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Development of Sightseeing Spot Recommendation System Considering Users' Visit frequency

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***Abstract*—The present study aimed to design, develop, operate and evaluate a sightseeing spot recommendation system that can efficiently support tourists while considering their visit frequencies. This system was developed by integrating social networking service (SNS), Web-geographic information systems (GIS) and recommendation system. The system recommends sightseeing spots to users with different visit frequencies, adopting two recommendation methods (knowledge-based recommendation and collaborative recommendation methods). Additionally, the system was operated for 6 weeks in Kamakura City, Kanagawa Prefecture, Japan, and the total number of users was 61. Based on the results of the web questionnaire survey, the usefulness of the system when users travel or plan tours was high, and the recommendation function of sightseeing spots, which is an original function, has received mainly good ratings. From the results of access analyses of users' log data, the total number of sessions in this system was 329, 77% used mobile devices, and smartphones were used most frequently. Therefore, it is evident that the system has been used by different types of devices just as it was designed for, and that the system has been used according to the purpose of the present study, which is to support the sightseeing activities of users.**

Keywords—Sightseeing spot recommendation system, Web-GIS, SNS, Recommendation Systems, Visit frequency

I. INTRODUCTION

Due to the advancement of information in recent years, anyone can easily send and receive information regardless of time and place, and obtain an abundance of various information from the internet. The same can be said with sightseeing information. Tourists must select necessary information from among a significant amount of sightseeing information, and it is tremendously difficult to find information tailored to their purposes. Therefore, it is important to provide tourists with relevant sightseeing information using the internet.

At popular sightseeing sites, there are not only tourists who are visiting for the first time or who have only made a few visits, but there are also repeat tourists who have made several visits. Okamura et al. (2007) [1] identified the difference in sightseeing spots where tourists with different visit frequencies visited. In this regard, taking up Kamakura City, Kanagawa Prefecture, Japan as an example, the enhancement of sightseeing support for repeat tourists was addressed as one of the issues on sightseeing (Kamakura City, 2016) [2]. Therefore, it is best to provide sightseeing spot information according to the visit frequency of tourists. Because it is difficult to use the same method to provide adequate and appropriate support for both tourists that visit for the first time and have limited knowledge and sense of locality as well as tourists including repeat tourists who have knowledge and sense of locality concerning sightseeing spots.

Based on above background, the present study aims to develop a sightseeing spot recommendation system that can efficiently support tourists, taking their visit frequencies into account. This system is designed and developed by integrating social networking service (SNS), Web-geographic information systems (GIS) and recommendation system. SNS is used to gather, accumulate, evaluate and share sightseeing information. Web-GIS is used to visualize the sightseeing information on digital maps. Recommendation system is used to recommend sightseeing spots to users by taking the difference in the visit frequencies into account.

II. RELATED WORK

The present study is related to 3 research fields including (1) studies related to sightseeing support systems, (2) studies related to sightseeing information system especially for repeat tourists, and (3) studies related to sightseeing recommendation systems. Taking up the representative studies in the above three research fields, in (1), Fujita et al. (2016) [3] developed navigation systems integrating SNS, Web-GIS and augmented reality (AR) to support sightseeing activities during normal times and evacuations during disasters. In (2), Masuda et al. (2012) [4] proposed a system to promote the creation of repeat tourists by providing only nearby information up to the sightseeing spots, and also provide a feeling of incompleteness when they are unable to find what they are looking for. Additionally, Katayama et al. (2017) [5] developed an information providing system to promote the creation of repeat tourists by providing users with the information concerning hidden spots that are little known but have been visited by others in the past, and have a relatively high satisfaction rate among tourists. In (3), Ikeda et al. (2014) [6] developed a social recommendation GIS that can recommend sightseeing spots using the similarity between users' preferences and sightseeing spot evaluation. Mizutani et al. (2017) [7] developed a sightseeing spot recommendation system that supports both individual and groups. Tarui et al. (2011) [8] developed a sightseeing spot recommendation system based on users' travel histories, adopting collaborative recommendation and content-based recommendation systems.

