Apply image processing techniques (scaling, rotation, blurring, edge detection) using OpenCV

Step 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)
```

Step 2: Import Necessary Libraries

```
import cv2
import numpy as np
import matplotlib.pyplot as plt
# Function to display an image using matplotlib
def display_image(img, title="Image"):
  plt.imshow(cv2.cvtColor(img, cv2.COLOR_BGR2RGB))
  plt.title(title)
  plt.axis('off')
  plt.show()
# Function to display two images side by side
def display_images(img1, img2, title1="Image 1", title2="Image 2"):
  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()
```

Step 3: Load an Image

```
from google.colab import files
from io import BytesIO
from PIL import Image
# Upload an image
uploaded = files.upload()
# Convert to OpenCV format
image_path = next(iter(uploaded)) # Get the image file name
image = Image.open(BytesIO(uploaded[image_path]))
image = cv2.cvtColor(np.array(image), cv2.COLOR_RGB2BGR)
display_image(image, "Original Image")
```

Choose Files HIPOLITO.png

- **HIPOLITO.png**(image/png) - 135224 bytes, last modified: 9/16/2024 - 100% done

```
Saving HIPOLITO.png to HIPOLITO.png
```

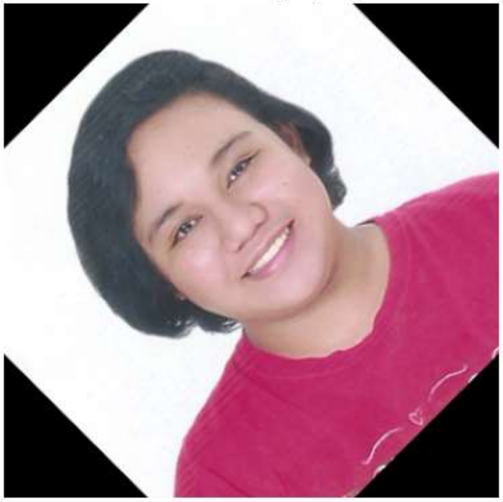
Original Image

Exercise 1: Scaling and Rotation

```
# Scaling
def scale_image(img, scale_factor):
  height, width = img.shape[:2]
  scaled_img = cv2.resize(img,
  (int(width * scale_factor), int(height * scale_factor)), interpolation=cv2.INTER_LINEAR)
  return scaled_img

# Rotate
def rotate_image(img, angle):
  height, width = img.shape[:2]
  center = (width // 2, height // 2)
  matrix = cv2.getRotationMatrix2D(center, angle, 1.0)
  rotated_img = cv2.warpAffine(img, matrix, (width, height))
  return rotated_img

# Scale image by 0.5
scaled_image = scale_image(image, 0.5)
display_image(scaled_image, "Scaled Image (50%)")
# Rotate image by 45 degrees
rotated_image = rotate_image(image, 45)
display_image(rotated_image, "Rotated Image (45°)")
```

Scaled Image (50%)

Rotated Image (45°)

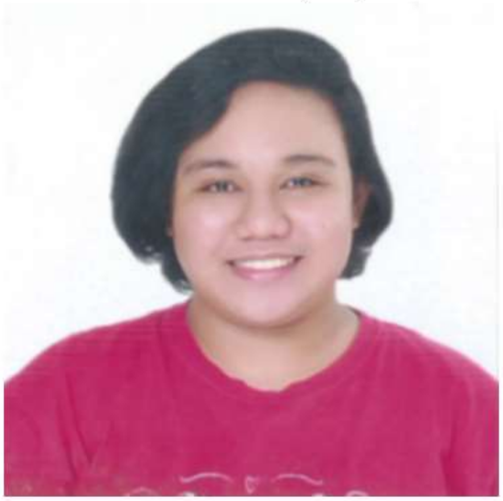


Exercise 2: Blurring Techniques

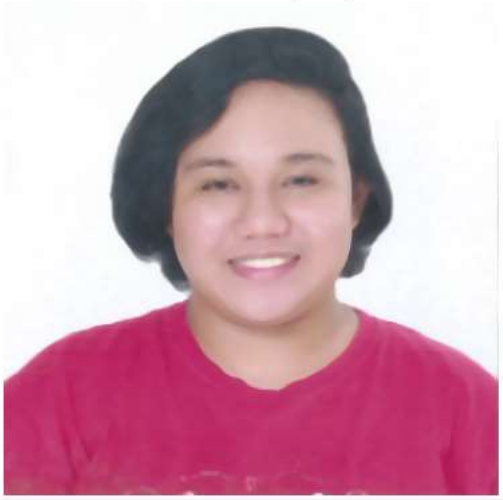
```
# Gaussian Blur
gaussian_blur = cv2.GaussianBlur(image, (5, 5), 0)
display_image(gaussian_blur, "Gaussian Blur (5x5)")

