Draft on the Project Proposal v5

Beyond Pattern: Enhance Interactivity of Map Visualization with In-Map Interaction

Maps visualization mainly serves two functions: 1. to encode the individual location based data item onto a geographic map; 2. to help users observe the **pattern** of the data as a whole.

However, both functions focus on display and presentation of the data. Except zooming and panning, few interactions are involved in the map visualization. **Further** research shows that there are some good platforms for map based interaction, such as power map by Microsoft, but they normally adopt the “dashboard” design paradigms: The map is used only as the presentation layer, almost all interactions happen in the dashboard layer, with minimum supports for **intuitive and direct interactions** on the map itself.

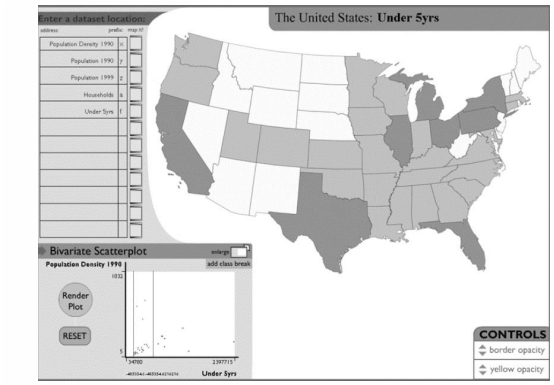


Fig1. dashborad interface

The **problem** of the dashboard design is that to help link the presentation layer (the map) with the interaction layer, a common approach to show more information is **linked brushing**. However, since map is **information intense** interface, without careful design, linked brushing across **multi-views** can be distracting. This is especially true for web based visualization where **hover** action is normally used to select the data continuously. Another solution for web based visualization is to use **storytelling** to show more information about the data, but it is **passive** instead of **active**. One additional consideration is about the user and context. It is acknowledged that for desktop softwares, whose target users are experts like data analyst, separating the presentation layer and interaction layer could provide a clearer interface for complicate data analysis. However, the goal of this project is to encourage the **non experts, general web users** to effectively explore the map based information. That’s why I come up with the idea of **enhancing interactivity of map visualization with direct in-map interaction**.

What is the potential use cases for in-map interaction? After reviewing several popular maps and related papers, I think the answer depends on the types of the maps. And among them, I come up with two alternatives, which I think in-map interaction can be most beneficial for the data exploration:

1. Dot Map. (**In-map spatial selection & temporal filtering**)
   It normally uses dot to represent the actual location of an event. And the data normally have two dimensions: spatial and temporal. Use Todd W. Schneider visualization of NYC taxi "*Analyzing 1.1 Billion NYC Taxi and Uber Trips, with aVengeance.*"**[1]** as an example: He uses parallel placed maps to show the pickups and drop offs of the taxi, assisted by several line and bar charts to shows additional dimension of the data, such as the duration of of the trips. However, most of his information can actually be integrated into one map centric visualization. For example, pickups and drop offs can be combined into one by hover action. Uber does solve that using hover selection as follows**[2]**:

Fig2. left: orginal parallel pickups and drop offs; right: Uber hover to see destination

However, the vis is still not able to filter the traffic by time or specific destination. And I come up with an idea of using a selection **ring** to select the spatial dots while filter them by time distribution. The idea is as follows:

Fig3. selction and filter ring

2. Symbol Map (**In-map interaction on the symbol to achieve intuitive and direct interaction**)
   The idea is simple, for example, for the pie chart symbol map, user can filter the data based on the symbols to see what will be changed if one part of the data is included/excluded. Or they can drag the symbol to another chart to see the additional dimension of the data, as showed in my demo.

