Advance Neuroscience HW8

Ali Ghavampour - 97102293

1 Part 1 - Eye Tracking Database

The code is modified so that we can see the eyetracking data on images. Here are some examples.

Figure 1: ShowEyeData function

Fixations are indicated by yellow rectengles and fixations are shown by a number respectively.

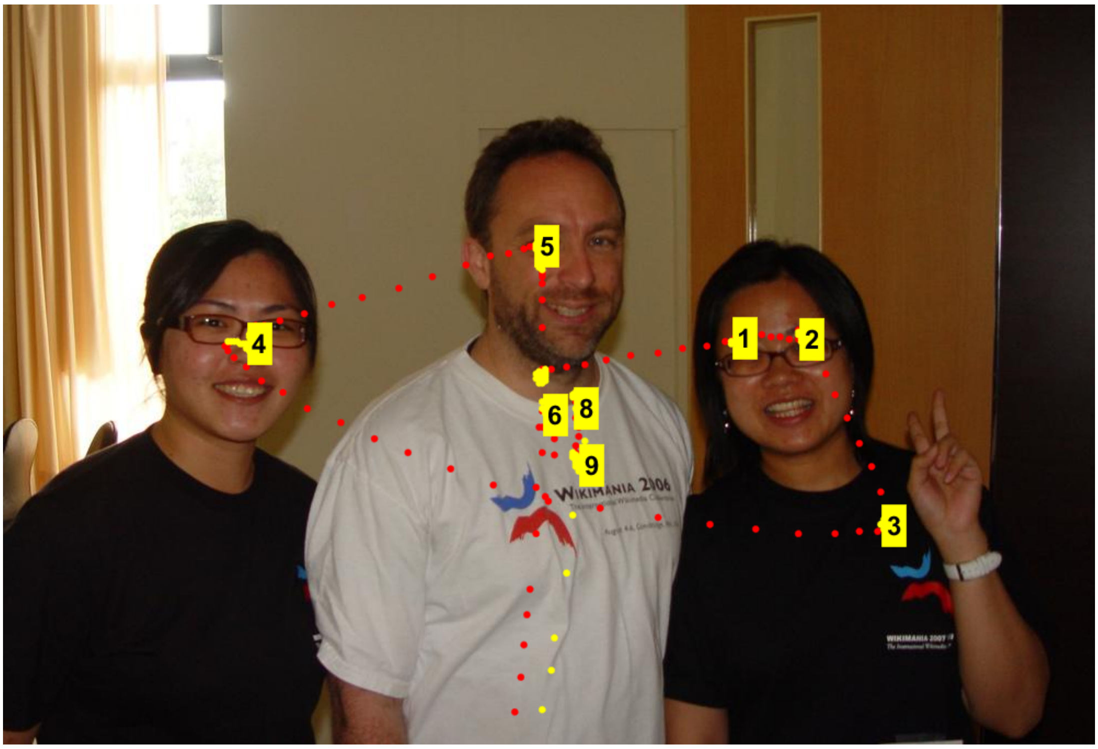

Figure 2: ShowEyeData function

Figure 3: ShowEyeData function

Also, figure 4 shows the result of showEyeDataAcrossUsers function on a sample photo. It indicates the number of fixation and name of the subject in the photo.

