DEVELOPMENT OF SMARTPHONE-BASED SUPPORTING SYSTEM FOR TOURIST

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ABSTRACT
Recently, mobile applications have begun to be used in tourism; however, most of these applications mainly provide basic information about tourist spots. For this reason, these applications do not lead to a memorable experience at tourist attractions. In this study, we developed a supporting system for tourists. This system collects souvenir photos taken by user at different tourist attractions in order to provide a better travel experience. To identify where the photos were taken, the system uses the positional information from the GPS. This system restricts the use of the camera function so that it works only when the user is near a participating tourist attraction. To evaluate this system, we performed experiments in two areas; the Aichi Commemorative Park and the Cultural Path that wends from Nagoya Castle to Tokugawaen. Our experimental results indicate that this system leads to a better experience of tourist attractions.

Keyword: Smartphone-based Application, Tourism, Photo

INTRODUCTION
Information and communication technology (ICT) is used in multiple fields, including tourism, where ICT had caused changes in the way tourists obtain information. When we need information about tourist attractions, we typically use magazines or guidebooks written about the location, or we visit the tourist...
information center located in the area. ICT provides ways to access information on the
Internet easily, using websites, mobile applications, and other digital media. According to an ICT promotion program in tourism published by Japan Tourism Agency, the combination of mobile applications and technologies (e.g., GPS and augmented reality) was greatly anticipated. In fact, local governments and private enterprises provide mobile applications that assist tourists.

Interactive tourism, which uses tourism resources in the community and emphasizes experiences and communication within tourism, is promoted as a new and developing field. However, mobile applications for tourists mainly provide the basic information about the tourist attractions, and the applications do not lead to truly experiencing tourist attractions.

Therefore, the purpose of this study is to develop a support system that leads to better experiences of tourist attractions through interactive tourism. Hishida (2011) developed the application, Linimo de AR, which provides information about an area along the Linimo Line. Linimo de AR, uses augmented reality to provide neighborhood information based on positional information. The purpose of Hishida’s research is to provide community information; therefore, it is different from our research, which focuses on improving experiences at tourist attractions. Sugase (2011) developed a communication system that exchanges community information in Facebook. This system is smartphone-based, and the user communicates by submitting information on a Facebook page. However, the main purpose of Sugase’s system is to increase communication, which is also different from our research. Sugase designed the application with the focus on provide the communication function and on making it portable.

Our approach in providing a better experience at tourist attractions is to simulate a stamp rally by collecting photos using the device’s GPS and camera. A stamp rally is an activity where the tourist or pilgrim stamps a book or a special sheet of paper with a uniquely designed rubber stamp at each location visited. Our system has two main functions; one to provide information about the tourist attractions and the other to collect photos. The former provides the map-based information and a quiz about the tourist attraction. The quiz plays a role in teaching about the significance of the tourist attraction or the surrounding area. The latter works with the GPS and restrict taking photos; that is, the camera function only when near the tourist attractions. This system also displays photo album containing the photos taken by the user to make it convenient to review the visit at the tourist attractions.
SYSTEM STRUCTURE

Approach

In this research, we use the concept of a stamp rally to motivate a tourist to visit a location. In Japan, a stamp rally is commonly used in tourism events, and it has been proven as an effective motivation for visiting an area. In order to apply the stamp rally concept to our system, we need a way to identify the tourist attraction. Some solutions include QR code, GPS, and near field communication. However, we use GPS to determine the distance between tourist attractions and other necessary devices. Moreover, tourists typically use photos as the way of recording their visit. Tourists can record their visit in other ways, e.g., typing information or taking the videos; however, taking photos is easier and the photos are reusable. Additionally, by taking the photos, the tourists are encouraged to explore and pay closer attention to the tourist attraction. We expect that this would lead to interest in tourist attractions.

IMPLEMENTATION

Summary of this system

This system has two modules: the server module and the client module. The server module manages the information about the tourist attractions. The client module is a smartphone-based application with two kinds of functions: the function that displays the tourism information and the function related to taking and displaying photos. The user gets tourism information through the client module and travels to the tourist attractions. While traveling, the user takes photos using the client module. The client module was developed as an Android application, because it greatly depends on the hardware, such as the GPS and the camera.

Tourism information function

This function provides the user with information about the tourist attractions, including the name, a summary description, an image URI, positional information, and quizzes. The server module manages this information, and the client module retrieves the information via the Internet when it starts. This information shows a Map page and a Spot page in the client application.

The Map page (Figure 1) shows the locations of tourist attractions with markers on the user-centered map. When the user taps one of these markers, an annotation balloon with the names of the tourist attraction pops above the tapped marker. When the user taps this annotation balloon, the Spot page appears to show additional information about the tourist attraction.
In the Spot page (Figure 2) for each tourist attraction, the user can retrieve additional information about the tourist attraction and take photos. This system shows the name of the tourist attraction on the upper part of the screen and shows the image under the name. When the user takes photos using this system, the image on the Spot page is updated to the latest one. To read the summary description of the tourist attraction, the user taps the Summary button. Similarly, to take the photos, the user taps the Camera button. To take the quizzes, the user taps the Quiz button.

The quizzes are related to the tourist attractions and are included to promote understanding of these places. The contents of the quizzes are trivia questions that require some observation of the tourist attractions. The quizzes are multiple-choice with two options that are easy to answer. When the user taps the Quiz button, this system shows a question and the choices in a dialog message (Figure 3). The choices are buttons that display predetermined content at random each time. When the user taps a choice button, the system shows whether the choice is correct or not. Moreover, it shows additional information about the question. The user can answer the quizzes repeatedly.
When the user taps the Camera button on the Spot page, this system runs the camera function. However, the user must be within a predetermined distance from the tourist attraction. For the camera to work with this system, the user needs to move closer to the tourist attraction. The user's position is determined using the device's GPS. The system calculates the distance between the user’s current position and the tourist attraction the latitudes and longitudes. Then it determines whether the camera function should run based on the calculated distance. The photos that the user takes with this system are stored in the phone’s SD card. When the system stores the photos, it adds the unique ID that associated with the tourist attraction to the start of the name of the photo. This system uses this ID when searching the photos.

**Function of album**

In this function, the user browses and manages the photos taken by the client module of this system. This system shows an album on the Album page (Figure 4), and sorts the photos into an album for each tourist attraction. Sorting the photos is based on the ID that was added when the photo was stored. The photos are displayed as thumbnails in the frame that associated with the tourist attraction. To browse the photos, the user swipes horizontally on the album, and then taps the photo desired. Then this system displays the photo in its original size in the dialog. The user can also use this dialog to set the photo as the favorite for the tourist attraction or to delete the photo. This system shows and the favorite photo on the Spot page.
EXPERIMENTS

Fields

Experiments were performed in two areas: the Aichi Commemorative Park and the Cultural Path.

The Aichi Commemorative Park is a prefectural park in Aichi, Japan, where the 2005 World Exposition was held. This park has many facilities and distinctive places, which we used as tourist attractions in our system. We obtained detailed and accurate information about the park from the park management association. In particular, we used the information about this park both in the description and in the trivia quiz.

The Cultural Path has many historical buildings. In this area, a town walk event is held every year on Culture Day Holiday (November 3), and many people visit this area during the event. Therefore, we ran our experiment at this event. We used the historical buildings as the tourist attractions in our system, and developed the quizzes with the cooperation of a guide volunteer.

Experiment situations

We conducted the evaluation experiment in three situations. The experiment conditions are shown in Table 1.

1. Using this system in a free walk
2. Using this system in a guided tour
3. Using this system in a town walk event
TABLE 1  Experiment conditions

<table>
<thead>
<tr>
<th>Place</th>
<th>In a free walk</th>
<th>In a guided tour</th>
<th>In a town walk event</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aichi Commemorative Park</td>
<td>14</td>
<td>4</td>
<td>17</td>
</tr>
<tr>
<td>Cultural Path</td>
<td>18</td>
<td>17</td>
<td>36</td>
</tr>
</tbody>
</table>

Using this system in a free walk

The free walk experiment was conducted in the Aichi Commemorative Park. After this experiment, we evaluated this system using a questionnaire, which contained question (24 multiple-choice and 1 free-form) about using this system and about the provided content.

The users visited an average of 7.11 tourist attractions, and they took an average of 19.6 photos. Based on the questionnaire, about 80% of the users said that traveling in the park was enjoyable, and about 80% of the users said their point of view or perception of this park was also changed (Figure 5). Moreover, users indicated that they felt excitement like they feel when treasure hunting and that this system encouraged them to look for the next tourist attraction. Therefore, this system leads to the users experiencing the tourist attractions by motivating them to taking the photos at those locations.

Figure 5 Results of questions in a free walk.
Using this system in a guided tour

The guided tour experiment was conducted in the Aichi Commemorative Park. The evaluation was carried out in almost the same way as in the free walk experiment. All users traveled to all the tourist attractions in the guided tour, and they took at least one photo per tourist attraction. However, we did not use all the places in guided tour as tourist attractions in our system. In the questionnaire, about 90% of the users said that they wanted to take photos of other places (Figure 6). Therefore, in order to use this system in a guided tour, we need to include all the tourist attractions in the course of the guided tour. However, in the questionnaire, about 90% of the users felt that taking photos using this system was enjoyable and about 90% of the users looked for objects to take photograph (Figure 6). Therefore, whether in a free walk or in a guided tour, the function of taking photos when the user visits tourist attractions is effective.

![Figure 6 Results of questions in a guided tour.](image)

Using this system in a town walk event

The experiment in a town walk event conducted in the Cultural Path. For this experiment, we prepared a gift as an incentive. If a user visits seven or more tourist attractions, we gave them the gift, as well as a discount coupon for a local restaurant. The evaluation was carried out in almost the same way as the other experiments.

The user visited an average of 9.7 tourist attractions and took an average of 28.1 photos. Out of 36 participants, 28 users visited more than seven tourist attractions. In this case, we believe that the incentives affected the behavior of people. In the questionnaire, about 90% of the users felt that taking photo with this system was enjoyable and about 90% of the users purposely looked for objects to photograph.
Therefore, this case received high evaluation scores like the other experiment. Moreover, about 80% of the users wanted to browse the photos taken by other people and to show their own photos to other people. Regarding photo sharing, about 70% of the users in the free walk experiment answered affirmatively; however, only 50% of the users in the guided tour experiment answered affirmatively. Therefore, photo sharing is desired more in free walking, where users arbitrarily chose their destinations, than in a guided tour, where the destinations are fixed on the tour route (Figures 8 and 9).

![Figure 7](image1.png) Results of questions in a town walk event.

![Figure 8](image2.png) Comparison of the experiment in terms of browsing photos taken by other people.
CONCLUSION

In this study, we developed a system that enhances the experience of tourist attractions through interactive tourism. We designed a smartphone-based application for this system, based on stamp rally concept where the user collects photos of the tourist attractions, instead of stamps, to encourage visits and experiences in those places. The system is comprised of a server module and a client module. Through the client module, the user can get information about the tourist attraction and create a photo album. This system calculates the distance between the user’s position and tourist attraction based on latitudes and longitudes obtained from GPS. The camera function becomes available only when the user is within a certain distance from the tourist attraction. In this way, we motivate the user to travel different tourist attractions. Experiments of this system were conducted in two areas (the Aichi Commemorative Park and the Cultural Path), in three different situations (in a free walk, in a guided tour, in a town walk event). The results of these experiments and evaluations lead us to the following conclusions.

1. This system encourage users to visit and experience the tourist attractions by motivating them to take photos of the location
2. The function of taking the photos when the user visits tourist attractions is effective
3. The photo-sharing function is desired more in a free walk than in a guided tour

In the future, we are going to implement the system that manages the photos taken by this system.
REFERENCES
