Development of Walking Observation System to Log Personal Migratory Behaviors

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Abstract: In this study, we develop the walking observation system for the experiment of behavioral science. We have been focusing on human behavior, especially walking behavior. However it has been difficult to log walking activity in a real time since every walker has different background, departure place, destination, task and objective. Recently positioning devices and location-based services (LBS) have been very common for personal use, such as GPS-guided cell phone. LBS supports and affects human behavior, so it is supposed to make people more freely to act and make decisions. However, LBS now provides only location-based service. Providing personalized information based on walking behavior and context aware service is inevitable, though this is difficult to figure each walker's preference and background. Surrounding environment interacts with walkers in a diverse way. Walkers switch their speed, destinations, routes, and walking mode frequently. It is therefore necessary to figure out behavioral context and to conduct not only location-based, but also time-based analysis.

This system is consisting of two parts: Activity Logger and Information Provider. Activity Logger is a simple system to watch walking behavior through the videophone and log the behavior. We can track down walkers' location and observe walker's walking history in real-time. And Information Provider could prepare and send information as observer like. This system is expected to be a very useful tool for the experiment and

analysis of the mechanism of migratory walking.

Keywords: migratory walking behavior, modeling, sequence, knowledge, and narrative.

1. Introduction

Behavior of human being, especially walking behavior, is filled with a variety. Every walker has different background, departure place, destination, task and objective. Walking is a part of our lives. It sounds simple, but very complicated actually. There are many studies to figure out the mechanism of walking. For example, Yamaga(1997) tried recording walking behavior in 3D space. Tanaka (2003) conducted the experiment at Venus Fort, a famous shopping mall. He insists that walkers schedule their own behavior to accomplish tasks decided before.

We have been focusing on migratory walking. Migration walking is a type of walking behaviors such as shopping and sightseeing. It is consist of not only practical behavior like going destination but also impractical behavior like enjoying experiences on the way. Though, it is different and unique compared with other types of walking, we have tried to analyze this behavior, with several experiments in an agent model. Mikami (2003) also conducted experiment in Asakusa, Tokyo. She introduced three concepts in the model of migration walking: “Travel Story”, “Travel Plan”, and “Link Choice.”

Following theses studies, Mikami et al. (2005) developed a new model with two behavioral sequences: “sequence of activity” and “sequence of experience.” ‘Sequence’ is originally a term in a scriptwriting for movie or acting. It means a series of small scenes composing a meaningful part of story. As migration walking has “Travel Story,” it is natural to have sequences in this behavior just like a narrative story.

Figure 1 shows the model we use. Migration walking is structured with two connecting sequences: “Sequence of Activity” and “Sequence of Experience.” Sequence of activity includes behavior concerning “Travel Plan” and “Link Choice” involved in reaching a destination. In this context, pedestrians undoubtedly choose the most efficient behavior. The sequence of experience includes individual experiences such as enjoyment, discovery and surprise: pedestrians have small experiences that occur sequentially. We regard migratory walking behavior as integrating these two complementary sequences.

In migratory walking behavior, walkers often change their destinations and objectives of walking due to sequencing. In addition, they can interchange these two sequences by interacting with the environment. For example, if a pedestrian finds meaning in the current activity, the sequence of activity becomes a sequence of experience. Conversely, if his or her next task is motivated by the current experience, the sequence of experience becomes a sequence of activity. Both transformations occur dynamically and actively.

