Q1: Signature Matching

```
The signature image is our identity, banks and other
places signatures are used, can youtake10 copies of
your signature and show that they represent you, we can
use morphological operations like thinning, Skelton
Can we find bends and curves to identify them
Can we use envelope to make them more robust
```

Approach

Pre-Processing

- Gaussian Blur
- Morphological Opening
- Otsu Thresholding
- Morphological Opening

Transformation (Skeletonize)

- We use the `skimage` library function for skeleton transformation by thinning the thresholded image. This gives us a signature with only 1 pixel boundary
- Then we can save this as our reference skeleton

Matching (structural similarity)

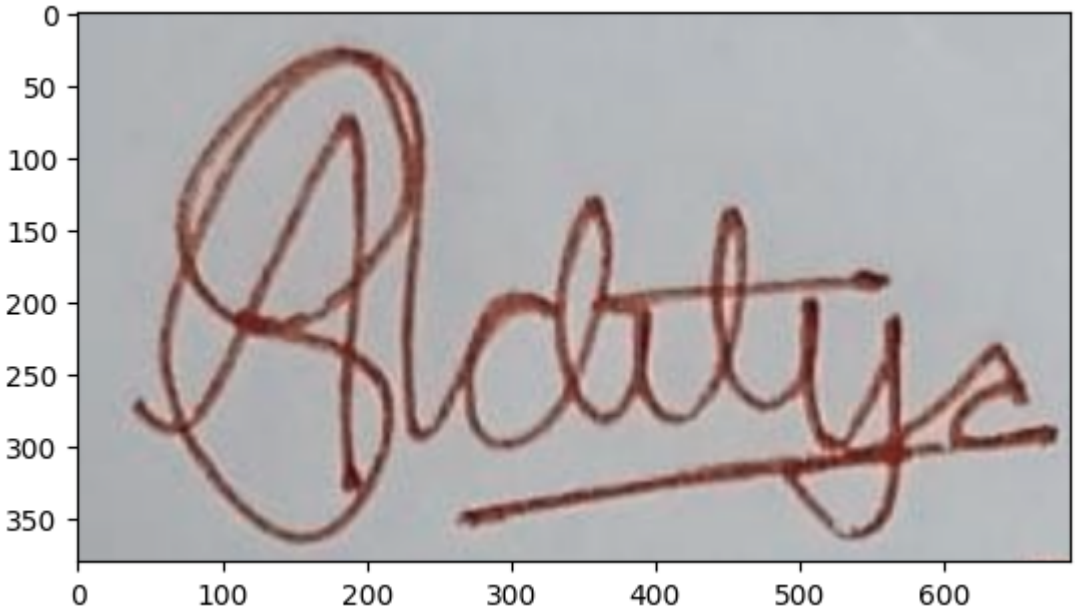
- We will use `skimage`'s structural similarity, to calculate the accuracy of the signature match

In [1]:
```
import cv2 as cv
import numpy as np
import matplotlib.pyplot as plt
import skimage
```

In [2]:
```
REFERENCE_IMAGE = "sign1.png"
TEST_IMAGE = "sign2.png"
```

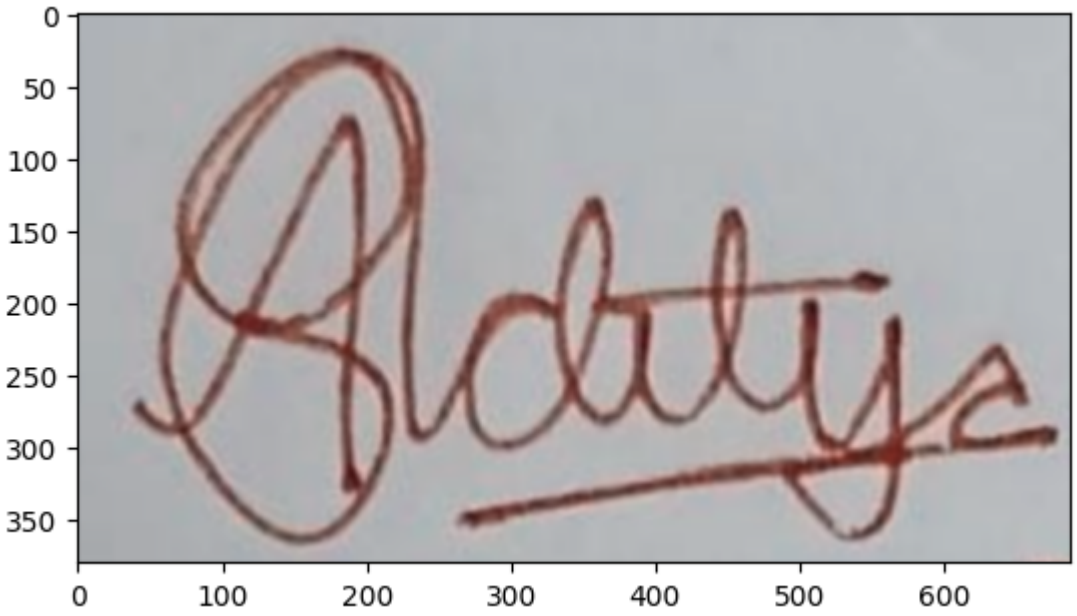
In [3]:
```
img = cv.imread(REFERENCE_IMAGE)
plt.imshow(img)
```