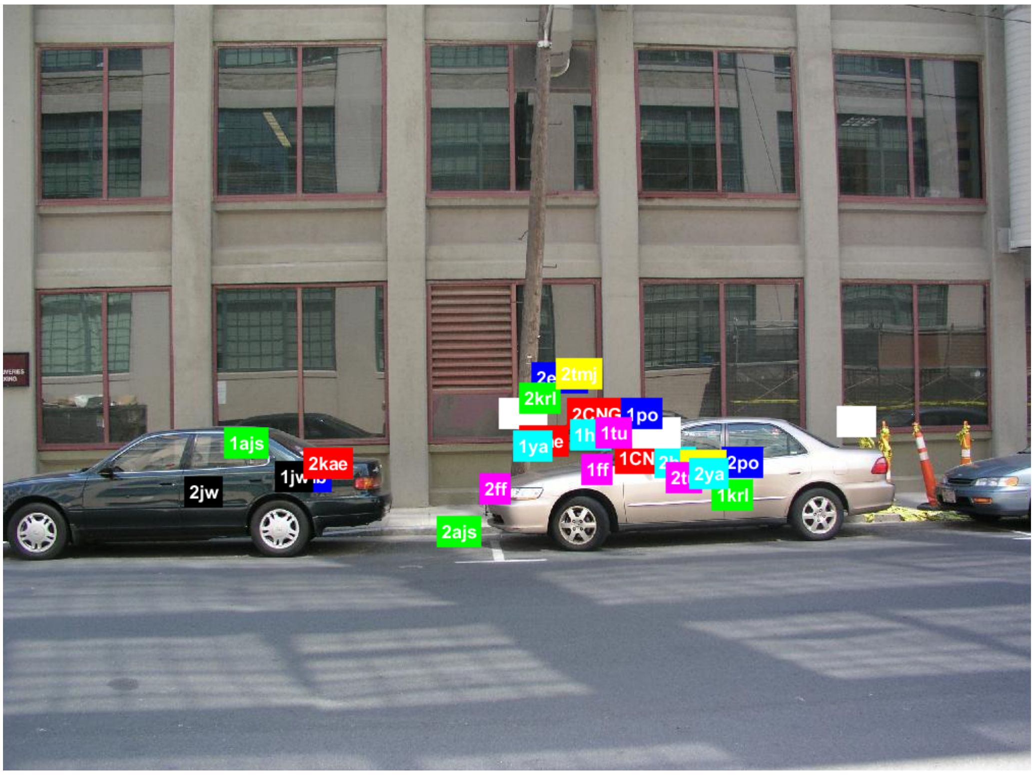

Figure 4: showEyeDataAcrossUsers function

2 Part 2 - Saliency Model

Saliency map is built based on 3 set of features. These are called low, mid and high level features. Each function in the saliency.m code, extract one of the features and make a saliency map based on them. Then, the saliency maps are normalized and added together to make a final saliency map of the image. Here we discuss all of the features and find the respected function.

1) Subband (low-level):
Subband features are found by taking wavelet transform of the image. They represent frequency features like mean of the image, edges and repeating patterns.

2) Itti (low-level):
Itti features are consist of intensity, orientation and color contrast.

3) Color (low-level):
Color features consist of red, green, blue and their probabilities in the image.

4) Torralba (low-level):
Torralba saliency map is also calculated from subband pyramids of the image. So, it should be similar to subband.

5) Horizon (Mid-level):
It finds the possible horizon in the image and puts a gaussian area around the horizon.

6) Object (High-level):
Person and car detection. Puts a white rectangle in the places of the cars and people.

7) Distance from Center (low-level):
When humans take pictures, they naturally frame an object of interest near the center of the image. For this reason a center feature is included.

Figure 5 shows the features and the original image together.

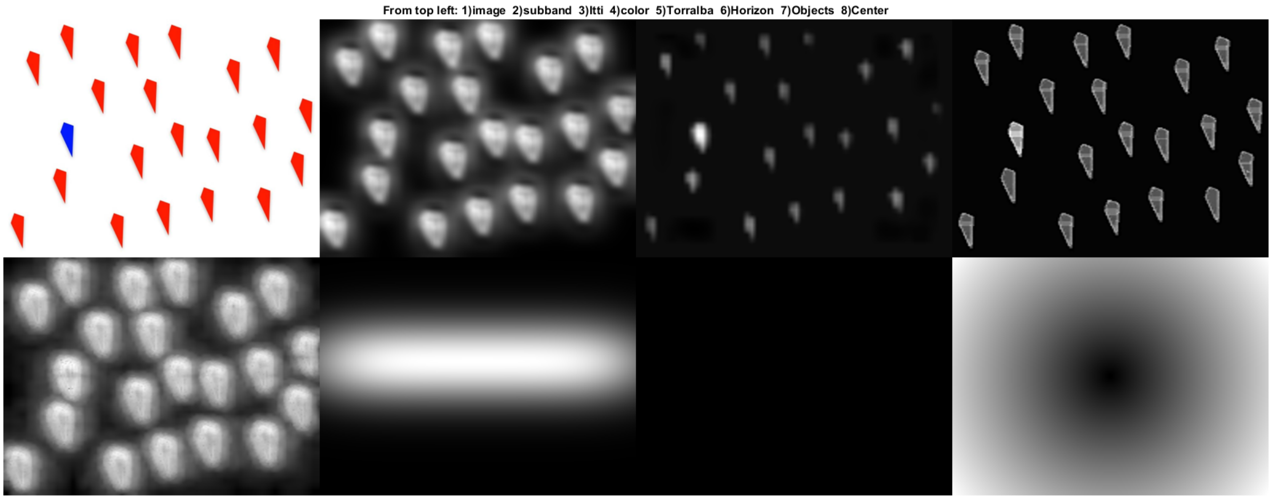

Figure 5: Features

We can see that color related features have brightened the blue shape. In figure 6 we can see how orientation affects the saliency map. Torralba and subband plots have brightened the oriented shapes so, they take orientations into account.

