Shanghai Metro Flow - Multiple perspectives into a subway system

Till Nagel* Benedikt Groß†

Abstract

One of the main characteristics of cities is the large amount of people moving around. These flows are reflected in all the subways dashing through the city. With our visualizations we want to give an impression of this pulse of the city.

In this art show submission, we present Shanghai Metro Flow, which consists of an animation, and an accompanying infographic poster. The animation is composed of three scenes, each giving another perspective into the metro network. The static poster shows details on the subway lines. Each visualization combines established techniques with an highly aesthetic form in order to attract people to observe and dwell on different aspects of urban mobility.

Index Terms: H.5.m [Information Interfaces and Presentation]: Miscellaneous—; I.3.6 [Computer Graphics]: Methodology and Techniques—Graphics data structures and data types

1 Introduction

Maps represent the physical world, and in large-scale city maps our direct environment. To achieve this they have to generalize, and thus always reduce and simplify the real world. Korzybski's famous "the map is not the territory" tightly highlights this issue inherent in cartography. That not necessarily is a problem; it is more about the question for what specific purpose a map was created. In the 1930ies, the London tube system become increasingly complex, and the geographical map cluttered and less usable. Harry Beck put aside geographical precision in order ease the task of finding routes from A to B. He straightened the lines and evenly spaced the stops to reduce the map's visual complexity. It was so successful that his diagram style became the norm of showing subway networks [4].

But do we understand that different areas of the city are differently shown? Do we realize the city center is under some kind of fisheye lens? And does this change the way we see our city? Of course, most of us do not navigate through the city with a perfect mental map anyway, but use landmarks and/or have only rough estimations of distances. Many factors influence our perception of the city: from how the speed of travel affects which details we can observe, to how senses such as smell affect our memory of a place.

With our work, we wanted to illustrate the distortions of Shanghai's metro network, and question if and how strongly such schematic subway maps affect our understanding of the city.

2 Related Work

While our project builds on visualization research both from scientific as well as design fields, in this paper we are only referring to own work to highlight our artist's practice of multi-project iterative design. Shanghai Metro Flow was inspired by three previous projects of ours (see Fig. 1). *Touching Transport*, a multitouch tabletop with three visualizations of Singapore's bus network [3], influenced the transitions between views, and the poster design. *A day in Berlin*, an interactive visualization of Berlin's open public transit data [2], influenced our visual style. And *Metrography*, a study into the mental map of London's public transit network [1], influenced our distortion experiments.

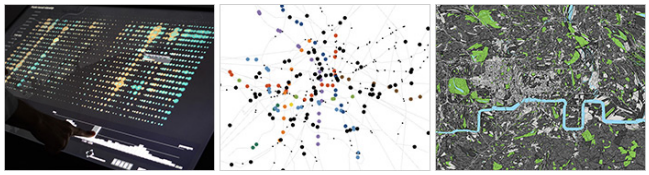

Figure 1: Our prior work: Touching Transport (left), A day in Berlin (center), and Metrography (right)

3 Visualizations

Shanghai Metro Flow consists of a large projection showing different metro network visualizations, and an accompanying infographic poster showing subway line details. The main animation (https://vimeo.com/82303397) is shown on a large wall projection screen, and the poster on a 0.84×1.19 meter foam board.

The narrative animation consists of three non-interactive visualization scenes: a) introductory scene with overview and detail, b) transitioning between geographic, schematic and linear views, and c) an animated small multiple view.

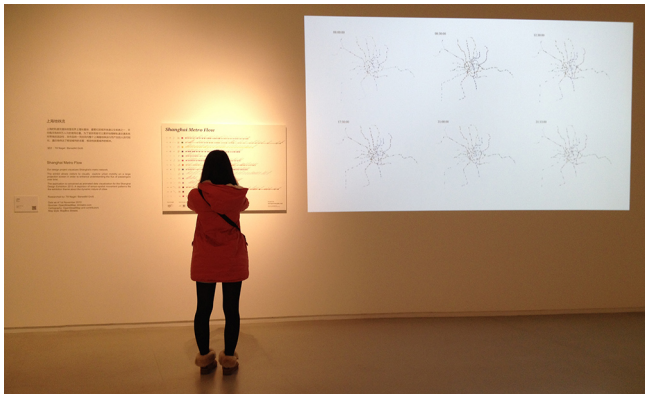

Figure 2: Exhibition setup with poster and projection side by side at the Shanghai Power Station of Art.

3.1 Data

We chose Shanghai Metro as an exciting use case: It is one of the fastest-growing metro networks, and with over 8 millions rides a day one of the busiest rapid transit systems in the world. Shanghai has not published its transport network as open data, yet, and thus we had to gather it from two sources. We scraped the timetable data (service times, frequencies, and durations between stops) from the official website of the transport company, and collected the geographic data such as stop locations and track paths from OpenStreetMap.

