Department of Computer Science and Engineering (Data Science)

Image Processing and Computer Vision I (DJ19DSL603)

Lab 2: Image Negative Transformation, Thresholding, Gray Level Slicing with without background

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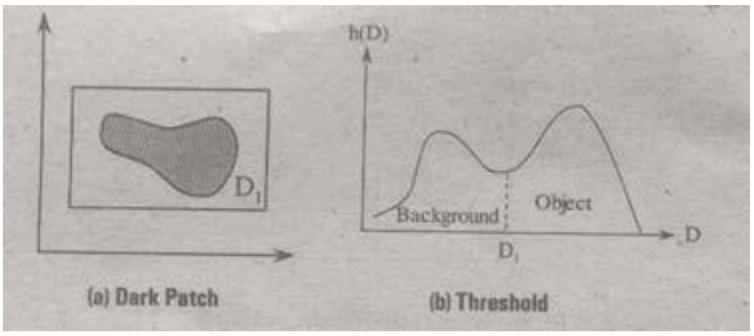
Aim: To Perform Gray Level slicing with and without background

Theory: Thresholding is a simple but effective image processing technique that is widely used in computervision and image analysis applications. The basic idea behind thresholding is to segment an image into foreground and background regions based on the intensity values of the pixels in the image

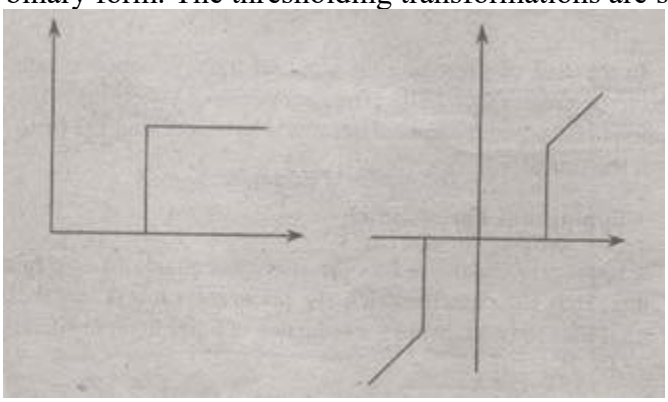
Clipping and Thresholding:

Clipping is considered as the special scenario of contrast stretching. It is the case in which the parameters are $\alpha = \gamma = 0$. Clipping is more advantageous for reduction of noise in input signals of range [a, b].

Threshold of an image is selected by means of its histogram. Let us take the image shown in the following figure.



(b) consists of two peaks i.e., background and object. At the abscissa of histogram minimum (D1) the threshold is selected. This selected threshold (D1) can separate background and object to convert the image into its respective binary form. The thresholding transformations are shown in figure



Intensity Level Slicing:

The images which consist of grey levels in between intensity at background and other objects require to reduce the intensity of the object. This process of changing intensity level is done with the help of intensity level slicing. They are expressed as

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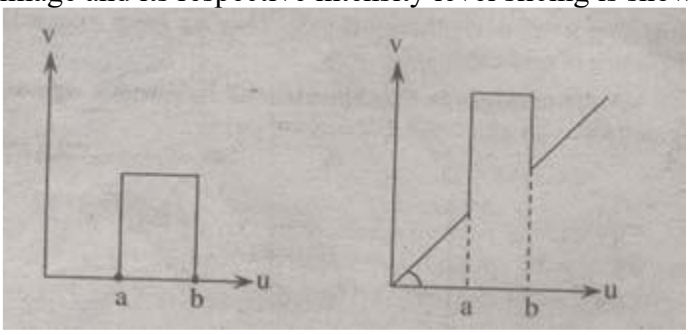
$$V = \begin{cases} L, & a \le u \le b \\ 0, & \text{elsewhere} \end{cases} \quad \text{without background}$$

And $$V = \begin{cases} L, & a \le u \le b \\ u, & \text{elsewhere} \end{cases} \quad \text{with background}$$

