Research and Development of Application of Mobile Barcode to Mobile Sightseeing Guide on Mobile Phone

CHIH MING CHEN HongTai Information Technology CO.,Ltd. 11F.-5, No.248, Sec. 2, Yonghua Rd., Anping Dist., Tainan City 708 TAIWAN jrming@htit.com.tw http://www.htit.com.tw/index.aspx

TINGSHENG WENG Department of Management Information Systems National Chiayi University 580 Sinmin Rd., Chiayi City 600 TAIWAN politeweng@mail.ncyu.edu.tw http://www.mis.ncyu.edu.tw/english/Tea_weng.php

Abstract: - With rapid developments in the combined technologies of tourism and mobile communications, Internet access is readily available, anytime and anywhere. The mobile data service industry has gradually replaced voice services, and become the target market of mobile telecommunication system operators. In the mobile commerce field, the characteristics of Location Based Services (LBS) vary widely according to the users' current environment, service demands, and variations in positions. Therefore, how to know the current position of a user and respond to requests to provide different services is an important challenge of the future. This study proposes corresponding solutions to overcome the above problems. Using the tour guide map as an example, to complete a "mobile tourist guide map information service", a user can employ the camera function of a mobile phone to sense and capture a mobile barcode, and then connect it to the backend database of the server, through a wireless network for e-map information and voice guides, and make on-line inquiries regarding e-maps. The most convenient route of nearby communications can be obtained through the tourist guide map, allowing users an audio guide service to find their way.

Key-Words: -Mobile barcode, wireless network, LBS, mobile tourist guide map, GIS

1 Introduction

Many countries have promoted tourism and leisure as key industries. The Taiwanese government is promoting the Doubling Tourist Arrivals Plan, and tourism is developing rapidly in Taiwan. Domestic travellers are giving more attention to leisure and tourism, however, it is difficult for most travellers to find local roads and scenic spots. In order to provide convenience for tourists, a highly manoeuvrable electronic product that incorporates e-maps is needed to provide tour guide services. At present, known navigational products are applied to automobile navigation. In Taiwan, automobile navigation systems are practical and universal, and together with improvements to the accuracy of navigation and the satellite GPS, this service could be easily realized. The cities of Taiwan have many high-rise buildings, which may affect satellite signal reception, however, this problem could be improved with further researches [1].

Current navigation products focus on the "road", users are provided with the information of "current location and how to reach a destination". However, the navigation targets of leisure and tourism are "roads" as well as "scenic spots", providing information for users, and focusing on information gathering of specific areas and introduction of scenic spots. Due to the differences in development orientation, if applying the automobile navigation systems to tourism, it would lack information of accommodations. communications. foods. Thus. and current navigation products cannot meet the demands.

With the rapid development of mobile communications, surfing the Internet is available at anytime and anywhere. Mobile devices have added channels for communicating with remote servers, and the mobile data service industry has gradually replaced audio only services, to become the target market of mobile telecommunication system operators. In the mobile commerce domain, the application of Location Based Services (LBS) has become a desirable technology in recent years [2]. Hong & Yang [3] provided real-time information to users by obtaining their position information and using relevant position information services. The characteristics of positioning services may vary with the services provided according to users' current environment, requests, and variations in position. Therefore, this study aimed to improve the disadvantages of the existing automobile navigation systems, and develop a regional tourist service guide. Portable electronic products, such as a Personal Digital Assistant (PDA) or 3G on-line function with wireless network technology, could be used to display local tourist information, which tourists can access through a local geographic positioning system, with a scenic spot guide, and learn about local specialties, folk customs, and current activities. The tours could be both in-depth and educational.

2 Purposes

With the convenience of hand-held devices, the advantages of multimedia, easy access to a wireless network, and a Quick Response Code (QR Code) for addressing functions of e-maps, scenic spot locations, peripheral geographic positioning, and scenic area information, which could be displayed immediately, and construct a mobile tour guide platform. Generally, the development target of automobile navigation systems are roads, however, tourism focuses on local information. Thus, the mobile tour guide platform in this study takes a local scenic area spot guide as its development target to provide local real-time information during a tour, as well as assistance and reference for the tour.

