

Forbidden City Explorer: A Guide System that Gives Priority to Shared Images

Jun Munemori ^{*}, Thai Minh Tri ^{**} and Junko Itou ^{***}

^{*} Faculty of Systems Engineering, Wakayama University

930 Sakaedani, Wakayama 640-8510, Japan, munemori@sys.wakayama-u.ac.jp

^{**} Graduate School of Systems Engineering, Wakayama University, s051066@sys.wakayama-u.ac.jp

^{***} Faculty of Systems Engineering, Wakayama University, itou@sys.wakayama-u.ac.jp

ABSTRACT

There have been developed many guide systems using location information. But most systems have a one-way communication system. We have developed a prototype universal two-way communication guide system, which was named The Forbidden City Explorer. This system has real-time information sharing functions including image data, chatting, and mutual location information. It gives priority to shared images and chats, supporting a friendly user interface and simple operation methods, especially creating shared images to be used by general people. We applied the system twice to the Forbidden City in Beijing at the end of 2005. Users were Chinese. The results of the experiments are as follows: (1) The evaluation of the image data sharing function was timely. (2) With a simple operation, many shared images and chat messages were created and they helped make the users' sightseeing more effective and interesting.

Keywords: Navigation system, GPS, PDA, Wireless LAN, Forbidden City.

1 INTRODUCTION

After years of research, many location aware systems using positioning information have been proposed. GPS receivers have begun to appear in cell phones [1]-[5]. Most of the present systems are one-way guidance systems. These services, however, only offer information around the user's present position. It means that location information systems using wireless communication mainly offer information about one's present location or the information around a destination.

Up to now, we had developed the Beijing Explorer, which is a system for the guidance of the Palace Museum (Forbidden City) in Beijing, China [6]. It was an interactive location aware system, which exchanged a user's positioning information and situation to other users using a PDA (Personal Digital Assistant) with built-in wireless LAN, a Bluetooth communication card and a Bluetooth GPS (Global Positioning System) receiver in real time. Its experiments at the end of 2004 showed that the service using positioning data and shared images, especially photos, are valuable and interesting. However, it is necessary that the system have a friendly user interface and simple

operation methods to be used by general people. Furthermore, there are important problems: how to create shared images easily, coordinate chats and images in some way, and find images that are the topics of chats. Therefore, we have developed the Forbidden City Explorer (the Beijing Explorer version II), which gives priority to shared images and chats. This paper shows the development and application of the Forbidden City Explorer.

2 THE FORBIDDEN CITY EXPLORER

The Forbidden City Explorer is an interactive location aware guidance system using PDAs. Users of the system can get and present positioning data of other users real-time. Each participant brings his (her) own system. The GPS receiver of the system shows their positions. So, they don't need to act as a group. They can go sightseeing individually. They can understand the positions of other users and chat with each other. When approaching any historical site, they can take pictures and share them. So, they can understand the contents of the historical site deeply. The whole system consists of a base station of a wireless LAN and many PDAs as clients.

2.1 Design policy

The following items are the design policies of the Forbidden City Explorer.

- Support a user-friendly interface in easy English [7] and simple operations so that a user can dynamically create and view shared photographs (images) anytime. A primary function of the system is sharing users' individual information about historical sites or anything in the Forbidden City. It helps make users' sightseeing more active and interesting.
- Support users' communication by chat function, sharing shared images, and meeting point location.
- The system informs users automatically when shared images and chat messages come or a user logs in or logs out. Shared images and chats are the most important elements of users' communications [8]. Users must know when shared images and chat arrives so that they can start their communications.
- Support real-time radio communication. The mobile system is always connected to the server in order to

follow the user's frequent location changing and to immediately share images about buildings or anything posted by him/her.

2.2 Structure of the system

Figure 1 shows a client system of The Forbidden City Explorer. It consists of a PDA and a GPS receiver. The whole system of The Forbidden City Explorer consists of a base station of a wireless LAN and many PDAs as clients. The client system uses a wireless LAN for communication with the server. The transmission method is IEEE 802.11b wireless LAN with a speed of 11Mbps. Table 1 shows the components. Figure 2 shows a screen of the client system. We used a map that was available on the market [10]. It shows an area of 640m x 800m. Each dot corresponds to 1m on the map.



Figure 1: A client system.

