

GNV System: A Tool for Visualizing Geo-tagged Data

Andreas Kerren, Member, IEEE*

Ilir Jusufi†

Marcelo Milrad, Member, IEEE‡

School of Mathematics and Systems Engineering (MSI),
Computer Science Department, Växjö University, Sweden

ABSTRACT

The total population of GPS-enabled location-based services (LBS) subscribers is constantly increasing. These GPS-enabled devices produce a wide range of media content (e.g., text/audio notes, pictures, or videos) enhanced by geo-tagged information. This poses a challenge regarding how to store and retrieve it and opens new research opportunities for visualizing this type of data. The overall aim of our current research is to develop novel approaches and methods for visualizing the content of these documents that will be placed in maps using GPS-coordinates as well as to visualize the semantical, temporal, and spatial relations between the documents themselves. We combined different visualization and interaction techniques, such as glyph-based techniques and visual clustering, to analyze the produced data. Our prototype application, called GNV System (GeoNotes Visualization System), demonstrates the interplay of different interaction techniques and components as well as their functionality.

Keywords: information visualization, geosciences, text visualization, location-based services

Index Terms: I.3.6 [Computer Graphics]: Methodology and Techniques—Interaction Techniques; I.3.8 [Computer Graphics]: Applications;

1 INTRODUCTION

According to a study conducted by ABI Research [1], the total population of GPS-enabled location based services (LBS) subscribers will reach 315 million in 2011, in significant contrast to 12 million in 2006. This estimation shows a heavy increase of the use of GPS-enabled devices, e.g., smartphones or PDAs. In the future, we will have to deal with a huge amount of GPS-encoded data produced by these mobile devices. Therefore, we should search for novel possibilities for visualizing such geospatial data. The format of data produced by these devices is different. It can be text, voice, picture or video. In the scope of our current efforts, we only focus on those formats of the data which can be transformed into text and use the term *geonote* [2] to refer to these data in this paper¹.

Geonotes are GPS-encoded which makes them suitable for visualization in a map. Moreover, we should think about visualizing the content and possible semantic relations they have. We have concentrated our work on analyzing and finding novel visualization and interaction techniques to address this specific problem. We developed a system that visualizes geonotes in (Google) maps and provides visualization of the content and semantic relation of these geonotes. Note that our work covers mainly the visualization part of the problem. Design and implementation of the data mining approaches and geonote format transformation to text are beyond the scope of our work.

*e-mail: andreas.kerren@vxu.se

†e-mail: ilir.jusufi@vxu.se

‡e-mail: marcelo.milrad@vxu.se

¹This poster paper is based on the work [2] written by the same authors.

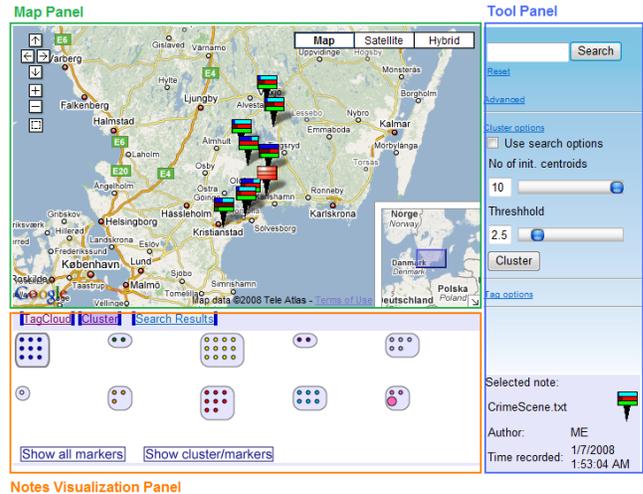


Figure 1: Overview of the GNV System

2 THE GNV SYSTEM – VISUALIZATION APPROACH

At first, we present our prototype application and its features. We divided our GUI into three distinct panels as displayed in Figure 1. Each one of these panels holds different visualizations or tools. Changes made to one of the panels should reflect to the others, thus making the application interactive and user friendly. For instance, if the user selects a geonote icon (see Figure 2) in the map, the visual representation of the same note should be highlighted in other panels as well by using coordinated views techniques.

