Application of Parallel Processing - A Case Study on Vertebra Detection in X-ray Images

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***Abstract*— X-ray computed tomography (CT) is non-invasive imaging technique that creates cross-sectional images of an object from two-dimensional X-ray projections. For the case study on the vertebra detection in X-ray images, this technology is linked to the machine called the Computed Axial Tomography or well known as the CAT or CT scan. This application on the parallel processing is widely used in the medical field society to detect the vertebra in the X-ray images. It is a present-day imaging instrument that consolidates X-rays with PC innovation to deliver a more point by point, cross-sectional picture of your body. A CT scan gives your specialist a chance to see the size, shape, and position of structures that are somewhere inside your body, for example, organs, tissues, tumors and vertebrae. It also gives a much detail look on the problems parts of the body that need to be cured. Beside vertebrae detection, it is also used to detect cancer cells. CT scan have helped us a lot in the medical world by detecting what our plain eyes cannot see.**

Keyword: **vertebra, tumors, parallel processing, cancer**

I. INTRODUCTION

In this paper, focus will be more on the application of parallel processing on a case study on vertebra detection in X-ray images. X-ray computed tomography (CT) is non-invasive imaging technique that creates cross-sectional images of an object from two-dimensional X-ray projections. The traditional X-ray images would not be sufficient to further investigate in a person illness on their vertebrae or some other parts of their body. Thus, the CT scan application on the parallel processing will be further explained.

A. Definition

Computed tomography or CT is initially known as body section rentenography or computed axial tomography (CAT) or commonly known as CAT scan [1]. The CT scan consists of parallel processing that process the image of the X-ray by employing the tomography which is the medical imaging method [2].

This advanced geometry handling is utilized to create three-dimensional picture of the internals of an item from an extensive arrangement of two-measurement X-ray pictures as it is taken amid a solitary round of the pivot of turn [1].

II. BACKGROUND

X-ray computed tomography is a truly huge received medicinal imaging strategy that utilization projections to recuperate the inside picture of a subject. In the 1970s, since the innovation of X-ray computed tomography there are a few era of CT scanners have been produced consistently [2]. Parallel computing is a software engineering method that uses different PC assets to execute a computational assignment all together as each of its asset registers just a piece of the whole errand, along these lines this will especially bring down the computational time handling it [2].

Thus, combining it both together with the parallel computing and the medical imaging method, the CT scan was made in the part to fulfil its purpose in the medical world until today.

III. PAPER REVIEW

In this section, a collection of paper review is analysed regarding the topic of this research paper. Each paper is discussed in detail as stated below:

A. Heterogeneous Computing for Vertebrae Detection and Segmentation in X-ray Images

In this paper, the work on the vertebra segmentation is being optimized by abusing the full computational energy of parallel (GPU) and heterogeneous (multi-CPU/multi-GPU) designs [3].

They propose a parallel crossover implantation as an in-depth step to boost the performance. The data transfer time between the GPU and CPU memories is observed based on the proposed implementation.

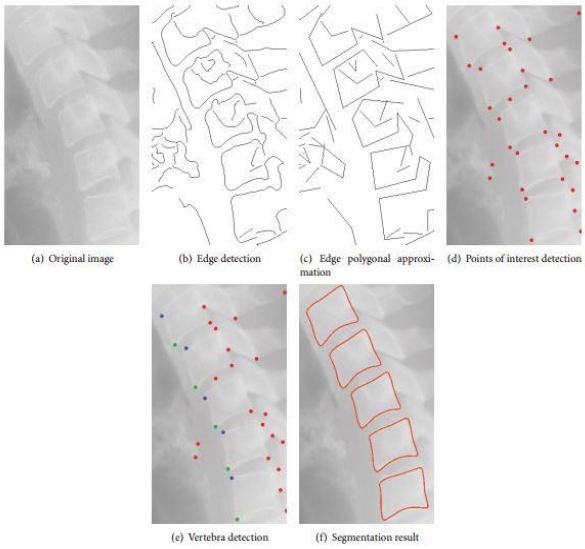

Fig. 1. The result of the segmentation by using the parallel hybrid implementation [3]

B. *GPU-based segmentation of cervical vertebra in X-ray Images*

The division of cervical vertebra in X-Ray radiographs would give a beneficial information for the examination of the vertebral adaptability. One typical for the X-Ray pictures is that they show low dim level assortment and makes the division difficult to perform. In this paper, they propose a division technique in light of the Active Shape Model to deal with this issue [4].

