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CONTENT AND SHAPE-AWARE IMAGE ADAPTING

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Abstract: In the rising edge of technology everyday new technologies have been coming in the market, but with the new technologies it becomes difficult to use the older ones. Image is one of the very important things in day-to-day life as it makes visualizing the things very easy also it become easy to store our memories. But viewing the same image on different devices is not easy as of now every device has different size and aspect ratio and resolution so that image may look different on different device. So, to handle this scene we have to resize our image but the traditional ways of image resizing such as cropping, scaling etc. can lead to loss of important content, distortion of image. To overcome these deficiencies seam carving is the best method to resize the image. It is a retargeting method which considers the images in a semantic manner for resizing to bring them to target aspect ratio. The change in the final resized image is trivial to the human eye and the final image will look very similar to the original one. Also using seam carving image enlarging, object removing is possible.

Keywords : Image retargeting, seam carving, image processing, content-aware image resizing.

I. INTRODUCTION

Today in the digital age we come across a variety of images every day can be our profile picture, place photos, personal photos, drawings, work related photos etc. But when we consider our profile photos, images of scenery we are always thinking of enhancing the images according our choice to make it more appealing visually. Effective resizing of images should not only use geometric constraints, but consider the image content as well. Conventional image resizing consists of cropping or evenly down sampling that lead to loss of important features or distortion. This method enables us to remove pixel from uninteresting parts of the image while preserving important content. Scaling does not 1 always preserve the aspect ratio (height to width ratio) of an image so the content of an image must be modified to fit the new dimensions. Normal resizing techniques include stretching and cropping. Neither of these options are ideal as stretching distorts the image and cropping reduces the image content. “Seam carving” provides a generally superior method. At a high level, seam carving is an algorithm that preserves the sizes and shapes of “important” objects, while resizing “less important” parts if the image. Hence, seam carving can be used for distortion free image expansion by inserting least energy seams in the image. This can also be extended to object removal and object protection in an image.

II. LITERATURE SURVEY

Anish Mittal, Anush Krishna Moorthy, Alan Conrad Bovik [1], “No-Reference Image Quality Assessment in the Spatial Domain” This paper mainly deals with the method of checking image quality based on BRISQUE evaluator which uses scene possible losses of naturalness in the image due to the presence of distortions, to measure holistic quality of image. This paper clarifies that BRISQUE is statically better than full reference peak signal-to-noise ratio and the structural similarity index. For quality evaluation a mapping is learned from feature space to quality sores using a regression module which gives a measure of image quality, here a support vector machine (SVM) module is used as regressor. The paper used LIVE IQA database to test the performance of BRISQUE which consists of 779 distorted images spanning five different distortion categories JP2K, JPEG, WN , Blur, FF and 29 reference images. After evaluating BRISQUE on the LIVE IQA database there is no need to be dependent again on that database. The paper compares BRISQUE with the FR PSNR and the NR BLIINDSII and DIIVINE for the overall computational complexity with the images having same resolution of 512 x 768 on a 1.8 Ghz single-core PC of 2 GB RAM and listed time taken in seconds for machine-independent scenario, this suggests that the spatial-domain BRISQUE is an ideal method for real-time blind assessment of visual quality.

Fahime Shafieyan, Nader Karimi, Ebrahim Nasr-Esfahani, Shadrokh Samavi [2], “Image Seam Carving Based on Content Importance and Depth Maps ” , This paper deals with traditional method of seam carving along with considering gradient, saliency and depth maps to generate efficient energy map. The paper explains an edge preservation algorithm to avoid passing of seams through salient pixels. The paper proposed the method of generating efficient energy map by extracting

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three different maps, these three maps are carved using dynamic programming, the first map is gradient map, this map is mostly used by existing seam carving methods. Although this map has good efficiency but for with many cases it may cause serious distortions due to sensitivity to noise and allocation of higher energy to edge pixels. To overcome this issue there is second map called saliency map which uses salient object segmentation based on context and shape prior. This method associates the bottom-up saliency information with object-level shape prior. This segmentation is done by performing energy minimization based on initial irregular estimation. And the third map is depth map through which closer objects can be distinguished from the background. In order to protect the closer objects largest depth energy is assigned to it. On the other hand smallest depth energy is assigned to far objects. As this paper uses depth map to focus on main and foreground object and give them highest pixel energy value we taken reference from it and used binary image masking technique to completely preserve the masked objects in the retargeted image.

