GPS i-appli Push Delivery

Technology Reports

Position-linked Targeted Information Delivery System

We have developed a prototype information delivery system that can provide not only basic functions for delivering information relating to the current vicinity in conjunction with positional information obtained by a mobile terminal, but also movement analysis results and recommendation information based on statistical processing of this positional information. We have also conducted demonstration tests to verify the operation of this system.

Service & Solution Development Department

Muneo Konishi

Masato Yamada†

Tomoki Hara†

Katsumi Akao†

1. Introduction

There has recently been growing interest in services that deliver diverse content and advertising matched to the user's behavior (behavior-targeted delivery). By tailoring the delivery of content based on information such as the user's location, search history and browsing history, it is possible to deliver effective advertising and information that matches the user's tastes and preferences.

Services that uses positional information are also available for mobile phones. Typical examples are services that search for information about the user's current vicinity, services that show the user's current location on a map, and navigation services. These services are mostly either pull-type services where the user actively uses positional information to search for information, or services where local information is displayed on a map together with the position of the mobile terminal.

NTT DOCOMO has provided Global Positioning System (GPS) capabilities in all mobile terminals since the FOMA 903i series, and the popularity of GPS mobile terminals is growing year on year. Furthermore, by introducing a function that uses the results of GPS positioning and network positioning to confirm the user's current location [1] and a function that reduces the time taken for GPS positioning [2], we have made progress in establishing a platform for the utilization of positional information on the FOMA network.

With the aim of providing position-linked information delivery services as a Business to Business to Consumer (B2B2C) corporate-oriented solution, we have made a prototype position-linked targeted information delivery system. This system implements the automatic (push-type) delivery of local information by periodically delivering information associated with the user's current location. By presenting the user with information about the content, it differs from the information service by the map. Another advantage of this system is that in addition to basic services that deliver information linked to the user's position, it can also provide services that utilize statistical data on the positional information used for delivery. By using statistical data derived from positional information, it can deliver information on places that the user is highly likely to visit next after the current location, and can provide content providers with quantitative and

† Currently Solution Business Department

visual information about the characteristics of the user's movements.

In partnership with JTB Publishing Inc., we used this system to implement demonstration tests to confirming the usefulness of the position-linked information delivery service. In these demonstration tests, under the service name "Tsugi-Doko," we provided a service to automatically provide travelers with tourist information on local attractions and maps suggesting where they might like to go next (**Figure 1**).

In this article, we describe the features of the prototype system, and the joint demonstration tests conducted with JTB Publishing using this system.

2. A Position-linked Targeted Information Delivery System

2.1 System Overview

This system consists of i-appli software downloaded onto GPS mobile terminals, and the corresponding servers (**Figure 2**). The i-appli software periodically uses GPS positioning to acquire the user's current location, and notifies this positional information to the delivery server. The delivery server retrieves the closest content information from the content database based on the user's position, and delivers it to the i-appli software.

The content provider's content information is registered in the content database together with its positional information. It is also possible to desig-

