1. Install OpenCV

```
!pip install opencv-python-headless
```

```
Requirement already satisfied: opencv-python-headless in /usr/local/lib/python3.10/dist-packages (4.10.0.84)
Requirement already satisfied: numpy>=1.21.2 in /usr/local/lib/python3.10/dist-packages (from opencv-python-headless) (1.26.4)
```

2. Import Libraries

```
import cv2
import numpy as np
import matplotlib.pyplot as plt

def display_image(img, title="Image"):
  plt.figure(figsize=(6,3))
  plt.imshow(cv2.cvtColor(img,cv2.COLOR_BGR2RGB))
  plt.title(title)
  plt.axis("off")
  plt.show()

def display_images(img1, img2, title1="Image 1", title2="Image 2"):
  plt.figure(figsize=(6,3))
  plt.subplot(1,2,1)
  plt.imshow(cv2.cvtColor(img1,cv2.COLOR_BGR2RGB))
  plt.title(title1)
  plt.axis("off")

  plt.subplot(1,2,2)
  plt.imshow(cv2.cvtColor(img2,cv2.COLOR_BGR2RGB))
  plt.title(title2)
  plt.axis("off")
  plt.show()
```

3. **Load Image**

```
# prompt: connect to google drive, add image path

from google.colab import drive
drive.mount('/content/drive')

image_path = '/content/drive/MyDrive/image.jpeg'  # Replace with your image path in Google Drive
image = cv2.imread(image_path)
display_image(image, "Original Image")

'''
from google.colab import files
from io import BytesIO
from PIL import Image

uploaded = files.upload()

image_path = next(iter(uploaded))
image = Image.open(BytesIO(uploaded[image_path]))
image = cv2.cvtColor(np.array(image), cv2.COLOR_RGB2BGR)

display_image(image, "Original Image")
'''
```

```
Drive already mounted at /content/drive; to attempt to forcibly remount, call drive.mount("/content/drive", force_remount=True)
```

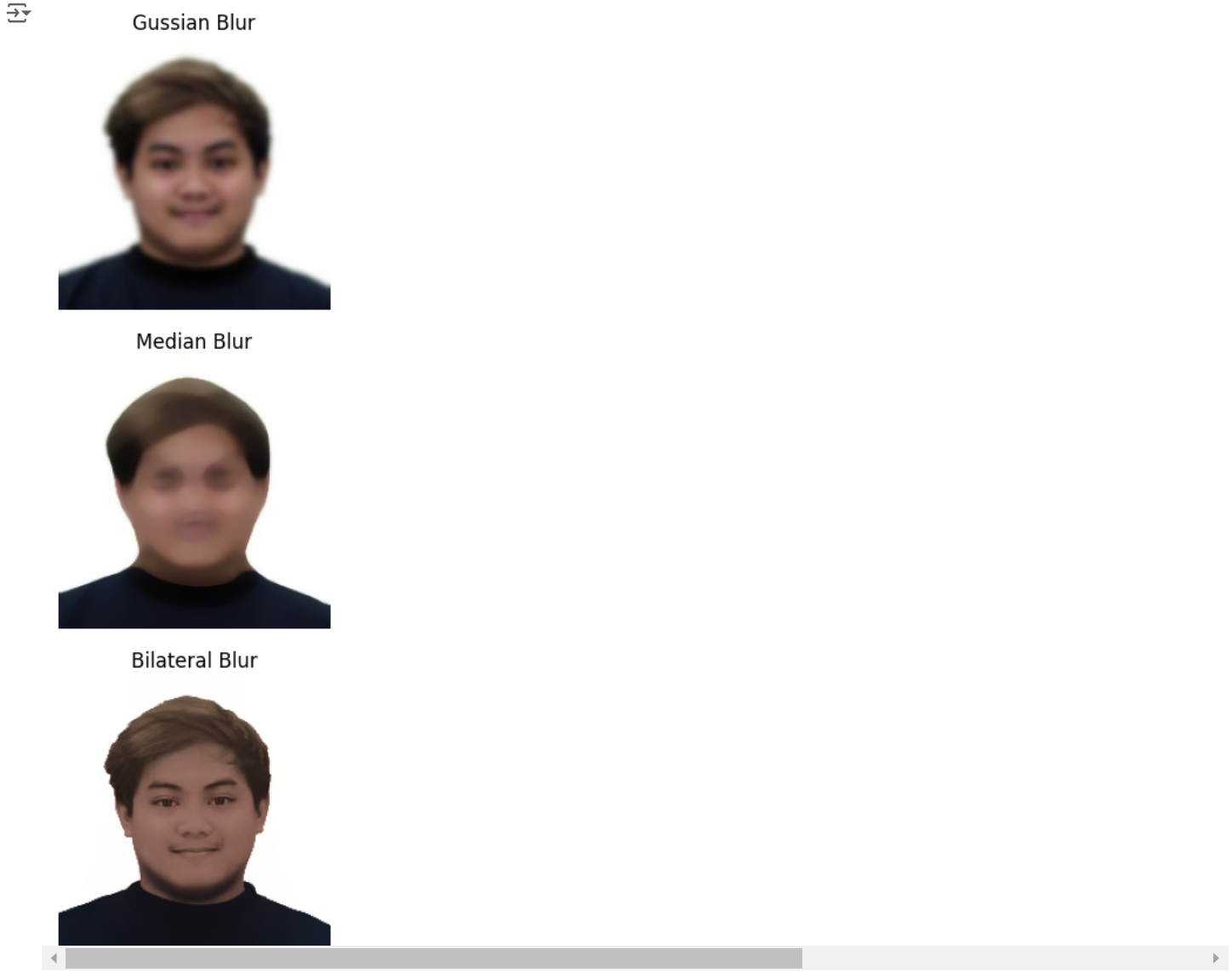

```
'\nfrom google.colab import files\nfrom io import BytesIO\nfrom PIL import Image\n\nuploaded = files.upload()\n\nimage_path =
next(iter(uploaded))\nimage = Image.open(BytesIO(uploaded[image_path]))\nimage = cv2.cvtColor(np.array(image), cv2.COLOR_RGB2B
```