Regarding (1), support is provided for sightseeing activities during normal times by means of the functions of

submitting, viewing, recommendation, sightseeing planning assistance and navigation. Additionally, support is also provided for evacuation during emergencies by displaying support facilities (evacuation centers, water stations, etc.) on the digital map. Regarding (2), though the sightseeing information system promote the increase of repeat tourists, most of these does not provide sightseeing support for them. For (3) excluding Tarui (2011) [8], while sightseeing support through sightseeing spot recommendation by knowledge-based recommendation is conducted, the recommendation of appropriate sightseeing spots according to the preferences of users with different visit frequencies has not been satisfactory. Additionally, with Tarui (2011) [8], though sightseeing information that suits the preferences of users based on their visiting history can be recommended adopting the collaborative filtering and content-based recommendation, users are restricted as they must have experience visiting several sightseeing spots, and the travel history for specific sightseeing spots is not taken into consideration.

In comparison with the preceding studies mentioned above, the first original feature of the present study is that the system can be utilized by users with different visit frequencies including tourists that visit for the first time and have little knowledge and sense of locality as well as tourists who are repeat tourists and have an abundance of knowledge and sense of locality concerning sightseeing spots. The second original feature is that it adopts both knowledge-based recommendation and collaborative recommendation as methods to recommend sightseeing spots according to the different preferences of users that occur due to the difference in visit frequency.

III. SYSTEM DESIGN

A. System Characteristics

As shown in Fig. 1, this system is developed by integrating SNS, Web-GIS and recommendation system. The purpose of this system is to support the sightseeing activities of users with different visit frequencies, and by adopting both knowledge-based recommendation and collaborative recommendation as recommendation methods, provide appropriate sightseeing spot information that suits the preferences of such users. For users with low visit frequency such as tourists visiting for the first time, recommendations will be made based on the required conditions entered for sightseeing spots adopting knowledge-based recommendation method. For users with high visit frequency such as repeat tourists, recommendations will be made based on their information including evaluation history of sightseeing spots, sightseeing spot added to favorites and visiting history adopting collaborative recommendation method. Additionally, combining SNS and Web-GIS, the system enables to display the evaluation data on digital maps, submit the comments and images for any location as well as new sightseeing spot information, and easily gather and accumulate sightseeing spot information. As user information is simultaneously saved in the system, the longer the system is operated, the more support that caters to the preferences of users can be provided. In this way, the system can provide efficient support for sightseeing activities by recommending sightseeing spots that take the visit frequency of users into account.

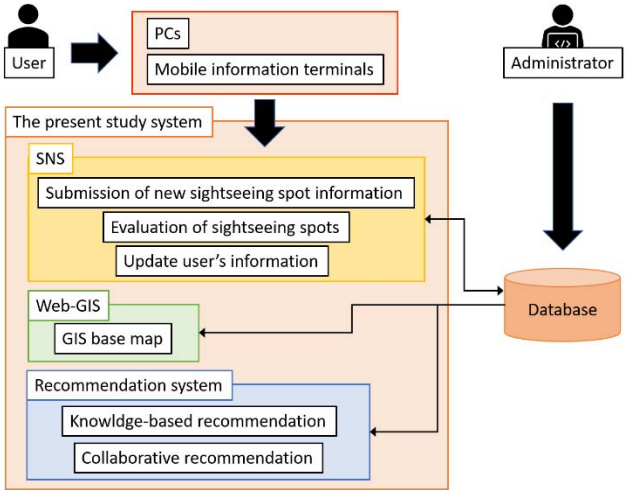

Fig. 1. System design.

B. Design of Each System

1) SNS

An original SNS is uniquely designed. The main functions of SNS originally designed in this system are the submitting and viewing of sightseeing spot information. Additionally, using the designed SNS, submitted information, "favorite sightseeing spots" and "visited sightseeing spots" can be made public. The information as each user's profile, the information related to account names, genders and age groups and numbers of past visits to Kamakura City is disclosed.

2) Web-GIS

Though there are many types of Web-GIS, this system uses ArcGIS API for JavaScript provided by the ESRI to display the location of recommended sightseeing spots, as it is convenient to access the websites without the installation of any software. Additionally, Leaflet, which is the JavaScript open-source map library using JavaScript, is used to display the recommendation results for sightseeing spots as well as the location of submitted information and sightseeing spots in the page for the detailed information of sightseeing spot.

