

Aly Sultan
Hardware Software Co-Design
Lab 2 Report

Code Clean up and SpecC modifications:

The following changes were made to canny.c file

- Changed all NULL initializations to 0
- Removed all non-constant initializations
- Put main in a behavior with only one argument passed for input file name with corresponding abort if no file name is provided
- Changed the following parameters to #defines (rows, cols, sigma, tlow, thigh, maxval, WINSIZE)
- Removed functions radian_direction, angle_radians, read_ppm_image, write_ppm_image (As a result removed any mallocs and frees in them)
- Modified function parameters to exclude #defined values all references to pointers were changed to straight pointers. SpecC didn't like them, and passing pointer by value doesn't really change much because all pointers are allocated statically and functions just edit the arrays they point to.
- Corrected off by one error mentioned in PDF file
- Removed mallocs in read_pgm_image and corresponding free
- Removed Calloc in canny for nms array and corresponding free
- Removed Calloc in canny for edge array and corresponding free
- Removed Calloc in magnitude_x_y for magnitude array and corresponding free in canny
- Removed Calloc in derivative_x_y for delta_X and delta_Y array and corresponding frees in canny
- Removed Calloc in gaussian_smooth for tempim and corresponding free
- Removed Calloc in make_gaussian_kernel for kernel and corresponding free in gaussian_smooth
- Replaced dynamic allocations for nms edge delta_X delta_Y templm kernel with static allocations of rows*cols except kernel which was set at size 21
- Removed unused variables as dictated by scc compiler

Results

Output results match modified reference image. Modifications done are:

1. Remove extra space after image dimensions
2. Remove # for comments

Modified reference image is present in image directory of the tar file

Initially the following changes were detected (and assumed to be the issue) however they can now be disregarded and are left for documentation purposes.

The wild goose chase:

There was a difference of around 6500 pixels between the output image and the reference image. This was due to a minor difference in calculated floating point values in gaussian_smooth and non_max_suppress that compounded with each calculation per pixel. The difference can be first seen in gaussian_smooth line 359 of the submitted canny.sc file when calculating the dot product of the convolution, specifically the multiplication. The difference is incredibly small in terms of floating point precision. Unfortunately this tiny difference between the c file and the sc file ends up compounding and creating the invisible differences in the output file but differences nonetheless. As a last ditch effort I tried the following:

- Applying the following compiler flags hoping to fix the difference -ansi -O2 -DNDEBUG -DHAVE_LLONG -DX86 -DLINUX but they made no difference when comparing the output and the reference. These were the flags used to compile the Specc compiler so I assumed there might be some correlation between specC's compilation and it's own compiler.
- I tried the -ansi c flag to see if I was violating any ansi specific rules and I was not.
- I tried rounding every floating point calculation with roundf in both the file and the sc file hoping to get them to match but there were still differences

This error was eliminated by not being an error in the first place. This was a simple matching issue that was resolved after editing the reference file.