Abstract – As location positioning system such as GPS becomes popular, there is a growing demand for location-based applications. It is getting easier to utilize map information by connecting a GPS receiver to PC and PDA. Corresponding to this momentum, GPS receivers are now embedded into mobile phones and applications using the location of the user in real-time are widely available. Location information is also gaining attention as meta-data for web content and is applied to semantic web [1], which provides advanced search services using meta-data information of web content. Taking advantages of these situations, creation of web content “on the spot” in a flexible form on a mobile phone is becoming important. In this paper, we propose a system called “LocationWeb”, which provides location-based web content search and creation on the mobile phone. This uses the location information as meta-data of the web content and enables handy search services based on real time location information.

1. Introduction

Recently, the applications combined with location information such as navigation system for car and human are paid attention. Combining location information with other content information such as restaurant, shops adds value to the services. Furthermore, adding location information to a picture [2] or to an e-mail is also becoming common. These services are currently used within small groups of people such as friends or family. However, there are many attempts to open public location information for unspecified groups of people. Mobile phones equipped with digital cameras have become widespread, which makes it easier to create content with photos taken by such cameras and to upload it on the spot like moblog [3].

If it is possible to attach location information to the content, it can be used for a keyword search and used as a meta-data for semantic web [1, 4]. The semantic web is an extension of the current web in which information is given well-defined meaning, better enabling computers and people to work in cooperation. Information associated with the content is represented as meta-data and by attaching such information on the web content, more precise and useful services can be provided. For example, GeoURL is a database system for registering the longitude and latitude and showing the position on the map [5]. However, the location information must be obtained using a special device, or the position has to be obtained by other means such as using a website that provides the longitude and latitude by specifying the point in the map. There are some websites that offer search by location information. They present search results close to the position by providing location information such as an address and keywords for the search [6]. The targets of these sites are, however, usually for information on fixed objects such as restaurants and hotels. One another service provides the location of the nearest landmark, puts the location information to URL and shows it on the map. If the search target is a moving object, their location information must be updated to give timely information. In this situation, a positioning device and a content searching device need to be portable. With the reduction in the cost of GPS receivers, connecting one with note PC and PDA becomes convenient. Research work using these positioning devices therefore has become active. For example, equipping a PDA with a GPS receiver and indicating a group’s individual location information is useful for meeting up. Some groupware using this function is studied [7].

Equipping PDAs with GPS receivers and installing driver software are time-consuming and troublesome for general public. On the other hand, a growing number of GPS equipped mobile phones make it enable to construct a variety of useful location related applications. There are already several map applications using mobile phone’s GPS function. But the appearance and the GUI interface for inputting information are prepared in advance and the liberty of its usage is limited even in moblog. People usually visit websites from a desktop PC, which is convenient to use. But when the user is in a mobile environment, it is difficult to reflect the location information or to renew the content. By enabling to upload real time location and to create the content “on the spot”, we can expect more variety of location-based applications.

LocationWeb: Proposal and Implementation of Location-based Web Content Search and Creation using the Mobile Phone

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services. To realize these features, we propose LocationWeb, which is an enhanced location-based service platform in a mobile environment.

2. Proposal of an integrated web application based on location information

The discussion in the previous section motivates us to adopt the design principle that the following functions are realized “on the spot”:

1. Creating and editing web content,
2. System to upload location information,
3. Search function using location information of the user, and
4. Displaying search results on the screen.

Fig. 1 The concept of LocationWeb

We propose a system that coordinates an application to edit content in real-time on the mobile phone and one to search websites by interpreting the semantic of the location. Fig. 1 describes the concept of the LocationWeb. LocationWeb is based on three basic factors, internet, mobile phone and GPS. This realizes handy system that can create and search web content using location information as a meta data.

The four functions above provide an ideal environment for working “on the spot.” In this paper, we also propose mobile phone applications and a location semantic combination web search system. Mobile phones have a function of capturing location information and creating and searching web content using captured location information.

