

lab1

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1 Problem 1

In the figure 1, the original gray-scale picture is shown on the top left. This picture was taken from the host venue from Shanghai World Expo in 2010. The picture has quite a lot of edge directionality as is typical for most buildings. The top right is the result by the prewitt filter. There are some gaps in the edges, especially for the diagonal roofs. The Sober result is shown in the middle left. It performs better than prewitt as it gives more weight to the middle neighbour and the effect is more smooth lines. On the middle right is the result of Canny filter. The edges are cleaner and sharper compared to previous filters. Significantly, irregular shapes like cloud is also visible in the result picture. On the bottom left is the result after the LoG filter. It uses zero crossing to detect edge, so is able to detect the main structures while also preserving details. Similar results are also plotted in the figure 2 for the lolipop image as per problem requirement. The rest analysis will be focused on the first image unless specifically requirement is asked for the second image.

In the figure 3, results of applying the custom kernels are plotted. On the top left is the horizontal sober kernel. On the top right is the vertical kernel. On the bottom left is the -45 diagonal line kernel, and on the bottom right is the +45 diagonal kernel. These plots correspond well to the underlying mask. For example, in the horizontal plot, the vertical lines in the middle are much more absent compared to the rest. The diagonal plots each emphasize their own directionality as is clearly shown from the 'roof' in the building, but in the same time also preserves some of the vertical and horizontal ones. In the figure 4, the gradient image, which represents the magnitude of the gradient vector using the $|\frac{df}{dx}| + |\frac{df}{dy}|$ approximation is plotted.

In the figure 5, the Laplacian(second order difference) image is shown. The result is transformed to a full intensity gray-scale image in a standard fashion.

Salt and pepper noise is then added with size 0.05. The results using the standard filters are again shown in the figure 6. We see that the roof structure disappears from the prewit and sober filters, and the canny filter suffers badly from false contours. This shows that the performance of the differential filters are subject to the influence of noises.

To address that, a median filter of size 3x3 is applied first to the image, since the median filter is best for removing noise which has a sudden rise in intensity value. The result is again plotted in the figure 7. The noises in the sky are removed, however, the roof edges also suffer a bit for the prewitt and sober filters. However LoG and Canny perform still well after applying the median filter.

2 Problem 2

In the figure 7, the original image of the building and its representation in the polar coordinate system are plotted side by side(using the Cartesian coordinate system). Because the problem does not state from which center to do the transform, I choose the center of image for the transform. As can be seen, the straight lines in the original image is transformed into curved lines in the polar representation. In the figure 9, the similar comparison is plotted for the lolipop image. The

