

Image Processing App Documentation

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Section 1 - User's Manual

1.1 Introduction

The Image Processing App is a powerful image processing toolbox designed to help users easily perform various image processing tasks, such as cropping, flipping, rotating, scaling, linear and power-law mappings, convolution, and histogram equalization. This user-friendly GUI application is suitable for both beginners and experts in the field of image processing.

1.2 Using the Toolbox

When the app is running the main window will appear with a canvas and a set of buttons for various image-processing operations. (As seen below in Figure 1a)



Figure 1a - Opening the App

To start, load an image by clicking the "Load" button and selecting any image file using the file folder. Once the image is loaded, you can perform various operations using the buttons on the main window. The results will be displayed on the canvas. (Figure 1b)

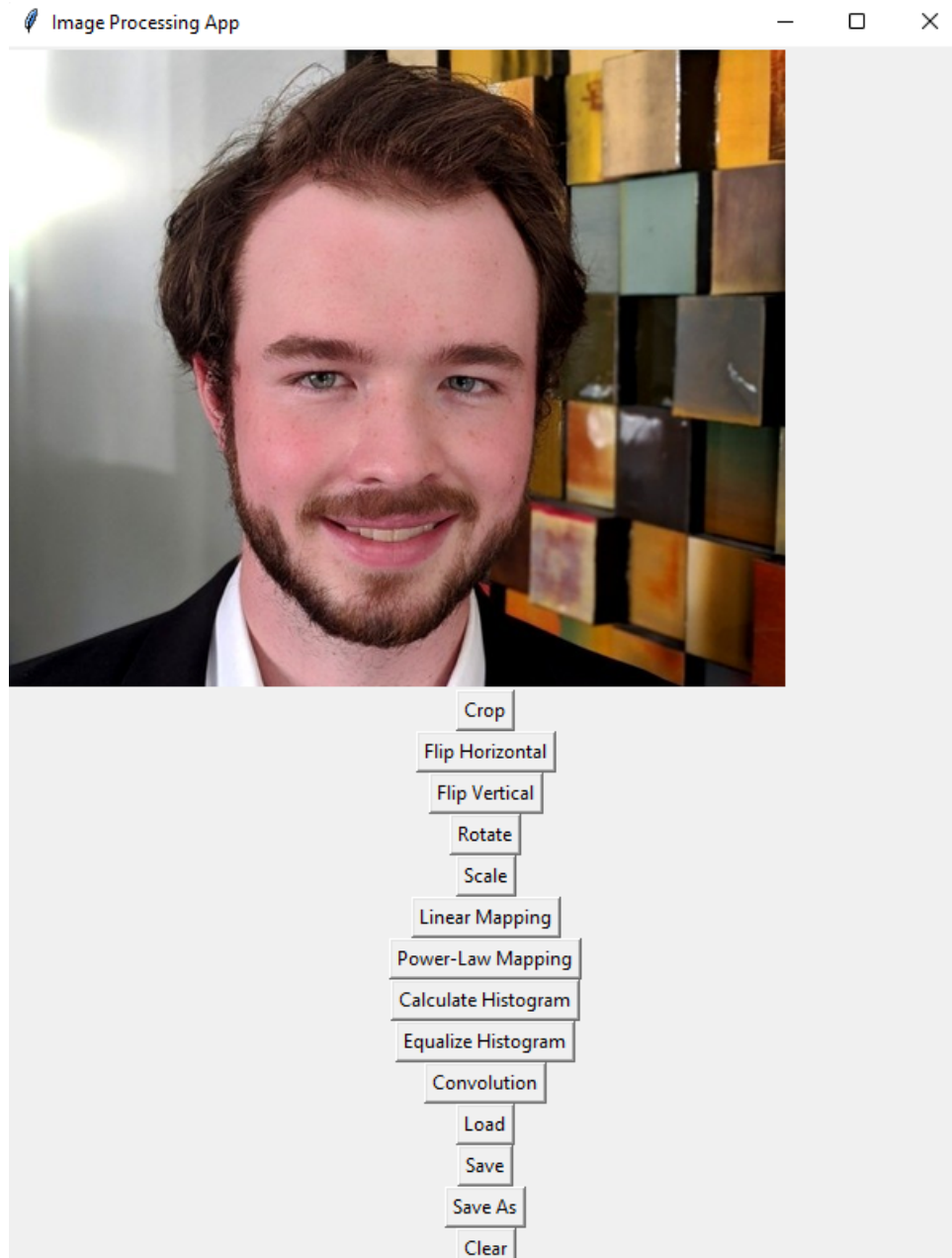


Figure 1b - Image loaded

To save the processed image, click the "Save" button to save the image to its original location or the "Save As" button to save the image to a new location.