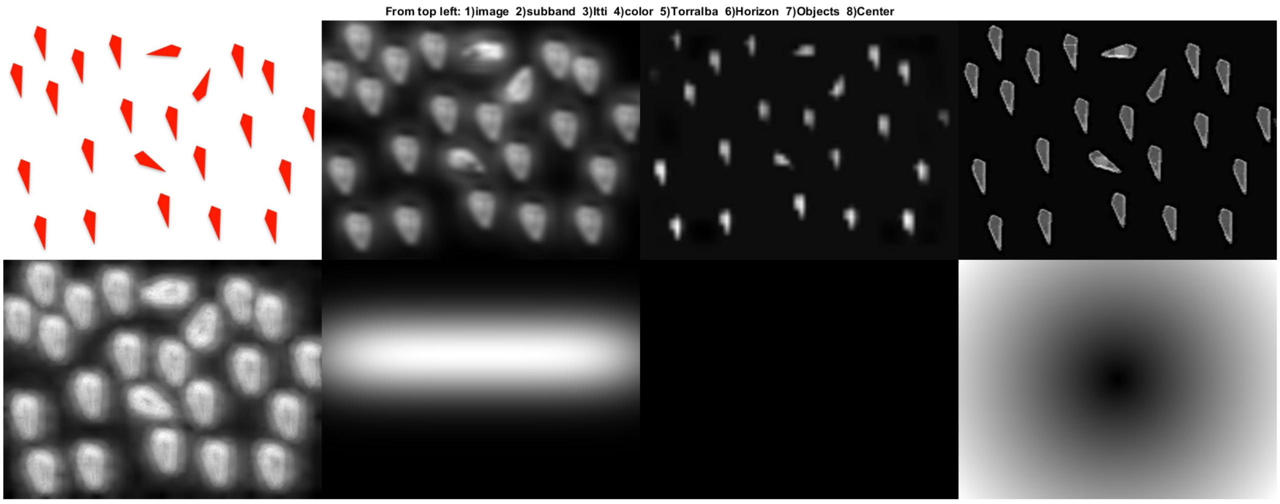

Figure 6: Features

Another example is figure 7. The color is an important feature in this image.

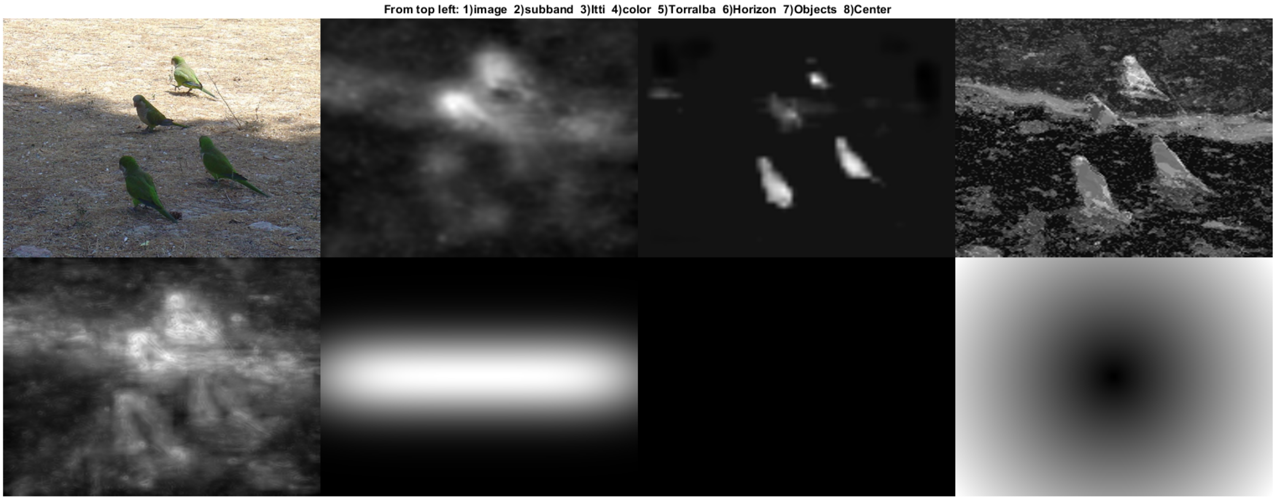

Figure 7: Features

In figure 8 subband and Torralba clearly find the edges in the image.

