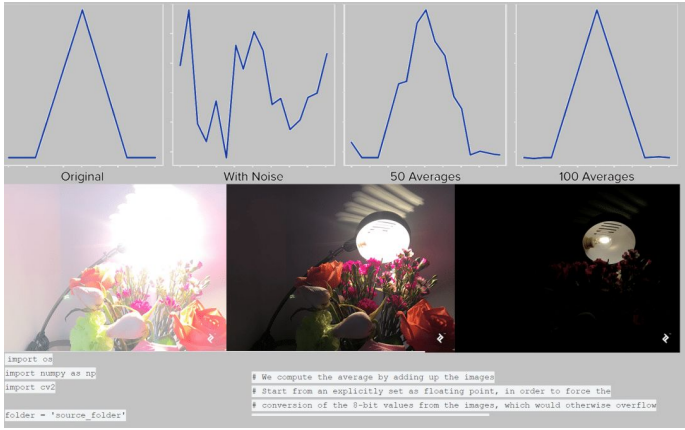
Python Final Project Presentation Image Processing (GUI)

David Lara, Jomar Veloso

Project Description

- For the project, a Graphical User Interface (GUI) with Image Processing capabilities was decided upon
- The image processing capabilities that were decided upon were the ability to invert colors, apply a black and white filter, blur an image, sharpen an image and detect edges on an image
- The GUI library that was used in this project is Tkinter, a GUI library that comes pre-packaged with Python
- For image processing, Python Pillow was used since it allowed for information about an image to be easily revealed such as the Red, Green and Blue values of a pixel, as well as the height and width of the image which allowed for easy processing
- The Graphical User Interface (GUI) is a desktop interface that allows the user to communicate with computers
- There was also math involved since height and width were a key factor and the size of the picture or image



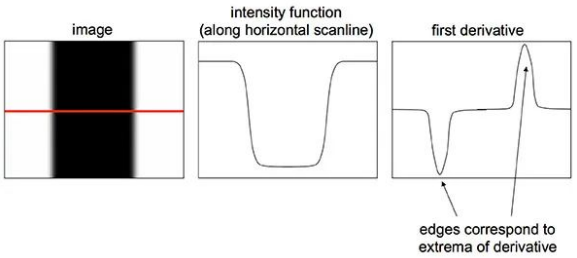
Project Features

- The program can load a variety of file types such as bitmaps, .gifs, .pngs, and .jpeg files
- Once an image is loaded, the user can play around with a variety of filters that will suit their needs
- These filters are chosen from a drop-down combobox that calls on user defined functions to process the image
- Apart from using Pillow to get information about the image such as it's pixel color information, all of the functions that perform any sort of signal processing on the image are created from scratch, meaning that library usage was kept to a minimum to make sure there would still be a level of complexity within the project
- Once the filter is selected, the user can then save the image to their computer and view it at anytime
- All of the filters are applied to an image in realtime, meaning that the user gets visual feedback whenever they decide on a filter option.
- There is one graphical user interface that was used for this project, which is called Tkinter
- However, there are other ones that are featured such as wxPython and JPython
- In programming Tkinter is a standard library for GUI (see more in Slide 8)

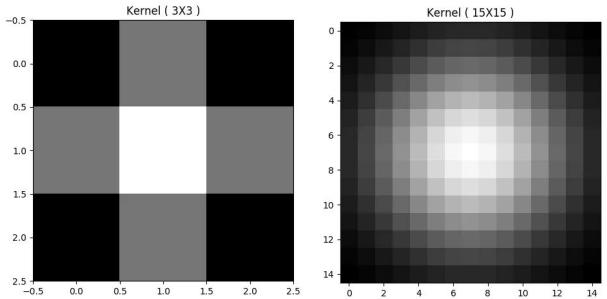
The major algorithms that gave this project life

- Sobel Edge Detection algorithm was implemented in order to apply edge detection to the image
- The Gaussian Blur algorithm was implemented in order to apply a blur to an image that is a lot more context aware than a ‘mean blur’ which would only take the averages of the values around the target pixel.
- Finally, a generic sharpening algorithm was used to apply a sharpening filter to an image

Sobel Edge Detection algorithm



Gaussian Blur algorithm



Generic Sharpening algorithm

How do these algorithms work?