Out[3]:
```
<matplotlib.image.AxesImage at 0x17bf5bc50>
```



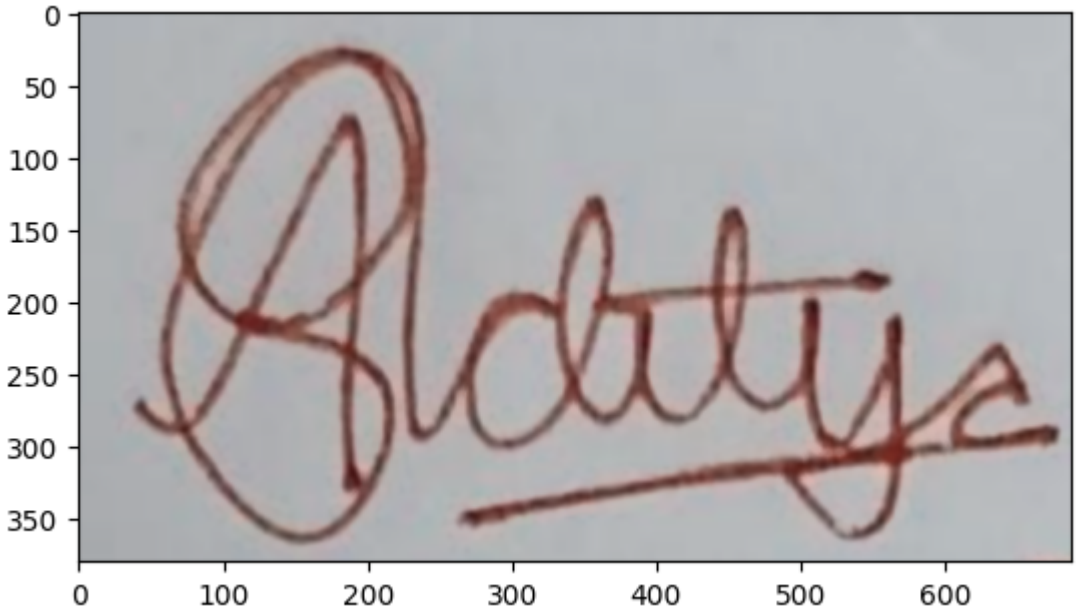
In [4]:
```
img_blur = cv.GaussianBlur(img, (5,5), None)
plt.imshow(img_blur)
```

Out[4]: <matplotlib.figure.AxesImage at 0x17c1e9b90>



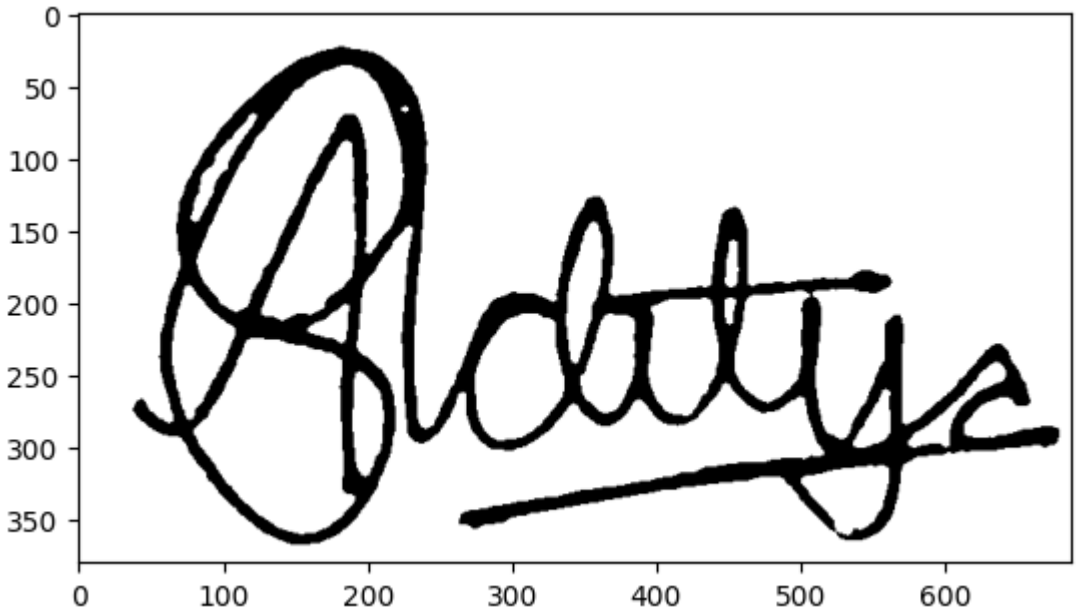
In [5]:
```
img_close = cv.morphologyEx(img_blur, cv.MORPH_OPEN, cv.getStructuringEle
plt.imshow(img_close)
```

