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Parallel Processing of image in multi-core System

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ABSTRACT

Parallel Processing is type of high performance computing. In parallel processing data is divided into small parts and then allocate to different execution unit. So distribution of data in parallel processing is challenging. To increase the performance of computer system by reducing execution time and memory bottleneck data partition should be fine-grained. In this research work we consider matrix as input data because traditional method for processing large matrix are extremely time consuming. By applying parallel system technique we can increase the overall performance of matrix operation. For this we take image as large matrix and perform image processing algorithm as matrix operation. 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. Image processing algorithm is applying 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 324 for an image with 8,512 × 8,512 pixels.

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

1. INTRODUCTION

PARALLEL computing is the use of multiple compute resources to solve problem simultaneously, [1] For con-currently solving problem, this problem is divide into small part. Each part is later broken down to a series of in-structions. 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.

1.1. 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, med-ical 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

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an substitute to solve image processing prob-lems 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 simultaneously, 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 perfectly parallel because they are so straight forward. So they require very less inter-task communication.

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2. RELATED WORK

The problems of data partitioning represent great challenges for Parallel processing. Many researchers had created several methods to deal with the problem of data partitioning . In reference [1] Multi-Threading and K-Means Algorithm method is proposed to segment images using multi-threaded programming and k-means clustering. In this work image is segment without using multi-threaded programming where parts of images are used as a thread and k-means clustering is used to segment them on every thread. Performance of processing system is check. Then the same image part are sentimentalize using multi-threaded programming.

However an approach for point to point processing of digital images using parallel computing, particularly for grayscale, brightening, darkening, thresholding and contrast change is also present[2]. In this point to point technique transformation applies to each pixel on image concurrently rather than sequentially.This approach used CUDA as parallel programming tool on a GPU in order to take advantage of all available cores.

Despite this work is done in utilizing all CPU cores and all GPUs on heterogeneous multi-core and multi-GPU systems to support dense matrix computations efficiently [3]. In this work they have design heterogeneous algorithms with hybrid tiles to accommodate the processor heterogene-ity, and introduce an auto-tuning method to determine the hybrid tile sizes to attain both high performance and load balancing.

Meanwhile in previous work some basic image pro-cessing operations are done using parallel computing al-gorithm like noise reduction, feature calculation etc. From this research we got strength and weakness of each parallel approach for matrix operation in image processing.

3. 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.

3.1. Computational System for Fracture Detection

The propose system in references used different computa-tional 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 morphol-ogy 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.

4. IMAGE SEGMENTATION

Image Segmentation [7] is the way toward apportioning image into numerous sections. Division is just change the representation of a picture into something that is more significant and less demanding to dissect. In segmentation process, we are using k-means clustering technique to seg-ment target regions. Segmentation is a technique which provides information regarding the region of the image. The various segmentation techniques are partition clustering (k-means, Particle Swarm Optimization) thresholding, region growing and watershed. Partition Clustering: [13] The K-means clustering strategy is a segment grouping procedure. segment n perceptions into k cluster in which every per-ception has a place with the group with the closest mean of cluster. In this strategy, k is the quantity of groups in the divided image. The primary favorable position with k-means clustering procedure based segmentation is that it chips away at global data of the image close by.

Thresholding: [13] Thresholding based segmentation is especially powerful for images containing objects resting upon a complexity background. Amid Thresholding pro-cess, singular pixels in pictures are isolates into back-ground (binary 0) and foreground (binary 1) object-of-interest classes based upon their comparability in Gray-level power. The gray scale image is converted into binary image using Otsu method. The drawback of thresholding is not always straightforward and assigned pixels to a solitary class require not form coherent regions as the spatial areas of pixels and totally disregarded.

Region Growing: [13] In this, technique, the neighboring pixels are analyzed to form an region or class, if no edges are recognized. At that point, the procedure is rehashed for every limit pixel in the region under examination. The drawback of region growing method, the computation is consuming, no matter the power and time.

Watershed: In this technique, it utilizes marker con-trolled watershed segmentation procedure. Local minima of the gradient of the image might be picked as markers and includes converging of region. Marker in light of watershed transformation makes utilization of particular marker po-sitions which have been either unequivocally characterized by the user or decided consequently with morphological administrators or different ways. So, K-means clustering al-gorithm is used in our approach. After getting pre-processed image then k-means clustering algorithm is applied and generate segmented image.

