International Journal of Pervasive Computing and Com...

A method for controlling crowd flow by changing recommender information on navigation application

Ruiwei Shen Tsutomu Terada Masahiko Tsukamoto

A method for controlling crowd flow by changing recommender information on navigation application

Ruiwei Shen, Tsutomu Terada and Masahiko Tsukamoto
Department of Engineering, Kobe University, Kobe, Japan

Received 15 August 2015
Revised 8 October 2015
Accepted 1 February 2016

Abstract

Purpose – This paper aims to control the crowd flow naturally by presenting appropriate information.

Design/methodology/approach – The authors developed a navigation application for an event held in Osaka called "Osaka Mizube Bar", and divided users into three groups to present different information in restaurants' view list.

Findings – The results of the experiment confirmed that users will focus on the position of the rank list, regardless of the information for each item.

Originality/value – This paper used persuasive technology in information presentation for event application.

Keywords Behavioral economics, User interface, Navigation system, Persuasive technology, Smartphone application, Web application

Paper type Research paper

1. Introduction

In recent years, navigation systems have been widely used in various amusement parks and sightseeing spots. Navigation systems, such as car navigation systems and navigation applications in smartphones, are also used in our daily life. By using a navigation system, users can not only find their location but also browse information on nearby attractions such as restaurants or department stores; furthermore, it can show the route to lead users to their destination. In these situations, users will set their destinations by using the navigation system, but in tourism or for events, users may have no idea about the current conditions. On the other hand, while event organizers or system providers for the navigation system have a demand on controlling the crowd flow, it becomes difficult, as more and more tourists use their own mobile devices to search for the information they want. In this research, we propose a navigation system to control the crowd flow and lead users to specific destinations or areas naturally by presenting suitable information to them according to the requirements from organizers. In this paper, we will explain the experiments on the proposed system during an actual event held in Osaka, Japan, called "Osaka Mizube Bar". The results of the experiment

This research was supported in part by a Grant-in-Aid for Precursory Research for Embryonic Science and Technology (PRESTO) from the Japan Science and Technology Agency and by a Grant-in-Aid for Challenging Exploratory Research (25540084) from the Japanese Ministry of Education, Culture, Sports, Science and Technology.

International Journal of Pervasive Computing and Communications
Vol. 12 No. 1, 2016
pp. 87-106

1742-7371
DOI 10.1108/IJPCC-01-2016-0007

confirmed that the behavior of users could be affected by controlling the rank list that they check on their devices; furthermore, users could be led to a specific destination or area by taking advantage of this function.

Navigation systems are becoming an important part of our daily life. Aircrafts and ships need navigation systems to show the crew the direction to the destination. Most cars are equipped with a car navigation system that can provide users with plenty of information like directions, locations and nearby stores and even share current traffic information with other car navigation systems (Yamashita *et al.*, 2005).

Furthermore, because of the widespread use of smartphones, more and more navigation systems run on high-performance smartphones that are constructed with many sensors (Atzori *et al.*, 2012). To use these navigation systems, users have to set their destinations on their devices by themselves, and it is hard for organizers to lead users to specific areas without disturbing the users' activities or showing unwanted information. Although tourists can use some navigation applications to plan their schedule, they have no idea about the conditions at each place (Nie *et al.*, 2009). Therefore, navigation systems need not only to give users the information that they need but also to lead users to the right place. In Tim's research, they developed an application called "ArtMaps" for the users who want to enjoy the art works in the art gallery. By using the application, users can find the location that the art works created on the map, and enjoy the same view from the street view or by going to the place. They find that users are very overjoyed to find where the art works were created, even though some of them were created based on the imagination of the artists.

Behavioral economics is an important field in economics, but the way it analyzes economic behaviors is different from classic economics (Hursh, 1984). Behavioral economics always analyzes people's behaviors by psychology experiments and can predict users' choices by using this analysis. In the classic economics model, an economic man will always show rational economic behaviors, and this premise is used to build economic models. However, in behavioral economics, many factors affect an economic man's choices. For instance, the appearance and advertisement of products or the earnestness (Colin and George, 2004). In this research, we introduce these factors into a navigation system to lead the crowd to the destination naturally. Moreover, we take the experiments by using the proposed system during an event held in Osaka called "Osaka Mizube Bar". The results of the experiment confirmed that the behavior of users could be affected by controlling the rank list that they check on their devices; furthermore, users can be led to a specific destination or area by taking advantage of this function.

This paper consists of seven parts: introduction in Section 1, reference research in Section 2, introduction of system design in Section 3, system implementation in Section 4, application and evaluation of the prototype system in Section 5, discussions in Section 6 and conclusion of this article in Section 7.

2. Related work

The navigation system was first developed for military purposes, for instance, the global position system (GPS) is one of the most widely used navigation systems, and it was developed for the US Army. Moreover, most of the navigation systems use GPS as location awareness (Getting, 1993).