Out[5]: <matplotlib.figure.AxesImage at 0x17c1d1b90>



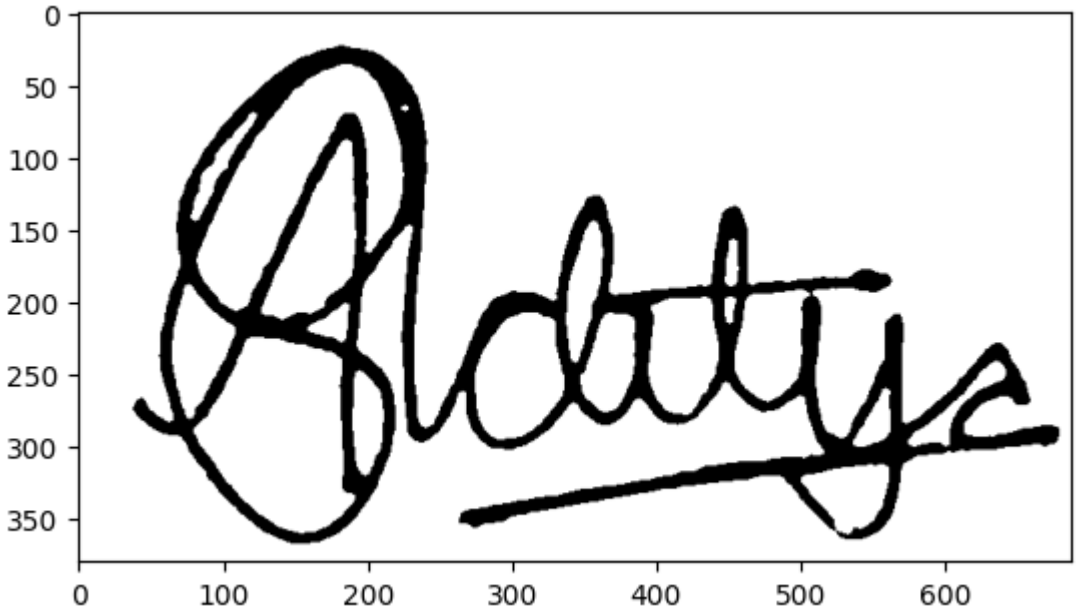
In [6]:
```
img_g = cv.cvtColor(img_close, cv.COLOR_BGR2GRAY)
_, bw = cv.threshold(img_g,0,255,cv.THRESH_BINARY+cv.THRESH_OTSU)
plt.imshow(bw, cmap="gray")
```

Out[6]: <matplotlib.image.AxesImage at 0x17c989a50>



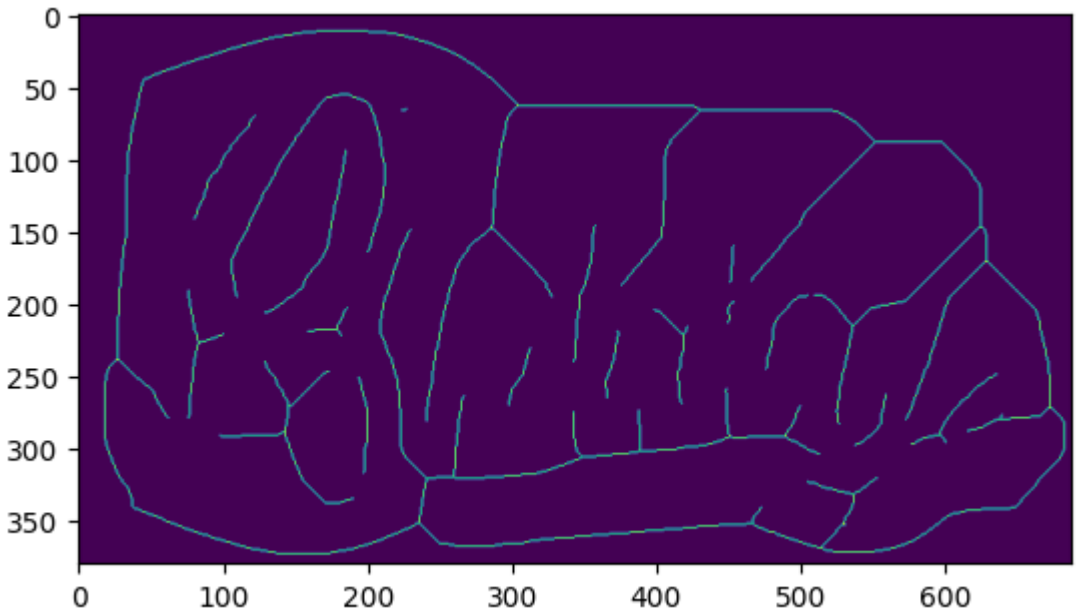
In [7]:
```
img_closed = cv.morphologyEx(bw, cv.MORPH_OPEN, cv.getStructuringElement(
plt.imshow(img_closed, cmap="gray")
```

