Image Processing Lab Report

Set up different image processing libraries in Python. Perform basic image manipulations and transformations.

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Aim

To set up different image processing libraries in Python. Perform basic image manipulations and transformations.

Theory

1. Introduction

Image processing is a critical area in computer vision and data analysis. Python provides a wide range of libraries that make image manipulation efficient and accessible. This write-up discusses the setup of image processing libraries and demonstrates basic operations such as resizing, rotating, and flipping images.

2. Setup of Required Libraries

The following Python libraries are used:

- **OpenCV (cv2)** – for powerful image processing functions.
- **Pillow (PIL)** – for simple image manipulations.
- **Matplotlib** – for displaying images.
- **scikit-image** – for scientific image transformations.
- **NumPy** – for handling image arrays.

Install the required packages using the following command:

```
pip install opencv-python pillow matplotlib scikit-image numpy
```

3. Loading and Displaying an Image

Using OpenCV to read and display an image with Matplotlib:

```
import cv2
import matplotlib.pyplot as plt

image = cv2.imread('image.jpg')
image_rgb = cv2.cvtColor(image, cv2.COLOR_BGR2RGB)

plt.imshow(image_rgb)
plt.title('Original Image')
plt.axis('off')
plt.show()
```

4. Basic Image Manipulations

a) Resize

```
resized = cv2.resize(image, (200, 200))
```

b) Rotate

```
(h, w) = image.shape[:2]
center = (w // 2, h // 2)
matrix = cv2.getRotationMatrix2D(center, 45, 1.0)
rotated = cv2.warpAffine(image, matrix, (w, h))
```

c) Flip

```
flipped = cv2.flip(image, 1)  # 0 = vertical, 1 = horizontal
```

5. Image Manipulations using Pillow (PIL)

```
from PIL import Image, ImageOps

img = Image.open('image.jpg')
img_resized = img.resize((200, 200))
img_rotated = img.rotate(45)
img_flipped = ImageOps.mirror(img)
```

6. Transformations using scikit-image

```
from skimage import io, transform

img_sk = io.imread("image.jpg")
resized_sk = transform.resize(img_sk, (200, 200))
rotated_sk = transform.rotate(img_sk, 45)
```

Implementation

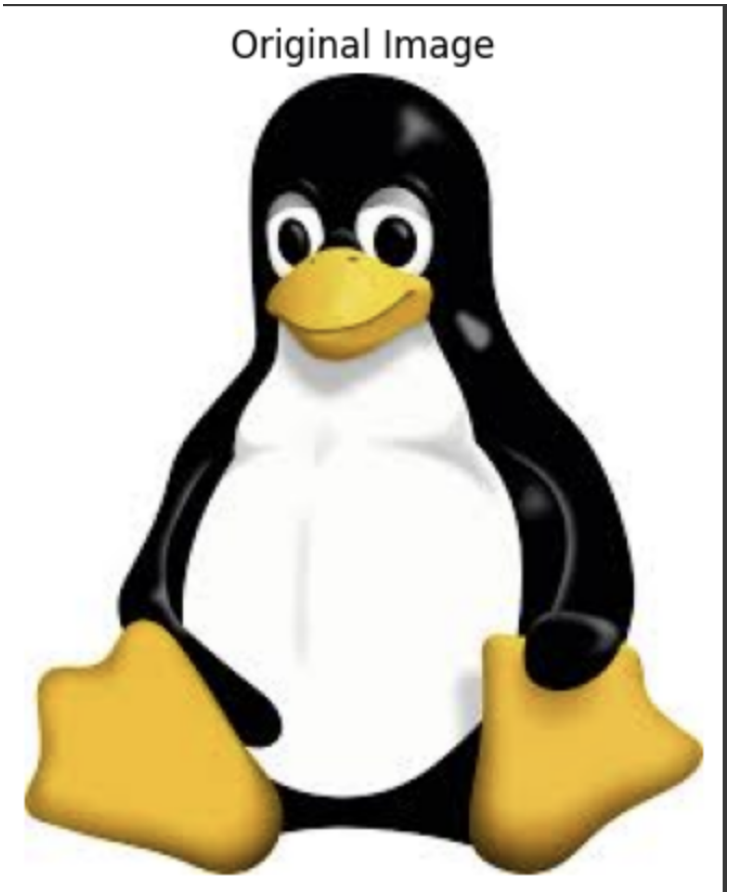

Figure 1: Original Image

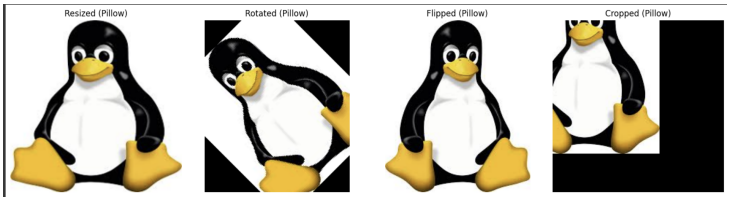

Figure 2: Manipulated

Conclusion

In this lab session, we explored the fundamentals of image processing using Python. We began by setting up essential libraries such as OpenCV, Pillow, Matplotlib, NumPy, and scikit-image, each offering unique capabilities for handling and manipulating digital images.

We learned how to:

- Install and import multiple image processing libraries in Python.
- Read and display images using OpenCV and Matplotlib.

- Perform basic manipulations such as resizing, rotating, and flipping images using both OpenCV and Pillow.
- Apply image transformations using scikit-image for resizing and rotation.
- Understand the structure and array-based representation of images in Python.

By completing this lab, we are now equipped with the foundational knowledge and hands-on experience to:

- Preprocess images for machine learning and computer vision applications.
- Use Python code to programmatically manipulate images for different real-world use cases.
- Choose the appropriate library depending on the complexity and requirement of the image operation.

These skills are essential stepping stones toward more advanced topics such as image filtering, feature extraction, object detection, and deep learning-based image analysis. The ability to confidently manipulate images at this level will significantly contribute to our understanding of more complex computer vision pipelines in future labs and projects.