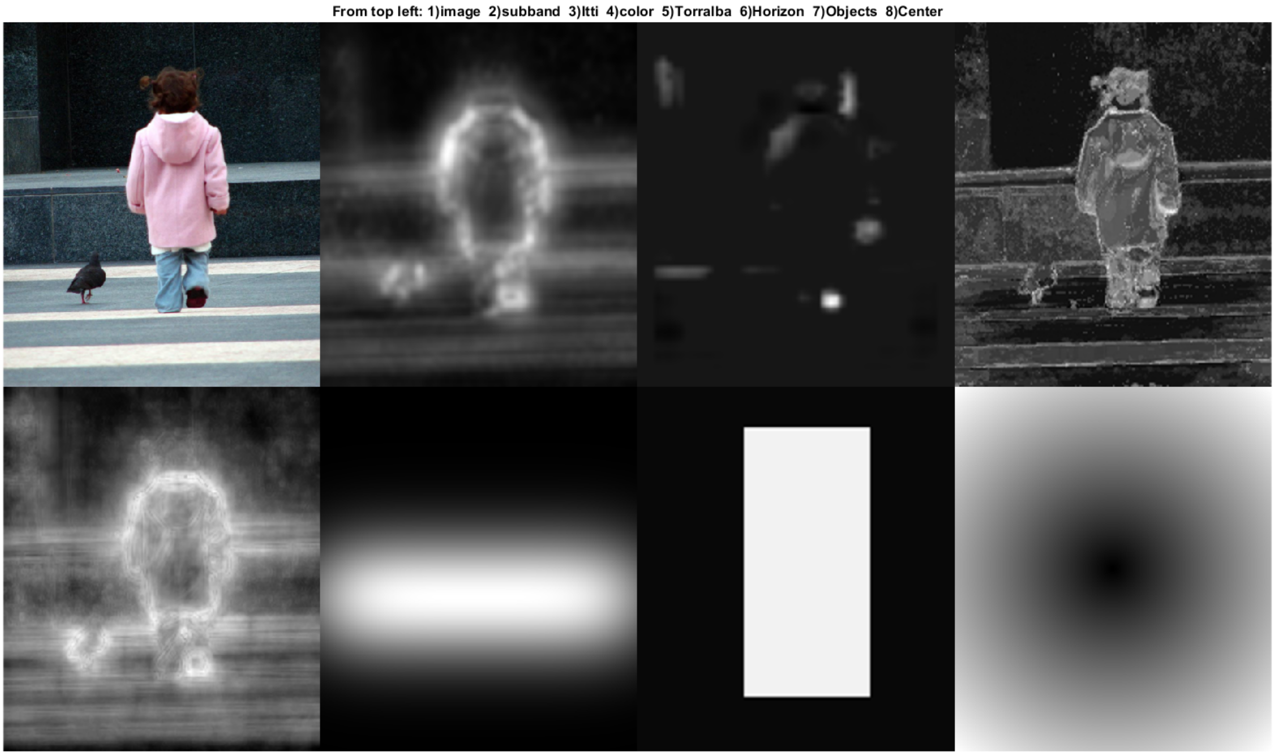

Figure 8: Features

3 Part 3 - Compare Saliency Map and Fixations

First, we take a look at the relation between eye tracking data and saliency maps. Figure 13 is eye tracking data on the calculated and generated saliency map.