Out[7]: <matplotlib.image.AxesImage at 0x17ca20610>



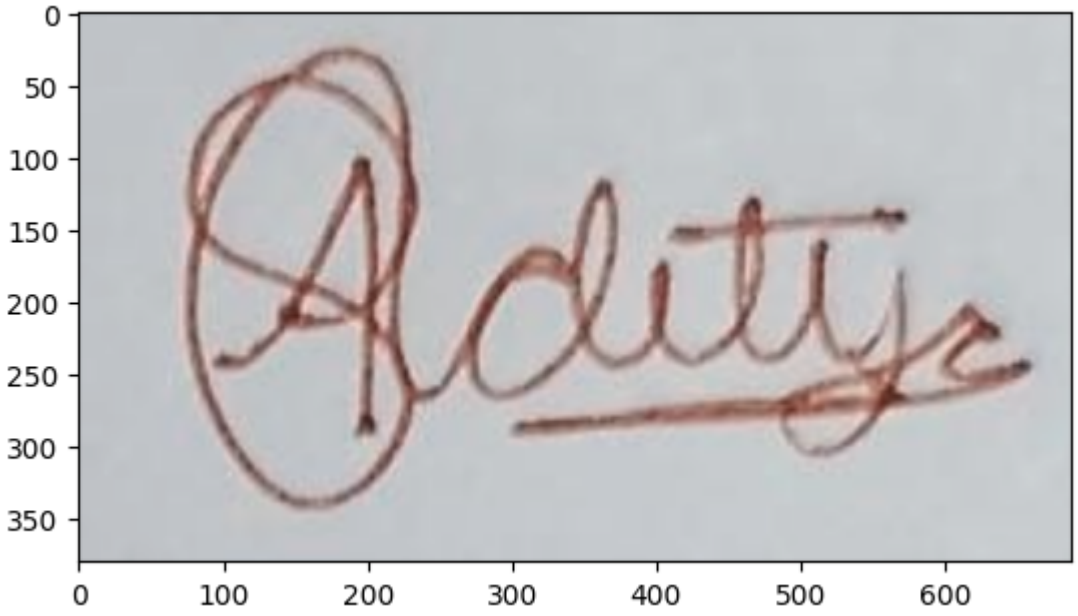
In [8]:
```
img_skeleton = skimage.morphology.skeletonize(img_closed)
img_skeleton = skimage.util.img_as_ubyte(img_skeleton)
plt.imshow(img_skeleton)
cv.imwrite("ref.jpg", img_skeleton)
```

Out[8]: True



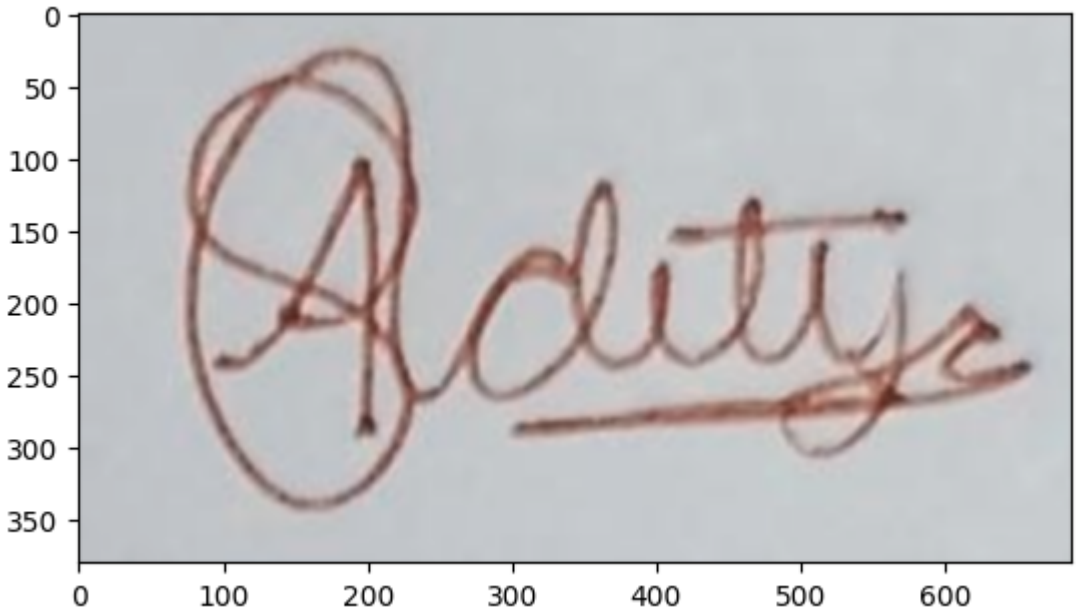
In [9]:
```
test = cv.imread(TEST_IMAGE)
plt.imshow(test)
```

