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5) I have performed combination of 4 types of operation to show different effects:

- a) Width reduction
- b) Width increment
- c) Height reduction
- d) Height increment

To enlarge the image, first I find the optimal seams for seam removal. After getting the optimal seams, I do the inverse operation. Instead of removing them I just replicate the seams and enlarge the image.

Image 1

Image Sizes

Input Image: 466X700

Output Image: 116 X700

Operation

Remove 350 rows

We make use of a useful property of the image that is the sky and sea are uniform and hence we can remove them using height seams. But this advantage cannot be exploited in case of the imresizing. Hence it appears to be deformed.

(Source: Taken from Seam Carving for Content-Aware Image Resizing)



Original paper



Im resized image



Seam carved image

Image 2

Image Sizes

Input Image: 494X480

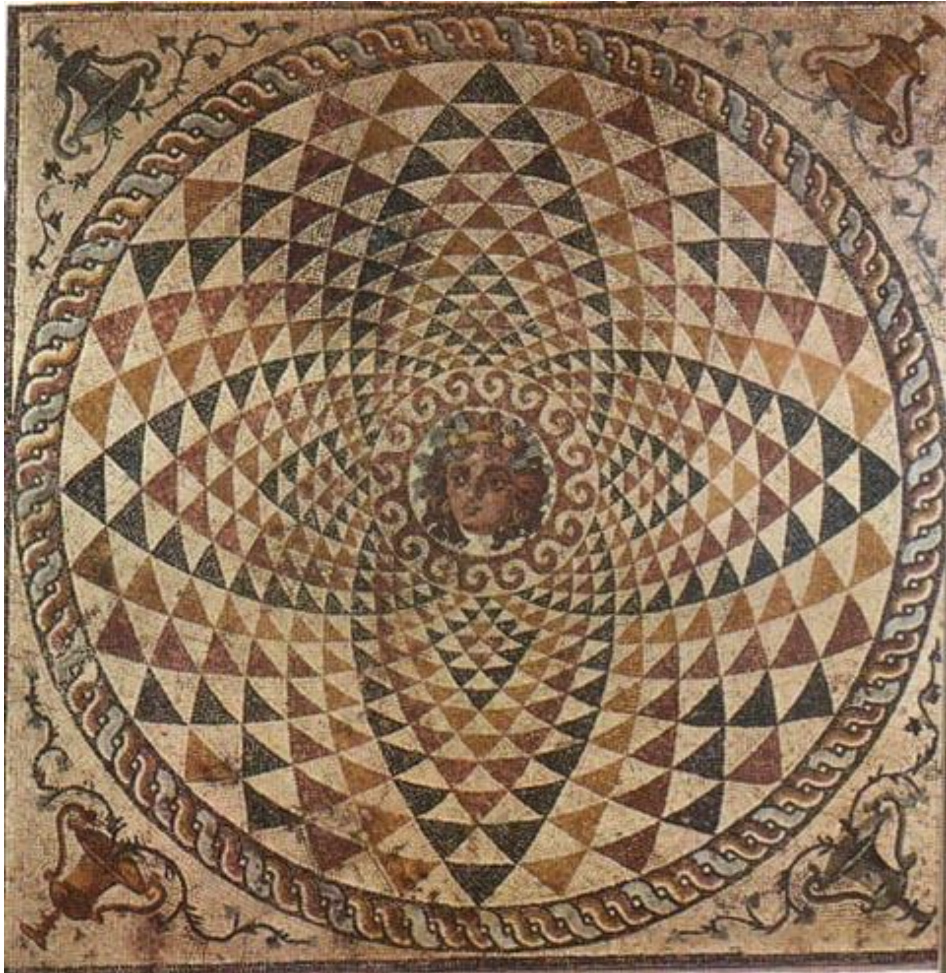
Output Image: 464X450

Operation

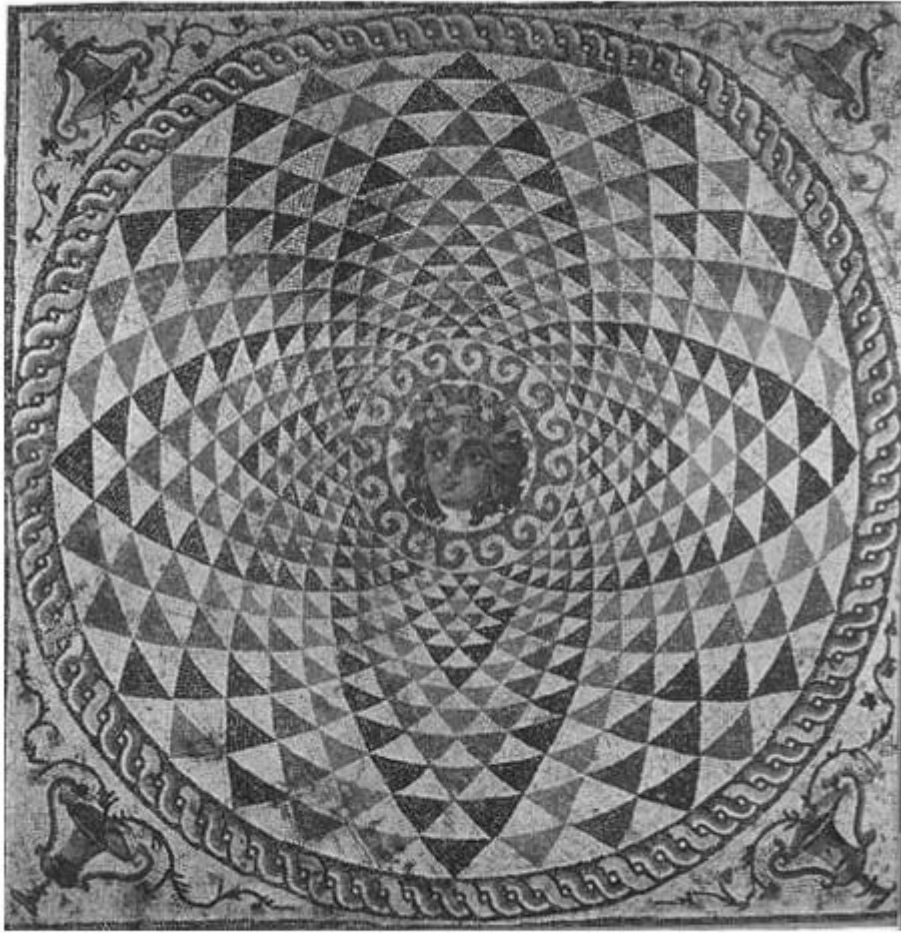
Remove 30 columns followed by removing 30 rows

Carving performs bad for mosaic as it removes of the design part in the image and the design is distorted but there is no noticeable distortion in imresized image.

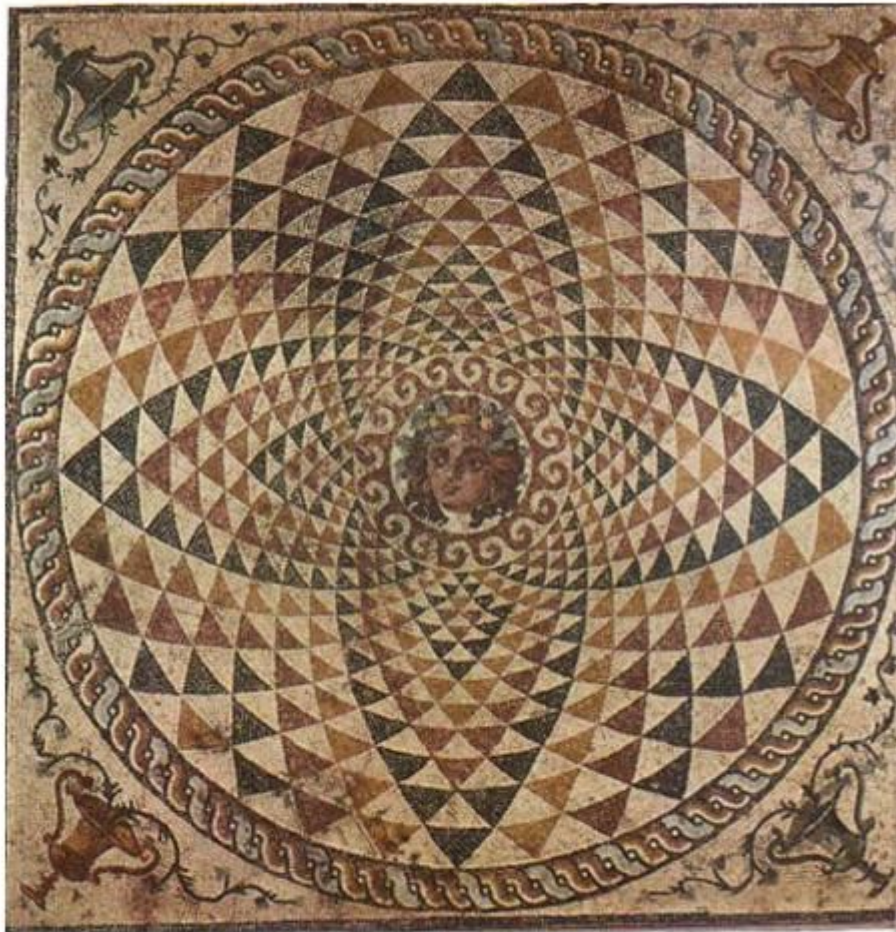
Source: <http://www.sikyon.com/Korinth/Monuments/mosaic1.jpg>



