Tour Navigation System Using Landmarks that Are Customized by Personal Preference

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Abstract: This study proposes a new Tour Navigation System that does not guide the tourist to the destination through routes predetermined by a guidebook or a tour navigation system, but instead recommends landmarks considering the preferences of tourists in order to guide them to the destination. The purpose of this study is to support leisurely strolling by tourists. This system does not show the route information to the destination, but instead provides the information of current position, direction, distance, and photos of the landmarks that are recommended automatically by the system considering the preference of the tourist. The evaluation experiments for this study were performed in Kyoto, which is a famous tourist city in Japan, by using a prototype system on the iPhone. The result showed that most of the users were able to enjoy this new type of tour, in which the opportunities of chance encounters and new discoveries have been increased by strolling with this system. In addition, the information of photos and direction were found to be the most important information for the users.

Keywords: tour navigation system, landmark, preferences

1. INTRODUCTION

1.1 Background

In today's information society, information recommendation systems based on personal preferences are garnering attention in diverse arenas. For example, the Internet shopping site Amazon analyzes the personal preferences of users using information pertaining to the products which they have purchased. Moreover, Amazon also recommends other products that are similar to the items purchased. As a result, Amazon is profiting from this system [1]. And Internet shopping is not the only area to make use of these systems based on personal preferences. The smartphone, for example iPhone and Android phones, makes use of downloaded applications in which users are interested and can be customized by users as they like. In these ways, numerous systems exist that are based on actively incorporating the personal preferences of users, and these systems are available to the user on a daily basis.

Concerning sightseeing, many people use a navigation system like Google Maps or refer to a guidebook of the region when visiting a place. However there are many cases wherein the selection of the recommended places to visit or routes to the destination is determined on the basis of the views of hosts of the sightseeing area. Therefore, systems that suggest information based on tourist preferences are rarely seen.

This study proposes a new Tour Navigation System that does not guide the tourist to the destination through a route predetermined by a guidebook or a tour navigation system, but instead recommends landmarks considering the preferences of tourists in order to guide them to the destination.

1.2 Sightseeing Style in Recent years

Traditionally, the package tour has been the most popular sightseeing style in Japan. The package tour is a travel product wherein the entire process, from the departure to the destination, is managed by a tour company. The common practice is for the tour company to determine the route or time for sightseeing and then let the participants enjoy their sightseeing following the instruction of a tour guide. However, another sightseeing style has significantly come into usage in recent years. This is a style wherein tourists determine the process of their sightseeing themselves and enjoy their trip without using a package tour. Ishimori [2] points out that this is "autonomous tourism." In addition, "Travelers Trends 2010," published by the Japan Travel Bureau Foundation, calculated that the amount of people who were interested in gourmet food, history, urban tourism, and strolling had increased to 10% in 2009 as compared to 2007.

Therefore, the sightseeing style is changing from moving efficiently along a predetermined route to freely visiting places of interest anywhere, anytime.

2. Previous Research

2.1 Tour Supporting System Trends

In recent years, most mobile phones provide a tour service called LAC (Location Aware Computing) that uses a position locating system. For example, NAVITIME locates a user's position and then it shows the user details including the optimal shortest path to the requested destination, methods of transport, and total monetary and time amounts required. Therefore, it is popular among businessmen, who often visit unfamiliar areas and have limited amounts of time. Various types of systems for tour guidance have also been developed recently. For example, "AssisTra" is a system supporting Kyoto sightseeing by audio assist. "Watashi no 100 sen" is a system wherein users can save sightseeing places, shop locations, and photos taken by users and comment on map information.

Kurata and others [3] have conducted research about an automatic tour planning system that considers personal preferences. First, this system measured the preferences of individuals. Then, it evaluates these preferences and resources for sightseeing. Finally, users are showed the most appropriate route. They also developed a system that shows the points of interest around the current location of the users.

2.2 Problem of Previous Research

First, much of the existing research on tour navigation systems attaches a high value to the efficiency of user movement. In order to attach a high value to efficiency, the user's area of activity is limited and opportunities of chance encounters and new discoveries that may happen in sightseeing decrease. As a result, users cannot enjoy their sightseeing freely. These characteristics go against the type of tourism that is popular in recent years and do not satisfy the needs of tourists.

Second, there are many systems that have become focused on information recommendations or limited to events and shops for recommendation. In other words, the problem is that there are few systems that consider personal references.

3. Outline of Proposal

3.1 Approach

This research focuses on the tourism trend of recent years and proposes a system that recommends landmarks based on personal preferences for tourists who are strolling sightseeing. This system will allow each user to experience a different, personalized route. Therefore, this system is designed from a view that differs from recent tour navigation systems which pursue efficiency or convenience, so that users can have a good time carefully viewing landscapes around them during sightseeing.

