Digital Image Analysis (COL783)

Project Report

Image and Video Retargetting

K N Ajay Shastry (2021CSY7547)

Suraj Patni (2021CSY7550)

Image Retargeting

Image retargeting is an operation in which we try to resize the image by removing seams (list of pixels) which will cause minor visual distortions or fewer visual artifacts.

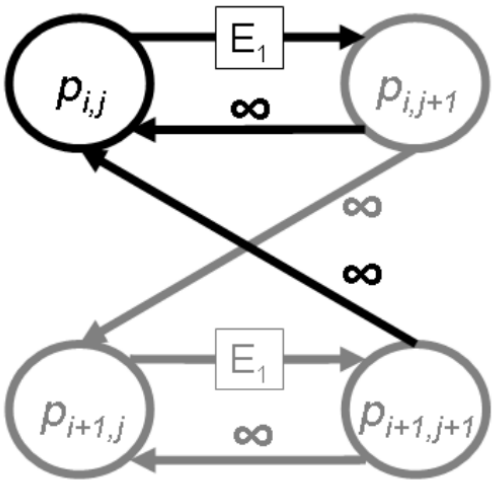
There are various ways to perform image retargeting. In our project, we have worked on the below techniques.

- Graph-cut-based seam carving based on the energy function.
- Graph-cut-based seam carving based on the energy function and forward energy.
- Graph-cut-based seam carving based on the energy function and region proposals.

Graph-cut-based seam carving based on the energy function

In this method, to perform seam carving, we consider the gradient of the image to be the energy function. And based on this energy function, we generate a directional graph and compute its min-cut or max-flow. This min-cut will provide us the information on which seam to be removed. This seam will usually contain those pixels which have minimum energy. Below is the energy function and the structure of the graph used.

$$E1(i, j) = \partial x(i, j) + \partial y(i, j)$$



Outputs

For image 1

On the left is the original image and on the right is the transformed image.

Seams removed are

For image 2

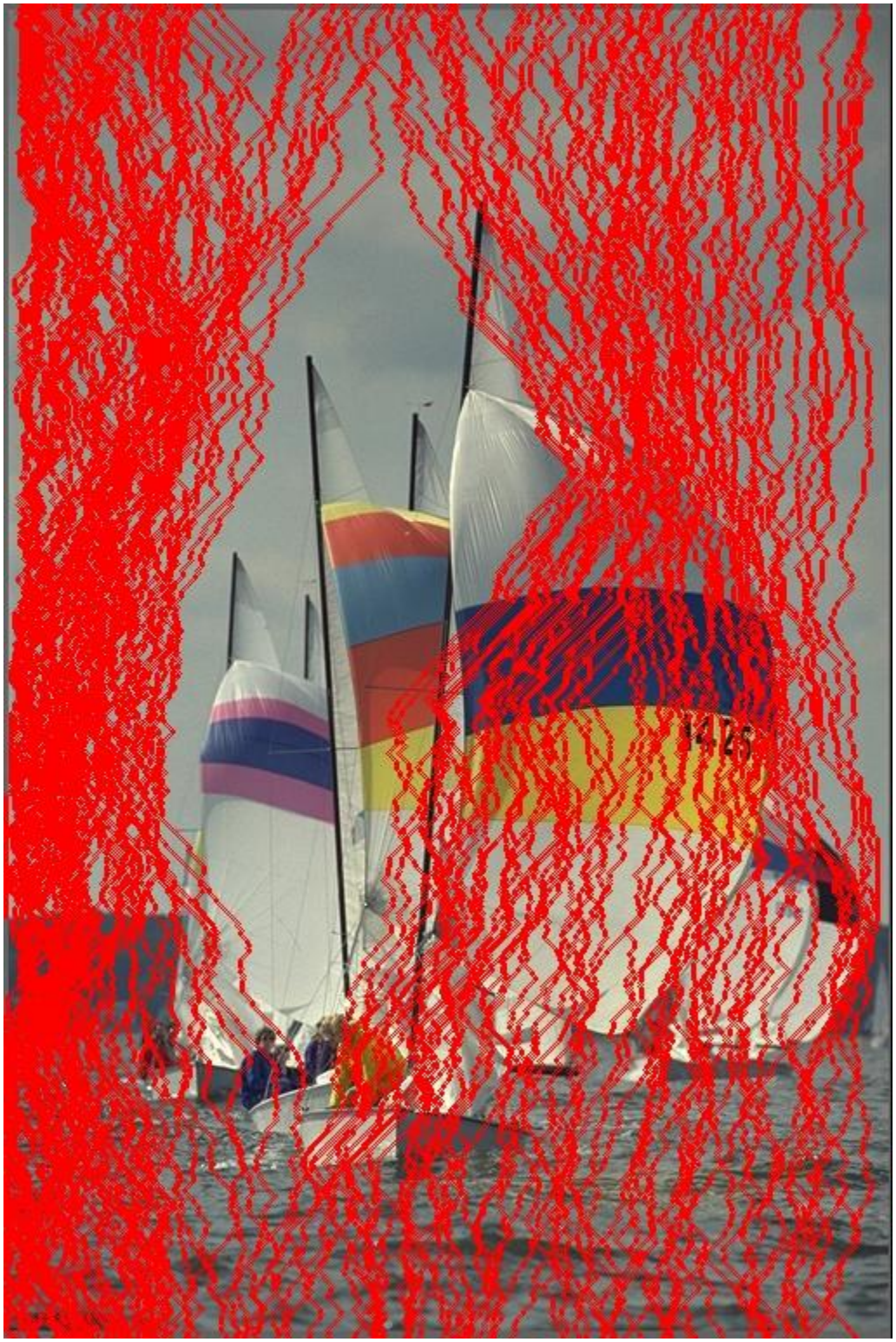
On the left is the original image and on the right is the transformed image.

