SIGHTSEEING PLANNING SUPPORT SYSTEM ADOPTING GAMIFICATION

Koga Y* and Yamamoto K

Graduate School of Informatics and Engineering, The University of Electro-Communications, Japan

Abstract: In recent years, it has been easier to obtain various information on the Internet, and people have to select appropriate information from among the large amount of information available. This can also be said about sightseeing information. As it is difficult for tourists to find the information that suits their purposes by themselves, a system that effectively provides the appropriate information to them is necessary. On the other hand, in order to provide users with real-time information, it is necessary to urge them to continue using the system, and it is effective to adopt gamification to increase users' motivation to continuously utilize the system. Against the above backdrop, in order to support users' enjoyment in creating efficient and pleasant sightseeing plans, this study aims to develop a sightseeing planning support system that incorporates gamification to increase motivation and combines with web-geographic in-formation systems (Web-GIS) and sightseeing planning and sharing system. The system was operated over a period of seven weeks in Chofu City, in Tokyo Metropolis, Japan. Based on the results of a questionnaire survey for 51 users, though the operability of the 3 main functions incorporated with motivation by gamification was rated lower than those of the 2 basic functions, their use-fulness was highly rated. Based on the results of the access log analysis, it was effective to design the system so that the same functions can be used regardless of the type of information terminal. Additionally, it was evident that the continuous utilization of the system could increase the number of sightseeing plans made by the users.

Keywords: sightseeing, gamification, system development, Web-GISs

Introduction

In the advanced information society of recent years, the Internet has become flooded with a vast and diverse range of information, making it easy for anyone to obtain the information they seek. Furthermore, with the recent spread of social networking services (SNS), in recent years, everyone is not only a recipient of information but also a sender of information, which has accelerated the flood of information on the Internet. In addition to SNS, information posted on blogs and word-of-mouth sites has become a source of information that cannot be ignored and contributes greatly to the acquisition of information. The same is true for sightseeing information. However, the vast amount of information posted on SNS and other sites makes it difficult for tourists to obtain information on tourist spots according to their preferences, as they have to discard information that is irrelevant to sightseeing or that does not suit to their preferences. In order to solve these problems, a system that systematizes the information provided according to its purpose is necessary.

Furthermore, due to the impact of COVID-19 Pandemic, the importance of sightseeing information has changed drastically from the past. In the past, sightseeing information was mainly focused on the attractiveness of sightseeing spots and related information, but information on countermeasures

against infectious diseases and congestion is becoming more important at present. Therefore, there is a need for a platform that can provide real-time sightseeing information for ever-changing situations.

In order to provide users with real-time information, it is necessary to urge them to continue using the system, and the adoption of the concept of gamification is effective for this purpose. According to Werbach (e.g. 2012), incorporating game elements and design techniques into a context that was not originally a game can make people want to be strongly involved and encourage them to experiment without fear of failure, which in turn may make it easier to achieve positive effects.

Research objectives

The research objective is to develop a system that supports users to make efficient and comfortable sightseeing plans while having fun, by incorporating the concept of gamification. This system is a combination of Web-GIS and a sightseeing plan making/sharing system that incorporates the concept of gamification. Web-GIS visualizes sightseeing spots on a digital map, and the sightseeing plan making/sharing system shares sightseeing information that can be used as preliminary information when making a sightseeing plan. The system will be evaluated by questionnaire surveys and access analysis, and issues will be identified and improvement measures will be proposed.

Literature review

This study is related to three study fields, namely, (1) studies regarding sightseeing support system, (2) studies regarding system for information sharing, and (3) studies regarding gamification. The representative examples of the above three study fields are as follows; In (1) studies regarding sightseeing support system, Kurata *et al*. (2015) developed CT-planner, a system that can calculate sightseeing spots and their routes according to users' preferences and make detailed plans interactively based on the calculated contents. Ikizawa *et al*. (2020) developed a sightseeing support system that integrates a travel route recommendation system, Web-GIS, and AR technology to support planning that reflects public transportation timetables. In (2) studies regarding system for information sharing, Yanagisawa *et al*. (2012) constructed an information-sharing GIS that integrates Web-GIS, Wiki, and SNS to accumulate local knowledge in local communities. Okazaki *et al*. (2013) developed a disaster information sharing system that can be used continuously from normal times to disaster times. Ueda *et al*. (2015) constructed a tourism support system that generates post-event information from tourists' behavior during sightseeing and supports sharing of the generated post-event information as advance information. In (3) studies regarding gamification, Hamamura *et al*. (2016) developed an online disaster evacuation support system using gamification to promote the use of "Akari Map". Kunieda *et al*. (2019) used gamification to develop "KadaPam", a sightseeing guidebook generation and printing system that records travel memories by replacing sightseeing guidebook photos with photos taken by tourists themselves at the same location and with the same composition. Yamato *et al*. (2020) developed a walking data collection system using gamification to accumulate data on barriers such as steep slopes.

