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# Skew recognition

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## ABSTRACT

***Skew detection has been an important part of the document recognition system. If the document includes the skew it will be difficult for reader to read the document. In the proposed work, new techniques that detecting the angle of skewed document. The main advantage is that the method works on all types of scripts. The major problem with the existing systems was that they just rotate the entire document in the reverse direction of the angle detected to remove the skew but the proposed system process the document on the line by line basis using scan line algorithm and skew angle is detected with the help of hough transformation. The performance of the proposed system is calculated on various images having different types of skew in them. The overall accuracy of the proposed system is 98% which is far better than that of existing system. In future the proposed system can be extended for colored images and other types of documents. Proposed system can also be extended to made it for word level skew detection and correction to get more accuracy.***

***Keywords:*** *Skew Detection, Hough Transformation, Scan Line Algorithm, Document Skew Detection, Image Processing.*

## 1. INTRODUCTION

The detection and correction of document skew is one of the most important document image analysis steps. Page layout analysis and preprocessing operations used for character recognition depend on an upright image or, at least, knowledge of the angle of skew. A few methodologies have been proposed as choices for skew point identification of document images. Profile project technique is a popular method for skew detection. It is capable of locating fragmented lines in a binary image. Therefore given a group of black pixels, one can find the imaginary line or lines that go through the maximum number of these pixels. Existing techniques doesn't work for images in which there is unequal space patterns in between the lines. Existing techniques cannot detect the skew in multiscript documents. Existing system is not capable of detecting correcting the upward and downward skew together in a single text document. Existing system Rotate the whole document at once to correct the skew from the given text document. A lot of work is required to be done in context of skew detection and correction for multiscript text images. These problems are required to be solved to make use of the system in the real world applications. The proposed system for skew detection and correction is implemented with the help of scan line algorithm along with hough transformation algorithm. Proposed system works on the document in line by line basis i.e. detect and correct the skew of every line independently. It can work on the documents having multiple scripts on it. It can detect and correct the skew from the documents even if there is an unequal space in between the two adjacent lines. It will rotate the document on line by line basis to correct the skew from the given document. Detects and correct the upward and downward skew together in the single text document.

## 2. TYPES OF DOCUMENT SKEW

There are two sort of skew in record pictures
1. Single Skew
2. Numerous Skew

**Single Skew:** In this skew, entire archive is skewed to single edge. A large portion of report pictures have this sort of skew-ness. This work manages Single Skew issue. Part of work has been done in this field and parcel of research is as yet going on.

**Multiple Skew:** In this, examined record can have numerous areas; each might be skewed to various point. Distinguishing such kind of skew-ness needs part of endeavors. Numerous Skew issue exists infrequently and lacks parcel consideration from specialist.

## 3. LITERATURE SURVEY

Darko Brodić & Zoran N. Milivojević.et.al [2016], utilized Combined Entropy Algorithm for slant recognition. This paper proposes the calculation for text slant assessment dependent on the joined entropy figuring. The strategy comprises of three

 

stages. In the initial step, it computes the flat and vertical projection profiles. In the subsequent advance, the level and vertical entropy for the unpleasant points is determined. In the last advance, the horizontal and vertical entropy figuring for the smooth edges is performed. The determined entropy makes the two cost capacities: level and vertical. The position where every one of cost capacities has an outright least speaks to level and vertical assessed text slant edge. In the last advance, it gauges the content slant point as a mean of even and vertical assessed text slant edges. The usefulness, accuracy and vigor of the proposed calculation is examined by the analysis, which depends on DISEC'13 report information base.

Postal et.al. [1988], utilized the flat projection profile for slant recognition. He utilized the whole of squared contrasts between contiguous components of the projection profile as the rule work.

