Assignment 3 – Image Processing Toolkit

Module: Image Processing Fundamentals & Computer Vision
Deadline: Sep 8, 2025
Level: Beginner → Intermediate → Advanced

■ Objective

The objective of this project is to design and implement a GUI-based image processing application using Python, Streamlit, and OpenCV. The application allows users to upload images, apply various transformations, filtering, and enhancement operations, and visualize results interactively.

■ Introduction

Image processing is a fundamental area of computer vision where images are enhanced, transformed, and analyzed. This project focuses on developing an interactive toolkit that integrates fundamental image processing operations with a graphical user interface. By using Streamlit, the application ensures accessibility and user-friendliness, making it easier to visualize the effects of various operations.

■ Libraries / Packages Used

| Library	Usage
Streamlit	GUI development and layout
OpenCV	Image processing operations (filters, transformations, conversions)
NumPy	Image data representation and matrix operations
Matplotlib	Visualization (histograms, plots)
ReportLab	Report generation

■■ Methodology

The project was implemented in several phases: - Phase 1: Setup of Streamlit layout with sidebar and image upload option. - Phase 2: Implementation of image fundamentals (color conversions, image info). - Phase 3: Transformations (rotation, scaling, translation, affine, perspective). - Phase 4: Filtering & Morphology (Gaussian, Median, Sobel, Laplacian, Dilation, Erosion). - Phase 5: Enhancement & Edge Detection (Histogram Equalization, Contrast Stretching, Canny). - Phase 6: Compression & File Handling (JPG, PNG, BMP support). - Phase 7: GUI polish with status bar, parameters sliders, and save option.
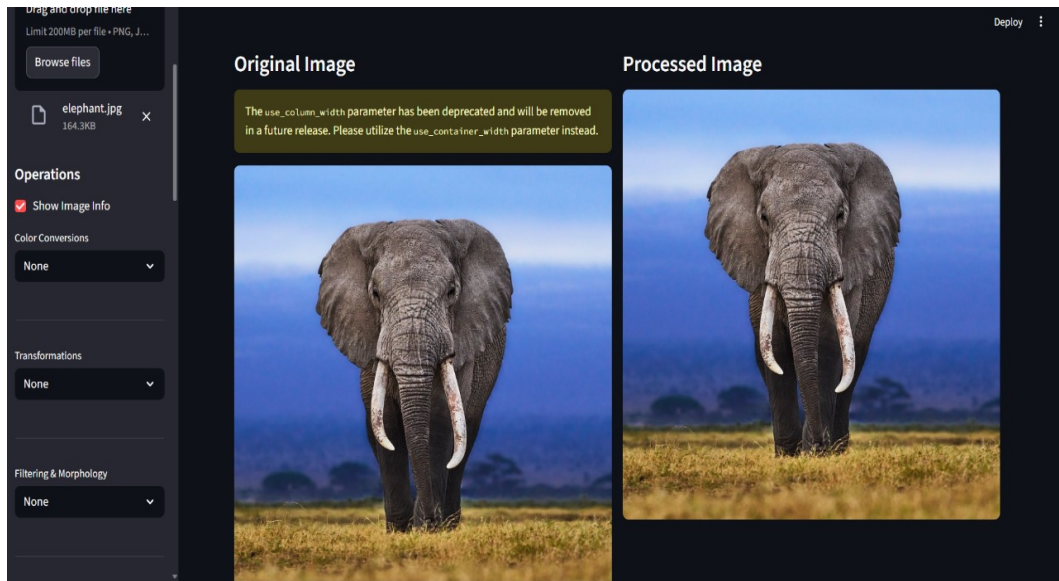
■ Results

Below are some of the results from applying different operations to an elephant image using the toolkit:

