CS301: HIGH PERFORMANCE COMPUTING
ASSIGNMENT FOUR

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PROBLEM STATEMENT

Image warping and filtering.

METHOD

Each pixel of a given input image is radially relocated- leading to the twisting of the image. For this purpose, the amount of displacement is made directly proportional to the distance from the center.

COMPLEXITY

The serial code runs in O(mn) time, where n width and m is the height of the image, in terms of the number of pixels.

Typically, a 512x512 image is taken, thus n=m=512 (or 256).

The output is stored in a different file, hence an extra O(nm) space is used.

OPTIMIZATION STRATEGY

The double loop runs through each pixel and calculates the new location of the pixel. The outer loop is parallelized using OpenMp. Since the output is in a different file, there are no data dependencies. The expected speedup is O(n/p) where n is the height of the image.

OBSERVATIONS AND PROBLEMS FACED

We observed that the parallel implementation took lesser amount of time in all the three programs, namely image twisting, and image filtering of pictures of sizes 512x512 and 256x256 pixels.

We primarily faced the problem of handling image files and managing their I/O operations. Once that was done, it was not a major task to parallelize the codes. This is because the all the codes have loops which have no data dependency. So, theoretically each pixel could be twisted in a separate thread. We tried doing that in a maximum of 16 threads and the results are as mentioned.

HARDWARE DETAILS

No. of Processors   : 31
vendor_id   : GenuineIntel
cpu family   : 6
model   : 62
model name   : Intel(R) Xeon(R) CPU E5-2640 v2 @ 2.00GHz
stepping   : 4
cpu MHz   : 1200.000
cache size   : 20480 KB
siblings   : 16
cpu cores   : 8

INPUT PARAMETERS

    Image file (nxm).
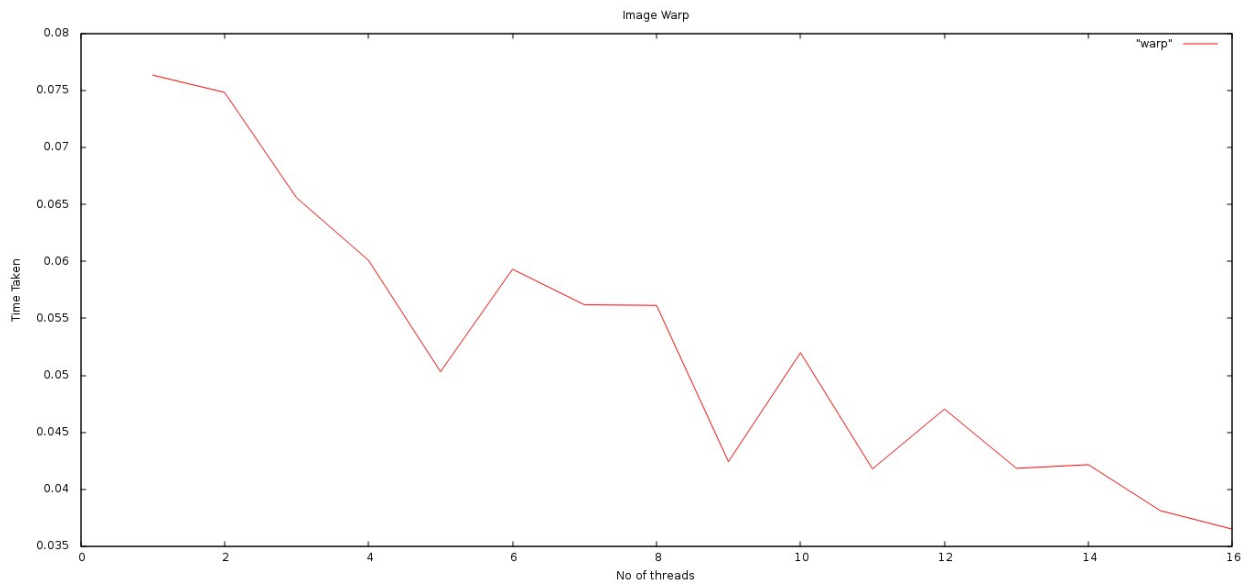   n and m are 512 each for the first filter code, and 256 for the second.

