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Realization of Web Based with Turf.JS Library of Spatial Analysis in Open Source Softwares

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ABSTRACT
In this study, the analysis, process and outputs of an integrated system that will enable the spatial analysis of web-gis applications will be discussed. Desktop GIS software, spatial database, web-map server and web server will be selected from open source software. The system architecture of the problem will be analyzed and the most appropriate system architecture will be developed. System architecture consists of open source software; QGIS as desktop GIS software, PostgreSQL / PostGIS as spatial database, Turf library, alternative to Web Processing Service (WPS) service for spatial analysis, Apache Tomcat web server will be used. The urban test data prepared as a result will be subjected to spatial analysis in the study and the system's operability will be tested.

1. INTRODUCTION

Due to the development of open source web-based technologies day by day, its use in the map / geomatics sector is increasing daily. The spatial / spatial information perception of our profession; It has been instrumental in taking great steps in keeping up with the pace of the day; This situation also played an important role in determining the purpose and target of the study.

Open source softwares used in today's world are shown in Figure 1. These softwares are preferred because they are free, user-friendly and easily accessible.
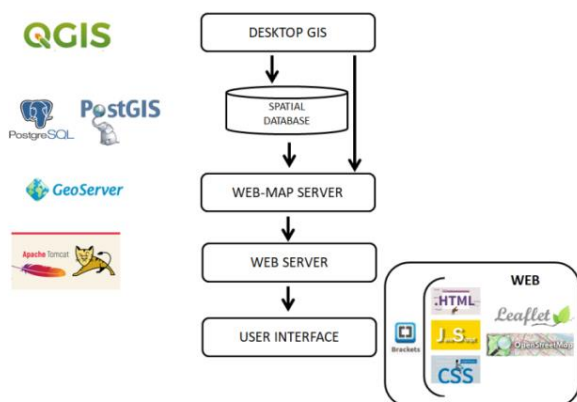

Figure 1. Open Source Softwares

Open source thinking has the key role on that situation in terms of being free, independent and managaeble in a manner of answering the necessities of policy makers, engineers and researches (Akın, 2020).

Spatial analysis using to perform statistical inferences, perform spatial relations of point, line and area data, It is the whole of exploratory processes that help us to understand space and geography based on spatial data.

Spatial analysis studies are important in that they provide the opportunity to evaluate spatial data under certain conditions and values and assist engineers and managers in decision-support stages. The obligation to fulfill this opportunity only through desktop GIS software, the obligation to use licensed software, and moreover, the absence of knowledge to use these software; It can restrict the possibility of spatial analysis and even make it face with the inability to make any analysis (Yilmaz, 2009). In such a situation, it seems essential for users to switch from desktop GIS software to web-based platforms.

Geographical Information Systems have some requirements including both hardware and software. With the rapid development of internet technology over time, various data can be delivered to users via web pages without any location and time problems (Guler, 2020).

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Web based applications; Many maps and platforms with a widespread use and an easy user interface provide convenience for us (Filiz, 2013). The subject of this study also offers us solutions at this point.

Spatial analysis includes a variety of techniques and processes used to understand patterns and relationships of geographic features. WPS where these processes can be performed, is a web processing service that enables the execution of spatial analysis information processing processes and the retrieval of metadata explaining their purposes and functions. With this service, spatial data can be easily analyzed and displayed on the web (Granell, 2012).

The core capabilities of the WPS server fall into two categories: The first category is process determination and process capabilities. The second category includes the ability to manage and track machining jobs. Because the processes provided by a WPS server can have varying degrees of complexity, the server must show the mode of job control capabilities allowed per transaction offer. It may be provided with the service for other service capabilities, namely secure communication and user authentication, but does not cover or limit these details unless they change the meaning of other business control capabilities (OGC, 2018).

