

Weibo Footprint: A Web-based Visualization System to Analyzing Spatial-temporal Movement of Geo-tagged Social Media Users

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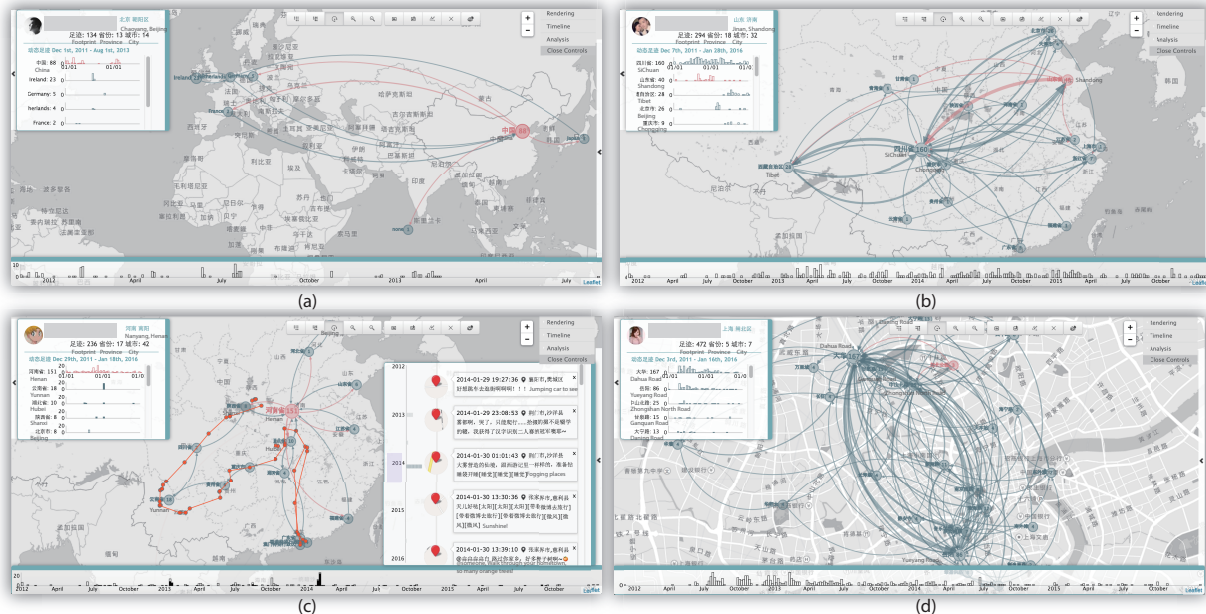


Figure 1: Different characters of individual people's movement. (a) A academic researcher, visiting different countries to attend conference; (b) A pilot, addressing the general OD pattern of her airline; (c) A traveler, indicating the traveling routes across multiple places of interest; (d) Work-home revisiting patterns of general people.

ABSTRACT

Geo-tagged social media acts as sensors recording people's behavior. We proposed a web-based interactive visualization system, visualizing individual trajectories of geo-tagged social media users. The system provides multi-level exploration capabilities to analyze social media user's movement, from spatial and temporal aspects. Annotation and filtering functions are supported to enhance the memory seeking and sharing. We deployed the system to the Internet and pushed forward one step further for visualization for the general public. Multiple diversified trajectory patterns are derived. We also provide a detailed case to illustrate its applicability.

Keywords: Social Media, Spatial-temporal Visualization, Visualization for General Public

1 INTRODUCTION

Geo-tagged social media is popular now. Many users post the micro-blog messages, with texts, multi-media and geo-tagged information. However, normal people can't easily explore their historical data with spatial temporal information. We aim to fulfill the

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gaps of massive of normal people and their understanding of own data. Visualization is a key to solve the problem. In this work, we propose a visualization system allowing users to explore their own trajectories from geo-tagged social media. Our system enables users to understand the global movement trends and spot interesting and memorable behaviors. We can observe many interesting patterns shared by users and their friends. It also provides a new perspective to understand people's movement behavior, compared with the traditional survey techniques in social science research.

Personal visualization [2] is gaining more focus these years with the development of sensing techniques. We gain larger amounts of data and could describe people from different angles. In geo-tagged social media analysis, existing works analyze the global pattern of large amounts of people [1]. Few works addressed analyzing individual movement with detail and allow public users to explore their own data. Thudt et al. proposed Visits, show a sequence of visited places as segmented maps on a timeline, derived from Flickr [3]. Our approach focus on the spatial temporal exploration and could explore multi-level diversified patterns. Our final goal is to bridge the gap of general public and their understanding of data.

2 WEIBO FOOTPRINT

Our system combines three components, including data crawling and authoring, visualization and sharing. Our targeting users are

the Sina Weibo Users (Chinese microblog service). They can log into our system by authoring the permission of crawling their data, and visualize the results in the clients. We aim to provide intuitive visual interface, allowing users without visualization background to explore their data easily.

The visualization view includes timeline view, spatial view, small multiple timelines, detail panel and control panels (Figure 1). Initially, the timeline view shows the posting time histogram of all the geo-tagged weibos of one person. In the spatial view, we provide multiple layers to show information in the different level of details. Users can control the display of the raw data layer, points layer connecting with chronological order, aggregated layer and density map layer. Raw data layers and density map are provided to understand the distribution of the geo-tagged weibos. Multiple levels of details - country, province, city and inner city level are intuitively provided to the users. Links of aggregated circle represent the aggregated movement between two regions. The width of the link indicates the number of such movement.