Nowadays, there are many research works on navigation systems. Tumas developed a system that helps users to find a personalized path connecting two arbitrary points in a city using city transport and walking. The navigation system targets mobile device users and provides a location-based service recommending the optimal path based on the specific user preferences (Tumas and Ricci, 2009). In Brown and Laurier's research, they discussed some normal problems when using a navigation system when driving, such as destination, route, map, sensor, timing, relevance and legality problems (Brown and Laurier, 2012). In the experiments, they used both a car navigation system and a smartphone navigation application to help the driver to navigate. They gave some advice on how a navigation system can help drivers to know about the nearby situations. Intelligent transportation system is an important field of navigation. These navigation systems can not only search for routes from the current location to the destination, but also calculate the most effective route for users in different conditions (Figueiredo *et al.*, 2001). Therefore, users can use these navigation systems to plan their schedules for different places. Baurs developed a personal navigation system to lead users in a landscape (Baus *et al.*, 2002). They calculate the route based on the user's context, such as the user's location, time or user's surrounding environment. Baurs's navigation system can work indoors and outdoors. In some cases, tourists will try to find some recommended information if they are not familiar with the location. In Yang's research, they proposed a location-aware recommender system that accommodates customers' shopping needs with location-dependent vendor offers and promotions (Yang and Hwang, 2013). Gavalas explored the landscape for a mobile recommendation system and provided an up-to-date survey for mobile recommendation systems for tourism (Gavalas *et al.*, 2014). In Shiraishi's research, they developed a schedule planning system for landscapes; it can generate a tourism plan if the user enters some factors like time, favorites, etc., into the system (Shiraishi *et al.*, 2005). By using the navigation system, users can take the tour more effectively, but it cannot lead users to some places where events are being held or let the user make a reasonable decision when there are crowds of tourists in the landscape. Tanaka developed a navigation system for tourists based on web pages (Tanaka and Nakatani, 2010). When users search for destinations on their devices using the navigation system, it will show the destinations on the map and delete the part of the map around the destination to encourage users to enjoy traveling in the deleted part. However, it is hard to use for the tourists if they have no idea where the destination is. In Tim's research, they developed an application called "ArtMaps" for the users who want to enjoy the art works in the art gallery (Coughlan *et al.*, 2015). By using the application, users can find the location that the art works created on the map, and enjoy the same view from the street view or by going to the place. They find that users are overjoyed to find where the art works were created, even though some of them were created based on the imagination of the artists. Keith developed an intelligent electronic tourist guide system that can guide people based on groups (Cheverst *et al.*, 2000). They find that it is important to show clear benefits over the traditional facilities available to tourists, such as paper-based guidebooks, and give users not only the information based on the current location but also more on the tourism. In Norma's research, they created a recommendation system that is location-based (Savage *et al.*, 2012). Furthermore, the system can learn users' preferences through the social network. Pieter developed a Web-based application to generate the trip plan between different cities in Europe (Vansteenwegen *et al.*, 2011).

Users need to choose what they are interested in on the website and input other parameters such as time of trip. The system will give users the route and some tips for trips to support the tourists. In research, Damianos created a tourism recommendation system for users (Gavalas and Kenteris, 2011). The system provided a score rated by other users, and users can upload the comments and photos of the landscapes. The score is also an important factor in generating the route for tourists.

Behavioral economics shows that people will choose based on many factors, such as the emotional or visceral state of the person and impression of the goods (Kahneman, 2003). This understanding can help us to persuade users to make decisions by presenting some information. Persuasive techniques become more important in human interaction (IJsselsteijn *et al.*, 2006). There are many research works on persuasive technology, especially the design of the user interface. Most of these research works focus on how to lead users in accordance with the purpose of the designers. Nowadays, more and more people use smartphones and tablets, so the interface design strategies of the applications for smartphones are becoming more important to developers. Users have different preferences; therefore, developers have to persuade users to touch or make a gesture on a specific place on the touchscreen (Munson, 2012). There are many strategies for persuasive technologies that affect user behaviors and activities; Fogg investigated the changes of user's behaviors and motivations (Fogg, 2002). They figured out that self-monitoring and conditioning are most notable. Users will make an effort to reach the goal if they have set a target beforehand. Bravata's research was based on a quantitative synthesis of literature and found that pedometers in combination with a step goal can significantly increase physical activity (Bravata *et al.*, 2007). In Fritz's research, they investigated 30 participants who had adopted wearable activity-tracking devices of their own volition and had continued to use them for between 3 and 54 months. They aim to learn the value that the systems provide over the long-term and how the systems can be designed better to provide long-term support (Fritz *et al.*, 2014). As a result, by looking at the changing use of metrics, data sharing and rewards, they provided grounded insights about how systems can evolve alongside wearers and continue to provide benefits. Lee tried to find how to use persuasive technology to let users make healthy choices (Lee *et al.*, 2011). They performed some experiments on how users make choices in different situations; for example, in one of the experiments, they asked participants to choose between snacks and fruit for three days one time or every time before the participants had food and found that the participants preferred to choose the default. As a result, they found that extremely simple changes in user interfaces can substantially affect people's choices, and behavioral economics is a theoretical approach that can be used to structure information to help people make decisions and change their behaviors. Sparks tested experimentally how source, content style and peripheral credibility cues in online postings influence four consumer beliefs, and how those in turn influence attitudes and purchase intentions for an eco-resort (Sparks *et al.*, 2013). They find that the type of content presented for online social media in a tourism context also had an influence on customer beliefs, and customer-generated information that included specific content was the most persuasive, followed by manager-generated content that was also specific in nature. In Kim's research, to design the website, they find that inspiration-related elements had the greatest impact on first-impression formation, and usability was the second most significant driver of first-impression formation (Kim and Fesenmaier, 2008). Nurulhuda finds that tourism websites realized the importance of

building good relationship with their customers (Ibrahim *et al.*, 2013). Building a good relationship is significant with the representation of reciprocation, commitment and consistency in the design. Sufficient uses of liking and scarcity have also demonstrated that triggering customers' attention is important.

3. System design

In this research, we aim to develop a navigation system that controls the crowd flow naturally when users check information on their devices. In this section, we will first describe the construction of the proposed system, second introduce the methods of information presentation and finally explain the method of crowd flow control.

