Testing approaches to visualize land cover/land use changes in time series with cloud-based tools

by **Jesse Friend**

Web GIS applications which are high functioning, efficient, and meet the performance demand of the client are essential in modern cartographic workflows [1]. With more and more complex spatial data being integrated into web applications, such as time related features, it is essential to harmonize the means of data presentation so that the end product is aligned with the needs of the end-user.

In this context, the general aim of this master's thesis was to explore the microservices as a way of building Web GIS applications which display various time-series visualizations from historical CORINE Land Cover (CLC) data [2]. In accordance with user-centered design (UCD) principles for cartography, usability and utility are emphasized as a key component of the end-product [3].

Research Objectives

I. Identify the needs and abilites of a cartographic end product for land cover/land use (LCLU) time series products in accordance with UCD principles.

II. Investigate how to implement Web GIS applications into digital infrastructures as microservices.

III. Identify whether or not it is an advantage to create a Web GIS visualization application for time related geospatial data over implementing existing technologies, or other methods such as static maps, reports, and other graphics.

Methodology

The methodology followed **three** steps to gain insight into the topic.

1. **Expert interviews:** Four qualitative expert interviews were conducted. Three were conducted with employees of the core user, GAF AG, and a fourth with a GIS emergency dashboard professional.
2. **Microservice prototype:** A microservice prototype [Figure 1] was designed and developed using UCD principles, feedback from the expert interviews, and a review of current methods on the topic.
3. **User study:** A user-study was completed to gain insight into user sentiment towards the functionality of the prototype. Further insight into the capabilities of the application were also studied with a user task which required users to ascertain coniferous tree cover in an area of interest (AOI) over time. The user study was divided into two groups, one with full functionality of the application, and one with reduced functionality that did not include the statistic generator [Figure 2].

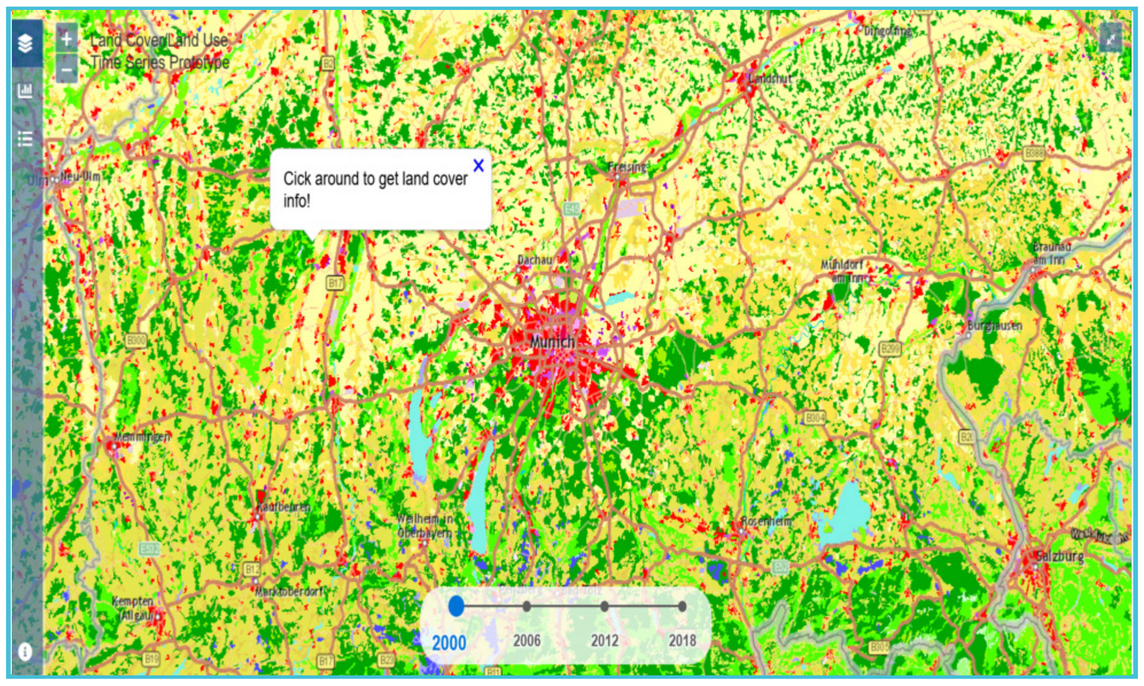

Figure 1: The overall view of the microservice prototype application when loading the web page.

Microservice Prototype

The microservice prototype [Figure 1] was created in collaboration with the core user, GAF AG. Some of the features which are included to help present time related data include: a time slider, yearly pie charts and tabular data for user specified AOIs, and coordinate specific time series information presented in the form of a pop-up.