Seams removed are

For image 3

On the left is the original image and on the right is the transformed image.

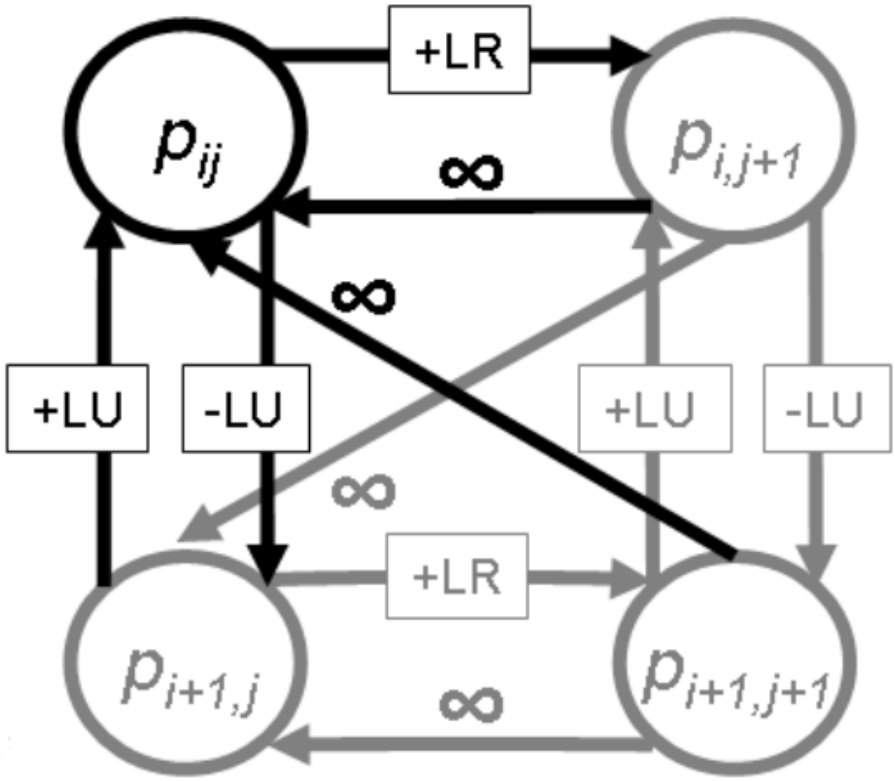
Seams removed are



Graph-cut-based seam carving based on the energy function and forward energy

In this method, to perform seam carving, we consider the gradient of the image to be the energy function. Along with this gradient, we consider a forward energy-based function that gives us information about that seam, which will add less energy to the gradient when removed. And based on this combination of the energy function and forward energy, we generate a directional graph and compute its min-cut or max-flow. This min-cut will provide us the information on which seam to be removed. This seam will usually contain those pixels which have minimum energy. Below is the energy function and the structure of the graph used.

$$+LR = |I(i, j+1) - I(i, j-1)|$$
$$+LU = |I(i-1, j) - I(i, j-1)|$$
$$-LU = |I(i+1, j) - I(i, j-1)|$$



Outputs

For image 1

On the left is the original image and on the right is the transformed image.

