TIME-EFFICIENT FRACTURE DETECTION USING MULTI-CORE PARALLEL PROCESSING

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Abstract

Parallel Processing is type of high performance computing in which data is distribute across the multiple core and execute simultaneously for better performance. Partition of data is main difficulty in achieving a successful parallel system. There are number of task like matrix operation which have to distribute in fine grain parallel form for efficient results. Traditional method for processing large matrix are extremely time consuming. By applying parallel system technique we can increase the overall performance of matrix operation.

In this research work we take image as large matrix data set. Recent studies suggest that parallel implementation of image processing on multi-core system has potential to process the image very fast. Using X-ray image we implement Fracture detection through multi-core architecture. A key step in proposed workflow is load the X-ray image having large pixel matrix and divide this matrix into small matrices. After partition this small matrices are allocated to different available core. Then image processing algorithm is apply on different core to detect fracture present in bone X-ray image. This is done simultaneously. According to experimental results, the proposed multi-core parallel image processing algorithm provides benefit with a speedup factor up to 365 for an image with 8,192x8,192 pixels.

Keywords: Parallel Processing, Data partitioning, multi-core system, Matrix operation, Image processing, Fracture detection.

Introduction:

Parallel computing is the use of multiple compute resources to solve computational problem simultaneously,[1] For concurrently solving problem, this problem is divide into small part. Each part is later broken down to a series of instructions. Instructions from each part execute on different processors simultaneously. An overall control/coordination mechanism is deployed.

Parallel processing system depends on hardware and memory architecture. [2]On the basis of this architecture there are several type of parallel processing model. Anyone can use any model according to their task there is no best model for all type of task.

Matrix Operation is binary operation in which take two matrices and produce another matrix by addition, multiplication, division. [3] Sequential system have O (N3) time complexity for multiply two N*N matrices.

For fast operation of matrix we need to do parallel implementation because Matrix operations, like matrix multiplication are commonly used in almost all areas of scientific research work. Matrix multiplication has significant application in the different areas like graph theory, numerical algorithm, signal processing, and digital control. There are two approaches for parallel implementation of matrix operation like shared memory parallelism and distributed memory parallelism.

Parallel Image Processing

Image Processing is the process of enhance the image and extract meaningful information from an image. [4] Image processing is gaining more involvement in a variety of application areas.

Image processing is broadly used in many application areas including the entertainment, medical imaging, satellite imaging, weather forecasting etc. In some of these areas the images size is very large and the processing time is very small and in some cases real-time processing is required.

[5] Image Processing with parallel computing is an substitute to solve image processing problems that require more times of processing or handling large amounts of information. The main idea of parallel image processing is to divide the image into small matrices and solve them concurrently, in such a way the total time can be divided between the total matrix image. [6] We take Image as input in our research work because image is large matrix data set. The image data can easily distributed to multiple processor that can act independently of each other to do their portion of work. This type of problem are often called embarrassingly parallel because they are so straight forward. So they require very less inter-task communication.

Related Work

The problems of data partitioning represent great challenges for Parallel processing. Many researchers found created several methods to deal with the problem of data partitioning.

Jian Liang, Bao-Chang Pan, Yong-Hui Huang, Xiao-Yan Fan, [7] presented their work on parallel system of different sequential algorithms used in medical imaging for diagnostic purpose. The main focus was to improve the performance of partitioning, preprocessing, and fracture detection. They used multi-core system for designing parallel processing algorithms like noise reduction, features calculation etc. Performance Analysis of Parallel Matrix Multiplication Algorithms Used in Image Processing is done by [8] Ziad Al-Qadi and Musbah Aqel. They present matrix operation on parallel system. This work helps to improve the performance of image processing algorithm and try to utilize maximum no of the cores and allow maximum utilization of available core.

J. Fung and S. Mann in 2008, examined an algorithm for edge finding which was then analyzed on different tests. The main focus in the research was medical images. This work deals with reducing the amount of time required to represent the digital images. The conclusion drawn was that every algorithm is not committed to parallel computing and also parallel solutions can improve the performance of image processing.

Fracture Detection:

[7] Fracture is of partial break of skeleton caused by injury. The possibility of bone fracture is when pain, abnormal movement in the particular part of body or difficulty in the ability to control movements. In medical field there are different imaging techniques like X-ray, MRI, CT-Scan to use to capture the images of the human internal body for diagnose the fracture in bone.

