Robust Automatic Detection and Extraction of a Document in an Images

Detect a document in an image, crop and transform to flatten it and reduce to black and white

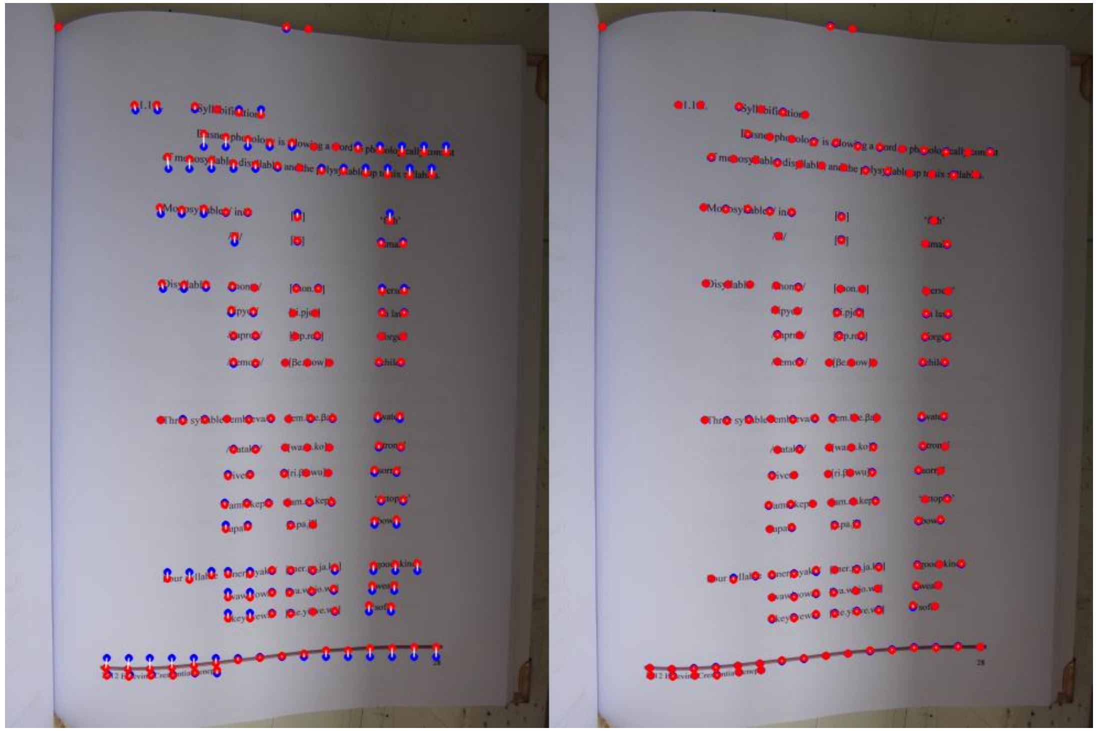
By Christopher Skorka

Introduction

- **Detects the document** in the image
  - Detect **corners**
  - Detect edges and **hough lines**, group similar lines and **find intersections**
  - Detect 4 cornered **contours**
- **Combine** the data to determine the 4 corners
- **Local search** to estimate parameters for the above tasks
- **Crop and transform** the image to **flatten the document**
- Recued colours to **black and white** (optional)
  - Using **Otsu's method**.
  - **Thresholds gradient** to overcome shadow gradients

Previous work

- Detecting **contours**
  - Using a only contours my not be as accurate as possible
- De-wrapping by **detecting horizontal lines** of text
  - calculates transformations from these **lines**.
  - Requires horizontal text
  - Requires **image from directly above**



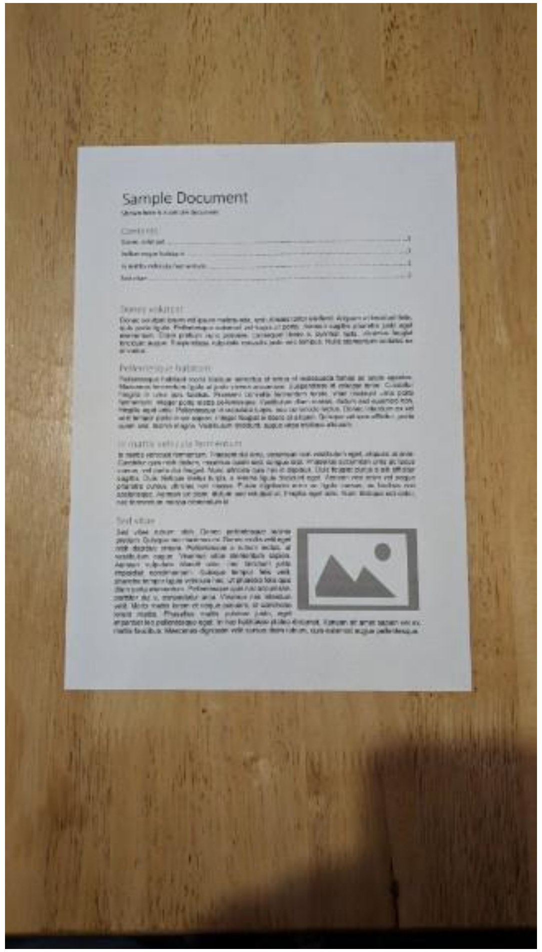
https://mzucker.github.io/2016/08/15/page-dewarping.html

Technical approach

- Preparation
    - Gaussian smoothing
    - Closing (dilating and eroding)
- Corner detection
    - Harris corner detection
    - Dilate to points
- Edge detection
    - Canny edge detection
    - Hough lines
- Contour detection
    - Contour from canny edge
    - Filter polygons of degree 4
- Detect document
    - Match hough line intersections with corners
- Image transformation
    - Transform corners of the page to the full image
- Color thresholding
    - Otsu’s method to produce a binary image

