Toonification

Team

203050009 : Tarun Saurabh
203050034 : Ayush Gupta
203050107 : Saurabh Telure
203050055 : Piyush Sharma

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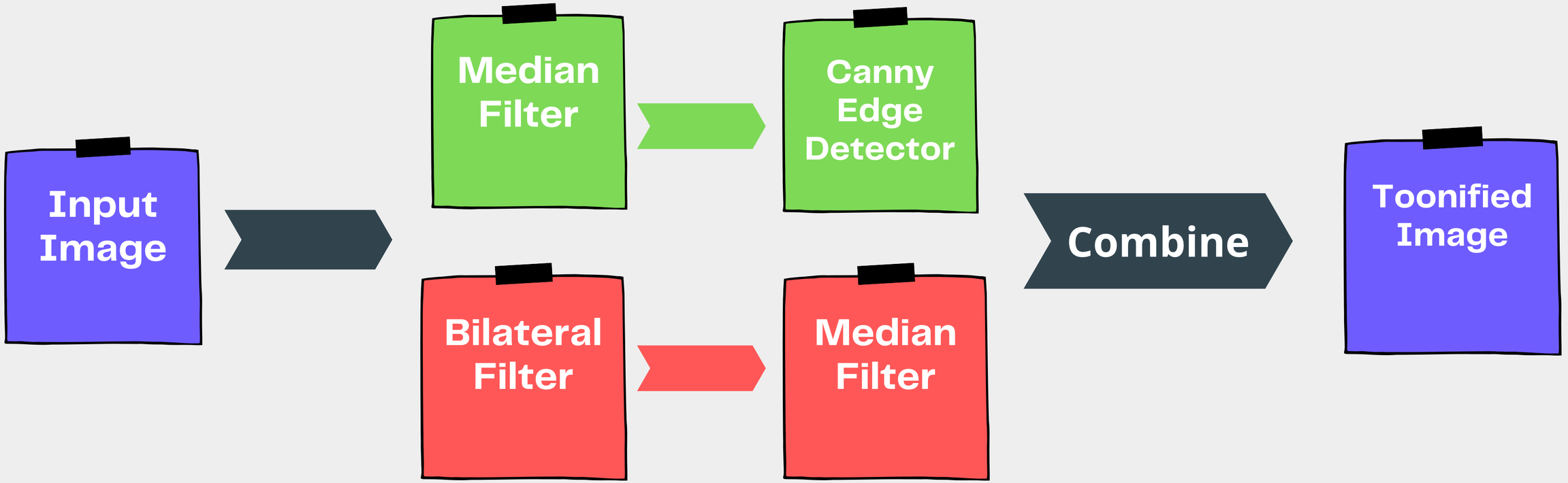
Introduction

- The popularity of social media has brought many advancements in image processing techniques, which allows users to apply some effect on their images.
- Application like Instagram, snap-chat etc. comes with inbuilt feature where users can apply multiple filter/effect on images.
- One among many such effect is toonification.
- Toonification is a process of converting an image into cartoon.
- It is one of the application of bilateral filter which is a robust edge-preserving filter introduced by Carlo Tomasi and Roberto Manduchi.

Background

- A lot of work has already been done in this field. Toonification, today, is done using Deep Learning.
- One of the method which is used today is GANs (Generative Adversarial Networks) which use two neural networks, in order to generate new, synthetic instances of data that can pass for real data.
- Since this project was meant to be done in image processing, we used bilateral filter to acheive our result.

Method Used


Input Image
Median Filter
Canny Edge Detector
Bilateral Filter
Median Filter
Combine
Toonified Image

1 Bilateral Filter

- Bilateral filter is applied to the input multiple times to give the image cartoon effect. In the process, any noise present in the image is also removed.
- While smoothening the image, it also preserves the edges and does so by introducing another filter(Gaussian over intensity) along with spatial filter(Gaussian over distance).