3.1 System construction

Figure 1 shows the construction of our proposed navigation system. The proposed navigation system consists of the local part and the cloud part. On the local part, we developed an application that can run on smartphones and other mobile devices with a GPS function. By using the application, we can obtain users' GPS information in real time, and we will provide the navigation information to users on their devices. For instance, we can give users information on nearby sightseeing spots and show users the route from the current location to the destination. On the cloud part, we create a database to save both users' information and spot information. Users' data saved in the database include:

- users' id;
- users' position information;
- users' check timestamp; and
- users' check history.

Spots' data saved in the database include:

- spots' id;
- spots' title;
- spots' location information;
- spots' introduction information;

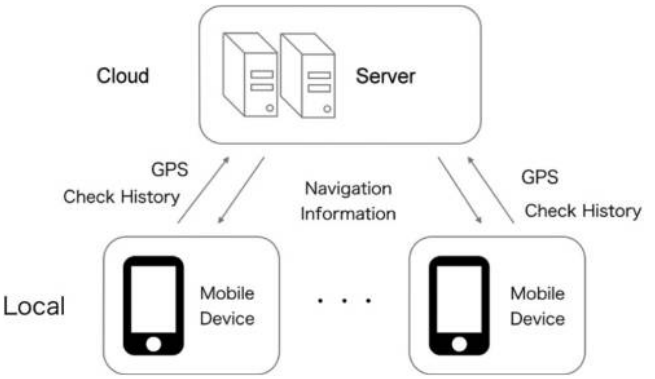

Figure 1.
Construction of proposed system

- spots' review text; and
- spots' area.

We obtain users' ID, GPS information and users' check histories to grasp the crowd flow situation. Spots' information also was inputted into the database beforehand, and users can access the spots details to find the information that they want, also the location information and route information on the map. Moreover, we divide the crowd into several groups to control the directions of each group by controlling the information presented on users' devices.

3.2 Information presentation

To control the crowd flow, we need to inspect the information presentation methods. We considered taking behavioral economics into our research; persuasive technology is widely used in context design (Lockton *et al.*, 2008). We suggest the following methods for information presentation (Dan, 2008).

3.2.1 Certainty effect. The certainty effect means that people prefer to focus on the things that will occur with certainty rather than those that will probably occur (Schmidt, 1998). For example, when people are asked to make a choice between "obtain some money with certainty" and "probably obtain lots of money", more people will choose "obtain some money with certainty", even though the second option has an expectation of winning lots of money. In brief, when we are asked to make a choice, we consider the risk of each option and choose the one that has less risk than the others (Cohen and Jaffray, 1988). A navigation system can present more information on a destination for tourists to make users head there when they have no idea where to go. For instance, the navigation system can show more pictures or more comments of the destination for users. Changing the reliability of the information of each place can help users to make the decision.

3.2.2 Anchoring effect. The anchoring effect means that we always judge things at first glance (Wilson *et al.*, 1996). Even if we know more details about a situation afterwards, the impression can be only adjusted a little (Strack and Mussweiler, 1997). For example, when a store holds a campaign for products, more customers will buy the goods if the difference in the price is emphasized. In a navigation system, we can make a rank list for the landscapes; moreover, when there is a high rank and a low rank in the rank list, users may prefer to choose the places that have a high rank.

3.2.3 Reflection effect. The reflection effect means that people make different choices when they are in different environments; people in the benefit will avoid the risky choice; on the other hand, some people would like to take the risk (Fagley, 1993). In a navigation system, we can present information about crowded places to users. Tourists may head for places that they are unfamiliar with.

3.2.4 Default effect. The default effect means that people like to maintain the current state (Samuelson and Zeckhauser, 1988). People like to choose the same or a similar option in the same situation and make less effort considering other options (Kahneman *et al.*, 1991). In a navigation system, we could provide a default recommendation option for users to help them make decisions when they have no idea where to go next after enjoying the current sightseeing spot. Moreover, by changing the default recommendation options, we can control the crowd flow and lead them to the destination.

Our information presentation methods control the crowd flow naturally. Therefore, in our prototype system, we introduced the anchoring effect into the system to investigate whether information presentation can affect users' behaviors and made a recommendation list for users to find out how the rank list information can affect users' behaviors.

4. System implementation

We implemented the system for an event called "Osaka Mizube Bar". We conducted an experiment to investigate whether information presentation can affect users' behaviors.

4.1 Osaka Mizube Bar

Aqua Metropolis Osaka is a project that aims to build a network around Nakanoshima Gate and create an attraction for the city of Osaka (Osaka Mizube Bar, 2012). In this project, there are some programs to let tourists enjoy Osaka City. Osaka Mizube Bar is one of these programs that try to encourage tourists to travel around the city. Osaka Mizube Bar was one of the events held in 2011, 2012 and 2013. This event let tourists travel around Osaka in different ways to enjoy the city for two days in October each year. Usually, we travel in Osaka by subway, bus or bicycle; however, in the Osaka Mizube Bar area, some ports open, so participants could take shuttle ships to travel from one area to another. There were lots of restaurants and stores in each area, and when the participants bought tickets for the ships, they also could buy the tickets to enjoy a special menu called "bar menu" at these restaurants and stores. In this event, there were six areas: Tenmabashi, Kitahama-Yodoyabashi, Higashi-Yokobari, Dotonbori, Taisho and Nakanoshima Gate. Ninety-five restaurants and stores located in these areas took part in the event. Fourteen shuttle ships traveled between eight ports in the event areas. Figure 2 shows a flyer indicating the event areas in Osaka Mizube Bar (2013). This flyer is a simple guide map of the event area; the blue lines stand for the rivers, and the colored boxes stand for each area. At each port, there was a small counter, as shown in Plate 1, to provide both the shuttle ship tickets and the special menu tickets for the participants. Plate 2 shows one of the ports for participants taking the shuttle ships. Plate 3 is a photo taken by a customer who was taking a shuttle ship in the Dotonbori area.