X-Ray is widely used imaging technique because with help of X-Ray doctors can easily detect the deep fracture or fracture in the joints which is some time difficult with of MRI or other techniques. And it is convenient in checking, cost for X-ray is also low than other imaging techniques,

Even with X-ray have some issues like different doctors have different detection opinion about same X-ray. Time required for analysis and accuracy of result is also the complexity. In the recent development different computer visions are used in image processing for analysis of image or recognition of specific pattern present in image.

Computational System for Fracture Detection

The propose system in references used different computational system to detect the fracture in image in bone. There are different computerized techniques for X-Ray, MRI, CT-Scan by analyzing the image.

In these existing system basic image processing algorithm are used such as segmentation for partition, edge detection using mathematical morphology for fracture. [7] In Segmentation skeleton image specify and provide basic detailing for further processing.

In Edge detection the edge of the target is extracted, and then the skeleton. Dilation algorithm and corrosion algorithm are used for Skeleton extraction.

Further Fracture identification is done in which point of intersection is find out which are produced by overlapping of boundary image on skeleton image. With the help of these point fracture is identified.

Proposed System:

In proposed system, we take image as input because image is itself large matrix data set. This

method is fast parallel implementation of matrix multiplication in parallel system.
Parallel System consists multiple number of processors as we name it like P1, P2, P3,…..Pn. For the parallelism purpose each processor has its own local memory, and there is no global shared memory. Processors communicate with each other via message passing for synchronization because when data or image is partition into number of parts and allocate to different core then processing can be done concurrently. Finding an optimal data partitioning for a data-parallel program is challenging. The basic idea is to break down, or partition, the computation into smaller units that data is distributed among the processors. In this way, computation time is reduced by a number of processors in the multiprocessor system.

In Data Partitioning work is divide so that each processor performs exactly the same function on different sub blocks of the data. For This approach we requires algorithms who allow us to divide the work and execute efficiently in parallel way .

We use Multiple Program Multiple Data (MPMD) model for parallel execution because it allow us to execute different task on different core simultaneously. In this parallelization model communication is done by using thread and massage passing. This model have another advantage that functional decomposition can be done that means free memory of one core can be allocate to another thread.

In our case Input data will be an image to be segmentize, First approach for solving problem is to analyze image and then partition image into n number of blocks, these blocks are then allocated available cores and perform fracture detection on each core parallel [9].
To compute the product of two N × N real matrices A and B. requires computing inner products, one for each combination of a row of A and a column of B. On a particularly parallel, synchronous multiprocessor, all inner products could be computed in parallel with reasonable efficiency since, by default, every processor executes the same sequence of instructions at the same time. However, on an asynchronous multiprocessor each process has to be created and destroyed explicitly, and each inner product requires moderately little computation.

System workflow:

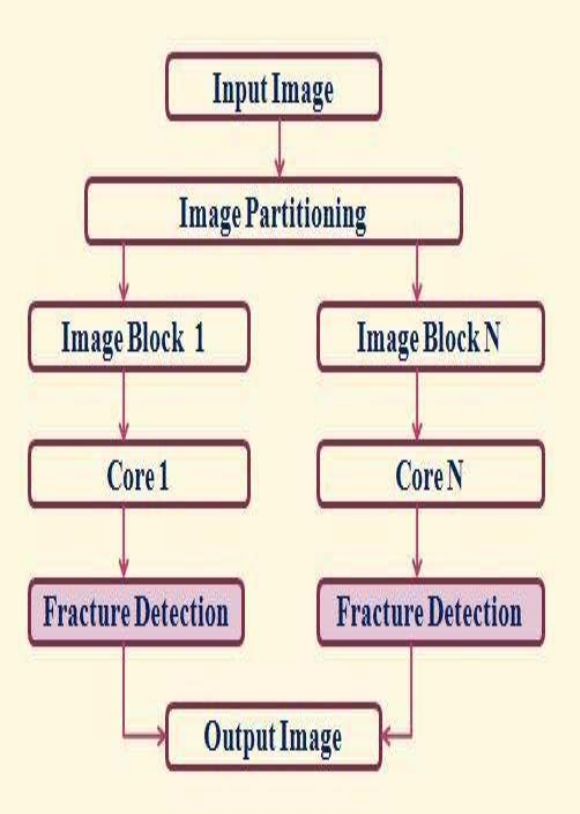
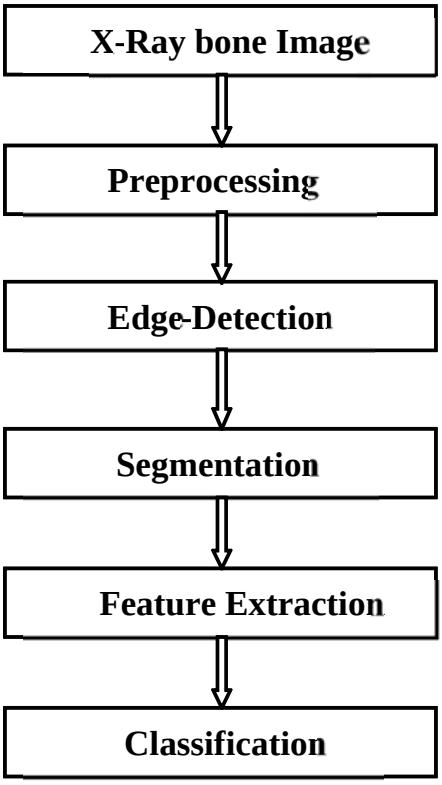