Regardless, this application is truly hampered by its broad computational time. They indicate how vertebra extraction can capably be performed in manhandling the enormous taking care of vitality of the Graphics Processing Units (GPU) [4].

They propose a CUDA-based GPU usage of the most escalated handling steps empowering to help execution. Experimentation have been led utilizing an arrangement of high determination X-Ray restorative pictures, demonstrating a worldwide speedup extending from 15 to 21, by examination with the CPU execution [4].

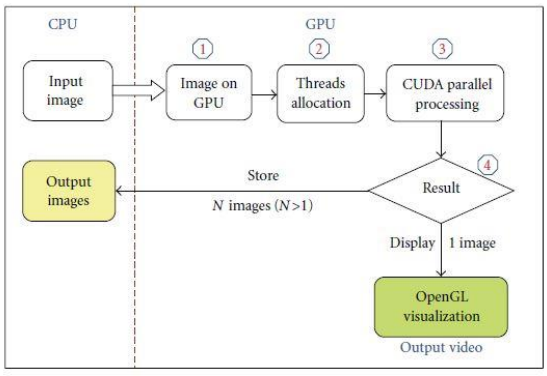

Fig. 2. Image processing on GPU based on CUDA and OpenGL [4]

C. *Edge detection and classification in X-Ray images. Application to interventional 3D vertebra shape reconstruction*

In this paper, there are two methods that had been proposed for the reconstruction of 3D vertebra shape by using the parallel computing process [5].

The principal strategy is the wavelet-based edge recognition, which is a multiscale edge indicator that recognizes point that are probably going to have a place with an edge [5].

The second method is the snake-based edge detector, which was recently developed and called the Gradient Vector Flow (GVF) method. It relies more heavily on the gradient approach than the first method [5].

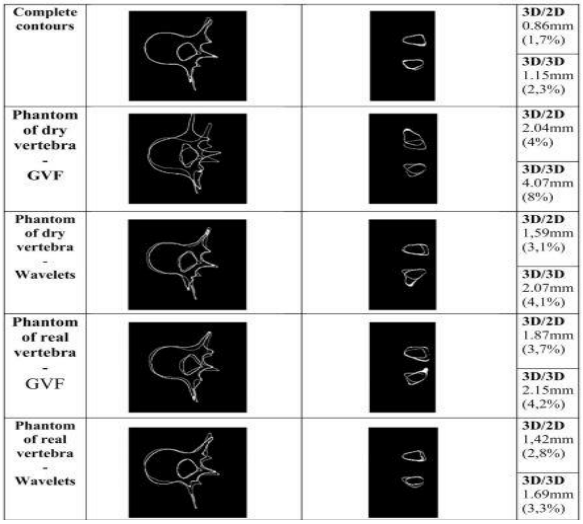

Fig. 3. The reconstruction result based on the method proposed [5]

D. *Parallel computing techniques for computed tomography*

Three representative recreation algorithms, to be specific, Katsevich, EM, and Feldkamp calculations are researched in this work. With the Katsevich calculation, a disseminated memory PC bunch is utilized to lead the examination. This parallel calculation segments and disseminates the projection information to various PC hubs to play out the calculation. Endless supply of each sub-assignment, the outcomes are gathered by the ace PC to create the last picture. This parallel calculation utilizes an indistinguishable recreation recipe from the consecutive partner, which gives an indistinguishable picture result [2].

The parallelism of the iterative CT calculation utilizes a similar PC group as in the first. It conditionally depends on a neighbourhood CT reproduction calculation, which is not quite the same as the consecutive EM calculation, the picture comes about are distinctive with the successive partner. Additionally, an exceptional technique utilizing in homogeneous determination was utilized to additionally accelerate the calculation. The outcomes demonstrated that the picture quality was to a great extent saved while the computational time was extraordinarily decreased [2].

