

# Proposal for a Database of Gaze Points When Looking at Paintings

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Keywords: Painting, Gaze Point, Database, Saliency Map

## ABSTRACT

*By constructing a database of eye movements and gaze point distribution when looking at paintings, it is possible to clarify the relationship between the artist's intention and the viewer's eye movement. Here, we introduce our experimental method and initial experimental results.*

## 1 INTRODUCTION

A good painting can elicit emotions in its viewers because they can feel the intention that the artist brought to the works, at least in part because the artist guides their gaze [1]. Noton [2] named such gaze patterns "scan paths;" scan paths indicate the movement of regular gaze patterns from one feature to another when scanning a figure and predict the regularity of eye movement in visual perception. A calculation model that estimates the locations at which people's gaze points are likely to convene based on the features of image is called a "saliency map" [3].

We assumed that there was regularity in the movement of the gaze when looking at an excellent painting, and began constructing a database of gaze and gaze point distribution in order to clarify the relationships among the artist's intention, the viewer's eye movement, and saliency map. Here, we introduce our experimental method and present our initial results.

## 2 EXPERIMENT

We presented 45 paintings to each of 5 subjects for 15 seconds each. We used paintings from "The Outstanding Paintings, Visit the Orsay Museum of Fine Arts" (BS Japan, 2016) photographed with a 4K camera so that the original image would be reproduced as faithfully as possible. We used a 4K display to show the paintings in the format of a video upconverted to 4K. The viewing distance was 1.5H, where H is the display height. In order to prioritize the reliability of the database, each subject's head was fixed with a head support. Binocular eye

movement was recorded at 240 Hz using "NAC Imaging Technology EMR-9" to measure eye movement. Our subjects were 21- to 22-year-old university students with a visual acuity of 1.0 or more including corrected vision. This experiment was conducted in accordance with the regulations on "Research on Human Subjects" of the Tokai University Ethics Committee.

## 3 RESULTS

We examined the distribution of fixation points of 5 subjects when presented with 2 works: "The Gleaners" (Fig. 1) and "The Path through the Long Grass" (Fig. 2), both of which have distinctive human and landscape features. We used scatter diagrams to show the subjects' gaze points, based on the data from each subject's dominant eye. The gaze point distributions of the 5 subjects are shown in different colors in the image on the right in Fig. 1 and 2.

In "The Gleaners" (Fig. 1), 3 women pick wheat in the center of the picture. All subjects had a high rate of gaze points at the women. Four subjects also looked at the trees and wheat, while the fifth (blue) looked only at the 3 women.

"The Path through the Long Grass" is a landscape painting depicting people walking downhill. Four subjects looked at the whole picture, and one subject (blue) looked only at the people and the direction they are going in the painting.



Fig. 1. "The Gleaners"  
(left: original; right: gaze points)



Fig. 2. "The Path through the Long Grass"  
(left: original; right: gaze points)

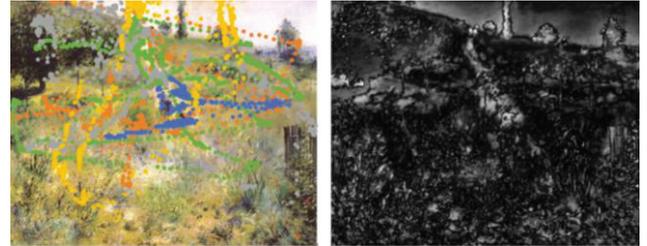


Fig. 4 "The Path through the Long Grass"  
(left: gaze points; right: saliency map)

#### 4 DISCUSSION

The results from the landscape painting confirmed eye movements showing that the viewer looked over the whole, including trees and flowers, and the border between the meadow and the sky. It was also confirmed that there are differences among subjects. Therefore, we gathered data on gaze points and began building a database based on their distribution.

For this experiment, in order to investigate the relationship between eye movements and image features, we used saliency maps. The saliency maps of each of the two works under consideration are shown in Fig. 3 and 4. The saliency maps show the most outstanding parts of the image in white and gaze points are predicted to accumulate in those area. In "The Gleaners", the saliency map shows many white parts around the three women, and our experimental results conform a high number of gaze points at that location. Similarly, in "The Path through the Long Grass", the saliency map shows white parts scattered all over, and our experimental results conform that some subjects looked over the whole painting.

We found that all subjects had gazed at the most outstanding parts of the saliency maps, and indeed, one subject (blue) looked only at those parts most strongly indicated by the saliency maps.

To date, only 5 subjects have participated in this experiment. However, it can be understood from the present experimental results that there are individual differences in where people look. We are currently continuing the experiment in order to increase our understanding of eye movements by acquiring data from a large number of subjects.



Fig. 3 "The Gleaners"  
(left: gaze points; right: saliency map)

#### 5 CONCLUSIONS

The artist of any painting is said to compose the painting in order to lead the gaze of the viewer to the intended subject. Attempts to predict human gaze positions are being actively conducted in research on gaze estimation taking saliency mapping into consideration [4]. Such studies target a variety of natural images, and it has been found to be difficult to determine typical gaze movement due to significant individual differences. It is possible that we may use our data as training data, given that that a good painting is likely to induce to lead the viewer's gaze to the place intended by the artist. Our planned gaze database for paintings will make it possible to more easily compare how different people view a painting. We believe that it will also help to clarify the relationships among the artist's feelings, the viewer's eye movements, and the saliency map.

Additionally, we would like to increase the number of subjects in order to be able to provide our data to researchers in the most reliable and reproducible way possible. In addition to examining the viewpoints of a painting, we would like to contribute to studies on the high precision of saliency maps for works of art.

#### 6 REFERENCES

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