5. PROPOSED SYSTEM

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 parallel processing different model are present like shared memory with thread without thread, multiple program single data model, multi-ple program multiple data model. In this exploration work we utilize multiple program multiple data model demon-strate on the grounds that in this model every processor has its own local memory, and there is no global shared memory for the parallelism reason. Processors communi-cate with each other by means of 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. The essential thought is to separate, or segment, the calculation into littler units that information is circulated among the processors. Along these lines, time required for

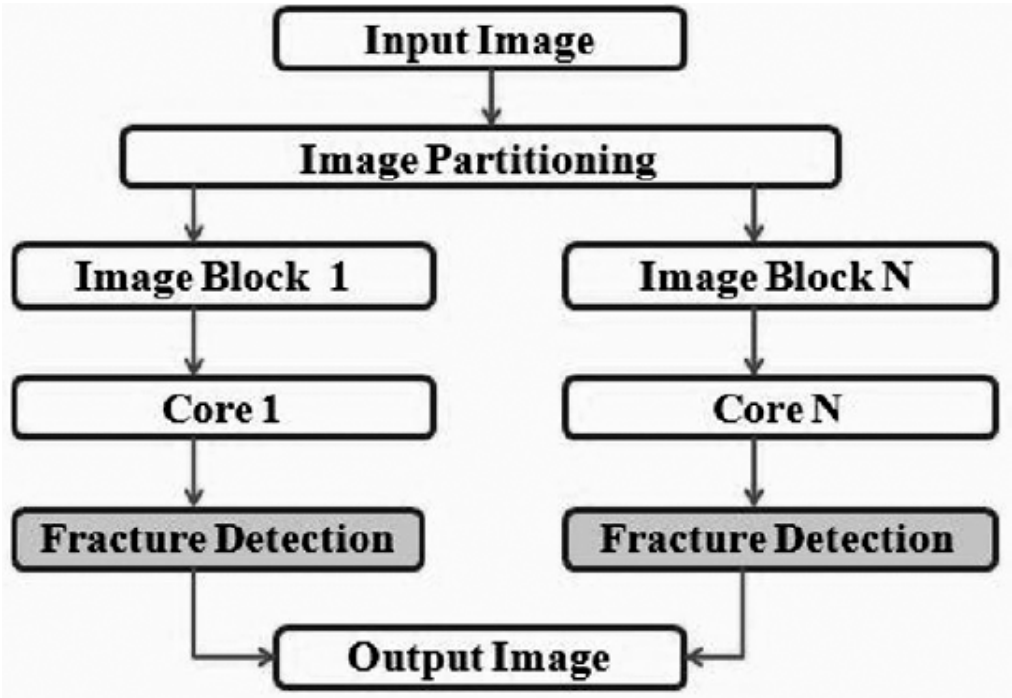

Figure 1: Parallel image blocks processing.

computation is diminished by a most extreme element of p, where p is the number of processors present in the multiprocessor framework. In Data Partitioning, task is separation so that every processor performs the very same function on various sub blocks of the information. This approach requires algorithms with solid intrinsic parallelism. 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. Image can be divide into block using programming logic where image is cut horizontally and vertically. For this work we divide the image into 4 and 6 part by dividing the height and width by 2 or 3 and allocate this 4and 6 block to individual core and then segmentation is perform parallaly on these blocks. Here the blocks are treated as bitmap which is nothing but a set of pixels arranged in matrix which is 2-diamensional.

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 algo-rithm. After that every pixel in the sequence is find out and distance from the centroid of each cluster is computed. By segmentation we can find detailing of image which can help for further image processing like detection or classification.

6. 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.

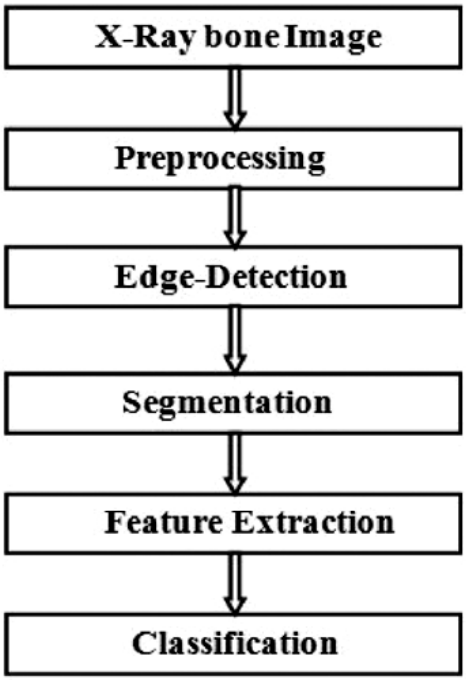

Figure 2: Fracture Detection.