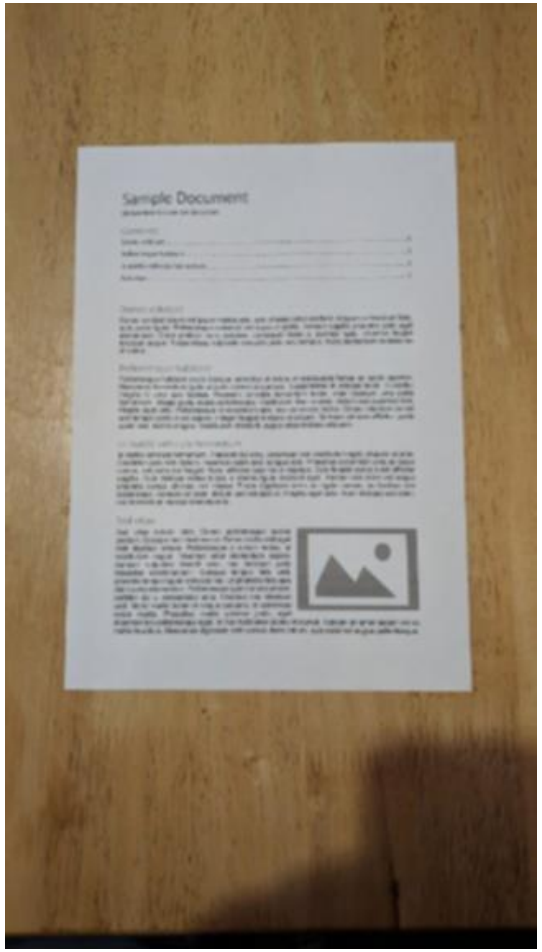
Gaussian smoothing

Original



Sample Document

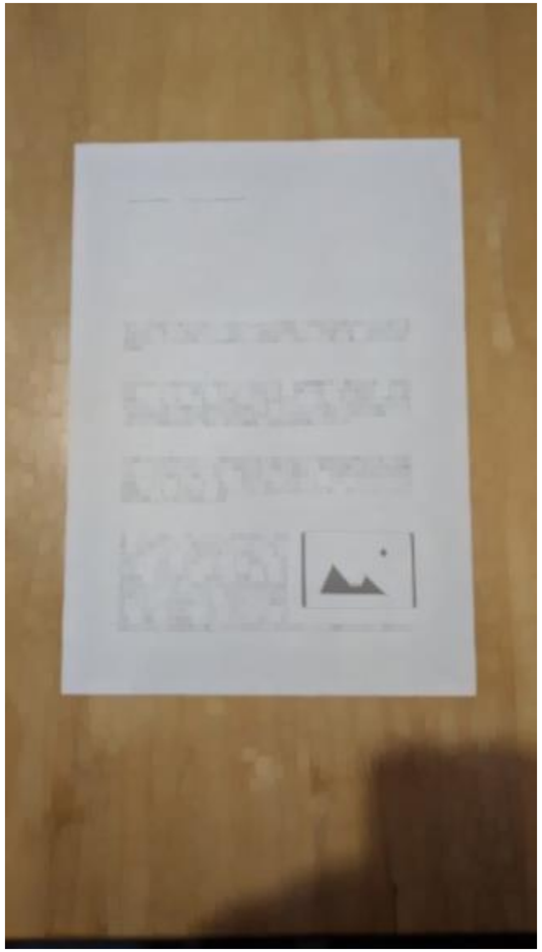
Smoothed



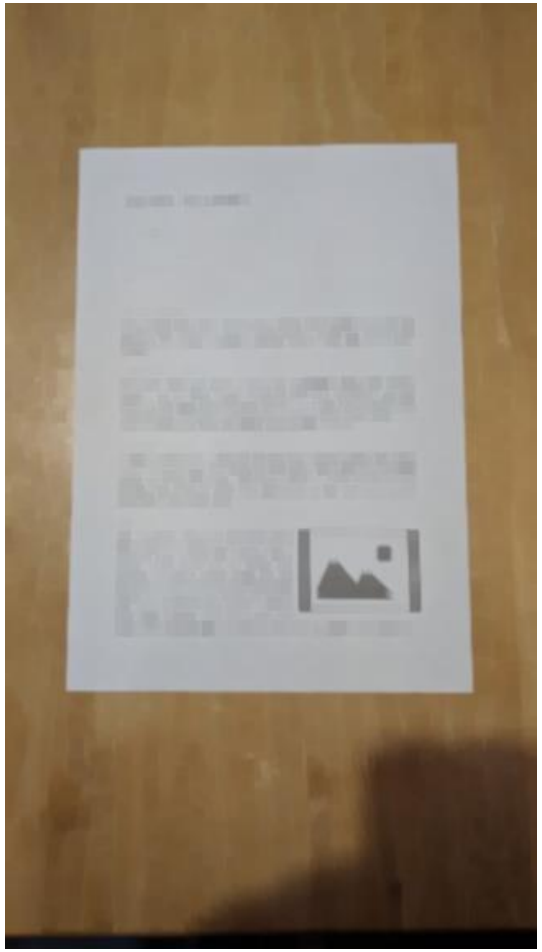
Sample Document

Closing (dilating and eroding)

