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Content and Shape - Aware Image Retargeting (CASAIR)

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***Abstract*: The project proposes an image retargeting algorithm that can retarget images to a large family of non- rectangular shapes. This project based on broader perspective that include content as well as shape of the image. Seam carving algorithm that successively removes low energy pixels from the image. Seam carving is having two types one is horizontal seam carving and other is vertical seam carving. Vertical seam carving is used for resizing purpose. The main purpose of this project is to any kind of image we want to change shape or image background. Suppose image is having rectangular shape I want that image in another shape also we can done in CASAIR. The project we are using camera projector system it is the application example for CASAIR. CASAIR equips the camera–projector system with the capability of retargeting images online in order to maximize the quality and fidelity of the displayed images whenever the situation demands.**

***Keywords*: Image retargeting, image processing, camera projectors systems**

1. Introduction

Digital images are now displayed on the increasing variety of devices and platforms, content-aware image retargeting has attracted considerable amount of attention recently. The image retargeting algorithm retargets non- rectangular shapes. In existing system we only retarget rectangular shapes. In proposed system different shapes like rectangular and non-rectangular we are used. The non –rectangular shapes means irregular shapes we are used in this project. However, there are many instances irregular shape outputs are preferred or desired.

Fig. 1. Image Retargeting with an Irregularly Shaped Boundary. Left: Original image. Center: An irregular-shaped target domain (highlighted in red). Right: The retargeted image preserves relevant image details. (Images best viewed in color).

The existing methods are both inappropriate and inadequate for producing satisfactory results. In Content and shape-aware image retargeting (CASAIR) algorithm to retarget the image to detect the seam from an image. Seams can be either vertical or horizontal. A vertical seam is a path of 8 connected pixels from top to bottom in an image with one pixel in each row. A horizontal seam is similar with the exception of the connection being from left to right. This method enables us to remove pixel from uninteresting parts of the image while preserving important content. Seam carving method preserves the interesting features of the image when resized the image. On the contrary scaling introduces geometric distortion and cropping resulted in loss of important features of the image. In CASAIR project are using binary mask, mask means any shape we want. In this project Saliency map is used to create the binary image. The seam carving algorithm is used to remove the low energy pixels from the image. The selection of seam segments determined by cost function incorporating inputs from the image content and target shape. Camera projector application system is used in this CASAIR. The advantage of the proposed system is simple in concept and in experiments we have demonstrated its efficiency and effectiveness the lowest seam segments determined efficiently using dynamic programming as in other seam carving based method. A Seam is simply a connected path of pixels that extends from top-to-bottom or left-to-right in an image. Seam carving uses energy based function that defined importance of the pixel. There are many ways to calculate the energy of the image and common way to compute the gradient. The application example such as icon design, commercial advertisement and poster and magazine production, images are often intentionally reshaped for generating more pronounced and impressive visual effects, and in creation of E-cards and the production of digital photo albums.

2. Related work

Effective resizing of images should not only use geometric constraints, but consider the image content as well. We present a simple image operator called seam carving that supports content-aware image resizing for both reduction and expansion. A seam is an optimal 8-connected path of pixels on a single image from top to bot-tom, or left to right, where optimality is defined by an image energy function. By repeatedly carving out or inserting seams in one direction we can change the aspect ratio of an image. By applying these operators in both directions we can retarget the image to a new size. The selection and order of seams protect the content of the image, as defined by the energy function. Seam carving can also be used for image content enhancement and object removal. We support various visual saliency measures for defining the energy of an image, and can also include user input to guide the process. By storing the order of seams in an image we create multi-size images, that are able to continuously change in real time to fit a given size[1],We present a “scale-and-stretch” warping method that allows re-sizing images into arbitrary aspect ratios while preserving visually prominent features. The method operates by iteratively computing optimal local scaling factors for each local region and updating a warped image that matches these scaling factors as closely as possible. The amount of deformation of the image content is guided by a significance map that characterizes the visual attractiveness of each pixel; this significance map is computed automatically using a novel combination of gradient and salience-based measures [2], We present a general approach to shape deformation based on energy minimization, and applications of this approach to the problems of image resizing and 2D shape deformation. Our deformation energy generalizes that found in the prior art, while still admitting an efficient algorithm for its optimization. The key advantage of our energy function is the flexibility with which the set of “legal transformations” may be expressed; these transformations are the ones which are not considered to be distorting.

