Rohit Gupta
Sumiran Shubhi

Final Project Plan

ECE 285 FA19
December 4, 2019

1 Goal

In this course project, we aim to create a popular edge detection algorithm - *Canny* using CUDA. Edge detection algorithms are becoming increasingly popular due to machine learning & computer vision which requires image segmentation. Edge detection involves marking boundaries of objects based on sharp changes in the brightness around them.

Canny Edge Detection algorithm was proposed by John Canny in 1986 [1] and it involves 5 stages

- Noise Reduction
- Gradient Calculation
- Non-maximum suppression (NMS)
- Double Threshold
- Tracking edges using hysteresis

However, since debugging CUDA kernels is tougher than a serially executed code on CPU, we'll develop two versions of this algorithm - purely for host (serial) and other using CUDA. This provides us an opportunity to compare step-by-step output of the algorithm for sanity checks and also to compare the speedup provided obtained by using CUDA over CPU.

2 Technical Approach

Our approach towards achieving the goal is as follows -

- Integrate image reading and writing libraries with our code. We will explore popular libraries like ImageMagick.
- Implement the serial algorithm for host.
- Implement efficient kernel for convolution, NMS, edge-tracking and other helper kernels for initialization using the best known techniques.
- Highlight the advantages of using CUDA over CPU for this algorithm

3 Team Members and Responsibilities

- Rohit Gupta (A53272428)
  - Serial CPU implementation
  - CUDA kernels for convolution*
  - Analysis and comparison
  - Presentation*
- Sumiran Shubhi (A53314039)
  - CUDA kernels for NMS, thresholding, edge tracking*
  - Analysis and comparison
  - Presentation*

Note - * here indicates more work will be discovered we progress.

4 Final Deliverables

1. Canny edge detection algorithm for CPU and CUDA
2. Presentation illustrating our work, problems and results.

References

[1] Canny, John. "A computational approach to edge detection." IEEE Transactions on pattern analysis and machine intelligence 6 (1986): 679-698.

[2] Luo, Yuancheng, and Ramani Duraiswami. "Canny edge detection on NVIDIA CUDA." In 2008 IEEE Computer Society Conference on Computer Vision and Pattern Recognition Workshops, pp. 1-8. IEEE, 2008.

[3] Ogawa, Kohei, Yasuaki Ito, and Koji Nakano. "Efficient Canny edge detection using a GPU." In 2010 First International Conference on Networking and Computing, pp. 279-280. IEEE, 2010.