# Weekly Report: Hybrid Multi-Frequency Image Illusion

Week 2

Group 10

Dhyey Patel AU2340245, Dhvani Hirapra AU2340238,
Hetvi Raval AU2340015, Shreena Patel AU2340240

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## 1 Objective

Our team aimed to start the process of hybrid image creation, i.e. frequency-based filtering of the image pairs of choice this week. This was aimed at trying various cutoffs in low-pass and high-pass filters and determining their aesthetic effects on the resulting hybrid image.

## 2 Work Done :

### a. Finalization of Image Selection:

• Two appropriate images have been captured on the compatibility of alignment, contrast and visual clarity.

• The conversion of grayscale and resizing of both images were done so that these two images would be of the same size and intensity range.

### b. Landmark Detection:

- To identify key facial feature such as the eyes, nose and mouth, using MediaPipe helped in automatically detecting facial landmarks.

- These landmarks generated in the above steps aided in the alignment of the two images accurately by matching their main facial structures.

- To fit the perspective of one image by adjust the another image, a homography based transformation then can be applied.

- Through above step, smooth alignment and blending was ensured, forming a consistent base for the hybrid illusion.

## c. Implementation of Image Allignment:

- **Image Preprocessing:** All photographs were converted to grayscale and resized to ensure uniform dimensions across all input images.

- **Feature Point Selection:** Key facial features (such as the corners of the nose, mouth, and eyes) were identified either manually or with the help of a facial landmark detector. These points guided the alignment process.

- **Delaunay Triangulation:** The selected feature points were connected using Delaunay triangulation to form triangles such that no point lies inside the circumcircle of any triangle. This created a network of small triangular regions across the image.

- **The transformation of Piecewise Affairs:** A matrix of affine transformation was applied to each triangle in the first image towards a triangle in the second image. The pixels were distorted in each triangle in such a way that they were readily morphable and alignable.

## d. Visualization and Testing:

• Viewed hybrid images in varying distances.

• Within the short range the high frequency image was dominant; with range the low frequency image became predominant - which is what was anticipated in the hybrid illusion.

# 3 Challenges Faced :

• The process of picking image pairs that had similar features (structure, orientation, and scale) took several trials.

• Problem with the alignment of the two images still not in place even after resizing.

• There was slight brightness discongruence with blending.

• The illusion was changing depending on the display resolutions and lighting conditions.

• The adjustments in the color balance were required to prevent the unnatural tinting in the final image.

• In initial trials, the hybrid image for illusion generated was distorted as the features of the high frequency image was lost and only the low frequency was seen at all the varying distance.

# 4 Result obtained

Week 2: Python and OpenCV were used to realise the first successful generation of hybrid images. The realization of low pass and high pass filters of the Gaussians produced a visual difference in layers, which when overlaid produced a credible illusion of a hybrid.

The illusion effect was accomplished well - the high frequency image was more evident when you looked close at the image, and the low frequency one was observed when you looked from far at the image. This denoted the influence of the change in perceptions, which are the essence of the concept of multi-frequency image illusions.

It was observed that: Overall, the experiment successfully demonstrated the theoretical concept of frequency-domain blending, yielding aesthetically appealing hybrid outputs that effectively justified the initial design goals.

# 5 Next Week's Plan

- Expand the Dataset with new images to make innovative and featured hybrid image illusion.
- Compare the visual observation and perceptual balance analysis.

# 6 Conclusion

Week 2 was to focus on practical application of hybrid image formation by using Gaussian filter and image combining. The group was able to generate the first outputs of the illusion confirming the theoretical knowledge of Week 1. The next step will involve enhancement of automation and visual quality.