EXERCISE 1. Scaling and Rotation

```
def scale_image(image, scale_factor):
  height, width = image.shape[:2]
  scale_img = cv2.resize(image,(int(width * scale_factor), int(height * scale_factor)), interpolation = cv2.INTER_LINEAR)
  return scale_img

def rotate_image(image, angle):
  height, width = image.shape[:2]
  center = (width//2,height//2)
  matrix = cv2.getRotationMatrix2D(center,angle,1)
  rotated_image = cv2.warpAffine(image,matrix,(width,height))
  return rotated_image

scaled_image = scale_image(image, 0.5)
display_image(scaled_image,"Scaled Image")

rotated_image = rotate_image(image, 45)
display_image(rotated_image,"Rotated Image")
```

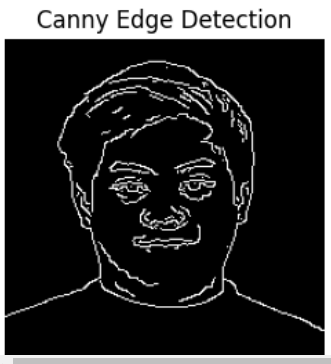
Exercise 2: Blurring Techniques

```
gussian_blur = cv2.GaussianBlur(image, (11,11), 0)
display_image(gussian_blur, "Gussian Blur")

median_blur = cv2.medianBlur(image,17)
display_image(median_blur, "Median Blur")

bilateral_blur = cv2.bilateralFilter(image, 99, 99, 99)
display_image(bilateral_blur, "Bilateral Blur")
```



3. Edge Detection using Canny

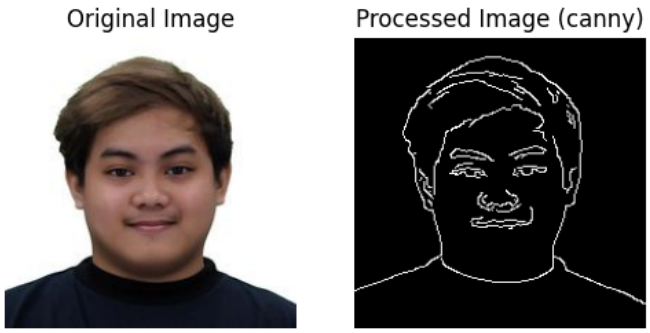
```
edge = cv2.Canny(image,100 ,150)
display_image(edge, "Canny Edge Detection")
```