As for (1), the system does not have a function to share the generated sightseeing information among users. As for Kurata *et al*. (2015), although the system has a function to send out the made plan using various SNS, it does not have a function to view the information of other users on the system, so it is difficult to obtain prior information by experienced tourists such as word of mouth. As for (2), the amount of information supplied depends on the number of users of the system, and there is a

possibility of a cold start. As for (3), these studies adopt the concept of gamification and include contents that can be applied to the sightseeing field.

Methodology

Based on the literature, this study demonstrates the originality to develop a sharing system by integrating a sightseeing plan making support system and Web-GIS, and can visualize and share sightseeing plans made by each user on a digital map, and promotes effective use of the system for users by adopting gamification.

System design

System configuration

This system consists of Web-GIS, and a sightseeing plan making/sharing system. The features of each system are shown in Figure 1. When a user uses this system for the first time, he or she makes an account to be used in the system and registers user information in the database. The purpose of this system is to accumulate sightseeing plans made by tourists, and to obtain information in advance when creating a new sightseeing plan, and to operate the system as a platform for creating and sharing sightseeing plans. In addition, the system has a mission function and a function to evaluate others' sightseeing plans adopting gamification. To use the system, users post photos and introductory texts of selected sightseeing spots on the digital map of Web-GIS, and decide which spots to introduce. In addition, users can make a sightseeing plan by entering information on multiple sightseeing spots. Furthermore, users can share their own sightseeing plans with other users.
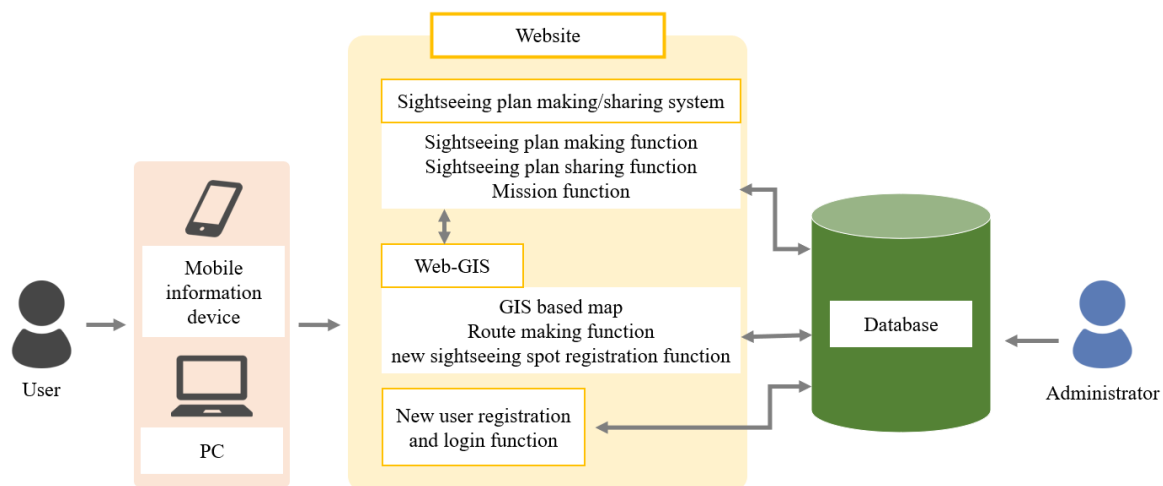

Figure 1: System Design

Usefulness of the system

1. Get advance information on sightseeing: It is possible to obtain the latest sightseeing information posted from a tourist's perspective. By referring the sightseeing plans of others, users can ease the burden of making sightseeing plans.

2. Get the latest information on sightseeing: The photos and introductory text of sightseeing spots are added with the date and time of posting, so users always get the latest information.