We developed a navigation application for the participants and worked in the event as a supporter. Users could know the availability of the shuttle ships' tickets in real time; moreover, they could find restaurant information when using the navigation application.

4.2 Local implementation

The local part refers to the application that runs on the user's device. We developed both a Web-based application and an iPhone application for the participants. Figure 3 shows screenshots of the Web-based application. On the left, there is the root view, and users can click on the blue boxes to use different functions. On the right, there is a screenshot of the restaurant list. Figure 4 shows screenshots of the iPhone application. On the left, the different functions are shown. On the right, there is a screenshot of the restaurant list. The user can access the application from the URL "http://mizube.net" by using the Web browser on their mobile device. The user can also search for the application named "Mizube" on the App Store by using an iPhone. The iPhone application has higher performances. For example, it can show the user the current location in real time, users can use gestures to switch between views conveniently and the response is more rapid

Figure 2.
Event areas in Osaka Mizube Bar, 2013

Source: Osaka Mizube Bar (2013)

and smooth. Figure 5 shows the transition of the Web-based application. On the top page, there are three functions for users: recommended function at the top, ship information in the middle and store information at the bottom. Ship information provides ticket information for shuttle ship in real time. Store information provides a search function enabling users to search for the stores by keywords or ID number, and our system will provide users with detailed information, location and route from the users' current location. The recommended function can give users the recommended list of restaurants, and users can find detailed information on each restaurant just like when using the search function by clicking on the list. Figure 6 shows the transition of the iPhone application. On the top page, users can find their current location on the map in real time and the restaurants around them. In recommended information, users can get the recommended list from the server and can get the same detailed information and route information as provided by the Web-based application when they click on the list. Ship information will provide ticket information in real time, and store information will provide a search function and a list of all the stores that take part in the event.

Plate 1.
Counter at port

Plate 2.
Port in area

Plate 3.
View from shuttle ship

4.3 Cloud implementation

We put the locations, menus and photos of the restaurants into the database on the server; moreover, users will upload their check history and GPS history into the database. When the user runs the application or accesses the website, the system will connect with the server and the server group users. In brief, the crowd flow is randomly divided into several groups. Furthermore, the recommended list will provide different information depending on the group. For instance, when some users access the recommended list, the list will be ranked by the distance away from the users' current location; on the other hand, some users' recommended list will be ordered randomly. In the experiment, we divided the users into three groups: users' recommended list with the stores ordered by the distance away from the users' current location, users' recommended list showing nearby port information above the list and users' recommended list with the stores ordered randomly.

5. Application and evaluation

The prototype system was used in the event on October 13th and 14th in 2012 and October 12th and 26th in 2013. Figure 7 shows a flyer for the navigation application that participants could receive in the event. The flyer introduces the functions of the navigation application and the way to get it, but we do not tell users that they will be divided into several groups, so that we can provide different recommended information.

Table I shows the state of the website in 2012, and Table II shows the state of the website in 2013. Accesses means the number of times that a user used the website.

Figure 3.
Screenshots of Web-based application

Figure 4.
Screenshots of iPhone application

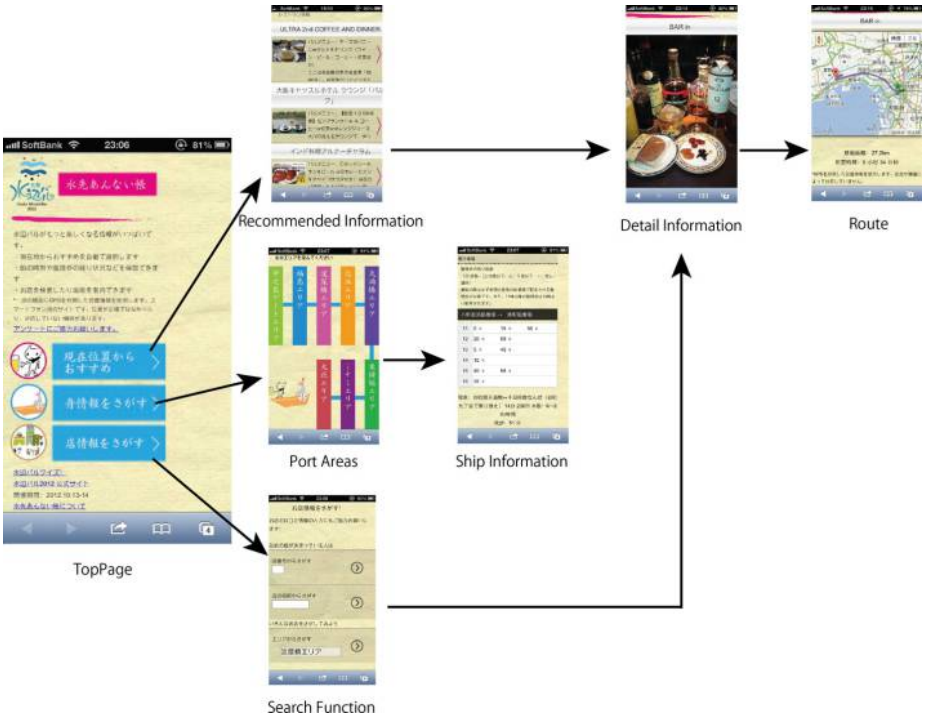

Figure 5.
Transition of Web-based application

Independent users means the number of times that they access all the web pages of the website. Page clicks means the number of clicks on all the web pages. The number of participants who took part in the event in 2013 greatly decreased because the weather was not fine. The result of accesses shows that more than half of the users used the website three or fewer times; 79.07 per cent of the users visited the website three or fewer times in 2012 and 68.18 per cent of the users visited the website three or fewer times in 2013. We also counted the number of views on each function. There were 11,395 page views of ship information, 207 page views of recommended information and 197 page views of store information. In total, there were 11,436 page views of the navigation application in 2012. In the next year, we have 2,696 page views of the Web-based application and 11 iPhone application users. There are 2,652 page views of ship information, 142 page views of recommended information and 111 page views of store information.