Dissimilar to the two past methodologies, the third sort of parallel execution utilizes a common memory PC. Three noteworthy quickening techniques - SIMD (Single direction, numerous information), multi-threading, and OS (requested subsets) were utilized to accelerate the calculation. Introductory examinations demonstrated that the picture quality was practically identical to those of the traditional approach, however the calculation speed was essentially expanded [2].

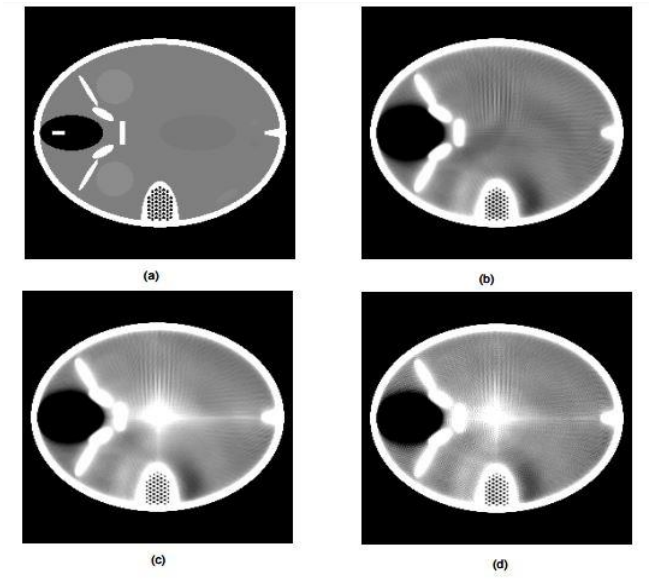

Fig. 4. The results of the used techniques that show the much clearer images [2]

E. Parallel computation in medical imaging application

There is as of now a quickly developing enthusiasm for parallel calculation application in different therapeutic imaging and picture handling fields. This pattern is relied upon to proceed developing as more complex and testing restorative imaging, picture handling, and high-arrange information representation issues are being tended to. The advancing cost drop in computational instruments and their wide accessibility have an inside impact as well. Given its short history, this range is so far not a particularly described sensible instruct. The picked topics and papers for this one of a kind issue shed more light on various parts of this developing field and its potential in animating therapeutic imaging applications as well as parallel applications [6,16-18].

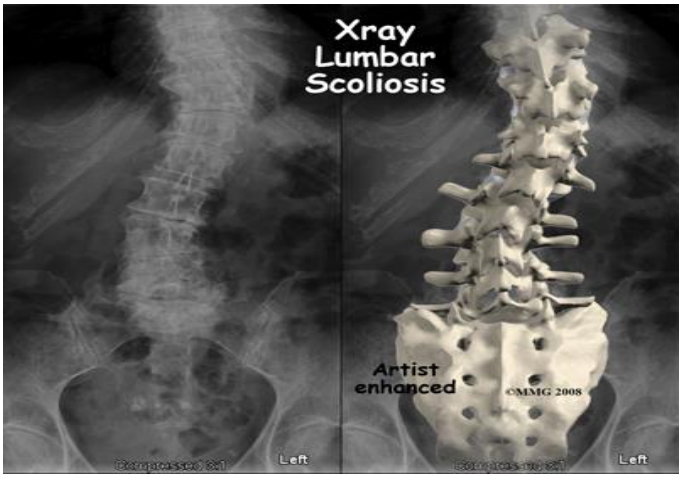

Fig. 5. The image shows the result of CT scan on a patient vertebra [6]

IV. CONCLUSION

Being a non-invasive imaging technique, X-ray computed tomography (CT) creates cross-sectional images of an object from two-dimensional X-ray projections. Furthermore, with the assistance of the Computed Axial Tomography (CAT) machine, the vertebra detection in X-ray images is medically enhanced. Based on all reviewed research papers, it can be properly concluded on the similarity of the application of parallel processing in the case study on vertebra detection in X-ray images. There are various methods that can optimize and quicken the process of obtaining the X-ray images nowadays. Due to this, there tend to be significantly more improvement in obtaining the X-ray images by making it much more in detail which could lead to less fatal accident towards the patient. In the future it can unlock more advances in medical image to be produced.

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