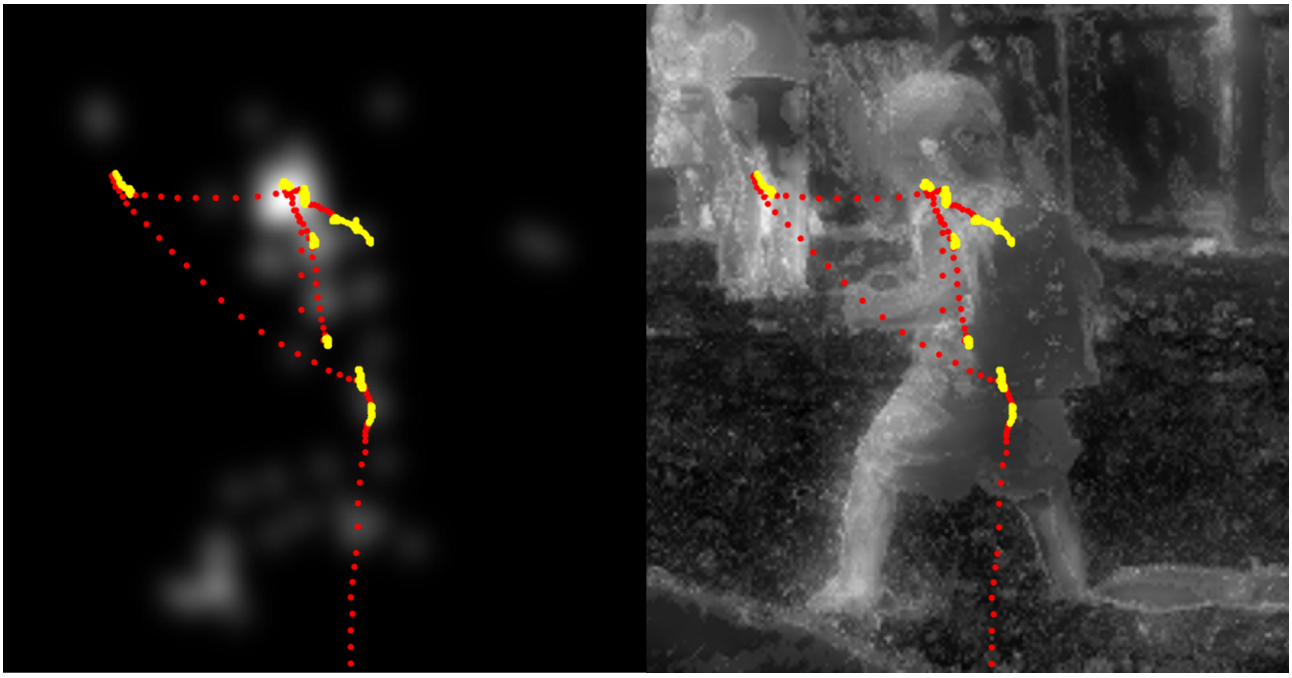

Figure 9

We do the same for another example.

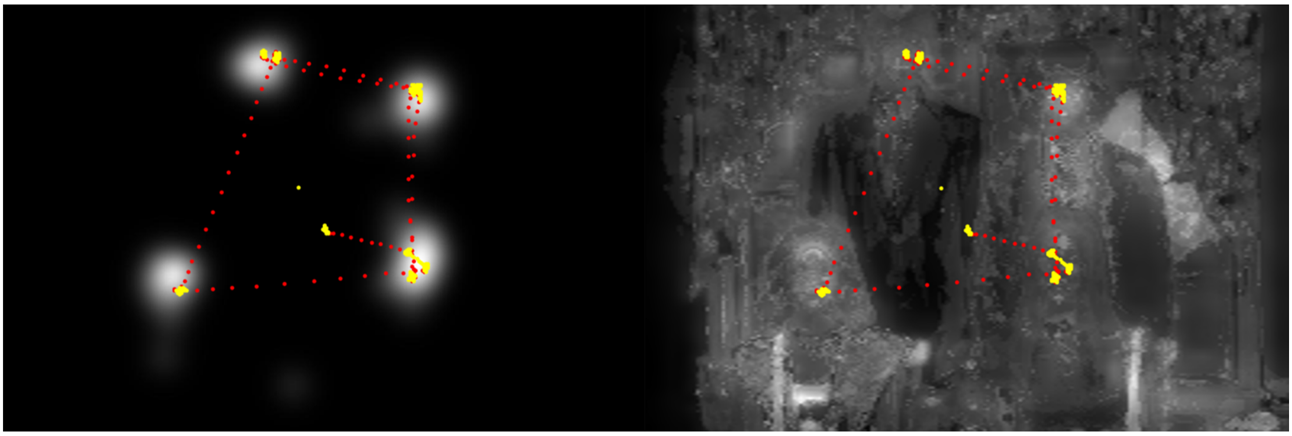

Figure 10

Here because of the lack of face detection in the algorithm, it does not act good and the faces are not brightened.

Now we bring some examples to compare the model's output with the real eye tracking data.

