Pictorial Map Generation based on Color Extraction and Sentiment Analysis using SNS Photos

Yuanyuan Wang
Graduate School of Sciences and Technology for Innovation
Yamaguchi University
Ube, Japan
y.wang@yamaguchi-u.ac.jp

Abstract—In recent years, many SNS photo-posting sites have become popular, and many users share photos of various spots. On the other hand, the top ranking of the purpose of overseas travel as a form of entertainment is related to sentiment such as relaxation and stress reduction. Previous sentiment-based tourist spot recommendations relied heavily on textual data for sentiment analysis. However, they do not utilize the characteristics of photos showing tourist spots. In particular, color information has its specific image and psychological effects, and using this information in recommending tourist information can affect the senses and sentiments of people. For example, the green provides psychological effects, such as relaxation and healing. Therefore, in this work, we focus on the psychological and sentimental effects on colors and propose a method for generating a pictorial map by extracting color information from SNS photos, analyzing the sentiments of colors, and then combining them with the metadata of the SNS photos. It allows users to intuitively search for the desired spots when traveling for purposes related to their sentiments, such as relaxation or stress reduction, by mapping the photos of tourist spots that match their destinations on the map. Furthermore, it is expected to improve sensory behavior, such as choosing colors for a trip. Finally, we developed a visualization interface for the pictorial map using spot information and tag clouds, and we validated the usefulness of the pictorial map visualization by users through a questionnaire survey.

Index Terms—pictorial map, SNS photos, color information, sentiment analysis, visualization

I. Introduction

In recent years, with the spread of smartphones, many users have come to post photos online daily through social networking services (SNS), such as Instagram[1] and Flickr[2], regardless of time or location. For example, Instagram is growing at a tremendous pace, with 1.386 billion users worldwide and more than 48 million users in Japan as of July 2021 [1].

From photos posted on SNS, we can acquire various metadata, such as colors, objects, times of posting, and tags. In particular, colors can promote images of objects, change people's moods, or even affect their health, depending on the situation. In other words, colors affect arousing images, atmospheres, and sentiments. For instance, green has a calming effect on people's feelings, such as healing and relaxation. Some other colors also have a calming or energizing effect. Using the psychological effects of colors, some have applied them to the interior, coordination, and logo design. Therefore, utilizing these factors in recommending tourist information can influence people's senses and emotions.

On the other hand, in the tourism field, which is a form of entertainment, Table I shows that the top 10 purposes of overseas travel, as determined by Recruit Jaran Research Center [2], include emotional purposes such as "to relax" (No. 1), "to escape from daily life" (No. 3), and "to relieve stress" (No. 9).

TABLE I
Ranking of Purposes of Overseas Travel

Japanese People (n=1.267)		
No. 1	to relax	12.3
No. 2	to eat delicious food	11.0
No. 3	to escapefrom daily life	9.3
No. 4	to spend quality time with my partner	8.8
No. 5	to taste different cultures unique to the area	7.4
No. 6	to visit world heritage sites	7.1
No. 7	to deep into the history and culture unique to the area	6.0
No. 8	to do some shopping	5.0
No. 9	to relieve stress	4.7
No. 10	to have a fun and exciting time with my friends	3.3

Therefore, in this work, we aim to utilize photos posted on SNS to promote comfortable and casual travel that matches the current mood of travelers [3]. In this work, we propose a method to generate a pictorial map by analyzing sentiments of colors extracted from photos posted on SNS in a specified region and combining them with metadata (titles, posting times, tags, #views) of the SNS photos. A pictorial map is an intuitive and easily understandable map of potential features in a given region using diagrams and pictures. It differs from commonly used maps in that it does not contain detailed names of towns and routes and mainly contains information on foods, animals, and so on. By this way, it will be possible for people to see at a glance what is representative of any given region, which is expected to lead to the development of tourism and the economy.

