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SEAM CARVING: STUDY AND SIGNIFICANT COMPARISON

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***Abstract*—The basic idea of applied algorithms are the removal of the vertical as well as horizontal paths of pixels those contain low salient information .the content of the image should also be considered instead of only considering the use of geometric constraints in the process of effective resizing of image. In this paper a simple image operator known as seam carving that helps in efficient content aware image resizing for reducing as well as expanding the content of the image. Optimality of an image is defined by image energy function, which is used in seam as 8-connected path of pixels in an image defined from top-bottom or horizontal to vertical direction. Content aware image re-tagging methods are defined or applied to basically change the aspect ratio of an image also preserving visual prominent features. Gradient Vector Flow method is used to find the seam path which is to be removed where the gradient vector flow fields are very dense vector fields derived from images by the reduction of certain energy functions in a framework.**

***Keywords*— Image Resizing, GVF, Seam Carving, Saliency**

I. INTRODUCTION

Very excess use of display devices with variation in resolution such as tablets, pc and smart devices generated the requirement of image resizing methodologies which bother the visual content during the scaling process .The basic resizing methodology involves geometric constraints like scaling which is used to change the size of an image including its height and width of fixed ratio with respect to original image. Image scaling is not that much sufficient as it is oblivious to image content and can only be applied uniformly. Cropping is not sufficient for image resizing because it can only remove pixels from image boundaries. Effective and efficient resizing can be achieved by involving the image content instead of only considering geometric constraints. Image processing is a methodology or technique which enhance received raw or distorted images by various sensors placed on satellite or from the cameras, pictures clicked from day to day life like scene images. Typically image processing involves importing the image with digital photography, observing and manipulating the image which involves data compression, image enhancement and spotting pattern that are not visible to human eyes like satellite photographs and finally result is the final stage in which output can be changed image and/or report that is basically based on image analysis. Their major purpose is to visualize the objects that are not visible, sharpening and restoration to create better image, image retrieval, measurement of pattern and image recognition is to distinguish the objects in an image. The procedure of getting an image of the area from various sources having the text, preprocessing that image extracting the individual characters and explaining the text characters in a form compatible for computer processing also recognizing/detecting those individual characters might be in the scope of digital image processing.

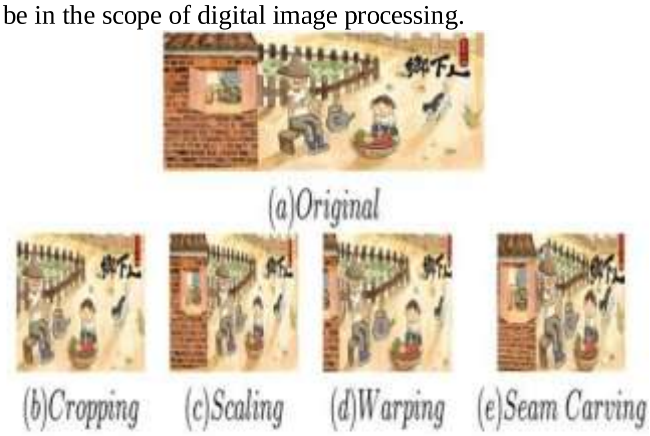

Fig 1. Image showing effect of various methods.[7]

II. TECHNIQUES AND METHODS

There exists lot of methodologies to increase the quality of the image in the resizing process. Blending method can be included in order to better visual results in joining adjacent images after seam removal

A. Image Resizing

Digital image size is dimensioned in pixels. A pixel is a physical and the smallest addressable element in a raster image . Every pixel is a sample of an original image. The intensity of the pixel is variable. Resizing an image has different meaning such as cropping, resampling and scaling. The standard image scaling is not that much sufficient as it is not aware of the image content and it can be applied only uniformly.

B. Gradient Vector Flow

Snakes or active contours are curves that are defined in an image domain which can flow under the effect of internal force coming from within the curve itself and the external force computed from the image data. Snakes are widely used in most of application like various edge detection, shape modelling, segmentations and motion tracking. Gradient Vector Flow field, are dense vector fields derived from images by reducing a certain energy functions in a framework.

Fig 2. Original image(Left), Image showing its GVF(Right)

C. Saliency Map

The Saliency Map is a topographically arranged map that represents visual saliency of a corresponding visual scene.. Saliency map easily avoids artifacts that the seam carving generates and these are robust in the presence of noise. Saliency maps are computed only once and independent of the number of seam added or removed. Visual saliency estimation algorithm focus on the content based visual retargeting. Despite of the energy map the visual saliency map uniformly highlight salient region with well-defined boundaries that is being used for content aware image resizing purpose.