Table 1: Components of the Forbidden City Explorer

Component	Model
Server	Macintosh iBook OS X, 12V Battery Power with Inverter ALINCO RCO15
Client	SONY CLIE PEG-NX80V (Wireless LAN (PEG-WL100), Bluetooth Communication Card (PEGA-MSB1), Bluetooth GPS Receiver (GU-BT1) Japanese PalmOS 5.0/Chinese PalmOS 5.25 [9]
Wireless LAN Router	BUFFALO AirStationPro WLA-AWCG (2.4GHz Wireless LAN)
Antenna	BUFFALO 2.4Ghz Wireless LAN AirStationPro Long-distance Non-directional Antenna (WLE-HG-NDC)

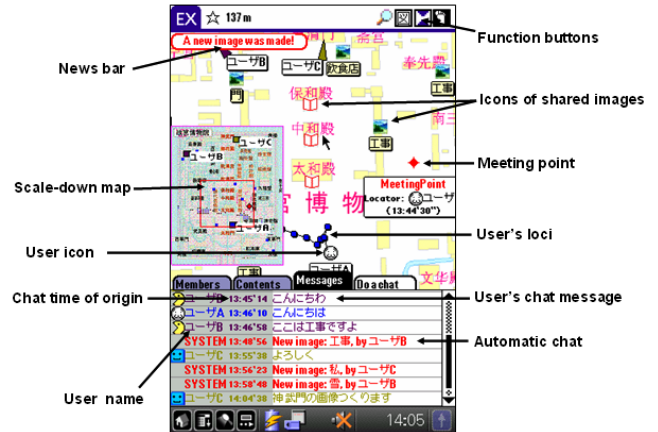


Figure 2: An example of a screen of the client.

2.3 Functions

If the user is in the wireless LAN area (about 200 meters in diameter), the system enables the following functions: The client system shows the positions of the user and others. Each position is shown as a face icon in Fig.2.

- The user can share images and informal data. By touching any place on the screen, he/she can create them and draw on the image data freely. Hereafter, we shall call it SIO (Shared Image Object). Figure 3 shows an example of an SIO.
- The system will inform the user by sound, news bar and automatic chat messages when shared images arrive.
- The user can view shared images by tapping on chat messages that contain keywords of those images or using the search function.
- When the user comes within 15 meters of a building, the image of the building will be displayed.
- The users can do chats in English, Chinese or Japanese. Chat messages are shown at the bottom part of the screen in Fig. 2.
- The user can share the waiting point between participants (meeting point-sharing function). The meeting point is shown as the red star icon in Fig. 2.
- The system shows the loci of the users. The loci are shown as fine lines in Fig. 2.
- The system has a self-assignment function if they can't get GPS data.
- Photos taken by PDA can be viewed on the web later.

The state, chat messages, sharing information, and location information of clients can be managed at the server end. The server controls users' position information, shared images, chat messages or any shared information. It operates receiving data, expansion of data, saving, creating and reading log files, and transferring data to other users.



Figure 3: An example of an SIO.

2.4 Operation procedure

• Logging in

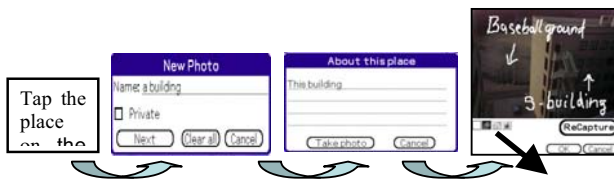
At first, by touching the button at the bottom of the PDA, a user can start the application. After a profile input window appears, he (she) can input his name, favorite map icon, loci's (or chat message's) color in order to login into the system and the connection between his PDA and the server will be established. If the connection is the first time, the server will provide an ID and the communication is as follows:

- Transmitting data (Client to server): user name, ID of the icon, loci's color, last disconnect time.
- Receiving data (Server to Client): user ID provided by the server, other users' information (user's name, user ID, etc.) registered by the server, other users' shared images and chats from the last disconnection, information of the meeting point, the server's present time (used for the synchronization between the server and clients).

The client system will receive GPS signals and automatically the show user's present position on the map for a fixed period of time. The server uses FIFO queue to manage transmitting and receiving data.

• Creating an SIO

By double-tapping any place on the map, a user can create an SIO. Following interactive instructions of displayed windows, he/she inputs the image's name, comment, and starts capturing (Fig. 4). After capturing, he/she can draw many things on the image by using the freehand mode.