3.1 Landmark Recommendation based on Personal Preferences

The degree of pleasantness of sightseeing depends on how much the tour experience differs from everyday life and how much it coincides with the interests of the tourist. Hence, the purposes of sightseeing vary greatly from person to person. Thus, this system recommends landmarks based on personal preferences, such as gourmet food, shopping, history, and landscapes, during the sightseeing process. Recommended information includes attached photos to attract the interest of the users. These photos include elements such as views of the front of shops and the mood around the city. This information is based on the concept of "Influential Medium" proposed by Matsumura [4]. The concept of "Influential Medium" is a physical or psychological element that changes people's recognition or behavior. In this case, photo information influences user behavior in order to motivate the user to visit the recommended place. In addition, photo information provides clues when users look for landmarks in an unfamiliar city.

3.2 Navigation Using Direction

When people are strolling and sightseeing in an unfamiliar city, they generally feel anxious or excited because they cannot know what lies ahead on the road. This factor is the "difficulty of prediction." If the "difficulty of prediction" acts on people's psychological state, a feeling of anxiousness of not knowing what will happen next induces a feeling of expectation. Finally, it strongly remains in the memory after the issue is solved.

The proposed navigation system uses the information of current position, direction, distance, and photos of landmarks based on the preferences of users, which are recommended automatically by this system, to guide them to landmarks. Therefore, it does not show users detailed routes to destinations. This concept is based on system design considering the "Benefit of Inconvenience" [5]. This means that inconvenient things can have a positive effect on people. Not showing a detailed route forces users to pay attention to surrounding landscapes in order to gather information around them. As a result, the opportunities for chance encounters and new discoveries will increase. By hiding information in this way, users feel anxious or excited, which results in being even more satisfied with the sightseeing experience. And after that, the experience becomes a good memory.

4. System Interface

4.1 Development Environment

This system uses the iPhone. It is equipped with a GPS (Global Positioning System) and users can use it anytime, anywhere. The development language is Objective-C.

4.2 System Function

First, the user is asked for a destination and the purpose of the tour with choices selectable from among gourmet food, shopping, landscape, history, and street view on the welcome screen of this system. The purpose

is considered as a preference of the user. Then the system recommends to the user landmarks that match their preferences near to their current position. These landmarks involve at least one landmark that does not match the user's purpose. This is for variety's sake. The user selects one of the proposed landmarks based on their photos and other information, and strolls around the city to find it.

This is how the user visits the landmarks in which the user is interested. As a result, the user can experience strolling and sightseeing on a unique route, not the route predetermined by a guidebook or a tour navigation system.

4.3.1 System Structure

Fig. 1 is a system structure of this system. A user uses iPhone as a terminal just like Fig. 1 to stroll. The iPhone obtains the current location of the user using a GPS. The system shows landmarks based on user's personal preferences, and then it shows the current position, a direction, and landmarks.

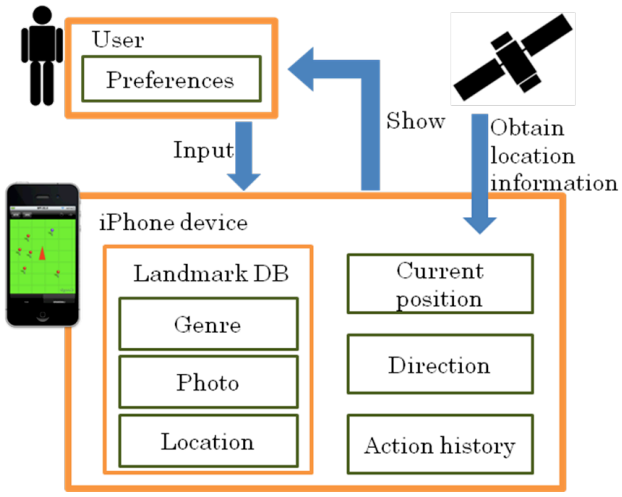

Fig. 1 System configuration diagram

4.3.2 Main Screen

Fig. 2 is the main screen of this system. The purple pin is a departure place or a destination, and the four red pins are landmarks recommended by the system. When the user starts the system, it recommends four or five landmarks like Fig. 2. At that time, the user's current position is set as the departure place. These landmarks are based on user's personal preferences. The current position is updated by tapping the "RTN" button, and then the center of the main screen becomes the current position.