3) Recommendation System

a) Outlines of the Recommendation System in the Present Study

According to Jannach et al. (2011) [9], there are 3 types of recommendation methods, including collaborative recommendation, content-based recommendation, and knowledge-based recommendation, that can make recommendations from vast information groups to match the preferences of users. This system is expected to be used by 2 types of users: users who visit a sightseeing spot for the first time or who have only made a few visits, and users who have visited several times (repeat tourists). Therefore, the system will adopt knowledge-based recommendation and collaborative recommendation methods. Knowledge-based recommendation method was selected, as it is the best method for users that visit a sightseeing spot for the first time and have little knowledge and sense of locality. The method can recommend appropriate sightseeing spots, by explicitly asking for preferences and creating preference

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data of users who receive recommendations. On the other hand, the collaborative recommendation method was selected, as it is the best method for users such as repeat tourists who have their own preferences based on their previous visits to the sightseeing spots. The method can recommend appropriate sightseeing spots which suit the preferences of users, by referring to the utilization and preference information of users.

Additionally, the cold-start problem can be solved by adopting knowledge-based recommendation method. Cold start is a problem where appropriate recommendations cannot be made due to insufficient past information. Since knowledge-based recommendations are conducted by creating preference data of users, appropriate recommendations can be made without any past information by explicitly asking for their preferences beforehand.

b) Knowledge-Based Recommendation

Regarding knowledge-based recommendation method, user profiles are created by having users evaluate the items set beforehand on a scale of 1 to 5. The created user profile is set as the user's characteristic vector. Regarding the evaluation data of sightseeing spots also, characteristic vectors for sightseeing spots are created by evaluating each item on a scale of 1 to 5. Based on the created characteristic vectors of users and sightseeing spots, a maximum of 10 sightseeing spots in descending order of similarity will be recommended by calculating the degree of similarity using equation (1).

$$Sim_i = \frac{\sum_{j=1}^{n} U_j \times S_{ij}}{\sqrt{\sum_{j=1}^{n}(U_j)^2} \times \sqrt{\sum_{j=1}^{n}(S_{ij})^2}} \qquad (1)$$

Sim_i: Degree of similarity
U_j: Evaluation information of user concerning condition j
S_{ij}: Evaluation data of sightseeing spots
i: Number of sightseeing spots
j: Item number of user's conditions and sightseeing spot's features

c) Collaborative Recommendation System

According to Kamishima (2007) [10], collaborative filtering (collaborative recommendation in the present study) method can be divided into memory-based method and model-based method. Memory-based method of collaborative recommendation system was selected, as user information will be accumulated in the database, and the preference information of users will be expected to be insufficient right after the start of the operation of this system.

Additionally, according to Kamishima (2007) [10], memory-based method can be divided into 2 types: user-based type and item-based type. The system will adopt item-based type of collaborative recommendation system for the same reason memory-based method was selected which is that the lack of preference data of users can be expected right after the start of the operation of the system. This method enables recommendations to be made based only on the preference data of users, by accumulating the evaluation data of sightseeing spots beforehand. Regarding the preference data of users, it can be gathered by registering the evaluation data of sightseeing spots as well as "favorite sightseeing spots" and "visited sightseeing spots" using the designed SNS in Section III-B. Therefore, the system will use the item-based type to develop a memory-based collaborative recommendation system. More specifically, Item-Based Neighborhood Model proposed by Aggrawal (2016) [11] will be used. First, the degree of similarity between sightseeing spots is calculated using equation (2) from the evaluation data of sightseeing spots accumulated in the database of the system.

$$Sim(i,j) = \frac{\sum_{u \in U_i \cap U_j}\{(r_{ui} - \bar{r_u}) \times (r_{uj} - \bar{r_u})\}}{\sqrt{\sum_{u \in U_i \cap U_j}(r_{ui} - \bar{r_u})^2} \times \sqrt{\sum_{u \in U_i \cap U_j}(r_{uj} - \bar{r_u})^2}} \qquad (2)$$

$Sim(i,j)$: Degree of Similarity between sightseeing spot i and sightseeing spot j
r_{ui}: Evaluation data of sightseeing spot i by user u
$\bar{r_u}$: Average value of evaluation data of user u
u: User number
i, j: Sightseeing spot number
U_i: User who evaluate sightseeing spot i