THE MAP PANEL displays our geonote icons in a map using the Google Map API (cp. the green rectangle in Figure 1). Users can see the geographical positions of geonotes and interact with them. The Google Map API offers different ready to use control tools, such as zooming, panning and overview techniques through a small map in right-down corner. We also built our own control for selecting geonotes in the map through mouse interaction. This control was added to the standard controls.

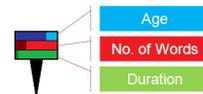


Figure 2: A geonote icon

Our aim was to present more information about each geonote instead of presenting them as simple markers in the map. In order to facilitate this, we developed a note metaphor realized by a specific *geonote icon*, shown in Figure 2. This icon displays three important attributes of a geonote in form of colored stripes: the relative age of the geonote (blue), the number of words (red), and the duration (green) if the content of the note is playable (e.g., in case of audio notes). Each attribute value is normalized, i.e., we compute the overall range of all values for each attribute which results in the horizontal background stripe of the icon. Then, the attribute value for each geonote is represented by a more color-saturated stripe that overlaps the background stripe from the left (progress bar metaphor).

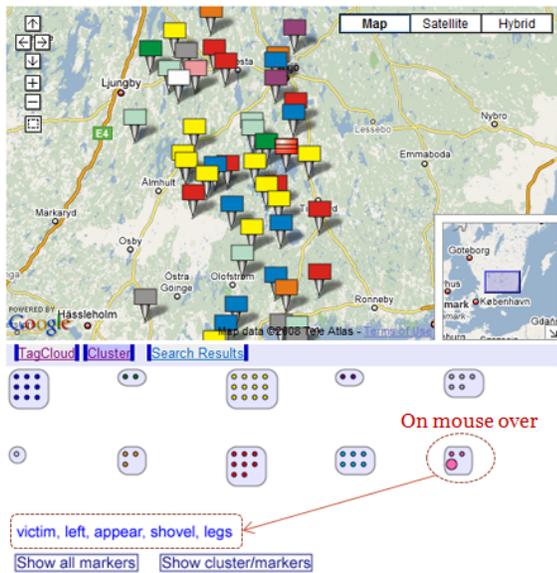


Figure 3: Spatial representation of clusters in the map

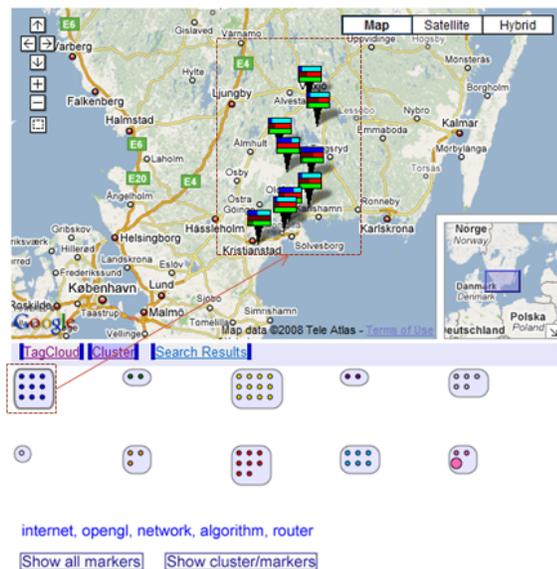


Figure 4: Spatial representation of a single cluster in the map

THE NOTES VISUALIZATION PANEL, which is located below the Map Panel (Figure 1, denoted by an orange rectangle), holds three tabs. The first tab *TagCloud* displays the content visualization of a selected geonote. *Cluster Tab* visualizes the semantic relations of geonotes. The third tab *Search Results* displays search results in form of a simple adjustable list.

