it leads to create a skew angle in document. Character recognition is very sensitive to page and line skew. Skew detection and correction in document image having multiple skew lines are critical steps before layout analysis. Therefore, document skew estimation is required before any processing on the document. In this proposed method, a new technique is used that detect the angle of skewed line or documents dividing the document in connected component. After that, we estimate and correct the skew angle.

2. Related work

For detection of skew angle number of techniques where used previously. In that one is projection profile
analysis method [1], [2] this method makes one dimensional array with size equal to number of rows in the document image. Each array slot contains the number of black pixels in the related row of the document image. The maximum amplitude and frequency of histogram is found when document image does not have skew. They compute the projection profiles of the document at various angles and then compute the feature which is extracted from each projection profile. The features are compared to determine the largest peak. Skew angle is determined based on the maximized criterion function. This method is sensitive to the layout of the document and it is expensive operation to rotate the document.
Nearest neighbor methods are detecting the skew of angle between each component and its nearest neighbor, and then calculating the histogram of the angles. The value of the peak is referred to the angle of skew.
Hough transform analysis [3] is a well known technique that can detects lines and curves in digital images. The methods that based on Hough transform compute the values of the parameters of all the curves of a particular type that can pass through each black pixel.
The nearest neighbor and Hough transform analysis methods are failed to take out the text region in the case of complex layouts. Moreover, Hough transform methods require a large memory space to store an intermediate data in Hough plane.

3. Method descriptions

Our method comprises three main steps: 1) pre-processing and thresholding 2) dividing the document into connected component 3) skew angle estimation and correction.

3.1pre-processing and thresholding

Image acquisition is done by image scanning device like camera, scanner. Then first step in preprocessing is document enhancement for degraded and poor quality documents image, preprocessing is very important to enhance the degradation and eliminate noise [6]. In our approach we use retinex theory to solve the degradation problem.

$$I(x, y) = R(x, y) . L(x, y)$$

Where I(x, y) is the intensity of the image with reflection R(x, y) and illumination L(x,y) which can approximated by using low-frequency component of the measured image

If we have grayscales image I(x, y) has degradation, we can obtain the Lightness image L(x, y)by divide the original grayscale image I(x,y) on its smooth version M(x, y) with large kernel as:

$L(x, y) = I(x, y)/M(x, y)$

Thresholding technique is used for extracting object from background.

3.2Dividing the document into connected component

Compute the angle of the largest connected component of the document image. We can use the properties of extreme points to obtain the rectangle which can fit the largest connected component with the same skew angle. Each connected component has eight extreme points top-left, top-right, right-top, right- bottom, bottom-right, bottom-left, left-bottom and left-top.

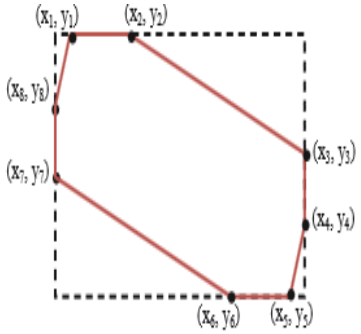


Fig.1. Example of the eight extreme point of the region.

3.3 Skew angle estimation and correction

Document contains lines Li where i =1, 2, 3 Each line has two endpoints (xi1, yi1),(xi2, yi2) for each line angle is calculated as

$\theta = \tan^{-1}(xi2-xi1/yi2-yi1)*180/\pi$

Then document image is then rotated by $-\alpha 1$ or $-\alpha 2$

- If θ is positive
  $\alpha 1=\theta$, $\alpha 2=\theta-90$
- If θis negative
  $\alpha 1=\theta+90$, $\alpha 2=\theta$

Figure 2 shows when angle θ is positive then α1 is equal to θ and α2 is equal to θ-90

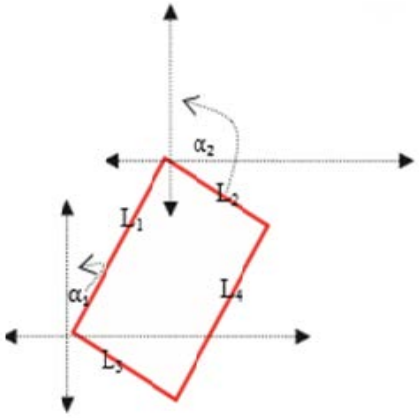
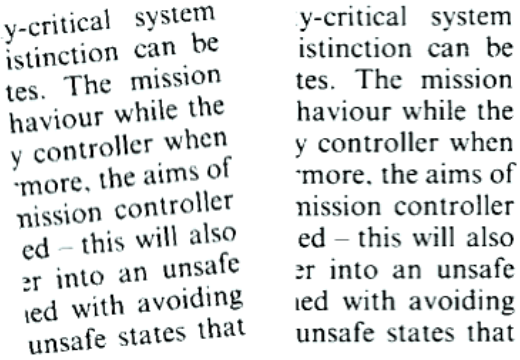


Fig.2. Example of compute the angle of rectangle with positive angle.

Rotating with positive or negative θ, new image of corrected skew angle is formed.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(a) (b)

Figure 3: (a) image having skew angle. (b) image with no skew.

Above example shows document having skew angle shown in fig.3 (a) predicted output having no skew angle shown in fig.3 (b). This method can be tested on document having multiple skew.

Conclusions

Regarding a study on new technique for document image skew detection and correction method may be gives a good results together. The proposed method is based on extreme point's properties to obtain the corners of the rectangle which fits the largest connected component of the document image. The skew angle will be detect from this rectangle. The proposed method may be test on variety of documents with different levels of complexity. The error averaging of the proposed work may be illustrates the effectiveness compared to the other related works. Moreover, the proposed method can handle the documents that have border noise.

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