Seams removed are

For image 2

On the left is the original image and on the right is the transformed image.

Seams removed are

For image 3

On the left is the original image and on the right is the transformed image.

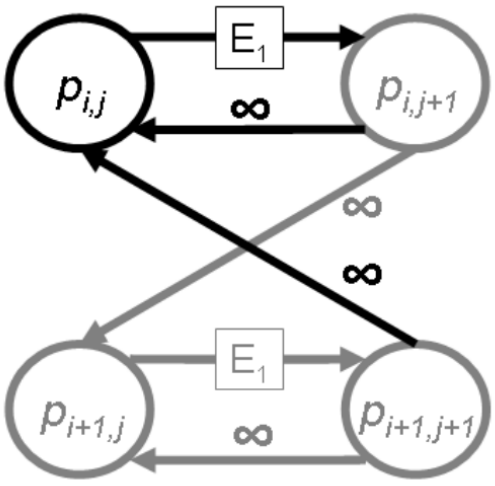
Seams removed are

Graph-cut-based seam carving based on the energy function and region proposals

In this method, to perform seam carving, we consider the gradient of the image to be the energy function. Along with this gradient, we consider region proposals of that image using the selective search algorithm, which gives us information about the most prominent objects present in the image. We take a mask of these region proposals and perform a weighted sum with our energy function. And based on this combination of the energy function and region proposals, we generate a directional graph and compute its min-cut or max-flow. This min-cut will provide us the information on which seam to be removed. This seam will usually contain those pixels which have minimum energy.
Below is the energy function and the structure of the graph used.

$$E1(i, j) = \partial x(i, j) + \partial y(i, j) + RP(i,j)$$

Here RP(i,j) is the mask value at the location i and j.



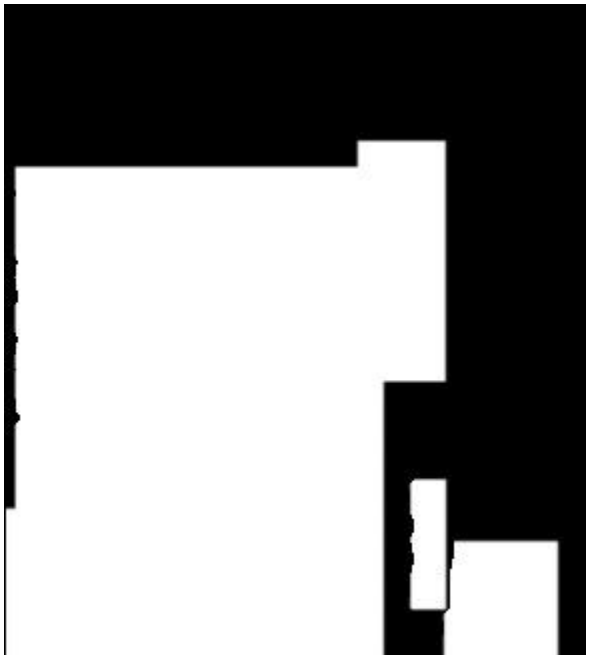
Outputs

For image 1

On the left is the original image and on the right is the transformed image.

Seams removed are

Mask is

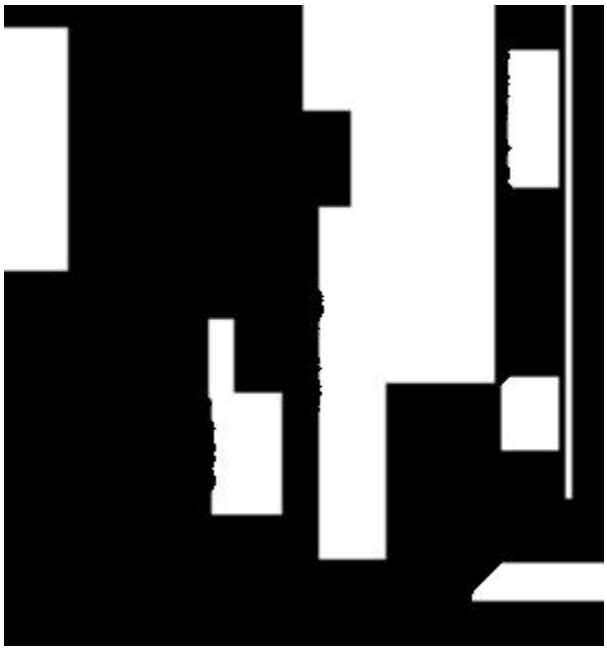


For image 2

On the left is the original image and on the right is the transformed image.