Original Image



Seam carved image



Imresized image

Image 3

Input Size : 520X677

Output Size :420 X 577

Remove 100 columns followed by removing 100 rows

The tiger silhouette gets deformed and it gets irregular. Imresized image performs better here.

Source :

http://www.solarnavigator.net/animal_kingdom/animal_images/Tiger_panthera_tigris_tigris_Bengal.jpg



Original Image



Seamed Image



Imresized Image

Image 4

Image seals .jpg

Input Size 375X500

Output Size 275 X600

Operation Insert 100 columns and decrement 100 rows

If we insert the columns in the image, the low energy regions will be replicated in the seals.jpg but if we resize the image for the same dimension, it gets distorted as shown in the figure. Decrementing the rows removes the sky being of low energy profile in seamed image.



Original Image



Seamed image



Imresized image

Image 5

Input :375X500

Output:275X300

Reduce width by 10 followed by reducing height by 5 (20 times)

Middle muddy Paths and dark trees on right side of image are removed as they are of low energy in seamed image



Seamed image



Im-resized Image

Image 6

Input Image Size 375 X500

Output Image Size 275X 600

Reduce the image height by 100 and increase the width by 100

Seam carving performs poor in enlarging the width because the groceries image is taken from depth view point and it gets distorted when width is increased.



Original Image



Seamed Image



Imresized Image

Extra credit Section:

- 1) I have used the alternate function to be entropy energy which is calculated as mentioned in the paper. The entropy energy computes the entropy over a 9×9 window and adds it to e1.

I have used the following line to run the extra credit portion

You could uncomment it in Energy.m

```
Energy =Energy+ entropyfilt (Im);
```

It takes in to account the local entropy in the neighborhood with the gradient.

Example taken

Input Image

500X400

Output Image

300X400

Operation

Remove 200 rows using 2 different functions

Gradient computation Energy

Gradient computation Energy +Entropy

There is only a slight difference between the 2 results in the seam removal around the river.

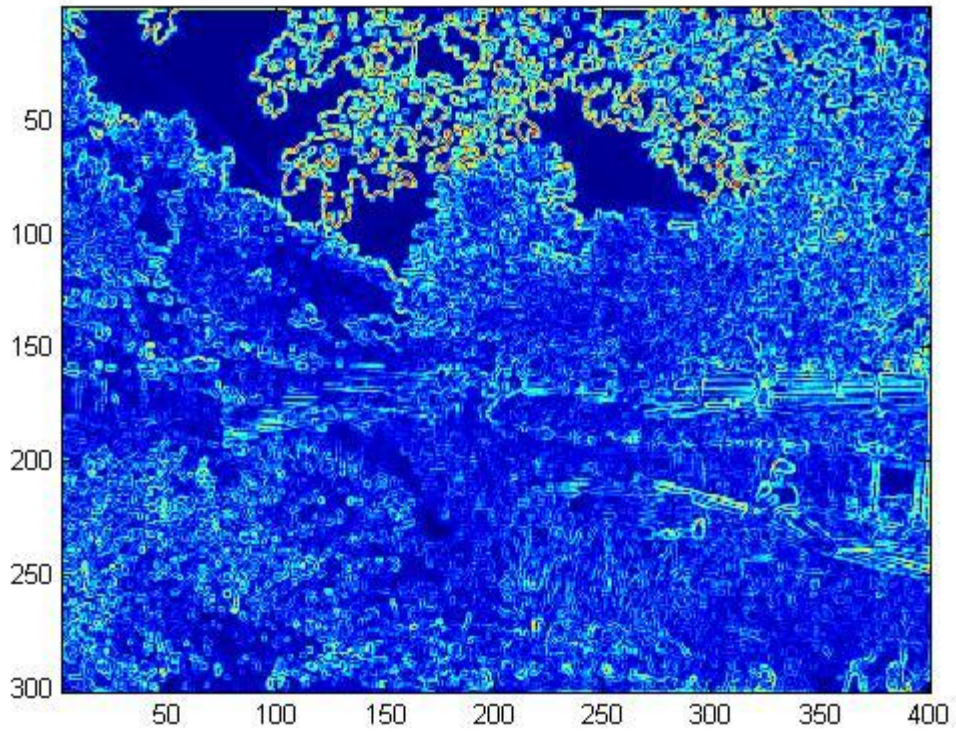
Source: Seam Carving for Content-Aware Image Resizing Paper



