

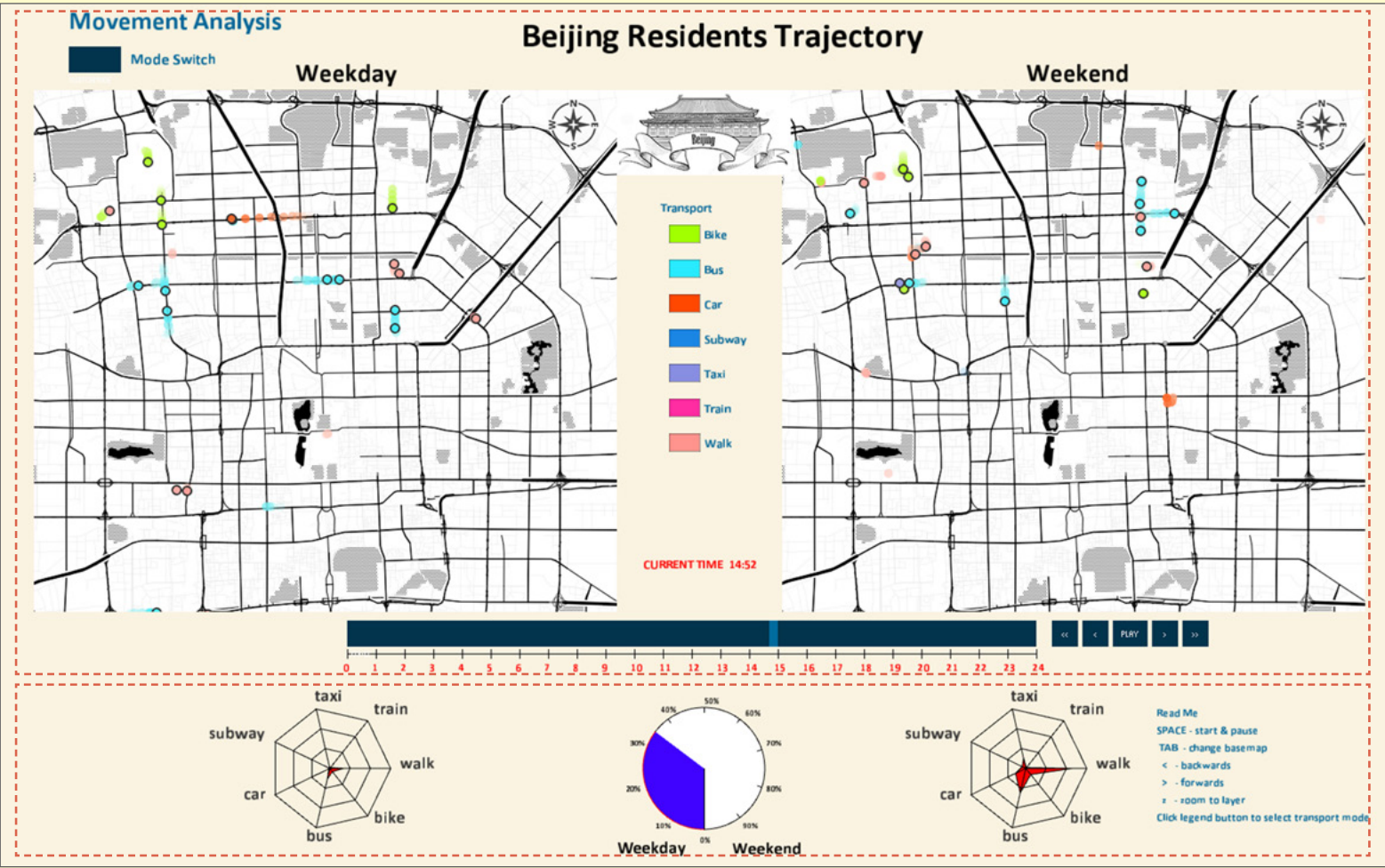
GEOM90007 A3 Major Project Design Report

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Data Pre-processing

R was used in data pre-processing to combine the transport mode data with trajectory data and reduce the recorded points from every second to every 20 seconds. Only the data within studied area in Beijing were selected and the time zone was converted to Beijing time zone. The data were sorted into two types, trajectories on weekdays and weekends respectively and sampling in Excel. In sampling, we ensured that the final output of trajectories on weekdays and weekends has the similar number of trajectories. Then, we converted the output csv files into geojson through QGIS for interface in Processing.