Seams removed are

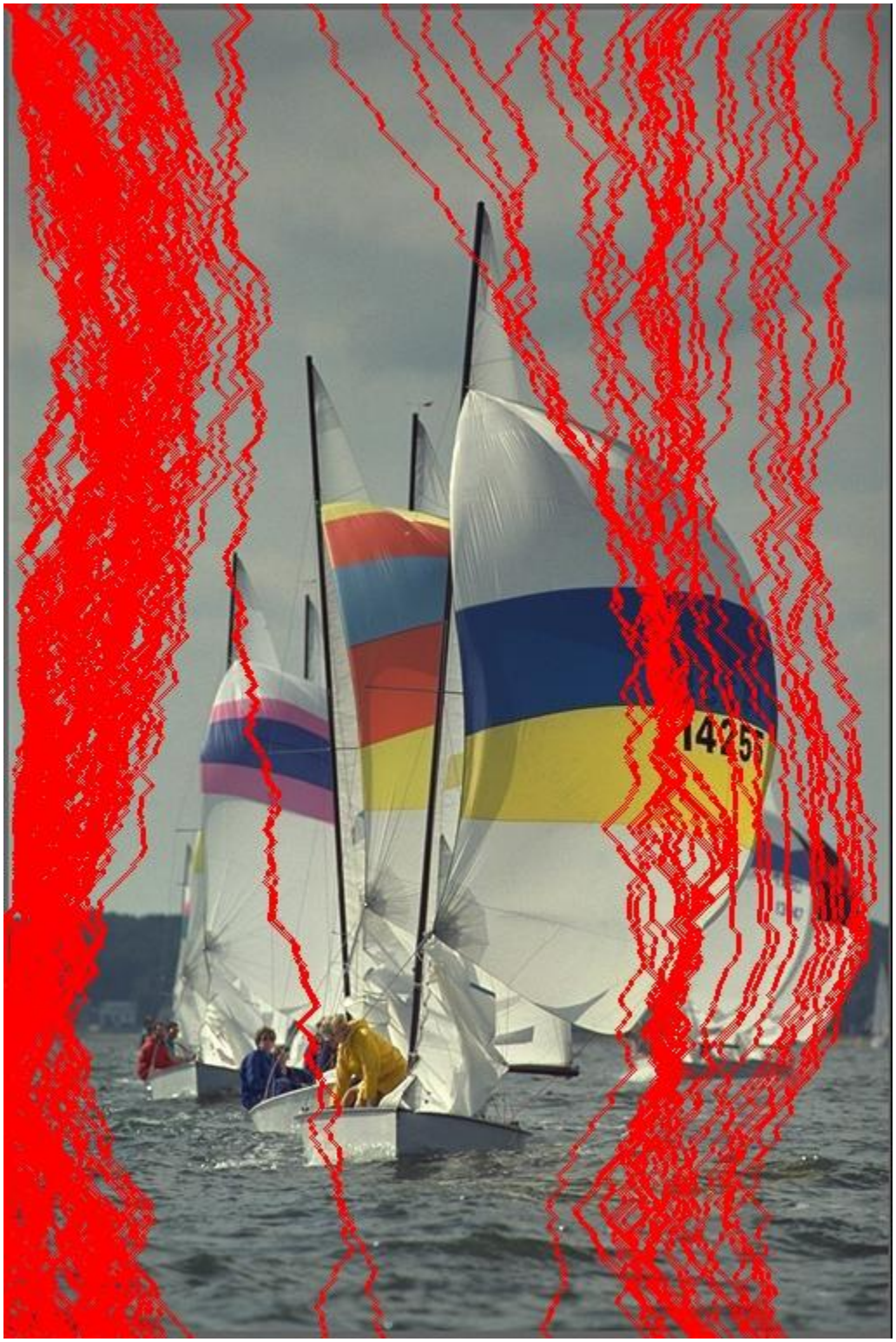
Mask is



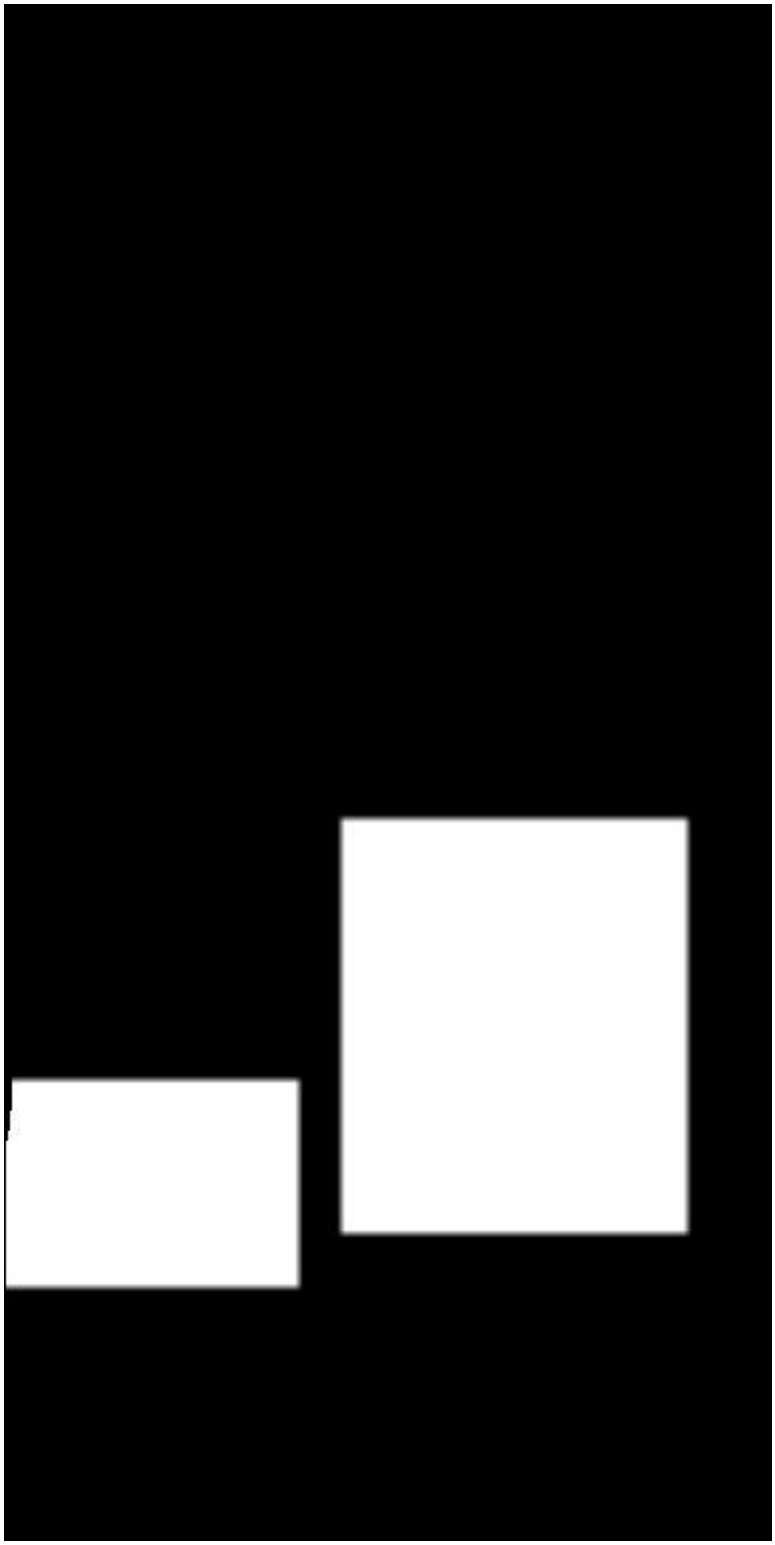
For image 3

On the left is the original image and on the right is the transformed image.