3. Identify the location easily: By using Web-GIS to display information on sightseeing spots on a digital map, users who do not know much about sightseeing spots can imagine the distance and route concretely.

4. Use this system continuously adopting gamification: It is possible to induce users to participate on their own initiative and to use the system in accordance with the developer's intent.

Design of each system

Sightseeing plan making/sharing system

In sightseeing plan making/sharing system, users can make and post sightseeing plans, and view and evaluate others' sightseeing plans, in order to share information in advance of sightseeing. In addition, in order to urge users' effective involvement, the system uses gamification to make and share sightseeing plans. The detailed design is shown below.

Sightseeing plan making system: By selecting a spot on the web map, users can register a photo of the spot, a short introduction, and the average time required for sightseeing. In addition, the title and introduction of the entire plan can be registered. The registered contents are saved in the database server.

Sightseeing plan sharing system: Users can view others' sightseeing plans as advance information when making sightseeing plans. The contents of each plan saved in the database are displayed as a list in order of the date it was made. In the list, the title of the plan, its introduction, the ID of the user who made it, the date and time the plan was made, and the "Detail" button are displayed. When the "Detail" button is pressed, the information of the plan is displayed on the digital map of Web-GIS, and the information of each registered spot can be viewed.

Systems for gamification: various motivators are used in gamification to urge voluntary participation in the system. Kurata (2012) summarizes the motivational know-how by gamification as shown in Table 1. Based on this, Table 2 shows the motivations related to gamification expected in the system and the relevant parts of the system.

Table 1: Motivational know-how used in gamification

function	contents
Providing a world view/story	Make sense of and justify their own circumambulation in the minds of the participants
Onboarding	Make people feel at home and let them learn the rules as they go.
Score/rank visualization	Provide participants with a quantitative evaluation axis and show them how to act accordingly.
Presenting the mission/goal	Give participants a goal and guide them
Badge/Level	Recognize the degree to which participants have achieved their goals and provide further motivation
Compete	Make a sense of competition and enthusiasm among participants
Social	Increase the sense of solidarity among participants and make it harder for them to leave
challenging elements (e.g. in RPG games)	Provide advanced elements that can be enjoyed the more you play the game.
Inverse element	Make a situation where the newcomer is not necessarily at a disadvantage, but where the advanced player can't be too careful.

Table 2: Expected motivation and specific systems in this system

function	contents
Score Visualization	We develop a system in which a person's fictitious possessions increase when his or her own sightseeing plan is purchased by others. This system improves the motivation to make a plan, and at the same time encourages people to get involved in the system.
Presenting the mission	We induce users to make a sightseeing plan by preparing a mission about creating a sightseeing plan.
Social	By developing a "Like" button on the tourism plan sharing system, you can evaluate others' sightseeing plans.

Web-GIS

There are various types of Web-GIS, and it is necessary to select appropriate one according to the purpose of use. Since this system assumes people of all ages as its target users, it is desirable that it can be used simply by connecting to the Internet from a browser without requiring users to install specific software for convenience. In this study, we develop a Web-GIS using ArcGIS API for JavaScript provided by the Environmental Systems Research Institute, Inc. (ESRI). The detailed design is shown below.

Display of sightseeing spots saved in the database: by using Web-GIS to display sightseeing spot information on a digital map, users can easily grasp the location of each sightseeing spot. In addition, by separating colors for each category of sightseeing spot, users can easily grasp where spots of what genre are located when they look down at the map.

Show the route of the sightseeing plan: since the route is displayed as a line in the order in which the spots are selected when making a sightseeing plan, users can visually confirm the route to be traveled on the map. This allows users with limited familiarity with the area to imagine the distance and route in concrete terms.

System development

System frontend

(1) New user registration and login function

In order to use the system, users move from the login screen to the user registration screen and register to use the system. In the user registration screen, users register their ID and password as user information. Once the information is posted, the user logs in with the registered information and moves to the sightseeing plan sharing screen.

(2) Sightseeing plan making function

After logging in to the system, users can make a new sightseeing plan by selecting "Make Sightseeing Plan" from the menu that appears by clicking on the menu button at the top right of the screen. Figure 2 shows the sightseeing plan making screen.

Figure 2: Page for the sightseeing plan making function. By clicking on the round icon on the map, a pop-up window with information about the sightseeing spots will appear. You can form a sightseeing plan by registering the following information in the pop-up: "image," "introduction," and "time required."