Buttons for freehand mode

Figure 4: The operation of creating an SIO.

• Viewing an SIO

There are 4 ways to view an SIO:

- i) Tap the icon of the SIO on the map.
- ii) Tap on chat messages which include the name of the SIO (Fig. 5).
- iii) Display the list of SIOs by tapping the "Images" tab and tap the SIO.
- iv) Use the SEARCH function by tapping the SEARCH button.

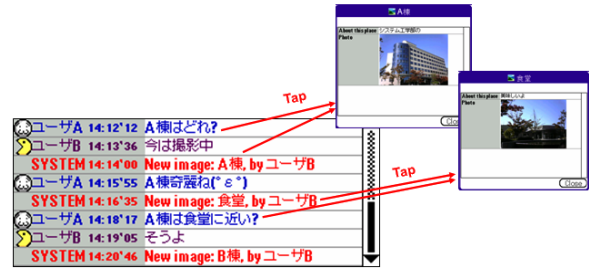


Figure 5: An example of tapping on messages to see an SIO.

• Chat

By tapping the "Messages" tab on the lower part of the PDA, a user can see chat message logs. There are user names, user icons, time of origin, and content of chats in the logs. By tapping the "Do a chat" tab, he/she is able to input a new chat message (Fig.2). Numerous emoticons and set phrases are supported.

3 EXPERIMENTS

Six participants joined in two experiments at the Forbidden City. The experiments were carried out between the Hall of Supreme Harmony (Tai He Dian) and The Gate of Supreme Harmony (Tai He Men) in the winter of 2005. In the 1st experiment, the users were one man and two women. The man was a designer and the women were programmers of the Institute for Digitization of the Palace Museum. It was carried out in the Chinese language. In the 2nd experiment, the users were 3 Chinese speaking Japanese. It was carried out in the Japanese language. The procedure of the experiments was as follows: (1) They go for sightseeing individually. (2) They do chats. (3) They take pictures and input informal data. Then, they share it with each other. (4) They decide on a meeting point on the screen and then they meet at the point.

Each of them took about 40 minutes. After the experiments, we performed questionnaire surveys.

4 RESULTS AND DISCUSSION

4.1 Results

Table 2 shows the number of chat messages, used set phrases used and SIOs taken during the experiments. (): the results of last year's experiments (the Beijing Explorer's experiments).

We analyzed many items from the questionnaire results. We used a Likert scale from 1 to 5. 5-points means very good, and 1-point means very bad. Several things were evaluated: creating and viewing SIOs, chatting, and general impressions. The average evaluations of these are shown in Table 3, Table 4, and Table 5 respectively. (): the results of last year's experiments (the Beijing Explorer's experiments). NA: Not Available.

Table 2: Number of chat messages, set phrases used and SIOs.

	No. of chat messages	No. of set phrases used	No. of SIOs
Chinese experiment	29(17)	5(0)	14(6)
Japanese experiment	36(35)	9(0)	23(9)

Table 3: Questionnaire on creating and viewing SIOs.

Questionnaire items	Evaluation
(1) Was it easy to create SIOs?	5.0 (3.5)
(2) Was the number of an SIO items enough?	4.0 (3.8)
(3) Were you able to switch smoothly to the photograph mode?	4.7 (3.8)
(4) Do you think that the SIO function is effective?	4.0 (4.2)
(5) Did you notice at once when a new SIO was posted?	3.5 (NA)
(6) Was it easy to view an SIO?	4.2 (4.0)
(7) Is the function that the SIO of a place pops up automatically when a user approaches that place helpful?	3.2 (NA)
(8) Was the SIO information enough for you?	3.7 (3.4)
(9) Do you think the search function is necessary or not?	4.7 (NA)
(10) Did use of the search function take a lot of time?	2.8 (NA)
(11) Were you able to find your desired SIO easily?	4.0 (NA)

The following are the users' descriptive opinions of creating and viewing an SIO:

- It is easy to create an SIO. However, the resolutions of images were not excellent.
- I think that sharing images is good. The speed of uploading was slow.
- The range of photographing is small.
- The operation is good. It is easy to use.
- I want a zoom in/out function when viewing an SIO.
- The system is very convenient.