At the same time, user profiles will be created based on the users' evaluation data of sightseeing spots registered in the system using the designed SNS in Section III-B. Aside from the users' evaluation data, the evaluation values of sightseeing spots according to each category as calculated using equation (3) are added to the evaluation values of sightseeing spots that belong to their respective categories, based on the data of "favorite sightseeing spots" and "visited sightseeing spots" registered by users.

$$C_{ui} = 5 \times \frac{s_{ui}}{I_u} \ldots (3)$$

C_{ui}: Evaluation data of user u for category i
I_u: Number of favorites and visits of user u
s_{ui}: Number of favorite sightseeing spots and visited sightseeing spots of user u
u: User number
i: Category number

Next, for sightseeing spots that have not been evaluated by users, the estimated evaluation values of users are calculated using equation (4), based on the degree of similarity between sightseeing spots and user profiles, and up to 10 sightseeing spots will be recommended in the descending order of the estimated evaluation value.

$$p_{ut} = \frac{\sum_{j \in Q_{t(u)}} Sim(j,t) \times p_{uj}}{\sum_{j \in Q_{t(u)}} |Sim(j,t)|} \qquad (4)$$

p_{ut}: Estimated evaluation values of sightseeing spots that have not been evaluated by users
$Q_{t(u)}$: Aggregation of sightseeing spots evaluated by user u

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t: Number of sightseeing spots that are not evaluated by users
j: Number of sightseeing spots

IV. System Development

A. System Front End

1) Viewing Function of Sightseeing Spots

Users are transferred to the page for the viewing function of sightseeing spot information from the "Kamakura area map" in the menu of the top page. This page allows users to search for sightseeing spots using "search from map" or "search by category". When using "search from map", a popup including the "name of sightseeing spot", "category" and "link to the page for the detailed information of sightseeing spot" will be displayed, by clicking onto the markers on the digital map. Additionally, the markers are color-coded according to category. On the other hand, when using "search by category", sightseeing spots will be displayed in a list according to category. Users are transferred to the page for the detailed information of sightseeing spot, by selecting a sightseeing spot from the list. Additionally, users who have created their own account and log in to the system can register their "favorite sightseeing spots" and "visited sightseeing spots", by clicking onto the buttons of "register favorites" and "register past visits" from the list.

In the page for the detailed information of sightseeing spot, the "name of sightseeing spot", "category", "postal code", "address", "link (external site of the sightseeing spot)", "details (sightseeing spot information)" and "number of comments on the sightseeing spot" as well as the "image of the sightseeing spot" and "map" are displayed. The buttons of "register favorites" and "register page visits" are displayed on this page, and users can use them to register their "favorite sightseeing spots" and "visited sightseeing spots". The link for each category transfers users to the list of sightseeing spots for the selected category, while the link in the comments on a sightseeing spot transfers users to the list of comments. Additionally, the link of "click here to update sightseeing spot information" transfers users to the page for the editing of sightseeing spot information. This page allows users to update information excluding the "name of sightseeing spot", "category", "image" and "location information".

2) Submitting Function of Sightseeing Spots

Users are transferred to the page for the submitting function of sightseeing spots from the "submitting function" in the menu of the top page. In this page, information on a location can be submitted by entering the "name of sightseeing spot", "title", "category", "comment", "image" and "evaluation for each item", and clicking onto the location on the digital map or by acquiring the present location information. For each evaluation item, 5 items including the "satisfaction level", "access", "non-crowdedness", "landscape", and "accessibility for those with special need" must be evaluated on a scale of 1 to 5. Additionally, in the page for this function, users can be transferred to the list and map of submitted information. Users can visit the page for the submitted information list from the page for the submitting function of sightseeing spots as well as the top page. This page displays the "title", "name of sightseeing spot", "submitter", "submitting date and time" and "image". Users can go to the page for the detailed information of sightseeing spot, by selecting one of the submitted information.

Regarding the map with submitted information, markers are displayed on the digital map based on the location information from the submitted information. By clicking onto a marker, a popup including the "title", "name of sightseeing spot", "category", "submitter", "submitting date and time" and "comments" is displayed. These markers are color-coded according to category. On the page for the detailed information of sightseeing spots, the "title", "target sightseeing spots", "category", "submitter" and "comments" as well as "submitted image" and "map" are displayed. Selecting a target sightseeing spot leads to the page for the detailed information of sightseeing spots, selecting a category leads to the page for the submitted information list of such category, and selecting a submitter leads to the My Page of the person who submitted the information. Additionally, only the administrator and the user who submitted the information can go to the page for the editing of sightseeing spot information to delete submitted information.