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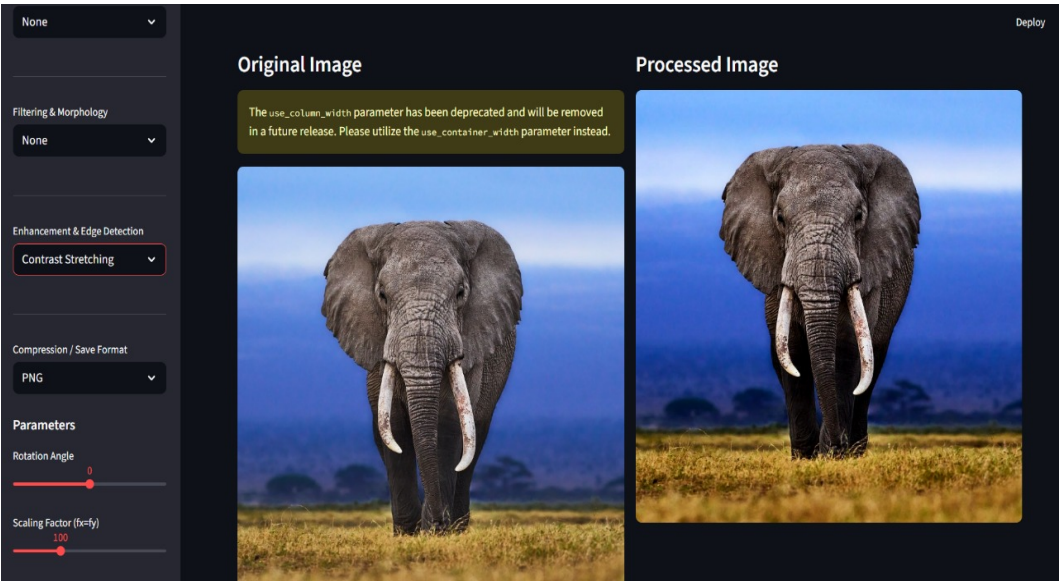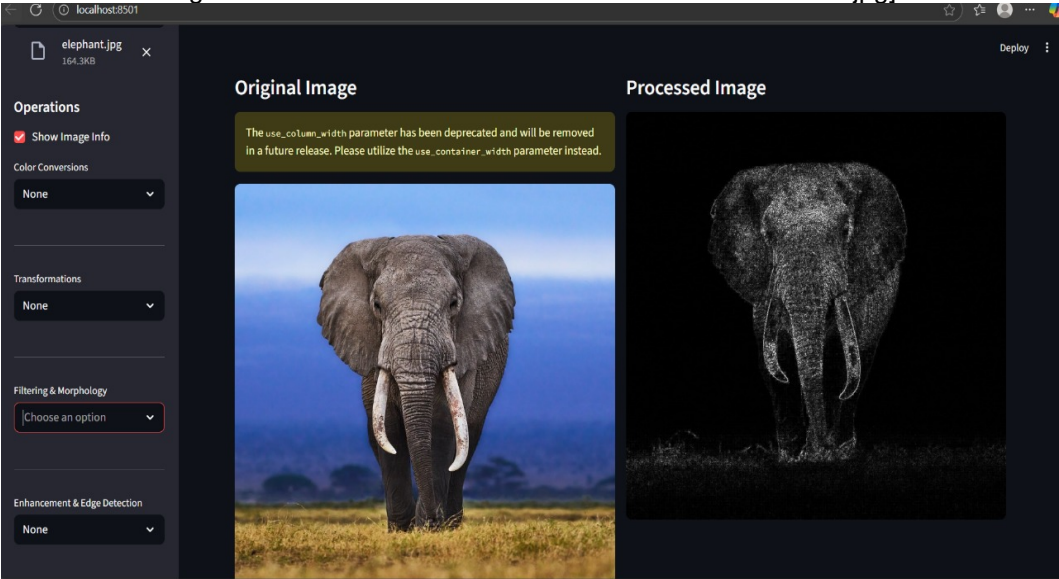
■ Conclusion

This assignment provided practical exposure to fundamental image processing techniques while integrating them into an interactive GUI. Key learnings included handling color spaces, applying spatial filters, performing morphological operations, and visualizing image transformations. Challenges included ensuring compatibility of OpenCV operations with Streamlit display functions. Future improvements may include adding advanced deep learning-based enhancements and real-time video processing.