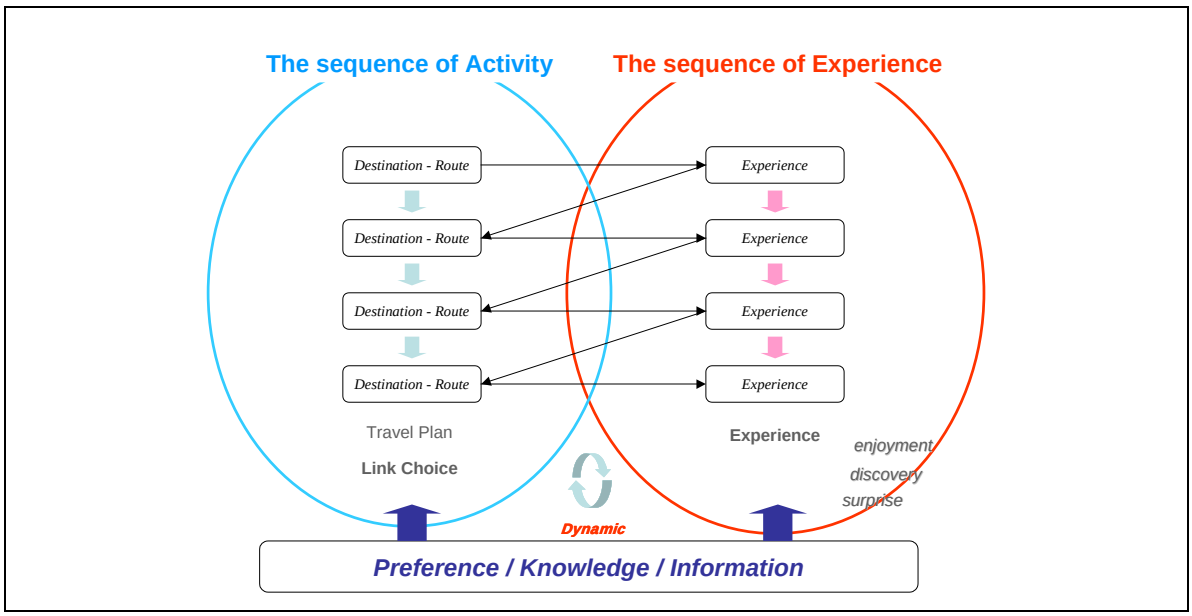

Fig. 1 Model of Migration Walking

With this model, they had a field experiment in Asakusa and shown that knowledge and "narrative story" are important for migratory walking behavior and logical development of a story and satisfaction with walking are related. And they concluded that it must be emphasized that the approach of the narrative method is efficient.

However, at the same time, they points out that more research is necessary especially concerning the exploratory mode. Especially it is necessary to figure out external or internal trigger into the exploratory mode.

2. Objectives

There are several studies about the mechanism of migration walking. However, none of study reveal the mechanism of this behavior. To prove this mechanism, more data and researches are inevitable. t have been very difficult to observe walking behavior inside the city. Migration walking is common to be done in the urban area. Usually, GPS is the originally way to track the location, but it is very difficult to detect correct location because of the limited view above the walkers. What is more, it is necessary to know not only the location but also the activity they are doing. In previously studies, videotaping and interviewing have conducted, but both ways are imperfect to observe and record migration walking in a real time.

In this study, the main objective is to develop the walking observation system for the experiment in behavior science, especially for the study of migration walking. This system detects not only location but also activity of walkers and logs them in a real time. And also information providing system is developed. General LBS is getting popular to provide information up to the location, however, this system is developed with the model of migration walking. It can provide information based on location, walking history and preference.

3. Development of System

Fig. 2 shows the structure of system we develop. Each walker has one videophone and one PDA or cellphone. Videophone is supposed to be used to send video picture and PDA or cellphone to be used as a viewer of information during walking. As for the observer's side, system is consisting of several application software and databases. With this system, we could observe migration walking in real time through videophone, log the activity and provide information based on walker's "story."

This system is divided into 2 parts, Activity Logger System and Information Providing System. The part marked as "1" in fig. 1 is Location Logger System and "2" is Information Providing System.

In both systems, we used googlemaps API as a platform of web-GIS service. Google Maps is a free web map service just started February 2005 (http://maps.google.com/), and Google opened the API to deal with spatial information for free. This API is simple and speedy using JavaScript and XML, so-called Ajax technology (Asynchronous JavaScript + XML). And all data in this system are stored as XML format.

