# Destination Retrieval System using an Association Retrieval Method

Yuya Kanazawa, Yosuke Hidaka, and Katsuhiko Ogawa

***Abstract*—Until recently, people searched for travel destinations by browsing brochures obtained from their local travel agent, but many people now use the Internet instead. However, typical destination retrieval systems on travel websites do not improve the efficiency of the destination retrieval process. In this paper, we propose an association retrieval method to search for destinations using feature vectors composed of impression words. We implement a prototype system based on this retrieval method and evaluate its effectiveness. Finally, we propose and design a system that uses the association retrieval method for exploratory searches.**

***Keywords*—Association retrieval, destination image, retrieval interface, retrieval process.**

## I. Introduction

Potential tourists used to research travel destinations using paper brochures, typically obtained from a travel agent, but nowadays many people utilize the Internet for this purpose instead [1]. Consequently, a great many travel websites have appeared, usually offering a specialized destination retrieval interface for queries that include a regional name, keyword, and some conditions of travel. However, has the efficiency of the destination retrieval process been improved by these retrieval systems? With the old paper medium, we could browse many information sources and search for suitable destinations to fit our ideal. On the Internet, the cost of browsing is not markedly improved, because these retrieval systems cannot precisely reflect this ideal destination image.

In the process of choosing a holiday location, tourists prefer to determine their destination by comparing what they are browsing against the image they hold of an ideal destination. This ideal image consists of three factors [2]: internal factors, including the potential desire to travel, external factors including past travel experiences and the influence of the media, and environmental factors, including any restrictions to travel such as economic conditions.

Most queries in a destination retrieval system can only reflect environmental factors in their results. Thus, the ideal destination image cannot be expressed precisely in the query. After all, we need to check the potential results one-by-one, even on the Internet.

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In this paper, we propose an association retrieval system that can reflect the destination image precisely in its results. The aim of this system is to improve the efficiency of the destination retrieval process. (Note that the travel and destinations described in this article are based around Japan).

## II. Retrieval Method

First, we consider a retrieval method for our system. We apply a general association retrieval method using feature vectors.

In Section II-A, we give an overview of this retrieval method, and in Section II-B we introduce the *impression word* that composes the feature vector. In Section II-C, we test the precision of this retrieval method by comparing it with a conventional search method.

### A. General View of the Retrieval Method

To reflect the image of a suitable destination in the results, we must enable the system to accept abstract queries, such as impressions. There are three major methods for regarding impressions as a query in a retrieval system [3].

- Use of visual features in pictures
- Relevance feedback
- Use of feature vectors composed of impression words

The destination image is formed not only by visual factors, but also according to other stimuli. Therefore, method A is not suitable for destination retrieval systems. We construct our retrieval system based on method B and C (mainly method C).

Some retrieval systems that use feature vectors require the searcher to designate each parameter as a query in order to represent their image, although this is a troublesome task. Therefore, in this system, we regard a destination picture with a feature vector as a query. Consequently, the searcher need only choose the picture that is most relevant to their destination image, and the feature vector of the selected photo will be regarded as a query. Other pictures whose image is similar to that of the query are then displayed as results.

We now explain our retrieval algorithm. We use $X$ to denote the set of feature vectors $\vec{x}^{(i)}$ that represent the impression of each destination picture. All components of vector $\vec{x}^{(i)}$ correspond to an impression word, parameterized in the range [0-1]. After a feature vector is issued for query $\vec{q}(q \in X)$, which denotes the destination image of the searcher, a similarity matrix $S$ is calculated by the following expression:

$$S = \vec{q}^{T} X . \quad (1)$$

The contents are ranked according to *S* (expected contents matching the query) and displayed as the search result. If the searcher finds a more suitable image in the results, they can select it and repeat the retrieval.