The red arrow in the center of Fig. 2 is an electronic compass that constantly points to the north. It appears when the user taps the "DRC" button shown in Fig. 2. The user checks the direction to the landmarks in a method that is similar to using a magnetic compass and recognizes the approximate direction to get there.

Fig. 3 is photo information of the landmark. These pictures were taken in advance using the iPhone camera. In addition, they were selected for attractive landscapes or historic buildings on the basis of our subjective viewpoint. Finally, they are saved in the landmark database as one set comprised of the photographic information, location, and genre (Fig. 1).

The user strolls to the landmark depending on the information of the current position, the direction, the photos, and the distance between the current position and the landmark after the user selects one landmark that the user likes.

4.3.2 Feature of Landmark Update

When the system detects that a user has entered within a 30 meter radius of a recommended landmark, the user can update the landmarks. When a user updates the landmarks, a new set of four or five landmarks are recommended around the user. At that time, the current position is set as the landmark that is the closest when the user updates the landmarks. For example, the left side of Fig. 4 is the first screen displayed when the user starts this system. Four landmarks are recommended randomly inside a blue frame (the blue frame itself is not actually displayed). Then, if the user visits the landmark surrounded by the yellow circle, new landmarks are recommended randomly inside a new blue frame as in the right side of Fig. 4.

Following is a description of how the blue circle is formed. First, the system calculates the latitude and longitude of the point corresponding to a quarter of the straight-line distance from the current location (in this case, this is the landmark surrounded by the yellow circle) to the destination. That point is set as the center of the blue frame. Next, the system makes a square by taking the distance of approximately 300 meters to the north, south, east, and west from the center. The reason why the center of the frame is a quarter of the straight-line distance is to make the user visit at least four landmarks on the way to the destination.

Fig. 2 System main screen

Fig. 3 Photo screen

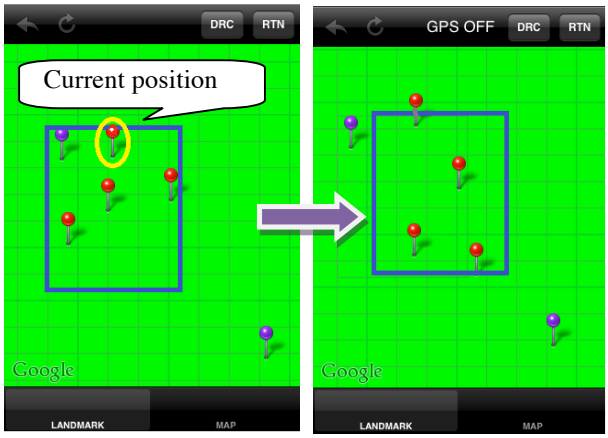

Fig. 4 Example of landmark update

5. Evaluation Experiment

5.1 Evaluation Place

An evaluation experiment was carried out in Higashiyama, Kyoto. The departure place was the Kyoto City Hall and the destination was Yasaka Shrine. The reasons why Kyoto was chosen as the evaluation experiment area are below. The experiment was carried out in January 2012.

1) There are many various spots for example historical places, cultural places, general stores, and eating facilities.
2) It is easy for tourists to visit various places because there are many narrow streets.
3) It is easy for tourists to understand the direction because Kyoto streets are laid out in a grid pattern.

5.2 Experimental Subjects

The experimental subjects were 9 people of their 20's who live in the Kansai area. They were divided into three groups on the basis of the objects of their personal preferences and how frequently they had visited Kyoto.

In addition, they were divided considering whether or not they could go to Yasaka Shrine from Kyoto City Hall without consulting a map. Options for the preferences are "landscape," "history," "gourmet food," and "shopping." Table 1 shows the group structure of the experimental subjects.

Table 1 Subject group division

	Group A	Group B	Group C
Sex	Male	Male	Male
Preference	Landscape	Gourmet food	Gourmet food
Kyoto sightseeing experience	1-2 times	More than 3 times	More than 3 times
Going without consulting a map	Can	Cannot	Cannot

5.3 Method of Evaluation

We asked the subjects to stroll freely to the destination of Yasaka Shrine from the departure point of Kyoto City Hall with this system. After we explained how to use the system and the experimental procedure, we provided each group with one iPhone that is equipped with this system. The experimental procedure is below.

First, the subjects select one landmark from the landmarks that are recommended by the system. Then, they stroll freely using this system. Finally, they reach the destination by repeating this procedure several times. Moreover, we asked them to answer three types of questionnaires to gather evaluation data on the usefulness of the system.

1) Questionnaire before the experiment

The purpose of this questionnaire is to inquire their personal preferences and to divide the group.