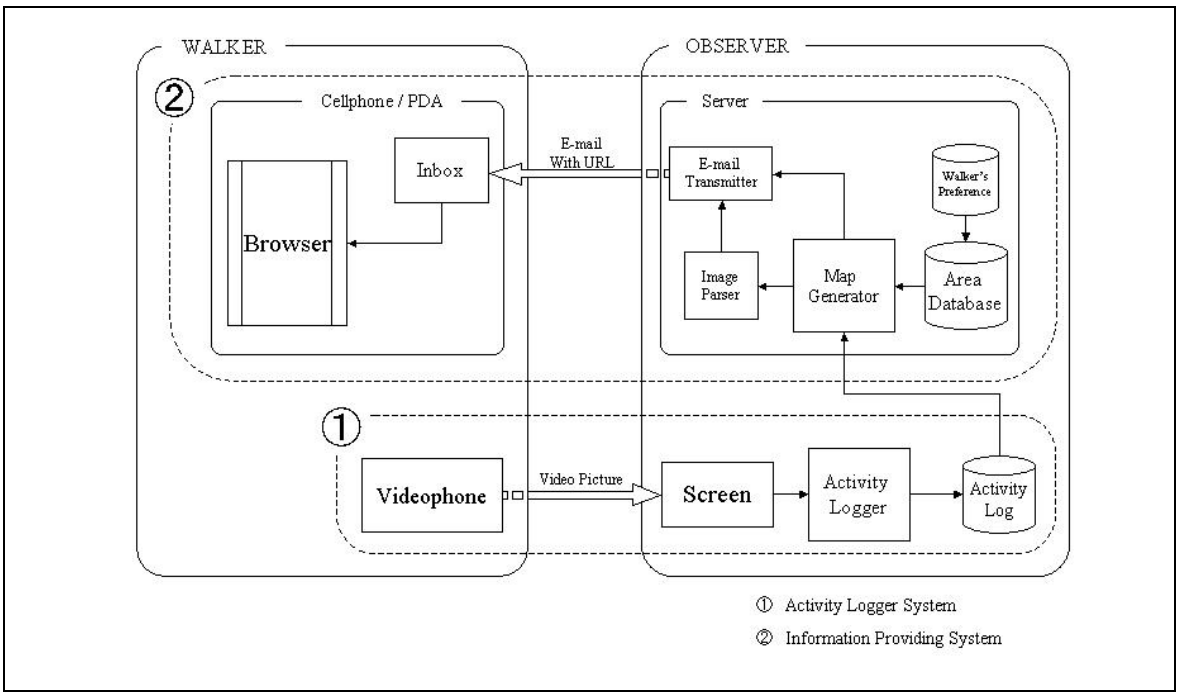

Fig. 2 Structure of System

1) Activity Logger System

Videophones provided by NTT Docomo, so-called FOMA TV-phone, are used to observe walker's activity in this system. Fig.3 shows actual devices in this system. Using G-324M standard, a combination of MPEG4 and AMR, these videophone provide real-time communication with color motion picture and audio. Both motion pictures and audio are recordable, so it makes possible to build the archive of migration walking.

In an experiment, one videophone is attached to the front side of the walker. He/she just hooks up the phone when he/she starts walking, then observer can keep the remote connection to observe the walker. Regular battery can last about one and half hour. It is long enough for experimental use, but this could be longer with an external battery if necessary.

Fig. 3 Videophones (Left : FOMA SH901iS / Right : FOMA F900iT)

Observer watches the activity through the video screen, but it won't be easy to log everything. Then, we develop a web-based application to record the activity easily. This application "Activity Logger" is based on GoogleMaps API and built with simple JavaScript. PHP is also used for file handling routine. Fig. 4 shows a screenshot of this application.