Besides the basic spatial-temporal visualization of people’s trajectories, we also provide two additional panels for interactive explorations. The top-left panel (Figure 1a) indicates the distribution timeline of different aggregated regions. It automatically updates according to people’s zooming and panning interactions on the map. Users can select detail information on the timeline and map, the detailed timeline would pop up to show the raw weibo information in a chronological order (Figure 1c). Interactive brushing filtering is supported in each view, allowing users to filter the global time range, spatial regions and specific visitings on different regions. Through such exploratory interactions, users can derive many interesting patterns in different periods of time. Furthermore, users could annotate the events on the map, share and invite friends to visualizing their movement.

3 CASE STUDY

We deployed our system to the Internet. Public users with Weibo accounts could log in and visualize their own movement. People can share their results in the social media. We provide encouragement methods, such as usage rank, to attract people to use it. In the half year, there were 4,086 page views with 2,244 sessions from 1,778 distinct users. We observed many interesting patterns from people’s participations and received positive feedback.

3.1 Diversified Movement Patterns

There are different types of movement pattern according to different people’s job, hobby, and other characters. Patterns spanned in the different period of time and space scale (Figure 1). In the global scale, we can see a researchers’ trajectories (Figure 1a). Though he doesn’t post weibos frequently or regularly, he marked several important footprints on the map when he attended several international conferences. From Figure 1b, we observed the distributed revisiting patterns of a women pilot. She mainly flew between Sichuan and Tibet Province, sometimes she also flew to Beijing and Hangzhou. The red circle in Shandong indicates the home place. Besides the regular patterns, we can observe traveler’s behavior on the map (Figure 1c). People like posting weibos when sightseeing. We can see he went through Shanxi, Sichuan, Yunnan province in China, which are all with historical and beautiful places. The last case is the general pattern of home-working repeating patterns, indicated by two main directions on the map (Figure 1d).

3.2 Multi-level Pattern Analysis

Besides the general pattern, we drill down the multi-level pattern analysis for one individual user. She has 643 geo-tagged social media events (Figure 2). She lived and studied in Shanghai in these years. She mainly appeared in Heilongjiang in the summer and winter vacation, which indicates it was her home place (Figure 2a).

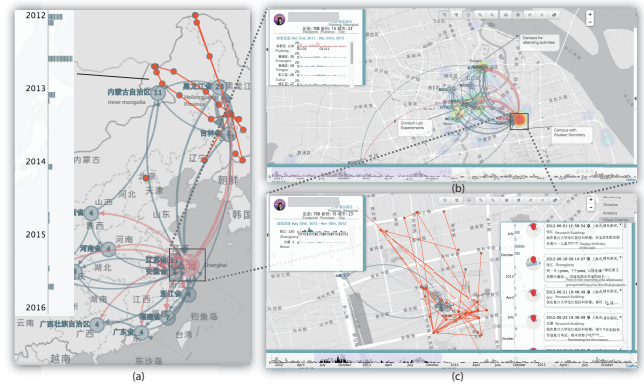


Figure 2: Multi-level exploration. (a) Country-level view, (b) City-level view, (c) Detail region view.

By drilling down to the details of Shanghai, we found her footprints distributed in all parts of Shanghai (Figure 2b). By hovering and highlighting functions, we can see there are several outstanding positions, including Pudong (210), Yangpu/Hongkou (56) and Xuhui (30) region. Zhangjiang in Pudong is the campus place she lived, and we saw wide arrows communicating among these regions. Through reading the texts, we know these are three main campuses of her university. For the most frequent revisiting pattern as Pudong-Xuhui-Pudong, it was the experience to go to a lab in the other campus by train. The other category of patterns indicates she had participated several activities or lectures in the main campus region in Yangpu District. Our system supports the annotation of such events from users to memorize the experiments. Furthermore, we could drill down to the detail level of Pudong region, which are mainly in Zhangjiang District. We can see the finer movement details among restaurants, teaching buildings and the dormitory. By clicking each event, we can see the text of raw weibos are aligned in the temporal order (Figure 2c).

4 DISCUSSION

We proposed a visual analytics system for users to analyze the spatial-temporal visiting data from social media. Throughout these cases, we confirm that our system could detect multi-level movement patterns. The geo-tagged social media provides fruitful sources for social movement analysis. From the other aspect, the general public users are not data experts and can’t easily understand their own data. We provide the visualization system aiming to bridge the gap. In the future, we will evaluate and improve our system with more user feedback.

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REFERENCES

- [1] S. Chen, X. Yuan, Z. Wang, C. Guo, J. Liang, Z. Wang, and J. Zhang. Interactive visual discovering of movement patterns from sparsely sampled geo-tagged social media data. *IEEE TVCG*, 22(1):270–279, 2016.
- [2] D. Huang, M. Tory, B. Aseniero, L. Bartram, S. Bateman, S. Carpendale, A. Tang, and R. Woodbury. Personal visualization and personal visual analytics. *IEEE TVCG*, 21(3):420–433, March 2015.
- [3] A. Thudt, D. Baur, and S. Huron. Visual mementos: Reflecting memories with personal data. *IEEE TVCG*, 22(1):369–378, 2016.