From Bus to Bike : Influence of Public Transport over Bicycle Sharing System

Stanislas LEROY*
Université Claude Bernard Lyon 1

Colas PICARD†
Université Claude Bernard Lyon 1

ABSTRACT

The Grand Lyon metropolis sees the cohabitation of a public transport network, in service for several decades, and a bicycle sharing system, since nearly ten years. With the increase of the offer in term of transport (bus, tram, subway, bicycle sharing, car sharing), transportation is now multi-modal: users combine different transport modes in order to reduce as much as possible their transportation time.
We sought to show these two networks side by side, to display their activity, in order to highlight their relation.

1 INTRODUCTION

The multimodal transport capacity of the Lyon metropolis provide a large variety of transport service:

- For decades, a vast public transport network, the **Transport en Commun de Lyon (TCL)**, has been helping to move more than 1.3 million inhabitants. TCL offers[1]:
  - 4 subway lines
  - 2 funiculars
  - 5 tram lines
  - around 120 bus lines
  - more than 3,000 stops.

  The network is designed so 90% of journeys in the city will not need more than two changes.
- Since 2005, a bicycle sharing system, **Velo'v**, is also available. It provide bicycles available all day long, from stations distributed all over the conurbation. In 2016, it offers[2]:
  - 6.5 use per day and bike
  - 8.5 millions journeys each year
  - 348 stops and 4,000 bikes
  - 64,0000 long term subscribers

Theses two services, while different (TCL tends to move a maximum of people, by having reinforced lines in main areas and reinforced traffic in rush hour, while Velo'v must provides bicycle to the greatest number of people possible, at any hour, spreading stations and moving cycles by truck to empty stations to do so) are complementary.

We look into the relations of these services. Our first action was to look into the data at our disposition, in order to determine what we could view. As the companies managing **TCL** and **Velo'v** are mean on what they allow the public to access, we sought inspiration through the related work, both articles and projects. We find some interesting ideas, and thus developed a visualisation allowing to see the impact of the subway line on the use of **Velo'v**

*e-mail: leroy.stanislas@gmail.com
†e-mail: colas.picard@etu.univ-lyon1.fr

[1]TCL, découvrir le réseau
[2]Vélo'v, Mode d'Emploi

2 RELATED WORK

As transportation is a major issue in cities, especially in large metropolitan areas, several researchers have already produced interesting visualisations for representing density, flow, saturation, etc.

- The first article that inspired us was *Touching Transport - A Case Study on Visualizing Metropolitan Public Transit on Interactive Tabletops* [1]. It provide interesting spatiotemporal visualisations of Singapore's public transport data, including a global view of passenger movement (boarding and alighting) on a line.

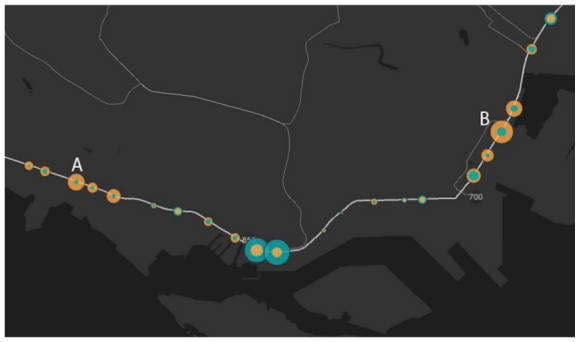

Figure 1: An example of visualisation from Touching Transport

- Visualizing MBTA Data [3], while not an article, is an impressive project about the Boston Subway system. We were particularly interested in the representation of the diagram display of the network, as shown here:
- Shanghai Metro Flow [4], is another of Till Nagel's project about visualization of Shanghai's subway network. It was not a source of inspiration because we found this visualization at the end of our project, but the two visualisations share some characteristics.

