SPATIAL DATA BASED E-GOVERNMENT APPLICATIONS

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KEYWORDS: Cartography, Internet, Web based, Mapping, GIS, Virtual Reality, Spatial.

ABSTRACT:

E-government concept, defined as the use of information technologies (Wide Area Networks, the Internet, and mobile computing) that have the ability to transform relations between citizens, businesses, and other branch of the government, has been adopted by many government agencies. In general, there are two most important applications; interactive web maps that can be queried on Internet and spatial data based e-government information that can be accessed by the clients or public on the Internet. In Turkey, in spite of fact that non-spatial data based e-government applications have shown a great improvement, there has been little progress in spatial data based e-government applications. Effective use of Web-based e-government applications reduces user time, saves money, and increases efficiency. It is highly anticipated that interest in spatial data based applications will increase as many government agencies have been recently providing spatial data based services in Turkey. This paper discusses spatial data based e-government application being developed to allow the user to access e-government spatial information on the Internet.

1. INTRODUCTION

E-government can be simply defined as "continuous and safe execution of the mutual duties and the services between the government and the citizens in the environment of electronic communication and transaction" (Aktepe et al., 2002). Even though it is specified by its definition that e-government works in all kinds of electronic environment, the main platform of the e-government applications is the Internet because it is interactive, fast, well-known, and communal (Eraslan, 2003). The internet, which removes the boundaries of time and location, is a proper environment for information exchange. The unique feature of the internet is that someone can connect it from anywhere and at anytime; therefore, one-time generated data can be reached by many users (Karas, 2001).

In Turkey, many of the government agencies have currently carry out their services on the Internet. Especially, due to improved relationships with the European Union (Aktepe et al., 2002), e-government concept has been adopted by government agencies in more systematic and specified standards. There are wide variety of online operations including payments (bill, tax, etc.), bank transactions, customer services, job and school applications, insurance services, and library services. While there were only about 30 municipalities had a web site up until 1999 (Yildiz, 1999), currently most of them have web sites. According to Aktepe et al. (2002), 109 out of 158 main government agencies have active web sites in which 4 of them provide only information, 24 of them provide electronic documents, and 81 of them provide intercommunication.

The applications mentioned above deals with the non-spatial data, which can be organized and transferred on the internet environment by using classical web tools. However, many government agencies not only deal with non-spatial data but also spatial data. There are two main types of web based GIS applications for spatial data based e-government applications over internet. The first type is online and interactive maps which can be used for spatial query, address search, route analysis, buffering, and overlaying analysis. The second type web based GIS application is transmitting the spatial documents of various agencies (cadastral administrations, local goverments and forestry, mining, water managing acencies, etc.) to their clients over the web. The contents of these documents include information such as land usage plans, landowner boundaries plans, construction permission plans.

The numbers of e-government applications using non-spatial data have been continuously increasing, while few applications using spatial data have been conducted by the related government agencies. As more agencies provide spatial data based services, web based GIS applications will become more common in the near future. In this study, the structure of the web based GIS applications was investigated and web based interactive maps and the applications of developing parcel based spatial government documents were introduced.

2. INTERNET BASED GIS

The internet based interactive map was first presented by Xerox Alto Research Center in 1993. Following this presentation, the number of internet based GIS applications dramatically increased (Su et al., 1999). There are generally two main architectures of these applications: Thin Client and Fat Client (Abel et al., 1998).

2.1. Thin Client

The architecture, in which map productions and geographic

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processes are done in one center and which has a graphical data base, is called "Thin Client" architecture. In this architecture, visual objects required by a client are sent in known raster formats such as jpg, gif, etc. The most of the geographic analysis is handled by the server, while the client only displays the HTML pages and runs Java Scripts.

The system, which consists of the complex GIS software and GIS data base, locates on the server. The data required by a client is prepared in the server, and then compiled and sent to the client's browser in HTML format (Figure 1). The biggest disadvantage of a server based solution is that a user can not entirely accomplish the functions expected from GIS.