Zehra Karapinar Senturk, Devrim Akgun [3], "Seam Carving Based Image Retargeting ", This paper deals with the general idea of seam carving method for image retargeting. The paper elaborate advantages of seam carving for image resizing over old traditional methods like cropping, homogenous scaling. The traditional methods has many disadvantages such as loss of content, distortion in the image etc. As converting the images to different aspect ratio as of our need is a basic and most important process for many image processing applications so image retargeting should be done in way such that it provide us most conventional output. The paper explains how seam carving works, various algorithms used for it and how it is better than other traditional methods. The seam is connected path of pixels. The connected path of pixel from bottom to top or vice-versa is called as vertical seam and connected path of pixel from left to right or vica-versa is called as horizontal seam. The logic behind seam carving (SC) is to add/remove pixel paths for image enlargement/downsizing. This method removes the most negligible pixels while protecting fundamental features of the images. The seam carving is divided into two main sub-parts 1st one is creating the energy map or weightage map as every pixel has some value. For formation of energy map various methods have been using few of them are gradient magnitude, entropy, visual saliency, eye-gaze movement. After this stage 2 is identification of seam and adding or removing the seam i.e seam modification. As we have value for each seam in the image now the seam with the least value will be removed and we will check the final aspect ratio if it matches then we will stop or the process will continue with next least valued seam till we acheive the final ratio for both vertical as well as horizontal direction. In the case of image enlargment a pseudo seam will be created with the help of least valued seam and will be added in the image so that the overall energy of the image will not be affected. This 2nd part of seam carving can be done using dynamic programming or graph cut method. Though this paper explains all about seam carving but it has a disadvantage. It only explains seam carving and its advantages over other methods for image retargeting and it only explain generalize seam carving method. As we know for energy map creation there are different method this paper does not explain any specific method and its advantages/disadvantages nor the algorithm. Also the seam identification and modification can be done by various method like dynamic programming and graph-cut method and this paper does not explain in details about any one of them. So this paper only gives us general idea about seam carving and its various methods for doing it.

Eungyeol Song, Minkyu Lee, Sangyoun Lee [4], "• CarvingNet: Content-Guided Seam Carving Using Deep Convolution Neural Network ", This paper is mainly focus on 1st phase of seam carving i.e creating the energy map of the image, which is use for seam detection. In general for creating energy map of pixels, there are various methods like gradient magnitude, entropy, visual saliency, eye-gaze movement, these method have accuracy level almost similar to each other. But this research introduced new method by using DCNN. With the help encoder-decoder CNN the deep energy map is created which is more efficient than other previous method. And also the energy displacement at edges at content of image is minimal it gives more quality retargeted image. In this paper, a deep convolution neural network (DCNN) is implemented using the structures of an encoder and a decoder. Although the deep energy map using the E–D CNN proposed in this paper has the same functions and goals as the conventional energy map, it was proposed to produce a higher performance. What is important here is cross entropy. Cross entropy is defined to show the difference between two probability distributions. More specifically, cross-correlation (CC) is used when showing a correlation between two functions whereas cross entropy (CE) shows the distance between two probability distributions. Therefore, in the E–D CNN, the final cross entropy loss function outputs an energy map by combining the final feature map and Sigmoid function. So as glancing at the paper it is clear that the deep energy map created by the E-D CNN method is way more practical and sharp for seam carving. Also it minimize the distortion in the targeted image and main part is that is gives impressive results at the edges which was not the case with previous cases. Still the paper only focused on energy map creation and seam identification and modification is done by dynamic method only.