The remainder of this paper is structured as follows. In Section II, we discuss previous research that has been carried out related to pictorial map generation and visualization, and research dealing with the relationships between colors and sentiments. Afterward, in Section III, we provide an overview

[1]https://www.instagram.com/
[2]https://www.flickr.com/

978-1-6654-5348-6/23/$31.00 ©2023 IEEE

of our proposed method for extracting the color information from SNS photos and analyzing the sentiments of these colors. In Section IV, we describe the generation of pictorial maps based on the proposed method in terms of representative photo extraction and visualization. Section V evaluates and discusses our generated pictorial maps. Finally, in Section VI, we conclude this paper and discuss future work.

II. Related Work

In recent years, many studies and systems have been developed for recommending and providing information on tourist attractions based on Web information and their analysis [4] [5] [6]. In particular, several of them analyze tourist images from data on the Web [7], travelers' impressions [8], select representative regional features based on visual characteristics [9], and recommend tourist routes from SNS such as Flickr and Twitter [10] [11]. Nakajima et al. [12] analyzed geotagged tweets from tourist destinations and proposed a method for recommending tourist routes according to travelers' preferences. Ishino et al. [13] proposed an information support system to efficiently present users with detailed information on tourist spots that are difficult to find in book-based travel guidebooks. Nanba et al. [14] proposed a method for automatically detecting travel blog entries from general blogs using the machine learning method. They employed CRF as the machine learning method and succeeded in detecting travel blog entries with a high accuracy of 86.7%. Furthermore, Tsuchida et al. [15] used Word2Vec, a neural network-based language model. They proposed a method for finding similar spots in other regions by adding words from a corpus generated by extracting and analyzing tourist information from SNS. Mikasa and Okuno [16] proposed a method to dynamically generate summary sentences by classifying sentences according to tourist topics for users to efficiently gather tourist information. Users can view summary sentences according to their interests and make preliminary judgments that these sentences are unnecessary, which reduces the time spent browsing the site. In this work, we aim to support tourism by using photos posted on SNS.

In addition, several studies have been actively conducted to generate pictorial maps using geotagged photos posted on SNS. Gao and Ushiama [17] proposed a method to generate pictorial maps using Instagram, a popular photo-based SNS, by extracting representative regions for the geotagged photos through clustering regarding cities and using the imagery features of those photos. Wang and Yue [18] proposed a method that uses the metadata of photos posted on Flickr to calculate the degrees of popularity and satisfaction of spots in a target region. Also, their proposed method could automatically generate two types of pictorial maps (a popular spot map and a little-known but good spot map) that reflect these degrees. In addition to the location information of posted SNS photos, they calculated the degrees of popularity and satisfaction of spots using the number of SNS photos and posting periods to detect popular spots and little-known but good spots. In these studies, pictorial maps are generated by focusing on the imagery features of photos, such as hue, hue, saturation, and lightness, using the HSV color model [19]. Also, various metadata (user ID, location information, posting time, etc.) of posted SNS photos. In this work, focusing on the sentiments and psychological effects of colors, we propose a method to generate pictorial maps by extracting color information from posted SNS photos and performing the sentiment analysis of these colors, focusing on the general atmosphere of the spots.

In the visualization of maps, studies have been conducted to find the area represented by a tag in map space and to visualize it on a map using location information and tags assigned to photos on Flickr [20] [21]. Yamada and Takayama [22] developed a system that visualizes useful sentiments in word-of-mouth sentiment data as areas on a map. This system not only describes the location of tourist spots with pins but also describes the sentiment areas of word-of-mouth with polygons. Miyata et al. [23] also compared visualization methods for barrier information in barrier-free maps. In addition to representing barriers as dots, they visualized them in various ways: dot maps, heat maps, bubble maps, and cluster maps. They summarized that it is necessary to consider whether information should be presented accurately or ambiguously for readability. Since color is also the subject of our study, it is necessary to make some adjustments in this regard.

Furthermore, several studies have been conducted on colors and sentiments, which are the subjects of our work. Inanami et al. [24] evaluated ten words with positive and negative opposites on a five-point scale for 12 colors: white, red, yellow, green, blue, purple, peach, brown, orange, yellowish green, gray, and black. Shinoda et al. [25] conducted a sentiment analysis of facial expressions in photos and corresponding sentences from travel blogs and recommended tourist information based on the sentiments. The body text and images were extracted from the blogs, respectively, and after vectorization, the body text and their corresponding images were determined using the cosine similarity. In this work, we directly associate colors with sentiments, assuming that the sentiments corresponding to the colors obtained from the photos of the spots are the sentiments that people can experience at these spots.

