2014 Sixth International Conference on Intelligent Human-Machine Systems and Cybernetics

Design and Evaluation of Intelligent Tourist Guide System Based on Mobile Devices

Yaohua Yu
School of Electronics and Information Engineering
Ningbo University of Technology
Ningbo, China
e-mail: yuyaohua@dlmu.edu.cn

***Abstract*—This paper presents the design and evaluation of an intelligent tourist guide system that runs on Android tablets with GPS feature. The main steps of system design and implement are described in detail. The results of a follow-up user study show that the intelligent tourist guide system is very helpful for tourists, particularly enhancing self-guided tours and improving tourists' experience in their touring.**

Keywords- Tourist Guide System, Intelligent Guide System, Mobile Terminal, GPS

I. INTRODUCTION

The amount of applications of information technology in tourism is increasing rapidly in digital era. The reason is that traditional print guides cannot meet the requirements from tourists and sight spots. On one hand, tourists need convenient and intelligent services that print guides cannot provide. On the other hand, sight spots want to provide comprehensive services and maintain the quality of their services by reducing instability caused by human factors. Compared with print guides, electronic guides can make it easier for tourists to be familiar with sight spots. As a result, more tourists will be attracted to those sight spots that they know well. Furthermore, electronic guides can serve as an alternative for tourist guides, especially during the tourist season when the demands for tourist guides are high.

In recent years, the rapid development and mutual penetration of computing and communications promote the development of information technology and information devices. New technologies and devices provide solid ground for developing intelligent tourist guide systems. Some researchers have been investigating location-based tourist applications based on mobile devices, such as PDAs and cell phones. Integrated with Global Positioning System (GPS), these hand-held devices can provide users constantly updated information about their locations [1, 2, 3].

Now there are some context-aware services based research and applications. The applications combine context-aware with the tourism industry, whereas most of the research focuses on the mechanism of tourism guide service recommendation for the application and development of tour guide system [4]. For example, Rakotonirainy explores tour experience in museums based on the context information of users' interest and knowledge level [4, 5]. Gulliver exams the context tour guide system in groups from the standpoint of usefulness, and finds that the context tour guide system is faster and more efficient to complete assigned tasks and gets better user satisfaction than general tour guide system [4, 6]. In addition, Tan Peiqiang et al. propose a context-aware system service model [7].

II. OVERVIEW OF A TOURIST GUIDE SYSTEM

An intelligent tourist guide system should provide enriched tour experiences for tourists. When tourists approach a sight spot, GPS on their mobile devices should automatically receive location information about this sight spot. Details about the spot sight should be displayed in text on uses' mobile devices, as well as images, audios, videos, and animations. The introduction will help tourists to gain better understanding of the background information of this sight spot. In other words, a sight spot with such information available on tourists' mobile devices will be more attractive.

The goal of this paper is to develop an intelligent context-aware self guided system as a context aware real world application, which provides some intelligent and personalized guide services based on implicit awareness of context, such as location. As such, a tablet based location-aware tourist guide system for some Chinese sight spots is developed. This system will guide tourists to sight spots by providing their current location and details about the sight spots, including names and facilities nearby. Multimedia are embedded in the system to provide extra features for enhancing self-guided tour process.

The intelligent tourist guide system chooses Samsung T111 GALAXY Tab3 Lite (Figure 1) as the hardware. Android runs on this Samsung tablet, which has a GPS receiver and uses ARM-based mobile terminal system. The intelligent guide system is developed as a customized application. It consists of two modules, namely GIS functionality service and GPS functionality. The GIS functionality service module has the following features: reading data, displaying tour map, labeling points of interest, and providing routes. The GPS function module has the following features: sending positioning requests, receiving positioning data results, completing self-positioning, and recording routes. This application enables tourists to participate in a self-guided tour of a specific area by displaying detailed information about specific features linked

978-1-4799-4955-7/14 $31.00 © 2014 IEEE
DOI 10.1109/IHMSC.2014.79

to their current positions. This application can provide multimedia tour guides with a simple and easy user interface. Because the intelligent guide system is developed for running on wireless networks, the tablet can communicate with the servers of sight spots in real time. For sight spots, this application can help them to manage their facilities and guide tourists.

Figure 1. Samsung T111 GALAXY Tab3 Lite

III. System Design

Intelligent path planning, route algorithm, and user interface are three important elements in the system design. A detailed description of these elements is provided as follows:

A. *Intelligent Path Planning*

The most important feature of intelligent guide system is to perform intelligent tour route planning. Tourists' needs require intelligent guide systems to automatically design and generate tour routes. A well-developed intelligent guide system should lead ways for tourists. Completion of intelligent path planning depends on tourists' choices. Therefore, the process of intelligent path planning greatly reflects the autonomous behavior of tourism process. The prerequisite for intelligent path planning is to select the sight spot that tourists are interested. Before searching a path, tourists can select some sight spots in a specific touring area based on their interests. And then they set this spot as their destinations. After all destinations are confirmed, the system starts to automatically calculate from the first spot, displays the shortest path between two adjacent destinations that are pair-wise connected, and ultimately generates a schematic diagram of the overall planning of tourist routes.