Seams removed are



Mask is

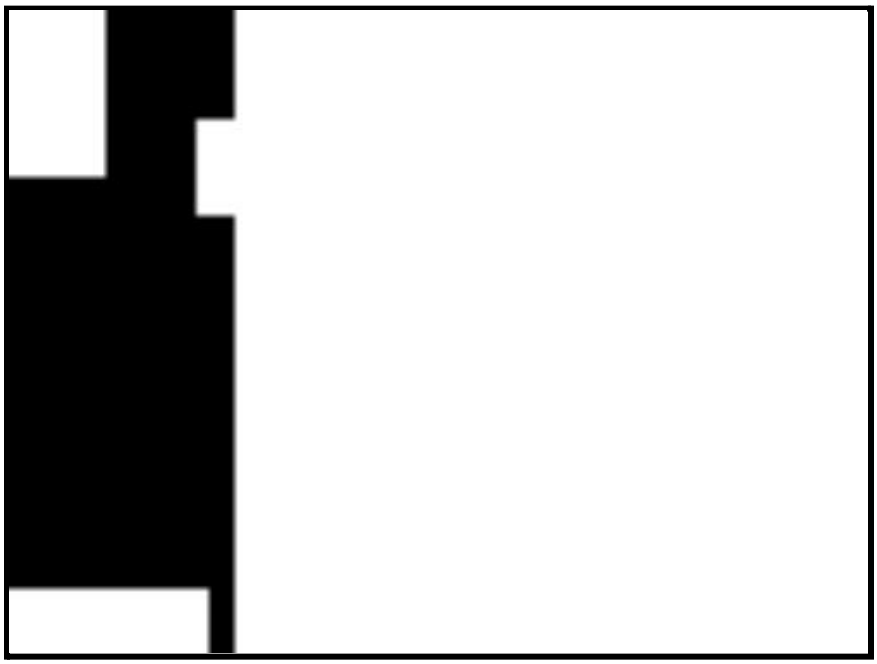


For image 4 (Extended dataset)

On the left is the original image and on the right is the transformed image.

Seams removed are

Mask is



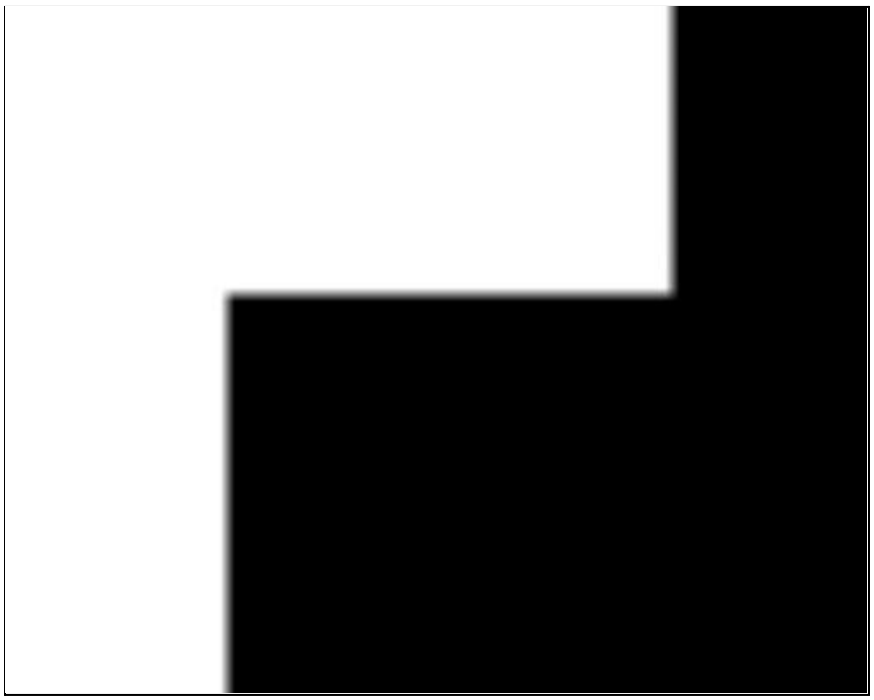
Output from forward energy is

For image 5 (Extended dataset)

On the left is the original image and on the right is the transformed image.