3) Recommendation Function of Sightseeing spots

Users are transferred to the page for the recommendation function of sightseeing spots adopting knowledge-based recommendations from the "recommendation conditions" in the menu of the top page. By clicking onto the button of "send" after evaluating each items for sightseeing spots on a scale of 1 to 5, and selecting the range of recommendation results from "main station" and "distance (250m, 500m, 1km, or not specified) from the mains station", users can go to the page for the recommendation results. The center of recommendations can be set as users' present locations by using their present location information. Additionally, users can be transferred to the recommendation function of sightseeing spots adopting collaborative recommendations from the "recommended spots" in the menu of the top page. Sightseeing spots are recommended in the same way as the recommendation function of sightseeing spots adopting knowledge-based recommendations.

Users can go to the page for the recommendation results by clicking onto the button of "send" on the pages of "recommendation conditions" and "recommended spots". The page for the recommendation results displays a list of sightseeing spots (up to 10) that were recommended as well as the map with the locations. A popup containing the "name of sightseeing spot", "category", and the "link to the page for the detailed information of sightseeing spot" can be displayed, by clicking onto the markers on the digital map. These markers are color-coded according to category. The list of recommended sightseeing spots and the links in the popups lead to the link to the page for the detailed information of sightseeing spot.

B. System Back End

1) Processing Concerning the Evaluation of Sightseeing Spots

In order to improve the accuracy of the recommendation function of sightseeing spots, users are

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asked to evaluate sightseeing spots using the designed SNS in Section III-B. and new evaluation values are calculated with the backend of this system.

2) Processing of Knowledge-Based Tecommendations

The backend of the system is used for the process of calculating the degree of similarity adopted to recommend sightseeing spots to users, creating user profiles based on the preference information entered by users, and narrowing of sightseeing spots within the range of the recommendation results to be displayed. Users can receive recommendations, by entering their preference information and the range of recommendation results for sightseeing spots.

3) Processing of collaborative recommendations

The calculation process for the degree of similarity between sightseeing spots, the evaluation information of sightseeing spots obtained through the users' SNS, the degree of similarity between the user profile created from the registered information such as "favorite sightseeing spots" and "visited sightseeing spots" and evaluation data of sightseeing spots were used. The backend of the system was used for the calculation process of the estimated evaluation values of unevaluated sightseeing spots, and the narrowing process of sightseeing spots within the range of the recommendation results entered by users. After the users have used each function of SNS, they can receive recommendations by entering the range of recommendation results for sightseeing spots.

C. Interface

The interface of this system has 2 types: the PC (Fig. 2.) and mobile device (Fig. 3.) screen of users, and the PC screen of the administrator. For the users' screen, a responsive design was selected and 2 types of interfaces were prepared according to the screen size of the devices used. For the administrator's page, users, sightseeing spot information, and submitted information can be managed. By utilizing Graphic User Interface (GUI), malicious users and inappropriate sightseeing spot information can be deleted without being affected by the information technology (IT) literacy of the administrators.

V. Operation

A. Selection of Operarion Target Area

Kamakura City, Kanagawa Prefecture was selected as the operation target area. The first reason for this selection is that there are many visits by tourists with different visit frequencies. As mentioned above, Kamakura City is a well-known sightseeing area and the number of visits by repeat tourists has increased in proportion to the enhancements made to the sightseeing support for them. It has also received many first-timer tourists, making it a concentrated location by tourists with different visit frequencies. The second reason is that Kamakura City has many sightseeing spots such as retail shops and restaurants for tourists in addition to historical buildings. Therefore, it is anticipated that the system can be used to recommend sightseeing spots according to tourist preferences and visit frequencies.

B. Operation Overview

The operation of this system was conducted over the course of 6 weeks (26 December 2019 - 31 January 2020) with people inside and outside the operation target area as subjects. The authors promoted the use of the system through the website, Twitter and Facebook of their labs. Users will register when using the system for the first time. Registration is completed by entering their account names, email addresses, genders, age groups, numbers of past visits to Kamakura City and passwords. The email address and password are required when logging in to the system. Users are automatically transferred to the top page only

Fig. 2. PC interface and deception of featuers.