3.2 Animation: Three scenes

In the design of the animation we followed a theme of contrasting juxtaposition, inspired by the ever changing surroundings we are exposed to in an urban environment:

*e-mail: mail@tillnagel.com
†e-mail: bg@benedikt-gross.de

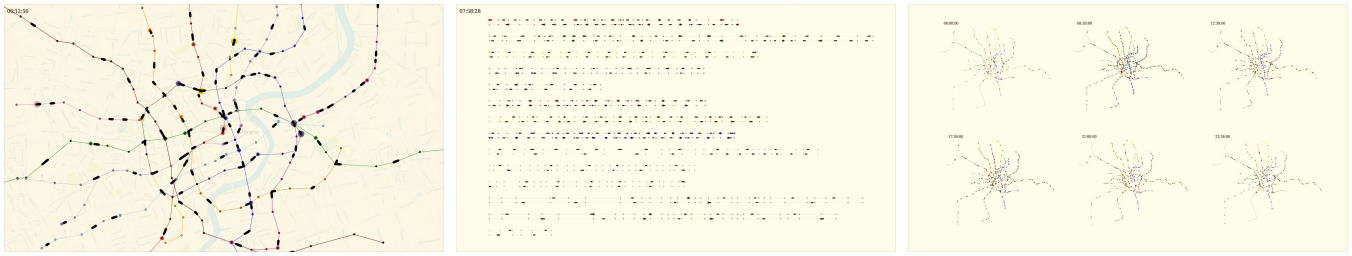

Figure 3: Three visualization scenes: a) introductory scene with overview and detail, b) transitioning between geographic, schematic and linear views (here: linear), and c) an animated small multiple view.

- The contrast between animation and visual style. The animation shows the stations with a steady beat. The trains and thus the pulsing stops are based on the time plan. That is how the metro would look like in the perfect world of a transit planner. The visual style however is friendly, colorful, and vibrant.
- The contrast between geographical and schematic maps. Shows how different representations of the city have very distinct characteristics. Visualizing the distortion of inner and outer urban areas illustrates how maps not only transform the image of the city, but influence our perception of space.
- The contrast between different times of day. The side-by-side comparison of the network over time reveals temporal patterns such as morning and evening rush hour.

The animation starts with the first trains in the morning, showing a full view of Shanghai's network (Fig. 3a). Then, it follows a single train with guided camera panning until it cuts to the next scene. Here, the network morphs from the geographic map view to a schematic, and then to a linear layout (Fig. 3b). All the while, the trains still follow their schedule. Riding an underground train robs us from using visual references of the city. As subway maps typically strip away most of the geographical features, in our animation we also let the base map in the background fade away while transitioning to the schematic view (Fig. 4). Finally in scene 3, the small multiples are shown (Fig. 3c). While the overall time is running through the day, a new snapshot is made at specific intervals showing most prominent patterns for different times of day.

Figure 4: Morphing from geographic to schematic map view.

3.3 Poster: Detailed information

The poster was designed to work as a complement to the main projection. Here, visitors can delve into line details, and compare characteristics of different subway lines (Fig. 5). Every two minutes, when the animation reaches the second scene, the layout matches the one in the visualization on the main screen (see Fig. 3b).

The glyphs on the left side show the proportional line length – , the interchange stations ⊙, the geographic track ◡, and the connections to other lines ⁘. On the right, the lines are shown scaled to their track length with the actual distance between stations becoming visible. Station markers with an inner dot indicate interchange stations.

An important characteristic of a network structure is its connectivity. In metro networks typically each station is connected to every other, thus a passenger can reach any place within the network.

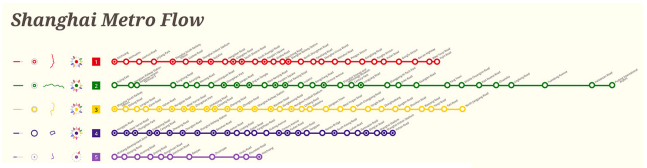

Figure 5: Poster (excerpt) showing details for the metro lines.

What varies is the degree of connectivity, i.e. whether a passenger can travel to another place directly, or has to change lines to get there. In our poster, we visualize different properties of connectivity. Compare for instance yellow line M3 ◯ having a high degree with pink line M13 ⊙ having a low degree of connectedness.

Figure 6: Connectivity between lines for metro lines M1 - M6.

The graph in Fig. 6 shows to which other lines a metro line is connected. A 12h clock face is used so each line is always displayed at the same angle. (This metaphor of course only works as long as Shanghai Metro has twelve lines.)

4 Conclusion

With Shanghai Metro Flow we presented an artistic visualization exhibit providing three plus one perspectives into the complex system of a metropolitan subway network. We briefly outlined our vision, and explained the animation with three scenes, and the juxtapositioned poster. Each visualization combines established techniques with an highly aesthetic form in order to attract people to observe and dwell on different aspects of urban mobility. With our appealing visualizations we hoped to encourage viewers to reflect on their individual perception of our environment.

Acknowledgements

The project has been part of the Design Shanghai 2013 - Aesthetics City. We would like to thank Ruan Hao and Lai Zhenyu from LYCS Architecture for inviting us. This project was funded in part by the Committee of Design Shanghai.

References

[1] B. Gross and B. Clerc, 2012. http://benedikt-gross.de/log/2012/02/metrography.

[2] T. Nagel, 2012. http://tillnagel.com/2013/01/apps-the-city-open.

[3] T. Nagel, M. Maitan, E. Duval, A. V. Moere, J. Klerkx, K. Kloeckl, and C. Ratti. Touching Transport - a Case Study on Visualizing Metropolitan Public Transit on Interactive Tabletops. In *Proceedings of Advanced Visual Interfaces AVI '14*, pages 281–288. ACM, 2014.

[4] M. Ovenden. *Metro maps of the world*. Capital Transport, 2005.