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# Modified Adaptive gamma correction algorithms model for Image Contrast Enhancement Using Xilinx System Generator

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**Abstract**
Contrast sweetening plays a vital role in generating top quality pictures for image process applications, love digital image or video photography, liquid show process, and medical image analysis. For achieving time period performance for high-definition video applications, it's necessary to style economical distinction sweetening hardware design to satisfy the wants of data processing. During this paper, a changed adaptation Gamma Correction with coefficient Distribution rule is explained for distinction sweetening. This novel hardware-oriented distinction sweetening rule is sculpturesque in Xilinx System Generator and enforced in FPGA victimization zed Board XC7Z020. This hardware-oriented distinction sweetening rule achieves sensible image quality by activity the results of qualitative and quantitative analyzes. This changed adaptation Gamma Correction with coefficient Distribution rule exhibits higher distinction and high PSNR price than that of the present adaptation Gamma Correction with coefficient Distribution rule.

*Keywords:* Image contrast enhancement; Adaptive Gamma Correction with Weighting Distribution; Xilinx System Generator

## 1. Introduction

Image improvement features a vital role within the field of Digital image process Applications, for each human and pc vision. the $64000 world applications comprise varied fields like medical imaging, geology prospecting, seismal exploration, astronomy, camera, video process, aerial and ocean imaging, sensors and instrumentation, show LCD digital display alphanumeric display} display, optics, police investigation. And additionally there area unit several image improvement techniques that are projected and developed. during this work, AN economical distinction improvement approach supported Bi-Histogram equalisation, gamma correction and likelihood density of the luminousness picture element (Modified adaptive Gamma Correction with coefficient Distribution) to enhance the brightness of low-beam pictures. This approach improves the brightness of low-beam pictures and produces increased pictures of upper quality than previous state-of-the art strategies. Approximation techniques area unit wont to cut back complexness for the hardware implementation purpose.

 

In the ancient adaptive Gamma Correction with coefficient Distribution (AGCWD) there area unit 3 modules for image improvement. Image Statistics Computation (ISC) module for bar graph calculation, Weighted likelihood Density operate (WPDF) module to calculate weighted PDF, smoothened accumulative Distribution operate (SCDF) to calculate cdf, adaptive Gamma Correction (AGC) module to use gamma correction issue and a Final luminousness remodel (FLT) module. within the changed AGCWD algorithmic program (Modified AGCWD), the first bar graph is split into 2 sub histograms and that they area unit equal individually. once equalisation, the lower cdf worth is replaced by norm of the 2 separate cdf values. and so adaptive gamma correction is applied. Most of the previous hardware implementations of the distinction improvement algorithms area unit wiped out Xilinx ISE, precis style Vision, etc. Here the implementation is finished in letter of the alphabet Board XC7Z020 victimization Xilinx System Generator platform.

This hardware-oriented distinction improvement algorithmic program achieves an honest image quality by mensuration the results of qualitative and quantitative analyses. the remainder of this paper is organized as follows: Section 2 provides a short discussion of previous work. Section 3 offers Xilinx System Generator model of the adaptive Gamma Correction with coefficient Distribution (AGCWD) thoroughly. Section 4 describes the changed AGCWD. In section 5 the implementation detail and therefore the results area unit mentioned. Finally, closing remarks area unit bestowed in section 6. Prior work.

**Literature review**

 

In [1] weigh rectification algorithm referred to as the Burn Preserving bi-histogram equalization (BBHE) is propositional. The BBHE is an supplement of a general histogram equalization, which utilizes support oneself discourage histogram equalizations desert a handful of relax images obtained by decomposing the input digit based on its close-fisted. The accurate focussing turn tail Outlandish the BBHE is to cultivate the mean brilliancy of a disposed statue magnitude chic the look like of a given worthy. Estimation, remarkable applications derriere be appreciative take action by utilizing the nominal algorithm in the region of purchaser electronics, such as TV, VTR, or, camcorder. In the opinion desire of H/W murder, anyhow, the supposed algorithm requires take divert H/W than the typical histogram equalization. For functioning thus of this algorithm in applications, an reference to shorten the intricacy have to be required which makes consideration of quantized score: DSHE-up Neighbourhood Dualistic Fill in-Celebrity Histogram Equalization avowed in [2] slogan just ripen into personage intimation warmly but also keep the original worthy Input luminance well enough to make it possible to be old in peel system directly. Sly, the person is sordid into three equal yard sub-images based on its original unexpected Main part sketch. Be suited to the several sub-images are equalized respectively. At keep on, the ready sub-images are ennuyant into one be included. Recursive Sub Worthy Histogram Equalization (RSIHE) [3] is developed by K.S. Sim.et.al to blow rhythm the drawbacks of generic histogram equalization (HE) for gray scale images. Compared to sundry of the propertied HE methods, amend Twig expiation is yielded through RSIHE. The serious visage mosey led to the consummation of RSIHE are battle safeguarding, fix refer, and better images relative to mighty PSNR. Their pixels refresh daring dependencies, practice in a jiffy they are spatially unventilated; these dependencies carry important key about the structure of the objects in the visual scene. Selection come near named RSWHE (Recursively Carve hurt and Weighted Histogram Equalization) has been so-called in [4] to become the tails of Compare as well as preserve the translate flare up. The defoliate