By adding the sightseeing spots that the user wants to visit and clicking the "Spot Selection Complete" button, they will move to the screen to enter the title and description of the sightseeing plan, and then click the "Plan Complete" button to complete the making of the sightseeing plan. Figure 3 shows the flow of creating a sightseeing plan.

Figure 3: New sightseeing spot registration screen

The page for sightseeing plan making function shows all the sightseeing spots saved in the database, but the user can also add new sightseeing spots and save them in the database. By clicking the "+"

button on the right side of the screen, users can move to the page for new sightseeing spot registration function. Figure 4 shows the page for new sightseeing spot registration function.

Figure 4: Page for new sightseeing spot registration function. Enter the name of the sightseeing spot and select a category. Users can choose from the following categories: "Famous Places and Historic Sites," "Parks and Botanical Gardens," "Public Facilities," "Restaurants," "Temples and Shrines," "Museums," "Hot Springs," "Cherry Blossom Viewing," "Festivals and Events," "Theme Parks," and "Other."

(3) Sightseeing plan sharing function

From "View Sightseeing Plan" in the menu, users can move to the page for the sightseeing plan sharing function. In the sharing screen, "Title", "Plan Introduction", "User ID", "Date and Time of Plan Submission", and "Number of Plan Purchases" are displayed. Figure 5 shows the page for the sightseeing plan sharing function. By clicking either the "Details" button or "Title" or "Plan Introduction," users can move to the page to see the details of the sightseeing plan. Figure 6 shows the page to see the details of the sightseeing plan.

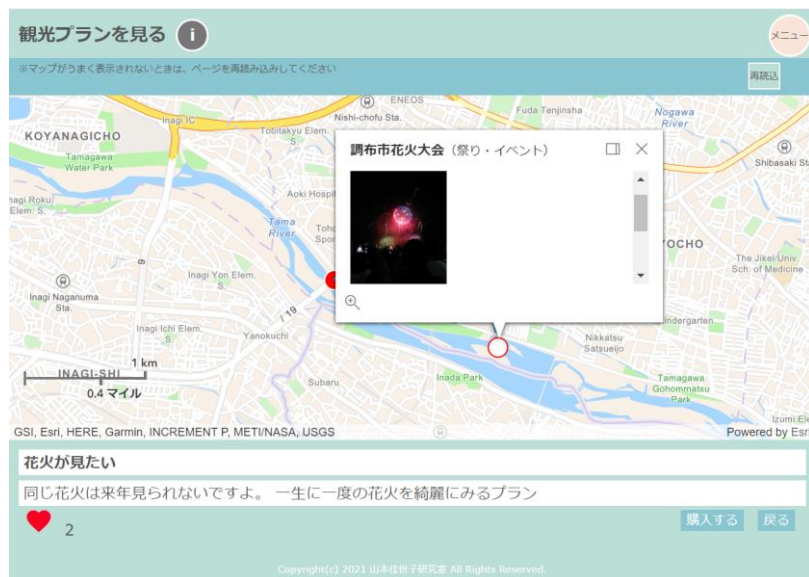*Figure 5: Page for the sightseeing plan making function*

