Task 3 Report
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Course: AIML-A
Subject: Computer Vision
Task: Image Processing Toolkit Submission

1. Introduction

The project Image Processing Toolkit is a web-based application built using Streamlit , OpenCV , NumPy, and PIL. The main objective of this application is to provide an interactive platform for applying various image processing operations such as color conversions, transformations, filtering, morphological operations, enhancement, edge detection, and compression.

This toolkit helps users visualize the effects of different image processing techniques in real-time, making it a useful learning and experimentation tool for students, researchers, and developers.

2. Technologies Used

• Python: Core programming language.
• Streamlit : For creating an interactive web -based user interface.
• OpenCV (cv2) : For image processing operations.
• NumPy: For handling numerical operations on arrays and matrices.
• PIL (Python Imaging Library) : For saving and compressing images in different formats.
• Matplotlib : For visualization support (if extended).

3. Features of the Toolkit

The toolkit supports the following functionalities:

A. File Handling

• Upload images in formats such as .jpg, .jpeg, .png, .bmp.
• Display original image details such as dimensions, channels, file size, and format.

B. Image Operations

1. Color Conversions
o RGB ↔ BGR
o RGB ↔ HSV

- o   RGB ↔ YCbCr

- o   RGB → Grayscale

2. **Transformations**

- o   Rotation (custom angle)

- o   Scaling (zoom in/out)

- o   Translation (move along X and Y axes)

3. **Filtering & Morphological Operations**

- o   Gaussian Blur

- o   Median Blur

- o   Mean Blur

- o   Sobel Edge Detection

- o   Laplacian Edge Detection

- o   Dilation, Erosion, Opening, Closing

4. **Enhancement**

- o   Histogram Equalization

- o   Contrast Stretching

- o   Image Sharpening

5. **Edge Detection**

- o   Canny Edge Detection (with adjustable thresholds)

6. **Compression**

- o   Save images with compression in **JPEG, PNG, and BMP formats**.

- o   Adjustable **JPEG quality** and **PNG compression level**.

C. User Interaction

- Side panel to select operation category and parameters.

- Real-time image display with both **Original** and **Processed images** side by side.

- Download option for saving processed images.

- Status bar showing current image details and operations applied.

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4. Workflow of the Application

1. **Image Upload:**
   User uploads an image file → Application reads and stores the image in session state.

2. **Operation Selection**:
   User selects an operation category and specific transformation from the sidebar.

3. **Parameter Adjustment**:
   Sliders and input controls allow adjustment of parameters like kernel size, angle, scale, thresholds, etc.

4. **Apply Operation**:
   On clicking **Apply Operation**, the image is processed using OpenCV functions.

5. **Output Display**:

   o   Original image and Processed image are displayed side by side.

   o   Detailed image information is shown for both.

   o   Option to download the processed image is provided.

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5. Advantages

- Easy-to-use graphical interface.

- Real-time visualization of image processing effects.

- Supports multiple operations in a single platform.

- Downloadable outputs for further use.

- Educational value for learning image processing techniques.

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6. Possible Extensions

- Add support for **video processing**.

- Implement **region of interest (ROI) selection**.

- Provide **batch processing** for multiple images.

- Include **machine learning-based filters** (e.g., super-resolution, style transfer).

- Add **histogram and intensity plots** for deeper analysis.

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7. Conclusion

The **Image Processing Toolkit** provides a comprehensive and user-friendly environment for experimenting with various image processing operations. It combines the power of **OpenCV** with the simplicity of **Streamlit**, making it suitable for both academic learning and practical applications.

This project demonstrates the integration of **Python libraries** into a functional web application and can serve as a base for more advanced image processing and computer vision projects.

Operations

Upload an image

Drag and drop file here
Limit 200MB per file • JPG, JP...
Browse files

RDT_2025012... ×
1.3MB

Select Operation Category
Transformations ▾

Select Operation
Translation ▾

X Translation   -93

Y Translation   98

Apply Operation

Download Processed Image

Deploy ⋮

Original Image

Processed Image

Operation applied successfully!

Image Information:

Dimensions: 4096 x 2160

Channels: 3

File Size: 1316252 bytes

File Format: image/jpeg

Processed Image Information:

Dimensions: 4096 x 2160

Channels: 3

File Size: 1316252 bytes

File Format: image/jpeg

Upload an image

Drag and drop file here
Limit 200MB per file • JPG, JP...
Browse files

RDT_2025012... ×
1.3MB

Select Operation Category
Filtering & Morphology ▾

Select Operation
Gaussian Blur ▾

Kernel Size   15

Apply Operation

Download Processed Image

Deploy ⋮

Original Image

Processed Image

Operation applied successfully!

Image Information:

Dimensions: 4096 x 2160

Channels: 3

File Size: 1316252 bytes

File Format: image/jpeg

Processed Image Information:

Dimensions: 4096 x 2160

Channels: 3

File Size: 1316252 bytes

File Format: image/jpeg

Upload an image

Drag and drop file here
Limit 200MB per file • JPG, JP...
Browse files

RDT_2025012... ×
1.3MB

Select Operation Category
Filtering & Morphology ▾

Select Operation
Mean Blur ▾

Kernel Size   15

Apply Operation

Download Processed Image

Deploy ⋮

Original Image

Processed Image

Operation applied successfully!

Image Information:

Dimensions: 4096 x 2160

Channels: 3

File Size: 1316252 bytes

File Format: image/jpeg

Processed Image Information:

Dimensions: 4096 x 2160

Channels: 3

File Size: 1316252 bytes

File Format: image/jpeg

Screenshot 1

Image Processing Toolkit

localhost:8501

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Deploy

Upload an image

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RDT_2025012... ×
1.3MB

Select Operation Category
Filtering & Morphology

Select Operation
Dilation

Kernel Size
15

Apply Operation

Download Processed Image

Original Image

Image Information:
Dimensions: 4096 x 2160
Channels: 3
File Size: 1316252 bytes
File Format: image/jpeg

Processed Image

Operation applied successfully!

Processed Image Information:
Dimensions: 4096 x 2160
Channels: 3
File Size: 1316252 bytes
File Format: image/jpeg

Screenshot 2

localhost:8501

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Deploy

Operations

Upload an image

Drag and drop file here
Limit 200MB per file • JPG, JP...
Browse files

RDT_2025012... ×
1.3MB

Select Operation Category
Enhancement

Select Operation
Histogram Equalization

Apply Operation

Download Processed Image

Original Image

Image Information:
Dimensions: 4096 x 2160
Channels: 3
File Size: 1316252 bytes
File Format: image/jpeg

Processed Image

Operation applied successfully!

Processed Image Information:
Dimensions: 4096 x 2160
Channels: 3
File Size: 1316252 bytes
File Format: image/jpeg

Screenshot 3

Image Processing Toolkit

localhost:8501

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Deploy

Operations

Upload an image

Drag and drop file here
Limit 200MB per file • JPG, JP...
Browse files

RDT_2025012... ×
1.3MB

Select Operation Category
Enhancement

Select Operation
Sharpening

Apply Operation

Download Processed Image

Original Image

Image Information:
Dimensions: 4096 x 2160
Channels: 3
File Size: 1316252 bytes
File Format: image/jpeg

Processed Image

Operation applied successfully!

Processed Image Information:
Dimensions: 4096 x 2160
Channels: 3
File Size: 1316252 bytes
File Format: image/jpeg