III. Color Extraction and Sentiment Analysis

This section describes a method for extracting color information from posted SNS photos and performing a sentiment analysis. In this work, we utilized photos posted on Flickr. In addition to the Flickr photos, we extract metadata from the Flickr photos (titles, posting times, tags, #views) as shown in Figure 1.

A. Color Extraction from Photos

In this work, we extract color information from photos posted on Flickr to analyze the sentiments of colors. We randomly collected 100 Flickr photos from each spot. Then, we obtained two colors from each Flickr photo: dominant color background and dominant color foreground, with the Microsoft Azure Computer Vision API[3]. The Microsoft Computer Vision API then extracts 12 colors: white, red, yellow,

[3]https://azure.microsoft.com/en-us/

Fig. 1. Metadata for Flickr photos.

green, blue, purple, peach, brown, orange, yellowish green, gray, and black.

B. Sentiment Analysis of Colors

Each color has its own image, meaning, or effect on people, which can be associated with an emotional aspect. Moreover, each color has both positive and negative sentiments. For example, in contrast to the negative aspects of the black color, such as fear and darkness, there is also the positive aspect of calmness. To use sentiments as the purpose of travel in this work, we summarized colors and sentiments, focusing on those that are positive and can be established as the purpose of travel [24] [26] [27]. The target colors are the 11 colors that could be extracted in this work out of the 12 colors returned from the Microsoft Azure Computer Vision API, which is used to determine the colors. Table II shows a summary of the 11 colors that could be extracted and their sentiments.

TABLE II
COLORS AND SENTIMENTS

Color	Sentiment
white	bright, beautiful, refreshment
red	bright, beautiful, happy, vigorous, positive, courageous, energetic
yellow	bright, beautiful, happy, joyful, energetic, cheerful
green	relax, quiet, healing, reassurance, refreshing
blue	beautiful, calmness, refreshing, cool
purple	quiet
peach	warmth, bright, happiness, gentle, beautiful
brown	warmth, comfort, quiet
orange	bright, beautiful, happy, energetic, cheerful
gray	calmness, quiet
black	calmness

IV. Pictorial Map Generation and Visualization

This section describes the visualization of the pictorial map generated based on our proposed method. The visualization interface consists of four parts: a pictorial map, a tag cloud, spot information, and a list of photos of spots.

A. Representative Photo Extraction

Since many posted photos are related to the same tourist spot, we need to select appropriate posted photos to present on the pictorial map. In this work, we extract representative photos of the tourist spots from the posted photos tagged with the spot names on Flickr from the output of tourist spots.

We first calculate the color proportion V from the set of photos for each tourist spot i using the following formula Eq. (1).

$$V = \frac{\text{\#photos of each color of } i}{\text{Total \#photos of } i} \tag{1}$$

The color with the highest color proportion V for each tourist spot i is then determined as the target color. Finally, we select the photo with the highest number of views as the representative photo from among those photos with the target color. In addition, since the sizes of those original photos are different, we standardized those sizes when visualizing the data.

B. Visualization with Tag Clouds

In this work, the system consists of four parts: a pictorial map, a tag cloud, spot information, and a list of photos of spots. The system visualizes representative photos on a map using the Google Maps API[4] and Leaflet[5]. The pictorial map part uses Leaflet to create a map. Representative photos are mapped to spots using geotags. When mapping the representative photos, we colored the edges of those photos with the target colors of the regions to highlight the colors considered significant in this study. However, in the current experiment, white, black, gray, and brown had a high proportion across all spots. To reflect the significance of presenting a variety of colors on the map, we use a color preferentially as the edge color since it occupies 10% or more of all the colors in each spot and is not one of the four listed above. The tag cloud part shows the sentiments corresponding to the selected spots in the pictorial map as tags. The spot information part shows the location information of the selected spots by geocoding. The list of photos of spots part shows the photo information of the selected spots in the pictorial map. Specifically, it shows the title, posting time, the tags, and the number of views for each photo. These are updated each time when selecting a spot on the pictorial map. Figure 2 shows the pictorial map visualization interface.

