A Survey on Estimation & Correction of Multiple Skew in Document Image Processing

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Abstract—This paper addresses research area document Image skew. Skew is any deviation of the image from that of the original document, which is not parallel to the horizontal or vertical. Skew Correction remains one of the vital parts in Document Processing. Many methods have been proposed by researchers for the detection of skew in binary image documents

Keywords—Skew, Document

I. INTRODUCTION

In today's world, the field of image processing brings out the idea of automatic gathering and processing of the observed information. Most of the documents are present in the printed form. But if they are needed to be converted into electronic form, it has to be done through scanning. Image scanning is widely used for various applications.[1-5] Scanning the document image may not be fed properly into the scanner by either hand placement or automatic document feeders. It leads to create a skew angle in the document image. Character recognition is very sensitive to the page and line skew. The handwritten document having different skew lines is shown in figure 1. Skew detection and correction in document images having multiple skew lines are the 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 document. In our method, we divide the document into connected components.[6-7]
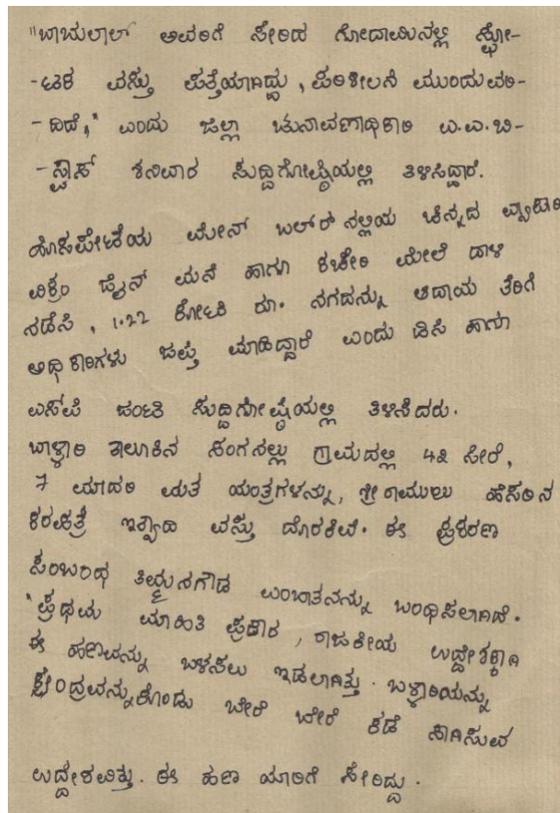

Figure 1: Handwritten document

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Then we compute the extreme points of largest connected component, to obtain the rectangle which fit this connected component. After that, we estimate the skew angle and compare result with existing technique.

II. RELATED WORK

Algorithms which detect the angle at which a document image is rotated called a document's skew. There are various methods for rotating the image to remove the skew. Generally, there are a variety of global skew detection and correction techniques available. Most of these techniques are reviewed by Hull [4]. Global skew estimation approaches are classified into basic categories. It includes projection profile, Hough transforms nearest neighbour clustering, and cross correlation.

Jiang et al. used Hough transform with detecting points in coarse form and accurate skew is obtained by choosing peak value for skew angle [5]. Spitz et al. used the data reductions techniques that used for compressed images, in which data points are obtained with single pass and mapped into Hough space [5].

Yu and Jain used a fast and accurate approach on set of low resolution images. They use hierarchical Hough transform and centroids of connected components. Firstly, algorithms efficiently computing connected components and at their centroids by using block adjacency graph then Hough transform is applied to centroids using two angular resolutions [8].
Texts or lines make an angle with respect to x axis due to a document copying process, before digitization. The images have variety of documents like various skew lines, mixtures of text and languages with different levels of complexity and border noise. It is very problematic to rotate skewed line instead of rotating full image. This forces us to think about a technique, which can detect and correct that skew angle for different skew lines. Thus, it proposes to overcome the problem by improving the techniques which were attempted previously.

S. Li, Q. Shen, J. Sun[1] and A. Bagdanov, J. Kanai [2] described projection profile method for skew angle correction. Projection profile analysis methods are a straight forward solution to estimate the skew angle based on a horizontal projection profile. These methods create one dimensional array with size equal to the number of rows in the document image. Each array slot contains the number of black pixels in the corresponding row of the document image. The maximum amplitude and frequency of histogram is found when the 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. Finally, criterion function is calculated that provide a numerical expression for the peaked characteristic. The skew angle is determined based on the maximized criterion function.

X. Jiang, H. Bunke, D. Widemer-Kljajo,[3] detected the skew angle by Nearest neighbor. This method detects the skew angle between each component and its nearest neighbor, and then computing the histogram of the angles. The value of the peak is referred to the angle of skew.

C. Singh, N. Bhatia, A. Kaur [4] proposed a system to detect skew by Hough transform. This method computes the values of the parameters of all the curves of a particular type that can pass through each black pixel. Then, a multidimensional array which corresponds to each curve with dimension for every parameter is used. The highest number of co-liners pixels is on lines that are co-incident with the baseline of the text. The idea is that collinear pixels in Cartesian space constitute cluster bins in Hough space. The peak in the Hough space corresponds to the angle of skew.

C.-H. Chou, S.-Y. Chu, F. Chang [5] explained parallelogram method in which document is divided into several non-overlapping slabs and the object within each slab is covered by parallelogram at different angles. The angle of the object whose best covered by parallelogram is refer to document skew angle. This technique is faster and robust than previous methods.

Table 2.2.1: comparative data

Sr No	Technique	Key idea	Advantages	Disadvantages
1	Cross correlation	In this technique the document skew is calculate by finding the vertical shift required to maximize the cross correlation between horizontal elements then maximum cross correlation find the skew angle	It has high accuracy	High computational cost
2	Fourier transform	In Fourier transform the density of Fourier space for direction is detected and where density of Fourier space is largest that is Skew angle.	Fourier transform can recognize skew angle without knowing the detailed context	Limitation for high angle rotation.
3	Nearest neighbour	In this method firstly all connected component are identified then all nearest neighbour pairs of accumulated in histogram and maximum histogram indicate the skew	It can be used to detect the skew which contains different types of font size scripts and layouts	Accuracy is not good as compared to other approaches.
4	Hough transform	Hough transform detecting the fragmented curves mostly straight lines in images then find the skew angle from that parametric curves	Hough transform have strong ant interference capability.	It can create difficulty if text is sparse.
5	Projection profile	technique we store the numbers of black pixels of each row of the image and then find the maximum amplitude histogram and that maximum histogram indicate the skew angle	This is very straight ward solution to determine the skew angle.	Efficiency is not good due to iterative process

III.   CONCLUSION

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A variety of skew detection algorithms are discussed in this paper. We also present a comprehensive analysis of these techniques including their advantages and disadvantages. We may conclude that algorithms based on Hough transform have very good scope of improvement in case of speed of execution. These methods already have inherent advantage of accuracy.

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