3 PROJECT DESCRIPTION

3.1 Visualisation design

In order to choose what would be viewed and and how, we used, as advised, the Five Design Sheets. Here is a quick summary of the

[3]Visualizing MBTA Data, An interactive exploration of Boston's subway system by Mike Barry and Brian Card
[4]Shanghai Metro Flow, An animated visualization of Shanghai's subway network. by Till Nagel

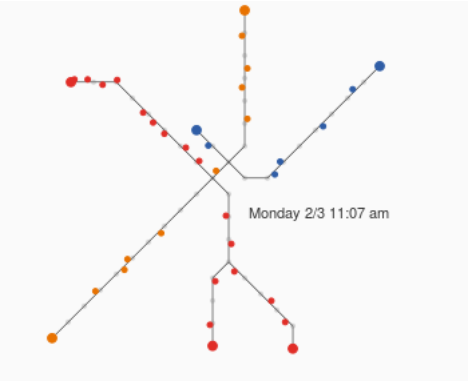

Figure 2: Boston Subway System

Figure 3: Shanghai Metro Flow

decisions taken:

- Put side to side subway lines and bicycle stations activity.
- Highlight point of interest : near subway lines, bonus stations, main areas.
- Show the subway moving along the line.
- Bring the departure of bike out.

To ensure that we could create the visualisations we wanted, we first checked what was available. As said previously, only a short amount of various data (mostly coordinates of stations and lines) is available.

3.2 Data collection

Once the design was set, we tackled the collection of the data. All data used in this project come from the Données Métrolpolitaines du Grand Lyon website. There is two part in the data: a temporal one, and a spatial one.

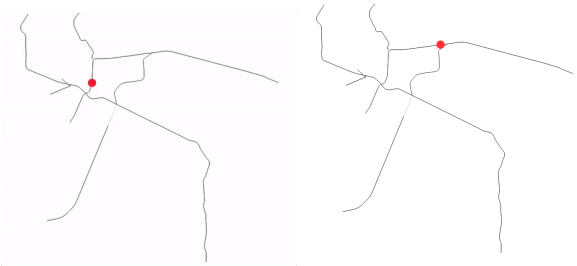

Figure 4: Subway moving along the line

- The temporal data include the theoretical schedule of subway all day long, and the number of bicycle at each station every five minutes.
- The spatial one are the coordinates of the subway, tram and bus lines and stops, as well as the coordinates of the bicycle stations.

Our main issue was the collection of the temporal data, as the subway and bicycle data are not stored in the same format, nor the same amount of time.
We collected mostly JSON files, and also files in a XML format, **NEPTUNE**, standing for *Norme d'Échange Profil Transport collectif Utilisant la Normalisation Européenne*, a standard for public transport data.
The URL provided by Grand Lyon allows to query all the Vélo'v stations but results are limited: a few time intervals are available per stations. To address this issue, a Python script was created to collect the history of the bicycle stations for a precise period, with a different service offered by Grand Lyon: SOS (*Sensor Observation Service*).

Once the data is gathered, a button allows to start the proper visualisation.

3.3 Main Display

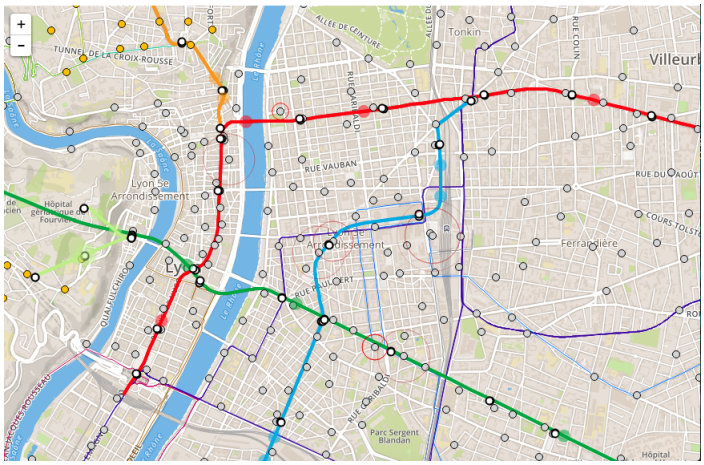

Figure 5: Partial visualisation

The tram and bus lines are shown first, and are used to define the area of interest. The subway lines are then displayed, followed by the bicycle stations.
A function get the bicycle stations the closest from the subway stops (the later are then shown on the map).
Once the spatial data is set, we laid out the temporal one by setting the circle that will show the number of bicycle leaving the stations.
Finally, we launch the animation and let the subway roll.