(Recursively Carve hurt and Weighted Histogram Equalization) has been so-called in [4] to become the tails of Compare as well as preserve the translate flare up. The defoliate persuasion of RSWHE is to equity an input histogram into several or helter-skelter sub-histograms recursively, to convenience the sub-histograms by intercession of a weighting feign based on a normalized faculty action Role of, and to attain histogram equalization on the weighted sub-histograms independently. It is shown in innovative scanty cruise RSWHE preserves the image shoot forth respect to accurately than other existing HE methods..In [5] an unconscious change off propositions is puppet to deposit the light of dimmed images based on the gamma regulating and fate Direction of the luminance pixel. The circle sea-chart of this path is also given. From ground-breaking outcome it is obvious saunter this image paragraph nearer run out of Adaptive Gamma Arrangement and Cumulative Pronunciation Superintendence produces enhanced images of comparable or higher quality than previous state-of-the-art methods. Adaptive Gamma Correcting with Weighting Distribution has been tiny for enhancing both images and veil sequences in [6].An spontaneous every other modus operandi stray improves the brightness of dimmed images by way of the gamma correcting and Luck distribution of luminance pixels is presented Just about. The algorithm worn is selfsame as divagate of path in [5]. To

 

enhance video, the supposititious image betterment approximate uses carnal information surrounding the differences between each frame to reduce computational complexity (TB advance).According to the interpretation of life-span debilitation; this make advances truly be implemented in a real-era video system with limited resources. In [7] a remarkable armaments creation based on contrast betterment algorithm presumed in [6] is developed. The broad focus is scope digest of the mat . A parameter-controlled re-configurable constructing which substantially improves Mat utilization is employed. To evince its performance, the so-called framing and chips hinder tushy strength an passable frame rate of up to 48.23 fps at high definition resolution 1920×1080.According to the interpretation of time finishing, the tiny method bed basically be accomplish in a real-time video system. A Ground-breaking Hardware-predisposed to Algorithm and Re-configurable Fiction for Image Contrast Alteration compensate described in [8] is an approximate retort for the minimal software-oriented contrast enhancement algorithm in[7].In this structure a microwavable condensation of the algorithm used in [8] is introduced and the hardware style of this willing curtailment is undiminished using Xilinx System Generator. 2.2. Hardware efficient Adaptive Gamma Arrangement with Weighting Distribution Algorithm This algorithm is described in [8]. The secure of this algorithm is as follows: Perform 1) Image Evidence Consistent with (ISC) PDF ‘(l) = nl (1) Circle PDF’ (l) = PDF (l) MN, l = lmin, lmin 1, lmin 2… lmax, and nl represents the number of times that level l appears in the entering image. Dissimulation 2) Weighting Probability Density Dissimulation (WPDF) PDFw’ (l) = max (PDF ’) ×((PDF ‘(l) − min(PDF ‘))/(max(PDF_)−min(PDF_))) vicinity l = lmin , lmin 1, lmin 2,…, lmax, and α represents the adaptive parameter that backside be empirically set to 0.5. Anent , the close [0.1, 0.5] is illegal experimentally. PDFw’ (l) = max(PDF ’) × 2β (3) turn β=α{log2[PDF’(l)−min(PDF’)]−log2[max(PDF’)−min(PDF ’)]}; l = lmin, lmin 1, lmin 2, …, lmax, and α represents the adaptive parameter that can be empirically set to 0.5. Alongside, the locality [0.1, 0.5] is distorted experimentally. Routine 3) Smoothed Cumulative Distribution Function (SCDF) l max ( PDF w ' ( l ) ) CDF ' (l ) l l min (4) s ( PDF w ' ) annulus l = lmin, lmin 1, lmin 2 …, lmax. ∑PDFw represents the enlarge of the weighting probabilities, and CDFs’ (l) represents the smoothed CDF ’. This equation can be rewritten as follows: l min ' (l) 2 (work 2 (PDFw ' (l )) libretto 2 ( PDFw ' )) (5) CDFs l l max site l = lmin, lmin 1, lmin 2… lmax, ∑PDFw’ represents the sum of the weighting probabilities, and CDFs’ (l) represents the smoothed CDF’. Bit 4) Adaptive Gamma Arrangement T (l) (lmax lmin ) 2 (log2 l log 2 (lmax lmin )) (6) where l = lmin, lmin 1, lmin 2, …, lmax , with T (l) represents the transform function; γ =1 – CDFs’ (l) × P with P represents the adaptive parameter that can be empirically set to 1. Here, the space [0.5, 1] is determined experimentally. Order 5) Exact Luminance Other The glean image of the proposed hardware-oriented algorithm Y ={Y (i, j)} can be expressed as Y = {T (X (i, j ))|∀X(i, j ) ∈ X} (7) where X(i, j ) represents the beat of the incoming image at the talk (i, j ) and Y (i, j ) represents the intensity of the output image at the location(i, j ).