2) Questionnaire during the experiment

This questionnaire is conducted each time the subjects reach a landmark. In addition, it asks them about the degree of correspondence, the degree of expectation, and the degree of satisfaction. The purpose of asking about the degree of correspondence is to measure how much their preferences and landmarks match (correspond). The purpose of asking about the degree of expectation is to measure how much they expect the landmark. The purpose of asking about the degree of satisfaction is to measure whether they are satisfied with the landmark that they visit. Each degree has 5 levels.

3) Questionnaire after the experiment

The purpose of this questionnaire is to obtain feedback from the subjects on the experiment.

5.4 Results

Group A: This group selected "landscape" as their personal preference. It took the group an hour and a half to stroll to the destination from the departure place. The landmarks that they visited during the experiment were three in total. It is notable that they all were interested in "landscape" at first. However, they selected different genres for landmarks. Table 2 shows the degree of correspondence, the degree of expectation, and the degree of satisfaction for each landmark.

Group B: This group selected "gourmet food." It took the group an hour and forty minutes to stroll to the destination. The landmarks that they visited were five in total. The noticeable point of Group B is that they selected the gourmet food landmarks that coincide with their preferences five times. The reason why they selected them is in a large part due to the time when the experiments were conducted. In the questionnaire during the experiments, they answered that the reason why they selected them is in a large part due to being hungry (the experiments was conducted from 12:00 to 14:00) and the attractiveness of the photo. Table 3 gives detailed information about each of the degrees recorded for Group B.

Group C: This group conducted a method consisting of receiving recommendations for landmarks in all of the

genres without considering their personal preferences. This was done in order to observe the effect of the personal preferences on their selecting of the landmarks. It took the group an hour and fifty minutes to stroll to the destination, and they visited four landmarks in total. The feature point of this group is that they lost their way several times because they were not familiar with the experiment place and because they were confused with how to use this system. On the other hand, they were able to pass through alleys that are generally not passed through on the way to the landmark. Moreover, they were able to see the maiko of Kyoto. At the end, they answered that they had a fun time. Table 4 displays detailed information about each of the degrees of Group C.

5.5 Result of Questionnaire

According to the questionnaire given after the experiment, most subjects answered that sightseeing using this system is more fun than traditional sightseeing. For the question of, "Were there any landmarks that you were not able to visit, but wanted to visit during the experiment," the subjects who answered "YES" numbered seven and the subjects who answered "NO" numbered two. Moreover, all of the subjects who answered YES also answered, "I want to visit it if there is a chance." In the last question, "Do you want to do strolling and sightseeing with this system," all of the subjects answered "YES."

6. Discussion

6.1 Effect of considering personal preferences on landmark selection

This system recommends landmarks to users based on user personal preferences. During the experiment, subjects enjoyed the procedure of selecting the landmarks that they want to visit.

In addition, the questionnaire revealed that the most important clue to selecting a landmark is the "photo information." In the questionnaire conducted during the experiment, in most cases the degree of expectation scored higher points than the degree of correspondence, with the amount of cases wherein expectation scored higher than correspondence equaling 88.9%. Thus, if the recommended landmark does not coincide with their personal preferences, the photo information becomes the influential medium. That is how they expect the landmark. It can also be said that the photo information becomes their motivation to select the landmark. For example, Fig. 5 is the photo that was selected as a landmark by subjects. These two photos especially scored high points for the degree of expectation. However, the degree of expectation was lower than that of the correspondence.

Next, we will discuss the degree of satisfaction. Table 5 shows a comparison of the degree of expectation and satisfaction. Cases wherein the degree of satisfaction is lower than that of expectation occur 15 times (41.7% of the total). The following sentences indicate the reasons why those cases happened.

1) The shop which subjects visited was closed.
2) The landmark which they visited was not as attractive as they had expected.
3) They did not know what the shop was.

On the other hand, the degree of satisfaction exceeded that of expectation 5 times. The reasons are indicated below.

1) They felt a sense of achievement in discovering the landmark.
2) They had never been to the place before.
3) A gap existed between their prediction and the actual situation.

