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An Enhanced Memory Management For An Advanced Line Buffer Based Image Processing Pipeline

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Abstract: The performance of the image is mainly based on the memory consumed, time and the quality of the image. High flexibility can be achieved by using the software implementation and by using the various image processing algorithms. In this paper the memory usage is considerably reduced by implementing certain rules and by reducing the noise in the image. By using the low memory environments the insertions of the algorithms will be easy. In the previous implementation the memory usage will be high compared to our present work .In the previous the filtering techniques and the image enhancement was not properly specified. So we are moving to a advanced techniques for removing the noise using median filter and image enhancement using the Otsu's method. The implemented framework will increase the performance using various pipeline configurations.

KeyWords — Pipeline, Otsu's Method ,Median Filter, Image Enhancement

I . INTRODUCTION:

A 2D picture which is commonly processed by a computer system is referred to as image processing . An image defined in the "real world" is considered to be a function of two real variables, for example, a(x,y) with a as the amplitude (e.g. brightness) of the image at the real coordinate position (x,y). Image-processing operations require that an image or partial image be stored in a memory system that permits access to sequences of image points along any row or column of this image array and/or to the image points within small rectangular areas of the array Most usually, image processing systems require that the images be available in digitized form, that is, arrays of finite length binary words. For digitization, the given Image is sampled on a discrete grid and each sample or pixel is quantized using a finite number of bits. The digitized image is processed by a computer. To display a digital image, it is first converted into analog signal, which is scanned onto a display. Closely related to image processing are computer graphics and computer vision. An ideal model of how a camera measures light is that the resulting photograph should represent the amount of light that falls on each point at a certain point in time. This model is only an approximate description of the light measurement process of a camera, and image quality is also related to the deviation from this model. In computer graphics, images are manually made from physical models of objects, environments, and lighting, instead of being acquired (via imaging devices such as cameras) from natural scenes, as in most animated. It refers to accentuation, or sharpening, of image features such boundaries, contrast to make a graphic display more useful for display. This process does not increase the inherent information content in data. It includes gray level & contrast manipulation, noise reduction, edge crispening and sharpening, filtering, interpolation and magnification, pseudo coloring. Noise usually quantified by the percentage of pixels which are corrupted. Corrupted pixels are either set to the maximum value or have single bits. There are several ways that noise can be introduced. Image reconstruction is relevant to any device containing adigital camera. In order to have acceptable image quality, raw image data are processed with various image processing algorithms. The widely used image processing algorithms include noise

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filtering and several color correction operations. The combination of algorithms is organized into an image reconstruction pipeline.

II . RELATED WORK

As digital imaging becomes more prevalent in consumer products, the industry strives to reduce the cost and the complexity of imaging solutions and, at the same time, to improve the color quality and resolution of the images. Before most of the image processing can be conducted, dead pixel values must be removed. Traditionally, dead pixel detection and correction is achieved by storing the locations of the dead pixels during sensor manufacturing test. The ordering as well as the algorithm adopted in each stage for processing a color image is usually called color image processing pipeline (IPP).Although many algorithms have been proposed to address the issues of color image processing, covering the stages from raw image data to the final JPEG file

A good IPP should consider the ordering as well as the algorithms for color reproduction, tone reproduction, noise filtering, and edge enhancement. The aim of AWB is to guess the illumination under which the image is taken and compensate the color shift affected by the illuminate. The AWB problem is usually solved by adjusting the gains of the three primary colors R, G, or B of the image sensors to make a white object to appear as white under different illuminants.

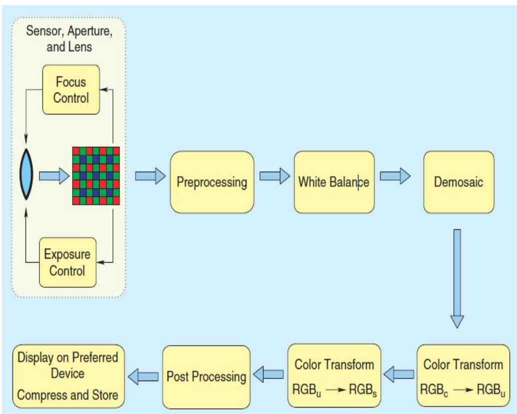

Fig 1.Image processing in DSC

Removing noise while preserving and enhancing edges is one of the most fundamental operations of Image processing. It is customary to apply edge enhancement algorithm on the image in order to improve the sharpness, but this process usually increase the noise level as a by-product. The issues of noise filtering and edge enhancement includethe following items: (a) some false edges resulted from random noise are produced by edge detectors. This is because edge points could be estimated by evaluating the maximum gradient components. Without prefiltering, many random noise may be judged as edge points by edge detectors.(b)Bilateral filter considers both geometric closeness and photometric similarity with domain and range filtering, respectively. However, it is still possible for the bilateral filter

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to blur some high resolution image details if a global view of edge locations is not available. (c) The edge detector for guiding bilateral noise filter provides local high frequency information, but the false edges must be identified and

removed. Otherwise, the noise cannot be smoothed out in the bilateral filter stage. With the advances in integrated circuit technology, the computation power is not always the major considerations for the design of image pipeline.