Fig. 2. Pictorial map visualization interface.

[4]https://developers.google.com/maps/
[5]https://leafletjs.com/

V. Evaluation

In this section, we evaluate the usefulness of our generated pictorial maps. In this work, we extracted color information from photos of the top 20 most popular tourist spots in Kyoto City registered on Tripadvisor [28] and conducted sentiment analysis to generate a pictorial map. Table III shows the top 20 most popular tourist spots in the target city of Kyoto. We omitted “Samurai & Ninja Museum with Experience,” which was the 10th of the most popular tourist spots, since there were no results from Flickr when searching by place name, and we added “Nanzenji Temple,” which was the 21st of the most popular tourist spots. Our dataset consists of a total of 2,000 photos extracted from a total of 447,999 photos taken in Kyoto City and collected from Flickr, of which 100 photos were randomly extracted from each of the 20 tourist spots shown in Table III.

TABLE III
Popular Tourist Spots in Kyoto City (Top 20)

Rank	Tourist Spot
1	Fushimi Inari Shrine
2	Kinkakuji Temple
3	Sanjusangendo Temple
4	Arashiyama Monkey Park Iwatayama
5	Nijo Castle
6	Gion
7	Kiyomizu-dera Temple
8	Arashiyama
9	Tofukuji Temple
10	Eikando Zenrinji Temple
11	Ginkakuji Temple
12	Katsura Imperial Villa
13	Toji Temple
14	Ninenzaka and Sannenzak
15	Kyoto Railway Museum
16	Ninnaji Temple
17	Nishiki Market
18	Kenninji Temple
19	Kurama-dera Temple
20	Nanzenji Temple

A. Experimental Method

To evaluate the usefulness of the generated pictorial maps, we conducted a questionnaire survey. In the questionnaire survey, subjects were asked to view a visualization demonstration of the generated pictorial map and answer the following questions. In the visualization demonstration, we first displayed a visualization screen when selecting the tourist spot “Kinkakuji Temple,” shown in Figure 3 on the pictorial map.

After that, we displayed a visualization screen when selecting the tourist spot “Kiyomizu-dera Temple,” shown in Figure 4 on the pictorial map.

Finally, the visualization screen was displayed when selecting the sentiment tag “relax” in the tag cloud, shown in Figure 5.

The questionnaire mainly asks questions about the visibility and comprehensibility of pictorial maps, color and sentiment

Fig. 3. Visualization screen of “Kinkakuji Temple” when selected on the pictorial map.

Fig. 4. Visualization screen of “Kiyomizu-dera Temple” when selected on the pictorial map.

judgments, visualization interface functions, and improvements that need to be improved. The questionnaire items were as follows.

- Q1. The pictorial map was easy to read.
- Q2. The spots were intuitively easy to recognize from the photos of the spots and the overall coloring on the map.
- Q3. The sentiments of the tags selected from the photos of the spots were reflected.
- Q4. The sentiments of the tags selected from the colors of the photos were reflected.
- Q5. You wanted to use each function of the visualization interface (pictorial map, sentiment tag cloud, photo information list, and spot location information). Please describe any other functions you desire to use.
- Q6. Please select the five sentiment tags you would most like to use.
- Q7. Please rate each of the sentiment tags you selected in Q6.
- Q8. Please let us know if there is anything that needs to

Fig. 5. Visualization screen of "relax" when selected on the tag cloud.

be improved throughout the visualization interface.

The questionnaire items Q1-Q5 and Q7 were rated on a 5-point scale (1: strongly disagree, 2: disagree, 3: neutral, 4: agree, and 5: strongly agree). Q6 was a multiple-choice question, and Q8 provided a comment field where users could freely write a detailed description. We evaluated the usefulness of this pictorial map using those questionnaire results. A total of ten subjects in their 20s (5 males and 5 females) participated in this experiment.

B. Experimental Results

Figure 6 shows the average of the Q1 and Q2 ratings on a 5-point scale. Q1 and Q2 obtained good results for the visibility and comprehensibility of the generated pictorial maps, with Q1 having an average value of about 3.7 and Q2 having an average value of about 3.7.