This flexibility allows us to pose the problems of image resizing and 2D shape deformation in a natural way and generate minimally distorted results. It also allows us to strongly reduce undesirable fold overs or self-intersections. Results of both algorithms demonstrate the effectiveness of our approach [3]. Content-aware image retargeting has attracted a lot of interests recently. The key and most challenging issue for this task is how to balance the trade-off between preserving the important contents and minimizing the visual distortions on the consistency of the image structure. In this paper we present a novel filtering-based technique to tackle this is-sue, called” importance filtering”. Specifically, we first filter the image saliency guided by the image itself to achieve a structure-consistent importance map. We then use the pixel importance as the key constraint to compute the gradient map of pixel shifts from the original resolution to the target. Finally, we integrate the shift gradient across the image using a weighted filter to construct a smooth shift map and render the target image. The weight is again controlled by the pixel importance. The two filtering processes enforce to maintain the structural consistency and yet preserve the important contents in the target image. Furthermore, the simple nature of filter operations allows highly efficient implementation for real-time applications and easy extension to video retargeting, as the structural constraints from the original image naturally convey the temporal coherence be-tween frames. The effectiveness and efficiency of our importance filtering algorithm are confirmed in extensive experiments [4].

3. Proposed system

For creating binary image shown in figure below.The figure shows that the binary image can be found by taking binary input images by using saliency map the binary mask image can be found.

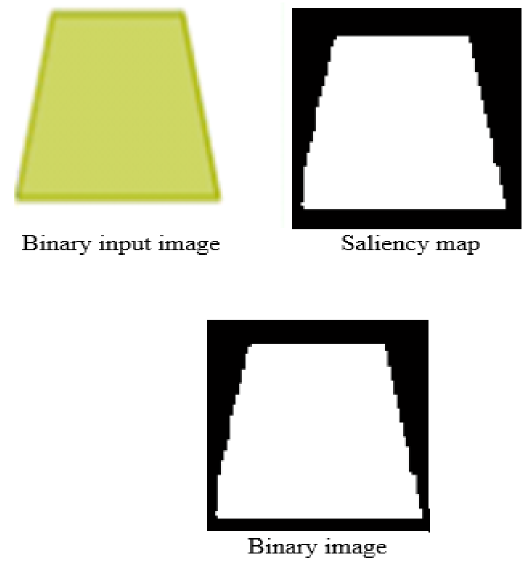

Fig. 2. Shows that create binary image using saliency map

In Fig. 2, first we take binary input images and after awards by using saliency map we can create a binary mask image .The section presents the details of CASAIR. The proposed algorithm that retargets an image based on its content to a user-specified target shape .The below figure shows that the content and shape-aware image retargeting(CASAIR).In this we retarget the image in to non-rectangular s hape. In existing method only regular shapes are found that’s why we are go to non-rectangular shapes.

A schematic illustration of CASAIR is shown in Fig. 3, and the algorithm has the following four main steps: The first Step is image acquisition and second step seam carving and third step shape placement and fourth shape Retargeting

1) *Image Acquisition:* Image acquisition in image processing can be broadly defined as the action of retrieving an image from some source, usually a hardware-based source, so it can be passed through whatever processes need to occur afterward. Performing image acquisition in image processing is always the first step in the workflow sequence because, without an image, no processing is possible. The image that is acquired is completely unprocessed and is the result of whatever hardware was used to generate it, which can be very important in some fields to have a consistent baseline from which to work.
2) *Seam carving:* Seam carving is the algorithm for content-aware image resizing. The image is retargeted

into rectangular domain using seam carving.

3) *Shape placement:* In this stage, shape placement is performed. Shape placement means our binary mask image is placed into Seam carved image is called shape placement.
4) *Shape Retargeting:* In this stage, shape retargeting is performed. Inside masking is used for get desired shape of image.