How to use the functions that require input:

Crop: Once “Crop” is pressed a “Crop Image” window will appear (As seen below in figure 2). Then the user will enter a new pixel value for where each border will cut off the image. This is done assuming (0,0) is top left and the bottom right will be (Width,Height).

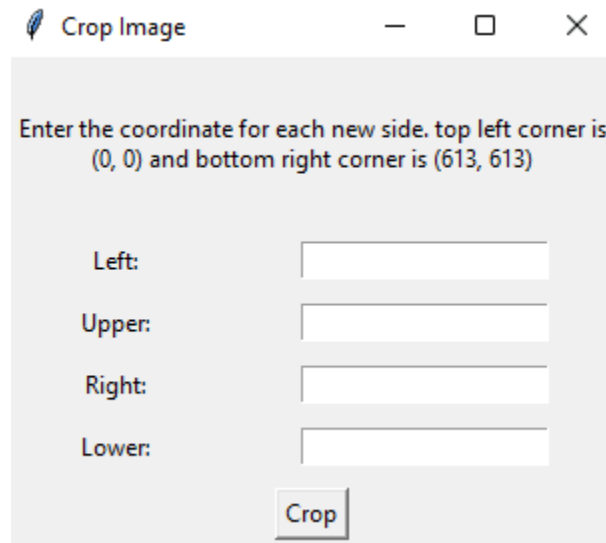


Figure 2 - Crop image

Scale: Once “Scale” is pressed the “Scale Image” appears

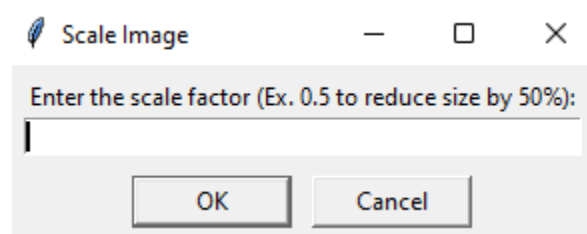


Figure 3 - Scale Image

Linear Mapping: Once “Linear mapping” is pressed then a prompt comes up to “Enter the slope:” (Figure 4a) then the user must enter the intercept for that line in the next window (See Figure 4b) then the mapping is applied to the image

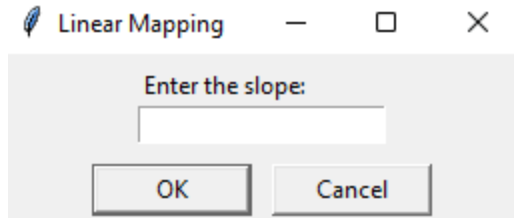


Figure 4a - Linear Mapping Slope

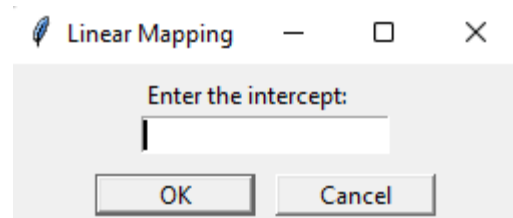


Figure 4b - Linear Mapping Intercept

Power-Law Mapping: Similar to Linear Mapping with 2 input windows one for gamma (Figure 5a) and one for the constant with the default being 1 (Figure 5b)