TABLE I: MAKE-UP OF FOCUS GROUPS

| Group | Group 1 | Group 2 | Group 3 | Group 4 |
|---|---|---|---|---|
| Demographic | Men in twenties | Men in twenties | Women in twenties | Fifties |
| Group size | 3 | 4 | 4 | 2 |

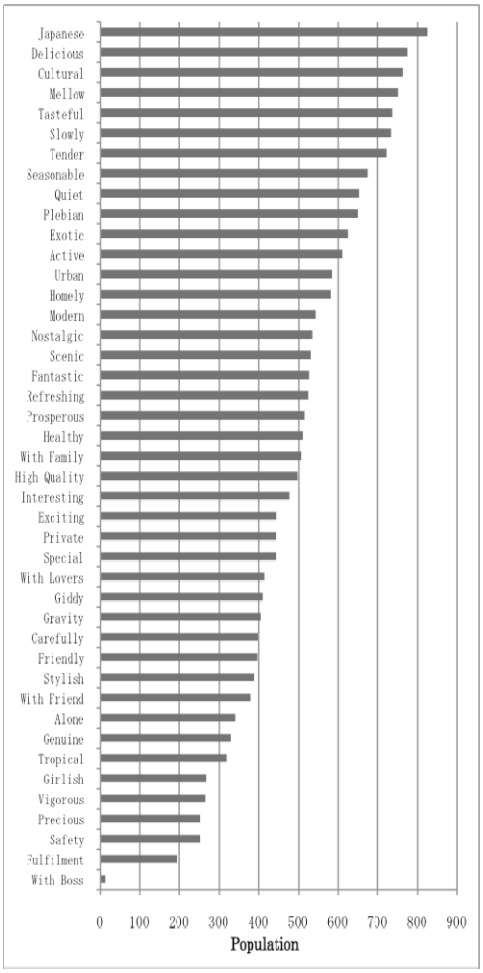



Fig. 1. Number of people that used each impression word to describe a destination image.

### B. Impression Words for the Feature Vector

We utilize feature vectors composed of impression words to quantitatively express the contents of each image. These impression words must be generally used to describe the destination image. Therefore, we referred to [4] and implemented two investigations to extract suitable impression words for the feature vectors: a focus group interview to provide initial descriptions, and an impression evaluation experiment to confirm the generality of the words.

#### 1) Focus group interview

Initially, we attempted to find the impression words that described each destination image. For this, we implemented a focus group interview consisting of four demographically distinct groups (see Table I).

We prepared 30 fictitious travel brochures. These were made up solely of pictures and captions. In the group interviews, we displayed each of these pamphlets and asked group members to express the impression they felt from the picture. When members expressed their impression too broadly or with no impression words, we asked them to use alternative words or describe how they would feel visiting the pictured destination.

We noted which impression words appeared, and additionally recorded the interview by camcorder. From these records, 250 impression words were extracted. These were then classified by researchers using the KJ method [8], such that the 250 words could be summarized in just 43 words. Moreover we noticed that the use of words is different by age and gender.

#### 2) Impression evaluation experiment

We performed an impression evaluation experiment with the 43 impression words extracted from the focus group interview.

In the experiment, subjects selected the words that best fitted their impression of the destination picture, in order to verify whether those words represented a typical description of the image.

We prepared 30 destination pictures from our fictitious travel brochures, and conducted the experiment via an Internet survey of 1000 Japanese living in the Metropolitan area (500 male and 500 female).

Fig. 1 shows the results of this experiment (words were originally in Japanese). The horizontal axis shows the number of people who used each word for the destination image. With the exception of "With Boss," most of the extracted impression words were used by more than 20% of subjects. The average number of words used for each image is 24.215.

Furthermore, we surmised that different groups used different words from the interview, and so a statistical test was employed to analyze the variation between the words used by different demographics. We tested the mean difference by gender and age. In terms of gender, there was a difference of 15 words at significance level $\alpha < 0.05$—women tended to use all words more than men. There was a difference of 9 words at significance level $\alpha < 0.05$ for age groups, with older men tending to use most words more than younger men. Consequently, we found that women and older people used more words than others, and that the use of words differed by gender and age.

Finally, we adopt these 42 words (the original 43 minus "With Boss') as the components of the feature vector. This may seem to be too many words, but some people, especially women and older men, tend to use many words to represent destination images. Moreover, if there are many contents in the retrieval system, the difference between them will not be expressed precisely by a limited set of impression words.

### C. Evaluation of the Retrieval Method

We now evaluate the precision of the proposed retrieval method. We built a prototype system and conducted two evaluations with nine subjects. At first, we compared the precision of the proposed method against that of a conventional method. Secondly, we subjectively evaluated the precision of the ranking function.