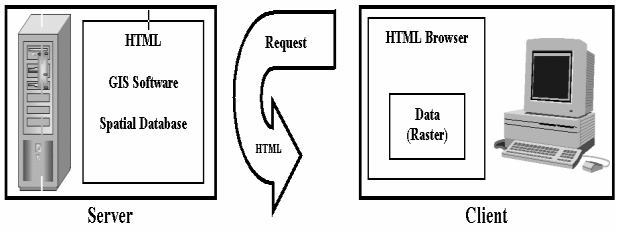

Figure 1. Thin Client Architecture

2.2. Fat Client

In order to overcome the disadvantages of the "Thin Client", "Fat Client" architecture was developed. In this architecture, the task of the server is limited to only sending the data, while most of the geographic analysis is handled by a client in a platform. The client's web browser is improved by adding new plug-ins such as Java language, java applets, and ActiveX (Figure 2). Some of the client based solutions may require a user to install entirely different program in stead of a browser improved by the plug-ins. In this architecture, the server sends a client the data in vector format, which is more complex than raster format data (Eraslan, 2003).

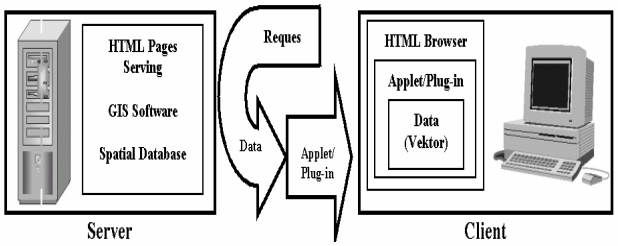

Figure 2. Fat Client Architecture

In internet based GIS, Java is mostly preferred computer programming language. In fat client architecture, Java is generally used in the software, which is distributed to the end users because it is simple, object oriented, independent of the platform, dynamic and high performance language.

The most important advantages of a client based solution are that user interface can be improved and the solutions are reached using data in vector format. Client based solutions using vector data allow many geographic analysis and graphical tasks to be performed locally. It increases the performance by providing the image alterations without data transfer on the screen. The fundamental tasks of GIS such as buffering, overlaying, route analysis can be performed very effectively by using vector data.

There are several disadvantages of client based solutions. The reliability of the data decreases due to transferring the data to the user. Some problems may occur due to plug-ins such as Java, ActiveX, and incompatibility between software and computer system. None of the software including Java, which is developed to perform in any system, can be compatible with every computer systems. Therefore, some of the potential users cannot login to the web page or can simply give up. They may also have some problems installing software and this can prevent users to benefit from the web page if technical support is not provided. Besides, the time spent on installing software may cause a problem since some of the potential users don't like to wait for installing software while there are other web pages where the data can be reached instantly as just logging in to the site (Eraslan, 2003).

In both thin and fat client architectures, there are various technologies, languages, and plug-ins, which provide interaction between by server and client. The technologies such as Cgi, Asp, Php are run by the server and they use script languages. "Scripts" are small programs that run over the server. They are used to reach data bases and files in the server. "Scripts" are written by computer programs such as Bourne Shell, C Shell, C/C++, Perl, Python, Tcl, Visual Basic, JavaScript and VBScript. The features of a browser can be used more effectively and efficiently by client based scripts. For example, response of a HTML page to a user when he locates and clicks on a mouse is done by one of these scripts.

Java, VRML and XML, on the other hand, are the languages that are run by the client. The client also uses plug-ins such as ActiveX and Java Applets. ActiveX controls, also known as OCX, can run over the web just like Java Applets, except ActiveX components only work on Microsoft Windows environment.

3. E-GOVERNMENT APPLICATIONS

E-government concept has the ability to transform relations between citizens, businesses, and other branch of the government. In general, there are two most important applications; interactive web maps that can be queried on Internet and spatial data based e-government information that can be accessed by the clients or public on the Internet.