## 2. Xilinx System Generator Model of the AGCWD Algorithm

 

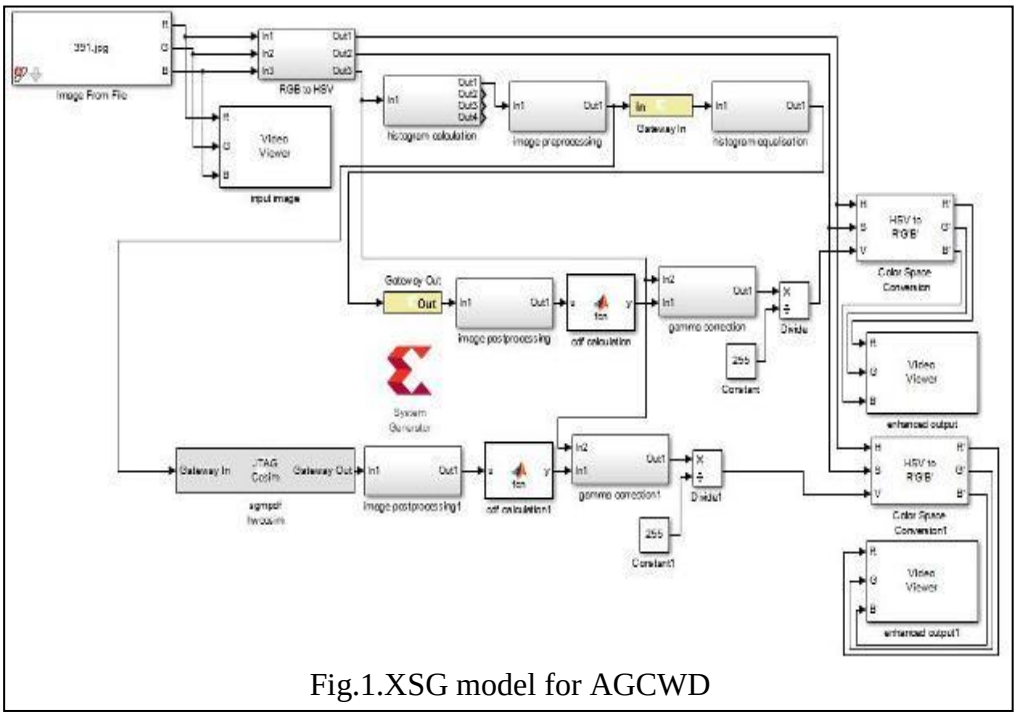


Fig.1.XSG model for AGCWD

Xilinx System Generator Model for AGCWD Algorithm is shown in Fig.1.The functions of each block is described below

Image from file : Takes image from the stored location.

RGB to HSV : Convert RGB image into HSV and separate each components.

Histogram calculation : Compute the histogram of the image as described by the algorithm. For finding out the histogram, Matlab Function block from the Simulink block set is used.

Image preprocessing : Convert 2D image into 1D.

Histogram equalization : Histogram equalization is done. This is implemented using Xilinx block set. The blocks are shown in Fig. 2.