The histogram of input image and its respective intensity level slicing is shown in the figure



When an image is uniformly quantized then, the nth most significant bit can be extracted and displayed. Let, u = k1 2^B-1 + k2 2^B-2 +……..+ k^B-1 2 + kB Then, the output is expressed as

$$V = \begin{cases} L, & \text{for } k_n = 1 \\ 0, & \text{elsewhere} \end{cases}$$

Grey Level Slicing without background:

Grey level slicing is an image processing technique used to enhance the contrast of an image by selectively enhancing a range of pixel intensities. The basic idea behind grey level slicing is to setall pixel values within a specific intensity range to a maximum value, while leaving all other pixelvalues unchanged

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Lab Assignments to complete in this session

Problem Statement: Develop a Python program utilizing the OpenCV library to manipulate images from the Fashion MNIST digits dataset. The program should address the following tasks:

1. Read random image(s) from the MNIST fashion dataset.
2. **Dataset Link:** Fashion MNIST Github
3. Display the before & after image(s) used in the task below.
4. Perform image negative transformation.
5. Perform image thresholding operation at various threshold level and write your observation.
6. Perform gray level slicing with and without background intensity slicing and write your observation.

The solution to the operations performed must be produced by scratch coding without the use of built in OpenCV methods.

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Shri Vile Parle Kelavani Mandal's
DWARKADAS J. SANGHVI COLLEGE OF ENGINEERING
(Autonomous College Affiliated to the University of Mumbai)
NAAC Accredited with "A" Grade (CGPA : 3.18)

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Image negative transformation