Mahdi Ahmadi, Nader Karimi, Shadrokh Samavi [5], "Image Seam-Carving by Controlling Positional Distribution of Seams " , As discuss above seam carving is better and faster method for image retargeting. But with the continuously enhancement in technology seam carving should get better. And in this paper advanced seam carving is introduced which required the same resources as previous older one but way more efficient than it. The energy map here will be created by

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saliency map method and after that instead of traditional method we will used the advanced method for seam identification and modification, this advance method is known as the graph-cut method for seam carving. At first we have to find 8-connected passes of pixels called seams that will be deleted. The method can also be used for image enlargement so that new pixels are inserted next to the location of seams. In seam-carving, the image is retargeted iteratively by deleting vertical seams at each iteration. The goal in each iteration is to find seams that have the least energy. In the graph representation of the seam-carving method, the image pixels are nodes of a directed graph. In each iteration, the best seam is found by the graph-cut algorithm and then is deleted. Graph-cut is a mathematical tool to cut a graph so that the removed arcs have the least (or greatest) summation of weighs among all other possible cuts. In directed graphs, the directed arcs originate from a source node and go to a target node. In the seam-carving, a source node and a target node are added to the graph. Each arc stands for the energy of its beginning node. Hence, cutting an arc means removing the pixel/node at its beginning. Note that in directed graph-cut, all removed arcs must be directed from source to the target node. Therefore, cutting an arc that is in the opposite direction does not count in energy calculation. This fact enables us to design the graph in a way that satisfies the problem requirements This advanced seam carving method has many advantages over the older one as is it more efficient with same time consumption. As graph-cut method is more general it can be used for video retargeting also. Despite this paper explain in detailed about graph-cut method it does not give satisfactory explanation to the energy map creation which can also be improved with newer method.

III. METHODOLOGY

A. The systems accepts input image (the image to which retargeting has to be done) and binary mask image (the image from which the system has to protect particular objects in the retargeted image).

B. The system then asks for a option of visualization or non-visualization which displays the process of removing or adding seams on a window iteratively.

C. In the next step system calculates the energy map for input image using forward energy algorithm.

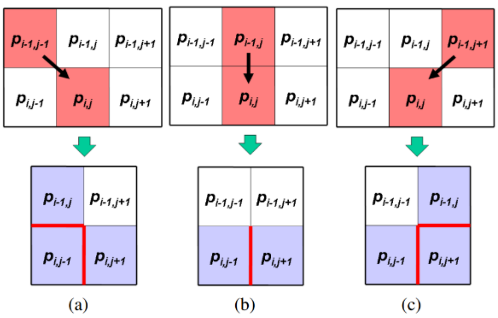
D. After that system uses dynamic programming to identify least energy seams and further either add or remove then as per the required resolution of final image.

IV. ALGORITHMS

Forward Energy Map:-

The artifacts created in video frames can actually be seen on static images as well. They are created because the original algorithm chooses to remove the seam with the least amount of energy from the image, ignoring energy that is inserted into the retargeted image. The inserted energy is due to new edges created by previously non adjacent pixels that become neighbours once the seam is removed (see e.g. the steps artifacts in Figure below). Assume we resize an image $I = I_{t=1}$ using k seam removals (t = 1...k). To measure the real change in energy after a removal of a seam, we measure the difference in the energy of the image after the removal ($I_{t=i+1}$) and the energy of only those parts that were not removed in the previous image $I_{t=i}$ (i.e. the image energy $E(I_{t=i})$ minus the seam energy). In our new graph cut formulation, the energy of the image is no longer an attribute of the pixels, but rather an attribute of the arcs in the graph. Hence, the energy of an image E(I) is given by the sum of all finite arcs of its induced graph, and the energy of a seam E(C) is simply the cost of the cut C. The energy difference after the i^{th} seam carving operation is:

$\Delta E_{t=i+1} = E(I_{t=i+1}) - [E(I_{t=i} - E(C_i)]$



As can be seen in above fig, ΔEt can actually increase as well as decrease for different seam removals using the original seam carving approach (the energy measured in this case is E1). The figure also shows a specific example of a seam that inserts more energy to the image than it removes. Following these observations, we propose a new criterion for choosing

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the optimal seam. The new criterion looks forward at the resulting image instead of backward at the image before removing the seam. At each step, we search for the seam whose removal inserts the minimal amount of energy into the image. These are seams that are not necessarily minimal in their energy, but will leave less artifacts in the resulting image, after removal. This coincides with the assumption that natural images are piece-wise smooth intensity surfaces, which is a popular assumption in the literature. We will show how to define forward energy on images and then discuss the extension to video. As the removal of a connected seam affects the image, and its energy, only at a local neighbourhood, it suffices to examine a small local region near the removed pixel. We consider the energy introduced by removing a certain pixel to be the new "pixel-edges" created in the image. The cost of these pixel edges is measured as the forward differences between the pixels that become new neighbours, after the seam is removed. Depending on the direction of the seam, three such cases are possible.

Dynamic Programming for Seam Identification:-
For each of the three possible cases, costs are respectively:
(a) $C_L(i, j) = |I(i, j+1)-I(i, j-1)|+|I(i-1), j)-I(i, j-1)|$
(b) $C_U(i, j) = |I(i, j+1)-I(i, j-1)|$
(c) $C_R(i, j) = |I(i, j+1)-I(i, j-1)|+|I(i-1), j)-I(i, j+1)|$
using these costs in a new accumulative cost matrix M to calculate the seams using dynamic programming. For vertical seams, each cost M(i, j) is updated using the following rule:

$$M(i, j) = P(i, j) + \min\{M(i-1, j-1) + C_L(i, j), M(i-1, j) + C_U(i, j), M(i-1, j+1) + C_R(i, j)\}$$

where P(i, j) is an additional pixel based energy measure, such as the result of high level tasks (e.g. face detector) or user supplied weight, that can be used on top of the forward energy cost.

V. IMPLEMENTATION

1) Implementation details :-

- To implement the project we have use python only we have done all the backend implementation by making python script for it and then run it according to our need. And also for the front end of the project we have use streamlit library in python to make the web application for our project.
- The first step is accepting a image from the user which will be having dimension less than 1000*1000 for the faster seam carving. The image format will be png or jpg. Also we can select the name and location for the final output image which will be seam carved.
- After getting the input image the system will ask for further important parameters such as

1) no. of vertical seam to change (i.e change in width) +ve for adding and -ve for removing
2) no. of horizontal seam to change (i.e change in height) +ve for adding and -ve for removing
3) selecting visualization option which will show the user real time seam carving on image when it is selected
4) masking option which will preserve the content of object which is masked
5) the path and name for output image if stated by user

- The second step in implementation is to find the energy map of the image which is very important phase in the project, as this phase will decide the accuracy of the project i.e the output image quality and overall disturbance in the image. The energy map of the image is a kind of matrix which stores theh value of each pixel of the image so we can use them for the further calculation. This energy map calculation process has been implemented by using forward energy map algorithm.
- And after finding energy map for given image we will use dynamic programming algorithm on it to find the minimum seam and remove it and this process will be in iteration untill it remove the given number of seams stated by user. And same will be in the case of adding the seam to the image to expand it, only difference is we will add the minimum seam to the image untill it met the requirement of user.
- As we have used forward energy map functionn so while finding the minimum seam of the image i.e the seam with the least energy the system will consider the neighbouring seam also. Because of this the effect of the seam updation on its neighbour seam will be least so the overall energy of the image will not change drasitically. And the visual distortion in the final image after all iteration will be minimum.
- We have only implemented the seam removal and seam addition code for vertical seam and while updating horizontal seam we have used same function only we have rotated the image and passed it.