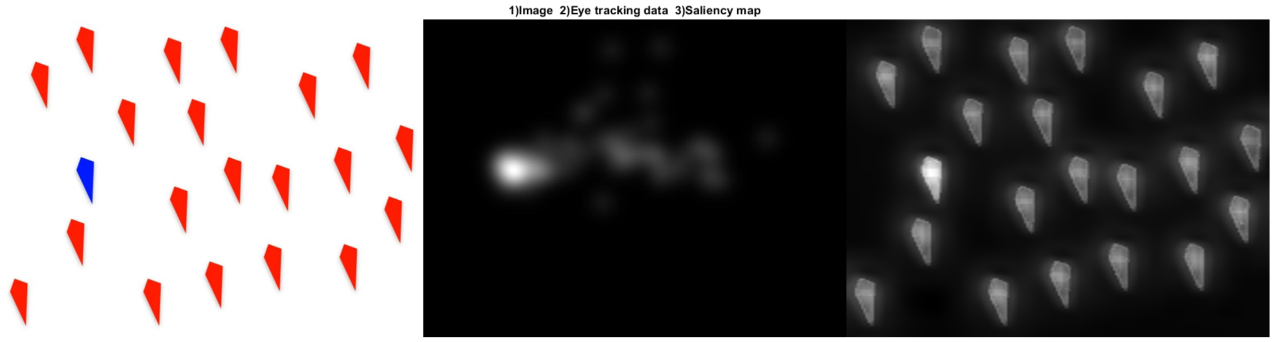

Figure 11

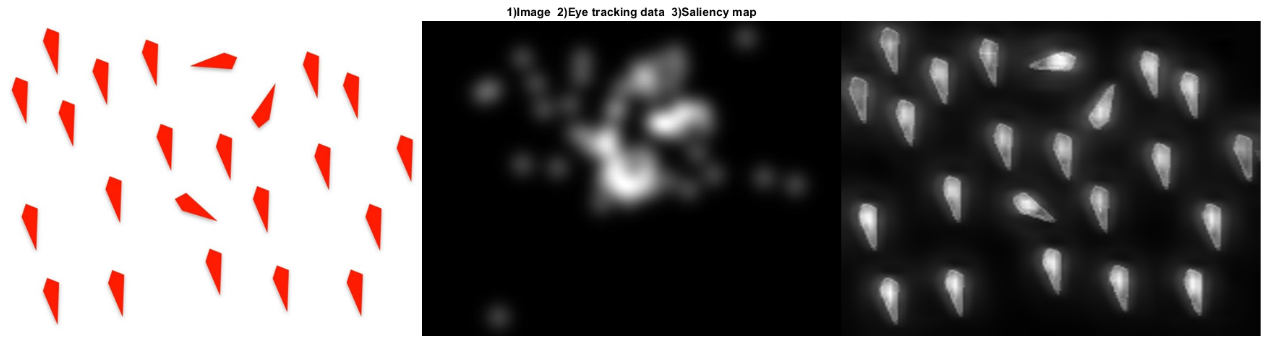

Figure 12

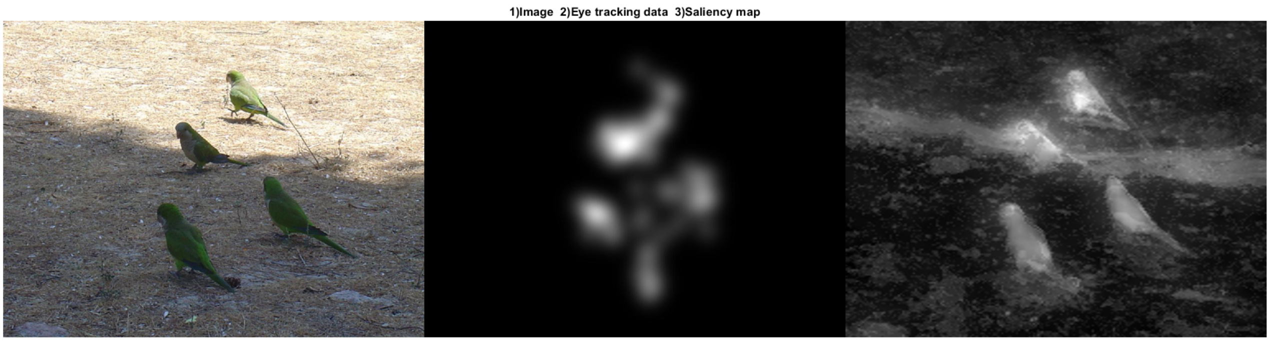

Figure 13

We can see that the model is somehow close to the real data in these particular images. But, when we add images with faces or more complex ones, the model will not generate a real saliency map. (Figure 10)

Now we investigate the difference between early and late saccads. Red dots in figure 12 are first half saccads and the green dots are second half. Also, the middle black circle is the starting fixation point.

Figure 14

Another example.

Figure 15

Because the fixation point is at the center, they eye tracking always starts from the center of the image. Then, if there are faces in the image, the subject will first look at the faces. Then, it goes for other details like texts, vehicles, etc. So, we can conclude that the subjects will first inspect the high-level features like faces and objects then, he/she inspects the details and namely low-level features.

Here we calculate histogram of the scores. First, we calculate the scores for subject **hp**. Figure 16 is the score histogram for all the low-level and high-level features.