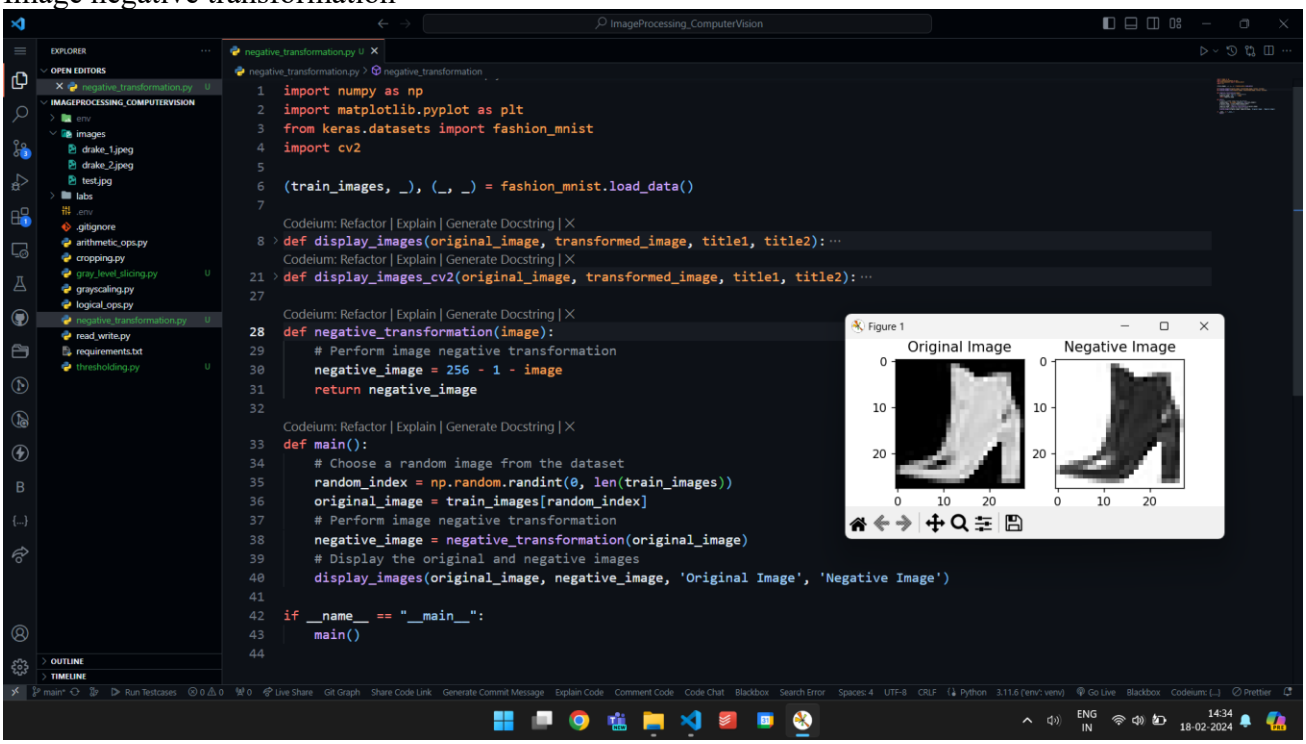

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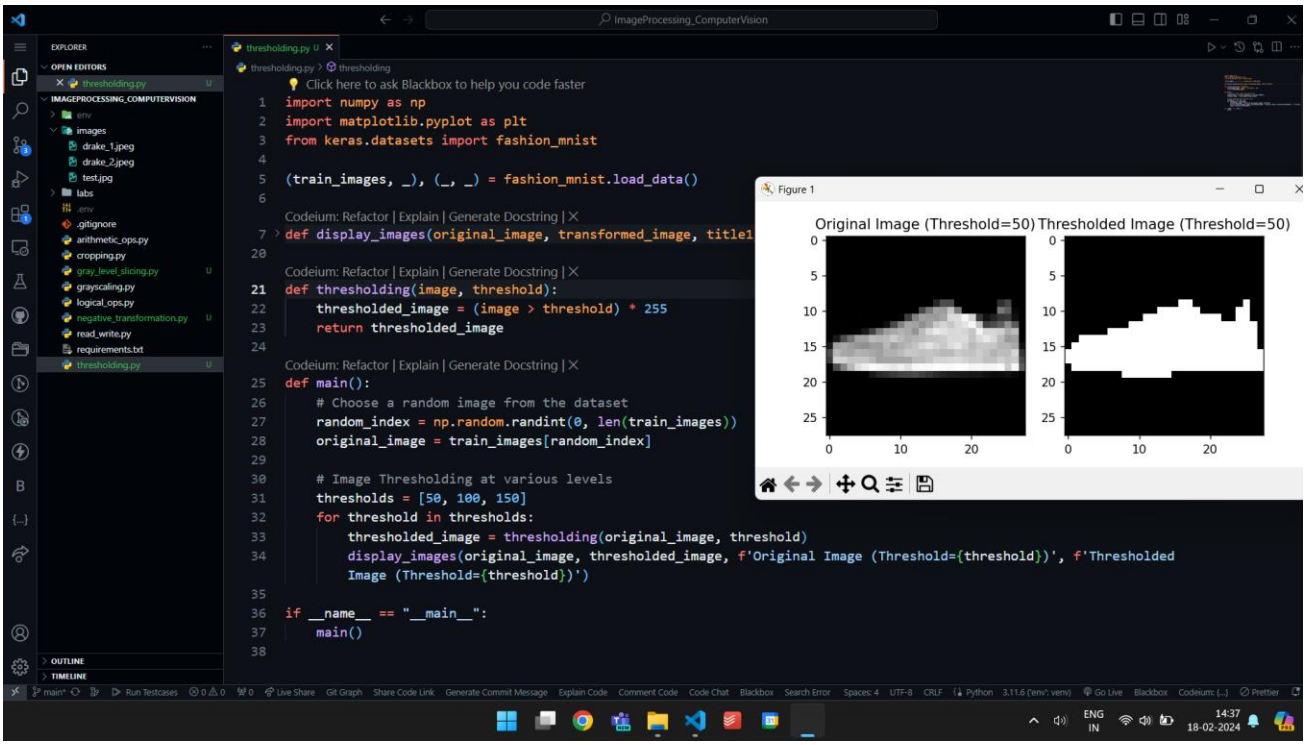
Image thresholding operation at various threshold level

