A Study on the Prediction of Emotion from Image by Time-flow depend on Color Analysis

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***Abstract*— When people are looking at a landscape, we feel different depending on time/season. This part is based on the colors of the landscape, even if you look at the same landscape due to the visual elements. We wanted to analyze human emotions, especially based on color, among these visual elements. For this purpose, machine learning models were established according to color and human emotion changes were analyzed quantitatively over time. Finally, we analyzed how much color affects human emotions.**

Keywords—Emotional Analysis, Machine Learning, Logistic Regression, Random Forest, Landscape Image

I. INTRODUCTION

People feel various emotions according to time and season. There are emotions that they feel because of the events of the day, but they change even on a day when nothing happens. There are many factors that change people's emotions from day to night, from night to dawn, or from season to season, but one of the things that they see visually is one of them. Just as we can feel certain emotions when we look at an image, we expect that changes in the landscape we see in our daily lives can also affect our emotions. To confirm whether these hypotheses are true, we analyzed whether the landscape with changes in time/season affects one's emotion.

We used mechanical learning to analyze these emotional changes. If previous emotional studies[1-4] only predicted direct results from input, we focused on analyzing the emotional changes from input changes. The part that changes in the image of the same place as time changes is color. Therefore, we analyzed the change of emotion based on color.

The contribution of our research is as follows. The first image was analyzed and a model was produced to predict emotion. There are many studies that predict emotion in images, but we have produced emotional prediction models centered on color so that we can analyze the changes in time. Emotional forecasting models can be applied not only to our research but also to other emotional studies. Second, by using various machine learning models, we could find a matching machine learning model in image-color analysis. Third, emotions were analyzed to make them easier for users to understand by categorizing them into several categories. Some previous studies predict emotion with a numerical value called Arousal-Valence, but there is a disadvantage that it is difficult for the general public to understand. However, we have made predictions with representative human emotions so that even ordinary users can understand them. Finally, emotional analysis with time change was conducted. By finding the basis for the gloomy, daytime lively emotions at dawn, which we generally know, we were able to analyze the universal feelings of people in our daily lives.

II. COLOR AND EMOTION

When humans perceive things and phenomena, they receive 70 percent of the information from visual elements in five senses. According to [5], color is a factor that affects unconsciousness and consciousness at a stage ahead of form, and it affects emotion more than form. Also, [6] says that color plays a role in human physiologic reactions, as well as in various thoughts, judgment, emotion, and psychological reactions. In other words, color is the most important element of emotion. For this reason, many studies have been conducted on the relationship between color and emotion, especially [7][8] conducted a study on how emotions are felt through various color combinations, and we applied this part to our research. We categorized the predicted emotions in order to extract them from colors. We divided emotions into four categories of happiness, depress, comport and passion, and proceeded with four emotional categories for images.

III. SYSTEM

In order to predict emotion in the image, we proceeded with the study in the same order as Figure 1. Analyzing a single image of numerous colors required a lot of time and resources to extract and analyze by color, so we found the primary color in the image. This is because, in general images, the amount of information, if not primary colors, is small, and thus has less impact on the results. We extracted some colors from the image and used them to conduct machine learning. The analysis was conducted on the relationship between time and emotion using the results.

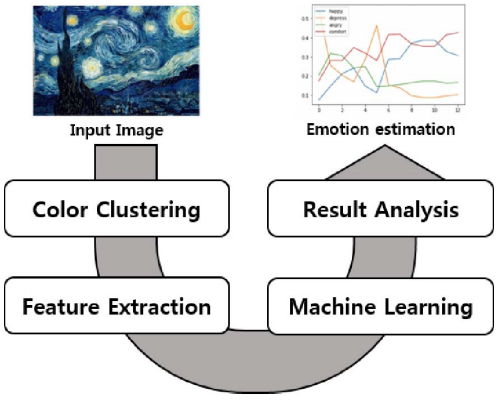

Fig. 1. System Flow for estimating emotion for image

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A. K-means Clustering for color

K-Means clustering algorithm is utilized for clustering. Groups have been formed to ensure that the color spectrum is well representative of the color information of a single image, while maintaining the degree to which the operation speed is not too slow. As in Figure 2, the color spectrum data clustered into five groups were used to analyze images and to use them in the course of future machine learning.

Fig. 2. Example of clustering 5 color for input image ("The Starry Night, Vincent Van Gogh, 1853)

B. Feature Extraction

There are many visual elements that are affected when a person recognizes pictures. When taking pictures or drawing paintings, based on these elements, the producer expresses his intention in the work. Color placement, harmonization, or contrast of colors, as well as color information, may affect the observer. We extracted several features to predict emotion.

Through k-mean clustering, five color information clustered and its ratio determined the RGB color information of the image. The color difference was calculated using Euclidean distance. The harmonization of colors is generally indicated by the coloration relationship, and we calculated and measured the relationship with the adjacent color.