Another spatial analysis process is the Turf.js library, which is open source code and faster and more ergonomic than the WPS service(Miller, 2019). This javascript library is user friendly thanks to its open source, free and easy use. And for software developers, it can give results in a shorter time with less code without tiring system architectures.

In this article, a user-friendly web interface will be developed with open source web technologies to facilitate the spatial analysis that is desired to be carried out. Thus, spatial / spatial analysis that will produce solutions to many different problems will be easily achieved. In addition, by introducing the WPS standard, using the alternative Turf.js library, it is aimed to share and organize / contribute data between the user and the administrator for the first time with a system architecture operation, unlike the one used until today (Miller, 2019).

The road map followed in the study is as follows. By analyzing the system of the problem, the most suitable system architecture will be developed for the system. System architecture consisting of open source software; QGIS will be used as desktop GIS software, PostgreSQL / PostGIS as spatial database, Turf.js library as an alternative to WPS service (Integrated to Geoserver) for spatial analysis operations and Apache Tomcat as web server.

The data to be used as test data in the study will primarily be prepared as geographical and verbal data in desktop GIS software. It will then be integrated into the spatial database. Then the data will be integrated into the spatial database to be created on the web server. Finally, by developing a user interface where spatial analysis can be done with web programming (HTML, CSS, JS and PHP), the work will be integrated into the web server (in localhost) environment.

2. METHOD

With today's dense spatial data sets, our modeling of our world has become quite complicated, and in this respect, GIS appears before us as a method and tool for reaching the determined goal. In GIS applications \ projects to be made in this respect, first of all, determining the purpose and target; will play a very important role in system analysis and shaping the system architecture. Because a goal that has not been well analyzed; It will lead to waste of time, opportunity and human resources. In this case, it will cause the projects to fail halfway and prevent the development of future projects.

Within the scope of the study, the subject of "spatial analysis" that will take place with user interface interaction of spatial data in the web environment is adopted as a theme. In this context, the study; system analysis consists of the design of the system architecture and the realization of the system.

2.1. System Analysis

System analysis is an area of interest that determines how the data available in the information system should be used, examines the logic of the inputs required for the system, the process of transformation, and ultimately creates a system. All information systems reach the result by going through a certain cycle (Yüregir, 2001).

Within the scope of the study, the structural and functional properties of the user, spatial data, web technologies and spatial analysis processes were examined. Thus, a system analysis flow diagram has emerged where spatial analysis can be performed. The resulting diagram is shown in Figure-2.
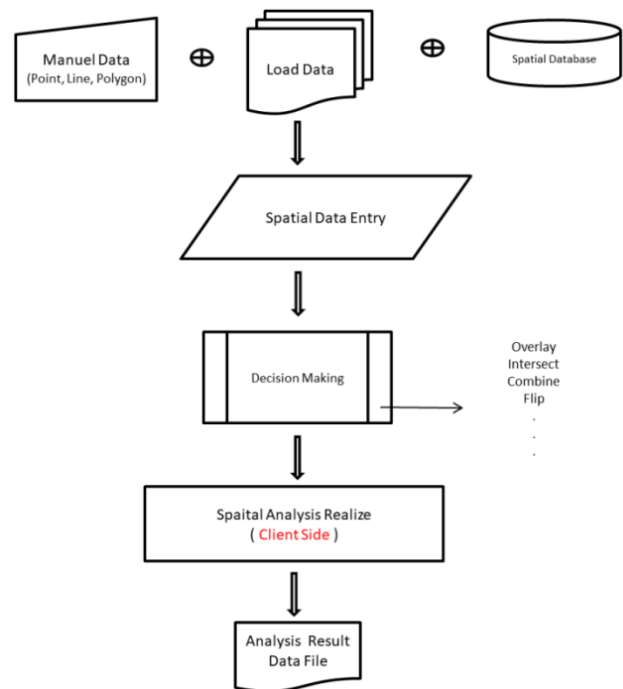

Figure 2. After System Analysis Flow Diagram

According to the diagram, the user can transfer data to the web environment with three different methods. Then he will be able to analyze according to the type of analysis he will choose. Finally, it can complete the process as a printout or by downloading.