No.	Description
1	Go to "Kamakura area map"
2	Go to user information page
3	Go to page where sightseeing spot are recommended adopting knowledge-based recommendation
4	Go to page where sightseeing spot are recommended adopting collaborated-based recommendation
5	Go to page for submitting sightseeing spot information
6	List of latest five submissions
7	About new concerning this system
8	Logout

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Fig. 3. Mobile device interface and deception of featuers.

No.	Description
1	Go to “Kamakura area map”
2	Go to user information page
3	Go to page where sightseeing spot are recommended adopting knowledge-based recommendation
4	Go to page where sightseeing spot are recommended adopting collaborated-based recommendation
5	Go to page for submitting sightseeing spot information
6	Logout

after the initial registration. After completing the registration process, users can use all the functions of the system only if they are logged in. While the “Kamakura area map” and other information concerning Kamakura area can be utilized without logging in, “favorite sightseeing spots” and “visited sightseeing spots” cannot be registered. The My Page can be used to change the information concerning users and their preferences which will enable them to receive recommendations of sightseeing spot that suit individual preferences.

C. Operation Results

TABLE I and TABLE II respectively show the details of the users and web questionnaire survey respondents during the operation period, and the users’ visit frequency. There was a total of 61 users, with 44 male and 17 female users. Regarding the age of users, there were many users in their 20s for both males and females. Regarding the visit frequency to the operation target area, the system was used by users with both high and low visit frequencies

TABLE I. USERS AND WEB QUESTIONNAIRE SURVEY RESPONDENTS DUING THE OPERATION PERIOD

Age Groups Users	10-19	20-29	30-39	40-49	50-59	60+	Total
Number of users	3	39	4	1	8	6	61
Number of web questionnaire survey respondents	1	36	4	1	6	5	53
Valid response rate (%)	33.3	92.3	100	100	75.0	83.3	86.9

TABLE II. OVERVIEWS OF USERS’ VISIT FREQUENCY

Visit Frequency	0	1	2	3	4-5	6-10	11+	Total
Number of users	9	6	7	2	8	7	22	61

VI. EVALUATION

A. Evaluation Based on a Web Questionnaire Survey

1) Overview of Respondents

After the end of the operation, a web questionnaire survey and access analysis of the user’s log data were conducted to evaluate the system developed in the present study. The overview of the questionnaire survey is also shown in TABLE I. As shown in this table, 53 people out of the 61 users responded which is an 87% valid response rate. The 2nd evaluation focused on the original functions of this system used by users on their own initiative.

2) Evaluation Concerning the System Utilization

For the number of visits to the operation target area before using the system, those with 0 visits are defined as “first-time visitors”, 1-2 visits are “few-time visitors”, 3-5 visits are “semi-repeat tourists”, and 6-11 or more visits are “repeat tourists”. According to this definition, 16% of users were first-time visitors, 25% were few-time visitors, 14% were semi-repeat tourists, and 45% were repeat tourists. In this way, the percentage of repeat tourists was high for both men and women, and there were also many first-time and few-time visitors. Therefore, it is evident that the system was used by people with different visit frequencies including first-time and few-time visitors who have limited knowledge and sense of locality as well as semi-repeat tourists and repeat tourists who have sufficient knowledge and sense of locality concerning sightseeing spots.

Additionally, the number of new sightseeing spots submitted during the operation was 22, and the number of evaluations for sightseeing spots that were accumulated in the system before the operation was 45. Therefore, it can be expected that the number of submits for new sightseeing spot information as well as the evaluations for accumulated sightseeing spots will increase, by conducting the operation of the system on a long-term basis.

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3) Evaluation Concering the Original Functions

a) Recommendation Function of Sightseeing Spots Adopting Knowledge-Based Recommendations

The evaluation results concerning the recommendation function of sightseeing spots adopting knowledge-based recommendations are shown Fig. 4. As mentioned in Section IV-A, when using this function, users must register their recommendation conditions for sightseeing spots. Hereafter, first-time visitors and few-time visitors are regarded as low visit frequency users, and semi-repeat tourists and repeat tourists are regarded as high visit frequency users. The function was used by 72% of those who responded to the questionnaire survey, and 42% of those who were low visit frequency users for whom the function supports. Because Fig. 4. shows the results including high visit frequency users, hereafter, the results of low visit frequency users are described. Regarding the satisfaction rate of sightseeing spots recommended, 94% of those who used the function with low visit frequency answered "I think so" or "I somewhat think so". For the suitability of users, all of those answered "I think so" or "I somewhat think so". Additionally, for the compatibility of the recommended sightseeing spots with the preferences of users, 88% answered "I think so" or "I somewhat think so".