The technology stack for the microservice prototype application is composed of HTML, CSS/SCSS, and JavaScript. The slippy map API used for the web map interface was accessed from OpenLayers.

Results and Conclusion

Many of the features and design strategies used for the prototype came directly from the **expert interviews** conducted in the thesis workflow.

The user study helped provide insight into how the developed statistic generator adds value to the usability of time-series applications. **Eighty percent** of the group which had the additional statistics [Figure 2] found the application intuitive, **sixty percent** of the second group without the statistics either disagreed or were neutral that the application was intuitive.

Further, the utility of the application is higher for the task of the user study when additional graphics are included in the Web GIS microservice. The group which did not have the full functionality had an average error of 16.10% when discerning the coniferous forest percentage in the given AOI. The group with the additional statistic graphics had an average error of 2.5% per year.

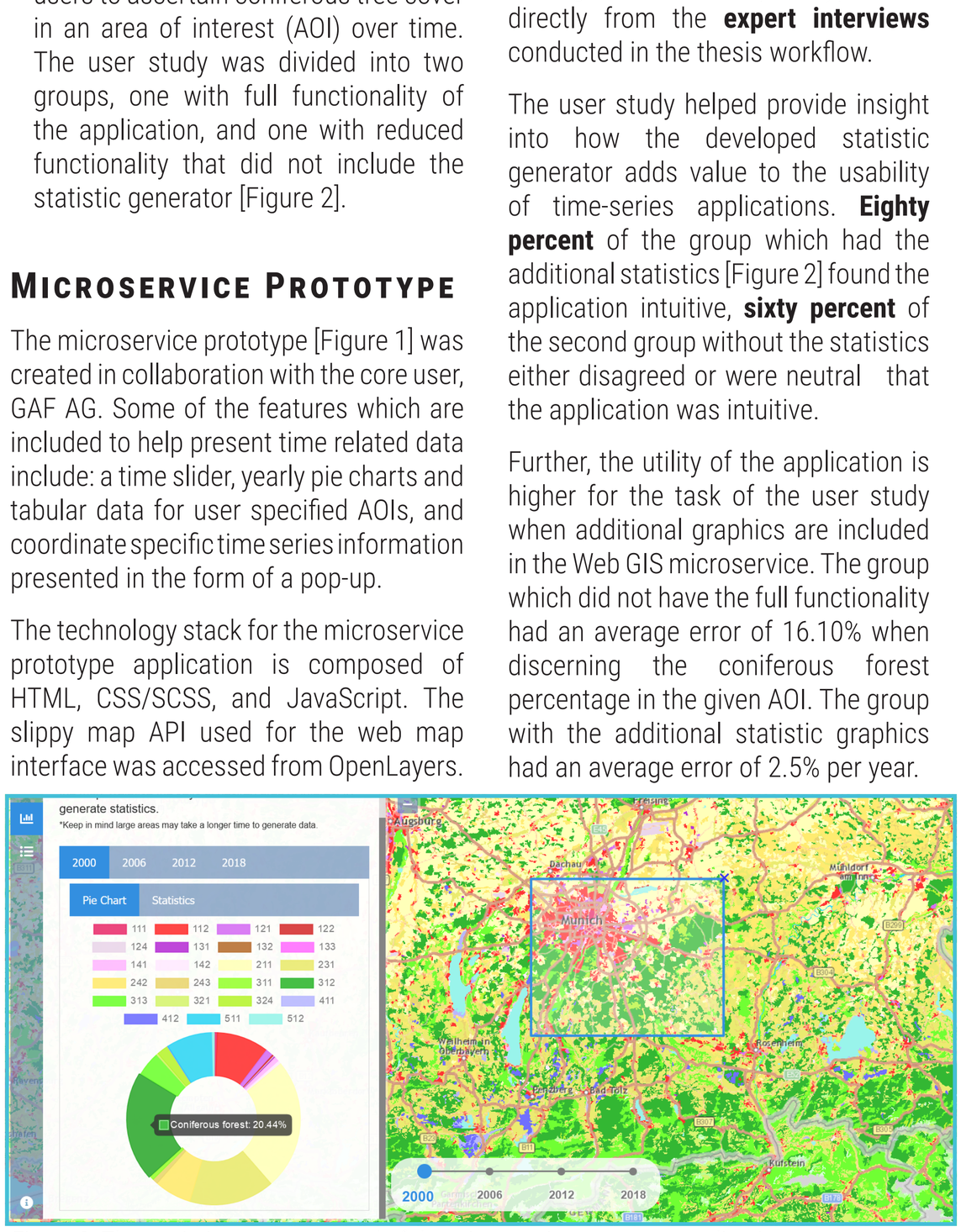

Figure 2: The statistic generator panel of the microservice prototype application.

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Prototype Link

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