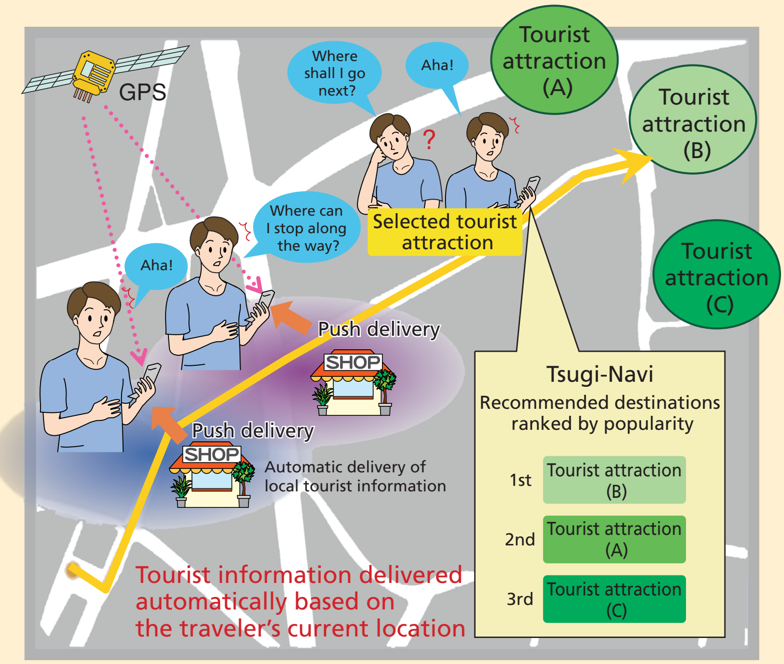


Figure 1 Overview of the Tsugi-Doko service

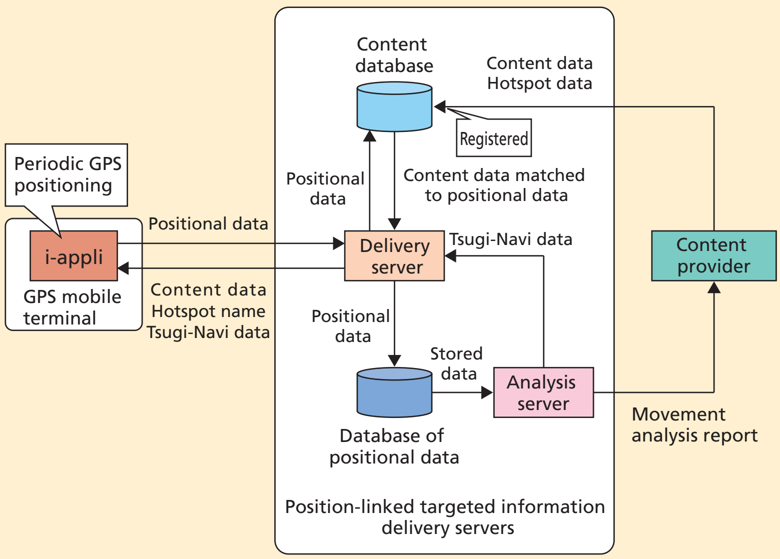


Figure 2 A position-linked targeted information delivery system

nate certain locations as "hotspots," and to report the name of the hotspot where user is currently situated.

The delivery server uses a positional information database to store the positional information used for information delivery, and the analysis server uses the stored positional information to analyze the user's movements. This allows it to deliver recommendations of where to go from the current location (Tsugi-Navi information), and to provide movement analysis reports to content providers.

In this system, the positional information is acquired with the user's consent, and is handled in such a way that it is not possible to identify individual information.

Location	Characteristics	Delivery period
Inside hotspot	Area of densely concentrated content	Shorter
At edge of hotspot	Edge of area with densely concentrated content	↕
Outside hotspot	Area of sparse content	Longer

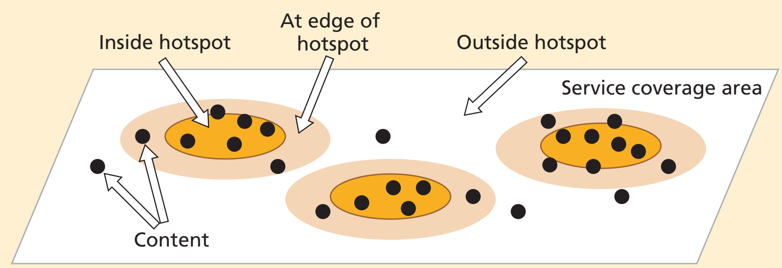


Figure 3 Controlling the information delivery period based on the user's position

2.2 Control of Information Delivery Period

If the GPS positioning and information updates are performed very frequently, then it is possible to ensure that the user is always provided with local information that tracks the user's movements. On the other hand this means the mobile terminal must handle greater traffic levels and higher processing loads, leading to increased power consumption and lower battery life.

In this system, it is possible to control the period with which the i-appli software reports positional information to the delivery server (**Figure 3**). In the vicinity of a hotspot, it is likely that content providers will set up large numbers of content items, so the content nearest to the user will change frequently as the user moves. Consequently, a shorter information delivery period adopted inside hotspots to increase the information update frequency, thereby allowing the information delivery to track the user's movements. Conversely, outside of hotspots, the information delivery period is made longer, thereby reducing the unnecessary information update processing and allowing the battery life of the mobile terminal to be extended.

It is also possible to control the period with which positional information is reported to the delivery server based not only on positional information but also on the time of day, so that the frequency can be reduced in the middle of the night, for example.

2.3 Tsugi-Navi Information Delivery

Tsugi-Navi information delivery is a function that uses the results of performing statistical processing on the collected positional information to deliver information to users about recommendations on where to go next (**Figure 4**). To provide Tsugi-Navi information delivery, the transition probability between hotspots[*1] is first calculated from the collected positional information data used for information delivery. The magnitude of this probability is a statistical expression of the hotspot to which users went to from this hotspot in the past. Accordingly, by providing users who have visited a certain hotspot with information about other hotspots based on the transition probability between hotspots, it provides information on recommendations

*1 **Transition probability between hotspots**: A probability expressing the number of times for users moved to another hotspot as a ratio of the total number of movements to other hotspots.

about where to visit next.