Fig 3. Original image(Left), Image with Saliency map(Right)

D. Energy Map

Energy is used to describe a measure of "information" when formulating an operation under a probability framework such as MAP (maximum a priori) estimation in conjunction with Markov Random Fields. Sometimes the energy can be a negative measure to be minimised and sometimes it is a positive measure to be maximized.

E. Seam carving

Seam carving by using Saliency map that assign higher importance to visually prominent regions and it is a noise robust retargeting scheme. Saliency map easily avoids artifacts that the seam carving generates and these are robust in the presence of noise. Saliency maps are computed only once and independent of the number of seam added or removed. Visual saliency estimation algorithm focus on the content based visual retargeting.

Fig 4. Original Image(Left), Image with Seam carving vertical(Right)

III. SEAM CARVING ALGORITHMS

Algorithm 1:

Dynamic programming stores the computed result of sub calculations in order to simplify the calculations of tricky and vague results and it is used for computing the seams. When you wish to calculate the value of a vertical seam with minimum energy for each pixel in a row, you compute the energy of the present pixel in addition to the energy of one of the three pixels on top of that. Have a look at the picture shown below.

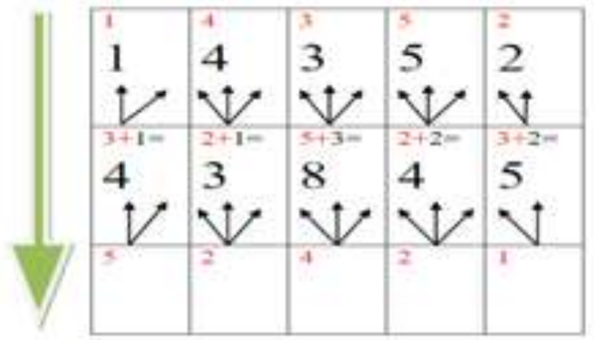

Fig 5. The green arrow alongside shows the algorithm's direction[1]

Here every square represents a pixel, and the top-left value in red represents the energy value of that explained pixel. The value in black represents the aggregative sum

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of energies leading up to and involving that pixel. In the picture shown above, there are no rows present above the first row therefore the sum (in black) is just the same as the energy value of the current pixel. Now look at the second row and the second pixel, whose energy value is 2. It has three possible values of the pixels i.e. 1, 4, 3 (black). Since the minimum value amongst them is 1, therefore you have to add 1 to the current energy value i.e. 2 plus 1. Ignore the rest of the values. After the above operation is carried out, the table would appear like this.

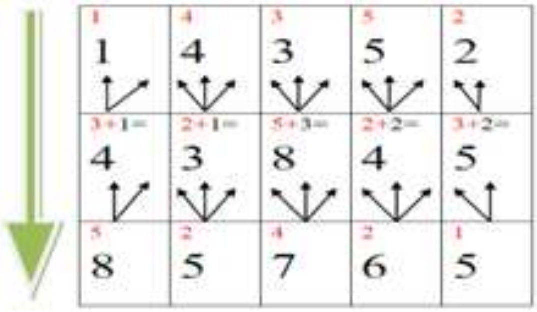


Fig 6. Values calculated after carrying out the respective operation[1]

Dijkstra's Algorithm - Dijkstra's algorithm was introduced by the computer scientist Edsger Dijkstra in 1956 and was published in 1959. In this algorithm, if you are provided with a particular node or vertex in the graph, the algorithm will find the path with the lowest cost (i.e. with the shortest path) between that particular vertex and every other vertex through that [2,3,4]. For example, suppose if you have number of tasks to be accomplished and there are different procedures available for accomplishing it, then this

Fig 7. Original Image[1]

Fig 8. Seam carving with dynamic (Left) and Dijkstra's algorithm (Right)[1]

Dijkstra's algorithm will help you to find the path with the shortest procedure or the procedure having the lowest number of steps; where the tasks are representing the nodes and the procedures with specific number of steps are representing the paths.

Algorithm 2:

We start with an image, then the weight, density and energy is calculated of each pixel. This can be done by different algorithms: gradient magnitude, entropy, visual saliency[1].