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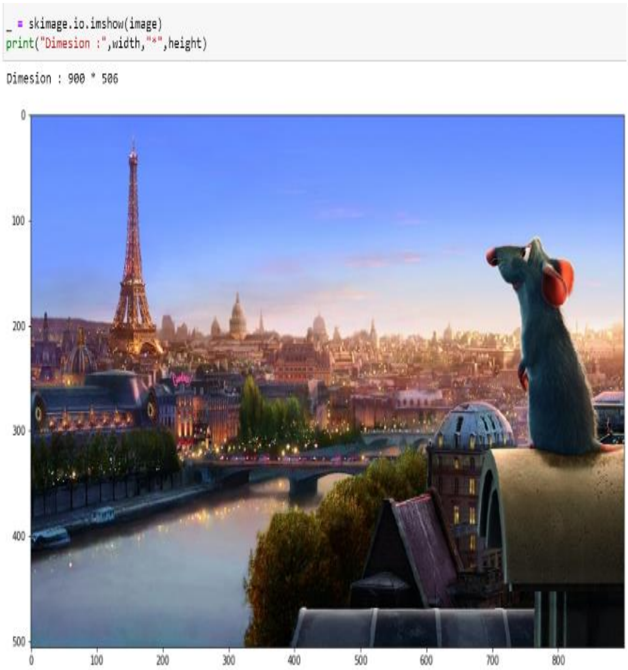
- If user had selected the option of visualization then for each iteration the system will show the updation of seam either removal or the addition. The seam would be displayed in blue colour on image, for each iteration seam will display and it will seems like a thunder.
- And if user has selected the masking option the process will be slightly different than the usual one which will be discussed in further point.
- So after all the iteration the final image will be made available to the user for download and if the path has already set by the user then the retargeted image will be save on that location.

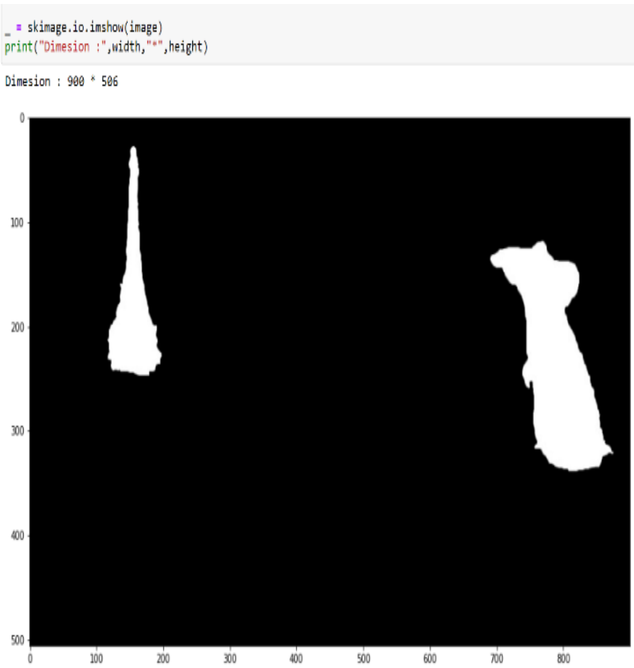
2) **Process of seam carving while masking is on :-**

- As discussed above we will have the option of masking which while selected the user can give protection to the selected object. While masking option is on the user has to give the binary image to the program, binary image is tha image containing two colours only mainly black and white.
- After binary image will be in such a manner that the object which has to be protected will be in white colour and all remaining part in black. This binary image of the original image will have the same dimension as of the original one thats the condition for binary image.
- After getting both original and its binary image our system will do all the remaining steps. But while creating the energy map we will merge both the image and the we will set the the pixel value of the selected masked area to the highest level.
- So now the masked area has very high values so that while calculating the minimum seam that area will not comes in play and there will be no seam updation on that part of the image.
- After all the iterations the final image will be saved.