Table 2 Group A: Average of each degree

Genre	Correspondence	Expectation	Satisfaction
Landscape	4	4.7	4.7
Gourmet food	3.7	4.7	4.3
History	3.3	4.3	4.3

Table 3 Group B: Average of each degree

Genre	Correspondence	Expectation	Satisfaction
Gourmet food	2.3	4.7	1.7
Gourmet food	4	4.7	5
Gourmet food	4	4.3	1
Gourmet food	4	4.7	3.3
Gourmet food	4.7	5	2.7

Table 4 Group C: Average of each degree

Genre	Correspondence	Expectation	Satisfaction
History	3.7	4	4.3
History	4	3.3	4.7
Landscape	2.6	2.6	2.6
Other	3.7	3.3	3.3

Table 5 Comparison of expectation and satisfaction (expectation : satisfaction)

	Group A	Group B	Group C	Total
<	0	1	4	5 (13.9%)
=	8	2	6	16 (44.4%)
>	1	12	2	15 (41.7%)

As a result, subjects testified that they do not select the landmark when the landmark coincides with their personal preferences, but they select the landmark with the highest degree of expectation, whether it coincides with their personal preferences or not. In addition, it is highly important to show attractive landmarks in order to raise the degree of satisfaction. The degree of satisfaction depends on how much they are interested in the landmark.

Fig. 5 Examples of selected photos

6.2 Psychological action by the distance to the landmark

We asked subjects, "Did you feel that the distance was 'far' on the way to the landmark," in the questionnaire conducted during the experiment. Almost all subjects answered "Near" or "Suitable" to this question. Table 6 shows the detailed results of that question. Regarding this factor, it is thought that the subjects purposely avoided selecting landmarks that were located far away from their current position and that they already knew the route to the landmarks because some subjects were familiar with the evaluation experiment place. This system has a function that recommends landmarks within approximately 300 meters from the current position when landmarks are updated. Therefore, the efficacy of the function that limits the range of the recommended landmarks can be proved (Fig. 4).

Next, we will discuss the case wherein the subjects felt that the distance was "Far" on the way to a landmark. Group C was the only group to answer "Far" in the entire experiment. The reason that all of them answered was, "Because we lost our way." Other reasons are below.

1) They were not familiar with the experiment area.
2) They did not know how to use this system appropriately.
3) They did not pay enough attention to the landscape around them.

Thus, the landmark that they selected was not so far away, but they felt exhausted due to the extra walking time because of losing their way. In addition, they felt anxiety because they did not know where the recommended landmark was. In short, we can consider that these negative impacts made them feel that the distance was "Far."

Table 6 Distance to the destination

	Group A	Group B	Group C	Sum
Near	5	6	4	15
Suitable	4	9	5	18
Far	0	0	3	3

6.3 Difference between this system and existing navigation systems

From the questionnaire conducted during the experiment, it can be concluded that all subjects depended on "direction information" in order to visit the landmark. They had to check the direction to the landmark when they viewed the system screen or they would lose their way. Therefore, the function of showing direction information is especially important for a tour navigation system.

This system is an inconvenient navigation system because it does not show detailed route information. Nevertheless, all subjects enjoyed strolling using this system. Many of them answered that they were able to discover new things during the sightseeing experience, and some also answered, "Not being showed a detailed route, we worked seeing around them more carefully than usual." Therefore, their enjoyment can be thought to be due to the fact that subjects strolled gathering information around them more than usual in order to complement the deficient information. This result is exactly what is meant by the utility of the "benefit of inconvenience."

In addition, one subject answered, "the sightseeing changed to an adventure," in the questionnaire given after the experiment. Thus, this function of guiding the subjects using the direction or photos without showing a detailed map makes them feel like they are playing an adventure game.

As previously described, the opportunity for chance encounters and new discoveries increased by using this system, and the subjects were able to enjoy a different kind of sightseeing. Therefore, the beneficial nature of this tour navigation system compared to existing systems has been proven.

7. Conclusion

From the result of the experiment and discussion, this system can be seen as having three challenges for the future, which listed below.

1) Landmark diversity

This system set the genre of the recommended landmarks based on user preferences. However, it could also be said that it is important for users to receive recommendations for many attractive landmarks without considering their preferences. Therefore, other methods of recommendation need to be incorporated in order to recommend a wider array of landmarks.

2) Additional landmark information

This system attached photo information only.

However, some subjects stated that, "We wanted other information about the landmark," in the questionnaire given after the experiment. For example, they requested information on things including shop business hours and area history.

3) Navigation system for attracting repeat users

All of the subjects answered, "If I could have another chance, I would want to stroll using this system again." Therefore, this system generates a feeling of expectation which can be used to attract repeat users.

We proposed a tourist navigation system that did not provide detailed route information, but instead guided users by showing information on their current position, the direction, photos, and the distance between the current position and the landmark. The system was evaluated in Higashiyama, Kyoto. From the result of the evaluation, it was verified that the photos and the direction were the most important information for the subjects to visit the landmark. In addition, the beneficial nature of this proposal was proven because we verified that the opportunity for chance encounters and new discoveries increased through the usage of this navigation system.

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