

This work aims to create collage of a set of images by overlapping them i.e hybridising the images. Collage is very catchy form of representation of set of images especially when they are of a single context and the major issue in collage making is the problem of merging portions of images. There has to be a smooth transition between one image and another. In this work I use 2 novel ideas to merge images to form collage.

## 1 Method

Collage Creation consists of 2 major parts:

1. Merging 2 images using the *hybrid images* technique.
2. Blending the 2 images to ensure smooth transition between them.

### 1.1 Merging using Hybrid Images

For the first task i.e Merging using Hybrid Images, I use the technique of *hybrid images* presented by *Oliva et al.*[1]. In this I first of all consider a region of overlap between the 2 images (0.2% overlap), now the task is to merge these two portions. So for this I consider a low pass filter  $L_1$  and a high pass filter  $H_1$  and apply them to images  $I_1$  and  $I_2$  respectively. I get the hybrid image  $H$  as

$$H = I_1.L_1 + I_2.H_1 \quad (1)$$

or in other words

$$H = I_1.L_1 + I_2.(1 - L_2) \quad (2)$$

where  $L_2$  is another low pass filter. Note that these operations are all done in the frequency domain (after taking fourier transform). For my experiments, I have considered the  $L_1$  to be *butterworth low pass filter* and  $H_1$  to be *butterworth high pass filter*.

As mentioned earlier, this technique is applied only to the overlapping portion of the 2 images. In the original paper, the hybrid image technique was applied to the complete image resulting in hybrid of both the images. The interpretations of the image would differ as the distance of viewing keeps varying. I have also reproduced the result of the paper.



Figure 1: Hybrid Image of Elephant and Leopard. Low pass butterworth filter was applied on Elephant's image and high pass butterworth filter was applied on Leopard's image.

### 1.2 Blending Images for smoothing

Merging the two portions is simply not enough. After the first task the image consists of clear visible edges at the merged portion. In order to smoothen the transition of the pure image to the merged portion, we apply blending. Blending is basically weighting the pixel depending on which

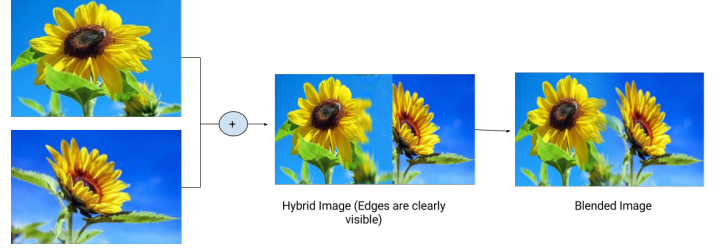


Figure 2: Hybrid Collage of two images. You can clearly see the smooth transition between the 2 different images.

region( $I_1$  or  $I_2$ ) it is in. If the pixel is in  $I_1$  region then the  $I_1$  pixel gets relatively higher weight and vice versa. Now the blended image  $B$  is given as

$$B = \alpha \times I_1 + (1 - \alpha) \times H \quad (3)$$

where  $\alpha$  is the weight parameter, as the pixel goes away from  $I_1$ ,  $\alpha$  value decreases. A similar procedure is applied on  $I_2$  as well. You can clearly see the edges smoothing in Figure 1.

This approach can be extended to  $n$  number of images by considering overlapping at every 2 images. An example of collage with 3 images is shown in figure 3.

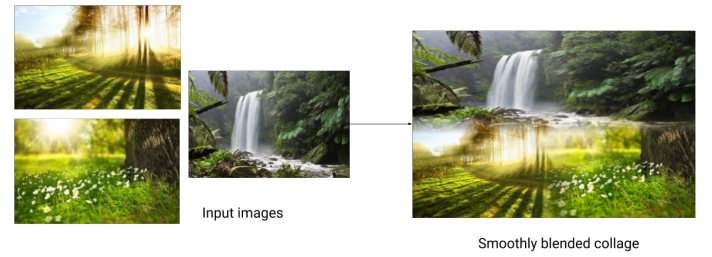


Figure 3: Hybrid Collage of three images. You can clearly see the smooth transition at the junction of every 2 images.

## 2 Butterworth Filters

In the original paper of hybrid images, Gaussian low and high pass filter was used. But in my work I have used Butterworth low and high pass filters. Butterworth low pass filter is given by

$$BL(u, v) = \frac{1}{1 + \left[ \frac{D(u, v)}{D_0} \right]^{2n}} \quad (4)$$

where  $D(u, v) = (u^2 + v^2)^{1/2}$  and  $D_0$  is the cut off frequency. Butterworth high pass filter is given by

$$HL(u, v) = 1 - BL(u, v) \quad (5)$$

## 3 Conclusion

In this work, I have successfully designed a technique for making collage of  $n$  images using hybrid image technique and then by blending the two images using the hybrid image.

- [1] Philippe. G. Schyns Aude Oliva, Antonio Torralba. Hybrid images. In *SIGGRAPH*, 2006.