Although most of edges can be preserved by the modified bilateral filter, the optical lens imperfections will cause the image to be blurred, especially at the four corners. Hence it is necessary to enhance the edges in the image processing pipeline. Several noise filters are adopted to deal with different classes of noise and different color spaces are used to handle the problems of noise filtering and edge enhancement.Although the computation complexity of the proposed approach is higher than traditional bilateral filter.

A desirable property of any color digital imaging system is to render real world scenes on electronic as close as possible to what human beings can perceive. High dynamic range (HPR) image display has been a very challenging issue in the pursuit of this goal. The dynamic range of real-lifescenes spans up to 106 :1 whereas the human vision system can discriminate a dynamic range of about 104 : 1. On the other hand, electronic devices can only handle a much narrower range: the dynamic range that a digital camera can capture does not exceed 2N : 1 (Nbeing the bit depth of the camera), and an 8-bit display has a dynamic range lower than 100:1

Digital cameras can also function as digital video cameras with few additional hardware components, especially when they have programmable processing units to implement video coded algorithms. Traditional video cameras will be the benchmark for this functionality and will drive video signal processing requirements such as real-time auto white balance, exposure and focus
control, and vibration blur compensation. The imaging pipeline is implemented as a synthesizable
image sensor companion chip. Therefore, it has to meet stringent real-time performance requirements and operate within a low power budget .But in our paper we are focusing on the software implementation of the work.

III . SYSTEM DESIGN

The System architecture diagram for our proposed diagram will be discussed below:

A. MEDIAN FILTERING:

Median filtering is a nonlinear process useful in reducing impulsive or salt-and-pepper noise. It is also useful in preserving edges in an image while reducing random noise. Impulsive or salt-and pepper noise can occur due to a random bit error in a communication channel. In a median filter, a window slides along the image, and the median intensity value of the pixels within the window becomes the output intensity of the pixel being processed.

The median filter considers each pixel in the image in turn and looks at its nearby neighbors to decide whether or not it is representative of its surroundings. The median is calculated by first sorting all the pixel values from the surrounding neighborhood into numerical order and then replacing the pixel being considered with the middle pixel value. (If the neighborhood under consideration contains an even number of pixels, the average of the two middle pixel values is used.)

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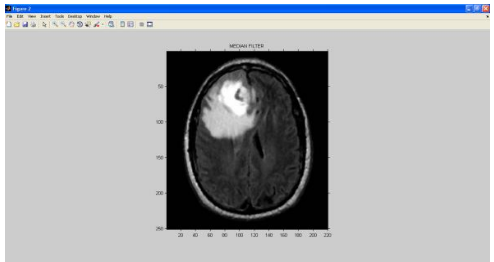

FIG 2.image after median filtering

B.OTSU'S METHOD:

Otsu's method is used to automatically perform clustering-based image thresholding, or, the reduction of a gray level image to a binary image. The algorithm assumes that the image to be threshold contains two classes of pixels or bi-modal histogram (e.g. foreground and background) then calculates the optimum threshold separating those two classes so that their combined spread (intra-class variance) is minimal. The extension of the original method to multi-level thresholding is referred to as the Multi Otsu method.

$$\sigma_w^2(t) = \omega_t(t)\,\sigma_1^2(t) + \omega_2(t)\sigma_2^2(t)$$

In Otsu's method we exhaustively search for the threshold that minimizes the intra-class variance (the variance within the class), defined as a weighted sum of variances of the two classes:

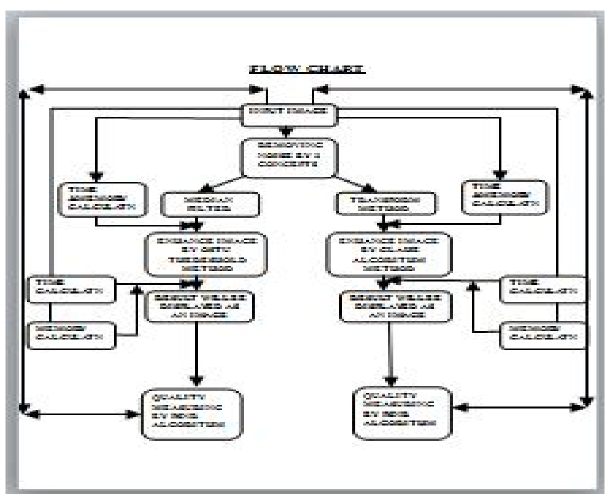

Fig 3.System architecture

C.**CLAHE ALGORITHM**

CLAHE was originally developed for medical imaging and has proven to be successful for enhancement of low-contrast images such as portal films. The CLAHE algorithm partitions the images into contextual regions and

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applies the histogram equalization to each one. This evens out the distribution of used grey values and thus makes hidden features of the image more visible. The full grey spectrum is used to express the image.

