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MAPPING ON THE INTERNET

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I. ABSTRACT

1. The Internet is a major tool to disseminate information. Geographic Information Systems (GIS) software provides the ability to create interactive maps on the Internet. This paper reviews the research and development of ***Intramapper***, a thematic mapping site of demographic data on Statistics Canada Intranet. Internet and Intranet are identical technologies except Intranet is defined, as an internal private network within organisations while Internet is a global public network. This paper discusses the technical requirements, the web design and the GIS functionality of the ***Intramapper*** application.

II. BACKGROUND

2. Geography Division has been involved in GIS and mapping products for over a decade. These mapping products include *Census Reference Maps* [Statistics Canada, Catalogue No. 12-572-XPB, 1997] and *Metropolitan Atlas Series* [Statistics Canada, Catalogue No. 98-101 to 112, 1989]. Creating maps on paper and atlases in book form are very expensive and, by their very nature, are static products. With the advent of Internet and the advancement of GIS tools, Geography Division is developing Internet-based mapping applications.

3. Geography Division has initiated a project called Enterprise GIS in order to research the use of new GIS technologies. The main objective of this project is to provide GIS capabilities to all workstations within Statistics Canada wide area network. This will be done in a cost efficient manner by centralising the geography infrastructure, and will be an effective end user by providing seamless access to data through user-friendly interfaces. New GIS software and Intranet tools are technologies that make Enterprise GIS possible.

4. The first application developed on the Intranet under Enterprise GIS was a thematic mapping tool of the recent 1996 Census population and dwelling counts data. Research showed that while there were many mapping sites on the Internet, there were very few thematic mapping sites. This application was of interest to many new GIS users within Statistics Canada. There were no extra hardware or software requirements for the user. In addition, other data-producing divisions could assess this application for possible use in displaying of their own data.

III. TECHNICAL REQUIREMENTS

5. Internet and Intranet are identical technologies except Intranet is defined, as an internal private network within organisations while Internet is a global public network. Applications are interchangeable on both networks. Intranet is an excellent development platform for troubleshooting applications and for user feedback before launching an application on the Internet.

6. Users or clients access a network server through an Internet browser. The server houses the digital boundaries and data, processes the user's request, and then sends back the results to the user. This client/server model allows for dynamic interactive mapping functionality to disseminate data in a map form.

7. Client Requirements

Client requirements are minimal and would include a modem or network card and browser software. A fast modem would allow the client to receive data transferred over the Internet more quickly. Popular Internet browser software include Netscape Navigator and Microsoft Explorer, both relatively inexpensive.

8. **Server Requirements**

Data files and digital coverages are located on the web server. The web server handles client requests, and process them using GIS software. The main GIS software used is ESRI's MapObjects Internet Map Server. This software runs on a Windows NT operation system.

9. **Client / Server Architecture**

The client with a web browser connects to the web server through the Internet or Intranet. The user would send a request to an application requiring GIS processing. The web server would send that request MapObjects that in turn will create a map. This map is then transferred back to the client.

10. All of the actions take seconds to perform. In the ***Intramapper*** application, the GIS processing includes selecting a geography boundary, a census variable, classifying the data, creating a map and converting the map into an image format. Once this is completed, the map is sent back to the client. It is the transfer of data takes most of time in this application.

IV. WEB SITE DESIGN

11. **Target audience**

When designing the web site, you must determine the target audience. The target audience in turn will determine the complexity of GIS mapping capabilities that could be added to the application. The ***Intramapper*** application assumed that users would have no knowledge or experience with GIS. The text on the web interface was written with plain text or non-GIS terms. Help functions were also included throughout the application in order to assist users.

12. **Mapping Inputs**

To create a thematic map, users must make certain choices from four separate drop down menus: Boundary, Census Variable, Classification and Number of Classes.

13. The Boundary is the geography layer to which data is to be mapped. Boundaries include Provinces, Census Divisions, Census Subdivisions, Census Tracts and Enumeration Areas.

14. The Census Variable is the census data to be mapped. Currently, this includes population, dwelling counts, population density and dwelling density. More variables will be added when they become available.

15. The Classification is the method under which the data is classified. In MapObjects, there are two methods of classification, *equal interval* and *quantile*. In the *equal interval* method, the highest and lowest value in the data set are calculated and equally spaced classes are created depending on the Number of Classes (see below) chosen. In the *quantile* calculation of class intervals, the number of values is divided by the Number of Classes selected. This results in an equal number of values in each class. Added to these two classification types are Canada or window options. When the Canada option is selected, classifications will be based on all records in Canada. If the window option is chosen, only records from the map display region will be classified. This allows users to visualise the data for the windowed region, and be able to compare the windowed region to the national data set.