We have chosen the well-known Tag Cloud metaphor [3] to visualize the *content of geonotes* by showing the most frequently used words in the geonote text in form of tags of different sizes dependent on their frequency in the text. We think that this metaphor suits our needs very well, since it offers quick insight into the content of geonotes. Because of the limited space, we give no further explanations on the *TagCloud* and *Search Results* tabs.

As seen in the lower-left part of Figure 1 (see the orange rectangle), the shown *cluster representation* is pretty intuitive. It allows users to perceive clusters very fast by showing notes as colored dots in rounded rectangles. We added several useful interaction techniques to enrich the overall experience and utility of this metaphor as described in Section 3.

THE TOOL PANEL, denoted by a blue rectangle in Figure 1, holds different tools that are necessary for interaction and general adjustments. It contains tools for searching, advanced (spatial and temporal) filtering, clustering options, and tag cloud options. Also, it offers an information box at the bottom for displaying meta information of the selected geonote.

3 TYPICAL APPLICATION AND INTERACTION

In this section, we give more details in certain aspects of the visualization and interaction. If users double click on a geonote icon within the Map Panel, a short prefix of the document text will be displayed nearby. In this way, one could get some more details about the document beside the tag cloud representation in the Notes Visualization Panel. Here, the user can also select a “read more” link to get the whole content of the geonote in a separate window.

In order to select a certain region, users need to utilize a selection tool. They can pick a selection tool attached to the standard tool area of Google Maps and can specify the desired area by two diagonal clicks on the map. Then, they can use this area as a spatial filter for searching or clustering.

One possible problem of the cluster metaphor is that we do not know what kind of documents are in the individual clusters. So, we added a feature to overcome this problem: by placing the cursor over a cluster, our tool displays the five most used tags by the documents contained in that cluster as shown in Figure 3. Another interesting feature of our tool is that it shows the spatial representation of the cluster members (geonotes) in the map. This is useful if we want to see how members of different clusters are related in a spatial context. For instance, we might notice that geonotes of two clusters are more concentrated in some region. This could show some spatial relation of these clusters although their content may vary. To see the spatial representation of cluster members, we just need to click the “Show cluster/markers” button. Then, the geonotes icons will be substituted with markers colored with the color of the cluster they belong to as shown in the upper part of Figure 3. Additionally, we might want to see the spatial representation of a single cluster. In this case, we should hide all cluster members of the other clusters. This is done by clicking on the cluster object we are interested in, see Figure 4. We implemented standard zooming and panning functionalities if the clustered geonote icons do not fit on the screen.

4 CONCLUSION

In this paper, we presented our prototype application GNV System. Our tool offers a novel combination of visualization and interaction techniques which addresses the increasing amount of geo-tagged data. It allows users to get valuable insights into the content of geonotes and visualizes the semantic relation of their data. In this way, GNV System provides spatial and temporal context by using various interaction techniques. It also offers a seamless interaction of various parts of the system. A formal evaluation of the system will be done in the future, and we hope to prove the functionality and efficiency of our prototype implementation.

Acknowledgments We would like to thank Lulzim Junuzi who helped us in the development of certain parts of the GNV System.

REFERENCES

- [1] Allied Business Intelligence Inc. GPS-Enabled Location-Based Services (LBS) Subscribers Will Total 315 Million in Five Years. <http://www.abiresearch.com/abiprdisplay.jsp?pressid=731>, 2006.
- [2] I. Jusufi, L. Junuzi, A. Kerren, and M. Milrad. Visualization of Content and Semantical Relations of Geonotes. In *Proceedings of the 8th IASTED International Conference on Visualization, Imaging, and Image Processing (VIIP '08)*, Palma de Mallorca, Spain, 2008. ACTA Press.
- [3] O. Kaser and D. Lemire. Tag-Cloud Drawing: Algorithms for Cloud Visualization. In *Proceedings of Tagging and Metadata for Social Information Organization (WWW '07)*, Banff, Canada, 2007.