B. *Best Route Algorithm*

Dijkstra algorithm is applied according to the weights of the edges of a connected graph generated by intelligent path planning. First, a multi-dimensional matrix, in which the dimensions are the amounts of interests, is constructed. Those adjacent sight spots that have connecting paths are assigned performance values to the path in the matrix. Those sight spots that are not adjacent are assigned with a value of ∞ . If the index of the initial points and the end points are set, then the matrix transforms to a new status, in which the initial point is the object. The initial point is placed as the initial element of matrix. After Dijkstra algorithm is applied to calculate the shortest path from the initial point to the rest points, and the touring route, the shortest path and all touring routes are outputted.

C. *User Interface*

The user interface of the intelligent guide system has three modes: Mode A, Mode C and Mode E. Designed based on tourists' age, these modes provide different services. For example, the interface for elderly tourists has bigger font sizes and higher volume of audio.

1) Mode C (children tourists)

The user interface on Mode C is designed to children tourists. It guides children tourists with information in one of three types of voices: friend, teacher and guide. The voice is set to the default 'Friend' voice. Children tourists can also take a quiz about the scenic shot to improve the comprehension if they want.

2) Mode A (adult tourists)

The user interface on Mode A is designed to adult tourists. The voice is set to the default 'Guide' voice.

3) Mode E (elderly tourists)

The user interface on Mode C is designed to elderly tourists. The voice is set to the default 'Teacher' voice. Information is also displayed in the bigger font size for elderly tourists who have difficulty in identifying small letters. Voice, audios and videos are also present in the bigger volume.

IV. Implement

The system implement stage deals with some functions that are critical for the intelligent tourist guide system. It includes the following steps: loading the scenic maps, positioning, setting up intelligent guide function for sight spots, and building multimedia subsystem.

A. *Loading the Scenic Maps*

The scenic maps use the digital maps provided by Baidu Company. The offline maps of sight spots are downloaded to the mobile devices so that they can be accessed when the system needs them.

B. *Positioning*

Based on the development kit Positioning SDK from Baidu, the positioning function of this intelligent tourist guide system requires GPS module. The Positioning SDK supports devices that are installed operation system Android 1.5 or above. The positioning function calls BaiduMapAPI to get the adverse geographical coding function. The positioning function gets tourists' the current locations by GPS or network hybrid positioning, to. The adverse geographical coding function analyzes sight spots' locations and conducts the inverse conversion to obtain the information of their latitude and longitude. A tourist area is divided into some small blocks to calculate tourists' current positions efficiently according to the information provided by GPS. The small blocks are numbered. One small block covers a small region of latitude and longitude. When a tourist enters a block, the program first identifies the block number based on latitude and longitude information provided by GPS. Base on the block number, the system displays the tourist's current position information about sight spots in the block on a map.

C. Intelligent Guide Function for Sight Spots

The intelligent guide function is implemented on the basis of tourists' interest and self-positioning points. Listeners are set up in the intelligent tourist guide system to store tourists' points. The method in the listeners can be used to set up specific information. The listeners consist of four parameters, namely the position to be stored about the latitude, longitude, distance, and coordinate system type. These listeners are bound up with tourists' location methods. When a tourist enters the geographic range of any listener, the listener is activated. After that, the listener reads its name from the list of interest points and passes the name to a dialog procedure. At the same time the mobile device starts shaking and reminds the tourist. The screen displays the name of tour point arrived. Finally, the multimedia subsystem presents the information of a sight spot to the user.

D. Multimedia subsystem

When the intelligent tourist guide system is running, positioning module and human-computer interface are initialized. When tourists enter a tourist area, positioning module automatically receives and processes their location information to get an ID number of the sight spot. Then the system checks a pre-set corresponding list to find out another ID number that is corresponding to the address in a database which stores multimedia information of sight spots. The storage module reads the corresponding data from the database and decodes them. At last, the multimedia information decoded is played automatically if tourists do not operate the system through the human-computer interface. If tourists choose to access the intelligent tourist guide system through the human-computer interface, they have the control to play, forward, backward, pause the multimedia contents.

V. EVALUATION

It is important to obtain tourists' opinions and preferences about the intelligent tourist guide system since a system's usability depends on not only its performance (e.g., time to complete tasks), but also tourists' subjective impressions and user experiences in the touring process.