VI. RESULTS

We have successfully implemented the system, here are some results of it with BRISQUE score.
Example no.1 :-





Original image

Binary masked image of original image

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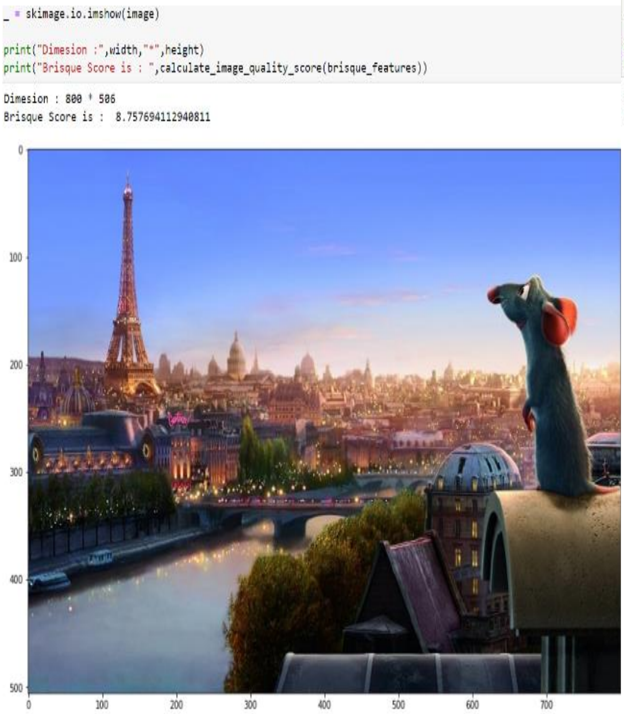
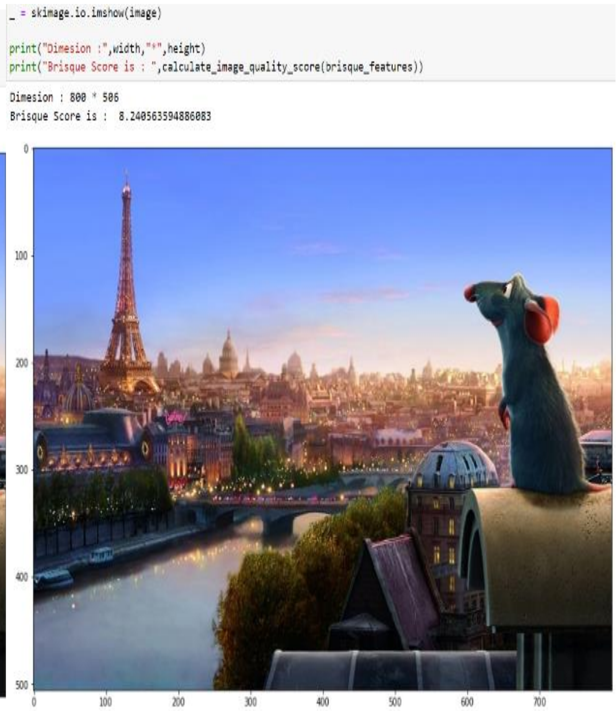