This application is consisting of a simple map and several forms. GoogleMaps API acquires longitude and latitude of the center at once and also simple clock acquire the time. In experiment, operator double-clicks the location of the walker he/she is observing, then the map would redraw map centering the double-clicked point and longitude and latitude are also refreshed. To log the point, clicking "Log" button put the xml text into the form "XML." If necessary, free text memo could be included in the result and "Export" button generates external XML file. So, this application provides simple function but exported XML can be applied in many ways.

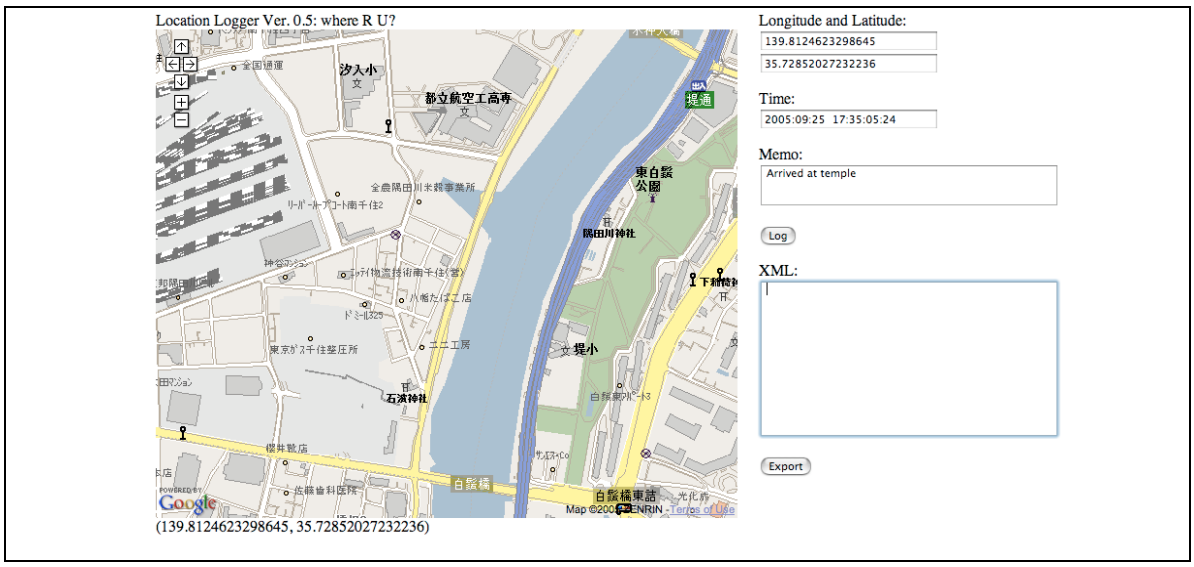

Fig. 4 Screenshot of Activity Logger

2) Information Providing System

With this system we can send e-mail with map image and information of local area. This system is also a combination of web and standalone applications: Map Generator and Image Parser. Map generator is based on GoogleMaps API and KsGMap, which is a free JavaScript library to extend original function of GoogleMaps API. KsGMap is distributed freely at http://www.movies.ne.jp/theatermap/release_script.html. And Image Parser is a standalone application built with Java.

This system is designed not for a specific study area but for general use. Thus information to be provided is stored in the external database. Database composed with point data about study area should be collected and categorized based on the "story" for each walker beforehand. Fig. 5 shows the example of a map with external database. This data is taken from the website of TV program "Ad-machic Tengoku." And it shows the location of famous restraints and grocery and tourist points in Asakusa area.

Fig. 5 Example of Spatial Data

In an experiment, the operator should determine what kind of information according to the “story” and send it to the walker in a real-time. To assist to generate the information, we develop “Map Generator.” Fig. 6 shows a screenshot of Map Generator. This is also simple web application software, but it has powerful factions.

