SUMMARY

of the doctoral thesis entitled:

WEB GIS APPLICATION FOR LOCAL PUBLIC ADMINISTRATION

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In the context of technological progress and the increasing needs of local public administrations, the implementation of a web GIS application represents a significant advance towards the efficient management of geospatial data and informed decision-making. This innovative application focuses on collecting, structuring, and integrating geospatial data to support local administrations in resource management, urban planning, and providing quality services to the community.

Organizing geospatial data into thematic layers allows for detailed analysis of urban, economic, and social aspects. This structuring facilitates resource planning and management, encompassing urban infrastructure, environmental aspects, and green spaces. By simplifying the process of adding and updating information, the application facilitates efficient data management, contributing to increased transparency and operational efficiency.

The intuitive web interface provides local administrations with access to interactive maps that integrate detailed information about the territory. Data collection is performed from various sources, including terrestrial data, aerial images, and demographic information, ensuring a comprehensive and up-to-date view of the administration area. This approach allows administrations to gain a holistic perspective, contributing to more informed decision-making and improving services to the community.

This thesis proposes the development and implementation of an advanced web GIS application, focused on the efficient management of resources for a local public administration, using existing geospatial data from the local public administration and other geospatial data available from ANCP, County Council, etc.

The web GIS application enables the management of geospatial data to issue urbanism certificates and view land register extracts within the local administration. The project aligns with European policies and standards, such as INSPIRE (European Spatial Data Infrastructure) and NRRP (National Reform and Modernization Program), with the main objective of creating an intelligent administrative environment in accordance with European Union requirements.

In Chapter I, a brief history of cartography is presented, with a focus on the emergence and development of spatial data, GIS technology, satellite imagery, components of a GIS system, GIS software solutions, digital maps, digital geographic data, and the description of the stages

of the digital map creation process.

A Geographic Information System (GIS) consists of several essential components working together to collect, manage, analyze, and visualize geospatial data. The components of a GIS include geospatial data, GIS software, hardware, people, metadata, geospatial databases, maps, communication networks, standards, and procedures, visualization and display tools.

These components interact to allow a GIS to fulfill its specific purposes, from urban planning to natural resource management and environmental monitoring.

In Chapter II, the web GIS application for local public administration is described. In this context, the proposed research explores the impact and potential of web GIS applications in local public administrations, focusing on the advantages, challenges, and optimizations required to maximize efficiency and positive impact on the community. This research aims to contribute to a deeper understanding of how geospatial technologies can contribute to the modernization of public administration and the improvement of local life quality.

The PortalGIS application integrates existing geospatial databases at the local administration level, the General Urban Plan (PUG) of the Sadu commune, and geospatial information from ANCPI, the digital map of properties stored in the ETERRA application, and property addresses stored in the RENNS application.

In Subchapter **2.2 Materials and Methods**, the materials and methods used for the development of the PortalGIS application are presented. The materials used include geospatial data, GIS software, spatial databases, and GIS web services.

The geospatial data category used includes the General Urban Plan, geospatial data and property addresses from the ETERRA application, and administrative limits, Reference Territorial Units (UTR), from the eGIS application of the Sibiu County Council.

The methods used in this work include:

- Data collection: from terrestrial and aerial sources, through drone flights, and the creation of a high-resolution orthophotomap.
- Data processing and transformation: using GIS software such as MapInfo, Global Mapper, and QGIS.
- Spatial database design using MapInfo: defining the structure for creating a geospatial data model using the MapInfo application.
- Front-end development: the front-end is responsible for building the user interface and handling data manipulation in the web browser.
- Back-end development: the back-end represents the part of a web application that manages data processing, database interaction, user authentication, and other functionalities not visible to the user.
- Integration of GIS web services: to access and display geospatial data in the GIS web application, we used APIs provided by GIS web services.
- Testing and optimization: individual functionality and integration are tested, along with assessing the application's responsiveness to user queries.
- Implementation, and maintenance: the application is installed on the local administration server or other external servers.

In Subchapter **2.3 Data Preparation**, the processing of geospatial data through

conversion, standardization, and optimization is presented. The correct choice of formats allows better management of the conversion process of geospatial data into the ESRI shape standard for use in the web GIS application and GeoJSON for data implementation in the PortalGIS application.

In Subchapter **2.4 PortalGIS Application**, the benefits of the PortalGIS application are presented. The web GIS application allows users to access geospatial data from anywhere, view interactive maps, zoom, move, and select data layers. Users can perform complex spatial analyses using the tools integrated into the web GIS application. The application provides users with the ability to make real-time decisions based on geospatial data stored in the application. Data updates in the application are easier than with desktop applications; users do not need to manually install updates. Updates can be done automatically, ensuring that all users have access to the latest data and functionalities. The application is scalable as it can handle large volumes of data and users as the project or organization expands.

In Subchapter 2.4.1 PortalGIS Application Requirements, the opportunity to develop a web GIS application is presented. The need of the local administration to use as much geospatial data as possible in a single GIS application has been identified.

In Subchapter 2.4.2 Development of the PortalGIS Web Application, the development stages of the application are described step by step.