3 Literature Review

3.1 QR Code

At present, the common barcode for goods is a linear barcode, and contains only tens of letters. The 2D barcode introduced by the U.S. in 1993, as shown in Fig.1, indicates information in a two-dimensional mode [4][5]. It is similar to the linear barcode. It can store approximately 1000 English characters and 500 Chinese characters. Therefore, it could be used for storing forms, text data, and video data. The data of the entire form is compressed in a barcode, which a receiver can access with a special

scanner to input form data to computer. It has good anti-wearing ability, with no viruses, degaussing, damages, or under-capacity. The 2D barcode has many specifications, including PDF417, Data Matrix, RSS, and QR Code, which are widely used in Japan, and Magi code, which is used in Korea[6]. The Industrial Development Bureau of the Ministry of Economic Affairs of Taiwan and the Open Mobile Internet Alliance have established the Mobile Barcode portal site (www.mobicode.org.tw) to promote mobile barcodes and information exchanges, which provide relevant information about the market, technology, and patents of mobile barcodes. It is an interactive communication platform of technology, patented for domestic and foreign mobile barcode organizers. Taiwan is cooperating with Singapore, and other Asian countries, by promoting public departments to use mobile barcodes, such as in the Council of Agriculture, Mass Rapid Transit, and the Tourism Bureau. It is expected that these public departments can promote the application of mobile barcodes, not only for public adoption, but to create business opportunities for mobile barcodes[7].



Fig.1 Types of 2D barcodes [8]

QR Code is a type of 2D barcode invented by the Denso-Wave Corp. (Japan) in 1994 [9]. The inventor hoped that the QR code could enable its contents to be quickly decoded, thus its name, the mobile barcode or quick response code.

QR code is square shaped, three of the four corners are printed with small square patterns, similar to the Chinese character "". These three patterns are provided for decoding software locations, users do not need to accurately align the system, and data can be read correctly when scanning at any angle (Fig.2).

Storage capacity of QRCode:

- A. Digit: 7,089 characters maximum .
- B. Letter: 4,296 characters maximum .
- C. Binary number (8bit): 2,953 bits maximum .
- D. Japanese Kanji/katakana: 1,817 characters maximum (Shift_JIS).
- E. Chinese character: 984 characters maximum (UTF-8).
- F. Chinese character: 1,800 characters maximum (BIG 5).



Fig.2 QR Code resolution (Source: by author on QuickMark website[10])

Users can exchange emails, websites, or information (image or text) into the 2D barcode, and use the information on different printed media. When consumers are interested in information, they only need to take a photo of the 2D barcode using a 3G camera phone with scanning, to download the information through 3G. In Japan, posters, shop information, webpages passports and visas, and travel brochures of the Japan Railway Bureau have QR Codes. Users only need to photograph the barcode with their mobile phones, and the software in the phone can decode the barcode (Fig.3) to provide direct relevant information, such as websites, text data, or pictures. Thus, the input time is greatly shortened, and picture information can be input directly to mobile phones[12].

QR Code can also be applied to mobile commerce. For example, customers only need to photograph the QR Code beside a catalogue picture with their mobile phones, and send the information to the stores, on the 2D barcode platform, through a wireless network. After verification, the purchase process is complete and payment details are added to the telecommunication bill, and the products are sent to customers through the logistics system (Fig.4). On the contrary, when purchasing tickets online, a QR Code is sent to their mobile phones in a text message, the customers only needs to show the QR Code at the gate for scanning [8].

The applications of 2D barcodes contain digital data downloads, personal identification, and business trade. The mobile barcode has a feasible business mechanism, as well as great potential. Especially as relevant information and communication hardware are maturing, and the information service trend can initiate users' demands [13]. Kato and Tan [14] applied 2D barcodes to data transmission of mobile phones. Schmidmayr et al. [15] applied QR Codes on printed media to transmit updated information or advertisements to subscribers. Ebner[16] described how a QR Code is applied to enterprises, such as applications of office PC to mobile commerce.



Fig.3 Information decoding services[11]



Fig.4 Application of QR Code to consumption [17]

3.2 Business application of QR Code

Examples of mobile barcodes applied to mobile commerce, at present:

- Automatic text transmission can convert business card data into a 2D barcode, and print on a card. By using the camera to photograph the card, the data can be transferred to the phone book of the mobile phone [18].
- (2)Digital content downloads contain catalogs, tickets, and other information that customers can easily access and carry with them. In Marunouchi, Tokyo, Japan, 2D barcodes are attached to trees, when users point a camera to the barcode and scan it, they can gain the introduction information of that tree, including surrounding buildings and restaurants [17].
- (3)Quick links of websites to user manuals, specifications, newspapers, and magazines are attached mobile barcodes. The barcodes store websites that can be quickly linked to webpages after decoding by mobile phone. Business transactions can be linked to e-commerce websites through mobile barcodes, after payment is complete, the system will return a mobile barcode to identify the transaction. It has been applied to purchasing tickets and vending machines [19].