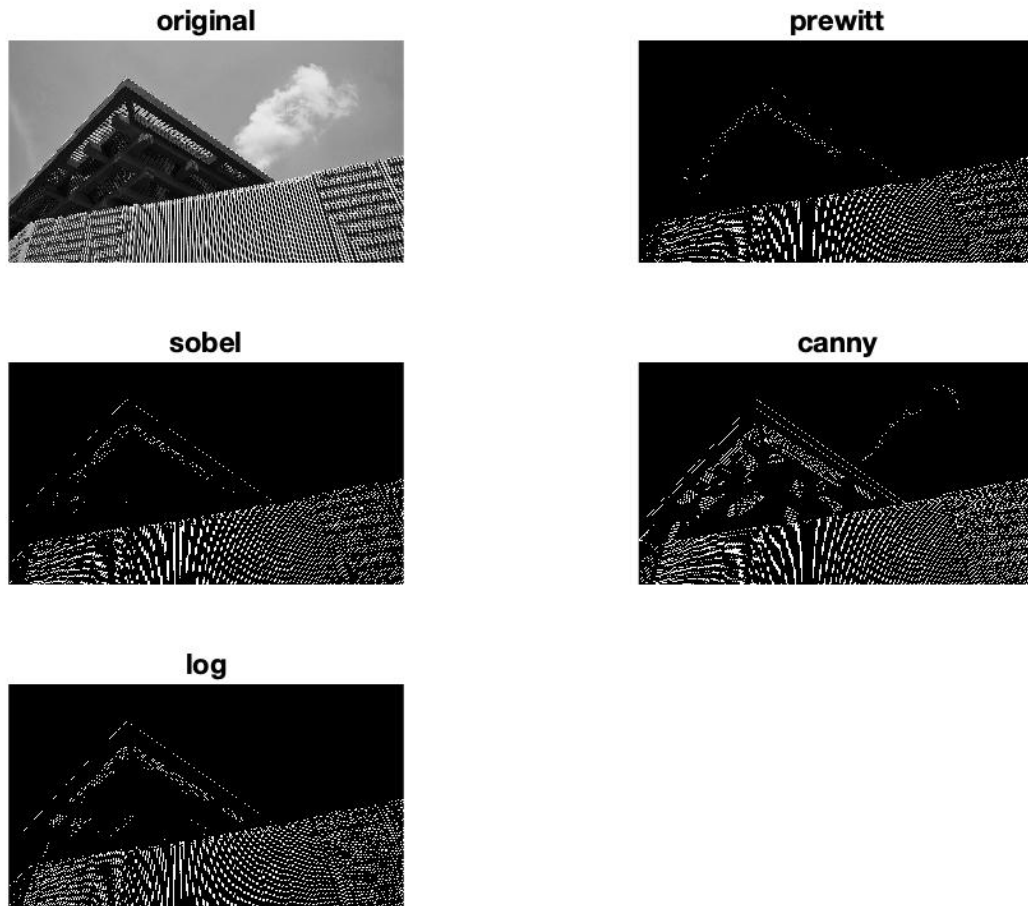


Figure 1: Results using toolbox function edge on building image

curved lines here are straightened in the polar representation. This is expected with the properties of polar and Cartesian coordinate system. That is a straight line maps from one system to another system and vice versa.

In the figure 10, the original image of the anime character Akai is shown on the top left. The glass effect applied on the image is shown on the top right. A square box of size 20 is used here to select the pixel. The visual effect is very artistic and it goes along quite well with the mysterious nature of the character. The swirl effect is shown on the bottom left and the wave effect is shown on the bottom right. Both effects use sinusoidal functions. The wave effect basically pick up point in a way that follows the sinusoidal function. The swirl effect chooses pixel according to the polar coordinate and the effect is harder to imagine.

