

Design of Effective Algorithm for Removal of Multiple Skew in Document Image

Miss. Kashmira Santosh Kolhapur¹ Mr. K. K. Pandey²

¹PG Student ²Associate Professor

^{1,2}Department of Electronics Engineering

^{1,2}PVPIT, Budhgaon, Sangli, India

Abstract— This paper presents a method for estimation and correction of skew angle in document image. The main idea of this method is based on the concept that any document has an object of rectangular shape such as text, lines, and tables. These objects can be restricted by rectangles. The rectangle is formed by cropping the single line when document contain single skew or by cropping multiple lines when document contain multiple skew. Depending on that cropped rectangle skew angle is corrected. The experimental results show high performance of the algorithm in detecting the angle of skew for a variety of document.

Key words: Multiple Skew, Document Image

I. 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 in to 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 skewed paragraph. After that, estimation and correction of skew angle is done.

II. RELATED WORK

For detection of skew angle number of techniques where used previously. In that one is projection profile analysis method 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. 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.

Hough transform analysis 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 [1].

Hough transforms 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.

III. METHOD DESCRIPTIONS

Our method comprises three main steps:

- 1) Pre-processing and thresholding
- 2) Cropping the document
- 3) Skew angle estimation and correction

A. Pre-Processing and Thresholding

Image acquisition is done by image scanning device like camera, scanner. Then first step in preprocessing is conversion of RGB image to gray image and then gray to binary image. Then next step is to remove smaller objects from binary image

B. Cropping the Document

Segmentation of the text lines in an un-constrained handwritten document [3] still a challenging task Document image analysis involves the tasks of text block segmentation, text line separation. There are many problems encountered in the segmentation

- 1) When there are multiple skew present in single document we cannot use same formula for separation of blocks or lines. When line is skewed we have to crop line in such a way that whole data should be taken by that single strip this type of line cropping is challenging.
- 2) Another major problem is of language because there are many technique used previously are based on language, specific code is used for specific language for segmentation of lines. To prepare a single code for all languages is difficult task.

In our proposed method we have overcome all problems mentioned above. Our main goal of cropping the document is to correct skew. So we have to segment data in such a way that, if one paragraph contains single skew that whole paragraph should be cropped in single strip. In another case if paragraph contain two or more skew angles then that paragraph should be cropped in such a way that one strip should contain single skew. No matter that strip is of single line or is of two lines or more than two lines.

C. Skew Angle Estimation and Correction

There are two types of skew: a global skew, when there is a common orientation for all the page blocks; a multiple skew, when several orientations are present on the page (e.g. handwritten pages); we will focus on both cases for correction of skew angle.

Most of the proposed algorithms are appropriate for machine-printed pages and fail when they deal with handwritten documents. Applying other known algorithms

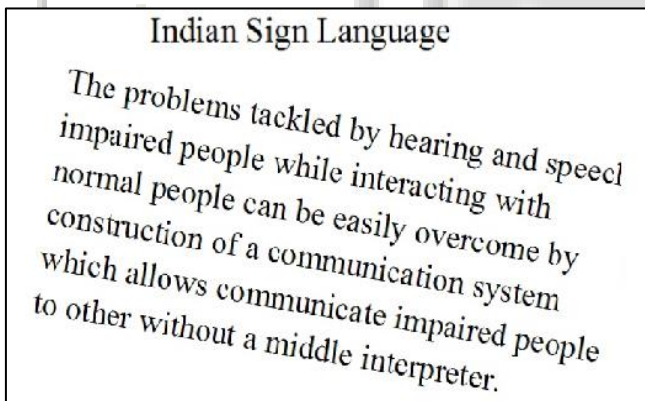
to handwritten pages and underlines that the methods which handle printed pages successfully, either do not manage to deal with handwritten pages with comparable accuracy. Majority of methods usually fail in the case where the language varies.