Bloomberg and Kopek et.al. [1993], utilized the fluctuation of the quantity of dark pixels in each line as the measure work esteems. They included an element choice sub-step before ascertaining the projection profile and down examining the picture, to decrease the computational weight of this technique .In down inspecting of the picture, the quantity of picture lines and sections are chosen. In this way, picture down inspecting is an element choice sub-step. In the measurement decrease step, the picture is pivoted to various points. These edges are the conceivable slant and decide the inquiry space. In 1995, Bloomberg and his associates, so as to lessen the inquiry space measurement, included an element choice sub-venture to the start of the measurement decrease step. The contribution of this sub-step is the entire pursuit space and the yield is a little chosen aspect of the entire hunt space that the slant put in it. In this sub-step, they ascertain the projection profile for a succession of edges. A range around the point that amplified the model capacity is the yield scope of this sub-step. With the execution of the calculation dependent on this range, higher goal can be accomplished.
Kavallieratos et.al. [1999], utilized the flat projection profile and a few time-recurrence dissemination of Cohen's group to slant recognition. They included an element extraction sub-step among "an" and "b" in the measurement decrease step and determined Cohen's conveyance of projection profile. They utilized the histogram of most extreme power of every dispersion as a reasonable component for slant discovery, and they acquired the edge relating to the greatest estimation of that histogram as the slant. They show that Wigner-Ville circulation, regarding exactness and computational time is superior to different dispersions of Cohen's group.

## 4. RESEARCH GAP

Existing techniques doesn't work for images in which there is unequal space patterns in between the lines. Existing techniques cannot detect the skew in multiscript documents. Existing system is not capable of detecting correcting the upward and downward skew together in a single text document. Existing system Rotate the whole document at once to correct the skew from the given text document. A lot of work is required to be done in context of skew detection and correction for multiscript text images. These problems are required to be solved to make use of the system in the real world applications.

## 5. PROPOSED METHODOLOGY

Scan line detection or Hough transformation is a good choice for skew detection for scanned documents or text images where we detect the skew of the image by casting rays along the image horizontally and vertically through different angles. Generally in text images or scanned document type of images all texts are oriented in a particular direction so only object is text.

But in case of regular images there are many objects inside an image so we can not detect any particular object and then calculate its orientation. In that case we have to use edge detection technique.

To apply Scan Line to any particular document image we need to cast a horizontal line across the image from one side to the other say from top to bottom or left to right. In this algorithm for document type of images we need to cast lines from left to bottom and then count the pixels encountered by those rays and then again performing the same operation with the same lines being rotated by a small amount. We track that angle for which the pixels encountered is highest as the skew of the images. [3]
In case of regular image we need to first convert the regular image into the its corresponding edge and then we perform the same operation mentioned above and check the skew.

## 6. ALGORITHM FOR SCAN LINE

1. First find out the coordinate of those scan lines that are at slope of θ in the plane. We can do this by bresenham's algorithm.
2. Count the number of pixels encountered by each of those scan line.
3. Then calculate variance value v of the total black pixels that is cut by the scan line for angle θ.
4. Pick up that theta for which v is maximum.

## 7. HOUGH TRANSFORMATION

Hough transformation is one of the basic boundary detection and edge linking technique to identify location of a special class of shape. Main motive of this technique is to find the number of object or instances of a particular class of such instances or object drawn on a voting process. The process is done through the introduction of parameter space. For a particular parameter space objects are collected as local maxima.[4]Thealgorithmperformsatotalcheckthenitcomputestheglobalmaxima.
We know that any straight line can be expressed through the equation

$$y = mx + c$$

we call $m$ the slope of the straight line and $c$ the intercept og the $y$-axis. In hough transformation model we represent a straight line as the slope intercept model.

 

The same equation can be written in polar form

$$y = -\frac{\cos\theta}{\sin\theta}x + \frac{r}{\sin\theta}$$

Where $\theta$ is the vector orthogonal to the line pointing towards the half upper plane. Now we can write it in a different way

$$r = x\cos\theta + y\sin\theta$$

So each edge of an image can be represented with a unique value of $r$ and $\theta$. Form these things it comes to be quite clear that a horizontal line will have $\theta$ equals to 0 and a vertical line will have $\theta$ equals to 90.