2.4 User Movement Analysis Reports

In this system, the results of statistical processing on the accumulated positional information can be used to provide the content providers with user movement analysis reports. The main content of these movement analysis reports is quantitative information such as the number of users that visited each hotspot and how long they stayed there, and visual information showing on a map the places that most users visited and stayed for a long time (called "location clusters"). An example of a user movement analysis report is shown in **Figure 5** [3].

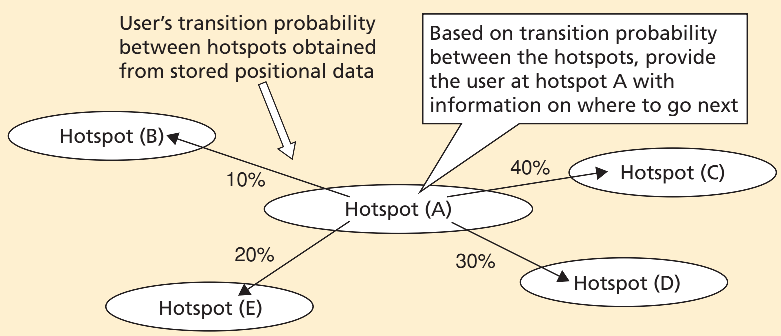
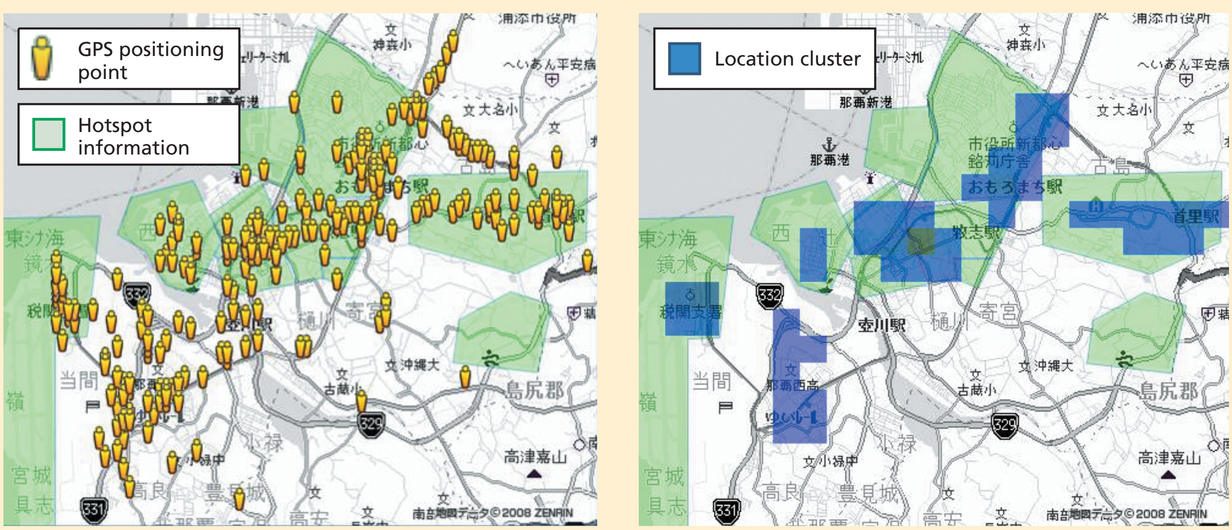


Figure 4 Tsugi-Navi information delivery

The derivation of location clusters is performed by first weighting each item of stored positional information according to the difference in acquisition times between two successive items of positional information for the same user. This process reflects the users' movements as a weighting coefficient applied to each item of positional information. From the weighted positional information, kernel density estimation[*2] is used to calculate the kernel density at each sampling point on the map, and the regions where this value exceeds a threshold value are classed as location clusters. These plots of positional information are themselves treat-



(a) Plots of GPS positioning points

(b) Example of calculated location clusters

Figure 5 Example of a user movement analysis report

*2 **Kernel density estimation**: A method for estimating the probability density at a specific point from sampling values. Used for purposes such as the interpolation of discrete data.

ed as a single plot regardless of whether the user has moved or has stayed in the same place (Fig. 5(a)). However, location clusters are able to reflect the characteristics of users' movements with regard to how long users stay in each place (Fig. 5(b)). By calculating separate location clusters for different user attributes such as age bracket and gender, it is possible to figure out how different types of user are likely to behave, thereby providing content providers with information that is useful for marketing.

3. Tsugi-Doko Demonstration Tests

To confirm the usefulness of information delivery services linked to positional information, we performed demonstration tests in conjunction with JTB Publishing during the period from January to March 2008. In these demonstration tests, travelers were provided with tourist information from JTB Publishing in the form of a service called "Tsugi-Doko" which was held in Okinawa and Kyoto.