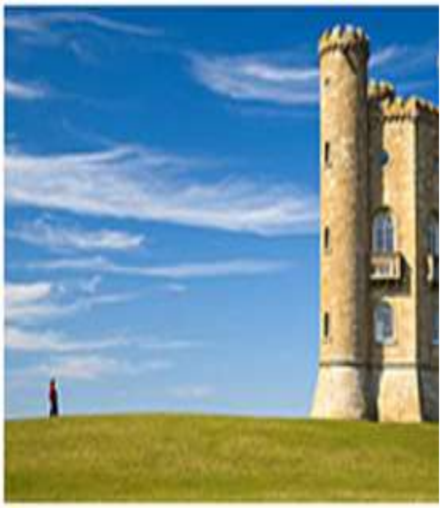


Fig 9. Original Image[1]

Once the energy is calculated of the image, a list of seams is generated, seams are listed by energy with minimum energy seams being of least importance to the content of the image. Through the dynamic programming approach seams can be chosen to be calculated [2]. Seams are removed from the image, minimizing the size of the image as a output.

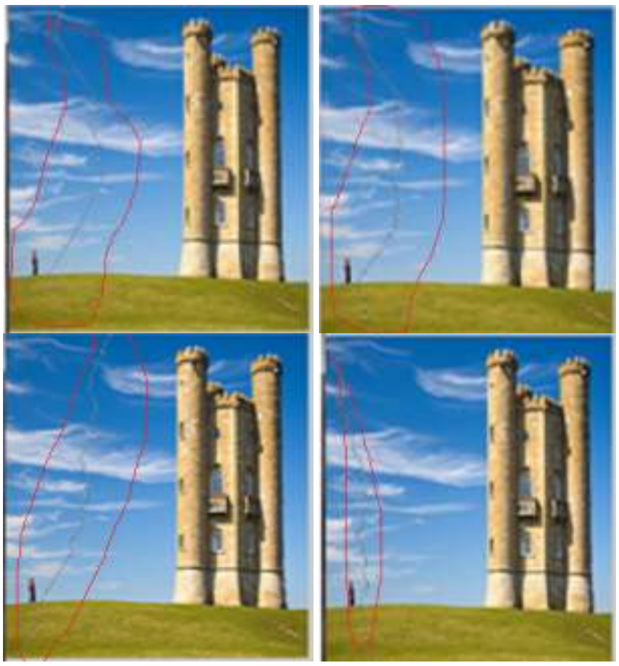


Fig 10. Image with different seams[1]

Algorithm 3 :

Take the original image, Find the horizontal and vertical seam for the image. Then calculate the Gradient Vector flow of the image. At last find the vertical and horizontal energy flow of the image. The flow thus found can be considered while resizing the image.

