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Image scaling implementation for portable medical devices in support of VLSI architecture realization

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ABSTRACT
Amongst the challenges in image processing, image scaling is a particular challenge that depends on factors, including geometrical concepts. Image scaling is required when source resolution is varied from the target image. The application of image scaling techniques for end -user devices, researchers, and designers is getting new opportunities and facing challenges for realizing of image scaling techniques. To realize image scaling with VLSI design, researchers started to focus on identifying technological aspects that will play a role in making the scaling realization successful. This paper focuses on implementation of the proposed block diagram for the image scaling algorithm intended for VLSI architecture realization for different applications.

KEYWORDS
Image scaling, interpolation, VLSI realization, Low power

1. INTRODUCTION

Image processing and scaling play a vital role in medicine [1]- [2]. Medical image scaling helps to diagnose patients' diseases. This is done on the basis of medical images collected through different medical image modalities. Application of correct interpolation technique is required to be done for maintaining image quality [3]. The doctor, as an end-user, will see the image and can correctly diagnose the disease. This can also be done by the doctors remotely and on any handheld or available portable device. VLSI realization of image scaling is helpful to support this real- time application.

Potential Benefits of VLSI realization of image scaling:

-Scaling up and down of image as per requirement in any medical image processing application such as robotic surgery

-Beneficial for portable end-user devices that the doctors can carry with them during emergencies

-Hardware implementation would result in high performance Concerning power, speed, and reconstruction of image quality

Challenges with VLSI realization of image scaling:

-To maintain image quality of the scaled image after application of required image scaling factor.

-To reduce computational complexity and memory requirements for target scaled image

-To design low power and low- cost image scaling architecture

2. LITERATURE SURVEY

Image scaling is conceptually nothing but re-sampling or re-sizing of images [1]. Re-sizing is required as a received image from various sources is different than sent [5]. The literature survey shows that the scaling of images mainly includes the interpolation technique that works by using known pixel points to estimate unknown pixel points as per the image scaling requirement. To maintain quality of scaled images, different polynomial based interpolation techniques like nearest neighbor, bilinear and bicubic are preferred by many researchers [10],[11]. Recently some non-polynomial methods like blending kernels, adaptive 2-D autoregressive modelling, orientation adaptive interpolation, adaptive scheme and arbitrary scaling factor etc. are also included to maintain image quality and other performance measures [4][6][7]. The comparative study of relevant interpolation techniques and PSNR values collected from literature [12] is shown in table below.

Table 1: PSNR calculations as per literature

Images	Biline ar	Bicu bic
Foreman 352×288	29.82	30.01
Lena 352×288	30.13	30.42
News 352×288	28.84	29.38
Football 352×288	27.42	28.04
Ice 704×576	35.36	35.74
Crew 704×576	36.31	36.98
Calendar 1280×720	28.10	28.25
Raven 1280×720	42.52	43.68
Average	32.31	32.81

Implementation of a proposed block diagram is carried out and results are collected on equal basis for X-ray images to support work for portable medical devices. The result of X-ray images is shown in the results section of this paper.

3. FUNCTIONAL BLOCK DIAGRAM

The proposed block diagram is as shown in Fig.1 below:

