

Hybrid images report - Lab3 - Computer Vision

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Index Terms—Hybrid images, Filtering, blended image, Laplacian Pyramid

I. INTRODUCTION

THE human eyes allow to capture the visual information of the environment, allowing us to have a perception of the real world. In some cases, this perception becomes an optical illusion, that is, a distorted perception of reality is generated. There are many types of optical illusions, but one very interesting are those that generate the hybrid images.

By having a hybrid image, our brain generates a different perception of the image depending on the distance we observe it, that is, if we look closely at the hybrid image we see something totally different from what is seen being far away.

The goal of this laboratory is the generation of a hybrid image to observe this phenomenon, applying different tools of image processing, such as filters.

II. MATERIALS AND METHODS

For the develop of this work we used the mathematical programming environment MATLAB R2015a. The images we used for the image processing methods was a screenshot of a monkey Animoji with the mouth open which is formatted as 392*534px RGB 96ppp 24bits and compressed as JPEG Figure 1. And an photograph of a girl taken in a Canon EOS REBEL T5, with a resolution of 1200*1599px, RGB, 96ppp, 24bits compressed as JPG Figure 2.



Fig. 1. Screenshot of an animoji

It was necessary to do some preprocessing to the girl's image to set the same resolution as the monkey image, also to align both images faces. It was applied a simple crop to the girl's image with the program MSPaint to match 392*534px. The cropped photo is in the Figure 3.

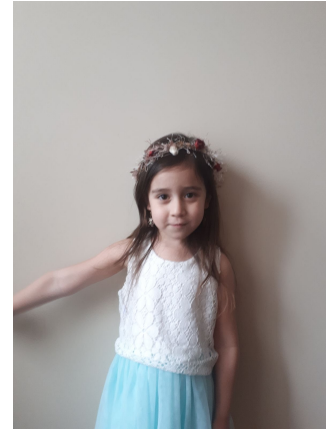


Fig. 2. Photograph of a Girl



Fig. 3. Cropped photograph of a girl

A. Hybrid image

To create the Hybrid image it was necessary to create the filter for the images and do some processing to the filtered images. To achieve this we used a 4 step algorithm:

1. We created the filter to apply to the images, in the next case we used a simple homogeneous filter of a normalized ones matrix of 9 by 9.

```
1 | m_FilterFirstImg =  
   | [1,1,1;1,1,1;1,1,1]/9;  
2 | m_FilterSecondImg =  
   | [1,1,1;1,1,1;1,1,1]/9;
```

We also used a gaussian filter with the Matlab command `fspecial`, using it with a parameter 'gaussian' as the desired filter.

```
1 | m_FilterFirstImg = fspecial('gaussian'  
   | );
```

```
2 | m_FilterSecondImg = fspecial('gaussian
   | ');
```

2. We applied the filter to both the images, To create a high impact to the resulting hybrid image we applied the filter to the image various amounts of times to increase the difference of frequencies between the images.

```
1 | m_FilteredFirstImg = imfilter(
   | m_FirstImg, m_FilterFirstImg);
2 | m_FilteredSecondImg = imfilter(
   | m_SecondImg, m_FilterSecondImg);
3 | for i=1:50
4 |     m_FilteredFirstImg = imfilter(
   |         m_FilteredFirstImg,
   |         m_FilterFirstImg);
5 |     m_FilteredSecondImg = imfilter(
   |         m_FilteredSecondImg,
   |         m_FilterSecondImg);
6 | end
```

3. We created the high pass filtered image by subtracting the low pass filtered one to the original

```
1 | m_FilteredSecondImg = m_SecondImg -
   | m_FilteredSecondImg;
```

4. Finally we merged the low pass filtered image and the high pass filtered image by adding them.

```
1 | m_ResultingImg = m_FilteredFirstImg +
   | m_FilteredSecondImg;
```

B. Blended image

To create the Blended image it was necessary to preprocess the images to merge them into one, filter the resulting image several times creating a pyramid as follows:

1. We have taken the first half of the Girl's photo and the second half of the monkey's image, then we merged those halves in a single matrix:

```
1 | m_MergedImage=[m_FirstImg(:,1:end/2,:),
   | m_SecondImg(:,end/2+1:end,:)];
```

2. We created a gaussian filter using the MATLAB function fspecial.

```
1 | m_Filter = fspecial('gaussian');
```

3. We applied the filter to the merged image as we down-sample and upsample the downsampled one by a factor of 2, this was made to create de Laplacian pyramid using the Gaussian pyramid.

```
1 | m_result=m_MergedImage;
2 | for i=1:4
3 |     m_FilteredImg = imfilter(m_result,
   |         m_Filter);
4 |     for i=1:50
5 |         m_FilteredImg = imfilter(
   |             m_FilteredImg, m_Filter);
6 |     end
```

```
7 | m_downSampled = imresize(
   |     m_FilteredImg,0.5);
8 | m_upSampled = imresize(
   |     m_downSampled,2);
9 | m_result = m_MergedImage - (
   |     m_MergedImage - m_upSampled);
10 | end
```

III. RESULTS

A. Hybrid image

The result of the hybrid image is in the Figure 4. In the Figure we can see that the Girl is blurred and that means that the low-pass filter was applied, this means that just Broad Patterns dominates. For the Monkey it's clear that was applied a high-pass filter and the small details dominates.



Fig. 4. Result of the hybrid algorithm

B. Blended image

The result of the blended image is in the Figure 5. In the Figure we can see that the image is correctly blended in comparison with the image that is just merged (Figure 6)

IV. CONCLUSION

We can observe the potential in computer vision that the image processing can give just with playing with images with real processing units as filtering.

The filters of an image are more than just for cleaning it. They have a lot of advantages because of the possibility of changing the kernel. We can use them to blend images and do more tricks like hybrid images.

With just a few steps with filtering we observe the possibilities of image processing to be applied to real life applications.

0.5em minus 0.4em Harlow, England: Addison-Wesley, 1999.



Fig. 5. Result of the blended algorithm.



Fig. 6. Both images merged but not blended.