We found that more users would like to use the navigation application to check shuttle ship information because they receive a flyer that tells users how to access the navigation application when they buy shuttle ship tickets at the port. Therefore, most users are interested in checking the schedule of the shuttle ships that they would like to take. Furthermore, most of the participants are Osaka residents who can find the way to the destination without using the navigation application.

We also counted the number of clicks on the rank list of the users. Figure 8 shows the count data of the event in 2012. The vertical axis shows the proportion of each rank's click count to the whole click count, and the horizontal axis is the rank of the list that was

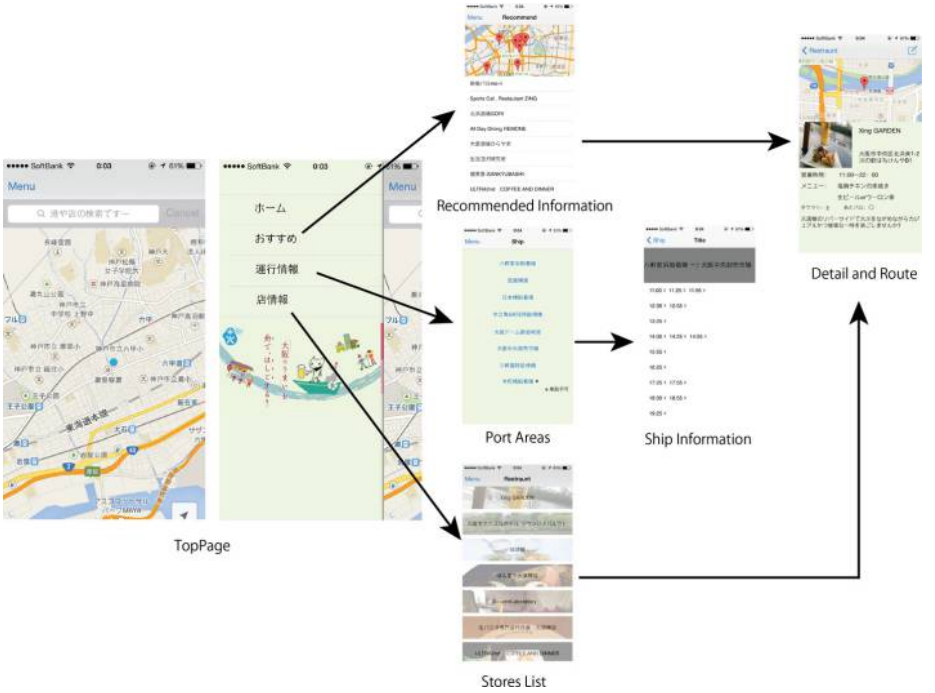

Figure 6.
Transition of iPhone application

Figure 7.
Flyer of navigation application

shown on users' devices. Figure 9 shows the count data of the event in 2013. The vertical axis is the proportion of each rank's click count to the whole click count, and the horizontal axis is the rank of the list that was shown on users' devices. Moreover, the data of each pattern are shown in a different color. The blue bars refer to the users' recommended list with the stores ordered by the distance away from the users' current

Accesses	Independent users	Page clicks
1	1,133	7,149
2	422	2,625
3	228	1,398
4	138	791
5	92	533
6	67	391
7	44	269
8	34	206
9-14	75	570
15-25	16	158
26-50	11	26

Table I.
Users' access data in 2012

Accesses	Independent users	Page clicks
1	282	1,359
2	118	598
3	67	342
4	46	208
5	33	165
6	22	155
7	19	113
8	19	110
9-14	47	244
15-25	19	233
26-50	13	93

Table II.
Users' access data in 2013

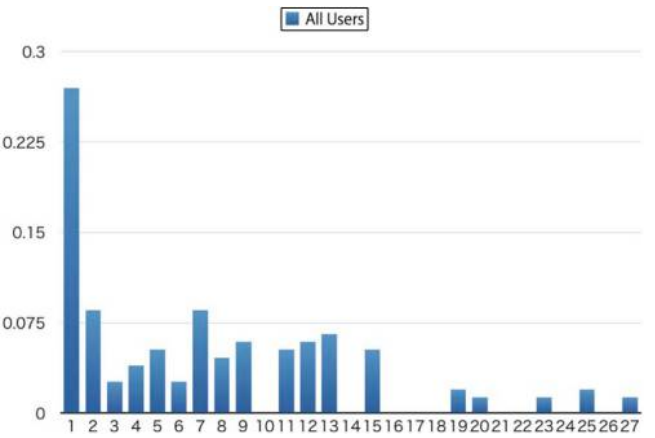

Figure 8.
Rate of clicks on each rank in 2012

location, the green bars refer to the users' recommended list that shows nearby port information above the list and the yellow bars refer to the users' recommended list with the stores ordered randomly. Through looking at Figures 8 and 9, we can see that most users selected rank 1. Moreover, most users only check the stores that are within rank 15