Out[9]: <matplotlib.image.AxesImage at 0x194e9cad0>



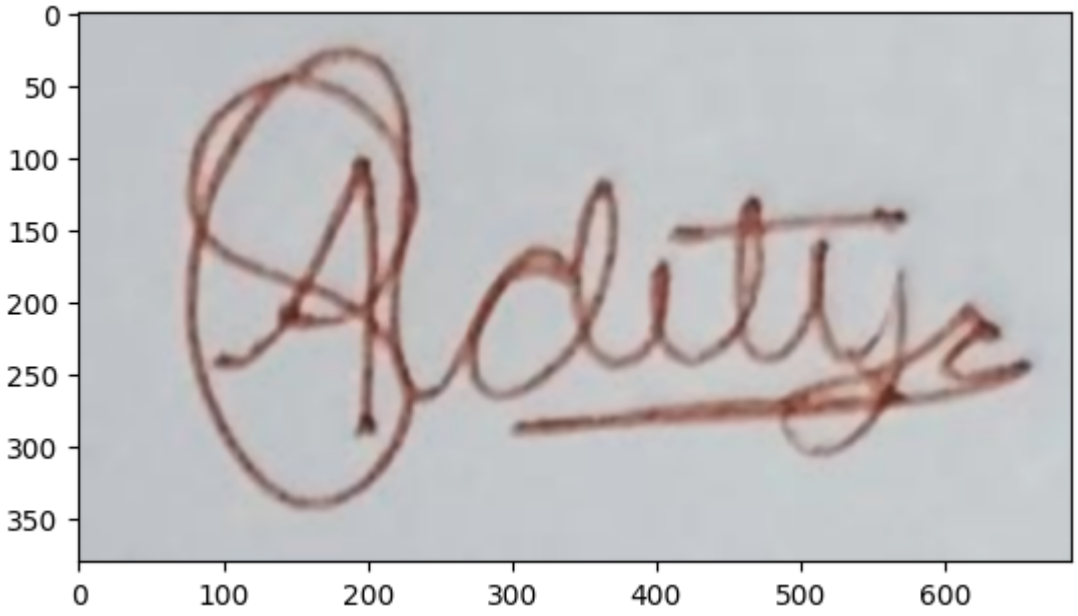
In [10]:
```
test_blur = cv.GaussianBlur(test, (5,5), None)
plt.imshow(test_blur)
```

Out[10]: <matplotlib.image.AxesImage at 0x195469a50>



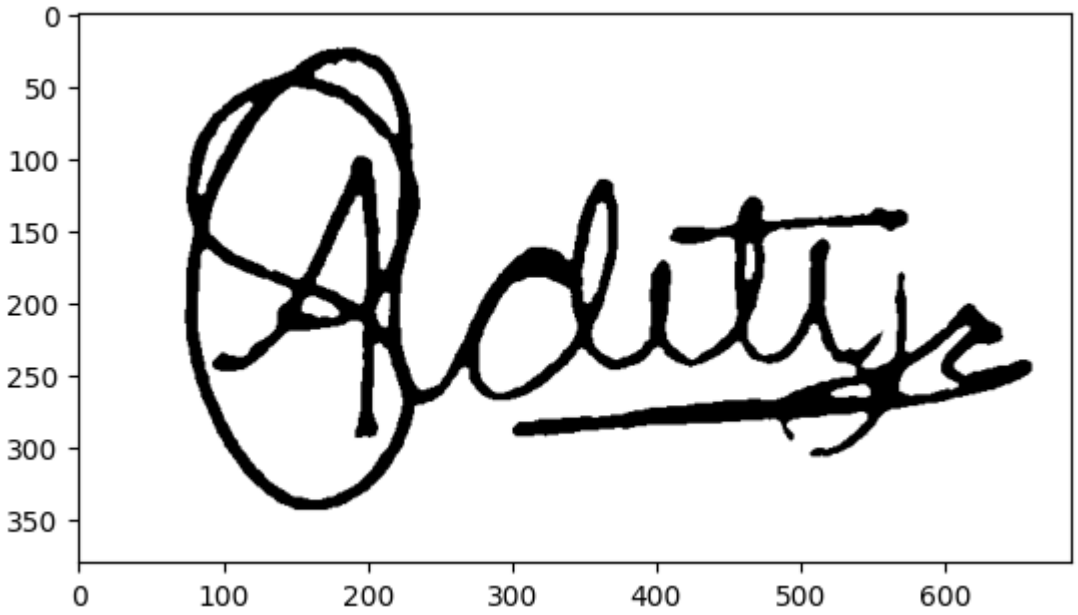
In [11]:
```
test_close = cv.morphologyEx(test_blur, cv.MORPH_OPEN, cv.getStructuringE
plt.imshow(test_close)
```