Exercise 4: Basic Image Processor (Interactive)

```
def process_image(img, action):
  if action == 'scale':
    return scale_image(img, 0.5)
  elif action == 'rotate':
    return rotate_image(img, 45)
  elif action == 'gaussian_blur':
    return cv2.GaussianBlur(img, (5, 5), 0)
  elif action == 'median_blur':
    return cv2.medianBlur(img, 5)
  elif action == 'canny':
    return cv2.Canny(img, 100, 200)
  else:
    return img

"""
process_image(): This function allows users to specify an image transformation (scaling, rotation, blurring, or edge detection). De
"""
action = input("Enter action (scale, rotate, gaussian_blur, median_blur, canny): ")
processed_image = process_image(image, action)
display_images(image, processed_image, "Original Image", f"Processed Image ({action})")
"""
This allows users to enter their desired transformation interactively (via the
input() function). It processes the image and displays both the original and transformed versions side by side.
"""
```

```
Enter action (scale, rotate, gaussian_blur, median_blur, canny): canny
```

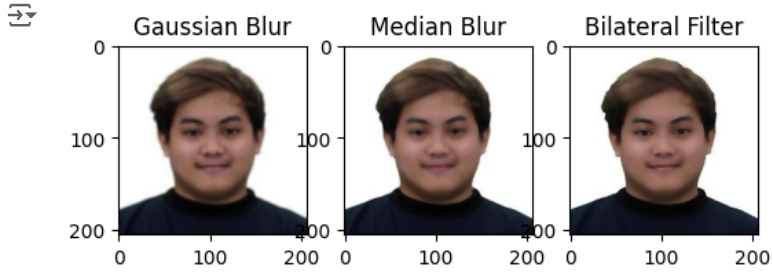



```
'\nThis allows users to enter their desired transformation interactively (via the\ninput() function). It processes the image a
nd displays both the original and transformed versions side by side.\n'
```

Exercise 5: Comparison of Filtering Techniques

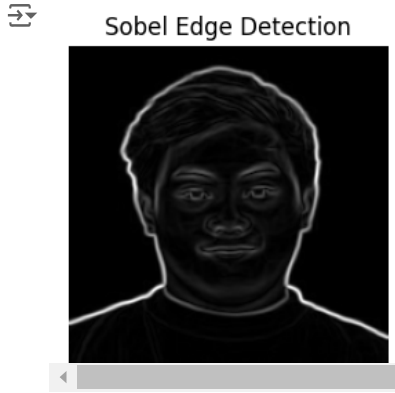
```
# Applying Gaussian, Median, and Bilateral filters
gaussian_blur = cv2.GaussianBlur(image, (5, 5), 0)
median_blur = cv2.medianBlur(image, 5)
bilateral_filter = cv2.bilateralFilter(image, 9, 75, 75)
"""
cv2.bilateralFilter(): This filter smooths the image while keeping edges sharp, unlike
Gaussian or median filters. It’s useful for reducing noise while preserving details.
```

```
"""

# Display the results for comparison
plt.figure(figsize=(6,3))
plt.subplot(1, 3, 1)
plt.imshow(cv2.cvtColor(gaussian_blur, cv2.COLOR_BGR2RGB))
plt.title("Gaussian Blur")

plt.subplot(1, 3, 2)
plt.imshow(cv2.cvtColor(median_blur, cv2.COLOR_BGR2RGB))
plt.title("Median Blur")

plt.subplot(1, 3, 3)
plt.imshow(cv2.cvtColor(bilateral_filter, cv2.COLOR_BGR2RGB))
plt.title("Bilateral Filter")

plt.show()
"""
Explanation: This displays the images processed by different filtering techniques (Gaussian,
Median, and Bilateral) side by side for comparison.
"""
```

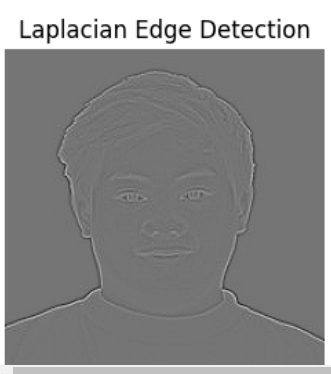



```
'\nExplanation: This displays the images processed by different filtering techniques (Gaussian \nMedian, and Bilateral) side b
```