$$BF[I]_{\mathbf{p}} = \frac{1}{W_{\mathbf{p}}} \sum_{\mathbf{q} \in \mathcal{S}} G_{\sigma_s}(\|\mathbf{p} - \mathbf{q}\|)\, G_{\sigma_r}(|I_{\mathbf{p}} - I_{\mathbf{q}}|)\, I_{\mathbf{q}},$$

where normalization factor $W_{\mathbf{p}}$ ensures pixel weights sum to 1.0:

$$W_{\mathbf{p}} = \sum_{\mathbf{q} \in \mathcal{S}} G_{\sigma_s}(\|\mathbf{p} - \mathbf{q}\|)\, G_{\sigma_r}(|I_{\mathbf{p}} - I_{\mathbf{q}}|).$$

2 Median Filter

- Median filter is then applied, to the output of bilateral filter, to remove if any noise (salt and pepper noise) is present in the image.
- It assigns the median intensity of the intensities of the filter window to the center of window.
- So upto this step we have removed the noise and made the cartoonic look of the image.
- Now edge is needed to give full cartoonic effect to image.

3 Median Filter

- To find the edges in the image, we first need to remove any noise if present, specially salt and pepper noise, as our edge detection technique might consider these noises as edge.
- Hence in order to detect the true edge of image, we apply median filter to the input image to remove salt and pepper noise.
- After the noise is removed, edge detection technique can be applied now.

4 Canny Edge Detetction

- Canny edge detection algorithm is applied, to the output of median filter, to detect the wide range of edges in image.
- Processes of Canny Edge Detection Algorithm:

1. Apply Gaussian filter to smooth the image in order to remove the noise.
2. Find the intensity gradients of the image.
3. Apply non-maximum suppression to get rid of spurious response to edge detection.
4. Track edge by hysteresis by applying double threshold to determine potential edges.

Result

- Superimposing the edge detected image obtained after step-4 and smoothed image obtained after step-2, we get our desired toonified image.
- However shadow caused by varied lighting might get accounted as edge in edge detection method and this can create a lot of edges in toonified image.