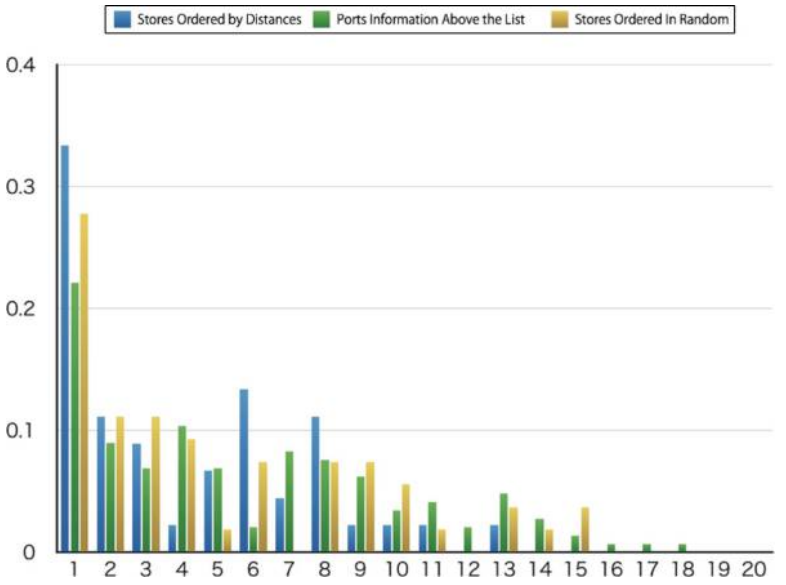

Figure 9.
Rate of clicks on each rank in 2013

in the event in 2012, and most users check the stores that are within rank 10 in 2013. Therefore, most users focus on the things with a high rank, especially rank 1. Moreover, despite the different patterns, users will have the same choice on the rank list. We do not tell the users how the rank list is ordered, and we do not even show the numbers of the rank before the title of each store in the list. In the three patterns of the rank list, although the random pattern gives users some information that is meaningless for them to enjoy the event, we get the same result. Therefore, for users, the information presented in the list is more important than what the information is.

In the event held in 2013, we gathered the GPS information of users and displayed it on a map. Figure 10 shows GPS information of some of the users on a Google map. The yellow pins refer to the 26 users' GPS histories. The other colored markers refer to stores and restaurants, and each color stands for an event area. The colored lines refer to the routes of shuttle ships, and each color stands for a round trip of a shuttle ship. Users use the application to move only around each area. Furthermore, after we made a timeline of the 26 users' GPS histories, we found that eight users head for the restaurants with a high rank. Therefore, users can be led to a specific area when we control the information that is presented in the rank list.

6. Discussion

In the experiments, we divided users into three groups to investigate the effect of information presentation control. Although we did not make a real-time tracking function for the Web-based navigation application, we used the results to make some tips on information presentation control through users' clicks and the GPS histories when users click on the application.

- Investigate the motivation of the user: In the event, most users accessed the application from the flyer that they received from staff at the ticket counter;

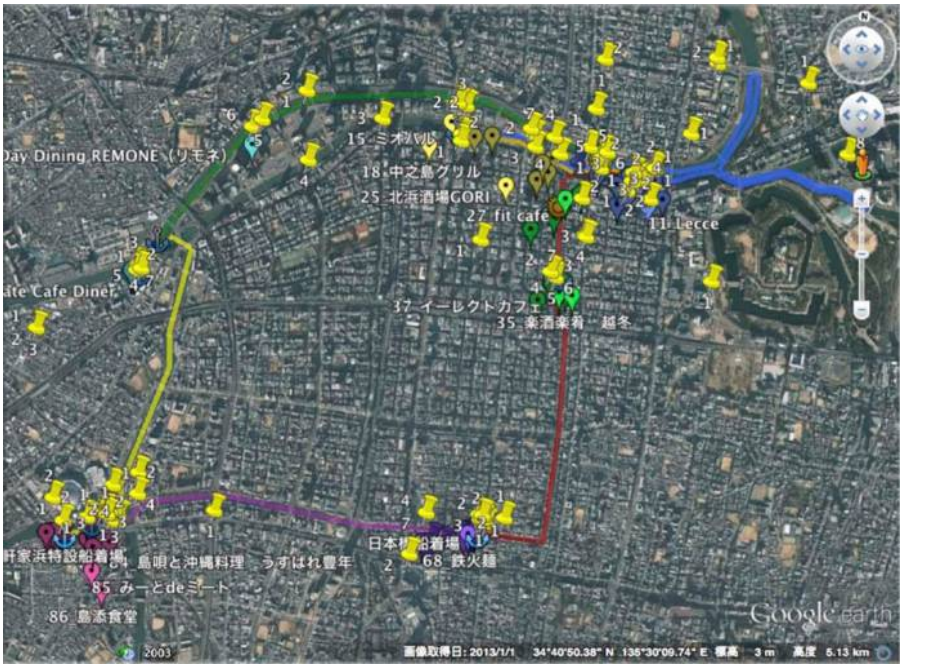

Figure 10.
GPS information of some users in 2013

therefore, more users may be interested in the shuttle ship schedule. This could be the motivation of most users. We should design each function in a complex way but not make each function separate. For instance, present the restaurant information in the schedule page when the user checks the ship information, and persuade users to check the recommended information from the ship information page.