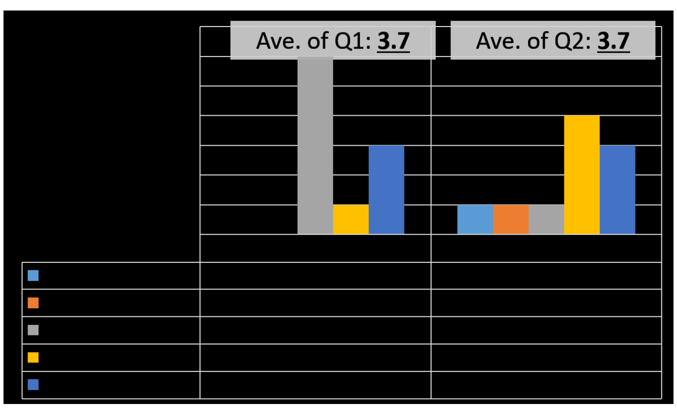

Fig. 6. Evaluation results for Q1 and Q2.

Figure 7 shows the average ratings of Q3 and Q4 on a 5-point scale. Q3 and Q4 achieved the best results for sentiments from photos and colors of the generated pictorial maps, with Q3 having an average value of about 4.1 and Q4 having an average value of about 4.0.

Figure 8 shows the average ratings of Q3 and Q4 on a 5-point scale. The results of Q5 showed that for each function of the visualization interface, the pictorial map averaged about 4.3, the sentiment tag cloud averaged about 3.9, the location information of spots averaged about 4.1, and the list of spots' photos averaged about 4.0, showing very favorable results.

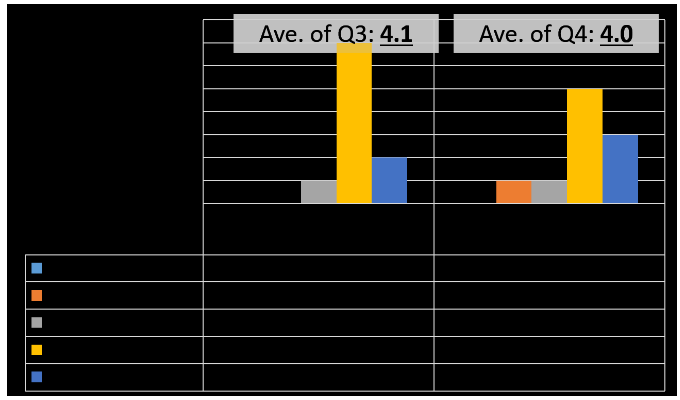

Fig. 7. Evaluation results for Q3 and Q4.

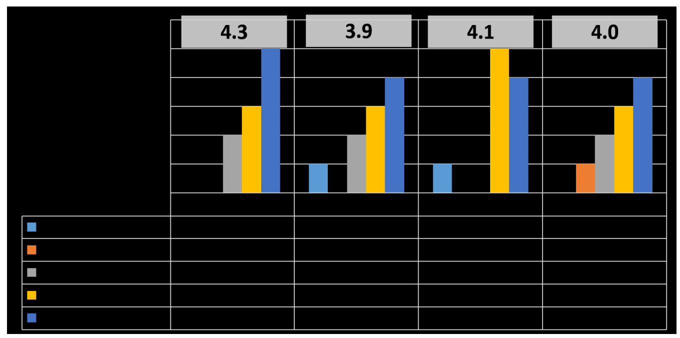

Fig. 8. Evaluation results for Q5.

Regarding other functions the subjects would like to use, their comments were as follows:

> To present recommended cafes
> To present additional "recommended times of the year and times of the day" for those spots

Next, Figure 9 shows the selection results for Q6. According to the results of Q6, there were a total of 48 responses due to a lack of answers regarding the sentiment tags that the subjects would most like to use. The most frequent response was "beautiful," with eight out of ten subjects. It was followed by "refreshment" and "calmness" with six out of ten subjects. No one selected the five tags "quiet," "vigorous," "courageous," "energetic," and "cool" with zero responses.