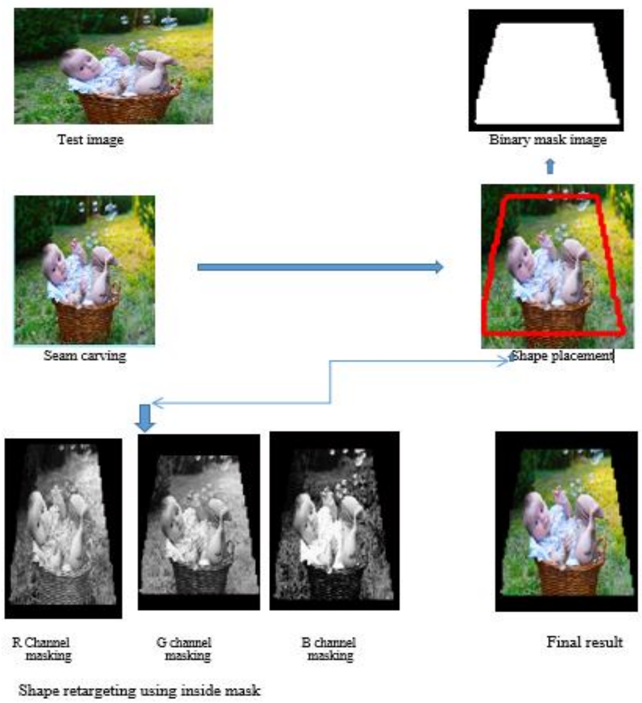

Fig. 3. CASAIR: Content and Shape-Aware Image retargeting

In Fig. 3, first we take the test image and afterwards we can do seam carving process. Seam carving is the algorithm for resizing process. Seam carving having two types horizontal seam carving and vertical seam carving. This project we prefer vertical seam carving. The vertical seam carving can be used for resizing the image. The horizontal seam carving can be used for enlarging the image. By using energy based function we can remove vertical seam carving. After seam carving we can create a binary mask image by taking binary input image and by using saliency map we create a binary mask image. Saliency map is defined as the detection of object in an image. Saliency map is used for generate binary input. Entropy function also used for generate map. In this all are used for generate the saliency map selecting the super pixel and combined the pixel generate the map. Based on saliency map we can create a binary mask image that take it and after awards shape placement is performed. Which shape we want place that shape and afterwards shape retargeting inside and outside masking is performed. In shape retargeting split the image in to 3 channels R channel, G channel and B channel. In this shape retargeting first the colour image is converted in to Grey scale image by using saliency map. Saliency map is increases the intensity of the colour. After converting RGB colour image to grey scale image we get pixel values. The pixel obtained we reconstructed means finally we get colour image with desired shape that is the final result.

4. CASAIR algorithm

This section presents the details of CASAIR, the proposed algorithm that retargets an image based on its content to a user -specified target shape. The content and shape-aware image retargeting retargets the image in to non-rectangular shapes. If the image is having rectangular shape I want that image in another shape means that also we can do in this project. The regular shapes and irregular shapes also we can do in this project. The regular shapes does not impact compared to irregular shapes. Seam carving uses energy function that defines the importance of the pixel.

A. *Seam segment carving:*

Seam Carving is a newly developed technique targeting image compression and resizing based on detection of seams from the energy function of the image. The method aims at finding seams (threads) of minimum energy and manipulating the image using them. Seams can be either vertical or horizontal. A vertical seam is a path of 8 connected pixels from top to bottom in an image with one pixel in each row. A horizontal seam is similar with the exception of the connection being from left to right. The importance/energy function values a pixel by measuring its contrast with its neighbour pixels. Why seam Carving means effective resizing of images should not only use geometric constraints, but consider the image content as well.

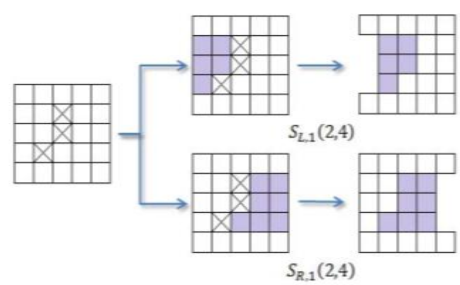

Fig. 4. Seam Segment removal

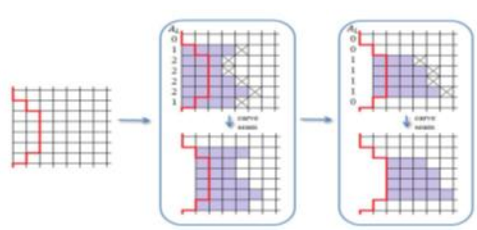

Fig. 5. Boundary formation and seam segment

In Fig. 4, the removal of a seam segment provides two possibilities as there are two different ways to fill the holes left by the removed pixels. In a 5×5 image, pixels on a vertical seam segment selected for removal are marked with ‘X’. Once the

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three pixels are removed, there are two ways to form a new image: shaded pixels are shifted to the right by one pixel (top row) or shifted to the left by one pixel (bottom row). The former modifies the left image boundary while the latter changes the right image boundary. In Fig. 5, The desired new (left) boundary is highlighted in red. In Centre of the figure4 the first seam segment (marked with 'X') is determined and after its removal, all the purple pixels to its left move to the right to form the new image.in right side of the figure after removing the second seam segment, the new boundary is successfully obtained. An example of the auxiliary array AL for seam extraction is also shown in the figure

