# IMAGE PROCESSING GROUP PROJECT

**Project Name:** Skew correction of Text Image


**Group**

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## Literature Review

Correcting the skewedness of a Text Image is a crucial step before performing other computer vision operations on it such as OCR etc.

We will be using Hough Line Transform to perform correction of the skewed lines in our text image.

### What is the Hough Line transform

The Hough Line Transform is a fundamental technique in image processing and computer vision, primarily used for detecting straight lines in images. Introduced by Paul Hough in 1962, this method has undergone various enhancements and adaptations to improve its efficiency and accuracy.

**Basic Concept**

The Hough Line Transform works by transforming points in the image space into a parameter space, where each point in the image space corresponds to a line in the parameter space. The most common parameterization is the polar coordinate system, where a line is represented by the parameters (ρ, θ). Here, (ρ) is the perpendicular distance from the origin to the line, and (θ) is the angle between the x-axis and the line's normal.

**Applications**

Object Recognition: Detecting edges and shapes in object recognition tasks.

Medical Imaging: Analyzing structures in medical images, such as blood vessels.

In this literature review we cite the sources that we will be building our own implementation of the Hough Line Transform

- A Review of Hough Transform and Line Segment Detection Approaches - VISAPP_2015_78.pdf (mdx.ac.uk)
  Payam S.Rahmdel, Richard Comley, Daming Shi and Siobhan McElduff
- Transmission Line Detection Based on Improved Hough Transform
  Wei Song, Pei Li, Man Wang - 2402.02761 (arxiv.org)
- A Review Paper on Hough Transform and it's Applications in Image Processing
  Biswajit Sit, Md. Iqbal Quraishi. - 27_81_A Review.pdf (ijirset.com)
- Text Document Alignment using Probabilistic Houghline Transform
  Netra Prasad Neupane

## Problem Definition: Skew Correction in Text Images for OCR

Skew correction is a critical preprocessing step in Optical Character Recognition (OCR) systems. It involves detecting and correcting the angular deviation of text lines in scanned or photographed document images. This process ensures that the text lines are horizontally aligned, which significantly improves the accuracy of subsequent OCR processes.

**Importance in OCR**

Improved Accuracy: Skewed text lines can lead to misinterpretation of characters by OCR algorithms, resulting in errors. Correcting skew enhances the readability and accuracy of text recognition.

Preprocessing Necessity: Skew correction is often a prerequisite for other preprocessing steps like binarization, noise removal, and segmentation, which are essential for effective OCR.

## Tentative Solution

**To create a program that detects and corrects skewedness of the text in an image.**

**Skew Detection:**

Objective: Identify the angle of skew in the document image.

Challenges: Variability in text alignment, presence of noise, and different font styles can complicate accurate skew detection.

**Skew Correction:**

Objective: Rotate the image to correct the detected skew angle, aligning the text lines horizontally.

Challenges: Ensuring minimal distortion of the text and maintaining the integrity of the document layout during rotation.

**Finally output the Skew corrected image ready for OCR**

## Proposed Methodology

1. **Image Acquisition**
2. **Pre-processing**
    - Converting image to grayscale: Reduces the image to shades of gray, simplifying the color information.
    - Blur image: Smooths the image by averaging pixel values, reducing noise and detail.
    - Threshold image: Converts the image to a binary format, distinguishing objects from the background.
    - Erode image: Removes small noise by shrinking the white regions in a binary image.

- Dilate image: Expands the white regions in a binary image, filling in small holes and gaps.

3. **Processing**
   - Use the Probabilistic Hough Line Transform which detects lines from the given document image.
   - Find the slope of each line to get the rotation angle.
   - Rotate the Image

## Tools/Techniques

### Probabilistic Hough Line Transform

The Probabilistic Hough Line Transform (PHT) is an optimized version of the standard Hough Line Transform used to detect lines in an image. Unlike the standard method, which considers all edge points, PHT randomly selects a subset of edge points to reduce computational complexity. This makes it more efficient, especially for large images or real-time applications.

### OpenCV

To implement PHT we use the OpenCV Library, which is an open-source computer vision and machine learning software library. The library has more than 2500 optimized algorithms, which includes a comprehensive set of both classic and state-of-the-art computer vision and machine learning algorithms. These algorithms can be used to detect and recognize faces, identify objects, classify human actions in videos, track camera movements, track moving objects, extract 3D models of objects, produce 3D point clouds from stereo cameras, stitch images together to produce a high resolution image of an entire scene, find similar images from an image database, remove red eyes from images taken using flash, follow eye movements, recognize scenery and establish markers to overlay it with augmented reality, etc.

The tutorial for how to use/implement PHT using OpenCV.