The following are the users' descriptive opinions of chatting:

- The operation of chat was easy, though the characters were small.

Table 4: Questionnaire on chatting.

Questionnaire items	Evaluation
(1) Was it easy to input chat messages?	4.7 (3.5)
(2) Did you notice at once when a new chat messages was posted?	4.7 (2.3)
(3) Is the function that the system alerts users by chat when a new SIO is posted useful?	5.0 (NA)
(4) Did you communicate well by chatting?	4.2 (3.2)
(5) Were the emoticons and set phrases supporting chat useful?	4.0 (NA)
(6) Is the function that you can view an SIO after tapping chat messages containing its keywords useful?	5.0 (NA)

Table 5: Questionnaire on general impressions.

Questionnaire items	Evaluation
(1) Do you think that the system takes up much space?	3.5 (4.0)
(2) Do you think that the system is convenient?	3.9 (3.7)
(3) Do you think that the service of information sharing using PDA is effective?	3.8 (3.8)
(4) Was the experiment interesting?	4.5 (4.8)

- The chat function was substantial and easy to use.
 - The chat was interesting. Speed of posting messages was quick.
 - I want sounds of arriving chat messages to be longer.
 - I want to be able to determine someone to send messages.
- Finally, the followings are the users' general impressions:
- The GPS information seemed not to be exact. The system is big and not easy to hold.

- In my ideal system the size would be small, the speed of receiving and transmitting would be high with exact position information and a wide usability range.
- This version is better than last year's version. Sharing SIOs was especially good. Drawing freely on the SIO was convenient. However, wave range was narrow and GPS information was not exact.

4.2 Discussion

- Concerning the number of chat messages, set phrases used and SIOs

The time of experiment and users are almost the same as last year but SIOs increased twice (Mean value: changed from 7.5 to 18.5 images per experiment). The reason may be that the operation was improved to become easier so that the users were able to create more.

The total number of chat messages rather increased (Mean value: changed from 26 to 32.5 messages per experiment) since numerous set phrases were used (changed from 0 to 7 sentences per experiment). The large amount of SIOs means that the users were enthusiastic about creating an SIO.

- Creating and view of an SIO

Since the number of tapping for creating an SIO was changed from 11 times (in the Beijing Explorer) to 5 times (in Forbidden City Explorer), that operation was evaluated highly (5.0, Table 3). Most of the SIOs created are images of buildings, scenes or people. The users were able to switch smoothly from the window of inputting text to the photograph mode (4.7, Table 3).

The availability of sharing SIOs is evaluated highly (4.0, Table 3), in fact the same as the Beijing Explorer (4.2). The reason may be that sharing people's points of view was interesting. A user was able to take a photograph, creating his/her favorite SIO, then post and chat with others about that SIOs. Users could get useful information created from various points of view; and much new information could be added one after another. Those activities make users' sightseeing more interesting and effective. According to the chat messages and SIOs, we can see that after a user had posted his/her SIO, other users began to post more and more continuously.

The users did not notice a new SIO very easily (3.5, Table 3). The reason may be as follows: i) The large amount of SIOs shows that the users were enthusiastic about creating SIOs, unable to see system's notices of SIOs easily. ii) Although there were sounds of posted SIOs, the users misunderstood since those sounds looked like sounds of chat messages.

The users thought that the search function was necessary (4.7, Table 3), though they used other methods (for example, tapping chat messages which contain keywords of SIOs) to find out the SIO they wanted easily instead of using this search function. Moreover, the search function takes more time than other methods since a user must input the keyword in order to search. They considered that that function is effective when the amount of SIOs is huge.

The main problem is that the range of taking a photograph is small and the resolution of SIOs is not good. Furthermore, a zoom in/out function for SIOs is necessary.

- Chat

A chat message is easier to input (4.7, Table 4). Since the system sounds once when there is a new chat message coming, the users were able to realize new messages (4.7, Table 4). Many of the chat messages were used to explain users' feelings, while many of Beijing Explorer's chat messages in the experiments in 2004 were used to inform about a new SIO posted. The reason may come from the fact that the system informed the users by displaying the automatic chat message "New image xxx, by yyy" and sounding, so that they did not need to inform other users by chat.

The function that a user can view an SIO by tapping any chat message which contains its keywords was very effective (5.0, Table 4). The users were able to communicate to each other by chat (4.2, Table 4)

The future work of the chat function is to make the arrival sound of chat longer and add the function of creating private messages.