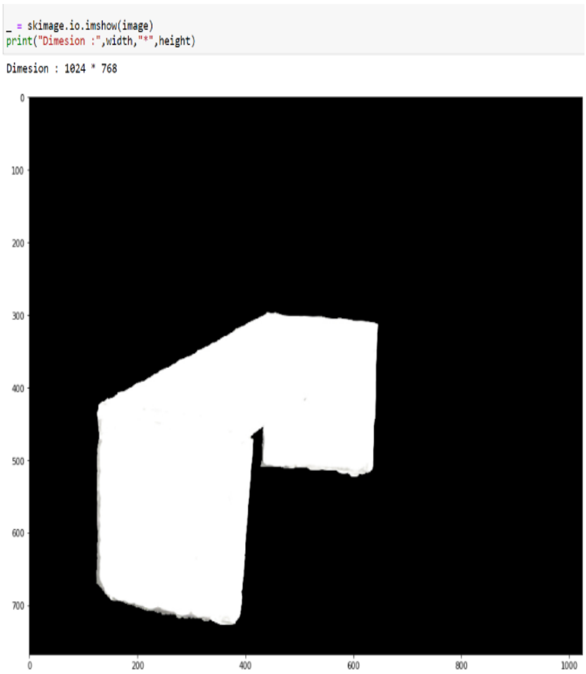
Output while masking is off



Output while masking is on

Example no.2 –

Original image



Binary masked image of original image

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Output while masking is off

Output while masking is on

VII. CONCLUSION

The title of the project is Content and Shape aware image adapting. Aim of the project is to develop a system which resizes the image without loosing its important content and the distortion in resized image should be minimum. In this new age of technology data is one of the most important factor for all of us. The image or photo is one of tghe form of data we used in our day-to-day life. We store our memories by clicking pictures of them, also this data is very effective and easy to use. But sometime we need to resize our images for thier further use like in image processing, sometime we have to adjust image aspect ratio according to the display. So to resize there are traditional method like cropping, scaling etc. But this methods have drawback like loss of content and distortion in image so to overcome all these drawbacks this projects has been implemented. The design of the system was such that the system consists mainly two block 1st one is energy map creation and 2nd one is seam identification and updation, these blocks that will take care of their respective functions. The system accepts the image in jpg,png format and feed it to the built model which calculates energy map for it. Then system identify the lowest seam from it and update that seam according to user input in iteration until image meets the final output dimension. For the implementation of the back-end of the project python is used and streamlit library to make web-app.

After successful implementation of the system we found out different factors affecting the outcome. These factors were like dimension of input image, function used to create energy map, is masking the image is on or off etc. On the basis of these factors some testing was done. For the testing of the project we have choosen the BRISQUE image quality assessment method. Some future work references could be video resizing, making a DCNN model for seam carving, finding some new function to create energy map. We can improve the performance and time efficiency of the system by making a energy function which will have less iteration and more detailed pixel value calculating functionality. We can also study about graph-cut method for seam identfication and updation instead of dynamic programming to compare the results between them, then we can improve our system so it will work for images with very high dimensions in very less time.

REFERENCES

[1] Anish Mittal, Anush Krishna Moorthy, and Alan Conrad Bovik, “No-Reference Image Quality Assessment in the Spatial Domain”, IEEE TRANSACTIONS ON IMAGE PROCESSING, VOL. 21, NO. 12, DECEMBER 2012.
[2] Fahime Shafieyan, Nader Karimi, Ebrahim Nasr-Esfahani, Shadrokh Samavi, “Image Seam Carving Based on Content Importance and Depth Maps”, In IEEE 22nd Iranian Conference on Electrical Engineering (ICEE), 2014.
[3] Zehra Karapinar Senturk, Devrim Akgun, “Seam Carving Based Image Retargeting: A Survey”, Engineering Faculty Computer Engineering Department Duzce University Duzce, Turkey, 2019.

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[4] Eungyeol Song, Minkyu Lee, Sangyoun Lee, "CarvingNet: Content-Guided Seam Carving Using Deep Convolution Neural Network", Department of Electrical and Electronic Engineering, Yonsei University, Seoul 03722, South Korea, 2019.

[5] Mahdi Ahmadi, Nader Karimi, Shadrokh Samavi, "Image Seam-Carving by Controlling Positional Distribution of Seams", 2020 International Conference on Machine Vision and Image Processing (MVIP) Faculty of Engineering, College of Farabi, University of Tehran, Iran, 19 & 20 Feb. 2020.