

## RESEARCH OF MOBILE GIS APPLICATION BASED ON HANDHELD COMPUTER

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### ABSTRACT:

With the coming of the digital age, geography information will become more important than ever. With the integration of the new technology, GIS make new achievement. The development of the handheld computer and Internet not only enlarge the applying field of the GIS, but also bring the new opportunities and challenges to GIS. GIS based on handheld computer, mobile GIS, will become the new branch of GIS and bring the GIS into a brand new world.

In post-pc age, the mobile device including the handheld computer will become the important field to serve the public for information service. With handheld computer, people can breakthrough the limitation of the GIS based on PC and enjoy the geography information freely., Mobile GIS makes geographical information as carrier and integrate all kind of information and implement the dynamic updating of information. So mobile GIS will make GIS apply widely and become one of the popular tools for the public.

Compare with traditional GIS, Mobile GIS based on handheld computer has many new functions. With the mobility character and extension for hardware and software character, the handheld computer will become the important part of the mobile GIS. With the GPS and communication device, people can use handheld device anywhere, anytime to access any information they wanted. That will meet the increasing demand of geographical information in information age. More and More scholars realize the importance of the integration between geographical information and wireless INTERNET and start the research and application of these fields.

After a systematic analysis to the handheld and related technologies, the strategy of applying these technologies to the mobile GIS and three applying mode are presented. The whole frame of the system is put forward along with system development which based on it is finished. At last, the system is verified.

### 1. INTRODUCTION

Recently, with the new challenge in the work and life, personal computer can not meet the demand of the people in many situation. So not only the individuals but also enterprise customers hope to access the information under the mobile environment .The development of the handheld computer make us come into the post-pc age. Especially, as for the 80 percent of the whole information is related to the spatial information, people want to get the spatial information related to current location under the mobile environment. [1]

Under this circumstance, the public and the professionals need spatial information service system .The spatial service application based on the handheld computer development very fast , because the handheld computer have mobility , practicability and extensibility character. These character make the handheld computer widely used by the people.

Mobile GIS make great achievement with the development of the wireless Internet and the mobile device . It is the new direction of the GIS and make the GIS easily accepted by the public.[2]. On one hand , the mobile device and the communication system develop very fast, the handling ability of the mobile device is equal that of the Pentium of the PC and the communication system is make a transition from second generation to third generation ; On the other hand ,the related software technology including GML(geographical extensible language), SVG(scalable vector graphics) and J2ME also accelerate the development of the Mobile GIS.In general

,Mobile GIS develop with the WEB-GIS technology, and there are many similar characters of two technology.

But mobile GIS show its own character because of the limitations of the mobile device and the wireless communication technology.

As we know , in the field of Mobile GIS there are still lots of problems to be solved. At present, many GIS companies research on Mobile GIS and bring up the product ,such as the MapInfo Mobile Location Suite(MMLS) , Intelliwherer Suit from the Intergraph, ArcPad from ArcInfo and so on. Because of the limit of the wireless communication and the mobile device, it is very hard to apply mobile GIS widely.

After the analysis of the current technology of handheld computer and wireless communication , the paper bring up three mode for mobile GIS based on handheld computer and the framework of the spatial information service system based on handheld computer. Considering the condition of the wireless communication and mobile device, the prototype of the system is finished.

### 2. SYSTEM APPLICATION MODE

At present, the hardware and software of the handheld computer develop very fast, the people can get the information with many method in mobile situation. As far as the method of the data service , there are three mode of mobile GIS based on the handheld computer.:

1) Off line mode based on the compact flash card

The handheld computer can support the mobile GIS for its handling ability and storing ability. At present, there are three main kinds of the product, including WINCE, PALM and LINUX. Compare with the other two kind of product, the handling ability is more powerful than others. Especially, there are many way to enhance the ability of the handheld computer powered by WINCE. The flash card can enlarge the storing ability of the handheld computer. The GPS device can get the location of the user. The modem can help the handheld computer to access the Internet easily.

Although the people can use the handheld computer to be on line, there are still problems to be solved for on line service such as the higher expense and the power supply. So it is necessary to take a balance strategy between the server and client and make full use of the handling ability of the handheld computer.

The Pocket Streets from the Microsoft Corporation is belonging to this kind. The Pocket Streets includes the map of the most of the city of American and Europe, supports the GPS navigation and the query function and stores the data on the handheld computer.[5]

2) Wired Internet mode

This mode is similar to the web-GIS based on the PC. Figure1 show the structure of this mode. The client sends the request to the server, the server send the content back to the client. The interactive of the server and the client is based on the HTTP. When client send a URL with the HTTP header, the application on the web could be the application based on static HTML page, CGI or SERVERLET and so on, both of them will send the content back with the HTML format, then the page will be showed on the web browser(Figure 1).

