Supplemental Materials

1 Feature Description

Table 1 describes the visual features we used in this paper. Compared with traditional features, the features we utilized are mainly aesthetics based and have much stronger artistic evidences and nuanced connections with human feelings, as revealed by various art theories, so they are more appropriate to depict emotions, especially on highly subjective abstract paintings.

Table 1. Summary of the visual features utilized in this work.

Feature name	Short description
Saturation	Saturation value of the image
Saturation contrast	Average contrast of saturation
Bright contrast	Average contrast of brightness
Cool color ratio	Ratio of cool colors with the hue in the HSV ([0 - 360]) space between 30 and 110
Figure-ground color difference	Euclidean distance of mean colors between the figure and the ground
Figure-ground area difference	Area ratio difference between the figure and the ground
Foreground texture complexity	Density of Canny edges in the figure
Background texture complexity	Density of Canny edges in the ground
Saturation	Saturation value of the image
Saturation contrast	Average contrast of saturation
Bright contrast	Average contrast of brightness
Cool color ratio	Ratio of cool colors with the hue in the HSV ([0 - 360]) space between 30 and 110
Figure-ground color difference	Euclidean distance of mean colors between the figure and the ground
Figure-ground area difference	Area ratio difference between the figure and the ground
Foreground texture complexity	Density of Canny edges in the figure
Background texture complexity	Density of Canny edges in the ground

2 Explanations of Self-Contagion Factor

In this section, we provide exploratory analysis which inspires us to define self-contagion factors in the proposed model. Basically, the self-contagion factor contains two information: (1) how one's emotional status at present depends on her previous emotion,

and (2) how this dependency change over time. For better explanations, we conduct two kinds of experiments below.

2.1 The Influence of Time Dependency

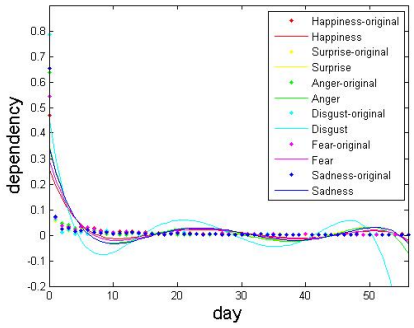

Fig. 1. Time dependency analysis.

Our emotions arise when stimuli appear, and evolve as time goes by. The emotions thus stimulated may last for a period of time, short or long. This correlation is defined as emotional time dependency. We conduct an experiment to justify whether this dependency also exists on image social networks.

Based on the problem definition, user v_i's emotional status at time $t-1$ is denoted as $y_{i,t-1}$ and user v_i's emotional status at time t is denoted as $y_{i,t}$. If the user's emotional status at time t remains the same as it is at time $t-1$, it might be possibly attributed to the emotional time dependency. Taking "happiness" as an example, the degree of the emotional time dependency between t and $t-1$ can be defined as follows:

$$P(Happiness, t, t-1) = \frac{Happiness(t, t-1)}{Happiness(t-1)} \tag{1}$$

The above formula is in the form of the conditional probability. The denominator refers to the number of users feeling happy at time $t-1$, and the numerator refers to the number of users feeling happy at both time $t-1$ and time t. It indicates that the larger the value of the conditional probability, the stronger the emotional time dependency.

The observation results are visualized in Figure 1. We can see that emotional time dependency decreases as time dates back, for all kinds of emotions. Also, different emotions have different emotion regression patterns. As shown in Figure 1, while other emotions fade away with time, the feeling of "disgust" fluctuates, which means that once a user is disgusted, the user will probably recall the feeling several days later.

Then we analyze the duration of different emotions. Figure 2 exhibits the results. As can be seen from the figure, "happiness" lasts for the longest period of time – almost a week. "Surprise","fear" and "sadness" come second. "Anger" and "disgust" last for the

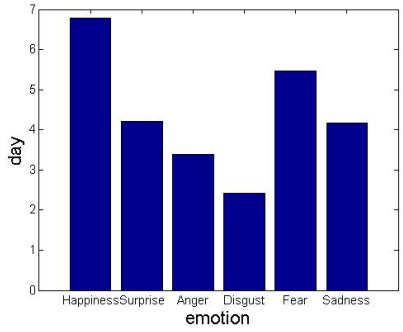

Fig. 2. Time duration analysis.

shortest period of time, just two or three days. The results indicate that positive emotions last longer, while negative emotions disappear more quickly, which corresponds to the findings of studies on the mobile social networks.

- The emotions fade away as time goes by, except for *disgust* which fluctuates.
- Positive emotions has a longer duration than negative emotions.

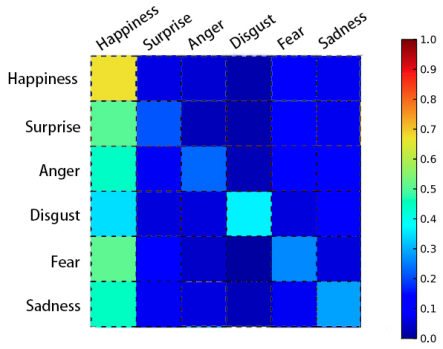

Fig. 3. Emotion transformation analysis.

2.2 The Influence of Previous Emotional Status

Besides the influence of emotion time dependency, which considers the duration of previous emotions, we are also interested in how likely it is that a user's emotion switch from a positive one to a negative one, or from a negative one to a positive one. Thus we calculate the probability of the users' emotion transformation.

We divide the continuous timeline into discrete time slices, where each time slice lasts for one day. Like the conditional probability defined for emotional time dependency, here we use a similar method to calculate the emotion tranformation probability. We define user v_i's emotional status at time $t-1$ as y_i^{t-1} and user v_i's emotional status at time t as y_i^t. Then we can calculate the probability of the user's emotional transformation from anger to fear as follows:

$$P(Anger(y_{i,t-1}), Fear(y_{i,t})) = \frac{Anger(y_{i,t-1}), Fear(y_{i,t})}{Anger(y_{i,t-1})} \tag{2}$$

Figure 3 presents the results. It can be concluded from the figure that:

- When feeling happy at $t-1$, more than 67% of users will remain happy afterwards at t.
- As for negative emotions, when feeling surprised, angry, fearful or sad at $t-1$, nearly half of the users are likely to overcome the unpleasant emotions and become happy at t.
- However, when the users experience disgust at $t-1$, the probability to keep disgusted is extremely high and they only has a probability of 35% to turn happy the other day.
- Additionally, when the users feel surprised the day before, they have a higher tendency to feel angry later. When the users feel fear the day before, they have a higher tendency to be surprised later.