Dilated

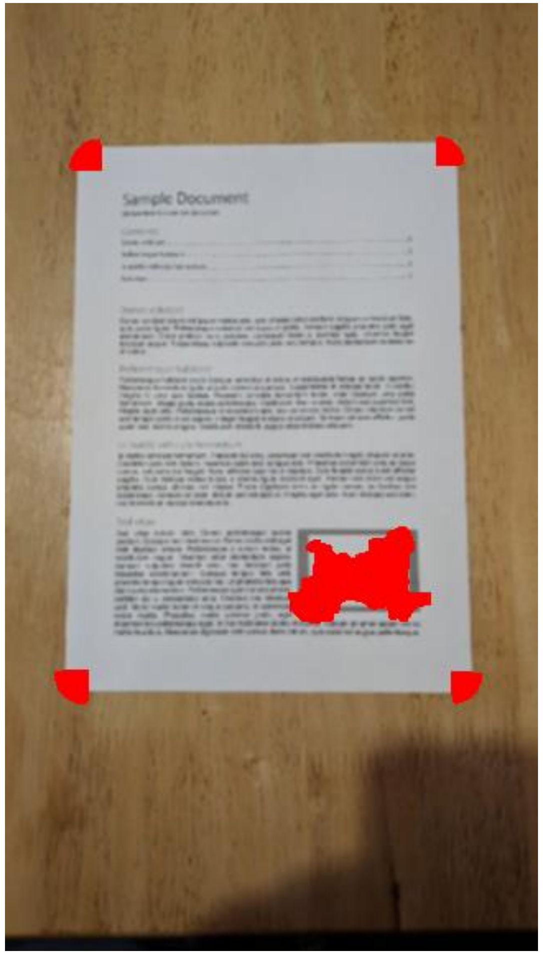


Eroded



Corner detection

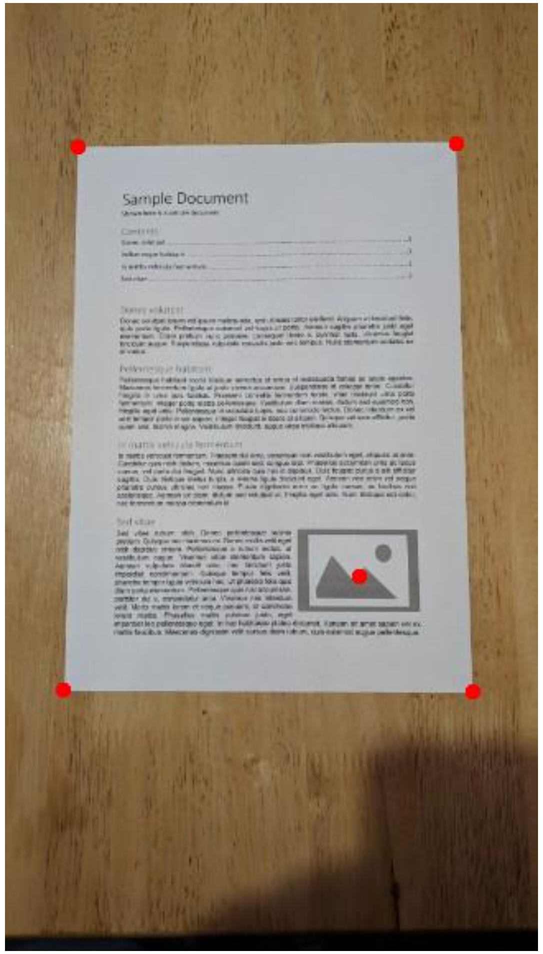
Harris corner detection



Eroded corners

Detects centres of each corner blob

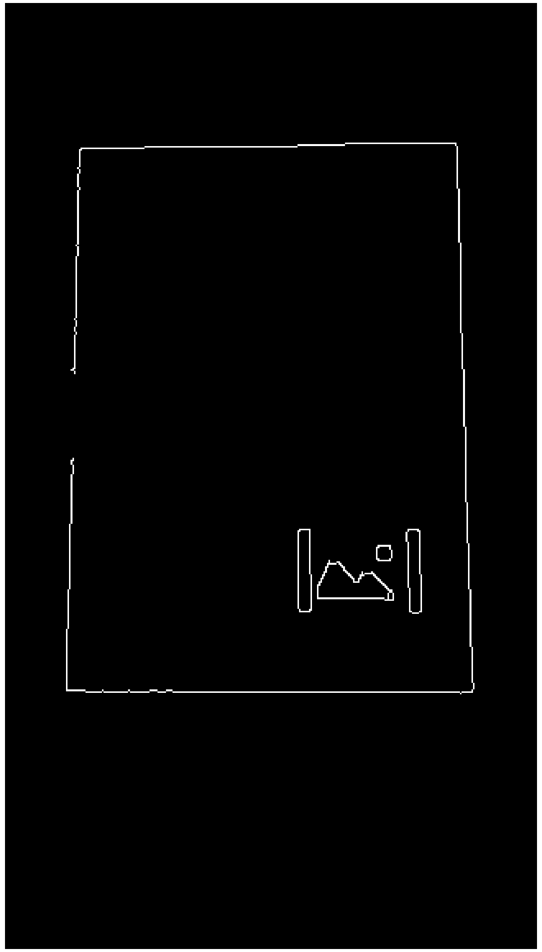
Not yet implemented



Edge detection

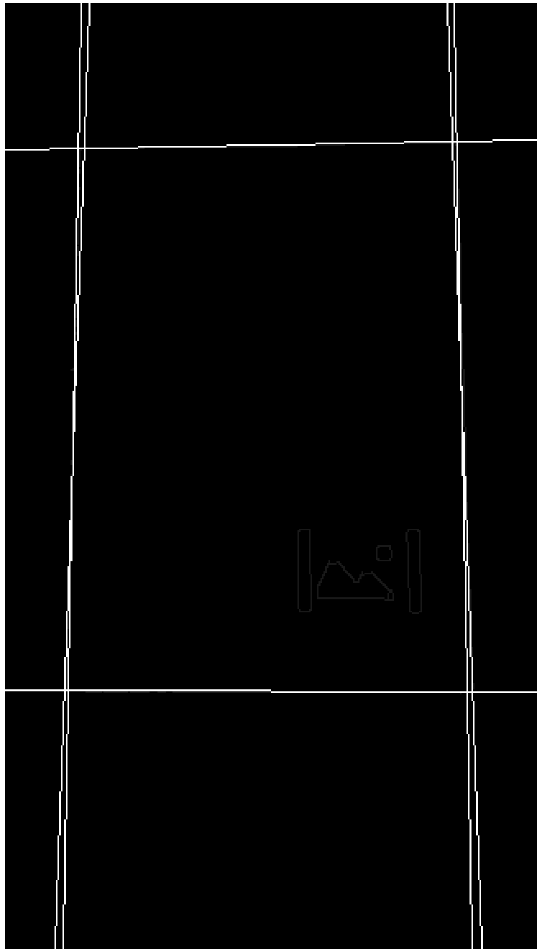
Canny edge detection

Algorithm adjusts thresholds as needed



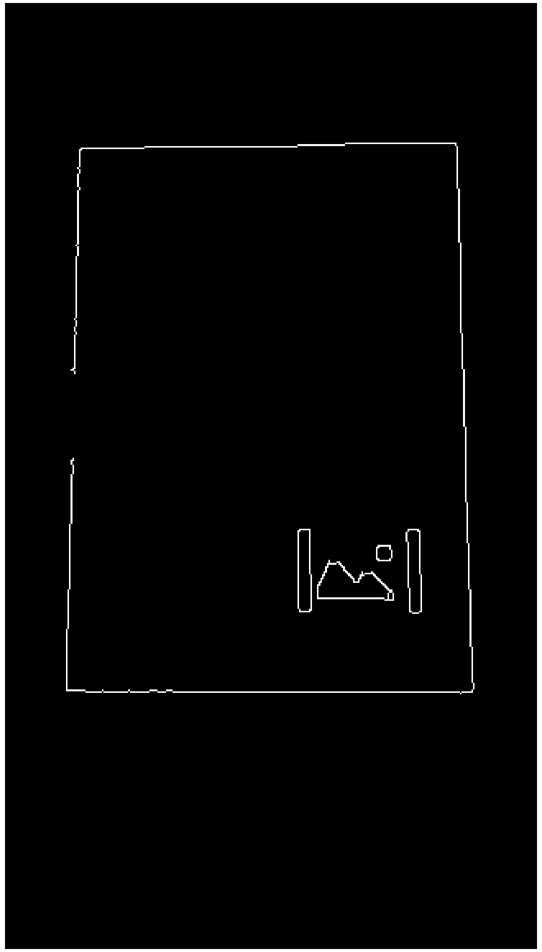
Hough lines

Similar lines will be merged

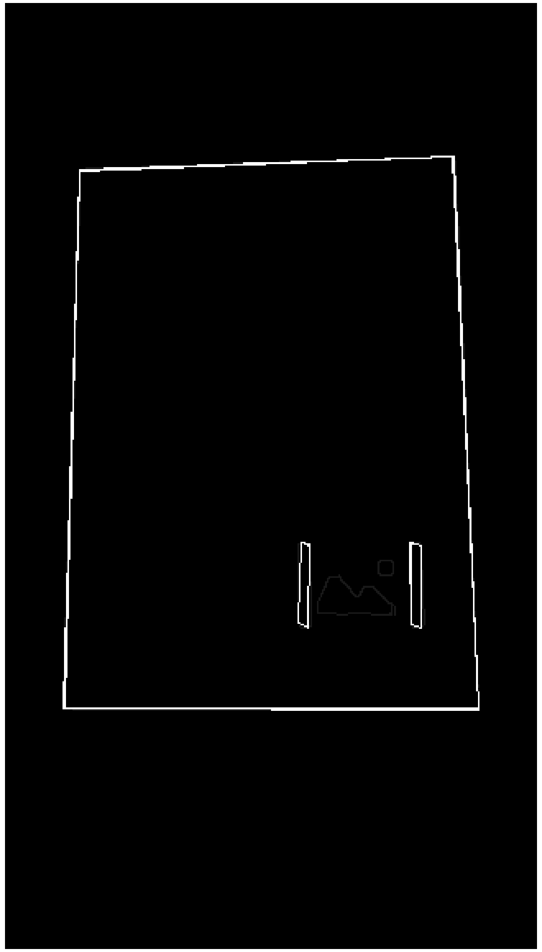


Contour detection

Canny edge detection



4 sided polygons



Detect document (not implemented)

Algorithm

- **Local search algorithm** searches parameters **until 4 corners are found** with sufficient confidence

Eg

- Repeatedly adjust canny parameters until
    - 4 line intersections are mapped to 4 corners
    - If too many matches increase canny threshold
    - If too few matches decrease canny threshold

Image transform (not implemented)