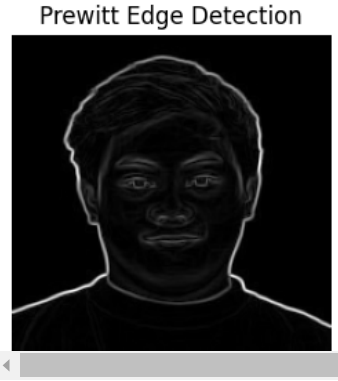
```
# Sobel Edge Detection
def sobel_edge_detection(img):
    # Convert to grayscale
    gray = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)

    # Sobel edge detection in the x direction
    sobelx = cv2.Sobel(gray, cv2.CV_64F, 1, 0, ksize=5)

    # Sobel edge detection in the y direction
    sobely = cv2.Sobel(gray, cv2.CV_64F, 0, 1, ksize=5)

    # Combine the two gradients
    sobel_combined = cv2.magnitude(sobelx, sobely)

    return sobel_combined
# Apply Sobel edge detection to the uploaded image
sobel_edges = sobel_edge_detection(image)
plt.figure(figsize=(6,3))
plt.imshow(sobel_edges, cmap='gray')
plt.title("Sobel Edge Detection")
plt.axis('off')
plt.show()
```



```
# Laplacian Edge Detection
def laplacian_edge_detection(img):
    # Convert to grayscale
    gray = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)

    # Apply Laplacian operator
    laplacian = cv2.Laplacian(gray, cv2.CV_64F)

    return laplacian
# Apply Laplacian edge detection to the uploaded image
laplacian_edges = laplacian_edge_detection(image)
plt.figure(figsize=(6,3))
plt.imshow(laplacian_edges, cmap='gray')
plt.title("Laplacian Edge Detection")
plt.axis('off')
plt.show()
```




```
# Prewitt Edge Detection
def prewitt_edge_detection(img):
    # Convert to grayscale
    gray = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)

    # Prewitt operator kernels for x and y directions
    kernelx = np.array([[1, 0, -1], [1, 0, -1], [1, 0, -1]], dtype=int)
    kernely = np.array([[1, 1, 1], [0, 0, 0], [-1, -1, -1]], dtype=int)

    # Applying the Prewitt operator
    prewittx = cv2.filter2D(gray, cv2.CV_64F, kernelx)
    prewitty = cv2.filter2D(gray, cv2.CV_64F, kernely)

    # Combine the x and y gradients by converting to floating point
    prewitt_combined = cv2.magnitude(prewittx, prewitty)

    return prewitt_combined

# Apply Prewitt edge detection to the uploaded image
prewitt_edges = prewitt_edge_detection(image)
plt.figure(figsize=(6,3))
plt.imshow(prewitt_edges, cmap='gray')
plt.title("Prewitt Edge Detection")
plt.axis('off')
plt.show()
```



```
# Bilateral Filter
def bilateral_blur(img):
    bilateral = cv2.bilateralFilter(img, 9, 75, 75)
    return bilateral
# Apply Bilateral filter to the uploaded image
bilateral_blurred = bilateral_blur(image)
plt.figure(figsize=(6,3))
plt.imshow(cv2.cvtColor(bilateral_blurred, cv2.COLOR_BGR2RGB))
plt.title("Bilateral Filter")
plt.axis('off')
plt.show()
```


```
# Box Filter
def box_blur(img):
    box = cv2.boxFilter(img, -1, (5, 5))
    return box
# Apply Box filter to the uploaded image
box_blurred = box_blur(image)
plt.figure(figsize=(6,3))
plt.imshow(cv2.cvtColor(box_blurred, cv2.COLOR_BGR2RGB))
plt.title("Box Filter")
plt.axis('off')
plt.show()
```


```
# Motion Blur
def motion_blur(img):
    # Create motion blur kernel (size 15x15)
    kernel_size = 15
    kernel = np.zeros((kernel_size, kernel_size))
    kernel[int((kernel_size - 1) / 2), :] = np.ones(kernel_size)
    kernel = kernel / kernel_size

    # Apply motion blur
    motion_blurred = cv2.filter2D(img, -1, kernel)
    return motion_blurred
# Apply Motion blur to the uploaded image
motion_blurred = motion_blur(image)
plt.figure(figsize=(6,3))
plt.imshow(cv2.cvtColor(motion_blurred, cv2.COLOR_BGR2RGB))
plt.title("Motion Blur")
plt.axis('off')
plt.show()
```


```
# Unsharp Masking (Sharpening)
def unsharp_mask(img):
    # Create a Gaussian blur version of the image
    blurred = cv2.GaussianBlur(img, (9, 9), 10.0)