In this system, the cross-correlation function is used for skew detection [5]. Consider two vertical lines l_1 and l_2 in locations $y = y_0$ and $y = y_0 + d$. Cross-correlation between the two lines is defined as follows:

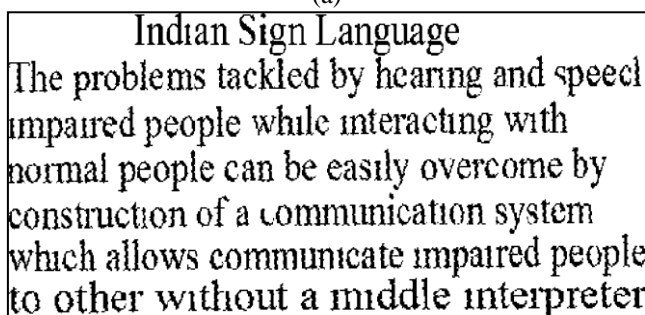
$R_1(y_0, s) = \sum_x f(x, y_0) f(x + s, y_0 + d)$ whenever the value of $f(x, y_0)$ and $f(x + s, y_0 + d)$ grow larger, the result of their multiplication is greater. Whenever the multiplication of $f(x, y_0)$ and $f(x + s, y_0 + d)$ for all values of x becomes larger the value of cross-correlation function between the two lines is greater. Large values of $f(x, y_0)$ and $f(x + s, y_0 + d)$ correspond to the light image pixels. Most of the light image pixels are the pixels between the lines. So, if for most values of $f(x, y_0)$ and $f(x + s, y_0 + d)$ correspond to the light pixels between the lines, the cross-correlation function between the two lines is greater. This happens when s is equal to the distance between two text lines. Taking the distance between two text lines and between two imaginary vertical lines, the text line angle from the horizontal axis can be found. One side of the triangle is the distance between two text lines, and the other side is the distance between the two imaginary vertical lines. Angle θ shown in the triangle is the angle of the text line with the horizontal axis. This angle is the skew of document image. That angle is rotated and final corrected image is obtained.

IV. RESULTS AND DISCUSSION

A. Document having One Line without Skew and another Paragraph with Skew

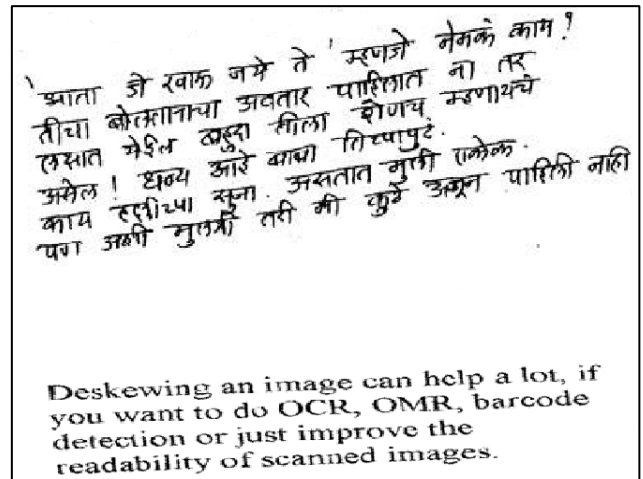


(a)

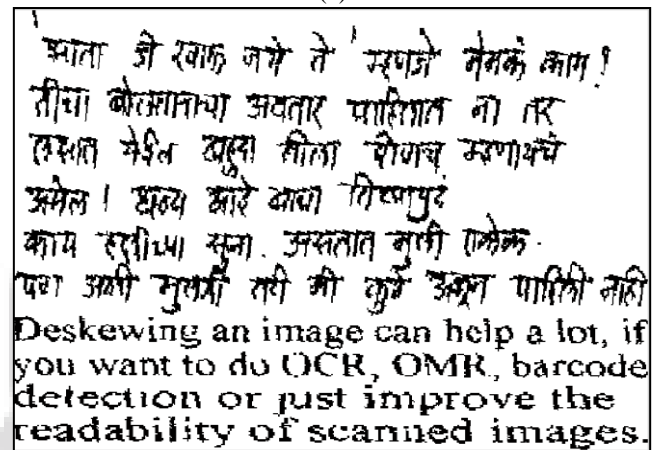


(b)

B. Document Having Combination of Two Languages and Combination of Handwritten and Printed Document

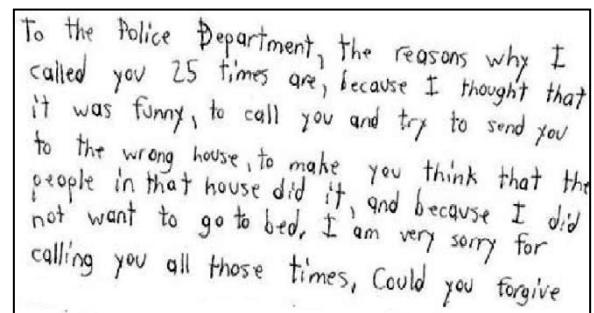


(a)