Feature Extraction: Feature extraction is important step in various image processing applications. For feature ex-traction 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 non-fractured image.

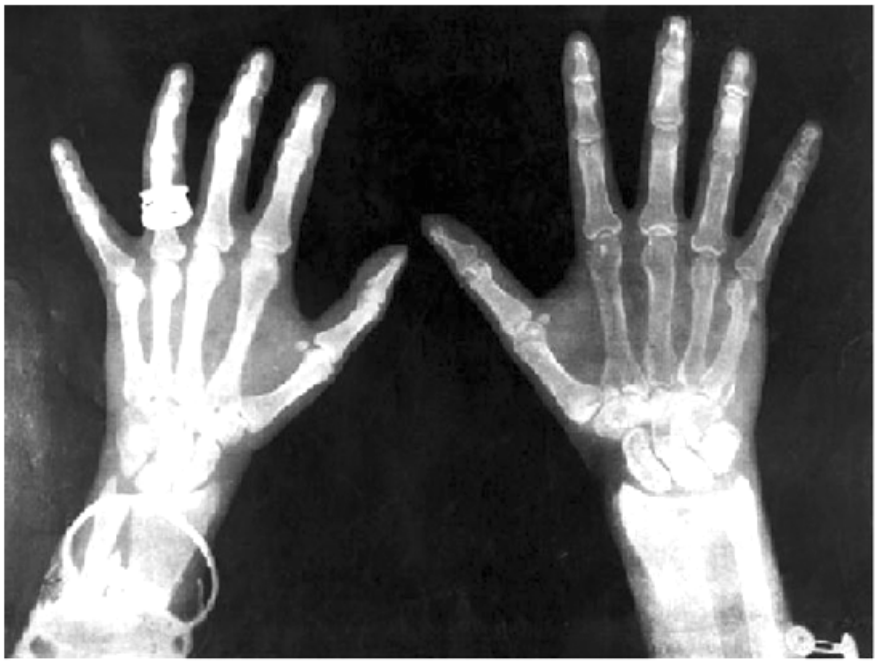

Figure 3: Original Image

Figure 4: Splited Image

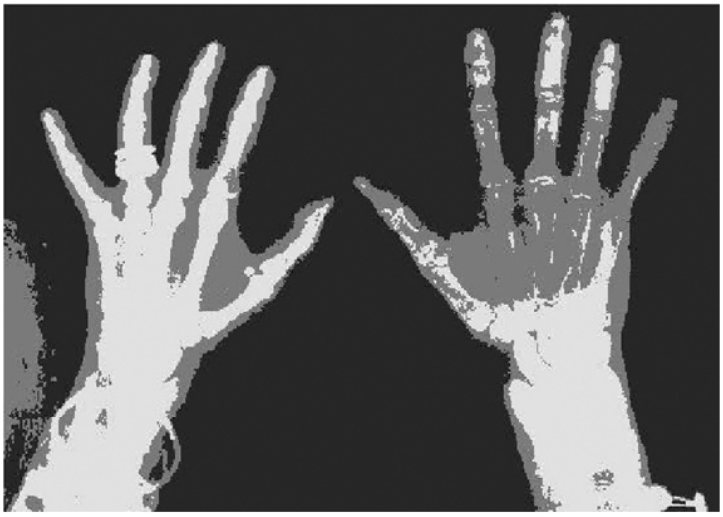

Figure 5: Segmented image

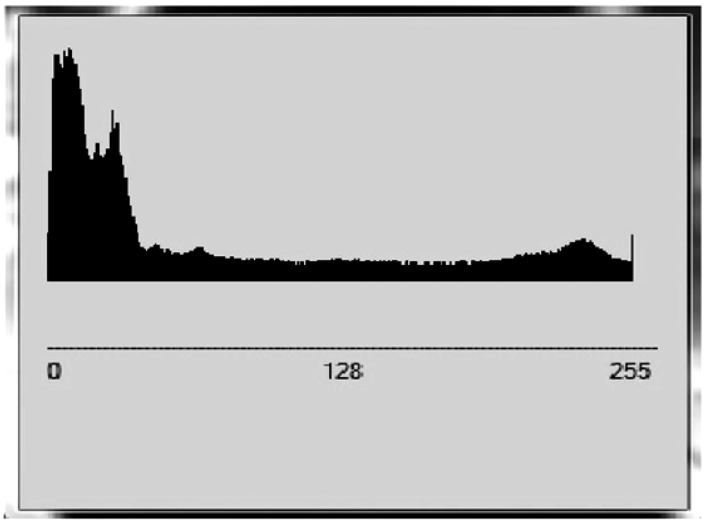

Figure 6: Histogram of original image

7. RESULT AND ANALYSIS

For segmentation we are using medical image dataset. Fig 1 is the original image and fig 2 shows the segmented image, and fig 4 and 5 are the respective histogram of both images [11] An image histogram is graphical representation of the tonal distribution in a digital image. It plots the number of pixels for each tonal value. By examining histogram for a specific image a viewer will be able to evaluate the entire tonal distribution at a glance.