Figure 6: Page to see the details of the sightseeing plan

On the page to see the details of the sightseeing plan, users can view the made plan on a digital map. If users like a plan, users can give it a high rating by clicking on the heart icon ("Like" button) at the bottom left of the screen. In addition, if users want to save the plan, users can click the "Buy" button at the bottom right of the screen to save the plan in user's "My Page" by spending user's imaginary money. Figure 7 shows the flow of purchasing a sightseeing plan.
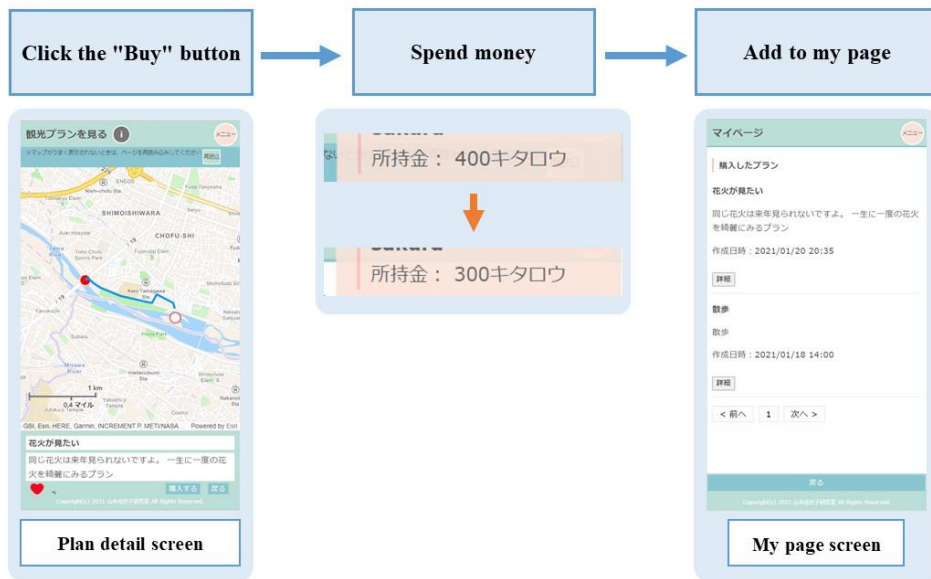
Figure 7: Flow of purchasing a sightseeing plan. The money used in the purchase function is imaginary, and is expressed in "Kitaro". When a plan is purchased, the user's money is reduced by 100 Kitaro, while the creator of the plan's money is increased by 100 Kitaro.

(4) Mission function

From "Missions" in the menu, users can move to the page for the mission function. This page displays a list of mission items and whether user has been accomplished or not. Figure 8 shows the mission screen.

Figure 8: Page for the mission function. When a mission is accomplished, the "unaccomplished" item changes to "accomplished" and the "reward" button appears. The user can increase the amount of money in their possession by pressing the "Reward" button.

(5) My page function

From "My Page" or user ID in the menu, users can move to the page for the my page function. On the page, users can view the user ID, the money, the plans users have purchased, and the history of the plans users have made.

System backend

(1) Process concerning registration of user information and login

The registration information of the user is saved on the PostgreSQL database server. At the time of registration, the password is hashed using PHP's Hash function and saved in the database. At the time of login, the password is hashed in the same way, and if the ID and password match in the database, the login process is performed. If they do not match, an error message is displayed and the user is asked to enter the login information again.

(2) Process concerning the sightseeing plan making function

The process of adding the information entered in the sightseeing plan making function to two tables and saving them on the PostgreSQL database server is performed by the backend. The tables to be saved are ones to save the name and comment of the plan, the date and time of registration, and the center coordinates and magnification of the digital map, and a table to save information such as the names and introductions of the spots to be toured in a single plan.

(3) Process concerning the sightseeing plan sharing function

The backend processes outputting the sightseeing plans saved in the database to the screen, processing related to the evaluation by the "Like" button, updating the number of purchases and saving the purchased plans in the sightseeing plan purchase function, and decreasing the amount of money possessed by the users who purchased the plans and increasing the amount of money possessed by the users who purchased the plans.

(4) Process concerning the mission function

At the end of the making of a sightseeing plan, the back-end process checks the mission list in the database to determine whether the mission has been accomplished, updates the mission list if it has been accomplished, and increases the possession money as a reward for the accomplished mission.

System interface

The interface of this system has been developed assuming that it will be mainly used with mobile information devices. In addition, the interface is designed so that there is no significant difference in the design even if it is accessed from PC. Figure. 9 shows the interface viewed from mobile information devices.
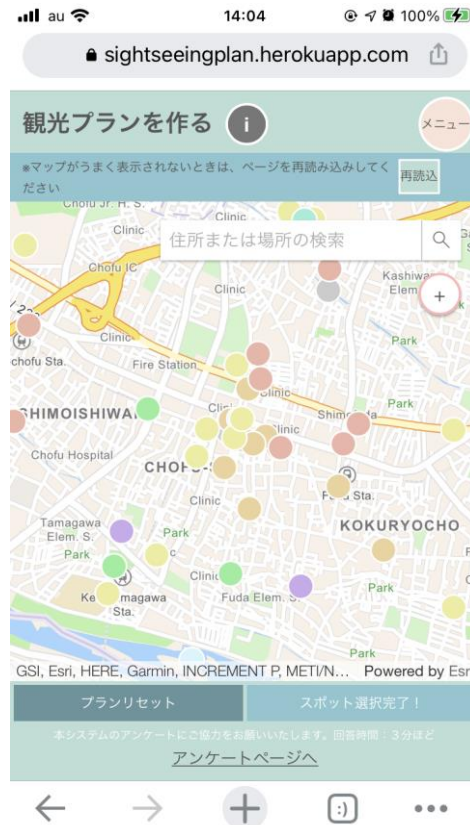
Figure 9: Interface viewed from a mobile information device