OBSERVATIONS

Time was calculated using omp_get_wtime() library function include in the "omp.h" header file.
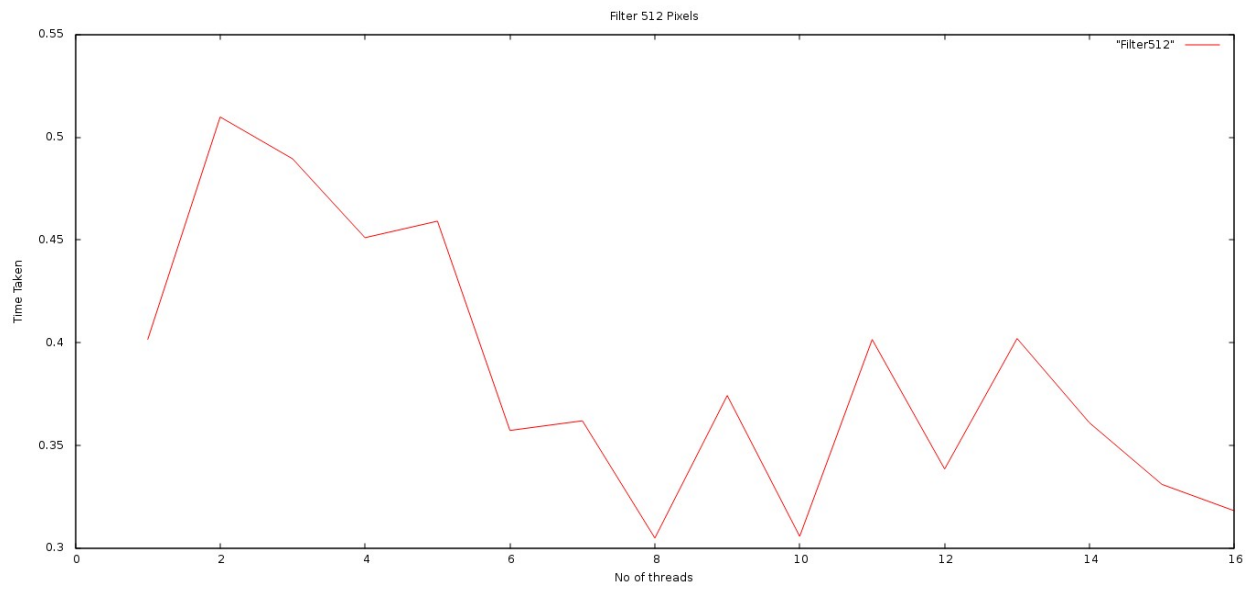
Time taken by serial codes:

Image Warping: 0.051578 sec
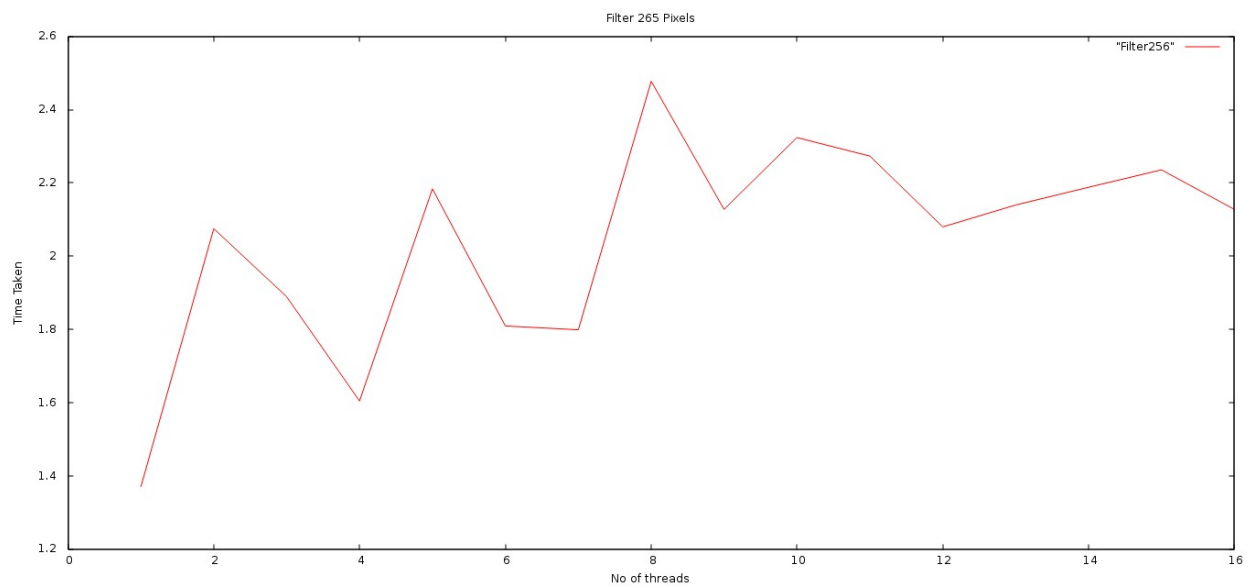Image Filter (256 pixels):   0.342531 sec
Image Filter (512 pixels):   0.330107 sec

Parallel Warping: No of threads vs. Time Taken

Parallel Filter: No of threads vs. Time Taken for 256 Pixels

Parallel Filter: No of threads vs. Time Taken for 512 Pixels