- Give an overview of the application for the user: Although developers can use the application in a normal way, users may use it differently, because users have different preferences. Most users may find it hard to understand the meaning of each function or how to use it correctly even if the application has been designed very well. We should give an overview of the application for users when they open the application for the first time. Therefore, users can be given the rules for some similar steps when they use the application, and can make full use of it.
- Persuade users to send some feedback: Even a photo of the landscape can be subjective feedback from the user, which will show the conditions of use. To upgrade the application or take the system to the next step, not only the use data, but also the feedback data from users can be important resources. In the experiments, we divided the users by cookie ID on the Web-based application and by device ID on the iPhone application. To grasp the conditions of use, a quick registration or the pop-up window with some simple questions with options on the page can be the approach.

- Make a course for each user: Each user can have a different situation, such as traveling with family or as a couple, wanting to take a walk or wanting to relax, etc. In the event, there can be different kinds of users, such as native residents, foreign tourists or people just passing by. Instead of providing different functions, we can ask users for a situation by making users check some options, and persuading them to go to a specific area by generating different courses for users. For example, native people may be interested in the menus of restaurants; foreign tourists may be interested in the landscape that the shuttle ship can reach. Furthermore, setting a goal and several steps for the course can persuade users to reach the goal and lead them to a specific area.
- Persuade users to rate each item: According to the related work that we investigated, users will trust the information from other users more than the information from the system, when both of them are presented to users. Therefore, we should try to persuade users to rate the items that they visited, and write some reviews, and lead to the specific area by recommend the spots with high scores to users. We need to place the information from users in the prominent place; therefore, users can have access to the information that we want to present. Moreover, the place to write a review should also be prominent, and to persuade users to write a review, we can give them some points when users write something.
- Design the contents: We need to choose the contents that are presented to users of each item in the list view. For example, whether we need to present the photo of each spot to users, how many reviews should we present for each item in the list view? First impression is more important than the function. Therefore, we need to design the contents that are attractive to users, and the layout of the contents is important. Presenting the important information and the information that we want users to see in a prominent place is important.

7. Conclusion

We developed a navigation system to control the crowd flow and conducted an experiment on controlling information presentation. The results of the experiment confirmed that users focused on the position of the rank list, regardless of the information for each item. We can affect the users' choice by controlling the rank list. If we put the place that we want the users to head for at the top of the list or at a high rank, we could control the crowd flow to make them head for the place naturally. In future work, we will make a real-time GPS tracking system that gives the location of the users to analyze the direction of the crowd flow, and try to persuade users to check-in at the place that they head for. Moreover, we would like to conduct the experiment using other methods, and try to combine several methods together to evaluate an effective way to control the crowd flow.

References

Atzori, L., Dessi, T. and Popescu, V. (2012), "Indoor navigation system using image and sensor data processing on a smartphone", *13th International Conference of Optimization of Electrical and Electronic Equipment (OPTIM), Brasov*, pp. 1158-1163.

Baus, J., Krüger, A. and Wahlster, W. (2002), "A resource-adaptive mobile navigation system", *Proceedings of the 7th International Conference on Intelligent user Interfaces*, *San Francisco*, pp. 15-22.

Bravata, D.M., Smith-Spangler, C., Sundaram, V., Gienger, A.L., Lin, N., Lewis, R., Stave, C., Olkin, I. and Sirard, J.R. (2007), "Using pedometers to increase physical activity and improve health: a systematic review", *JAMA*, Vol. 298 No. 19, pp. 2296-2304.

Brown, B. and Laurier, E. (2012), "The normal natural troubles of driving with GPS", *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, *Austin*, pp. 1621-1630.

Cheverst, K., Davies, N., Mitchell, K., Friday, A. and Efstratiou, C. (2000), "Developing a context-aware electronic tourist guide: some issues and experiences", *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, *Hague*, pp. 17-24.

Cohen, M., and Jaffray, J.Y. (1988), "Certainty effect versus probability distortion: an experimental analysis of decision making under risk", *Journal of Experimental Psychology: Human Perception and Performance*, Vol. 14 No. 4, pp. 554-560.

Colin, C. and George, L. (2004), *Behavioral Economics: Past, Present, Future*, Princeton University Press, NJ.

Coughlan, T., Carletti, L., Giannachi, G., Benford, S., McAuley, D., Price, D., Locatelli, C., Sinker, R. and Stack, J. (2015), "ArtMaps: interpreting the spatial footprints of artworks", *Proceedings of the ACM Conference on Human Factors in Computing Systems*, *Seoul*, pp. 407-416.

Dan, A. (2008), *Predictably Irrational: the Hidden Forces that Shape our Decisions*, HarperCollins Publishers, New York, NY.

Fagley, N.S. (1993), "A note concerning reflection effects versus framing effects", *Psychological Bulletin*, Vol. 133 No. 3, pp. 451-452.

Figueiredo, L., Jesus, I., Machado, J.T., Ferreira, J. and De Carvalho, J.M. (2001), "Towards the development of intelligent transportation systems", *Intelligent Transportation Systems*, Oakland, Vol. 88, pp. 1206-1211.

Fogg, B.J. (2002), "Persuasive technology: using computers to change what we think and do", Ubiquity, Vol. 2002 No. 5, pp. 89-120.

Fritz, T., Huang, E.M., Murphy, G.C. and Zimmermann, T. (2014), "Persuasive technology in the real world: a study of long-term use of activity sensing devices for fitness", *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, *New York, NY*, pp. 487-496.

Gavalas, D. and Kenteris, M. (2011), "A web-based pervasive recommendation system for mobile tourist guides", *Personal and Ubiquitous Computing*, Vol. 15 No. 7, pp. 759-770.

