

Point to Point Processing of Digital Image using Parallel Computing from CUDA to OpenCL

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Abstract— In this work we will combine a relation which arises between game developing languages invented by NVIDIA i.e. CUDA and OpenCL with grayscale conversion from digital image processing. Uses of gray scale images are slightly less known by the people, so in our paper we will show that the easy processes to convert image into grayscale and the suitable game developing programming language within CUDA and OpenCL. Color image based games are used a lot but according to user requirement people like different flavor all the time, but for that different kind of image conversion should be known. We will make a relation between gaming language with different filters of images.

Key words: Point to Point Processing of Digital Image using Parallel Computing, CUDA

I. INTRODUCTION

Parallel computing is operating on the principle where large problems can be divided into smaller ones, which are then solved at same time. For digital image processing is the way to processing of digital images on the basis of computer algorithms. Portable app is a computer program that we can carry around with us on a portable device and use on any Windows computer. Any kind of performance if controlled by us then it will be more effective, which is totally depends on a programming language. CUDA can have Scattered reads (code can read from any addresses in memory) CUDA exposes a shared memory in fast region that can be shared among bits. This can be used as a user-managed cache, which allows higher bandwidth on GPUs (GPGPU) using graphics APIs. OpenCL is a portable language for GPU programming, capable of dissimilar parallel processing devices.

Digital image processing is use to improve the pictorial quality and information in order to perform other tasks as classification of images, feature extraction or pattern identification. Image processing is generally an expensive and time-taking task, for ex- in point to point processing, a grayscale image of 1032×980 pixels, will require a CPU make to more than one million operations, and the number of operations multiplied by the number of channels for color image only. Intensity level of an image inverts by negative transformation. This is useful in grayscale images when is needed to find some significant characteristics and the primary color is white or black like in x- ray plate where as a color image has an intensity range of [0, 255]. Results show that CUDA get better results in all filters except negative filter with low resolution, but using high resolution this problem can be solved and the result of peak performance can be obtained in GEMM on both GPUs in Open CL.

Generally, people like to play different games with high pictorial quality. But we don't know about how game is formed by a simple programming language, so the requirement of grayscale conversion is for public attraction and different use of images.

II. POINT TO POINT PROCESSING

Any process that occurs between two different points or nodes simultaneously that is known as point to point processing. Let in a and b coordinates of an image (a, b) is a pixel Value, $s(a, b)$ a transformation of (a, b) and T a function over (a, b) . Then T Maps (a, b) into $s(a, b)$ and the transformation only affects to the pixel in (a, b) coordinates as showed in the Eq. $s(a, b) = T[t(a, b)]$ [1]

III. APPLICATIONS OF DIGITAL IMAGE

Digital image processing's work is not limited in just increasing the brightness of a image. Rather it is far more than the expectation.

Some another application like:

A. Image Filters

This refers to these purposes like zoom, blur, sharpen, gray image to color image and bringing back the image to former and recover state.

B. In Case of Medical Image

This refers to: X ray image, gamma ray image, UV image, CT scanning image.

These are some applications of medical imaging.

C. Recognising the patterns in an image

It describes for picking up the objects in an image. It is specially used in aided diagnosis, handwriting recognition and specially the recognition of images.

D. Microscopic Image

Here the digital image processing helps that how a microscopic image can be cleared and have more resolution in it by help of the digital imaging.

IV. GRAYSCALE TO RGB CONVERSION

Two methods are

Average method (average of 3 colors)

Grayscale = $R + G + B / 3$

Weighted method or luminosity method New grayscale image = $0.3 * R + 0.59 * G + 0.11 * B$ According to this equation, contribution of red is 30%, Green has contributed 59% which is greater in all three colors and contribution of blue is of 11% [8]

A. Negative Filter

The intensity level of an image inverts due to negative transformation. It is useful in grayscale images for finding important characteristics and the predominant color is white or black. Ex x-ray plate.

An intensity range of color image is [0, 255], then Eq. to obtain a negative color is

$$(x, y) = 255 - (x, y)$$

B. Contrast Filters

The application of making bright or dark does not highlight details of an image. Thus, we can handle two options:

- 1) To decrease the darker ones and increase the intensity of the lighter tones and
- 2) To increase the darker intensity and decrease the lighter tones.