Out[11]: <matplotlib.image.AxesImage at 0x195501a50>



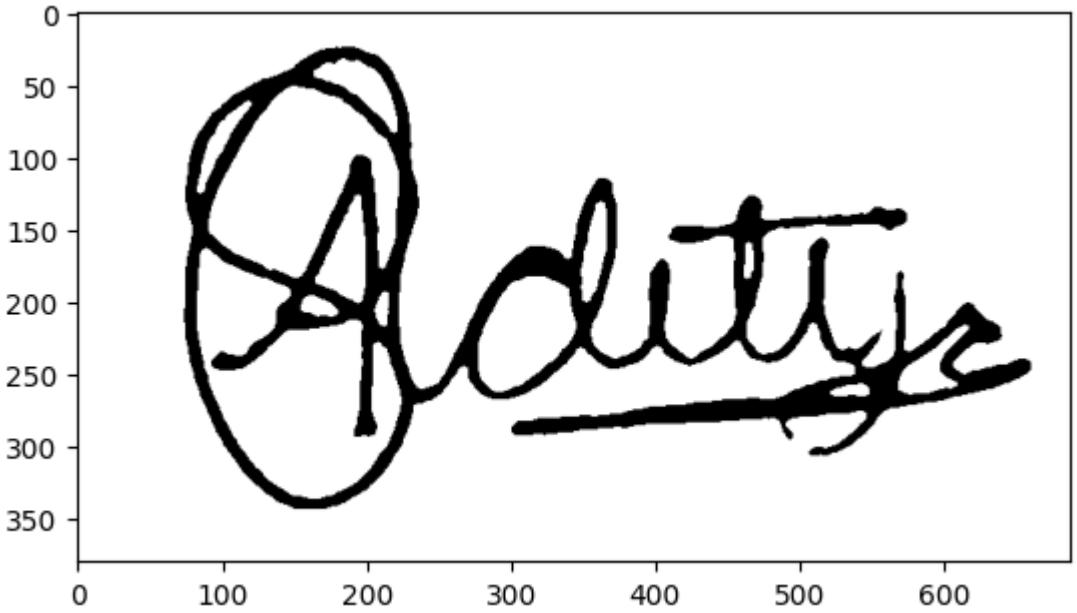
In [12]:
```
test_g = cv.cvtColor(test_close, cv.COLOR_BGR2GRAY)
_, test_bw = cv.threshold(test_g,0,255,cv.THRESH_BINARY+cv.THRESH_OTSU)
plt.imshow(test_bw, cmap="gray")
```

Out[12]: <matplotlib.image.AxesImage at 0x195598610>



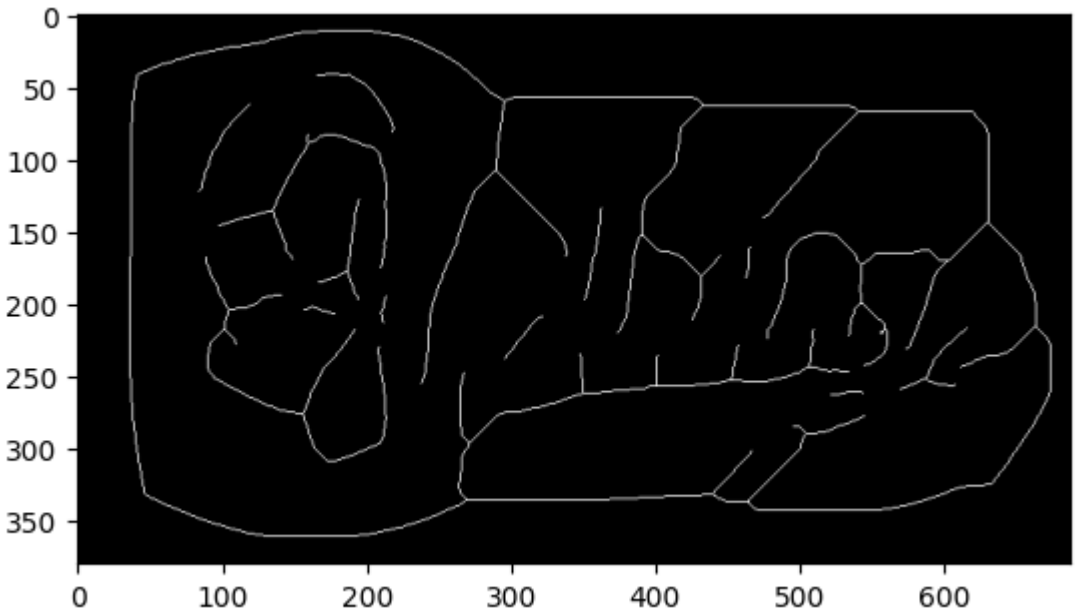
In [13]:
```
test_closed = cv.morphologyEx(test_bw, cv.MORPH_OPEN, cv.getStructuringEl
plt.imshow(test_closed, cmap="gray")
```

Out[13]: <matplotlib.image.AxesImage at 0x17d6f0610>



In [14]:
```
test_skeleton = skimage.morphology.skeletonize(test_closed)
test_skeleton = skimage.util.img_as_ubyte(test_skeleton)
test_skeleton = cv.resize(test_skeleton, (img_skeleton.shape[1], img_skel
plt.imshow(test_skeleton, cmap="gray")
```

Out[14]:
```
<matplotlib.image.AxesImage at 0x195648610>
```



In [15]:
```
skimage.metrics.structural_similarity(img_skeleton, test_skeleton)
```

Out[15]:
```
0.7153751527894728
```

Result

We obtain a 71% match between 2 signatures

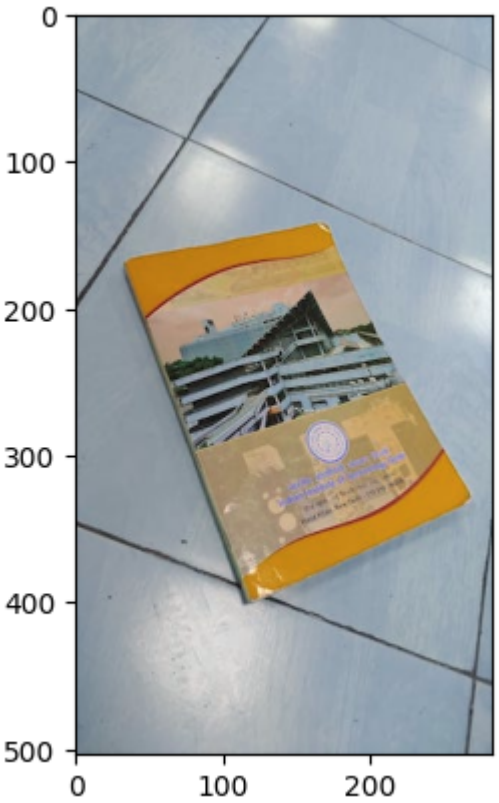
Q2: Regulated Dilation

A' = (A+B)−B
Take an image of a book placed on white background and show the output of this operation, youcanreport the result with square, rectangle, circle, diamond, plus sign structuring element