2.1 Overview and structure of the proposed system

The structure of the proposed system is shown in Fig. 2. The mobile phone on the user side is first connected to the operator’s network and accesses the web server via the Internet. The operator’s network provides several functions such as a WAP proxy to translate HTML to WML for WAP browsers or the java official server to download approved and clean java applications.

Fig. 2 The overall structure of the proposed system

The proposed web server consists of the following web applications:

1. User module to create and store contents,
2. Search module to search the content database,
3. Website module to respond to requests from the client for web contents.

On the other hand, the user access the web server with the mobile phone equipped with location information acquiring function, a java virtual machine and a WAP browser.

Data exchange between the user module on the server side and the Java client on the user side is conducted in XML format. The user module translates the XML format to the WML (Wireless Markup Language) / CSS (Cascading Style Sheet) [8] format for the mobile phone to browse, and store both formats in the database. The search module provides a function to use the location of the user and a geographical range as a search condition in addition to keywords in text format. The website module obtains the requested web content from the database, and transfers it to the mobile phone in the WML format.

The structure of the functional modules in the proposed system is shown in Fig. 3. We used apache (Version 2.0.4.8) for the web server, MySQL (Version 4.0.16) for the DBMS and PHP (Version 4.3.4) for coordinating both entities. Also, we use J2ME for java application runtime environment on the mobile phone, MIDP, which is a profile for a mobile phone and KDDI-P, which is a profile
provided by KDDI for GPS functions. For the communications between the Java client or the WAP browser on the client side and the web applications on the web server side, HTTP is supported and used.

2.2 Structure of the client side

The package structure of the functional modules on the client side is shown in Fig. 3. The main module handles the registration procedure for opening a website and the builder module accesses the user module on the server side to manage the website and cards, which are the units of content, and also sets up the location information. The drawer module provides a web editor function, which is the interface for making content using the mobile phone operating buttons. Created web content is stored in the XML format. The query module provides form for content search. Connecting with the search module, the search result is plotted in the coordinates on the display. The data module controls data access inside the mobile phone. This makes it possible to access data such as pictures stored in a data folder and also to capture location information using GPS. To avoid accessing the server every time the user makes and renews content, new content is kept in the cache inside the mobile phone. When making content, the information in this cache is first surveyed, and if the data is not stored there, the server is then accessed.

There are two ways of realizing the above operation environment on the client side. One is to prepare an application for web content editing on a mobile phone. The other is a method like CGI, where the client receives an HTML form from a web server and uploads it every time change of the web content is needed. The client application size in this system is about 95 Kbytes, and the average time to download the application from the java official server took 9.3 sec when using an actual mobile phone (Kyocera W11K). The size of an application that could be performed on a recent mobile phone is sufficiently large and the time for application downloading, which is needed only for the first time, takes within 10 sec. We considered adopting the former method using java application.

On the other hand, the latter method can be used also on a PC with a web browser and is therefore considered to be effective when a PC is used in combination with a mobile phone. However, a device for obtaining the location information needs to be prepared. The function modules shown in Fig. 3 are illustrated in a layered fashion in Fig. 4. Accessing the data folder inside the mobile phone, obtaining location information or cache information and the HTTP transfer function are performed by the Java client program via the APIs provided by J2ME. These types of information are solely managed by the data module, which bridges them to the main module, builder module, drawer module and query module. When the user requests date to create content, the request is received by the builder module with button operations (1), and handed to the data module (2). The data module first searches the RMS (Record Management System) provided by J2ME to see if stored in the cache (3). When no corresponding information is found, the data module obtains the necessary information from the web server by using HTTP transfer.
As shown in Fig. 5, when uploading the created web content, the request from the user will be transferred to the data module via the builder module (1), only the modified part including all the materials that construct the content is transferred from the data folder (2). At the same time, the information transferred to the web server is also cached in the RMS (3). From this time on, when data for the content are needed (4), those inside the cache are used (5).