Seams removed are

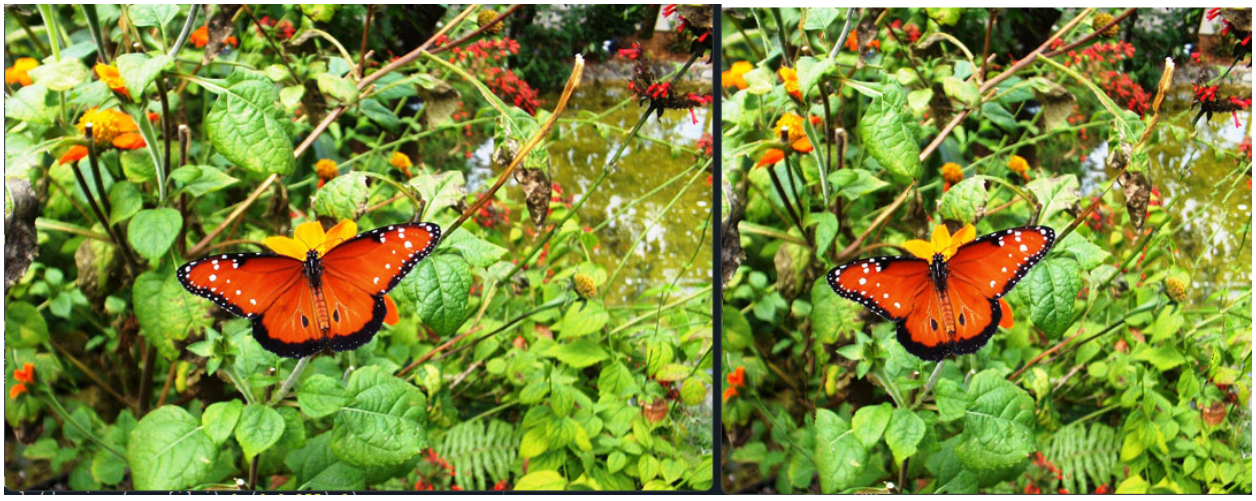
Mask is



Output from forward energy is

For image 6 (Extended dataset)

On the left is the original image and on the right is the transformed image



Seams removed are

Output from forward energy is

Video Retargeting

video retargeting is an operation in which we try to resize the video by removing seams (list of pixels) which will cause minor visual distortions or fewer visual artifacts.

There are various ways to perform video retargeting. In our project, we have worked on the below techniques.

- Applying image based seam carving on each frame of the video.
- Using static energy to remove the same seam in all the videos.
- Using 2D manifold to remove a seam in a 3D cuboid of the video.
- Improvement using region proposals.

Applying image based seam carving on each frame of the video

In this we apply forward energy based seam carving on every frame of the video.
The outputs of the same will be found in the below link

Link:
https://drive.google.com/drive/folders/1QYIng_9kwG0nYkMhQ7pnvFEXHbRCx4rF?usp=sharing

Using static energy to remove the same seam in all the videos

In this we apply static energy to all the frames in the video using the below formula

$$
\begin{aligned}
E_{\text{spatial}}(i,j) &= \max_{t=1}^{N}\{|\frac{\partial}{\partial x}I_t(i,j)| + |\frac{\partial}{\partial y}I_t(i,j)|\} \\
E_{\text{temporal}}(i,j) &= \max_{t=1}^{N}\{|\frac{\partial}{\partial t}I_t(i,j)|\} \\
E_{\text{global}}(i,j) &= \alpha \cdot E_{spatial} + (1-\alpha)E_{temporal}
\end{aligned}
$$

Usually the value of α is 0.3
Link for the output is :
https://drive.google.com/drive/folders/1QYIng_9kwG0nYkMhQ7pnvFEXHbRCx4rF?usp=sharing

Using 2D manifold to remove a seam in a 3D cuboid of the video

In this method we will remove a 2D manifold in a 3D cuboid of frames and we remove this manifold in all the frames.

The Link for the output is :
https://drive.google.com/drive/folders/1QYIng_9kwG0nYkMhQ7pnvFEXHbRCx4rF?usp=sharing

Improvement using region proposals

In this method we have involved region proposals of every frame in the static energy function.Now we have performed a weighted combination of spatial energy ,temporal energy and region proposals and then we find a seam that has minimum energy in all the frames.

The Link for the output is:
https://drive.google.com/drive/folders/1QYIng_9kwG0nYkMhQ7pnvFEXHbRCx4rF?usp=sharing

Conclusion

In this project we have implemented image and video based retargetting using the reference [1] and also have suggested improvements on the same.

References

[1] M. Rubinstein, A. Shamir, and S. Avidan, “Improved seam carving for video retargeting,” ACM transactions on graphics (TOG), vol. 27, no. 3, pp. 1–9, 2008.