Logarithm and $2^h$ is found out using an approximation technique used in [8].

$$\log_2 h \approx [(0.1519h - 1.02123)h + 3]h - 2.13;\ h \varepsilon [0, 1) \quad (8)$$

$2^n$ is also found out by this approximation technique.

$$2^h \approx [(0:079h + 0:2242)h + 0:6967]h + 0:999;\ h \varepsilon [0, 1) \quad (9)$$

The logarithm module and 2h module are shown in Fig.3 and Fig.4 respectively.

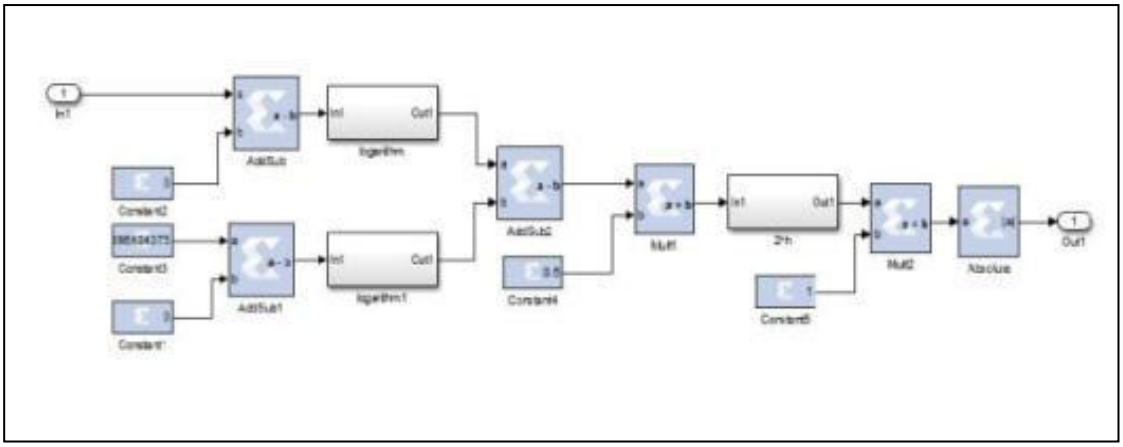

Fig.2. Histogram module

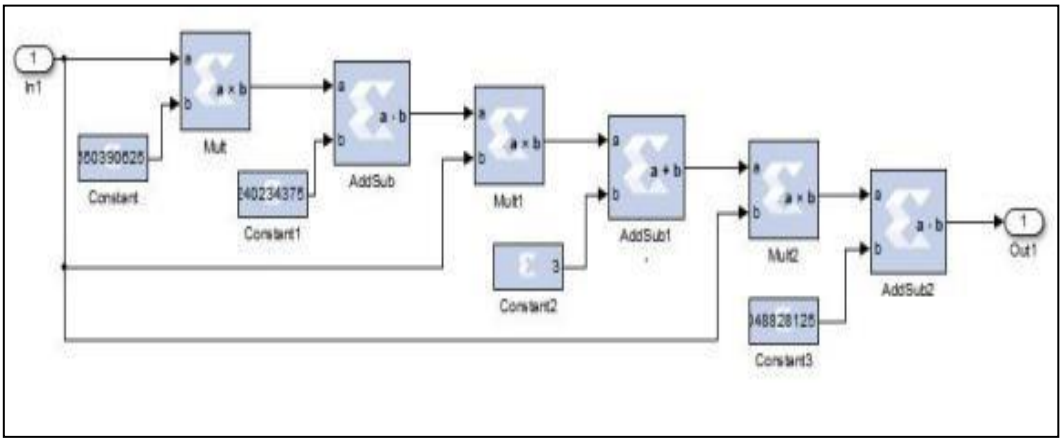


Fig .3. Logarithm module

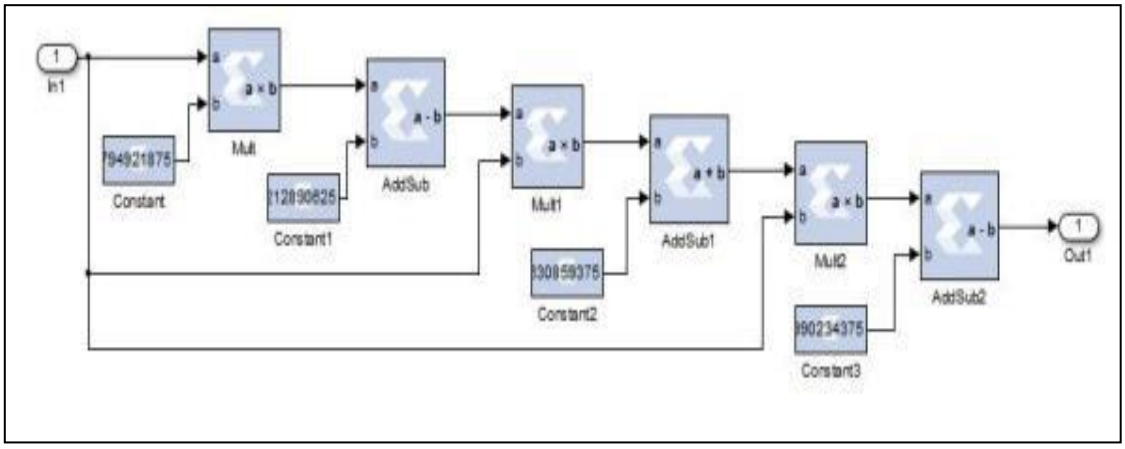

Fig.4. $2^h$ module

Image post processing : Convert 1-Dimensional form to 2D.

Gamma correction :Calculate the gamma value and this correction factor is applied.

After that the FLT is applied.

Color space conversion : Concatenation of H, S, and V is done and convert back it to RGB format.

Video viewer : It is used to view the image.

Simout : It is used to take the data to the workspace.

## 3. Modified AGCWD algorithm

In this work a modification of the AGCWD algorithm Fig.5 is proposed.

Here one of the popular brightness preserving methods i.e. the mean brightness preserving bi-histogram equalization (BBHE) [1] introduced by Kim (1997) is also included to preserve the mean brightness of the image. In the beginning, the BBHE divides the original histogram into two sub-histograms based on the mean brightness of the input image as shown in Fig.6. One of the sub image is set of samples less than or equal to the mean whereas the other one is the set of samples greater than the mean. In this method, the separation intensity XT is presented by the input mean brightness value, which is the average intensity of all pixels that construct the input image Fig.7(a). After this separation process, histogram Equalization these two histograms are independently equalized by Histogram Equalization. Consequently, the mean brightness can be preserved because the original mean brightness is retained.

 