In [1]:
```
import cv2 as cv
import numpy as np
import matplotlib.pyplot as plt
```

In [2]:
```
img = cv.imread("book.jpg")
plt.imshow(img)
```

Out[2]:
```
<matplotlib.image.AxesImage at 0x17de11e50>
```



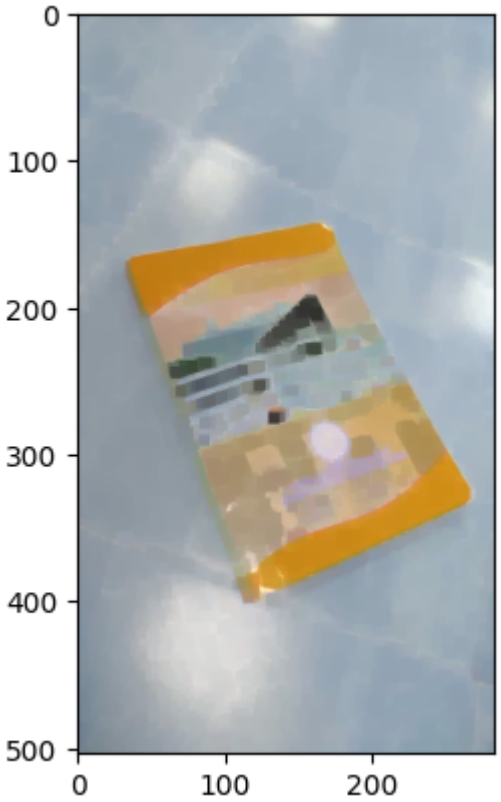
In [3]:
```
square = np.array([
    [1,1,1,1,1,1,1],
    [1,1,1,1,1,1,1],
    [1,1,1,1,1,1,1],
    [1,1,1,1,1,1,1],
    [1,1,1,1,1,1,1],
    [1,1,1,1,1,1,1],
    [1,1,1,1,1,1,1],
], dtype=np.uint8)

rectangle = np.array([
    [0,0,0,0,0,0,0],
    [0,0,1,1,1,0,0],
```

```
    [0,0,1,1,1,0,0],
    [0,0,1,1,1,0,0],
    [0,0,1,1,1,0,0],
    [0,0,1,1,1,0,0],
    [0,0,0,0,0,0,0],
], dtype=np.uint8)

circle = np.array([
    [0,0,1,1,1,0,0],
    [0,1,1,1,1,1,0],
    [1,1,1,1,1,1,1],
    [1,1,1,1,1,1,1],
    [1,1,1,1,1,1,1],
    [0,1,1,1,1,1,0],
    [0,0,1,1,1,0,0],
], dtype=np.uint8)

diamond = np.array([
    [0,0,0,1,0,0,0],
    [0,0,1,1,1,0,0],
    [0,1,1,1,1,1,0],
    [1,1,1,1,1,1,1],
    [0,1,1,1,1,1,0],
    [0,0,1,1,1,0,0],
    [0,0,0,1,0,0,0],
], dtype=np.uint8)

plus = np.array([
    [0,0,0,1,0,0,0],
    [0,0,0,1,0,0,0],
    [0,0,0,1,0,0,0],
    [1,1,1,1,1,1,1],
    [0,0,0,1,0,0,0],
    [0,0,0,1,0,0,0],
    [0,0,0,1,0,0,0],
], dtype=np.uint8)
```

Square

In [4]:
```
plt.imshow(cv.erode(cv.dilate(img, square),square))
```

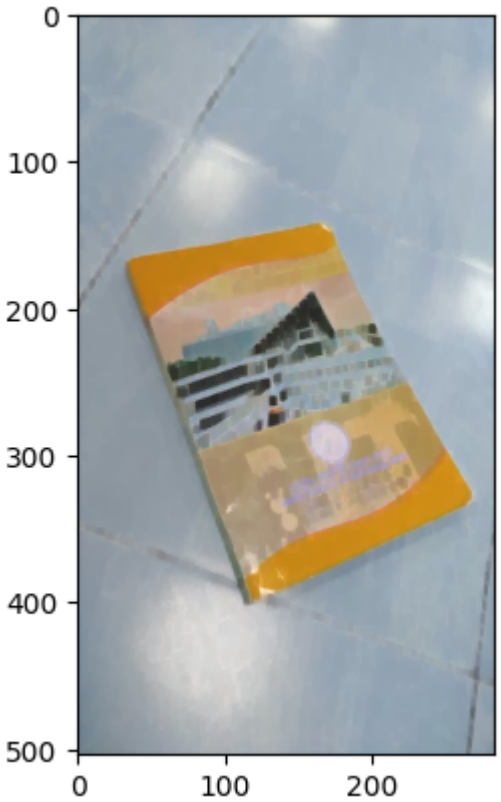
Out[4]:
```
<matplotlib.image.AxesImage at 0x17deb3e90>
```