3.1. Application 1

Web based Campus Information System of Gebze Institute of Technology (GIT) presented in this section is a good example for the first type of spatial based e-government applications. In this Information System, campus maps can be queried interactively and many graphical and written information can be obtained about GIT and its departments. "GIT University Geographic Information System (*)" has been also developed on ArcView 3.3 platform as a part of the Campus Information System (CIS). The main framework of web module's interactive pages is generated by using a plug-in called "HTML ImageMapper", which is a macro runs on ArcView platform. By using various possibilities of ASP technologies and HTML language, the system capabilities have been increased. Besides, by using animations (visual effects), it is aimed to give users the feeling that they are actually in the campus.

* The GIT University Geographic Information System is supported by Gebze Institute of Technology.

Interactive campus maps are presented to the user in two different layer structures. The user can query over the plan view of the campus that contains roads, buildings, and other facilities (Figure 3), as well as over the terrain views which are generated from raster based orthophotos (Figure 4). The user can zoom, pan, and scale the area in order to search roads, buildings, parking lots, and other facilities around the campus. When clicked on any building on these views, information about academic and admission departments in this building is displayed and related web pages are also listed.

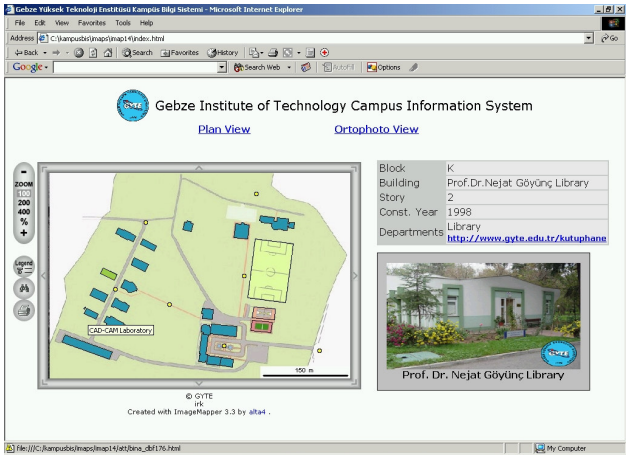

Figure 3. Plan View of The CIS

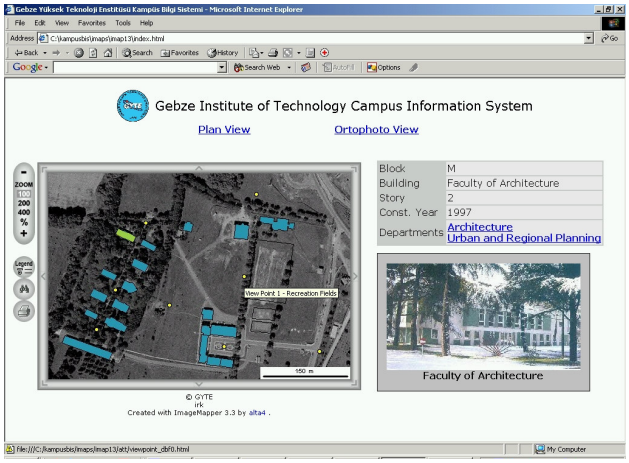

Figure 4. Ortophoto View of The CIS

Interactive Campus Information System, a server based application, was developed according to thin client architecture procedures. Server based GIS applications generate HTML files. In this system, user actions such as zooming, pan, selecting an object or a polygon, and data accusation are transmitted to the server, and related graphical and written data are managed by the server, then, these data are presented to the client in HTML format.

Client based scripts are used to perform interactive features on the online maps. This is done by keeping the coordinates of every map objects into a script located on the web page. When a user clicks on anywhere between these coordinates, graphical and specific data about the objects are displayed in a normal HTML connection.