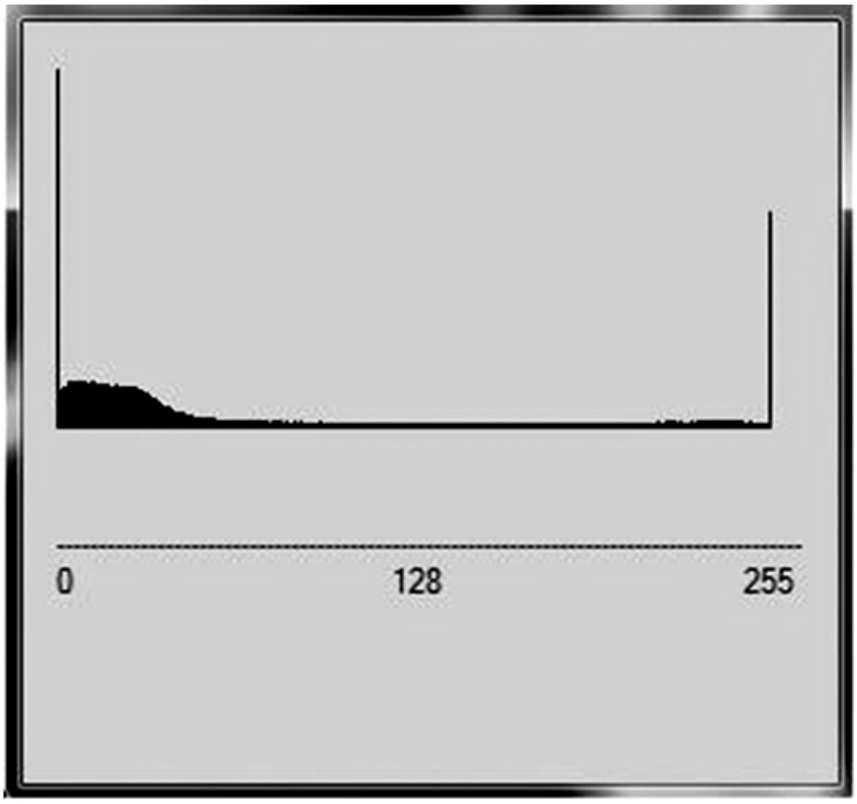

Figure 7: Histogram of segmented image

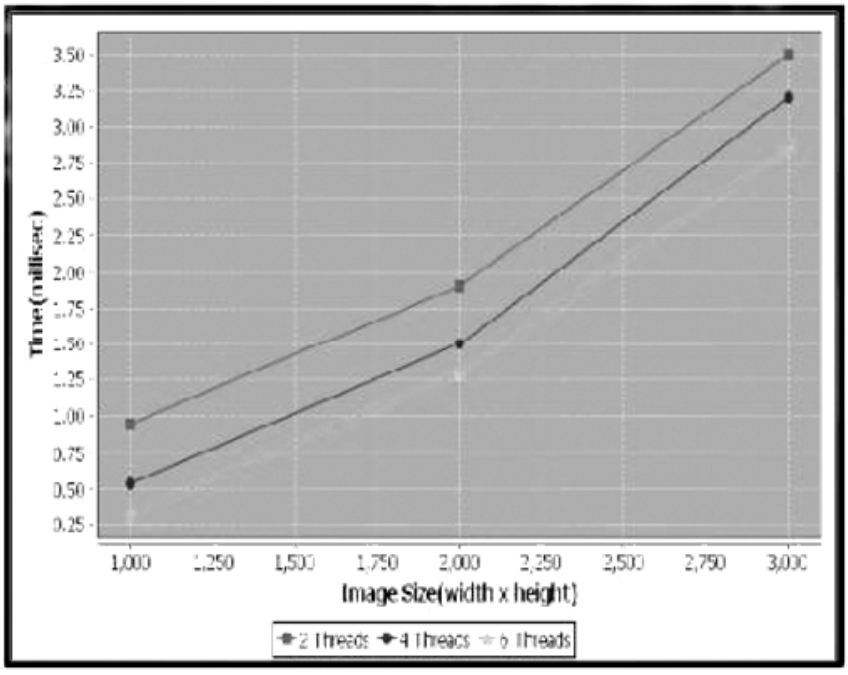

Figure 8: Processing Time

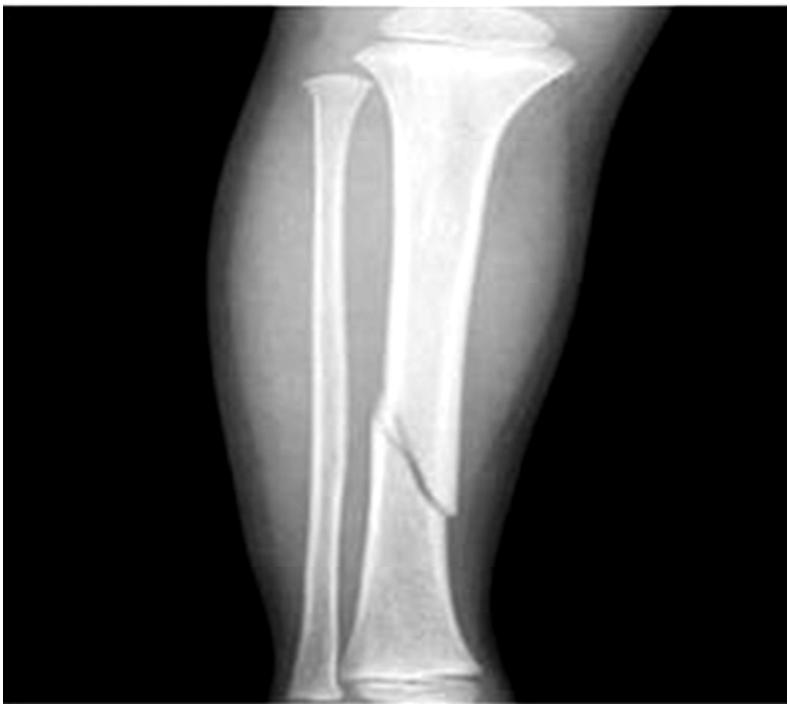

Figure 9: Input image

This proposed method uses k-means clustering and multi-threaded programming for parallel segmentation of the image parts shows remarkable outcomes. To show the significant performance of our proposed method, we are testing this method on images of various sizes.

In this research work we have examine the time required for single core to perform processing on particular matrix block of image. After then we check the time required for 4 and 6 core system and result were noted down. The obtained result have shown that our method has significant progress in time and memory utilization.

Figure 10: Output image

8. CONCLUSION

Data Partitioning is a technique to reduce the time complex-ity of a program by executing concurrently on multi-core system. Performing parallel image processing on multi-core and many core architectures is a challenging task. Proposed new k-means clustering algorithm successfully segmented the image for parallel processing. Input image is large matrix multiplication data set form of pixel contingently call image. Input matrix is partition into small matrices which are refer as block or image part. Idle cores from multi-core system are allocated to each image blocks and segmentation is performed in parallel way. In this paper, we present K-means clustering algorithm to solve a class of matrix problems.

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