Threshold level: 50



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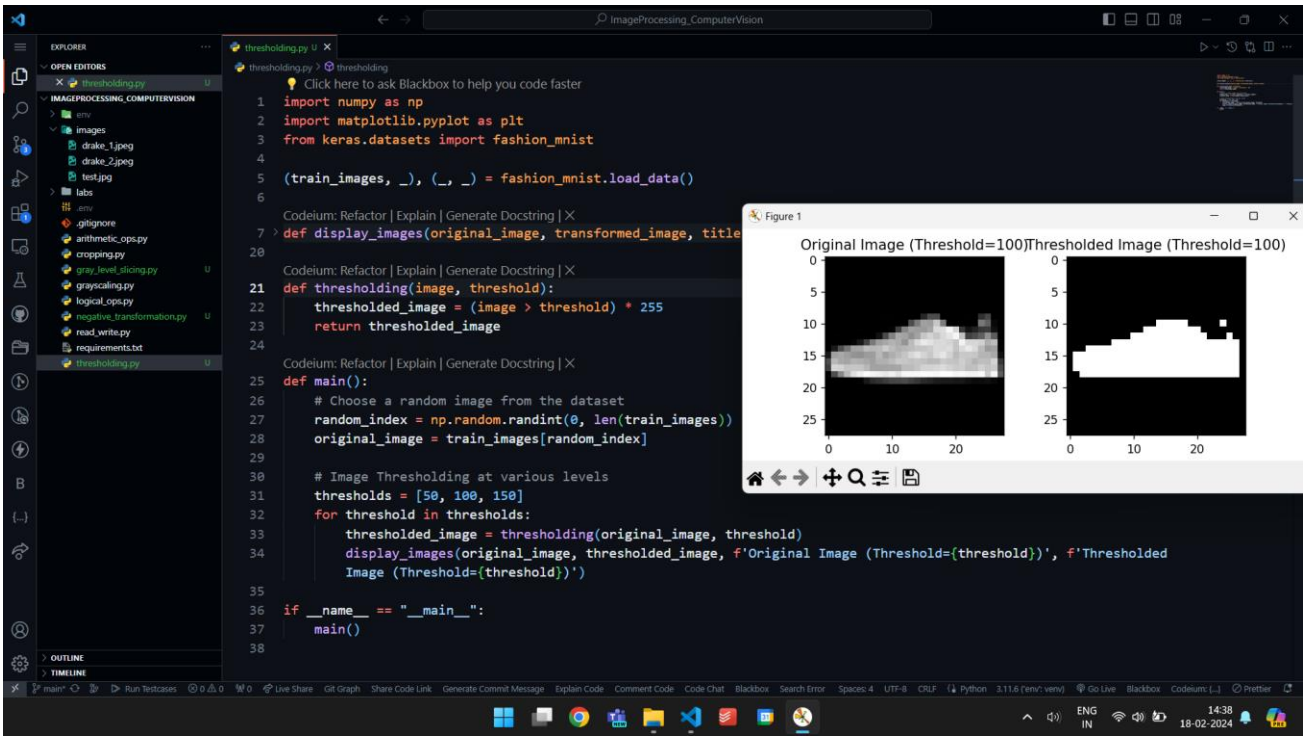
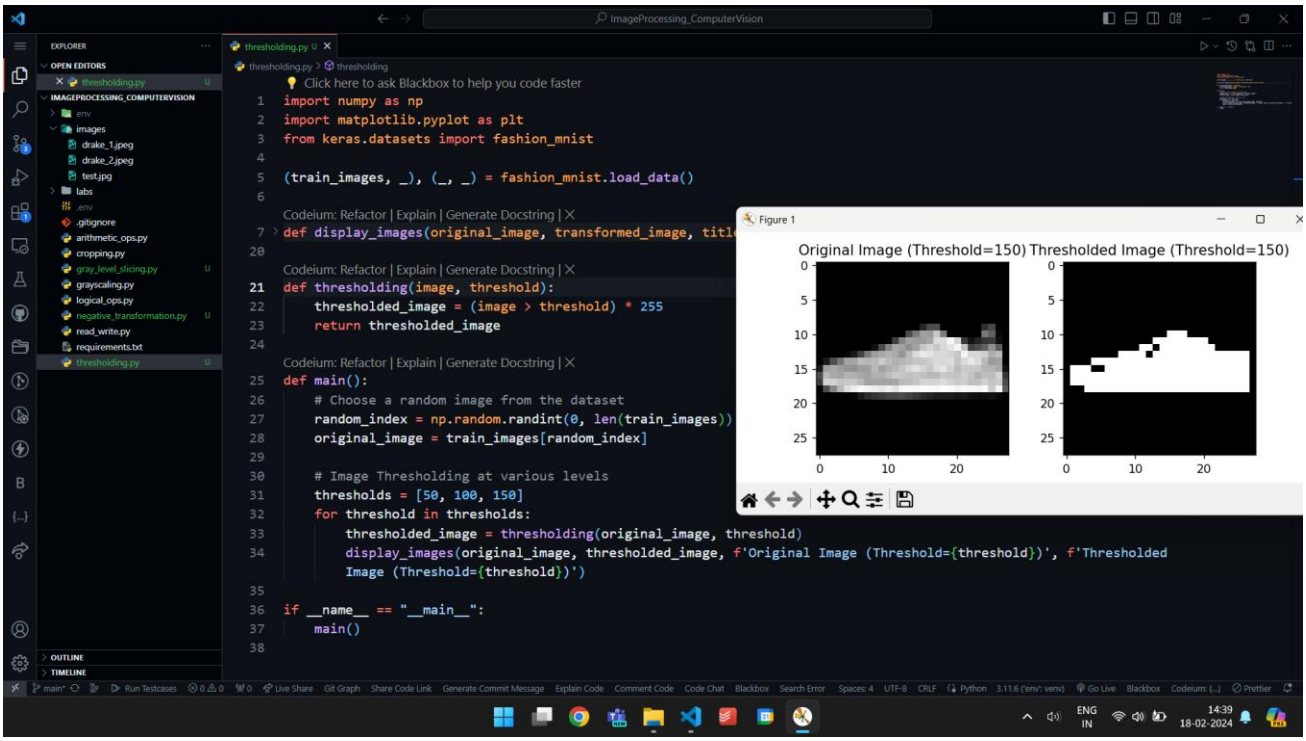
Threshold level: 100




```python
import numpy as np
import matplotlib.pyplot as plt
from keras.datasets import fashion_mnist

(train_images, _), (_, _) = fashion_mnist.load_data()

def display_images(original_image, transformed_image, title

def thresholding(image, threshold):
    thresholded_image = (image > threshold) * 255
    return thresholded_image

def main():
    # Choose a random image from the dataset
    random_index = np.random.randint(0, len(train_images))
    original_image = train_images[random_index]

    # Image Thresholding at various levels
    thresholds = [50, 100, 150]
    for threshold in thresholds:
        thresholded_image = thresholding(original_image, threshold)
        display_images(original_image, thresholded_image, f'Original Image (Threshold={threshold})', f'Thresholded
        Image (Threshold={threshold})')

if __name__ == "__main__":
    main()
```