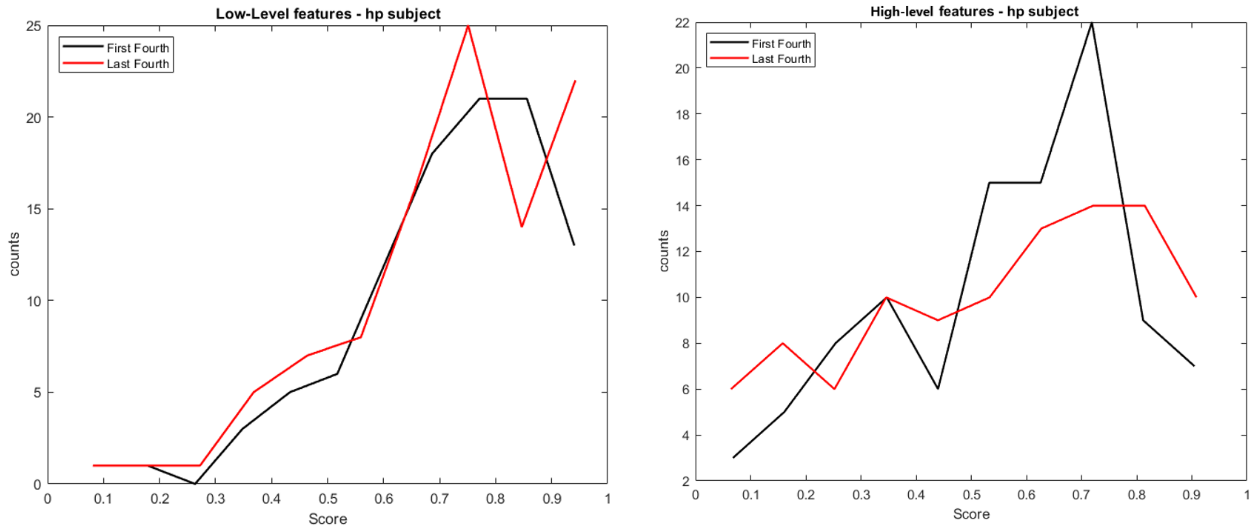

Figure 16: Score histograms

The low-level histogram does not imply anything. But, the high-level histogram shows that high-level features have more scores in the early saccads. Figure 17 is for the same subject but for 7 features.

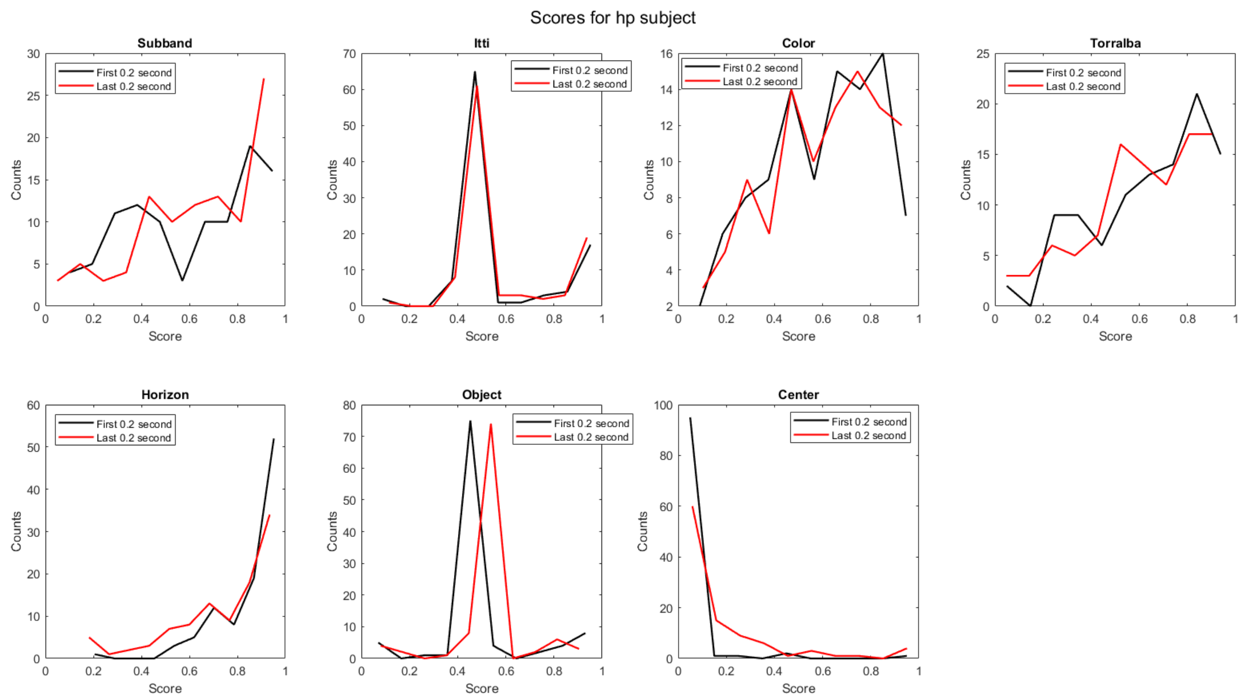

Figure 17: Score histograms

In table 19 we can see how the scores change for subject **hp**.

Subband	**Itti**	**Color**	**Torralba**	**Horizon**	**Object**	**Center**
Increase	–	Increase	–	Decrease	Increase	Increase

Figure 18: Score change table

Now we plot the same figures for all subjects and 50 images.