A seam segment S is again a set of n interconnected pixels, s1, s2, s3, ・ ・ ・ ,sn, with only one pixel in each row (vertical seam segment) or each column (horizontal seam segment), that does not necessarily start and end on the image boundary.. For clarity, we will refer to these special seam segments as through-seams. The primary difference between through-seams and seam segments is the effect of their removals from the image, and unlike the through-seams used in seam carving [1], the removal of a seam segment often permits two different image reconstructions as shown in Fig. 3running in parallel on top and bottom that mark the end points of the removed segment.

5. Bhv-convexity

In bhv-convexity is shown in figure5 In that we have three regions in first region horizontal seam segment only and in second region vertical seam segments only and in third region both horizontal seam segments and vertical seam segments for removing seam segments. For seam segment carving, a seam segment can be removed only if the resulting shape Si is bhv-convex, and we call this process seam segment carving with bhv-regularization.3. More precisely, to determine if a given shape S is bhv-convex, we start with the pixels in its complement .The topological points illustrated in Fig. 6 can be formalized using the notion of bhv-convexity.

Fig. 6. Left: The target shape S is marked in white. Its complement s can be decomposed into three types of regions: 1) regions that can be reached (seen) from one side of the boundary using horizontal or vertical lines, 2) regions that can be reached from two sides of the boundary and 3) regions that cannot be reached from any side. Right: Removal of a Type-1 region can be accomplished using one kind of seam segments (either horizontal or vertical) while Type-2 region can be removed by carving out a combination of vertical (orange) and horizontal (green) seam segments. Note that Type-3 region cannot be removed by seam segment carving. (Best viewed in color).

Definition: A shape S in DT is bhv-convex if its complement S = DT\S is a union of horizontal and vertical line segments with at least one end point on the boundary ∂DT of DT.

The set of these pixels can be partitioned into two disjoint subsets *A*, *B* such that pixels in *A* belong to a horizontal or vertical line segment in S emanating from ∂DT, and pixels in *B* are those that do not belong to such line segments. Clearly, S is bhv-convex if and only if the set *B* is empty. Furthermore, _S = S ∪ *B* is the smallest bhv-convex region containing S, its bhv-completion. In particular, the membership of *F* can be efficiently checked from the decomposition S = *A*∪ *B* with *A* determined as the union of horizontal and vertical line segments emanating from the boundary, and this membership verification is used in the first step of CASAIR for computing the bhv-completion of the user-specified target shape. We collect the various points discussed above into the following proposition whose proof is included in the supplemental material.

Proposition:

1) Every convex shape in DT is bhv-convex.
2) Intersections of bhv-convex shapes are bhv-convex.
3) All bhv-convex shapes are simply-connected (no holes).
4) A shape can be obtained by seam segment carving if and Only if it is bhv-convex.

For seam segment carving, a seam segment can be removed only if the resulting shape S*i* is bhv-convex, and we call this process seam segment carving with bhv-regularization. The regularization is both effective and efficient because the family *F* of bhv-convex shapes is sufficiently rich to include all convex shapes in DT, and its membership can be easily checked.

Fig. 7. Content and Shape-Aware Seam Segment Selection First row, from left to right, original image with new boundary highlighted, removing only horizontal seam segments, removing only vertical seam segments, seam segments selected by our method (green, blue, yellow, violet seam segments denote the four type of seam segments, L, R, T, B, respectively). Second row, from left to right, result from direct cropping, result from removing only horizontal and vertical seam segments, result produced by our method. Compared with the methods that remove exclusively only horizontal or vertical seam segments, objects such as the tree branches and the reflection of the bridge in the river appear much less distorted.

The criterion for seam segment selection is formulated using a cost function that quantifies the inconsistency introduced by removing the seam segment, and at each iteration, the seam segment with the lowest cost is selected for removal. With the cost function defined in Equation (1), the lowest- cost seam segment can be determined efficiently using dynamic programming as in other seam carving-based methods.