Initially, we implemented two prototypes with these retrieval methods. One is a system that adopts the proposed retrieval method using feature vectors (Fig. 2 (b)) and the other adopts a conventional retrieval method based on regional names (Fig. 2 (a)). The two systems used the same

contents, which were from the pictures used in the impression evaluation experiment. The contents include pictures, detailed information, and feature vectors constructed from the 42 impression words and parameterized by the impression evaluation experiment.

*1) Precision of the retrieval method*

We compared the precision of our retrieval method with that of a conventional destination retrieval method. After implementing the prototype systems, we conducted the evaluation experiment. In this experiment, we prepared four abstract queries: healing, adult, joy, and rapport, and asked the subjects to search for appropriate destinations with each system.

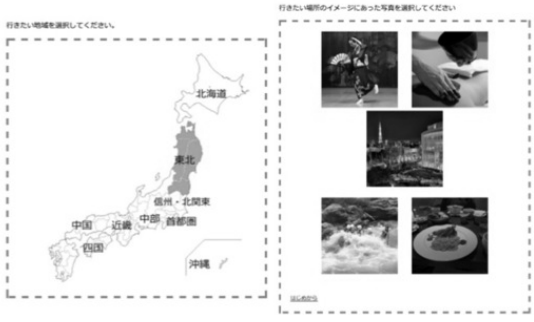
To calculate the recall and precision metrics, it is necessary to follow the retrieval process and obtain a relevant set. We recorded the retrieval process automatically in the system, and the subjects formed each relevant set. We requested subjects to push a button to record the ID of appropriate content found during the experiment. To ensure a relevant retrieval set, we asked them to find suitable contents in the paper brochures for every query (as some subjects may not have seen all contents in the system).

From the data of the retrieval process and relevant sets, we calculated the average precision of the two systems at each recall point. Fig. 3 shows the precision–recall curves obtained. We then calculated the break-even points of the two curves to intuitively express the precision in one value. The break-even point of the proposed method is 0.6675, whereas that of the conventional method is 0.5365. This means that the proposed method is more precise, and therefore searchers can find contents that fit their ideal image faster.

*2) Precision of the ranking function*

The contents were ranked by the similarity of images in this retrieval method, which enabled us to evaluate the precision of the ranking function.

To ascertain the precision of the ranking function, we had same asked subjects to evaluate the similarity of impression between the impression of the picture of query picture and their result in 4 on a four-points of ordered scale from 0 to 3 (If subjects think where more similarity, they choose more scores higher number). The evaluation is took place using implemented in five query pictures of query and their top 7 results.




(a) (b)

Fig. 2. Interface of the two prototypes used in the evaluation experiment

Fig. 4 shows the results of this evaluation. The horizontal axis denotes the ranking and the vertical axis shows the similarity score with respect to the query picture. Each score shows the average of the similarity evaluation in each order. From this graph, we can see that the evaluated similarity corresponds closely to the similarity as ranked by the system. The only exception to this is the fourth ranking, which was evaluated to have a higher similarity than the second and third ranking images. In this system, we have not parameterized the feature vector according to differences in word use among different ages and genders. If we used a ranking function that enabled parameter weights to change with the searcher, the ranking precision would be improved.