Gavalas, D., Konstantopoulos, C., Mastakas, K. and Pantziou, G. (2014), "Mobile recommender systems in tourism", *Journal of Network and Computer Applications*, Vol. 39, pp. 319-333.

Getting, I. (1993), "Perspective/navigation-the global positioning system", *Spectrum, IEEE*, Vol. 30 No. 12, pp. 36-38.

Hursh, S.R. (1984), "Behavioral economics", *Journal of the Experimental Analysis of Behavior*, Vol. 42 No. 3, pp. 435-452.

Ibrahim, N., Shiratuddin, M.F. and Wong, K. (2013), "Persuasion techniques for tourism website design", *In the International Conference on E-Technologies and Business on the Web*, *7-9 May*, *Bangkok*, pp. 175-180.

IJsselsteijn, W., de Kort, Y., Midden, C., Eggen, B. and van den Hoven, E. (2006), "Persuasive technology for human well-being: setting the scene", *In Persuasive Technology*, Springer Berlin Heidelberg, pp. 1-5.

Kahneman, D. (2003), "Maps of bounded rationality: psychology for behavioral economics", *American Economic Review*, Vol. 93 No. 5, pp. 1449-1475.

Kahneman, D., Knetsch, J.L. and Thaler, R.H. (1991), "Anomalies: the endowment effect, loss aversion, and status quo bias", *The Journal of Economic Perspectives*, Vol. 5 No. 1, pp. 193-206.

Kim, H. and Fesenmaier, D.R. (2008), "Persuasive design of destination web sites: an analysis of first impression", *Journal of Travel Research*, Vol. 47 No. 1, pp. 3-13.

Lee, M.K., Kiesler, S. and Forlizzi, J. (2011), "Mining behavioral economics to design persuasive technology for healthy choices", *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, *New York, NY*, pp. 325-334.

Lockton, D., Harrison, D. and Stanton, N. (2008), "Design with intent: persuasive technology in a wider context", *Persuasive Technology*, Vol. 5033, pp. 274-278.

Munson, S. (2012), "Mindfulness, reflection, and persuasion in personal informatics", in proceedings of the SIGCHI Conference on Human Factors in Computing Systems, Austin, Texas, USA.

Nie, Y.F., Fu, X. and Zeng, J.X. (2009), "A tourist route planning and navigation system based on LBS", *Proceedings of the 2009 International Symposium on Web Information Systems and Applications (WISA'09)*, *Nanchang*, pp. 288-290.

Osaka Mizube Bar (2012), "About Suito-Osaka festival 2012", available at: http://osaka-mizubebar2012.seesaa.net/category/14537680-1.html (accessed 20 November 2015).

Osaka Mizube Bar (2013), "About Suito-Osaka festival 2013", available at: http://osaka-mizubebar2013.seesaa.net/article/374546048.htm (accessed 20 November 2015).

Samuelson, W. and Zeckhauser, R. (1988), "Status quo bias in decision making", *Journal of Risk and Uncertainty*, Vol. 1 No. 1, pp. 7-59.

Savage, N.S., Baranski, M., Chavez, N.E. and Höllerer, T. (2012), *I'm Feeling Loco: A Location Based Context Aware Recommendation System*, Springer Berlin Heidelberg, pp. 37-54.

Schmidt, U. (1998), "A measurement of the certainty effect", *Journal of Mathematical Psychology*, Vol. 42 No. 1, pp. 32-47.

Shiraishi, T., Shibata, M.N.N., Nagata, M., Shibata, N., Murata, Y., Yasumoto, K. and Ito, M. (2005), "A personal navigation system with a schedule planning facility based on multi-objective criteria", *Proceedings of International Conference on Mobile Computing and Ubiquitous Networking*, *Osaka*, pp. 104-109.

Sparks, B.A., Perkins, H.E. and Buckley, R. (2013), "Online travel reviews as persuasive communication: the effects of content type, source, and certification logos on consumer behavior", *Tourism Management*, Vol. 39, pp. 1-9.

Strack, F. and Mussweiler, T. (1997), "Explaining the enigmatic anchoring effect: mechanisms of selective accessibility", *Journal of Personality and Social Psychology*, Vol. 73 No. 3, pp. 437-446.

Tanaka, K. and Nakatani, Y. (2010), "Sightseeing navigation system that promotes interaction with environment by restricting information", *International Conference on Systems Man and Cybernetics*, Istanbul, pp. 453-458.

Tumas, G. and Ricci, F. (2009), "Personalized mobile city transport advisory system", in proceedings of Information and Communication Technologies in Tourism, pp. 173-184.

Vansteenwegen, P., Souffriau, W., Berghe, G.V. and Van Oudheusden, D. (2011), "The city trip planner: an expert system for tourists", *Expert Systems with Applications*, Vol. 38 No. 6, pp. 6540-6546.

Wilson, T.D., Houston, C.E., Etling, K.M. and Brekke, N. (1996), "A new look at anchoring effects: basic anchoring and its antecedents", *Journal of Experimental Psychology: General*, Vol. 125 No. 4, pp. 387-402.

Yamashita, T., Izumi, K., Kurumatani, K. and Nakashima, H. (2005), "Smooth traffic flow with a cooperative car navigation system", *Proceedings of the Fourth International Joint Conference on Autonomous Agents and Multiagent Systems*, Utrecht, pp. 478-485.

Yang, W.S. and Hwang, S.Y. (2013), "iTravel: a recommender system in mobile peer-to-peer environment", *Journal of Systems and Software*, Vol. 86 No. 1, pp. 12-20.

Corresponding author
Tsutomu Terada can be contacted at: Tsutomu@eedept.kobe-u.ac.jp