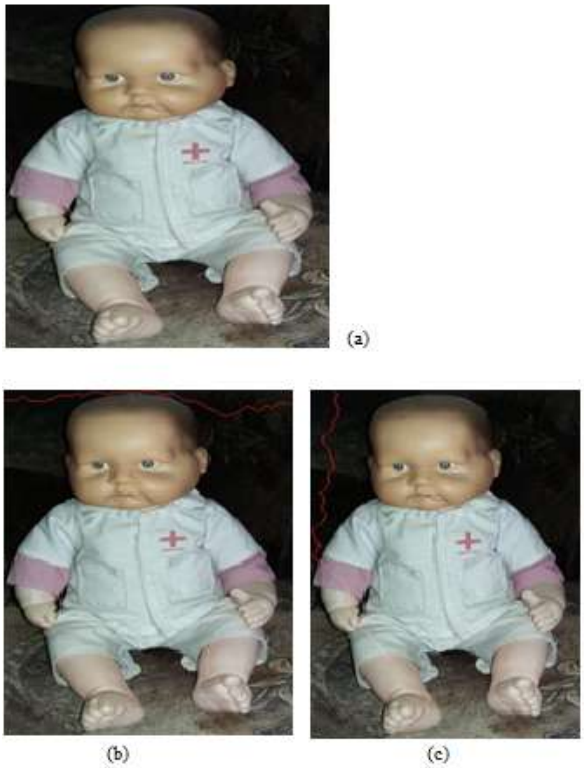


Fig 11. (a) Original image (b) Horizontal seam (c) Vertical seam

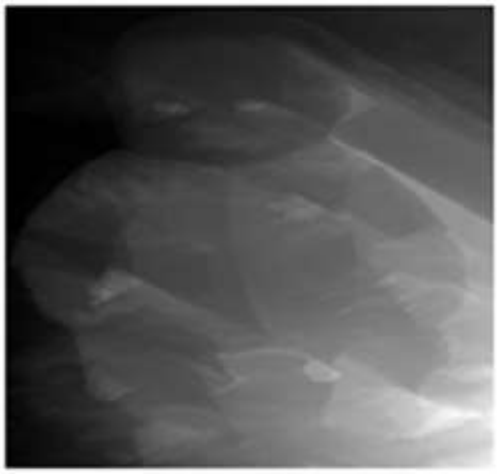


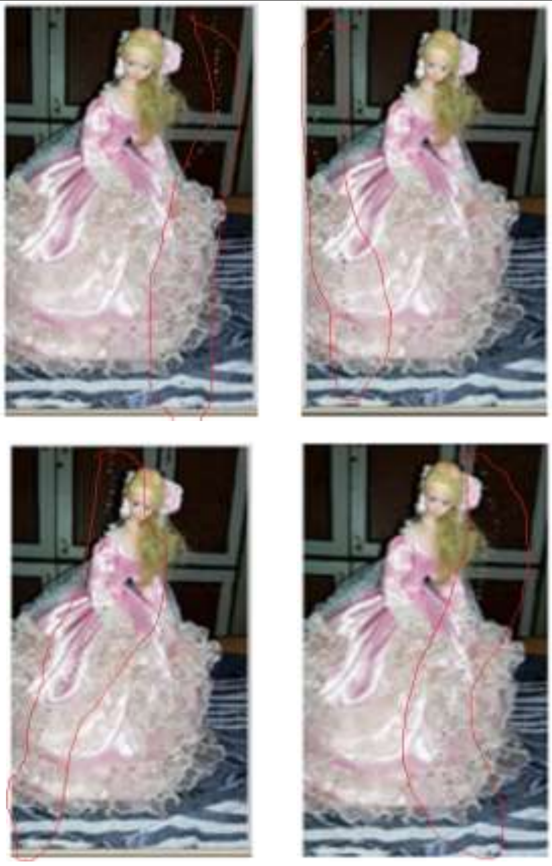
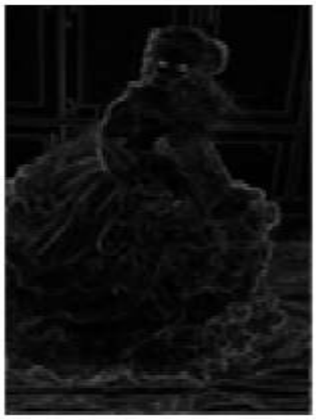
Fig 12. Image with Energy flows

Fig 13. Energy with horizontal and vertical seam

IV. Experimental Results

Table 1 Showing image outcomes of three algorithms

Algorithm 1	Algorithm 2	Algorithm 3
		
Original Image	Original Image	Original Image

<table>
<tr><td></td><td></td><td></td></tr>
<tr><td>Seam with dynamic programming</td><td>Different seams of original image</td><td>Vertical seam(Above) and Horizontal seam (Below)</td></tr>
<tr><td></td><td>
(a)</td><td>
(a)
</td></tr>
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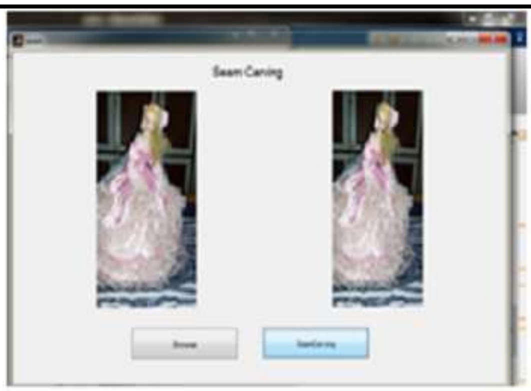
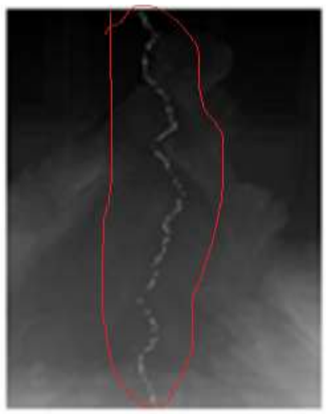


(b)



(b)

Seam with Dijkstra's Algorithm	(a) Image with seam carving (b) Image resized	(a) Image with GVF (b) Energy Flow vertical and horizontal

V. CONCLUSION

In this paper various methodologies are compared for content-aware image resizing algorithm which exploits information extracted through Gradient Vector Flow to establish the paths to be considered during the resizing of an image using saliency mas.

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