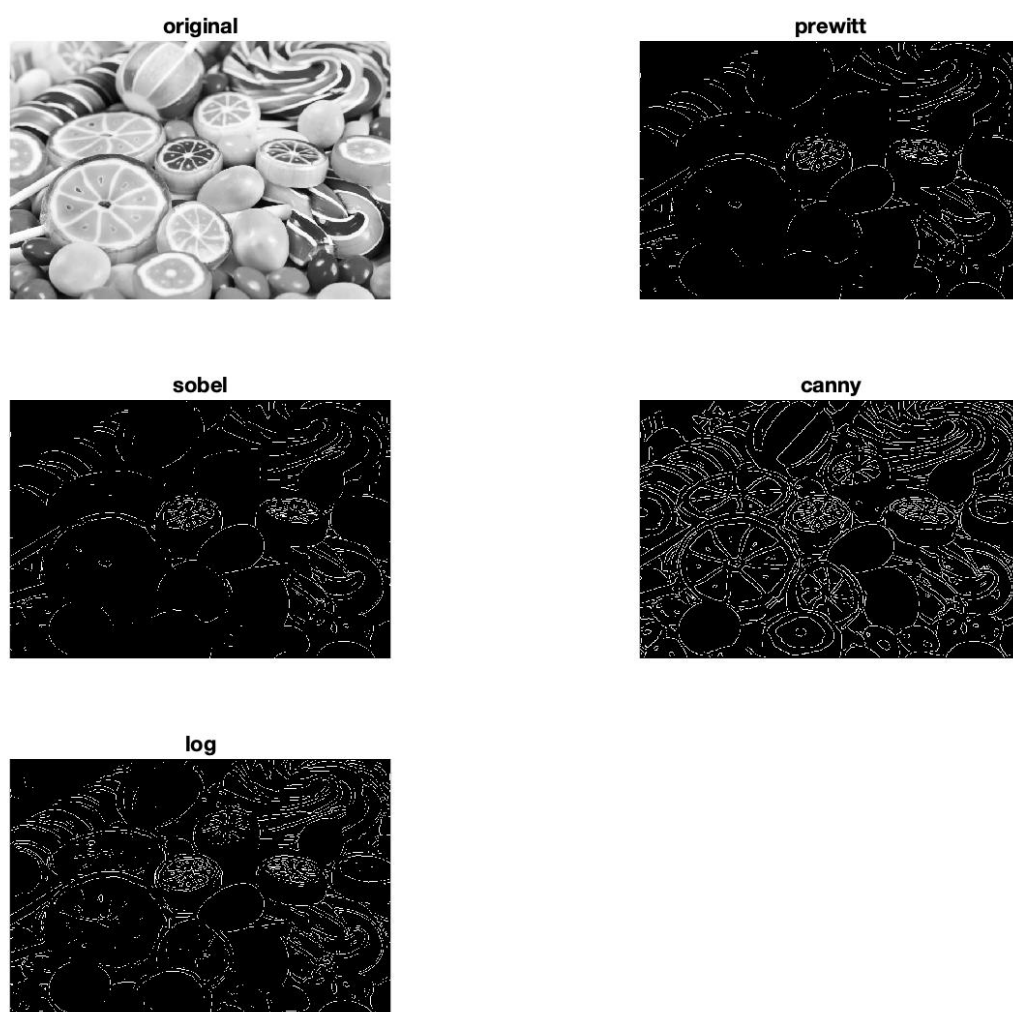


Figure 2: Results using toolbox function edge on lolipop image

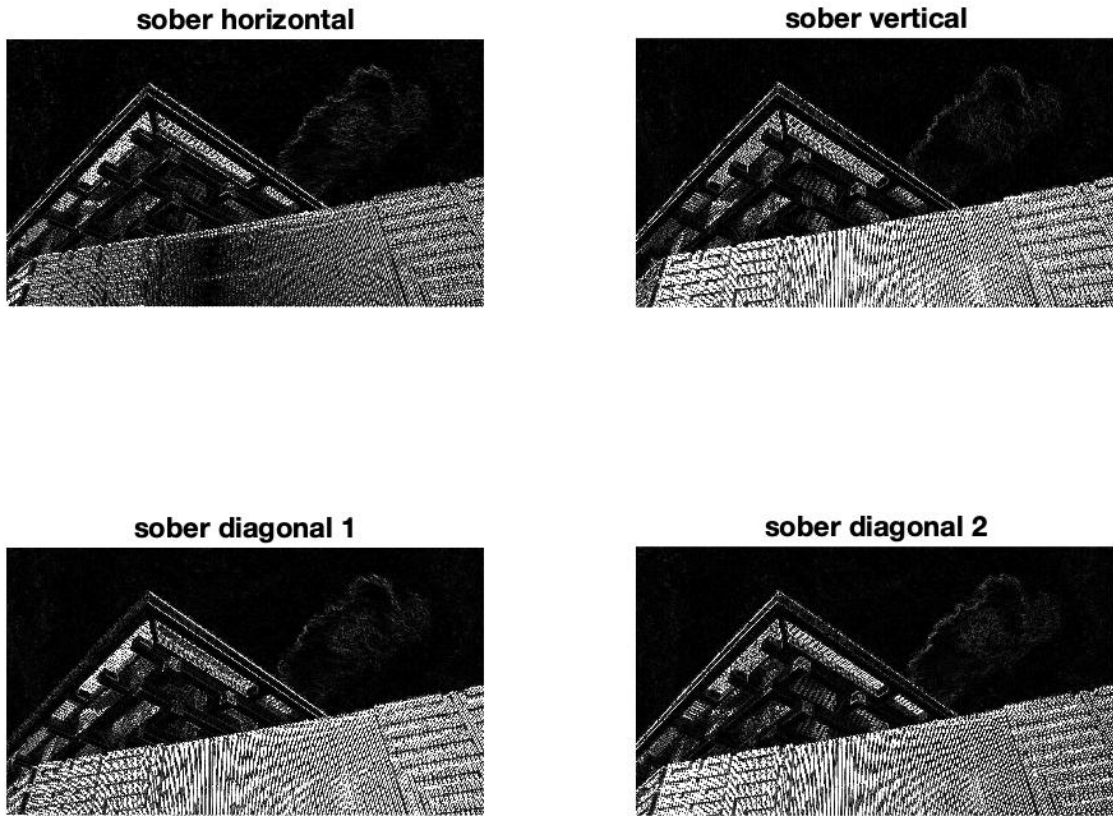


Figure 3: Results of using custom kernels

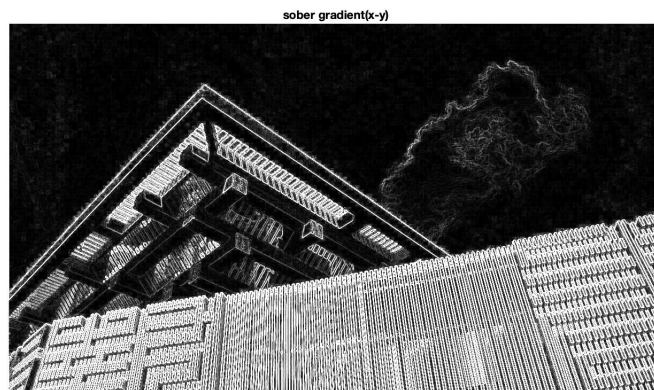


Figure 4: gradient map using $\left| \frac{df}{dx} \right| + \left| \frac{df}{dy} \right|$