In Taiwan, the Open Mobile Internet Alliance, the Industry Development Bureau, and relevant manufacturers have jointly promoted the mobile barcode in 2006, and main telecommunication service providers in Taiwan began to promote relevant business activities [13]. In addition, the Industry Development Bureau and information system manufacturers, such as Acer, Dopod, and BenQ, jointly promoted the 2D Barcode Demonstration Application System Plan, and linked with a wireless broadband network demonstrating application plans of the Industry Development Bureau. In addition, it linked with the exhibition guide of the National Museum of History, business information of nine counties and cities, such as Hsinchu, Miaoli, Penghu, etc., as well as shopping websites for promotions [20].

According to the report of the Science & Technology Policy Research and Information Center, in 2006, the QR Code is likely to lead to another trend of changing mobile phones because mobile phones for QR Code requires a camera of at least 0.3 mega pixel. Current mobile phones without built-in digital cameras are soon to be obsolete, and additional decoding software is required for the identification of QR Codes. The demand for feature phones and smart phones will increase with this trend. The utilization of a wireless network is expected to be increased, as QR Code requires transmission through a wireless network, thus, 3G or 3.5G networks will be further promoted.

The application of QR Codes allows convenient information circulation, texts, and pictures, which can be quickly transferred to users through QR Code. Therefore, the growing popularity of QR Codes may replace business by telephone and shopping by mail in the future. Furthermore, the range influenced by QR Code is not limited to only information and communication industries, but could establish the money circulation mechanisms that drive commodity transactions and goods transportation operations.

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Pictures	Capacities	Characteristics	Applications	Specifications
PDF417	Digits:2710 English letters: 1850 Special characters (Chinese): 1108	Stack 2D barcode has strong restoration force to smudge and scar, vertical and horizontal directions of symbols can be changed, the barcode is read by laser and CCD readers.	Bill of goods, cargo identification forms, guaranteed ID CARD with massive data capabilities.	ISO/IEC15438
DataMatrix	Digits:3116 English letters: 2335 Special characters (Chinese): 1556	Records high density information, rich text information, as well as tiny symbols.	Small volume labels, electronic products; semiconductors.	ISO/IEC16022
QRCode	Digit:7089 English letters: 4296 Special characters (Chinese)2953	Reading speed is faster than embedded symbols, high information density, large capacity for text content.	Small volume labels, goods bills, goods labels, standards for associations of automobile manufacturers.	ISO/IEC 18004
MaxiCode	Digits:138 English letters: 93	Reading speed is faster than embedded symbols and fixed symbol size.	Classification labels, standard barcode in transportation circles.	ISO/IEC16023
AztecCode	Digits:3832 English letters: 3067 Special characters: 1914	Reading speed is faster than embedded symbols, high information density, clearing space still area without quiet zone.	Small labels	ISS1997
Magicode	Digits:3832 English letters: 3067 Special characters: 1914	Mobile barcode originated from Korea for mobile camera phones, fast reading speed.	Can link to websites, dial, design personal websites, and change Magicode to different colors, fast identification, large capacity for information	

Table 1 Types, applications and specifications of all mobile barcodes [21]

As mentioned above, business mechanisms of mobile barcodes have great potential with the maturing technology of computer communication hardware, and more application services will increase user demand, and promote the development and reformation of computers, communications, currency circulation, and material circulation providers. QR Codes will lead the trend of communication development in Taiwan.

4 Research Method

4.1 Application mode of QR Codes (mobile barcodes)

This study constructed a mobile guide map system with QR Codes, using mobile barcode technology to provide automatic map guide services and automatic guide service of scenic locations. The operational mode uses PDA, Wireless, QR Code, and some backend equipment and program applications (e.g. Server, base station, database, etc.), and is expected to provide rapid, high quality automatic audio mobile guides, pictures, and text guide services. The software and hardware used in this study are shown in Table 2. The experimental areas are scenic locations and travel service centers in Taiwan.