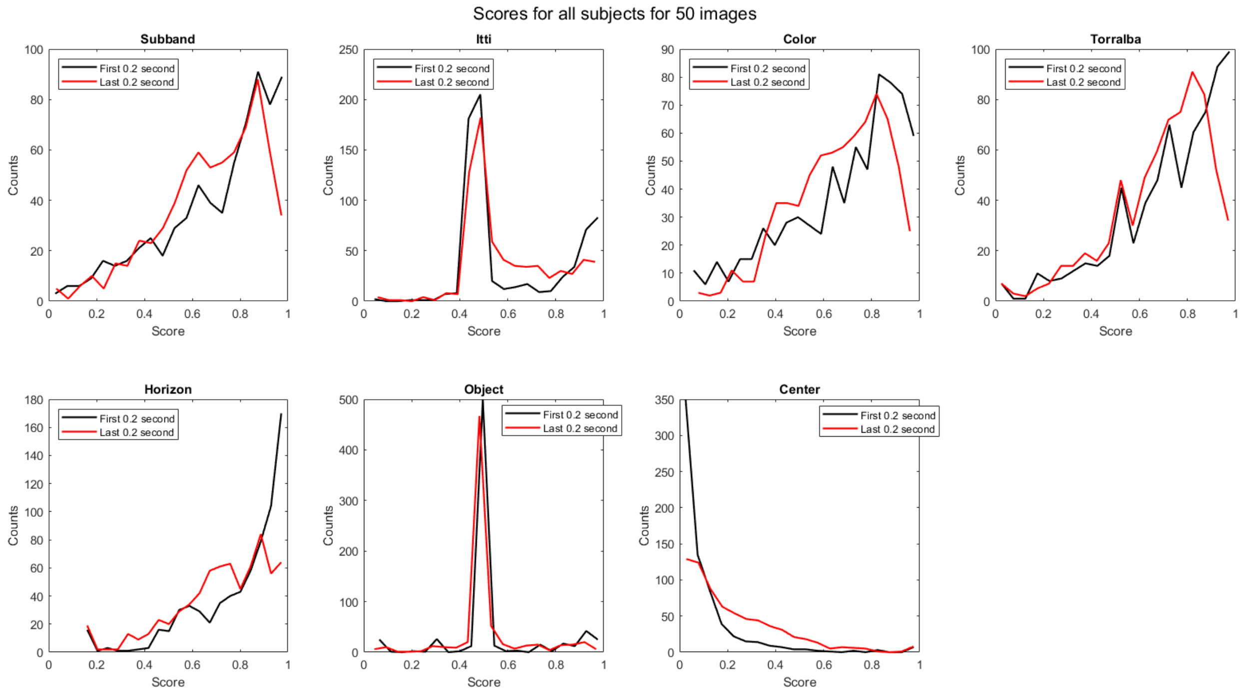

Figure 19: Score histograms

The changes are a in table 20.

Subband	Itti	Color	Torralba	Horizon	Object	Center
Decrease	–	Decrease	Decrease	Decrease	–	Increase

Figure 20: Score change table

Also, the low and high level feature scores are calculated for all the subjects and the result is as in fugure 21.

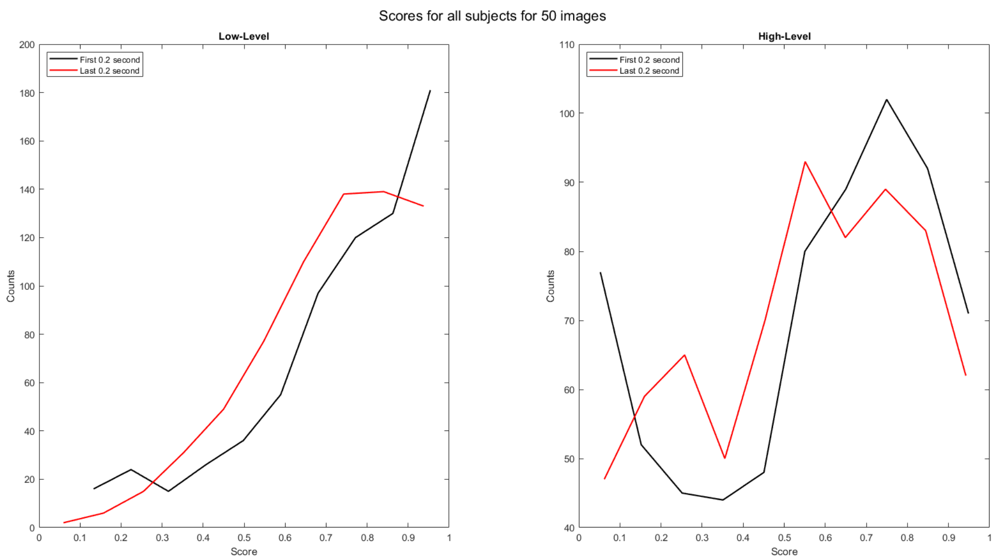

Figure 21: Score Histogram

We can see a decrease in both of the features.