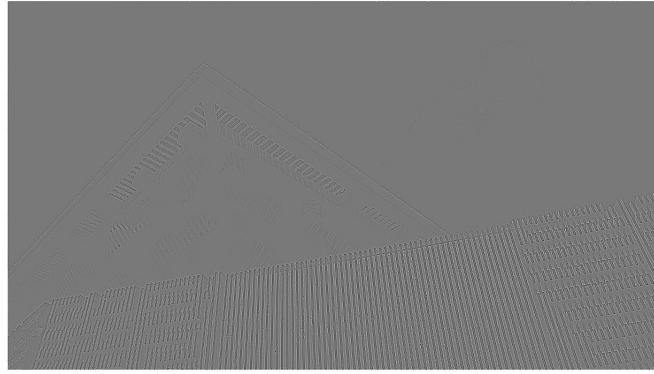


Figure 5: Laplacian image

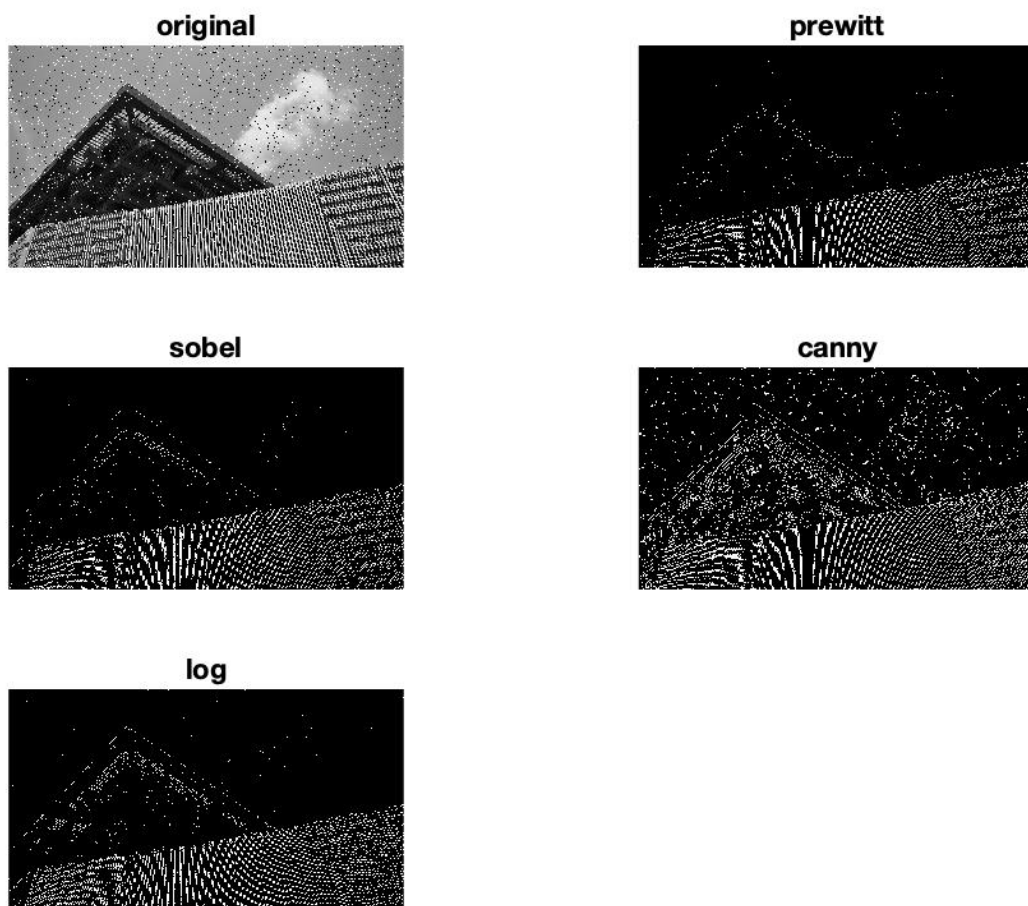


Figure 6: Results when added with salt and pepper noise 0f size 0.1

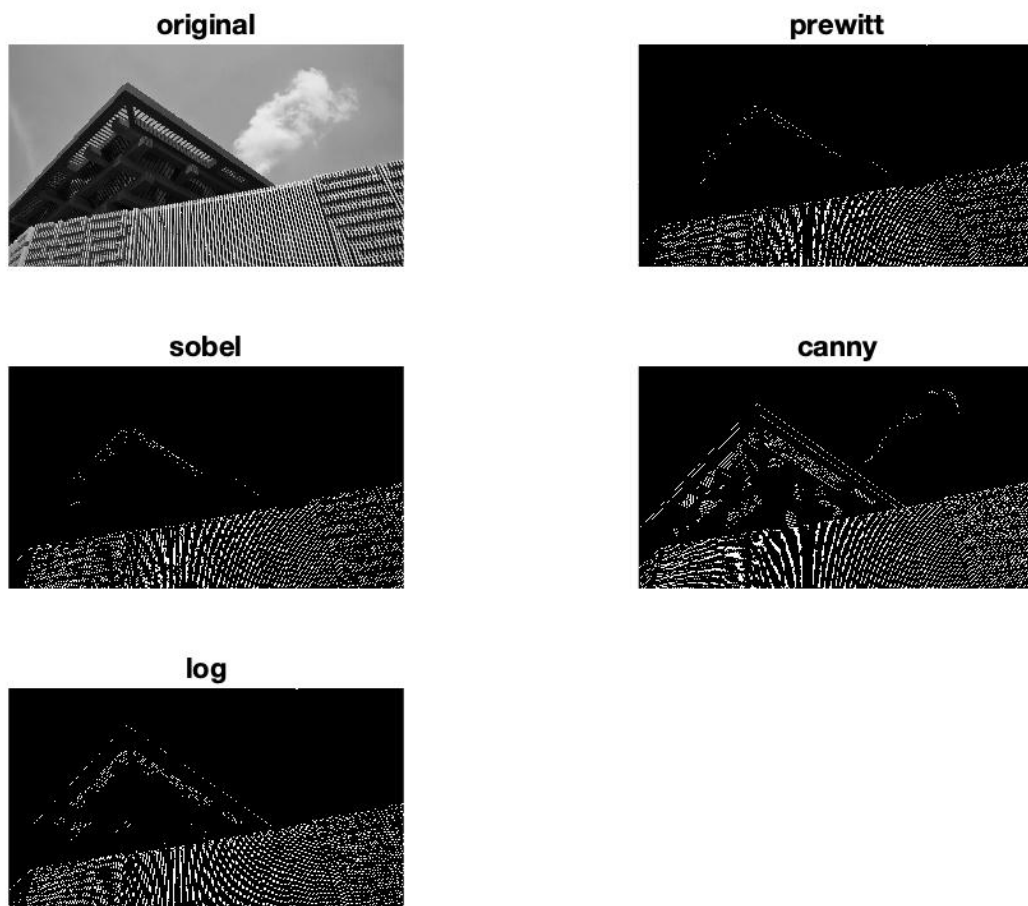


Figure 7: Standard results after applying the median filter