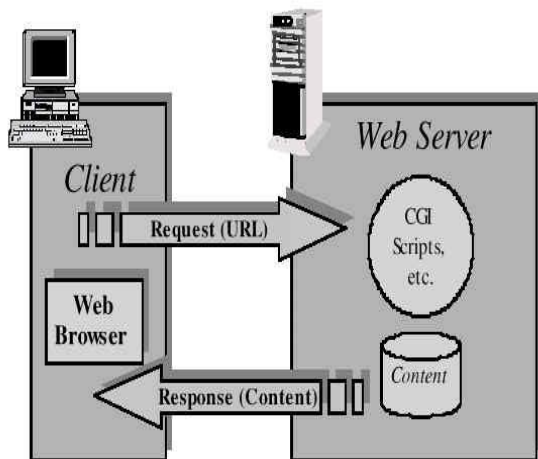


Figure 1. World-Wide Web Programming Model

In this mode, the handheld computer need the support of the browser or the client application. There are also two way of this mode, including the C/S mode and B/S mode.

As for the B/S mode, the handheld computer can exchange the data with server by modem. But for the limitation of the handheld computer, the complicate format HTML can not be showed on the browser of the handheld computer.

As for the C/S mode, it is necessary to finish the additional work to exchange the data with the server, but it is more flexible than B/S mode. The ArcPad from the ESRI is belonging to this

kind. With the technology of the ESRI, ArcPad can support not only the raster data but also the vector data. It also can be the client of the ArcIMS [6]

3) Wireless Internet mode

Wireless Internet is new trend of the IT and it can take the advantage of the handheld computer. The handheld computer can access the wireless Internet by mobile phone or wireless modem. There are also two mode B/S mode based on WAP and C/S mode based on Java.

WAP, wireless application protocol is supported by most of the country in the world. The mobile user can access WAP server to query the information and the WAP server can transfer the image and text to the client. Because the handling ability of the mobile device is limited, so the interactive function is limited and most of the function is fulfilled by the server. The following figure is the workflow of the WAP.[3] Figure2.

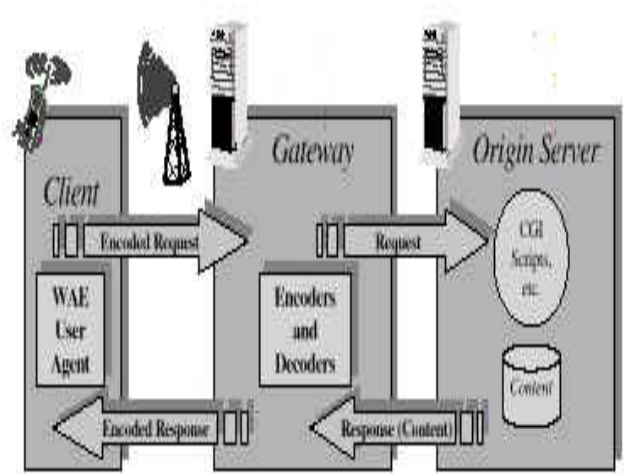


Figure 2. WAP Programming Model

J2ME is another way to support data service. It is technology from the SUN corporation. The most obvious advantage is that the interactive function can be fulfilled on the client-side and its platform independence[7]. With the development of the communication of the communication system, the mobile device will support more complicated interactive function. And the J2ME technology is the supplement of the WAP. The wireless part of the system is based on the WAP.

4) System mode

In conclusion, three mode have its own advantage and disadvantage. Off line mode can work independently, it is fit for the navigation and information collection; And on line mode can get the dynamic information, it is fit for the mobile target management and emergency help and so on. After the analysis on the mobile GIS, the solution is proposed. In the server side, MapXtreme for Java is serving as the map server, with the JSP/SERVERLET technology. In the client side, Pocket IE is serving as the browser to get the spatial and non-spatial information. Off line application, Mobile City 1.0 based on the PocketPC is finished with the support of the eMbed Visual C++.

### 3. THE THEORY AND IMPLEMENTATION ON THE CLIENT SIDE

#### 1. B/S mode (thin client)

The handheld computer powered by WINCE has its own browser for WEB and WAP. Especially the HTML and WML can be browsed on the PocketIE2002. So the three-tier structure can be adopt to the handheld computer, Not only the HTML but also WML can be showed on the WINCE

With the support of the javascript , the client can get the data including the image ,text and so on by modem. As for the wireless spatial service, The interactive function is fulfilled by wml and wmlscript. As for the wireless communication , WAP is an very important technology. WAP is wireless application protocol , it is an open communication protocol to share the data with the mobile phone , Internet ,PDA and so on.[3]. It is widely support by most of the country in the world . The workflow of the B/S mode is that the client send the request , then the web-server analysis the request and make the map server send the result back to the client .All of these work is based on the open protocol for development .

#### 2. C/S mode (fat client)

Because the limitation of the handheld computer and bandwidth of the Internet , it is necessary to balance the burden between the server and client . The basic spatial information is stored on the handheld computer and the dynamic information will send to the handheld computer if necessary.

The key point of the design of the fat-client is to put the data used usually on the handheld computer . The following function will be fulfilled on the client, including the map function , query function ,navigation function and so on. The system is development by eMbedded Visual C++.