Therefore, we define the two-term cost function of a seam segment *SL* as the sum of the seam cost $E_{Seam}(S_L)$)and the displacement cost $C_{disp}(S_L)$

$$C_{total}(S_L) = C_{seam}(S_L) + \alpha C_{disp}(S_L) \quad (1)$$

With α the coupling constant (set to 0.6 in our experiments). The seam segment cost **C** *seam (SL)* is similar to the seam energy proposed in [7] that quantifies the inconsistency and distortion along the seam segment, and it is defined as,

$$C_{Seam}(S_L) = \sum_{(i,j)\in S_L} C_v(i, i^+, j) \quad (2)$$

Where at each pixel *(i, j)* $\in S_L$ the horizontal cost

$C_h(i,j)$ and vertical cost$C_v(i, i^+, j)$ measure the intensity difference across the seam in horizontal and vertical directions, respectively. Specifically, the horizontal cost **C** *h* of removing the pixel *(i, j)* in the seam segment S_L is,

$$C_h\big(i+1, j) - I(i-1, j)\big) \quad (3)$$

For the cost in vertical direction, it is related not only to the pixel *(i, j)* but also the selected pixel in row4. The formula is for vertical seam segments and the analogous formula for horizontal seam segments can be easily derived from the formula.

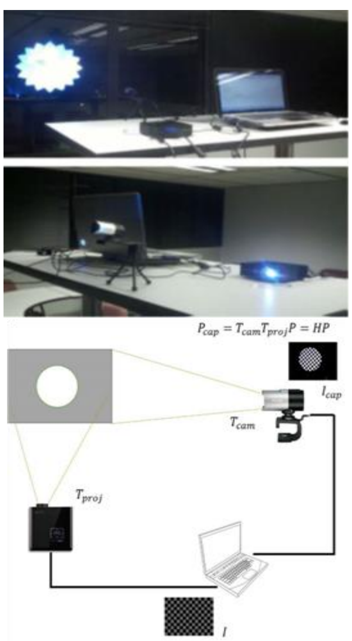

Fig. 8. Left: The proposed camera-projector system. The intended display area is on a glassy window and both the camera and projector are controlled by the laptop computer. Right: Camera-Projector distortion model. (Images best viewed in color).

The Fig. 8, shows that the application of CASAIR. The proposed system contains a hand-held projector and a typical web camera for capturing feedback images, with both controlled by a computer.

j + 1 (*(i*+, *j* + 1*)* ∈ *SL*) and

$$\mathbf{C}v(i, i+, j) = \begin{cases} |\mathbf{I}(i-1, j) - \mathbf{I}(i, j+1)| & i+ = i-1, \\ \mathbf{I}(i+1, j) - \mathbf{I}(i, j+1)| & i+ = i+1, \\ 0 & i+ = I \end{cases} \quad (4)$$

The displacement cost C_{disp}quantifies the inconsistency incurred along the fissures and it sums over the entire length of the fissures. As an example, for a vertical seam segment *SL (st, ed)*, the two fissures run across rows *st* −1 and *st* and also row *ed* and *(ed* + 1*)*, and $C_{disp}\big(S_L(st, ed)\big)$sums over these two fissures:

$$C_{disp}\Big(s_L(st, ed)\big) = C_1\big(i_{st,}s_t\big) + C_2\big(i_{ed,}ed\big)\Big) \quad (5)$$

Where C_1 and C_2 are defined below: if the first carved point is not lying on the left boundary or the starting row is not the top row (*st* _= 1), then

$$C_1(i_{st}, st) = \sum_{i=1}^{ist-1} |I(i, st) - I(i+1, st-1)| \quad (6)$$

Otherwise, C_1 is 0. Similarly, if a seam segment does not terminate at the left boundary or the bottom row, the cost C_2 is

$$C_2\big(i_{ed,}ed\big) = \sum_{i=1}^{i_{ed}-1} |I(i, ed) - I(i+1, ed+1)| \quad (7)$$

C_2 is set to 0 if *ied* = 1 or *ed* = *h*. It is clear that for through-seams C*disp* is zero and their cost is given by the first term C*same*. Similarly, if the seam segment contains only one pixel, C*disp* is also zero.

6. Experimental results

In this section, retargeting the non-rectangular shapes are performed and seam carving is used to resize the image without loss of information .Finally the results are non-regular shapes with quality image. In existing system loss of information is occurred and only rectangular shapes can be found that's we are using CASAIR method.

7. Conclusion

In this project we retarget the images into non-rectangular shapes. Seam carving is used for resizing process. Vertical seam carving is the one of the type of seam carving .seam carving is not only using for resizing process but also used for remove vertical seams in an image. The seam process depends on bhv-convex shapes is used to completely characterize the family of shapes. Finally, the smart camera-projector system is used in this paper it is the application example for CASAIR.

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