Movement Analysis



1. Mapping Section

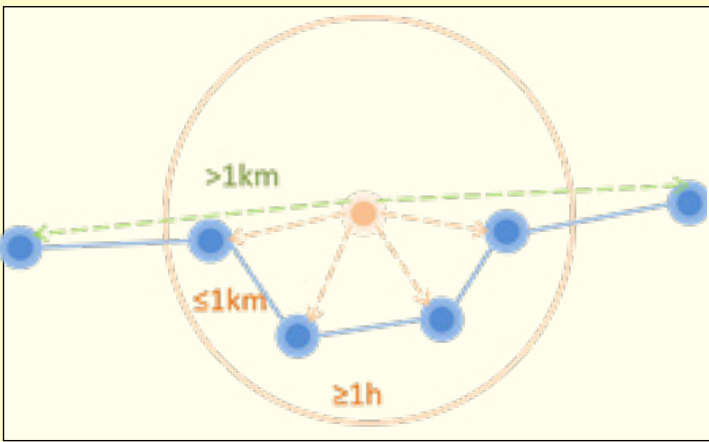
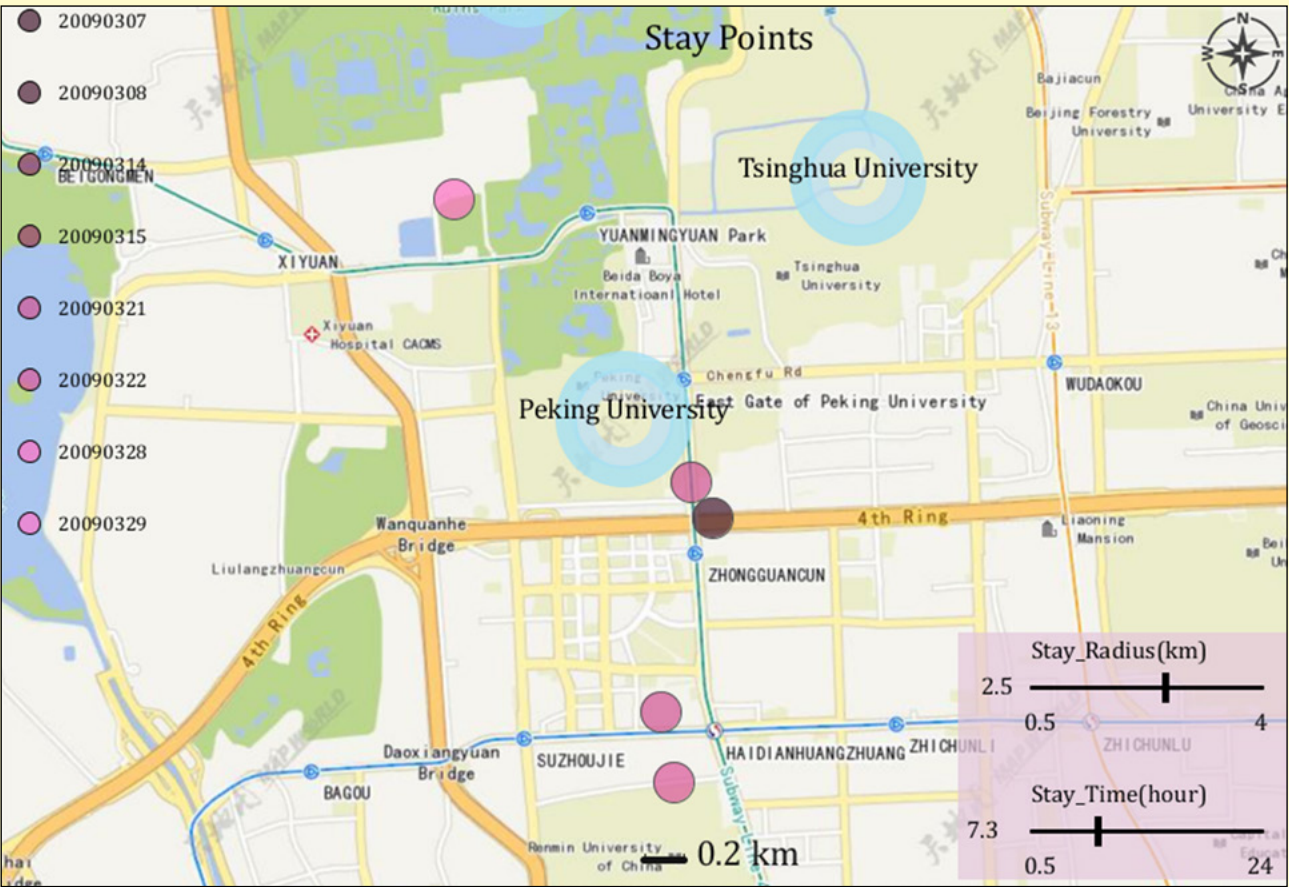
Our interface contains two maps, with one showing movements on weekdays and another on weekends. We have achieved almost all functions of a digital map. These functions include dragging, zooming in, zooming out, changing the base map and setting the visibility for each transport mode with different color, which can be selected on the transport legend. This will be easy to analyse sustainable transport and private transport separately. The time slider under maps is used to indicate the data time, which comes with various functions, including play and pause, drag to any time we want to observe, speed up and speed down up to three times of the default speed and backward and forward every 15 minutes. The five buttons next to the slider help us to achieve these functions easily or could just use the shortcuts shown in Read Me. We used dot points to visualize the movement in a specific time phrase