In Q7, Table IV shows the sentiment tags selected in Q6 and the average rating of those tags on a 5-point scale. Some tags had only one rating, which did not capture any particular trend.

Finally, in Q8, suggestions for improvement throughout the visualization interface are as follows:

> The pictures were too dense to block each other.

Fig. 9. Selection Results for Q6.

TABLE IV
EVALUATION RESULTS FOR Q7

Sentiment Tag	Average Rating
cheerful	5.0
joyful	5.0
reassurance	5.0
healing	4.8
comfort	4.6
refreshment	4.5
calmness	4.5
beautiful	4.5
warmth	4.5
relax	4.5
positive	4.0
refreshing	4.0
happiness	4.0
gentle	4.0
bright	3.7
happy	3.0

- It would be easier to browse if the overlapping photos on the map could be solved.
- It would be better if the location information could present the distances to the spots for users.
- It was hard to browse.

C. Discussion

The results for Q1 to Q4 were all above 3.5, which were good results, but Q1 and Q2 were slightly smaller than Q3 and Q4. There were many opinions in the descriptive answers to Q8 that the photos overlapped each other, which made it difficult to browse. From the results of Q5, we found that the pictorial map with the highest value was useful. The tag cloud and the list of photo information, which were a little low in evaluation, would require some improvements, such as intuitively presenting tags and providing highlights of the spots in addition to the location information. Q6 confirmed the necessary degree of each tag. Regarding Q7, the overall trend could not be captured because the responses varied by each sentiment. Since "beautiful," "refreshment," "calmness," and "relax," which received the highest number of responses, each reached a rating of 4.5, we considered that the tags that users would like to use would receive a high rating.

In addition, in this work, the target spots in Kyoto were mostly temples; therefore, there was a bias toward black, gray, brown, and white, which are the colors of these buildings. Sentiments such as "calmness," "quiet," and "refreshment" were given greater weight in the sentiment tags for these colors. Hence, it is highly likely that we can find color bias and sentiment bias in different regions. We believe that those biases can represent the features and atmosphere of the regions. Also, there is a possibility that the color analysis and sentiment analysis may change by narrowing down the target photos at a certain point, as was done in this work.

Therefore, we narrowed down the target photos by season and conducted further analysis. In this evaluation, we analyzed photos taken in spring when cherry blossoms appeared and in autumn when autumn leaves turned red, considering seasonal changes in plant life. The seasons here are the months of March, April, and May for spring and September, October, and November for autumn, referring to the Japan Meteorological Agency's time-related terminology [29].

Figure 10 presents a part of the collected spring photos. Due to insufficient data, we analyzed only 18 spots for spring

Fig. 10. A part of the collected spring photos.

photos; 14 of the 18 spots were relevant to cherry blossoms. The proportions of colors such as peach, white, and gray increased compared to the analysis results of all seasons in Section V-B. The number of photos of flowers other than cherry blossoms increased, and the percentages of purple and red increased in some regions. The proportions of sentiments such as "quiet," "happiness," and "gentle" increased compared to the other seasons.

Figure 11 presents a part of the collected autumn photos. 16 of the 20 autumn photos would be related to the autumn leaves. The proportions of colors such as red, orange, yellow, and brown increased compared to the analysis results of all seasons in Section V-B. The proportions of sentiments such as "happy," "energetic," and "joyful" were correspondingly larger than those in the spring. Furthermore, comparing the color

Fig. 11. A part of the collected autumn photos.

analysis in spring and autumn, the proportions of red, orange, yellow, and brown, which were more abundant in autumn, showed many spots with lower ratios in the color analysis in spring.

Therefore, the current system must consider seasonality, which we would like to improve in the future.

VI. Conclusions

In this work, we collected SNS photos posted on Flickr related to tourist spots and extracted color information from each of those photos. Moreover, we conducted a sentiment analysis based on the color information of those photos and generated pictorial maps based on the sentiments of each tourist spot. Finally, we developed a pictorial map visualization interface using spot information and tag clouds and evaluated the usefulness of our generated pictorial maps.

In the future, we plan to improve the generation of pictorial maps for each season by using seasonality. Furthermore, we need to enhance the visibility of the photos on the map, which were frequently commented on in the questionnaire results.

