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Distortion Free Image Generation

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***Abstract*—Considering changed aspect ratio and size of the display devices, it is required to resize the presentation of images of those devices. As displays become less expensive and are consolidated into an ever-increasing number of gadgets, there has been an expanded spotlight on image retargeting systems to fit a picture to a subjective screen size. Removing vigorous visual saliency guide and picture editing are central issues in PC vision, designs and many more. It is difficult assignment to precisely distinguish and trim the whole remarkable object from pictures with complex foundation. This paper, presents study for image resizing.**

***Index Terms*—** Salient Objects, Region of Interest, Image Retargeting, Saliency Map**.**

I. Introduction

With the growing digitization, images are being used on various platforms such as media houses, social media, informative data indexing etc., for which the image has to be adapted accordingly. Image retargeting plays a vital role for the applications relating to image browsing and web browsing, since there is continuous change in the layout of web pages while browsing, being redirected to another web page. In recent years, content-aware image retargeting techniques are used to reserve salient objects existing in the image and obtain results that are appealing and pleasing visually. Development and adaptability of new devices with different display and aspect ratio requires consistent improvement of efficient image retargeting algorithms. Since it involves conserving the pertinent information [2] while preserving an appealingly aesthetic image as per the requirement, the process of image resizing or retargeting becomes a challenge. Image resizing can be achieved in two steps: Detecting important region in the image; Applying resizing method.

Satellite imagery has become a vital source of surveillance for any nation. The images captured from the satellites are very high-resolution images which require more amount of space to be stored. The transfer and handling of such heavy images restricts their operation and thus affects adversely in their processing. For efficient storage and handling of these satellite images, content aware image retargeting operators must be employed so as to resize the images while preserving their salient objects. These operators must not induce distortions of any form which might result in data loss available in the satellite images. Once resized, these images can be further processed for obtaining the required information such as object identification, location of the objects and their coordinates etc.

II. Content Aware Image Retargeting

The main perseverance of employing content-aware image retargeting is preservation of salient objects in the image and also identifies salient Region of Interests (ROI) [5]. After image retargeting, the resized image quality is identified by approximating the resized image with the input image. Content aware image retargeting could be

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used in numerous applications such as steganography [2] and image hiding, shape preservation, Video retargeting, and object removal to name a few. Some image retargeting techniques such as warping and seam carving were suggested in [11,18] which propose the use of operators such as cropping or warping. These operators are mostly responsible for the worth of retargeted image, if the original image has less complex objects. Certain limitations of Content Aware Image Retargeting are distortion of geometrical structures [8] such as lines, curves etc. During image resizing, the problem of image segmentation also occurs when low energy pixels are removed from the image and two non-adjacent regions merge together.

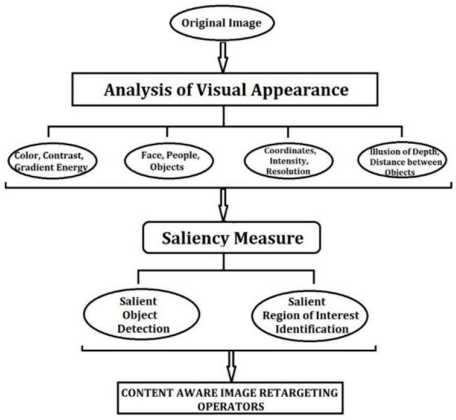

Figure 1: Process Flowchart of the Content Aware Image Retargeting

The figure 1 shows the process flowchart of the Content Aware Image Retargeting. The resizing operators trust on the saliency map to safeguard the salient regions of the image and avoid less-important contents. Importance measure comprises of gradients, entropy and saliency identifier, along with high level cues like face and motion identifier.

According to this workflow, the original image is first analysed for visual appearances such as colour, contrast and gradient energy available in the image which are the low level features in the image. Later, the high-level feature analysis such as face, object and people identification is carried out. In the last two feature analysis, the properties of the image is analysed and processed further. Then the importance map of the image is generated based on two steps, to identify the highly noticeable image contents. In these steps, first the salient objects are detected and then the region of interest is identified for preservation while resizing. Later, using the different available image retargeting operators can be used individually or in combination for obtaining the final retargeted image.