Example 1

Original Image

Toonified Image

Example 2

Original Image

Toonified Image

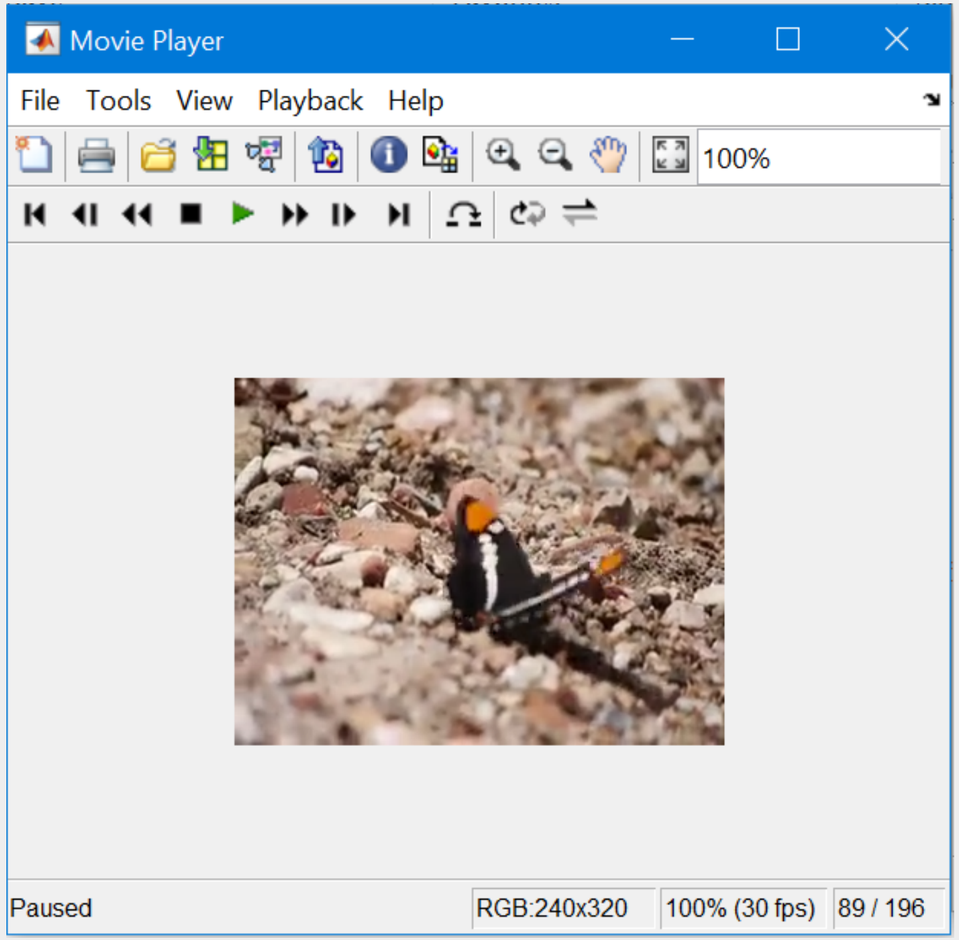
Toonification in Video

- The same idea is extended in the process of toonification of video.
- In Video toonification, we do the following:

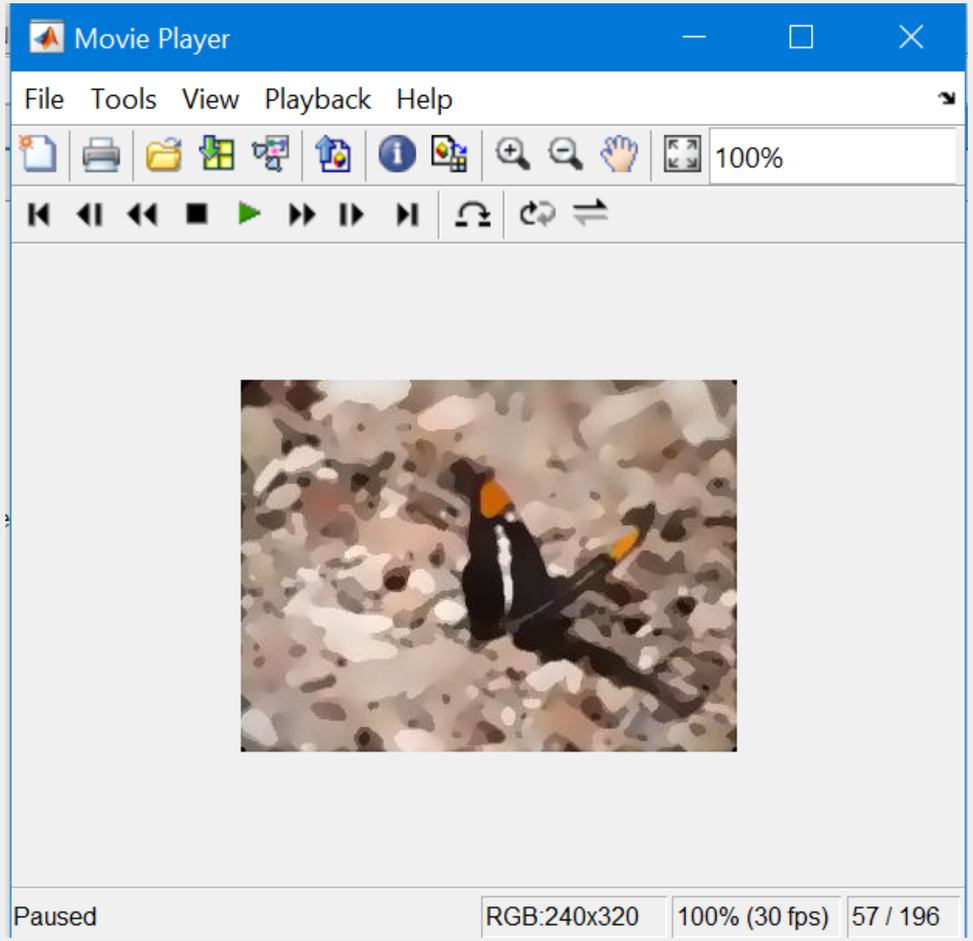
1. We read each frame of the video and apply the process of image toonification on it.
2. After every frame is toonified, we recombine the frames to form video.

- This is how toonification of entire video is done.

Snapshot from Video



Original Video



Toonified Video

Thank you!

Have a great day ahead.