The feature information we used for mechanical learning is as shown in Table 1. The spectrum was extracted for a given image and the characteristics and labels for each were matched. The labels are numbered 0, 1, 2, 3 and each means happy, depress, import, and passion.

C. Machine Learning

Emotional classification models were produced through the representative classification learning algorithms, Decision Tree, Random Forest, and Logistic Region. The line was optimized by tuning the hyper parameter of the classification model.

IV. Result

A. Analysis of Classification model

We tuned hyper parameters using Scikit-Learn libraries. Table 2 compares the classification accuracy of the three models used with the accuracy after tuning the hyper parameter. As you can see in the table, after hyper parameter tuning, we can see that the accuracy of the Random Forest Classifier is higher than that of the previous model.

TABLE II. Compare Accuracy of Classifiers

Classifier	Before tuning	After tuning
Decision Tree	0.625	0.700
Random Forest	0.725	0.825
Logistic Regression	0.700	0.725

Figure 3 schematizes the importance of features in the random forest classification model. In the case of color distribution through dispersion, it was found that the value(brightness) and saturation, and the average RGB color value were used as relatively important features for emotional judgment. In other words, we could see that the colors of Ton and RGB, which mean the combination of value(brightness) and saturation, affect the emotion.

TABLE I. Extracted Feature Data for Maching Learning

Image	Color Spectrum	R_avg Color_var	G_avg V_var	B_avg S_var	Label
		41.1599 8428.3303	6.3396 24893.5397	4.1223 0.3791	2
		9.8713 2311.0840	9.8712 3618.5322	9.8712 0	1
		40.9166 10127.2303	33.1570 17885.0298	34.6660 0.1028	0
		34.7076 5702.0937	40.0241 30707.1647	45.1782 0.1401	3

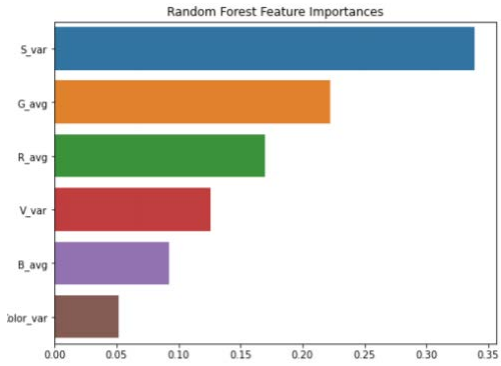

Fig. 3. Feature Importances in Random Forest Classifiers

B. *Extracting emotion from time/seasons*

The color-based emotional prediction model built by machine learning was used to predict the emotions of the video and to map them into a graph. As shown in Figure 4, "happy" and "comport" account for a large portion of spring compared to other seasons, and "passion" accounts for a high proportion in autumn. Also, it was analyzed that the meaning of quiet loneliness in winter was close to high ”depress”.

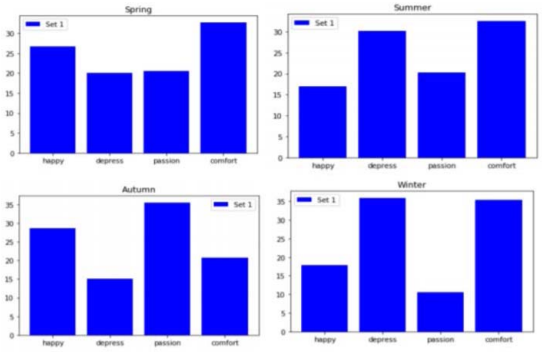

Fig. 4. Emotion estimating result depend on 4 seasons

Figure 5 and Figure 6 shows the results of extracting frames of the Time Labs images from night to afternoon after dawn and putting them into the emotional prediction model through the color spectrum as shown below. In particular, we can see a sharp rise in the "depression" value before dawn. '. It is going up so fast just before dawn. The brightness of the color is brighter than the night, but predicting emotion shows that simply being bright does not make you depressed. You can also see the value of "happy" go up as the day gets brighter. That is, in general, bright colors can be the basis for supporting positive effects.

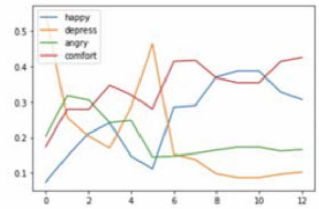

Fig. 5. Emotion estimation result over time using Figure 6.

Fig. 6. 13 Frame images for analyzing emotion from time-flow.

V. Conclusion

Based on color analysis, we analyzed the emotion felt in landscape image with time/seasonal changes. At this time, various classifiers and features were used to analyze which classifiers and features could extract effective results. By analyzing the results, we also proved that people's expressions of emotion over time were somewhat correct. Our classifier can be used not only in time/season, but also in various image analysis studies because it is an emotional classifier for images.

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