When we proceed for finding the skew first of all we have to interpret boundaries between which $\theta$ and $r$ lies. we can notice that $\theta$ can lie between −90 to +90 degrees and $r$ can lie between $-D$ and $D$. Where $D$ is the maximum distance between opposite.

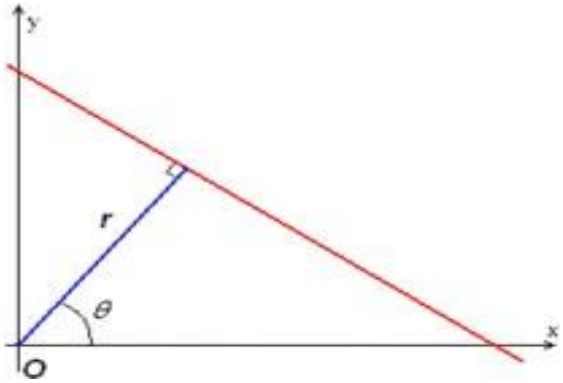


**Fig. 1: Representation of line**

Corner of the objects:

$$-90 <= \theta <= 90$$

$$-D <= r <= D\ ,$$

Where D is the maximum distance between opposite corners of the object. We take each pixel background or non-background and analyze. The pixel which is located at $(i, j)$ are set with an accumulator value $A(i, j)$. Each pixel is the square associated with the point with $r$ and $\theta$ values as $(r_i, \theta_j)$. We initialize each square to zero. Then we encounter each non-background point $(x_k, y_k)$ in the $XY$ plane. Now for each possible value of $\theta$ we compute the equation

$$r = x_k\cos\theta + y_k\sin\theta$$

we take all value of $r$ for each possible value of $\theta$ and round off each $r$ value to the near most point along $r$ axis.

For an example let us take $\theta_m$ and we get from that $r = r_n$, then we update the value $A(m, n) = A(m, n) + 1$. The more subdivision we consider in the $r, \theta$ plane the more accurate result we get. These are the sequential step to find out skew of an image through Hough transformation method.

1. Take each of the non-background pixel $P\ ({}^{i}x'_{i}, {}^{j}y'_{j})$ in account.
2. Calculate the value of $r$ for each value of $\theta$ i.e. $-90 <= \theta_i <= 90$ an round off the values obtained as result of r to the near most valid square cell value through the $r$-axis.
3. Increment the related matrix cell by one.

## 8. RESULTS AND DISCUSSION

The performance of the proposed system is tested on more than 60 documents written in singular as well as multiple languages. Proposed system is developed and performance of the proposed system is evaluated using MATLAB. Various image types conating various types of skew has been used for testing purpose. Proposed system uses Edge detection and scan line line algorithm to achieve the great accuracy. The overall accuracy of the proposed system is evaluated to as 98%.

**Table 1: Statistics of the proposed system**

| Parameters | Value |
|---|---|
| No. of Images Tested | 60 |
| Skew detected and corrected | 59 |
| Overall System accuracy | 98 |
| Avg. Time | 1.98 |
| Scripts | Punjabi, Hindi and English |
| Type | Printed and Handwritten |

## 9. CONCLUSION AND FUTURE WORK

### 9.1 Conclusion

The proposed system for skew detection and correction is implemented with the help of scan line algorithm along with Hough transformation algorithm. The major problem with the existing systems was that they just rotate the entire document in the reverse direction of the angle detected to remove the skew but the proposed system process the document on the line by line basis using

 

scan line algorithm and skew angle is detected with the help of Hough transformation. The performance of the proposed system is calculated on various images having different types of skew in them. The overall accuracy of the proposed system is 98% which is far better than that of existing system.

**9.2 Future scope**

In future the proposed system can be extended for colored images and other types of documents. Proposed system can also be extended to made it for word level skew detection and correction to get more accuracy.

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