2.2. System Architecture

System architecture, it is a conceptual model that defines the structure, behavior and formality of the system. An architectural definition; it is a standard explanation or representation of relationality, organized to support rationality about the structures and behaviors of the system.

In this application, the system architecture consists of open source software; QGIS as a desktop GIS software, PostgreSQL / PostGIS as a spatial database, Geoserver as a web-map server, WPS service for spatial analysis operations, and alternatively Turf.Js. library and finally, Apache Tomcat (in localhost) was used as the web server in the application phase of the study. The system architecture specific to this application is shown in Figure 3.
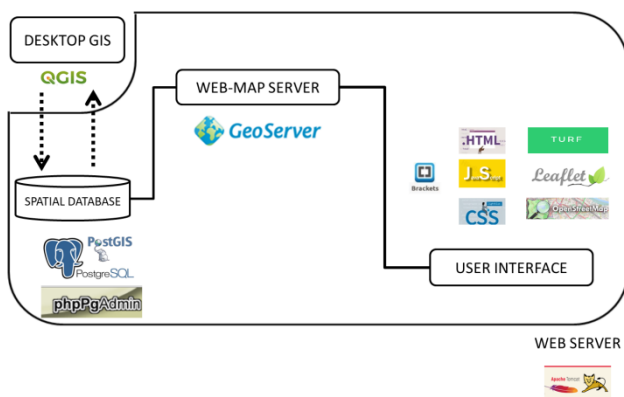

Figure 3. System Architecture

2.3. System Realization

The study consists of spatial analysis using test data after the installation and integration of open source software suitable for the system architecture.

Within the scope of the study, geographical and verbal data were prepared in QGIS desktop GIS software for database and ready data file entries. Geographical data; It was produced as a spatial data set consisting of point, line and area data. As point data, stop, lamp post data were generated. As line data, boulevard, street and street data were produced. Then, test data was imported into PostgreSQL / PostGIS spatial database.

Then, after the integration of the web-map server and Geoserver, the data was transferred to the working folder in Geoserver. By providing WPS service and Geoserver integration. Finally, the user interface where spatial analysis can be done with web programming (HTML, CSS and JS, Leaflet.js); the visual showing the steps for the application stages of the study is shown in Figure-4.
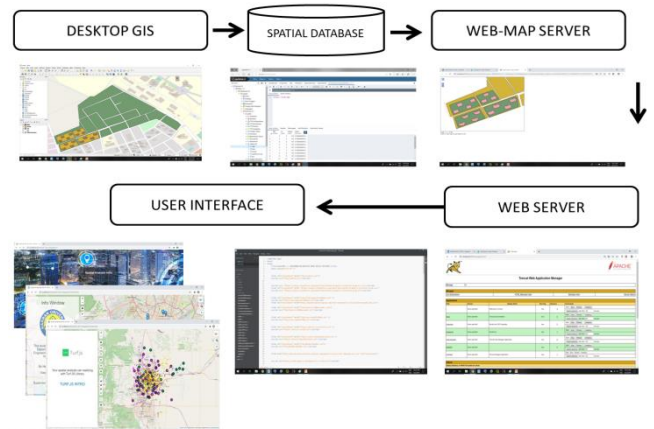

Figure 4. System Realization

Developed with the WPS and TURF.js library, the work was integrated into the web server (in localhost) and the spatial analysis of manual, ready-made data file and spatial database data was tested with the query and analysis performed, and the operability and usability of the system was revealed.

3. RESULTS

Finally, spatial analysis in web-GIS platform; the following findings were obtained by using the Turf.JS library.

- There is no software cost due to the use of open source software.

- Going beyond the classical web-gis applications, data can be entered data by the user in three different ways.