2.3 Structure of the server side
Figure 7 shows a series of procedures for translating and storing content on the server side. XML content sent from the client, is distinguished by the subscriber ID, which is attached to the HTTP request header. It is then translated into WML and stored in the database to support WAP browsers. Content information from the user is also stored in the search database. In the proposed system, tags are stripped off of the text and each word is extracted from the text and stored in the search table by linking it with the ID of the WML card that includes the word (Indexing). To perform the above transfer, we adopted the XSLT (eXtensible Stylesheet Language Translator) program. For the search method, we use two functions, keyword and search range measuring from the user location. By showing the result that meets these two functions, the web content can be selected.

3. Overview of the proposed system operations
In this section, we present the operation of and the use interface of the system below.

3.1 Creation of web content
To realize this function, the user downloads the Java application from a specific server and carries out the system. To input the text information and pictures taken by the mobile phone saved in the data folder, web content is created. By selecting the picture data (Fig. 8 a), the website can be indicated and edited (Fig. 8 b). After this process, access to this suggestion on the web server, including location information on the web content, is uploaded in XML form (Fig. 8 c). On the web server side, it is transferred into WML, and after this transfer, it is stored together with the XML form. With regard to the editing operations on the screen, text, line break, table making including alignment and list making can be performed in WYSIWYG.
Website has a title, description, shortname and location. So-called cards are created within a website. Cards are saved as XML and contain the actual web content (Fig. 9).

Fig. 10 shows a process flowchart for creating new web content. By following the process, the user creates, updates and views a website or web content. This system also enables to renew the web content and to upload new location information.

3.2 Search of web content and the result

To search web content, first, the user accesses the web server and chooses the search operation (Fig. 11 a). Then, the user inputs keywords and the searching range of the information desired (Fig. 11 b). The location information of the user is also attached to the above request and forwarded to the web server; the result is shown around the user’s real-time location (Fig. 11 c). By selecting from the search results shown, the desired information of the web content can be obtained by selecting the key. The web content information will appear on the screen.

As above mentioned, since creating, searching and showing web content can be operated on a mobile phone, it becomes easy to provide a handy and portable application services.
One of the features in the proposed system is to be able to upload the location information on demand. The proposed system does not allow sending location information when the user does not intend to do so. If the user is located where the GPS signal cannot reach or opts to save battery, the location information is not updated; however, contents are stored in the web server and accessed at any time. The usage of the location information connected to the content depends on how the user uses the system and the timeliness of the location information is totally controlled by the user.

To identify each mobile user, subscriber ID is used. Subscriber ID is a unique ID given to each mobile phone. By using this subscriber ID, it is possible to limit access to the web contents. This is attached to the HTTP request header. The form of the subscriber ID is constructed with the following elements:

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XXXXnnnnnnnn_[host name].[domain name]
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- Area ID code (4~7digits)
- Mobile code (7~10digits), unique ID given to the server
- “_”: Underscore
- Host name (e.g. ma)
- Domain name (e.g. Ezweb.ne.jp)

By using the proposed system, people can work on the same web content from different places by forming a group as shown in Fig. 12. In addition, this enables use from a mobile phone and also from a desktop PC, PDA, etc. This makes the environment of creating the content more efficient. This helps the user to use both mobile phone and desktop PC which is convenient.

4. Discussion

According to the increase in the amount of web content, the importance of the searching method will also increase. More efficient and context matched search will be provided by the combination of location information and text information. Further research is required, however, to make the search system quicker and more accurate when the amount of content increases. The prototype system stores content information in both XML and WML formats to takes into consideration the connection with the mobile phone. By supporting RDF (Resource Description Format), the proposed system will become a more effective semantic web system by jointly working with other web systems.

5. Conclusion

We developed a system of creating and searching web content based on location information using mobile phones, and suggested new methods of communicating. The increase in the amount of information available makes it difficult to find the information that is really needed, and the demand for essential and desired information from extraneous information is likely to increase. The proposed system will provide an effective method to create and search information on a real-time location basis and will extend the potential of a mobile phone and its applications.

References