Rectangle

In [5]:
```
plt.imshow(cv.erode(cv.dilate(img, rectangle),rectangle))
```

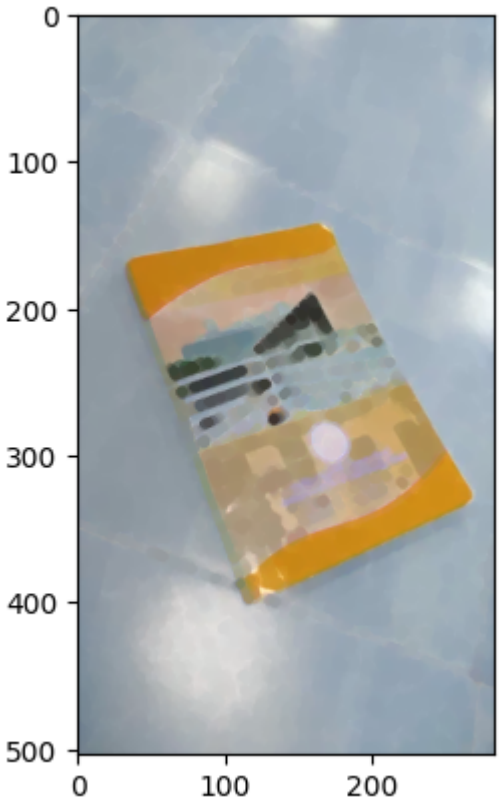
Out[5]:
```
<matplotlib.image.AxesImage at 0x17df05f10>
```



Circle

In [6]:
```
plt.imshow(cv.erode(cv.dilate(img, circle), circle))
```

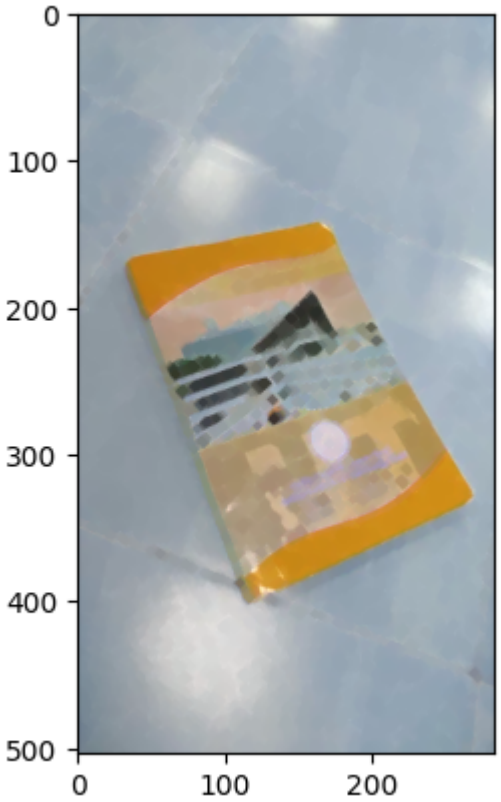
Out[6]:
```
<matplotlib.image.AxesImage at 0x17df86a10>
```



Diamond

In [7]:
```
plt.imshow(cv.erode(cv.dilate(img, diamond), diamond))
```

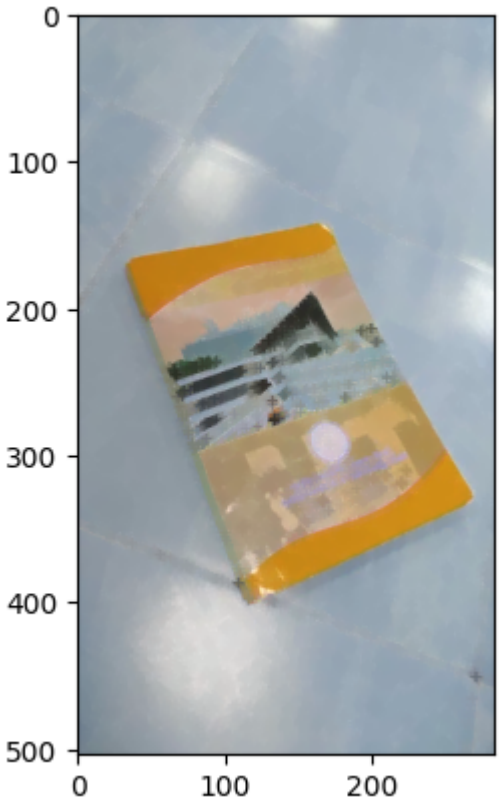
Out[7]:
```
<matplotlib.image.AxesImage at 0x17dfd3e90>
```



Plus

In [8]:
```
plt.imshow(cv.erode(cv.dilate(img, plus), plus))
```

Out[8]:
```
<matplotlib.image.AxesImage at 0x17e030ad0>
```



In [ ]: