MAPIC: A VISUALIZATION APPLICATION OF PERSONAL LOCATION INFORMATION FOR DATA ECOSYSTEM IN TOURISM

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Abstract
Although many foreigners have visited Japan for a variety of purposes, how they behave in Japan is not fully understood. Their activity information staying in Japan has been expected to improve service quality for tourism promotion, public transportation management and so on. Therefore, it is essential to provide the mechanism that encourages foreigners to log their actions in Japan. However, the continual information about visitors traveling in Japan is not accumulated well. While IC cards and smartphone apps have facilitated data acquisition during travel, in order to establish a sustainable ecosystem of data acquisition and application, enjoyable data visualization is necessary for visitors to remember and to share their activities. To collect visitors’ information, our research proposes an application “MAPIC” that visitors can create trips’ short movies with their location information and pictures. In this paper, in order to improve MAPIC service to be more attractive by overviewing actual activities of foreign visitors in Japan, we analyzed the log data obtained from free-WiFi app for foreign visitors.

Keywords: visualization, location information, application, tourism

1. INTRODUCTION
Since Tokyo was announced as the host of The 2020 Summer Olympic and Paralympic games, private companies and organizations in Japan started to prepare the acceptance for many foreign visitors from foreign countries. Their activity information staying in Japan has been expected to improve service quality for many fields such as tourism promotion, public and transportation management. Therefore, it is essential to provide the mechanism that encourages foreign visitors to log their activities in Japan. However, the continual information has not been accumulated sufficiently.

One prior research about foreign visitors in Japan by YABE & KURATA (2013) analyzed how they stayed around Tokyo based on the data of IC transit card “Suica & N’EX”. However, it is difficult to conduct periodic survey because this kind of surveys are usually expensive and take long time in addition to the privacy issue. Therefore, the continual information about how the foreign visitors get around Japan is not accumulated well. We need a sustainable system that could be attractive for them to leave their experience information without disturbing their activities in Japan.

While IC cards and smartphone apps have facilitated data acquisition during travel, in order to establish a sustainable ecosystem of data acquisition and application, enjoyable data visualization is necessary for the foreign visitors to remember and to share their activities. To collect their information, our research proposes an application “MAPIC” that the foreign visitors can create a short movie of their travel with their location information and pictures.

In this paper, we firstly describe research issues by contrast with prior researches about foreign visitors in Japan. Next, we explain how our application “MAPIC” works to solve the issues, compared to existing services that use location information and pictures. Finally, in order to improve MAPIC service to be more attractive by overviewing actual activities of foreign visitors in Japan, we analyze the log data obtained from OMOTENASHI APP, free-WiFi app. for foreign visitors, and consider how to visualize the experiences of foreign visitors with locations and pictures with MAPIC.
2. EXISTING RESEARCH & SERVICE USING MAP AND PICTURE

One prior research about visitors in Japan by YABE & KURATA (2013) analyzed how the foreign visitors stayed around Tokyo. Their research based on two types of datasets. The 1st data is log data of IC transit card “Suica & N’EX” serviced by JR-East (Japanese Railway-East). It contained the information about when and where each user got on and off trains around Tokyo. The 2nd is a questionnaire about personal attributes such as name, sex, age, and nationality, collected by YABE and KURATA. Their analysis shows 2 behavioral patterns. While people who belong to “1st pattern” stayed in one place for a long time, those who belong to “2nd pattern” visited many places even in a short period of time.

However, they could not conduct this survey periodically, because this kind of surveys are usually expensive and take long time in addition to the privacy issues. Moreover, since the service of IC card “Suica & N’EX” was terminated in 2014, they could not last the same analysis. To follow their trends in Japan, we need a sustainable system that could be more attractive for foreign visitors to leave their experience information without disturbing their activities in Japan.

Table 1. The difference between YABE & KURATA Research (2013) and our research

<table>
<thead>
<tr>
<th>Purpose</th>
<th>YABE &amp; KURATA (2013)</th>
<th>Our Research</th>
</tr>
</thead>
<tbody>
<tr>
<td>To analyze inbounds behavior</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Data / Source</th>
<th>1 IC transit card “Suica &amp; N’EX”</th>
<th>Data provided by inbounds</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2 Questionnaire</td>
<td>※ Creating a system to motivate inbounds provide their data.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Continuation</th>
<th>×</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Reason</th>
<th>The card “Suica &amp; N’EX” stopped. 2. Questionnaire took money &amp; time.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The technology like IC card &amp; smartphone can let anyone log data more easily.</td>
</tr>
<tr>
<td></td>
<td>Make use of the unused data!</td>
</tr>
</tbody>
</table>

In order to develop a mechanism that has an incentive for the foreign visitors to provide their accumulated information, we examined the existing services that use location information, such as Mapillary, PhotoField, facebook and flickr. Those services mainly use location information and pictures for visualization. As their usage, Mapillary can create street views by its application. PhotoField can also make a kind of street views with pictures. Facebook and flickr can add the place names and share pictures. The existing services compared in this paper employ the visualization that directly shows off recorded data or part of thumbnails. Accordingly, there is no functionalities to summarize and overview an entire travel experience in a shot movie like MAPIC.

The above features are summarized in Table 2. As the result of the comparison, we employed summarization of locations and pictures with a short movie as the feature of MAPIC. There is a great demand for a visualization tool that can summarize trip memories as a movie, because anyone can store their logs more easily than before due to the technology of smartphones and IC transit card.

The feature “summarization” is different from the existing service. It can be an incentive for the foreign visitors to their accumulated data in their own devices. In addition, our research service was named MAPIC. The name comes from “Map + Picture/Pick up information”. MAPIC uses a map and pictures to summarize the foreign visitors’ information.
Table 2. The difference between existing service and our research “MAPIC”

<table>
<thead>
<tr>
<th>Source</th>
<th>Mapillary</th>
<th>PhotoField</th>
<th>facebook</th>
<th>flickr</th>
<th>MAPIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visualization</td>
<td>· Picture</td>
<td>· Picture</td>
<td>· Picture</td>
<td>· Picture</td>
<td>· Picture</td>
</tr>
<tr>
<td>Media</td>
<td>· Location info</td>
<td>· Location info</td>
<td>· Location info</td>
<td>· Location info</td>
<td>· Location info</td>
</tr>
<tr>
<td>Summarize</td>
<td>(Full)</td>
<td>(Full)</td>
<td>△ (Album)</td>
<td>△ (Album)</td>
<td>○ (Trip)</td>
</tr>
<tr>
<td>Usage / Purpose</td>
<td>To create Street View</td>
<td>To create Street View</td>
<td>To brag the place Where user visit</td>
<td>To brag the place Where user visit</td>
<td>To brag Users’ trip</td>
</tr>
</tbody>
</table>

3. “MAPIC” A VISUALIZATION APPLICATION OF PERSONAL LOCATION INFORMATION

On MAPIC, visitors can make their trips in Japan as one-minute short movies. As shown in the Figure 1, to create a short move, MAPIC only needs users’ pictures and location information taken by their mobile devices such as smart phone. Users only need to select the date when pictures were taken, and to choose BGM embedding in a movie. Short movies created on MAPIC can be shared with friends and families.

The attraction of MAPIC depends on the way of visualizing users’ trips. There are two unique features in short movies created by MAPIC. First, the movies show pictures and their location information in order of time. Not only visitors but also their friends can easily understand the places where the pictures were taken. This function helps them share memories of the trips. (FIGURE 2 & 3) Second, the movies use graphics to show the distance and the staying time of trips in Japan. Visitors can enjoyably understand how long they stay in Japan and travel around Japan. (FIGURE 4) You can check the movie created by MAPIC by the URL (http://mapic.cw503.net/tw0110ken/sample31).
4. ACTIVITY ANALYSIS OF FOREIGN VISITORS

Since MAPIC is not released yet, there is no activity data collected from actual foreign visitors. Therefore, in order to sophisticate the MAPIC functionality in summarization and visualization, we analyze the other dataset about trajectories of foreign visitors getting around Japan, and explore the significant criteria to be more attractive.

4.1. Data Overview

Activity data of foreign visitors is collected by OMOTENASHI APP (Gateway App Japan). OMOTENASHI APP (https://www.ga-ja.com/english.html) an Android app to provide free-WiFi access to foreign visitors in Japan. With this application, foreign visitors are accessible free-WiFi for one week after activating it. Currently, the number of available WiFi access points for this app is 65,000 in Japan. When subscribing OMOTENASHI APP, a user firstly needs to answer a short questionnaire including purpose of visit, nationality, language, sex, age, entry date and plan of stay length. In addition, since this app automatically logs subscriber’s location information with timestamp while OMOTENASHI APP is available, the explicit agreement to data acquisition was obtained in advance. In this paper, by regarding the app subscribers as the potential users of MAPIC, we analyzed their activities in Japan in terms of spatiotemporal range of their activity. Here, we employed data collected from 3rd September, 2015 to 31th March, 2016. The basic statistics of OMOTENASHI APP data (160 people) are following.

Although only foreign visitors can use OMOTENASHI APP, there were many respondents that answered “Japanese” because of the free-answer questionnaire. With regard to language, the answer “English” is a majority, then “Chinese” followed.
There are many respondents that answered “30’s” and “40’s”. But a lot of women answered “20’s”. Regarding to sex, there are much more male than female. There may be more male foreign visitors than female foreign visitors. Male may have used OMOTENASHI APP than female.

### 4.2. Analysis and Consideration

In order to clarify the features of foreign visitor activities staying in Japan, we analyzed the time-series location information collected by OMOTENASHI APP in every 1 minute. We obtained available data of 50 samples from 3rd September, 2015 to 31th March, 2016.

Figure 7 shows aggregated results of unique users in municipal units of Japan. According to the results, some foreign visitors get around several major regions such as Hokkaido, Kanto, Kansai, Kyusyu and Shizuoka where there is one of the most famous mountains in Japan. Additionally, foreign visitors who visited Kanto Area are the most compared to the other areas. Figure 8 represents the detail of Tokyo area.
Activity pattern of foreign visitors getting around Tokyo can be divided into 2 spatial scales such as Small and Large. Small scale visitors only have location logs within Tokyo area. That indicates their purpose would be a business trip or a sightseeing focusing on Tokyo area. Large scale visitors usually use Tokyo as an entrance point to Japan and soon move toward other regions after arrival.

Regarding to total travel distance in Japan as shown in Figure 9, there is a tendency of all foreign visitors to be classified into 2 spatial scales as same as Tokyo area. In case that the average of total travel distance, 79.7 km, can be threshold value, small scale visitors get around internal area within some cities nearby while large scale visitors move across some regions far away (Figure 10).

Figure 9. Total travel distance in Japan

Figure 8. (left) Aggregated results at municipal level (Kanto Area) & (right) Trajectories colored by users
According to the above results, MAPIC should have a functionality to visualize their activities in different spatial scales. For example, when a foreign visitor moves within small spatial scale, basemap should also represent small area to show the detailed trajectories. With the function to choose any scale of basemap, User Experience can be better. In addition to the spatial scale, we need to take account of time scale like time duration staying in a specific area.

4.3 Further Consideration about Summarization of Pictures

Additionally, we need to consider how MAPIC makes use of the data of visitors’ pictures, because pictures are also used such as location information when MAPIC visualizes the foreign visitors information. So we regard 3 ideas for the visualization and summarization of MAPIC with pictures. The 1st idea is that MAPIC has a function to complement the animation (bullet train and airplane) for the situation when the foreign visitors ride in vehicles and trains. The location information of foreign visitors were not collected, because there is a technical issue of OMOTENASHI APP. That’s why we came up with this idea. While in vehicles and trains, the foreign visitors may not take pictures compared to tour spots. The 2nd idea is that MAPIC should makes use of the number of pictures that the foreign visitors took. Now MAPIC just has pictures shown in short movies. With the number of those pictures, what the scale of Japanese basemap changes as a cartogram is one of the ideas to use the information of pictures. The areas where they were taken and the number of the pictures are important factors to decide the scale of basemap automatically. The 3rd idea is that MAPIC uses the mechanism of machine learning to choose the foreign visitors’ pictures, because now users need to choose 10 pictures by themselves in order to make short movies. A new function with machine learning can help users have more choices to create short movies with MAPIC.

5. CONCLUSION AND FUTURE WORK

Analyzing the data of OMOTENASHI APP, there is a tendency of all foreign visitors in Japan to be classified into 2 spatial scales such as Small and Large. In case that the average of total travel distance, 79.7 km, can be threshold value, small scale visitors get around internal area within some cities nearby while large scale visitors move across some regions far away.

For future work, MAPIC should have 2 functionalities to visualize the foreign visitors activities in Japan. The 1st functionality is to cover Spatial scale (Time scale). The 2nd one is to make use of visitors pictures. (Ex: the number of pictures, the place where pictures are taken, the features of pictures classified by machine learning.)
ACKNOWLEDGMENT

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Flickr : https://www.flickr.com/

OMOTENASHI App (Gateway App Japan) : https://www.ga-ja.com/app.html

Suica & N’EX (JR-EAST): http://www.jreast.co.jp/e/press/20061202/