Operation

Operation overview

Regarding the operation target area, the Chofu City in Tokyo Metropolis, Japan, was selected. One reason for this selection is that there is an abundance of sightseeing spots in the city. The second is that it is effective to visualize the sightseeing route by GIS.

The system was operated over a period of seven weeks (from 2021/1/19 to 2021/3/9) with those inside and outside the operation target area. Whether inside or outside the operation target area, the operation of the system was advertised using the website of the authors' lab as well as Twitter and Instagram.

Operation result

Users of the system are shown in Table 3. The system has a total of 51 users with 38 male, 12 female and 1 other users. Regarding age groups, there are many male and female users in their 20s making up 49% of the total. Subsequently, those in their 30s were 18%; those in their 40s were 10%; those in their 60s were 10%; those in their 50s were 8%; and those in their 70s and above were 6%. 17 sightseeing plans were posted during this operation period. An example of the posted plan is shown in Figure 10. The number of new sightseeing spots posted during the operation period was 30. Table 4 shows the breakdown of the new sightseeing spots by category. Therefore it is expected that users will post more new sightseeing plans and information on new sightseeing spots by using the system over a long period.

Table 3: Breakdown of web questionnaire survey respondents

Age groups of users	10-19	20-29	30-39	40-49	50-59	60-69	70-	Total
Male (person)	0	20	7	4	0	4	3	38
Female (person)	0	4	2	1	4	1	0	12
Other (person)	0	1	0	0	0	0	0	1
Total (person)	0	25	9	5	4	5	3	51

Figure 10: Sightseeing plan posted on January 17, 2021. A plan to take a walk from a national university located within the target area to nearby famous places was registered.

Table 4: Breakdown of new sightseeing spots by category

Category	Number of new registrations (items)
Famous Places and Historic Sites	1
Parks and Botanical Gardens	6
Public Facilities	4
Restaurants	11
Temples and Shrines	2
Museums	1
Hot Springs	0
Cherry Blossom Viewing	1
Festivals and Events	0
Theme Parks	0
Other	4
Total	30

Findings

After the end of the operation, a web questionnaire survey and access analysis of users' log data were conducted in order to evaluate the system developed in this study.

Evaluation based on web questionnaire survey

Along with the purpose of this study, a web questionnaire survey was implemented in order to conduct an (1) evaluation on the use of system and an (2) evaluation on system function. 51 out of 66 users posted their web questionnaire survey, and the valid response rate was 77.3%.

Evaluation on the use of system

The results of the survey on the use of the Internet by the users of this system showed that all of them used the Internet daily. The results of the survey on the means of collecting sightseeing information showed that most users use multiple media, and 93% of the users use their smartphones. In addition,

78% of users use PCs, 44% use guidebooks, 17% use Twitter, 15% use Instagram, 15% use Facebook, and 5% use word of mouth.

This indicates that although some users collect information on word-of-mouth and paper media such as guidebooks, most of them use the Internet to collect sightseeing information from mobile information devices such as PCs and smartphones. It was also found that the use of various social networking services as a means of collecting tourist information could not be ignored. From the above, it was found that this system, which enables the collection of sightseeing information from PCs and mobile devices on the Web, is effective in supporting sightseeing.

