Toonification of Images

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Goal

To convert a real image into toonified image which looks like hand drawn or a cartoon which is fun and aesthetically pleasing.

Motivation

Cel-Shading is a type of non-photorealistic rendering which is used in graphics to make objects appear look like cartoons by quantizing color shades so that they have regions with discrete color. Achieving this effect is simple when we create models of objects and can use different illumination and shading techniques like Phong illumination model, Gourad Shading, Phong Shading etc. Achieving this effect for any given Image is quite complicated since we are dealing with real images which can have noise, varying lighting conditions. Here we are trying to tackle this problems using various image processing techniques.

Approach

For an image to look like cartoon it should have the following properties

1. It should be piecewise color quantized
2. It should have enhanced edges

So any toonification algorithm it should have the following steps involved

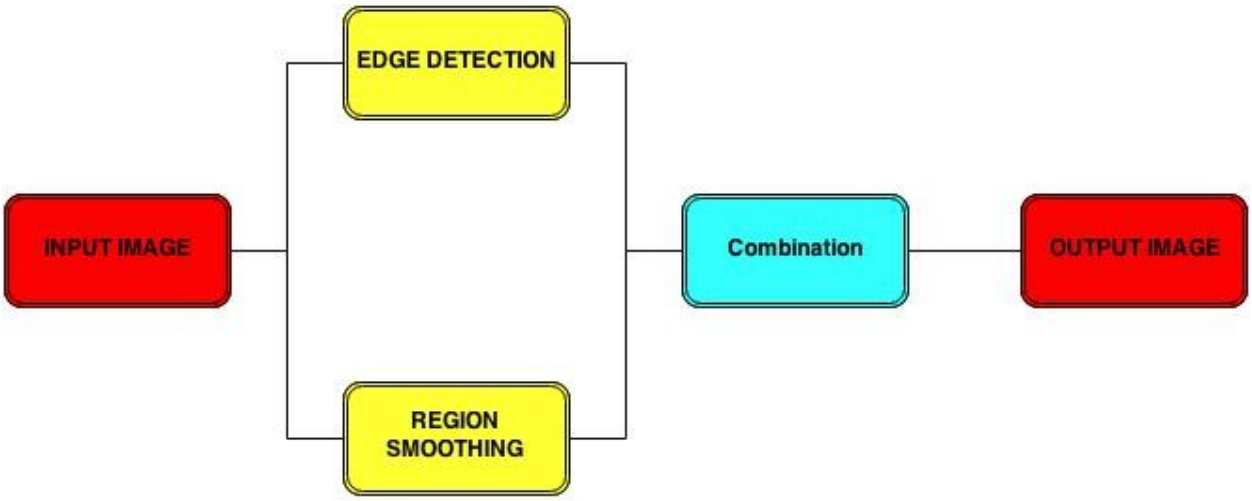
1. Detecting and Boldening of Edges
2. Smoothing and Quantization of Colors

But Images often contain noise so before applying the algorithm we have to reduce noise without significantly reducing the edges. Median Filter is best suited for this since it removes salt and pepper noise and also preserves edges.

For detecting edges we used the following methods

1. Canny Edge Detection
2. Sobel Edge Detection
3. Prewitt Edge Detection
4. Laplacian of Gaussian Edge Detection

For boldening of edges and smoothing the contours of edges we performed morphological dilation.This is followed by Edge Filter to remove small contours picked by edge detection algorithm



Genral Flow of Algorithm

Algorithm

1. Apply Mean Shift Filter to remove salt and pepper noise
2. Edge detection using various techniques like Canny, Sobel, Prewitt, LoG
3. Applying Morphological Operations to bolden and smooth contours of edges
4. Applying Edge Filtering based on area of edges.
5. Creating Homogeneous color regions using bilateral filtering, mean shift smoothing
6. Quantization of colors as multiples of some values
7. Recombining both color quantized image and edge detected image using black edges

Observations

We observed that mean shift is giving more aesthetically pleasing results than bilateral filtering and in many cases canny edge detection is overkill ie. it is giving more edges than others and results are not pleasing.

Generally faces we will have shadows cast on them and these are not shown when faces are drawn as portraits but using canny edge detection gives many contours on faces thus the results are bad. If we use sobel or prewitt we are getting some nice results for faces since they are not catching many edges. So based on requirement and type of image we need to toonify we have to choose best combination of Algorithms.

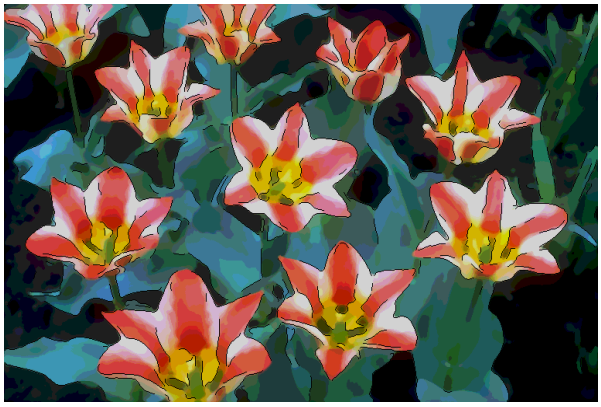
We observed that if image has larger areas of contrast colors toonification is working well but if we have smaller regions having less color contrast gives poor results since while applying

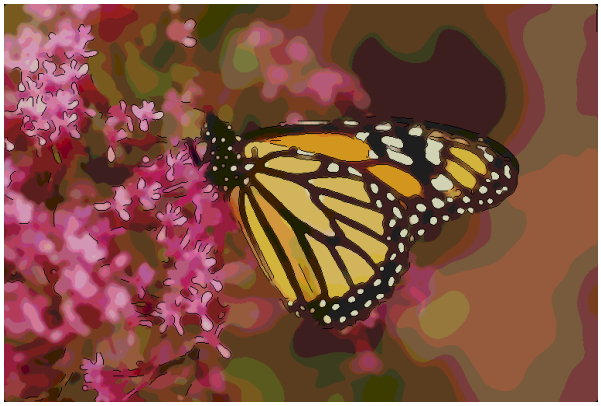
either mean shift or bilateral filter these come under same category in terms of clustering. This is inherent to the above algorithms. Here we need adjust parameters to get good results like error in mean shift and bilateral filter iterations, variance in region and intensity.

Using Canny Edge Detection	Using Prewitt Edge Detection

Results

Only results of some images are shown here if you want to see more image please refer to image folder.





Conclusion

From the above observation we can conclude that toonification of any arbitrary image is not possible with a single algorithm, since images we are dealing with can have noise, varying lighting conditions and different color contrast. So it is greedy to expect one-size-fits-all notion to solve this problem and we need adaptive algorithms to solve this problems as mentioned in observation (by tuning parameter of bilateral filtering, mean shift smoothing, type of edge detection algorithms). We also observed that edge detection plays some what crucial role in image abstraction we need better algorithms like edge tangent flow algorithm etc., If the reader is interested they can also see other techniques for toonificaton and painting effects of

photos. Finally we would like to thank our professors for teaching and helping important concepts throughout the course.

Some More Results