

# Image processing Accelerator

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## 1 Introduction

Digital image processing is the use of a digital computer to process digital images through an algorithm. As a subcategory or field of digital signal processing, digital image processing has many advantages over analog image processing. It allows a much wider range of algorithms to be applied to the input data and can avoid problems such as the build-up of noise and distortion during processing.

Since images are defined over two dimensions (perhaps more) digital image processing may be modeled in the form of multidimensional systems. The generation and development of digital image processing are mainly affected by three factors: first, the development of computers; second, the development of mathematics (especially the creation and improvement of discrete mathematics theory); third, the demand for a wide range of applications in environment, agriculture, military, industry, and medical science has increased.

## 2 Motivation

The main problem is that image processing is generally a time-consuming process. Parallel Computing provides an efficient and convenient way to address this issue.

Our teammate found a scenario during the internship. In his company, they will use a series of image processing methods to test the defect of the wafer. And the validation machine is bulky and unportable, it also takes a lot of time due to its old system and serial programming. If we can build some image processing tools in a parallel programming way. It can not only be easily maintained but also portable and we can install the system on small FPGA like NVIDIA JETSON.

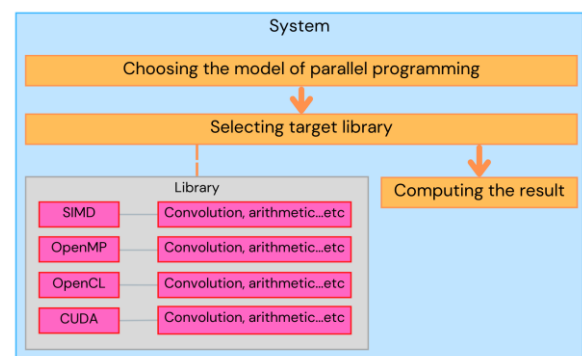
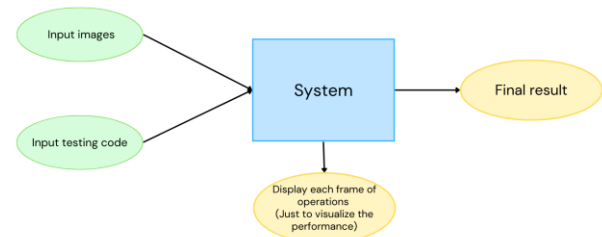
Our main purpose of this research is to analyze different parallel programming ways such as SIMD, CUDA, OpenCL, OpenMP ...etc. versus serial way. We want to know which one will be the best to improve image processing and that many applications of image processing can be faster.

## 3 Application Choose

We choose histogram, edge detection, gamma correction, and standing for our image processing way.

The reason for choosing these 3 ways is because it can have convolution, arithmetic operation...etc., so we can observe the difference between the benefits of using parallel programming.

## 4 Proposal Approach



The user needs to provide the test image and the operation to be used, then the system will complete the operation and display the final result, but to show the performance difference, we will display the frame after each operation.

In this system, we will implement the convolution operation for different image processing in different parallel programming, such as smoothing filter, laplacian filter...etc.

## 5 Language selection

We will use C+ to program our design. The reason we choose C+ is that CUDA and OpenCL are written in C++. It will be convenient if we use C++ to work.

## 6 Related work

Understanding the hardware architecture of GPU and CPU is more conducive to parallel acceleration, familiar with the algorithm of image processing, and the skills of program implementation.

## 7 Statement of expected results

Various image processing operations can be performed faster and more efficiently than serial operations after parallel processes, and the FPS can be improved. In the technology of various parallel operations, because there are a large number of cores on the GPU, we think that the performance of OpenCL and CUDA will be the best among them. The second is SIMD and OpenMP.

## 8 Timetable

11/4-11/10	Finished the serial version
11/11-11/17	Finished the pthread version
11/18-11/24	Finished the CUDA version
11/25-12/1	Finished the OpenCL version
12/2-12/8	Finished the OpenMP version
12/9-12/16	Calculate and compare results
12/16-1/3	Prepared presentation