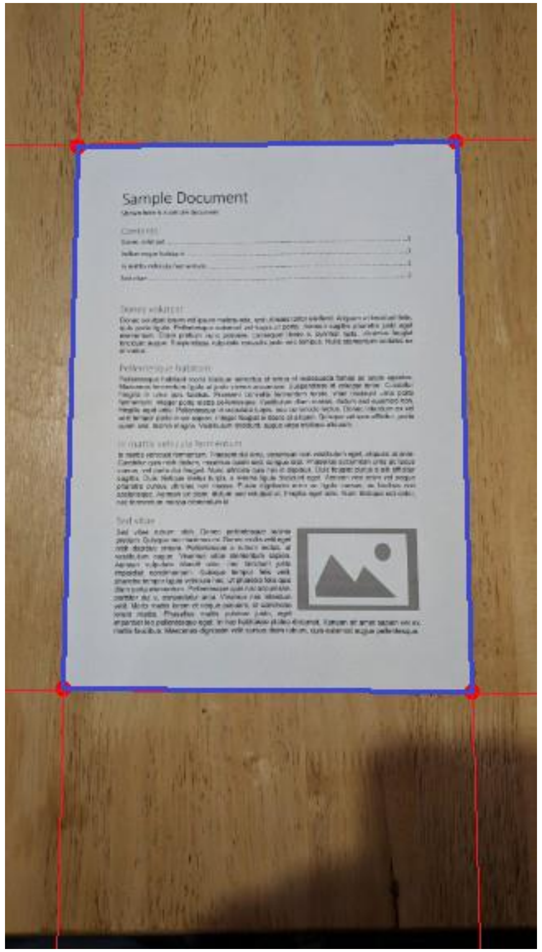
Detected document

Transform flatten

Crop

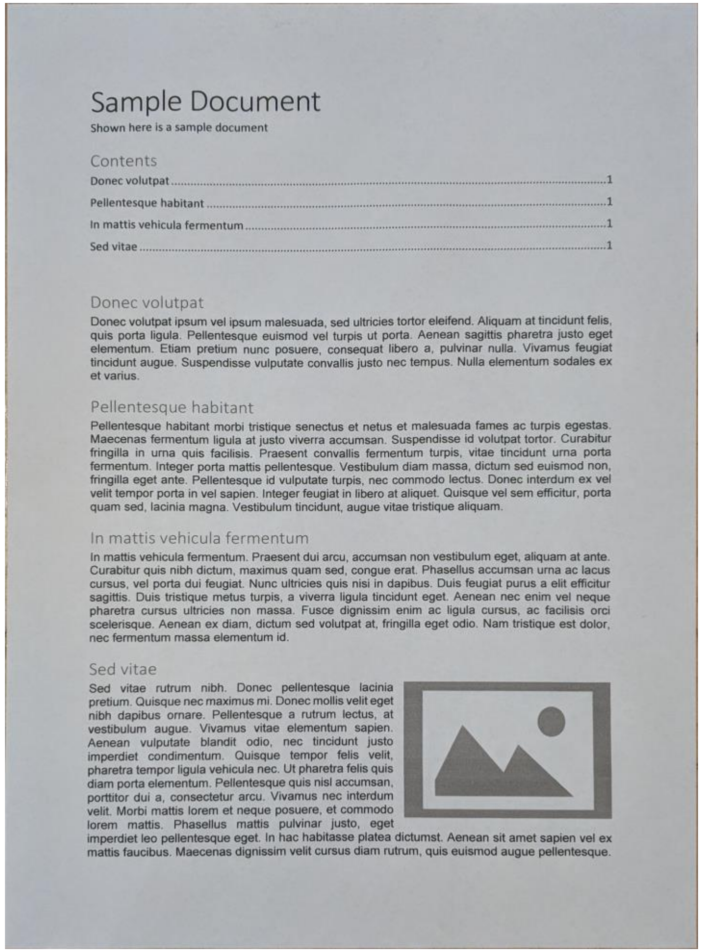
Keep aspect ratio

(not yet implemented)



Transformed

Retain aspect ratio of document



Sample Document

Shown here is a sample document

Contents

Donec volutpat

Donec volutpat ipsum vel ipsum malesuada, sed ultricies tortor eleifend. Aliquam at tincidunt felis, quis porta ligula. Pellentesque euismod vel turpis ut porta. Aenean sagittis pharetra justo eget elementum. Etiam pretium nunc posuere, consequat libero a, pulvinar nulla. Vivamus feugiat tincidunt augue. Suspendisse vulputate convallis justo nec tempus. Nulla elementum sodales ex et varius.

Pellentesque habitant

Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Maecenas fermentum ligula at justo viverra accumsan. Suspendisse id volutpat tortor. Curabitur fringilla in urna quis facilisis. Praesent convallis fermentum turpis, vitae tincidunt urna porta fermentum. Integer porta mattis pellentesque. Vestibulum diam massa, dictum sed euismod non, fringilla eget ante. Pellentesque id vulputate turpis, nec commodo lectus. Donec interdum ex vel velit tempor porta in vel sapien. Integer feugiat in libero at aliquet. Quisque vel sem efficitur, porta quam sed, lacinia magna. Vestibulum tincidunt, augue vitae tristique aliquam.

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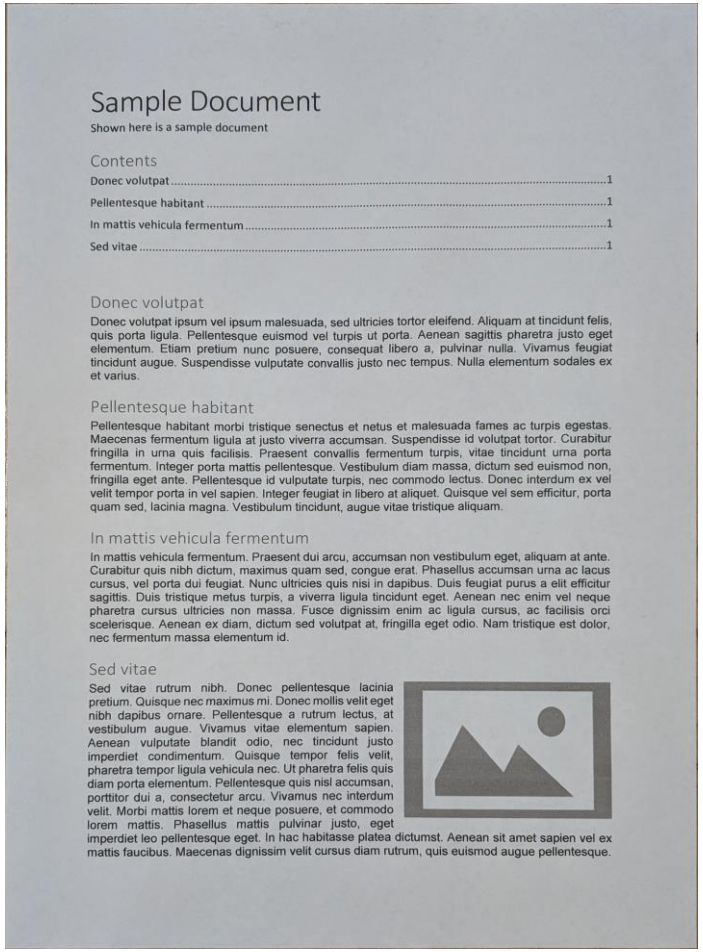
Color thresholding (Optional)

Transformed document



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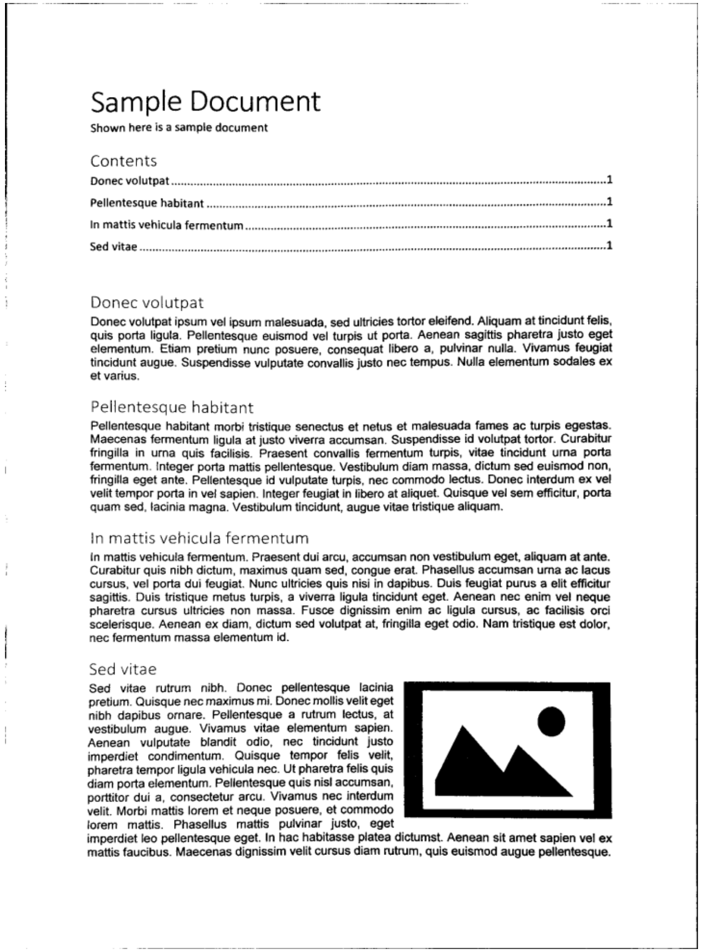
Binary coloured image

Limits the document to black and white



Sample Document

Shown here is a sample document

Contents

Donec volutpat 1
Pellentesque habitant 1
In mattis vehicula fermentum 1
Sed vitae 1