From these results, sightseeing spots recommended by knowledge-based recommendation method, which is based on the preference information of user obtained by their recommendation conditions, matched the preferences of low visit frequency users. In addition, the above questionnaire survey shows high visit frequency users utilized the system and give high scores to the evaluation item. This is because the function can recommend sightseeing spots only by registering users' conditions for sightseeing spots and it is used easily by them.

b) Recommendation Function of Sightseeing Spots Adopting Collaborative Recommendations

The evaluation results concerning the recommendation function of sightseeing spots adopting collaborative recommendations are shown in Fig. 5. This function used by 81% of those who responded to the questionnaire survey, and 67 % of those who were high visit frequency users for whom the function supports. Because Fig. 5. shows the results including low visit frequency users, hereafter, the results of high visit frequency users are taking up. Regarding the satisfaction rate of the sightseeing spots recommended, 93% of those who used the function with high visit frequency answered "I think so" or "I somewhat think so". For the compatibility of the recommended sightseeing spots with the preferences of users, 86% answered "I think so" or "I somewhat think so". Therefore, sightseeing spots recommended by collaborative recommendation method, which is based on the preference information and evaluation history of users, matched the preferences of high visit frequency users. In addition, the above questionnaire survey shows low visit frequency users utilized the system and give high scores to the evaluation item. This is because the function can recommend sightseeing spots based on not only users' histories of evaluation and visit but also registered their favorites, appropriate ones can be recommended to them without their histories of evaluation or visit.

B. Evaluation based on access analysis

Access analyses were conducted in the present study using the log data of users during the operation period. The present study used the Google Analytics of Google. The access log can be obtained by calling the Python Program, which contains the analysis code created with Google Analytics, from the HTML file read on each page within the website subject to access analyses.

The total number of sessions in this system was 329. Regarding the devices used to access the system, 23% used PCs, 74% used smartphones, and 3% used PC tablets. The reason for this is that smartphones are used most frequently as a convenient information acquisition method in recent years. Therefore, it can be considered effective to design the system to be used equally regardless of the type of device in order to eliminate the difference in obtaining information.