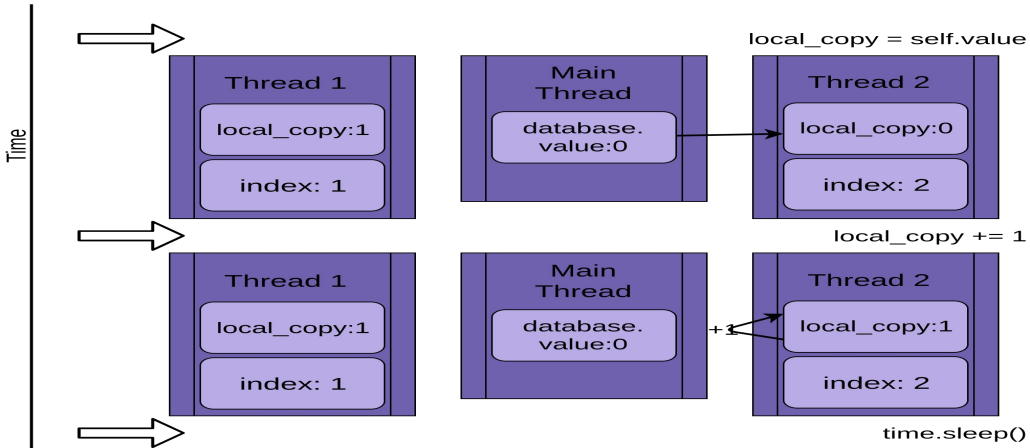
- Those three aforementioned algorithms all share a similar property of using a ‘box’ known as a kernel matrix to collect information about the image, in the case of this program, that kernel matrix for each of these algorithms is set to be a 3x3 matrix for performance sake.
- In the case of the Sobel Edge Detection algorithm, we grab a 3x3 of pixels from the target image, and we compute the ‘direction’ of those pixels in the X and the Y direction so that we can get an idea of what direction a change in pixel will occur in.
- We calculate these directionals by multiplying the 3x3 by another 3x3 matrix, one that is used to compute the X direction of the change in pixels, and another that computes the Y direction of the change in pixels.

Cont.

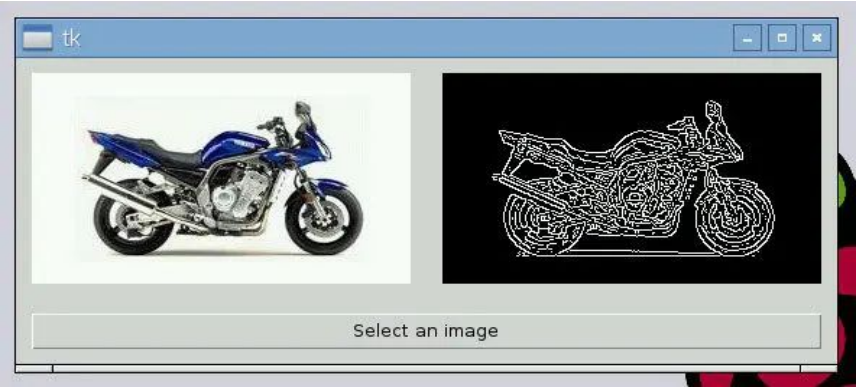
- Then, we normalize the result and then place the normalized result in place of the original pixel we decided to apply the filter to, our pixels i and j.
- Notes, this process is made a lot easier if you convert the image to black and white first since calculating a change in color is a lot harder with a colored image as opposed to a black and white one.

Threading

- An important feature when using one of the heavier filters as without assigning the image filter to another thread, the app wouldn't crash but it would hang and lead to a generally unfavorable user experience.
- With this feature, hanging would stop as the function responsible for transforming the image could do what it needed to without affecting the end user.

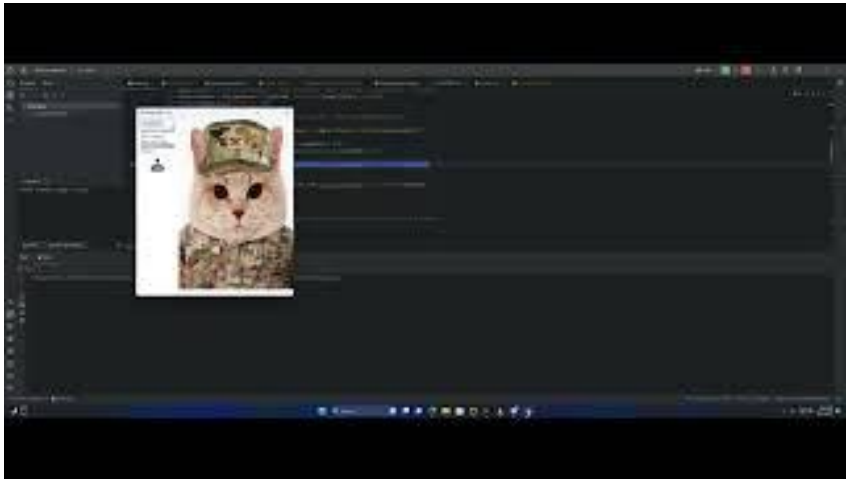


Tkinter



- Easy to develop a working GUI
- Feature rich and allows for a decent amount of customization in how you want your GUI to look
- Canvas feature of Tkinter allowed for a decent place to place images in for viewing and editing purposes
- The ability to map buttons to images also is a great boon in customizability in the GUI
- When Python and Tkinter combine, Tkinter can create GUI applications easily without delay
- Additionally, it provides a powerful object - oriented interface to the Tk GUI toolkit

Demonstration



Work Cited

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