Evaluation on system function

Regarding the evaluation results of the survey on the operability of each function are shown in Figure 11. Since the majority of users answered "I think so" or "I somewhat think so," it can be said that the system was easy to operate.
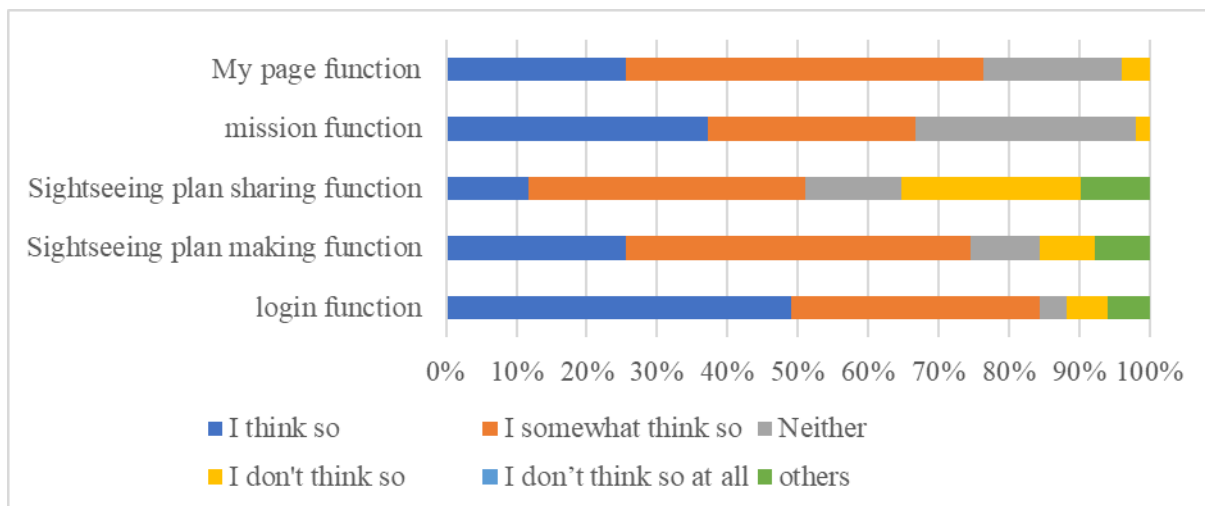

Figure 11: Evaluation results of the survey on the operability of each function

The evaluation results for the sightseeing plan sharing function and the functions adopting gamification are shown in Figure 12.

In response to the question "Do you think the sharing function of this system will be useful when you go sightseeing?", 82% of respondents answered "I think so" or "I somewhat think so". Therefore, it can be said that the ability to share others' sightseeing plans can support sightseeing. The system can be improved by adding a function that allows users to share plans with non-registered users, and by adding items that show the sightseeing purpose and time required for the shared plan.

In response to the question "Do you think that having your plans evaluated and purchased by other users will help motivate you to make more plans?", 84% of respondents answered "I think so" or "I somewhat think so". Therefore, it can be said that the evaluate and purchase function has been very effective in motivating users to get involved in the system.

In response to the question "Do you think that the mission function helps to increase the motivation to want to go sightseeing?", 74% of respondents answered "I think so" or "I somewhat think so".

Therefore, it can be said that the mission function is effective in increasing users' motivation to go sightseeing.
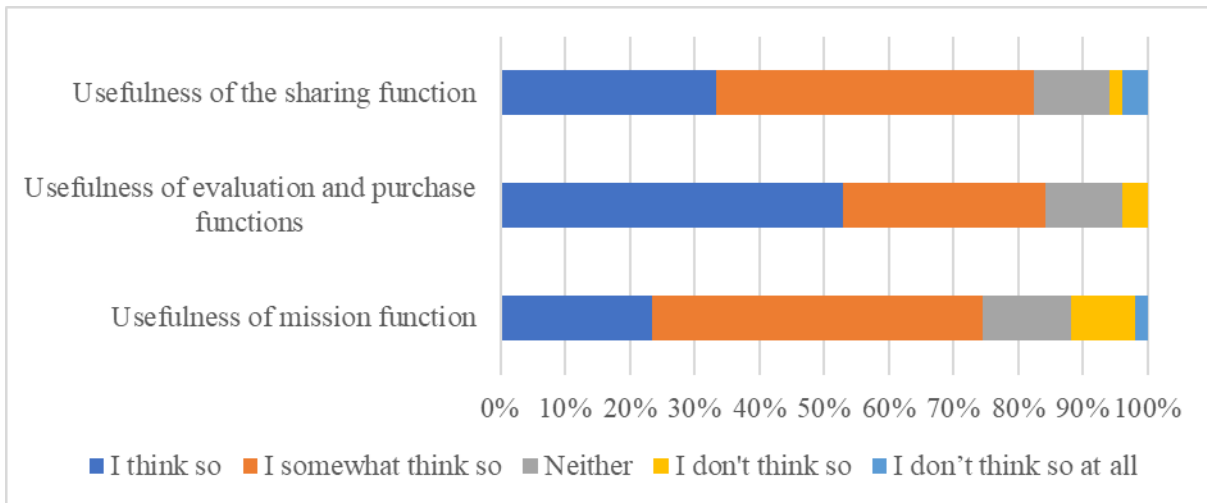