Another group of object on interactive maps is viewpoints. The image generated by the pictures taken at characteristic points (viewpoints) of the campus provides an idea about the general view of the campus area. By clicking on the viewpoints, one can see the panoramic view of that point, which can rotate 360 degrees (Figure 5). The user almost feels like he is actually walking around the campus by using the graphical features such as zoom-in, zoom-out, pan, and rotation.

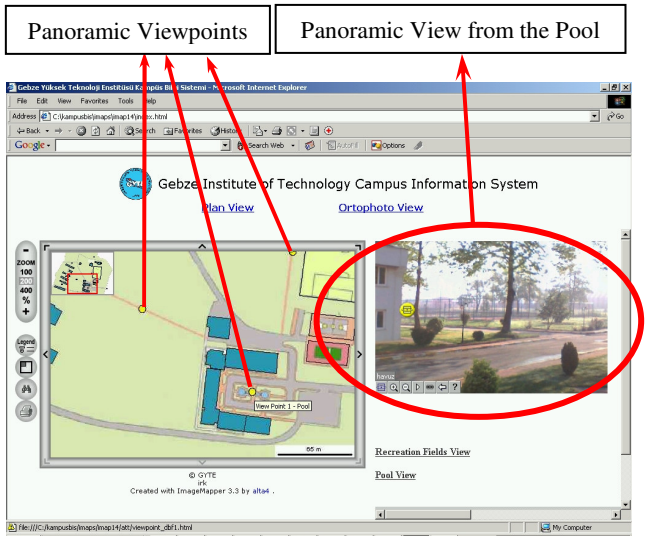

Figure 5. Panoramic View

Web based Campus Information System of GIT can be reached at www.gyte.edu.tr/jeodezi/KBS.

3.2. Application 2

This section presents an example of the second type spatial based e-government application, which is developed to access the parcel based official documents on internet. The purpose of generating this prototype is to transmit the spatial government documents (cadastral plans, construction permission plans, land usage plans, application plans, etc.) to related person and agencies in electronic environment using e-gverment applications.

In parcel based webGIS applications, considering that potential users will be ordinary people with limited computer knowledge, it is aimed to prepare the required documents automatically, as a user enters the minimum data (parcel number).

This application is generated using fat client architecture and it is a client based application. Once logging in to the system, an ActiveX component is downloaded and added into the user's browser. This component improves the browser's functions and transforms it to software, which meets the objectives of the system. The component, written in Visual Basic 6.0 platform, is interactive software.

When a user enters the parcel number to display its document; firstly, this number is transmitted to the server; secondly, Visual Basic scripts in Active Server Pages starts running; then, information about this parcel are pulled out from the data base; and finally, this information are sent back to the user's computer. The software added into the user's browser analyses

and processes the spatial and non-spatial data and then displays them on the computer screen in the form of an official document (Figure 6). The user can scale the graphical data and also can have it as a hard copy by printing it out.

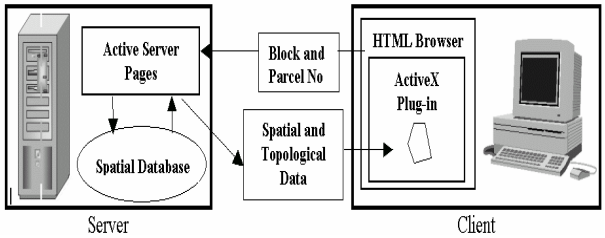

Figure 6

As mentioned before, vector based spatial data are sent from the server to the client. The data are saved in the data base of Microsoft Access. As it is aimed by the system, coordinate data as well as the topological information is saved in the data base. The documents generated by webGIS software are indicated in Figure 7 and 8. This application can be reached at www.gyte.edu.tr/jeodezi/webgis.

