Histogram Manipulation MATLAB App

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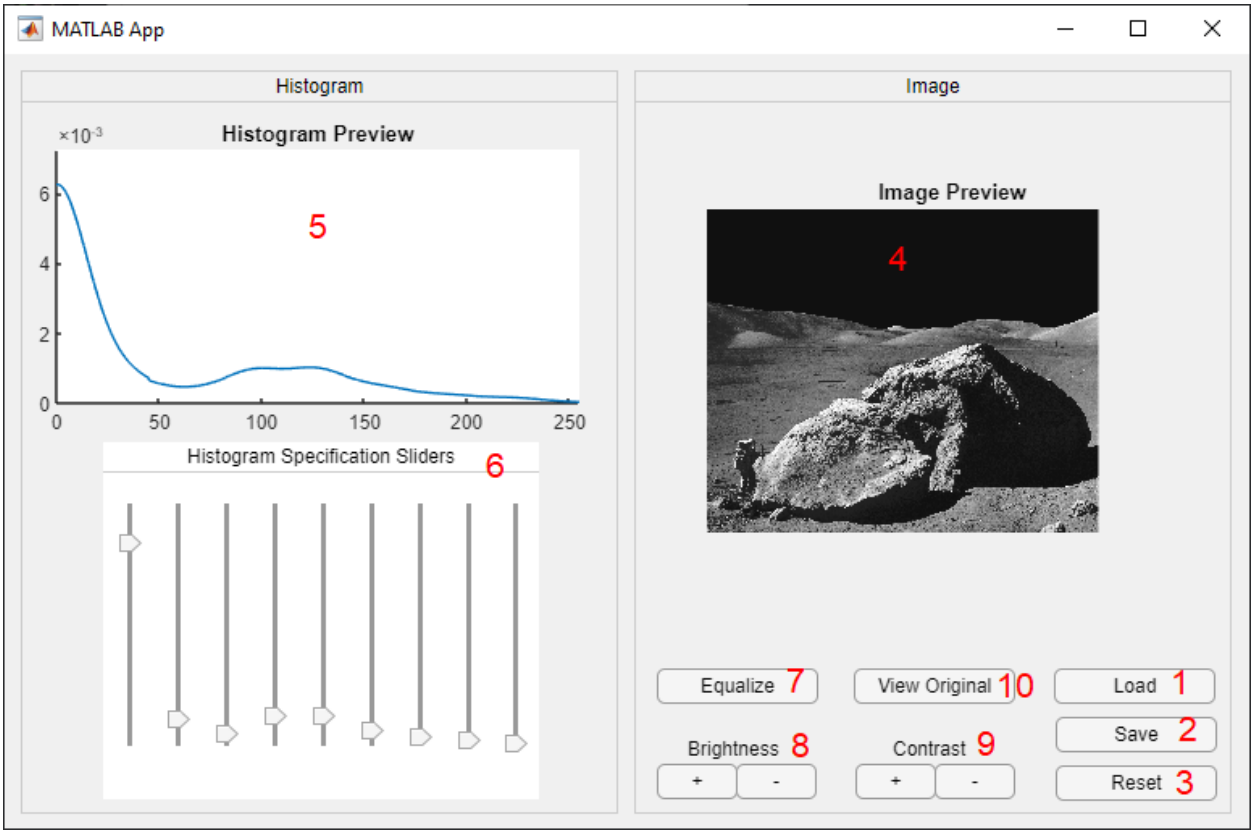
This MATLAB app provides tools for image histogram manipulation. These tools allow the user to adjust the number of pixels of each value in the image, allowing for histogram equalization, saturation changes, brightness changes, and other histogram effects.

Features

The app has many features to help you manipulate an image. These are labeled in the figure below.



1. **Load button:** Press this button to select the image you would like to load.
2. **Save button:** Press this button to save any changes you make to the image.
3. **Reset button:** This button reverts any changes made to the image.
4. **Image preview:** This window shows the adjusted image.
5. **Histogram preview:** This is a visualization of the histogram of the adjusted image. The left side is darker pixels and the right is lighter pixels. The scale isn't very important.
6. **Histogram specification sliders:** These sliders represent a discrete version of the image histogram. Adjusting them changes the histogram of the image, resulting in a change in the previews.
7. **Equalize button:** This button sets all the histogram sliders to the same value, resulting in an equalized histogram.

8. **Brightness buttons:** These buttons will adjust the histogram sliders to affect the brightness of the image.
9. **Contrast buttons:** These buttons will adjust the histogram sliders to affect the contrast of the image.
10. **View button:** This button toggles the preview window between the edited image and the original one.

Methods

This app uses the image processing method of histogram specification. The sum of the original histogram and the specified histogram are found from 0 to n to make a transforming function, and then the value of each pixel is sent through both transforms to find it's new value.

When an image is loaded, the histogram of the image is found. Taking the sum of the histogram from 0 to n gets the equalization transform, which is saved for later.

The histogram is then reduced into nine "buckets." Nine was chosen because it was a good balance between control of the histogram and ease of use. The sliders are then set to the values of the reduced histogram.

Whenever a slider is changed, either by the user directly or when another method changes the sliders, a new full-size approximate histogram is found. The values of the sliders are set at regular intervals on a 1x256 vector, and the vector is convolved with a gaussian distribution to create a smooth plot. The result is trimmed, normalized, and summed from 0 to n to get the transform to equalize this histogram.

Each pixel's value is run through the original to equalized transform, then run backwards through the new to equalized histogram to find what value the pixel needs to have in the new image. The resulting image is then displayed in the preview widow.

The equalization button sets all sliders to the same value. The resulting histogram isn't exactly flat though, because the convolution process can't exactly reproduce a flat line. The brightness and contrast buttons also adjust sliders, with contrast increasing or decreasing the edge or middle sliders, and brightness increasing or decreasing the left or right sliders.

Because this system only uses nine sliders, it may be impossible to exactly reproduce the original image. Sharp points are smoothed out by the histogram reduction and convolution processes. When you load an image, the sliders are set for the first time and the image shown on the preview is already adjusted to the simpler histogram made from the slider values.