Acknowledgment

This work was partially supported by JSPS KAKENHI Grant Numbers JP19H04118 and JP21K17862.

References

[1] K. Nakagama. (2021, November) A summary of major social media user counts [in japanese]. UNIAD Inc. [Online]. Available: https://www.uniad.co.jp/260204

[2] Recruit Jalan Research Center. (2019, April) Jalan overseas travel needs survey [in japanese]. Recruit Lifestyle Co. Ltd. [Online]. Available: https://jrc.jalan.net/wp-content/uploads/2019/06/59dfe57ddb75a817eda7c34208145e51.pdf

[3] A. Yasui, "A study on pictorial map generation based on color extraction and sentiment analysis using sns photos," Bachelor's Thesis, Department of Information Science & Engineering, Faculty of Engineering, Yamaguchi University, February 2022.

[4] H. Matsubara, M. Yamamoto, H. Kawamura, and K. Suzuki, "Tourism informatics : Application of information technology to tourism (¡special issue¿ where system & information technology meet tourism) [in japanese]," *SYSTEMS, CONTROL AND INFORMATION*, vol. 57, no. 8, pp. 316–322, 2013. [Online]. Available: https://ci.nii.ac.jp/naid/110009635682/en/

[5] H. Saito, "Analysis of tourism informatics on web (¡special issue¿ tourism informatics and artificial intelligence) [in japanese]," *Journal of the Japanese Society for Artificial Intelligence*, vol. 26, no. 3, pp. 234–239, 2011.

[6] M. Hirota, M. Endo, D. Kato, and H. Ishikawa, "Discovering hotspots using photographic orientation and angle of view from social media site," *International Journal of Informatics Society*, vol. 10, no. 3, pp. 109–117, 2019.

[7] W. C. Hunter, "The social construction of tourism online destination image: A comparative semiotic analysis of the visual representation of seoul," *Tourism management*, vol. 54, pp. 221–229, 2016.

[8] G. McCartney and R. Pao Cheng Pek, "An examination of sina weibo travel blogs' influence on sentiment towards hotel accommodation in macao," *Journal of China tourism research*, vol. 14, no. 2, pp. 146–157, 2018.

[9] C. Doersch, S. Singh, A. Gupta, J. Sivic, and A. A. Efros, "What makes paris look like paris?" *Commun. ACM*, vol. 58, no. 12, p. 103–110, nov 2015. [Online]. Available: https://doi.org/10.1145/2830541

[10] K. H. Lim, "Recommending tours and places-of-interest based on user interests from geo-tagged photos," in *Proceedings of the 2015 ACM SIGMOD on PhD Symposium*, ser. SIGMOD '15 PhD Symposium. New York, NY, USA: Association for Computing Machinery, 2015, pp. 33–38. [Online]. Available: https://doi.org/10.1145/2744680.2744693

[11] H. Niitsuma, K. Arai, and M. Ohta, "Efficient constraints for tour recommendation [in japanese]," *IPSJ Transactions on Databases (TOD)*, vol. 9, no. 2, pp. 34–45, 2016.

[12] H. Nakajima, H. Niitsuma, and M. Ohta, "Travel route recommendation using tweets with location information," *IPSJ SIG Notes*, vol. 2013, no. 28, pp. 1–6, 11 2013. [Online]. Available: https://cir.nii.ac.jp/crid/1570572702908570496

[13] A. Ishino, K. Fujii, T. Fujiwara, T. Maeda, H. Nanba, and T. Takezawa, "Enriching travel guidebooks with travel blog entries and archives of answered question [in japanese]," *Transactions of the Japanese Society for Artificial Intelligence*, vol. 29, no. 3, pp. 328–342, 2014.

[14] H. Nanba, H. Taguma, T. Ozaki, D. Kobayashi, A. Ishino, and T. Takezawa, "Automatic compilation of travel information from automatically identified travel blogs," in *Proceedings of the ACL-IJCNLP 2009 Conference Short Papers*, ser. ACLShort '09. USA: Association for Computational Linguistics, 2009, p. 205–208.