The objective of the proposed algorithm is to develop the algorithm for desktop pc as the conventional image retargeting algorithms are mainly based on it. The conventional image retargeting algorithms may not work efficiently on mobile platforms [29]. The existing image retargeting techniques are generally based on shallow features [3] in order to perform the retargeting using deep features desktop pc are more suitable as the conventional image retargeting techniques take high computation time on the mobile processors.

As in case of satellite images computation time and memory requirements are very high, hence it is better to discover the algorithm based on desktop-based image retargeting technique. In future work the proposed desktop-based mage retargeting technique can be improved to make it compatible with ios/android.

III. Conventional Techniques

Saliency Map of the image helps to analyze any given digital image in a more meaningful manner. It looks into the pixels of an image and groups them into various segments. These segments are then studied and analyzed to arrive at the insights which are helpful in decision making. The segments are based on the intensity of the pixels; high intensity and low intensity pixels.

Figure 2 shows different conventional techniques for content aware image retargeting; Scaling, Cropping, Warping, Seam Carving and the multi operator. The Year with the technique signifies the year of existence of this problem for multi operators-based retargeting.

Scaling *(2001)* operator is the default technique and hence widely used in image retargeting operations. It is a technique of mapping pixels of image in a homogenous manner to create resized image in scaling, the input image can be compressed and enlarged uniformly or non-uniformly depending upon the scaling factors regardless of the content. This operator is used when the user wants to zoom in/out the input image on the computer to change its aspect ratio. Conventional interpolation scaling methods like bi-cubic, nearest neighbor and bilinear are used and can generate image artifacts, such as aliasing.
Retargeted results using scaling operator causes image deformation if the difference between dimension of the retargeted image and source image is very high. The benefit of scaling is that it can be performed at real time and visual effects can be maintained but on the other hand scaling also leads to generating aliasing and artificial block of pixel. Distortion of the output image can be seen compared to the original image.

Cropping *(2003)* is a widely used image retargeting technique as it is very simple and easy. In this an optimal cropping window is used to crop the undesirable portions of the image which lies outside the window edges. The primary objective in cropping technique is to include prominent image regions or energy in the cropping window rectangle which describes the image structure completely.
Cropping is done to reduce the size of image. The major disadvantage of this technique is the loss of the image from the border of the image. There are techniques to preserve image in cropping but, it is time taking and complex process

Seam Carving *(2007)* eliminates the optimal path of pixels from the image regions where pixel energy is low. Computed optimal seams are the path of pixels having low energy in both vertical and horizontal direction. The objective of this technique is restricting travelling of optimal seam [14] over high energy pixels so that salient contents present in the image can remain intact. Examples of image regions having low energy pixels can be sky, water and sand. These image regions have homogeneous pixels having same low-level features.
Inserting a seam is done for increasing the size of image and removing of seam is done to decrease the size of image. Demerits of this method is, when the intensity of the background variation is large as compared to the important objects in the image, then a distortion in output image can be observed. Also based on the number of seams inserted or removed from image it can create distortion in output image. Forward and backward seam carving techniques are used to protect important objects and distortions when aspect ratio of image is changed.

Non-homogeneous Warping *(2007)* is a continuous method and specialized form of scaling to perform nonlinear distortion to generate the retargeted image. In this technique the important structures of the image distorted less while the regions which are less noticeable are distorted more. This is done based on the mapping of pixel position between original and the output image. Warping does not lose any part of the image completely and also maintain the global configuration to remove the distortion of the image.

Scale-and-Stretch *(2008)* resizes the image by computing the optimal scaling factors in each region and then distorts each local region using the saliency maps. In this way the aspect ratio of important areas can be changed uniformly while the areas having similar properties are distorted. For minimizing the distortions, this technique distributes the distortions in all spatial directions so that the noticeable areas or objects having prominent features or structures does not deforms further.

Shift Map *(2009)* is used to readjust or eliminate the pixels of input image to fit in the retargeted image. This technique is used to change the location of pixels from the source image to resized image. Initial calculations are done at very low resolution so as to speed up the computation process. The obtained outcomes are further used as initial guess for computations on the resolution of the original image.
In this altering a global optimization for a discrete label is performed over individual pixels, conquering the majority of the challenges. A basic removal of a part in the net that leaves its structure flawless is effectively conceivable with shift map. Shift map abstains from scaling and for the most part expel or shift the image locales.