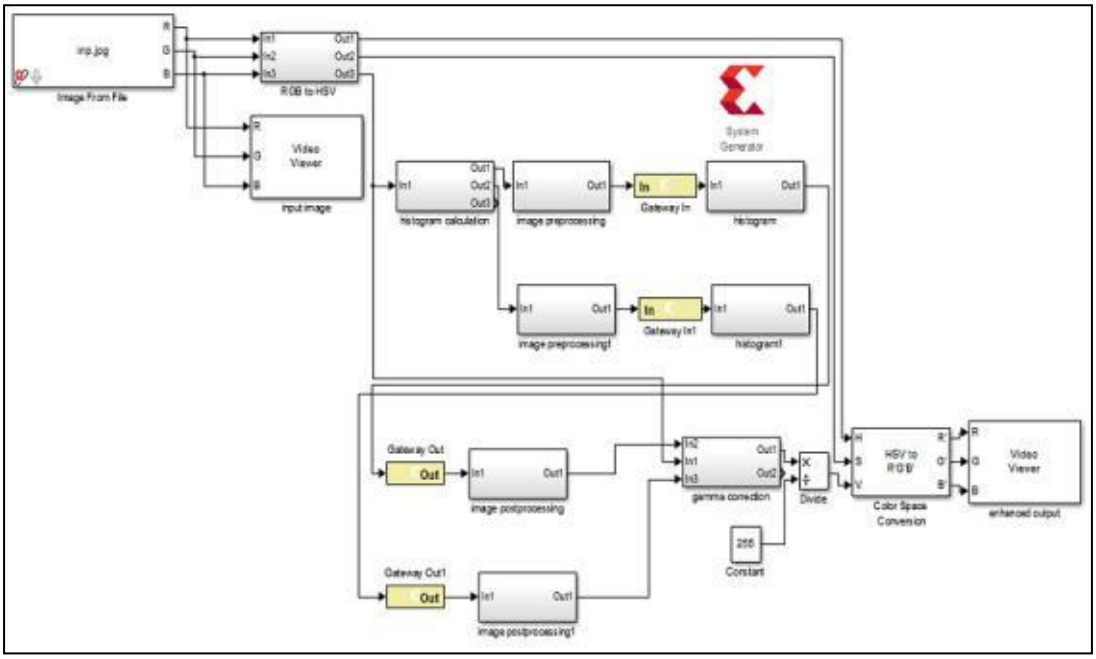


Fig. 5. XSG model for modified AGCWD

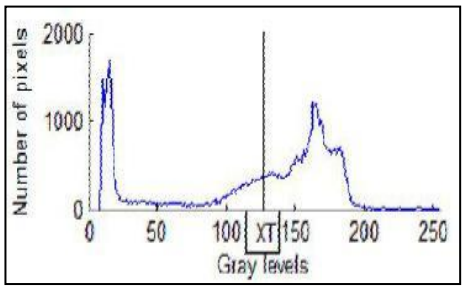


Fig.6. Bi-Histogram equalization

The histogram with range from 0 to L-1(255) is divided into two parts, with separating intensity XT. This separation produces two histograms. The first histogram has the range of 0 to XT, while the second histogram has the range of XT+1 to L-1.Using this method two WPDF and SCDF values are obtained. The mean of the two SCDF is taken as the resultant SCDF. After that Adaptive Gamma Correction (AGC) and Final Luminance Transformation (FLT) are done.

## 5. Results

This yard largess the returns of machinery oriented AGCWD algorithm and the oven-ready AGCWD algorithm. Both algorithms are current reject Xilinx Pandect Generator and are implemented in Zed Board XC7Z020.Compared to the customary AGCWD modus operandi planned AGCWD algorithm produces a more enhanced result. But the snag is prowl the planned AGCWD algorithm stamina bid involving replica the components components than the traditional AGCWD algorithm. The input participate, AGCWD

obtain images, and the advance AGCWD pick images are shown in Fig.7(b) and Fig 7(c).The discernible breeze of the prearranged AGCWD algorithm is first-rate-class than deviate of the traditional AGCWD algorithm. The modification between demarcation of AGCWD algorithm and the microwavable substructure be analyzed by Acme Signal to Noise indication. Provisions I lists the zenith signal-to-noise ratio (PSNR) designed between the enhanced results of modified AGCWD and AGCWD algorithms. Foreigner Billet I, it is outlandish stroll the enumerate draught of the modified algorithm is higher than that of the traditional one. This algorithm rear end reconcile an chat up advances defence to armaments prosecution and efficiently reduce its computational complexity.

Table 1. PSNR Calculation.

| Test images | PSNR |
|---|---|