A user study consisting of thirty users is conducted to evaluate the intelligent tourist guide system. We select five spots in Ningbo University of Technology as testing spots. The five spots include the stadium, the Administrating Building, the school of human studies, the parking and the first dining hall. The Map of spots in user study is showed in Figure 2. Users need to visit the five spots by using the system. After these selected users finish their touring, they are asked to complete a questionnaire that adopts the System Usability Scale (SUS) applied in [8, 9] for system usability. Originally created by John Brooke (DEC) in 1986, SUS is one of the best known standardized usability rating scales. It focuses on providing lightweight (10 questions) subjective feedback from participants. SUS is open for public to conduct usability assessment, and has been used for a variety of research projects and industrial evaluations [8]. Because it is well known and adopted widely, a large number of reviews and evaluations about its strengths and weaknesses are available. SUS has been proved a valuable, robust, and reliable evaluation tool. In addition, it correlates well with other subjective usability measures (e.g., the general usability subscale of the SUMI inventory developed in the MUSiC project (Kirakowski, personal communication)).

User study participants fill SUS to evaluate the intelligent tourist guide system after they complete their tours. Debriefing is not available and discussion is not allowed because the effect could be impacted. Participants are asked to record their immediate response to each item, rather than thinking about them for a long time. All items should be checked [8]. If a participant feels that he cannot provide his feedback to a particular item, he should mark the center point of the scale.

Figure 2. Map of spots in user study

SUS questionnaire is different from other questionnaires and it has a special calculation method. In this user study, the scores of SUS questionnaires from the thirty participants are calculated. The average score is 86.3% and the median is 87.6%. The confidence interval (a = 0.05) is (82.8%, 89.6%). Generally speaking, results are relatively poor if the average of SUS scores is less than 60%. If the average of SUS scores is greater than 80%, the results are very good [10]. Thus the overall usability and satisfaction level of the intelligent tourist guide system is relatively high. The minimum value of confidence interval (82.8%) is more than 80%.

An in-depth interview is conducted on each participant in this user study as well. Participants are allowed to provide their comments anytime during the process. The results of the interview and SUS scores in the user study, the acceptance level of the intelligent tourist guide system is high. Participants are happy to use the intelligent tourist guide system. They think the system can improve their experiences in the touring process.

VI. CONCLUSION

This paper presents the design and evaluation of an intelligent tourist guide system that runs on Android tablets with GPS feature. The details of the main steps of design and implement the system are described. A follow-up user study shows that the overall usability, satisfaction level, and acceptance level of the intelligent tourist guide system is relatively high. The results of the user study also show that the intelligent tourist guide system is very helpful for the tourists and that the system is an effective way for tourists to enhance self-guided tours and to improve their experiences in their touring.

ACKNOWLEDGMENT

This paper is supported by Ningbo Nature Science Foundation Funding (No.2012A610020) and Zhejiang Province Department of Education Foundation Funding (No.Y201225208).

REFERENCES

[1] Cheverst, K., Davies, N., Mitchell, K. and Friday, A. “Developing a Context-aware Electronic Tourist Guide: Some Issues and Experience”, In Proc. Of the 6th Int. Conf. on Mobile Computing and Networking, ACM, pp. 20-31, 2000.

[2] Abowd, G.D., Atkeson, C. G., Hong, J., Long, S., Kooper, R. and Pinkerton, M. “Cyberguide: A Mobile Context-Aware Tour Guide”, ACM Wireless Networks, 3: 421-433, 1997.

[3] Simcock,, T., Hillenbrand, S. and Thomas, B. “Developing a Location Based Tourist Guide Application”, The Australasian Information Security Workshop, 2003.

[4] Bei Wang, Dongsheng Liu, and Szemin Wong, “A Context Information Ontology Hierarchy Model for Tourism-oriented Mobile E-commerce”, JOURNAL OF SOFTWARE, 7(8):1751-1758.

[5] Rakotonirainy, Andry and Lehman, Nicholas, “Augmenting a Museum Visitor's Tour with a Context Aware Framework”, Proceedings of 1st International Workshop on Ubiquitous Computing, pp.104 -112, Porto, Portugal. 2004.

[6] Gulliver S R, Ghinea G, Patel M, et al. “A Context-Aware Tour Guide: User Implications”, Proceedings of International Conference on Convergence Information Technology: November 21-23, Gyeongju, Korea, 2007.

[7] Peiqiang Tan, “The Study of Decision reasoning mechanism in context-aware service”, Fudan University, 2007.

[8] J. Brooke. SUS: a quick and dirty usability scale. In P. W. Jordan, B. Thomas, B. A. Weerdmeester, and A. L. McClelland, editors, Usability Evaluation in Industry. Taylor and Francis, London, 1996.

[9] Saura, Jeff, Measuring Usability With The System Usability Scale (SUS), Measuring Usability, 2011 http://www.measuringusability.com/sus.php

[10] TullisT，Albert W. “Measuring the User Experience: Collecting，Analyzing， and Presenting Usability Metrics”. Morgan Kaufmann，2008.