This type of processing is called *contrast*. [6]

V. NVIDIA

It is a gaming technology company situated in America. This company is very much known for making games with the using of designed graphics.

VI. CUDA VS. OPENCL

CUDA is a platform of parallel computing and application programming interface (API) model created by NVIDIA. Software developers to use a CUDA-enabled graphics processing unit (GPU) for general purpose processing – GPGPU as an approach.

CUDA is one of the most widely used GPGPU (General-Purpose computation on Graphics Processing Units) platforms by NVIDIA. Other popular GPGPU platform, CUDA is best and only runs on NVIDIA graphics h/w as it was invented. However, OpenCL supports most CUDA-enabled video cards, so that programmers can write code for either platform when developing applications of hardware for NVIDIA.

OpenCL (Open Computing Language) is the open, free standard for cross-platform, parallel programming of different processors found in computers, servers, mobile devices and different platforms.

OpenCL improves the speed and responsive nature of a wide spectrum of applications in more no of market categories from gaming and enjoyment to scientific and medical software.[7]

Both are two language which are used for gaming

Feature	OpenCL™	CUDA
Compilation Methods	Online + Offline	Offline Only
Mathematical Precision	Well Defined	Undefined
Math Libraries	Defined Standard	Proprietary
CPU Support	OpenCL™ CPU Device	No CPU Support
Native Host Task Support	Task Parallel Compute Model w/ Ability To Enqueue Native Threads	No Native Thread Support
Extension Mechanism	Defined Mechanism	Proprietary
Vendor Support	Industry-Wide Support AMD, Apple, etc.	NVIDIA Only
C Language Support	Yes	Yes

Fig. 1: Differences

VII. SIMILARITIES OF CUDA AND OPENCL

NVIDIA's GPUs was designed parallel computing framework CUDA and for diverse platforms OpenCL is a standard designed including CUDA-enabled GPUs, some ATI-GPUs, and AMD, and other processors such as the Cell Broadband Engine. OpenCL shares a range of core ideas with CUDA:

VIII. DIFFERENCE OF CUDA AND OPENCL

Both are invented by NVIDIA for gaming purpose with different graphics. OpenCL can be run with and without online but CUDA can run in offline. Any kind of changes can be done in CUDA which is the most preferable part for this language.[10]

IX. WHY WE ADD DIGITAL IMAGE WITH CUDA

As we are showing here CUDA is a better for image processing. And as It is invented by NVIDIA, so specially this is used for gaming purpose. So as per user's need, when a game is created it should look user friendly and should be attracted towards the user. That's why the graphics should look good and attractive. And by adding digital digital image with CUDA, we can get a good quality picture.

X. CONCLUSION

We have read an approach for digital image processing using parallel computing from different papers. Due to some filters are not implemented in OpenCL CUDA can be used as a programming language to implement grayscale. Here we concluded that for digital image processing and conversion of gray scale CUDA is the best programming language for development.

REFERENCES

- [1] J. Fung and S.Mann, "Using multiple graphics cards as a general purpose parallel computer: Applications to computer vision," in Proceedings of the 17th International Conference on Pattern Recognition (ICPR2004) 2004, vol. 1, pp. 805-808.,
- [2] IJCSI International Journal of Computer Science Issues, Vol. 9, Issue 3, No 3, May 202
- [3] A Comprehensive Performance ComparisonOf CUDA and OpenCLJianbin Fang, Ana Lucia Varbanescu and Henk Sips Parallel and Distributed Systems GroupDelft, the Netherlands
- [4] Parallel computing in digital image processing by Sharanjit Singh1, Parneet kaur2, Kamaldeep kaur3 Assistant Professor Mtech (CSE),
- [5] Bilateral Filtering for Gray and Color ImagesC. Tomasi _ R. ManduchiCS Department Interactive Media GroupStanford University
- [6] A Comprehensive Performance Comparison of CUDA and OpenCLJianbin Fang, Ana Lucia Varbanescu and Henk SipsParallel and Distributed Systems GroupDelft University of Technology
- [7] GRAYSCALE to RGB conversion
- [8] A Performance Comparison of CUDA and OpenCLKamran Karimi Neil G. Dickson FirasHamzeD-Wave Systems Inc.100-4401 Still Creek Drive
- [9] A Performance Comparison of CUDA and OpenCL Kamran Karimi the University of Calgary