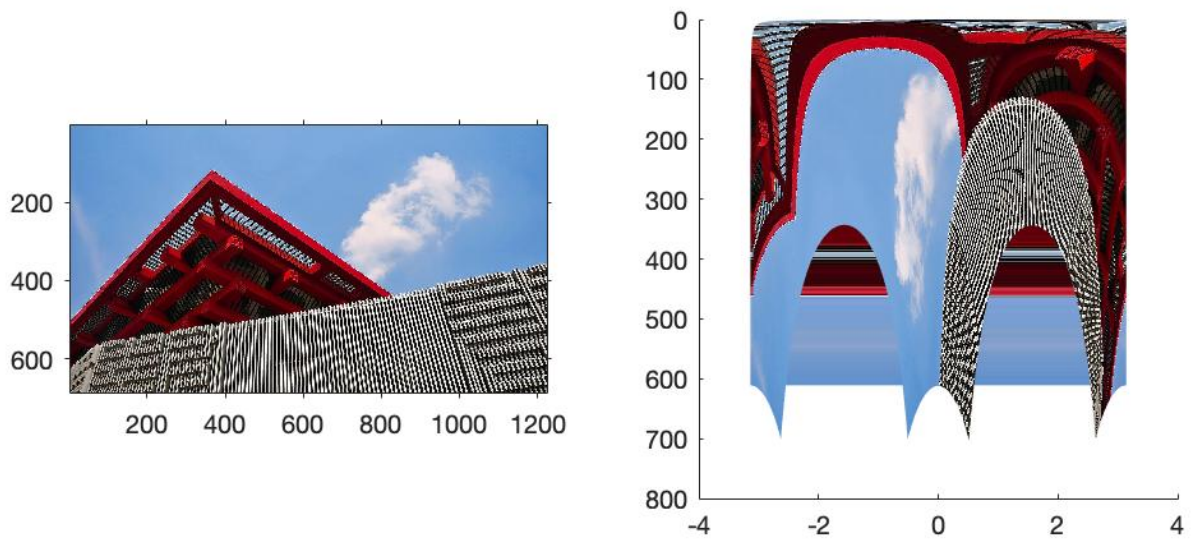


Figure 8: Cartesian to polar coordinate transformation with coordinate center in the image center applied on building image

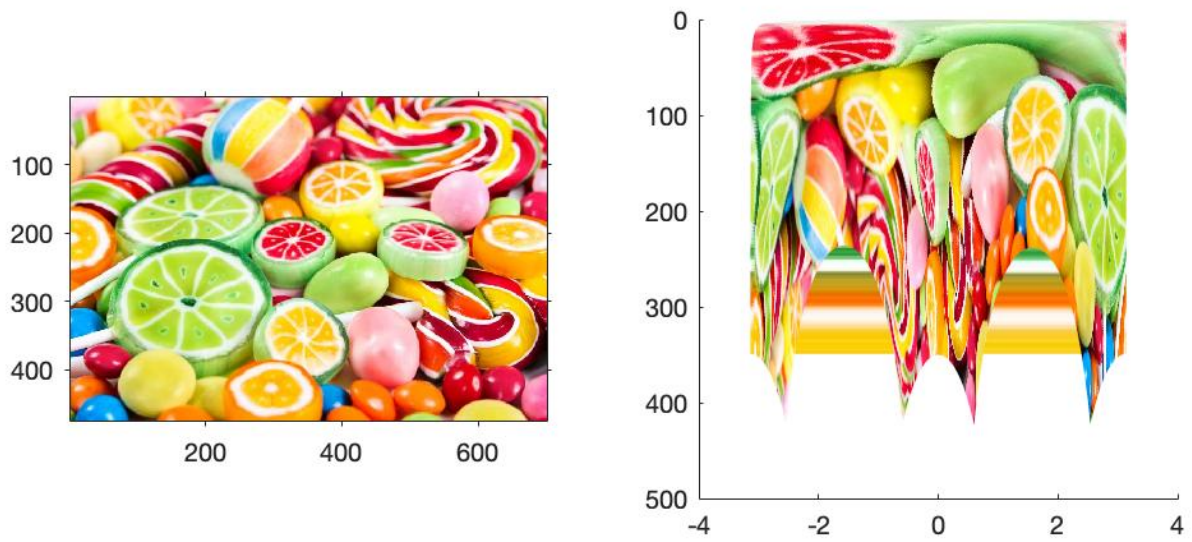


Figure 9: Cartesian to polar coordinate transformation with coordinate center in the image center applied on lollipop image