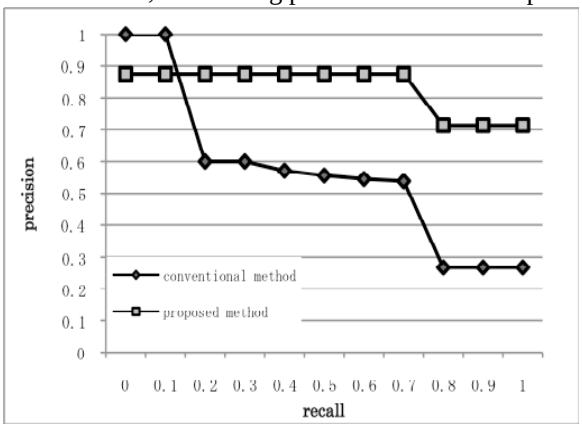



Fig. 3. Precision–recall curve

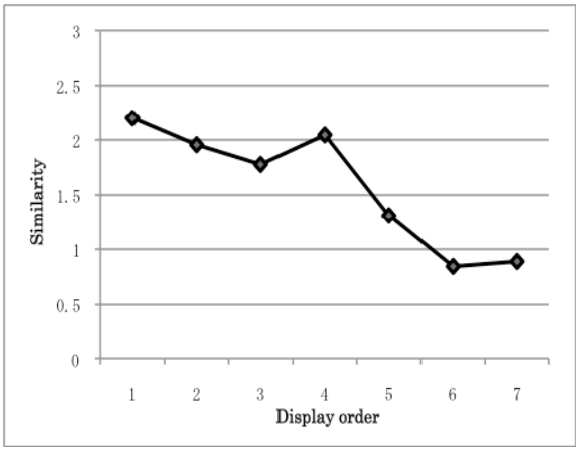



Fig. 4. Image similarity between query and results

In section Ⅱ, we have described the retrieval method used in this study. We found that when the searcher issues an abstract image query, the retrieval method using feature vectors is more precise than the conventional retrieval method.

## III. Implementation of Prototype System

We implement a prototype of destination retrieval system based on the result of Section Ⅱ. In Section Ⅲ-A, we introduce a design of the system. In section Ⅲ-B, we refer to a system that tags the impression word to the destination picture.

### A. Design of the Retrieval System

We introduce a retrieval process and algorithm of the system. Fig. 5 shows the page transition and interface of this retrieval system.

At first, searchers use look-up search interface [5] to designate their conditions such as regional name, charge, and date. We didn't refer to the conditions in Section Ⅱ. As we mentioned before, the conditions are one of the factor

(environmental factor) that composes a destination image and necessary for reflecting the image more precisely. After designating the conditions, the system finds corresponding contents and displays them. The association retrieval is performed from these pictures.

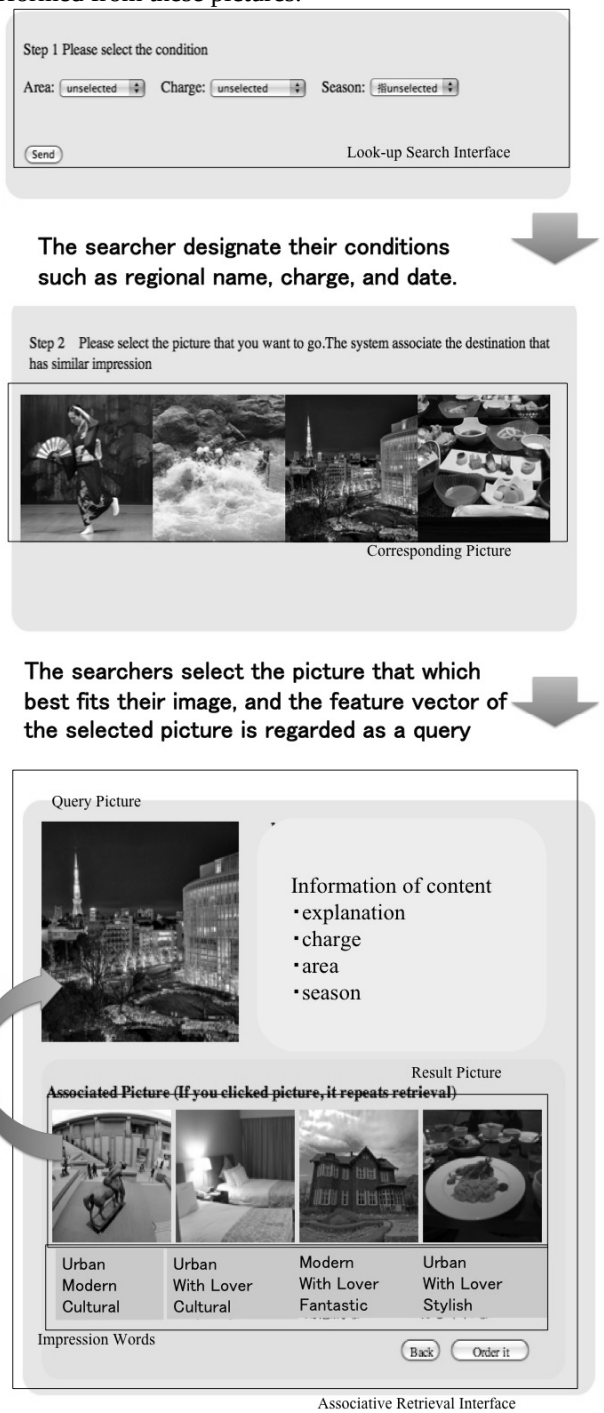



Fig. 5. Page transition and Interface in our retrieval system

In the association retrieval, the searchers clarify their image through the browsing. First, the searchers select the picture that which best fits their image, and the feature vector of the selected picture is regarded as a query. Result pictures with a similar impression are searched from the formula of (1) and displayed. Moreover, the system derives and displays the impression words that explain the similarity between pictures most from the word of Fig. 1 by taking the inner product of the feature vector of the result picture and the query picture. These words give searchers an interpretation about the feature of the destination which they want to go.