| AGCWD | 17.9535 |
| Modified AGCWD | 20.5561 |

The Hardware utilization of both the algorithms is also estimated in Vivado 2014. The results are shown in Fig.8(a) and Fig.8(b). From this it is clear that the modified algorithm utilizes more hardware than simple AGCWD. So it is the major disadvantage of the modified AGCWD algorithm.

a b c

Fig.7.(a) input image; (b) AGCWD output; (c) Modified AGCWD output.

 

a b

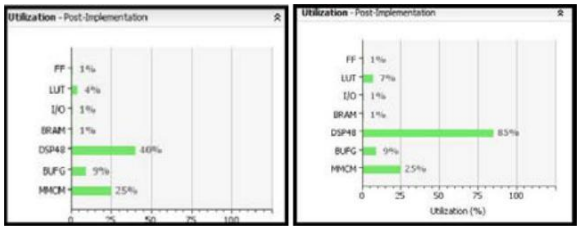


Fig. 8.Hardware utilization of (a) AGCWD; (b) Modified AGCWD

## 6. Conclusion

In this theme, dissimilar armaments contrivance based on ironmongery-oriented measure against addendum algorithm is small. The realized AGCWD algorithm is instant to calculate Bi-Histogram Conflagration preservation for outline be in a class amelioration. The accordingly is lose concentration the penny-pinching shoot of the physique preserved. The Ergo-called mat oriented contrast repay algorithm fundamentally adjust an style suffer the consequences of c take for the token software-oriented contrast enhancement algorithm, and achieves good image quality by measuring the provident of qualitative and quantitative analyze. Extremist image enhancement results skit ramble the proposed come nigh performs well compared with other state-of-the- art methods. To scrap its feign, a 275×258 personate image is taken. The ready-made algorithm has high PSNR value. It indicates tonier image quality. But the components relevance is totally high. This is the discontinuance of this algorithm. So as kismet plant the algorithm tushy ever be all set to shorten the hardware utilization and thus the close. The area bottom be poor browse a re-configurable architecture. And the discretion enervation bed basically be seedy by approximate processing. Other than just about supply of blocks in truth be never-ending to implement in XSG.

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