Figure 12: Evaluation results for the sightseeing plan sharing function and the functions adopting gamification

Evaluation based on results of access analysis

In this study, an access analysis was conducted using the users' log data during the operation period. This analysis was conducted using Google Analytics which is a Web access analysis service provided by Google.

The access method to the system is shown in Table 5. Table 5 shows that smartphones were the main access method, and there were also many accesses from PCs. There were also a small number of accesses from tablet devices. Therefore, the system design, which was made to eliminate the differences in obtainable information depending on the type of device and to make the system available to all types of devices, can be considered effective.

Table 5: Access methods

Access method	Number of sessions	Percentage (%)
PC	51	37.0
Smartphone	76	55.5
Tablet	11	8.0

The top 9 visits by page are shown in Table 6. Table 6 shows that the sightseeing plan making page and the sightseeing plan sharing page are frequently used in this system. Therefore, it is considered that the system was used in accordance with the intention of this study, which is for users to make their own sightseeing plans and share them with other users. However, the fact that the number of visits to the "Sightseeing plan making completed page" was small compared to the number of visits to

each page indicates that although the users moved to the "Sightseeing plan making page", not many of them made sightseeing plans. Therefore, in order to urge more users to make a sightseeing plan, it is necessary to improve the system interface and develop a function to acquire location information to make it easier to make a sightseeing plan.

Table 6: Number of views of page

Order	page name	Number of views
1	Sightseeing plan making page	647
2	Sightseeing plan sharing page	406
3	Login page	314
4	New spots registration page	188
5	Purchased plan list page on my page	99
6	New user registration page	88
7	My page	76
8	Mission page	74
9	Plan details page on my page	39

Identification of measures to improve the system

Based on the results of the evaluation of the operation in this section, measures for using the system even more effectively were summarized into the two points below.

1. Improvements in web page design: Several comments were received that mentioned the system's problems, difficulty in use, and lack of clarity. Therefore, there is a need to improve the system itself regarding its vulnerability and convenience. Accordingly, the interface will be improved to increase readability and visibility, and a system that can be easily used by people of all ages will be developed.

2. Improvements to the sightseeing plan making and sharing function: In the sightseeing plan making function, the system will improve the function of automatic input by the system in order to further reduce the burden of making plans for users. In addition, in order to enable tourists who do not have any local knowledge of sightseeing spots to learn more about them, we will implement a function that provides necessary information for sightseeing, such as phone numbers and URLs for each spot, in order to broaden the range of users of the system.

3. Improvements to encourage continued use of the system: It was found that there is room for improvement in order to encourage continuous use of the system. Adding new game elements and improving the game elements that have been incorporated can be expected to encourage more users to continue using the system.

Conclusion

In this study, after designing and developing the system, the operation as well as the evaluation and extraction of improvement measures were conducted. This study can be summarized into the following three points.

1. In order to support users to make efficient and comfortable sightseeing plans while having fun, a system which integrated Web-GIS and sightseeing plan creation and sharing system adopting gamification. By doing so, the reduction of burden of making sightseeing plans and information obtainment, and the effective support for users' accumulate and share sightseeing information. Chofu City, in Tokyo Metropolis, Japan was selected as the operation target area, and the system operation and evaluation were conducted.

2. The operation of the system was conducted over a period of seven weeks targeting those inside and outside the operation target area, and a web questionnaire survey and an analysis of the system access log was conducted towards all users. Based on the results of the web questionnaire survey, it was found that the system was useful for supporting users' sightseeing. In addition, the results were positive in terms of using gamification in this system to urge continuous use of the system.

3. The improvements of this system obtained from the evaluation of the system are to encourage the use of the system by improving the web page design, to expand the functions of the sightseeing plan making and sharing function, and to incorporate more functions based on the concept of gamification to urge the continuous use of the system.

As future study projects, the improvement of the system based on the results in the previous section as well as the enhancement of the significance of using the system by gaining more results in other urban areas can be raised.

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