This software imports import XML database just like fig. 5 and overlay multi data on a map, so it can generate different maps up to database. If the data is defined with categories, it is possible to display some specific categories. Also, activity log exported by Activity Logger is also XML format and can be overlaid on the map.

However, map generated by this application is originally not accessible for the mobile devices such as PDA or cellphone. So another application called “Image Parser” convert map into a simple image file, such as PNG, JPEG, GIF format. Converted image would be attached with e-mail, which contains explanation of each point on the image and message from operator, such as “…. is recommended”, or “time is running out”, if necessary.

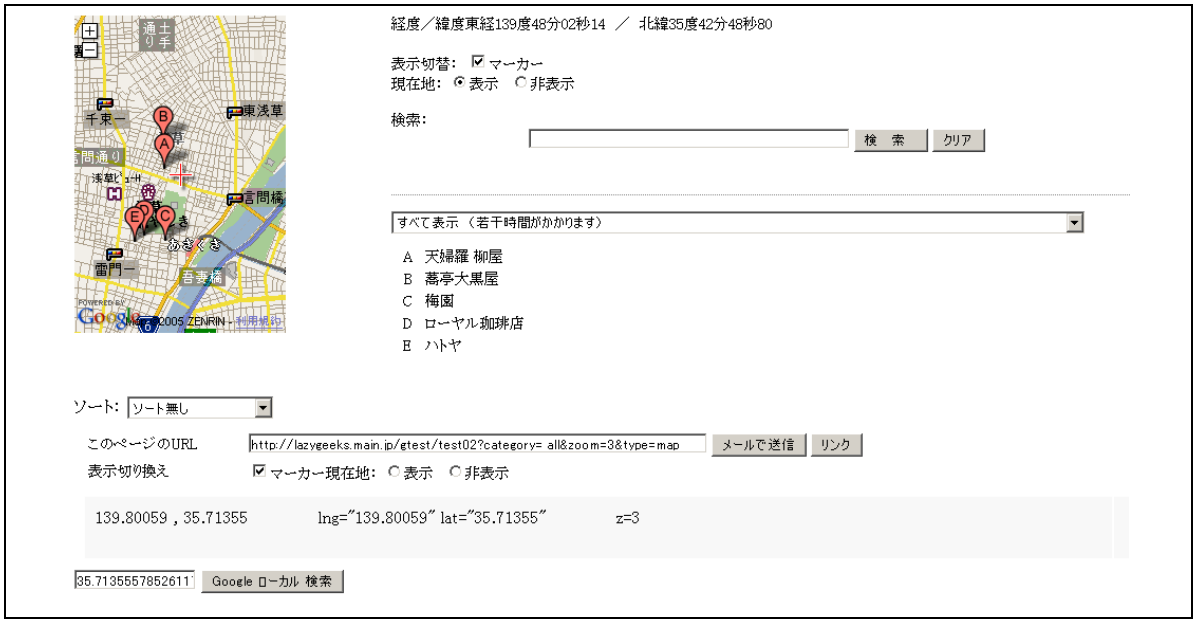

Fig. 6 Screenshot of Map Generator (*Beta Version*)

4. Conclusion and Prospect

In this study, we develop a well-organized walking observation system for the experimental use. It had been very difficult to observe migration walking before especially in urban area. However, using videophone, it came into possible to watch activity of walkers in a real-time. And it is also possible to log the result of the observation as a simple XML file. Moreover, this system includes powerful information providing system, thanks to GoogleMaps API. We could make thousands of maps based on external XML file and deliver the information to the mobile devices. It is strongly expected as a great tool to conduct experiments for behavioral science.

However, there are some difficulties we have to overcome in this system. For example, since this system is just semiautomatic and at least two operators are required, we could observe only one person at the same time. Information database of area and the “story” for walkers is hand-made. Above all, it is impossible to log the real-time emotion and intention through walking. Further development of the observation system and research of behavior itself is inevitable in the future.

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