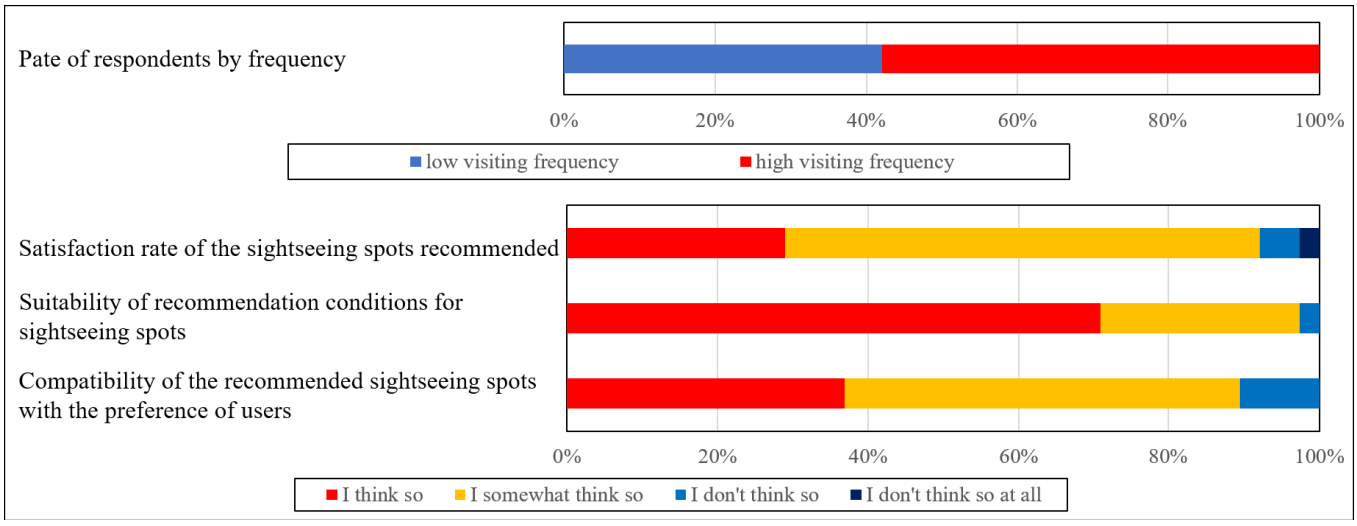

Fig. 4. Evaluations concerning the recommendation function of sightseeing spots adopting knowledge-based recommendations.

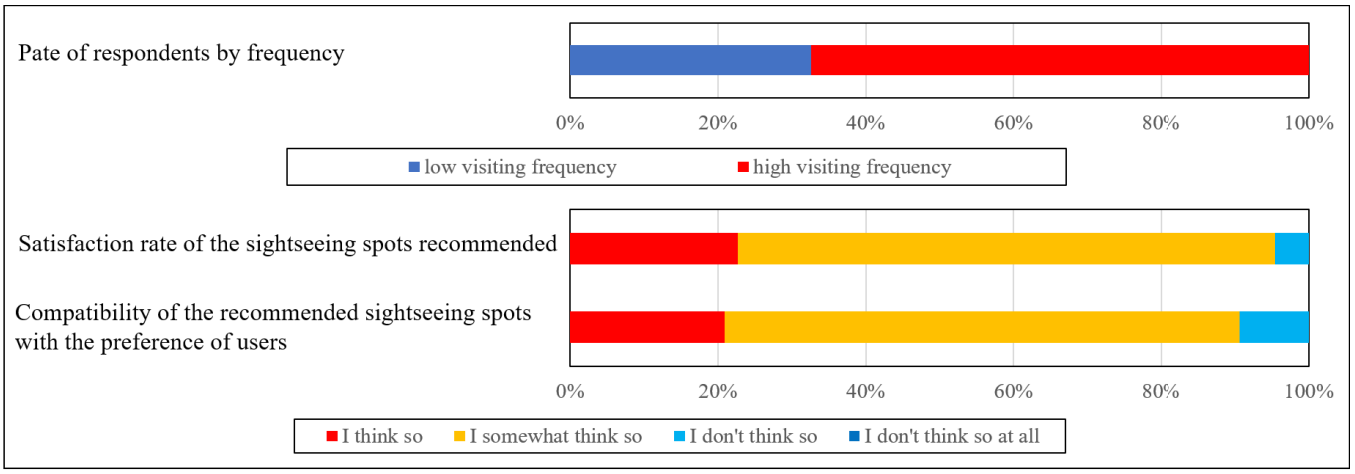

Fig. 5. Evaluations concerning the recommendation function of sightseeing spots adopting collaborative recommendations.

VII. CONCLUSIONS

In the present study, a system was designed and developed (Sections III and IV), the operation was implemented (Section V), and evaluations were conducted (Section VI). The present study can be summarized in the following 3 points.

(1) In the present study, a system was designed and developed by integrating SNS, Web-GIS and recommendation system in order to recommend sightseeing spots to users with different visit frequencies. This system reduced the burden of gathering sightseeing information to recommend sightseeing spots to users with different visit frequencies and enabled the gathering and accumulation of sightseeing spot information
Kamakura City, Kanagawa Prefecture, Japan was selected as the operation target area, and the operation and evaluations of the system were conducted.

(2) The operation of the system was conducted over the course of 6 weeks with people inside and outside the operation target area as subjects, and the total number of users was 61. A questionnaire survey was conducted for users. Based on the results of this questionnaire survey, it revealed that recommendation system for sightseeing spots adopting 2 recommendation methods is effective in supporting the sightseeing activities of users with different visit frequencies.

(3) According to the results of access analyses, it made clear that the system was used in line with the purpose and design of the present study which was to enable the system to be used regardless of the type of device used, and support the sightseeing activities of users with different visit frequencies adopting different methods. The total number of sessions in the system was 329. Regarding the devices used to access the system, 77% used mobile devices, and smartphones were used most frequently.

In regards to future research tasks, the improvement of its utilization significance by increasing performance records of the system in other urban sightseeing destinations can be raised.

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