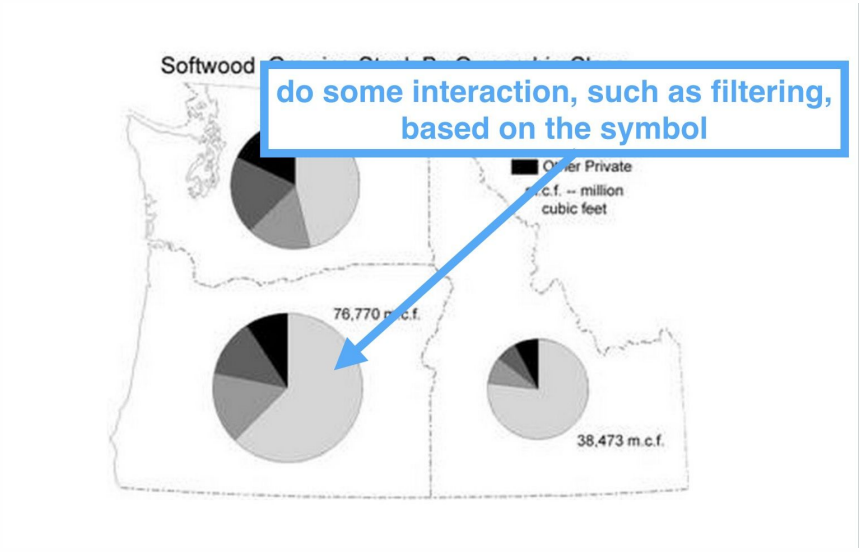
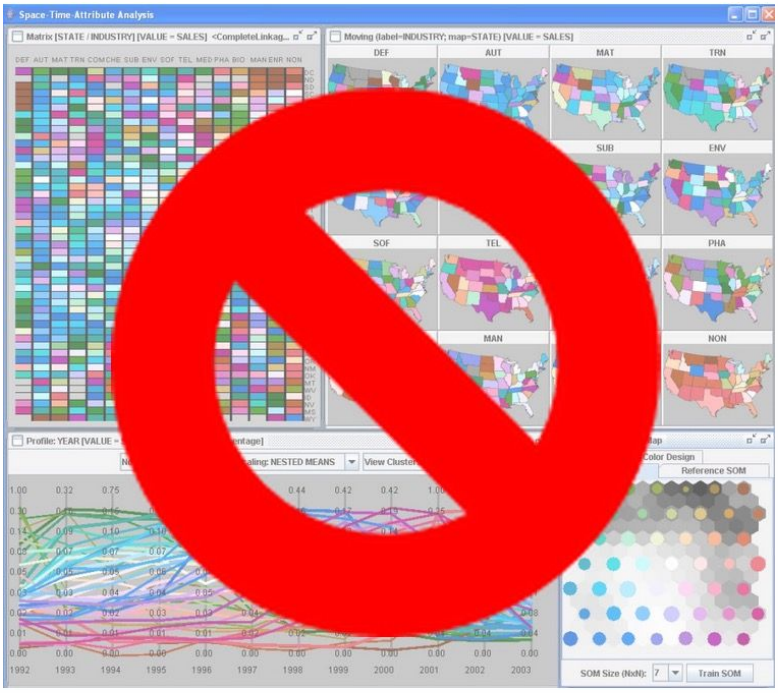


Fig4. interaction with the symbol

Why choose dot/symbol map)? Originally I focus on choropleth, especially for the election data. However I choose dot map/symbol map over choropleth for this research since it is better medium for in-map interaction. Compared to choropleth, where data is color mapped onto the map itself, the dots/symbols on the map provide the physical **visual components** to interact with. Besides, the dot is mapped to an actual GPS location, and corresponding to a physical instance , such as trip, which makes direct interaction on it more meaningful.

Context and **user** are identified to further refined the problem. It is designed to be a **web based** interactive visualization, the anticipated interactions are based on the web based mouse events, such as short click, double click, hovering, entering/leaving, etc.

Besides, unlike dashboard tool, this research is not targeted at expert users, and it is not used to do heavy data analysis. As mentioned, the goal of this research is for **non experts, general web** users to effectively explore the map based information through the intuitive and direct in-map interactions.



The identification of target users can help to choose right UX metrics, which is one the keys for the UX study. Ease of use, learnability, guessability and desirability will be put to the higher priority compared to other UX principles. After an allowed limit amount of trial and error, the users should be able to construct a mental model which matches the conceptual model of the design.

Reference:

1. Analyzing 1.1 Billion NYC Taxi and Uber Trips, with aVengeance http://toddwschneider.com/posts/analyzing-1-1-billion-nyc-taxi-and-uber-trips-with-a-vengeance/
2. ENGINEERING INTELLIGENCE THROUGH DATA VISUALIZATION AT UBER https://eng.uber.com/data-viz-intel/
3. Developing Lightweight, Data-Driven Exploratory Geo-Visualization Tools for the Web http://www.isprs.org/proceedings/XXXIV/part4/pdfpapers/097.pdf
4. Exploring spatial data representation with dynamic graphics http://ac.els-cdn.com/S0098300497000095/1-s2.0-S0098300497000095-main.pdf?_tid=e4d5f70c-4dd4-11e6-9098-00000aab0f01&acdnat=1468948925_96a7b34d4795caaee83a6763c5ad6779
5. A Visual Inquiry System for Space-Time and Multivariate Patterns (VIS-STAMP) http://www.geovista.psu.edu/publications/NCI/GUO_tvcg_manuscript_revision.pdf