If the searchers find more appropriate content in the results, they can click an image and repeat the retrieval process. Once a suitable destination is found, they can order the tour.

TABLE Ⅱ: THE CONVERSION TABLE OF A TYPICAL PICTORIAL SUBJECT AND THE IMPRESSION WORD

| Impression word＼Subject | Inn | Hot Spring | Beauty Salon |
|---|---|---|---|
| Active | 0 | 0 | 0 |
| Mellow | 1 | 1 | 1 |
| Gravity | 1 | 0 | 0 |
| Special | 1 | 0 | 0 |
| Exotic | 1 | 0 | 0 |
| Urban | 1 | 0 | 0 |
| Japanese | 1 | 0 | 0 |
| Seasonable | 1 | 1 | 0 |
| Plebeian | 1 | 0 | 0 |
| Vigorous | 0 | 0 | 0 |
| Healthy | 1 | 0 | 0 |
| Tender | 0 | 0 | 0 |
| Prosperous | 1 | 0 | 0 |
| Slowly | 1 | 1 | 1 |
| : | | | |
| Impression word＼Subject | Night View | Shop | Art |
| Active | 1 | 1 | 0 |
| Mellow | 0 | 0 | 0 |
| Gravity | 0 | 0 | 1 |
| Special | 0 | 0 | 1 |
| Exotic | 1 | 0 | 1 |
| Urban | 1 | 0 | 1 |
| Japanese | 0 | 0 | 1 |
| Seasonable | 1 | 0 | 0 |
| Plebeian | 0 | 1 | 0 |
| Vigorous | 1 | 1 | 0 |
| Healthy | 0 | 1 | 0 |
| Tender | 0 | 1 | 0 |
| Prosperous | 1 | 0 | 1 |
| Slowly | 1 | 0 | 0 |

### *B. Semi-Automatic Tagging*

In this system, each content has data of a picture, destination information (such as charges, seasons, regions, and explanations), and a feature vector for association retrieval. Although pieces of information are inputted into a database by human power, it will take greater time and effort because of the numerousness of the numbers of steps. Especially in a feature vector, they have to judge whether a picture is fitted to the impression words of Fig. 1 one by one.

Therefore, we enable the system to tag a picture semi-automatically. We construct the conversion table of a typical pictorial subject and the impression word beforehand. If people specify a pictorial subject, the system will attach a tag automatically based on the conversion table. Thereby, we can reduce the costs of a database input.

The TABLE Ⅱ shows the conversion table. We constructed this table from the result of impression evaluation experiment. The column like “Inn” denotes the subject and each subject is derived from experiment. The row like “Active” denotes the impression words. The number in each cell denotes the relation between the word and the subject. If there is a relation between them (each word is used as expression of impression more than average in each subject), the parameter becomes 1.

In SectionⅢ, we designed the prototype of the system that using association retrieval method. This system is still in

development. We'll evaluate the effectiveness of the system after development.

## IV. Conclusion

In this paper, we discussed a destination retrieval system that utilizes an association retrieval method. Through an evaluation experiment, we confirmed the precision of this association retrieval method for abstract queries. Finally, using our destination retrieval process, we designed a retrieval system.

However, we must consider some issues with our implementation. To allow full association retrieval, we must consider the differences in the use of impression words among different age and gender groups, and derive a suitable parameter to change the weight of each impression word in accordance with the searcher's demographic.

And we also consider about the method of evaluation of the system, we can't measure the effectiveness of the system only by preciseness. The association retrieval system also has the value to make aware of new conception [6],[7]. To measure the entire effectiveness of the system, we must evaluate the effectiveness of the retrieval system qualitatively like protocol analysis as well as quantitatively.

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