colored by transportation modes. Each point represents the position in a trajectory. The point with stroke means the current position of this trajectory while other without stroke means the previous position of the same trajectory. The longer tail this trajectory had, the higher speed it travelled with. On the top left side, it is a mode switch button. Once we click the button. The stay point analysis window can pop out.

2. Charts Section

The star plot and pie chart are the visualization of the number of different transportation modes information. For the star plots, they separately show the proportion of seven kinds of transportation changing hourly on weekdays and weekends, which can directly reveal the transport preferences during a day. For the pie chart, it shows the proportion of trajectories on weekday and weekend at the same time with totally proportion setting to 100%. That can help user find the regularity of transportation on weekday and weekend, for instance, the rush hours vary on weekend and weekday.

Stay Points Analysis



A new window for drawing stay points will pop up when users press "q". Users can manually define distance and time thresholds by dragging the pointers. For instance, if the distance threshold is 1 km and time threshold is 1 hour as the above figure, the stay point means that this person stayed in a circle with the radius at 1 km for at least 1 hour. This analysis generates all the stay points for all the trajectories collected on weekends in March 2009. The blue circles in figure 2 represent the clusters of stay points.

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Introduction

In this assignment, our group chose GeoLife GPS Trajectories data from Microsoft Research Asia to analyse the daily movements in Beijing, mainly focus on the transport mode analysis and stay point analysis. Based on the data, our group tried to reveal the following patterns in our interface. Our target users are the officers of government scientific agency charged in urban planning and development, as well as the researches who are interested in social behaviours and travel pattern analysis. It can also be used as guideline in tourism to plan the tours covering interest places.

Patterns analysis

1. Travel patterns

Because we have designed a time slider, it is easy for users to observe pattern in different time period. There are two major patterns, one is the rush hours on weekdays and weekends are different and another is the travel directions vary during weekdays. In the morning on weekdays between 8:00 AM and 9:00AM, we can observe a large number of dot points moving from northern areas to the inner city by buses. From 9:00AM, many cars are moving from eastern suburbs to the inner city. While around 6:00PM to 7:00PM, many people are traveling from inner city to suburbs. The explanation for these patterns would be that many Beijing citizens live in the suburb and work in the city, so they need to ride to city by different means of transportation on weekdays during morning. On weekends, there is no clear pattern showing the exactly destination where Beijing residents are heading to during that period of time. The movement on weekends is more likely to be evenly distributed around the city. Considering the rush hours, it is clear that between 8:00AM and 9:00AM, there are not much people traveling around, which is contrast to that time on weekdays, and while between 12:00PM and 1:00PM, there is lots of travelers. Meanwhile, on weekend, they travel randomly to entertain on weekends.

2. Transport usage patterns

The star plots indicate that in the morning (8:00AM) of weekday, the preferable transport modes are walking, riding bikes and taking buses, while on weekend at the same time, the proportion of driving cars increase. In the evening (7:00PM) of weekday, the first three kinds of transportation are walking, riding bikes and taking buses, while on weekend at the same time, the first three transportations are walking, taking buses and riding bikes. Therefore, user can improve the arrangement or timetable of the public transportation based on the transportation changes between weekday and weekend.

3. Stay point patterns

We can find some regularity from the distribution of points on the maps: most points in campuses of universities and parks are walking and riding bikes. The reasons are the environments of these places are better than others and the roads and instruments in these places are friendly to walkers and riders.

The clusters of stay points show that people spend a long time on weekends in

- University: This may indicate that the majority of users being tracked are students, who study and live in the university. If not, this pattern represents that these universities are worth travelling.
- Airport: Waiting for airplanes usually takes a long time.
- Parks: The clusters show some popular parks, like Beihai Park, Dongxiaokou Forest Park and Summer place.

Critical Analysis of Data

The points mainly distribute in the northern part of Beijing, where there are more universities and Information Technology working places, so, we can assume that the position recorders in Beijing are mainly students and IT workers. There are no GPS signals underground; therefore, most recorders cannot record their positions successfully. However, taking subway is one of the most popular transportations in Beijing. Hence, the data cannot show the percentage of taking subways accurately.