# Median Blur
median_blur = cv2.medianBlur(image, 5)
```

```
display_image(median_blur, "Median Blur (5x5)")
```

Gaussian Blur (5x5)



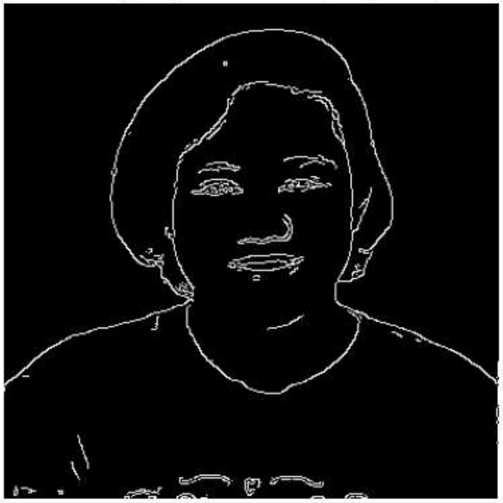
Median Blur (5x5)



Exercise 3: Edge Detection using Canny

```
# Canny Edge Detection
edges = cv2.Canny(image, 100, 200)
display_image(edges, "Canny Edge Detection (100, 200)")
```

Canny Edge Detection (100, 200)



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). Depending on the action passed, it will apply the
corresponding image processing technique and return the processed image.
"""
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): scale
```

Original Image

Processed Image (scale)

```
'\nThis allows users to enter their desired transformation interactively (via the\ninput() function). It processes the image and displays both the ori
ginal and transformed\nversions 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=(10, 5))
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()
```

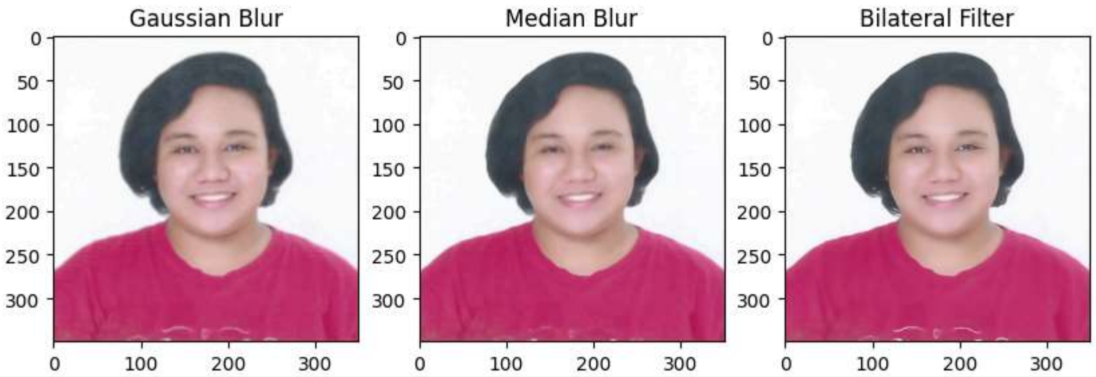


Image Processing

```
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
```

```
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
```

```
# Laplacian Edge Detection
def laplacian_edge_detection(img):
  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
```

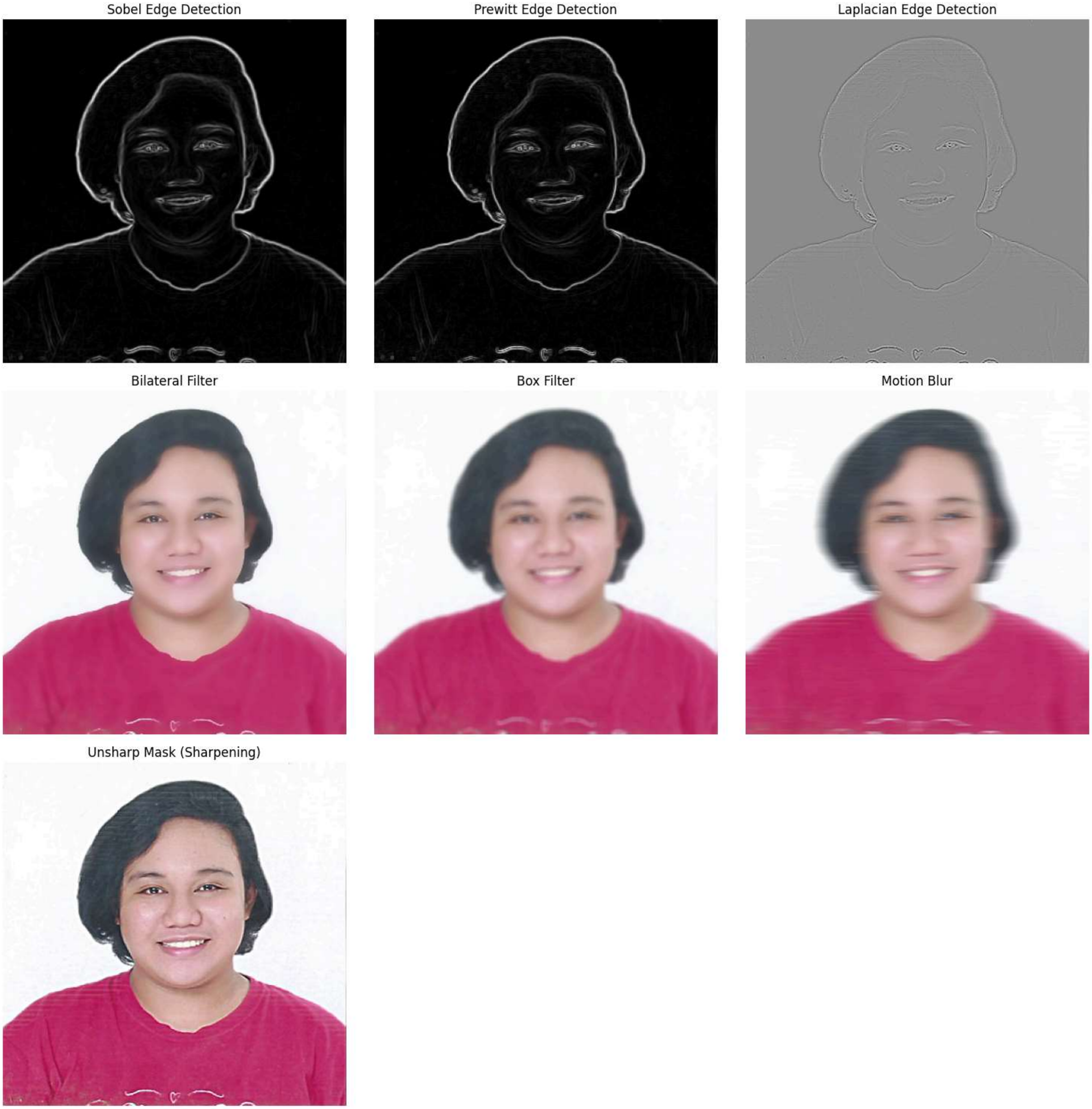
```
# Bilateral Filter
def bilateral_blur(img):
  bilateral = cv2.bilateralFilter(img, 9, 75, 75)
  return bilateral
# Apply Bilateral filter to the uploaded image
```

```
# Box Filter
def box_blur(img):
  box = cv2.boxFilter(img, -1, (5, 5))
  return box
# Apply Box filter to the uploaded image
```

```
# 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
```