### 4. THE THEORY AND IMPLEMENTATION ON THE SERVER SIDE

The main function on the server-side is to handle the request from the client and query from the database ,then send the result back to the client. There are many technology can be used ,including the CGI ,APS ,PHP ,JSP and so on. In general , the JSP/SERVERLET has it own advantage in many aspects. So the application on the server side is based on the mapxtreme for Java .(Figure 3). The workflow on the server side is to make different of the client , then send back the response result, including WML page, HTML page and self-defined data, the following is the structure of the system(Figure 4).

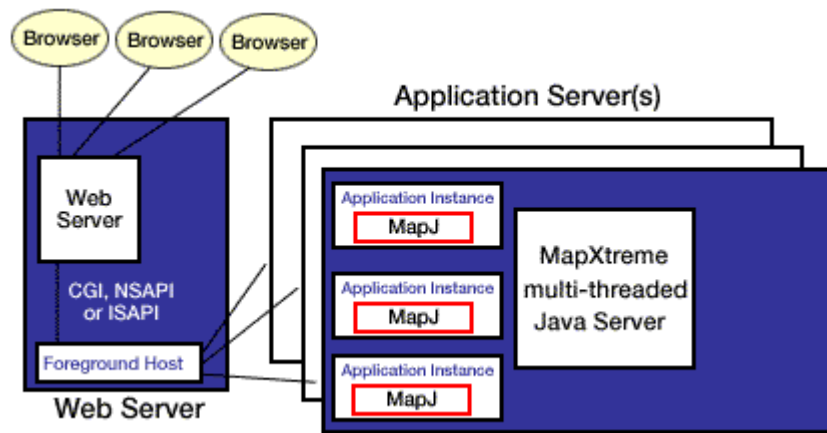


Figure 3 The workflow of the mapxtreme for Java

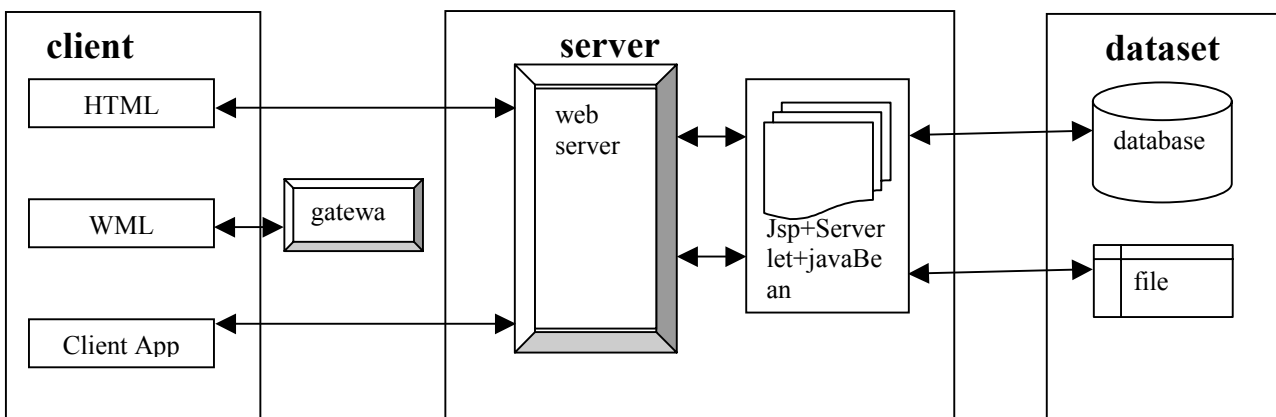


Figure4 The structure of the system.

## 5. THE SYSTEM DEVELOPMENT AND CONCLUSION

The application is finished by the Jbuilder5 , the server side is based on the mapxtreme for Java and the client is based on the embedded Visual C++3, the client is based on the HP jornada548. The WuHan map is used for test and there are also plenty of the information including hotel, hospital ,market and so on. The system function including the map function , query function , road function and so on. The on line service and off line service can be accessed by the prototype of system. The following is the example of the system.



Figure 5. Map example

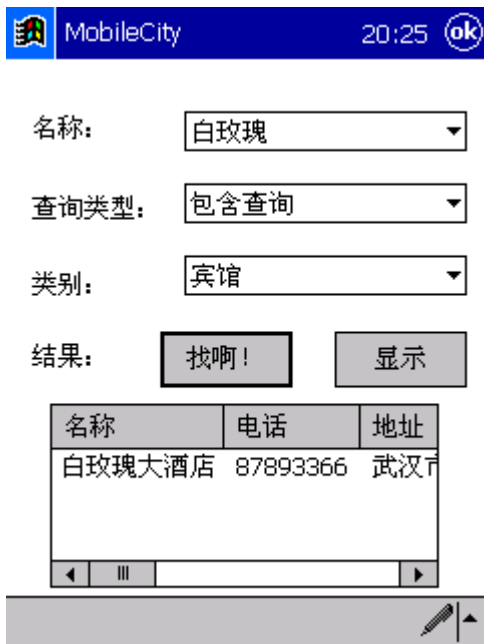


Figure 6. Query example

The three modes are proposed in the paper based on the handheld computer and the prototype is finished based on the research. And we will modify the system to make it better in the future.

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