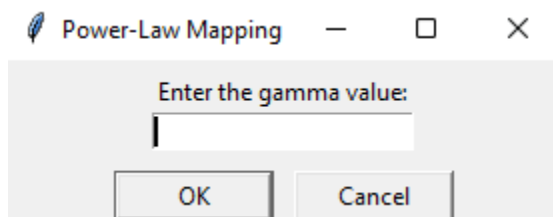


Figure 5a - Power-Law Mapping Gamma

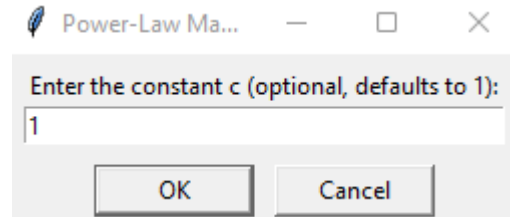


Figure 5b - Power-Law Mapping constant

Histogram:

“Calculate Histogram” displays a new window showing the histogram of intensity for the image (Figure 6)

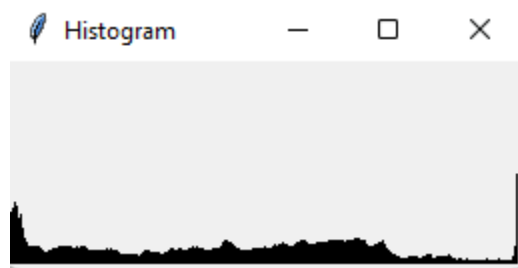


Figure 6 - Histogram Example

“Equalize Histogram” converts the image to greyscale then it equalizes the intensity which enhances its contrast. Takes an image of my face (Figure 7a) then converts to greyscale and equalizes it (Figure 7b).



Figure 7a - Before equalizes



Figure 7b - After equalizes

1.3 Limitations

The Image Processing App has the following limitations:

- It can only load and save images in formats supported by the PIL library.
- The app only supports grayscale images for certain operations like histogram equalization, linear and power-law mappings, and convolution.
- No undo functionality is available.

Section 2 - Technical Discussion

2.1 Image Processing Techniques

The Image Processing App implements various image processing techniques, including:

- Cropping
- Flipping
- Rotating
- Scaling
- Linear and Power-law Mappings
- Convolution
- Histogram Equalization

2.2 Algorithms and Implementations

The application uses the following algorithms and methods:

- Cropping: The app uses the `crop()` function provided by the PIL library.
- Flipping: The app uses the `transpose()` function provided by the PIL library.
- Rotating: A custom algorithm is used to rotate the image by 90 degrees.
- Scaling: The app uses the `resize()` function provided by the PIL library.
- Linear and Power-law Mappings: The app uses NumPy operations for these mappings.
- Convolution: The app uses the `filter2D()` function provided by the OpenCV (cv2) library.
- Histogram Calculation: The app takes the intensities and graphs them from 0-255 in a new window
- Histogram Equalization: The app uses the `equalize()` function provided by the ImageOps module in the PIL library.

Section 3 - Discussion of Results and Future Work

3.1 Results

The Image Processing App successfully implements the intended image processing techniques and provides a user-friendly interface for users to interact with their images. The application has been tested with various image formats and sizes, demonstrating its versatility and performance.

3.2 Future Work

There are several areas where the Image Processing App can be improved:

- Add support for undo and redo functionality.
- Implement additional image processing techniques, such as edge detection and noise reduction.
- Enhance the user interface with more advanced controls, such as sliders, toggles, color pickers, and customizable hotkeys. This will enable users to fine-tune the application to their preferences and improve their overall experience.
- Develop more advanced algorithms to improve the accuracy and efficiency of facial recognition. This could include incorporating machine learning techniques to better recognize and differentiate between various facial features and expressions.
- Integrate cloud storage and sharing capabilities so that users can save their edited images and projects, and easily share them with friends, family, or colleagues. This feature will also allow for collaboration between users on editing projects.
- Create a multi-platform application to ensure that users can access and use the software across various devices and operating systems, such as Windows, macOS, Android, and iOS.
- Incorporate support for RAW file formats to cater to professional photographers who require higher-quality image processing.
- Add a built-in tutorial or guided tour for new users to learn the basic functionalities and features of the application. This will help them get started quickly and make the most out of the software.
- Expand the range of editing tools available, such as advanced filters, layer support, and blending options. This will allow users to create more complex and visually striking images.