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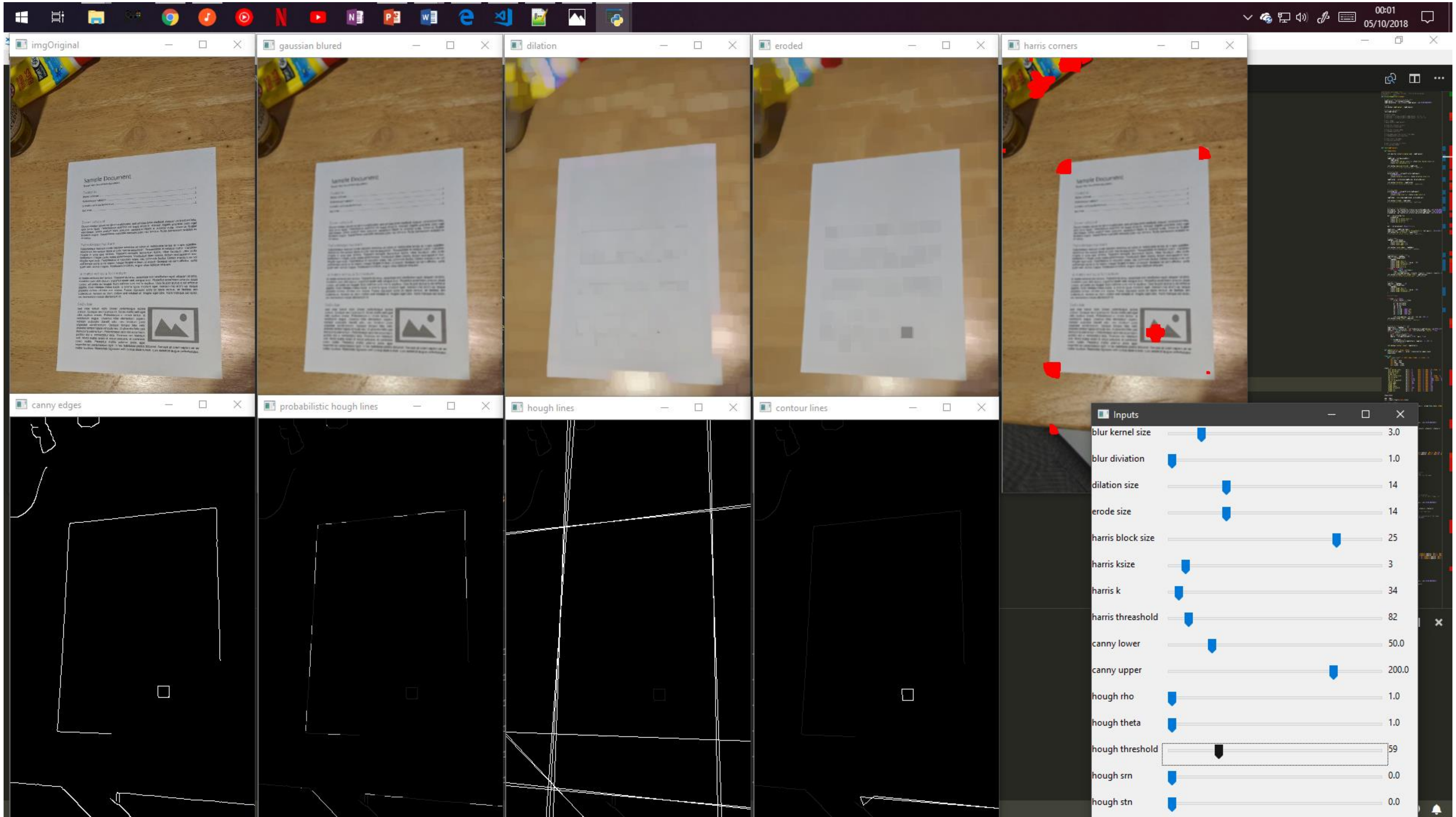
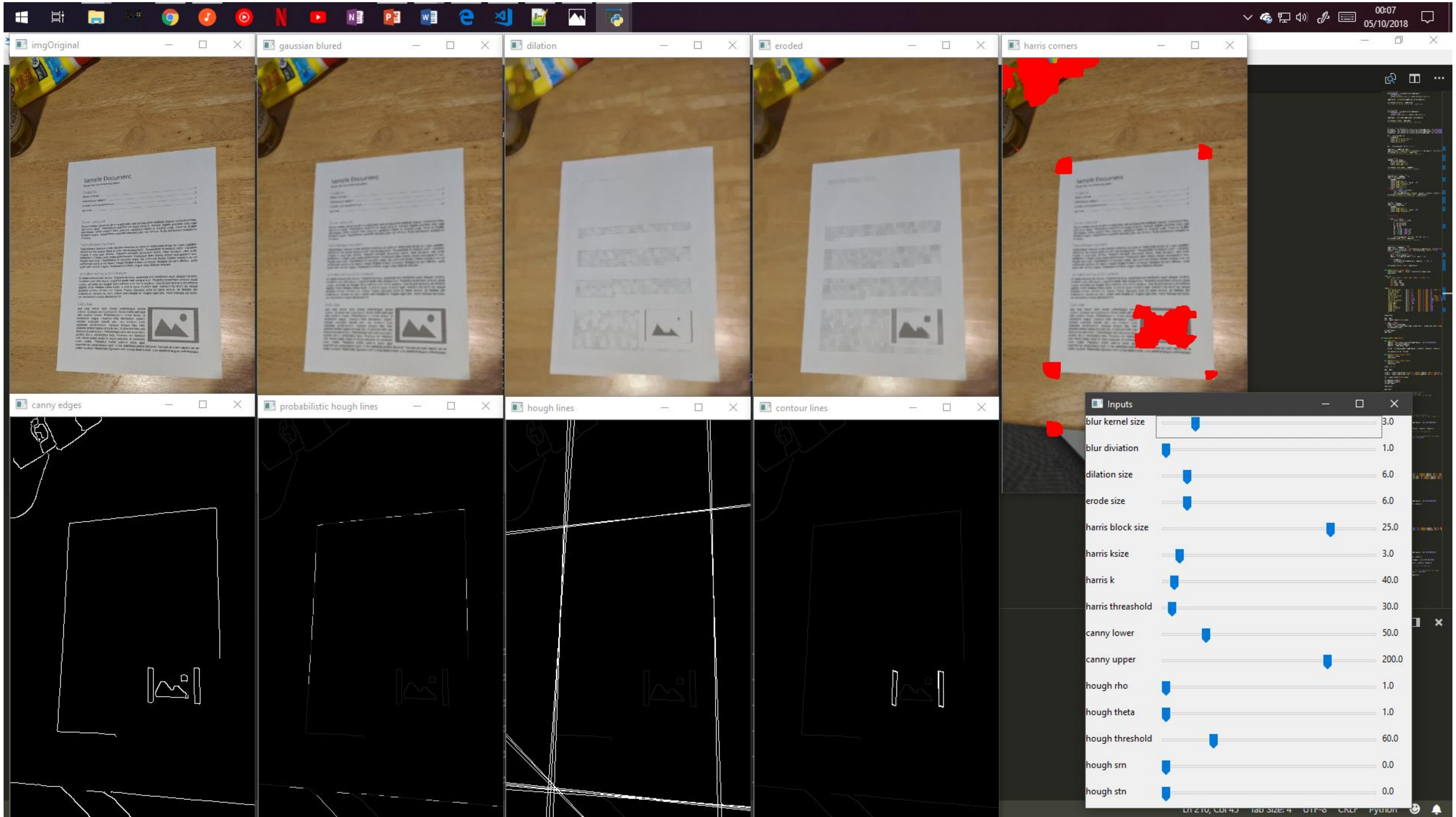
Result (so far)