- These are manual, ready data to be transferred to the platform by drag and drop method and the use of the database. As shown in Figure 5, the possibility to enter data directly into the database from the user interface is shown.
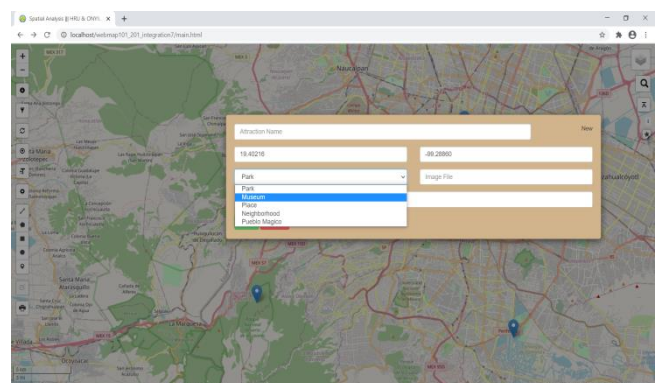

Figure 5. Database Data Entry

- We perform in desktop gis software, proximity, distance, area, merge, intersection, etc. Spatial analysis can be performed on the web using the Turf.JS library procedure(Miller, 2019). The results of the buffer and area calculations performed are shown in Figure 6 as an example.
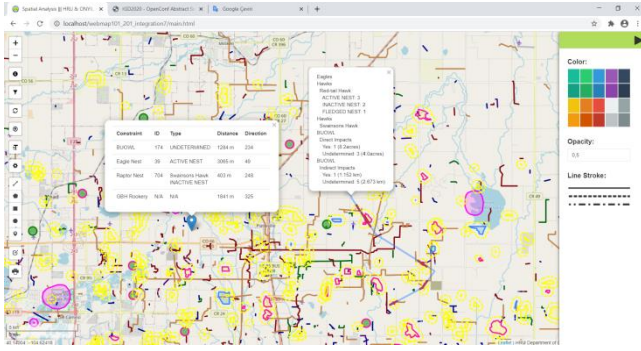
Figure 6. Turf.Js Library Applications(Distance, Buffer etc.)

- It is faster and more flexible than WPS services.

- Having an easy, accessible and user-friendly interface.

As a result, in the implementation phase of the study, going beyond a classical web-GIS, not only the queries but also; A platform that can offer analysis, data entry and data download has been obtained.

It is hoped that the study will shed light on new studies and contribute to our country's webGIS studies.

4. DISCUSSION

In Turkey, increasing web-GIS studies to be an alternative to desktop GIS applications. The use widespread of closed source software, for many institutions also beyond being a costly process cannot go. This situation, is requires open source a software revision for institution and persons.

5. CONCLUSION

Geographical information systems appear before us as a method and tool for reaching the target and purpose determined using spatial data. In GIS applications to be made, first of all, is required determining the purpose and target; this situation, it will play a very important role in system analysis and shaping the system architecture. Thus, during the implementation of the study, many problems to be experienced; Before working, it will be prevented.

Spatial analysis includes a variety of techniques and processes used to understand patterns and relationships of geographic features. It is essential to make these processes web-based today.

Web based applications; With many maps, platforms that are widely used and have an easy user interface provide convenience for us (Filiz, 2013).

It is a great advantage to perform spatial analysis processes with the open source, web-based Turf.js library, which is faster and more ergonomic than the WPS service. This javascript library is user friendly thanks to its open source, free and easy use (Miller, 2019).

In this context, the study is important in terms of showing that web-based spatial analysis is feasible in terms of feasibility, use and cost. It is attractive and valid for institutions and organizations to use a method that provides spatial analysis such as open source GIS software, spatial databases, web-map servers and Turf.JS library.

In the upcoming scientific process, it is foreseen that the WPS and Turf.JS library can be used in many studies, and that these possibilities and technologies can be used in virgin areas such as the last period of Polar Research and Wildlife Ecology in our country.

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