In Subchapter 2.4.2.1 Web GIS Application Development Module, a brief description of how the application was developed is provided. The project was first configured in the created directory, and the package.json file was defined. In the next step, dependencies were installed using the turf.js library for geospatial data manipulation and analysis. The JavaScript file where the application code was written was created. Throughout the development of the application, the code was run for verification whenever needed, and whenever new elements or functionalities were added to ensure its correctness.

For the implementation of geospaţial data in the web GIS format, the GeoJSON format (JavaScript Object Notation for Geospatial Data) was used. GeoJSON is an easily understandable format for representing geospatial data, based on the JSON (JavaScript Object Notation) standard. It has been widely adopted for the transmission and storage of geospatial information and described the representation of geographic objects (point, line, and polygon) in the application code.

The GeoJSON format has a simple and easy-to-understand structure for developers, can be parsed and manipulated directly in JavaScript, facilitating integration into web applications. It provides serialization and deserialization services and is widely accepted and used in the GIS community, facilitating interoperability between different platforms and systems. The format is recognized as an Open Geospatial Consortium (OGC) standard, allows the association of attributes and properties with spatial objects through feature objects, can be edited manually in a text editor, provides support for different types of geometries, including points, lines, and polygons, covering a wide range of spatial data, and is offered by many web service providers, facilitating their integration into web GIS applications.

In Subchapter 2.4.2.2 Introduction of Geospatial Data into the GIS Portal, the content of geospatial data from PUG, ETERRA, RENNS, and the eGIS application is presented in the PortalGIS application.

From the General Urban Plan, the following information was converted: administrative limits, UAT limit, protection zone limits, intravilan limits, roads, buildings, property limits, watercourses, lakes, power networks, water networks, gas networks, water sources. All this geospatial data was converted into a standard GIS format, ESRI shape, in Stereographic 70 projection, EPSG 3488.

Before being introduced into the application, the PUG data was converted into GIS format, as described in Chapter 2.3 Data Preparation.

To be integrated with the background maps of OpenStreet and Google Earth in the web application, the geospatial data was converted, and the projection was changed from EPSG3844 to EPSG 4326, the projection with the WGS84 ellipsoid (World Geodetic System 1984), the same as the OpenStreet and Google Earth standards, for an exact overlay of geospatial data.

In Subchapter **2.5 GIS Portal**, the PortalGIS web application is presented, starting with Subchapter 2.5.1 Interface and Menus of the Application, a chapter that details the application interface and menus.

In Subchapter 2.5.2 Using the Portal GIS Application, the operation of the application is described, starting with logging into the application, the data required for connecting to the application. In Subchapter 2.5.2.2 Layer Management in the PortalGIS Web Application, the way we import layers into the application and the settings we need to make to build all the fields we need in the application, the settings for the format of graphic objects, and how we manage the visible information on the map, both graphic and descriptive information, from the database.

In Subchapter 2.5.2.3 Project Management in the PortalGIS Application, we explain how project management is done, how a new project is created, the settings we need to make, the original zoom at which the layers included in the project are opened, together with the background map, and how these layers will be visible by default. In this chapter, the options for Private External Link and Public External Link were also presented, options that allow saving public or private maps from the application. Public maps are used to provide citizens access to the maps available in public administration without requiring login. These maps will not contain personal data, thus complying with the personal data protection law.

In Subchapter 2.5.2.4 Quick Toolset, we presented the elements in the application with which we can make edits on the map, build graphic objects such as point, line, polygon, copy a graphic object, delete, save modified objects, and print the currently visible map in the active window. In this chapter, we also presented the functionalities active in the application window, after opening a project, the general Info and Tax and Agricultural Info windows, which provide specific information about graphic objects and information from the object's database.

To extract information about Taxes and Agricultural information, the application connects through two APIs to databases from the Tax and Agricultural programs, where we have access to the entire database specific to these departments, and we bring the information into the Agricultural and Tax Info windows.

For viewing the land register extract for information, we connected using an API to the ETERRA application of ANCPI and extracted this file, which we can view in PDF format. This land register extract is very useful for finding out the legal status of each property registered in the land register. All properties with cadastral documentation from 2014 to the present have cadastral documentation entered into the ETERRA application of ANCPI, including their

geometry with geographic coordinates in Stereographic 70 projection.

Following the requirements of the Sadu commune public administration, we have also introduced the functionality of issuing an urbanism certificate and an RLU (Land Use Restriction) certificate of information, automatically from the PortalGIS application. To issue this document, we had to introduce the Reference Territorial Units (UTR) and Functional Areas (ZF), zones that we extracted from the eGIS application of the Sibiu County Council. In these zones, we entered information from the Local Urbanism Regulation, with specific information for these zones, legal, economic, and technical regimes, and other specialized information. This urbanism certificate of information can only be issued by authorized personnel of the town hall and can only be issued to the owner of that property, based on requests submitted to the urbanism department, with a clear mention of the destination of this urbanism certificate.

Issuing an RLU certificate of information can be done by anyone, accessing the public map on the town hall's website. This certificate will only contain technical information about the property in question, without making any public information about the owners.

The PortalGIS application will bring efficiency and value to the local public administration and greater appreciation from citizens for community leaders.