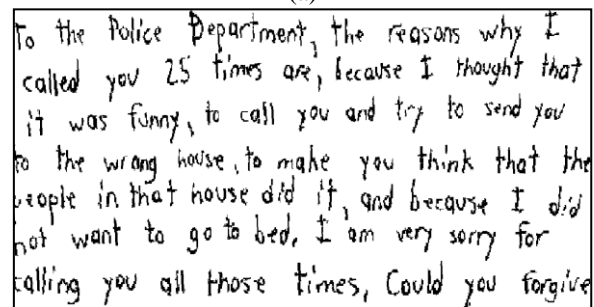


(b)

C. Hand Written Document Having Single Skew

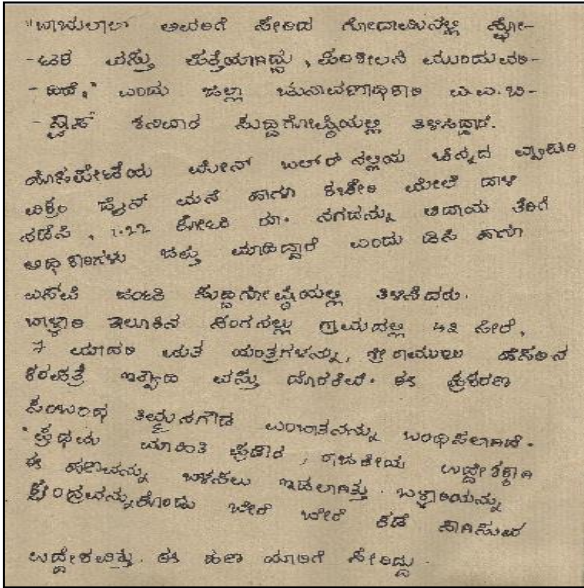


(a)

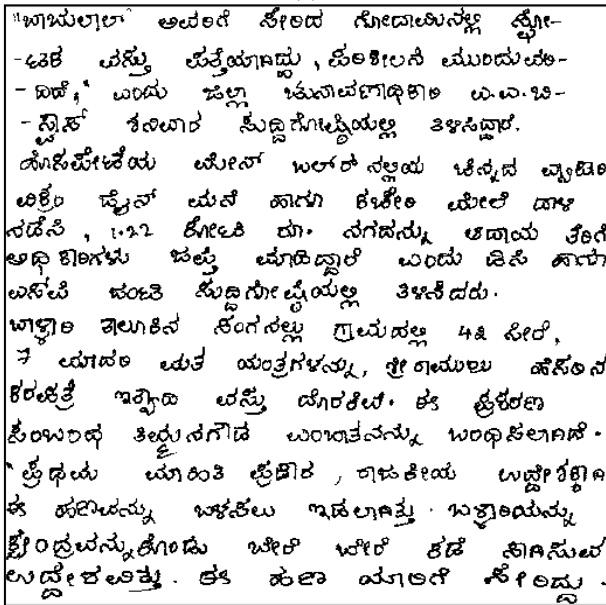


(b)

D. Hand Written Document having Multiple Skew

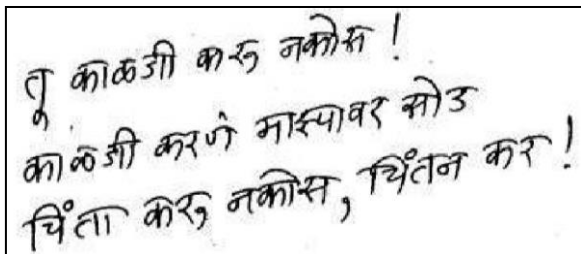


(a)

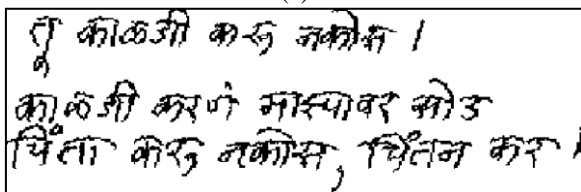


(b)

E. Document having Marathi Language



(a)



(b)

F. Document having Skewed Table

Style No.	Time (min) taken	Time (min) value added activities	Time (min) non value added activities
65540	710	545	165
81323	580	475	105
64079	670	485	185
65546	695	533	162
80204	655	549	106
54077	734	585	149
Total	4044	3172	872