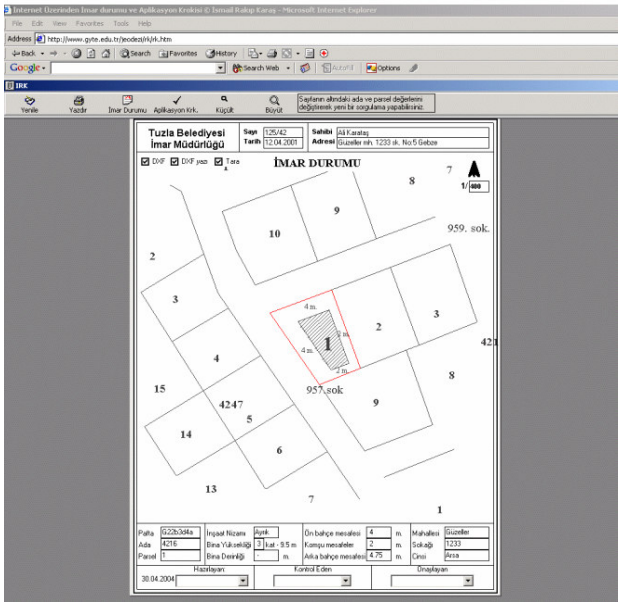

Figure 7. On-line construction permission document on Internet

3. CONCLUSIONS

As the trend of the globalization increases and economical boundaries are removed around the world, continuous improvements in information and communication technologies widens the gap between highly-developed countries and Turkey. In order to narrow down this gap and to generate an information society, the government, using both very last technologies and most current admission techniques, must consider a reorganization of its structure in which the individuals and serving each individual citizen should have the biggest priority. This reorganization model can be defined as e-government.

E-government, as a new administration model, aims to increase performance and efficiency of the government by using last technologies in exchange of information, science, and goods between government agencies, citizens, and private sector. The main objectives of the e-government are: (1) to transparent the government, (2) to run the government fast an defectively, (3) to ease the daily life of the citizen, (4) to give citizens important role in the administration, (5) to prevent repetition of the work and data, and (6) to improve the periods of information based decision making (Aktepe et al., 2002). In the lights of these objectives, the applications of e-government presented in this study can be good examples for government agencies that use spatial data. Government agencies can automatically perform some of the procedures that causes excessive loading in the system, slows down the activities; therefore, the system will run easily and service quality will be dramatically increased. Besides, effective use of web-based e-government applications reduces user-time, saves money, and increases efficiency.

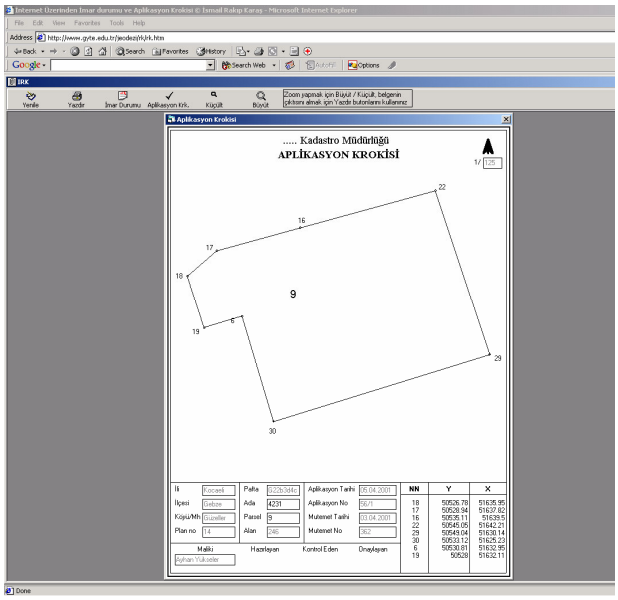

Figure 8. On-line cadastral plan document on Internet

As the interest in spatial data based e-government applications increase, the communication between various local GIS applications will increase as well. Therefore, the dependency between the agencies increases, which will lead to collaboration and establishment of common standards. This will open the doors of systems will determine the features of internet based GIS technologies.

ACKNOWLEDGEMENTS

This paper draws on the contributions of EMI Harita Bilgi İşlem Ltd. Şti. We would like to thank for its supports.

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