The travelers were able to easily obtain information on tourist attractions close to their current location simply by starting up the i-appli software while traveling. Also, information on the closest attractions was updated as the travelers moved, and the travelers were notified of these information updates by causing the mobile terminal to vibrate.

The i-appli DX "Tsugi-Doko" user interface consists of four tabs. The "Nearby" tab (**Figure 6**(a)) shows the hotspot name of the current location, together with tourist information for the ten attractions that are closest to the current location. Users can also be notified with tourist information for attractions within a fixed distance via the "Not Far" icon. The "Favorites" tab (Fig. 6(b)) displays information on the ten closest tourist attractions that match criteria specified by the user (purpose of travel). The "Tsugi-Navi" tab (Fig. 6(c)) lists the ten most highly recommended tourist destinations that people travel to from the current location. The

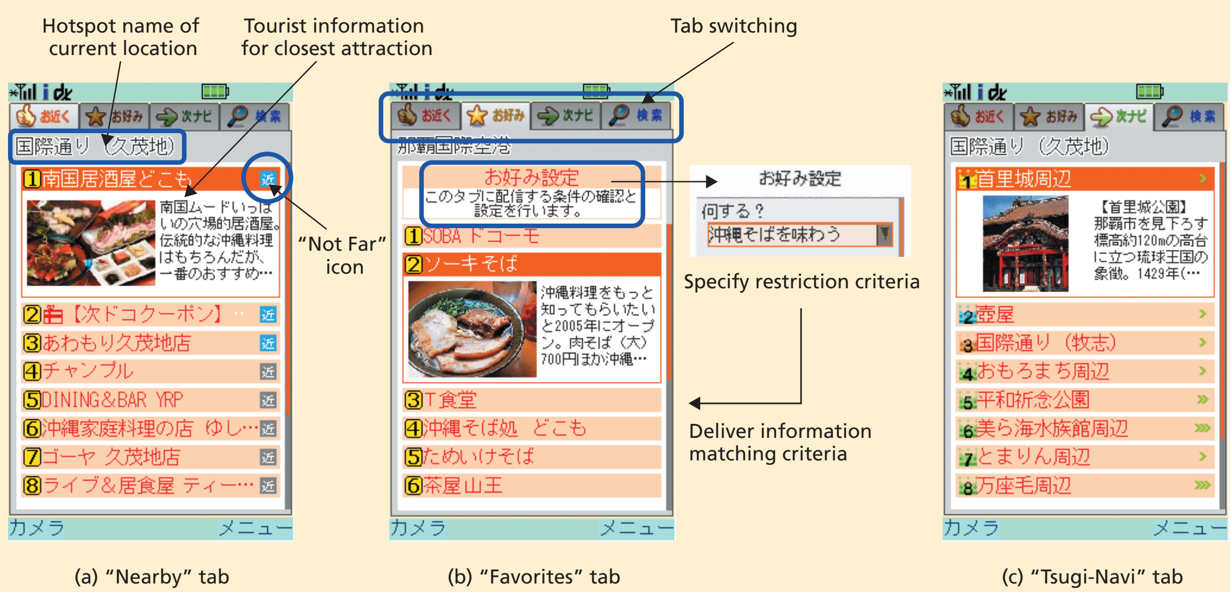


Figure 6 User interface of the "Tsugi-Doko" i-appli DX

"Search" tab allows users to retrieve information in a pull-type fashion. In this way, by pressing (clicking) the select key on each tab, it is possible to display detailed tourist information on the selected destination, and in cooperation with the Application Service Provider (ASP) Zenrin DataCom Co., Ltd., it is possible to obtain a local map and confirm the walking route.

In these demonstration tests, several hundred monitor users put the i-appli software to practical use and of the total number of tourist information items delivered by the i-appli software, the click-through rate[*3] to detailed information on individual tourist attractions was approximately 3%. Although a pure comparison is not possible, this demonstrates that position-linked information delivery is able to achieve a much higher click-through rate than the 1% figure typical of banner ads on the Internet.

4. Conclusion

In this article, we have described a position-linked targeted information delivery system. In the future, we plan to apply this system to movement-targeted advertising as a corporate B2B2C solution.

References

[1] M. Aso et. al: "Location Information Functions for FOMA Terminals—Location Positioning Function—," NTT DoCoMo Technical Journal, Vol. 7, No. 4, pp. 13–19, Mar. 2006.

[2] A. Tsutsui et. al: "Time Reduction Function for GPS Positioning," NTT DoCoMo Technical Journal, Vol. 9, No. 4, pp. 18–22, Mar. 2008.

[3] Copy authorization number: Z08LE No. 012

*3 **Click-through rate**: A measure of the effectiveness of Internet advertising. In this article, it is calculated using the formula [Number of adverts displayed] divided by [Total number of deliveries].