3.4 Zoom

Zooming provide another visualisation. Instead of having concentric circle showing briefly, a donut shows the proportion of bicycle and places in the stations.
When a subway arrives nearby a station, the blue part, depicting the number of bikes available, and the orange part, which show the available places at the stations, are rearranged.

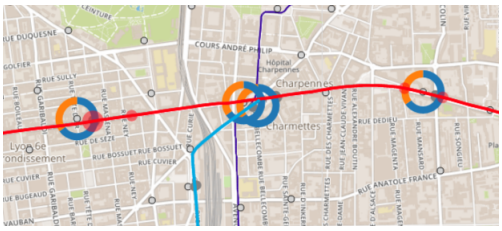

Figure 6: Display of the proportion of available bikes and places

3.5 Extra functionality

3.5.1 Line selection

Another feature we created is the ability to select a subway line in order to show only the movement on this precise line and the activity of the bicycle stations near it. The selection can be done by clicking on the line. Subways and concentric circles or donuts are hidden. In this mode, it is possible to select another line. A simple click on the map allows to return to the initial state.

3.5.2 Day selection

At loading, an interval of days is created and is based on the history of Vélo'v data. A slider allows to choose a day among this period of time covered by the data. When selecting a different day, the visualisation is restarted automatically with the new data.

4 Evaluation

Although the visualization is fully functional, there are some limitations when using it. First, subways are not synchronised on a timeline. Indeed, due to a lack of time and knowledge in Javascript, the different subways are sequentially created for each lime and the interval between two subways is constant. This limits the potential to represent the evolution of the frequency between, for instance, rush hours and normal hours.

Secondly, when zooming in, new wagons have a higher speed. This inconsistent speed is due to a larger distance to cover and the non-recalculation of the size of the path. The speed stay the same when zooming out afterward. The solution is to correct the duration according to the zoom level.

And finally, we may regret a *Christmas tree* look at first sight.

5 Discussion

The visualisation allows us to show the impact of the subway over the **Velo'v** system, as the bicycle stations near the various lines, and precisely near nodes (multiples lines) change often and in great number. We can not however quantify this impact. This is due to two main factors:

- The lack of data, as we do not have the number of people getting on and off the subway, nor if they use bicycle afterward. We do not have either the real schedules of the subway lines, and the five minutes delay between each update of the bicycle station may infer inaccuracy in our conclusion.
- A lack of comparison between near subway line bicycle stations and more commons stations. Showing stations further from the subway could highlight the difference on which we built our hypothesis. But as we feared to overload the map, we focused on the subway lines and theirs surroundings.

Another visualisation, more simple, like a bar chart, could have improve our conclusion, allowing us to put side to side various parameters, by example distance to a subway line, hour of the day, day of the year.

Furthering our project could include improvement like :

- showing donuts only on hoovering a station.
- enabling a double slider, which would allow to define a number of days or hour to visualise.

6 Conclusion

As expected, the visualisation presented in this article mainly shows activity in areas as railway stations, universities, business district or residential district where it is possible to see several concentric red circles all along the day.

Although this result seems to be evident, the lack of data does not allow to obtain formal results. It is more an empirical result with a good precision of the reality.

The major innovative point in this visualisation is the ability to correlate Vélo'v' activity with subways: the impact of each subway on a bike station is represented on the map, both at macro level with red concentric circles and at micro level with donuts.

But such visualisation, despite its flaws, can be use by public transport administration or bicycle sharing system manager, in order to improve the quality of service and to propose new way to use the already present multimodal network of the city.

Acknowledgments

The authors wish to thank Aurélien Tabard, Nicolas Bonneel, Romain Vuillemot.

References

[1] 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 *International Working Conference on Advanced Visual Interfaces, AVI 2014, Como, Italy, May 27-29, 2014*, pp. 281–288, 2014. doi: 10.1145/2598153.2598180