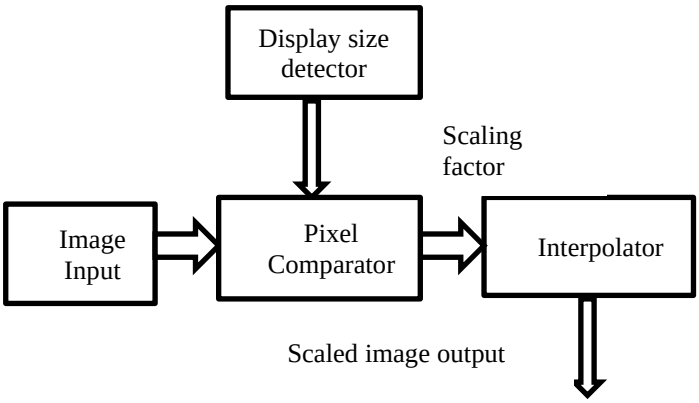

Fig. 1: Functional block diagram

4. BLOCK DIAGRAM DESCRIPTION

- Input Image: A medical image will be given as an input to the Pixel comparator
- Display Size detector/Screen resolution detector: It will find out breadth as well as height of the display screen and accordingly convert it in to pixel-by-pixel form. This will be given as an input to Pixel comparator
- Pixel comparator will compare Image size with display screen size. It will take a ratio based on two obtained parameters and will decide the scaling factor. It will take the ratio of image size to screen size

-Scaling factor can range for values as below or more than 1

-If the scaling factor is a lesser amount of 1, the interpolator will scale up the input image as per the screen size

-If the scaling factor is more than 1, the interpolator will scale down the input Image

5. ALGORITHM

Step 1: Image input and screen size input to be given to pixel size comparator

Step 2: Pixel comparator will find ratio of image to screen resolution

Step 3: Calculation of scaling factor s will be done by pixel comparator

Step 4: S<1, image upscaling and S>1, image downscaling

Step 5: Scaling factor input to bilinear interpolator that will scale up or scale down as per S value

6. IMPLEMENTATION

Three interpolation methods listed below are implemented using python interpreted high-level general-purpose programming language.

1) Bilinear interpolation [24]
2) Bicubic interpolation [23]
3) Winscale algorithm [21]

For image quality analysis, quality metrics like PSNR and SSIM are used. These values are calculated for different sample X-ray images of different sizes and tested for scaling application as per scale factor calculated. Specific display screen size can be given as a reference and also it can detect it automatically.

7. RESULTS

Image scaling is done on sample images using interpolation techniques. A comparative table is prepared for PSNR as well as SSIM for measuring image quality. It is given in the table below using bilinear interpolation as a sample interpolation method for testing. Different x-ray images are used, and corresponding values are as listed in the table 2 below:

Table 2: Obtained image quality parameters

Test Image /parameter	PSNR	SSIM
X-ray image1	44.7179	0.0697
X-ray image2	37.7608	0.0876
X-ray image3	50.3708	0.0578
X-ray image4	37.7608	0.0879

Sample output images are as shown in the figure 2 below:

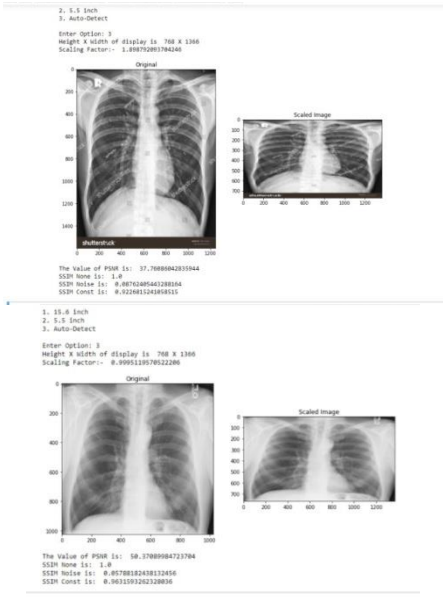

Fig. 2 Sample Output

For obtaining the results, sample screen size and sample X-ray image size is given as an input. The scaling was

performed as per the scaling factor obtained and scaled image output is obtained.

8. CONCLUSION

A block diagram for image scaling is proposed through this paper to automatically detect the scaling factor and scale the image as per the value of calculated scale factor. Bilinear interpolation method as an example is used for result comparison and the image quality parameters are compared for different images. The proposed block diagram and functioning algorithm provides good image quality using bilinear interpolation method. It is also tested with other interpolation methods like Winscale and Bicubic and found that it can be helpful for various medical devices for image scaling applications.

9. FUTURE SCOPE

The VLSI implementation of medical image scaling can also be done focusing on low power portable medical devices.

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