- The general impression

The users felt the experiments were interesting (4.5, Table 5). However, they also expect a smaller system, a wide range of wave and exact GPS information.

- Comparison of the Forbidden City Explorer with other systems

GUIDE [2] is a guide system based on a notebook using wireless LAN and Internet browser to show a guide. It displays proposed spots of sightseeing to users. The Parks PDA [3] uses IrDA to show position information; users can take photographs at any place and be guided by voice and image, but are unable to share information. The guide system DinosaurFACTory [4] display users' position but information can not be shared among users; a user can take a photograph in place and view it on the web later. CYSMN [5] is a system that is the nearest to the Forbidden City Explorer. However, the communication in CYSMN is between runners' and online players'. Moreover, images of

CYSMN are used to make high realistic sensation more than communication of users. The summary comparison of the Forbidden City Explorer with other systems is shown in Table 6.

Table 6: Comparison between systems.

System	The Forbidden City Explorer	GUIDE	The Parks PDA	Dinosaur FACTory	CYSMN (Reference)
Transmission method	Wireless LAN Bluetooth	Wireless LAN	IrDA	Bluetooth	Wireless LAN
Transmission channel	Bidirectional	Bidirectional	Unidirectional	Unidirectional	Bidirectional
Position display	○	△	○	○	○
Chat function	○	×	×	×	○
Information sharing	○	○	×	×	○
Guide in voice	×	×	○	○	○
View of photograph	○	×	○	○	○

5 CONCLUSION

We have developed “The Forbidden City Explorer”, a prototype system that provides sharing images, chat messages posted by users and performed practical experiments in the Forbidden City, Beijing, China. The experiments were interesting. The evaluation of sharing SIOs is high because of the fact that sharing people’s points of view is interesting. The simple operation of creating an SIO and chatting in Forbidden City Explorer helped make the users’ sightseeing more effective with more shared images and chat messages. We believe that next-generation mobile services for advanced ubiquitous computing environments need to be based on sharing information.

According to the experiments, the future work is to make the system more easy-handling, enlarge the range of practicable area by increasing wireless LAN stations and know how to respond when many shared images are created. We are planning to repeat improvements, experiments, and evaluations further.

ACKNOWLEDGEMENT

We would like to express our appreciation to everybody in the Institute for Digitization of the Palace Museum for their assistance and Mr. Daisuke Kamisaka, who developed the original Beijing Explorer.

REFERENCES

- [1] S.Long, R. Kooper, G.D.Abowl, and C.G. Atkeson, Rapid Prototyping of Mobile Context-Aware Applications, The Cyberguide Case Study, *Proc. of MOBICOM '96*, pp.97-107 (1996).
- [2] K. Cheverest, N. Davies, K. Mitchell, A. Friday, C. Efstratiou, Developing a Context-aware Electronic Tourist Guide: Some Issues and Experiences, *Proc. of CHI 2000*, pp.17-24 (2000).
- [3] Y. Ohshima, J. Maloney and A. Ogden, The Parks PDA: A Handheld Device for Theme Park Guests in Squeak, *Proc. OOPSLA '03*, pp.370-380 (2003).
- [4] Dinosaur FACTory, FACT Scope <http://dinosaurfactory.jp/pda.htm>
- [5] M. Fintham, R. Anastasi, S. Benford, T. Hemmings, A. Crabtree, C. Greenhalgh, T. Rodden, N. Tandavanitj, M. Adams, and J. Row-Farr, Where On-Line Meets On-The-Streets: Experiences With Mobile Mixed Reality Games, *Proc. of CHI 2003*, pp.569-576 (2003).
- [6] J. Munemori, D. Kamisaka, T. Yoshino, and M. Chiba, The Beijing Explorer: Two way Location Aware Guidance System, *Proc. of KES 2004*, pp.905-911 (2004).
- [7] http://simple.wikipedia.org/wiki/Basic_English
- [8] T. Kindberg, M. Spasojevic, R. Fleck, A. Sellen, I Saw This Thought of You: Some Social Uses of Camera Phones, *Proc. CHI 2005*, pp.1545-1548 (2005).
- [9] Waterworld :<http://www.waterworld.com.hk>
- [10] Sinomaps :<http://www.sinomaps.com>