Web Service for geographic locations search
Bachelor’s Thesis within the Computer Science and Computer Engineering program
EXTENDED ABSTRACT

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Bachelor thesis analysis

Main target of the bachelor thesis is a design and development of a web service based software solution for accessing GIS functionalities which product is interactive geographic location search in the territory of Republic of Macedonia. The main contribution of the bachelor thesis is design and development if web service solution for searching geographic locations on the territory of Republic of Macedonia.

The bachelor thesis is consisting of five headings. In the first heading is given detailed explanation of service oriented architecture as a most adequate architecture solution. The main definition of SOA and their role in the nova day’s software solutions is given. Also in this heading are described the main roles in SOA like Service Provider, Service Requestor and Service Registry. In same time, the web service protocol is described with all the undelaying technologies that are used. The next heading describes the GIS server and its main characteristics. The other headings cover the system architecture, system design and conclusion which are explained in more details in this extended abstract.

GIS server

In the third heading was elaborated the GIS server and all his capabilities. In this heading in details is elaborated the GIS server (Figure 1) and mostly the properties that makes him special and different from the other kind of servers in an ordinary client – server solution. GIS server enables GIS resources exchange in a company or on Internet. GIS resources can be maps, globes, address locators, geo databases, exchange tools, etc. The main characteristic of the GIS server is that the GIS server enables access to GIS resources and also to the functionalities that those GIS resources have. For example, if one want to access to some location on a map, and if that map is georeferenced with geo data like nearest hospital, nearest petrol station, etc. it will be very beneficial to the user to access to that data too. Exactly this access to the additional data related to that part of the map makes the GIS server different from the standard client server technology. Detailed architecture of standard GIS server is given on Figure 1.
GIS server – GIS server hosts the GIS resources, like maps, address locators, etc. and make them accessible to the client applications. GIS server is consisting of two parts:

- **Server Object Manager (SOM)** – responsible for service management. When a client application sends a request for some service, SOM is the part of the GIS server which dedicates instance of the resources. SOM is always connected with one or more SOC.

- **Server Object Container (SOC)** – SOC are actually containers or service hosts that are managed by SOM

**Web server** – Server which hosts web applications and web services that use GIS resources.

**Data server**— Data server responsible for GIS resources storage.

**System architecture**

In this heading is given detailed overview of the system architecture. Firstly is given architectural diagram (Figure 2) and after that the main processes and interactions with the system are explained via use case and activity diagrams. The main processes in the system are: map layers preview, feature class search, map zoom function and map navigation...
function. All of them are explained in details and later in the bachelor thesis are implemented in the demo application. In this heading also is explained the geo data base that is use in the system backbone. The main characteristic of the database is that is consisting of geo feature classes and ordinary classes. Geo feature class is class that has at least one spatial attribute.

System Design

System design is the heading where the named processes in the previous heading are explained from design point of view. In this heading is given deployment diagram (Figure 3) of the software solution and the processes are illustrated via sequence diagrams. On Figure 3 is shown that the solution is consisting of GIS server which has an access to Geo Database Server. The Web service access to the GIS server functionalities and makes them accessible to the other client that communicate with it.
The main system functionality is a map generating. The map can contain different content. The role of the web service is to provide communication service between the client and the GIS server and to show his requests with which the map will be generated. In the same time, the web service can be used as an engine for content defining if one integrates business logic in it.

On the next picture (Figure 4) is given the sequence diagram which describes the process how the client gets the start information about the GIS product (including the list of map layer or feature classes in the geo database).

Since the client has the information about the system capabilities, the next step is to select one of those capabilities according to his needs (Figure 5). That means the client send a request to the web service with a list of selected map layers. The web service communicates with the GIS server and forwards the client list of selected layers in a form of list of feature classes. After that, the GIS server pulls the selected feature classes from the geo database and generates a map which is located on some place on the system. That location is send to the client.
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Second important system function is a map zoom function. If the user gets a map with selected layers, then according to his current location the web service can zoom in the map to show his nearest location. The process of map zooming is described on Figure 6.

Figure 5 Sequence Diagram: Map layer request

Figure 6 Sequence Diagram: Zoom in/out function
Next important functionality that should be implemented in the system is map navigation. Actually, from technical point of view, this functionality is very similar with the previous. In the both, the system manages the view of the map. In the previous is scaling view of the map; in the second is moving the view of the map. The client sends the current view and the required action (moving up, down, right or left) to the web service. The web service sends the request to the GIS server, which selects the required feature classes and move the view to the desired location. On the next figure (Figure 7) is shown the sequence diagram of this functionality.

![Sequence Diagram: Map navigation](image)

**Implementation details**

As a part of the bachelor thesis a web service and a client application that uses the service were developed. The web service was fully developed according to standards described in the second heading. The web service anatomy is given on Figure 8.
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WSDL defines the services as a collection of end access points or ports. The abstract definition of the ports and the messages is separated from their concrete usage which enables multiuse of the definitions. The port is defined with an association of network address with a binding. The collection of this kind of ports represents a web service. On Figure 9 are given implementation details of the developed web service.

On Figure 9 one can notice that in the web service are implemented functionalities that are completely identical to the one described in the System Design heading. There is a special function which returns the list of map layers and functions for map rendering and searching a map. The zoom in, zoom out and navigation functions are implemented using the previous two.
In the system requirements and system analysis is stated that the system should be accessible from different client types. That’s why the service oriented architecture is most appropriate for this system. Since the web service and their functionalities are implemented, the next step is clients to access those functionalities. In order to access the functionalities clients should access the WSDL document and to get the web service information. After the initialization with the web service the client can integrate the web service functionalities in his application in order to use the web service on the most optimal way.

In order to demonstrate a practical usage of the web service as a part of the bachelor thesis a web based client application was developed. The website interface was specially designed to accent the web service functionalities. On Figure 10 is given the demo application interface which show the navigation buttons as an interface to the map navigation functionalities, on the left upper corner are zoom in, zoom out and reset buttons and under the navigation buttons is shown the list of map layers from which the user can select the wanted ones.

![Demo Application](image)

Figure 10 Demo Application
Conclusion

There are several benefits from the software solution designed and developed as a part of the bachelor thesis. First of all, with the provided solution GIS server functionalities are not only acceptable for GIS clients (who can understand the GIS server functionalities), but for any kind of clients who can connect to a web service. Actually with the web service is provided a middle layer between the GIS server and an ordinary client (who doesn’t need to understand the GIS functionalities). With other words the web service has a role of a function mapper from GIF functionalities to standard functionalities. Another important benefit comes from the service oriented architecture. With SOA, the GIS functionalities are ready services, which can be used form any client who can read and understand WSDL document. This means that the GIS functionalities can be integrated in any kind of large system and then the real service oriented architecture is achieved.
References