(a)

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(b)

Fig. 1: (a) Different types of skewed documents (b) Final image obtained with corrected Skew angle

Types of examples taken above	Angle of rotation	Time required
Document having one line without skew and another Paragraph with skew	-9.628156e	2.054177e
Document having combination of two languages and combination of handwritten and printed document.	1)5.523221e 2) 2.202598e	9.732799e
Hand written document having single skew	-3.559267e	6.028763e
Hand written document having multiple skew	1)5.841980e 2)-5.996474e	2.145995e
Document having Marathi language.	1.061966e	4.955244e
Document having skewed table	1.289048e	2.916853e

Table 1: Corrected Angles and Time Required for Correction

V. CONCLUSION

	Multiple Skews	Multilingual	Handwritten	Printed	Combination of handwritten and Printed
Kavallier atou et al., (2002)	NO	NO	YES	YES	NO
Gatos et	NO	NO	NO	YES	NO

al., (1997)					
Amin and Wu (2005)	NO	NO	YES	YES	NO
Lu and Tan (2003)	NO	NO	YES	YES	NO
Dey and Noushat h(2010)	NO	NO	NO	YES	NO
Proposed Model	YES	YES	YES	YES	YES

Table 2: Qualitative Comparative Analysis of the Proposed Model with other state of the art techniques

Regarding a study on new technique for document image skew detection and correction method may be gives a good results together. Processing on handwritten documents is quite challenging and prone to errors due to structural complexity and increased character set of languages. An attempt is made in this direction and extraction of lines is done considering documents with different font sizes and font style, then skew detection is carried out by cross-correlation. Obtained skew angle is rotated by that value to get required result. The experimental result shows that the proposed algorithm works on printed as well as handwritten document having multiple skew.

REFERENCES

- [1] C. Singh, N. Bhatia, A. Kaur, "Hough Transform Based Fast Skew Detection and Accurate Skew Correction Methods", *Pattern Recognition* 41 (2008) 3528 – 3546.
- [2] C.-H. Chou, S.-Y. Chu, F. Chang, "Estimation of Skew Angles for Scanned Documents Based on Piecewise Covering By Parallelograms", *Pattern Recognition* 40 (2007) 443 – 455.
- [3] Yi Li, Yefeng Zheng, David Doermann, Stefan Jaeger, "Script-Independent Text Line Segmentation in Freestyle Handwritten Documents." *IEEE Transactions on Pattern Analysis and Machine Intelligence*, vol. 30, no. 8, Aug. 2008.
- [4] X. Jiang, H. Bunke, D. Widemer-Kljajo, "Skew detection of document images by focused nearest-neighbor clustering", in: *Proceedings of the Fifth International Conference on Document Analysis and Recognition*, (1999), pp. 629–632.
- [5] Sepideh Barekat Rezaei, Abdolhossein Sarrafzadeh, and Jamshid Shanbehzadeh "Skew Detection of Scanned Document Images" *Proceedings of the International MultiConference of Engineers and Computer Scientists 2013 Vol I, IMECS 2013, March 13 - 15, 2013, Hong Kong*
- [6] J. V. Beusekom, F. Shafait, T. M. Breuel, "Resolution Independent Skew and Orientation Detection for Document Images", (2009), *SPIE-IS&T / Vol. 7247*.
- [7] H. Yan, "Skew Correction of Document Images Using Interline Cross-Correlation," *CVGIP: Graphical Models and Image Processing*, vol. 55, pp. 538-543, 1993.
- [8] Kavallieratou K., Fakotakis N., and Kokkinakis G.,: Skew angle estimation for printed and handwritten

- documents using wigner-ville distribution. *Image and Vision Computing*, pp. 813 – 824 (2002)
- [9] Gatos, B., Papamarkos, N., Chmzas, C.,: Skew detection and text line position determining in digitized documents, *Pattern Recognition*, Vol.30, no. 9, pp. 1505 – 1519. (1997)
 - [10] Amin, A., Wu, S.,: Robust skew detection in mixed text / graphics documents, *International conference on document analysis and recognition*, Vol.1, pp. 247-251. (2005)
 - [11] Lu, Y., Tan, C, L.,: A nearest- neighbour chain based approach to skew estimation in document images, *Pattern Recognition letters*, Vol. 24, pp. 2315-2323. (2003)