Contrast Limited AHE (CLAHE) differs from ordinary adaptive histogram equalization in its contrast limiting.Contrast Limited Adaptive Histogram Equalization, CLAHE; It is an improved version of AHE, or Adaptive Histogram Equalization. Both overcome the limitations of standard histogram equalization.

In the case of CLAHE, the contrast limiting procedure has to be applied for each neighborhood from which a transformation function is derived. CLAHE was developed to prevent the over amplification of noise.

Selective enhancement is accomplished by first detecting the field edge in a portal image and then only processing those regions of the image that lie inside the field edge. This method is one of the efficient for reducing the noise in the image.

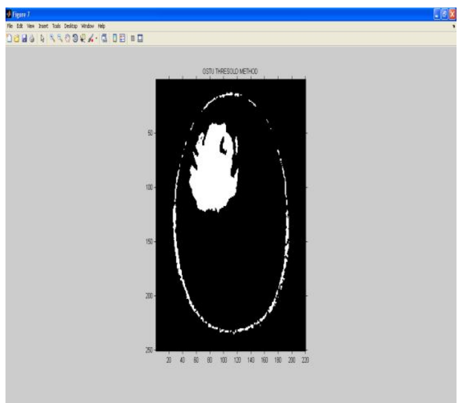

Fig 4.clache algorithm

A variety of adaptive contrast-limited histogram equalization techniques (CLAHE) are provided. Sharp field edges can be maintained by selective enhancement within the field boundaries.. Noise can be reduced while maintaining the high spatial frequency content of the image by applying a combination of CLAHE, median filtration and edge sharpening. This technique known as Sequential processing can be recorded into a user macro for repeat application at any time. A variation of the contrast limited technique called adaptive histogram clip (AHC) can also be applied. AHC automatically adjusts clipping level and moderates over enhancement .

PSNR ALGORITHM:

The PSNR block computes the peak signal-to-noise ratio, in decibels, between two images. This ratio is often used as a quality measurement between the original and a compressed image. The higher the PSNR,the better the quality of the compressed or reconstructed image.

The Mean Square Error (MSE) and the Peak Signal to Noise Ratio (PSNR) are the two error metrics used to compare image compression quality. The MSE represents the cumulative squared error between the compressed and the original image, whereas PSNR represents a measure of the peak error.The lower the value of MSE, the lower the error.

E.**TIME CALCULATION:**

Time calculation is done by TIC-TOC method. **toc** reads the elapsed time from the stopwatch timer started by the **tic** function. The function reads the internal time at the execution of the **toc** command, and displays the elapsed time since the most recent call to the tic function that had no output, in seconds.

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Elapsed time = toc returns the elapsed time in a variable.

toc(time val) displays the time elapsed since the tic command corresponding to timerVal.

elapsedTime = toc(timer val) returns the elapsed time since the tic command corresponding to timerVal.

F.**WAYS TO REDUCE THE MEMORY:**

1. Load Only As Much Data as You Need
2. Process Data by Blocks
3. Avoid Creating Temporary Arrays

IV . DISCUSS AND RESULTS

The implemented SW framework is compared with a traditional image reconstruction pipeline which uses a ping pong buffer scheme. In ping-pong buffering, two full-sized image buffers are used as the input and output buffers. After a

single image processing algorithm has been completely executed, the image buffers are swapped, so that the output buffer of the current algorithm is used as the input buffer for the next algorithm and vice versa.

Statistics-dependent algorithms such as tone reproduction assume by default that the in a gestatistics is calculated in between the pipeline. However, in the designed pipeline, image data would enter the next processing stage before the next stage.

The execution times for the individual algorithms were measured by running the algorithms separately, i.e., without any other stages in the pipeline. The execution times for both approaches were calculated as an average of processing the same image ten times.

The performance improvement of our framework is due to the fact that the line buffer memory, being significantly smaller than the full-sized image buffers in the ping-pong pipeline, has better cache locality. During execution, the line buffers stay better in the cache, which decreases the amount of data cache misses. This was verified by analyzing both pipelines with Intel VTune Amplifier XE 2011. According to VTune, the implemented SW framework caused 16.1% less Sdata cache misses than the ping-pong pipeline when the whole pipeline was executed.

FILTER	MSE	PSNR
Linear	265.1121	55.0277
Median	131.3515	62.0456
Adaptive	39.2500	74.1258

V . CONCLUSION

This paper presented a novel SW framework for the management of a line-buffer-based image reconstruction pipeline. The SW framework reduces memory consumption drastically without any performance compromises. Therefore, the framework is well suited for a wide range of limited devices that need image processing. Easy configurability also guarantees that the SW framework decreases the time spent in the management of the image reconstruction pipeline .At the same time in our paper the memory is reduced by implementing the rules and avoid

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using temporary memory. It also increases the performance by reducing the time taken to execute the program.In the future work the hardware implementation can be used with lower memory.

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