16. The Number of Classes is uses by the Classification method to calculate the class breakdowns.

17. A Region drop down menu is included here to make it easier for the user to zoom to a particular region or area. Province and major city selections have been included.

18. Once all the user inputs are chosen, the user clicks on the *Map it!* button to send the mapping request to the server or the *Map Region* button to create a map of the user-selected province or city.

19. **GIS Mapping Functions**

GIS mapping functions provide tools for users to navigate on the map and to identify data for a selected area. GIS functions activated by clicking on the radial button include Info, Pan, Zoom In, Zoom Out and Zoom Factor. Once the radial button has been activated, the user must click on the main map display to send the request to the server. A drop down menu selects the Zoom Factor.

20. The Info function lets the user identify the data for the selected polygon on the map. A table appears on the screen with the data (see Figure 3). Because there are currently only four data variables, all are shown in the table. When more variables are added, a modification will have to be made to the display of the data.

21. The Pan function allows the user to move the map display area and shift it at the same scale. By clicking on the Pan radial button and then on the map, the location of the click will be displayed in the centre of the new map display.

22. The Zoom In and Zoom Out features allow users to change the area of the map displayed. The user can select a Zoom Factor, the scale factor the map display will increase or decrease, from the drop down menu and then click on the map area.

23. **Scale Dependency**

The ***Intramapper*** application draws different reference layers dependent on the scale of the map area. For example, at the national scale, a hydrography layer consisting of major inland water bodies is shown, while at a city scale, the local rivers are displayed. This is advantageous for the following reasons: 1) the map displayed are not cluttered with too much detail and information; and 2) the transfer of the map image is faster because it takes less time to create, and a smaller file is transferred back to the user.

24. The Boundary drop down menu selections is also scale dependent. For example, the user would only be able to choose Enumeration Areas when the map display is at a city scale. There are approximately 50,000 Enumeration Areas for Canada and if mapped at a national scale, the resulting map display would be very cluttered. This scale dependent feature is including inherit knowledge from a GIS application developer into the mapping application.

25. **JAVA Technology**

These GIS functions selected were based on the requirements for the user to be able to interactively change the map display area. For users familiar with GIS software, activating the zooming in and pan functions of clicking on the map is not similar. GIS users are use to drawing a box to zoom to a selected area or clicking and holding on a spot to pan. This is not possible with the software used in this Internet application. However, with the development of JAVA applets that are downloaded on the client's computer, these functions can be simulated in an Internet mapping application.

26. **Web Page Layout**

The design of the web page is very important because it is the users first impression of the application. If the site is too complex or confusing, the user will be discouraged to use the mapping application, especially new GIS users. The objective in designing a web page was to make the application simple and informative. The ***Intramapper*** application was developed with two specifications: 1) the default monitor resolution is 800 x 600; and 2) the entire application is to fit on one page. The user has access to all application functions without

having to scroll. If the user has a lower resolution monitor than the default resolution, scroll bars would appear on the side and bottom of the web page

27. **Map Display Elements**

The features that have to fit on the page include the user inputs, GIS functions and the map display elements. The user inputs and GIS functions are the ones describe earlier in this paper. The map display elements include the map display area, a key map and a legend. The map display area is the largest map image because it is the map the user is generating based on the inputs as well as the map which GIS functions are activated. A key map was included because users may not be familiar with Canada. When zoomed in in the map display area, the key map shows the map area location relative to Canada. The legend is necessary to relate the data classification to the map. The user inputs were grouped to the right of the map display elements and the GIS functions placed on the bottom of the page. All these features were located and organised on one page to make the web application simple and easy to use.

28. **Help Functions**

A Help function was included to assist users in how to use and understand the GIS functions and data. Users activate the help functions by clicking on the underlined text, for example Classification. This launches a browser window that displays the help file associated with the Classification underlined text.

V. CONCLUSIONS

29. The Internet provides an enormous potential to disseminate data to a large clientele. With the development of GIS tools for the Internet, statistical agencies are able to create new mapping applications and data products. In the past, providing these applications and products to a user was very expensive and the users needed to have specialised computer skills. Now, users can access these applications at a very low cost and with minimal computer knowledge.

30. In Geography Division, a major activity will be to use geography and GIS tools to disseminate data. Research and development will focus on creating custom GIS applications for data producers within Statistics Canada and other agencies.