    # Sharpen by adding the difference between the original and the blurred image
    sharpened = cv2.addWeighted(img, 1.5, blurred, -0.5, 0)
    return sharpened

# Apply Unsharp Masking to the uploaded image
sharpened_image = unsharp_mask(image)
plt.figure(figsize=(6,3))
plt.imshow(cv2.cvtColor(sharpened_image, cv2.COLOR_BGR2RGB))
plt.title("Unsharp Mask (Sharpening)")
plt.axis('off')
plt.show()
```


```
# Update process_image function to include new blurring techniques
def process_image(img, action):
    if action == 'scale':
        return scale_image(img, 0.5)
    elif action == 'rotate':
        return rotate_image(img, 45)
    elif action == 'gaussian_blur':
        return cv2.GaussianBlur(img, (5, 5), 0)
    elif action == 'median_blur':
        return cv2.medianBlur(img, 5)
    elif action == 'canny':
        return cv2.Canny(img, 100, 200)
    elif action == 'sobel':
        return sobel_edge_detection(img).astype(np.uint8)
    elif action == 'laplacian':
        return laplacian_edge_detection(img).astype(np.uint8)
    elif action == 'prewitt':
        return prewitt_edge_detection(img).astype(np.uint8)
    elif action == 'bilateral_blur':
        return bilateral_blur(img)
    elif action == 'box_blur':
        return box_blur(img)
    elif action == 'motion_blur':
        return motion_blur(img)
    elif action == 'unsharp_mask':
```

```
            return unsharp_mask(img)
        else:
            return img

    # Add new blurring options for interactive processing
    action = input("Enter action (scale, rotate, gaussian_blur, median_blur, canny, sobel, laplacian, prewitt, bilateral_blur, box_blur
    processed_image = process_image(image, action)
    display_images(image, processed_image, "Original Image", f"Processed Image ({action})")
```

```
Enter action (scale, rotate, gaussian_blur, median_blur, canny, sobel, laplacian, prewitt, bilateral_blur, box_blur, motion_blu
```


```
    plt.figure(figsize=(3, 3))
    plt.imshow(cv2.cvtColor(image, cv2.COLOR_BGR2RGB))
    plt.title("Original Image")
    plt.axis('off')
    plt.show()

    plt.suptitle("BLURRED IMAGE")
    plt.subplot(2, 3, 1)
    plt.imshow(cv2.cvtColor(gaussian_blur, cv2.COLOR_BGR2RGB))
    plt.axis('off')
    plt.title("Gaussian Blur")

    plt.subplot(2, 3, 2)
    plt.imshow(cv2.cvtColor(median_blur, cv2.COLOR_BGR2RGB))
    plt.axis('off')
    plt.title("Median Blur")

    plt.subplot(2, 3, 3)
    plt.imshow(cv2.cvtColor(bilateral_filter, cv2.COLOR_BGR2RGB))
    plt.axis('off')
    plt.title("Bilateral Filter")

    plt.subplot(2, 3, 4)
    plt.imshow(cv2.cvtColor(box_blurred, cv2.COLOR_BGR2RGB))
    plt.axis('off')
    plt.title("Box Filter")

    plt.subplot(2, 3, 5)
    plt.imshow(cv2.cvtColor(motion_blurred, cv2.COLOR_BGR2RGB))
    plt.axis('off')
    plt.title("Motion Blur")

    plt.subplot(2, 3, 6)
    plt.imshow(cv2.cvtColor(sharpened_image, cv2.COLOR_BGR2RGB))
    plt.axis('off')
    plt.title("Unsharp Mask")
    plt.show()

    plt.suptitle("EDGE DETECTION IMAGE")
    plt.subplot(2, 2, 1)
    plt.imshow(edge, cmap='gray')
    plt.axis('off')
    plt.title("Canny Edge")

    plt.subplot(2, 2, 2)
    plt.imshow(sobel_edges, cmap='gray')
    plt.axis('off')
    plt.title("Sobel Edge")

    plt.subplot(2, 2, 3)
```

```
    plt.imshow(laplacian_edges, cmap='gray')
    plt.axis('off')
    plt.title("Laplacian Edge")

    plt.subplot(2, 2, 4)
    plt.imshow(prewitt_edges, cmap='gray')
    plt.axis('off')
    plt.title("Prewitt Edge")

    plt.show()
```