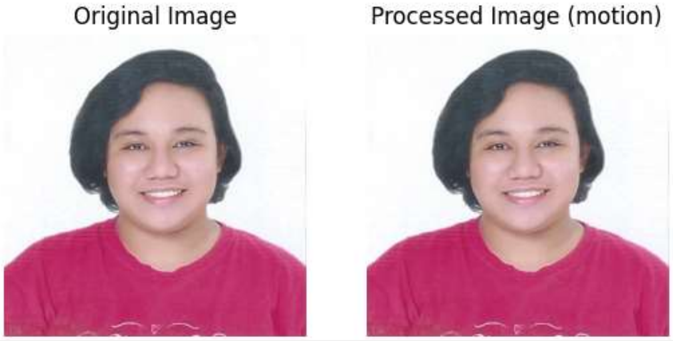
```
# Unsharp Masking (Sharpening)
def unsharp_mask(img):
  # Create a Gaussian blur version of the image
  blurred = cv2.GaussianBlur(img, (9, 9), 10.0)
  # Sharpen by adding the difference between the original and the blurred image
  sharpened = cv2.addWeighted(img, 1.5, blurred, -0.5, 0)
  return sharpened
# Apply Unsharp Masking to the uploaded image
```

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

def display_images_in_grid(images, titles, cols=3):
    rows = len(images) // cols + int(len(images) % cols != 0)
    fig, axes = plt.subplots(rows, cols, figsize=(15, 5 * rows))
    axes = axes.ravel()  # Flatten the 2D array of axes to make iteration easier

    for i in range(len(images)):
        if len(images[i].shape) == 2:  # If the image is grayscale
            axes[i].imshow(images[i], cmap='gray')
        else:  # If the image is RGB
            axes[i].imshow(cv2.cvtColor(images[i], cv2.COLOR_BGR2RGB))
        axes[i].set_title(titles[i])
        axes[i].axis('off')

    # Hide any extra subplots that are unused
    for i in range(len(images), len(axes)):
        axes[i].axis('off')

    plt.tight_layout()
    plt.show()

# Processed images and their titles
sobel_edges = sobel_edge_detection(image)
prewitt_edges = prewitt_edge_detection(image)
laplacian_edges = laplacian_edge_detection(image)
bilateral_blurred = bilateral_blur(image)
box_blurred = box_blur(image)
motion_blurred = motion_blur(image)
sharpened_image = unsharp_mask(image)

# Collect images and titles
images = [
    sobel_edges, prewitt_edges, laplacian_edges,
    bilateral_blurred, box_blurred, motion_blurred, sharpened_image
]
titles = [
    "Sobel Edge Detection", "Prewitt Edge Detection", "Laplacian Edge Detection",
    "Bilateral Filter", "Box Filter", "Motion Blur", "Unsharp Mask (Sharpening)"
]

# Display images in a 3-column grid
display_images_in_grid(images, titles, cols=3)
```



```
# 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)
  elif action == 'laplacian':
    return laplacian_edge_detection(img)
  elif action == 'prewitt':
    return prewitt_edge_detection(img)
  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, motion_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_blurmotion
```


Original Image

Processed Image (motion)