Fig: 2 Parallel image blocks processing.

Fracture Detection Algorithm:
Image Pre-processing: In image preprocessing noise present in image is remove by using various filter. techniques such as RGB to grayscale conversion are also apply in preprocessing step.
Edge Detection: In Edge detection step identify the points in a digital image at which brightness the image changes sharply or, more formally, or image has discontinuities. In this experiment sobel operator is used for edge detection.
Segmentation: The segmentation method we are going to use in our research work is k-means clustering algorithm. The image is divided into 2, 4 or 6 parts as and these parts are considered as blocks and allocate core to each blocks. Then after these blocks are segmented using the k-means clustering algorithm. After that output from all core are joined and image is reconstructed.

Fracture Detection algorithm:



The flow diagram of steps in detecting the bone fracture in Xray/CT images

Feature Extraction: Feature extraction is important step in various image processing applications. For feature extraction and selection Gray-Level Co-occurrence Matrix is used. GLCM is main tool used in image texture analysis. In this step we try analyze all small matrices which may have complex visual pattern that are composed of regions with the characteristics of brightness, color, shape, size.

Classification: Classification is a step of data analysis in which categorization of data is done by studying all data in number of category. Different category has its own characteristics and the data that belong to one have the same properties of this category and data from another category have their characteristics. In proposed method, SVM classifier is used such as Based on the GLCM textural features, classifiers classify the given image into fractured and nonfractured image.

Experiment result and discussion:

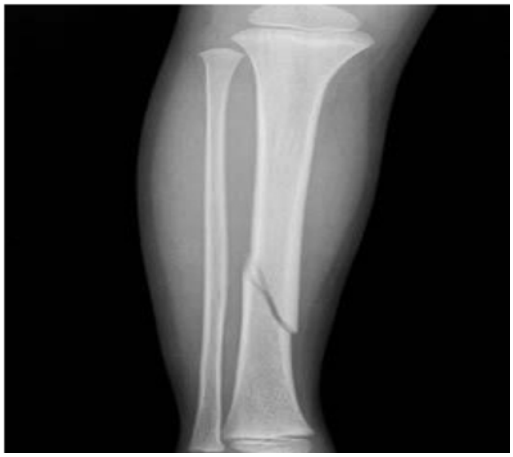


Fig 3: Input Image.

Fig 4: Output Image

Conclusion*:*

Data Partitioning is a technique to reduce the complexity of a program in order to aid debugging or comprehension. It has a multitude of uses, variations and implementation methods. Performing an parallel image processing on multi-core and multi-GPU architectures is a challenging task. Proposed new k-means clustering algorithm successfully segmented the image for parallel processing. Input image is an large matrix multiplication data set, this matrix is a form of pixel contingently call image. This matrix is divide into small submatrix which are refer as block or image part.

Available cores from multi-core system are allocated to each image blocks and segmentation is performed in parallel way. In this paper, we present new K-means clustering algorithm to solve a class of matrix problems.

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