IV. LITERATURE REVIEW

With the advancement in the areas of image retargeting, researchers have made prodigious efforts in this field. Content- aware retargeting methods follow mainly two steps: (i) estimation of the visual attention (importance, saliency), and (ii) resizing images in content aware fashion by adopting importance-based resizing operator. In every content aware image retargeting technique, the first fundamental step of visual attention analysis is to estimate the importance and saliency of image pixels. Contents (Pixels, Regions) which are highly noticeable to

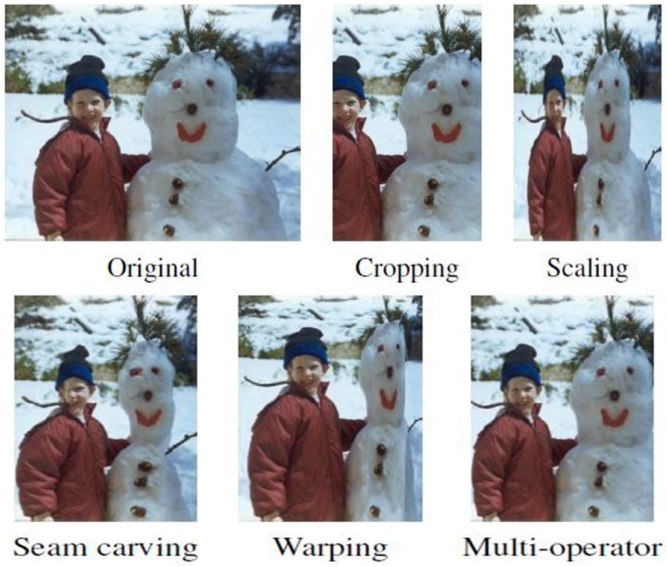

Figure 2. Conventional Methods [19]: a) Original Image b) Cropping c) Scaling d) Seam Carving e) Warping f) Multi–operator

human eyes must be protected entirely. Features which fascinate human attention can be categories into: high & low - level features. The low-level features catch human attention at pixel level such as contours, edges, color features, textural contrasts, image frequencies etc. In high level features highly, noticeable regions are considered such as face, people and objects.

Saliency map of the image can be computed on the basis of low as well as high level features. To identify important region available in the image computation of gradient magnitude is the easiest way. Gradient magnitude measures the variation of intensity in horizontal and vertical direction.

An importance map based on fuzzy and contrast growing [15], is an assembly of other efficient saliency detection approaches. The results obtained from saliency region detection can be used in semantic image and video compression.

The problem associated with the creation of thumbnails from the source images. In thumbnail generation [24] dimension or aspect ratio of a large image changed to generate a retargeted image. They suggested that the conventional techniques of thumbnail creation do not protect from blur and noise, and proposed a technique to generate thumbnails in better way that having noisy as well as blurry characteristics from the source images.

An image retargeting technique [13] was projected which was based on Fourier analysis [22]. To split the source illustration into multiple strips, they used gradient sequence which was further scaled adaptively as an optimization problem with constraints. The technique of Langrangian [17] multiplier was used to solve this problem.

A technique based on visual attention reorganization on wavelet decomposition [9,10] was proposed. The difference between minimum seam and maximum seam is taken into consideration according to the average IV to ensure the replacing to scaling operator.

A multi-operator-based image retargeting approach [23] was proposed which integrates mainly three image resizing operators such as seam carving, scaling and cropping. To get the optimal path of seams on low energy pixels the concept of dynamic programming was used. As the retargeting space of the operators has six dimensions, the search for the optimal solution is very complicated for image resizing.

A scaling factor based on the energy of saliency-weight [27] was proposed where a quadric energy has been suggested to maintain the integration between the saliency and scaling factor of local regions. An image retargeting technique using axis-aligned deformation having real time performance, robustness, and smoothness [19] was proposed to protect the configuration of the image globally, non-homogeneous warping methods were suggested.

A non-homogeneous image warping method [18] was applied in which they computed the image distortions using a quadratic metrics and also suggested an approach of patch-linking. Patch-linking approach resolves the problem of energy mitigation for the mesh resizing that can protect the configuration of the image globally. Usually, these methods are required to resolve bulky linear systems and are lengthy.

A method to integrate the traditional L−1 standard of gradient through depth-aware 3D saliency to generate energy map [4] was Proposed. With the use of features of these operators their energy function comprises local as well as global information, which has been proved effective in seam carving.

The conventional seam carving technique was modified to maintain and protect prominent structure of the objects by employing controlled optimal seams [7] that are sparingly assigned to each other. Experiments showed that the projected technique generate plausible retargeting results and best suited for image having edges or lines.

