

A Study on Reflecting User's Emotions Using a Painterly Rendering System

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Abstract

Painters express visual experience in paintings through their own form of artistic expression and viewers feel various emotions about the elements appearing in paintings. However, it is very difficult for non-experts to express their emotions in painting by using painting elements as painters do. Thus, we aim to help users to express their feelings by improving their understanding of painting elements. To do this, we created a variety of paintings based on elements using a painterly rendering system with painting features. Then, the relationship between painting elements and emotions was examined through the study of users. We present a method of generating a painting expressing a specific emotion by applying elements according to certain emotional values.

CCS Concepts

• **Computing methodologies** → *Non-photorealistic rendering*;

1. Introduction

Paul Klee, a German painter of modern abstract art, said “Art does not reproduce the visible but makes visible”. That is to say that painters depict the experience of seeing things to painting through the form of specific artistic expression. Because of this form appearing in the painting, people feel various emotions when they admire an art work. The painting on the left in Figure 1 is Munch’s ‘The Wedding of the Bohemian’. Munch is the artist, famous for his work ‘The Scream’ On the right is ‘The Dinner’ by Eva Armisen. Both painters have drawn people who enjoy a meal, but the emotion that we feel upon regarding these images is quite different. Munch, who had suffered a series of unfortunate events, created paintings with dark colors, rough strokes, and heavy outlines and his paintings tend to make people feel unstable and depressed. On the other hand, the works of Eva Armisen, who is known as a painter of happiness, focuses on capturing daily life and everyday reality as something extraordinary and makes people feel positive and happy.



Figure 1: An example of picture showing the emotional change depended on the elements of the painting.

The aim of this paper is to help non-experts, who lack understanding about the elements of painting and do not have good technical skills, to express their feelings in painting by improving their understanding of the elements of painting. However, most of the research into generating image with specific emotions has focused on colors. In the study of [MSMP12], [WJLC12], [HQZ15], [CSMS11], [KKL16], emotion-based color transfer techniques were proposed. Some research that aimed to generate emotional painting with color and painting elements has been done. In the study of [SBC06], painting elements such as region turbulence, tonal variation, stroke denotation style were used for generating empathic paintings. In another study by [CVP08], emotional portraits were generated by rendering stroke style, rendering curves, segment filling style. And more recently, [LP18] proposed a texture-aware emotional color transfer method between images, which considered not only main colors but also texture features in process of computing the target emotion. But this method generates the result images only by an emotion-color model. In this paper we propose a method for generating paintings of specific emotions by applying painting element about brush information using a painterly rendering system.

2. System

Using the painterly rendering system that applies painting elements as parameters, paintings were generated to evoke specific emotions. Figure 2 shows the overview of emotion based painterly rendering system .

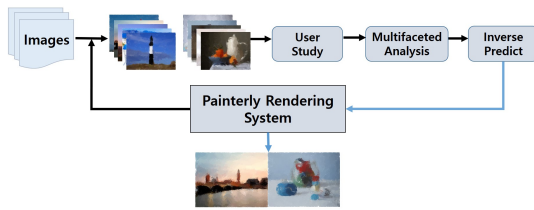


Figure 2: Overview of the System

2.1. Generation of a representative painting model

In order to develop a representative painting model based on painting elements for emotion measurement, we used the stroke-based painterly rendering system of [CKY17, SY09]. The painting elements have an effect on the process of selecting brushes, so a variety of paintings were generated.

To identify a clear relationship between the painting elements and the emotions evoked, four parameters having the greatest effect on the results were selected. LayerIndex, which is related to brush size, is a parameter for how many layers are used. Then the larger the layer value, the more smaller brushes are applied. AngleWeight, which indicates how much the brush follows the edge direction, is affected in brush selection process. Setting AngleWeight to a large value is equivalent to selecting a brush that has a similar angle with edge direction. The AbstractLevel is a parameter that represents the level of abstraction of paintings. For this, a super pixel algorithm is used. The larger the parameter value, the larger the set of pixels is created. ColorRandomness represents the range of color diversity. If this parameter has a large value, more variation is given to the hue value.

2.2. User study for analysis of emotion

The paintings generated in the section above were used for the collection of emotional data. The paintings used in the questionnaire were obtained from six input images consisting of landscape and still life pictures. Twenty-four non-experts responded to questions about the emotional values of the paintings. In this questionnaire, We used 'Russell's Circumplex Model of Affect' which consists of the valence dimension and the arousal dimension [PRP05]. For each painting, the intensity of Arousal and Valence were evaluated in five steps. Through this user study, a database of emotional information was built based on the painting elements.

2.3. Multifaceted analysis of painting elements and emotions

The correlation coefficient shows the relationship between two variables. We obtained correlation coefficient from a database of emotional change about paintings. Through this, we confirmed that LayerIndex and AbstractLevel have positive correlations with emotion, while AngleWeight and ColorRandomness have negative correlations.

Regression analysis was used to estimate the influence of each independent variable on the value of the dependent variable and

analyze their relationship. In order to construct a predictive model to determine painting element values for certain emotions, linear regression analysis with the model equation of $y = \beta_1 x_1 + \dots + \beta_n x_n + \epsilon$ was used.

2.4. Generate painting for user's specific emotions

The linear regression model obtained in Section 2.3 was used to generate a painting that represents certain emotions. First, independent variables for specific Arousal and Valence values were found in the database of emotional information which obtained from userstudy and the mean values were determined. Then, the mean values were applied to the equation below that was obtained using a linear regression model to acquire the appropriate parameter value [BB17]. The following equation is an example of a formula for estimating the parameter value for a certain emotion. The parameter value obtained through the equation does not completely represent the parameter value. We therefore, normalize the data and transform it into a value suitable for the rendering system.

$$\text{PredictedLayerIndex} = \frac{y - (\epsilon + \beta_2 \times \bar{x}_2 + \beta_3 \times \bar{x}_3 + \beta_4 \times \bar{x}_4)}{w_1}$$

3. Result

Applying the parameter values that obtained by prediction to the rendering system, a painting image for a certain emotion can be obtained as shown in Figure 3. The right side of Figure 3 shows painting with a value of one for both Arousal and Valence and these painting expresses emotional adjectives, which is close to 'sad', 'depressed', 'boring', and 'tired'. The painting on the left has a value of five for Arousal and Valence, and expresses emotions, which is close to 'hilarious', 'happy'.

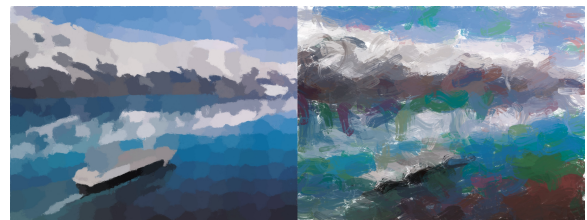


Figure 3: An example of paintings generated by applying a painting element value for a certain emotions

4. Conclusion

This work introduces a method for generating paintings relating to a user's specific emotions. However, in the result, there is no significant change in each painting. Therefore, analyzing relationship between emotions and painting elements and applying additional algorithm about recoloring method are an ongoing research topic and can improve the performance of express more precise emotion.

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