Inputs

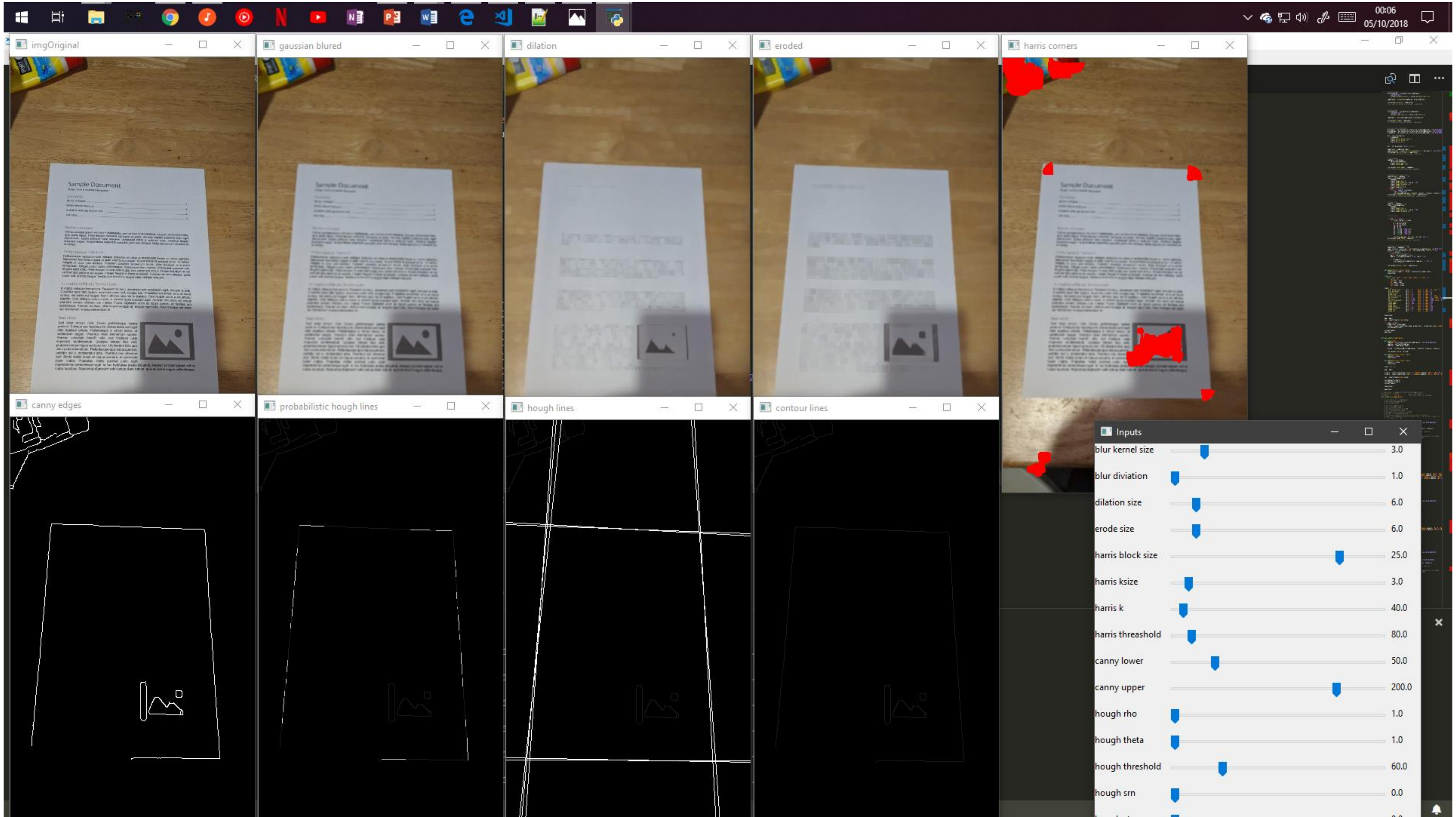
blur kernel size	3.0
blur diviation	1.0
dilation size	14
erode size	14
harris block size	25
harris ksize	3
harris k	34
harris threashold	82
canny lower	50.0
canny upper	200.0
hough rho	1.0
hough theta	1.0
hough threshold	59
hough srn	0.0
hough stn	0.0

Result (so far)



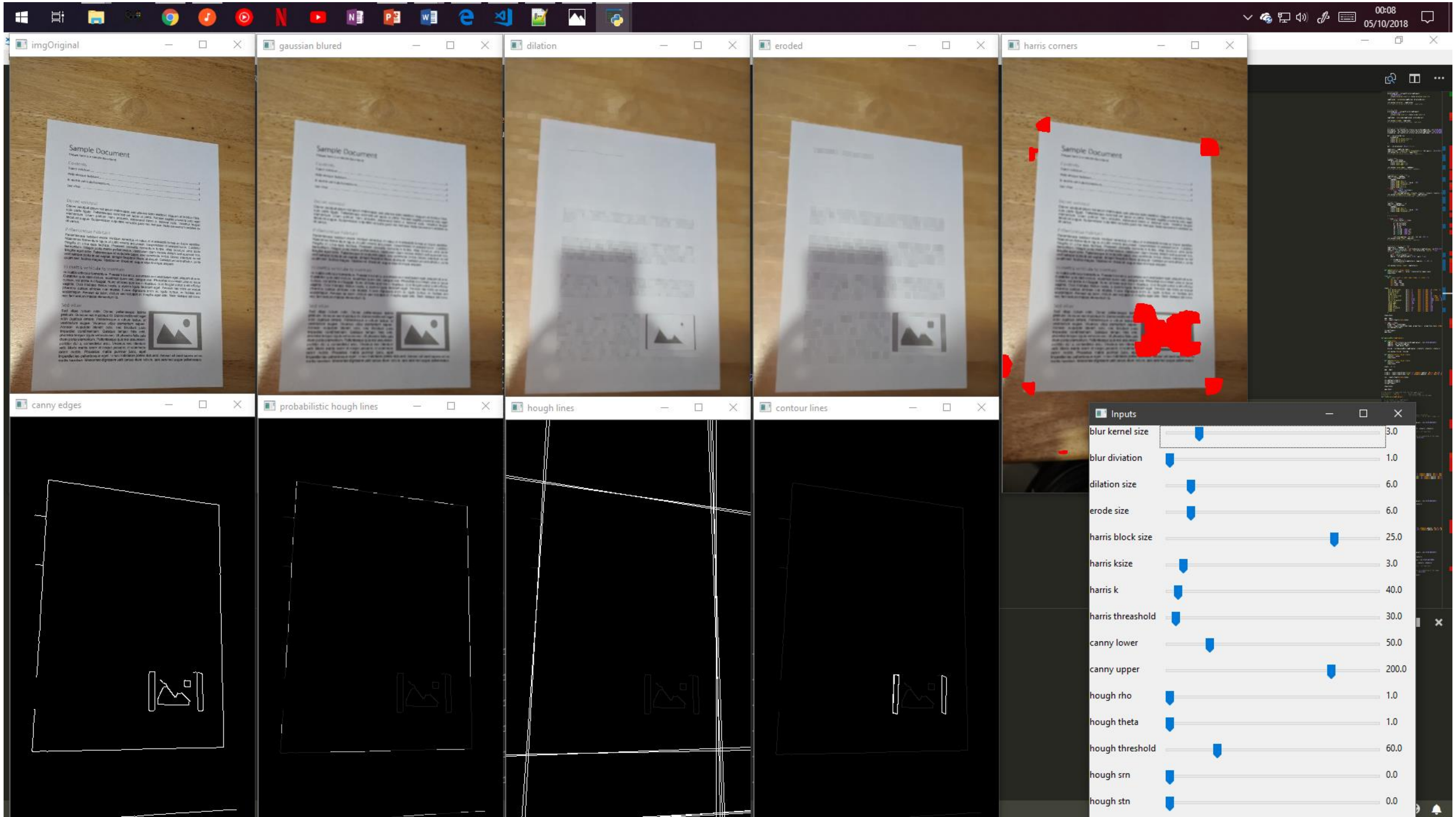
```
blur kernel size      3.0
blur diviation        1.0
dilation size         6.0
erode size            6.0
harris block size     25.0
harris ksize          3.0
harris k              40.0
harris threashold     30.0
canny lower           50.0
canny upper           200.0
hough rho             1.0
hough theta           1.0
hough threshold       60.0
hough srn             0.0
hough stn             0.0
```

Result (so far)



blur kernel size 3.0
blur diviation 1.0
dilation size 6.0
erode size 6.0
harris block size 25.0
harris ksize 3.0
harris k 40.0
harris threashold 80.0
canny lower 50.0
canny upper 200.0
hough rho 1.0
hough theta 1.0
hough threshold 60.0
hough srn 0.0

Result (so far)