A method to identify the iris area [16] was projected with various phases of the process, such as sharpness of image, median filter, sharpness, binarization and auto cropping which is based on analysis of histogram.A hybrid scheme [30] was proposed which retarget images into random aspect ratio while protecting visually salient features and suppress sequence loss globally. The novelty of proposed technique is an enhanced saliency map which incorporates the effects of the skin map, gradient map, canny edge map [25], and context-aware saliency map.

A neural network-based method for deep convolution [6] in image resizing was suggested. The suggested method learns a saliency map implicitly. The learning of importance map leads to a shift map in content aware fashion for image resizing. Hence, discriminative areas present in the image are protected from deforming, while regions which are related to background are adjusted seamlessly. Pairs of an image and its image level annotation in the training phase are exploits to compute loss over structure and contents.

An auto crop mechanism [11] based on aesthetic and important energy map of the image was propounded. In proposed method quality is evaluated by learning the aesthetic map using a deep CNN with a large-scale dataset. Edge spatial distribution can be presented by the gradient energy map and is created to compute the simplicity of the images. In order to assess the quality of composition for crops, composition model is educated with the aesthetic map and gradient energy map.

The problems associated with photo cropping, with an objective to compute a cropping window of source image to protect its significant parts. A neural network has been designed to obtain optimal deep learning- based solution [27], having two branches i.e., aesthetics assessment (AA) and attention box prediction (ABP).

The cropping representation generates eminent results, with the restricted ease of use of training data for photo cropping by aesthetics evaluation and leveraging attention prediction. Seam carving technique was speed up by eliminating or inclusion of batch seams constructed by multiple pixels in a single iteration [20]. To prevent inclusion of false edges eliminated and inserted energy of pixels is minimized after removal of the batch seam. They observed that the computation time is significantly minimized with increase in width of a multiple pixels wide batch seam. Using different quality evaluation metrics, the proposed method has been compared with other state-of-the-art image resizing operators.

A procedure in which deep learning approach [21] was applied to train a big image dataset, to obtain the importance map from the source image using gray level adjustment and graph-based segmentation that improves and retrieves precise and perfect saliency map was proposed. To represent visual contents of the image more accurately the image scaling and Gaussian filter were used with cropping technique. The significant job of the structure is to ensure about the contents of the appropriate image and to recognize more ROIs and get ideal rectangle from the importance map with maximum & minimum rectangular windows.

A video saliency model [28] to identify important objects present in the video was implemented. This model produces multi-level deep features using symmetrical CNN. The major benefits of proposed model depend upon the attention module, the hierarchical integration and boundary information. In order to obtain temporal importance map optical flow vectors are analyzed from the video stream to recognize the moving pixels and their paths from others. Importance map generated for stereoscopic video integrates motion, image and depth saliency.

A Multi-Operator [1] based image retargeting scheme which was the integration of seam carving and visual saliency-based scaling operator was proposed. The competency of the proposed technique is evaluated on a dataset containing natural image. An image retargeting in feature space [3] was performed where the deep layers of a neural network comprise extensive significant semantic information. The extracted image feature maps from already trained classification network are adjusted and reconstruct the retarget image using a neural-network based optimization.

V. Scope of the Research

A. Image Processing

Since there is a huge demand of distortion free images in each and every domain, the advancements are needed in the existing image processing techniques. Image resizing and retargeting is one such application

having utmost importance when image data storage, transfer and handling comes into picture. Seam carving algorithm will enhance its usage and increase its efficiency over the existing schemes.

B. Enhanced Performance

The new optimized Multi-Op will be able to reduce the distortions comprehensively and will further reduce the image process time and hence increase the efficiency of the complete image retargeting system.

C. Security & Surveillance

The retargeted images can be fed to a convolution neural network-based scheme that will generate the coordinates of any salient object present in the image. This will help in reducing the infiltration activities.

VI. Conclusion

The current work tried to showcase the evolution of the content aware image retargeting over the decades and how it is more inclined towards different learning factors that are responsible for the distortions occurring in the images. The current scenario recommends taking a broader approach in perception of the images and the affecting factors. By improving the methods (cropping, warping, seam carving etc.) and combining these, one can easily improve the resolutions of the images. The proposed future work can be more focused on the identification of different factors which will be used for integration of images and improves the accuracy of the models.

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