Software	Hardware		
Windows 2003 Server operating system	Servo host (CPU: Intel Xeon Dual-Core 3065		
	2.33GHz, 1GB DDRII 667 SDRAM)		
MicroSoft SQL 2000 Server Database operating	PDA mobile phone (Windows Mobile 6.0 Chinese		
system	version (included) above)		
QuickMark mobile phone QR Code identification	Wireless network base station (conform to IEEE802.11		
software	network specifications)		
Mobile barcode generator			

Table 2 Software and hardware used in this study

4.1.1 QR Code pattern identification mode

(1) The characteristics of QR Code are shown in Fig.5.



Fig.5 Characteristic of QRCode

(2) Identification principle and flow: Using a mobile phone, with a camera over 0.3 mega pixels, and installed QR Code decoding software to photograph the QR Codes, will automatically read and display the information on the phone screen. By linking to the server settings, after identification, the contents can be displayed as films, photos, music, articles, or automatic link to a website [22]. The barcode does not contain all the information required, only the index information. The index information is sent from the phone reader to the server, and converted into URL information in the server, and is then skipped to the corresponding webpage. The identification principles and flow are shown in Fig.6.



Fig.6 Identification principle and flow

4.1.2 Structure diagram and method described as follows:

(1) This paper studies an application for the camera function of a mobile phone for sensing and capturing mobile barcodes, linking to the backend database of a server through a wireless network for e-map information and voice guides, to provide a search service for e-maps. The structure diagram is shown in Fig.7 and Fig.8, which illustrate the application of the camera function of a mobile phone to sense and capture mobile barcodes.



Fig.7 Structure diagram of flow



Mobile tourism and business automatic guide system platform

- Fig.8 Structured diagram using the photography function of mobile phones to sense and capture mobile barcodes
- (2)Structure flow explanation: The method of using network functions of mobile phones to sense mobile barcodes on e-maps to obtain desired information of e-maps (see Fig.9 and Fig.10), contains the following steps:
- (a) To obtain e-map media, begin with a mobile phone sensing a mobile barcode.
- (b) Create a network connection and process an

information inquiry through a wireless network, which connects the mobile phone.

- (c) Download data from a database to the mobile phone through a backend host.
- (d) Display texts and pictures of the e-map on the mobile phone.
- (e) Activate the voice guide of the e-map through the mobile phone's audio transmission mode.



Fig.9 Application of mobile barcodes on suggested route guided tour maps

The learning pattern of the current audio guide service used in museums and galleries is relatively limited. Under the newly risen trend of applying information technology to scenic and cultural location identification through a wireless network, hand-held communication carriers integrated with new technology innovation have been applied to knowledge learning environments, such as scenic locations, cultural relic guides, zoos, libraries, and botanical gardens. The purpose is to allow visitors further convenience of automatic services for immediate knowledge of exhibition contents and locations. This study provided a digital, automatic guiding system development model, which can be applied to scenic and cultural locations (e.g. holiday villages, zoos, botanical gardens, museums of history and culture, libraries, etc.) (Fig.10).



Fig.10 Application of mobile barcodes for sightseeing guide information maps

5 Conclusions

This study aimed to expand and increase the social shortcomings of traditional and existing navigation systems through mobile devices, such as mobile phones or PDA, as well as mobile QR Code barcodes, accessed through 3G wireless networks, in the following directions: allow mobile QR Code barcodes to integrate scenic locations and tour information, to facilitate increased convenience of mobile phones and PDA that are able to obtain detailed information. Fig.11 is the situation diagram of the mobile guide service application.

(1)Guide of scenic locations: traditional tourism and sightseeing modes are usually arranged through tour groups or self-service tourism. Group tourism offers a guide for the introduction of scenic locations, and self-service tourists can enjoy the sceneries, but may lack knowledge about the site. The professional abilities of the guide would also influence the content of the tour. With this special guidance device, visitors can access information, such as local geographic information, to make the tour more interesting.

- (2)Introduction of basic information: With a special guiding device, visitors can have immediate information of local snacks, amusement centers, accommodations, cultural information, etc., and inquire about flights or shipping schedules, as well as transportation information.
- (3)Local weather information: The weather also affects the quality of the tours. If visitors can access local weather information at anytime, and they prepare and schedule an outing to avoid undesired weather, allowing for a pleasant tour.

(4)Tour schedule: Some visitors may find it difficult to plan a schedule, or discover the guided tours are not convenient for their plans, thus, the system can provide a recommended schedule and route according to the number of days and the type of tour (e.g. historic site tour, beach tour, etc.), allowing for a more interesting tour.

Mobile guide service system application



Fig.11 Situation diagram of mobile guided service application.

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