[15] T. Tsuchida, M. Endo, D. Kato, H. Ehara, M. Hirota, S. Yokoyama, and H. Ishikawa, "Semantic calculation of regions and landmarks using word2vec [in japanese]," in *DEIM Forum 2016*. H5–1, 2016.

[16] M. Hiroki and T. Okuno, "Summarizing articles on the sightseeing web sites based on users' purpose of browsing [in japanese]," *IPSJ SIG Notes*, vol. 2014-DD-93, no. 4, pp. 1–8, March 2014. [Online]. Available: https://ci.nii.ac.jp/naid/110009691497/en/

[17] S. Gao and T. Ushiama, "Automatic generation of pictorial maps using sns [in japanese]," in *DEIM Forum 2017*. D7–4, 2017.

[18] Y. Wang and W. Yue, "Proposal and evaluation of a pictorial map generation method based on degrees of popularity and satisfaction for tourist spots using sns photos," *Journal of the Japan Personal Computer Application Technology Society*, vol. 16, no. 1, pp. 1–10, 2021.

[19] N. Hochman and L. Manovich, "Zooming into an instagram city: Reading the local through social media," *First Monday*, vol. 18, no. 7, 2013.

[20] H. Zhang, M. Korayem, D. J. Crandall, and G. LeBuhn, "Mining photo-sharing websites to study ecological phenomena," in *Proceedings of the 21st International Conference on World Wide Web*, ser. WWW '12. New York, NY, USA: Association for Computing Machinery, 2012, p. 749–758. [Online]. Available: https://doi.org/10.1145/2187836.2187938

[21] B. Thomee and A. Rae, "Uncovering locally characterizing regions within geotagged data," in *Proceedings of the 22nd International Conference on World Wide Web*, ser. WWW '13. New York, NY, USA: Association for Computing Machinery, 2013, p. 1285–1296. [Online]. Available: https://doi.org/10.1145/2488388.2488500

[22] T. Yamada and T. Takayama, "Feelings visualization map system using word of mouth [in japanese]," in *Proceedings of the 79th National Convention of Information Processing Society of Japan*, vol. 2017, no. 1, March 2017, pp. 785–786.

[23] A. Miyata, K. Okugawa, Y. Yamato, T. Maeda, Y. Murayama, M. Aibara, M. Furuichi, and Y. Murayama, “A crowdsourcing platform for constructing accessibility maps supporting multiple participation modes,” in *Extended Abstracts of the 2021 CHI Conference on Human Factors in Computing Systems*, ser. CHI EA ’21. New York, NY, USA: Association for Computing Machinery, 2021. [Online]. Available: https://doi.org/10.1145/3411763.3451688

[24] M. Inanami, T. Kuriyama, and M. Abe, “Emotion and color (3) [in japanese],” *Memoirs of the Faculty of Education. Literature and Social Science*, vol. 28, pp. 35–50, 12 1994. [Online]. Available: https://cir.nii.ac.jp/crid/1050564288436400512

[25] H. Shinoda, N. Shibata, H. Nanba, A. Ishino, and T. Takezawa, “Emotion-based recommendation of tourist information [in japanese],” *IPSJ SIG Technical Report*, vol. 2020-IFAT-137, no. 2, pp. 1–6, February 2020. [Online]. Available: http://id.nii.ac.jp/1001/00202980/

[26] Iro-Color. Typical color images, properties and color meanings [in japanese]. [Online]. Available: https://iro-color.com/episode/about-color/

[27] akane. (2018, June) The meanings, effects, and images of colors -the basics of colors- [in japanese]. Akaneiro Techo. [Online]. Available: https://akaneiro.me/webmemo/webdesign-story/color/

[28] TripAdvisor.jp. The top 10 recommended tourist spots in kyoto city you won’t want to miss [in japanese]. TripAdvisor K.K. [Online]. Available: https://www.tripadvisor.jp/Attractions-g298564-Activities-a_allAttractions.true-Kyoto_Kyoto_Prefecture_Kinki.html

[29] Japan Meteorological Agency Homepage. Terminology related to time [in japanese]. [Online]. Available: https://www.jma.go.jp/jma/kishou/know/yougo_hp/toki.html