Original Image



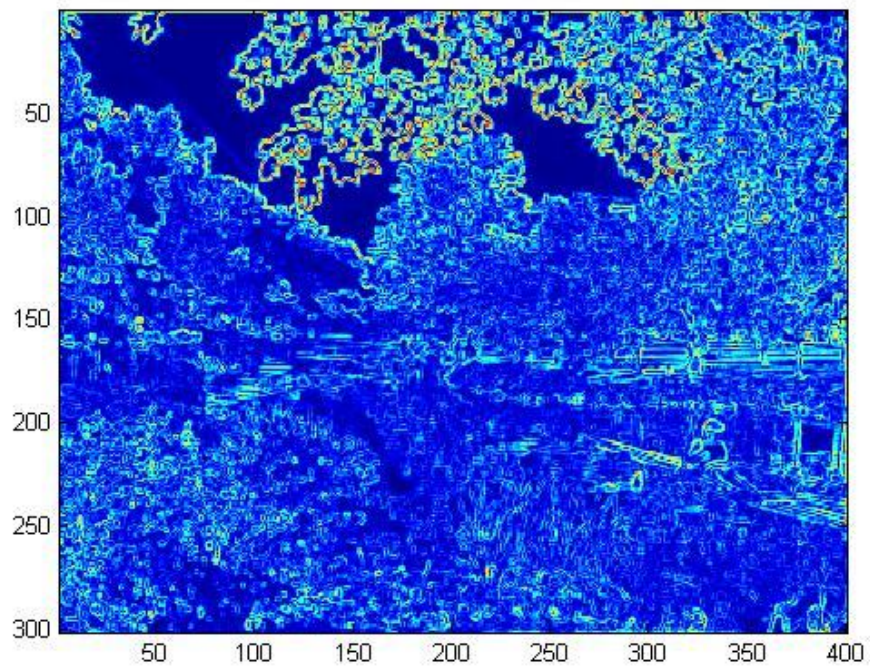
Seamed Image using gradient computation



Energy Function



Seamed Image using Energy Entropy



Energy Entropy Function

- 2) Using the hue cue to be between 0.01 and 0.1, the skin pixels are detected and the energy function at those points are kept high at 2^{200} so that they are not removed and hence we can avoid warping of human faces from the image.

I have used `face.m` to find the skin region which gives the skin regions as output which is called segment.

For executing this part of code, you need to uncomment the lines in `reduceheight.m` and I have commented the line `Energy(r,c)=2^200;` in `energy.m`. So while executing this code, you need to uncomment that too.

```
imname = 'lady.jpg';  
  
im=imread(imname);  
  
[Im_output Energy Mhorz horz_seam] = reduceHeight(im,200);
```

The results on the image after removing 200 horizontal seams are shown with and without warping. It shows that if we warp the human faces we can avoid seam removal passing through them and can achieve optimal seam removal.

Source: Seam Carving for Content-Aware Image Resizing paper



Original Image



Skin Detection Using hue



Seam Removal without warping regions containing people's faces



Seam Removal with warping regions containing people's faces

1) extracredit1.m is the file for running the program

The energy of all the pixels is put to zero for the pixels which are supposed to be removed.

imrect is used to select the region of the image supposed to be carved.

Please uncomment the energy function where the lines mention extracredit1 for running the program

reduceWidth_extracredit.m is the function used for reducing the width here.

I have used the difference of maximum (column index) – minimum (column index) to calculate the number of seams to be removed from the image.

Source: Seam Carving for Content-Aware Image Resizing paper

Original Image with selected portion to be removed