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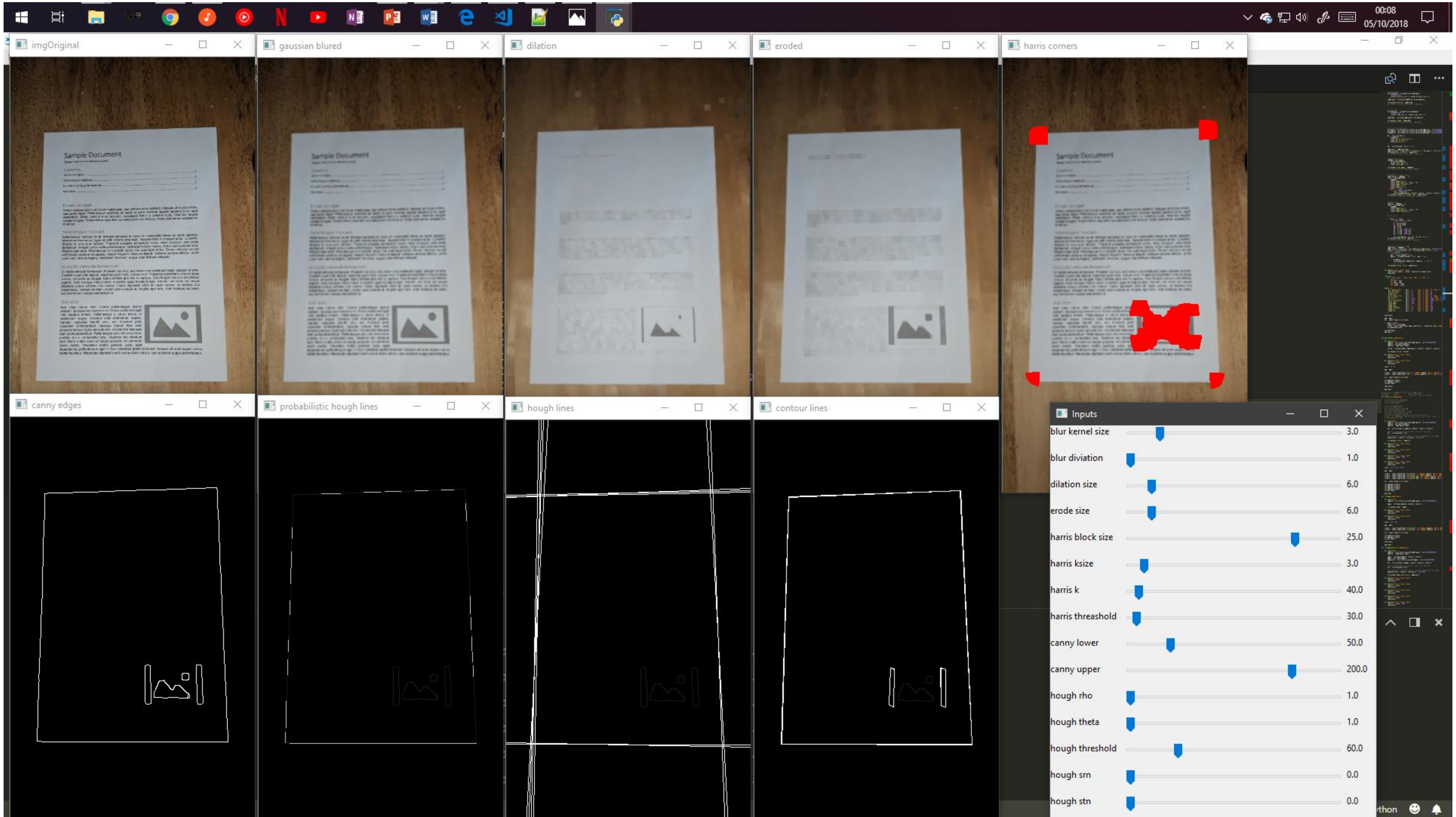
blur diviation      1.0
dilation size       6.0
erode size          6.0
harris block size   25.0
harris ksize        3.0
harris k            40.0
harris threashold   30.0
canny lower         50.0
canny upper         200.0
hough rho           1.0
hough theta         1.0
hough threshold     60.0
hough srn           0.0
hough stn           0.0
```

Result (so far)



blur kernel size 3.0

blur diviation 1.0

dilation size 6.0

erode size 6.0

harris block size 25.0

harris ksize 3.0

harris k 40.0

harris threashold 30.0

canny lower 50.0

canny upper 200.0

hough rho 1.0

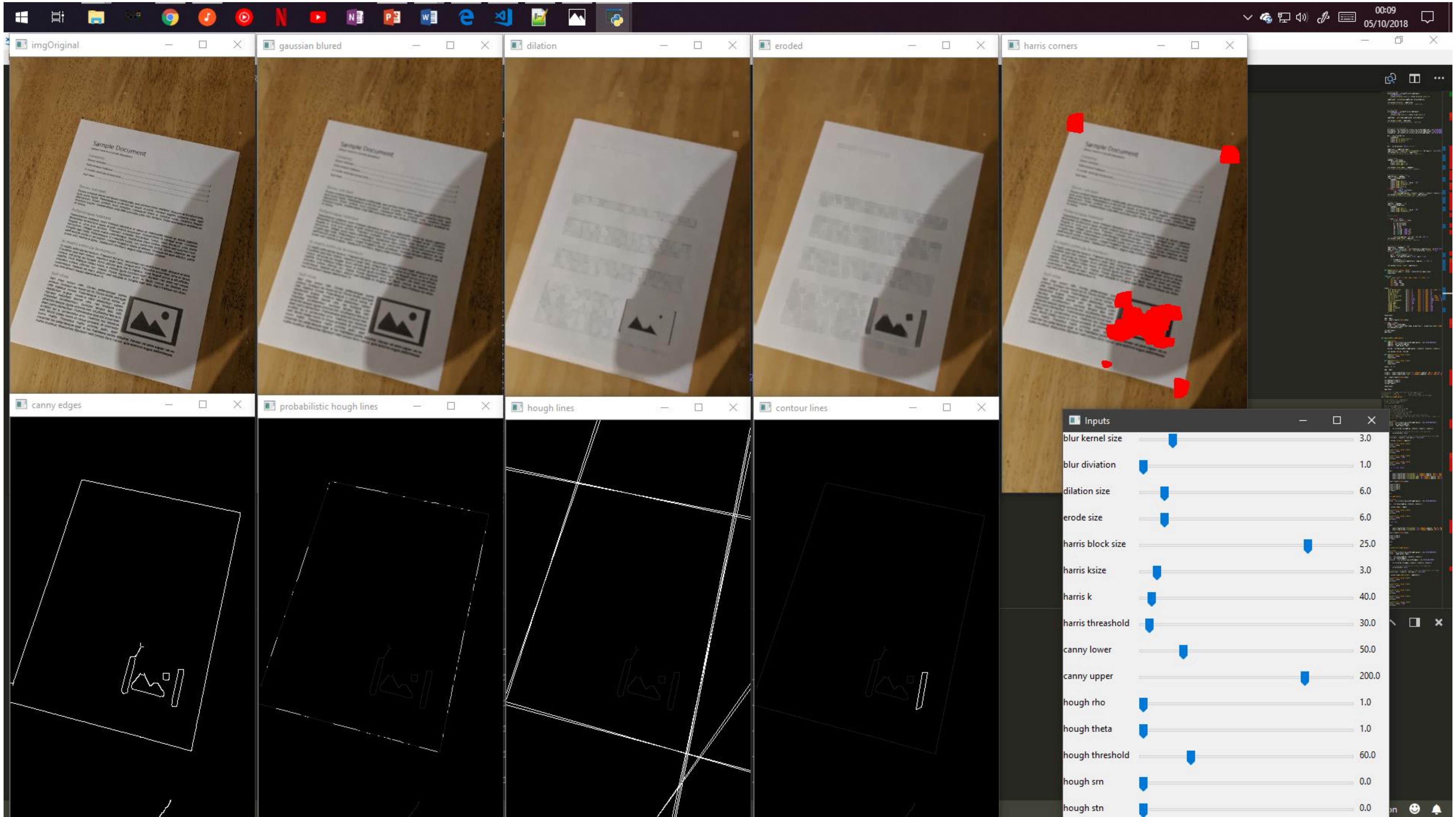
hough theta 1.0

hough threshold 60.0

hough srn 0.0

hough stn 0.0

Result (so far)



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blur diviation        1.0
dilation size         6.0
erode size            6.0
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harris threashold     30.0
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hough theta           1.0
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hough srn             0.0
hough stn             0.0
```
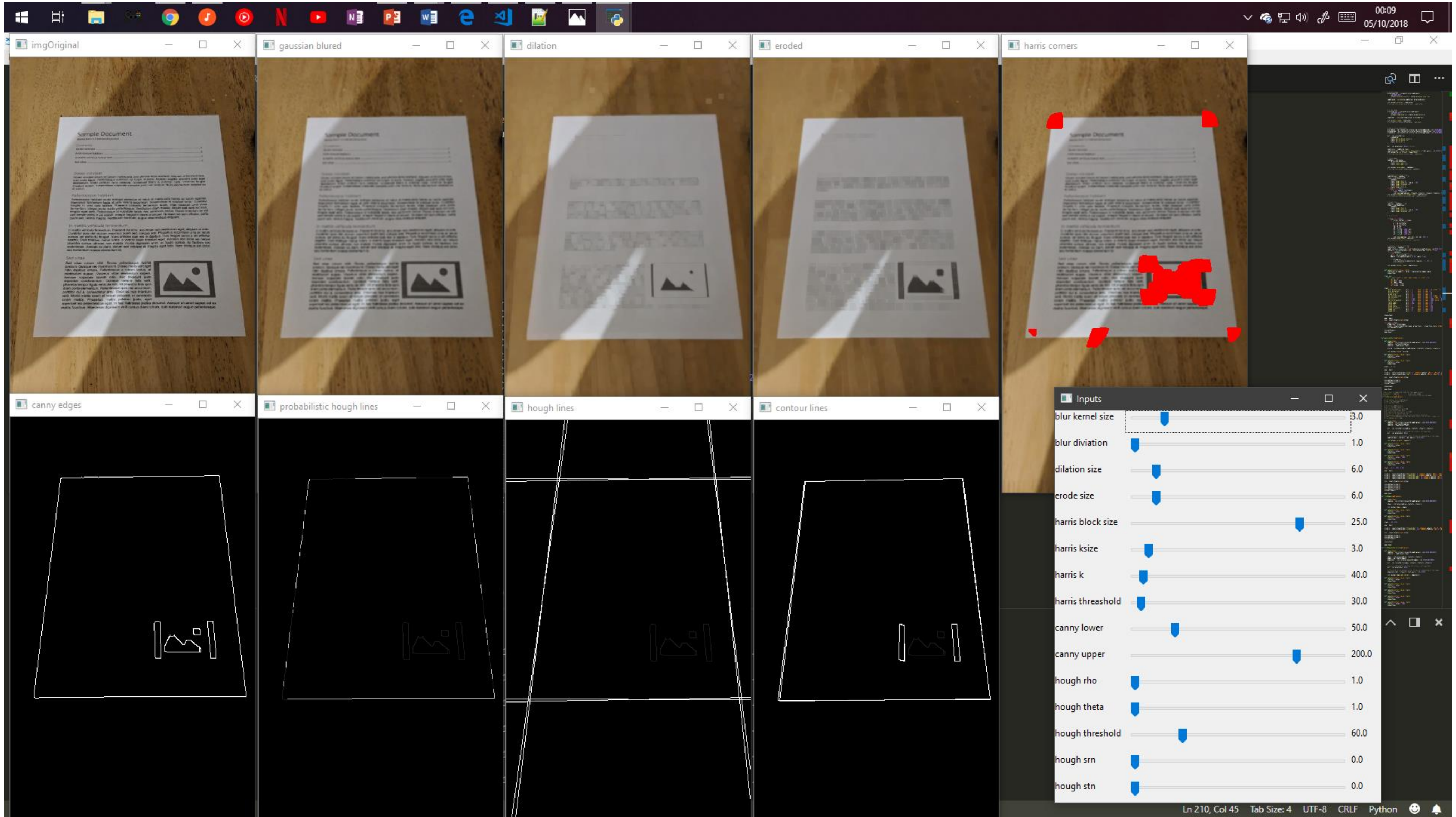