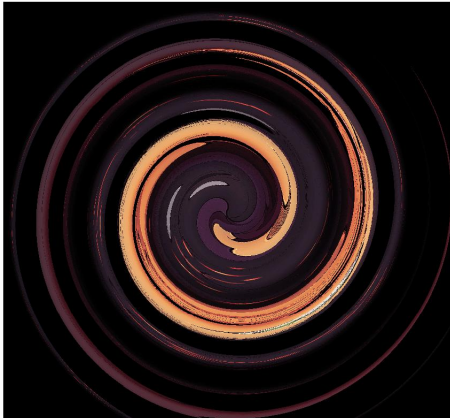
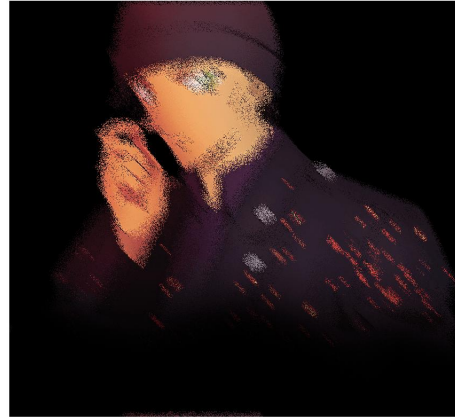


Figure 10: a.the original image. b. The image applied with the glass effect. c. the image applied with the swirl effect. d. the image applied with the wave effect.