Threshold level: 150

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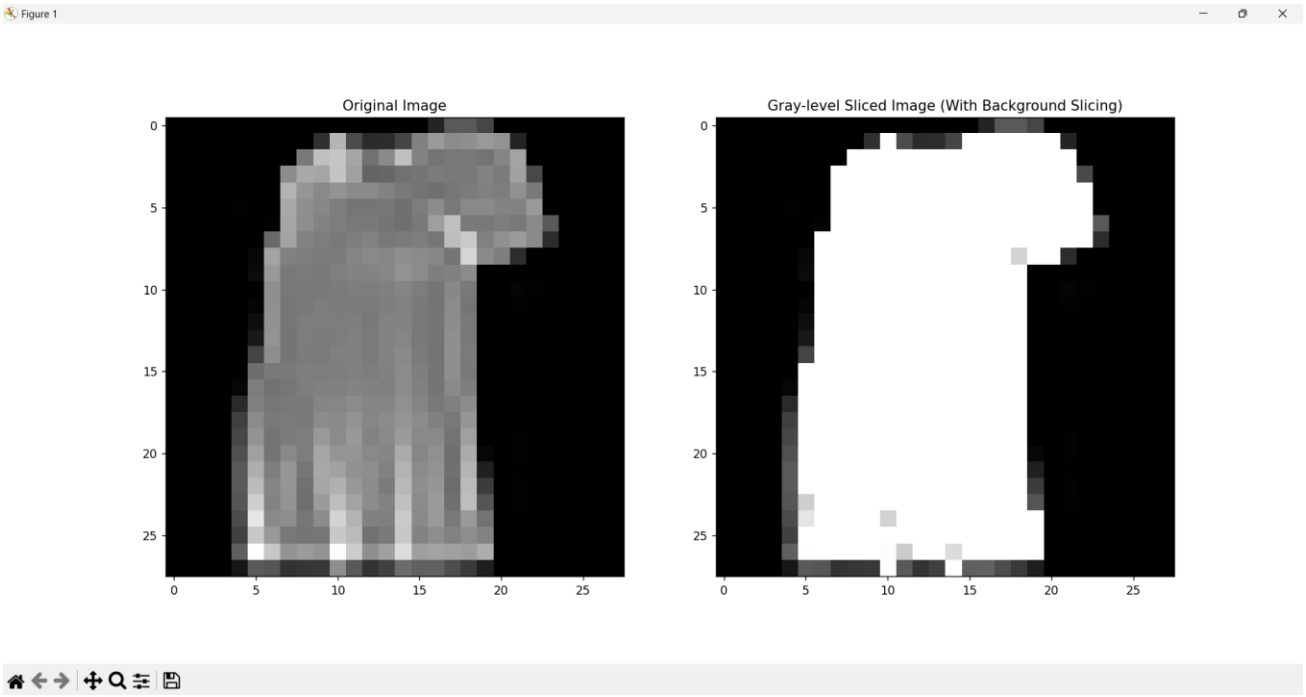
Gray level slicing with and without background intensity

```python
def gray_level_slicing(image, lower_bound, upper_bound, background_intensity=False):
    # Perform gray-level slicing
    if background_intensity:
        sliced_image = np.where((image >= lower_bound) & (image <= upper_bound), 255, image)
    else:
        sliced_image = np.where((image >= lower_bound) & (image <= upper_bound), image, 255)
    return sliced_image

def main():
    # Choose a random image from the dataset
    random_index = np.random.randint(0, len(train_images))
    original_image = train_images[random_index]

    # Gray-level slicing with and without background intensity slicing
    lower_bound = 100
    upper_bound = 200

    # With background intensity slicing
    sliced_image_with_background = gray_level_slicing(original_image, lower_bound, upper_bound, True)
    display_images(original_image, sliced_image_with_background, 'Original Image', 'Gray-level Sliced Image (With Background Slicing)')

    # Without background intensity slicing
    sliced_image_without_background = gray_level_slicing(original_image, lower_bound, upper_bound, False)
    display_images(original_image, sliced_image_without_background, 'Original Image', 'Gray-level Sliced Image (Without Background Slicing)')

if __name__ == "__main__":
    main()
```

With background intensity



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Without background intensity