Result (so far)



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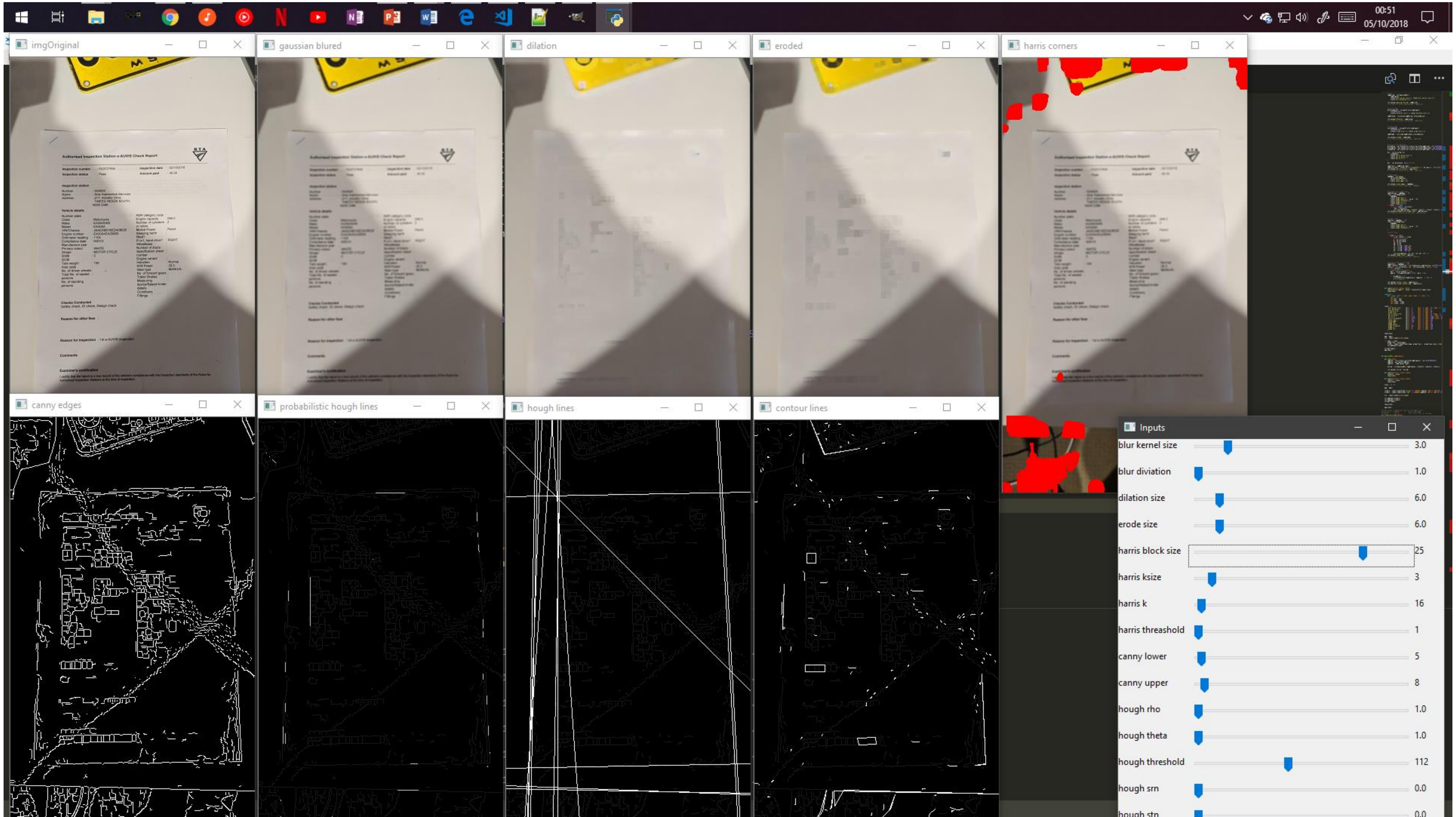
hough stn	0.0

Result (so far)



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blur diviation 1.0
dilation size 6.0
erode size 6.0
harris block size 25
harris ksize 3
harris k 16
harris threshold 1
canny lower 5
canny upper 8
hough rho 1.0
hough theta 1.0
hough threshold 112
hough srn 0.0
hough stn 0.0

Conclusion

- This project is incomplete
- Final results and benchmarks have not been established yet
- Thus far results a promising
  - Corner, edge and line data is relatively reliable for ‘easy’ images
  - Still struggles with difficult problems
- Remaining components need to be implemented before final evaluation